1100A / 1100H
Oxygen Analyser

Instruction Manual

Ref : 01100 / 002A / 17
Order as part No. 01100 002A

NOTES

SERVOMEX 1100A Oxygen Analyser

This manual is for the following models.

Control Unit Model 1101 from serial no: 181C
Interface Unit Model 1102 from serial no: 11C
Transducer Unit Model 1131 from serial no: 181C
Transducer Unit Model 1132 from serial no: 01C
Transducer Unit Model 1133 from serial no: 01C

and software versions 01100 66X, 01100 67X, and 01100 68X where X is 0, 1, 2 or 3.

It may also be used for software versions 01100 651, 01100 652 and 01100 699. Differences incorporated in these versions are highlighted in the text and listed in Appendix 7.

See Section 1.3 for location of serial numbers and Section 3.3 for software identification.

This manual is only for instruments which have the letter "C" after the serial number.

Only units with the same letter after the serial number should be connected together to make an analyser.

Connecting together units with different letters will invalidate any safety approvals for use in hazardous areas.

NOTE: New style front panel graphics were introduced from these serial numbers onwards:

	S/N
1101	5200 C
1102	270 C
1131	3800 C
1132	340 C
1133	1200 C

USE OF WARNING, CAUTION AND NOTE

This publication includes WARNING, CAUTION, and NOTE information where appropriate to point out safety related or other important information.

WARNING - Hazards which will result in personal injury or death.

CAUTION - Hazards which will result in equipment or property damage.

NOTE - Alerts user to pertinent facts and conditions.

ELECTRICAL SAFETY WARNING

The electrical power in this equipment is at a voltage high enough to endanger life.

Before carrying out maintenance or repair, persons concerned must ensure that the equipment is disconnected from the electrical power supply and tests made to verify that the isolation is complete.

When the supply cannot be disconnected, functional testing, maintenance and repair of the electrical units is to be undertaken only by persons fully aware of the danger involved and who have taken adequate precautions.

HAZARDOUS APPLICATIONS

The 1100A analyser has been certified by BASEEFA (The British Approvals Service for Electrical Equipment in Flammable Atmospheres) for use in hazardous areas and with flammable sample gases.

Certain variants of the 1100A have been certified by Factory Mutual (USA), Eidgenossisches Starkstrominspectorat (Switzerland), CSA (Canada) and Japanese Ministry of Labour for use in hazardous applications.

Details of the certification are in Appendix 1. Copies of the certificates are contained in the supplementary manual 01100008A.

WARNING

To ensure safe operation in hazardous applications the analyser must be installed to comply with the conditions of certification, relevant standards and codes of practice. Failure to do so may invalidate the certification.

Any modification to the standard analyser, or repairs or servicing using parts that are not specified or approved by Servomex, will invalidate certification. In case of doubt contact Servomex or their agents.

NOTES

The 01100A GEN, EUR, UK2 and FM2 and the 01100H GEN and EUR comply with the European Community “Electromagnetic Compatibility Directive” 89/336/EEC by the application of the following:

A Technical Construction File No. 01100-P-004-1 dated 27.11.95 and
A Test Report No. 5044/981 issued by:

ERA Technology Ltd, Cleeve Road, Leatherhead, Surrey, KT22 7SA

The 01100A GEN and the 01100H GEN comply with the European Community “Low Voltage Directive” 73/23/EEC and the “CE Marking Directive” 93/68/EEC and are rated in accordance with:

IEC664 for	“Installation Category II” which is characterised as being local level (i.e. not distribution level), appliances and portable equipment with over-voltage impulse withstand up to 2500V.

The 01100A EUR and UK2 and the 01100H EUR are certified for use in hazardous areas and are excluded from the scope of the European Community “Low Voltage Directive” 73/23/EEC.

The 01100A GEN, EUR, UK2 and FM2 and the 01100H GEN and EUR are CE marked (when fitted with external mains filter) for the European Community “Electromagnetic Compatibility Directive” 89/336/EEC only. They also comply with the transitional arrangements of the European Community “ATEX Directive” 94/9/EC.

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This analyser may have been modified for a particular application.

Details of any modification will be described before Section 1.

NOTES

SECTION 1 : GENERAL DESCRIPTION

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NOTES

SECTION 1. GENERAL DESCRIPTION

1.1 INTRODUCTION

This manual provides descriptive information, installation and maintenance instructions for the Servomex 1100A and 1100H Oxygen Analysers. Unless stated otherwise references to the 1100A include the 1100H. Comprehensive parts lists are included, also descriptive information covering optional plug-in modules and variants to the basic instrument which extend the range and capabilities.

It is divided into the following sections:

Section 1. General description of the analyser, its operating principle and options
Section 2. Installation of the analyser and user connections.
Section 3. Operating instructions.
Section 4. Routine maintenance.
Section 5. Fault diagnosis and repair.
Section 6. Parts lists for the analyser and sampling systems.

The appendices at the back of the manual contain details of safety certification for hazardous area use, specification and other background information.

The Servomex model 1100A Analyser is a microprocessor controlled, paramagnetic process oxygen analyser incorporating the magneto-dynamic measuring cell of proven service, manufactured by Servomex for many years.

In its basic form the instrument comprises two units:

1. A Transducer unit which contains the measuring cell, heaters and the mechanical zero adjustment.

   Three different Transducer units are used depending on application:

   a. Model 1131, certified for Zone 2 installation.

   b. Model 1133, certified for Zone 1 installation.

   c. Model 1132 certified for Zone 1 installation, operating at 110°C, for the measurement of gas samples which have a high dewpoint, and used in 1100H systems.

2. A Control unit, model 1101, which processes the signal from the Transducer unit to provide:

   a. A digital display.

   b. An electrical current output.

This unit also provides the power supplies for the Transducer.

Variants of the 1100A allow the two units to be separated by up to 100m, or up to 500 m (1600 ft) with the addition of an interface electronics unit, model 1102, (refer to Figure 1.1 and Section 1.4).

Optional extras available include auto-calibration, alarm outputs, pressure compensation, digital output and sample conditioning systems. If corrosive sample gases are used the Transducer unit has a dilution purge option. There are a limited range of options available on the high temperature version (1100H).

1.2 SAFETY APPROVALS

Details of safety certification are in Appendix 1. Section 2 gives further information on installation.

Safety certification offered with an analyser will depend upon country of destination. Refer to the certification labels attached to the analyser to determine which certification is applicable.

1.3 PRODUCT IDENTIFICATION

The individual units of the analyser (Control, Interface and Transducer units) all have serial numbers. This serial number will be found on a label fixed to the back of the door of the Control unit or to the inside base of the enclosure on the other two units.

WARNING

Only units with the same letter after the serial number should be connected together to make an analyser.

Connecting units with different letters will invalidate any safety approvals for hazardous areas.

A label identifying the analyser as a whole is fixed to the inside of the control unit door below the serial number label. This label has the following information:

Identification Number	e.g. 804347
Software Issue	e.g. 1100-681 Rev 1
Date Tested	
Picture Code	

The picture code identifies the exact build of the analyser. It is of the following form:

01100A 7 GEN 01 01 0 0 0 0 0 0

- Analyser Type 01100A
- Picture code issue number 7
- Hazardous area certification .... GEN
- Analyser configuration code (Feature 1) 01
- Options, etc. (Features 2 to 14) 01 0 0 0 0 0 0

1100 systems using the high temperature transducer (1132) have the analyser type 01100H, not 01100A.

A set of picture codes is shown in Appendix 2. Choose the appropriate picture code by issue number.

When ordering spare parts, the identification number and the serial number of the relevant unit should be quoted.

Major sub-assemblies, e.g. printed circuit boards, have part numbers of the form 01100925B (analogue amplifier board). A listing of the major sub-assemblies or commonly used parts is given in Section 6.

Software is identified on the analyser identification label and on the display when the analyser is first powered-up - see Section 3.3. It is also shown on the memory circuits. Note that the microprocessor board (01100918C or 01100918D, or earlier versions) are only supplied as a spare part complete with software. The ordering information for this is given in Section 6.

1.4 ANALYSER CONFIGURATIONS

The Servomex 1100 series oxygen analyser is available in several different configurations, identified by Feature 1 of the picture code.

Feature 1	Separation	Certification / Area Classification
01	Close Coupled	Both units Safe Area or BASEEFA Zone 2
21	Close Coupled	Both units FM Div 2
02	100m maximum	Both units Safe Area or BASEEFA Zone 2
22	100m maximum	Both units FM Div 2
03	500m maximum	Both units Safe Area or BASEEFA Zone 2
23	500m maximum	All units FM Div 2
04	100m maximum	Transducer CENELEC Zone 1, Control unit Safe Area only
14	100m maximum	Transducer CSA Div1, Control unit CSA Div 2
24	100m maximum	Transducer FM Div1, Control unit FM Div 2

Feature 1	Separation	Certification / Area Classification
04 (1100H)	100m maximum	Transducer unit CENELEC Zone 1, Control unit Safe Area only
06	500m maximum	Transducer CENELEC Zone 1, Interface and Control unit Safe Area only
16	500m maximum	Transducer CSA Div1, Interface and Control unit CSA Div 2
26	500m maximum	Transducer FM Div1, Interface and Control unit FM Div 2
06 (1100H)	500m maximum	Transducer unit CENELEC Zone 1, Interface and Control unit. Safe Area only

The 1100H is available in configuration codes 04 and 06 only.

With the exception of the close coupled units (codes 01 and 21) the configurations described require interconnecting cables between the various units. This is not supplied unless specifically requested since individual installation requirements vary. Cable specifications and requirements are detailed in Sections 2.8 and 2.9 of this manual.

For codes 02 and 22 a terminal box is fitted to the Transducer unit allowing the Control unit to be separated by a cable length of 100 metres maximum.

For codes 03 and 23 an Interface unit is close coupled to the Transducer unit allowing the Control unit to be separated by a cable length of 500 metres maximum.

For codes 04, 14 and 24, two terminal boxes are fitted to the Transducer unit allowing the Control unit to be separated by a cable length of 100 metres maximum.

For codes 06, 16 and 26, two terminal boxes are fitted to the Transducer unit allowing an Interface unit to be separated by a cable length of 100 metres maximum and the Control unit to be separated by a further cable length of 500 metres maximum.

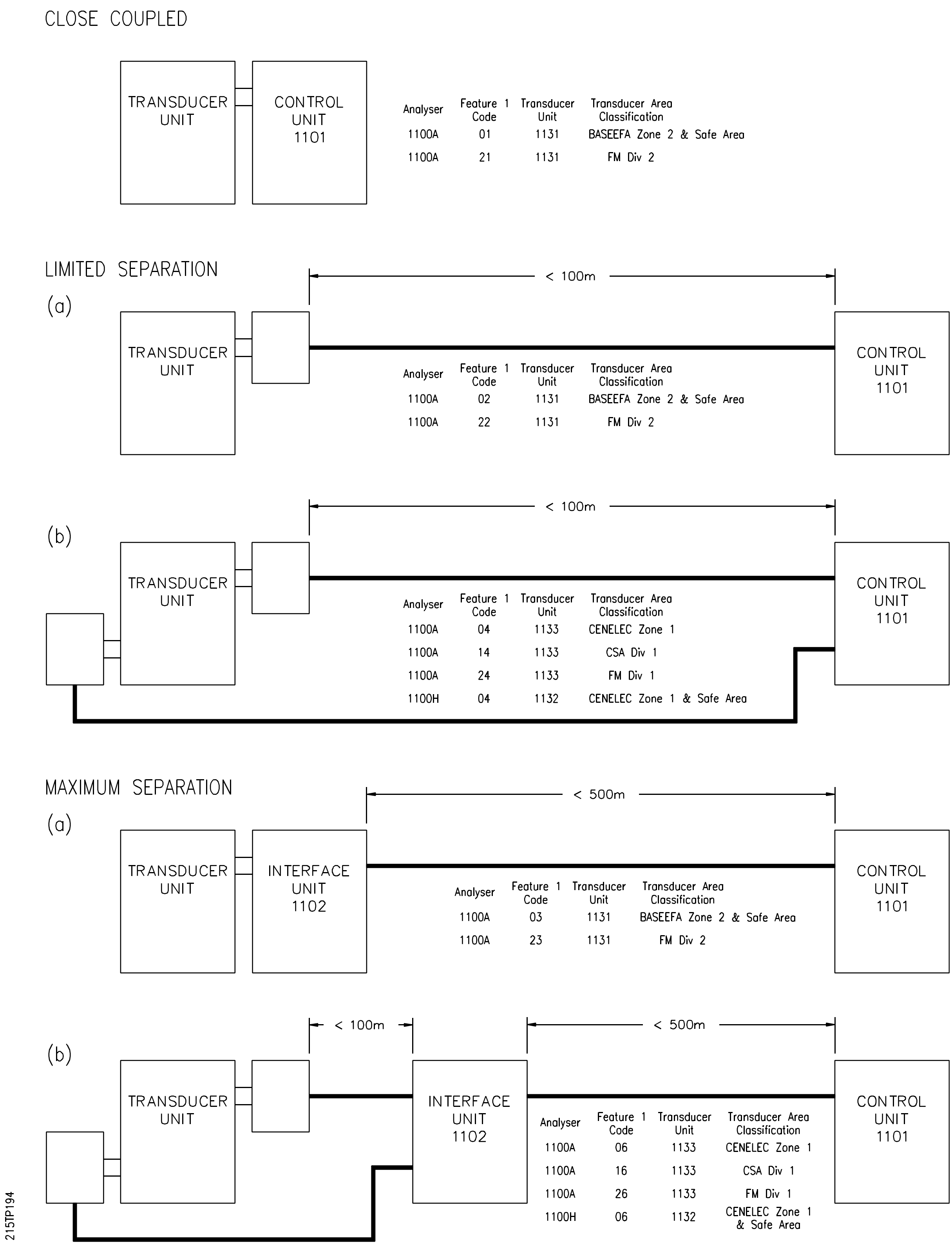


Figure 1.1 Analyser Architecture Configurations

1.5 SPECIFICATION

See Appendix 8 for specification.

1.6 FUNCTIONAL DESCRIPTION AND OPERATION

1.6.1 Transducer Unit

The Transducer unit can be divided into three basic functional units:

1. Measuring Cell
2. Heaters and Temperature Sensor
3. Pressure Compensation (Optional)

1.6.1.1 Measuring cell

The 1100A oxygen analyser measures the paramagnetic susceptibility of the sample gas by means of a magneto- dynamic type measuring cell.

The paramagnetic susceptibility of oxygen is significantly greater than that of other common gases. This means that oxygen molecules are attracted much more strongly by a magnetic field than are molecules of other gases, most of which are diamagnetic (repelled by a magnetic field). Magneto-dynamic oxygen analysers are based upon Faraday's method of determining the magnetic susceptibility of a gas by measuring the force developed by a strong non-uniform magnetic field on a diamagnetic test body suspended in the sample gas.

The test body of all measuring cells in Servomex paramagnetic oxygen analysers consists of two nitrogen filled Pyrex glass spheres arranged in the form of a dumb-bell as shown by Figure 1.2.

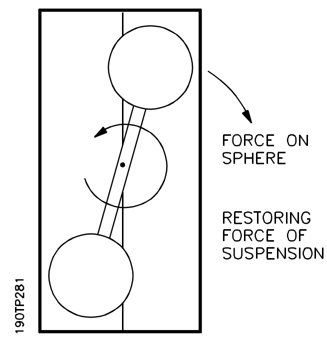


Figure 1.2 Dumb-Bell System

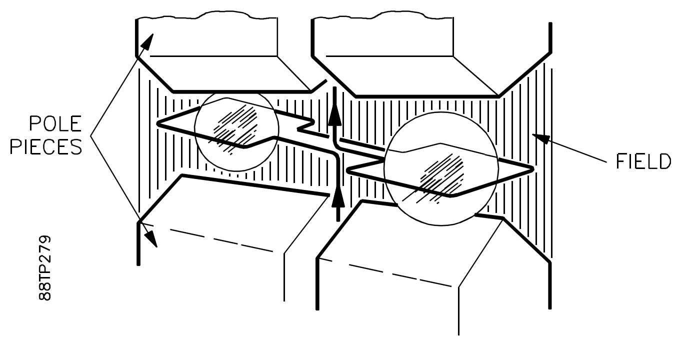


Figure 1.3 Oxygen Measuring Cell

A single turn of fine platinum wire (the feedback coil) is secured in place around the dumb-bell. A rugged, taut band platinum ribbon suspension attached to the midpoint of the dumb-bell positions the dumb-bell in the strong non-uniform magnetic field existing between the specially shaped pole pieces of the permanent magnet structure. See Figure 1.3.

The angular position of the dumb-bell is sensed by a light beam projected onto a mirror attached to the dumb-bell from which it is reflected onto a pair of photocells. See Figure 1.4. The difference in the output from these photocells is fed to an amplifier.

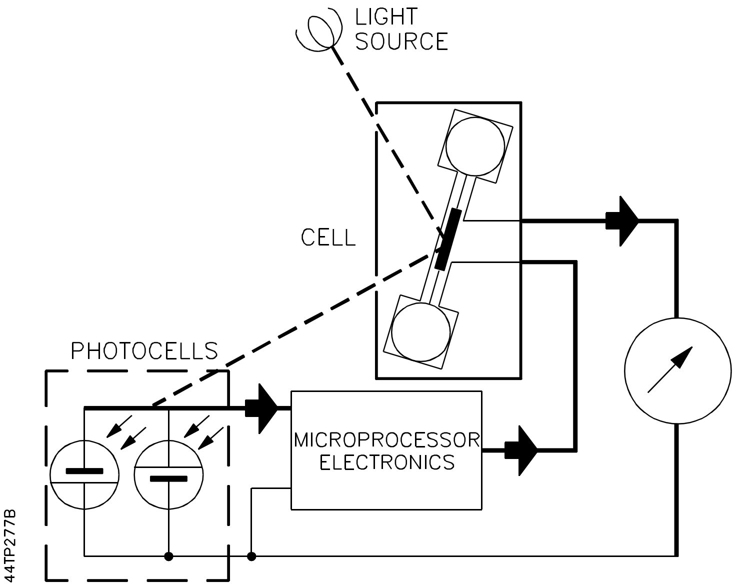


Figure 1.4 Analyser Schematic

When a sample gas containing oxygen surrounds the dumb-bell, the oxygen molecules are attracted to the strongest part of the magnetic field, thus enhancing the magnetic field around the dumb-bell. This changes the force acting on the dumb-bell causing a displacement of the light beam across the photocells, which in turn results in a difference signal being sensed by the amplifier. The resulting output of the amplifier is a current, proportional to the oxygen content of the sample, which is fed to the feedback coil of the measuring cell. This produces a magnetic field which opposes the forces causing the dumb-bell to rotate. Thus the dumb-bell is maintained in its original position.

Since this current is proportional to the oxygen content of the gas sample it is used to develop the output signal from the analyser. This current feedback force balance design is resistant to mechanical shock and has outstanding accuracy and linearity.

See Section 1.7.5 for measuring cell options.

1.6.1.2 Heaters and Temperature Sensor

The transducer unit is temperature controlled.

Heaters of type of construction 'N' (non-sparking) are fitted to the 1131 Transducer (Zone 2/Div 2) and of type 'd' (flameproof) construction to the 1132 and 1133 Transducer (Zone 1/Div 1).

A platinum resistance thermometer senses the internal temperature of the transducer and transmits a signal to the amplifier board. Power to the heaters is switched through a solid state relay located in the Control unit.

1.6.1.3 Pressure Compensation 01100997B

See Section 1.7.3 for a description of pressure compensation.

1.6.2 Control Unit

The Control unit has seven basic functional blocks:

1. Amplifier Board
2. Analogue to Digital Converter
3. Microprocessor Board
4. Isolated Current Output Board
5. Keypad
6. Display Board
7. Power Supply Unit

1.6.2.1 Amplifier Board 01100925B

The amplifier board accepts inputs from the platinum resistance thermometer, photo-cells and, if fitted, the pressure transducer. The signal from the photo-cells is used to generate the feedback current to the measuring cell and from this a voltage signal which is proportional to oxygen content. The platinum resistance thermometer and the pressure transducer each form one arm of a measuring bridge the outputs of which are amplified. The three analogue signals are fed to the analogue to digital converter and hence to the microprocessor.

1.6.2.2 Analogue to Digital Converter 01100916A

The analogue to digital converter converts the three analogue signals from the amplifier board, oxygen content, temperature and pressure, into a digital form acceptable for the microprocessor board.

1.6.2.3 Microprocessor Board 01100918C or 01100918D

The microprocessor board controls all the functions within the system. It processes digital signals from the oxygen measuring circuit, temperature sensor and keypad to provide outputs to the digital display, isolated current output board, heater control and optional relay and data output modules.
There are 2 versions of the microprocessor board, 01100918C which features a lithium battery powered memory back-up, and 01100918D which uses a capacitior to maintain the memory (used on ISSEP INIEX purged analysers only).

1.6.2.4 Current Output Board 01100929A or 01100939.

The microprocessor board sets the zero offset and range of the oxygen signal. The current output board converts the digital signal to give an 0-20 or 4-20 mA (or reversed) output.

01100939 has a general purpose output; 01100929 and 01100929A are for connection to intrinsically safe indicators.

Earlier analysers have output board 01100929.

1.6.2.5 Keypad

The keypad contains twenty-one touch sensitive keys which are colour coded to simplify operation of the keypad. Some of the numerical keys are dual function. The colour codes are as follows:

Black	-	Six Keys, used for calibrating.
Green	-	Four Keys, used to set or display the span range and zero offset of the analogue input.
Blue	-	Five Keys, for oxygen level alarm codes.
Grey	-	Four command keys, a decimal point, minus sign and ten numerical keys, some of which are multi function.

NOTE: Up to S/N 1101/5199 the colour code for keys was as follows:

Yellow	-	Replaced by Black
Orange	-	Replaced by Green
Red	-	Replaced by Blue
Grey	-	Remains

1.6.2.6 Display Board 01101902

The microprocessor generates a digital signal to drive the L.E.D. display. This signal provides an oxygen content reading on the eight character display down to 0.01% oxygen resolution. The display board also encodes the keyboard signals.

1.6.2.7 Power Supply Unit 01100968

The power supply unit generates +5V d.c., 0V and +/-8V d.c. supplies and also two isolated a.c. supplies for the analogue output and optional digital output board. An on/off signal is generated to provide the microprocessor with an indication of the state of the power supply unit.

In the case of electricity supply failure ('Brown Out') the operation of the microprocessor will be closed down in a logical way. The power supply unit also receives a heater control signal which actuates a solid state relay via an opto-coupler. This relay switches power through to the heaters in the transducer unit.

1.6.3 Interface Unit

The Interface unit is used when the separation of the Transducer from the Control unit has to be greater than 100m (330 ft). The link from the Interface unit to the Control unit is digital and can be up to 500m (1600 ft).

The Interface unit is similar to a Control unit but has no keyboard or display. It includes a digital output board (01100927). The Control unit used as the receiver comprises only a digital output board (used as termination for the digital link from the Interface unit), microprocessor board and display/keyboard.

The Control unit checks the status of the digital link and if corrupted information is received it will alarm. The alarm is self cancelling once communication is re-established.

The Interface unit stores all the information in the system and when first powered-up, or after a communications failure, this data has to be transmitted to the control unit. This takes approximately 30 secs. During this time the display on the Control unit shows a flashing sequence of hyphens and blanks.

The optional alarm relay card (01100936) can be mounted in either the Interface or Control unit.

The optional auto-calibration relay card should be fitted in the Interface unit.

For servicing in a SAFE AREA ONLY, it is possible to connect a keyboard and display to the microprocessor board in the Interface unit. This local keyboard takes precedence over control signals from the Control unit.

1.7 OPTIONS

1.7.1 Alarm Board 01100936

The optional alarm board has four sets of change-over relay contacts. The analyser has 15 dedicated alarm functions, and any alarm function can be allocated to any relay, more than one function can be allocated to the same relay and the same function can be allocated to more than one relay.

1.7.2 Data Output Board 01100927

A data output board may be fitted. The board uses an ASCII transmission code operating an asynchronous signal with a start bit, eight data bits and two stop bits at a transmission rate of 300 baud.

Two types of output are available from the board. The first switches a 20 mA current loop signal to allow maximum cable length from the Control unit . Secondly, the data may be transmitted as a bipolar RS 232C type signal for interfacing to a local computer terminal.

Full details of the protocol of the digital data output is given in Appendix 4.

1.7.3 Pressure Compensation 01100997B

Pressure compensation is an option which should be specified at the time of ordering. It cannot be fitted in the field.

The 1161 dry gas sample panel should be fitted if pressure compensation is specified as this has facilities for calibrating the pressure compensation option.

The pressure transducer measures the pressure inside the measuring cell and provides an output which is used by the microprocessor to compensate for changes in pressure to ensure that the oxygen concentration reading remains constant for fluctuations in sample pressure.

NOTE: The pressure in the cell should be within the range 83 to 124kPa absolute (12 to 18 psia).

If the sample is vented to atmosphere the reading will be compensated for changes in barometric pressure. This arrangement is recommended for very critical applications, particularly when samples with a high oxygen content are being measured (e.g. in oxygen purity monitoring), when normal atmospheric pressure variations could represent a significant change in the reading.

If the sample is being returned to process then pressure compensation may be required to compensate for possible fluctuations in process pressure.

Note that in order to calibrate the pressure compensation it is necessary to use a calibrating gas with a high oxygen content. If the sample is being returned to process it may be necessary to fit stream selector valves to the exhaust of the analyser so that calibrating gases are vented to atmosphere.

The dry gas sampling system type 1161 has facilities for calibrating the pressure compensation. It is suggested that this should always be used with pressure compensation.

On systems with separated Transducer and Control (or Interface) units with pressure compensation fitted the cable length should not exceed 30m (100ft). The performance will be degraded if the cable length is between 30 and 100m.

Pressure compensation is not available for analysers fitted with the 1162 wet gas sampling system or with the model 1132 Transducer unit.

1.7.4 Auto-calibration 01100936

The analyser can be programmed to carry out an automatic calibration sequence. An optional relay board is fitted which has relays to drive three solenoid valves for controlling the zero, span and sample gases. The optional board comprises the relays only, it does not include the solenoid valves, these must be obtained by the user.

The auto-calibration sequence may be initiated from the keypad or at preset time intervals which are set by the user or by momentary closure of remote contacts. During the auto-calibration sequence the diagnostic procedures in the software check the oxygen content and response times of the zero and span gases. If any of these parameters are outside the limits defined by the user an alarm is initiated and the sequence is aborted without recalibration taking place.

During auto-calibration the analogue output signal may if required, be preserved at the last measured process value. Up dating will recommence when the auto-calibration sequence is completed, or aborted.

1.7.5 Measuring Cell Option

Two measuring cells are available, the standard type 325 which is suitable for most applications and the type 364 which can be used with many solvents or corrosives.

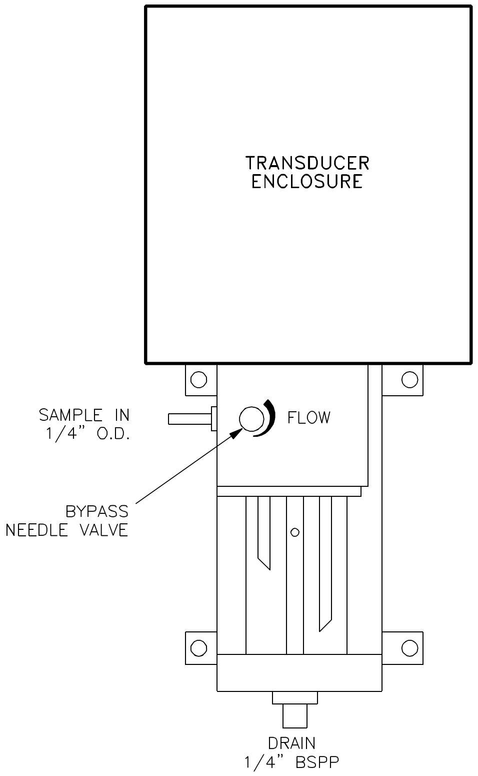
Earlier analysers were supplied fitted with type 312 (standard) or type 313 (solvent resistant) cells.

Materials of the analyser in contact with sample gases are as follows:

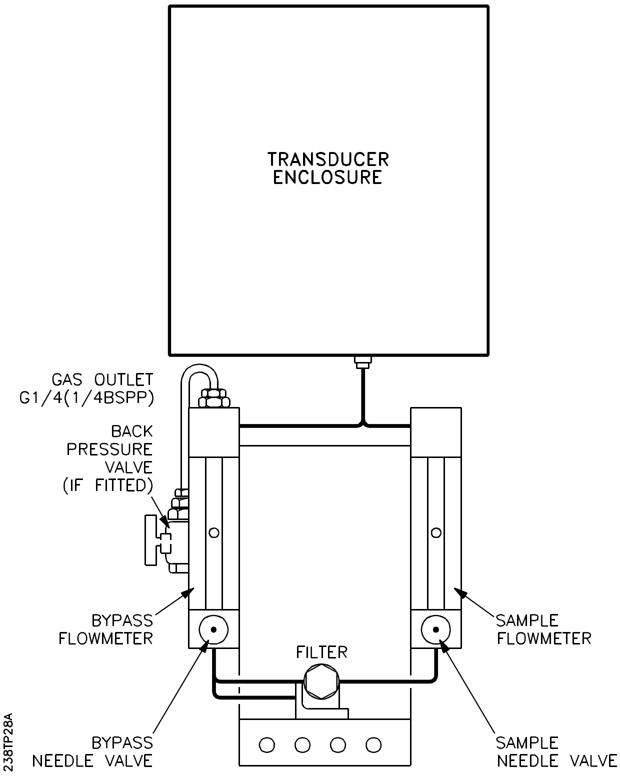
	Standard	Option
Cell Type:	325	364
Stainless steel 316	*	*
Electroless nickel	*	*
Platinum	*	*
Pyrex glass	*	*
Viton	*	
PTFE		*
PTFE elastomer		*

The fitting of any cell except those shown above will invalidate certification.

The 1132 (1100H) transducer may be fitted with the 364 cell only.



1162 Wet Gas System



1161 Dry Gas Sample System

Figure 1.5 Sampling System Options

1.7.6 Sampling Systems

See Figure 1.5. Two standard sampling systems are available:

The 1161 for dry gases, comprises two flow meters fitted with needle valves to set bypass and sample flow rates and a filter with a replaceable element.

The 1162 for wet samples, comprises a water-filled bubbler, a filter with a replaceable element and a needle valve to control the flow. The latter is suitable for samples saturated at temperatures up to 45°C (113°F)

The high temperature 1100H, using the model 1132 transducer, will generally require a custom designed sampling system.

1.7.7 Flow Alarm

A version of the 1161 dry gas sample panel is available fitted with a flow alarm. The signal from the alarm can be interfaced into the Control unit which will display an alarm if the sample flow through the cell falls below a predetermined level.

NOTE: The flow alarm is not suitable for use in hazardous areas.

1.7.8 Customised Default Values

To reduce the setting up of the analyser and to ensure correct start-up conditions the software can be supplied with customised default values for alarm levels and setting the analogue output. They should be specified when the analyser is ordered but may be retrofitted at a later date by replacing the microprocessor board with one bearing the required default values.

Customised default values are not available with 01100651, 01100652 and 01100699 software.

SECTION 2 : INSTALLATION OF ANALYSER

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SECTION 2 INSTALLATION OF ANALYSER

This section includes installation instructions for the various options, information for connecting the analyser units together and for the electrical and sample gas connections.

Installation Overview

1. Mounting of analyser - Section 2.3

2. Sample gas connections - Section 2.5

3. Electrical supply connections - Section 2.6

4. Transducer to Control unit interconnections (separated systems only) - Section 2.8.

5. Interface to Control unit interconnections (max separation systems only) - Section 2.9

6. Analogue output, alarm and auto-calibration connections - Section 2.11.

2.1 SAFETY CONSIDERATIONS

2.1.1 General Safety Requirements

Specific standards of safety are not included in this manual, since requirements of relevant authorities vary widely.

WARNING

The installer must be satisfied that the analyser installation conforms to the relevant safety requirements and that the installation is safe for any extremes of conditions which may be experienced in the operating environment of the analyser.

The safety precautions described in the following installation instructions ensure that the existing safety features of the instrument are not impaired during installation. The precautions do not guarantee a safe installation if other relevant safety codes are ignored.

2.1.2 Hazardous Area Requirements

If the analyser is being installed in a hazardous area then any "Special Conditions for Safe Use" and/or "Schedules of Limitation" as detailed in the Safety Certification must be adhered to.

A summary of the certificates are in Appendix 1. Copies of the certificates and variations/revisions are supplied with certified product as a supplement part number 01100 008A.

WARNING

To retain safety certification cable glands and unused gland holes must be weatherproof to IP54 or NEMA 4 standards.

The analyser contains intrinsically safe circuits. The installer must ensure that the requirements of a safety earth (or ground) are met.

2.2. PRE-INSTALLATION CHECKS

Unpack the instrument and inspect the unit for signs of damage during transit. If any damage is evident, inform Servomex or their Agents immediately.

2.3 POSITIONING

Accurate and secure installation will minimise maintenance and instrument breakdown and will provide reliable service.

The location should be reasonably vibration free and be subject to minimal fluctuations in ambient temperature.

The enclosure is protected to IP 54 (NEMA4). If the units of the analyser are installed in an aggressive environment or outside where they are exposed to the weather then further protection will be necessary. If there is a possibility of low ambient temperatures then installation in a heated cabinet may be required.

The sample conditioning system should be positioned below the level of the Transducer unit. This prevents a possible carry-over of condensate into the measuring cell. Servomex can advise on the design of suitable systems to remove particulates or condensate.

2.4 MOUNTING DETAILS

2.4.1 Close Coupled Configuration

The close coupled variant of the 1100A is supplied with straps for surface mounting (Refer to Figure 2.1 for principal dimensions).

2.4.2 Separate Configuration

The Transducer and Interface units are supplied with straps for surface mounting (Figure 2.2).

The arrangement used to mount the control unit depends on which mounting kit was specified.

Installation instructions for the three arrangements are as follows:

1. Surface mounting using kit 01100 401 (Figure 2.2)

   Attach the two straps to the rear of the Control unit using the screws supplied.
   This unit can now be hung on any convenient vertical surface.

2. Flush panel mounting using kit 01100 413 (Figure 2.3)

   Make a rectangular hole in the panel as shown in Figure 2.3.
   Insert the Control unit through the panel from the front.
   Fasten in place with the brackets and screws provided,
   making sure that the flanges at the front of the control unit are tight against the panel.
   Each bracket is fixed to the unit with two screws.

3. 19 inch rack mounting using panel kit 01100 414 (Figure 2.4).

   Insert the Control unit through the hole in the panel from the front.
   Continue as described in section 2.4.2, para (2) "Flush Panel Mounting".

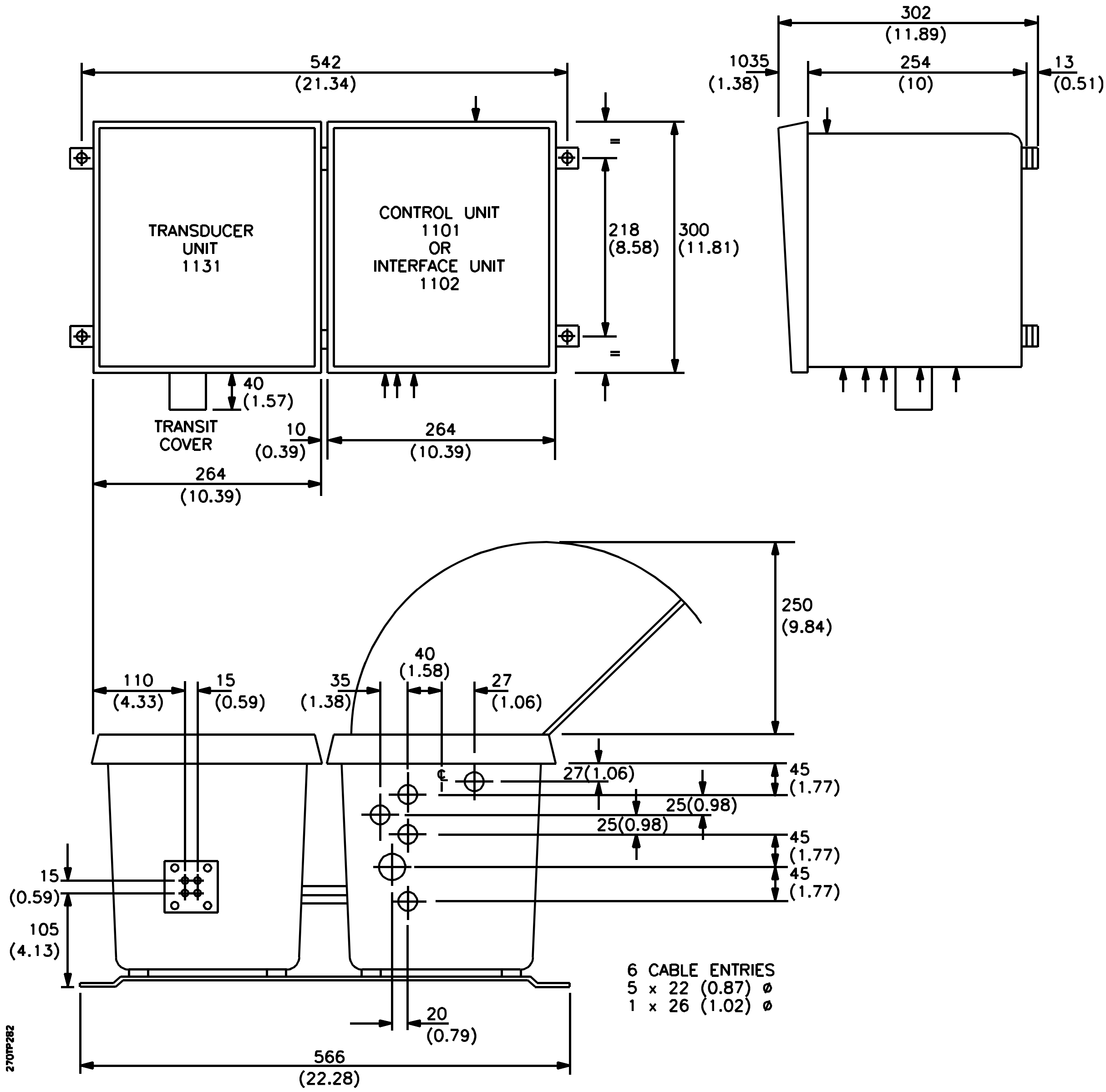


Figure 2.1 (a) Principal Dimensions Close Coupled Analyser or Transducer with Interface Unit

Architecture Codes 01, 03, 21 and 23

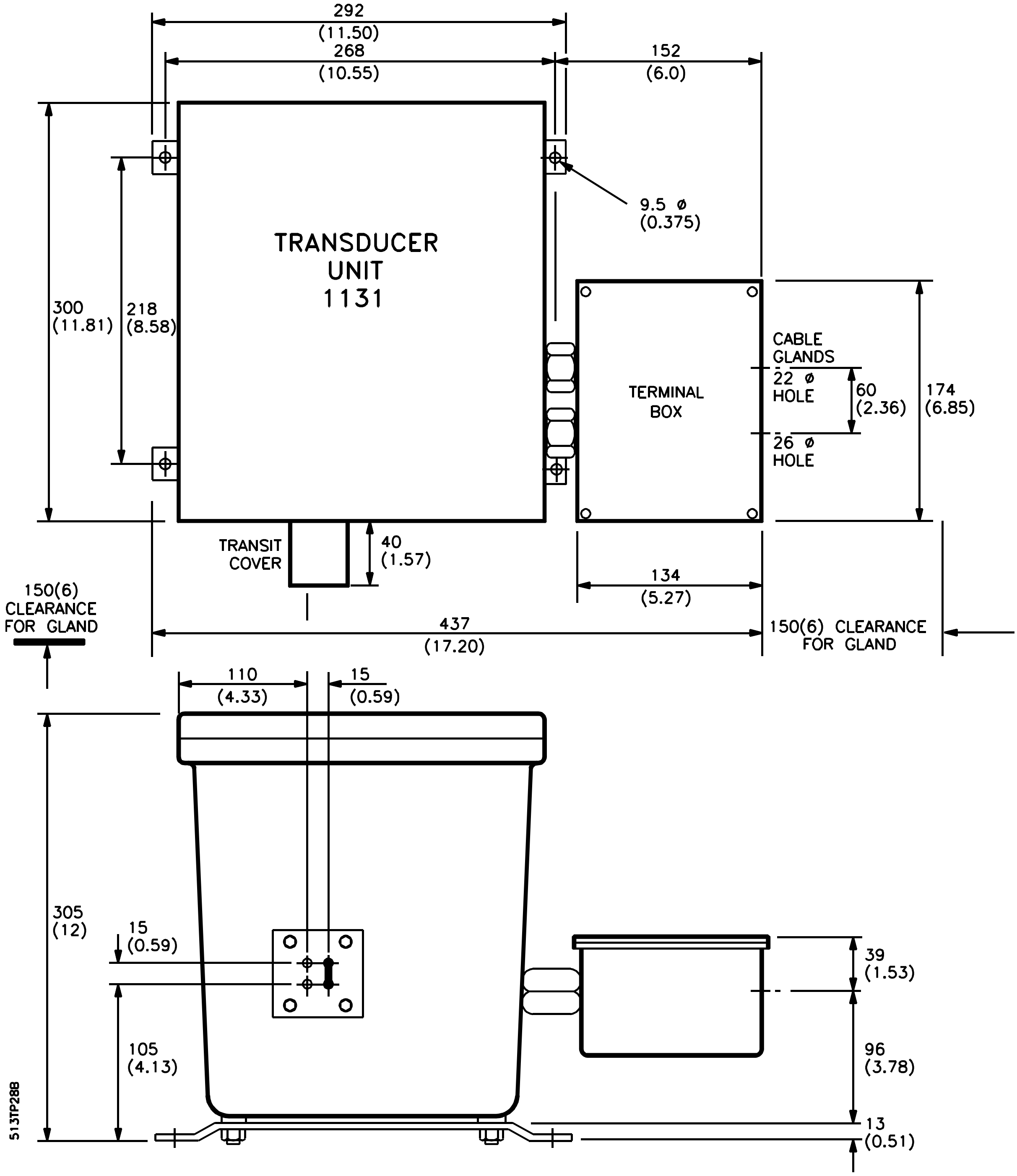


Figure 2.1 (b) Principal Dimensions 1131 Transducer Unit

Architecture Codes 02 and 22

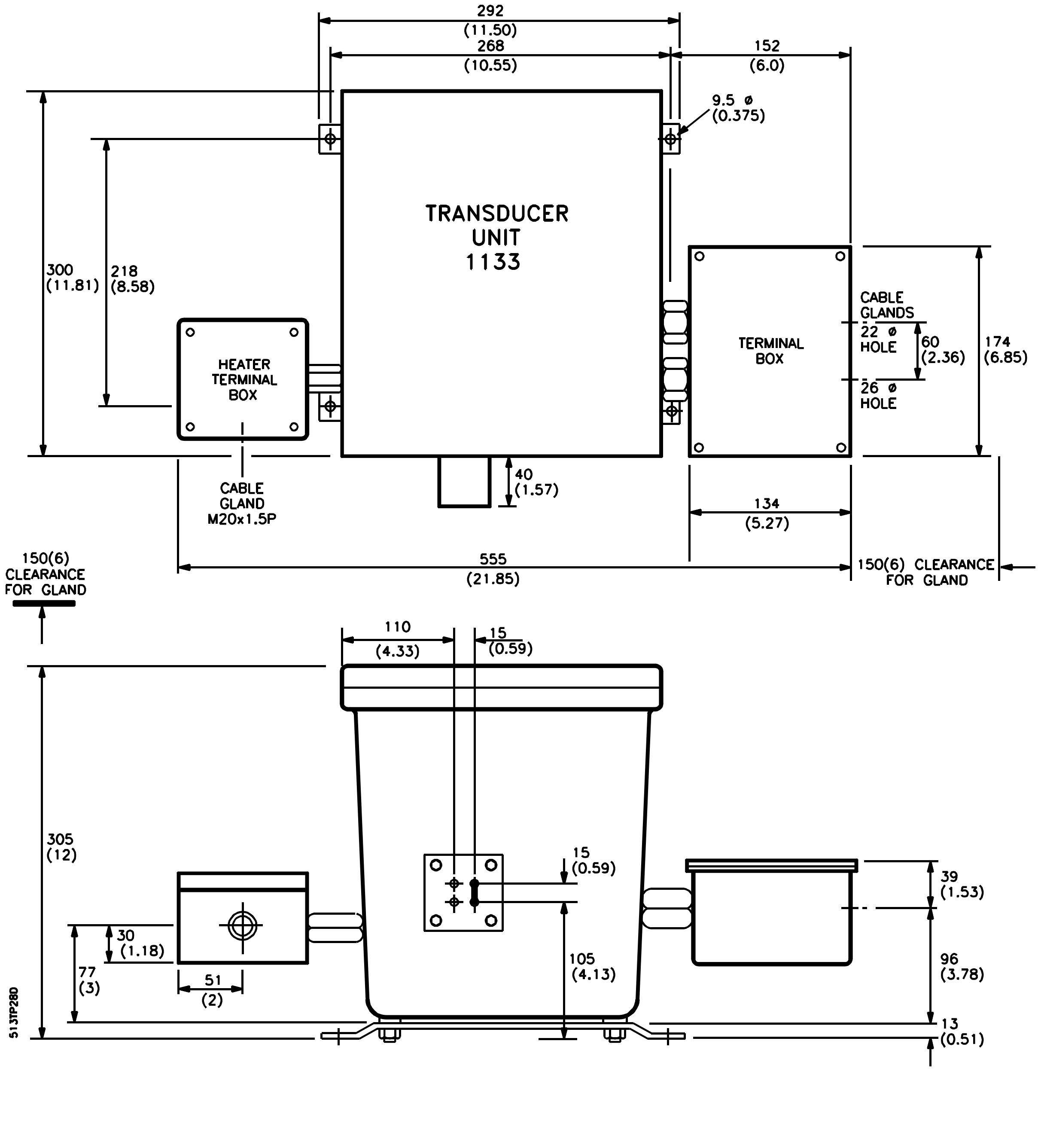


Figure 2.1 (c) Principal Dimensions 1133 Transducer Unit

Architecture Codes 04, 06, 14,16, 24 and 26

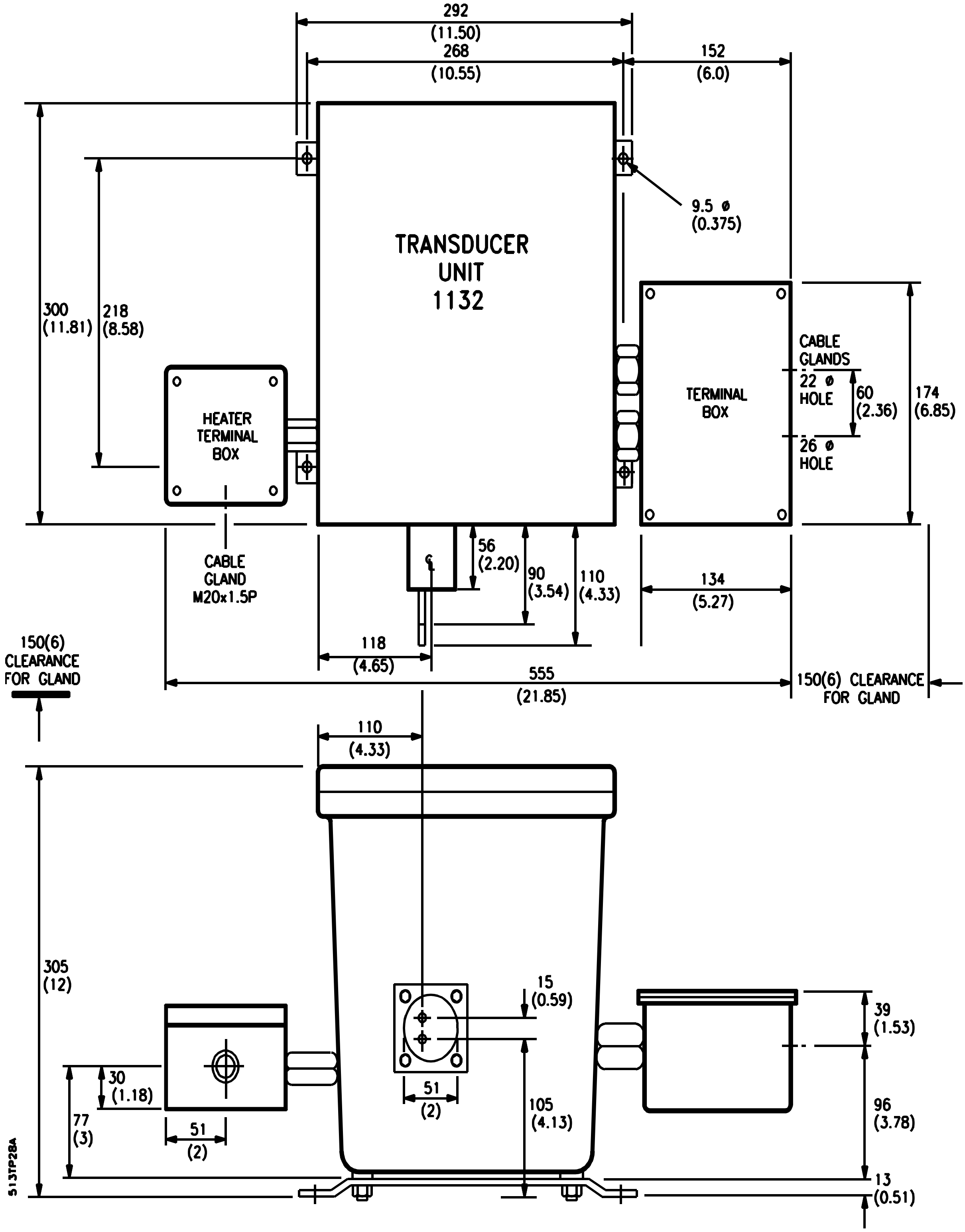


Figure 2.1(d) Principal Dimensions 1132 Transducer Unit

Architecture Codes 04 and 06

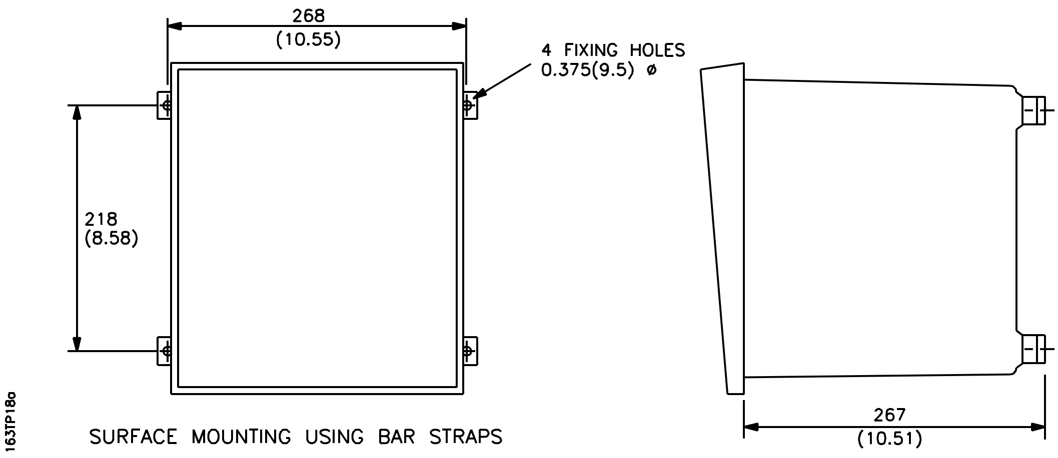


Figure 2.2 Surface Mounting Control Unit

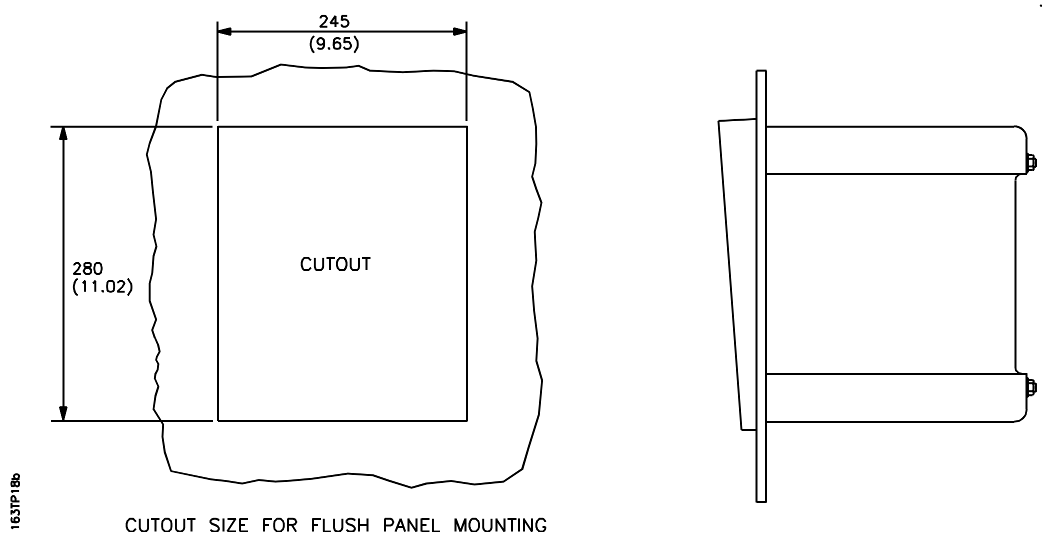


Figure 2.3 Flush Panel Mounting (Control Unit Only)

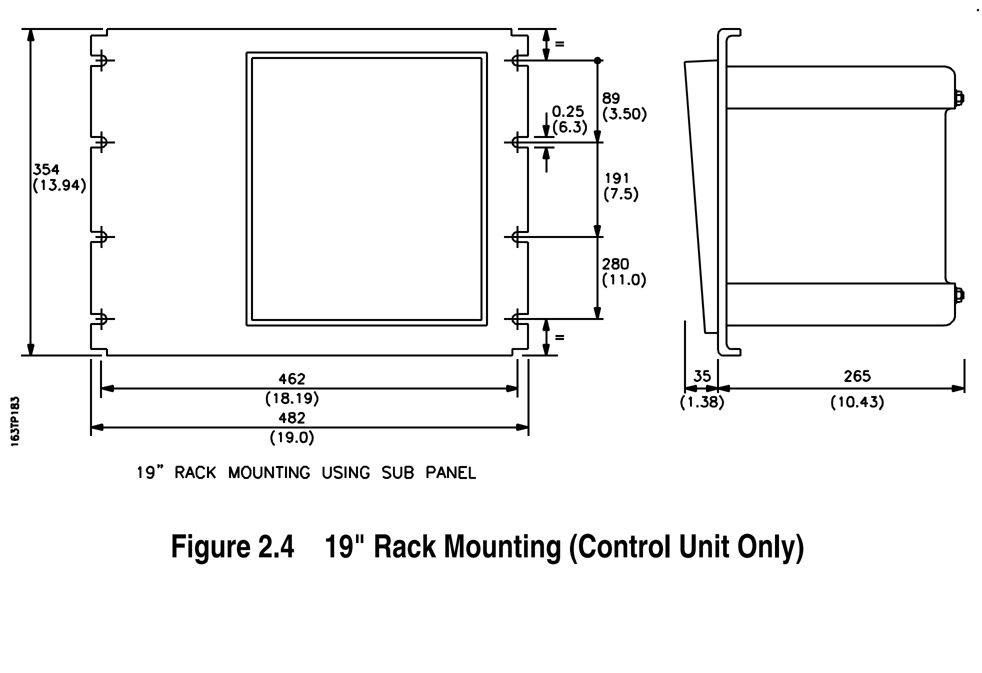


Figure 2.4 19" Rack Mounting (Control Unit Only)

2.5 SAMPLE GAS CONNECTIONS

Before the gas is analysed it has to be conditioned to ensure that:-

1. The pressure range is correct.

2. Water and/or solvents are removed.

3. Dust is removed by filtering.

4. Flow is controlled.

The 1161 sampling system (for dry gases) or the 1162 (for wet gases) are suitable for many applications. Servomex can advise and supply sampling systems for more rigorous applications.

Correct conditioning of the sample gases will greatly improve the reliability of the analyser. Most analyser faults are caused by inadequate sample conditioning.

The standard analyser is fitted with 1/8 in o.d. tubes which project from the base of the transducer unit. These provide inlet and outlet connections to the measuring cell. (Refer to Figure 2.5 (a)).

A cover, which is fitted over the tubes to protect them during transit, should be removed to access the connections.

Do not bend the inlet and outlet pipes emerging from the bottom of the transducer. Servicing difficulties will be encountered if these pipes are bent or have metal ferrules attached. It is recommended that 'O' ring fittings are used for inlet and outlet connections.

If a Servomex sampling system is not used then the sample requirements are:

Inlet pressure to analyser:	0.3kPa (50mm wg) maximum relative to vent pressure.
Maximum Sample Pressure:	28kPag (4psig) relative to atmosphere.
Cell flow rate:	Cell types 325 and 364: 250ml(air)/minute maximum. Cell type 313: 150ml/min for cell type 313. Cell type 312: 200ml/min for cell type 312.
Dew point:	
1131 and 1133 transducers:	5°C (9°F) below lowest ambient temperature.
1132 transducer:	Less than 105°C (221°F).

Temperature:

1131 and 1133 transducers:	50°C (122°F) maximum, ! 10°C (14°F) minimum at analyser inlet.
1132 transducer:	105°C (221°F) maximum, ! 10°C (14°F) minimum at analyser inlet.

The sample must be dry and clean with a maximum particulate size of 3 micron.

It will be necessary to regulate the sample pressure and flow to ensure stable operation and to prevent damage to the measuring cell. If a sample pump is used then precautions may be necessary to prevent pressure pulsing.

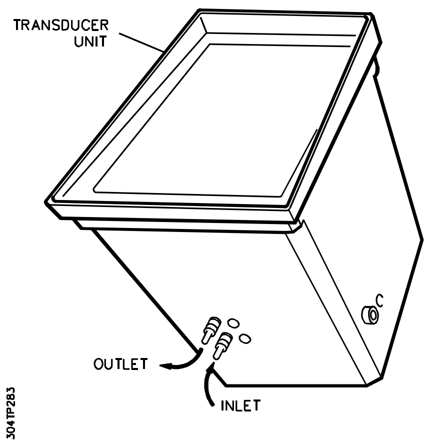
The exhaust from the transducer should not be constricted. If the exhaust is piped away then, to avoid a back pressure in the cell, the diameter of the piping used should be greater than the inlet piping.

Note that if pressure compensation is fitted then facilities have to be made available for calibration. These are provided with the 1161 dry gas sample system. If this is not used then there has to be a means of putting a stable back pressure on the analyser of about 7kPa (0.7psig).

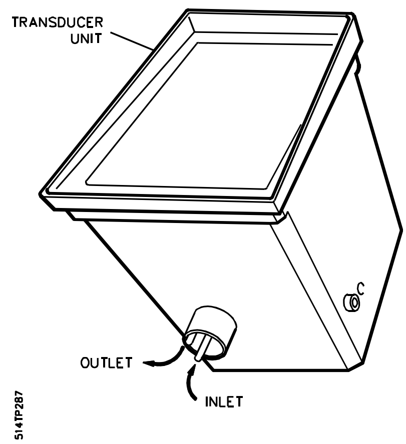
Sample pipework should be tested to ensure it is leak free. When using oxygen enriched (>21% O_2) sample gases in hazardous areas it is a condition of safety certification that pipework should be of metal.

Figure 2.6 shows schematically systems which give good regulation of flow through the sample cell.

If venting to atmosphere, ensure local environmental regulations are not violated.

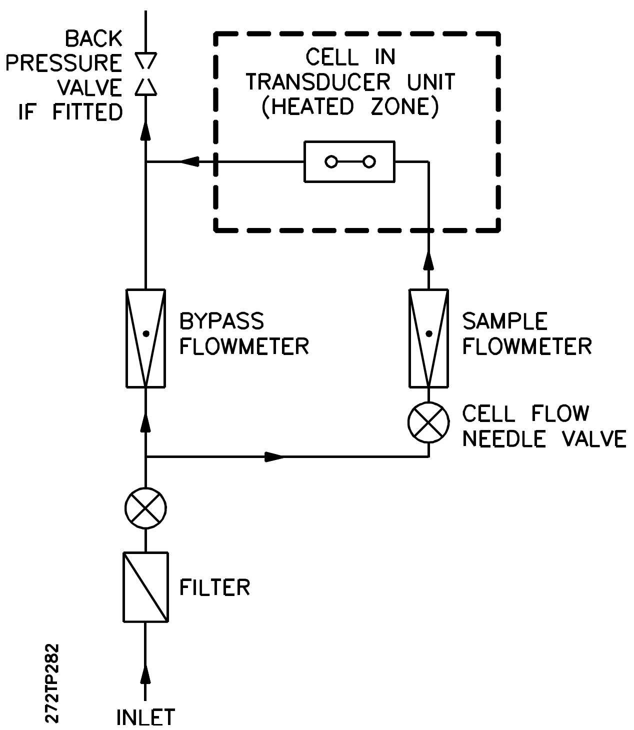


(a) 1131/1133 Transducers

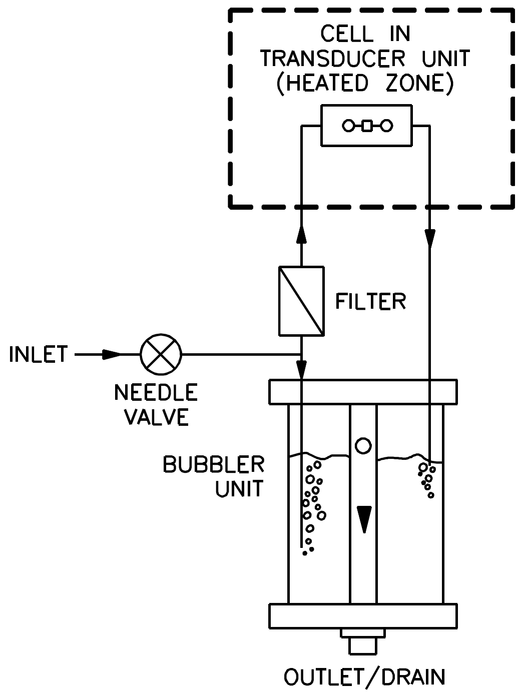


(b) 1132 Transducer

Figure 2.5 Gas Connections to Transducer Units.



(a) Dry Gas Samples



(b) Wet Gas Samples

Figure 2.6 Recommended Sample System Schematics

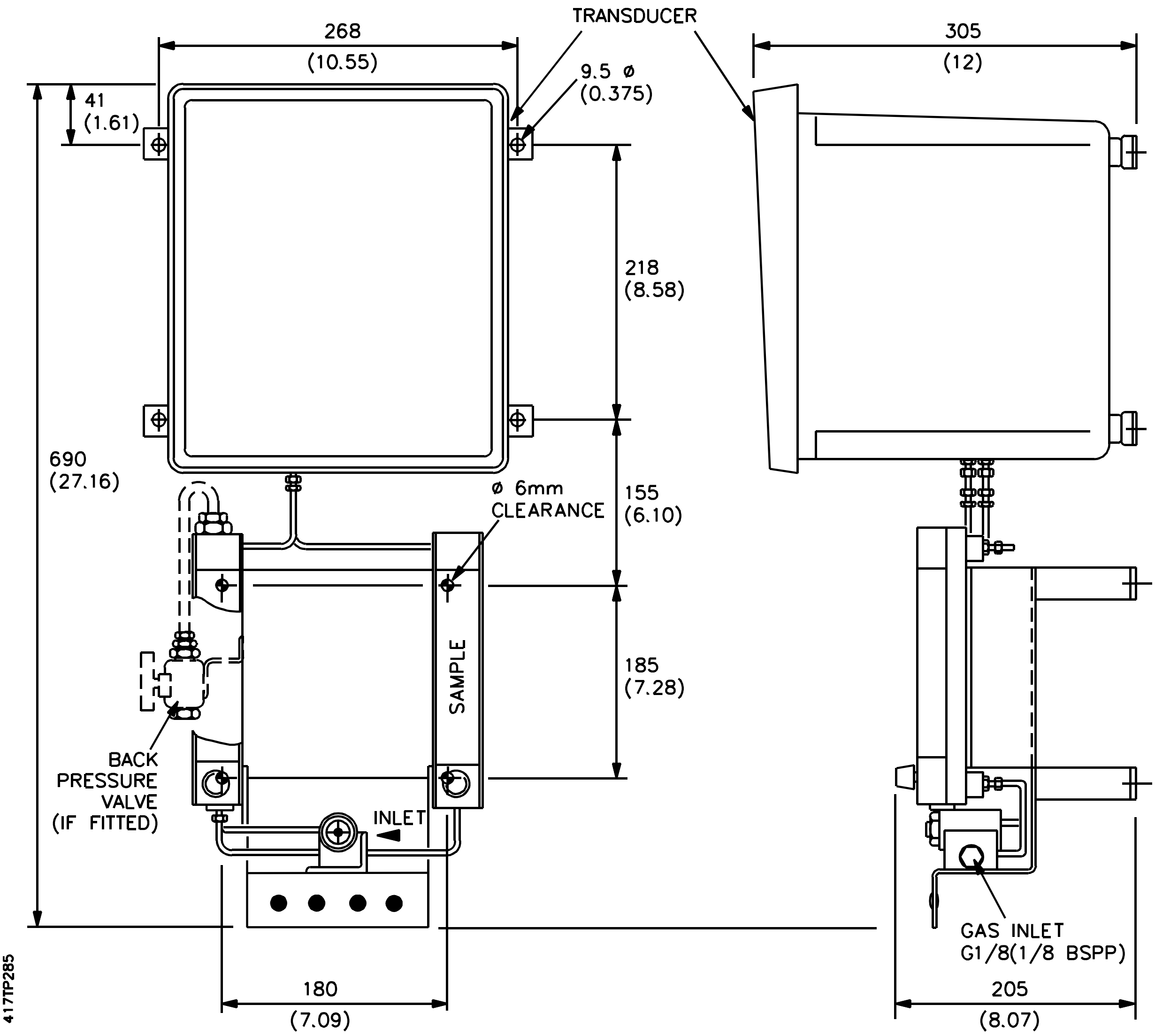


Figure 2.7(a) Connection of 1161 Dry Gas Sampling System

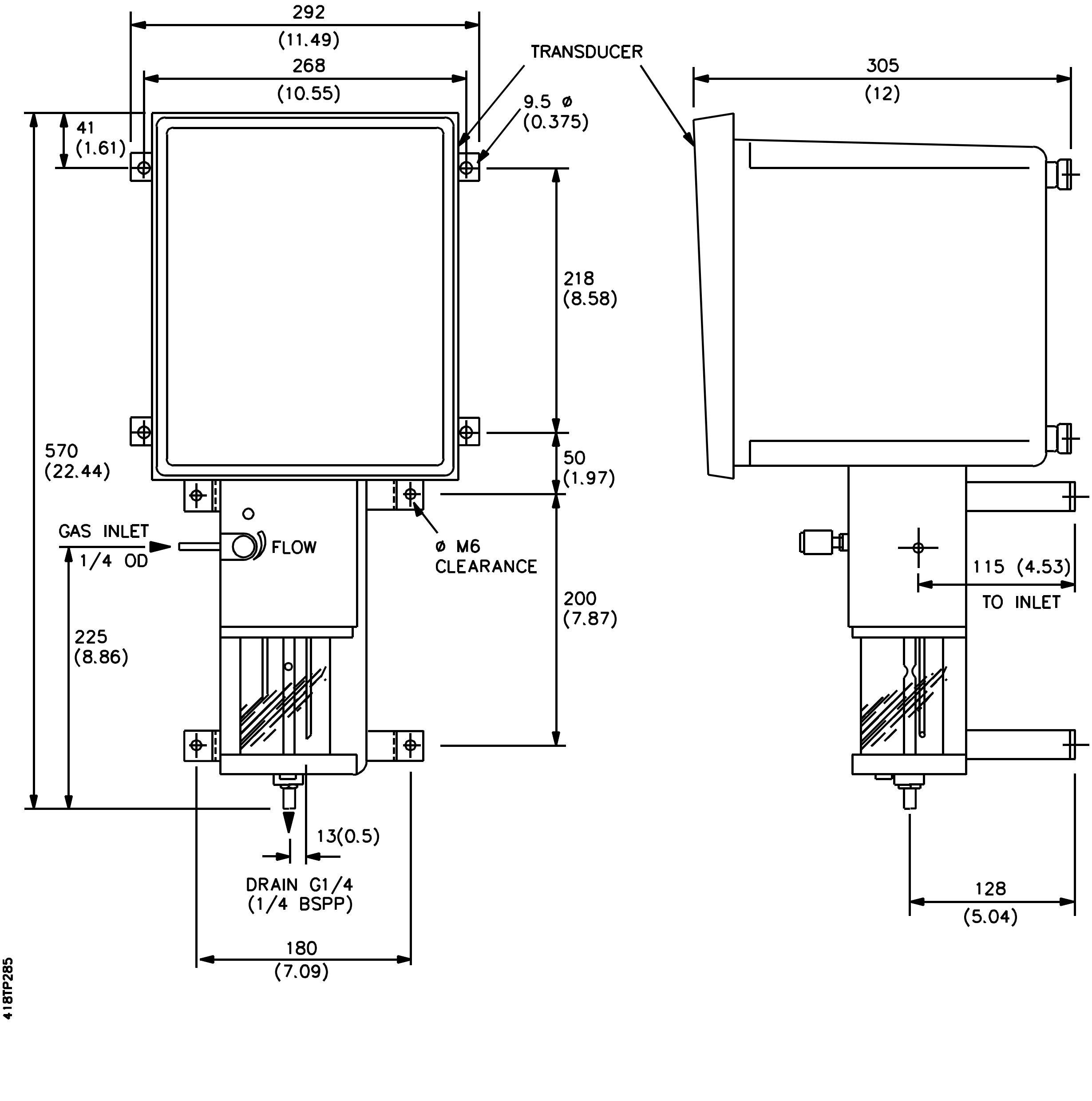


Figure 2.7(b) Connection of the 1162 Wet Gas Sampling System

2.5.1 1131 and 1133 Transducers Gas Connections:

If a Servomex type 1161 or 1162 sampling system has been supplied, this must be mounted beneath the transducer unit and connected as shown in Figure 2.7. The sample gas inlet connection to the sampling system is a Rp 1/4 (1/4 in.BSPP) fitting for the 1161 dry gas sampling system; 1/4" o.d. tube for the 1162 wet gas sampling system.

The 1161 dry gas sampling system will keep the flow of sample gas through the measuring cell essentially constant for a wide variation in sample pressures or bypass flowrates.

Note that if pressure compensation has been specified a calibrating valve will have been supplied as a loose item. This should be installed on the bypass flowmeter as shown in Figure 2.7 (a).

The 1162 is suitable for use with sample gases containing low levels of water or condensed solvents. If high levels of condensation may occur then it is recommended that the dew point of the sample gas is reduced before it is introduced into the analyser.

Information on sample requirements for the 1161 or 1162 sampling systems is given in Appendix 8, Sections 6 and 7.

Check that the materials of the sampling system are compatible with the sample gases.

2.5.2 1132 Transducer Gas Connections

This transducer is suitable for use with sample gases which have a dew point between ambient temperature and 105°C (221°F). The sample system must be heated from the sample take-off point to the 1132 transducer. Particular care must be taken to avoid cold spots where condensation may occur especially between the sample conditioning system and the transducer.

See Figure 2.5(b).

2.6 ELECTRICAL SUPPLY

WARNING

Since an isolating switch is not fitted to this instrument it is necessary to ensure that the electricity supply is fitted with a switch to disconnect the instrument.
The instrument cases must be connected to earth (ground) at all times.

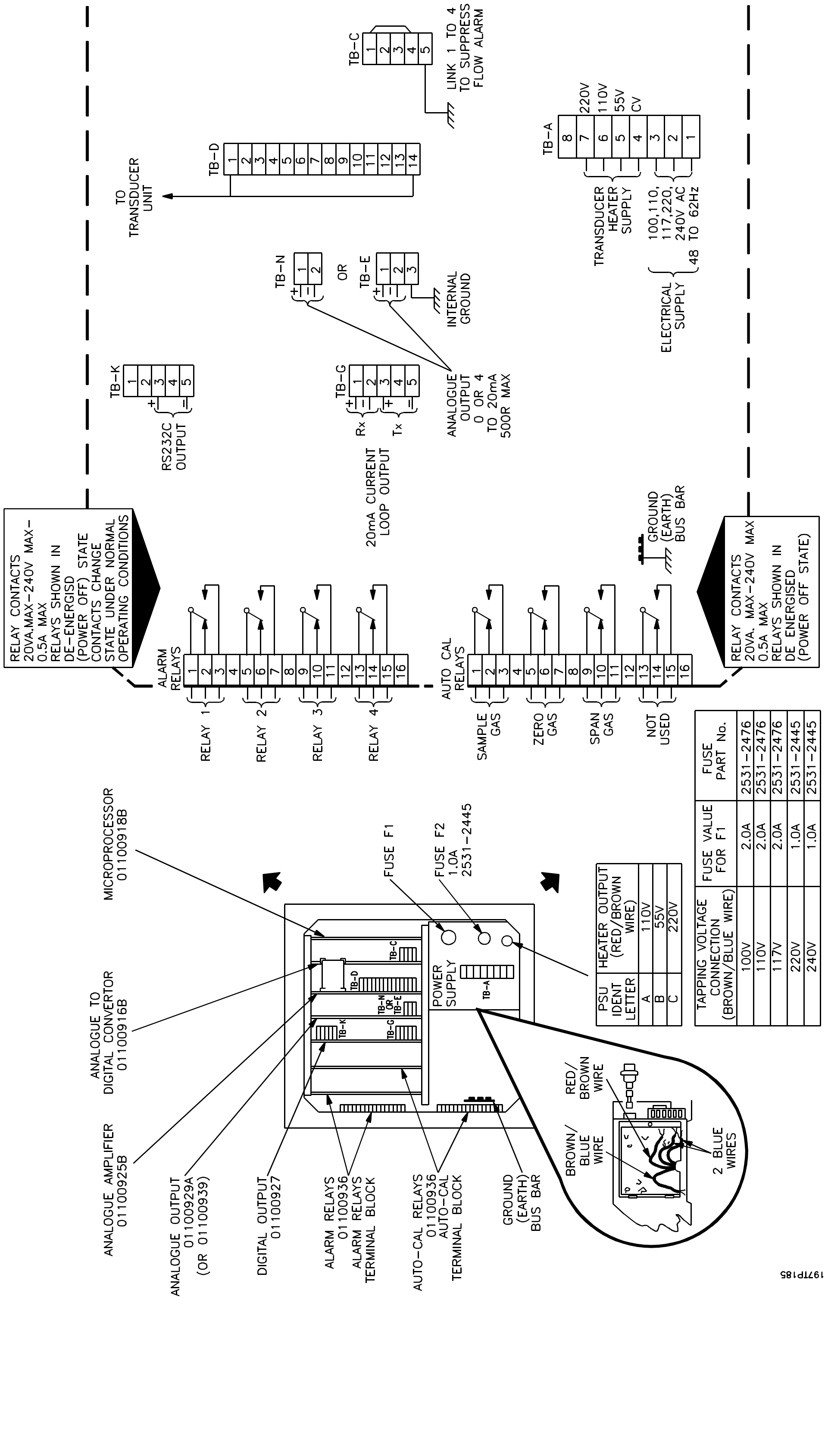


Figure 2.8 Electrical Connections

Electrical power connections are made to the Control Unit, See Figure 2.8

In the case of systems with an Interface unit (Codes 03, 06,16, 23 and 26) then an electrical supply is also required for the Interface unit. The data link between the Interface unit and Control unit is isolated and floating so the two supplies will usually be separately switched.

If a centre tapped electrical power supply is used (eg 55-0-55V) then both poles must be switched and fused.

On installations where the electrical supply is not referenced to ground an isolating transformer must be fitted and its secondary winding suitably grounded. If there is a possibility of the electrical supply carrying interference into the analyser then a filter should be fitted adjacent to the analyser. A suitable filter is available from Servomex, part number 01100 981 (BASEEFA and FM approved) or 01100 959 (CSA approved).

Adaptors are included to enable 20mm glands to be fitted to 22mm gland holes.

2.6.1 Voltage Selection

CAUTION

1100H systems using the 1132 Transducer are supplied to operate from 110V or 220V nominal electrical supplies. Transformer tappings may only be changed between 100, 110, 117V or between 220, 240V respectively. If it is necessary to change between the 110V and 220V ranges, consult Servomex.

The transformer has tappings to accommodate the following nominal supply voltages:
100, 110, 117, 220, 240V a.c. (48 to 62 Hz).

The instrument is normally supplied for the voltage specified initially by the user. If it is necessary to select a different voltage tapping, proceed as follows:

WARNING

Electrical Hazard

Before attempting the following disconnect the electrical supply.

1. Loosen the four captive socket screws, located at each corner of the Control unit, with an M6 socket wrench. Pull the front panel forward until the hinge located on the right of the door reaches its limit and open the door fully to the right. The power supply unit is located at the lower right-hand side of the instrument.

2. The power supply unit is held in place by four screws, two located at the front and two at the rear of the assembly. Remove the two screws located in the front. Loosen the two screws located at the rear of the assembly.

   Slots in the power supply bracket allow the assembly to be manipulated and removed without removing the rear screws. Take care to avoid damaging wires with the screwdriver.

3. Sufficient wire is attached to the assembly to allow limited manipulation necessary to remove the voltage tapping cover on the left hand side of the power supply unit. Lift out the power supply unit taking care not to impose a strain on the wires. Remove the screw attaching the cover protecting the terminals and remove the cover.

4. Unsolder the grey wire (brown/blue on earlier models) and resolder to the terminal marked with the required voltage. Do not move the yellow (red/brown on earlier models) or blue wires.

5. If necessary change fuse F1. 2A for 110V, 1A for 220V nominal.

6. Refit cover and screw then replace the power supply unit, ensuring that the slot in the bracket at the rear of the assembly locates correctly on the screw.

   NOTE: When manipulating the power supply unit into position ensure that wires are not trapped.

7. Tighten the screws at the rear of the assembly. Insert and tighten screws at the front using thread sealant. Replace the voltage label on the front of the unit with a new label showing new voltage.

8. The power supply in the interface unit is identical to that in the Control unit.

2.6.2 Connection to Power Supplies

Specific installation requirements vary widely, therefore cable and entry glands are not provided with the instrument and are not available as a standard option.

Power cable rating, insulation protection and overall installation should conform to the National Wiring Regulations, Hazardous Area Codes of Practice, Local Authority Regulations and conditions of use detailed in the certification relevant to each individual installation.

The minimum requirements of the power cable are as follows:

1. 3-core cable (L.N.E)

2. Voltage rating should conform to the supply voltage; 100 to 120V a.c., or 200 to 240V a.c.

3. Current rating of the conductors should not be less than the fuse rating (1A or 2A).

4. The cross-sectional area of the conductors should be within the range 0.5 to 2.5 mm^2. (20 to 14 AWG).

To connect the instrument to the electrical supply, proceed as follows:

Note: to meet CE requirements for EMC it is necessary to fit the mains filter unit.
(See section 2.14)

1. Remove the instrument cover as described in Section 2.6.1(1).

2. The terminals for connecting the instrument to the electrical supply are located at the front of the power supply unit (TB-A) and are protected by a plastic cover. Remove the single screw attaching the cover to the terminal block and remove the cover.

3. Loosen the screws located on the left of the terminal block on the terminals marked 'SUPPLY 160VA MAX'

4. Bring the power supply cable into the nearest glandhole and insert the wires into their respective terminals and tighten the screws.

CAUTION

A suitable strain relief gland must be fitted to the cable entry hole in the case to prevent abrasion of the cable by the edges of the hole, and to avoid straining the electrical connections.
Cable entries must also be weatherproof to IP 54 or NEMA 4.

5. Replace the cover, taking care not to over-tighten the screw. Damage to the cover could result from too much force being used.

2.6.3 Ground (Earth) Connections

The analyser contains intrinsically safe circuits. For hazardous area applications the grounding via the power supply may be inadequate. In such cases a separate ground connection will be required to comply with relevant standards and is made to the grounding point on the lower left side of the enclosure (see Figure 2.8)

Both the Control unit and Interface unit (if used) require grounding.

2.7 BATTERY BACK-UP

Analysers fitted with microprocessor board 01100918C or 01100918D and software version 0110068X (X = 1,2 or 3) do not need battery back-up of the memory. These analysers have serial number of the Control unit 1101/2301 and above and serial number of Interface unit 1102/201 and above.

Earlier analysers have to have batteries fitted to power the microprocessor memory during periods when electrical power is removed from the analyser. Failure to fit, or renew batteries, will result in loss of memory. This includes calibration constants, alarm levels, allocation of alarm levels to relays etc.

The batteries are mounted in a holder below the card frame. Batteries are not supplied with the analyser. Section 4.5 gives details of how to fit the batteries.

Note that in separated systems the batteries are fitted in the Interface Unit.

Battery specification: Size - AA
Type - Alkaline, non-rechargeable
Voltage - 1.5V
Quantity - 3

The batteries should be changed annually. They have sufficient capacity to power the memory continuously for a minimum of 12 months.

Note: If the analyser is to be taken out of service and stored for a period longer than 6 months the batteries should be removed to prevent leakage and corrosion.

2.8 TRANSDUCER TO CONTROL OR INTERFACE UNIT INTERCONNECTIONS

Except for the close coupled analyser it is necessary to install cables to connect the various units together. Two cables connect the Transducer unit to the Control or Interface unit, a signal cable and a heater supply.

The 1131 Transducer unit has one terminal box for both cables, the 1132 and 1133 have a separate terminal box for the heater cable.

2.8.1 Signal Cable

The signal cable is a multicore instrumentation cable carrying analogue signals from the Transducer unit to the Control or Interface unit. It is terminated in the terminal box at the Transducer unit and on the analogue amplifier board (01100 925B) in the Control or Interface unit. The screen must be earthed at the Control unit end only.

This cable connects intrinsically safe circuits and special conditions apply for analysers installed on hazardous applications. These conditions vary depending on certification and are detailed below.

Cable requirements are:-

1. Seven twisted pairs with an overall shield or screen with drain wire. In electrically noisy installations it may be necessary to shield each individual pair.

   For analysers without pressure compensation, five twisted pairs only are used.

2. The recommended conductor size is 16/0.2mm (20 AWG), but others are acceptable provided the cross-sectional area of the conductor is within the range 0.5 to 1.5mm (20 to 16 AWG) and the loop resistance does not exceed 10 ohms.

   Note: The loop resistance of 100m of 16/0.2mm (20 AWG) cable is approximately 8 ohms.

3. The maximum length of the cable is 100m (330ft).

4. If pressure compensation is fitted this cable should not exceed 30m (100ft) otherwise performance will be degraded.

2.8.1.1 UK Certification Requirements - Hazardous Area Use

This cable should comply with BS 5308 (Instrumentation Cables). The cable must meet the requirements for a type 'A' or 'B' cable as defined in BS 5501, Part 9, 1982 (EN 50039), clause 5.3 and be correctly installed.

Capacitance and inductance or inductance to resistance (L/R) ratio must not exceed the following values:

For H_2/O_2 mixtures:

Gas group	Capacitance : F	Inductance mH	or L/R ratio : H/ohm
IIC	0.02	0.82	15.6
IIB	0.06	2.46	46.8
IIA	0.16	6.56	124.0

See certification details in Suplementary manual 01100 008A for conditions of use, in particular Certificate Ex 84394/2 (10 February 1988).

2.8.1.2 CENELEC Certification Requirements

The cable must meet the requirements for a type 'A' or 'B' cable as defined in EN 50 039, clause 5.3 and be correctly installed.

Capacitance and inductance or inductance to resistance (L/R) ratio must not exceed the following values:

For O_2 not exceeding 21% (CENELEC certification)

Gas group	Capacitance : F	Inductance or mH	L/R ratio : H/ohm
IIC	0.35	2.5	64
IIB	1.05	7.5	192
IIA	2.8	20.0	512

See certification details in Supplementary manual 01100 008A for conditions of use, in particular Certificate BAS No Ex 842393/2 (10 February 1988).

2.8.1.3 F.M. Certification Requirements - Division 1

This cable should conform to ANSI/ISA RP12.6-1987 " Installation of Intrinsically Safe Instrument Systems in Class 1 Hazardous Locations". See certification details in Supplementary Manual 01100008A for conditions of use, in particular system wiring schematic 01100/898 FM.

See Figure 2.8(a) for installation details of this cable to the Control (or Interface unit). The cable must enter the Control unit by the gland hole in the top of the unit and be retained by the metal cable shield. The cable screens are terminated to the earth (ground) lug on the gland locknut as close as possible to the cable gland. If individual wire pairs are also screened these should be terminated to the earth (ground) bus bar.

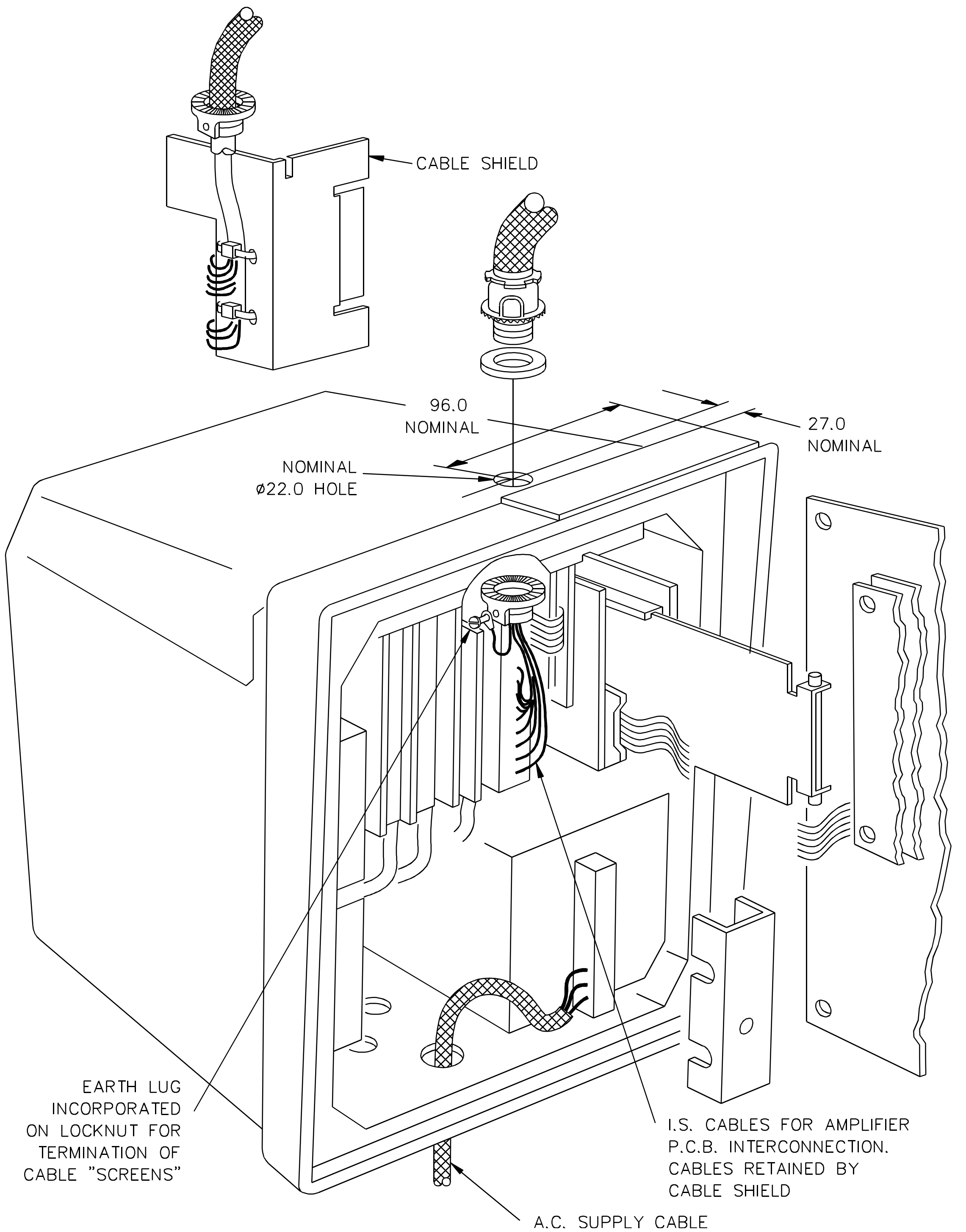


Figure 2.8(a) Installation of Signal cable (FM Requirements)

2.8.1.4 C.S.A. Certification Requirements

Capacitance and inductance or inductance to resistance (L/R) ratio for this cable must not exceed the following values:

For O_2 not exceeding 21%

Gas group	Capacitance : F	Inductance mH	or L/R ratio : H/ohm
B	0.35	2.5	64
C	1.05	7.5	192
D	2.8	20.0	512

Installation of this cable should conform to CSA STD. C22.2 No. 157 M1987: Clause 4.3.8.9. See certification details in Supplementary manual 01100 008A for conditions of use, in particular system wiring schematic 01100/898 CSA.

See Figure 2.8(a) for installation details of this cable to the Control (or Interface unit). The cable must enter the Control unit by the gland hole in the top of the unit and be retained by the metal cable shield. The cable screens are terminated to the earth (ground) lug on the gland locknut.

2.8.2 Heater Cable

The heater cable carries power to the Transducer unit heaters. It terminates in the terminal box at the Transducer unit and at the power supply unit of the Control or Interface unit. Cable requirements are:

1. 3-Core (L.N.E.)

2. Voltage rating suitable for 220V a.c. nominal

3. Current rating not less than 1A (heater fuse rating).

4. Conductor cross sectional area to be within the range 0.5 to 2.5 mm^2. (20 to 14 AWG) and the loop resistance to be less than 2.5 ohms.

5. For hazardous area applications the cable should be of a type suitable for the classification of the area and correctly installed. See certification details in Supplementary manual 01100 008A for conditions of use.

Where the heater cable is likely to pick-up high levels of interference from adjacent cables and equipment it is recommended that a shielded cable is used and grounded at the Control or Interface unit.

See Figure 2.9 for connections to the 1131 Transducer unit (analyser Codes 02 and 22) and Figure 2.10 for the 1132 and 1133 Transducer unit (analyser Codes 04, 14, 24, 06, 16 and 26).

2.9 INTERFACE TO CONTROL UNIT INTERCONNECTIONS

The Interface and Control units have to be connected by a cable carrying digital signals. This is terminated in both units on the Data Output board (01100 927). Cable requirements are:

1. Two twisted pairs with an overall shield or screen and drain wire.

2. The recommended conductor size is 16/0.2 mm (20 AWG), but others are acceptable provided the cross-sectional area of the conductor is within the range 0.5 to 1.5mm^2 (20 to 16 AWG) and the loop resistance does not exceed 50 ohms.

   Note: The loop resistance of 500m of 16/0.2 mm(20AWG) cable is approximately 40 ohms.

3. For hazardous area applications the cable should be of a type suitable for the classification of the area and correctly installed. See certification details in Supplementary manual 01100 008A for conditions of use.

4. The maximum length of the cable is 500m.

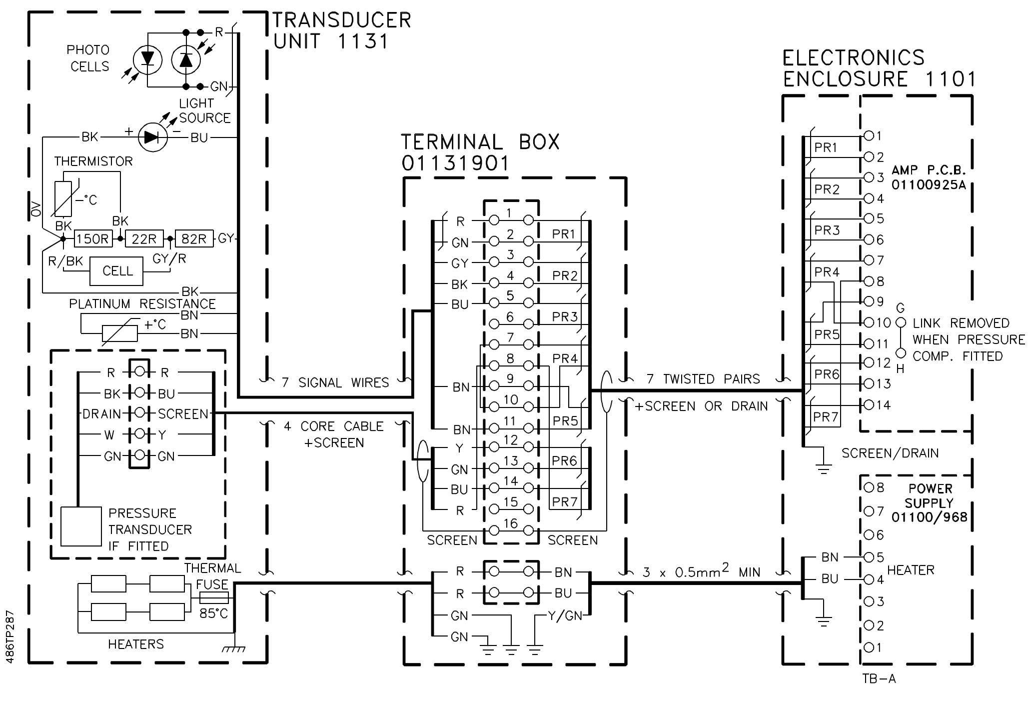


Figure 2.9 Connections to 1131 Transducer Unit

Architecture Code 02 and 22

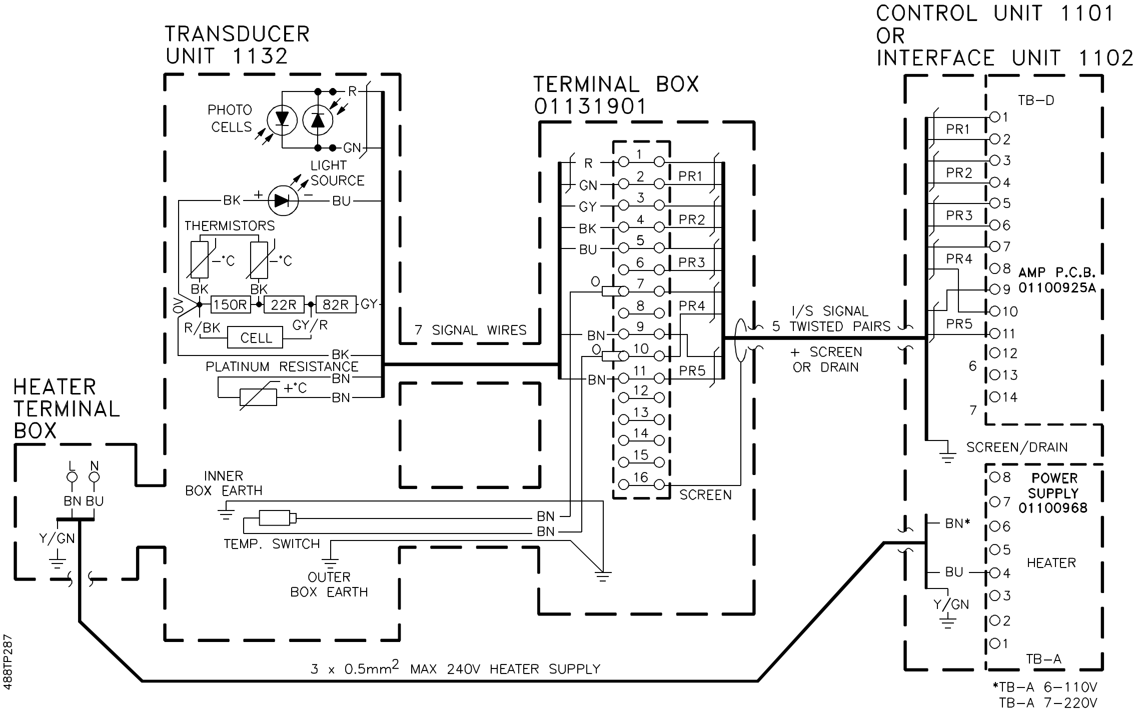


Figure 2.10a Connections to 1132 Transducer Unit

Architecture Code 04 and 06 (1100H)

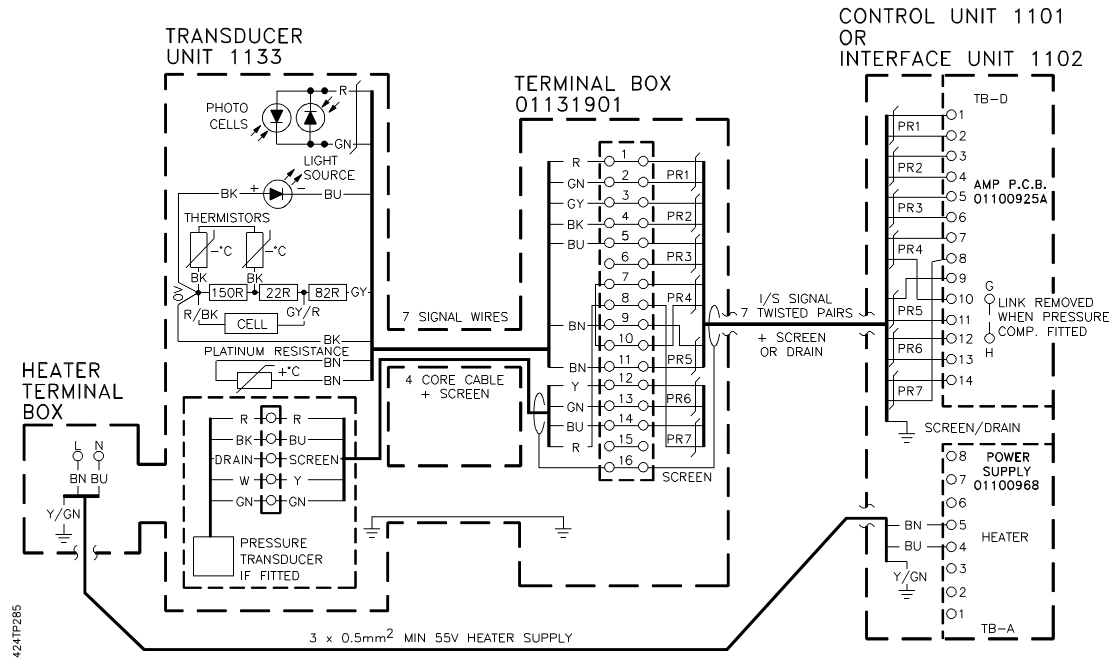


Figure 2.10b Connections to 1133 Transducer Unit

Architecture Codes 04, 14, 24, 06, 16 and 66

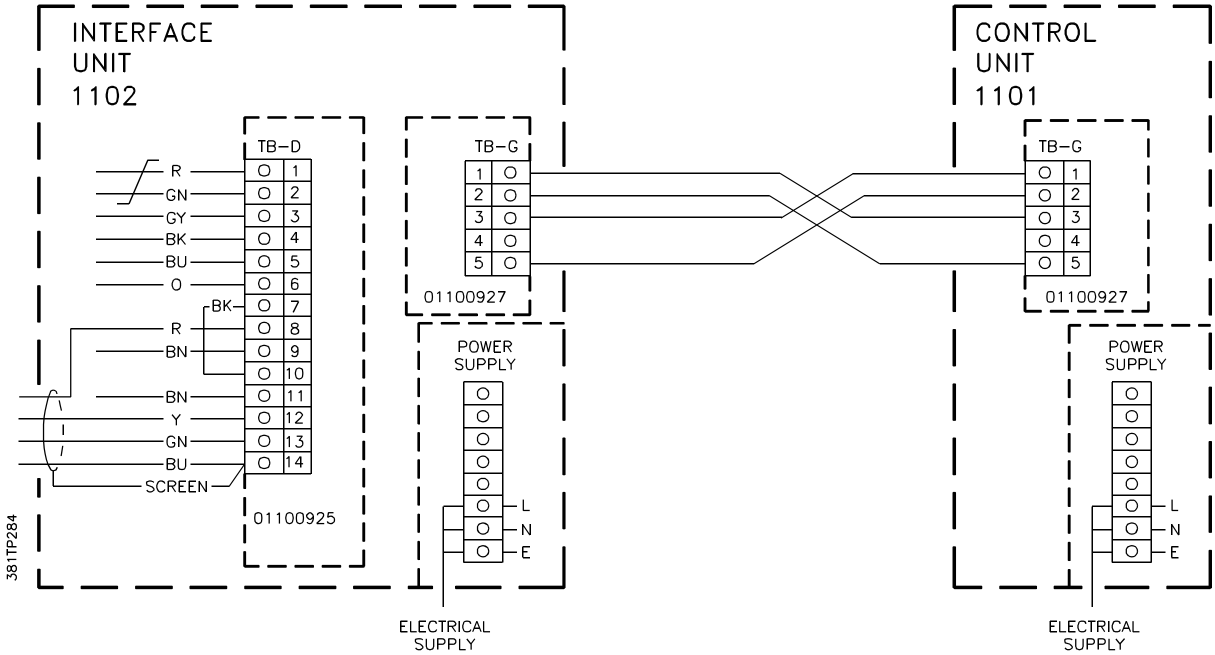


Figure 2.11 Interface to Control Unit Connections

Figure 2.11 shows the connections between the Interface and Control units (analyser Codes 03, 23, 06, 16 and 26).

See Section 2.11.2 if the 01100 927 boards have not already been fitted.

2.10 CABLE KIT OPTIONS

A cable kit is available for the signal and heater cables. The kit contains cable glands. Cable length should be specified up to a maximum of 100m. The signal cable meets the requirements detailed in Section 2.8.1.

Part Numbers are:	01100 995	(gland kit)
	1566-8741	(signal cable)
	1566-8215	(heater cable)

1. The signal cable option is seven twisted pairs of 16/0.2 mm (20 AWG) conductors, blue polythene insulated, with an overall shield and drain wire and an external polythene sheath and generally conforms to BS 5308 Pt.1 and is suitable for connecting intrinsically safe circuits. In hazardous areas it should be installed to comply with relevant certification conditions and local regulations. It complies with the electrical characteristics specified in the British, CENELEC and C.S.A. certification.

2. The heater cable option is a three-core pvc insulated,16/0.2 mm (20 AWG) conductor size with a pvc sheath.

WARNING

The heater cable is unsuitable for use in hazardous areas without further protection.

3. The kit includes four glands and sealing washers each for the heater cables and signal cables. The cable glands are constructed from brass Certified EEx 'd' IIC.

4. If used in a hazardous area, the glands must be properly fitted to the analyser enclosures to ensure that the sealing is maintained to IP54 (NEMA 4).

2.11 OUTPUT CONNECTIONS

Recommended conductor size is 16/0.2mm (20 AWG) but a cross-sectional area of 0.5 to 1.5 mm^2 (20 to 16 AWG) can be used.

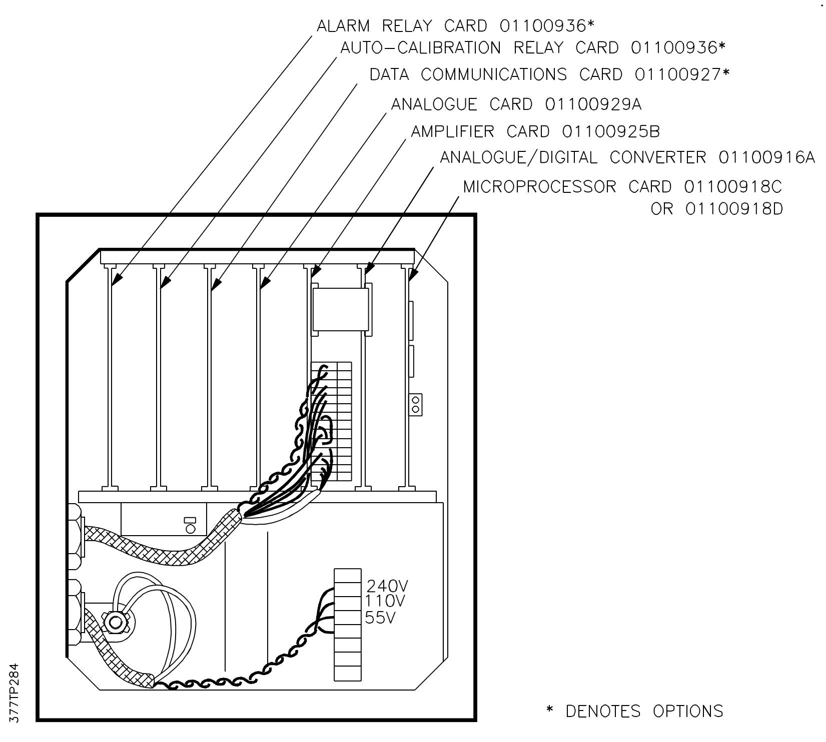


Figure 2.12 Location Of Boards

Blanking plugs should be removed from the gland holes located in the base of the Control and Interface units.

Glands should be used to protect the signal cables from chafing and to ensure the weatherproofing of the analyser. If the analyser is installed in a hazardous area these glands should have appropriate safety approvals and be fitted to maintain the IP54 (NEMA 4) protection.

2.11.1 Analogue Output

The analogue output board 01100 929A (or 01100 939) occupies the fourth position from the left in the card frame. See Figure 2.12. The output is 4 to 20 mA (switchable to 0 to 20 mA or reversed output via the keypad) for the span selected. It is not necessary to remove the card to make connections. This board takes its own power supply from the transformer via a flying lead connected to TB-F. Note the position of the wires in the terminal block if removing this board.

To maintain EMC requirements, connection to TB-N and TB-E must be made using a screened, twisted pair cable. The screen termination is made only to the 1101 (or 1102) enclosure and the terminating wire must be maintained as short as practical (less than 40mm).

Maximum loop resistance is 600 ohms. When isolated it may be floated by 200V with respect to the analyser.

Field connection details vary according to which analogue output board is fitted as follows.

2.11.1.1 Output With Board 01100 939

This board may be identified by having output connector, TB-N with two terminals. The top terminal, is positive.

The output may be connected to unspecified electrical equipment, ie chart recorders or other electrically powered apparatus.

2.11.1.2 Output With Board 01100 929A

This board may be identified by having blue output connector, TB-E with three terminals. The bottom terminal, is an earth (ground) point which is connected to the earth (ground). The top terminal, is positive.

The output is intrinsically safe (ib) and is not isolated. Connection may be made to one of the following intrinsically safe indicators without the use of supplimentary zener barriers.

BEKA Associates	Type BA 303B
Strainstall	D 913X
MTL	633 or 634

The capacitance and inductance or inductance to resistance (L/R) ratio of the connecting cable must not exceed the following values:

Gas group	Capacitance : F	Inductance mH	or L/R ratio : H/ohm
IIC	0.2	1.9	45
IIB	0.6	5.7	135
IIA	1.66	16.2	360

2.11.1.3 Output With Board 01100 929

This board was fitted to earlier analysers and may be identified by having three brown output terminals, TB-E.

The output can be either isolated or connected to ground at the analyser. In hazardous applications it must always be grounded.

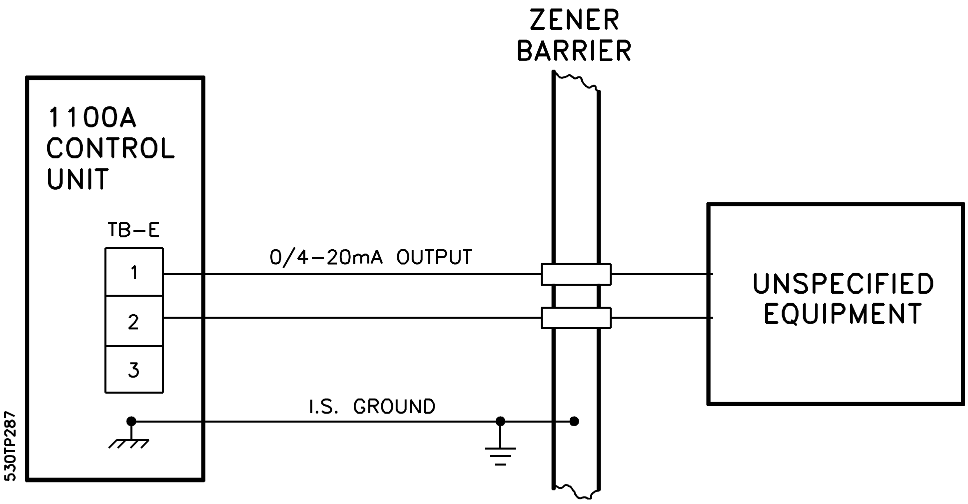


Figure 2.13 Analogue Output - Hazardous Area Applications With Output Board 01100929

The analogue output is certified intrinsically safe (ib) and, when the 1100A is used for hazardous applications, certification conditions place certain restrictions on the way the output may be connected. The certificates give full details (See Supplementary manual, part no. 01100008A). Unless the output is being connected to an intrinsically safe indicator then, in general, it will be necessary to fit zener barriers. A typical example is shown in Fig 2.13 but final installation details will depend upon local hazardous area requirements.

The exception is when an Interface unit is being used and the output card is in the Control unit; there are then no restrictions on the way the output may be used.

The bottom of the three terminals (TB-E 3) is a grounding point and may be connected to the grounding stud of the analyser by means of a flying lead. This connection should be removed if an isolated output is required.

Setting of the analogue output is described in Section 3.7.

2.11.2 Digital Data Output

The data output board (01100 927) is fitted into the third position from the left in the module rack (Figure 2.12). This board requires a separate power supply which is taken from the flying lead that is secured to the module rack. Unfasten this lead and connect it to the terminal block as shown in Figure 2.14.

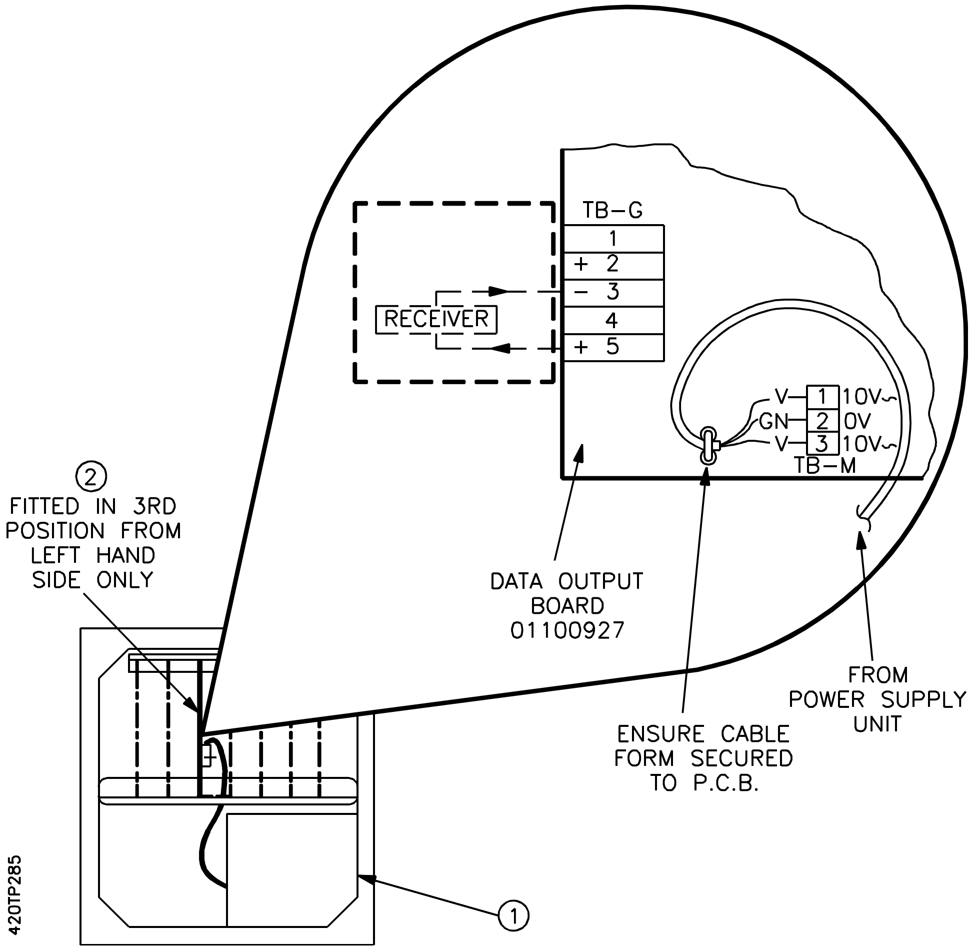


Figure 2.14 Data Output Board Installation

Two outputs are available - 20mA current loop and RS 232C.

1. Current Loop:

To maintain EMC requirements, connection to TB-G must be made using a screened cable having two twisted pairs. The screen termination is made only at one end (generally at the 1102 Interface Unit in maximum separation configuration) and the terminating wire must be maintained as short as practical (less than 40mm).

Connection is made to the lower (TB-G) of the two connector blocks on the front of the board.

Terminal	1 (top)	-	No connection
	2	-	No connection
	3	-	Tx -ve
	4	-	Common (No connection)
	5	-	Tx +ve

2. RS 232C:

The current loop output should be used whenever possible and the RS 232C only for connection to local digital equipment.

If the 20mA current loop is not in use, then on the lower connector block (TB-G) link the following terminals:

Terminal 1 to Terminal 3
Terminal 2 to Terminal 4

Connection is made to the upper terminal block (TB-K) on the front of the board.

Terminal	1 (top)	-	No connection
	2	-	No connection
	3	-	Data output
	4	-	No connection
	5	-	Common

The cable must be a screened, twisted pair, not exceeding 3 metres in length and having the screen terminated within the 1101 Control Unit enclosure. Screen terminations must be kept as short as practical (less than 40mm). The recommended conductor size is 16/0.2mm (20 AWG), or greater, since a smaller conductor may not be adequately clamped by the screw terminals.

This cable must not be installed close to other cables or equipment likely to generate severe levels of electromagnetic interference.
In systems using an Interface unit, the RS232C output is only available from the Control unit. The output of the digital data communications board is not intrinsically safe. In hazardous applications connecting cables should conform to the relevant certification requirements. For details of protocol and interpretation of data stream see Appendix 4.

2.11.3 Alarm Relay Board

The alarm relay board (01100936) is normally installed in the Control unit in the first slot on the left hand side of the module rack (Figure 2.12) and its associated terminal block is fixed to the upper left hand side of the enclosure. (NB: Terminal positions 4, 8, 12 and 16 are disabled.)

Before installation check that the link to the rear of the board is fitted between 'SC2' and 'SEL2'. This link selects whether the board is being used for alarm relays or auto-calibration.

Relay contacts are rated at:

Max Power	-	20VA	
Max Voltage	-	240V	) Max power should
Max Current	-	0.5A	) not be exceeded

The maximum switching power of the relays should not be exceeded. This is important if an inductive load or an incandescent lamp, with low resistance when cold, is connected to the relays.

The four relays have change-over contacts and are energised in the non-alarmed state. The schematic adjacent to the terminal block shows the position of the contacts in the de-energised (i.e. alarmed) condition. The top relay is number 1; the bottom, number 4.

The cable must not be installed close to other equipment likely to generate severe levels of electromagnetic interference. Where this is unavoidable, a shielded cable should be used and the screen terminated at the 1101 or 1102 enclosure. Screen terminating connections must be kept as short as practical (less than 40mm).

Intrinsically safe circuits can be connected to the relays, but they should not be mixed with non-intrinsically safe circuits on the terminal block in the analyser.

Allocating alarm functions to relays is described in Section 3.9.1 and setting oxygen alarm levels in Section 3.8.3.

The memory corrupted alarm (Code 67) is permanently allocated to relay 4 (not 01100651, 01100652 and 01100699 software).

2.11.4 Auto-Calibration Board

The auto-calibration relay board (01100936) is normally installed in the second slot from the left in the module rack (Figure 2.12) and its associated terminal block is fixed to the lower left hand side of the enclosure. (NB: Terminal positions 4, 8, 12 and 16 are disabled and relay 4 (terminals 13, 14 and 15) is not used.) With analyser Codes 03, 06, 16, 23 and 26, it may be fitted to the control unit or the interface unit.

Before installation check that the link to the rear of the board is fitted between 'SC2' and 'SEL3'. This link selects whether the board is being used for auto-calibration or alarm relays.

The top three relays are used to drive solenoid valves to switch gas streams.

Figure 2.15 shows suggested connections to solenoid valves. It is recommended that 3 off 2 way normally closed, electrically operated a.c. solenoid valves are used. The connections are:

Relay	1	(top)	-	Sample Gas
	2		-	Zero Gas
	3		-	Span Gas
	4		-	No connection

The logic is that when a given gas is flowing only the appropriate relay is energised while the remaining two are not.

Ratings of the relay contacts are:

Max Power	-	20VA	
Max Voltage	-	24OV	) Max power should
Max Current	-	0.5A	) not be exceeded

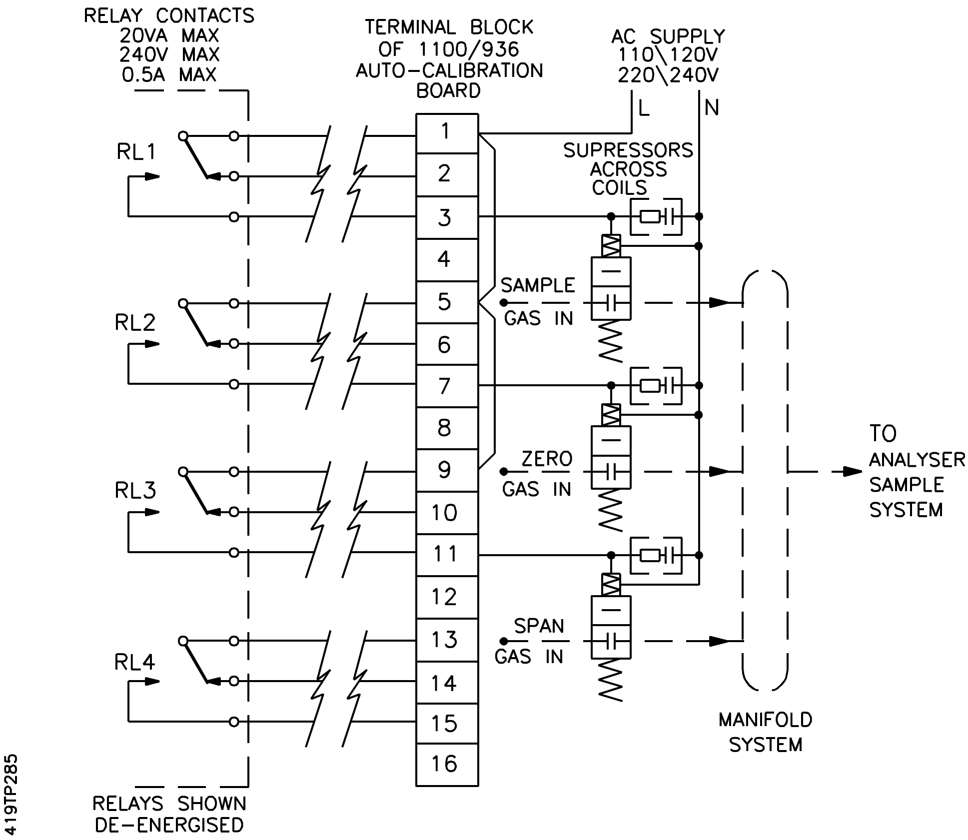


Figure 2.15 Connection Of Auto-calibration Valves

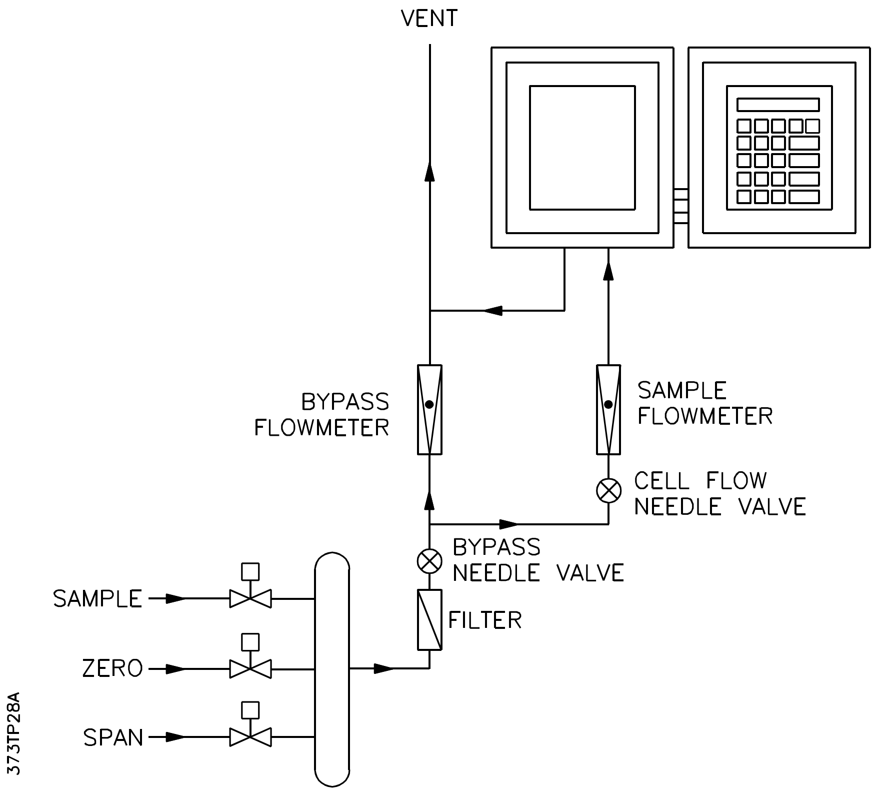


Figure 2.16 Fast-loop Manifold System

Care must be taken to ensure that the relay ratings are not exceeded otherwise the relays will be damaged. This is especially so when inductive loads are being switched.

It will be necessary to fit spark suppressors across the coils of the solenoid valves. For ac supplies, suitable ones are 0.047: F capacitors in series with 100 ohm resistors. They can be obtained from Servomex under part no. 2692-0029. For dc supplies suppressing diodes are required.

The cable must not be installed close to other equipment likely to generate severe levels of electromagnetic interference. Where this is unavoidable, a shielded cable should be used and the screen terminated at the 1101 or 1102 enclosure. Screen terminating connections must be kept as short as practical (less than 40mm).

Following switch on, all relays are de-energised for about 10 seconds, after which time relay 1 is energised.

Auto-calibration is described fully in Section 3.10.

For accurate auto-calibration, the DV lag (time for the gases to flush out the sample pipe work), should be as short as possible by placing the solenoid valves controlling the gases close to the analyser and having a good by-pass gas flow. A fast loop system is recommended and is illustrated in Figure 2.16.

2.11.4.1 Auto-calibration Initiation

Auto-calibration can be initiated by software, at fixed time intervals, by the keypad or by momentary closure of an electrical contact.

Electrical connection for an initiation by electrical contact is made to TB-C on board 01100916A. See Figure 2.17.

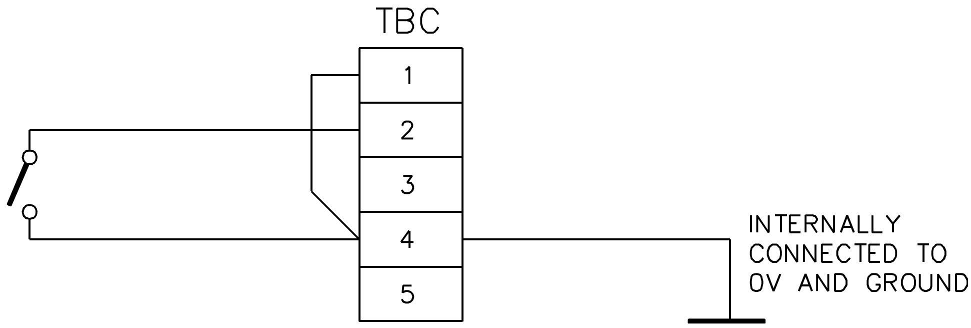


Figure 2.17 Remote Initiation of Auto-calibration

Make connection to terminal 2 and to terminal 4. There may be a wire connecting 1 and 4. This should not be removed.

The cable must be a screened, twisted pair, not exceeding 3 metres in length and having the screen terminated within the 1101 or 1102 enclosure. Screen termination connections must be kept as short as practical (less than 40mm). The recommended conductor size is 16/0.2mm (20 AWG) or greater, since a smaller conductor may not be adequately clamped by the screw terminals.

This cable must not be installed close to other cables or equipment likely to generate severe levels of electro-magnetic interference.

Momentarily closing the contact will start auto-calibration.

2.12 FLOW ALARM

The output from the optional flow alarm on the 1161 dry gas sampling system may either be taken to the 1100A system or to a separate annunciator.

Connections are made to the connector block (upper level) inside the flow alarm enclosure.

Electrical power connections are made to terminals 1, 3, and 5.

Signal connections are made to terminals 10 and 11. The logic is that when there is insufficient sample gas flow the contacts open. They also open when the flow alarm unit loses electrical power.

If the signal is to be used by the 1100A then connection is made to TB-C, terminals 1 and 4 on the 01100916A board. Remove and discard the shorting link on these terminals. This is in the Control unit (or Interface unit when this is used). Connections should be made with screened cable.

Maximum ratings of the relay contacts on the flow alarm unit are:

8A at up to 250 V ac
1A at up to 250 V dc

The unit will alarm when the flow is less than approximately 40ml/min. The alarm is self cancelling when the flow increases.

WARNING

The flow alarm unit is not suitable for use in hazardous areas or with potentially explosive sample gases.

2.13 TRANSDUCER UNIT DILUTION PURGE

If corrosive sample gases are being measured it is recommended that the Transducer unit is fitted with the optional dilution purge (01100996). This reduces the possibility of damage should the sample leak.

This is not available with 1100H systems using the 1132 Transducer.

The dilution purge should be specified at the time of ordering. It cannot be fitted in the field.

Gas purge connections are made to the marked 1/8 in o.d. tubes on the base of the Transducer unit.

Clean dry air or inert gas should be used for purging at a flow rate of 100 to 200 ml/min.

2.14 EFFECT OF ELECTRICAL INTERFERENCE

Good installation procedures should minimise the electrical interference to which the 1100A may be subjected. The analyser will work within specification with supply voltage reduced by 10% and has been tested not to malfunction at -15%. If the supply voltage drops by 20% to 30% of the nominal, this will be detected and the microprocessor will perform a restart. Such short term reductions can be due to the starting of large electric motors or supply faults.

If high levels of interference are present it is recommended that filters are fitted to the incoming electrical supply. A suitable filter is available from Servomex, part no. 01100981 (BASEEFA and FM approved) or 01100959 (CSA approved). Connections to the relay board for alarms or auto-calibration should be suppressed as necessary or spark suppressors or diodes fitted.

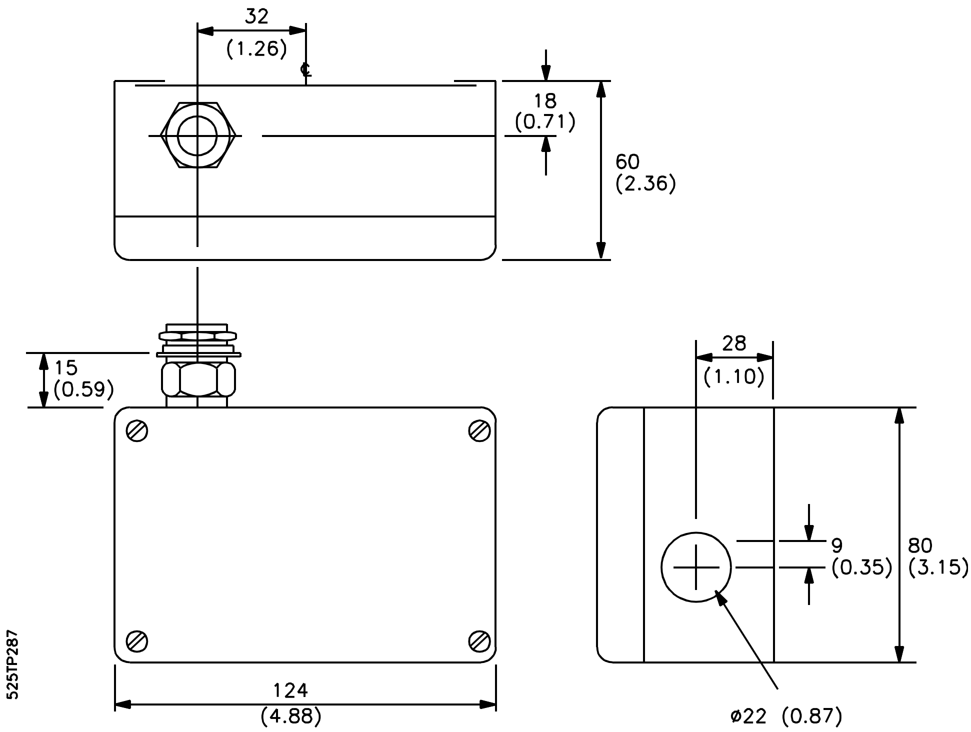


Figure 2.18 Mains Filter Unit - Dimensions

All cables connected to alarm, auto-calibration, data communication or analogue output boards which may introduce severe noise into the analyser from coupling with adjacent cables and equipment must be shielded and properly grounded.

The 1100A hardware and software incorporates a number of features to protect against incorrect operation, but these cannot guarantee against malfunctioning in extreme environments. The analyser can withstand a power interruption of 2 cycles and continue normal operation. Longer power interruptions, brown outs and interference may cause the analyser to perform a restart. During the restart sequence the following occurs:

1. The analogue output goes to zero.
2. All relays are de-energised.
3. The software issue number is displayed for one second if power loss is detected.
4. A display check is done if power loss is detected.
5. A memory test is performed.
6. Analyser returns to normal operation.

If the memory is corrupted then alarm code 67 will be shown and relay 4 will go to the alarm state (not 01100 651, 01100 652 and 01100 699 software). The analyser will need re-calibrating and re-programming as the default values will have been loaded into memory.

2.15 SHUT DOWN PROCEDURE

If the sample stream contains corrosives or solvents it is good practice to purge the sample pipelines of the analyser with dry nitrogen or instrument quality air for 12 hours before switching off the analyser. This will prevent the possibility of condensation and subsequent corrosion in the measuring cell.

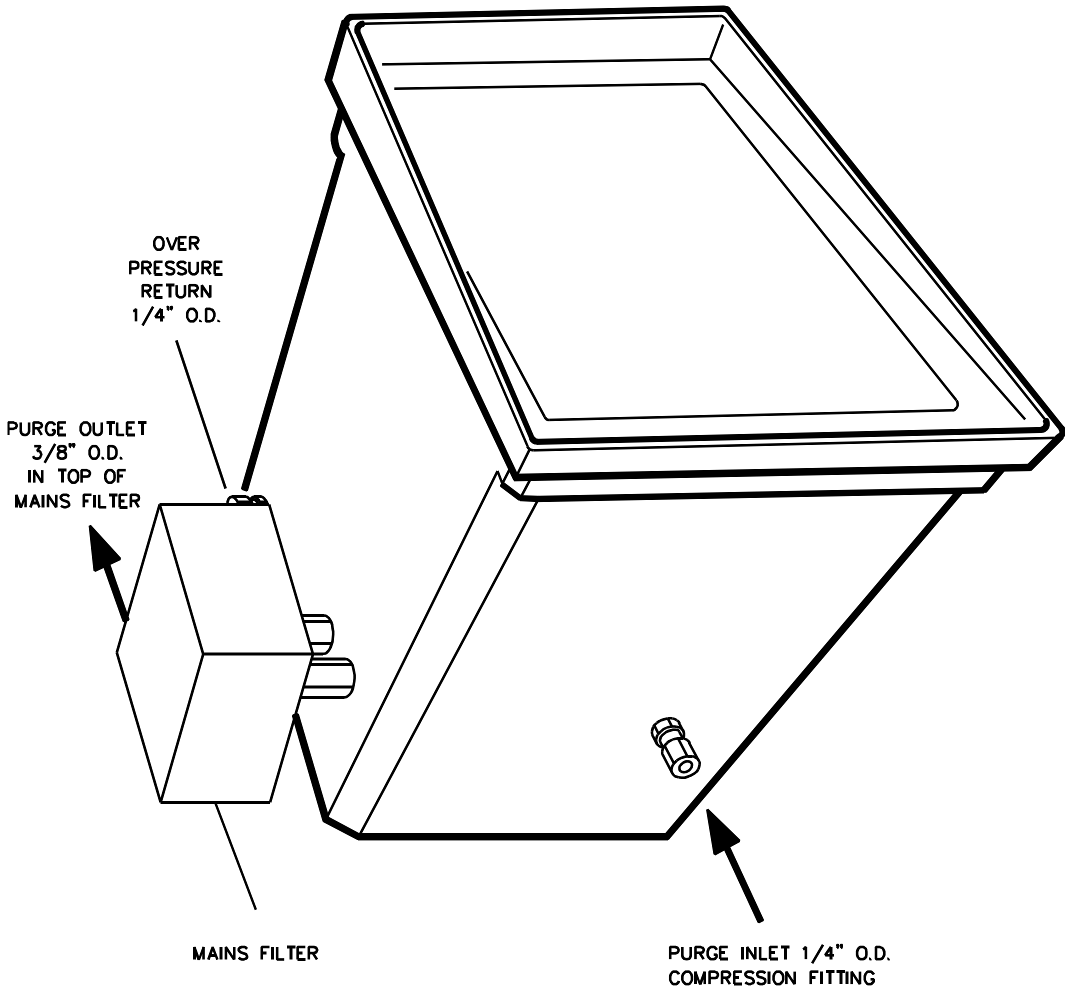
Before servicing the analyser all external sources of power including those to relay contacts must be disconnected.

Note: For earlier analysers fitted with a battery backup the batteries should be removed to prevent leakage and corrosion, if the analyser is to be taken out of service and stored for a period of more than 6 months.

2.16 SAFETY PURGE OF CONTROL UNIT

The Control and/or Interface unit may be purged to provide hazardous area safety. Figure 2.19 shows location of the purge connections.

Servomex can supply an analyser complete with certified purge system. See manual 00480001A for complete installation and operating instructions.



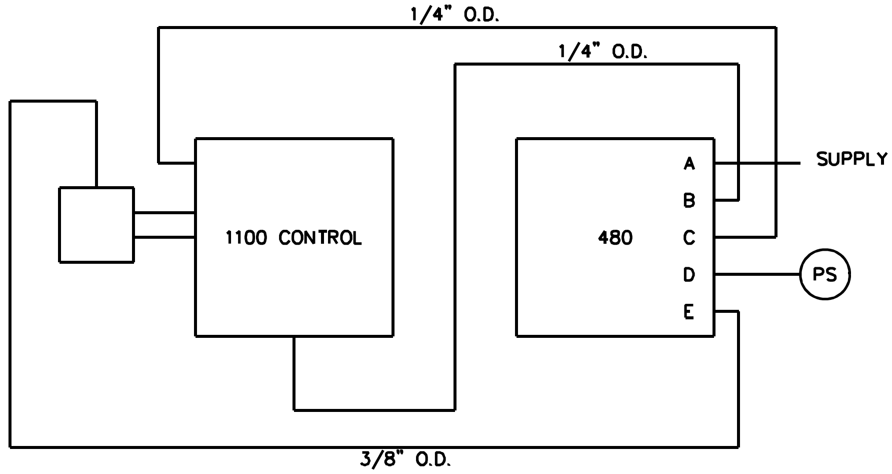


Figure 2.19 Purge Connections

NOTES

SECTION 3 : OPERATION

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SECTION 3 OPERATION

This section contains a detailed description of the full operating procedure of the 1100A analyser. Before operating the analyser it is advisable to check that the various services, sample and calibration gases are correctly connected and leak tight.

Some of the procedures described in this section are only available when certain options are fitted.

3.1 OPERATING PRINCIPLE

With the exception of the mechanical zero adjustment on the Transducer unit, which normally only requires adjustment after changing the cell, the analyser contains no analogue adjustments. All functions are done by the keyboard which has sealed pressure sensitive keypads.

There are three modes of control:

1. Oxygen - The display shows the oxygen concentration to two decimal places.

2. Display mode - Used for displaying information, e.g. alarm levels. The display changes to, for example;

   10.00 41

   Where 10.00 is a low oxygen alarm level and 41 is the 'Parameter Number' associated with low oxygen alarm.

3. Operator mode - Used for changing information. The display has the same format as in the DISPLAY mode.

   A password has to be entered before the operator mode can be used to prevent unauthorised alteration of the analyser parameters.

In both the Display and Operator modes the display changes to show a two digit parameter code number on the right and its associated value on the left. Day to day operation is carried out using the coloured keys which duplicate the parameter numbers. A full listing of parameter numbers is given in Appendix 3.

3.2 PRE START CHECKS

Before power is supplied or sample gas introduced ensure that the analyser is correctly installed by checking the following:

1. Check that the transformer voltage tapping is correctly set to agree with the supply voltage.

2. Perform a leak test on both the Transducer unit and any sampling system fitted.

3. Remove any packing material.

4. If a Servomex sampling system is not supplied with the analyser check that the sample condition requirements are met. (See Section 2.5).

3.2.1 Setting Sample Gas Flows

1. With 1161 Dry Gas Sampling System

a. Close both needle valves.

b. Check sample pressure is within the range 0.3 to 20 psig (2 to 140kPa).

c. Open bypass needle valve (left hand flowmeter) to give desired flowrate.

d. Open cell flow needle valve to give a flowrate dependant on cell type as follows:

325 and 364 cells - approx 200ml/min
312 and 313 cells - approx 100ml/min

CAUTION

Too high a gas flowrate through the cell may permanently damage the cell.

When the density or viscosity of the sample gas differs significantly from air, the calibration of the flowmeter will not indicate the same volume rates.

For example:

Sample gas: Air at 50ml/min is equivalent to:

Hydrogen 200ml/min
Ethylene 130ml/min
Argon 65ml/min
Helium 90ml/min

Flow rates with these gases will have to be set at a lower value.

Highest accuracy from the analyser will be achieved if the cell flowrate is kept constant. Calibration gases should have the same flowrate as the sample gas.

2. With 1162 Wet Gas Sampling System

a. Fill the bubbler bowl with water, using the filling port on the top plate, until it has reached the level of the drain hole.

b. Close the flow control valve.

c. Check sample pressure is within the range 0.3 to 20 psig (2 to 140kPa).

d. Open the flow control valve and adjust it so that there is a constant stream of bubbles from the shorter (small diameter) dip leg and a steady stream of bubbles through the bypass - the longer (large diameter) dip leg.

If the bypass flow is too excessive with violent bubbles then the oxygen reading will be noisy. Too slow a flowrate will give a long response time.

3.3 SOFTWARE ISSUE NUMBER

The issue of software is identified by a number, eg 1100-681, which is displayed during the self check routine. These instructions are for 0110066X, 0110067X and 0110068X versions (where X = 0, 1, 2 or 3). They can also be used for 01100651, 01100652 and 01100699 versions. Where these versions differ is highlighted in the text and summarised in Appendix 7.

3.4 INITIAL START-UP

Fit memory back-up batteries. (Earlier analysers only - see Section 4.5 for details)

Switch on the main electricity supply to the analyser.

Note: The analyser will need switching on twice to eliminate alarm code 67 - memory fail alarm. Leave a delay between each switch-on to allow the self-check routine to be performed.

In systems using an Interface unit it is this that will have to be switched on twice.

Allow at least 12 hours for the analyser to warm up before calibrating and making accurate measurements.

Sample gases with high dew points should not be passed through the analyser until the transducer has reached operating temperature to prevent the possibility of condensation in the measuring cell.

Transducer temperature may be checked by displaying parameter 17 (Refer to section 3.5.1).

Each time the analyser is switched on a self-check routine will be initiated. This routine will produce various indications on the front panel display as follows:-

1. Random numbers will show and the buzzer will sound.

2. The Software Issue Number will be displayed. (See Section 3.3)

3. If software with customised default values is fitted then a 6 digit reference number will be displayed. (Not on systems with Interface units).

4. A character check of the digits, nine to zero, at every position will be displayed.

If the self-check routine fails the keyboard bleeper will remain on and power will not be supplied to the heaters in the Transducer unit. (Refer to section 5 in this case).

Once the self-check routine has been completed the analyser will enter the oxygen mode.

3.5 USE OF THE KEYPAD

See Figure 3.1 and Figure 3.2

The keypad contains twenty-one touch sensitive keys which are colour coded to simplify its operation. The colour codes used are as follows:

Black	-	Six keys, used for calibrating.
Green	-	Four keys, used to set or display the span range and zero offset of the analogue output
Blue	-	Five keys, for oxygen level alarm codes.
Grey	-	Four command keys, a decimal point, minus sign and ten numerical keys, some of which are multi function.

NOTE: Up to S/N 1101/5199 the colour code for keys was as follows:

Yellow	-	Replaced by black.
Orange	-	Replaced by Green
Red	-	Replaced by Blue
Grey	-	Remains

The analyser is operated with two digit 'Parameter codes'. A full listing is given in Appendix 3. For day to day operation the coloured keys duplicate the two digits.

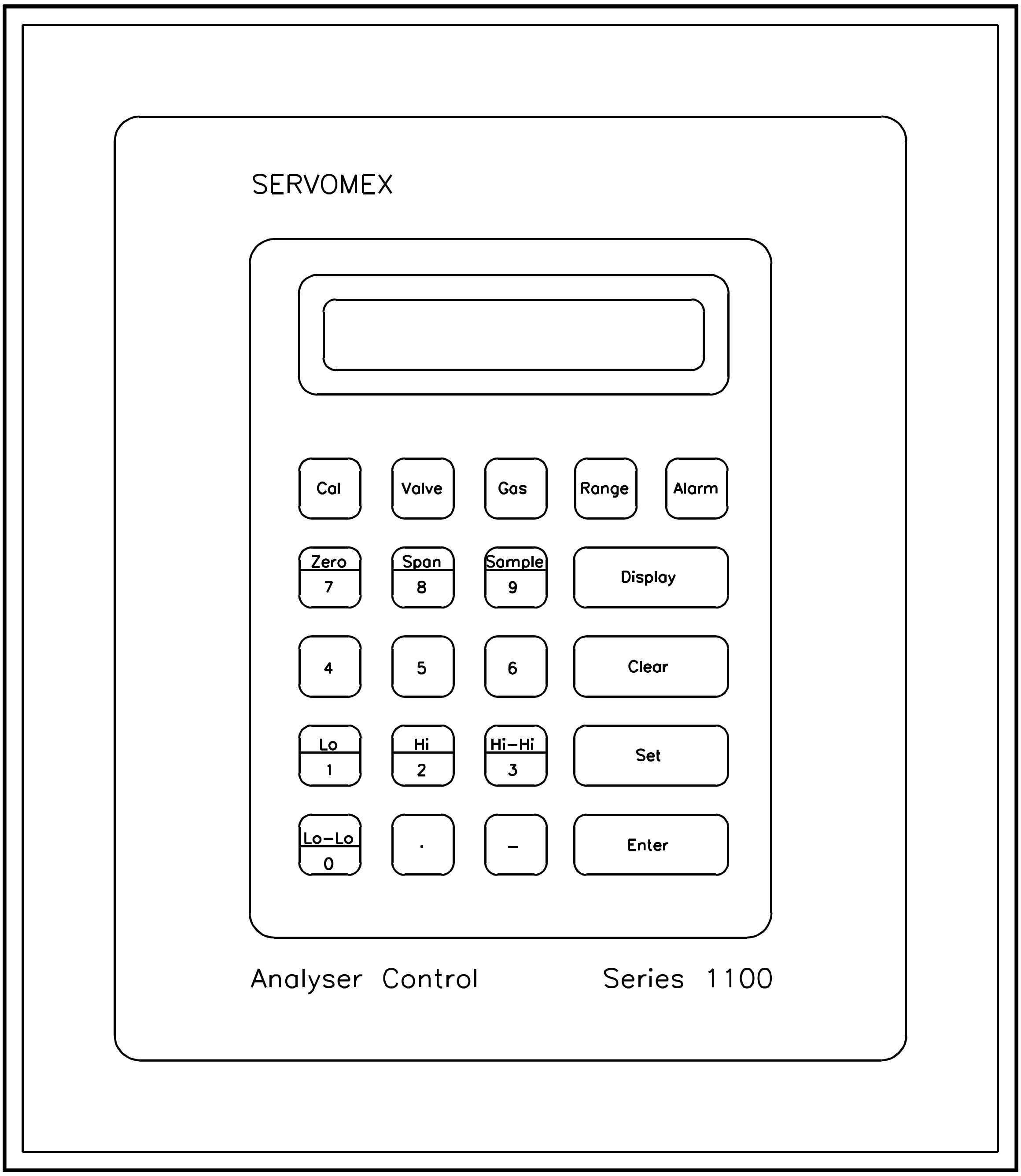

Figure 3.1(a) Keypad layout up to S/N 1101/5199

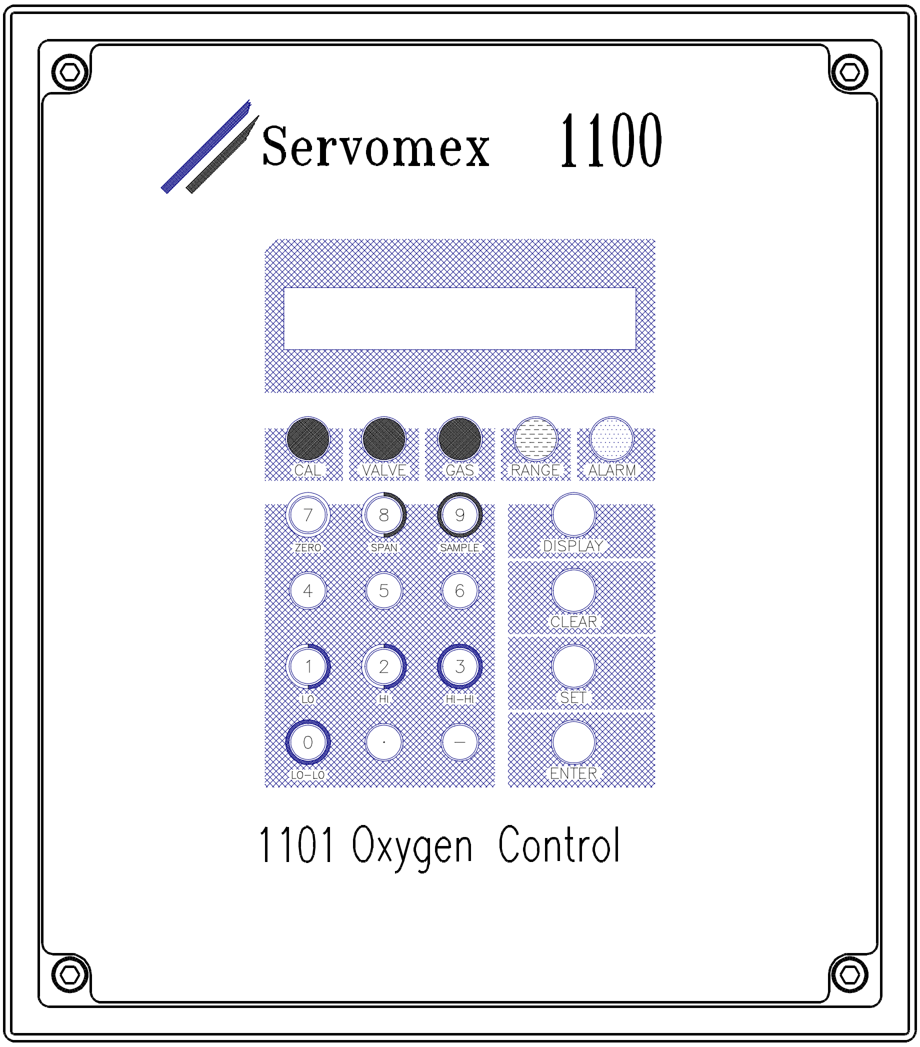

Figure 3.1 (b) Keypad layout from S/N 1101/5200

DISPLAY

* Used in both the display and supervisor modes to examine the values of parameters. Always folllowed by a parameter code.

CLEAR

Clears all information held in the buffer, ie anything entered after the last successful command

SET

Only used whilst in the supervisor mode to set parameter values and action calibration or check routines.

ENTER

Commands the microprocessor to accept the last entered information, if correct. Used only in the supervisor mode.

CAL

Used during calibration routines to set the zero and span points. Generally used in supervisor mode.

VALVE

A solenoid valve driver relay board must be fitted to enable this key to operate. When pressed in conjunction with either zero, span or sample keys, the appropriate solenoid will be selected.

GAS

* Used when setting the actual oxygen contents of the zero and span calibration gases.

3 HI–HI

* Oxygen very high alarm level and numerical three key

2 HI

* Oxygen high alarm level and numerical two key.

1 LO

* Oxygen low alarm level and and numerical one key

0 LO–LO

* Oxygen very low alarm level and nought key.

·

* Decimal point.

–

Negative sign.

RANGE

* When used with either Span, Lo or Hi keys the display will indicate the range, zero offset or full scale of the analogue output. Also used when setting these parameters.

ALARM

* For setting or displaying the oxygen alarm levels in conjunction with Lo–Lo, Lo, Hi or Hi–Hi keys.

9 SAMPLE

* Sample function and numerical nine key.

8 SPAN

* Span function and numerical eight key.

7 ZERO

* Zero function and numerical seven key.

6

* Numerical six.

5

* Numerical five.

4

* Numerical four.

* Indicates key functions available to operator

Figure 3.2 Keypad Functions

3.5.1 Display Mode

If software with customised default values is fitted then the values shown in the examples below may differ.

To display the Lo Lo alarm level press

DISPLAY	ALARM	Lo Lo 0

The display will show

-10.00   40

-10.00% is the alarm setting and 40 is the parameter number.

To display the span of the analogue output press

DISPLAY	RANGE	SPAN 8

The display will show

100.00   18

The analogue output is set to 100% span and 18 is the parameter number.

The top row of keys are also used for calibrating, remote switching of the calibrating gases (when auto-calibration is fitted) and entering the oxygen content of the calibrating gases. These top five keys are always used with their appropriately coloured keys on the numerical keypad.

Other, less commonly used parameters are accessed via two digit numbers. For example the transducer temperature is parameter 17. By pressing

DISPLAY	1	ZERO 7

the display will show the transducer temperature in °C.

If no key is pressed within 30 seconds the analyser will time out and the display will revert to showing the oxygen value or it can be made to revert by pressing

DISPLAY	GAS	SAMPLE 9

Note that the DISPLAY mode can only be used for displaying information, it cannot be used for changing information.

3.5.2 Operator Mode

This is used to change information and values. It is accessed via a password. As the analyser is supplied the password is:

4	5	6	ENTER

The SET and ENTER keys are only used in the OPERATOR mode.

For example to change the Lo Lo alarm setting to 5%:

First enter the password

4	5	6	ENTER

The display will change to

0.00 00

To change the alarm level press

SET	ALARM	Lo Lo 0	5	ENTER
	Alarm Lo Lo		New value	

The display will change to

5.00 41

Once the analyser is in the OPERATOR mode other values may be changed without re-entering the password. If no key is pressed within 30 seconds the analyser will revert to the oxygen mode and the password will have to be re-entered. This prevents the analyser being left in the OPERATOR mode. The analyser can also be made to revert to the oxygen mode by pressing

SET	GAS	SAMPLE 9	ENTER

Whilst in the OPERATOR mode information may be displayed without changing it by using the DISPLAY and ENTER keys in place of SET and ENTER.

Once the analyser is in the OPERATOR mode it is not necessary to re-enter the password between operations.

To change the password see Appendix 5.

3.6 CALIBRATION

There are no electrical adjustments for calibration, the microprocessor performs all the calibration functions. If the auto-calibration option is fitted the analyser should be initially calibrated manually to ensure its correct operation.

After switching on, the analyser should be left for 12 hours for the temperature to stabilise before accurate measurements are made.

Details of the purity specification of the calibrating gases and precautions to be taken when using compressed gases are given in Section 4.2.

It is first necessary to enter into the analyser the oxygen content of the calibrating gases. This is done using the

GAS	ZERO 7

keys for the zero gas oxygen content and the

GAS	SPAN 8

keys for the span gas oxygen content.

In the following example it is assumed the zero gas is nitrogen (oxygen content 0.00% O_2) and the span gas is air (oxygen content 20.95% O_2). Enter the password.

To enter the zero gas oxygen content press

SET	GAS	ZERO 7	0	!	0	0	ENTER
	Zero gas oxygen content parameter		Oxygen value				

The display should show

0.00 97

97 is the parameter number for the oxygen content of the zero gas.

To enter the span gas oxygen content, press

SET	GAS	SPAN 8	2	0	!	9	5	ENTER
	Span gas oxygen content parameter		Oxygen value					

The display should show

20.95 98

98 is the parameter number for the oxygen content of the span gas.

Once the oxygen contents have been entered they are stored and do not have to be re-entered unless the gases are changed or the microprocessor memory is lost because of battery failure.

3.6.1 Zero Calibration

This is performed using the keys:

CAL	ZERO 7

1. Introduce zero gas into the analyser at a cell flow rate of 100 to 250ml/min, (max 150ml/min for 313 and 364 cells).

2. Allow the oxygen reading to stabilise.

3. Check that the mechanical zero is within tolerances. This can be done by displaying the uncalibrated oxygen value which is parameter 14. This should be within ±2% of zero if the calibrating gas is nitrogen. If it is outside these limits the mechanical zero needs adjusting. See Section 4.3.

4. Enter the password.

5. The zero calibration is done by pressing:

SET	CAL	ZERO 7	ENTER

The display should show

0.01 77

77 is the parameter number for zero calibration, 0.01 is a status message which indicates a successful zero calibration. Other values indicate an error and the zero has not been calibrated. See Table 3.1 for a listing of manual calibration error messages.

Note: With 0110066X software, performing a zero calibration loses the previous span calibration. Therefore a new span calibration must follow a zero calibration.

See Appendix 6 for effect of background gases and how to compensate for them.

3.6.2 Span Calibration

A span calibration cannot be performed until a successful zero calibration has been done. However, a span calibration can then be performed independently of zero calibration. This allows the span to be set more frequently than the zero. A span calibration is performed using the keys:-

CAL	SPAN 8

1. Introduce span gas into the analyser at a cell flow rate of 100 to 250ml/min, (max 150ml/min for 313 and 264 cells).

2. Allow the oxygen reading to stabilise.

3. Enter the password.

4. The span calibration is done by pressing:

SET	CAL	SPAN 8	ENTER

The display should show:

0.01 78

78 is the parameter number for span calibration, 0.01 is a status message which indicates a successful calibration. Other values indicate an error and that the span has not been calibrated. See Table 3.1 for a listing of manual calibration error messages.

If the analyser is fitted with 0110066X software then the span calibration is lost when a zero calibration is done. A span calibration must always be done after a zero calibration.

The span calibration is not lost if 0110067X or 0110068X software is fitted.

See Section 5.3.6.10 for adjustment of coarse span resistors.

3.6.3 Calibration Limits

There are built in limits for both the zero and span calibration points. If the oxygen signal exceeds these the analyser will not calibrate. This has been done to prevent the analyser being calibrated when:

1. The mechanical zero is a long way out of adjustment.

2. There is a fault in the optical feed-back system of the cell which prevents a correct span reading.

If the analyser will not calibrate because it is out of limits, check the mechanical zero and perform a loop gain check. See Sections 4.3 and 4.6 respectively.

As the analyser is supplied the limits are 2% O_2 on the zero and 25% O_2 on the span.

It is recommended that the span gas limit is set to 25% of the oxygen content of the span gas being used. For example for air (21% oxygen) the tolerance is 5%.

The limits are stored in parameter 75 for the zero and parameter 85 for the span. To change these, first enter the password, press SET and then key-in the appropriate parameter number followed by the value. Terminate the sequence with the enter key.

If the analyser is to operate at high altitudes, or the sample output does not vent to atmospheric pressure, difficulty may be experienced in setting the span calibration. In this case it will be necessary to adjust the coarse gain resistors. Refer to Section 5.3.6.10 for details.

TABLE 3.1 CALIBRATION FAILURE DISPLAYS

DISPLAY	DESCRIPTION
0.01 77	Zero calibration successful
0.02 77	Zero calibration unsuccessful due to the zero gas being outside the limits.
10.01 77*	Both Zero and Span successfully calibrated.
100.01 77*	Refer to 0.02 78
0.06 77	Unable to perform a manual calibration because analyser is in the auto-calibration mode.
0.07 77	Unable to perform a manual calibration because analyser is in the first stage of pressure compensation calibration.
0.77 77	No previous zero calibration done.
0.01 78	Span calibration successful.
0.02 78	Span calibration unsuccessful because: 1. Out of limits 2. Span gas set point less than or equal to 1.0% more positive than zero gas set point. 3. Span reading less than or equal to 1.0% more positive than zero gas reading. 4. Span calibration factor out of range.
0.04 78	Span calibration aborted because no valid previous zero calibration.
0.06 78	Unable to perform a manual calibration because analyser is in auto-calibration mode.
0.07 78	Unable to perform a manual calibration because analyser is in the first stage of pressure compensation calibration.
0.78 78	No previous span calibration done.

* 10.01 77 and 100.01 77 are not available on software versions 0110067X and 0110068X.

Note: Span calibration will not be allowed to be performed if the previous zero calibration was unsuccessful.

3.6.4 Calibration Failure

If a zero calibration cannot be achieved it may be due to the mechanical zero requiring adjustment. See Section 4.3 for setting the mechanical zero.

If a span calibration cannot be achieved it can be due to a change in barometric pressure due to altitude or climatic effects. The 1100A is set for a barometric pressure of approximately 1000mbar. It may also be due to the measuring cell being replaced with one of a different sensitivity, see Section 5.3.6.10 for details on changing the sensitivity.

3.7 ANALOGUE OUTPUT

The analogue output gives 0 to 20 mA, 4 to 20 mA, 20 to 4 mA or 20 to 0 mA selected from the keypad.

Note : Reversed outputs (20 to 4 mA and 20 to 0mA) are not available with software:- 0110066X, 0110065X and 01100699.

3.7.1 Span Range

Eleven span ranges of the analogue output are available. They are:

100 %
50 %
40 %
25 %
20 %
10 %
5 %
4 %
2.5 %
2 %
1 % - Not available with 1132 Transducer (1100H systems).

40%, 20%, 4% and 2% not available with software:- 0110066X, 0110065X and 01100699.
When the analyser is supplied, span range is set to 100% It can be changed by using the keys:

| RANGE | SPAN 8 |

For example to change the span to 2.5%. Enter the password then press

SET	RANGE	SPAN 8	2	!	5	ENTER
	Output span parameter		Span value			

The display should show

2.50 18

18 is the parameter number for the analogue output span.

3.7.2 Zero Offset

The zero offset of the analogue output can be set to any value from -10.00 to +99.99%. When the analyser is supplied the offset is set to 0.00%. It can be changed using the keys:

RANGE	Lo 1

For example to change the offset to 20% press

SET	RANGE	Lo 1	2	0	ENTER
	Output offset parameter		Offset value		

The display should show

20.00 11

11 is the parameter number for the analogue output.

The analogue output is now set to indicate from 20 to 22.5% 0_2.

Note: The maximum value of the oxygen signal on the analogue output is 150% O_2 . The sum of offset and span cannot exceed this. Therefore 100% offset with 100% span is not allowed.

If a value which is not allowed is entered it is ignored and the old value retained.

3.7.3 Select 4-20mA, 0-20mA, 20-4mA or 20-0mA

As the analyser is supplied the analogue output is set to give 4-20 mA. It can be set to 0-20 mA by using parameter 13 and setting it to zero. Press:

SET	Lo 1	Hi Hi 3	ENTER

It can be set to 4-20mA by setting parameter 13 to 4. Press:

SET	Lo 1	Hi Hi 3	4	ENTER

To set the output to give 20-4mA or 20-0mA set parameter 13 to -4 or -0 respectively.

3.7.4 Analogue Output Status

The status of the analogue output can be seen by displaying the appropriate parameters.

1. Range Lo for the zero offset.
2. Range Span for the span.
3. Parameter 13 to see if set to 0 to 20 mA, 4 to 20 mA, 20 to 4mA or 20 to 0mA.

This can be done from the oxygen mode without entering the password.

3.7.5 Analogue Output Freeze

During auto-calibration the analogue output can be frozen at the last process value while the analyser is calibrating. This prevents external alarms etc from being tripped whilst calibrating gases are going through the analyser. See Section 3.10.5. This facility is not available for manual calibration.

3.8 ALARMS

3.8.1 Alarm Functions

Sixteen alarm functions are available and listed in Table 3.2.

TABLE 3.2 ALARM FUNCTIONS

Alarm/Diagnostic	Parameter Code	Default Value
Oxygen low-low	40	-10.00%
Oxygen low	41	-10.00%
Oxygen high	42	150.00%
Oxygen high-high	43	150.00%
Current output frozen	45	
Analyser in auto-calibration	46	
Range change	61	
Data-link between Interface and Control Units broken.	62	
Zero gas flow failure in auto-cal	63	
Span gas flow failure in auto-cal	64	
Sample gas flow failure	65	
Calibration gases out of tolerance limits in auto-cal	66	
Memory corrupted	67	
Loop gain low	68	
Cell temperature low	92	57.00 °C*
Cell temperature high	93	63.00 °C#

* 107.00 °C on 1100H systems
# 113.00 °C on 1100H systems

Alarms 45, 46, 63, 64, 66 are only meaningful when the auto-calibration option is being used.

The value of the four oxygen level alarms, 40 to 43 can be set by the user.

3.8.2 Display of Alarms

When an alarm occurs it is shown on the display. This can take two forms. As the analyser is supplied the decimal point will flash. This indicates that there is an alarm condition. The analyser can be set to display the parameter numbers of the relevant alarms. To do this parameter 44 is set to zero.

Enter the password and press

SET	4	4	ENTER

Return to the oxygen mode:

SET	GAS	SAMPLE 9	ENTER

The display will then show the oxygen value alternating with the parameter number of the alarm(s) which are active. As the alarms are cleared the relevant parameter numbers will be cleared from the display until with no alarms the oxygen reading is shown continuously.

The alternating display can be switched off by setting parameter 44 to 4.

3.8.3 Oxygen Level Alarms

There are four oxygen level alarms, two low and two high. The low alarms may be set down to -10% 0_2 and the high alarms down to 0% O_2. As the analyser is supplied the low alarms are set to -10% O_2 and the high alarms to 150% O_2. Setting the alarms to other values is done by using the key:

ALARM and one of the appropriate keys:

Lo Lo 0 , Lo 1 , Hi 2 or Hi Hi 3

For example to set the high alarm to 90%, Enter the password and press

SET	ALARM	Hi 2	SAMPLE 9	0	ENTER
	High alarm parameter		Alarm value		

The display should show

90.00 42

42 is the parameter number for the high oxygen alarm. This is also the number which will be displayed when the alarm goes active.

The oxygen alarm levels can be displayed without entering the password by using the DISPLAY key.

The oxygen level alarms are self clearing when the oxygen reading returns to normal.

3.8.4 Sample Flow Alarm

This is only available if the optional sample flow alarm is fitted. It is parameter number 65. No action on this alarm is possible via the keyboard. It is self clearing when the sample flow through the cell returns to within its normal limits.

This alarm can be disabled by linking terminal 1 and 4 on TB-C on board 01100916A. See Figure 2.12 for location of this board.

3.8.5 Auto-Calibration Alarms

These alarms are:

Current output frozen	-	45
Analyser in auto-calibration	-	46
Zero gas flow failure	-	63
Span gas flow failure	-	64
Calibration gases out of tolerance	-	66

These are described in Section 3.10.8.

3.8.6 Cell Temperature

These alarms are 92 for low cell temperature and 93 for high cell temperature. They are set at 57°C and 63°C respectively and cannot be changed by the user. The normal cell temperature is 60°C. These can be used as confirmation that the cell heaters are working correctly. They are self cancelling when the cell temperature is within its normal limits.

The alarm levels are set to 107°C and 113°C for the high temperature analyser (1100H with 1132 Transducer). Normal cell temperature is 110°C.

3.8.7 Corrupt Memory

When the microprocessor performs a restart after an electrical power failure or break, it checks certain locations in memory. If these are found to be corrupted it is an indication that the battery back-up of the memory has failed. To prevent wrong constants being used the memory is erased and the 'as supplied' values substituted. The analyser will need re-programming. This alarm, number 67, shows that the memory has been erased.

This alarm is permanently allocated to relay 4 on the optional alarm relay board (not in software versions 01100651, 01100652 and 01100699). When power is restored and the analyser returns to normal operation this relay will be in the alarmed state. This can be used to alert the user to the need to re-programme the analyser. Clearing of this alarm depends upon the software fitted and type of microprocessor board.

Software 0110068X

If this software is fitted to microprocessor board 01100918B, 01100918C or 01100918D, the alarm can be cleared either by switching the analyser 'on' and 'off' or by entering the password and setting parameter 67 to zero by pressing:

SET	6	ZERO 7	ENTER

Software 01100651, 01100652, 0110066X and 0110067X

These were fitted to earlier versions of the analyser.

The alarm can only be cleared by checking and, if necessary, installing, or fitting, new batteries (see Section 4.5) and then by switching the analyser 'on' and 'off' twice. Note that this alarm warns of corrupted memory, it does not warn of low battery voltage.

The batteries should be changed annually.

3.8.8 Data-link Broken

This alarm is only available when an Interface unit is being used (analyser codes 03, 06, 16, 23 and 26). It warns, at the Control unit, when the datalink is broken and data is not being received by the Control unit. The reason for this may be a physical break in the cable or loss of power at the Interface unit. The alarm is self cancelling when the link is restored.

During the period that data is not being received by the Control unit the display shows a sequence of flashing hyphens. This is replaced by the normal display about 30 secs after the link is re-established.

3.8.9 Alarm Store

The analyser stores the parameter numbers of alarms which have been active or are currently active.

To interrogate the store it is not necessary to enter the password. Press:

DISPLAY	SAMPLE 9	5

The display will now cycle through the parameter numbers of all the alarms which have been active since it was last erased. The alarms are presented in numerical order, preceded by a decimal point, and if the same alarm has been active on more than one occasion it will only be shown once.

To erase the store, enter the password and set parameter 95 to zero by pressing:

SET	SAMPLE 9	5	ENTER

3.8.10 Range Change Alarm

This alarm indicates any change in the setting of the analogue output. It is parameter number 61. Changing the following will cause the alarm to go active:-

Output range	- parameter no. 18
Zero suppression	- parameter no. 11
0-20mA or 4-20mA and reverse output	- parameter no. 13

When the analyser is supplied the alarm is disabled. The analogue output should be set-up as required. To enable the alarm enter the password and press

SET	6	Lo 1	ENTER

The display should show

0.01 61

The alarm will now become active when any of the analogue output parameters are changed. The alarm can be cleared by resetting the analogue output parameters to their original values or by resetting the alarm to new values by following the above procedure.

The alarm can be disabled by setting parameter 61 to 4.

3.9 ALARM RELAYS

If the optional alarm relay board containing four relays is fitted then the alarm functions can be allocated to the relays.

It is possible to allocate more than one alarm function to the same relay and the same function can be allocated to more than one relay. (Maximum of 16 alarm functions to one relay).

3.9.1 Allocation of Alarms to Relays

The four relays are numbered 1 to 4 (No. 1 is the top) and are given the parameter numbers 21 to 24. The parameter number of an alarm is used when it is allocated to a relay. For example, to allocate the cell low temperature alarm (parameter 92) to the third-relay (parameter 23).

Enter the password and press:

SET	Hi 2	3	!	SAMPLE 9	Hi 2	ENTER
	Parameter no. of third relay		Decimal Point	Parameter no. of alarm		

Note the decimal point which has to precede the parameter number of the alarms.
To allocate another alarm to the same relay, repeat the above but with the new alarm parameter number.

Note: Memory fail alarm (No 67) is permanently allocated to relay 4.

3.9.2 Displaying Allocation of Alarms

When in the oxygen mode it is possible to display the alarms allocated to a relay. The parameter numbers 31 to 34 (NOT 21 to 24 which are used for allocation of alarms) are used respectively for the relays 1 to 4. The relative parameter number is displayed and the display cycles through the parameter numbers of the alarms allocated to that relay.

3.9.3 Clearing Alarms Off a Relay

All the alarms can be cleared off a relay by setting the appropriate parameter number (21 to 24) to zero.

Enter the password and press

SET	Hi 2	Lo 1	ENTER
	Parameter No of first Relay		

will clear all the alarms off the first relay. It is not possible to clear individual alarms off a relay.

3.10 AUTOMATIC CALIBRATION

For auto-calibration with software versions 01100651, 01100652 or 01100699 see Appendix 7.

3.10.1 Introduction

The relay board has three relays which can be used to drive solenoid valves on the sample, zero gas and span gas streams used for calibrating the analyser. During the auto-calibration sequence the two calibrating gases are automatically passed through the analyser, the calibration points determined and the system then reverts to measuring sample gas. If the procedure is executed correctly the analyser re-calibrates on return to sample.

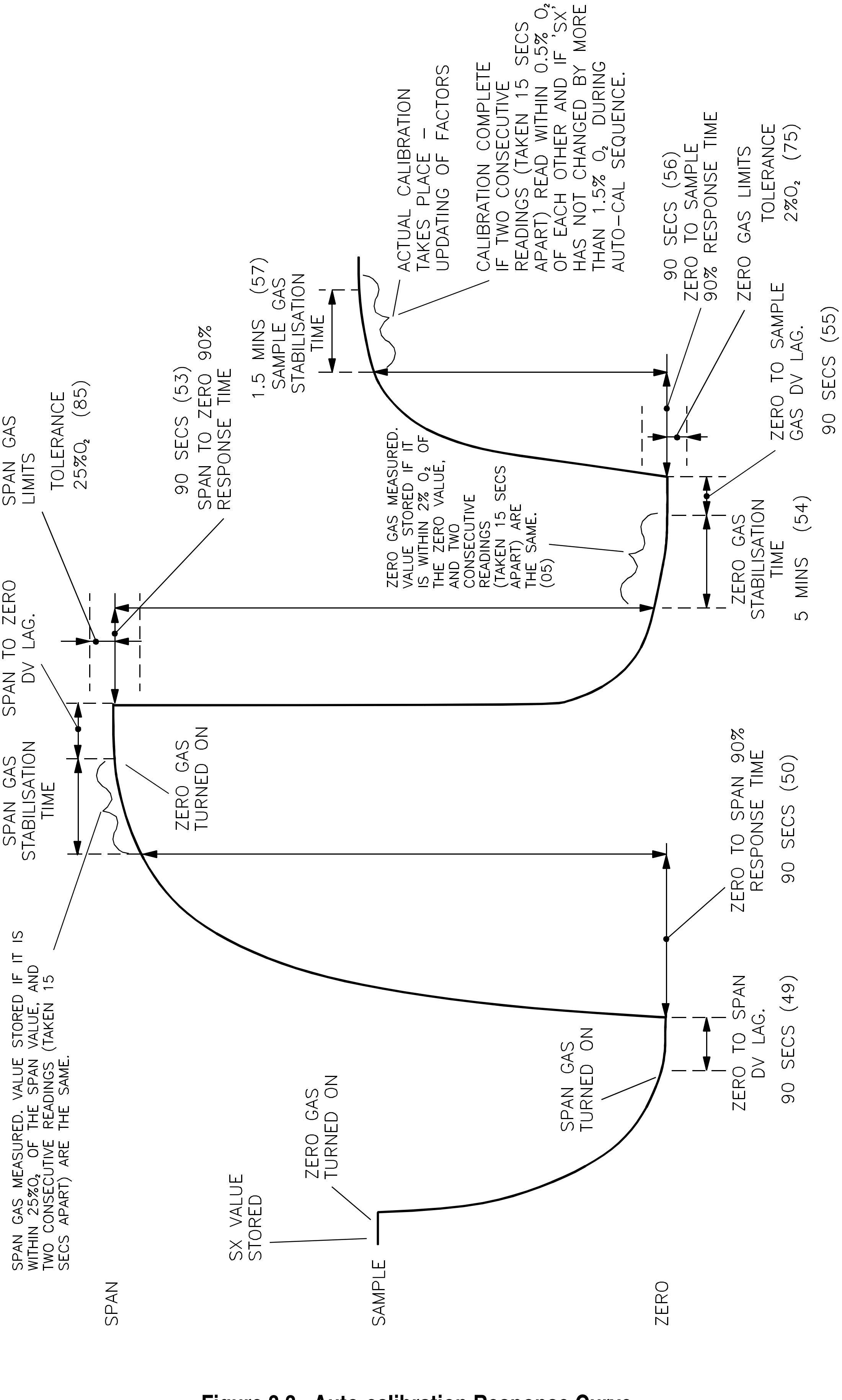

Figure 3.3 Auto-calibration Response Curve

Note: For auto-calibration to operate the oxygen content of the Span gas must be at least 10% greater than the oxygen content of the Zero gas.

The oxygen signal during the auto-calibration sequence is shown in Figure 3.3. At the start of auto-calibration the analyser measures and stores the oxygen content of the sample gas.

If the oxygen reading is greater than ±3% of the zero gas value (as stored in parameter no. 97) then zero gas is turned on. There is a short distance velocity (DV) lag before the oxygen reading changes towards zero gas. If there is no change in oxygen signal during a certain preset time, the auto- calibration sequence will be aborted since the analyser will assume that zero gas is not flowing. When the oxygen value is within 3% of the zero point the span gas is turned on.

With software 0110066X if the sample gas value is within ±3% of the zero gas value then span gas is turned on directly.

There is a DV lag and the analyser searches for the end of this lag indicated by a change in oxygen signal. If a change is not detected within a certain time the analyser will abort the auto-calibration sequence and will return to the sample gas without automatically re-calibrating.

The 90% point is searched for and if it is not reached within a pre-set time the auto-calibration is aborted and the analyser returns to sample. If the 90% point is detected the analyser will measure the oxygen reading every 15 seconds (this time is user adjustable to tune the accuracy). When two consecutive readings are identical the analyser will store that as the span calibration point.

If a stable reading is not obtained within a preset time auto-calibration is aborted.

Note: The analyser only stores this reading at this stage, it does not re-calibrate the span.

Zero gas is turned on and the analyser searches for the DV lag and the 90% point, again within preset time intervals, and if the oxygen signal does not reach that point within these times then the analyser will again abort the sequence. If the 90% point is detected the analyser will search for a plateau by measuring the oxygen reading every 15 seconds (user adjustable) and will compare consecutive readings. When two readings are identical the analyser assumes the plateau has been reached and stores that oxygen reading as the zero calibration point.

Again, if a stable reading is not obtained within a preset time auto-calibration will be aborted.

Note: The analyser at this stage has not yet re-calibrated.

Sample gas is turned on. After a time interval which is user settable, the analyser recalibrates and the analogue output becomes live (if it was previously frozen). With software 0110066X, the end of auto-calibration is when two sample gas readings are obtained which are within 0.5% O_2 of each other.

3.10.2 Automatic Calibration Initiation

Auto-calibration may be initiated either on demand, at fixed timer intervals or by momentary closure of an external contact. Enter the password before commencing.

3.10.2.1 On Demand

This sequence uses parameter code 46 and is initiated by pressing

SET	4	6	ENTER

The analyser will perform an auto-calibration sequence.

3.10.2.2 Fixed Time Intervals

If an auto-calibration sequence is required repetitively then the time interval between the sequences uses parameter code 47. The clock is started by pressing

SET	4	7	ENTER

The fixed time interval is then entered in multiples of 0.1 of a day. If an auto-calibration sequence is required every 12 hours, (0.5 days) press

SET	4	7	0	!	5	ENTER

The calibration sequence will then start 12 hours after setting the clock and will repeat every 12 hours subsequently.

The period between calibrations can be set from 0.1 day to 163.0 days.

The time since the last auto-calibration can be obtained by DISPLAYing parameter 58. This is in days.

Manual calibrations may be carried out between auto-calibrations. If an attempt is made to manually calibrate whilst the analyser is performing an auto-calibration the display will show the error message 0.06 and that manual calibration will be aborted. The auto-calibration will not be affected.

3.10.2.3 Remote Contact

If a remote contact is fitted (see Section 2.11.4.1) then auto-calibration is initiated by momentary closure. The calibration sequence will start irrespective of the status of the analyser. Note that it is not necessary to enter the password.

3.10.3 Initial Programming

To set up auto-calibration initially the following parameters will need to be adjusted to tune the analyser to the sampling system and to ensure that failure modes are detected.

Code	Function	Range	Default value
49	Zero to Span DV lag	0-163.00secs	90.00
50	Zero to Span 90% response	0-163.00 secs	90.00
51	Span stabilisation time	0-15.00 mins	5.00
52	Span to Zero DV lag	0-163.00 secs	90.00
53	Span to Zero 90% response	0-163.00 secs	90.00
54	Zero stabilisation time	0-15.00 mins	5.00
55	Zero to Sample DV lag	0-163.00 secs	90.00
56	Zero to Sample 90% response	0-163.00 secs	90.00
57	Return to Sample time	0-15.00 mins	1.50

The default values which have been chosen should provide adequate detection of fault conditions with most combinations of design of sampling systems and flowrates.

Where the design of sampling system could result in particularly long response times, or where a high degree of integrity in the operation of auto-calibration is required, then the values for parameters 49 to 57 may need to be changed.

It is recommended that the analyser is calibrated manually and then a number of auto-calibrations are performed under different conditions of flow, gas pressures, etc.

The actual response times measured during auto-calibration are stored in parameters 25 to 30. These can be used as a guide to setting parameters 49 to 57.

Code	Function	Equivalent to Code No.
25	Zero to Span DV lag	49
26	Span stabilisation time	51
27	Span to Zero DV lag	52
28	Zero stabilisation time	54
29	Zero to Sample DV lag	55
30	Sample stabilisation time	57

In setting times for parameters 49 to 57 a balance has to be achieved between detecting faults and causing false alarms.

For example, the function of parameter 49, the Zero to Span DV lag, is to abort the auto-calibration if no span gas is flowing. Depending on design of sample system the analyser should detect a change in oxygen reading within a few seconds of span gas being selected. Hence this time should be long enough for the gas to flow into the analyser but not so long as to excessively delay the time before a Span gas flow alarm is raised and the analyser aborts auto-calibration and returns to reading the sample gas.

Similarly, the span stabilisation time aborts the auto-calibration if a stable calibration point is not reached. This could be because of a failure in the sampling system or a malfunction of the analyser.

3.10.4 Accuracy

The accuracy from this system will be within approximately 0.02 - 0.03% oxygen, for both the zero and span gas calibrations.

The accuracy may be altered by changing parameter 05 (the asymptote timer, which is factory set to 15 seconds), the time interval the analyser takes to determine two identical readings. The auto-calibration accuracy will improve if this interval is increased to, say, 20 seconds, but the auto-calibration period will be extended. Reducing this interval to, say, 7 seconds, shortens the auto-calibration time but reduces the accuracy.

When an analyser with auto-calibration is installed it is recommended that a manual calibration is first carried out. A chart recorder should then be connected to the analogue output of the analyser and an auto-calibration done. If the calibration points are examined on the chart (at 1% span) then the accuracy of the calibration can be determined. This can then be optimised by changing the value of parameter 05, the asymptote timer.

3.10.5 Analogue Output Freeze

During auto-calibration the analogue output may be frozen at the last sample gas value. This prevents the analogue output following the oxygen content of the calibrating gases and possibly tripping external alarms or control equipment which may be connected. The analogue output becomes live again at the end of auto-calibration when the analyser re-calibrates (or aborts if the auto-calibration sequence has failed).

Parameter no. 45 is used to set this. It is set to 0 if the analogue output is to be frozen or set to 4 if it is to follow the calibrating gases. The status can be interrogated by displaying parameter 45.

Whilst the analogue output is frozen alarm code 45 will be displayed. This alarm may be allocated to a relay.

3.10.6 Automatic Calibration Status Indication

The status of the analyser during an auto-calibration sequence can be checked with the displays listed in Table 3.3.

The oxygen mode may be displayed during the sequence by pressing

DISPLAY	GAS	SAMPLE 9	ENTER

TABLE 3.3 CALIBRATION STATUS INDICATION

DISPLAY	DESCRIPTION
0.01 46	Initialising auto-cal.
0.02 46	Zero gas flowing and 3% point being searched for.
0.03 46	Span gas on and DV lag being measured.
0.04 46	Span gas 90% point being measured.
0.05 46	Stabilisation period, plateau being measured.
0.06 46	Testing span calibration value obtained Turning on Zero gas.
0.07 46	Span to Zero gas DV lag being measured.
0.08 46	Span to Zero 90% response being measured.
0.09 46	Stabilisation period, plateau being measured.
0.10 46	Testing Zero gas value obtained. Turning on Sample gas.
0.11 46	Zero to Sample DV lag being measured.
0.12 46	Zero to Sample 90% point being measured.
0.13 46	Stabilisation period.
0.14 46	Auto-cal successful, recalibrated.
0.20 46	Auto-cal failed.

Note: During auto-calibration the 30 sec time-out is disabled. Parameter code 46 will be permanently displayed during the routine, unless otherwise requested.

3.10.7 Failure to Auto-Calibrate

The analyser will not calibrate if any of the following are in error:

1. Zero or span gas oxygen contents out of limits.

2. DV lag (time between switching a different gas and the analyser output responding) too long.

3. 90% response too long.

4. Stabilisation period too long.

5. Span gas within 5% O_2 of zero gas (10% with software versions 0110066X, 0110067X and 010068X Rev 0).

Best accuracy will be obtained if the span gas is at least 10% greater than the zero gas.

If the analyser has failed to auto-calibrate then alarm codes 63, 64 or 66 will be shown and the value of parameter no. 46 will be 0.20.

Further diagnostic information is provided by parameter 48 and is obtained by DISPLAYing 48 as listed in Table 3.4.

TABLE 3.4 AUTO-CALIBRATION ERROR STATUS

DISPLAY	DESCRIPTION
0.21 48	Gases outside allowable range. Calibration gas values incorrect.
0.22 48	Could not get within ±3% of zero gas.
0.23 48	Zero to Span DV lag failed.
0.24 48	Zero to Span 90% point failed.
0.25 48	Span stabilisation time exceeded.
0.26 48	Span calibration point outside tolerance limits.
0.27 48	Span to Zero DV lag exceeded.
0.28 48	Span to Zero 90% point failed.
0.29 48	Zero stabilisation time exceeded.
0.30 48	Zero calibration point outside tolerance limits.

The default values of the various time lags itemised in 1, 2 and 3 are shown in Section 3.10.3. These codes 49 to 57 are user adjustable to suit individual installations. The analyser stores the time lags from the previous auto-calibration in parameter codes 25 to 30. These time lags will aid the resetting of default values for codes 49 to 57 and also assist in diagnosing a failed auto-cal.

When an auto-cal is initiated the values of these parameters are set to zero. As auto-cal progresses the values are updated. If auto-cal fails because a response time was exceeded then all subsequent values will still be set at zero. The test at which it failed will have the appropriate maximum value, as set by the user in codes 49 - 57, in it.

3.10.8 Auto Calibration Alarms

The following alarms are available in auto-calibration:

Analogue output frozen	45
Analyser in auto-calibration	46
Zero gas flow failure	63
Span gas flow failure	64
Sample gas flow failure	65 (if fitted)
Gas limits exceeded	66

All of these alarms can be allocated to relays. See Section 3.9.1 for allocation procedure.

The auto-calibration alarms 63, 64 and 66 will be cleared by either a manual zero or a manual span calibration, irrespective of whether or not it has been successful.

3.10.8.1 Analogue Output Frozen - 45

See Section 3.10.5 for description. This alarm is cleared automatically at the conclusion of auto-calibration.

3.10.8.2 Analyser in Auto-Calibration - 46

Goes active as soon as auto-calibration starts and is cleared automatically at the conclusion of the sequence. May be used as an indication that the analyser is not measuring the sample gas.

3.10.8.3 Zero Gas Flow Failure - 63

Indicates that the analyser has not detected a change in oxygen reading within a preset time interval after switching on the zero gas.

This may be due to:

1. No zero gas or low flow.
2. Preset time intervals too short. Perform a manual calibration and measure DV lag and 90% point on a chart recorder.

The time out period for the DV lag is in Parameter 49 and for the 90% point in parameter 50. This alarm is cleared by performing a manual calibration or by a successful auto-calibration.

3.10.8.4 Span Gas Flow Failure - 64

Identical to zero gas flow failure (Section 3.10.8.3). The time out period for the DV lag is in parameter 52 and for the 90% point in parameter 53.

3.10.8.5 Sample Gas Flow Failure - 65

This is only available if the optional sample flow alarm is fitted. It is cleared when sample flow returns to normal.

3.10.8.6 Gas Limits Exceeded - 66

See Section 3.6.3 for description of this alarm. This is cleared by performing a manual calibration or by a successful auto-calibration.

3.10.8.7 Oxygen Level Alarms In Auto-Calibration

The oxygen level alarms will be triggered by the change in the oxygen signal as a result of the calibrating gases passing through the analyser. The user can make use of the auto-calibration alarm (46) and external logic functions to inhibit any external annunciators.

3.10.10 Electrical Power Failure In Auto-Calibration

Assuming that the battery back-up of memory is good, then should electrical power fail during the auto-calibration sequence then when the analyser restarts the sequence is aborted and the previous calibration is still valid. The next auto-calibration will occur at the programmed time interval after the restoration of power.

If the power interruption occurs during normal operation then the clock which controls the auto-calibration repetition time is stopped but its settings retained in memory. When electrical power is restored the clock starts running again but the next auto-calibration will be delayed by the duration of the power interruption.

If the battery back-up of memory has failed then the complete memory is erased and the analyser, including auto-calibration functions, will have to be reprogrammed.

3.11 PRESSURE COMPENSATION CALIBRATION PROCEDURE

Pressure compensation is not available with 1100H high temperature systems (1132 Transducer).

It is not essential to know accurately the oxygen content of the gas used for calibrating pressure compensation. For the calibration sequence the sample gas stream may be used provided the oxygen content remains constant to within 0.01% oxygen. In the following description it is assumed that the zero and span calibration have been satisfactorily completed.

There has to be a means of putting a back pressure on the analyser. The most convenient way to do this is to use the back pressure valve supplied by Servomex. This is designed to be placed on the bypass of the 1161 sampling system and will give the correct back pressure when the bypass flow is 4 to 6 litres/min. It will have been provided with the sampling system.

Note: The maximum cell pressure is 4 psig (28 kPa).

The pressure compensation calibration sequence measures the oxygen level; initially at atmospheric pressure and then increased by 5% to 10% above atmosphere. From the resulting values the microprocessor calculates a calibration constant which then applies to all other oxygen readings.

Since the pressure transducer is very stable, calibration will normally only be necessary at monthly intervals. The frequency of calibration will depend however on the accuracy of the oxygen measurement required and to a certain extent the need by the user to ensure that the analyser is functioning correctly. Subsequent zero and span calibrations do not invalidate previous pressure compensation calibration.

In the following description it is assumed that fitted to the analyser is a mode 1161 dry gas sampling system with pressure compensation calibration valve. If this is not fitted then the general procedure remains the same but the details concerning the sampling system will have to be modified.

3.11.1 Pressure Compensation Calibration Initiation

1. Check that the pressure compensation option is fitted and the routine enabled.

Press:

DISPLAY	ZERO 7	0

If 0.08 70 is displayed, pressure compensation is NOT fitted.

Ensure the pressure compensation valve is open (handle in line with valve body).

2. Calibrate the analyser and leave span gas flowing. The span gas should be either instrument air, if the sample gas has an oxygen content less than 21% or a gas with a high oxygen content (usually 100% O_2) for sample gases greater than 21% In this example it is assumed 100% O_2 is being used.

3. Display the pressure in the measuring cell, press:

DISPLAY	Lo 1	5

The display should show

XXX.XX 15 (where XXX.XX is between 85 and 135)

Make a note of this reading.

4. Set the bypass flow to 1 litre/min and the sample flow to 100ml/min.

5. Enter the password then enter the initial calibration value, press:

SET	ZERO 7	Lo Lo 0	ENTER

The display should show

0.02 70

The microprocessor has measured and stored the first pair of oxygen and pressure readings.

6. Display the measured oxygen reading. Press:

SET	GAS	SAMPLE 9	ENTER

Display should show:

100.00 (±0.02%)

7. Increase the pressure in the measuring cell by closing the back pressure hand valve on the vent of the system.

8. Increase bypass flow to between 6.5 and 7 litres/min and set sample flow to 100ml/min.

   Observe the oxygen reading. Allow it to stabilise before proceeding.

9. Display the pressure in the cell, press:

DISPLAY	Lo 1	5

Display should show an increase of between 10 and 18 compared to the value noted in step 3 of this procedure. It must not exceed 149.00.

10. Enter the password then perform the second stage of the calibration procedure, press:

SET	ZERO 7	Lo Lo 0	ENTER

Display should show

0.01 70

The microprocessor has measured and stored the second set of oxygen and pressure readings and has calculated the compensation factor.

If the display does not show 0.01 70 see Table 3.4 for error messages.

11. Display the measured oxygen reading, press:

SET	GAS	SAMPLE 9	ENTER

Display should show

100.00 (±0.02%)

This is now the compensated oxygen reading.

12. Recalibrate the span point.

13. After calibration the pressure compensation can be checked by performing the following tests. Allow the oxygen reading to stabilise after each adjustment which takes about 30 seconds.

Bypass flow (Litres/min)	Sample flow (ml/min)	Back pressure valve	Display reading
6.5	100	Closed	100.00 ±0.02
5.0	100	Closed	100.00 ±0.03
4.0	100	Closed	100.00 ±0.03
3.0	100	Closed	100.00 ±0.03
2.0	100	Closed	100.00 ±0.03
1.0	100	Open	100.00 ±0.03

If these checks fail repeat the full pressure compensation calibration keeping the cell sample flow constant and avoiding vibration.

14. Return to the sample gas and check that the back pressure valve is open.

The output of the pressure transducer is available by DISPLAYing parameter 15. This is in arbitrary units and is linear with absolute pressure.

3.11.2 Pressure Compensation Calibration Error

The following error indications listed below in Table 3.5 will be displayed during a pressure compensation calibration.

TABLE 3.5 PRESSURE COMPENSATION ERROR INDICATIONS

DISPLAY	DESCRIPTION
0.01 70	Pressure compensation calibration completed. New correction being used.
0.02 70	First stage completed, back pressure to be applied.
0.04 70	Oxygen/pressure slopes in opposite directions or insufficient difference between first and second readings.
0.06 70	Auto-calibration in progress, pressure compensation calibration aborted.
0.08 70	Pressure compensation not fitted.
0.14 70	Second oxygen reading is negative. Calibration aborted.
0.24 70	First oxygen reading is negative. Calibration aborted.
0.70 70	Pressure compensation is fitted but is not calibrated. The oxygen reading is not corrected.

Note that if the calibration routine is aborted the previous calibration constants are retained (not 01100651, 01100652 and 0100699 software).

3.12 REMOTE SELECTION OF CALIBRATING GASES

Using the auto-calibration option board it is possible to select remotely the calibrating gases without using the full facilities of auto-calibration. This is useful when the Control unit is situated some distance away from the Transducer unit.

The gas selection system is identical to that used for auto-calibration (see Section 3.10).

To operate the valves the key 'VALVE' and the relevant key, ZERO, SPAN or SAMPLE is used, e.g. to select the span gas.

Enter the password and press:

SET	VALVE	SPAN 8	ENTER

Will open the span gas valve and ensure the other two valves are closed.

The display will show:

0.01 88

88 is the parameter number for the sample gas valve. 0.01 indicates that it is open. If it was closed 0.88 would be shown.

The status of the valves can be found by DISPLAYing the appropriate parameter number (87 for zero gas, 88 for span gas and 89 for sample gas).

If an attempt is made during the auto-calibration sequence to operate the valves then the display will show 0.06 and the valve will not operate. Auto-calibration will not be affected.

TABLE 3.6 VALVE ERROR MESSAGES

DISPLAY	DESCRIPTION
0.01 87	Zero gas valve open.
0.06 87	Auto-calibration in progress.
0.87 87	Zero gas valve closed.
0.01 88	Span gas valve open.
0.06 88	Autocalibration in progress.
0.88 88	Span gas valve closed.
0.01 89	Sample gas valve open.
0.06 89	Autocalibration in progress.
0.89 89	Sample gas valve closed.

NOTES

SECTION 4 : ROUTINE MAINTENANCE AND CALIBRATION

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SECTION 4. ROUTINE MAINTENANCE AND CALIBRATION

Note: Maintenance of the analyser should be done by qualified personnel who are familiar with good workshop practice.

4.1 GENERAL

Routine maintenance is limited to checking calibration, inspecting the sampling system and changing the memory back-up batteries.

The following maintenance instructions are suggested as a guide to the procedure and time intervals. Frequency of maintenance depends on the accuracy and reliance placed upon the analyser and may need to be modified as a result of operating experience.

4.1.1 Daily

1. Check the span point calibration and re-calibrate if necessary (See Section 3.6.2).

2. Check the operation of the sampling system and adjust as necessary.

4.1.2 Weekly

1. Check the zero point calibration (See Section 3.6.1)
   and then the span point calibration, re-calibrate if necessary.

2. Check filters and replace if necessary.
   If fitted, ensure bubbler levels are correct.

4.1.3 Monthly

1. Check loop gain and take corrective action if necessary (See Section 4.6).

2. Check pressure compensation calibration if fitted, and re-calibrate if necessary (See Section 3.11).

4.1.4 Annually

1. Replace memory back-up batteries if fitted. (See Section 4.5). This is only required on earlier analysers.

4.2 CALIBRATION GASES

The following calibration gases should be available:

1. Zero gas - Oxygen free nitrogen, minimum purity 99.99%, for setting the zero point.

2. Span gas - A test gas containing a known oxygen content for setting span point.

The oxygen content of the Span gas should be at least 5% O_2 greater than the oxygen content of the Zero gas.

Instrument quality air may be used as the span calibration gas. Alternatively, dry air from a cylinder, or clean, dust free atmospheric air may be used, provided it is dried.

For the best accuracy, the span gas should be at least 10% O_2 greater than the oxygen content of the zero gas. The oxygen content of the calibrating gases may be outside the range of the analogue output.

If the analyser is to be used to monitor a sample gas with an oxygen content above 21% then a span calibration gas with an oxygen concentration greater then the sample gas should be used, typically this will be pure oxygen. Its actual analysis must be known to the accuracy desired and should be determined by an absolute method.

WARNING

Compressed air from an ordinary shop compressor must not be used for setting the span. The oil vapour present will contaminate the pipework of the analyser and sample system. This could be a fire hazard if the instrument is used to monitor pure oxygen. Refer also to gas cylinder warning.

WARNING

Gas cylinders when full are pressurised to 15500 kPa (2500psi). They must be installed as detailed below to ensure maximum safety.

All gas cylinders must be fastened securely by fittings specifically designed for the purpose. A cylinder and/or valve could be violently propelled by the sudden expansion of the highly compressed gas contained in a cylinder if it falls and the valve ruptures.

All gas cylinders must be fitted with a regulator whose output pressure can be limited to a maximum of 70kPa (10 psi). This prevents serious over pressuring of the measuring cell. Damage to the cell could result if it is subjected to serious over pressure.

The reaction between pure high pressure oxygen and residual oil or grease in the system can reach a temperature sufficiently high to ignite the metal tubing. The resulting fire, fuelled by pure oxygen, will present a very serious hazard. Therefore all regulators valves, pressure gauges, tubing etc. which may come into contact with pure high pressure oxygen must be carefully degreased before use.

4.3 MECHANICAL ZERO ADJUSTMENT

Section 3.6 gives details of how to calibrate the analyser. If the zero point of the analyser cannot be calibrated then the mechanical zero will require adjustment. There are two adjustments possible, fine and coarse. The coarse adjustment is done as part of the cell replacement procedure and is described in Section 5.3.3.

To adjust the fine mechanical zero:

1. Allow the analyser to warm up for 12 hours. The temperature of the transducer is available by displaying parameter 17. Normal operating temperature is 60°C.(110°C for 1132 Transducer).

2. Pass nitrogen as a zero gas through the analyser at a cell flow rate of 100 - 200ml/min, (max 150ml/min for 313 and 364 cell).

3. DISPLAY parameter 14, the uncorrected oxygen reading. If this is greater than ±2% then the mechanical zero will need adjusting.

   If the reading is greater than ±6% then the coarse mechanical zero will need adjusting or there is a fault in the analyser, e.g. the cell has moved. It is recommended that the cell is re-installed in the analyser. See Section 5.3.2.1.

4. Remove the front panel of the transducer enclosure by unfastening the four 6mm socket head screws.

5. Remove the insulation by pulling it out by the corners.

CAUTION

The inner transducer box will be hot. Take precautions to prevent burns.

Temperatures up to 110°C (230°F) may exist if an 1132 Transducer unit is fitted.

6. The inner transducer box has a blanking plug on the front. Remove this.

7. Turn the screw exposed beneath the blanking plug to adjust the zero, clockwise to increase the reading. The uncorrected oxygen value (Parameter 14) should be displayed when making this adjustment.

8. If the adjustment screw has insufficient travel then the coarse zero will need adjusting. See Section 5.3.3.

9. Replace the blanking plug, insulation and front cover.

10. Re-calibrate the analyser.

4.4 SAMPLING SYSTEM MAINTENANCE

If a Servomex sampling system 1161 or 1162 is used refer to Section 5.4.

4.5 BATTERY REPLACEMENT

This is only required on earlier analysers

Batteries are located in the Control unit except for maximum separation systems when they are in the Interface unit.

WARNING

This procedure must not be performed in a hazardous area.

NOTE: Always ensure that the analyser remains ON when replacing batteries.

Failure to do this will result in the memory being totally lost from the microprocessor unit.

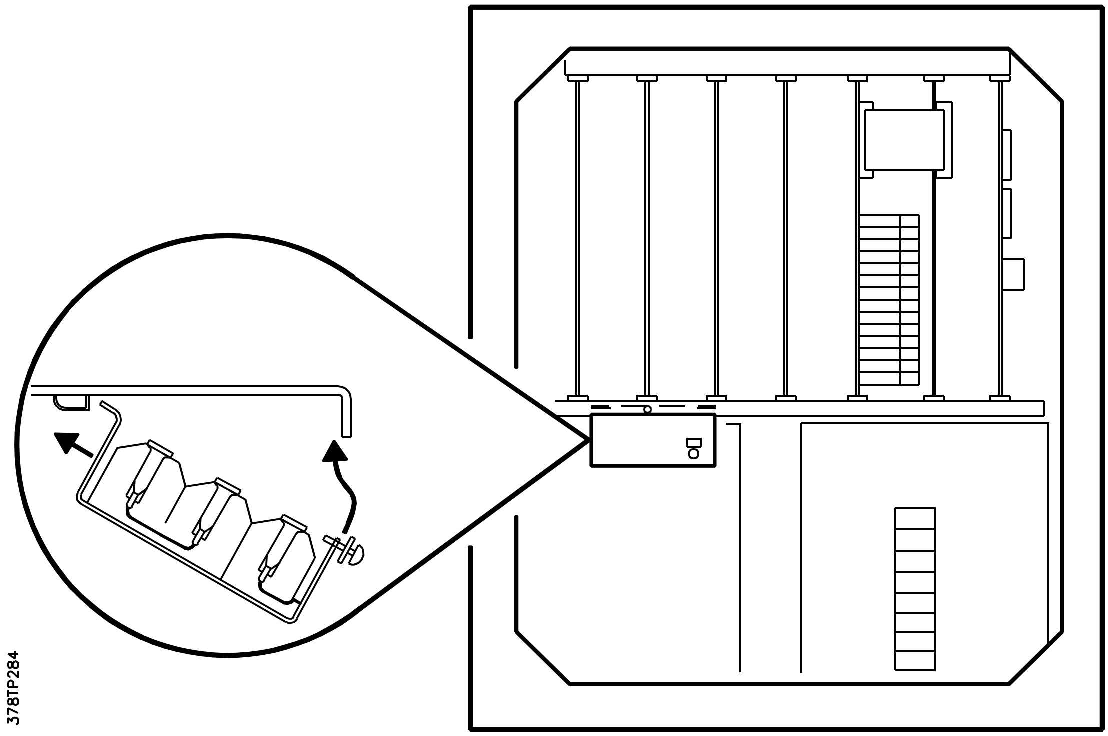

Figure 4.1 Location of Memory Batteries

To renew the back-up batteries proceed as follows:

1. Open the front panel of the Control (or Interface) unit by removing the four 6mm socket head screws.

2. Remove the battery housing located on the underside of the card frame by removing the screw.

3. Remove the batteries from the clips and replace.

   Battery Specification: Size - AA
   Type - Alkaline non rechargeable
   Voltage - 1.5 V
   Quantity - 3

   Observe polarity

4. Replace the Battery housing.

5. Replace the front panel.

4.6 LOOP GAIN

The loop gain check confirms the operation of the optical feedback. It checks the following items:

1. Satisfactory LED output.

2. Cell window contamination.

3. Reflectivity of cell mirror.

4. Photocell output.

5. Analogue amplifier.

The loop gain check should be performed monthly or whenever incorrect operation of the analyser is suspected.

A loop gain check is performed by setting parameter 68 to zero.

Enter Password and press:

SET	6	SPAN 8	ENTER

The loop gain value is stored in parameter 69 and this should be displayed.

The higher the value the less satisfactory the loop gain. If it is greater than 1.50 (4.00 in systems using the 1100H analyser) the cell should be examined. A value of less than 0.1 is extremely unlikely and is probably due to a fault in the loop gain circuit on PCB 01100925 - analogue amplifier board.

Note that when a loop gain check is carried out the oxygen signal is decreased by the value of the loop gain. This decrease lasts for about 1 second. There is a possibility that a low oxygen alarm might be triggered by this test.

See Table 4.1 for loop gain status codes.

TABLE 4.1 LOOP GAIN STATUS CODES

Display in Parameter 68	Interpretation
0.01 68	Loop gain satisfactory.
0.02 68	Loop gain error high - failed.
0.03 68	Loop gain error low - possible electronic fault.
0.06 68	Loop gain test performed whilst the analyser is in auto-calibration cycle.

SECTION 5 : FAULT FINDING AND REPAIR

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NOTES

SECTION 5. FAULT FINDING AND REPAIR

NOTE: Repair of the analyser should be done by qualified personnel who are familiar with good workshop practice and the requirements for repairing certified equipment.

Any spare parts which are used should be as specified by Servomex.

ELECTRICAL SAFETY WARNING

The electrical power in this equipment is at a voltage high enough to endanger life.

Before carrying out maintenance or repair, persons concerned must ensure that the equipment is disconnected from the electrical power supply and tests made to verify that the isolation is complete.

Also ensure that power is disconnected from external circuits connected to the analyser, eg., alarms.

When the supply cannot be disconnected, functional testing, maintenance and repair of the electrical units is to be undertaken only by persons fully aware of the danger involved and who have taken adequate precautions.

HAZARDOUS AREA

If the analyser is installed on a hazardous application the area must be made safe and shown not to contain explosive or flammable gases before covers are opened or work done on the equipment.

In the event of an analyser failure first ensure that any sampling system is in good condition, that filters, etc., are not blocked with dirt or condensation and that calibration gases are correctly connected and flowing.

Make a visual inspection of the analyser and associated equipment for loose or broken electrical connections or pipework.

This part of the manual is divided into 4 major sections:-

Section 5.1 Flow charts for diagnosing faults. By means of simple tests it should be possible to identify a faulty board or assembly.

Section 5.2 More detailed tests on certain assemblies which can be done if facilities are available.

Section 5.3 Detailed repair procedures.

Section 5.4 Servicing procedures for Servomex sampling systems.

5.1 DIAGNOSTIC FLOW CHARTS

The purpose of these diagnostic flow charts is to assist in locating analyser faults. They cannot include every potential fault but they will enable the identification of a sub-assembly which requires replacement.

Fault finding on 500m separation systems which have an Interface unit is slightly different. If the display of the Control unit shows flashing hyphens it indicates that data is not being received from the Interface unit. To assist in fault finding it is possible to remove the complete door assembly from the Control unit and fit it to the Interface unit, (In safe areas only). The Interface unit then works as a Control unit and it can be tested as a normal analyser.

Part numbers of printed circuit boards on some older analysers may differ to those mentioned in these flow charts.

01100 916A	replaces	01100 916
01100 918C and 01100 918D	replaces	01100 918A, 01100918B and 01100 915
01100 925B	replaces	01100 905 and 01100 905A
01100 936	replaces	01100 906 and 01100926
01100 927	replaces	01100 907
01100 939	replaces	01100 909
01101 902	replaces	01100 902

With the exception of the microprocessor board (01100918C and 01100918D) the later boards are compatible with the earlier boards and may be used as direct replacements for these.

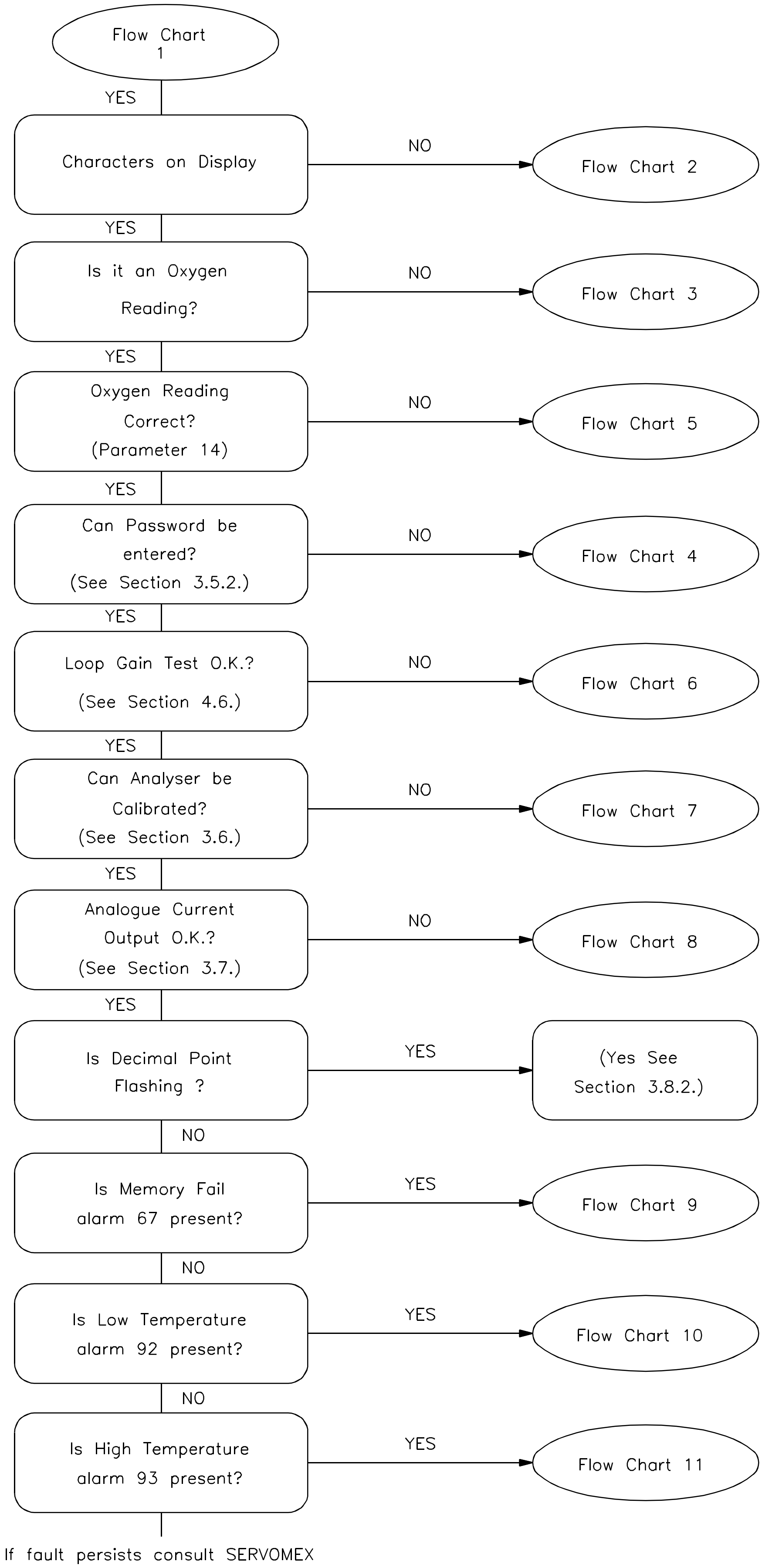
See Section 6.7 for full information on interchangeability of boards and software.

Note that some of the boards have a suffix letter after the part number (ie. 01100925B), this indicates that a small change has been made to the board, it does not mean that they cannot be interchanged.

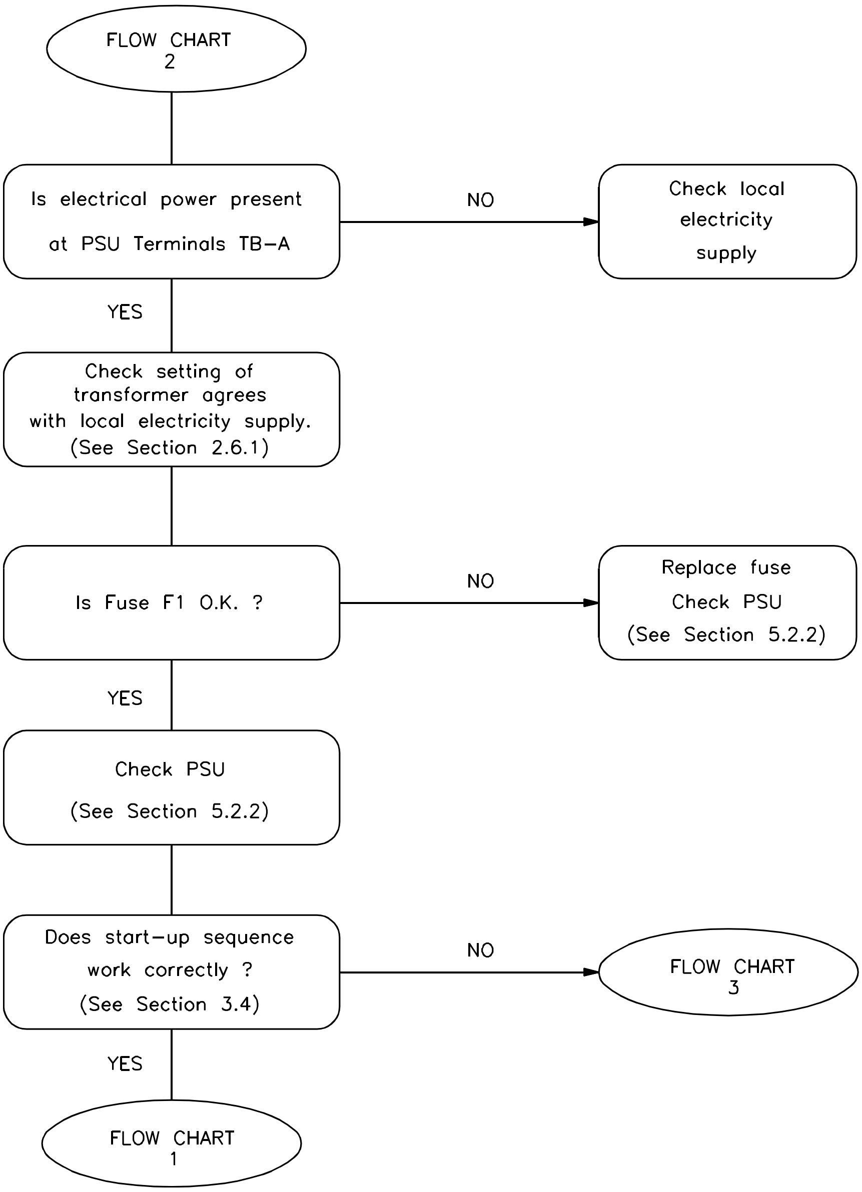
The flow charts can be used for the earlier analysers if the above part numbers are substituted.

5.1.1 Initialisation of Tests (Restart)

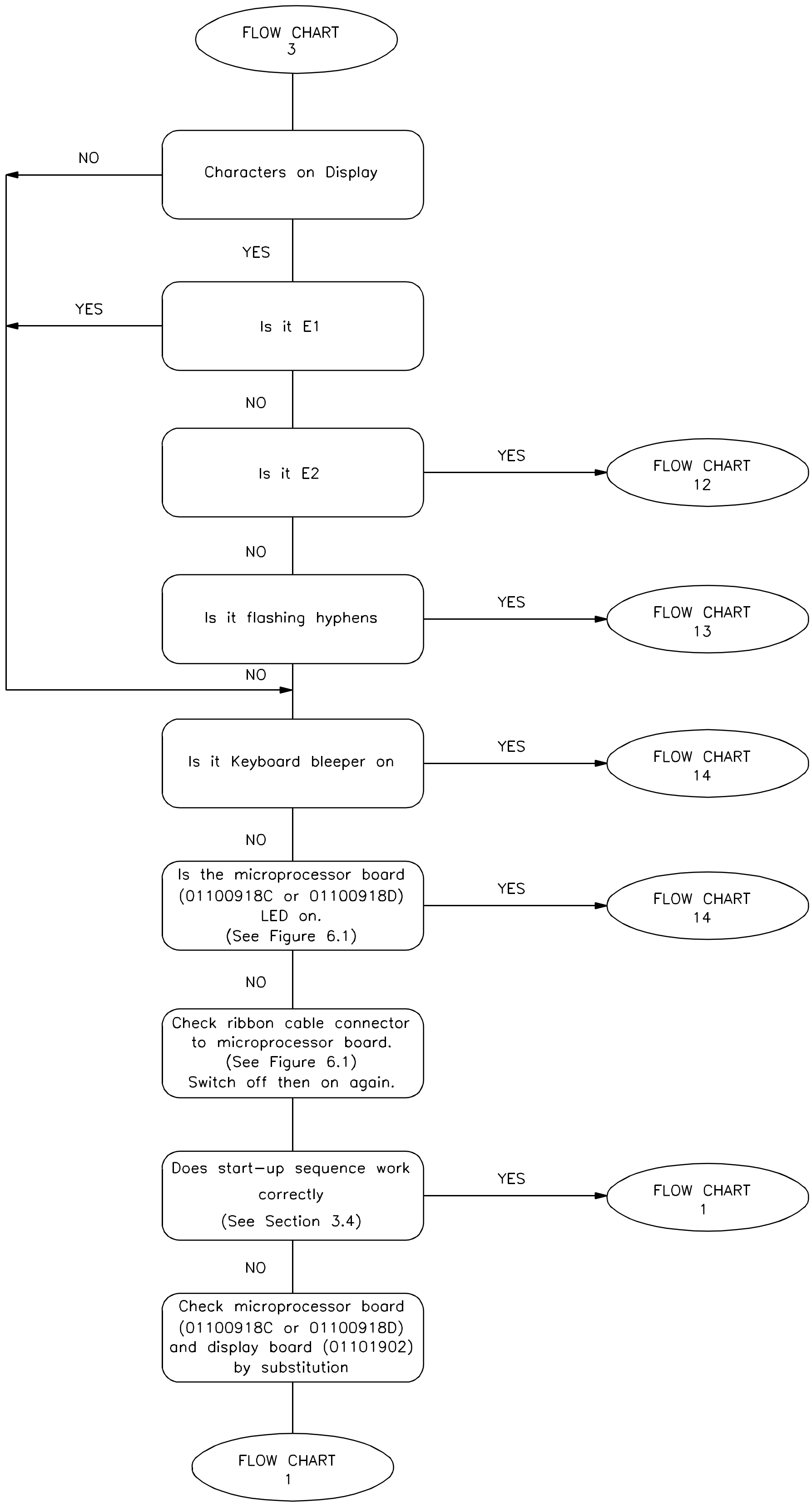
Before proceeding with the flow charts in the event of a malfunction of the analyser first restart the instrument by switching the electrical power off and on. Then follow the diagnostic flow charts starting at 1.



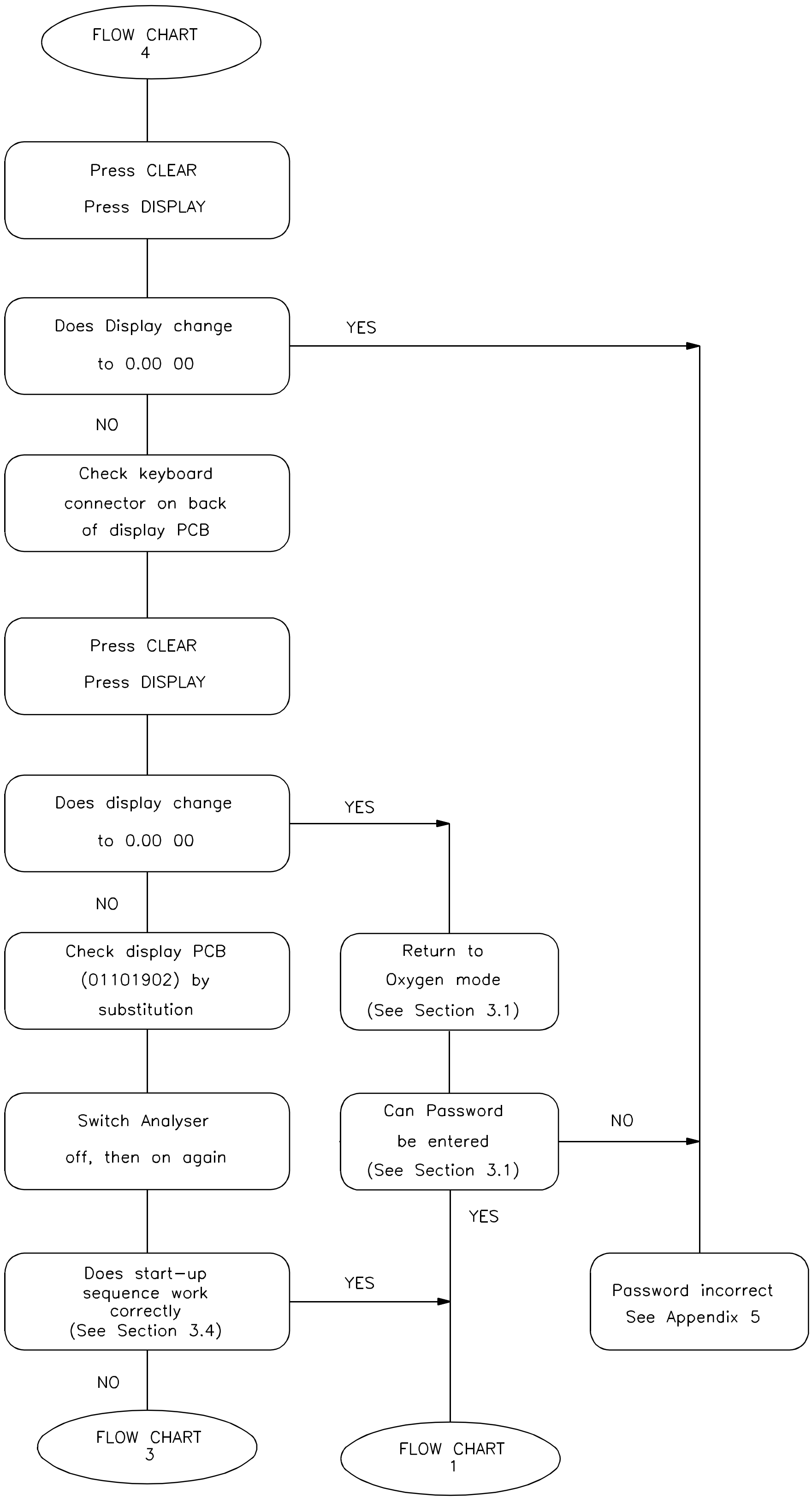
Diagnostic Flow Chart 1



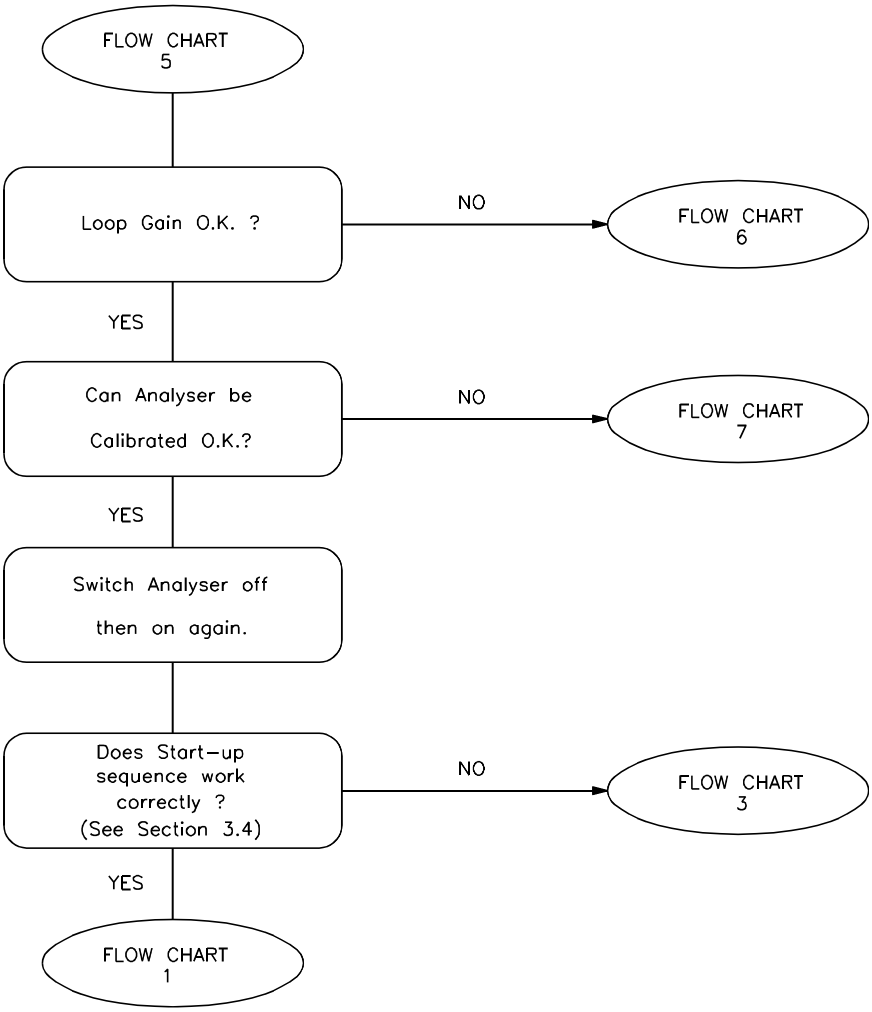
Diagnostic Flow Chart 2



Diagnostic Flow Chart 3



Diagnostic Flow Chart 4



Diagnostic Flow Chart 5

FLOW CHART 6

TRANSDUCER TESTS

1. Loop gain tests the performance of the cell and associated circuits. (See Section 4.6)

2. A loop gain error which is slightly larger than normal, say between 1.5 and 10 (4 to 20 on 1100H systems) could indicate a cell which is contaminated by condensation, corrosion or dirt. (Also possible photo cell and/or LED fault.)

3. Remove cell, examine and, if necessary, replace. See Section 5.3.2.1 Recalibrate analyser and repeat loop gain test. If still unsatisfactory follow test below.

4. A loop gain error which is very high indicates a failed cell or electronic component. Examine the cell and follow the tests below.

5. Measure voltage at junction of PL2, pin a8 and R6, with respect to TB–D 14 on amplifier board 01100925B.

   If voltage is not 0V +/– 0.7V replace the analogue to digital converter board 01100916A.

6. Repeat loop gain test. If voltage does not go to 4.0V +/– 1V for a few seconds during the test replace analogue to digital converter board 01100916A.

7. A loop gain error is low (< 0.10) indicates a possible fault on the analogue amplifier pcb (01100925B).

FLOW CHART 1

Diagnostic Flow Chart 6

FLOW CHART 7

CALIBRATION TESTS

1. Check calibration displays (See Table 3.1) for reason of non-calibration.

2. Check oxygen content of calibrating gases and that the gas cylinders are connected correctly and gas is flowing.

3. Check settings of calibration gas values in analyser agree with gases being used.

Use DISPLAY GAS ZERO

and DISPLAY GAS SPAN

4. Display parameter 14
4.1 Check Zero point with N2.
4.2 Check span with air or 100% O_2
Parameter 14 should be between 16 and 26% for air and 90 to 110% for 100% O_2 See test 6.

5. If zero point is in error then mechanical zero will need adjustment. See Section 4.3

6. If span reading is outside limits the coarse span resistors will need adjusting. See Section 5.3.6.10

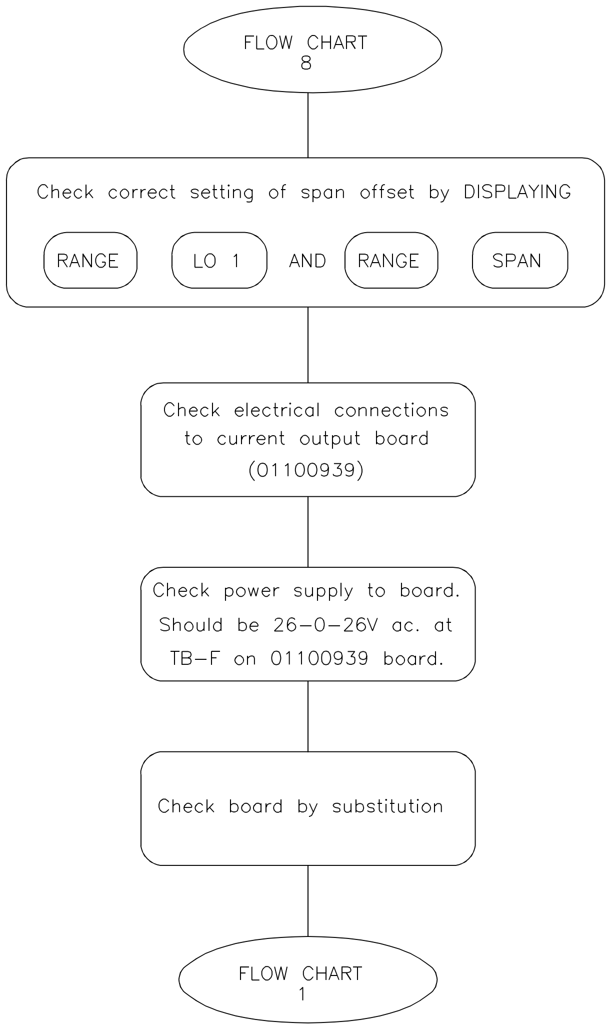
NOTE. A large error could be due to other faults, e.g., a loose cell.

7. Recalibrate analyser, repeat paragraph 4.

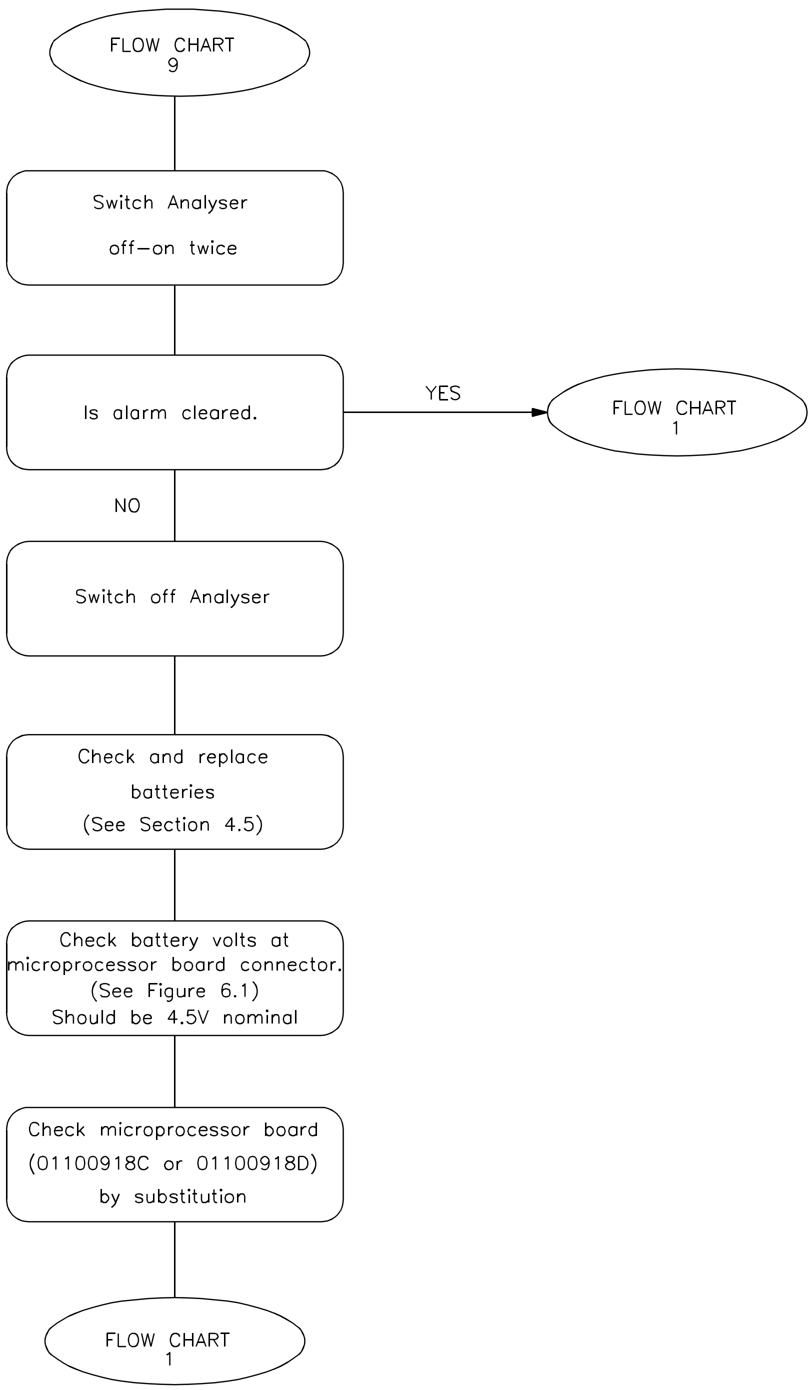
8. If span calibration point is still unsatisfactory, follow Flow Chart 6, Transducer Tests.

FLOW CHART 1

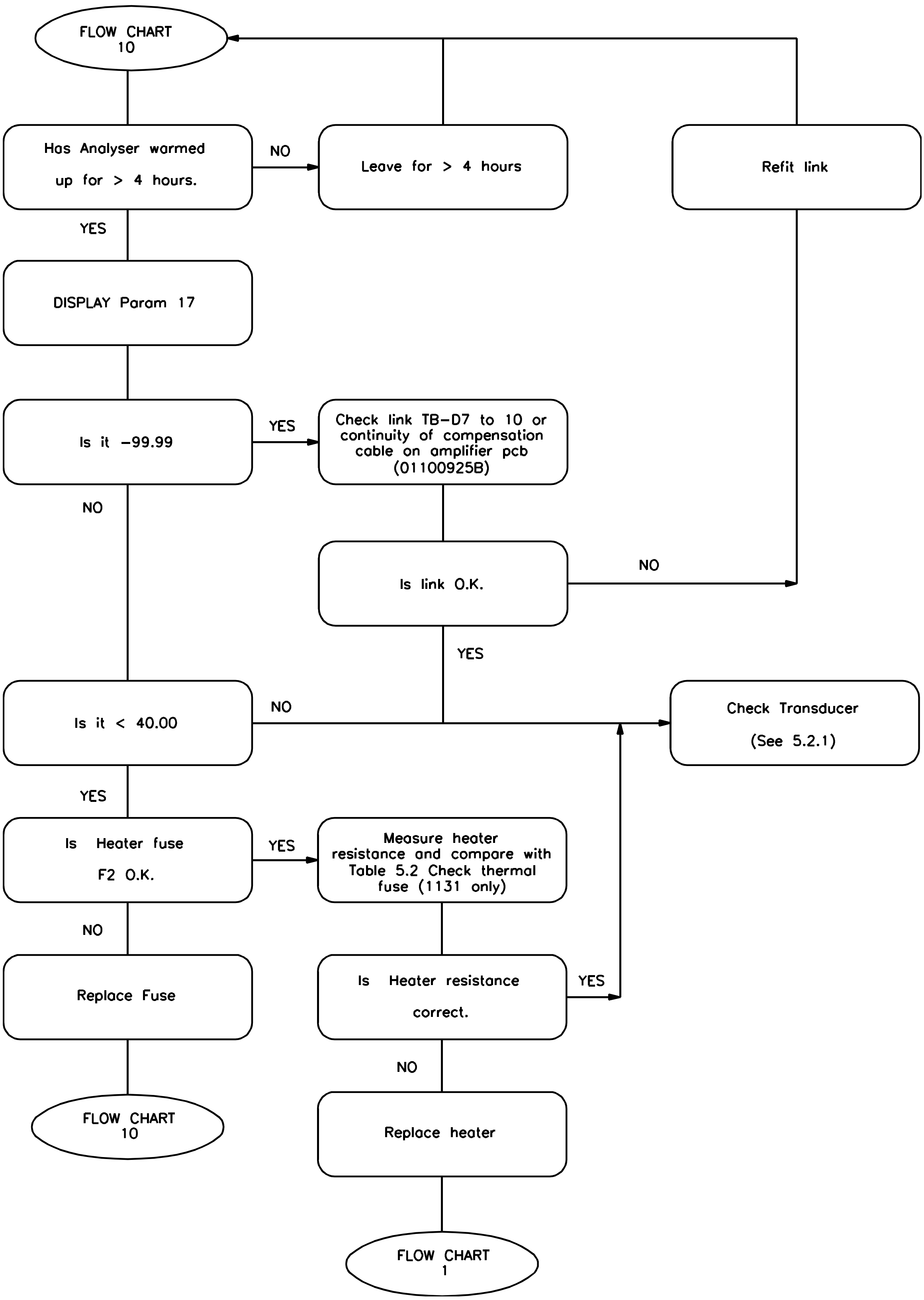
Diagnostic Flow Chart 7



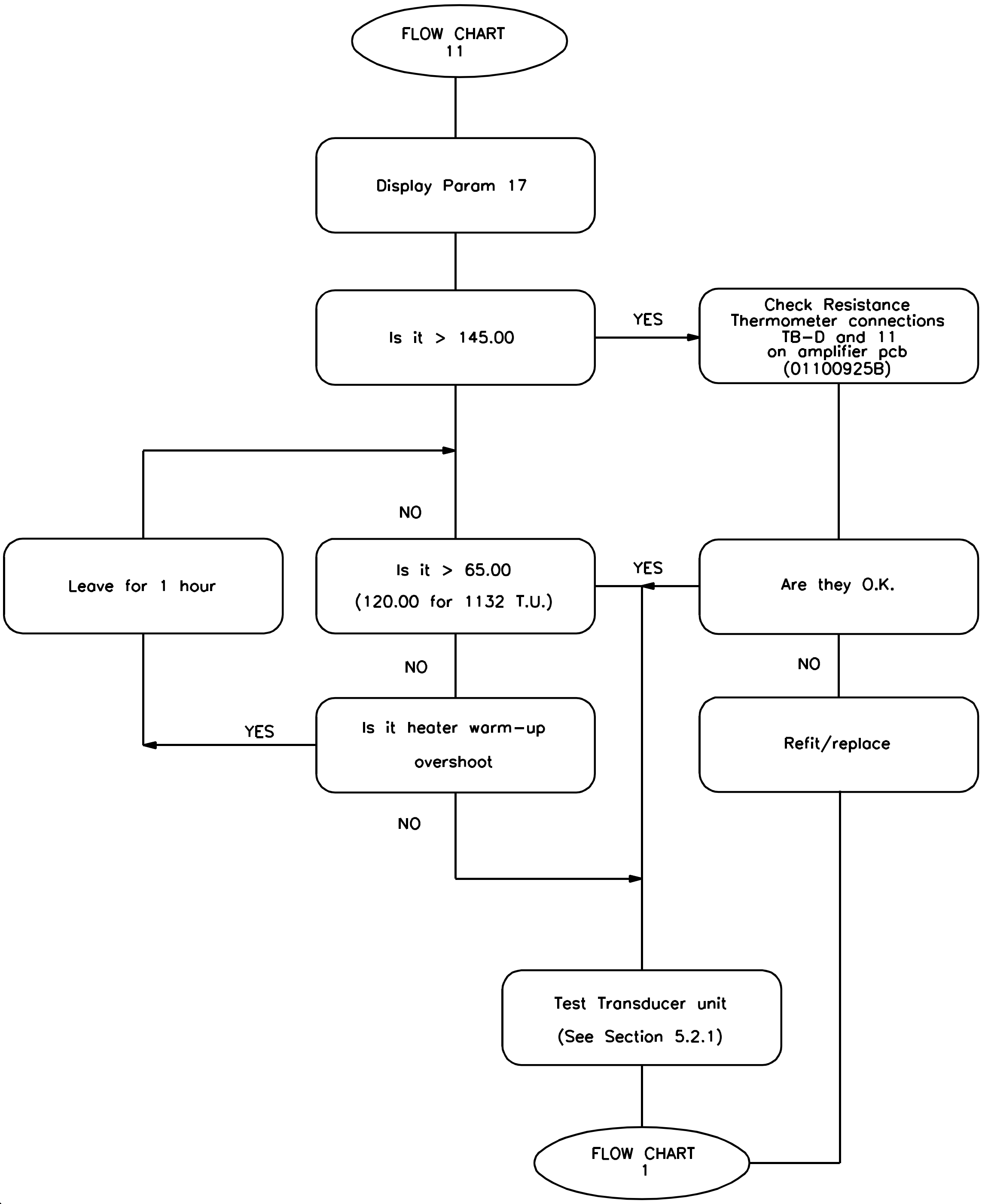
Diagnostic Flow Chart 8



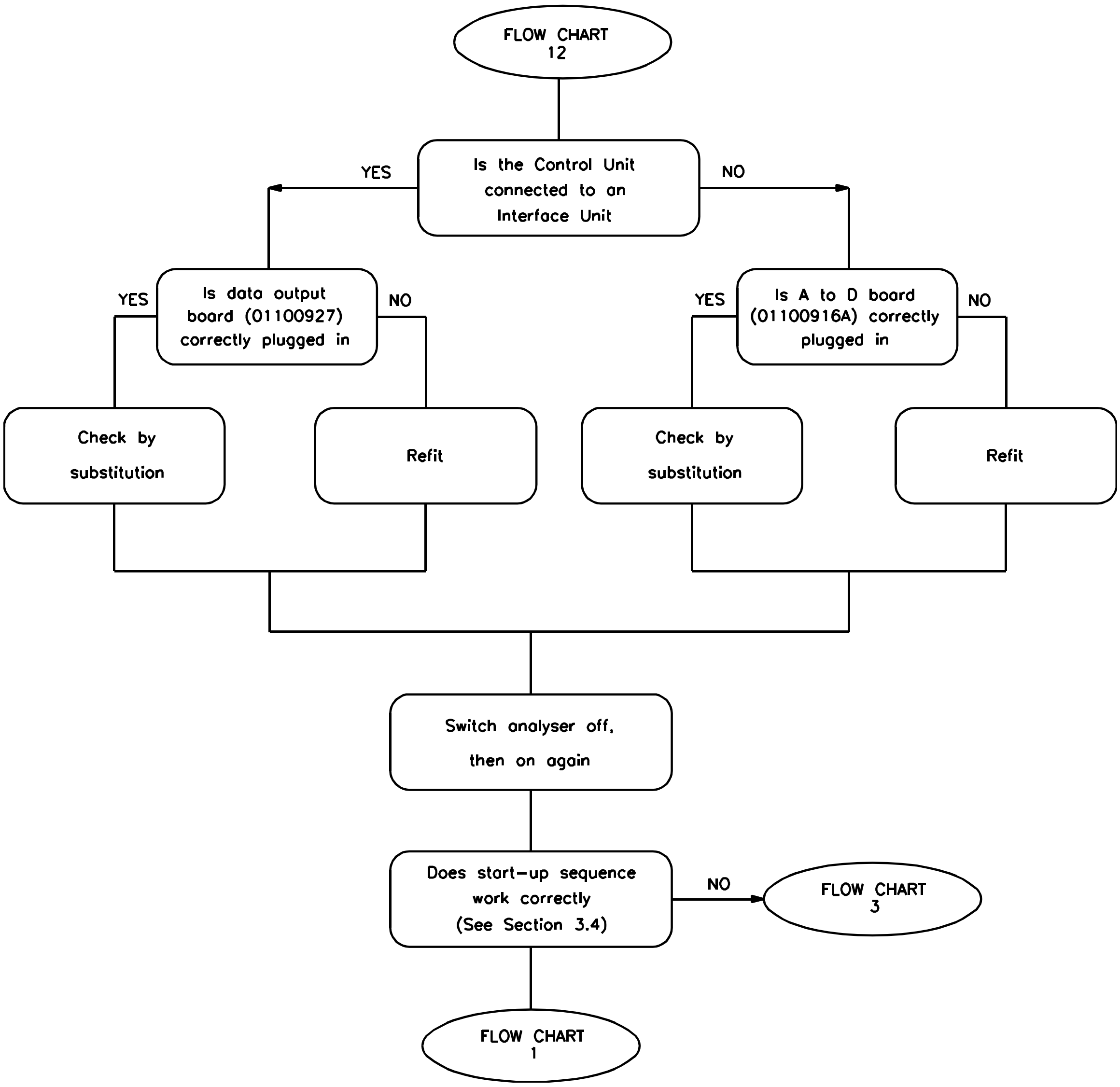
Diagnostic Flow Chart 9



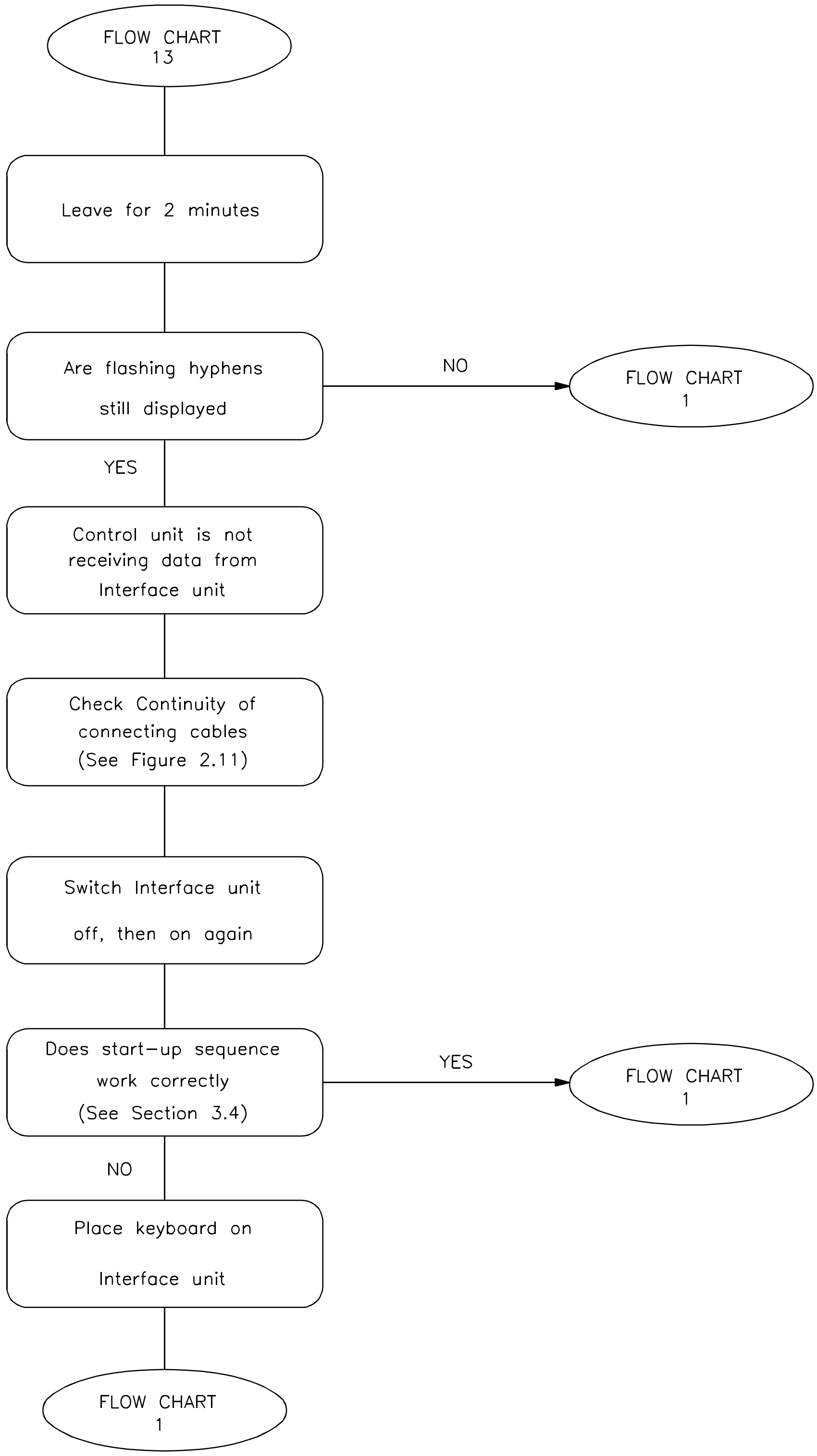
Diagnostic Flow Chart 10



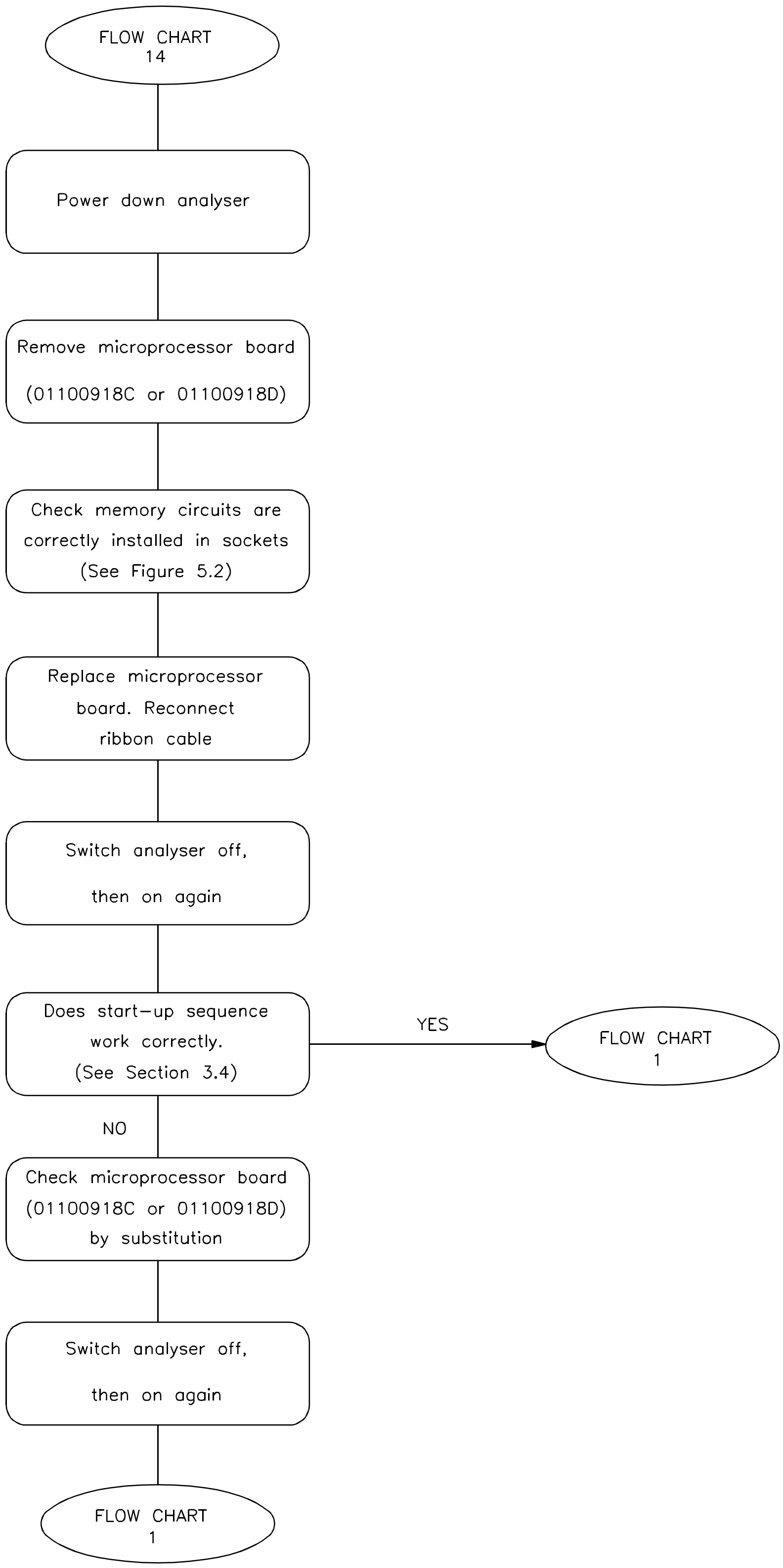
Diagnostic Flow Chart 11



Diagnostic Flow Chart 12



Diagnostic Flow Chart 13



Diagnostic Flow Chart 14

5.2 DIAGNOSTIC TESTS

The function of these tests is to isolate faults at a lower level than major sub-assemblies.

5.2.1 Oxygen Transducer

The following series of tests assumes that the transducer unit is connected to a close coupled control/interface unit in which a 01100925B amplifier board is fitted. In systems in which the transducer is separated from the control/interface unit, refer to circuit diagrams in Figures 2.9 or 2.10 (depending upon Transducer unit fitted) for connection details.

Step	Procedure	Normal Indication	Corrective Action
1	Remove LED wire from terminal TB-D-5 on amplifier board.		
2	Measure current from TB-D-5 to TB-D-4.	50mA+/-4mA (70mA+/-3mA upto Serial No. 925/546)	Replace Amplifier Board 01100925B
3	Measure current in series TB-D-5 and wire removed from TB-D-5	50mA+/-4mA (70mA+/-3mA upto Serial No. 925/546)	Replace LED in Transducer. See Section 5.3.2.3.
4	Refit wire into TB-D-5		
5	Pass nitrogen as a zero gas through the transducer at a sample flow rate of 100 to 200ml/min		
6	Remove photo-electric cell wiring at TB-D-1, 2 and 3, and measure the output from the photo-electric cells (Wire connected to TB-D-1 is negative polarity). Adjust mechanical zero (see Section 4.3) to ensure that it is possible to cause the reading to pass through zero. Set to 0mV +/- 5mV		Replace photo-cell LED, or, oxygen measuring cell.

Step	Procedure	Normal Indication	Corrective Action
7	Pass the air as span gas through the transducer at a sample rate of 100 to 200 ml/min.		
8	Output from the photo-cells should increase.	e.g.: N_2 1mV Air (21% O_2) 280mV	Replace oxygen measuring cell. See section 5.3.2.1.
9	Refit wiring to TB-D-1, 2 and 3.		
	Temperature Sensor		
10	Remove wiring from TB-D-11 and 9 (connections from resistance thermometer).		
11	Measure resistance and determine temperature of transducer unit from Table 5.1 and compare with known reference.	See Table 5.1	Replace resistance thermo-meter.
12	Refit wiring to TB-D-11 and 9		
	Pressure Compensation Transducer (if fitted)		
13	Measure voltage at TB-D-8 w.r.t. TB-D-14.	5V±0.03V	Replace amplifier board 01100925B or ADC board 01100916A.
14	At normal atmospheric pressure of 1 bar ± 50mbar Measure pressure transducer output at TB-D-13 w.r.t. TB-D-12	22mV±5mV	Replace pressure transducer. See Section 5.3.2.6.

TABLE 5.1 RESISTANCE THERMOMETER VALUES

Resistance in ohms across sensor (blue and brown wires)		Temperature in degC
100.0	-	0
103.9	-	10
107.8	-	20
111.7	-	30
115.5	-	40
119.4	-	50
123.2	-	60
127.0	-	70
130.9	-	80
134.7	-	90
138.5	-	100
142.3	-	110
146.1	-	120
149.8	-	130

5.2.2 Power Supply Unit Test

Remove PSU from analyser. See Section 2.6.1, paras 1 to 3.

With PSU still connected to analyser measure the following voltages on TB-B (terminal block on right hand side of PSU with analyser connections). Voltages are measured with respect to TB-B-5.

Terminal	**Voltage**
TB-B-9	+8V dc, ±0.2V
TB-B-10	! 8V dc, ±0.2V
TB-B-4	+5.0V dc, ±0.2V

CAUTION

This test must be completed within two minutes otherwise power supply unit may overheat.

If the voltages do not agree with those specified above unplug boards one at a time to identify potentially faulty boards. Check by substitution.

If all voltages are low check the transformer. See Section 5.2.2.1.

If the +5V is low and no current is being drawn, check the voltage regulator.

If either of the +8v or -8V supplies are low then replace the pcb 01100919. See Section 5.3.6.1.

5.2.2.1 Transformer Test

Note: Disconnect electrical supply to PSU when making connections/disconnections in the following test.

1. Remove PSU from analyser, See Section 2.6.1, paragraphs 1 to 3.
2. Remove connector from TB-B.
3. Remove brown wire from Pin 1 adjacent to D2 on pcb 01100919.
4. Measure voltage between brown wire and Pin 6. It should be 10.2V ac ±0.3V.
5. Remove brown wire from Pin 2 on pcb 01100919.
6. Measure voltage between brown wire and Pin 6. Should be 10.2V ac ±0.3V.
7. Measure voltage between the two brown wires. Should be 20.4V ac ±0.5V.
8. If these voltages are not correct the transformer may be faulty and should be replaced.
9. If these voltages are satisfactory then reconnect the brown wires to Pins 1 and 2.

5.2.2.2 Heater Supplies and Control Circuits.

Lack of power to the heater may be due to one of the following causes:

1. Heater fuse (F2) failure (See Table 5.2).
2. Faulty heater element (See Section 5.2.3).
3. Faulty heater control circuits.
4. Faulty transformer.
5. Faulty microprocessor board 01100918C or 01100918D.
6. Failure of thermal fuse in 1131 Transducer unit due to overheating.

5.2.2.3 Heater Control Circuit Tests

1. Remove the power supply unit from the analyser (See 2.6.1 Paragraphs 1 to 3).

2. Remove connector from TB-B.

3. Connect a load to simulate the heater resistance (see Table 5.2) or reconnect the heaters.

4. Connect an ammeter in series with the heaters and measure the current flowing. The current should be less than 5mA.

5. Connect a 150ohm, 2%, 0.5W resistor temporarily between TB-B-1 and TB-B-6.

6. Measure the heater current. This should agree with the value in table 5.2.

7. If test 6 fails, replace the PCB 01100919. If test 6 is satisfactory the fault probably lies with the microprocessor board 01100918C or 01100918D. Check by substitution.

8. Replace the connector on TB-B.

9. Replace the power supply unit into the analyser. See Section 2.6.1 Paragraphs 5 - 7.

5.2.3 Heater Resistance

Measuring the resistance of the heater in the Transducer unit gives an indication of failed heater elements.

Measure heater resistance by removing the heater wires from the power supply connector TB-A. Compare the resistance with the values shown in Table 5.2.

If the meter indicates open circuit check the continuity of any connecting cables.

The resistance of the heaters depends upon type of Transducer used.

TABLE 5.2 HEATER RESISTANCE

Transducer Model	Terminal Number PSU TB-A	Heater Voltage	Heater Resistance (ohms)	Heater Current (approx.)
1131A	6	110V	560±5%	200mA
1131B	5	55V	120±5%	450mA
1131C	5	55V	120±5%	450mA
1132/701	6	110V	201±10%	550mA
1132/000	7	220V	814±10%	270mA
1133	5	55V	96±10%	570mA

Note: Heater voltage measured relative to TB-A-4.

See Section 5.3.5 for details on the replacement of the heater elements in the Transducer units.

5.2.4 Keyboard Encoder Test

An abbreviated test of the keyboard encoder may be made by pressing the keys '5'and 'SET' in turn and observing the logic state of pins 2, 4, 6 and 10 of IC5 on PCB 01101902 on the front door of the Control unit.

In Tables 5.3 and 5.4 below:

L means a voltage between 0 and 0.7V
H means a voltage between 2.4 and 5.1V

with respect to ground.

TABLE 5.3 KEY BOARD ENCODER TEST

	IC5 Pin No.			
KEY	**2**	**4**	**6**	**10**
5	H	L	L	H
SET	L	H	H	L

If this test fails, it indicates that the encoder is faulty and pcb 01101902 should be replaced.

If the fault persists check the operation of the individual keys using Table 5.4.

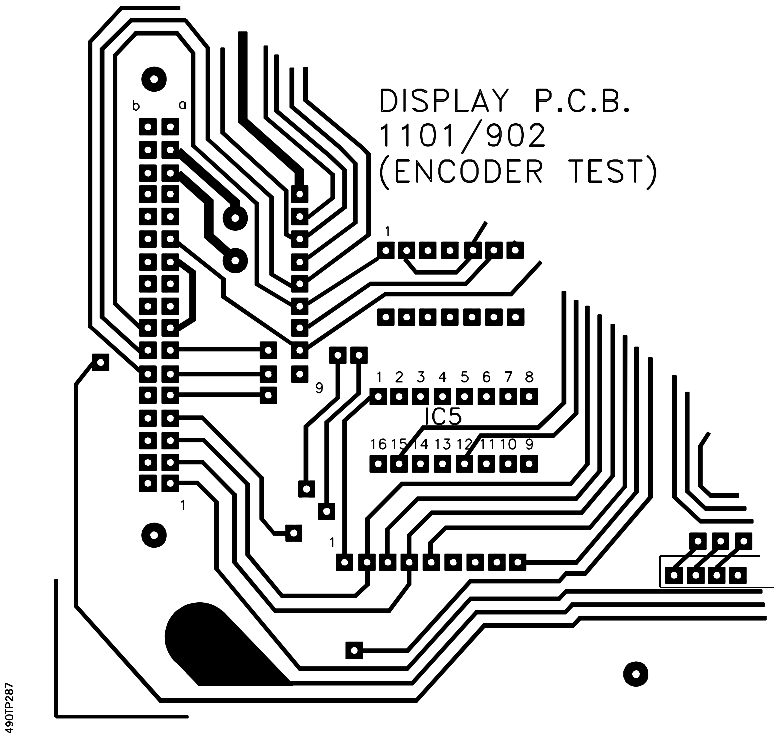


Figure 5.0 Rear view (solder side) of Display Board 01101902 showing location of test points on IC5

TABLE 5.4 KEYBOARD TEST

	IC5 Pin No.			
KEY	**2**	**4**	**6**	**10**
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	L	H
5	H	L	L	H
6	L	H	L	H
7	H	H	L	H
8	L	L	H	L
9	H	L	H	L
SET	L	H	H	L
DISPLAY	H	H	H	L
CLEAR	L	L	H	H
!	H	L	H	H
ENTER	L	H	H	H
!	H	H	H	H

If this test is unsatisfactory it indicates the front panel assembly should be replaced.

5.3 REPAIR

5.3.1 Repair Equipment and Tools

The following equipment and tools should be available to personnel responsible for maintenance and repair of the analyser.

1. - A volt/ohm/milliamp meter of high input impedance.

2. - Supadriv screwdriver, point size 2. (Cross headed)

3. - Flat bladed screwdriver, 6mm width.

4. - Allen key, 5mm across flats.

5. - Allen key, 3mm across flats.

6. - Nut spinner, M6, 10mm across flats.

7. - Open ended spanner, M4, 7mm across flats.

8. - Open ended spanner, 3/8", 9.5mm across flats.

9. - Soldering Iron 25W.

10. - De-solder braid or vacuum de-soldering tool.

11. - Open ended spanner, width across flats 0.28 in (9/32in) British 3BA, non-magnetic (only for 312 and 313 cells).

12. - Open ended spanner, width across flats 0.45 in (7/16in) British 3/16 Whit nominal, non-magnetic.

13. - Manometer with a range exceeding 500mm Wg and a bore not exceeding 5mm.

14. - Calibration gases:

    1. Clean dry nitrogen with an oxygen concentration of less than 0.1% O_2.

    2. Pure oxygen with a concentration of greater than 99.7% O_2.

5.3.2 Servicing the Magnet Assembly of 1131, 1132 and 1133

Note: Due to the strong magnetic field which exists around the transducer it is advisable to remove wrist watches if worn.

Refer to Figures 6.3 to 6.5.

Remove and replace magnet assembly as follows:

1. Remove front cover by removing the four M6 socket screws (5mm allen key).

2. Remove the foam insulation (19) carefully, pulling it out by the corners.

3. Remove front of inner box (1) by removing the 4 x M5 Supadriv screws.

CAUTION

Temperatures up to 110°C (230°F) may exist if an 1132 Transducer unit is fitted.

4. Undo the two sample connections to the cell. Use the non-magnetic spanner.

   If a 312 or 313 cell is fitted use two non-magnetic spanners and avoid turning the cell connections.

5. Loosen the 3 x M6 (20) nuts on back of magnet frame.

6. Lift the magnet assembly (3) carefully, easing it past the gas connections and then resting it in the case.

To replace magnet assembly:

7. Refit magnet assembly (3) onto the 3 x M6 studs and re-tighten the nuts (20).

8. Fit sample tubes (15) and (16) to the measuring cell (8) using two new 'O' rings. Tighten the connectors not more than three flats beyond finger tight.

9. Ensure the analyser is leak tight. See Section 5.3.4.

10. Set the mechanical zero. See Section 5.3.3.

5.3.2.1 Removal and Replacement of the Measuring Cell

Refer to Figures 5.1 and 6.2.

1. Remove magnet assembly (3) by following steps 1 to 6 of Section 5.3.2.

2. Unsolder wires from the terminal pins on the back of measuring cell (8).

3. Loosen cell clamp screw (21), M4 (7mm A/F).

4. Remove the 4 x M4 socket head screws (23) (3mm allen key) and then remove Zero Assembly (22).

5. Grip measuring cell firmly and pull it out of the magnet frame (2).

CAUTION

Do not pull the cell out by its gas connectors.

6. See Section 1.7.5. for the types of measuring cell which may be fitted.

7. Refit zero assembly (22) with the 4 x M4 screws (23) to the magnet frame.

8. The cell must be fitted the right way up. When looking through the window the right hand dumb-bell must be seen to be forward, and the serial number label must be on the left side. See Figure 6.2.

9. Tighten cell clamp screw (21) so that the cell is locked firmly.

10. Solder wires to measuring cell. Do not overheat the terminals as this could cause a leak. The black sleeved wire goes to the terminal pin adjacent to the black spot and the yellow sleeved wire goes to the terminal pin adjacent to the yellow spot.

11. Refit magnet frame. See Section 5.3.2., paragraphs 7 to 10.

5.3.2.2 Replacement of Photo-cells

Refer to Figures 5.1 and 6.2.

1. Remove magnet assembly (3) by following steps 1 to 6 of Section 5.3.2.

2. Unsolder green and red wires from the photo-cells (7).

3. Unscrew and remove coarse mechanical zero screw (9). Remove the photocell clamping screw (25), M4 socket head screw (3mm allen key), and remove photocell assembly (7).

4. Unscrew and remove 2 x M2 slot head screws holding photocells to the assembly.

5. Reassembly is the reverse of this process. Ensure that the photo-cells are clean and free of fingermarks before fitting.

   Note: The photo-cells are fragile. Take care not to damage them during assembly.

6. Screw new photocells to the assembly.

7. Slide photocell assembly into zero assembly carefully and lock in mid-position with the M4 screw (25).

8. Solder wires onto the pins, green wire to the top, red wire to the lower. See Figure 5.1. Care must be taken not to overheat the pins.

9. Replace magnet assembly. See Section 5.3.2, paragraphs 7 to 10.

5.3.2.3 Replacement of the LED Assembly

Refer to Figures 5.1 and 6.2.

1. Remove magnet assembly by following steps 1 to 6 of Section 5.3.2.

2. Remove photo-cells, see Section 5.3.2.2, paragraphs 2 and 3. Take care not to damage them.

3. Unsolder black and blue wires attached to the LED (6). See Figure 5.1.

4. Unscrew M3 pan head screw (28) and remove LED assembly (6).

5. Screw new LED assembly into position.

6. Solder the blue wire to the upper pin and the black wire to the lower pin. Care must be taken not to overheat the pins. See Figure 5.1.

7. Carefully slide photocells into zero assembly and lock in mid-position with the M4 screw.

8. Replace magnet assembly. See Section 5.3.2, paragraphs 7 to 10.

5.3.2.4 Replacement of Temperature Sensor Assembly

Refer to Figures 5.2 and 6.2.

1. Remove magnet assembly by following steps 1 to 6 of Section 5.3.2.

2. Remove wires connected to the assembly - one grey, two brown and four black.

3. Unscrew Thermistor (5) (3/8"A/F spanner)(10mm A/F on earlier instruments) and M4 pan head screw (41).

4. Unsolder measuring cell grey/red and red/black wires from back of assembly.

5. Reassembly is the reverse of the removal process. Ensure that the wires are connected correctly. See Figure 5.2.

6. Replace magnet assembly. See Section 5.3.2, paragraphs 7 to 10.

5.3.2.5 Replacement of the Thermistor.

Refer to Figures 5.2 and 6.2.

1. Remove magnet assembly by following steps 1 through to 6 of paragraph 5.3.2.

2. Unsolder two black wires on thermistor (5) and remove by unscrewing sensor (10mm A/F spanner). See Figure 5.2.

3. Reassembly is a reversal of removal process.

4. Replace magnet assembly. See Section 5.3.2, paragraphs 7 to 10.

5.3.2.6 Replacement of Temperature Switch (1132 Unit only).

1. Remove cover from heater junction box on left hand side of the transducer by removing 4 x M6 socket head screws and disconnect the heater supply.

2. Remove the front cover and front insulation as described in steps 1 and 2 of Section 5.3.2.

3. Unscrew the 20mm nut on the inside of the case securing the heater assembly.

4. Withdraw the heater assembly.

5. Undo the fittings to enable the transducer to be separated from the sampling panel and remove the heat transfer chimney by undoing the 4 M4 nuts.

6. Remove the cover of the right hand junction box and disconnect the signal and earth wires from the terminal block.

7. Undo and remove the two 1/2 inch BSPP nuts on the feedthroughs for the wires inside the junction box.

8. Remove the junction box and undo the top hexagonal spacer and slide it over the wires.

9. Lift out the inner box assembly.

10. Undo the 4 x M4 nuts holding the temperature switch assembly to the inner box.

11. Remove the old switch assembly and replace with the new one.

12. Refit the inner box, feeding the wires carefully through the outer case and refit the hexagonal spacer.

13. Refit the junction box by following paragraphs 1 to 6 above in reverse order.

14. Carry out a leak test (Section 5.3.4).

15. Reconnect the power, allow the analyser to warm up for 12 hours and re-calibrate. See Section 3.6.

5.3.2.7 Replacement of Pressure Transducer (if fitted).

Refer to Figure 5.3

1. Remove magnet assembly by following steps 1 through to 6 of Section 5.3.2.

2. Cut cable tie (1) from transducer body.

3. Loosen transducer (2) by unscrewing body approximately 1/2 a turn.

4. Unscrew and remove 4 x M4 slot head screws from bracket.

5. Lift bracket (4) out and unsolder wires from transducer on back of bracket.

6. Holding pipework, carefully unscrew and remove transducer.

7. Screw new transducer onto fitting by hand (do NOT use a spanner or wrench) taking care not to stress the pipes.

8. Solder wires onto pins. See Figure 5.3 and replace bracket.

9. Fit new cable tie.

10. Ensure the sample system is leak tight. See Section 5.3.4.

11. Calibrate analyser including pressure compensation.

5.3.2.8 Replacement of Sample Tubes

1. Carry out steps 1 to 4 of Section 5.3.2.

2. The sample inlet and outlet tubes (15 and 16) can now be removed by undoing the 3/8 inch AF nuts inside the transducer housing.

3. Re-assemble in the reverse order. New 'O' rings (14) should be fitted.

4. Leak test the assembly (Section 5.3.4) and recalibrate the analyser (Section 3.6).

5.3.2.9 Cleaning of the Measuring Cell

The window of the type 325 and 364 cells may be cleaned. If the loop gain is poor (see Section 4.6) it is possible the window of the cell has been contaminated.

1. Remove the measuring cell (see Section 5.3.2.1).

2. Examine the window. If the inner surface is contaminated the window may be removed for cleaning.

3. Remove the four 2.5mm screws holding the window bezel in place.

4. Remove bezel and window.

5. Clean the window by gentle rubbing and using water or solvent. Do not use an abrasive which may scratch the glass. Dry.

6. Replace 'O' ring. Part no. 2323-6343 (325 cell) or 2323-6963 (364 cell).

7. Replace paper gasket between bezel and window. Part no. 00325351.

8. Reassemble window and bezel.

9. Replace the measuring cell into the magnet frame.

10. Test complete transducer unit for leaks. See Section 5.3.4.

Note: Do not attempt to clean the internal parts of the cell. The dumbell and suspension are delicate and are easily damaged. Cells damaged in this way will not be covered by the Servomex guarantee.

5.3.3 Setting Mechanical Zero

See Figure 6.2.

1. Power up the analyser

2. Pass a zero gas (e.g. Nitrogen) though at a sample rate of 100-200 ml/min (150 ml/min max for 313 and 324 cells).

3. Turn the zero screw (9) anticlockwise until the photo cell assembly (24) reaches limit, then turn the screw clockwise to the limit, counting the number of turns (between 4 and 6). Adjust the screw to its mid position.

4. Display parameter 14, the uncorrected oxygen reading (or on separated systems, connect a volt meter to the photocells in the transducer unit. See Section 5.2.1., test 6).

5. Slacken coarse mechanical zero screw (25), M4 socket head screw (3mm allen key).

6. Slide photo-cells along the slot until a reading between ±3% is obtained for parameter 14, (allow for delay on display) or, if using a voltmeter, a reading between ±10.0mV.

7. Re-clamp screw. Check zero position is within limits.

8. Adjust zero screw (9) until a reading of between ±0.05% O_2 is obtained for parameter 14. (±5.0mV if using a voltmeter).

9. Replace front of Inner Box (1).

10. Replace foam insulator.

11. Replace front cover.

12. Allow the analyser to warm up for 12 hours and then re-calibrate. See section 3.6.

Note: It is possible that the coarse span resistors may require adjusting, See Section 5.3.6.10.

5.3.4 Leak Testing

1. Common the ‘Sample In’ and ‘Sample Out’ gas connections and connect a water manometer to the junction.

2. Pressurize the sample system to 500mm w.g. and measure the rate of pressure loss on the manometer. It should be less than 1mm w.g. / 2min.

3. If the leak rate exceeds this value, check analyser pipework for leaks using a solution of a neutral wetting agent. (Include the cell and its window).

4. Rectify leaks and recheck.

5.3.5 Replacement of Heaters and Thermal Fuse

5.3.5.1 1132 and 1133 Transducers.

See Figure 5.4.

1. Remove Cover of junction box on left hand side of the transducer by removing 4 x M6 socket head screws. (5mm A/F allen key).

2. Remove split pin (1).

3. Remove Heater wires from terminal block (2).

4. Release M3 pan head screw (3) and push terminal block down out of the way.

5. Pull out heater assembly (4).

6. Reassembly is the reverse of this process.

7. Restore power connections, allow the analyser to warm up for 12 hours and recalibrate.

5.3.5.2 1131 Transducers

See Figure 5.5

1. Release the transducer unit from the sampling system and corrosive purge lines (if fitted)

2. Remove the nuts (29) and bottom sealing plate (30) under the transducer.

3. Slide the ‘O’ rings (18) off the pipes.

4. Prise the top sealing plate (32) off the box with a screwdriver or similar implement.

5. Disconnect the signal wires at TB-D in the Control (1101) or Interface (1102) unit.

6. Disconnect the heater and earth wires.

7. Undo and remove the two nuts (33) on the wire feedthroughs (26mm AF spanner) inside the control or interface unit.

8. Unbolt the transducer from the rear mounting bars and separate it from the other unit, pulling the wires through the couplings carefully.

9. Remove the front cover of the transducer unit and pull out the front insulation by the corners.

10. Unscrew and remove the top hexagon spacer (34).

11. Lift out the complete transducer inner box assembly.

    To change the thermal fuse (1132 transducer only):

    a) The thermal fuse is located on top of the inner box assembly. Remove the two wire connections from the thermal fuse assembly.

    b) Undo fixing screw and remove the complete thermal fuse assembly.

    c) Install a new thermal fuse assembly (01131355) by screwing it to the top of the inner box and reconnecting the two wires (push-on-fitting).

12. Unsolder the heater wires using a high temperature (e.g. 430°C) soldering iron with a fine bit.

13. Unscrew the faulty heater(s). (Supadriv No.7).

14. Fit the replacement heaters and re-solder the wires using high melting point solder (approx 300°C).

15. Refit the inner box assembly feeding the wires carefully through the outer case and screw the hexagon spacer (34) into position.

16. Stick the top sealing plate back to the case of the analyser.

17. Push the 'O' rings (18) over the sample pipes and refit the bottom sealing plate, nuts and washers.

18. Refit the insulation and front cover.

19. Feed the wires carefully into the control or interface unit and refit the transducer to the mounting bars.

20. Refit the lock nuts (33), tighten carefully and reconnect the wires to the terminal blocks as shown in Figure 5.5.

21. Leak test (see Section 5.3.4) and recalibrate the analyser

5.3.6 Repair of Control / Interface Unit

See Figure 6.1 for location of boards and assemblies. All boards in the card rack are removed by:

1. Removing the 4 x M6 socket head screws (5mm Allen Key) securing the front cover.

2. Loosening the two screws holding the PCB locking bar and sliding the bar to the right.

After replacing boards:

3. Slide the PCB locking bar left and tighten the two screws.

4. Close the front cover and tighten the four screws.

5.3.6.1 Repair / Replacement of Power Supply

1. Remove front cover on Control or Interface Unit.

2. Disconnect heater and mains supply from terminal block TB-A on front of power supply.

3. Disconnect 26-0-26 VAC from 4-20mA board (01100929, 929A or 939) and 10-0-10 VAC from data communications board (01100927) if fitted.

4. Undo earth (ground) connection at left hand side of case and remove earth wire.

5. Unscrew and remove screws (20) holding power supply to case. See figure 6.1.

6. Pull power supply forward enough to enable access to terminal block TB-B and disconnect.

7. Remove power supply from case.

Remove power supply board (01100919) as follows:

Refer to figure 5.6.

8. Unsolder ten wires down edge of board and cut cable tie.

9. Unscrew and remove Supadriv screws holding heatsink on the end of the power supply. Lift heatsink out of the way.

10. Unscrew and remove the slot head screws holding the board (7).

11. If required the solid state relay can now be de-soldered from the printed circuit board.

12. Reassembly is the reverse of this process. See Figure 5.6 for electrical connections.

5.3.6.2 Replacement of Display Board.

(The Display Board is not fitted to an interface unit.)

1. Remove the front cover of the Control Unit.

2. Unplug the two 'IDC' connectors, one from the base of the display board (13), the other from microprocessor board (PCB 1).

3. Unscrew and remove slot head screws holding the printed circuit board to the front cover

4. If required, the display elements (14) can be replaced as necessary.

5. Reassembly is the reverse of this process.

5.3.6.3 Replacement of Front Panel with Keypad

1. Remove display board (13) by following steps 1 to 3 of Section 5.3.6.2.

2. Remove hinge pin by prising off one retaining ring (22) and sliding out the hinge pin (23).

3. Reassembly is the reverse of this process. The hinge pin must be fitted with the new retaining ring supplied with the front panel assembly.

5.3.6.4 Replacement of Microprocessor Board

The part number for a replacement microprocessor pcb including firmware, depends on the software fitted, which is dependent on the architectural configuration of the analyser system and the board location as follows:

	Microprocessor PCB and Software Part Numbers			
Feature 1 Code	PCB 01100971 S/W 01100680	PCB 01100971 S/W 01100681	PCB 01100972 S/W 01100682	PCB 01100973 S/W 01100683
01 & 21	-	Control Unit	-	-
02 & 22	-	Control Unit	-	-
03 & 23	Control Unit	Interface Unit	-	-
04,14,24	-	-	-	Control Unit
04 (1100H)	-	-	Control Unit	-
06,16,26	Control Unit	-	-	Interface Unit
06 (1100H)	Control Unit	-	Interface Unit	-
	Microprocessor PCB and Software Locations			

1. Disconnect the two wires from TB-H.

2. Unplug IDC Connector on front of board.

3. Pull out board (PCB 1) from unit.

4. Plug in replacement microprocessor board (see Figure 1.1 for correct board) into right hand slot.

5. Plug in IDC connector. Reconnect TB-H. (Observe polarity, top terminal is negative.)

5.3.6.5 Replacement of Analogue to Digital Converter

1. Unplug IDC Connector. Remove connections (if any) to lower terminal block. Note their position.

2. Pull out board (PCB 2) from unit.#

3. Plug in replacement A to D board in second slot from the right.

4. Plug in IDC connector. Replace connections to lower terminal block.

5.3.6.6 Replacement of Amplifier Board

1. Unplug IDC Connector.

2. Disconnect Signal wires on TB-D.

3. Pull out board (PCB 3) from unit.

4. If pressure compensation is fitted, ensure that Link G-H on the new board is removed.

5. Plug in replacement Amplifier board into third slot from right.

6. Reconnect Signal wires in TB-D as shown in Figure 2.8 depending on analyser configuration.

7. Plug in IDC connector. If, after changing the board, difficulty is encountered when setting the span calibration, it may be due to the setting of the coarse span resistors. Refer to sections 5.3.6.10 for re-setting details.

5.3.6.7 Replacement of Current Output Board

1. Pull out board (PCB 4) from unit.

2. Disconnect yellow and black wires from TB-F.
Disconnect output connections.

3. Plug in replacement Current Output board into centre slot.

4. Connect yellow and black wires into TB-F.
   Black wire to centre connector.
   Yellow wires to outer connectors marked ‘26V’.

5. Remake output connections. Observe polarity.

6. To select 4-20mA or 0-20mA see section 3.7.3.

5.3.6.8 Replacement of Data Output Board

1. Pull out board (PCB5) from unit.

2. Disconnect violet and green wires from TB ‘M’.
   Disconnect output connections (note their position.)

3. Connect violet and green wires into TB ‘M’ on new board.
   (Green wire to centre connector
   Violet wires to outer connector marked ‘10V’).

4. Plug in replacement Data Output Board into third slot from the left.

5. Remake Output connections.

5.3.6.9 Replacement of Alarm or Auto-Calibration Board

1. Disconnect wires from relay terminal block.

2. Unscrew and remove screws holding terminal block to case.

3. Pull board (PCB 6 or 7) from unit.

4. Set link ‘SC2' to select whether the board is being used for alarms or auto-calibration.

5. Alarms - Set link ‘SC2' to ‘SEL2'
   Auto-calibration - Set link ‘SC2' to ‘SEL3'

6. Plug replacement board into left hand or second from left slot.

7. Screw terminal block to inside of case and remake connections to terminal block.

5.3.6.10 Coarse Span Setting

If the analyser is to operate at a significantly different altitude to that at which it was first tested, difficulty may be experienced when adjusting the span calibration. In this case it will be necessary to select a new value for the coarse span resistor on amplifier board 01100925.

- On amplifier board 01100925B adjustments are made by changing the position of the wire link(s) between L, M and N.

- On amplifier boards 01100925 and 01100925A adjustments are made by changing the value of resistor R41. Use only the special resistors supplied by Servomex, part numbers as follows:

5K ohm	-	2621-1989
2.5K ohm	-	2621-1996

In extreme cases it may be necessary to fit two resistors in parallel.

To make the adjustment proceed as follows:

1. Perform a zero calibration, see Section 3.6.

2. Pass span gas (100% Oxygen) through the analyser.

3. Display the uncompensated oxygen reading and allow the reading to stabilise.

DISPLAY	Lo 1	4

4. Adjust value of R41, or position of O_2 coarse gain links, so that the reading on parameter 14 is between 80 and 118.

5. Perform a normal span calibration, see Section 3.6

5.4 SAMPLING SYSTEM REPAIR

The filter element should be checked once a week if the analyser is in continuos use. Th analyser must not be operated without the filter element in place because dust and other particulates will permanently damage the measuring cell.

The filter element may be inspected by unscrewing the filter plug on the front of the sample block. If dirty or wet, the filter element must be discarded and a new one fitted.

5.4.1 Dry Gas Sampling System 1161

5.4.1.1 Disassembly and Cleaning of Flow meters

See Figure .7

Note: The flowmeter tubes are fragile and excessive force will break them.

1. Turn of gas supplies to the analyser.

2. Slide cover (1) off vertically until released.

3. Remove plastic wedge (2) by pulling forward until it is released.

4. Push the top insert (3) up to the stop while holding the bottom insert (4) down.

5. Tilt the tube forwards until the lower end it clear of the bottom insert (4) and with draw tube.

6. Inserts (3) and (4) can now be lifted out.

7. Clean the tubes by washing them thoroughly with a volatile solvent or with soap and water.

8. Dry the cleaned tubes thoroughly using instrument quality air.

9. Replace ‘O’ rings as necessary. A complete set are in kit part no. 01161999 (Viton)

10. Replacing the ‘O’ rings should be carried out carefully ensuring that no surfaces are damaged. Moisten the ‘O’ rings or use a small amount of suitable grease, e.g. Voltalef, which is suitable for oxygen service.

11. Reassembly is the reverse of this process, using the plastic wedge (2) now as a sliding wedge.

12. Ensure the sample system is leak tight. See Section 5.3.4.

5.4.1.2 Needle Valve Overhaul

1. Turn off gas supply to analyser.

2. Unscrew and remove valve body assembly.

3. Replace ‘O’ rings as necessary. A complete set are in kit part no. 01161999 (Viton) or 01161998 (EPDM)**.**

4. Replacing the ‘O’ rings should be carried out carefully ensuring that no surfaces are damaged. Moisten the ‘O’ rings or use a small amount of suitable grease, e.g. Voltalef, which is suitable for oxygen service.

5. Reassembly is the reverse of the removal process.

6. Ensure the sample system is leak tight. See Section 5.3.4.

5.4.2 Wet Gas Sampling System 1162

5.4.2.1 Disassembly and Cleaning

See Figure 6.9.

1. Turn off gas supplies to analyser
2. Drain water out of bubbler tube by unscrewing and removing drain plug.
3. Disconnect vent/drain pipe if fitted.
4. Open door (2) by turning Dzus fastener (12) and remove door.
5. Unscrew and remove 2 X M6 slot head screws in base (4)
6. Unscrew and remove 1/4 BSP locknut (28) and collar (7) while holding bubbler base.
7. Slide glass tube and base down carefully.
8. Clean with soapy water and rinse thoroughly with clean water.
9. Replace 'O' rings as necessary. A complete set are in kit part no. 01162999 (Viton)
10. Reassembly is the reverse of the removal process.
    Note: Do not over-tighten locknut (28).

5.4.2.2 Setting Sample Flowrate

1. Measure total sample gas flow rate out of drain / vent.
   The flow meter used should have minimum back pressure.
2. Open valve slowly until a total flow rate of 200ml/min ±20ml/min is measured.
3. Adjust the sample dip leg (35) by slackening the coupling nut (33) and adjust until the flow from the bypass dip tube just stops.
4. Re-tighten coupling nut (33).

5.5 FIGURES AND CIRCUIT DIAGRAMS

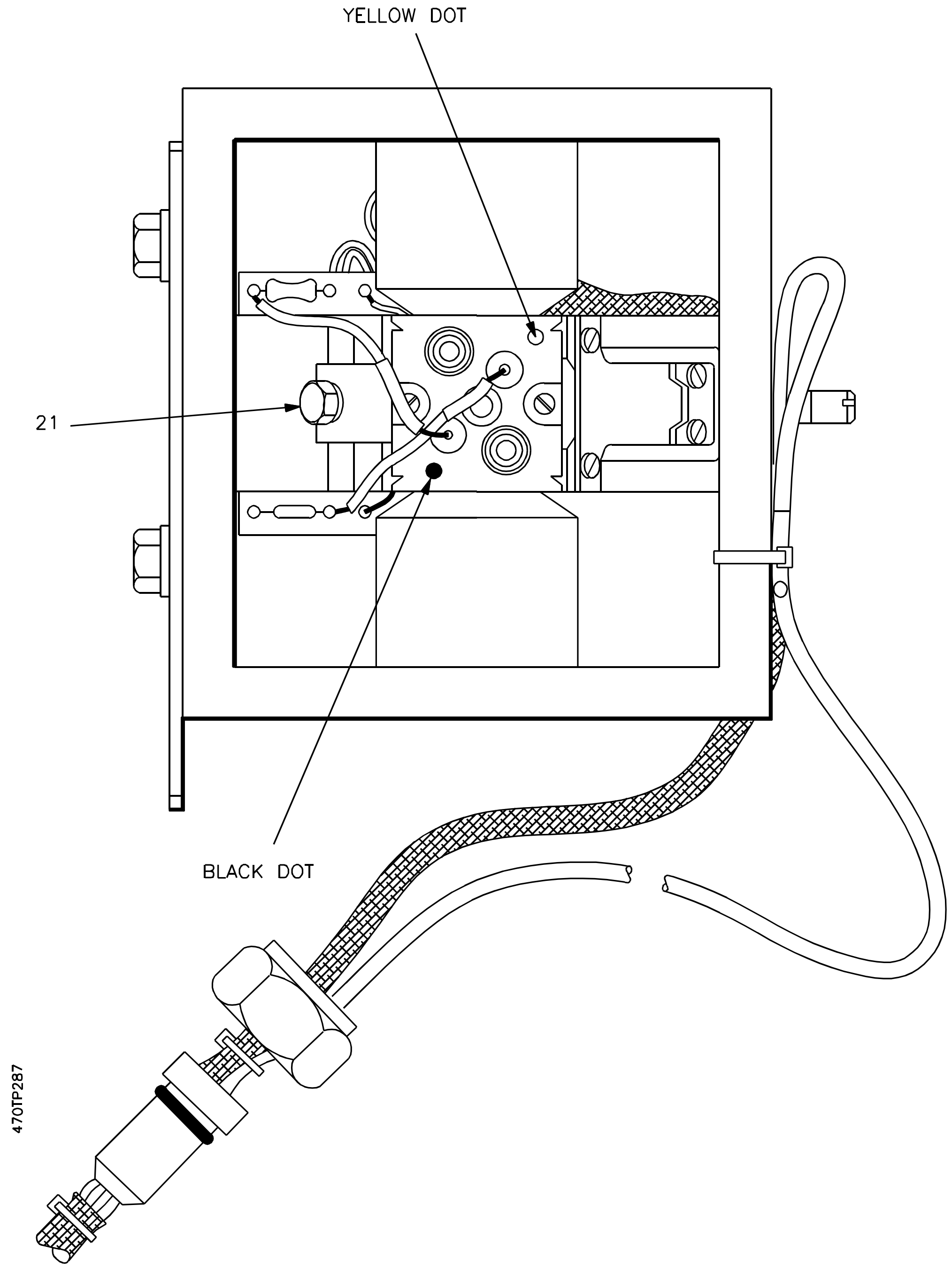


Figure 5.1 Positioning and Wiring Of Measuring Cell

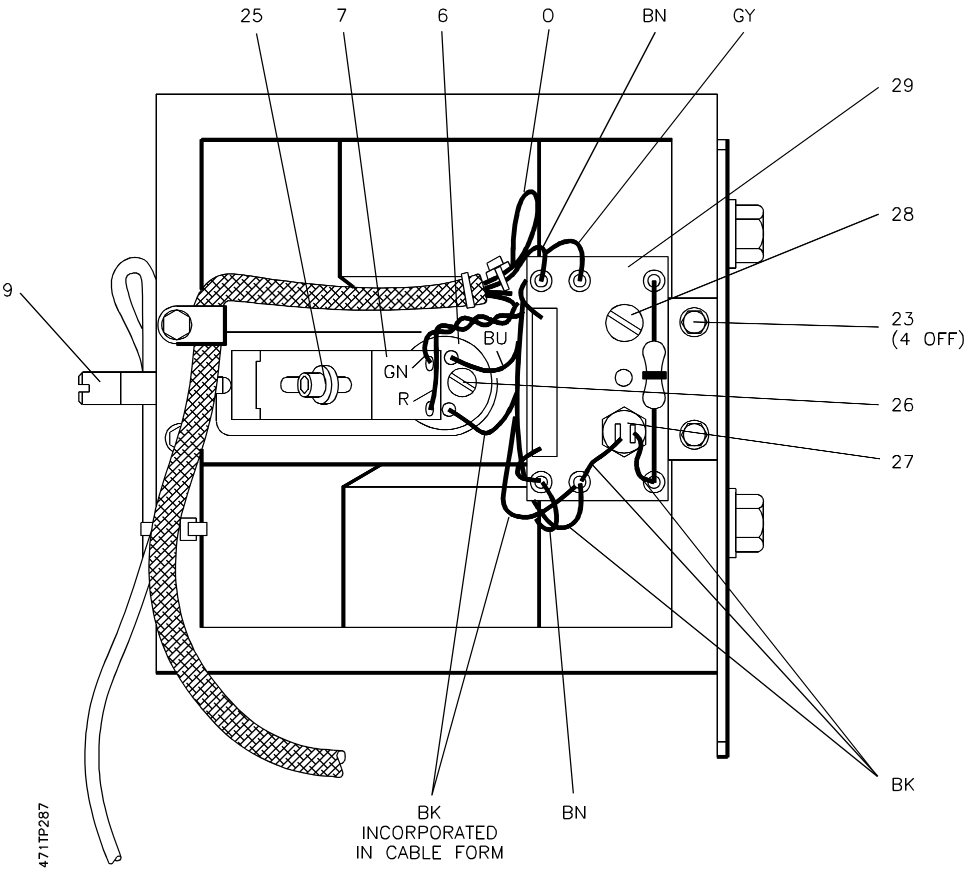


Figure 5.2 Wiring Connections to Magnet Assembly

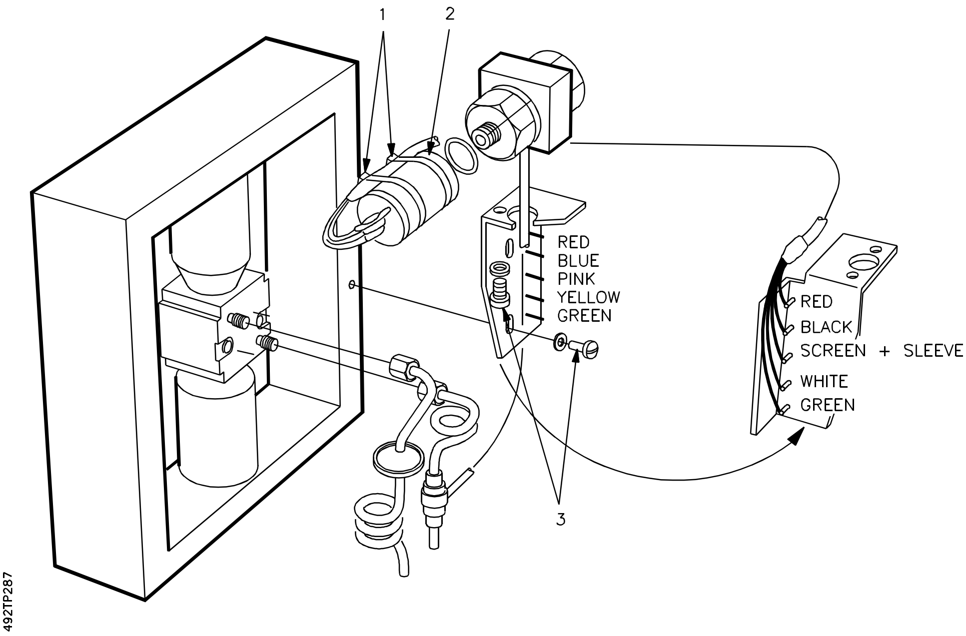


Figure 5.3 Connections to Optional Pressure Transducer

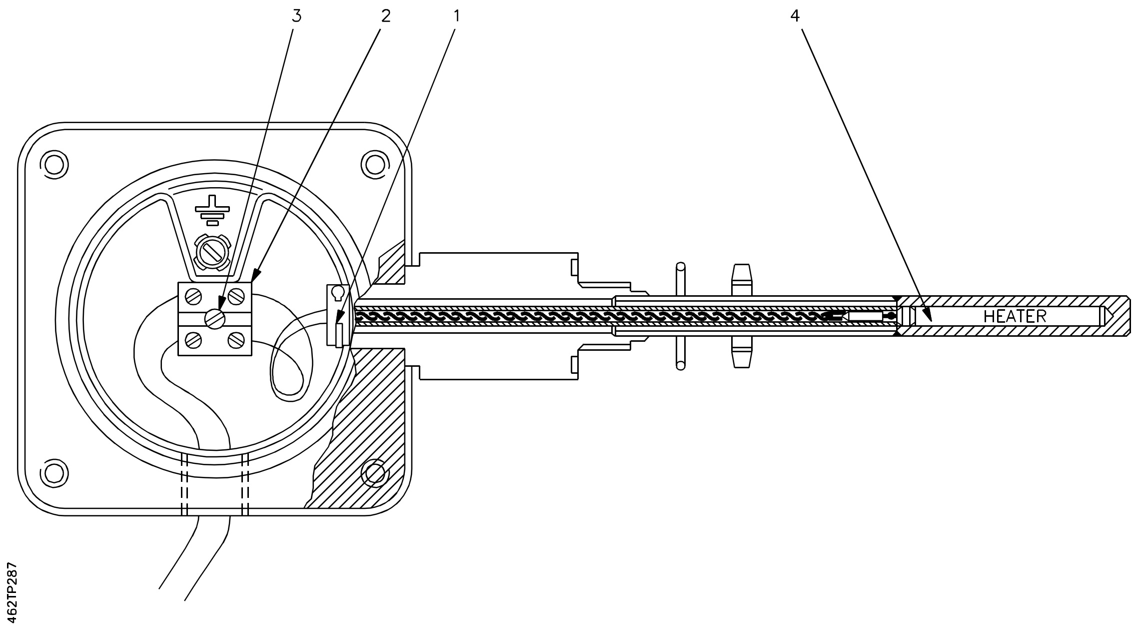
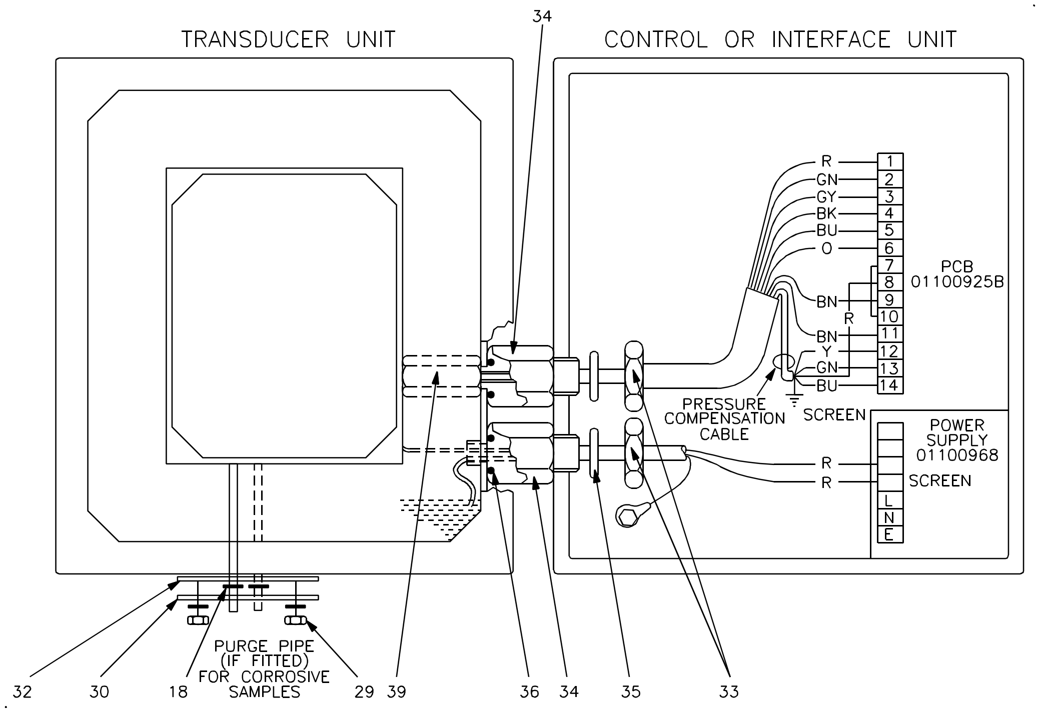


Figure 5.4 Heater Assembly 1132 and 1133 Transducers



Configuration Codes 01, 03, 21 and 23

Figure 5.5 Wiring Connections between Transducer and Control / Interface Unit

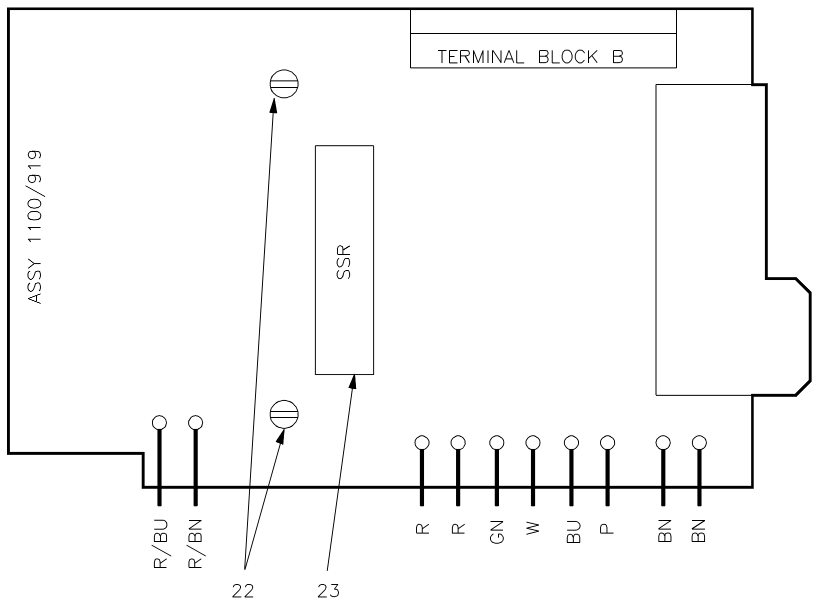


Figure 5.6 Power Supply Board 01100919

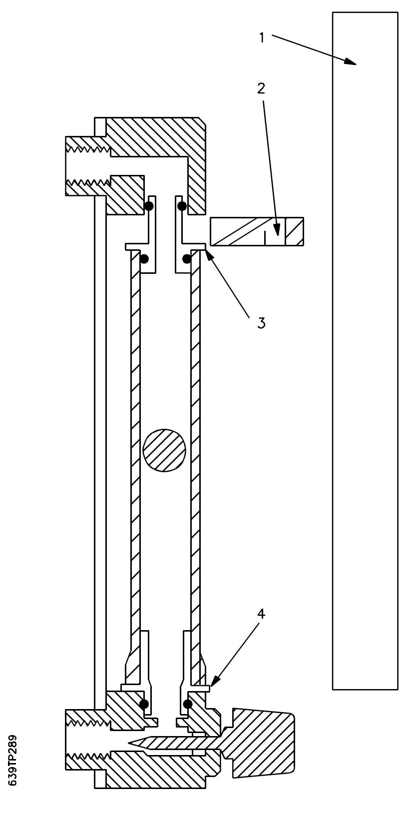
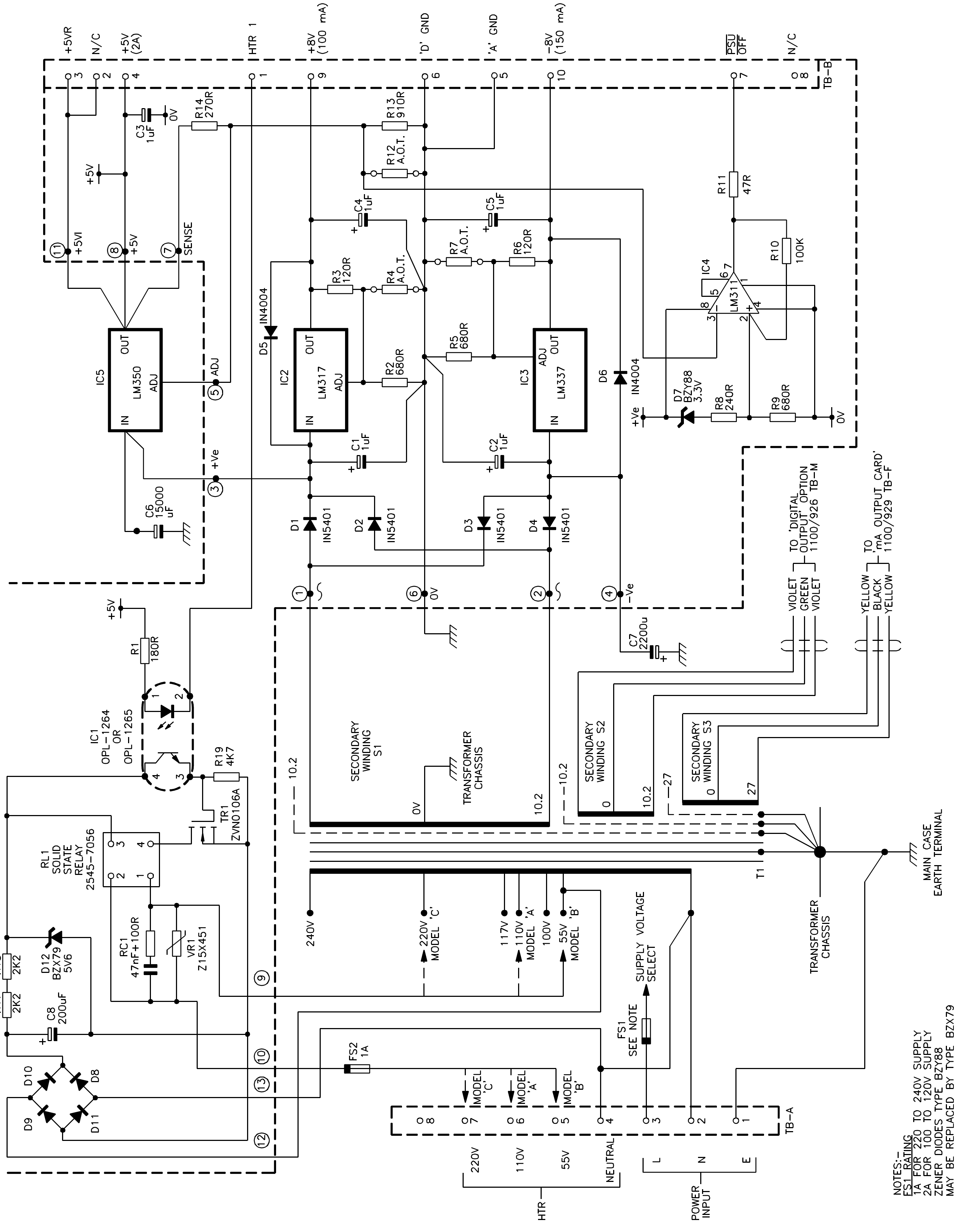


Figure 5.7 Flowmeter Assembly



Note Model A,B,C refers to the variant of power supply, not to the model A,B,C, of the Transducer Unit.

Figure 5.8   Power Supply Unit 01100919

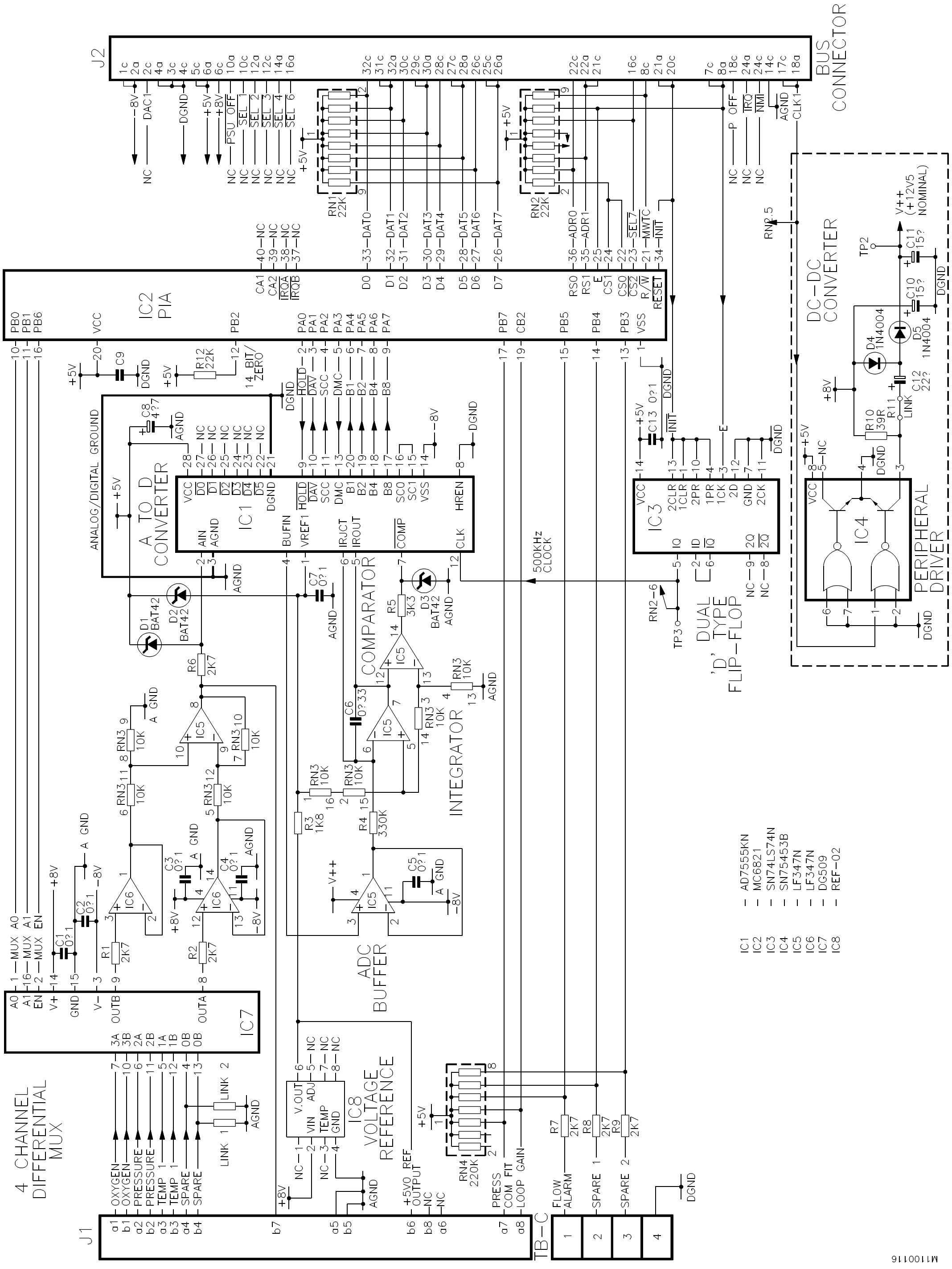


Figure 5.9 A to D Converter Board 01100916

NOTES

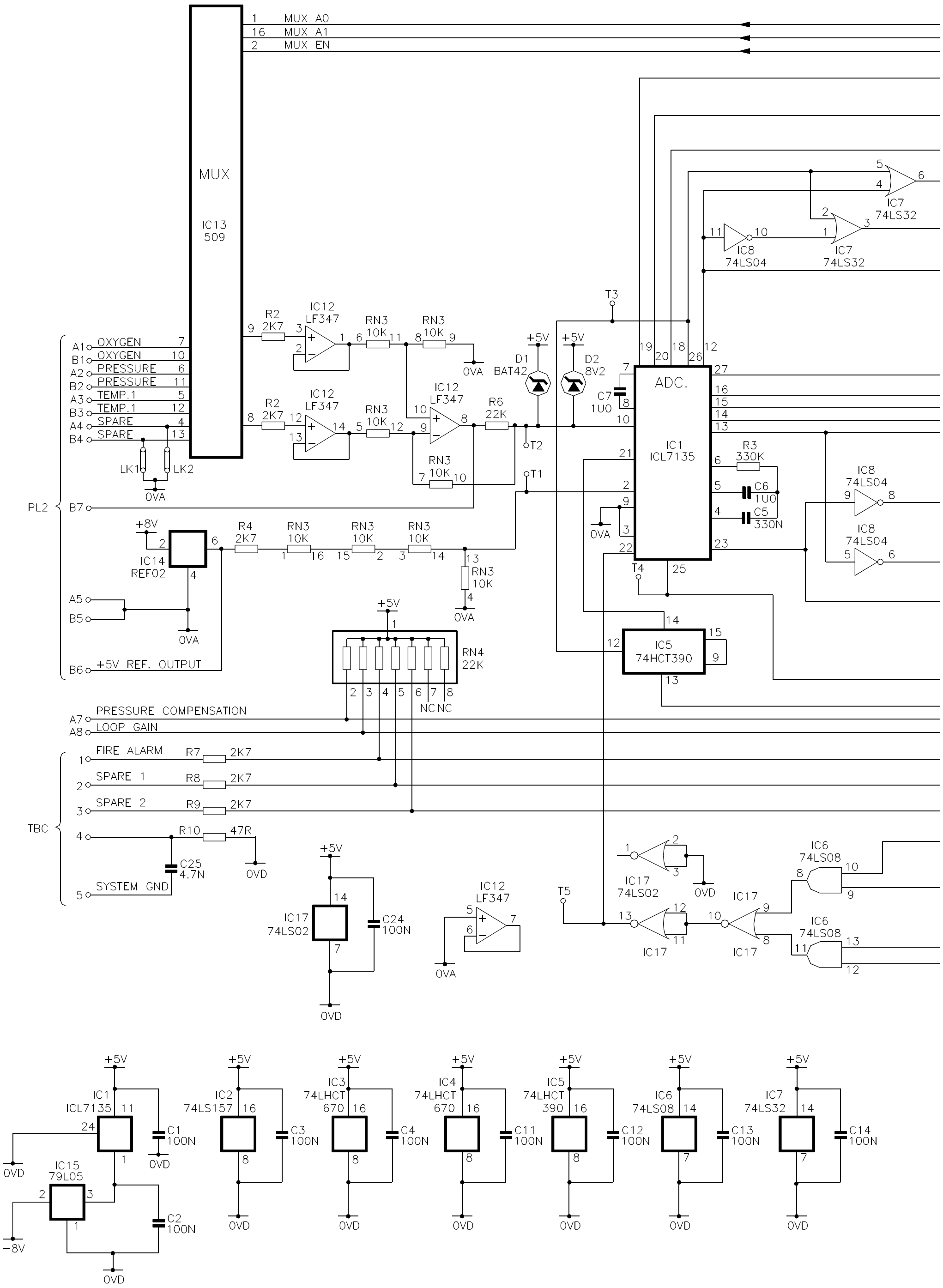


Figure 5.10 A to D Converter Board 01100916A

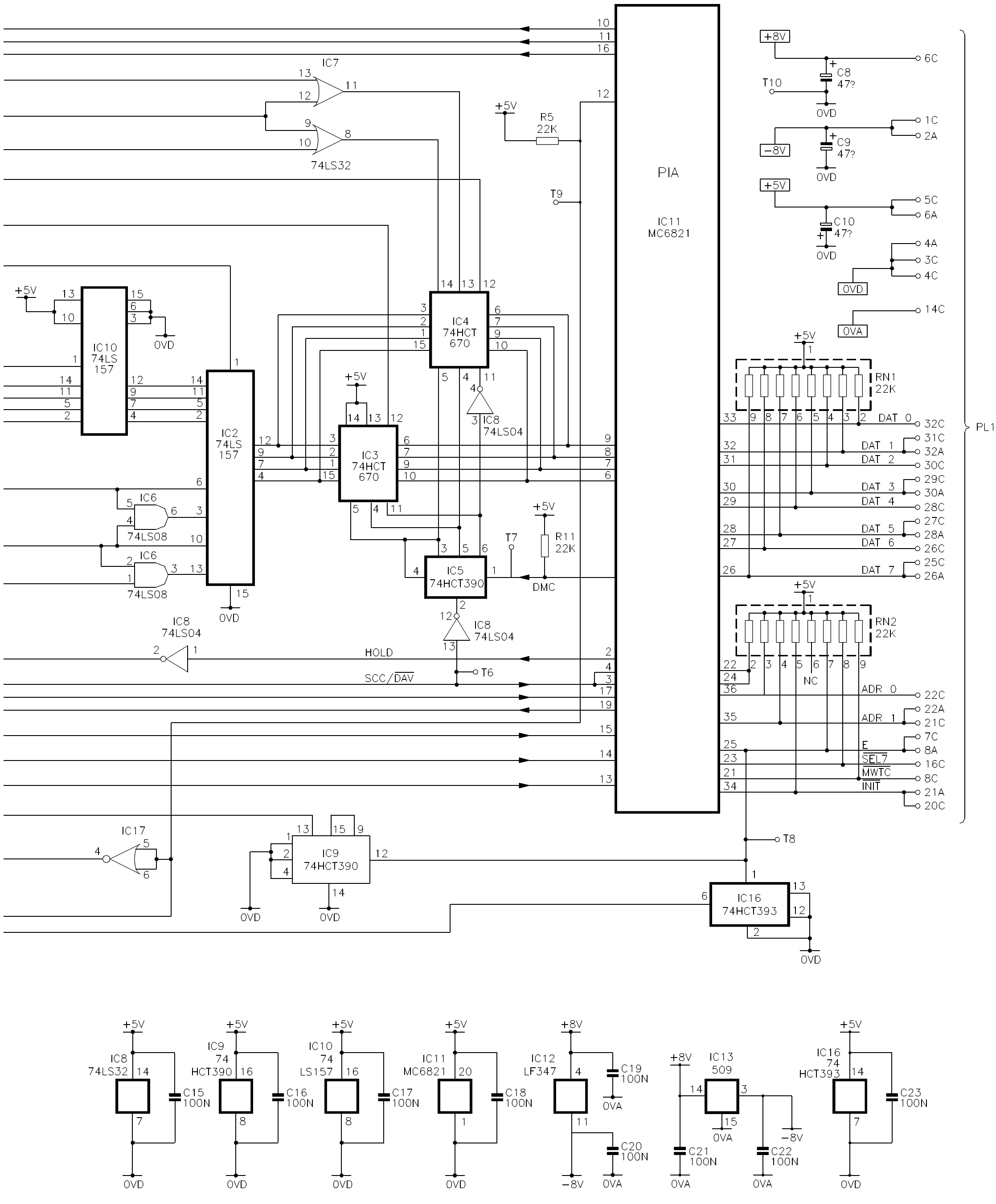


Figure 5.10   A to D Converter Board 01100916A

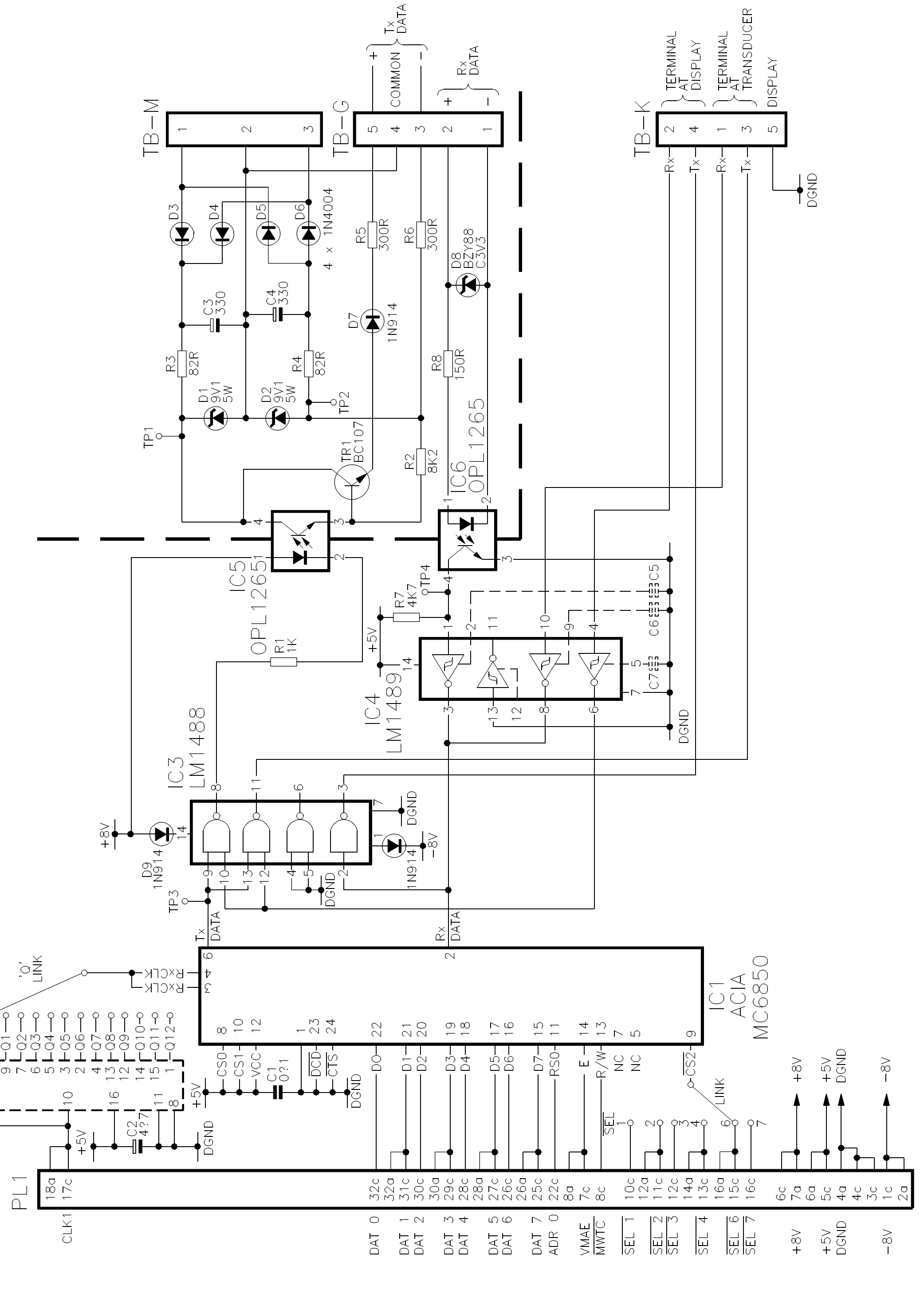


Figure 5.11 Data Communications Board 01100927

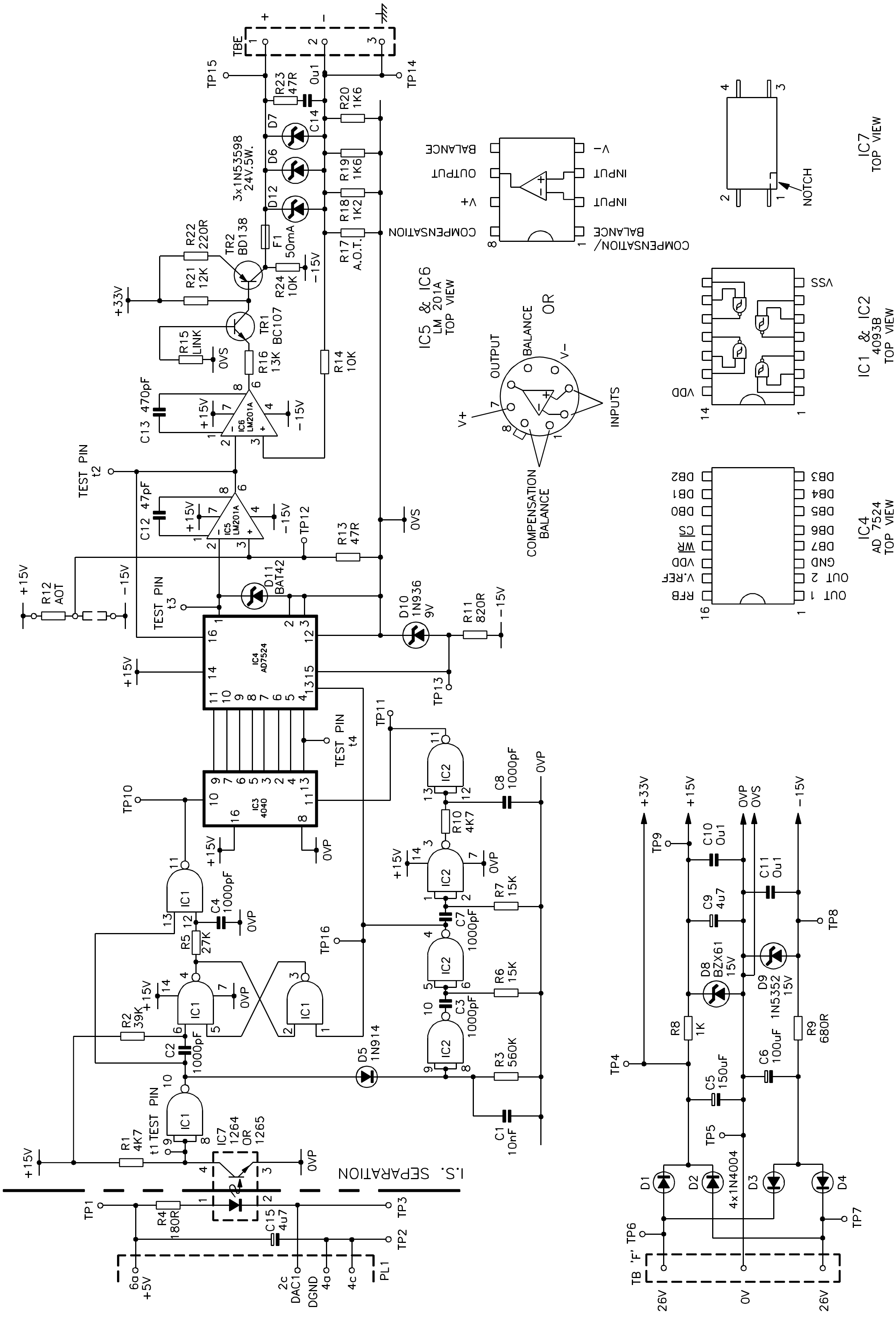


Figure 5.12 Current Output Board 01100929

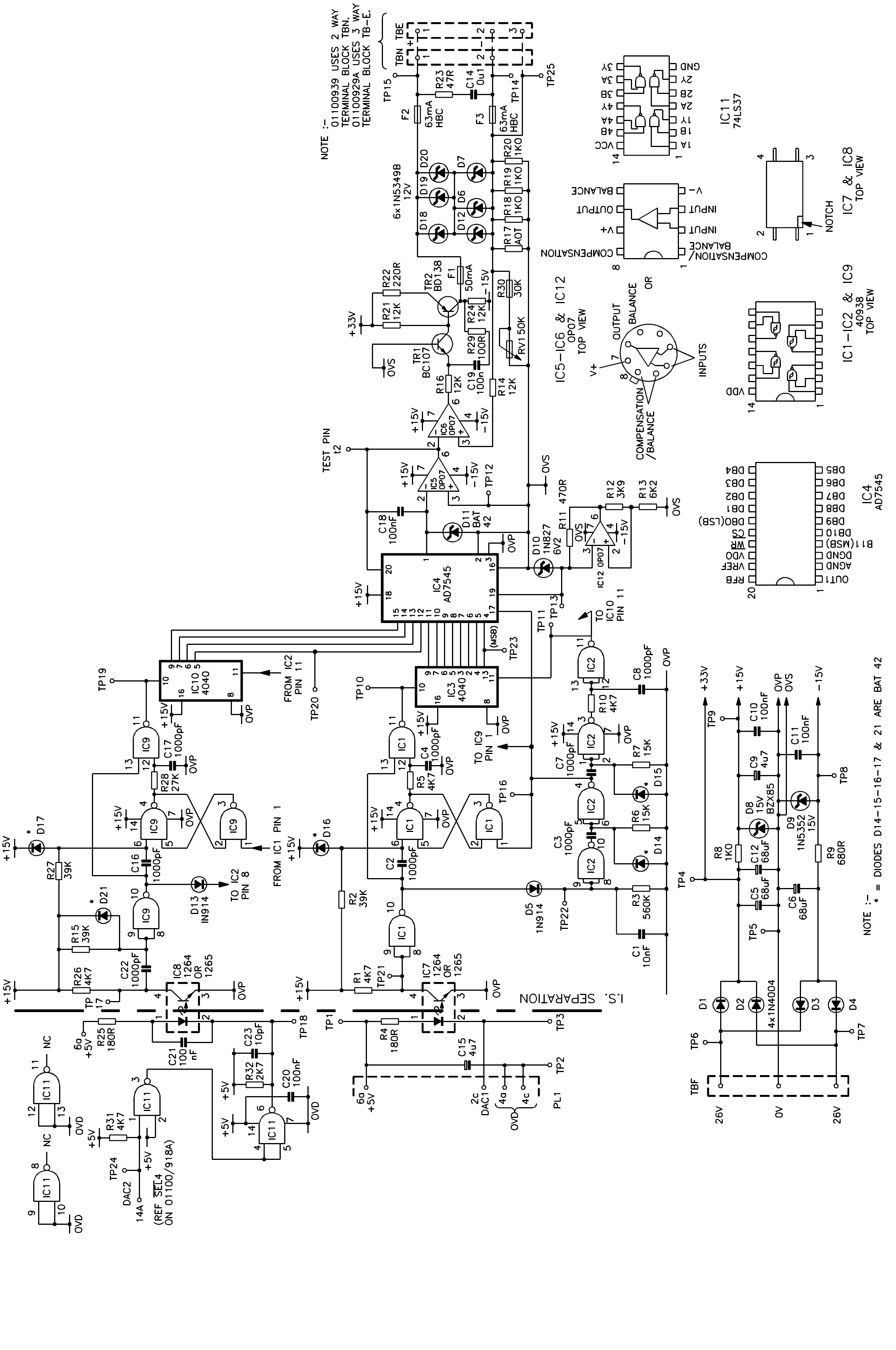
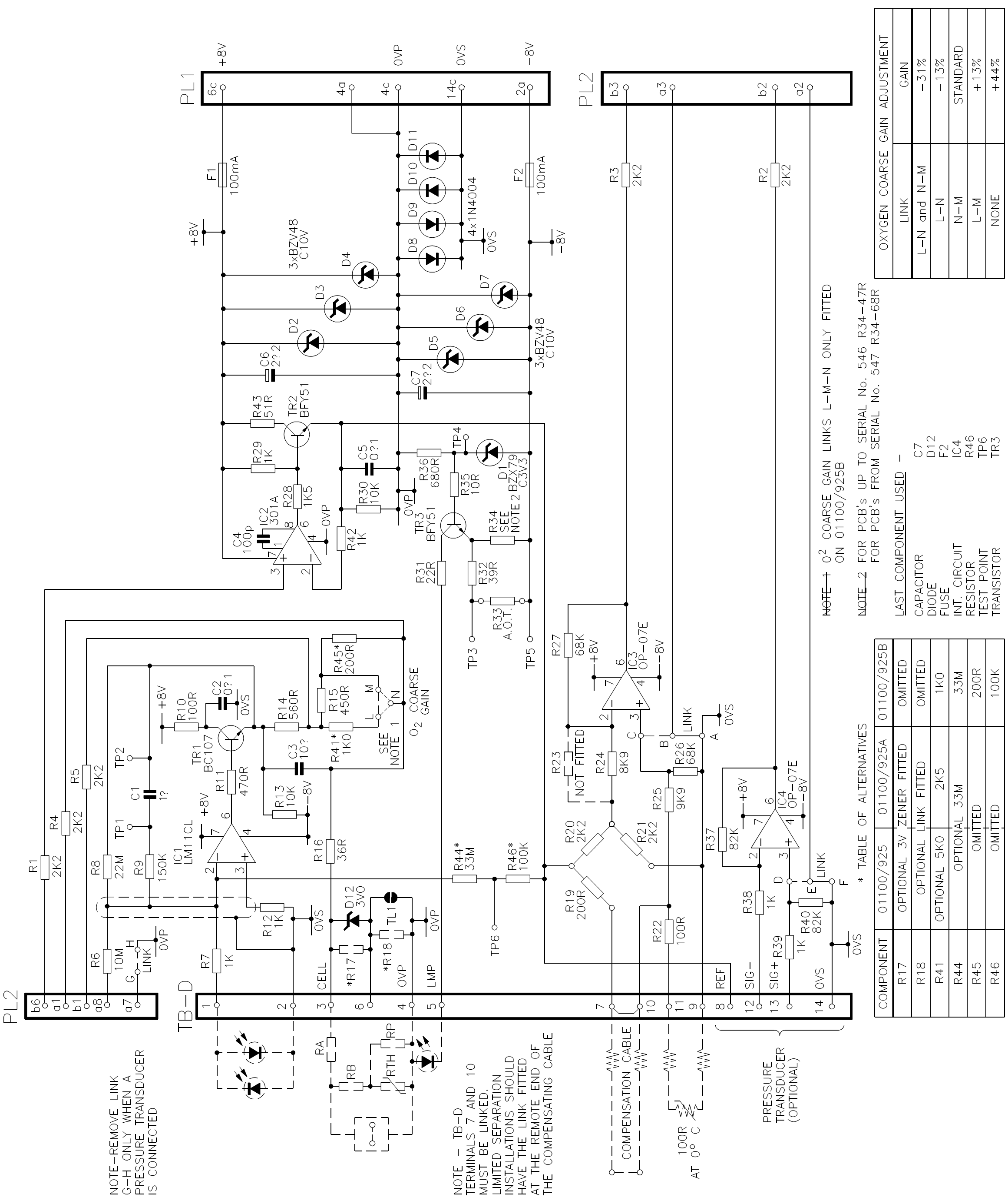


Figure 5.13 Current Output Board 01100939



* TABLE OF ALTERNATIVES

COMPONENT	01100/925	01100/925A	01100/925B
R17	OPTIONAL 3V	ZENER FITTED	OMITTED
R18	OPTIONAL	LINK FITTED	OMITTED
R41	OPTIONAL 5K0	2K5	1K0
R44	OPTIONAL	33M	33M
R45	OMITTED	OMITTED	200R
R46	OMITTED	OMITTED	100K

OXYGEN COARSE GAIN ADJUSTMENT	
LINK	GAIN
L-N and N-M	-31%
L-N	-13%
N-M	STANDARD
L-M	+13%
NONE	+44%

Figure 5.14 Amplifier Board 01100925B

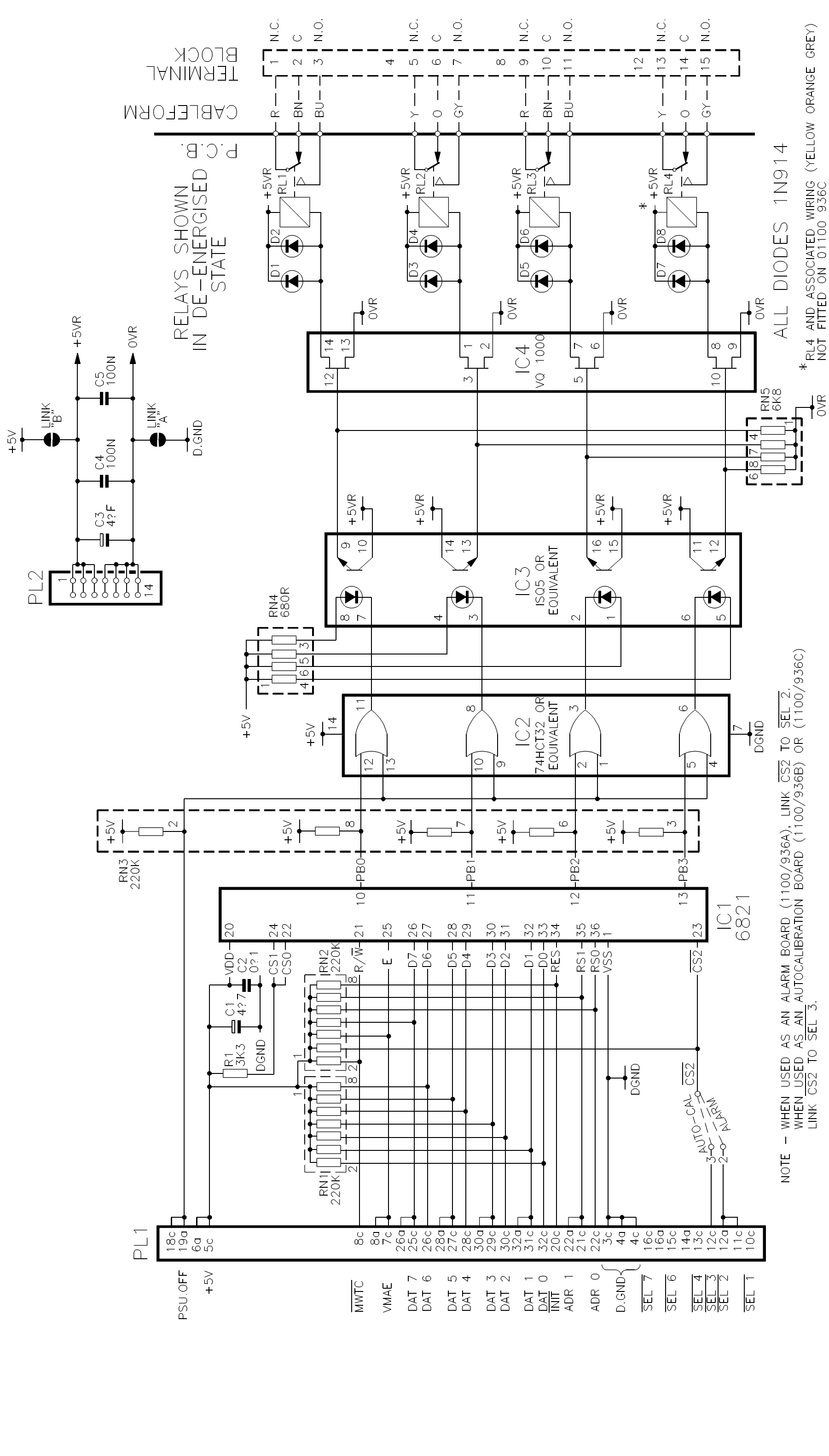


Figure 5.15 Relay Board 01100936

SECTION 6 : PARTS LISTS

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SECTION **PAGE**

NOTES

SECTION 6. PARTS LISTS

These lists are in tabular form. The headings are:

Item number - Identifies the item on the exploded view. Item numbers not illustrated are marked by an asterisk.

Description - The items are shown either as individual items or as sub-assemblies. The description is that of the item identified by the Part Number.

Part number - This is the number to quote when ordering a replacement. It describes completely the item as set out in Description.

Specify software issue number on all orders for microprocessor board 01100915 and 01100918X, where X represents A, B, C or D.

Where customised software has been supplied the Serial Number of the analyser and the initial display number (8XXXXX) which appears when the instrument is switched on must also be quoted.

Spare parts may be obtained from Servomex at one of the addresses on the back cover of this manual or from local agents.

6.1 RECOMMENDED SPARES LIST

The following is a guide. The exact number of spares which are required depends upon the reliance being placed upon the analyser and the availability of spare parts.

6.1.1 Control Unit 1101 or Interface Unit 1102

Description	Part No	Recommended Qty		
		No. of Analysers		
		1-3	4-9	10+
Fuse - heater (F2) 1A	2531-2243	4	8	10
Fuse - supply (F1) 120V 2A	2531-2476	4	8	10
Fuse - supply (F1) 240V 1A	2531-2445	4	8	10
Microprocessor board +	S1100918C or D	0	0	1
Current output board* (general)	S1100939	0	0	1
or Current output board* (i.s.)	S1100929A	0	0	1
Analogue to digital convertor **	S1100916A	0	0	1
Amplifier board **	S1100925B	0	0	1
Power supply assembly	S1100968	0	0	1
Display board* (LED only)	01101902	0	0	1
Alarm board - option	S1100936	0	0	1
Data output board - option	S1100927	0	0	1
Auto-calibration board - option	S1100936	0	0	1
LED Keypad assembly*	01101988	0	0	1

Note: Keypad assembly does not include display or display pcb (0101902).

* - Not used in the 1102 Interface unit.

** - Not used in the 1101 Control unit when an Interface unit is used.

+ - To order the microprocessor board with software refer to table 6.2.

Control Unit 1101 or Interface Unit 1102

Analyser code See Section 1.4		Control unit board	Interface unit board
01 and 21	(1100A)	01100971	-
02 and 22	(1100A)	01100971	-
03 and 23	(1100A)	01100970	01100971
04, 14 and 24	(1100A)	01100973	-
04	(1100H)	01100972	-
06, 16 and 26	(1100A)	01100970	01100973
06	(1100H)	01100970	01100972

The Data Output Board (01100927) is fitted to both the 1101 and 1102 when they are used together.

6.1.2 Transducer Unit 1131

Description	**Part No**	**Recommended Qty** No. of Analysers		
		1-3	4-9	10+
Photocells	4931-7174	1	1	2
LED assembly	01100941	1	1	2
Measuring cell (standard)	00325000 *	0	1	1
Temperature sensor	01100999	1	1	2
Seals kit (enclosure ports only)	S1131990	1	2	3
Cell connection kit	01131984	1	1	2
Thermal fuse assembly	2536-1012	1	1	2

* - or cell 00364000 (solvent resistant).

6.1.3 Transducer Unit 1132

Description	Part No	Recommended Qty		
		No. of Analysers		
		1-3	4-9	10+
Photocells	4931-7174	1	1	2
LED assembly	01191907	1	1	2
Measuring cell	00364000**	0	1	1
Temperature sensor	01100999	1	1	2
Seals kit (enclosure ports only)	S1132990	1	2	3
Cell connection kit	01132982	1	1	2
Heater cartridge (240V)	01191914	0	1	2
or Heater cartridge (110V)	01191917	0	1	2
Heat transfer assy. (135 deg C)	01132923	0	1	2

** No option is allowed.

6.1.4 Transducer Unit 1133

Description	Part No	Recommended Qty		
		No. of Analysers		
		1-3	4-9	10+
Photocells	4931-7174	1	1	2
LED assembly	01100941	1	1	2
Measuring cell (standard)	00325000 *	0	1	1
Temperature sensor	01100999	1	1	2
Seals kit (enclosure ports only)	S1131990	1	2	3
Cell connection kit	01131984	1	1	2
Inlet pipe	01131932	1	1	2
Heater cartridge	01133902	0	1	2

* or cell 00364000 (option)

6.1.5 Dry Gas Sampling System 01161000 or 01161710

Description	Part No	Recommended Qty No. of Analysers 1-3	4-9	10+
Sample flow tube and float	5981-3871	1	1	2
Bypass flow tube and float	5981-3888	1	1	2
O-Ring kit (Viton)	01161999	1	2	5
Filter element	2377-3608	5	15	25

6.1.6 Wet Gas Sampling System 01162000

Description	Part No	Recommended Qty No. of Analysers 1-3	4-9	10+
Bubbler tube	3932-1024	1	1	2
Filter Element	2377-3608	5	15	25
O-Ring kit (Viton)	01162998	1	2	5
O-Ring kit (EPDM)	01162999	1	2	5

NOTES

6.2 CONTROL AND INTERFACE UNIT PARTS LIST 1101 AND 1102

Refer to figure 6.1

Item	Description	Part No
PCB 1	Microprocessor board (See $ below)	S1100918C or S1100918D
PCB 2	Analogue to digital convertor **	S1100916A
PCB 3	Amplifier board **	S1100925B
PCB 4	Current output board (general) *	S1100939
	or Current output board (i.s.) *	S1100929A
PCB 5	Data output board - option	S1100927
PCB 6	Alarm board - option	S1100936
PCB 7	Auto-cal board - option	S1100936
4	Card frame assembly	01100940
5	Mother board	01100914A
6	Power supply unit	S1100968
7	Power Supply Board	Order item 6
8	Transformer	4961-0240
9a	Fuse F1 220/240V 1A	2531-2445
9b	100/120V 2A	2531-2476
10	Fuse F2 1A (heater)	2531-2243
11	Keypad Assembly *	01101917
13	Display board (LED only)	01101902
14	LED (8 digits required)	2553-8784

NOTE: Keypad assemblies do not include display or display PCB (01101902).

* - Not used in the 1102 Interface unit.

** - Not used in the 1101 Control unit when an Interface unit is used.

$ - Early microprocessor boards (01100915, 01100918, 01100918A and 01100918B) with software have now been superseded, refer to Section 6.7 for details of replacement parts.

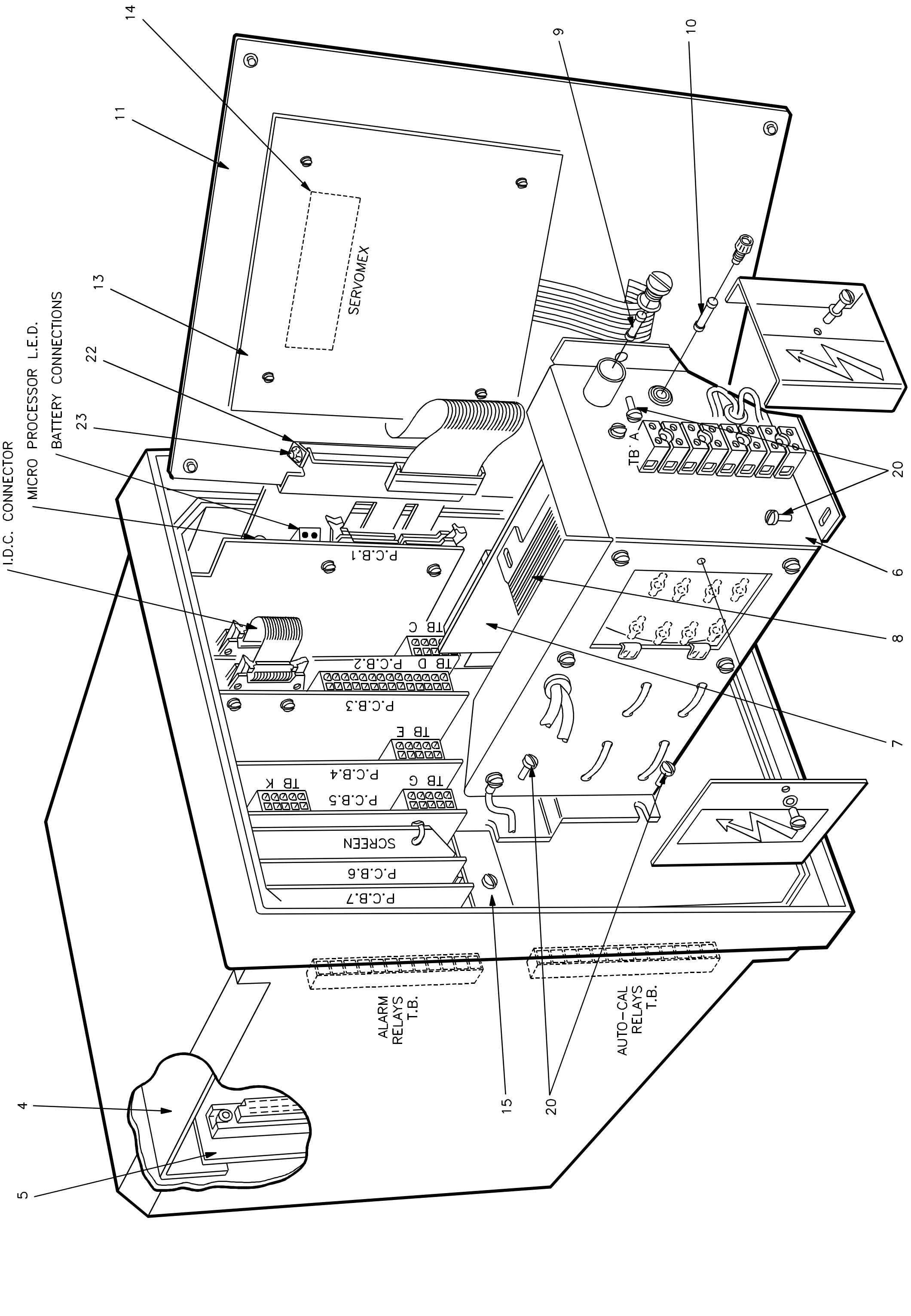

Figure 6.1 Control and Interface Unit - Exploded View
(Note: No Keypad is fitted to the interface unit)

NOTES

6.3 TRANSDUCER UNITS PARTS LIST

See Figures 6.2, 6.3, 6.4 and 6.5.

Item	Description	1131	1132	1133	
1	Inner Box - Front Assembly	01131913	01191909	01131913	1
2	Magnet Frame Assembly	S1131901	S1191911	01131931	2
3	Inner Box - Rear Assembly	01131914	01132924	01133905	3
4	Thermistor	2651-6330	2651-6330	2651-6330	4
5	LED Assembly	01100941	01191907	01100941	5
6	Photocell	4931-7174	4931-7174	4931-7174	6
7	Measuring Cell (Standard)	00325000	00364000	00325000	7
	(Option)	00364000	-	00364000	
8	Zero Adjusting Screw	00500417	00500417	00500417	8
9	Temperature Sensor Assembly	01130932	01130932	01130932	9
10	Heater/Heater Assembly	2666-2318	01191904	01133903	10
	(Option for 110V Supply - 1132 only)	-	01191917	-	
11	Heater Housing	-	01132922	01133901	11
12	Terminal Box Assembly	-	01131901	01131901	12
13	O-Ring BS006 (part of kit)	01131984	01132982	01131984	13
14	Inlet Tube (part of kit)	01131984	01132984	01131984	14
15	Outlet Tube (part of kit)	01131984	01132984	01131984	15
16	O-Ring BS006 (part of kit)	S1131990	S1132990	S1131990	16
17	Thermal Insulation	3921-5994	3921-5963	3921-5994	17
18	Seal Plate	01131436	-	01131436	18
19	Cable Form	01131934	01191913	01131934	19
21	Conduit Spacer	01131419	-	-	21
22	O-Ring BS212 (part of kit)	S1131990	S1132990	S1131990	22
23	O-Ring BS209 (part of kit)	S1131990	S1132990	S1131990	23
24	O-Ring BS210 (part of kit)	S1131990	S1132990	S1131990	24
25	Gasket (part of kit)	-	S1132990	-	25
26	Heat Transfer Interface	-	01191912	-	26
27	Conduit Spacer	01131413	01131413	01131413	27
28	Thermal Fuse Assembly Heat	2536-1012	-	-	28
	Transfer Block and Thermal Switch (1132 only)	-	01132923	-	

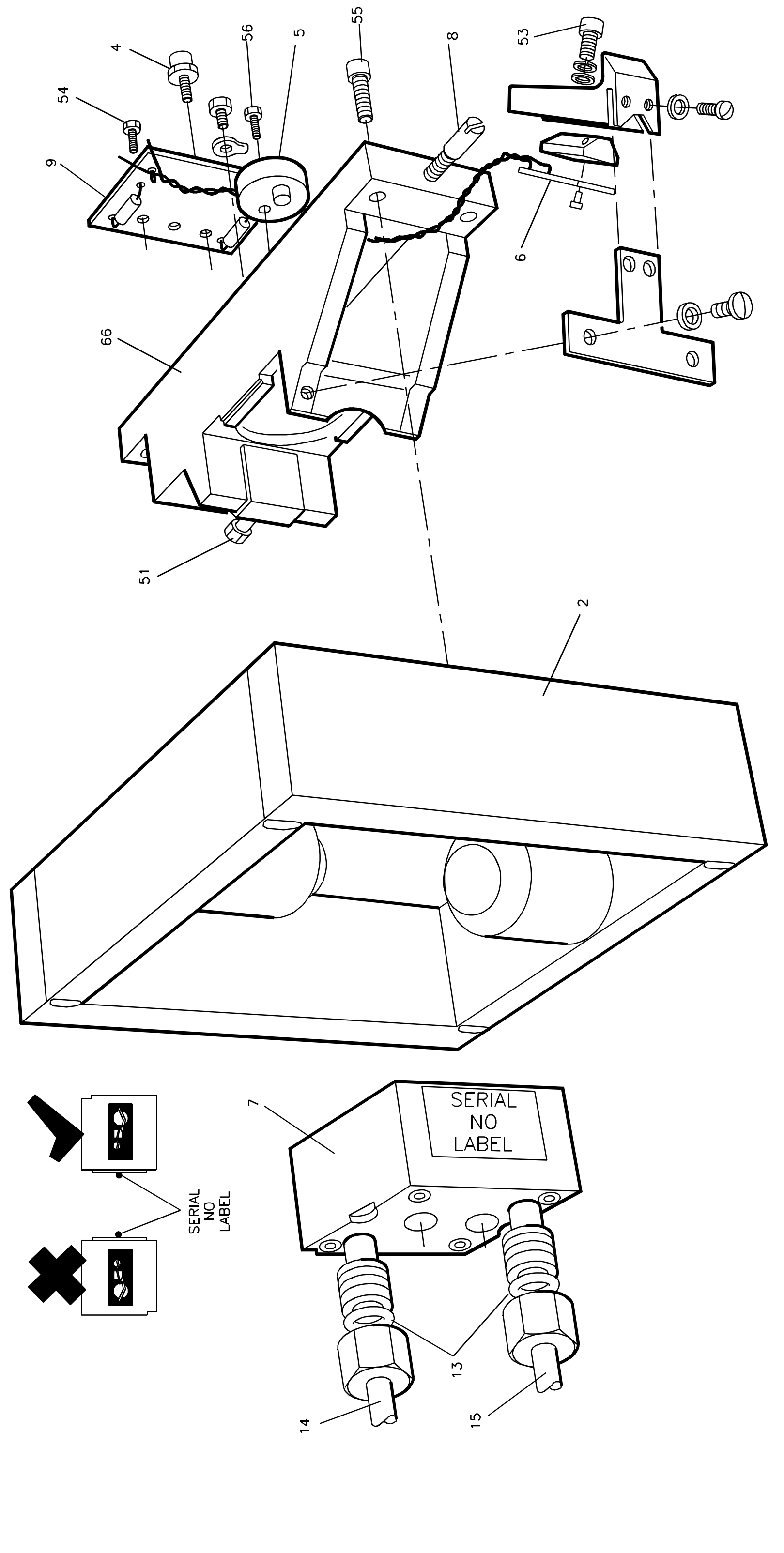

Figure 6.2 Zero Assembly and Magnet Frame

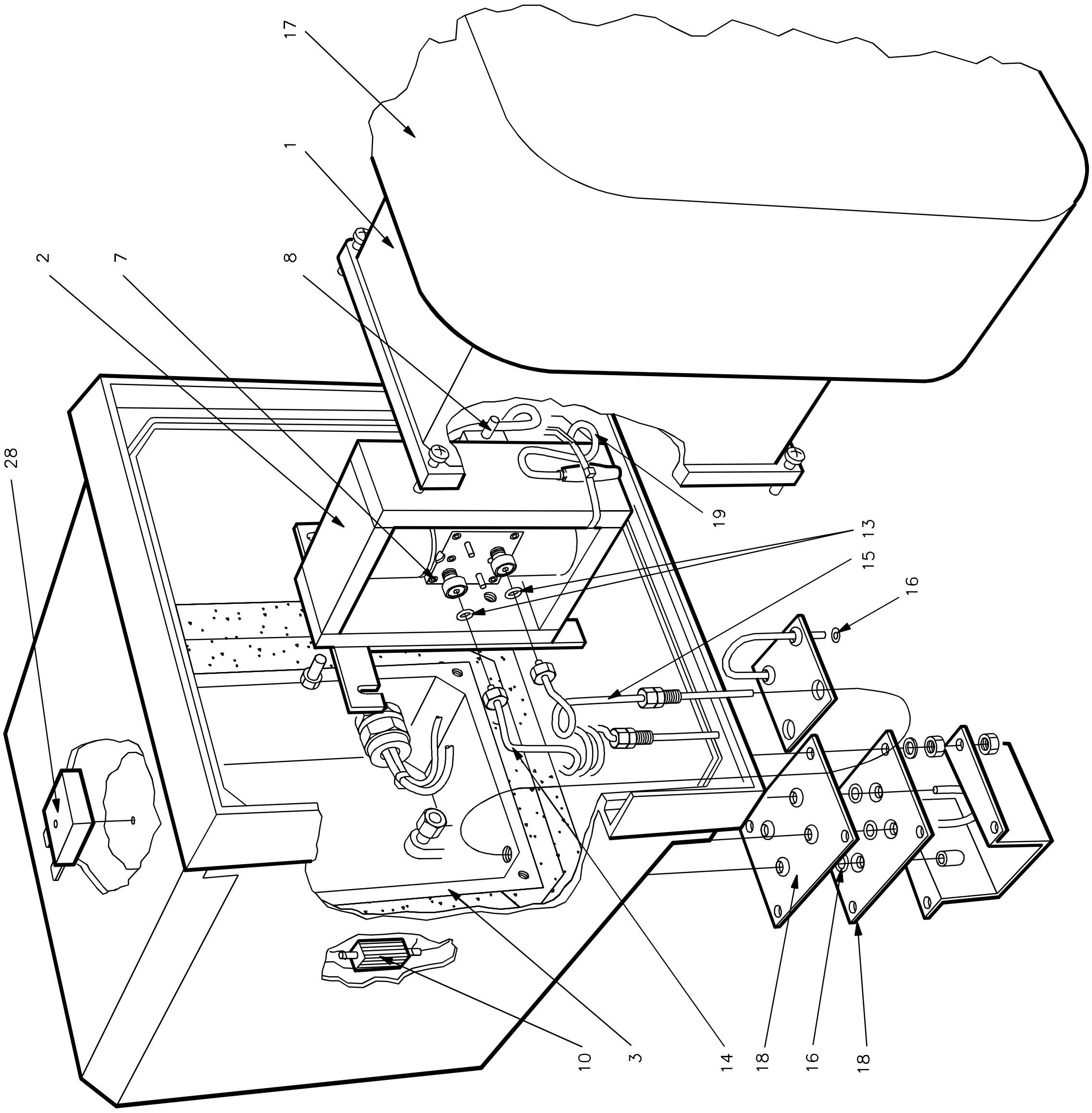
17
1
2
7
8
28
19
13
15
16
10
3
14
18
16
18

Figure 6.3 Transducer unit (1131) - Exploded View

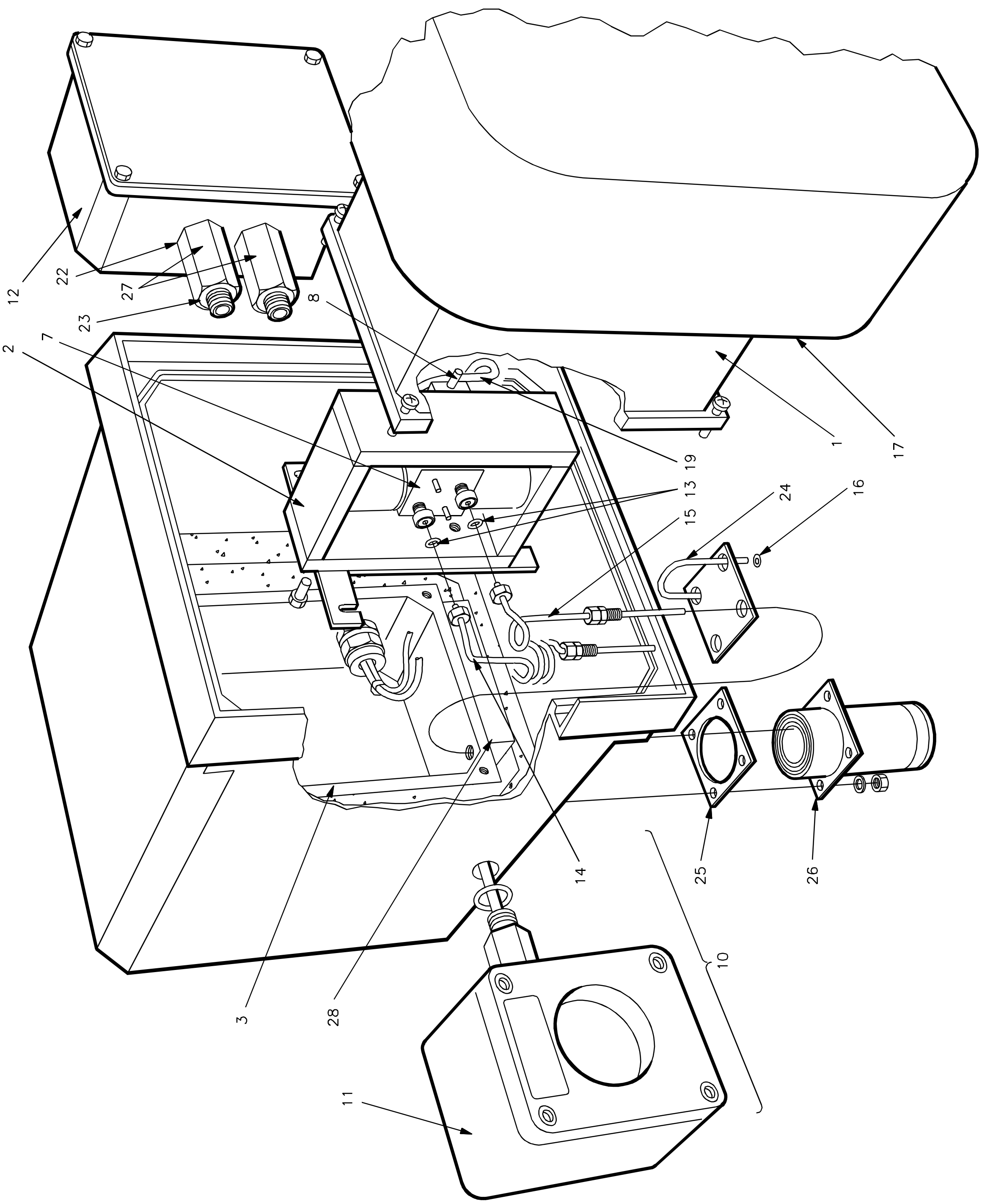

Figure 6.4 Transducer Unit (1132) - Exploded View

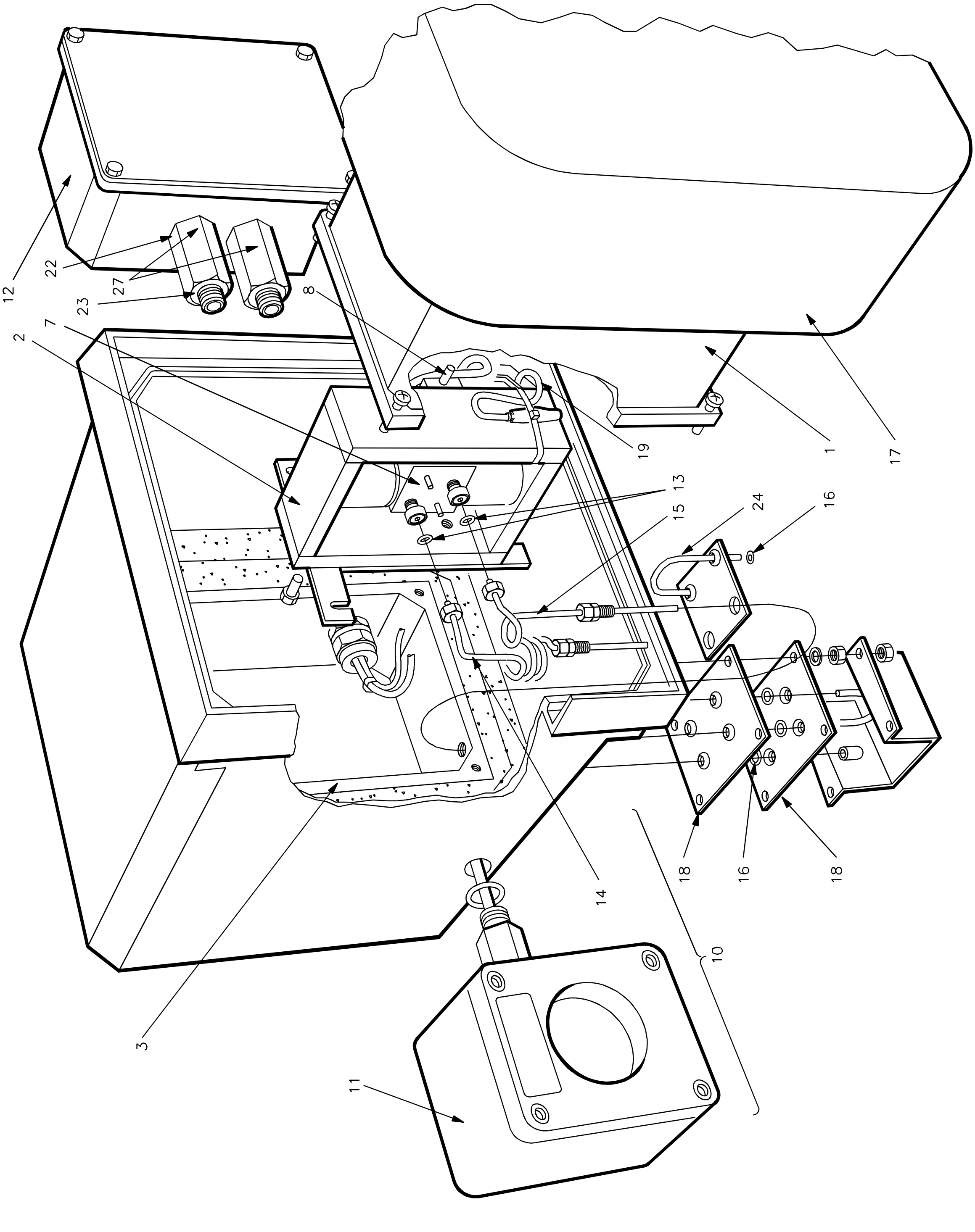

Figure 6.5 Transducer Unit (1133) - Exploded View

6.4 DRY GAS SAMPLING SYSTEMS PARTS LISTS

6.4.1 Model 01161000

Item	Description	Part No
1	Chassis flowmeter mounting	01161415
2	Tube - sample flowmeter in	01161414
3	Cell Outlet Tube	01161902
4	Cell Inlet Tube	01161903
5	Assembly - Filter block	01161904
6	Connector nut, stainless steel	00022472
7	Mounting bracket	01161416
9	Stud coupling $^1/_8$"OD x $^1/_4$" BSPP	2348-3121
16*	Sealing washer $^1/_4$" BSPP	2321-8020
17*	O-Ring BS006 Viton A	5981-0593
18	Bush	00184499A
21	Flowmeter - Sample (complete)	5981-3105
	Needle valve Assy only	5981-3840
22	Flowmeter - Bypass (complete)	5981-3112
	Needle valve Assy only	5981-3857
23	Sample flow tube and float only	5981-3871
24	Bypass flow tube and float only	5981-3888
*	O-Ring kit (Viton)	01161999
*	O-Ring kit (EPDM)	01161998

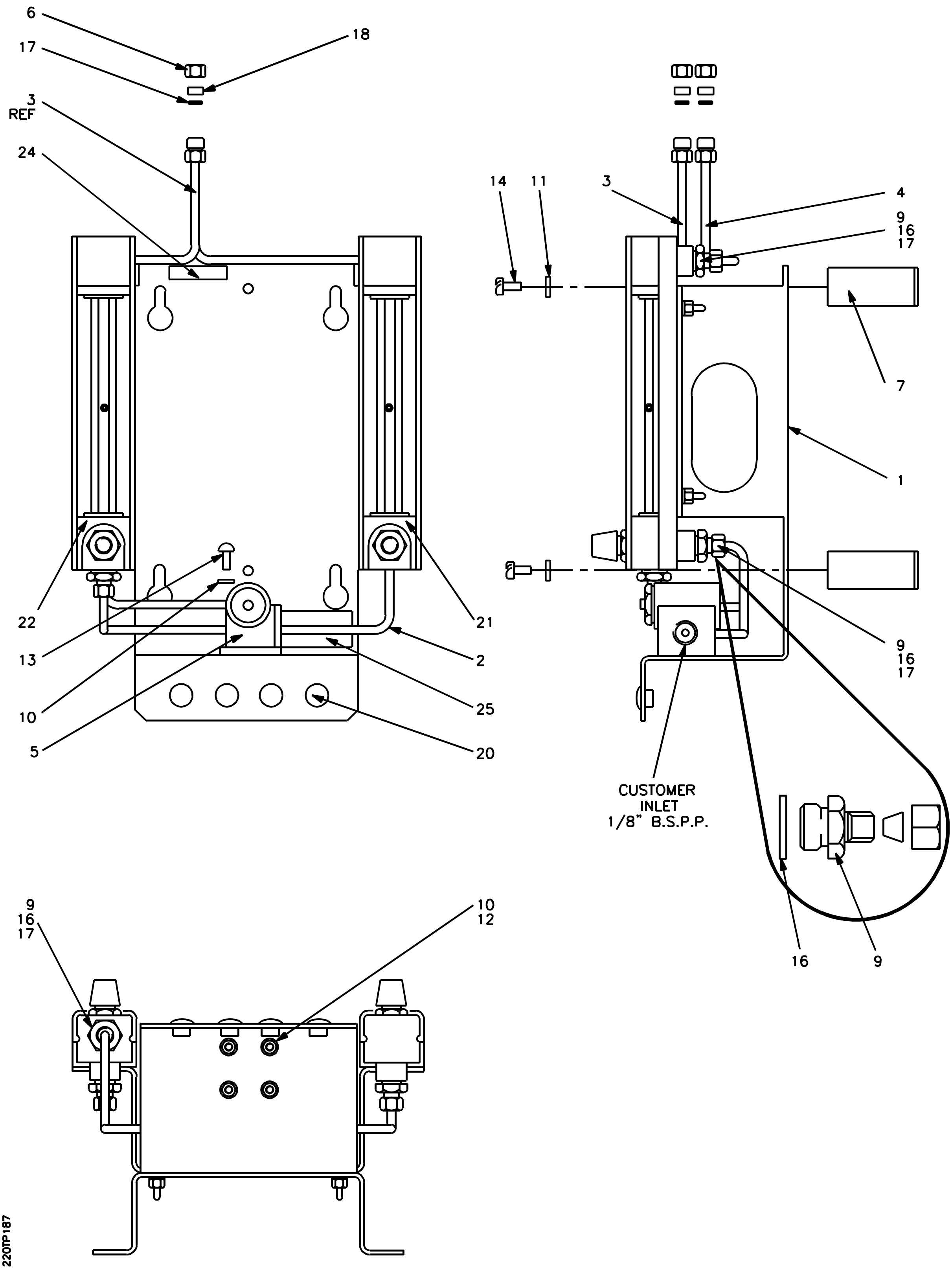

Figure 6.6 Dry Gas Sampling System 01161000

6.4.2 Filter block 01161904

Item	Description	Part No
1	O-Ring BS112 Viton A	2323-6019
2	O-Ring BS006 Viton A	5981-0593
3	Filter Element	2377-3608
4	Seal Washer PTFE 3/4" 1/D	2321-1012

* A complete set of seals for the 1161 dry gas sampling system is available, with part no 01161999 (Viton) or 01161998 (EPDM).

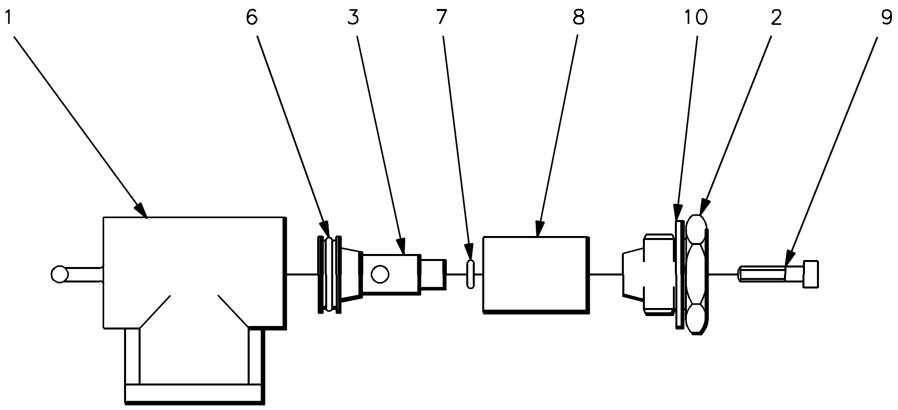

Figure 6.7 Filter Block Assembly (dry gas)

6.4.3 Flowmeter Seals Kits

Complete Sampling System Kit 01161999 (Viton) or 01161998 (EPDM).

Item	Manufacturer	
	Platon or MPB	**Techniquip** (year 2000 on)
1	BS006/BS011*	BS006/BS011*
2/3	BS013	BS014
4/5	BS611	BS4518 51-16

* denotes either type fitted depending upon bypass or sample flowmeter.

Also see appropriate spares instruction sheet 01161/998SP or 01161/999SP.

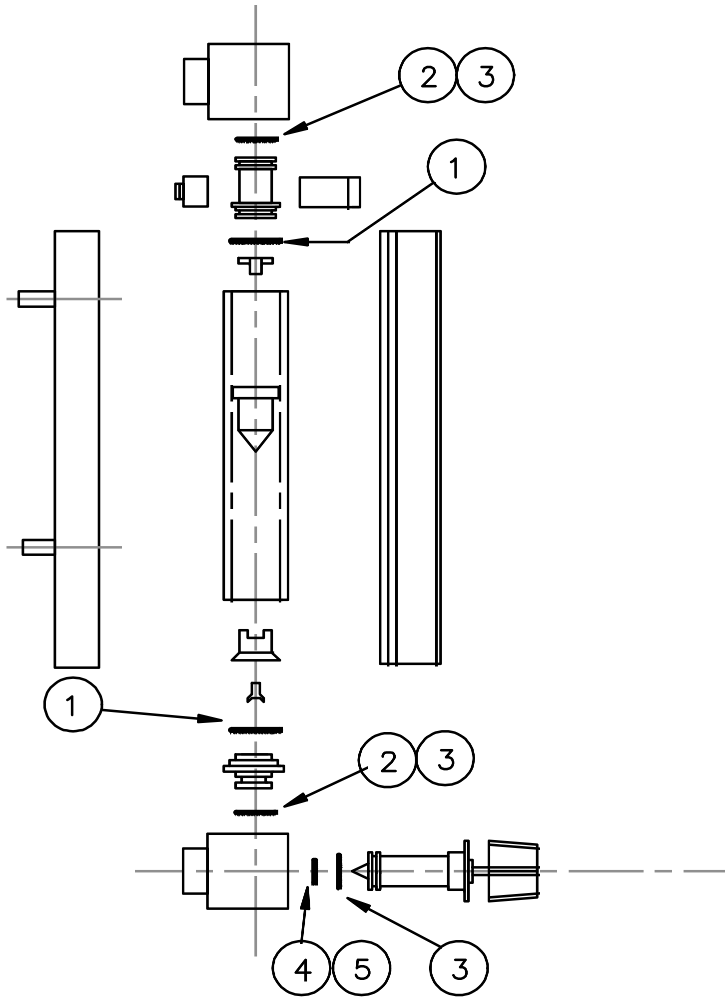

Figure 6.8
Location of Flowmeter Seals

6.5 WET GAS SAMPLING SYSTEM PARTS LISTS

6.5.1 Model 01162000

Item	Description	Part No
1	Support Bracket	01162412
2	Door	01152413
3	Bubbler - top	01162414
4	Bubbler - base	01162415
5	Modified Stud Coupling	01162421
6	Mounting Bracket	01162417
7	Collar - bubbler	00542425
8	Drain - bubbler	00542435
9	Lock Nut 1/4" BSPP stainless steel	00542428
16	Screw M12 x 14 hex hd stainless steel	01162420
20	Sealing Washer M8	2321-8082
21	Sealing Washer 1/4" BSP	2321-8020
22*	O-Ring BS112 Viton A	2323-6019
23*	O-Ring BS332 Viton A	2323-6158
24*	O-Ring BS006 Viton A	5981-0593
25	Screw M8 x 12 hex hd stainless steel	2252-4124
26	Glass tube	3932-1024
31	Access plate	01162425
33	Connector nut	00022472
34	Separator & filter/valve assembly	01162901
35	Cell exhaust pipe	01162424
36	Bush	00184499A
37	Bypass tube assembly	01162905

* A complete set of O-Rings and seals for the 1162 wet gas sampling system is available with part number 01162998 (Viton) and 01162999 (EPDM).

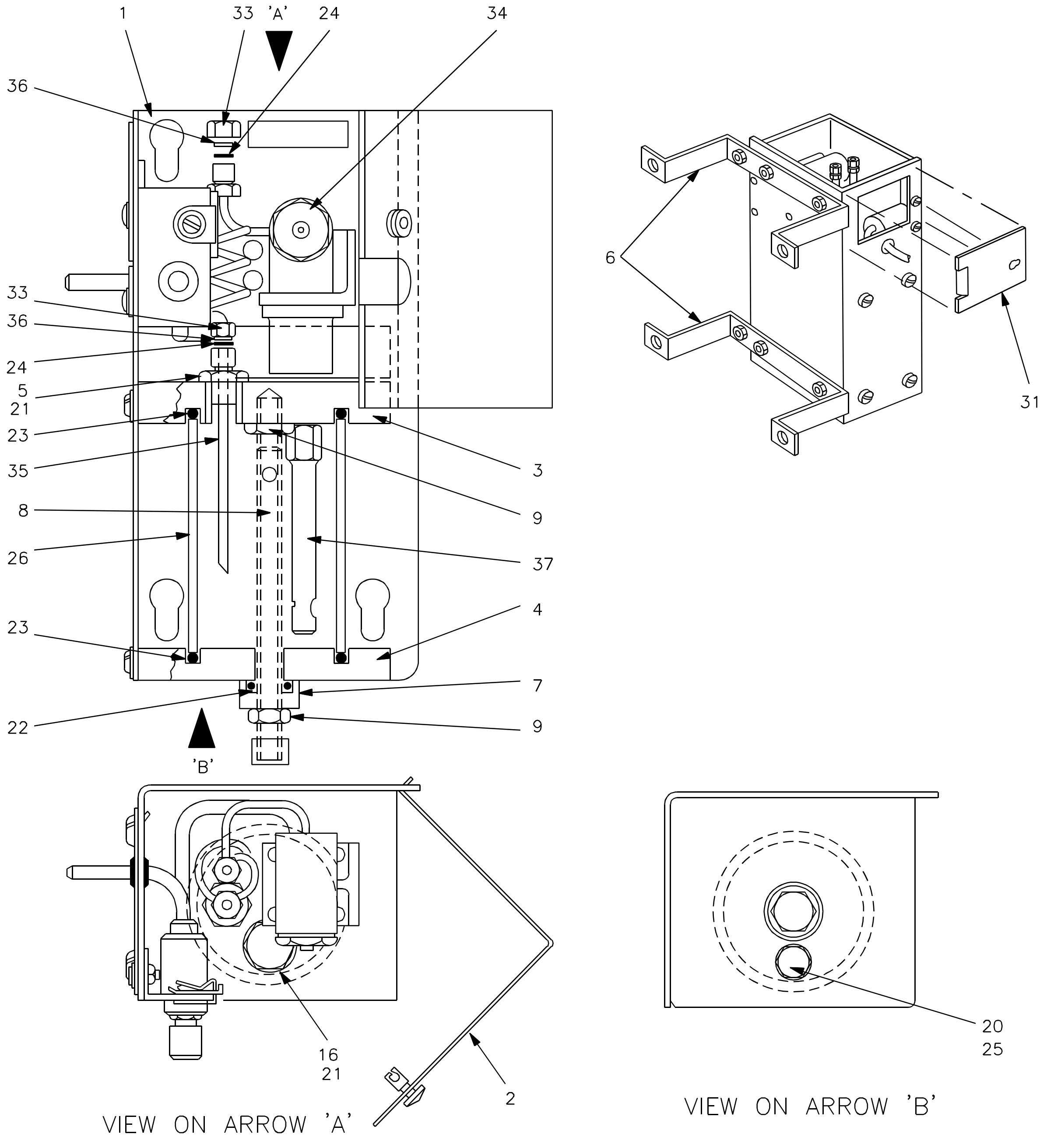

Figure 6.9 Wet Gas Sampling System Assembly 1162

6.5.2 Filter Block 01162901

Item	Description	Part No
1*	Seal Washer PTFE 3/4" I/D	2321-1012
2*	O-Ring BS006 PTFE	2323-1014
3*	O-Ring BS112 Viton A	2323-6019
4	Filter element	2377-3608
5	Cartridge valve	2372-0572

* A complete set of O-Rings and seals for the 1162 wet gas sampling system is available with part number 01162998 (Viton) and 01162999 (EPDM).

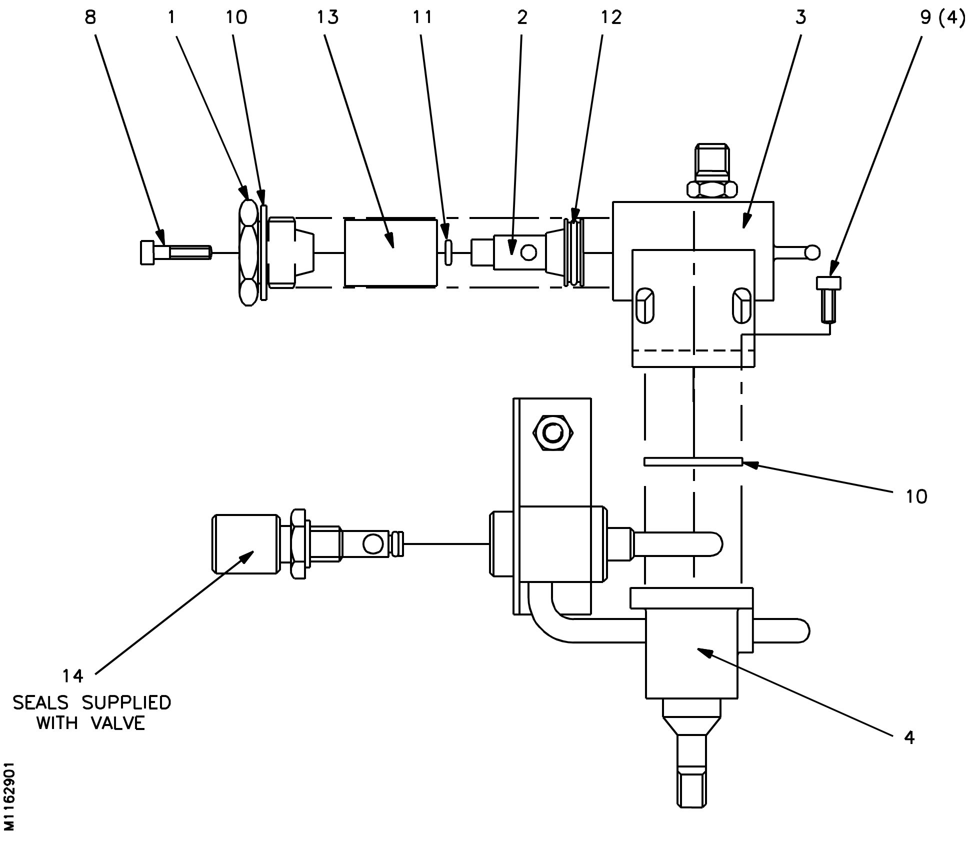

Figure 6.10 Filter Block Assembly (wet gas system)

6.6 PRESSURE COMPENSATION KIT S1100997B

Item	Description	Part No
12	Pressure transducer assembly	01100991B
23	O-Ring BS113 Viton A	2323-6057

6.7 INTERCHANGEABILITY OF BOARDS AND SOFTWARE

The following Table lists the part numbers of older printed circuit boards and the equivalent new part numbers. Fitting of the specified boards will not invalidate any safety approvals.

TABLE 6.1 EQUIVALENT PRINTED CIRCUIT BOARDS

Board Type	Previous Part Number	Current Part Number
Microprocessor	01100915 (Note1)	S1100918C
	01100918	S1100918C
	01100918A	S1100918C
	01100918B	S1100918C
	01100918D (Note 3)	S1100918D
Current Output	01100909	S1100939
	01100929	S1100929A
Analogue to Digital Converter	01100916	S1100916A
Relay	01100906	S1100936
	01100926	S1100936
Amplifier	01100905	S1100925B
	01100925	S1100925B
	01100925A (Note 2)	S1100925B
Data Output	01100907	S1100927
Power Supply Unit	01100958	S1100968

Note 1. The microprocessor board 01100915 may be replaced with 01100918, 01100918A 01100918B, 01100918C or 01100918D providing that the correct software is fitted, see Table 6.2.

Note 2. When the 01100925B is replacing an 01100925A, remove link N-M and install link L-N. This is also necessary if the uncalibrated oxygen reading is greater than the high tolerance limit for the span calibration gas.

Note 3. The 01100918D is fitted as standard to ISSEP INIEX purged units, and MUST be replaced with an S1100918D only.

TABLE 6.2 SOFTWARE COMPATIBILITY WITH MICROPROCESSOR BOARDS

Software issue	Microprocessor board			
	01100915	**01100918**	**S1100918A**	**S1100918B S1100918C S1100918D**
01100923	Yes	No	No	No
01100651	Yes	No	No	No
0110066X	Yes	Yes	Yes	Yes
0110067X	Yes	Yes	Yes	Yes
0110068X	No	No	No	Yes

X represents 0, 1, 2 or 3.

Note: 12 bit resolution on the 4 to 20mA analogue output will only be obtained if software 0110067X or 0110068X with microprocessor board 01100918A, 01100918B, 01100918C or 01100918D and output board 01100929A or 01100939 are fitted.

APPENDICES

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Appendix 1

SAFETY CERTIFICATION

APPENDIX 1. SAFETY CERTIFICATION

The 1100A and 1100H analysers have been approved by various authorities for installation in hazardous areas. The certification offered with a specific analyser will depend upon specification and country of delivery. See the certification labels attached to the analyser for exact approval details. The following information summarises the approvals that have been obtained.

If the analyser is installed in a hazardous area then electrical power and other connecting cables should be installed and protected according to conditions on the relevant certificates, national wiring regulations, hazardous area codes of practice and local authority regulations.

Analysers built to CENELEC standards also comply with the Swiss and Japanese standards.

Copies of approval certificates can be seen in the suppliment to this manual - part number 01100008A.

1. BRITISH STANDARDS

Control and Interface units (1101 and 1102)

Code: EEx N [ia] IIC T5 (Tamb = 50^0C)
to BS 5501: part 7: 1977 (EN50 020)
BS 4683: part 3: 1972
SM 4683/3: 1980 Certificate No. Ex 84392X

Transducer unit (1131)

Code: EEx ia N IIC T5 (Tamb = 50^0C) and hydrogen/oxygen mixtures.
to BS 5501: part 7: 1977 (EN50 020)
BS 4683: part 3: 1972
SM 4683/3: 1980 Certificate No. Ex 84390X

Transducer unit (1132 and 1133)

Code: EEx ia d IIC T3 (Tamb = 50^0C) and hydrogen/oxygen mixtures.
to BS 5501: parts 5 and 7 (EN50 018 and EN50 020)
Certificate No. Ex 84389X for model 1133 Certificate No. Ex 84389X/1 for model 1132

Systems certification:

Code: Ex ia IIC
to SFA 3012: 1972 Certificate No. Ex 84394

Power Supply Filter Unit

Code Ex N II T4
to BS 4683 : part 3 1972 and SM 4683/3 : 1980 Certificate No. 85238X

2. CENELEC STANDARDS

Control and Interface units (1101 and 1102)

Code: [EEx ia] IIC
to EN50 014 (1977)
EN50 020 (1977) Certificate No. Ex 84B2391X

Transducer unit (1132 and 1133)

Code: EEx ia d IIC T3 (Tamb = 50 deg C)
to EN50 014 (1977)
EN50 018 (1977)
EN50 020 (1977)
Certificate No. Ex 84B2388 for model 1133 Certificate No. Ex 84B2388/1 for model 1132

The Control (or Interface) unit may be purged to allow installation in a Zone 1 area.

Code: EEx p d e (ia) IIC T5
to EN50 014 (1977)
EN50 016 (1977)
EN50 018 (1977)
EN50 019 (1977)
EN50 020 (1977) Certificate No. 88B, 105, 050X

INIEX
Systems certification

System Code : EEx ia II C
to EN 50 039 (1982) Certificate No. Ex 842393

3. AMERICAN (F.M.) APPROVALS

Approval Numbers : 1J3A6.AX, 0M0A9.AX and Revision 3T2A9.AX

Control and Interface units (1101 and 1102)

Approved by F.M. to the following standards:

FM 3610 - 1988
FM 3611 - 1986

Approved as non-incendive for Class I, Division 2, Groups B, C and D; suitable for Class II, Division 2, Group G hazardous locations.

When used with the 1133 Transducer unit they have intrinsically safe connections for Class I, Division 1, Groups B, C and D hazardous locations. Installation must be in accordance with drawing 1100/898.

Transducer unit (1131)

Approved by F.M. to the following standards:

FM 3611 - 1986

Approved as non-incendive for Class I, Division 2, Groups B, C and D; suitable for Class II, Division 2, Group G hazardous locations.

Transducer unit (1132 and 1133)

Approved by F.M. to the following standards:

FM 3610 - 1988
FM 3615 - 1985

Approved as suitable for Class 1, Division 1, Groups B, C and D hazardous locations - temperature rating T3. Installation must be in accordance with drawing 1100/898.

4. SWISS APPROVALS

The Eidgenossiches Starkstrominspektorat have recognised the certification to CENELEC standards for the 1101 Control unit and 1132 and 1133 Transducer units.

Certificate No. 86, 1 14487, 03.

5. JAPANESE APPROVALS

The Ministry of Labour have approved the 1133 Transducer unit for Division 1 application.

Certificate No. 39568.

6. CANADIAN (CSA) APPROVALS

C.S.A have approved the 1100A (architecture codes 14 and 16) to the following standards:

C22.2 No 0-M
C22.2 No 0.4-M
C22.2 No 94
C22.2 No 142-M
C22.2 No 157-M
C22.2 No 213-M

Installation must be in accordance with drawing 01100/898 CSA.

Appendix 2

ORDERING INFORMATION

1100A Ordering Information

Select type of hazardous area safety certification by three character code. Select options from that column only.
Where a blank appears it indicates that option is not available

Industrial Oxygen Analyser 01100A — Issue No. 7 — Certification

Feature	Option	Safe area/General purpose (GEN)	BASEEFA Zone 2 (UK2)	CENELEC Zone 1 (EUR)	FM Division 2 (FM2)	FM Division 1 (FM1)	CSA (CSA)
F1 Architecture	Close Coupled	01	01		21		
	Limited separation	02	02	04	22	24	14
	Maximum separation	03	03	06	23	26	16
F2 Supply Voltage	100V	01	01	01	01	01	01
	110V	02	02	02	02	02	02
	117V	03	03	03	03	03	03
	220V	04	04	04	04	04	04
	240V	05	05	05	05	05	05
F3 Sample System	None	0	0	0	0	0	0
	Dry gas stainless steel – 1161	1	1	1	1	1	1
	Wet gas – 1162	3	3	3	3	3	3
	Dry gas stainless steel & flow alarm	4					
F4 Mounting	Close coupled surface mounting	1	1		1		
	Separated–Control Unit surface mounting	2	2	2	2	2	2
	Separated–Control Unit flush panel mounting	3	3	3	3	3	3
	Separated–Control Unit 19 inch rack mounting	4	4	4	4	4	4
F5 Alarm Relay Board	None	0	0	0	0	0	0
	4 x single pole change over relays (SPDT)	1	1	1	1	1	1
F6 Digital Output	None	0	0	0	0	0	0
	Digital output board — See Note 1	1	1	1	1		1
F7 Auto Calibration	None	0	0	0	0	0	0
	Autocalibration board — See Note 2	1	1	1	1		1
F8 Pressure Compensation	No pressure compensation	1	1	1	1	1	1
	Process pressure compensation — See Note 3	2	2	2	2	2	2
F9 Measuring cell	Standard cell – 325	0	0	0	0	0	0
	Solvent resistant – 364	2	2	2	2	2	2
F10 Corrosive Purge	None	0	0	0	0	0	0
	Corrosive sample purge	1	1	1	1	1	1
F11 Interconnecting Cable	None	0	0	0	0	0	0
	10m Zone 2 including glands	1	1		1	1	
	30m Zone 2 including glands	2	2		2	2	
	Gland kit – Specify cable length [ ] m	3	3				
F12 Customer Default Values	None	0	0	0	0	0	0
	Customer defined defaults	1	1	1	1	1	1
F13 Electrical Supply Filter	None	0	0	0	0	0	0
	Supply filter	1	1	1	1	1	1
F14 Analogue Output	Standard 0/4–20mA	0	0	0	0	0	
	Intrinsically safe 0/4–20mA	1	1	1	1		1

Ordering code: 0 1 1 0 0 A — 7 — [ ][ ][ ] — [F1][F2][F3][F4][F5][F6][F7][F8][F9][F10][F11][F12][F13][F14]

Model Number — Certification (Insert 3–character code from right–hand column e.g .EUR) — Feature Numbers F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 (Select the option required and write number in the appropriate box to give complete ordering code)

Notes:

Note 1 Digital output (voltage only) is standard with analyser architectures (F1) 03.06.23.26 and 16. Specify option 0

Note 2 Solenoid valves are not supplied. Auto calibration is not available if a wet gas sample system is fitted.

Note 3 A dry gas sampling system should be specified. Transducer Control (or Interface) unit separation should not exceed 30m.

1100H Ordering Information

Select type of hazardous area safety certification by three character code. Select options from that column. Where a blank appears it indicates that option is not available

Industrial Oxygen Analyser 01100H

Issue No. 3

Certification

Feature	Option	Safe area/General purpose GEN	CENELEC Zone 1 EUR	FM Division 1 FM1
F1 Architecture	Limited separation	04	04	24
	Maximum separation	04	04	26
F2 Supply Voltage	100V	01	01	01
	110V	02	02	02
	117V	03	03	03
	220V	04	04	04
	240V	05	05	05
F3 Sample System	None	0	0	0
	Refer to Servomex for details of sampling systems for the 1100H			
F4 Mounting	Separated–Control Unit surface mounting	2	2	2
	Separated–Control Unit flush panel mounting	3	3	3
	Separated–Control Unit 19 inch rack mounting	4	4	4
F5 Alarm Relay Board	None	0	0	0
	4 x single pole change over relays (SPDT)	1	1	1
F6 Digital Output	None	0	0	0
	Digital output board See Note 1	1	1	1
F7 Auto Calibration	None	0	0	0
	Autocalibration board See Note 2	1	1	1
F8 Interconnecting Cable	None	0	0	0
	10m Zone 2 including glands	1		
	30m Zone 2 including glands	2		
	Gland kit–Specify cable length [ ] m	3		
F9 Customer Default Values	None	0	0	0
	Customer defined defaults	1	1	1
F10 Electrical Supply Filter	None	0	0	0
	Supply filter	1	1	1
F11 Analog Output	Standard 0/4–20mA	0	0	0
	Intrinsically safe 0/4–20mA	1	1	
F12 Pressure Compensation	No Pressure Comp.			0
	Process Pressure Comp.			1

Feature Numbers

0	1	1	0	0	H	—	3	—	Certification [ ][ ][ ]	—	F1 [ ]	F2 [ ]	F3 [ ]	F4 [ ]	F5 [ ]	F6 [ ]	F7 [ ]	F8 [ ]	F9 [ ]	F10 [ ]	F11 [ ]	F12 [ ]

Model Number

Certification: Insert 3–character code from right–hand column e.g .EUR

Select the option required and write number in the appropriate box to give complete ordering code

Notes:

Note 1 Digital output (voltage only) is standard with analyser architecture (F1) 06. Specify option 0

Note 2 Solenoid valves are not supplied.

NOTES

Appendix 3

PARAMETER LISTING

Parameter Code No.	Equivalent Entry	Defaults/ Start-Up Value	Unit	Customer Entered Value	Description	Enterable Range of Values	Recommended Range
05	Asymptote Timer	15	secs		Time delay between checks during stabilisation time	2 to 100.00	5.0 to 20.0
11‡	Range Lo	0.00	% O_2		Analogue output - zero offset	-10 to 149.00	0.00 to +99.00
12	Range Hi	100.00	% O_2	* §	Analogue output - zero offset + span range		
13		4.00			Current output - 0 for 0-20mA, -0 for 20-0mA - 4 for 4-20mA, -4 for 20-4mA	-4, -0, 0, 4	-4, -0, 0, 4
14		Variable	% O_2	*	Uncorrected oxygen input (transducer signal)		
15		Variable	% O_2	*	Pressure input		
17		Variable	°C	*	Cell temperature		
18‡	Range Span	100.00	% O_2		Span range of analogue output	1, 2, 2.5, 4, 5, 10, 20, 25, 40, 50 and 100%	1, 2, 2.5, 4, 5, 10, 20, 25, 40, 50 and 100%
19		Variable	% O_2	*	Calibrated oxygen reading (not compensated)		
21		0.00	% O_2		Relay 1 of alarm board B #	0 to 163.80	0.40, 0.41, 0.42, 0.43, 0.45, 0.46,
22		0.00			Relay 2 of alarm board # C (if fitted)	0 to 163.80	0.63, 0.64, 0.65, 0.66, 0.67, 0.68,
23		0.00			Relay 3 of alarm board # #	0 to 163.80	0.92, 0.93 (and 0.62 on max, separated versions)
24		0.67			Relay 4 of alarm board D	0 to 163.80	0.67 is allocated as standard to Relay 4.
25			secs	*	Zero to span gas DV lag B		
26			mins	*	Span gas stabilisation time # Actual times		
27		Variable	secs	*	Span to zero gas DV lag C measured during		
28			mins	*	Zero gas stabilisation time # last auto-calibration		
29			secs	*	Zero to sample gas DV lag # sequence		
30			mins	*	Sample gas stabilisation time D		
31		0.00		*	Allocatio.n of alarms to Relay 1 - dependent on code 21		
32		0.00		*	Allocation of alarms to Relay 2 - dependent on code 22		
33		0.00		*	Allocation of alarms to Relay 3 - dependent on code 23		
34		0.67		*	Allocation of alarms to Relay 4 - dependent on code 24		

* Cannot be user set.

§ Is dependent upon codes 11 and 18.

‡ Parameter 11 plus Parameter 18 must not exceed 199.99.

Parameter Code No.	Equivalent Entry	Defaults/ Start-Up Value	Unit	Customer Entered Value	Description	Enterable Range of Values	Recommended Range
40	Alarm Lo Lo	-10.00	% O_2		Lo Lo oxygen alarm level	-10.00 to 163.80	-10.00 to 100.00
41	Alarm Lo	-10.00	% O_2		Lo oxygen alarm level	-10.00 to 163.80	-10.00 to 100.00
42	Alarm Hi	150.00	% O_2		Hi oxygen alarm level	0 to 163.80	0 to 150.00
43	Alarm Hi Hi	150.00	% O_2		Hi Hi oxygen alarm level	0 to 163.80	0 to 150.00
44		4.00			Alarm display and reset. 0 for current alarms 4 for cancel alarms	0 or 4	0 or 4.00
45		4.00			Analogue output freeze during 0 - freeze Auto Cal/Check and loop gain @8 4 - live	B C 0 or 4 D	0 or 4.00
46		0.46			Start auto-calibration/auto-check		0 to initiate auto-cal
47		0.00	days		Auto-calibration period	0 to 163.80 in 0.1 increments	0 to 163.80
48		0.00		*	Auto-cal error status - dependent on code 46		
49		90.00	secs		Zero to span gas DV lag B	0 to 163.80	5 to 163.80
50		90.00	secs		Zero to span 90% response time #	0 to 163.80	5 to 163.80
51		5.0	mins		Span gas stabilisation time # Parameters for	0 to 15.00	1 to 10.0
52		90.00	secs		Span to zero gas DV lag # setting the	0 to 163.80	5 to 163.80
53		90.00	secs		Span to zero 90% response time C maximum time	0 to 163.80	5 to 163.80
54		5.0	mins		Zero gas stabilisation time # that any event	0 to 15.00	1 to 10.0
55		90.00	secs		Zero to sample gas DV lag # during the	0 to 163.80	5 to 163.80
56		90.00	secs		Zero to sample 90% response time # auto-calibration	0 to 163.80	5 to 163.80
57		1.5	mins		Sample gas stabilisation time D cycle will take	0 to 15.00	0.1 to 5.0
58		0.0	days	*	Time since last auto-calibration		
61		4.00		*	Range change alarm		
62		0.00		*	Data link between Control and Interface units failed		
63		0.00		*	Zero gas flow failure alarm during auto-calibration		
64		0.00		*	Span gas flow failure during auto-calibration		
65		0.00		*	Sample gas flow failure alarm		
66		0.00		*	Gas tolerance out of limits during auto-calibration		

* Cannot be user set.

§ Is dependent upon codes 11 and 18.

‡ Parameter 11 plus Parameter 18 must not exceed 199.99.

Parameter Code No.	Equivalent Entry	Defaults/ Start-Up Value	Unit	Customer Entered Value	Description	Enterable Range of Values	Recommended Range
67		0.00		*	Corrupt memory		
68		0.68			Loop gain check request - set to zero to initiate test		0 to initiate test
69		0.00	% O_2		Loop gain error		
70	Cal 0	0.08 or 0.70			Calibrate pressure compensation (if fitted). Set to zero		0 to calibrate pressure
71					} Used for setting security codes - not displayable in		
72					display mode		
75		2.00	% O_2		Zero gas tolerance limits	0 to 5.00	0.0 to 2.00
77	Cal Zero	0.77			Calibrate zero point - set to zero		0 to calibrate zero
78	Cal Span	0.78			Calibrate span point - set to zero		0 to calibrate span
85		25.00	% O_2		Span gas tolerance limits	0 to 50.00	0 to 50.0
87	Valve zero	0.87			Zero gas solenoid valve		0 to select zero gas
88	Valve span	0.88			Span gas solenoid valve		0 to select span gas
89	Valve sample	0.01			Sample gas solenoid valve		0 to select sample gas
92		57.00	°C	*	Cell temperature low alarm		
93		63.00	°C	*	Cell temperature high alarm		
94		3.00		*	Cell temperature alarm deviation from set point		
95		0.67		*	Alarm parameter store		
97	Gas Zero	0.00			Calibration zero point	-10.00 to 21.00	-10.00 to 21.00 param
98	Gas span	100.00			Calibration span point	0 to 163.00	0 to +100.00
99	Gas sample	variable	% O_2	*	Oxygen reading of sample gas		

* Cannot be user set.

§ Is dependent upon codes 11 and 18.

‡ Parameter 11 plus Parameter 18 must not exceed 199.99.

Appendix 4

DIGITAL DATA COMMUNICATIONS
01100 927

APPENDIX 4 DIGITAL DATA COMMUNICATIONS - 01100927

Installation and electrical details are given in Section 2.11.2.

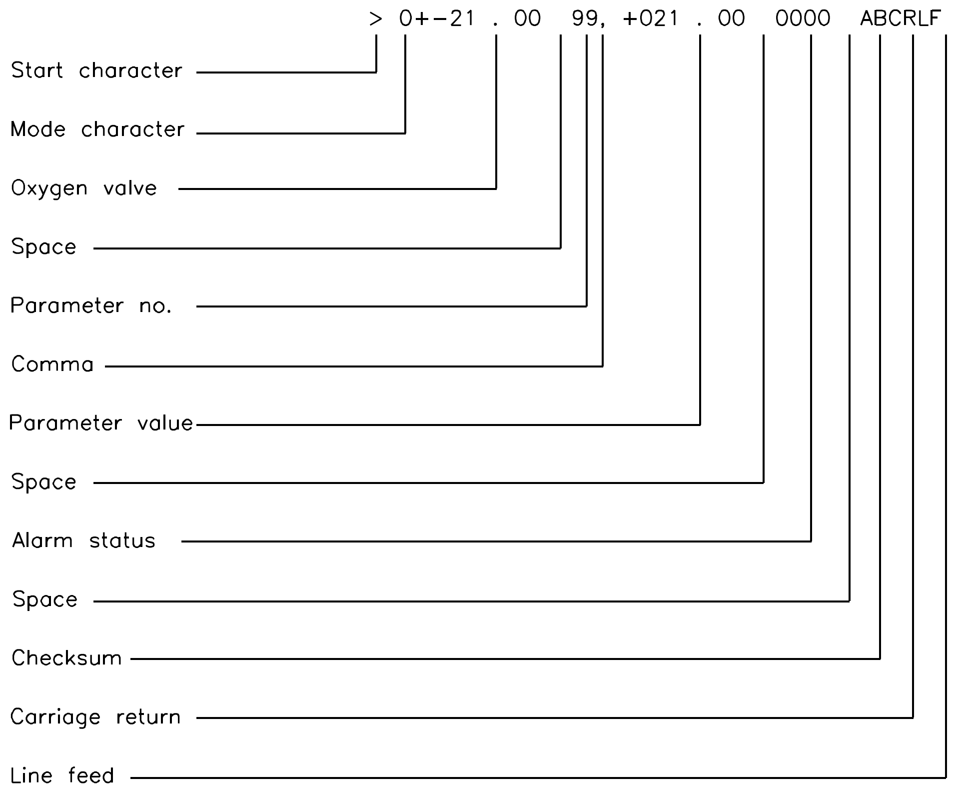
This Appendix gives information for the interpretation of the digital output.

Serial transmission code: ASCII

Protocol: Asynchronous signal with
a start bit, eight data bits
and two stop bits.

Transmission rate: 300 baud.

A data frame comprises 30 characters and is typically of the following form:



Character 1	-	Defines uniquely the start of the data frame.
Character 2	-	Mode character. Shows which mode the analyser is in. o - display is showing oxygen value. v - display mode, used for displaying parameter values. p - operator mode, used for changing parameter values.
Characters 3-9	-	Oxygen value with polarity sign.
Character 10	-	Space.
Characters 11, 12	-	Parameter number. This is used when parameters are being displayed or changed.
Character 13	-	Comma (changes to a semi-colon when the analyser is in display or operator mode).
Characters 14-20	-	Parameter value with polarity sign. This is the value associated with the parameter number.
Character 21	-	Space.
Characters 22-25	-	Status of the 16 alarm functions.
Character 26	-	Space.
Characters 27, 28	-	Checksum. Used internally by the 1100A.
Character 29	-	Carriage return.
Character 30	-	Line feed.

Consecutive data frames are output without a break, ie the start character immediately follows the line feed of the previous data frame.

ALARM STATUS

Each of the four characters gives the status of four alarms. eg: the first alarm character (character 22) gives the status of alarm numbers 93, 92, 68, 67 with 0110067X and 0110068X software or 68, 67, 41, 40 with 0110066X software, see following table.

These four alarms are given the decimal numbers 8, 4, 2, 1, respectively.

When an alarm condition exists this number is output. If more than one alarm condition is present then the numbers are summed.

The actual alarm status character is the hexadecimal number equivalent to the decimal number.

This enables two digit decimal numbers to be output as a single character hexadecimal number.

Decimal to hexadecimal conversion:

Decimal	Hexadecimal	Decimal	Hexadecimal
0	0	8	8
1	1	9	9
2	2	10	A
3	3	11	B
4	4	12	C
5	5	13	D
6	6	14	E
7	7	15	F
8	8		

e.g. With 01100 67X and 01100 68X software; if alarm parameters 93 and 92 are active, their sum of equivalent decimal numbers is 8 + 4 = 12. The equivalent hexadecimal number is C and it is this which is output on the datalink. Hence if no other alarms are active, the alarm status will be C000. Similar outputs are obtained from 01100 66X software, but in the example given above the output would be 0300.

The complete allocation of alarms is:

01100 67X and 01100 68X Software:

	Character 22	Character 23	Character 24	Character 25
Alarm No	93 92 68 67	66 65 64 63	* * 46 45	43 42 41 40
Decimal value	8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1

01100 66X Software

	Character 22	Character 23	Character 24	Character 25
Alarm No	68 67 41 40	43 42 93 92	* * 46 45	63 64 65 66
Decimal value	8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1

* Not used on standard instruments.

Appendix 5

CHANGING THE PASSWORD

APPENDIX 5. CHANGING THE PASSWORD

The password is factory set to:

4	5	6	Enter

but can be altered by entering into the system a pre-calculated number which relates to the new password.

Any three digits, from zero to nine, can be used as the password.

A value, calculated from these digits is entered into codes 71 and 72.

The formulae for calculating the entered values are:

$$\text{Code 71} = \frac{(NV1 \times 256) + NV2}{100}$$

$$\text{Code 72} = \frac{(NV3 \times 256) + 14}{100}$$

Where NV1 - 1st digit of new security code
NV2 - 2nd digit of new security code
NV3 - 3rd digit of new security code

Example: New security code

8	2	4	Enter

1st calculation.

$$\frac{(8 \times 256) + 2}{100} = 20.5$$

= value to be entered in Code 71

2nd calculation.

$$\frac{(4 \times 256) + 14}{100} = 10.38$$

= value to be entered in Code 72

To Enter these values:

1. Enter the existing password.

   Factory set as: [4] [5] [6] [Enter]

2. Enter the first new value.

   [Set] [7] [1] [2] [0] [!] [5] [Enter]

   Display will read. 20.50 71

3. Enter the second new value.

   [Set] [7] [2] [1] [0] [!] [3] [8] [Enter]

   Display will read 10.38 72

4. Revert back to the oxygen mode.

   [Set] [Gas] [Sample] [Enter]

Note: When altering the password both parameter codes 71 and 72 must be entered during the same time-out period.

The new password must now be used at all times when setting the system parameters.

If this password is forgotten the analyser will have to be powered down, including the battery back up. The analyser will revert, when powered up, to the default value of:

[4] [5] [6] [Enter]

NOTES

Appendix 6

EFFECT OF BACKGROUND GASES

APPENDIX 6. EFFECT OF BACKGROUND GASES

Oxygen is a paramagnetic gas, i.e. it is attracted into a magnetic field. Virtually all other gases are diamagnetic, ie they are repelled by a magnetic field. Servomex oxygen analysers are calibrated on a scale which is normalised for nitrogen at 0 and oxygen at 100. For high accuracy measurements it may be necessary to introduce a zero offset into the calibration to compensate for the background gas. The Table below presents, for many common gases, the data required to calculate the zero offset.

For example, an analyser calibrated with nitrogen as the zero gas will, when 100% carbon dioxide is passed through it, give a reading of ! 0.30% oxygen. If it is required to measure oxygen in carbon dioxide then this will give an error. There are two ways to compensate for this:

1. CO_2 is used as the zero gas.

2. N_2 is used as the zero gas and the zero is offset to a value equal but opposite to the reading produced by the background gas.

   In the example above this is ! 0.30% and the value +30 is entered as the gas zero instead of 0.00.

   If the background gas is a mixture then the proportional sums of the zero offsetsare used.

   E.g. For a background gas with a composition of 12% CO_2, 5% CO, 5% n-Octane, 78% N_2, the zero offset will be:

12% CO_2	= 12% of ! 0.30	=	-0.04
5% CO	= 4% of +0.07	=	+0.00
5% n-Octane	= 5% of ! 2.78	=	0.14
78% N_2	= 78% of 0.00	=	+0.00
	Total:	=	! 0.18

(Where ! 0.30, +0.07 and ! 2.78 are the zero offsets of 100% carbon dioxide, carbon monoxide and n-octane respectively relative to pure nitrogen. See following table)

In this case gas zero should be set to +0.18.

Note 1. Nitrogen dioxide exists in equilibrium with dinitrogen tetroxide. The relative proportions vary greatly with temperature. As nitrogen dioxide is paramagnetic and dinitrogen tetroxide is diamagnetic, the relative molar susceptibility of the equilibrium gas also varies. The data given in the Table are for cell temperatures of either 60/C or 11/C. Neither of these temperatures may actually be the temperature of the process.

Note 2. Servomex Application Note AP01 lists the zero offsets for a range of technically important gases at cell temperatures of 60/C and 110/C.

Table A1 Zero Correction for Various Gases

Gas	Formula	Molar mag.susc x 10^{-6}	Zero Offset 20/C x 0.01%	50/C x 0.01%	60/C x 0.01%	110/C x 0.01%
Acetaldehyde	CH_2CHO	-22.70	-0.31	-0.34	-0.35	-0.40
Acetic acid	CH_3CO_2H	-31.50	-0.56	-0.62	-0.64	-0.74
Acetone	CH_3COCH_3	-33.70	-0.63	-0.69	-0.71	-0.82
Acetylene	HCCH	-20.80	-0.25	-0.28	-0.29	-0.33
Acrylonitrile	CH_2=CHCN	-24.10	-0.35	-0.39	-0.40	-0.46
Allyl alcohol	CH_2CHCH_2OH	-36.70	-0.71	-0.79	-0.81	-0.93
Ammonia	NH_3	-18.00	-0.17	-0.19	-0.20	-0.23
Argon	Ar	-19.60	-0.22	-0.24	-0.25	-0.29
Benzene	C_6H_6	-54.84	-1.24	-1.36	-1.41	-1.62
Boron chloride	BCl_3	-59.90	-1.38	-1.53	-1.57	-1.81
Boron triflouride	BF_3	-19.00	-0.20	-0.22	-0.23	-0.26
Bromine	Br_2	-73.50	-1.78	-1.96	-2.02	-2.32
1,2 Butadiene	C_4H_6	-35.60	-0.68	-0.75	-0.77	-0.89
1,3 Butadiene	C_4H_6	-30.60	-0.54	-0.59	-0.61	-0.70
n-Butane	C_4H_{10}	-50.30	-1.11	-1.22	-1.26	-1.45
iso-Butane	$(CH_3)_2CHCH_2$	-51.70	-1.15	-1.26	-1.30	-1.50
1 Butene	$CH_3CH_2CH=CH_2$	-41.10	-0.84	-0.93	-0.96	-1.10
n-Butyl acetate	$CH_3COOC_4H_9$	-77.50	-1.89	-2.09	-2.15	-2.47
iso-Butylene	$(CH_3)_2CH=CH_2$	-44.40	-0.94	-1.03	-1.06	-1.22
1 Butyne (Ethylacetylene)	$CH_3C_3H_2$	-43.50	-0.91	-1.00	-1.03	-1.19
Carbon dioxide	CO_2	-21.00	-0.26	-0.29	-0.30	-0.34
Carbon disulphide	CS_2	-42.20	-0.87	-0.96	-0.99	-1.14
Carbon monoxide	CO	-9.80	0.06	0.07	0.07	0.08
Carbon tetrachloride	CCl_4	-66.60	-1.58	-1.74	-1.79	-2.06
Carbon tetraflouride	CF_4	-31.20	-0.55	-0.61	-0.63	-0.72
Chlorine	Cl_2	-40.50	-0.82	-0.91	-0.94	-1.08
Chloro ethanol	$ClCH_2CH_2OH$	-51.40	-1.14	-1.25	-1.29	-1.49
Chloroform	$CHCl_3$	-59.30	-1.37	-1.51	-1.55	-1.78
Cumene	$(CH_3)_2CHC_6H_5$	-89.53	-2.24	-2.47	-2.55	-2.93
Cyclohexane	C_6H_{12}	-68.13	-1.62	-1.79	-1.84	-2.12
Cyclopentane	C_5H_{10}	-59.18	0.35	0.38	0.39	0.45
Cyclopropane	C_3H_6	-39.90	-0.81	-0.89	-0.92	-1.05
Diacetylene	C_4H_2	-37.50	-0.74	-0.81	-0.84	-0.96
Dichloroethylene	$(CHCl)_2$	-49.20	-1.07	-1.18	-1.22	-1.40
Diethyl ether	$(C_2H_5)_2O$	-55.10	-1.25	-1.37	-1.41	-1.63
2,2 Diflouro 1 chloroethane	$CClH_2CHF_2$	-52.40	-1.17	-1.29	-1.33	-1.52
1,2 Diflouro 1,2 dichloroethylene	CFCl=CFCl	-60.00	-1.39	-1.53	-1.58	-1.81
Diflouro dichloro methane (Freon 12) (Freon 12)	CCl_2F_2	-52.20	-1.16	-1.28	-1.32	-1.52
Dimethoxy methane	$CH_2(OCH_3)_2$	-47.30	-1.02	-1.12	-1.16	-1.33
Dimethylamine	$(CH_3)_2NH$	-39.90	-0.81	-0.89	-0.92	-1.05
Dimethylether	CH_3OCH_3	-26.30	-0.41	-0.46	-0.47	-0.54
Dimethylethylamine	$(CH_3)_2NC_2H_5$	-63.60	-1.49	-1.64	-1.69	-1.95

Gas	Formula	Molar mag.susc x 10^{-6}	Zero Offset 20/C x 0.01%	50/C x 0.01%	60/C x 0.01%	110/C x 0.01%
Enflurane (Ethrane)	$C_3H_2F_5ClO$	-80.10	-1.97	-2.17	-2.24	-2.57
Ethane	C_2H_6	-26.80	-0.43	-0.47	-0.49	-0.56
Ethanol	C_2H_5OH	-33.60	-0.62	-0.69	-0.71	-0.82
Ethyl acetate	$CH_3COOC_2H_5$	-54.20	-1.22	-1.34	-1.39	-1.59
Ethyl amine	$C_2H_5NH_2$	-39.90	-0.81	-0.89	-0.92	-1.05
Ethyl benzene	$C_6H_5C_2H_5$	-77.20	-1.88	-2.08	-2.14	-2.46
Ethyl bromide	C_2H_5Br	-54.70	-1.23	-1.36	-1.40	-1.61
Ethyl chloride	C_2H_5Cl	-46.00	-0.98	-1.08	-1.12	-1.28
Ethylene	C_2H_4	-18.80	-0.20	-0.22	-0.22	-0.26
Ethylene glycol	$(CH_2OH)_2$	-38.80	-0.77	-0.85	-0.88	-1.01
Ethylene oxide	$(CH_2)_2O$	-30.70	-0.54	-0.60	-0.61	-0.71
Ethyl mercaptan	$C_2H_5OSO_3H$	-47.00	-1.01	-1.11	-1.15	-1.32
Flourochlorobromomethane	$CFClBr$	-58.00	-1.33	-1.46	-1.51	-1.74
Flourodichloromethane (Freon 21)	$CHCl_2F$	-48.80	-1.06	-1.17	-1.21	-1.39
Fluroxene	$CF_3CH_2OCHCH_2$	-56.70	-1.29	-1.42	-1.47	-1.69
Freon 114	$C_2Cl_2F_4$	-77.40	-1.89	-2.08	-2.15	-2.47
Furan	C_4H_4O	-43.09	-0.90	-0.99	-1.02	-1.17
Germanium tetrachloride	$GeCl_4$	-72.00	-1.73	-1.91	-1.97	-2.26
Halothane	$C_2HBrClF_3$	-78.80	-1.93	-2.13	-2.19	-2.52
Helium	He	-1.88	0.29	0.32	0.33	0.38
n-Heptane	C_7H_{16}	-85.24	-2.12	-2.33	-2.40	-2.76
n-Hexane	C_6H_{14}	-73.60	-1.78	-1.96	-2.02	-2.32
Hydrogen	H_2	-3.98	0.23	0.26	0.26	0.30
Hydrogen bromide	HBr	-35.30	-0.67	-0.74	-0.76	-0.88
Hydrogen chloride	HCl	-22.60	-0.31	-0.34	-0.35	-0.40
Hydrogen cyanide	HCN	-14.50	-0.07	-0.08	-0.08	-0.09
Hydrogen iodide	HI	-48.20	-1.05	-1.15	-1.19	-1.37
Hydrogen selenide	H_2Se	-39.20	-0.79	-0.87	-0.89	-1.03
Hydrogen sulphide	H_2S	-25.50	-0.39	-0.43	-0.44	-0.51
Isoflurane (Forane)	$C_3H_2F_5ClO$	-80.10	-1.97	-2.17	-2.24	-2.57
Isoprene	C_5H_8	-44.80	-0.95	-1.04	-1.08	-1.24
Ketene	CH_2CO	-15.70	-0.11	-0.12	-0.12	-0.14
Krypton	Kr	-28.80	-0.49	-0.54	-0.55	-0.63
Methane	CH_4	-17.40	-0.16	-0.17	-0.18	-0.20
Methanol	CH_3OH	-21.40	-0.27	-0.30	-0.31	-0.35
Methoxyflourane	$CHCl_2CF_2OCH_3$	-87.10	-2.17	-2.39	-2.47	-2.83
Methyl acetate	CH_3COCH_3	-42.60	-0.88	-0.97	-1.00	-1.15
Methyl cyclopentane	C_6H_{12}	-70.20	-1.68	-1.85	-1.91	-2.20
Methylene chloride	CH_2Cl_2	-46.60	-1.00	-1.10	-1.14	-1.31
Methylethlyketone	$CH_3COCH_2CH_3$	-45.50	-0.97	-1.07	-1.10	-1.26
Methyl flouride	CH_3F	-25.50	-0.39	-0.43	-0.44	-0.51

Gas	Formula	Molar mag.susc x 10^{-6}	Zero Offset 20/C x 0.01%	50/C x 0.01%	60/C x 0.01%	110/C x 0.01%
Methyl formate	$HCOOCH_3$	-32.00	-0.58	-0.64	-0.66	-0.75
Methyl iodide	CH_3I	-57.20	-1.31	-1.44	-1.48	-1.71
Methyl iso-butyl ketone (MIBK)	$C_4H_9COCH_3$	-69.30	-1.66	-1.82	-1.88	-2.16
Methyl mercaptan	CH_3SH	-35.30	-0.67	-0.74	-0.76	-0.88
Molybdenum hexaflouride	MoF_6	-26.00	-0.40	-0.45	-0.46	-0.53
Monochlorobenzene	C_6H_5Cl	-70.00	-1.68	-1.85	-1.90	-2.19
Neon	Ne	-6.70	0.15	0.17	0.17	0.20
Nitric oxide	NO	1461.00	42.56	42.96	42.94	41.62
Nitrobenzene	$C_6H_5NO_2$	-61.80	-1.44	-1.59	-1.63	-1.88
Nitrogen	N_2	-12.00	0.00	0.00	0.00	0.00
Nitrogen dioxide	NO_2	150.00	5.00	16.00	20.00	35.00
ortho-Nitrotoluene	$C_6H_4CH_3NO_2$	-72.30	-1.74	-1.92	-1.98	-2.28
para-Nitrotoluene	$C_6H_4CH_3NO_2$	-76.90	-1.88	-2.07	-2.13	-2.45
Nitrous oxide	N_2O	-18.90	-0.20	-0.22	-0.23	-0.26
n-Nonane	C_9H_{20}	-108.13	-2.78	-3.06	-3.16	-3.63
n-Octane	C_8H_{18}	-96.63	-2.45	-2.70	-2.78	-3.19
Oxygen	O_2	3449.00	100.00	100.00	100.00	100.00
Ozone	O_3	6.70	0.54	0.60	0.61	0.71z
iso-Pentane	C_5H_{12}	-64.40	-1.51	-1.67	-1.72	-1.98
n-Pentane	C_5H_{12}	-63.10	-1.48	-1.63	-1.68	-1.93
0.01%Phenol	C_6H_5OH	-60.21	-1.39	-1.54	-1.58	-1.82
Phosphine	PH_3	-26.00	-0.40	-0.45	-0.46	-0.53
Phosphorous oxychloride	$POCl_3$	-69.00	-1.65	-1.82	-1.87	-2.15
Propane	C_3H_8	-38.60	-0.77	-0.85	-0.87	-1.00
iso-Propanol	$(CH_3)_2CHOH$	-47.60	-1.03	-1.13	-1.17	-1.34
Propene	$CH_3CH{=}CH_2$	-31.50	-0.56	-0.62	-0.64	-0.74
n-Propyl acetate	$CH_3COOC_3H_7$	-65.90	-1.56	-1.72	-1.77	-2.03
Propyl amine	$C_3H_7NH_2$	-52.40	-1.17	-1.29	-1.33	-1.52
Propyl chrloride	C_3H_7Cl	-56.10	-1.27	-1.40	-1.45	-1.66
Propylene	C_3H_6	-31.50	-0.56	-0.62	-0.64	-0.74
Propylene oxide	OCH_2CHCH_3	-42.50	-0.88	-0.97	-1.00	-1.15
iso-Propyl ether	$(CH_3)_4CHOCH$	-79.40	-1.95	-2.15	-2.21	-2.54
Propyl flouride	C_3H_7F	-52.20	-1.16	-1.28	-1.32	-1.52
Pyridine	$N(CH)_5$	-49.21	-1.08	-1.19	-1.22	-1.40
Silane	SiH_4	-20.50	-0.25	-0.27	-0.28	-0.32
Silicon tetracloride	$SiCl_4$	-88.30	-2.20	-2.43	-2.50	-2.88
Styrene	$C_6H_5CH{=}CH_2$	-68.20	-1.62	-1.79	-1.85	-2.12
Sulphur dioxide	SO_2	-18.20	-0.18	-0.20	-0.20	-0.23
Sulphur hexaflouride	SF_6	-44.00	-0.92	-1.02	-1.05	-1.21
Tetrachoroethylene	$Cl_2C{=}CCl_2$	-81.60	-2.01	-2.22	-2.28	-2.63
Tetrahydrofuran	C_4H_8O	-52.00	-1.16	-1.27	-1.31	-1.51
Toluene	$C_6H_5CH_3$	-66.11	-1.56	-1.72	-1.78	-2.04
1,1,2 Trichloroethane (Freon 113)	$CHCl_2CH_2Cl$	-66.20	-1.57	-1.73	-1.78	-2.05
Trichloroethylene	$CHCl{=}CCl_2$	-65.80	-1.55	-1.71	-1.77	-2.03
Triflourochloroethylene	C_2F_3Cl	-49.10	-1.07	-1.18	-1.22	-1.40

Gas	Formula	Molar mag.susc x 10^{-6}	Zero Offset 20/C x 0.01%	50/C x 0.01%	60/C x 0.01%	110/C x 0.01%
Trimethylamine	$(CH_3)_3N$	-51.70	-1.15	-1.26	-1.30	-1.50
Tungsten flouride	WF_6	-40.00	-0.81	-0.89	-0.92	-1.06
Urethane	$CO(NH_2)OC_2H_5$	-57.00	-1.30	-1.43	-1.48	-1.70
Vacuum	-	0.00	0.35	0.38	0.39	0.45
Vinyl bromide	CH_2=CHBr	-44.80	-0.95	-1.04	-1.08	-1.24
Vinyl chloride	CH_2=CHCl	-35.60	-0.68	-0.75	-0.77	-0.89
Vinyl flouride	CH_2=CHF	-28.80	-0.49	-0.54	-0.55	-0.63
Water	H_2O	-13.00	-0.03	-0.03	-0.03	-0.04
Xenon	Xe	-43.90	-0.92	-1.02	-1.05	-1.20
Xylene	$(CH_3)_2C_6H_4$	-77.78	-1.90	-2.09	-2.16	-2.48

Appendix 7

SOFTWARE 01100 651, 01100 652 AND 01100 699

APPENDIX 7. SOFTWARE 01100 651, 01100 652 AND 01100 699

This manual may be used for the above versions of software but there are a number of differences.

Alarm code 67 (memory corrupted) is not permanently allocated to relay 4. It is not possible to allocate this alarm to a relay.

Customised default values are not available.

The major difference is auto-calibration. The section below replaces Section 3.10 of this manual.

3.10 AUTOMATIC CALIBRATION

3.10.1 Introduction

The relay board has three relays which can be used to drive solenoid valves on the sample, zero gas and span gas streams used for calibrating the analyser. The analyser can initiate an auto-calibration sequence in which the zero gas is turned on and a zero gas calibration point determined, the span gas turned on and span gas calibration point determined and finally a return to the sample gas. If the procedure is executed correctly then the analyser recalibrates on return to sample.

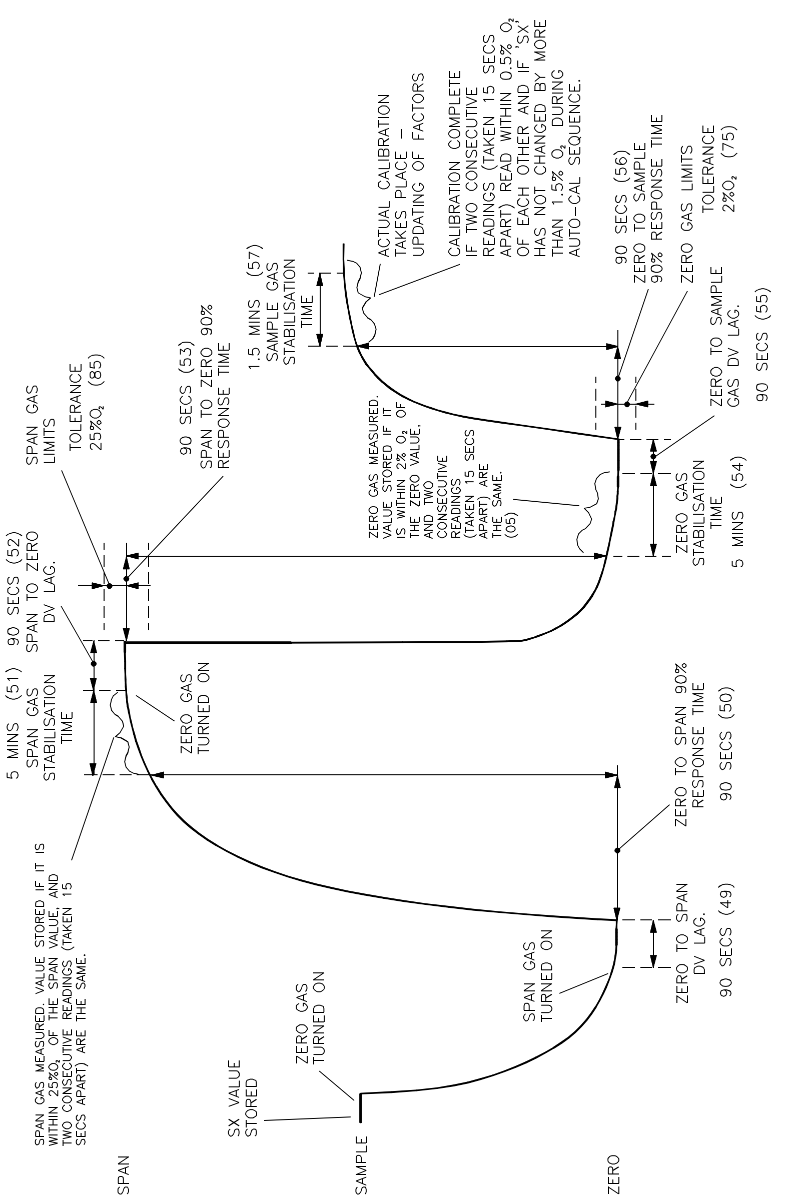
Note: For auto-calibration to be successful, the following conditions must be met:

1. The oxygen concentration of the zero gas must be at least 1.5% O_2 less than the oxygen content of the sample gas.

2. The oxygen concentration of the span gas must be at least 1.5% O_2 greater than the oxygen content of the sample gas.

3. The oxygen concentration of the sample gas must not change by more than 1.5% O_2 during the auto-calibration sequence.

4. Oxygen concentration of the sample gas must be between the oxygen concentrations of the zero and span gases.



Auto-calibration response curve

The oxygen signal during the auto-calibration sequence is shown in Figure 3.3. At the start of auto-calibration the analyser measures and stores the oxygen content of the sample gas. The zero gas is turned on and then there is a short distance velocity (DV) lag before the oxygen reading changes towards zero gas. This change is searched for by the analyser and the length of this DV lag is measured. If there is no change in oxygen signal during a certain preset time, which can be selected by the user, the auto-calibration sequence will be aborted since the analyser will assume that zero gas is not flowing. The analyser will then return to sample gas and sample reading without re-calibrating. If the zero gas is flowing the analyser will search for the 90% point again within a preset time interval, and if the oxygen signal does not reach that point within that time then the analyser will again abort the sequence. If the 90% point is detected the analyser will search for a plateau by measuring the oxygen reading every 15 seconds and will compare consecutive readings. When two readings are identical the analyser assumes the plateau has been reached and stores that oxygen reading as the zero calibration point.

Note: The analyser only stores these readings at this stage, it does not re-calibrate to zero.

Once the calibration point has been established the zero gas flow is stopped and the span gas flow is started. There is another DV lag and the analyser searches for the end of this DV lag indicated by a change in oxygen signal. If a change is not detected within a certain time the analyser will abort the auto-calibration sequence and will return to the sample gas without automatically re-calibrating. The 90% point is searched for and if it is not reached within a pre-set time the auto-calibration is aborted and the analyser returns to sample. If the 90% point is detected the analyser will measure the oxygen reading every 15 second. When two consecutive readings are identical the analyser will store that as the span calibration point. The span gas flow is stopped and the sample gas flow is started.

Note: The analyser at this stage has not yet re-calibrated.

A sequence similar to that already described is established for the sample gas. The analyser searches for an oxygen concentration in the sample gas which lies within a tolerance band of the oxygen reading at the start of the auto-calibration sequence. If this is established, again within a given time interval then the analyser assumes that the auto-calibration sequence is correct and the analyser then re-calibrates.

These checks ensure that a gas flow is available on each of the three gas streams obviating the need for flow alarms on the individual streams. This system does however, impose limitations on the oxygen concentrations of the three gases. The concentration in the sample gas must be greater (in order of 1.5% O_2) than the concentration in the zero gas and less than the concentration of the span gas. Similarly the oxygen concentration of the sample gas should not change by more than 1.5% O_2 during the calibration sequence.

The accuracy from this system will be within approximately .02 - .03% oxygen, for both the zero and span gas calibrations.

The accuracy may be altered by changing parameter 05 (the asymptote timer, which is factory set to 15 seconds), the time interval the analyser takes to determine two identical readings. The auto-calibration accuracy will improve if this interval is increased to, say, 20 seconds, but the auto-calibration period will be extended. Reducing this interval, to, say, 7 seconds, shortens the auto-calibration time but reduces the accuracy.

When an analyser with auto-calibration is installed it is recommended that a manual calibration is first carried out. A chart recorder should then be connected to the analogue output of the analyser and an auto-calibration done. If the calibration points are examined on the chart (at 1% span) then the accuracy of the calibration can be determined. This can then be optimised by changing the value of parameter 05, the asymptote timer.

3.10.2 Automatic Calibration Initiation

Auto-calibration may be initiated either on demand or at fixed timer intervals.

1. On Demand

   This sequence uses parameter code 46 and is initiated by pressing

SET	4	6	Enter

The analyser will perform an auto-calibration sequence.

2. Fixed Time Intervals

   If an auto-calibration sequence is required repetitively then the time interval between the sequences uses parameter code 47. The clock is started by pressing

SET	4	7	Enter

The fixed time interval is then entered in multiplexes of 0.1 of a day. If an auto-calibration sequence is required every 12 hours, (0.5 days) press

Set	4	7	0	!	5	Enter

The calibration sequence will then start 12 hours after setting the clock and will repeat every 12 hours subsequently.

Manual calibrations may be carried out between auto-calibrations. If an attempt is made to manually calibrate whilst the analyser is performing an auto-calibration the display will show the error message 0.06 and that manual calibration will be aborted. The auto-calibration will not be affected.

3.10.3 Analogue Output Freeze

During auto-calibration the analogue output may be frozen at the last sample gas value. This prevents the analogue output following the oxygen content of the calibrating gases and possibly tripping external alarms or control equipment which may be connected. The analogue output becomes live again at the end of auto-calibration when the analyser re-calibrates (or aborts if the auto-calibration sequence has failed).

Parameter Code 45 is used to set this. It is set to 0 if the analogue output is to be frozen or set to 4 if it is to follow the calibrating gases. The status can be interrogated by displaying parameter 45.

Whilst the analogue output is frozen alarm code 45 will be displayed. This alarm may be allocated to a relay.

3.10.4 Automatic Calibration Status Indication

The status of the analyser during an auto-calibration sequence can be checked with the displays listed in Table 3.3.

TABLE 3.3 CALIBRATION STATUS INDICATION

DISPLAY		DESCRIPTION
0.72	46	Zero gas flowing and zero gas DV lag being measured.
0.74	46	Sample to zero 90% response being measured.
0.76	46	Stabilisation period, plateau being measured.
0.78	46	Zero point reached.
0.82	46	Span gas flowing and span gas DV lag being measured.
0.84	46	Zero to span 90% response being measured.
0.86	46	Stabilisation period, plateau being measured.
0.88	46	Span point reached.
0.91	46	Sample gas flowing and delay for sample flow to stabilise.
0.92	46	Sample gas DV lag being measured.
0.94	46	Span to sample 90% response being measured.
0.95	46	Auto-calibration completed.
0.96	46	Stabilisation period, for sample gas.
0.97	46	Zero or span gas failure, routine aborting.
0.98	46	Auto-calibration unsuccessful. See Section 3.10.6.

Note:

1. For brief periods other numbers may be displayed.
2. During auto-calibration the 30 sec time-out is disabled. Parameter code 46 will be permanently displayed during the routine, unless otherwise requested.

The oxygen mode may be displayed during the sequence by pressing

DISPLAY	GAS	SAMPLE 9	Enter

3.10.5 Failure to Auto-Calibrate

The analyser will not calibrate if any of the following are in error:

1. Sample gas oxygen reading is within 1.5% O_2 of the zero gas content.

2. Sample gas oxygen reading is within 1.5% O_2 of the span gas oxygen content.

3. Zero or span gas oxygen contents out of limits.

4. DV lag exceeds programmed limits (time between switching a different gas and the analyser output responding).

5. Response time exceeds programmed limits.

6. Stabilisation period exceeds programmed limits.

7. The sample gas oxygen level has changed by more than 1.5% O2 since the start of auto-calibration. This may occur on multi-stream systems if a stream has switched during the auto-calibration sequence.

   Parameter code 46 (Auto-calibration alarm) can be dedicated to an alarm relay to provide contact closures for the prevention of stream switching during auto-calibration (Refer to section 4.9.1).

The default values of the various time lags itemised in 1, 2, and 3 are detailed in the parameter code listing in Appendix 3. These codes 49 and 57 are user adjustable to suit individual installations. The analyser stores the time lags from the previous auto-calibration in parameter codes 25 to 30. These time lags will aid the resetting of default values for codes 49 to 57.

3.10.6 Auto Calibration Alarms

alarms available in auto-calibration are :	Analogue output frozen	45
	Analyser in auto-calibration	46
	Zero gas flow failure	63
	Span gas flow failure	64
	Sample gas flow failure	65
	Gas out of limits	66

All of these alarms can be allocated to relays. See Section 3.9.1 for allocation procedure.

3.10.6.1 Analogue Output Frozen - 45

See Section 3.10.3 for description. This alarm is cleared automatically at the conclusion of auto-calibration.

3.10.6.2 Analyser in Auto-Calibration - 46

Goes active as soon as auto-calibration starts and is cleared automatically at the conclusion of the sequence. May be used as an indication that the analyser is not measuring the sample gas.

3.10.6.3 Zero Gas Flow Failure - 63

Indicates that the analyser has not detected a change in oxygen reading within a preset time interval after switching on the zero gas.

This may be due to:

1. No zero gas or low flow.

2. Preset time intervals too short. Perform a manual calibration and measure DV lag and 90% point on a chart recorder.

The time out period for the DV lag is in Parameter 49 and for the 90% point in parameter 50. This alarm can only be cleared by performing a successful auto-calibration.

3.10.6.4 Span Gas Flow Failure - 64

Identical to zero gas flow failure (Section 3.10.6.3). The time out period for the DV lag is in parameter 52 and for the 90% point in parameter 53.

3.10.6.5 Sample Gas Flow Failure - 65

Identical to zero gas flow failure (Section 3.10.6.3). It usually indicates a fault within the sample system. A manual calibration should be done to determine which calibrating point is in error.

This alarm can only be cleared by performing a successful auto-calibration.

3.10.7 Oxygen Level Alarms In Auto-Calibration

The oxygen level alarms will be triggered by the change in the oxygen signal as a result of the calibrating gases passing through the analyser. The user can make use of the auto-calibration alarm (46) and external logic functions to inhibit any external annunciators.

3.10.8 Electrical Power Failure In Auto-Calibration

Assuming that the battery back-up of memory is good, then should electrical power fail during the auto-calibration sequence, when the analyser restarts the sequence is aborted and the previous calibration is still valid. The next auto-calibration will occur at the programmed time interval after the restoration of power.

If the power interruption occurs during normal operation then the clock which controls the auto-calibration repetition time is stopped but its settings retained in memory. When electrical power is restored the clock starts running again but the next auto-calibration will be delayed by the duration of the power interruption.

If the battery back-up of memory has failed then the complete memory is erased and the analyser, including auto-calibration functions, will have to be reprogrammed.

Appendix 8

SPECIFICATION

APPENDIX 8 SPECIFICATION

1. Functional Characteristics

Display:	Digital LED display reading 0-100% oxygen with 0.01% resolution and over range capability.
Analogue output:	0/4 - 20 mA or 20 - 4/0mA isolated, selected by the keyboard. Maximum impedance 600 ohms. Option of the output to be intrinsically safe "ib" when it is connected to ground (ie non-isolated).
Spans	1, 2, 2.5, 4, 5, 10, 20, 25, 40, 50 and 100%. The 1% span is not available with the 1100H. 2, 4, 20 and 40% spans and reverse output are not available with software 0110066X.
Zero suppression:	The zero may be suppressed in 0.01% steps to a maximum of 99.99% suppression.
Power supply:	100, 110, 117, 220, 240V ac, +/! 10% 48-62Hz 200VA.

2. Environmental Limits

Operating ambient temperature:	! 10 to +50 deg C (14 to 122 deg F) in still air. (The unit will operate at ! 15 deg C with reduced specification).
Storage temp. range:	! 20 to +65 deg C (! 4 to +149 deg F).
Relative humidity:	5 to 95%, non-condensing.
Atmospheric pressure range:	83-124kPa (12-18psia)
Safety:	See Section 1.2 for details of certification for use in hazardous applications.

3. Sample Requirements (Transducer Units)

See also specification for sampling system (if supplied).

Inlet pressure to analyser:	0.3kPa (50 mm wg) maximum relative to vent pressure.

Maximum sample pressure:	28kPag (4 psig) relative to atmosphere
Cell flow rate:	250ml (air)/minute maximum. 150ml/min for cell types 313 and 364 and model 1132 Transducer unit. 200ml/min for cell type 312.
Dew point:	
1131 and 1133 transducers:	5 deg C (9 deg F) below lowest ambient temperature.
1132 transducer:	Less than 105 deg C (221 deg F).
Temperature:	
1131 and 1133 transducers:	50 deg C (122 deg F) maximum, ! 10 deg C (14 deg F) minimum at analyser inlet.
1132 transducer:	105 deg C (221 deg F) maximum, ! 10 deg C (14 deg F) minimum at analyser inlet.

4. Performance Characteristics

Resolution of display:	+/! 0.01% oxygen
Resolution of analogue output:	+/! 0.01% oxygen +/! 0.3% of span (+/! 0.5% of span with software 0110066X).
Drift (constant conditions)	Zero <0.02% O_2 /week Span (100% O_2)<0.02% O_2 /day, <0.05% O_2 /week
Repeatability	1100A 0.02% O_2 1100H 0.03% O_2
Effect of ambient temperature changes:	A change of 10 deg C (18 deg F) in the range ! 10 to +50 deg C (14 to 122 deg F) will cause the zero to change by +/! 0.01% max and the span to change by +/! 0.1% of reading (0.2% with model 1132 and 1133 transducer.)
Effect of change in cell flow rate :	A change of cell flow rate from 0-200ml/min (0-150ml/min for type 313 and 364 cells) will cause the reading to change by 0.1% (maximum).
Effect of barometric pressure or sample vent pressure:	The analyser measures the partial pressure of oxygen in the sample gas. Therefore the reading (at constant oxygen content) is proportional to the ratio of the cell pressure at the time of analysis to that at the time of calibration unless the pressure compensation option is fitted and calibrated. Pressure compensation reduces the effect due to sample pressure changes by a factor of better than 200 or +/! 0.02% O_2 whichever is the greater.

The performance of pressure compensation will be degraded if the separation of the Transducer and Control (or Interface) units exceeds 30m.

Pressure compensation cannot be fitted to 1100H systems.

Effect of supply voltage variation: A change of +/! 10% in the supply voltage will cause the output to change by less than 0.02% O_2 or 0.2% of FSD, whichever is the greater.

Effect of supply interruptions: A single cycle interruption in electrical supply will have no effect on the analyser.

Response time: At a sample flow rate of 200ml/minute a 90% response to a step change at the analyser inlet will be obtained in less than 4 seconds. (5 seconds for type 364 cell and 1132 transducer).

The addition of a sampling system will increase the response time.

Interference RFI: Less than +/! 0.1% O_2 change due to interference caused by a 3 watt RF transmitter of 144 and 432 MHz with 1/4 wavelength antenna located 1 metre from case.

Level sensitivity: Less than 0.01% O_2 change per degree of tilt from attitude at time of calibration.

Magnetic: Soft magnetic materials brought into contact with the transducer case will cause an error of less than 0.05% O_2.

5. Physical Characteristics

Case classification all units: IP54, NEMA 4

Case construction: Cast aluminium alloy, finished in corrosion resistant epoxy powder paint

Front panel: Aluminium panel finished in epoxy powder paint and with polycarbonate label or keyboard.

External dimensions: See Figure 2.1(a) to 2.1(d).

Weight:

Control unit	20Kg	(44lbs)
Interface unit	20 Kg	(44lbs)
Transducer unit 1131/1133	16 Kg	(35lbs)
Transducer unit 1132	17 Kg	(37lbs)

6. Dry Gas Sampling System 1161

(Not suitable for use with model 1132 transducer unit.)

By-pass flow rate:	1 to 9 litres/min (air)
Sample flow rate:	10 to 250ml/min (air)
Temperature range:	
Operating	! 10 to +50 deg C (14 to 122 deg F)
Storage	! 20 to +65 deg C (! 4 to 149 deg F)
Inlet pressure:	2 to 140kPa (0.3 to 20 psig).
Response time: (includes transducer response time.)	
312 or 325 cell	Bypass 6 l/min. Sample 200 ml/min 90% response 10 secs.
313 or 364 cell	Bypass 6 l/min. Sample 150ml/min 90% response 16 secs.
Inlet connection:	Rp 1/8 (1/8" BSPP)
Exhaust connection:	Rp 1/4 (1/4" BSPP)
Transducer connections:	1/8" OD tube compression
Filter:	90% retention of 0.6 um particles
Sample flow regulation:	Changing the by-pass flow rate from 1 to 9 l/min changes the sample flow rate by less than 20ml/min.

Materials in contact with the sample:

01161701	01161000
Borosilicate glass Duralumin Stainless steel 316 Nickel plated brass Brass Copper PTFE Nitrile rubber Glass fibre/epoxy filter	Borosilicate glass Duralumin (1) Stainless steel 316 PTFE Viton (2) Glass fibre/epoxy filter 1. May be replaced with PTFE or ebonite. 2. May be replaced with butyl, EPDM or nitrile rubber.

7. Wet Gas Sampling System 1162

(Not for use with model 1132 transducer unit.)

By-pass flow rate:	400 to 1100ml/min (air)
Sample flow rate:	200ml/min recommended
Temperature range:	
Operating	! 10 to +50 deg C (14 to 122 deg F) Note 1
Storage	! 20 to +65 deg C (! 4 to 149 deg F)

Note : Below 0^{0}C water in the bubbler should be replaced by ethylene glycol.

Inlet pressure:	2 to 140kPa (0.3 to 20 psig).
Response time: (includes transducer response time)	Bypass 400ml/min, Sample 200ml/min 90% response 12 seconds.
Noise:	Less than +/! 0.02% O_2 at optimum bypass flowrate with nitrogen.
Inlet connection:	1/4" OD tube
Drain/exhaust connection:	R_P 1/4 (1/4" BSPP)
Transducer connections:	1/8" tube compression
Filter:	90% retention of 0.6 um particles

Materials in contact with the sample:

Stainless steel 316
PTFE
Polypropylene
Glass fibre/epoxy resin
Glass
Viton