DOC024.52.93116

ORBISPHERE Model 51x Analyzer with K1200 and TC Sensors

USER MANUAL

08/2024, Edition 10

Table of Contents

Section 1 General Information 5
1.1 Disclaimer 5
1.2 Safety information 5
1.2.1 Use of hazard information 5
1.2.2 Safety precautions 6
1.2.3 Service and repairs 6
1.2.4 Precautionary labels 6
1.2.5 Intended use of this equipment 7
1.3 Product recycling information 8
1.4 Product disposal 10

Section 2 Specifications 11
2.1 Technical specifications 11
2.1.1 Analyzer 11
2.1.2 K1200 sensor 13
2.1.3 TC sensor 14
2.1.4 TC sensor purge gas pressure regulator 14
2.2 Hardware description 15
2.3 Model identification system 15
2.4 Security level table 16
2.5 Default parameters 17

Section 3 Installation 19
3.1 Unpacking 19
3.2 Installation check list 20
3.3 Wall mount and pipe mount instruments 21
3.3.1 Instrument dimensions 21
3.3.2 Wall mounting 22
3.3.3 Pipe mounting 22
3.3.4 Connection panel (bottom of instrument) 23
3.4 Panel mount instrument 25
3.4.1 Instrument dimensions 25
3.4.2 Mounting 26
3.4.3 Connection panel (bottom of instrument) 27
3.5 Connection to mains power supply 28
3.5.1 Power supply connection (low voltage instruments) 28
3.5.2 Power supply connection (high voltage instruments) 28
3.6 Connections to electronic boards 30
3.6.1 Sensor cable 30
3.6.2 Electronic boards connectors 30
3.6.3 Main board connections 30
3.6.4 Measurement board 31
3.7 Measurement alarm relays 32
3.8 Sensor installation 33
3.8.1 Purge gas system for the TC sensor 33
3.8.2 Sensor positioning information 34
3.8.3 Recommended sample flow rate 35
3.8.4 Sensor insertion 35
3.8.5 Sensor removal 35
3.8.6 Weld-on stainless steel socket 36
3.8.7 The 32003 insertion/extraction valve 37
3.8.8 The 33095 sensor housing 37
3.8.9 Tuchenhagen Varivent® in-line access unit 37
3.8.10 Instrument connections 38
3.9 Calibration devices 38
3.9.1 Portable calibration device - K1200 sensor 38
3.9.2 ORBISPHERE flow chambers 39

Section 4 User Interface 41
4.1 Instrument 41
4.2 Touch screen 41
4.2.1 Function keys on the header bar 42
4.2.2 Menu navigation 43
4.2.3 Rolling list 43
4.2.4 Virtual keyboard 43
4.2.5 Identification and authorization level 44
4.2.6 Warning windows 44
4.3 Main menu structure 45
Section 5 View Menu 47
5.1 Selection of the view style 48
5.2 Configuration of the view styles 50
Section 6 Measurement Menu 51
6.1 Instrument configuration 52
6.2 Measurement configuration 52
Section 7 Calibration menu 57
7.1 K1200 sensor calibration 59
7.1.1 Calibration configuration 60
7.1.2 Zero calibration 61
7.1.3 100% humid air calibration (high range sensors only) 61
7.1.4 High level adjustment 61
7.1.5 Sensor verification 61
7.2 TC gas sensor calibration 62
7.2.1 Calibration errors (TC sensors) 63
7.2.2 Interference calibration (TC sensor) 63
7.3 Barometric pressure calibration 63
7.4 External pressure calibration 64
7.5 Calibration reports 64
Section 8 Inputs/Outputs Menu 65
8.1 Configure snooze 66
8.2 View inputs/outputs 66
8.3 Relays 66
8.4 Analog outputs 67
8.5 Analog output characteristics 71
Section 9 Communication Menu 75
9.1 RS-485 simple mode configuration 76
9.1.1 Data available 77
9.1.2 Example of use 80
9.2 PROFIBUS-DP communication 80
9.2.1 Installation 81
9.2.2 Input/Output data 82
9.3 USB-A port (host) 85
9.4 HTTP/TCP-IP 86
9.4.1 Overview 86
9.4.2 PC interface 86
9.5 Printer 88
9.5.1 Install ferrite on the printer cable 89
9.5.2 Printer error messages 89
Section 10 Security Menu 91
10.1 Access rights management 91
10.2 Configure security 92

10.3 User management 92
10.4 User action log file 92
Section 11 Products Menu 93
Section 12 Global Configuration Menu 95
Section 13 Services menu 97
13.1 Sensor diagnostics 99
13.2 Language selection 100
13.3 Clock 100
13.4 Screen 100
13.5 Buzzer 100
13.6 Boards info 100
13.7 Batteries 101
13.8 Software download 101
13.9 End application 101
13.10 Channel activation 101
Section 14 Maintenance and Troubleshooting 103
14.1 Instrument maintenance 103
14.2 K1200 sensor maintenance 103
14.2.1 Equipment required 103
14.2.2 Sensor spot removal 103
14.2.3 Sensor spot replacement 104
14.3 TC sensor maintenance 105
14.3.1 Maintenance schedule 105
14.3.2 Testing the sensor condition 105
14.3.3 Membrane replacement 105
14.4 Troubleshooting 108
14.5 List of events and alarms 110
14.6 Storage, handling and transportation 111
Section 15 Accessories and Spare Parts 113
15.1 Instrument 113
15.2 K1200 sensor 113
15.3 511 analyzer kits to order (KTO's) 114
15.4 TC sensor parts 114
15.5 TC Sensor accessories 114
15.6 TC sensor maintenance kits 115
15.7 TC sensor protection caps and related part kits 115
15.8 Insertion and sampling devices 116
Section 16 Glossary 117
16.1 Gas units 117
16.2 Generic terms and definitions 117

Section 1 General Information

1.1 Disclaimer

The information in this manual has been carefully checked and is believed to be accurate. However, Hach Lange assumes no responsibility for any inaccuracies that may be contained in this manual. In no event will Hach Lange be liable for direct, indirect, special, incidental, or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, Hach Lange reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation.

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1.2 Safety information

Please read the entire manual before unpacking, setting up, or operating this analyzer.

Pay particular attention to all warning and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

1.2.1 Use of hazard information

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially or imminently hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

1.2.2 Safety precautions

DANGER



Always remove power from the controller before performing maintenance activities.

WARNING



Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

WARNING



Potential Electrocution Hazard. Connect only safety low voltage < 33 VAC RMS.

CAUTION

Personal Injury Hazard. Only qualified personnel should conduct the tasks described in this manual.

NOTICE

Install the device in a location and position that gives easy access to the disconnect device and its operation.

NOTICE



Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

- ***The power cord plug connection is also used as a main power switch.***
- ***The instrument must be connected to an electrical system which complies with applicable local regulations.***
- ***All the cables connected to the instrument must be fire resistant, type UL94V-1***
- ***The operator must read and understand this manual before using the instrument.***
- ***The instrument will not be used as a safety device. It does not provide a security function in a hazardous process.***

1.2.3 Service and repairs

None of the analyzer's components can be serviced by the user. Only personnel from Hach Lange or its approved representative(s) is (are) authorized to attempt repairs to the system and only components formally approved by the manufacturer should be used. Any attempt at repairing the analyzer in contravention of these principles could cause damage to the analyzer and corporal injury to the person carrying out the repair. It renders the warranty null and void and could compromise the correct working of the analyzer and the electrical integrity or the CE compliance of the analyzer.

1.2.4 Precautionary labels

Read all labels and tags attached to the analyzer. Personal injury or damage to the analyzer could occur if not observed.

	This symbol, when noted on a product, indicates a potential hazard which could cause serious personal injury and/or death. The user should reference this instruction manual for operation and/or safety information.
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists and indicates that only individuals qualified to work with hazardous voltages should open the enclosure or remove the barrier.
	This symbol, when noted on the product, indicates that the marked item can be hot and should not be touched without care.
	This symbol, when noted on the product, indicates the presence of devices sensitive to electrostatic discharge and indicates that care must be taken to prevent damage to them.
	This symbol, when noted on the product, identifies a risk of chemical harm and indicates that only individuals qualified and trained to work with chemicals should handle chemicals or perform maintenance on chemical delivery systems associated with the equipment.
	This symbol, if noted on the product, indicates the need for protective eye wear.
	This symbol, when noted on the product, identifies the location of the connection for protective earth (ground).
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems. In conformity with European local and national regulations, European electrical equipment users must now return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.
	Products marked with this symbol indicates that the product contains toxic or hazardous substances or elements. The number inside the symbol indicates the environmental protection use period in years.

1.2.5 Intended use of this equipment

This high accuracy ORBISPHERE instrument is designed for gas measurement using LDO (Luminescent Dissolved Oxygen) and TC (Thermal Conductivity) sensors. The instrument can be used for process and laboratory analysis, in applications such as beverage, life sciences, power generation, and the electronics industry.

ORBISPHERE 51x analyzers are available as wall, pipe and panel mount versions. According to the configuration, the ORBISPHERE 51x has provision for up to two patented gas phase (or dissolved gas) ORBISPHERE LDO and/or TC sensors.

NOTICE
Use of the instrument outside of the environmental conditions described in Technical specifications on page 11 may cause damage to the instrument but without endangering the user.

1.3 Product recycling information



ENGLISH

Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

Note: *For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.*

DEUTSCH

Elektrogeräte, die mit diesem Symbol gekennzeichnet sind, dürfen in Europa nach dem 12. August 2005 nicht mehr über die öffentliche Abfallentsorgung entsorgt werden. In Übereinstimmung mit lokalen und nationalen europäischen Bestimmungen (EU-Richtlinie 2002/96/EC), müssen Benutzer von Elektrogeräten in Europa ab diesem Zeitpunkt alte bzw. zu verschrottende Geräte zur Entsorgung kostenfrei an den Hersteller zurückgeben.

Hinweis: *Bitte wenden Sie sich an den Hersteller bzw. an den Händler, von dem Sie das Gerät bezogen haben, um Informationen zur Rückgabe des Altgeräts zur ordnungsgemäßen Entsorgung zu erhalten.*

FRANCAIS

A partir du 12 août 2005, il est interdit de mettre au rebut le matériel électrique marqué de ce symbole par les voies habituelles de déchetterie publique. Conformément à la réglementation européenne (directive UE 2002/96/EC), les utilisateurs de matériel électrique en Europe doivent désormais retourner le matériel usé ou périmé au fabricant pour élimination, sans frais pour l'utilisateur.

Remarque: *Veuillez vous adresser au fabricant ou au fournisseur du matériel pour les instructions de retour du matériel usé ou périmé aux fins d'élimination conforme.*

ITALIANO

Le apparecchiature elettriche con apposto questo simbolo non possono essere smaltite nelle discariche pubbliche europee successivamente al 12 agosto 2005. In conformità alle normative europee locali e nazionali (Direttiva UE 2002/96/EC), gli utilizzatori europei di apparecchiature elettriche devono restituire al produttore le apparecchiature vecchie o a fine vita per lo smaltimento senza alcun costo a carico dell'utilizzatore.

Nota: *Per conoscere le modalità di restituzione delle apparecchiature a fine vita da riciclare, contattare il produttore o il fornitore dell'apparecchiatura per un corretto smaltimento.*

DANSK

Elektriske apparater, der er mærket med dette symbol, må ikke bortskaffes i europæiske offentlige affaldssystemer efter den 12. august 2005. I henhold til europæiske lokale og nationale regler (EU-direktiv 2002/96/EF) skal europæiske brugere af elektriske apparater nu returnere gamle eller udtjente apparater til producenten med henblik på bortskaffelse uden omkostninger for brugeren.

Bemærk: *I forbindelse med returnering til genbrug skal du kontakte producenten eller leverandøren af apparatet for at få instruktioner om, hvordan udtjente apparater bortskaffes korrekt.*

SVENSKA

Elektronikutrustning som är märkt med denna symbol kanske inte kan lämnas in på europeiska offentliga sopstationer efter 2005-08-12. Enligt europeiska lokala och nationella föreskrifter (EU-direktiv 2002/96/EC) måste användare av elektronikutrustning i Europa nu återlämna gammal eller utrangerad utrustning till tillverkaren för kassering utan kostnad för användaren.

Obs! *Om du ska återlämna utrustning för återvinning ska du kontakta tillverkaren av utrustningen eller återförsäljaren för att få anvisningar om hur du återlämnar kasserad utrustning för att den ska bortskaffas på rätt sätt.*

ESPANOL

A partir del 12 de agosto de 2005, los equipos eléctricos que lleven este símbolo no deberán ser desechados en los puntos limpios europeos. De conformidad con las normativas europeas locales y nacionales (Directiva de la UE 2002/96/EC), a partir de esa fecha, los usuarios europeos de equipos eléctricos deberán devolver los equipos usados u obsoletos al fabricante de los mismos para su reciclado, sin coste alguno para el usuario.

Nota: *Sírvase ponerse en contacto con el fabricante o proveedor de los equipos para solicitar instrucciones sobre cómo devolver los equipos obsoletos para su correcto reciclado.*

NEDERLANDS

Elektrische apparatuur die is voorzien van dit symbool mag na 12 augustus 2005 niet meer worden afgevoerd naar Europese openbare afvalsystemen. Conform Europese lokale en nationale wetgegeving (EU-richtlijn 2002/96/EC) dienen gebruikers van elektrische apparaten voortaan hun oude of afgedankte apparatuur kosteloos voor recycling of vernietiging naar de producent terug te brengen.

Nota: *Als u apparatuur voor recycling terugbrengt, moet u contact opnemen met de producent of leverancier voor instructies voor het terugbrengen van de afgedankte apparatuur voor een juiste verwerking.*

POLSKI

Sprzęt elektryczny oznaczony takim symbolem nie może być likwidowany w europejskich systemach utylizacji po dniu 12 sierpnia 2005. Zgodnie z europejskimi, lokalnymi i państwowymi przepisami prawa (Dyrektywa Unii Europejskiej 2002/96/EC), użytkownicy sprzętu elektrycznego w Europie muszą obecie przekazywać Producentowi stary sprzęt lub sprzęt po okresie użytkowania do bezpłatnej utylizacji.

Uwaga: *Aby przekazać sprzęt do recyklingu, należy zwrócić się do producenta lub dostawcy sprzętu w celu uzyskania instrukcji dotyczących procedur przekazywania do utylizacji sprzętu po okresie użytkownia.*

PORTUGUES

Qualquer equipamento eléctrico que ostente este símbolo não poderá ser eliminado através dos sistemas públicos europeus de tratamento de resíduos sólidos a partir de 12 de Agosto de 2005. De acordo com as normas locais e europeias (Directiva Europeia 2002/96/EC), os utilizadores europeus de equipamentos eléctricos deverão agora devolver os seus equipamentos velhos ou em fim de vida ao produtor para o respectivo tratamento sem quaisquer custos para o utilizador.

Nota: *No que toca à devolução para reciclagem, por favor, contacte o produtor ou fornecedor do equipamento para instruções de devolução de equipamento em fim de vida para a sua correcta eliminação.*

1.4 Product disposal

Note: *The following only applies to European customers.*

Hach Lange is committed to ensuring that the risk of any environmental damage or pollution caused by any of its products is minimized as far as possible. The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) that came into force on August 13 2005 aims to reduce the waste arising from electrical and electronic equipment; and improve the environmental performance of all those involved in the life cycle of electrical and electronic equipment.



In conformity with European local and national regulations (EU Directive 2002/96/EC stated above), electrical equipment marked with the above symbol may not be disposed of in European public disposal systems after 12 August 2005.

Hach Lange will offer to take back (**free of charge to the customer**) any old, unserviceable or redundant analyzers and systems which carry the above symbol, and which were originally supplied by Hach Lange. Hach Lange will then be responsible for the disposal of this equipment.

In addition, Hach Lange will offer to take back (**at cost to the customer**) any old, unserviceable or redundant analyzers and systems which do not carry the above symbol, but which were originally supplied by Hach Lange. Hach Lange will then be responsible for the disposal of this equipment.

Should you wish to arrange for the disposal of any piece of equipment originally supplied by Hach Lange, please contact your supplier or our After Sales Service department in Geneva for instructions on how to return this equipment for proper disposal.

Section 2 Specifications

Specifications are subject to change without notice.

2.1 Technical specifications

2.1.1 Analyzer

Operating conditions	
Operating temperature limits	-5°C to +40°C
Storage temperature limits	-20°C to +70°C
Operating humidity limits	0 to 95% non condensing relative humidity
Operating altitude	From 0 to 2,000 m. (6,550 ft.) above sea level
EMC requirements	EN61326-1: EMC Directive ***Note:*** *The wall mount instrument is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.*
Pollution degree	2
Environmental condition	Indoor use
Korean registration	**User Guidance for EMC Class A Equipment** 업무용을 위한 EMC 등급 A 장치에 대한 사용자 지침 사용자안내문 A 급 기기 (업무용 방송통신기자재) 이 기기는 업무용 (A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 , 가정외의 지역에서 사용하는 것을 목적으로 합니다 .
CE compliance	EN61010-1: LVD Directive
Safety rating	ETL, conforming to UL 61010-1 and CSA 22.2 No. 61010-1
Enclosure ratings	IP 65 Totally protected against dust. Protected against low pressure jets of water from all directions. NEMA4X (wall mount only) Totally protected against dust. Protected against pressure jets of water from all directions.
Power supply	
Wall and panel mount	Universal 100 VAC to 240 VAC @ 50/60Hz - 40VA 10 to 30 VDC - 30W
Analog outputs	
Analog current output version on the measurement board(s)	4-20 mA (default) or 0-20 mA (configuration with software) 3 configurable outputs Maximum load: 500 ohm Sensitivity: 20µA Accuracy: ± 0.5% (between operating temperature limits)
Analog voltage output version on the measurement board(s)	0- 5 V output (hardware option) 3 configurable outputs Minimum load: 10 KOhm Sensitivity: 5 mV Accuracy: ± 0.5% (between operating temperature limits)
Digital outputs	

Measurement alarm relays on the measurement board(s)	Three alarm relays per measurement board 1A-30 VAC or 0.5A-50 VDC on a resistance load Configurable to Normally Open [NO] or Normally Closed [NC] contacts by changing the jumper positions.
	WARNING
	Potential Electrocution Hazard. Connect only safety low voltage < 33 VAC RMS. 
System alarm relay on the main board. One system board with one system relay per instrument	One "instrument system alarm" relay per instrument 1A-30 VAC or 0.5A-50 VDC on a resistance load Normally closed [NC] (NO relay also available) when instrument is turned on. Opens when a system alarm is detected, and when it does not receive any signal.
	WARNING
	Potential Electrocution Hazard. Connect only safety low voltage < 33 VAC RMS. 
General	
Thermal cut off	Prevents ageing of sensors when exposed to high temperatures
Communication	
Options	USB host Ethernet 10/100 Base-T
Size and weight	
Wall and pipe mount (H x D x W)	236.5 x 160 x 250 mm - weight 3.8 kg 9.31 x 6.30 x 9.84 ins. - weight 8.38 lbs
Panel mount: Face (housing) (H x D x W)	156 (123) x 250 x 220 (214) mm - weight 2.9 kg 6.14 (4.84) x 9.84 x 8.86 (8.43) ins. - weight 6.39 lbs

2.1.2 K1200 sensor

Operating conditions	
Sample temperature	Measurement from -5 to 50°C (23 to 122°F)
	Sensor resistant to temperature from -5 to 100°C (23 to 212°F)
Sample pressure	1 to 20 bar absolute (14.5 to 290 psia)
Sample flow rate requirement	50 to 300 mL/min
Sample types	Water only
CIP	Not designed for use in CIP processes
Measurement range	Low range sensors: 0 to 2,000 ppb (dissolved) High range sensors: 0 to 40 ppm (dissolved)
Repeatability	Low range sensors: ± 0.4 ppb or 1%, whichever is the greater High range sensors: ± 0.015 ppm or ± 2% whichever is the greater
Reproducibility	Low range sensors: ± 0.8 ppb or 2%, whichever is the greater High range sensors: ± 0.02 ppm or ± 3% whichever is the greater
Accuracy	Low range sensors: ± 0.8 ppb or 2%, whichever is the greater High range sensors: ± 0.02 ppm or ± 3% whichever is the greater
Limit of detection (LOD)	Low range sensors: 0.6 ppb High range sensors: 0.015 ppm
Response time (90%)	Low range sensors: < 10 seconds in gas phase; < 30 seconds in liquid phase High range sensors: < 10 seconds in gas phase; < 50 seconds in liquid phase
Warm-up time	None
Display resolution	0.1 ppb
Calibration	Low range sensors: Single point calibration (zero) High range sensors: Two at cap replacement (zero and air), one during use (air)
Calibration sample	Low range sensors: Standard 99.999% N_2 (quality 50) or equivalent oxygen free gas High range sensors: Standard 99.999% N_2 (quality 30) or equivalent oxygen free gas, air
Weight	
K1200 28 mm sensor	0.74 kg
Calibration device	0.7 kg

2.1.3 TC sensor

Sensor type	31 250 H_2 and 31260 H_2 (purge gas N_2) For other purge gases, please contact your Hach Lange representative for specification.			31 550 N_2 and 31560 N_2 (purge gas CO_2)
Membranes	29561A	2952A	2935A	29561A
Thickness	25 µm	25 µm	25 µm	25 µm
Membrane material	PFA	ETFE	ECTFE (Halar)	PFA
Recommended applications	Waste gas offgas, reactor coolant	Reactor coolant	High H_2 level	In-line beverage
Radiation limits	10^5 rad	10^8 rad	10^8 rad	10^5 rad
Measurement range at 25°C	0-2 ppm, or 0-25 cc/kg, or 0-1.5 bar	0-10 ppm, or 0-120 cc/kg, or 0-6 bar	0-20 ppm, or 0-220 cc/kg, or 0-12 bar	0-350 ppm, or 0-300 ml/l, or 0-20 bar
Accuracy (sample temp. 20-50°C within ± 5°C of calibration temperature)	The greater of ±1% of reading or ± 2 ppb, or ± 0.03cc/kg, or ± 1.5 mbar	The greater of ±1% of reading or ± 8 ppb, or ± 0.1cc/kg, or ± 6 mbar	The greater of ±1% of reading or ± 25 ppb, or ± 0.4 cc/kg, or ± 20 mbar	The greater of ±2% of reading or ± 0.3 ppm, or ± 0.25ml/l, or ± 15 mbar
Accuracy (sample temp. 0-50°C independent of calibration temperature)	The greater of ±3% of reading or ± 15 ppb or ± 0.18 cc/kg or ± 6 mbar	The greater of ±3% of reading or ± 60 ppb or ± 0.6 cc/kg, or ± 20 mbar	The greater of ±3% of reading or ± 150 ppb or ± 2.5 cc/kg, or ± 50 mbar	The greater of ±4% of reading or ± 1 ppm or ± 0.8 ml/l or ± 34 mbar
Measurement cycle (sec.)	17			22
Sample flow rate (through flow chamber)[1]	220 ml/min	200 ml/min	100 ml/min	300 ml/min
Linear flow rate (past sensor socket)[2]	N/A	N/A	N/A	150 cm/sec

[1] Minimal flow through an ORBISPHERE 32001 flow chamber.
[2] Minimal flow past an ORBISPHERE 29501 sensor socket

2.1.4 TC sensor purge gas pressure regulator

Model	29089
Filtration grade	40 µm
Input pressure min/max	1 bar / 16 bar
Output pressure min/max	0.5 bar / 7 bar
Standard nominal flow rate	900 Liters/minute
Condensate volume	22 cm^3
Temperature range (ambient and media)	-10°C to 60°C
Purge gas dew point	-10°C (+14°F)
Construction materials	Housing: metal Condensate bowl: polycarbonate Bowl guard: metal
Weight	460 g.
Size in cm (overall)	21 x 11.5 x 8

2.2 Hardware description

The instrument hardware is made of one main board, 2 measurement boards - one for each measurement channel (= one per sensor), a power supply and a battery pack as options.

The main board includes the controls for power, display, the touch screen, the barometric sensor, the alarms, and communication ports. The measurement boards perform measurements and executes commands from the main board. It holds the "Analog outputs" and "Relays" that send information to external systems, and "Digital Inputs" that receive information from external systems such as a “Hold” input.

A hardware watchdog is activated at program start up, to check that the system is not frozen (i.e. infinite loop, system crash, etc.). If the watchdog is not refreshed by the software every minute, the measurement display, the relays and the analog outputs are frozen for up to 2 minutes. Then the reset shuts down the instrument for 10 seconds and the start-up procedure is performed. At the same time all the hardware (sensor, measurement board) are reset.

2.3 Model identification system

The analyzer identification number and the instrument serial number are located on the label on the back panel, and can be found on order confirmation and invoice papers.

The different models available are described in the following matrix.

Model number matrix

5	**1**	**1**	**E**	**K**	**0**				**Nitrogen TC sensor + Oxygen LDO sensor**					
			F	**K**	**0**				**Hydrogen TC sensor + Oxygen LDO sensor**					
							W		**Wall**					
							P		**Panel**					
								1	**100-240 VAC**					
								2	**10-30 VDC**					
									C	**0/4-20 mA**				
										1	**PROFIBUS-DP / RS-485**			
											P	**External pressure**		

5	**1**	**1**		**K**	**0**	**/**			**C**	**1**	**P**	**0**	**N**	**0**

Example: 511FK0/W1C1P0N0

- Analyzer model 511 multi channel
- One hydrogen TC sensor and one oxygen LDO sensor
- Wall mounted
- 100-240 VAC
- 0/4-20 mA analog output
- PROFIBUS-DP / RS-485
- External pressure sensor

2.4 Security level table

A cross means that the user who has this user security level can access this function or setting (see User management on page 92).

Note: *When not shown, the sub-levels carry the same security level as the level above.*

Main	0	1	2	3	4
View	X	X	X	X	X
Measurement	X	X	X	X	X
Calibration			X	X	X
Inputs/outputs			X	X	X
Communication				X	X
Security				X	X
Products			X	X	X
Global config				X	X
Services				X	X

View	0	1	2	3	4
Numeric	X	X	X	X	X
Graphic	X	X	X	X	X
Statistical	X	X	X	X	X
Event	X	X	X	X	X
Diagnostic	X	X	X	X	X
Configure				X	X

Diagram Legend:					
Security level :	0	1	2	3	4
Available			X	X	X
Optional				X	X
Not available today				X	X

Measurement	0	1	2	3	4
Start stop	X	X	X	X	X
Config instrument				X	X
Config chan 1				X	X
Config chan 2				X	X
Config chan 3				X	X
Measurement file				X	X

(portable instr. only)

Calibration	0	1	2	3	4
Gas sensor			X	X	X
Interferences			X	X	X
Barometer				X	X
Ext pressure				X	X
Amplifiers					X
Reports			X	X	X

Gas sensor	0	1	2	3	4
Calibration chan 1			X	X	X
Calibration chan 2			X	X	X
Calibration chan 3			X	X	X
Verification chan 1			X	X	X
Verification chan 2			X	X	X
Verification chan 3			X	X	X
Config. chan 1				X	X
Config. chan 2				X	X
Config. chan 3				X	X

Reports	0	1	2	3	4
Sensor chan 1			X	X	X
Sensor chan 2			X	X	X
Sensor chan 3			X	X	X
Interf. chan 1			X	X	X
Interf. chan 2			X	X	X
Interf. chan 3			X	X	X
Barometer				X	X
Ext pressure				X	X

Inputs/Outputs	0	1	2	3	4
Snooze				X	X
View			X	X	X
Relays				X	X
Analog outputs				X	X

Communication	0	1	2	3	4
RS 485				X	X
RS 485 simple				X	X
Profibus DP				X	X
USB-A				X	X
HTTP / TCPIP				X	X

Security	0	1	2	3	4
Configuration					X
Access table					X
View log file				X	X

Products	0	1	2	3	4
Select product			X	X	X
Modify product				X	X

Global config	0	1	2	3	4
Save config				X	X
Select config				X	X

Services	0	1	2	3	4
Diagnostic				X	X
Language				X	X
Clock				X	X
Screen				X	X
Buzzer				X	X
Boards info				X	X
Batteries				X	X
Soft download					X
More					X

Note: *For the USB-A option in the Communication Menu, level 4 access is required to import the access table data.*

2.5 Default parameters

The table below indicates the factory default configurations. The instrument has these settings when started for the first time.

Parameter	Default settings	Customer settings
Security	Disabled	
Measurement		
Measurement mode	Continuous	
Measurement interval (TC sensor)	20 seconds (approximately)	
Measurement interval (LDO sensor)	2 seconds	
Data filter	Disabled	
Medium	Liquid	
Gas unit type	Dissolved	
Gas unit	ppm-ppb	
Liquid	Water	
Display resolution (TC sensor)	XX.XX	
Display resolution (LDO sensor)	XXX.X	
Storage mode	Rolling buffer	
User offset	Disabled	
Out of range protection	Enabled	
Temp unit	°C	
Pressure unit	bar	
Calibration		
Mode (LDO sensor)	Zero calibration	
Auto-end (LDO sensor)	Enabled	
Hold	Enabled	
Analog outputs		
Range	4-20 mA	
Outputs	Gas measurement	
Extended mode	Disabled	
Characteristics	Mono linear mode	
Alarm relays	Disabled	
Thermal cutoff	Enabled	
Thermal cutoff temp (TC sensor)	65°C	
Thermal cutoff temp (LDO sensor)	40°C	
Calibration timer	Disabled	
Service timer	Disabled	
Buzzer		
Screen tap	Enabled	
Alarm sound	Disabled	
Display		
Minigraph	Enabled	
Temperature	Disabled	

Section 3 Installation

This section provides necessary information to install and connect the analyzer. The installation of the analyzer should be performed in accordance with relevant local regulations.

DANGER	
	Electrocution Hazard. Do not connect AC power to a 5 VDC powered model.

WARNING	
	Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

WARNING	
	Potential Electrocution Hazard. A protective earth (PE) ground connection is required for both 100-240 VAC and 5 VDC wiring applications. Failure to connect a good PE ground connection can result in shock hazards and poor performance due to electromagnetic interferences. ALWAYS connect a good PE ground to the controller terminal.

CAUTION
Personal Injury Hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

NOTICE
Install the device in a location and position that gives easy access to the disconnect device and its operation.

NOTICE	
	Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

3.1 Unpacking

Remove carefully the instrument and its accessories from the box and packing material, referring to the packing list included to confirm that everything has been delivered.

Please visually inspect the instrument for shipping damage. If anything is missing or damaged, contact the manufacturer or your dealer immediately.

You may want to retain the box and other packing material in case later you need to ship the instrument (see Storage, handling and transportation on page 111). Please dispose safely and ecologically of the box and packing material (if not stored for future use).

Please read through this manual thoroughly before carrying out the installation.

3.2 Installation check list

To complete the installation, proceed to the following actions:

1. Follow the installation instructions in this section carefully.
2. On completion, verify once more that everything is properly connected.
3. If using the instrument with a TC sensor it is very important to ensure the purge gas supply has been connected properly and has been turned on, and that a purge safety backup unit has been installed (section 3.8.1 on page 33).
4. Turn the instrument on and set the operating language.
5. Set the security levels, users ID's and passwords.
6. Configure the instrument and measurement channels.
7. For the K1200 sensor, verify that the sensor cap selected (i.e. low or high range: K1200-L or K1200-H) corresponds to the sensor in use (section 6.2 on page 50).
8. Enable thermal cutoff and set it to the minimum possible value (e.g. 10°C if the liquid in the sample line is at 0-5°C). This is critical to ensure long-term stability (section 6.2 on page 50).
9. Set the measurement interval according to your response time needs (section 6.2 on page 50).
10. Enable the calibration timer and set the number of days to 180 days (6 months) or according to your quality needs (section 13.2 on page 93), to ensure a regular sensor calibration.
11. Enable the service timer and set the number of days to 360 days (1 year) or according to your quality needs (section 13.2 on page 93), to ensure a regular sensor service.
12. If required, program the relay and analog outputs to ensure an event is set when a calibration or service is required. These can be programmed for each as custom events (Section 8 on page 59). Note that when a calibration or service timer has expired, the instrument will automatically display this information as a warning message (see the table entitled List of events and alarms on page 99).
13. Perform a barometric sensor calibration.
14. Perform an external pressure calibration (optional).
15. Set the alarm thresholds.

The instrument should now be ready for operation. If a problem should arise, please refer initially to K1200 sensor maintenance on page 103. If the difficulty cannot be overcome, please contact your Hach Lange representative who will be happy to assist you.

3.3 Wall mount and pipe mount instruments

3.3.1 Instrument dimensions

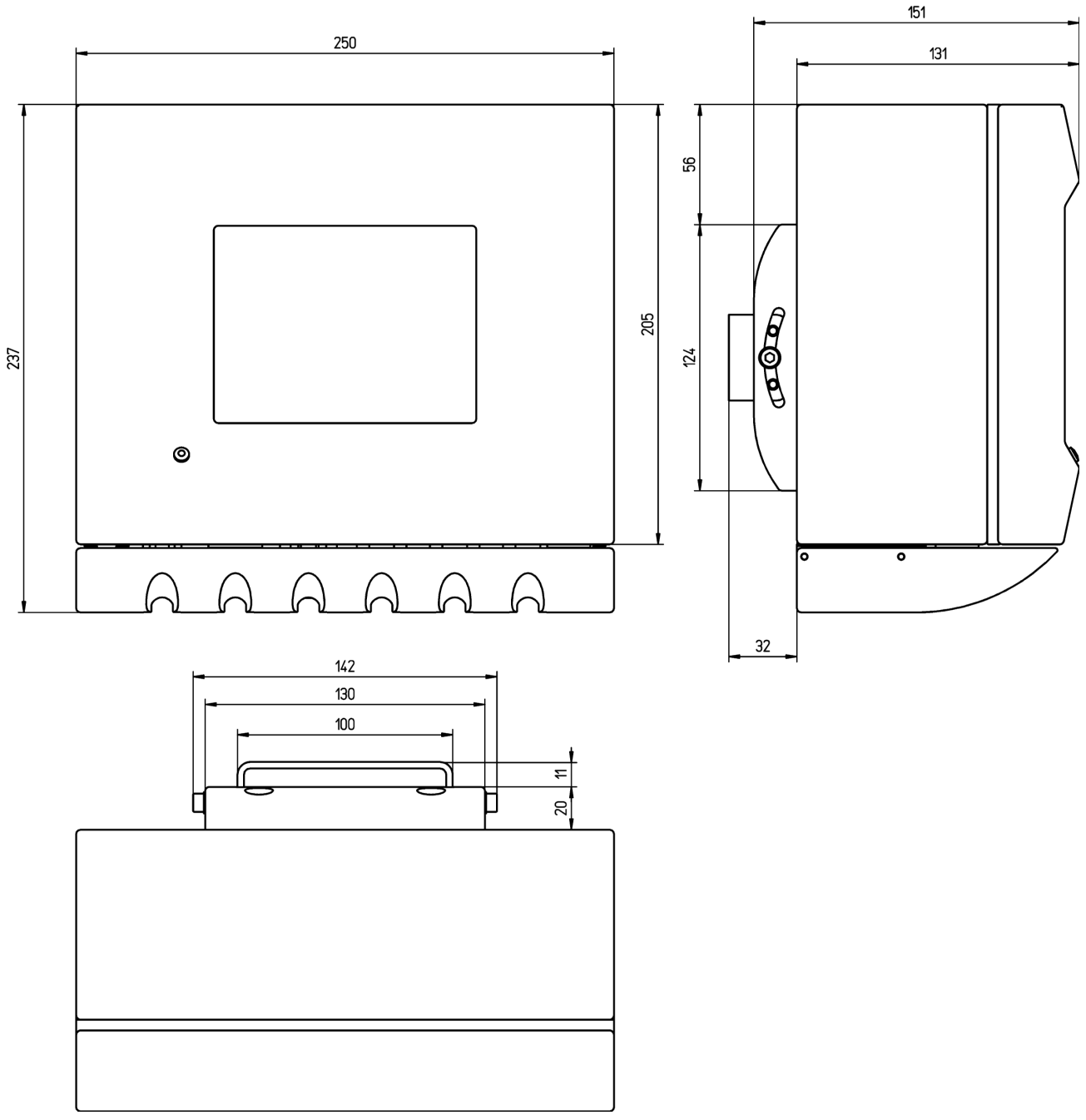
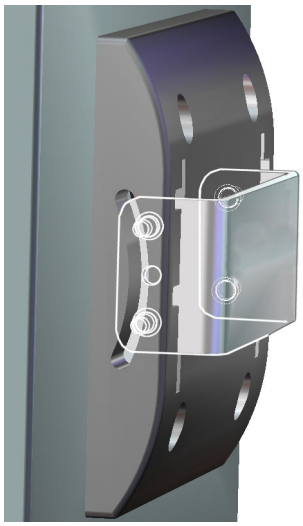
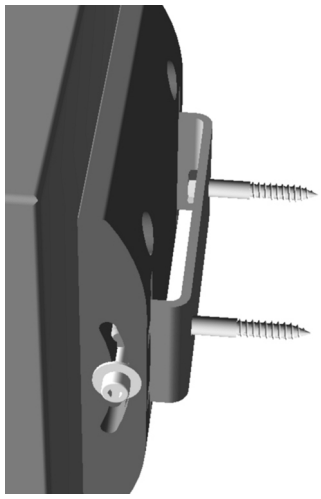


Figure 1 Wall and pipe mount instrument dimensions (in millimeters)

3.3.2 Wall mounting





Attach the U bracket provided to the wall with two screws (not provided).



Tilt the instrument slightly backwards to align the bracket pins and the insertion slots, and slide the instrument onto the bracket as shown.

Insert the 2 locking screws with washers through the side slots.

Adjust instrument angle for better screen vision, and lock both side screws.

Figure 2 Wall mount bracket

3.3.3 Pipe mounting

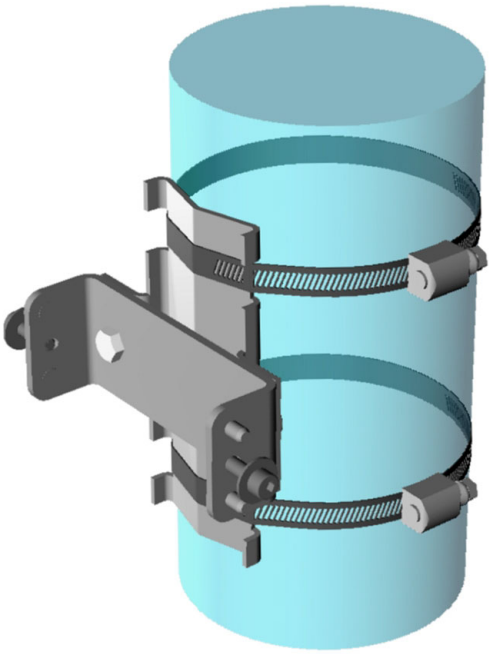
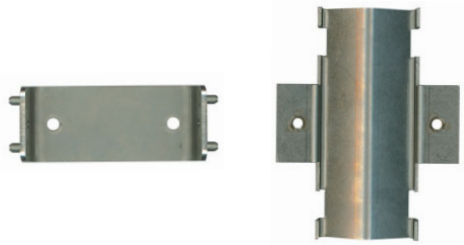


Figure 3 Pipe mount diagram

Assemble the pipe mount bracket to the U-bracket, using the two screws provided



Attach this assembly to the pipe using two clamps (not provided) as shown on the left

The rest of the procedure is similar to the wall mount version, pictured above.

Slide the instrument onto the bracket.

Insert the 2 locking screws with washers through the side slots.

Adjust the instrument angle for better screen vision, and lock both side screws.

3.3.4 Connection panel (bottom of instrument)

Cable protection shield

The cable protection located at the bottom of the instrument (shown in place in Figure 4 below) must be lowered, and eventually removed, to get access to the bottom of the instrument.

Pull the plastic protection firmly towards you, then lower it as shown in Figure 5 below. To remove it completely, push it back against the wall. Proceed in reverse order to install the cable protection. Make sure the 4 pins are securely in place.

Front panel door

A square key is provided to open the instrument front panel locks. The two locks are located on the right side of the instrument on the top and bottom panels (bottom panel indicated with the number 12 in Figure 6 on the next page).

The front panel can be easily pivoted to the left as shown below. To retain the instrument waterproof tightness, make sure the seal is clean and in good condition before closing the front panel.

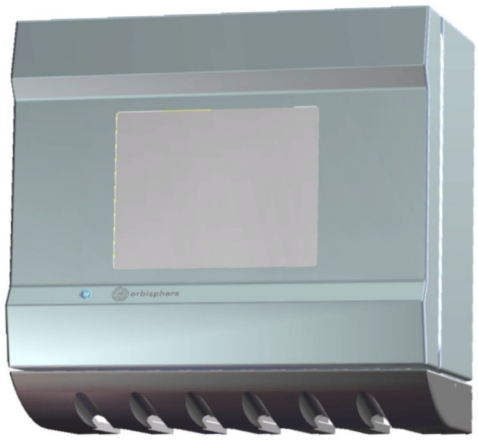


Figure 4 Cable protection shield in place and front door closed

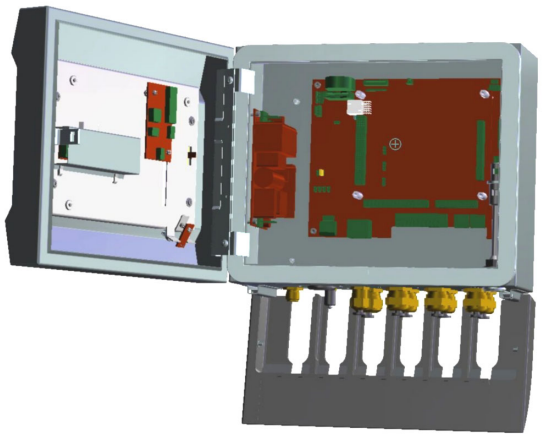


Figure 5 Cable protection shield lowered and front door open

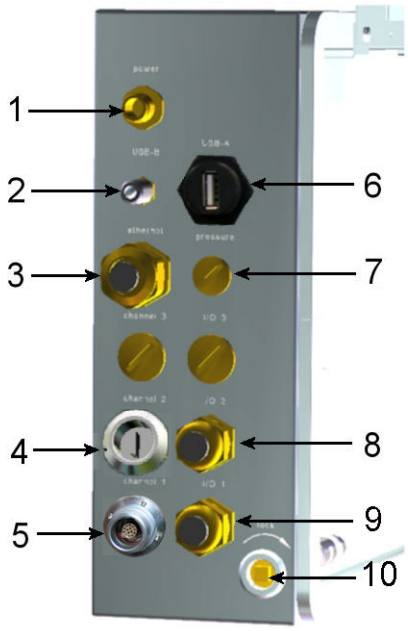


Figure 6 Wall and pipe mount connection panel

1. Power cable	**6.** USB-A host connector for mass storage device
2. USB-B 4 pin connector (reserved for Hach Lange service technicians)	**7.** External pressure sensor connection
3. Ethernet cable gland	**8.** Input/Output 2 cable gland
4. TC Sensor connection	**9.** Input/Output 1 cable gland
5. K1200 Sensor connection	**10.** Keylock

3.4 Panel mount instrument

3.4.1 Instrument dimensions

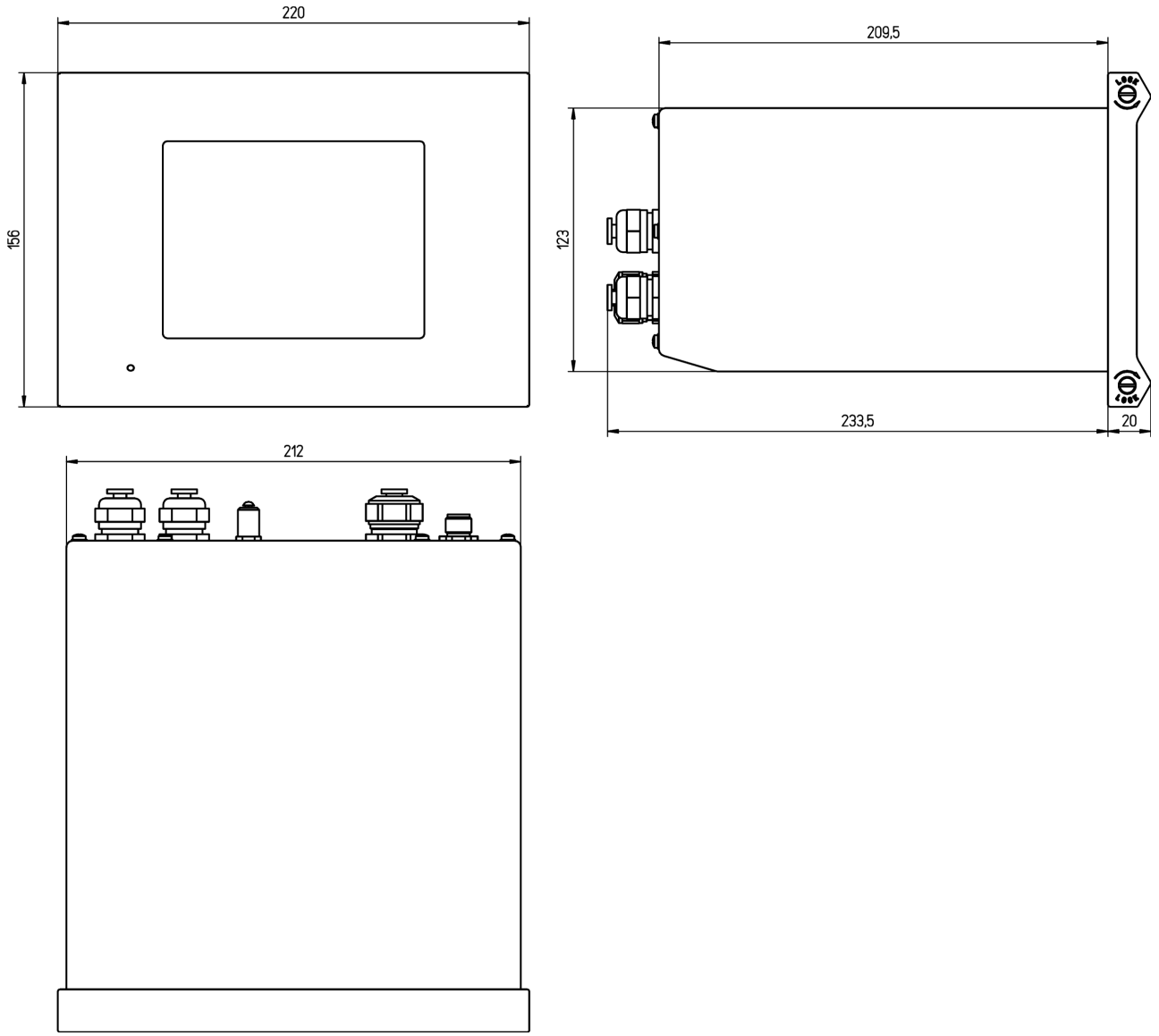


Figure 7 Panel mount instrument dimensions (in millimeters)

3.4.2 Mounting

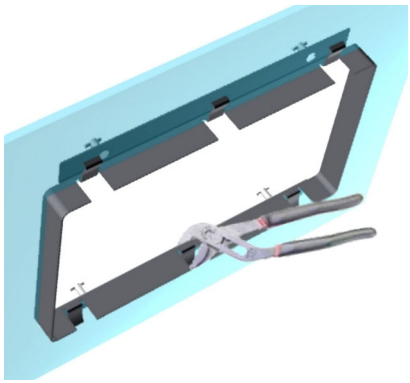


Figure 8 Panel mount bracket frame

1. Cut an opening in the panel to accommodate the bracket frame provided (this is the same size as previous generations of ORBISPHERE type 3600 instruments).

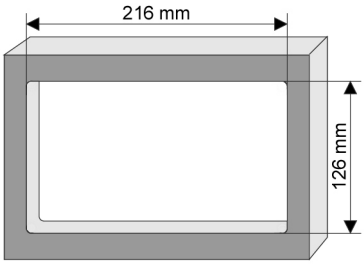
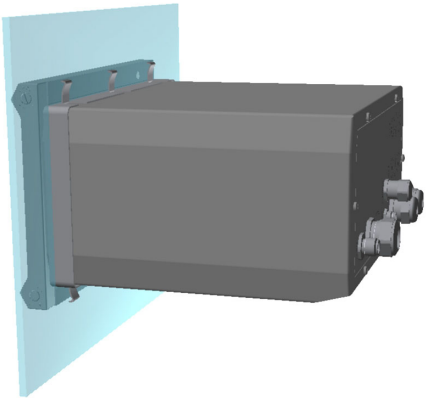
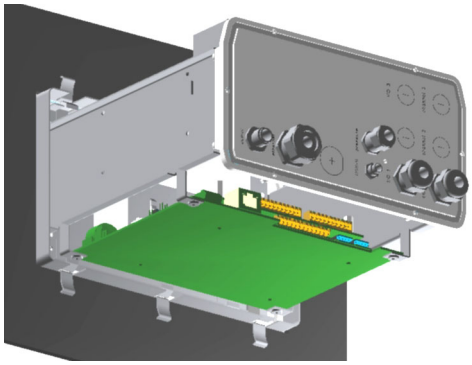


Figure 9 Opening dimensions

2. Install the provided frame in the opening
3. Fold the 6 tabs over the panel lips, using adjustable joint pliers.



4. Slide the instrument in the bracket frame. The instrument should go over the four “T” pins. Rotate the 4 fast locking screws on both sides of the front panel and slide it in.
5. Rotate the 4 fast locking screws 1/4 turn twice in the lock direction as indicated on the side of the front panel. This locks the instrument in place on the four “T” pins.



6. To access the connections inside the instrument, remove the instrument housing (six screws on the back panel, and slide the housing back out)
7. Pass the cables through the housing, then through the cable gland (if applicable) and then perform the connections as detailed below.

Note: *Do not forget to pass the cable through the housing before passing it through the cable gland on the back panel.*

Alternative instrument mounting procedure
When it is not convenient to work from the back of the panel, the instrument can be connected before fitting in the panel.

1. Install the panel support frame in the panel opening
2. Slip the cables through the panel opening
3. Remove the instrument cover
4. Slip the cables through the instrument cover
5. Slip the cables through the instrument back panel cable glands
6. Connect the cables to the instrument electronic boards
7. Tighten the cable glands
8. Reinstall the instrument cover
9. Install the instrument in the panel opening

3.4.3 Connection panel (bottom of instrument)

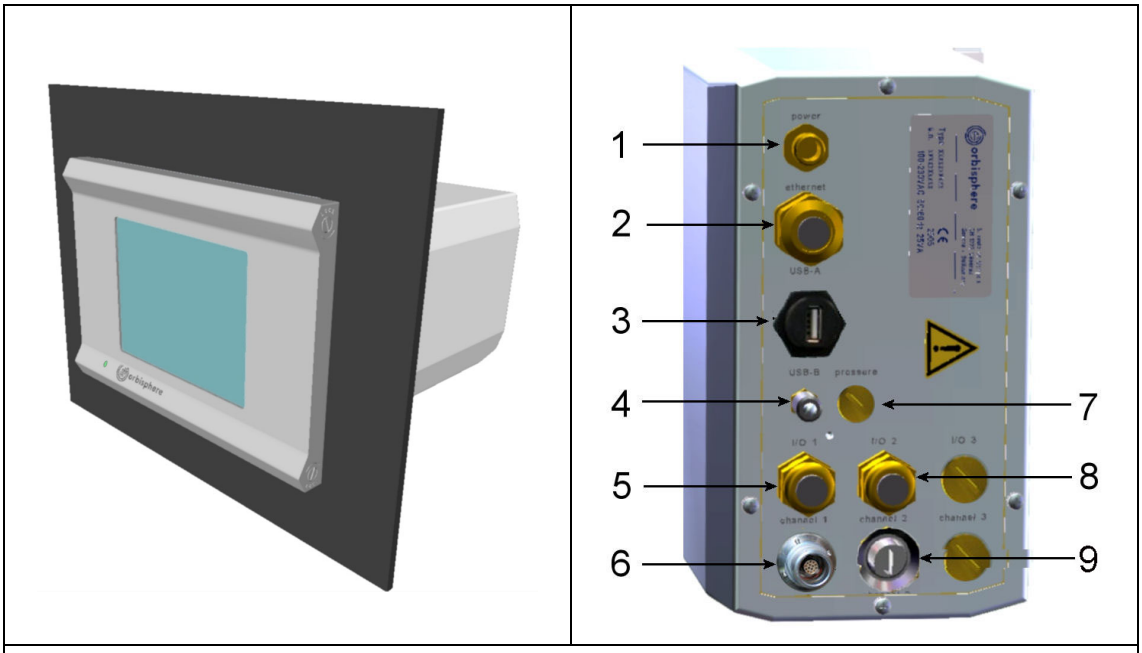


Figure 10 Panel mount connection panel

1. Power cable
2. Ethernet cable gland
3. USB-A host connector for mass storage device
4. USB-B 4 pin connector (reserved for Hach Lange service technicians)
5. Input/Output 1 cable gland
6. K1200 Sensor connection
7. External pressure sensor connection
8. Input/Output 2 cable gland
9. TC Sensor connection

3.5 Connection to mains power supply

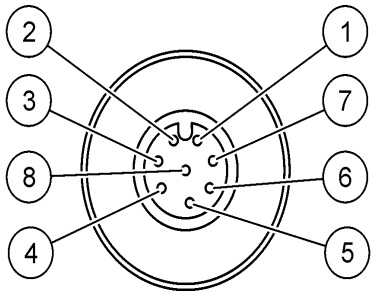
3.5.1 Power supply connection (low voltage instruments)

For low voltage instruments (10-30 VDC), connection to the mains power supply is with a 7-pin BINDER connector (supplied).

Connect the power cable to the connector as follows:



Figure 11 Wall mount BINDER connector



Pin Connections:

1. Power 10-30 VDC
2. Ground
3. Ground
4. Ground
5. Not used
6. Power 10-30 VDC
7. Power 10-30 VDC
8. Earth

3.5.2 Power supply connection (high voltage instruments)

High voltage instruments (100-240 VAC) have a 4-pin male connector pre-wired internally with a male BINDER connector ready for mains connection. A compatible female connector is supplied with the instrument.

If this female connector was supplied with a mains power plug already pre-attached (cable part numbers 33031, 33032, 33033 and 33034) then the female connector can be plugged directly into the instrument power connector. The two connectors are grooved to avoid an incorrect fitting. Tighten the female connector to the instrument power connector finger-tight.

If no power cable was ordered with the equipment, a mains power plug must be connected to the supplied female connector as described in the following procedure.

CAUTION

Personal Injury Hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

User-supplied power cable specifications:

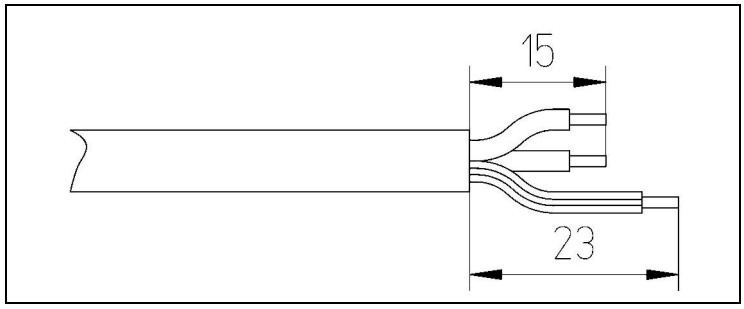
- 3-wire (live, neutral and earth)
- cable Ø ≥ 7mm; ≤ 9.5mm
- wire selection ≥ 1mm^2, AWG18; ≤ 2.5mm^2, AWG14

WARNING

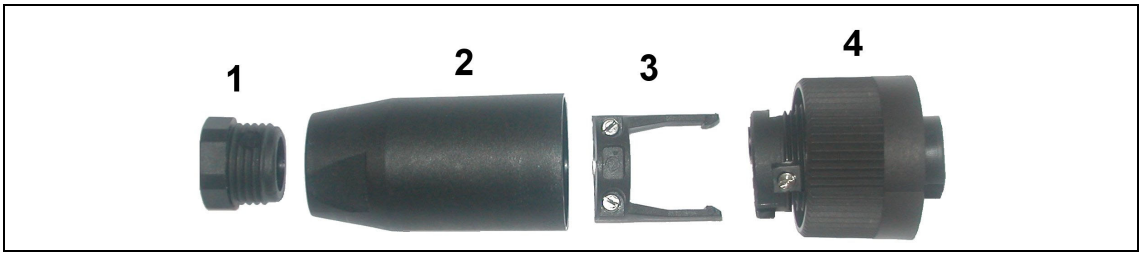
Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

Prepare the user-supplied power cable as follows:

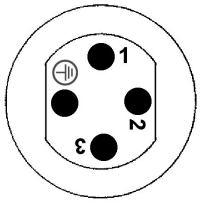
Strip off 23 mm (0.9 ins.) of shielding from the power cable. Cut back the live and neutral wires to 15 mm (0.6 ins.) in length but leave the earth wire as is. Then strip off a small amount of external insulation from the three wires as required:



Wire the female connector as follows:



1. Take the narrow end of the connector (4) in one hand and the main body (2) in the other and unscrew the two. Pull away the cable clamp (3) and unscrew the end plug (1) to reveal the four parts that make up the connector.
2. Loosen the screws on the cable clamp (3) to allow enough room to pass the power cable through.
3. Pass the power cable through the end plug (1), the main body (2), and the cable clamp (3), and then connect the three wires (live, neutral and earth) to the connector (4) as follows:

	1) Live (brown) 2) Neutral (blue) 3) Not used Earth (green and yellow)	***Note:*** *The numbers and earth symbol are stamped on the end of the connector. Ensure it is connected correctly.*

4. Slide the cable clamp (3) back onto the connector (4) and tighten the screws on the clamp to secure the cable.
5. Screw the two parts (4) and (2) back together.
6. Secure the power cable by screwing the end plug (1) back in place.
7. The female connector can now be plugged directly into the instrument power connector. The two connectors are grooved to avoid an incorrect fitting. Tighten the female connector to the instrument power connector finger-tight.

3.6 Connections to electronic boards

NOTICE	
	Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

Note: *Any loose connection wires should be bundled tightly together with the use of nylon cable ties.*

3.6.1 Sensor cable

An ORBISPHERE cable (10 wire shielded, Part N° 32505.mm) is needed to connect the sensor(s) to the instrument. The instruments have a Lemo 10 socket on the back panel where the sensor cable has to be connected.

3.6.2 Electronic boards connectors

Connectors P8 on the main board, and connectors J7 and J8 on the measurement board(s) are made of two parts. Push down carefully the black levers on either side of the connector and pull it out securely. Perform all connections with these connectors unplugged. Once finished, attach the connectors to the boards by pushing them firmly in place (levers up).

3.6.3 Main board connections

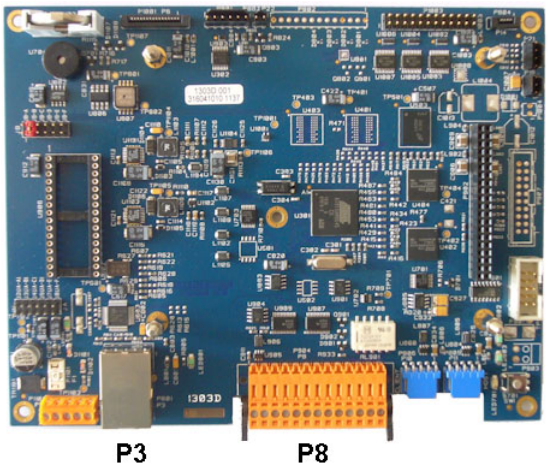


Figure 12 Main board

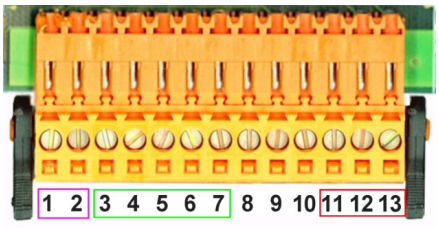


Figure 13 Connector P8

Connector P8:	
1. RS-485 (signal A)	**8.** Not used
2. RS-485 (signal B)	**9.** Not used
3. PROFIBUS-DP (GND)	**10.** Not used
4. PROFIBUS-DP (+ 5 V)	**11.** System alarm relay (N.O.)
5. PROFIBUS-DP (signal -)	**12.** System alarm relay (N.C.)
6. PROFIBUS-DP (signal +)	**13.** System alarm relay (Common)
7. PROFIBUS-DP (signal RTS)	

Connector P3
Ethernet RJ 45. Connect the wall and panel mount instruments to the local network by passing an ethernet cable through the ethernet cable gland (location illustrated in Figure 6 on page 24 for the wall mount and Figure 10 on page 27 for the panel mount). Connect to the P3 connector illustrated above.

3.6.4 Measurement board

The different measurement boards for the LDO and TC sensors are illustrated in Figure 14 and Figure 15 below. The type of board is easily identified by the J8 sensor connector. This connector is only present on TC boards.

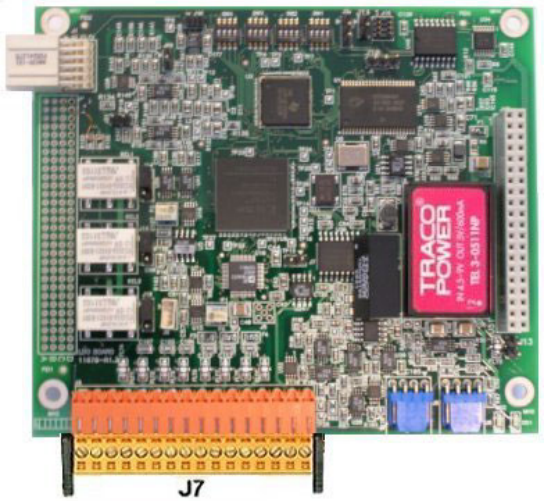


Figure 14 LDO Measurement board

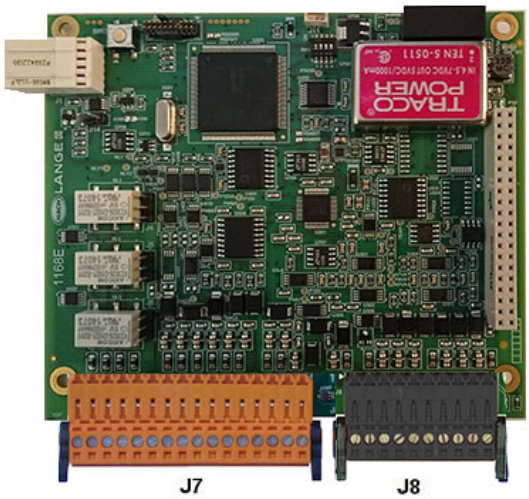


Figure 15 TC Measurement board

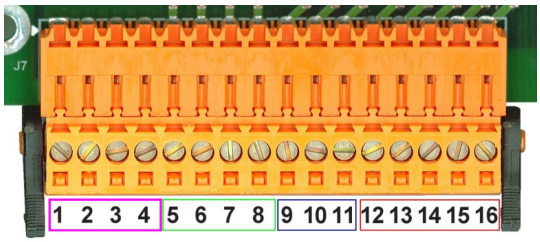


Figure 16 Connector J7

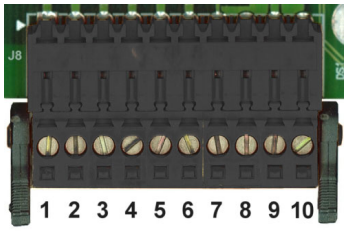


Figure 17 Connector J8

Connector J7 (inputs & outputs)

Measurement alarms relays

1. Common
2. Output relay 1
3. Output relay 2
4. Output relay 3

Note: *Relays N.O. or N.C. depends on the jumper position on the relays (see Measurement alarm relays on page 32).*

Analog current (or voltage) outputs

5. Analog GND
6. Output 1
7. Output 2
8. Output 3

Digital inputs

9. Hold input. To deactivate the sensor from a PLC system, connect a dry contact between J7.9 and J7.12
10. Not used
11. Not used
12. Digital GND
13. **to 16.** Not used

Analog inputs (when ext. press. sensor is directly connected)	Analog inputs (when ext. press. sensor extension, Part N° 32548.xx, is used)
14. GND	**12.** GND
15. Green: Input ext. press. sensor P+	**13.** Green: Input ext. press. sensor P+
16. White: Input ext. press. sensor P-	**14.** Yellow: Input ext. press. sensor P-
17. Red: Output ext. press. sensor +	**15.** White: Output ext. press. sensor +
18. Black: Ground (GND)	**16.** Brown: Ground (GND)
Note: *On multi channel systems, the external pressure sensor must be wired to the channel 1 measurement board, but the signal is used to compensate all channels.*	

3.7 Measurement alarm relays



The three output relays are located on the measurement board.

They can be individually configured to Normally Open (NO) or to Normally Closed (NC) by physically moving the jumper on each relay.

The LDO sensor measurement board is used as an example:

- Upper relay (J14) is set to NC
- Middle relay (J18) is set to NO
- Lower relay (J19) is shown with no jumper

The following table shows the relay number associated with the numbered connection for each sensor type:

Sensor type	Relay 1	Relay 2	Relay 3
LDO	J14	J18	J19
TC	J4	J5	J6

3.8 Sensor installation

3.8.1 Purge gas system for the TC sensor

NOTICE
Do not place the TC sensor into a liquid sample until a constant supply of dry purge gas has been connected, as liquid could condense inside the measuring chamber and cause damage to the thermal conductor chip.

To ensure the continuation of purge gas while the sensor is in contact with the sample, it is highly recommended to use a backup purge gas cylinder with an automatic changeover valve that activates when the first cylinder is empty.

The use of an ORBISPHERE Model 29089 gas regulator (or similar) is also recommended to deliver a constant, pressure regulated supply of dry purge gas to the sensor, filtered to 40 µm.

In addition, and to prevent any damage to the sensor electronics, the use of a purge safety backup unit (ORBISPHERE Model 32605) is highly recommended to ensure the supply of purge gas remains uninterrupted to the sensor in the event of a mains power outage.

3.8.1.1 Purge gas regulator

The role of the ORBISPHERE 29089 gas regulator is to deliver purge gas filtered at 40 µm. Attach the unit to a suitable bracket, using the M3 threaded holes on the back. It's position should be vertical ± 5%. The gas flow is indicated by an arrow on the regulator's body. See also TC sensor purge gas pressure regulator on page 14.

Maintenance:
Drain the condensate periodically. Unscrew by hand the drain at the bottom of the bowl.

If filter is contaminated:

- Turn off the gas supply
- Unscrew the bowl by hand
- Unscrew the black disc at the bottom
- Remove the white composite filter
- Wash under clean tap water, blow dry, and install



3.8.1.2 Purge gas supply

Note: *Check the purge gas specifications in TC sensor purge gas pressure regulator on page 14 of this manual.*

Make sure there is no interruption in the purge gas supply. The use of a backup gas cylinder and an automatic changeover valve, that activates when the first cylinder is empty, are recommended.

Use a 6 mm flexible (nylon or PVC) or rigid (stainless steel) line to connect the pressure regulator and thermal conductivity sensor to the purge gas supply. Swagelok connectors (6 mm or 1/4") are provided.

A short length of plastic tube is supplied for the purge gas to exit the sensor. To insert, push the tube firmly into the orifice. To remove, push on the ring surrounding the tube, and pull the tube out. For certain applications such as waste gas, a 3 mm (1/8") Swagelok fitting is provided for the purge gas exit, to enable safe evacuation of an eventually hazardous gas.

A source of dry and filtered gas (pure at 99.8%) is required with a flow rate set at 10 to 50 ml/min., and a pressure regulated at 2 bar gauge. Do not exceed this, since excess pressure will deform the membrane and change measurements.

To check the flow rate, put the exit tube into a cup of water. With the instrument turned on, you should see at least three bubbles per second during the purge cycle (or select the "Continuous Purge" function in the instrument "Options" menu).

NOTICE
Potential Sensor Damage. Do not leave the exit tube in water, as there is a risk that moisture will get sucked back into the sensor and damage it.

3.8.1.3 Purge gas backup unit

The gas analyzer must be switched on at all times, and purge gas must be constantly supplied to purge the sensor cell, to prevent damage to the sensor electronics. However, in the event of a mains power outage, the 32605 purge backup unit ensures that the purge gas supply to the TC sensor is not interrupted at any time. The cycle is slower than usual (around one minute), for approximately four days. The green LED is on as long as the battery charge is OK. The red LED is on when charging is needed. To save batteries, both LEDs are out when the backup unit is in use, and mains power is out.	

The 32605 purge backup unit is connected between the instrument and the sensor. The internal batteries are automatically charged through the sensor cable when the instrument is turned on.

3.8.2 Sensor positioning information

The sensor must be installed in a socket or flow chamber that allows contact with the sample fluid to be analyzed.

The sensor and measuring instrument are connected by a cable. The standard sensor cable lengths are 3, 5, 10, 15 and 20 meters.

Ensure that the sensor will be mounted:

- perpendicular to the pipe
- horizontal
- on a horizontal pipe section (or on flow-ascending vertical pipe)
- minimum of 15 meters away from the pump's discharge side
- in a place where the sample flow is stable and rapid, and as far as possible from:
  - valves
  - pipe bends
  - the suction side of any pumps
  - a CO_2 injection system or similar

Note: *There may be situations where not all the above conditions can be met. If this is the case, or you have any concerns, please consult your Hach Lange representative to appraise the situation and define the best applicable solution.*

3.8.3 Recommended sample flow rate

For optimal response time, the recommended sample flow rate is 150 mL/min.

Control the flow with the outlet valve on the flow meter (No. 3 in Figure 18 below) to avoid foam developing inside the flow chamber which could lead to erroneous oxygen measurement values.

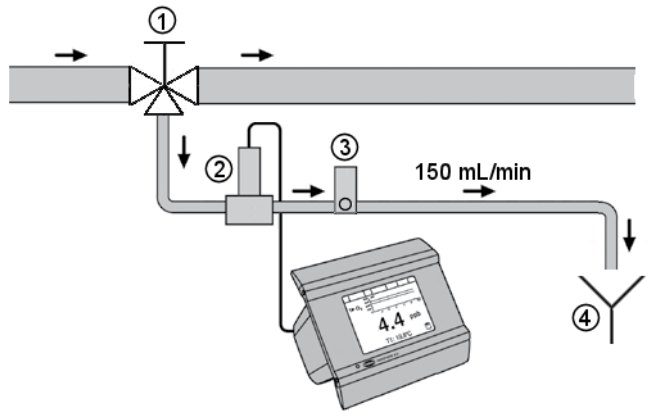


Figure 18 Typical measurement schematic

1. Valve to redirect sample for measurement	**3.** Flow meter with outlet valve
2. Sensor and flow chamber combination	**4.** Drain

3.8.4 Sensor insertion

- Insert the sensor straight into the flow chamber or socket. Do not twist the sensor.
- Hand tighten the attaching collar.
- Connect the sensor cable.

Check for leaks; replace O-rings if product leaks are visible.

3.8.5 Sensor removal

- If not using the ORBISPHERE 32003 insertion/extraction valve (see details in The 32003 insertion/extraction valve on page 37) you will need to shut off the sample flow and drain the sampling circuit of liquid.
- Remove the sensor cable connected at the sensor end.
- Hold the sensor body in one hand to avoid rotation, and unscrew the collar with the other hand.
- Pull the sensor straight out of the socket or flow chamber.
- Install sensor storage cap and sensor base (to protect the connection).

3.8.6 Weld-on stainless steel socket

The ORBISPHERE 29501 weld-on sensor socket can be used to install a sensor into a stainless steel pipe (min.Ø 50 mm or 2”). When welding the socket to the pipe, check that setback between the pipe’s inner diameter and the sensor tip does not exceed 4 mm (see diagram).

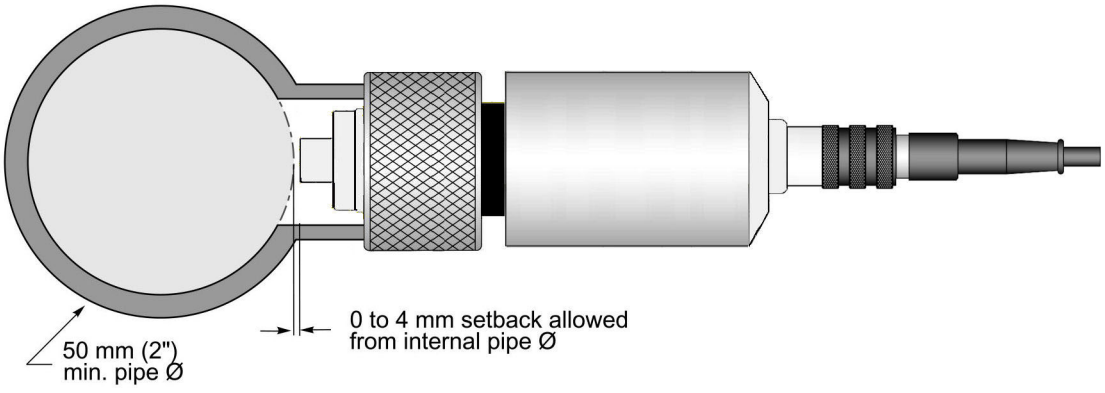


Figure 19 Weld-on sensor socket

Note: *Be sure to remove the two O-rings from the socket before welding and leave the sensor’s stainless steel cap screwed on during welding to prevent thread distortion.*

Recommendation:

To facilitate sensor removal and installation, we suggest installing the socket in a location where the liquid can be drained quickly and easily. By creating a one meter long piece of pipe (see Figure 20) with shut off valves at both ends, just a small volume of liquid needs to be drained to enable sensor removal.

Also, a precise sensor and socket installation can be performed in the workshop, and this assembly can be placed in the production line with minimal down time.

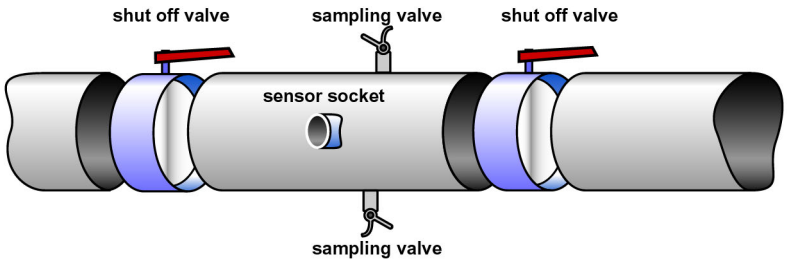


Figure 20 Installation in-line

3.8.7 The 32003 insertion/extraction valve

The ORBISPHERE 32003 insertion/extraction valve (illustrated below) allows for sensor removal and installation without having to drain the fluid in the line. It can withstand a pressure of up to 20 bars, with the sensor in place or not.

Sensor insertion is made by inserting the sensor into the housing and tightening the retaining collar until it stops. As the retaining collar is tightened, the valve will open to allow the sample to flow past the sensor head. Remove the sensor by unscrewing the collar and pulling the sensor out. As the collar is unscrewed, the valve will automatically close to avoid any sample spillage.

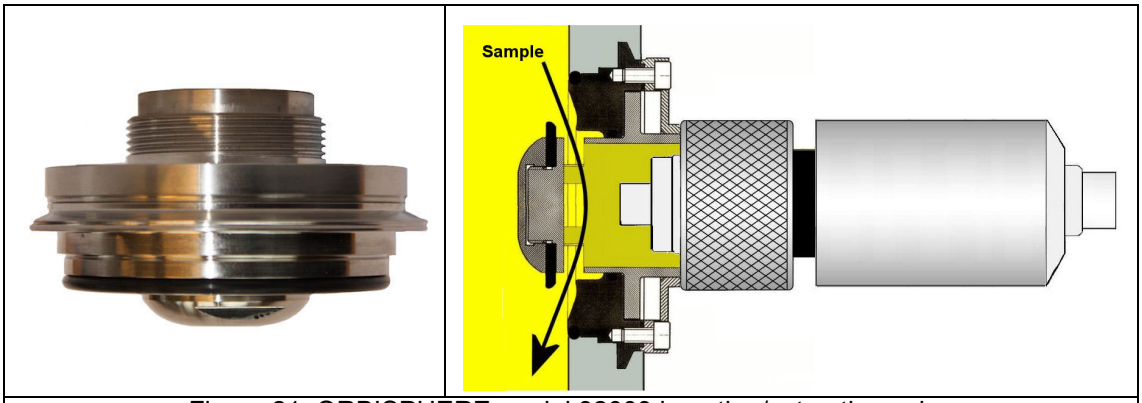


Figure 21 ORBISPHERE model 32003 insertion/extraction valve

The diagram above right, shows the sensor in a sample line with the valve open.

3.8.8 The 33095 sensor housing

Another type of sensor housing (the ORBISPHERE 33095 housing) is available for use with the K1200 sensor but requires that the sample flow be turned off prior to insertion or removal of the sensor.

Sensor insertion is made by inserting the sensor into the housing and tightening the retaining collar until it stops. Removal is made by unscrewing the collar and pulling the sensor out. Be sure that the sample flow has been turned off before inserting or removing the sensor.

3.8.9 Tuchenhagen Varivent® in-line access unit

The following illustration shows the Tuchenhagen Varivent® In-Line Access Unit.



Figure 22 Tuchenhagen Varivent® in-line access unit

Purchasing a Tuchenhagen Varivent® in-line access unit, or an equivalent fitting with a 68 mm flange diameter from the fitting manufacturer, is required to make use of the ORBISPHERE model 32003 or 33095 sensor housing devices detailed above.

3.8.10 Instrument connections

The sensor is supplied with a cable having a LEMO connector at both ends. One end is attached to the sensor and the other to the instrument.

A red dot can be seen on each LEMO connector and on both the sensor and instrument sockets. Be sure to line up these red dots when connecting the cable to the sensor and instrument. The LEMO connector can then simply be pushed into place.

Refer to the illustration of the connector panels for the correct instrument socket to attach the cable (see Figure 6 on page 24 for the wall and pipe mount instruments or Figure 10 on page 27 for panel instruments).

3.9 Calibration devices

3.9.1 Portable calibration device - K1200 sensor

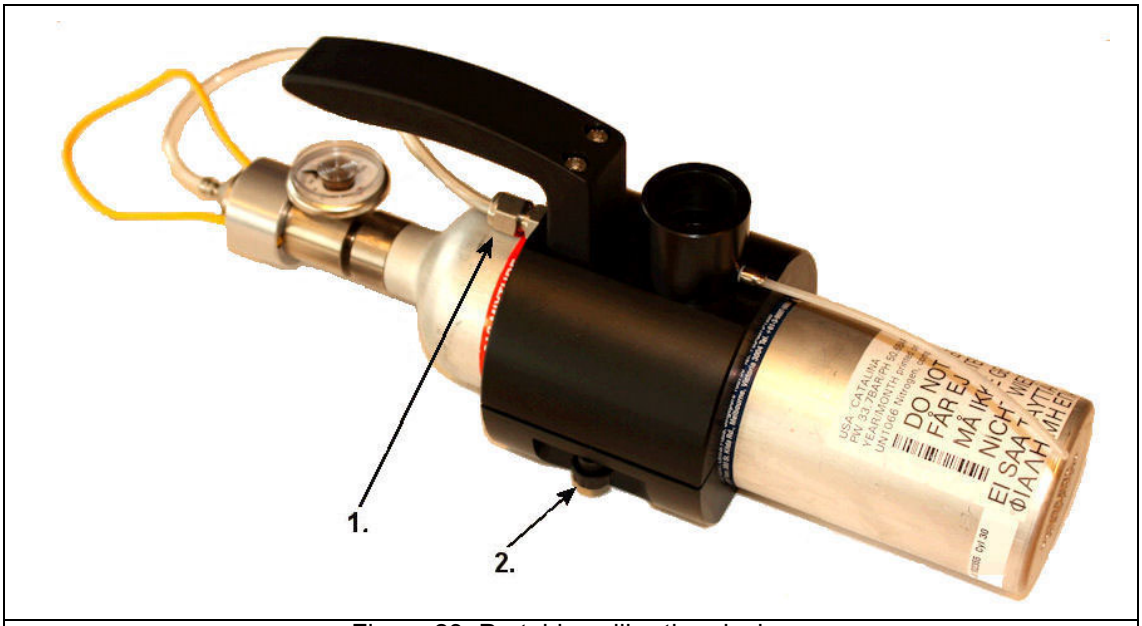


Figure 23 Portable calibration device

The portable calibration device (part number 33088 illustrated above) is ideal for calibrating the sensor close to its location in the sample.

The device is designed to hold a 1 liter gas cylinder (as shown above), but is fully compatible for use with other kinds of gas cylinders. When using other types of gas cylinders, simply connect the gas supply to the Swagelok™ connector (No. **1** in Figure 23), and make sure that the inlet gas pressure does **not** exceed 2 bars absolute.

The gas bottle is not supplied and must be purchased locally. To ensure the calibration works correctly, the calibration gas bottles must be of 99.999% (50) quality or better. Bottles containing 34 liters of compressed gas, with a 5/8-18 UNF (C10) fitting are compatible with the hand-held calibration device and recommended for this purpose.

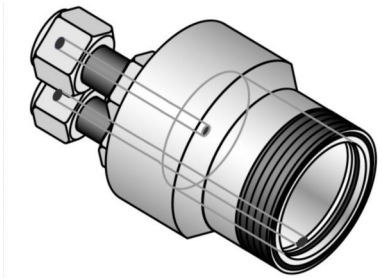
Empty gas bottles are easily removed from the device. Simply unscrew the small black screw (No. **2** in Figure 23) a few turns, slide the bottle out of the black plastic holder, and unscrew the bottle from the pressure reducer. Follow this same procedure in reverse order to install a new bottle.

3.9.2 ORBISPHERE flow chambers

Note: *This is the recommended option for the K1200 sensors.*

The ORBISPHERE flow chambers are used to draw the calibration sample past the sensor.

They connect to 6-mm or ¼" stainless steel tubing by means of two Swagelok™ fittings. If necessary, copper or plastic tubing with low permeability can be substituted.

	Dimensions of sensor and flow chamber assembly : • Width: 50 mm • Height: 210 mm (add 100 mm for connection length)

Section 4 User Interface

4.1 Instrument

The instrument front panel provides these user interfaces:

- A touch screen acting as display, touch pad and keyboard. Contrast can be adjusted.
- A LED, showing when the instrument is on.
- A buzzer which sounds each time the screen is touched, and when an event alarm is set.

Turning instrument On and Off

There is no power switch for the wall or panel instruments. The mains must be disconnected to turn the instrument off. The LED indicates when the instrument is on.

Measurement window

The main (numeric) measurement window continuously displays:

- Sensor numeric values
- Measured sensor trends (for the last 10 minute to last hour)
- Measured sensor data alarm limits and other events
- Temperature

4.2 Touch screen

The user interface on the front panel is a 320x240 pixels display with touch screen. To make navigation user friendly, the interface software is Windows CE based, providing easy selection through menus.

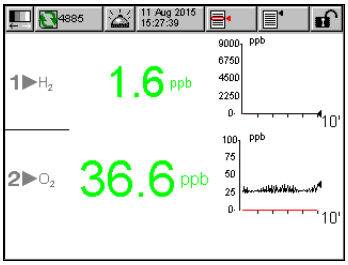


Figure 24 Numeric view

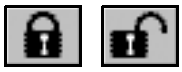
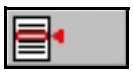
All the measurement, configuration, calibration and "standard service" routines can be called by pressing buttons and menu bars on screen.

Measurement displays shows one measurement slope.

The display can be configured to only show a sensor measurement, or to show a parameterized graphic representation of the last measurements.

Touching some items on the display calls a related function, similar to a shortcut.

4.2.1 Function keys on the header bar

	Shortcut to the user login window. Pressing this button for more than 2 seconds calls the ID and password window (see Identification and authorization level on page 44). • Closed padlock indicates that the touch screen is locked. • Open padlock indicates that the instrument is in view mode only, but no user is logged in (level 0). • When a user is logged in, this box show the authorization level of this user as 1, 2, 3 or 4 (4 being the highest, see User management on page 92).
	This icon is used for adjusting the display brightness to improve visibility. It is available all the time to any user, regardless of the user security level. This icon is a shortcut to the backlight adjustment window. See Screen on page 100
	Short cut to the data storage window. Number shows the number of measurement currently stored in volatile memory. • No storage • Store once: When the buffer is full (10,000 positions), the recording of measurement stops. • Rolling buffer: When the buffer is full, the latest measurement set replaces the oldest one (first-in, first-out)
 normal - snooze	In the event of an alarm, the “snooze” button stops the instrument buzzer and returns all the relays in the instrument to their normal state during the "snooze time". The icon indicates if the alarms is on “snooze” or not. This "snooze" is configurable (see Configure snooze on page 66).
	Current date and time. This is also a shortcut to the date and time setting window.
	Call the contextual menu. This menu is in the header bar and its content is related to the view displayed.
	Opens the main menu page for easy navigation through all available menus.

4.2.2 Menu navigation

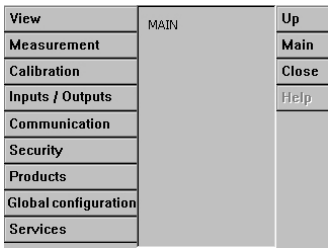


Figure 25 Main menu window

Pressing the “menu” button in the header bar calls the main menu. The display is made of three columns:

- The left column is the menus, or submenus (greyed out options are not available)
- The center column shows a tree view of actual position inside the menu structure
- The right column has the generic controls detailed below.

Up	Return to previous menu (one step back)
Main	Jump directly to main menu
Close	Close the menu and go back to measurement view display. If the menu button is pressed again, the menu returns to its previous state (tree structure is saved)
Help	Help topics concerning current menu

4.2.3 Rolling list

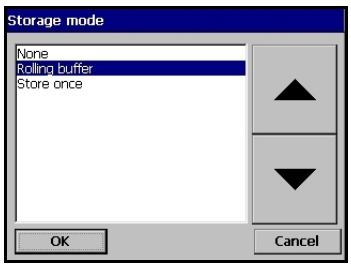


Figure 26 Rolling list example

For convenience, selection through a possible large list of items has been designed with a rolling list, like in this example. Use the up and down arrow to navigate, or select directly one item and press OK.

4.2.4 Virtual keyboard

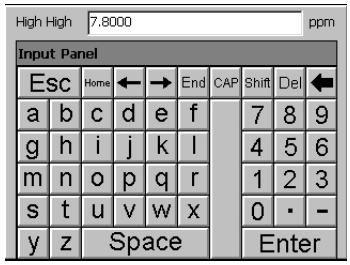


Figure 27 Virtual editing keyboard

When a text box (alphanumeric field) has to be edited and is pressed, a virtual keyboard appears on screen. It can be used as a PC keyboard (pressing CAP gives access to special keys).

Once values have been entered, press the ***Enter*** key to confirm and exit the virtual keyboard.

During the editing, the edited field name is displayed, along with units where applicable.

4.2.5 Identification and authorization level

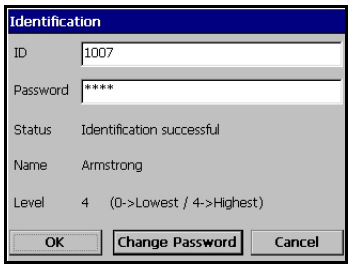


Figure 28 Identification window

Once the access rights have been set, (see User management on page 92) it is necessary to log in as an authorized user to get access to the instrument functionalities and settings.

Press the closed padlock  for two seconds to open the identification window. The user identification and password must be entered to access functionalities authorized by the security level of the given user (5 levels available. See User management on page 92).

For security, when the session inactivity delay period has expired (adjustable, via Configure security on page 92), the user is logged off automatically.

Note: *To get to level 0, press the unlock button and OK, without entering any ID or password.*

4.2.6 Warning windows

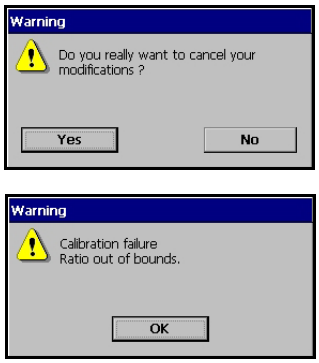


Figure 29 Warnings

At various stages, a warning message may be displayed to request confirmation from the operator that his last action(s) must really be saved or cleared, or that there is a problem that did not enable the requested action, such as during instrument calibration (example shown left).

4.3 Main menu structure

This is the structure of the main menu which is used to control every functionality of the instrument. These submenus are detailed in the following sections of this Operator Manual.

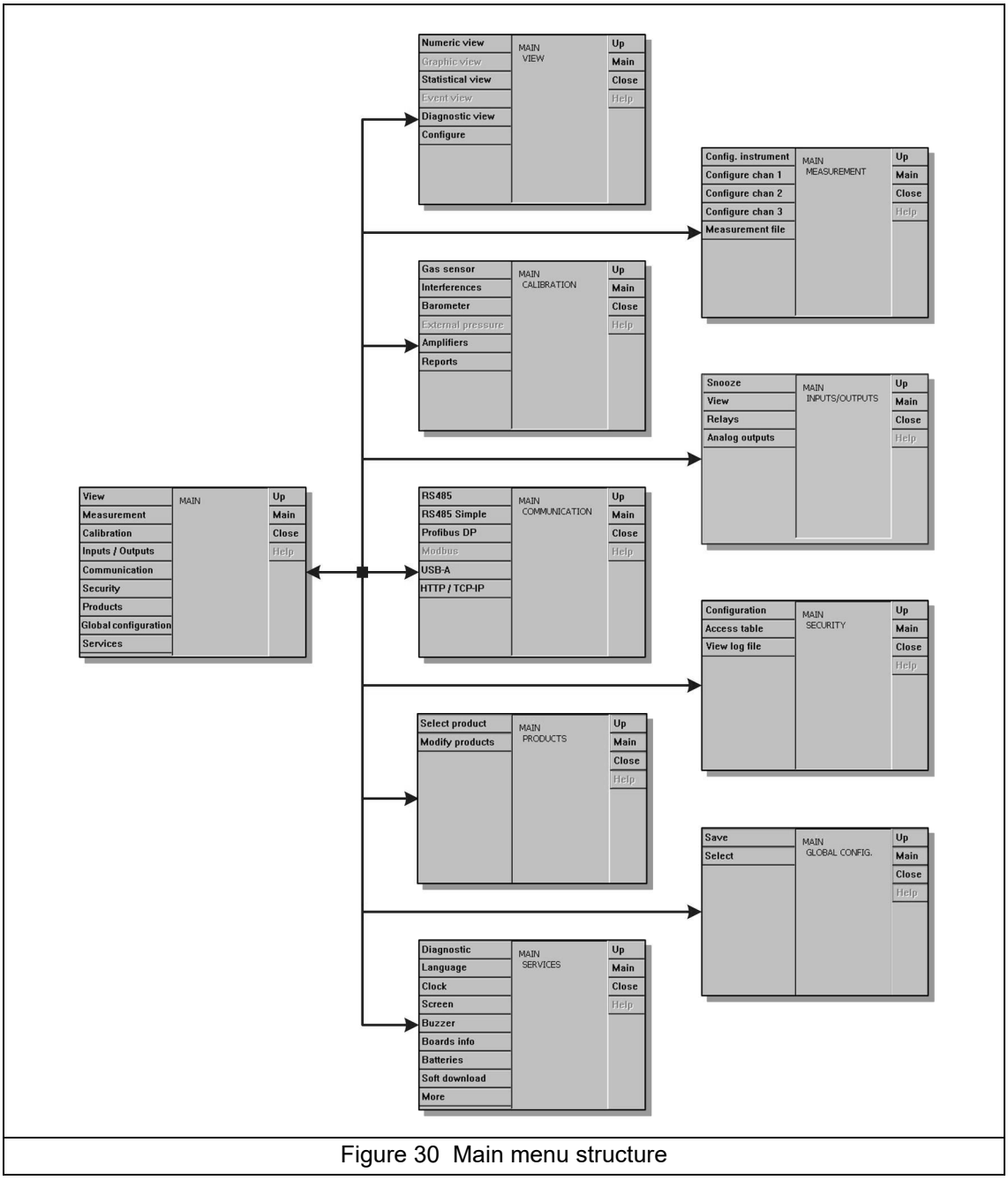


Figure 30 Main menu structure

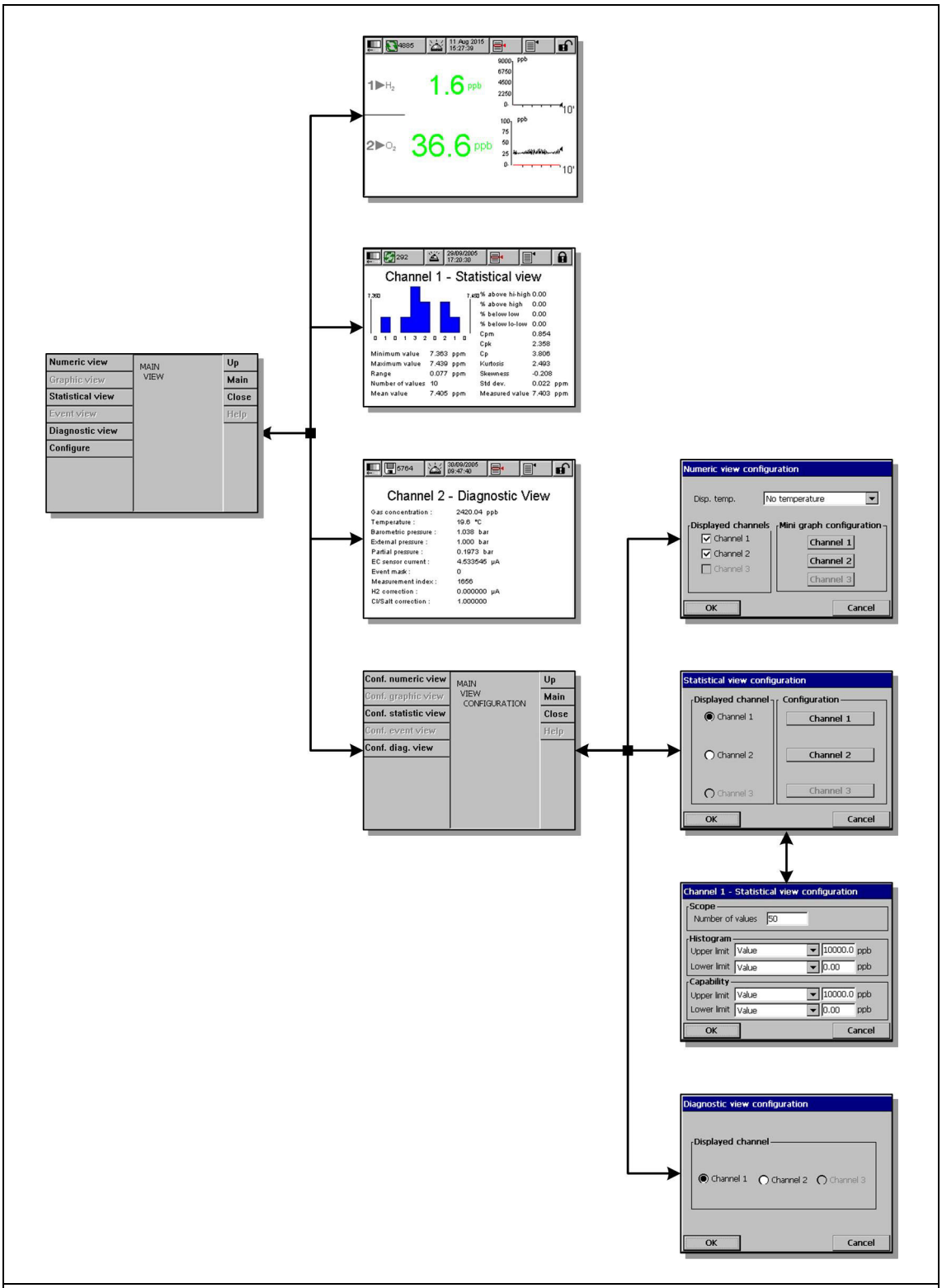


Figure 31 View menu

5.1 Selection of the view style

Numeric view

This is the default view. Display shows the numeric measurement value identified for each gas measurement channel used, a graphic showing measurement value evolution during the set time frame, and sample temperature.

The display is refreshed after each measurement cycle (approximately 4 seconds for the LDO sensor and 20 seconds for the TC sensor).

This display can be configured to suit individual conditions and convenience.

K1200 low range sensors measure dissolved oxygen up to a maximum value of 2,000 ppb. Should the measured concentration go above this value a warning screen will be displayed and the measurement cycle increased from 4 to 60 seconds.

The “> 2.0 ppm” value will blink alternately with an “Out of range” message. An arrow symbol to the right indicates if the value is increasing, decreasing or remaining constant.

Once the value falls below the 2,000 ppb value, then the measurement cycle returns to a 4 second interval.

For K1200 high range sensors, the above also applies but the maximum value measured is 40 ppm. Therefore the out of range message will display “> 40 ppm” which is suppressed when the measured value falls below 40 ppm.

Diagnostic view

The diagnostic view contains useful information for troubleshooting purposes. The amount of information displayed depends on the gas being measured and the channel configuration.

Statistic view

This feature offers statistical data that matches with Total Quality management tools. Statistics is a tool to better analyze how a process behave. The 51x statistics window gives some useful information.

The statistics are calculated from the data in the measurement file. The values are updated each time a new value is added to this file. Therefore the changes made in the configuration window are considered only once a new value is added.

Cp process capability

Cp is an index used to assess the width of the process spread in comparison to the width of the specification. It is calculated by dividing the allowable spread by the actual spread.

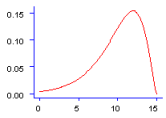
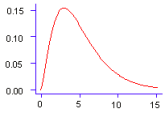
- A Cp of one indicates that the width of the process and the width of the specification are the same.
- A Cp of less than one indicates that the process spread is greater than the specification. This means that some of the data lies outside the specification.
- A Cp of greater than one indicates that the process spread is less than the width of the specification. Potentially this means that the process can fit inside the specification limits

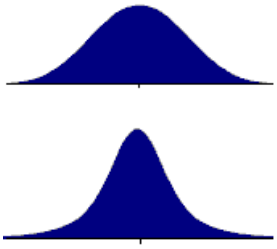
CPk process variability

Cpk takes into account the center of the data relative to the specifications, as well as the variation in the process.

- A Cpk value of one indicates that the tail of the distribution and the specification are an equal distance from the overall average.
- A Cpk of less than one means that some of the data is beyond the specification limit.
- A Cpk greater than one indicates that the data is within the specification.
- The larger the Cpk, the more central and within specification the data.

CPm process repeatability
Capability index that takes into account variation between the process average and the target. If the process average and the target are the same value, Cpm will be the same as Cpk. If the average drifts from the target, Cpm will be less than Cpk.

Skewness	
 negative  positive Figure 32 Skewness	An asymmetric frequency distribution is skewed to the left if the lower tail is longer than the upper tail, and skewed to the right if the upper tail is longer than the lower tail. Distributions of positive-valued random variables values are often skewed right.

Kurtosis	
 Figure 33 Kurtosis	Kurtosis is a parameter that describes the shape of a random variable's probability distribution. The graphs on the left illustrate the notion of kurtosis. The lower curve has higher kurtosis than the upper curve. It is more peaked at the center, and it has fatter tails

5.2 Configuration of the view styles

Numeric view configuration

List of parameters that can be adjusted to customize the numeric view display:

- **Display temperature**: no, channel x
- **Display channel** 1, 2: yes/no
- **Mini graph configuration button, per channel**:
  - Select the information displayed on the grid of the minigraph
  - **Autoranging**: Set automatically the upper and lower bound to get a correct range to enable easier reading of the measurement values.
- **Display time base**: yes/no
- **Display mini graph**: yes/no
- **Upper bound**: Adjust graph upper limit
- **Lower bound**: Adjust graph lower limit
- **Time base**: Adjust graph time span
- **Grid button**: Set up the graph to display the x or y axes, the grid, or the thresholds (see below)
- **Auto Scale update**: Automatically set the graph upper and lower bounds to best fit the actual values displayed.
- **Clean button**: Clear the slope displayed. The slope restarts from the left side.

Diagnostic view configuration

Select the channel to be displayed in the diagnostic window, and press **OK**.

Statistic view configuration

On the left side of the screen, select the channel to be displayed in the statistic window, and press OK.

To configure the statistic view for a channel, select the channel number in the right side of the window, to take you directly to the configuration window.

Scope:

- **Number of values**: Statistic calculation range (from 10 to 10,000 values). Number of values taken in consideration in the log file since the last value stored. The recorded values with alarms are not considered for calculation, but are part of the log file.

Histogram:

- **Upper limit**: Select High or High High alarm value, or a custom value.
- **Lower limit**: Select Low or Low Low alarm value, or a custom value.

Capability:

- **Upper limit**: Select High or High High alarm value, or a custom value.
- **Lower limit**: Select Low or Low Low alarm value, or a custom value.

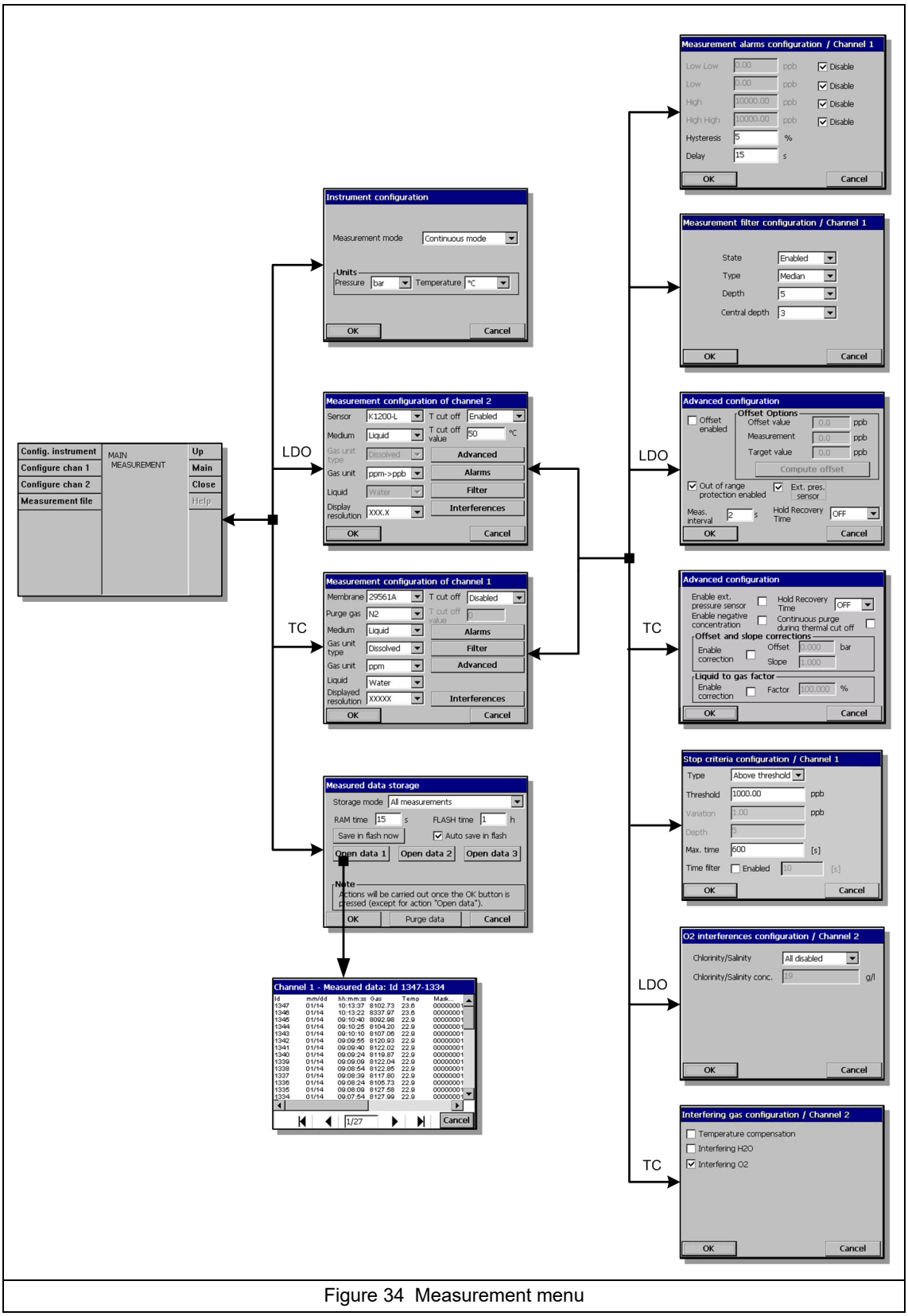


Figure 34 Measurement menu

6.1 Instrument configuration

Continuous mode description

Continuous mode is typically used for process measurement. The measurement mode is a parameter defined for the entire instrument, not for each channel.

Continuous mode cycle

- Every 2 sec. measurements are refreshed on the display
- The relays and the analog outputs are updated
- Measurements are continuously stored in memory (volatile and non volatile memory) according to individual settings

Measurement mode is locked on **Continuous**. Select the units for barometric pressure and temperature.

6.2 Measurement configuration

TC sensor

- Sensor's membrane number selection.
- **Medium**: Liquid or gas phase.
- **Gas unit type**: Partial, Fraction, Dissolved.
- **Gas unit**: The list of available units depends on unit type selected above.

Note: *This is the gas concentration measured by the sensor. When a composite unit is selected (e.g. ppm-ppb) the unit will change depending on the range of the value to display.*

- **Liquid**: When medium is liquid, select water or a liquid with a different solubility (if available).
- **Display resolution**: Maximum resolution depends on gas, membrane and unit. A maximum of 5 digits can be displayed. Decimals can be limited to 0, 1, 2 or 3 decimals for easier reading. That does not affect the actual resolution of data measured and stored, but only the data displayed.
- **Thermal cutoff**: To protect the sensor, the thermal cutoff function allows for setting a sample high temperature limit. If exceeded (during a Cleaning In Place cycle for example) the electrical signal to the sensor is cut off, the measurement session is suspended and the system displays a "HOT" alarm message. The system resumes when temperature drops to 90% of the specified cutoff temperature.
- **Thermal cut off options**: Disabled / enabled.
- **Thermal cut off temperature**: To be set according to conditions. The measurement configuration for a TC sensor is the same as for an EC sensor with the addition of one extra selection criteria:
- **Purge gas**: From the drop-down list, select the purge gas being used for the TC sensor.

Advanced configuration - TC sensor

- **Enable ext. pressure sensor**: Check as appropriate. See External pressure calibration on page 64.
- **Enable negative concentration**: Check as appropriate.
- **Hold recovery time**: This parameter defines the interval during which the outputs remain frozen after the measurement is no longer on HOLD. Set the value to between OFF and 10 minutes, according to the timing of your setup.
- **Continuous purge during thermal cut off**: If thermal cutoff has been enabled (see Measurement configuration on page 52), then check this box to ensure that a continuous purge of the TC sensor takes place while the measurement session is suspended due to the thermal cutoff temperature value being exceeded.

Note: *To manually set the TC sensor into a continuous purge mode, press the* ***Continuous Purge*** *button that is available from the* ***Services - Diagnostic - Channel x - Amplifiers*** *menu. See details in the section entitled TC sensor - Amplifiers on page 99.*

- **Offset and slope corrections**: Enable correction as appropriate.
- If enabled, the correction values for offset and slope must be entered. These values cannot be negative.
- **Liquid to gas factor**: Enable correction as appropriate. If checked, the percentage correction factor must be entered. This value cannot be negative.

Note: *If you believe you need to enable these corrections, it is advisable to contact a Hach Lange Service Representative first.*

K1200 sensor

- **Sensor**: Sensor model.
- **Medium**: Liquid or gas phase.
- **Gas unit type**: Partial, Fraction, Dissolved.
- **Gas unit**: The list of available units depends on unit type selected above.

Note: *This is the gas concentration measured by the sensor. When a composite unit is selected (e.g. ppm-ppb) the unit will change depending on the range of the value to display.*

- **Liquid**: For the K1200 sensor this option is locked on water.
- **Display resolution**: Maximum resolution depends on gas, membrane and unit. A maximum of 5 digits can be displayed. Decimals can be limited to 0, 1, 2 or 3 decimals for easier reading. That does not affect the actual resolution of data measured and stored, but only the data displayed.
- **Thermal cutoff**: To protect the sensor, the thermal cutoff function allows for setting a sample high temperature limit. If exceeded (during a Cleaning In Place cycle for example) the electrical signal to the sensor is cut off, the measurement session is suspended and the system displays a “HOT” alarm message. The system resumes when temperature drops to 90% of the specified cutoff temperature.
  - **Thermal cut off**: It is recommended to enable this feature to maximize sensor life and system performance.
  - **Thermal cut off temperature**: Set to 5°C above sample temperature e.g. if sample temperature is 2°C, set thermal cut-off to 7°C.

Advanced configuration - K1200 sensor

Important Note: *The offset feature described below should be used for minor measurement adjustments only, and not as an alternative to a sensor calibration. Make sure your sensor has been correctly calibrated before applying this feature.*

- **Offset enabled**: Check this box to enable the user measurement offset option. If checked enter an offset value or a target value:
  - **Offset value**: Enter an offset value to manually adjust (increase or decrease) the current measurement value. If the gas unit type or gas unit (defined in the main measurement configuration screen) are changed, the offset value is automatically reset to zero.
  - **Measurement**: This field cannot be updated. It shows the current measurement value with the offset value applied.
  - **Target value**: Enter a target measurement value. The offset value is then automatically computed so that the displayed measurement value will be equal to the target value.
  - **Compute offset**: Use this button to recompute the offset value at any time during the measurement process. The offset value will be computed based on the current and target measurement values.
- **Out of range protection**: Enabled by default. When enabled and the measured value exceeds the instrument specification, the measurement interval will be increased to 1minute to protect the lifetime of the sensor spot. If disabled, the lifetime of the spot can be negatively impacted if the sensor is exposed to high oxygen concentrations for long periods of time.
- **Ext. pres. sensor**: Check as appropriate. See External pressure calibration on page 64.
- **Measurement interval**: This parameter defines the interval for refreshing the measurement value on the display. Set the value to between 2 and 60 seconds, according to your response time requirements.
- **Hold recovery time**: This parameter defines the interval during which the outputs remain frozen after the measurement is no longer on HOLD. Set the value to between OFF and 10 minutes, according to the timing of your setup.

Measurement alarms configuration

Set the thresholds for the low/high concentration levels, according to the application. Each alarm type can be individually enabled or disabled without losing its settings.

These events can activate the relays and can be displayed.

- **Low-low**: 2nd stage for too low concentration
- **Low**: 1st stage for too low concentration
- **High**: 1st stage for too high concentration
- **High-high**: 2nd stage for too high concentration
- **Hysteresis**: A percentage of the above concentration values. The hysteresis is used to prevent relay “flickering” when the measurement is just at the alarm levels. Set this to a minimum, but enough to eliminate flickering.

  As an example, if the High Alarm is set to 40 units and the Hysteresis is set to 10%, then the High Alarm is activated once the measurement reaches 40 units, but only deactivated once the measurement drops below 36 units. With the Low Alarm the opposite is true, in that if the Low Alarm is set to 20 units and the Hysteresis set to 10%, then the Low Alarm is activated when the measurement drops below 20 units, and deactivated when the measurement rises above 22 units.
- **Delay**: The delay in seconds, before alarms go on whenever concentration values go above ”High alarms” or below “Low alarms”. Set this to a minimum value, but enough to avoid alarms for non-representative peaks beyond the set level.

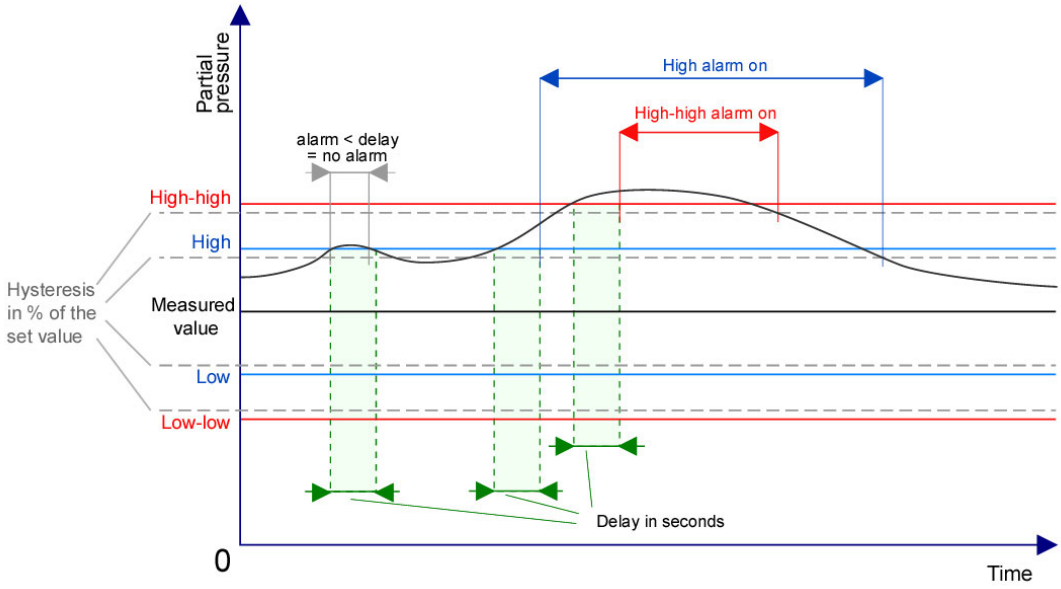


Figure 35 Alarms system diagram

Measurement filter configuration

The filters are aimed at “flattening” the measurement curve in situations where the process shows atypical peak values that could otherwise hamper the interpretation of measurement readings. The filter is applied on the last set of measurements each time a measurement is taken.

- **Mean**: Mathematical average of the last set (depth) of measurement values.
- **Median filter**: Allows for eliminating atypical peak measurement values, and average the remaining ones. The calculation sorts the last measurements set (depth) by values, then delete the highest and lowest values, and averages the remaining values (central depth).

  Example for depth 7, central depth 5:
  Sorted values, both ends eliminated, the average of the center five is then **3.88**.

  0.7 - 1.1 - 4.0 - 4.3 - 4.4 - 5.6 - **7.0**

  Example for depth 5, central depth 3:
  Sorted values, both ends eliminated, the average of the center three is then **4.23**.

  1.1 - 4.0 - 4.3 - 4.4 - **5.6**

  Example for depth 8, central depth 4:
  Sorted values, both ends eliminated, the average of the center four is then **4.43**.

  0.7 - 1.1 - 4.0 - 4.3 - 4.4 - 5.0 - **5.6 - 7.0**

Interferences configuration

These options are available to take into account the influence of some components or gases in the sample during measurement. All available interference corrections are disabled by default.

The following interference corrections are available:

- For oxygen measurements - Salt
- For hydrogen measurements - Temperature, H_2O, He, O_2
- For nitrogen measurements - Temperature, H_2O, O_2, H_2

Note: *If you believe you need to enable any of the above, it is advisable to contact a Hach Lange Service Representative first.*

Interferences in oxygen measurement

In some applications there can be high concentrations of of ClO_2 or other bleaching compounds. This can alter the lifetime of the LDO probe (shorter maintenance interval).

- **Chlorinity/Salinity**: Select Chlorinity, Salt or All disabled. For chlorinity or salt, it is required to enter the actual concentration in the sample.

Interferences in hydrogen measurement

The presence of oxygen in the sample can have an effect on the hydrogen sensor to varying degrees, depending on the membrane being used. The oxygen correction option enables the instrument to correct for this condition.

- **Temperature compensation**: If there is a significant fluctuation in the sample temperature enable temperature compensation to reduce the influence of these temperature fluctuations.
- **Interfering H2O**: This only applies to measurements taken in 100% humid gases or in traces of dissolved gas in water. It allows a correction to the slope and temperature coefficients calculated during calibration.
- **Interfering O2**: If the sample is known to contain oxygen, check this box.

The instrument can also compensate for the presence of helium in the sample.

- **Temperature compensation**: As described above.
- **Interfering H2O**: As described above
- **Interfering He constant**: If helium is the interfering gas enable this option to allow the instrument to correct for the presence of helium in the sample.
- **Interfering He**: If the sample contains a known concentration of helium, check this box and enter the concentration percentage in the box provided.

Interferences in nitrogen measurement

The presence of oxygen in the sample affects the nitrogen sensor. Oxygen produces about three times the effect of an equivalent amount of nitrogen in a TC sensor causing a comparably erroneous displayed value. For example, a properly calibrated nitrogen sensor, placed in air having 80% nitrogen and 20% oxygen would, uncorrected, display approximately 140% nitrogen (80% + 3*20%).

In the beverage application there is often little oxygen present, and this interference can be ignored. However, if this simplification cannot be made use this oxygen correction option to enable the instrument to correct for this condition.

- **Temperature compensation**: If there is a significant fluctuation in the sample temperature enable temperature compensation to reduce the influence of these temperature fluctuations.
- **Interfering H2O**: This only applies to measurements taken in 100% humid gases or in traces of dissolved gas in water. It allows a correction to the slope and temperature coefficients calculated during calibration.
- **Interfering O2**: If the sample is known to contain oxygen, check this box.

The instrument can also compensate for the presence of high hydrogen levels in the sample.

- **Temperature compensation**: As described above
- **Interfering H2O**: As described above
- **Interfering H2**: If the sample is known to contain hydrogen, check this box.

Measured data storage

There is one measurement file per channel which contains the data generated by the measurement cycle. The measurement files are updated in volatile memory, and regularly copied in non-volatile memory (file back-up). At start up, the measurement files in volatile memory are updated with the files from the non-volatile memory.

Note: *When the measurement file is full, it is managed as a First in-First out buffer.*

This dialog box allows adjustment of the parameters for recording and storing measurements.

Storage modes:

- No storage
- **Store once**: When the volatile memory is full (10,000 positions), the recording of measurement stops
- **Rolling buffer**: When the volatile memory is full, the latest measurement set replaces the oldest one continuously (first-in, first-out)

Note: *Data stored in volatile memory are lost when instrument is off, non-volatile memory is permanent. In case of an accidental power off event, the instrument resumes measurement storage after the last measurement stored in flash.*

- **RAM time (volatile memory)**: Delay in seconds between two recordings of measured data.
- **FLASH time (non-volatile memory)**: Delay in seconds between two data file transfers from volatile memory into non-volatile memory. The last data file erases the previous one. This field is only available if the Auto save in flash box is checked.
- **Save in flash now**: Press this button to store measurement data in flash (non-volatile memory) immediately. After pressing this button, press OK to initiate the process. A warning screen appears informing you that the operation can take up to 30 seconds. Press Yes to continue with the process, or No to abort.
- **Auto save in flash**: Check this box to save measurements in flash (non-volatile memory) automatically. Measurements are saved at regular time intervals as defined in the FLASH time box.
- **Start logging measurement**: Store once mode. Starts and stops the measurement recording session. Measurement recording is stopped when the buffer is full.
- **Purge data**: Clear all data for all channels in the volatile and non-volatile memories.
- **Open data 1 or 2**: Opens a table showing the measured values which are stored in the volatile memory (RAM). Use the scroll bar at the right to move to another data range (the id range will be shown in the title bar). The page number being viewed and the total number of pages are shown at the bottom.

  Use the keys at the bottom to move directly to the first page, previous page, next page or last page.

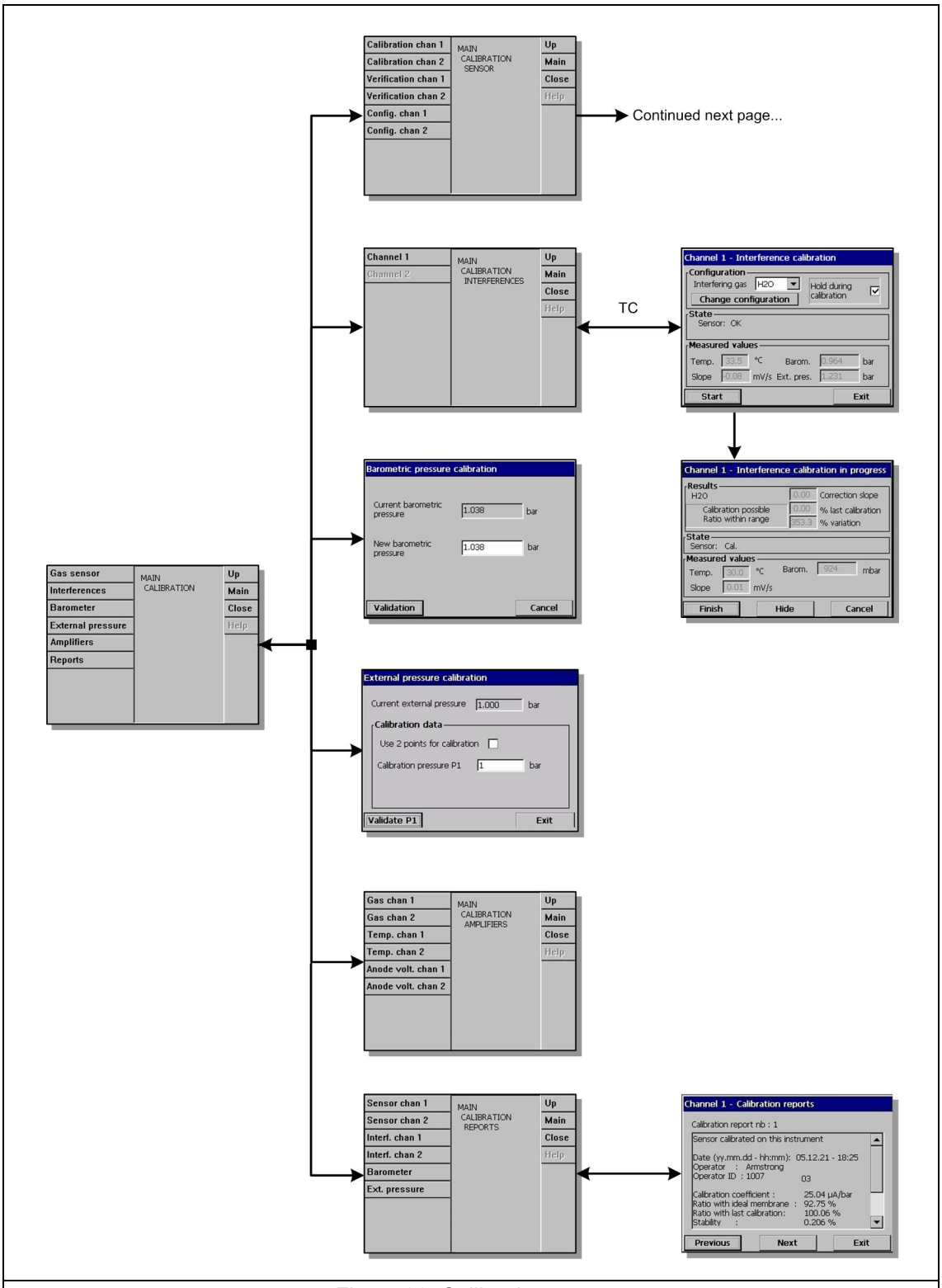


Figure 36 Calibration menu

Note: *The amplifiers calibration option is reserved for Hach Lange service technicians only, and is therefore not explained in this manual.*

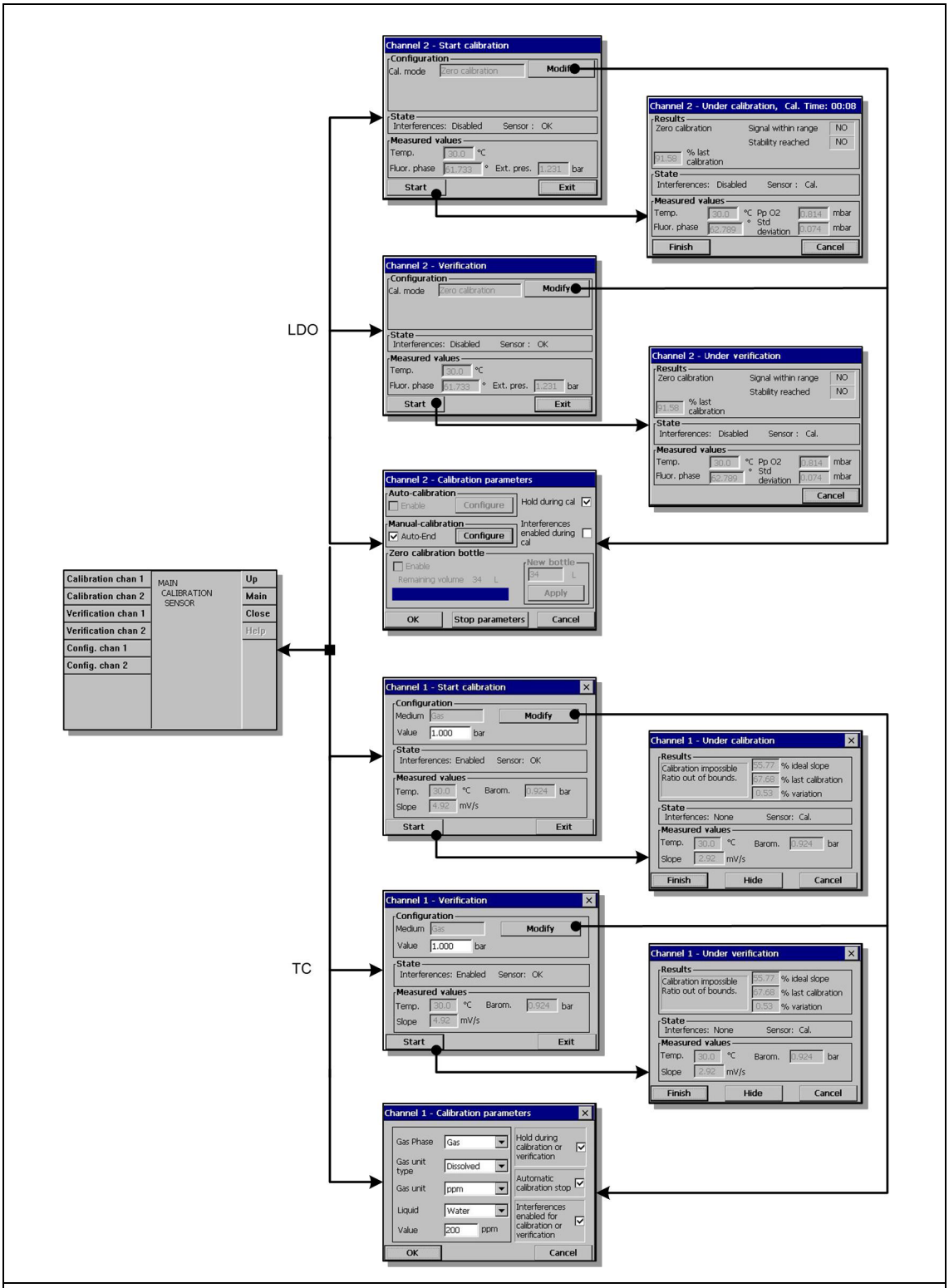


Figure 37 Calibration menu (cont. from previous page)

7.1 K1200 sensor calibration

Sensor calibration

The sensor can be calibrated manually on an ad hoc basis. By default, the mode is set to zero calibration with auto-end (see Calibration configuration on page 60 for more details), but these parameters can be changed.

For higher level concentrations (above 1% oxygen which corresponds to about 400 ppb dissolved O_2) a high level adjustment can be performed using a gas mixture containing more than 1% oxygen, or a known line sample. However, this should not be done without first ensuring the zero point is accurate. This can be achieved by performing a zero calibration first.

Low range sensors: (K1200-L spots)

There are two calibration modes available - zero or high level adjustment. The sensor is factory calibrated at zero. During use, the zero calibration is the best calibration to guarantee the sensor specifications. After a spot replacement, a zero calibration is recommended.

High range sensors: (K1200-H spots)

There are three calibration modes available - zero, high level adjustment or in 100% humid air.

The sensor is factory calibrated at zero and in 100% humid air. During use, humid air calibration is the best calibration to guarantee the sensor specifications. After a spot replacement, a zero calibration and a 100% humid air calibration are recommended.

Initial sensor calibration

The sensor has been calibrated at the factory prior to shipment and is ready for use upon delivery. However, if the sensor has not been used for a period of more than six months since delivery, or if the sensor spot has been replaced or changed in any way, then a sensor calibration will be required.

Select the **Configuration** option from the **Gas sensor** calibration menu to check the calibration parameters.

Ensure the parameters are set up as illustrated left:

- **Auto-calibration**: This option is not available for the K1200 sensor.
- **Manual-calibration Auto-End**: On by default.
- **Hold during calibration or verification**: On by default.
- **Zero calibration bottle**: Ensure this is **disabled** by unchecking the box as it is not relevant for the K1200 sensor.

Exit from the configuration screen by pressing on **OK**. Then select **Calibration** from the **Gas sensor** calibration menu and perform a manual zero calibration as described in Zero calibration on page 61. For high range sensors perform an additional 100% humid air calibration as described in 100% humid air calibration (high range sensors only) on page 61.

Manual calibration

Manual calibrations can be made at any time. Perform a calibration by following these steps:

1. Remove the sensor from the sample line.
2. Rinse the sensor head with clean water.
3. Wipe the sensor head with a clean soft tissue to remove any excess moisture.
4. If using the supplied calibration device (see Portable calibration device - K1200 sensor on page 38), insert the sensor into the sensor holder on top of the calibration device. If not using the calibration device, insert the sensor into the flow chamber.
5. Flow the calibration sample through the calibration device or flow chamber as applicable. If using the calibration device, fully open the valve on the pressure reducer to give a gas flow rate of 0.1 L/min. If you are **not** using the supplied calibration device with pressure reducer, the **maximum** allowable inlet pressure must be no more than 2 bar absolute.
6. Configure the calibration as described in Calibration configuration on page 60.
7. Start the calibration as described in Zero calibration on page 61 or 100% humid air calibration (high range sensors only) on page 61 depending on the preferred calibration method.

7.1.1 Calibration configuration

Calibration configuration

This option can be invoked directly from the main calibration menu by selecting the **Configuration** option, or by pressing the **Modify** button in either the zero calibration or high level adjustment screens. The process sets all the parameters used for sensor calibration.

- **Auto-calibration**: This option is not available for the K1200 sensor.
- **Manual-calibration Auto-End**: On by default. When enabled, a manual calibration will complete automatically when the parameters defined in **Stop parameters** are reached. Press on **Configure** to set the manual calibration parameters (see Configure manual calibration on page 60 for details). If the calibration fails, the previous calibration parameters remain unchanged and a warning message displayed.
- **Hold during calibration or verification**: On by default. This keeps the last measured value and stops updating the outputs during the calibration or verification process. This avoids sending invalid information to any connected device. At the end of a calibration, this hold remains for a further 10 minutes to allow the system to stabilize.
- **Zero calibration bottle**: Ensure this is **disabled** by unchecking the box as it is not relevant for the K1200 sensor.

If the **Stop parameters** button is pressed on the main configuration screen, you can view or change the existing values, or restore the default values.

It is highly recommended to leave these parameters at their default values and not change them.

These values apply to manual calibrations with the **Auto-End** parameter set.

- **Start period**: is the minimum time period that must elapse before measurements are considered valid.
- **Number of points**: is the minimum number of measurements that must be taken.
- **Stop criteria**: is the maximum allowable signal standard deviation value to ensure an accurate calibration.

Configure manual calibration

This option sets the parameters required for manual sensor calibration.

- Calibration mode:
  - Zero calibration
  - High level adjustment
  - In 100% humid air calibration (available for high range sensors only)

If zero calibration or 100% humid air calibration is selected, no other parameters are required to be set. However, the following parameters must be set if high level adjustment has been selected.

- **Calibration sample**: Set to **In line sample**, **Gas bottle** or **Factory parameters**. If factory parameters is selected, the Ksv value is displayed but can be changed.

These additional parameters are required if in line sample or gas bottle has been selected as the calibration sample.

- **Medium**: This is automatically set to **liquid** if in line sample has been selected as the calibration sample, or **gas** if gas bottle has been selected.
- **Gas unit type**: Either **partial** or **dissolved** are available for an in line sample. If gas bottle was selected this is set to **fraction**.
- **Gas unit**: The list of available units depends on unit type selected above.
- **Liquid**: This defaults to **water** for K1200 sensors.
- **Reference value**: Enter the reference value for calibration

Press **OK** to return to the main calibration screen.

7.1.2 Zero calibration

Zero calibration
With this method, the sensor should be removed from the sample and exposed to pure N_2 gas. It is recommended to use the specially designed portable calibration device for this purpose (see also Calibration devices on page 38). Press **Start** to start the calibration. A screen is displayed showing the measured values and length of time the sensor has been under calibration. These values are continually refreshed. The value **% last calibration** displayed in the top box is an informational message showing the difference between the current and previous sensor calibrations. The **Signal within range** and **Stability reached** boxes in the top right corner indicate whether the calibration is within acceptable limits. When both boxes indicate **YES**, press **Finish** to accept the new calibration. A confirmation screen then asks to accept and store the new parameters. If one or both boxes show **NO**, you can still perform a calibration but it is not recommended, and the calibration should be aborted by pressing the **Cancel** button. In the case of a calibration failure, attempt a second calibration after about 5 minutes. If the second attempt also fails, then refer to your Hach Lange representative for advice. ***Note:*** *If the Auto-End parameter is set (see Calibration configuration on page 60), then the calibration will be deemed successful when the parameters defined in* ***Stop parameters*** *are met. You will then be asked to confirm the calibration.* If you have not accepted or cancelled the calibration after an elapsed time of 10 minutes then the process will time-out, a warning message will be displayed.

7.1.3 100% humid air calibration (high range sensors only)

In 100% humid air calibration
With this method, the sensor should be removed from the sample and exposed to air saturated with humidity. Do this by putting a drop of water in the calibration cap before installing the cap on the sensor. Press **Start** to start the calibration. The process is then the same as for the zero calibration described previously.

7.1.4 High level adjustment

High level adjustment
Note: *Before using this option, ensure a zero calibration has been successfully completed first.* This calibration exposes the sensor to a gas or a liquid sample with a known gas concentration. You also have the option to reset the sensor's calibration parameters to factory settings (from drop-down list for **Cal. sample**). Press **Start** to start the calibration. The process is then the same as for the zero calibration described previously.

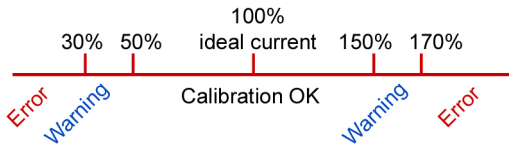
7.1.5 Sensor verification

Sensor verification
Similar to the calibration procedure, but used for verifying the calibration values. The results of the measurements made during the verification are not stored and the calibration data is not modified.

7.2 TC gas sensor calibration

Calibration of the measured gas	
Start	Before initiating a calibration process, the calibration parameters must be set by pressing on the **Modify** button. The last calibration parameters are memorized, so this step can be ignored if the correct parameters are already set. Similarly, if only the calibration value has changed, then this can be updated directly instead of pressing the **Modify** button. ***Note:*** *When calibration is started, a calibration event is set, and the analog output and relay are put on hold (if selected below) to avoid unwanted alarms or potential process problems. This resumes when calibration is finished.*
Modify calibration parameters	• **Gas Phase**: Select **liquid** or **gas** (direct calibration only) • **Gas unit type**: **Partial**, **fraction** or **dissolved** (dissolved is for calibration in a liquid only) • **Gas unit**: The list of available units depends on unit type selected above. • **Liquid**: Select as appropriate. • Enter the gas concentration according to the value in the calibration media. • **Hold during calibration**: On by default, this stops any output from the instrument during the calibration process to avoid sending invalid information to any connected device. • **Automatic calibration stop**: If selected, when the stability criteria is reached, the calibration process stops automatically. • **Interferences enabled**: If selected, this takes into account the influence of interferences during calibration. By default the same interferences as during measurement are selected. Press **OK** to start calibration
Calibration results	A calibration screen will be displayed showing current measurement data which is continually refreshed. The value "**% ideal current**" is a percentage of the current against the ideal current for the membrane type selected. If this percentage is not within the accepted range, an error message is displayed and the calibration process fails (see Calibration errors (TC sensors) on page 63). A warning message can be displayed when this value is close to the boundaries, but when calibration can be accepted. The message is first displayed in the result box. The dialog box with the error message or the warning is displayed when the finish button is pressed. The value "**% last calibration**" shows the ratio between the current measurement and the previous sensor calibration. The value "**% variation**" indicates the variation during the last 3 measurements, which is the stability of the measurements. A variation as low as possible is needed for a precise calibration. The display shows the actual calibration parameters, and the actual readings (temperature, barometer, current). ***Note:*** *In case of calibration failure, consider replacing the membrane. See the sensor maintenance manual for details.*
Verification	Similar to the calibration procedure, but for verification of the actual calibration values. The result of the measurements made during the verification is not stored and the actual calibration data is not modified.

7.2.1 Calibration errors (TC sensors)

Calibration errors (TC sensors)
The calibration is not possible in the following circumstances: • When the "**ratio ideal current**" is greater than 170% or smaller than 30% • When the sensor cannot measure (thermal cut off, sensor out, etc.) • When the "**ratio ideal current**" is greater than 150% or smaller than 50%, a warning is displayed but the calibration is valid. 

7.2.2 Interference calibration (TC sensor)

Interference calibration (TC sensor)	
This calibration is available for TC sensors and is required when one of the interferences has been enabled (see Interferences configuration on page 55). The lower part of the screen displays the actual measurement. • Select from the interfering gas to be calibrated from those available, or press the **Change configuration** button to reconfigure and go back to the process described in Interferences configuration on page 55 • **Hold during calibration**: Selected by default, this holds the measurement sequence to avoid storing invalid values during calibration.	
Instructions	For interfering oxygen on measured hydrogen or nitrogen, expose both sensors to ambient air, or a 100% oxygen source, and press **Start** to initiate the calibration. For interfering hydrogen on measured oxygen or nitrogen, expose both sensors to a 100% hydrogen source and press **Start** to initiate the calibration.

7.3 Barometric pressure calibration

Barometric pressure calibration
Upper box shows the barometric pressure measured by the instrument. Using a precision certified barometer, measure barometric pressure in the location where the measuring instrument is used. Compare the values, if values are the same press **Cancel**, otherwise enter the new barometric value in the lower box and **Validate** the new setting. On completion a calibration report is created. ***Note:*** *The barometric sensor has been factory calibrated.*

7.4 External pressure calibration

This option is only available if the external pressure option has been enabled for both channels (see Advanced configuration - K1200 sensor on page 53 and Advanced configuration - TC sensor on page 52). Enable channel 1 first, then channel 2.

External pressure calibration	
Two calibration methods for the external pressure sensor can be selected: • Two point calibration (recommended) • One point calibration By default the two point calibration is selected.	
Two point calibration (recommended)	Connect a certified absolute pressure gauge to the sample line, and use a certified precision barometer. • The two point calibration starts with barometric pressure for the lower point. Expose the external pressure sensor to the atmosphere. Enter the barometric pressure read on the barometer in the upper window and **validate P1**. • Expose the external pressure sensor to line pressure, making sure it is exposed to the same pressure as the certified absolute pressure gauge. Enter the absolute pressure value read on the certified absolute pressure gauge in the lower box, and **validate P2**. ***Note:*** *Any pressure can be used for P1 and P2, but for an accurate calibration P1 and P2 should be as different as possible.*
One point calibration	Connect a certified absolute pressure gauge to the sample line. • Expose the external pressure sensor to the line pressure, making sure it is exposed to the same pressure as the certified absolute pressure gauge. Enter the absolute pressure value read on the certified absolute pressure gauge in lower box, and **validate P1**. ***Note:*** *Any pressure can be used for P1, but for one point it should be as close as possible to the sample pressure*

7.5 Calibration reports

Calibration reports
Once a calibration is completed (for a gas or pressure sensor), the calibration report is updated with the new details. The calibration report contains data for the last 50 calibrations. For full details on the data displayed for all the different type of calibration reports, refer to the examples listed under Data available on page 77. Each calibration record will contain parameters useful for traceability. For instance, it will contain: • the user name and ID • the date and time • the calibration coefficient • all the measurements which influence the calibration (temperature, barometric pressure, current, etc.) Calibration reports are generated after a sensor calibration. For interfering gas calibration reports, you will be asked to select the interfering gas from those available.

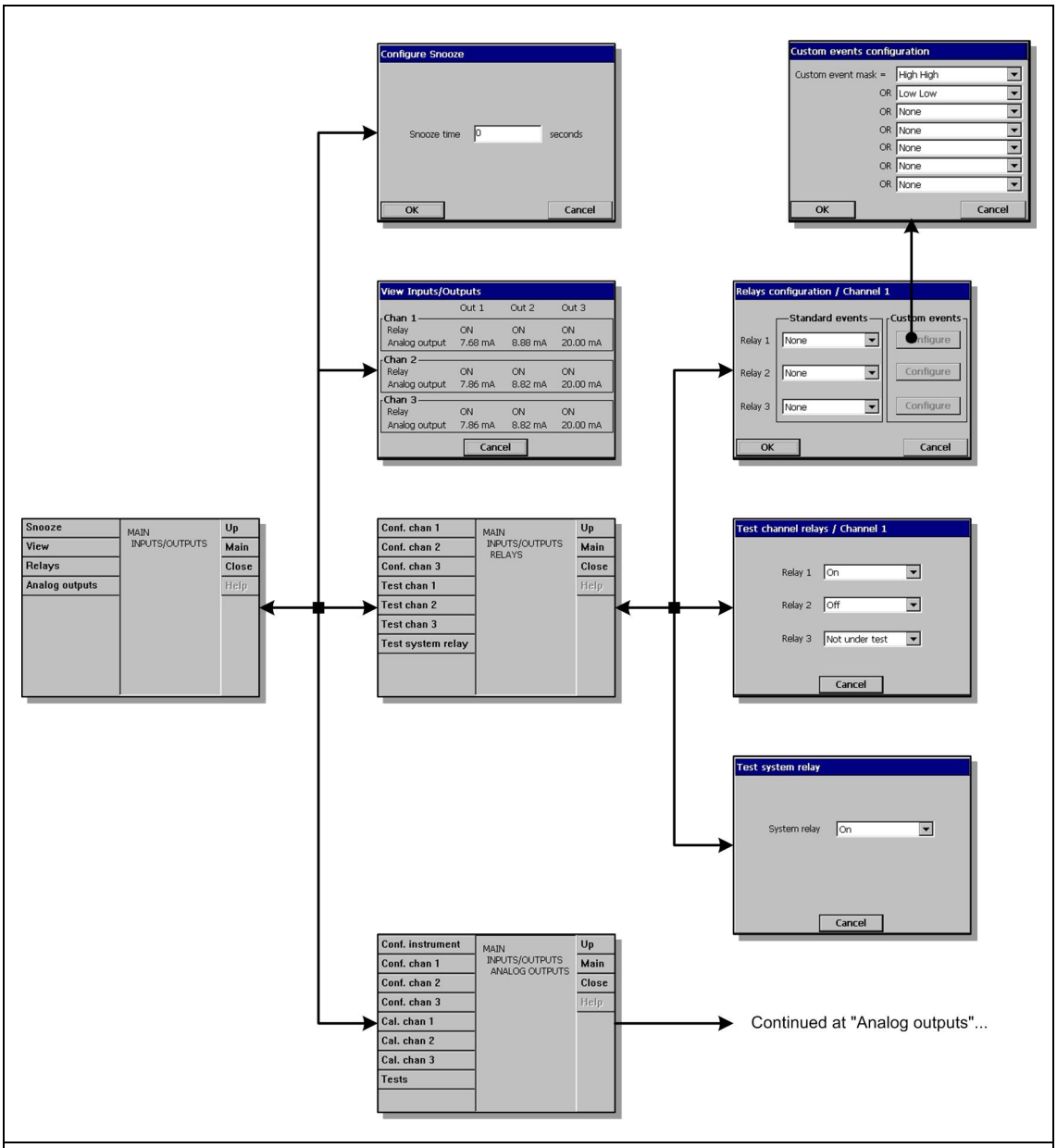


Figure 38 Inputs/Outputs menu

8.1 Configure snooze

Configure snooze
In the event of an alarm, the “snooze” button stops the instrument buzzer and returns all the relays in the instrument to their normal state during a "snooze time". Enter the snooze time in seconds and press **OK**.

8.2 View inputs/outputs

View inputs/outputs
For each channel, this view option displays the state of the 3 alarm relays (on or off), and the analog output current (or voltage, depending on the instrument version) value for each.

8.3 Relays

Relays	
There are three measurement alarm relays per channel and one system alarm relay for the instrument. These relays are configurable as either standard or custom events through the instrument menu. • An alarm relay can be activated or deactivated • When the alarm is OFF, it is activated, • When the alarm is ON, it is deactivated All the relays are activated as soon as the instrument is ON (but alarms are OFF). When the instrument is OFF, the relays are deactivated, thus in this state, all alarms are ON. The logic "Relay deactivated = Alarm ON" has been chosen for this safety reason. When the main board does not communicate with the measurement board for more than 30 seconds, the measurement board switches all the alarm relays and the analog output to the alarm state.	
Relays configuration	The three relays (per channel) can be triggered by several standard events, or a combination of events (custom). The relays output can be used to turn on a beacon, horn or PLC (see Connections to electronic boards on page 30) ***Note:*** *Relays can be set to Normally Open [NO] or Normally Closed [NC] by changing the jumper positions on the measurement board (see Measurement alarm relays on page 32).* • Select a standard event in the rolling list • If “Custom event” has been selected, it has to be configured by touching the **configure** button • Press on the text box to open the selection menu (rolling menu). Select the events that must trigger the relay, and press **OK**. Proceed in the same manner for other events that should trigger the relay.
Test channel relays	The three measurement alarm relays can be manually activated for testing purposes: • Select Relay **On**, **Off** or **Not under test**. See note regarding the relays below. “Not under test” means the relay is in operating mode, and it will be triggered normally. ***Note:*** *A relay set to NO will close when activated (**On**), but a relay set to NC will open. See Measurement alarm relays on page 32*
Test system relay	Similarly, the system alarm relay can be manually activated for testing purpose. • Select Relay **On**, **Off** or **Not under test**.
Note: *In both the Test Channel Relays and Test System Relay options above, once the tests have been completed press Cancel to exit the screen. At the same time, this will reset all relays (including the system relay) back to a status of “Not under test”.*	

8.4 Analog outputs

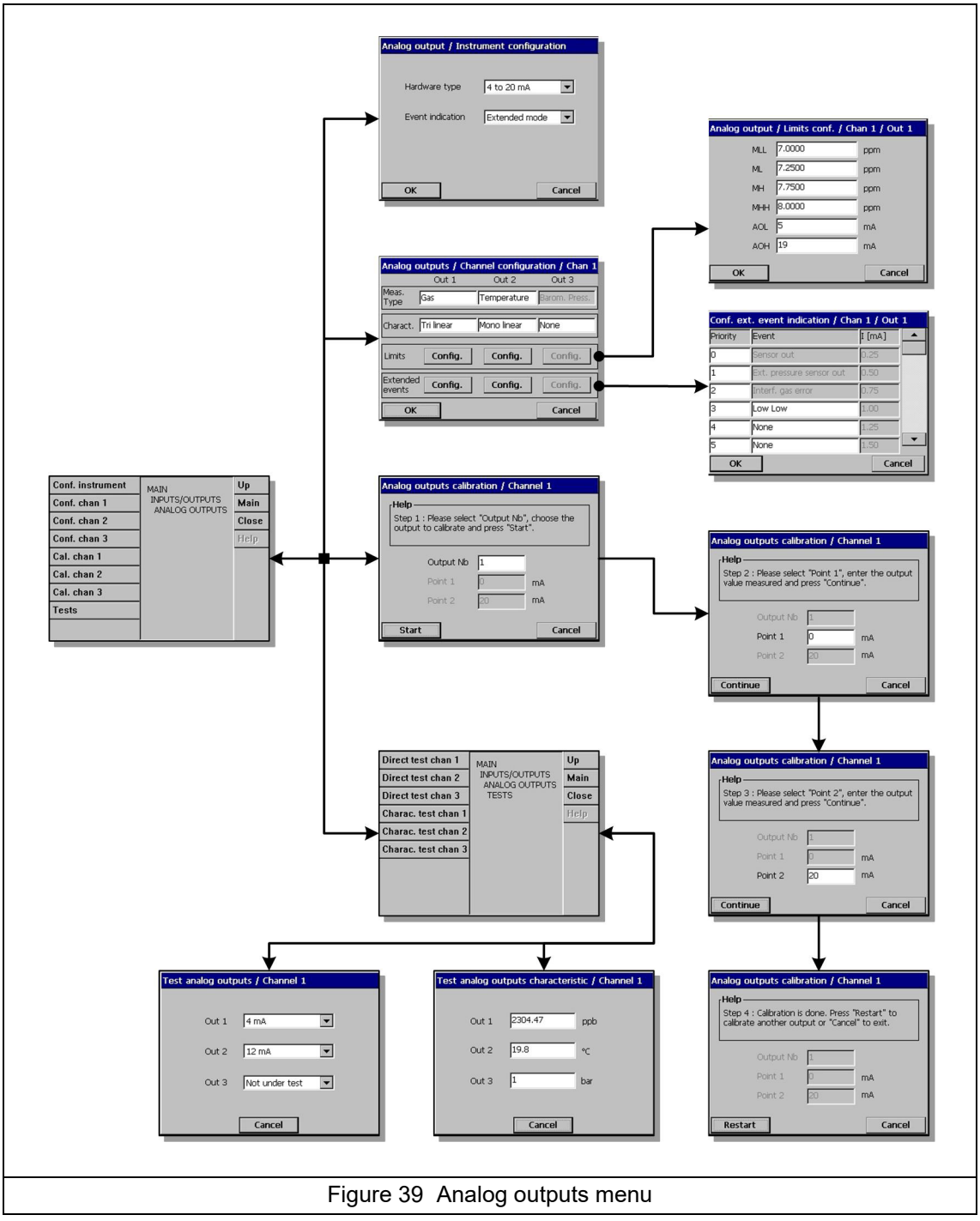


Figure 39 Analog outputs menu

Analog outputs	
There are three analog outputs per channel. These outputs are configurable in terms of function, content, and behavior through the instrument menus. Analog outputs are used to output a voltage or a current which is a function (e.g. a linear characteristic) of a measurement: AOut = *f* (M). The analog outputs can be typically connected to a PLC. Knowing the function (*f*), the PLC can compute the value of the measurement. Two types of instrument hardware are available: • measurement board with current output (I = 0-20 mA or 4-20 mA). • measurement board with voltage output (U = 0-5 V).	
Instrument configuration	• Select analog output range of current: 4-20 mA or 0-20 mA • The 4-20 mA range (recommended) allows for an extended event indication mode that can be selected and configured (default = standard mode) ***Note:*** *Features of the instrument with a voltage analog output are similar to the 0-20 mA features.* For some events (sensor out, purge failure, etc.) the actual measurement is not significant, but the PLC needs to know how the analog output behaves in these cases. Two "Event indication modes" are available: • Standard mode (default) • Extended mode
Standard event indication	Refer to Table 1 Standard event indication below.
Extended event indication	The "Extended event indication" mode is only available when the 4-20 mA output is selected. In this mode, the range between 0 mA and 4 mA is used to indicate selected events. The events are defined using the channel configuration option (see Channel configuration on page 69). ***Note:*** *The extended mode is not available for the voltage output versions of the instrument.*

Table 1 Standard event indication

Analog output	Event output range			Event
	0-20 mA	4-20 mA	0/5 V	
Gas concentration	20 mA	20 mA	5 V	• Channel out • Sensor out • Thermal cut-off • Interfering gas error
Temperature	20 mA	20 mA	5 V	• Channel out • Sensor out
External pressure	20 mA	20 mA	5 V	• Channel out • External pressure sensor out

Analog outputs (continued)	
Channel configuration	For each of the three analog output channels, set the type of measurement that will be transmitted through this channel, and the output characteristics. • **Meas. type**: Select between the type of measurements available in the rolling list. • **Characteristics**: Select either Linear, Tri-linear or None (see Analog output characteristics on page 71). • **Limits**: Press the configure button to adjust the analog output set points for each output. Enter values in the appropriate text boxes. In Linear mode, only the ML and MH values can be adjusted. Tri linear mode allows all limits to be adjusted, and the None mode denies access to this screen. The authorized user may define a maximum of 12 customized events for each of the three outputs on each channel and change the order of priority of all events. ***Note:*** *This only applies to Tri linear and Linear outputs. It is not available if the output characteristic is set to None.* Configure the events that should be signaled at the corresponding current shown in the right column. • Only one event signal at a time can be sent via the current output. As there is a possibility to have several events at the same time, an order of priority must be set. This order has been set by default, but it can be modified to suit particular needs and conditions. Touch the priority number in the left column and edit it. • The shaded events in the list have preset outputs and only the priority can be changed. The other events can be customized by the user. Touch a white text box to call up the rolling list. Select an event from this list and press **OK**. Then adjust the priority as required. ***Note:*** *When an event occurs, measurement information is superseded by the event information on the output.*

The following table lists the default configuration. The first three events on the list are pre-set and only the priority can be changed:

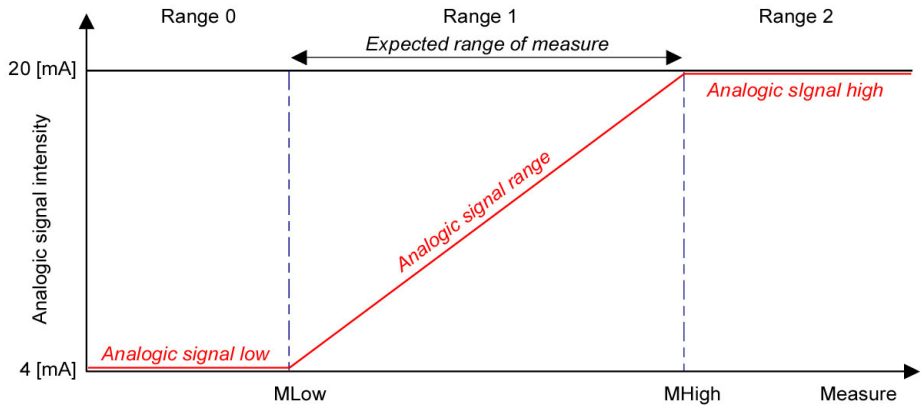
Table 2 Extended event table

Priority	Event	I [mA]
0	Sensor out	0.25
1	External pressure sensor out	0.50
2	Interfering gas error	0.75
3	*Custom Event 1*	1.00
4	*Custom Event 2*	1.25
5	*Custom Event 3*	1.50
6	*Custom Event 4*	1.75
7	*Custom Event 5*	2.00
8	*Custom Event 6*	2.25
9	*Custom Event 7*	2.50
10	*Custom Event 8*	2.75
11	*Custom Event 9*	3.00
12	*Custom Event 10*	3.25
13	*Custom Event 11*	3.50
14	*Custom Event 12*	3.75

Analog outputs (continued)	
Calibration of the analog output	The calibration of the analog output is aimed at aligning the internally calculated current to the real current output. This was performed at factory, but could become necessary again because of electronic tolerances. A precision amperometer (or voltmeter for the voltage versions) connected at the corresponding analog output connection point is required. See Measurement board on page 31. • Select the analog output channel to calibrate and press the **Start** button. • Measure with the amperometer the current value for point 1. It should be below 4 mA • Edit point 1 and enter the same value as read on the amperometer, then press the **Continue** button. • Measure with the amperometer the current value for point 2. It should be above 20 mA. • Edit point 2 and enter the same value as read on the amperometer, before pressing the **Continue** button. Calibration of the selected analog output channel is completed. Proceed in the same way for the other analog output channels available.
Direct test	Test to check the calibration of the analog outputs. A precision amperometer connected at the analog output connection point is required. • Select a value (4, 12, 20 mA available) for each channel and compare this value (± 0.02 mA) with what the amperometer shows. A calibration is required if the value on the amperometer differs from the current selected ± 0.02 mA). ***Note:*** *It is possible to test one analog output without interfering with the others. During the test, the other analog outputs will continue to indicate the measurement.*
Characteristics test	This is a test for the correct operation of the peripherals connected to each analog output, by verifying that the PLC computes the correct value. The analog output will send the current corresponding to the value entered in the text boxes. • Type in a test value for each analog output, and check for the related action on the peripheral.

8.5 Analog output characteristics

Analog output characteristics	
“Linear” analog output	The "Linear" output is the default setting for the analog output. It is illustrated below (4-20 mA output is shown, 0-20 mA or 0-5 V settings are similar).



The goal of this setting is to use all the points available on the slope from 4 mA to 20 mA to show the range of measurements that are usual in the measured process. Setting the output this way allows for the highest signal resolution for the actual conditions.

The downside is that any measures below the set range will have the same analog signal locked at 4 mA. Similarly, any measure over the set range will have the same analog signal locked at 20 mA. Settings must be made in balancing these aspects.

Settings

For the output, set ML and MH in the current measuring unit (e.g. °C for a temperature output). When a compound unit is selected the smallest unit will be used (e.g. ppb for a "ppm-ppb" compound unit).

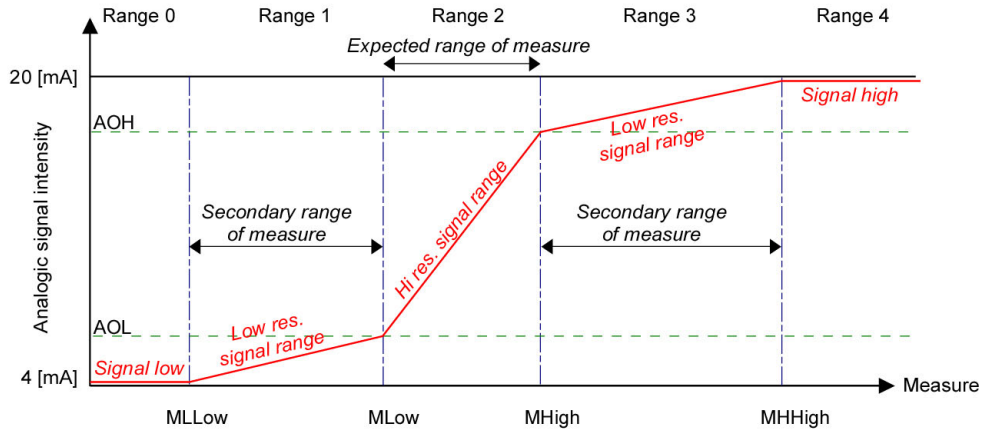
These points should be set keeping in balance the following conditions (see illustration above):

- The smaller is Range 1, the better is the analog signal resolution within the expected range of measure.
- In Range 0 the analog output only shows that measurement is below the ML value. Similarly in Range 2 the analog output only shows that measurement is over the MH value.

The formula to compute the measurement knowing the current I (or voltage U) and the resolution R is given in the following table:

Linear	Range	Measurement M	Resolution R
4-20 mA	20 > I > 4	M = ML + (MH - ML) * (I - 4) / 16	R = (MH-ML) / 808
0-20 mA	20 > I > 0	M = ML + (MH - ML) * I / 20	R = (MH-ML) / 1010
0 - 5 V	5 > U > 0	M = ML + (MH - ML) * U / 5	R = (MH-ML) / 1010

Analog output characteristics (continued)	
“Tri-linear” analog output	The "Tri-linear" output brings benefits over the “Linear output” discussed before. It is illustrated below (4-20 mA output is shown, 0-20 mA or 0-5 V settings are similar).



Compared to the “Linear” mode, the expected range of measure is Range 2. A Range 1 and 3 are available to show the measures falling out of this Range 2, but normally at a lower resolution. Expected measurements for the measured process are supposed to be in Range 2 most of the time, and in Range 1 or 3 occasionally (problems, calibration, line stop, etc.). The benefits are:

- The PLC can compute the measurement over a large range (1, 2 and 3).
- The PLC can compute a higher resolution signal for the expected measuring range (Range 2: MH > M > ML).
- Carefully selecting the set points allows for an individual resolution for each range, so a different resolution can be applied to Range 1, 2 and 3, allowing to tailor the analog output to the actual conditions.

As before, the downside is that any measure below or over the Range 1, 2 and 3 will have the same signal locked at 4 mA and 20 mA respectively, but Range 1, 2 and 3 should cover a larger range than in the “Linear” mode. Settings must made in balancing these aspects.

Settings

For each output, set MLL, ML, MH, and MHH in the current measuring unit (e.g. °C for a temperature output). When a compound unit is selected, the smallest unit will be used (e.g. ppb for a "ppm-ppb" compound unit). Also set AOL (Analog Output Low) and AOH (High) in mA (or Volts).

These points should be set keeping in balance the following conditions (see illustration above):

- The smaller is Range 2, the better is the analog signal resolution within the expected range of measure.
- Size of Range 1 and 3 should be set to deliver an adequate level of resolution for the measures falling out of the expected range of measure.
- In Range 0 the analog outputs only shows that measurement is below the MLL value. Similarly in Range 4 the analog output only shows that measurement is over the MHH value.

The formula to compute the measurement knowing the current or the voltage and the resolution R is given in the following table:

Tri-linear	Range	Measurement M	Resolution R
4-20 mA	1: AOL ≤ I > 4	M=MLL+(ML-MLL)*(I-4)/(AOL-4)	R=(ML-MLL)*20/((AOL-4)*1010)
	2: AOH ≤ I > AOL	M=ML+(MH-ML)*(I-AOL)/ (AOH-AOL)	R=(MH-ML)*20/((AOH-AOL)*1010)
	3: 20 > I > AOH	M=MH+(MHH-MH)*(I-AOH) / (20-AOH)	R=(MHH-MH)*20/((20-AOH)*1010)
0-20 mA	1: AOL ≤ I > 0	M=MLL+(ML-MLL)*I/AOL	R=(ML-MLL)*20/(AOL*1010)
	2: AOH ≤ I > AOL	M=ML+(MH-ML)*(I-AOL)/ (AOH-AOL)	R=(MH-ML)*20/((AOH-AOL)*1010)
	3: 20 > I > AOH	M=MH+(MHH-MH)*(I-AOH)/(20-AOH)	R=(MHH-MH)*20/((20-AOH)*1010)
0-5 V	1: AOL ≤ U > 0	M=MLL+(ML-MLL)*U/AOL	R=(ML-MLL)*5/(AOL*1010)
	2: AOH ≤ U > AOL	M=ML+(MH-ML)*(U-AOL)/ (AOH-AOL)	R=(MH-ML)*5/((AOH-AOL)*1010)
	3: 5 > U > AOH	M=MH+(MHH-MH)*(U-AOH) / (5-AOH)	R=(MHH-MH)*5/((5-AOH)*1010)

Analog output characteristics (continued)	
None	This is the default value. Setting the analog output to “None” means that the output value will always be zero and importantly ensures that no current is emitted on that output, so reducing power consumption as well as reducing heat within the instrument.

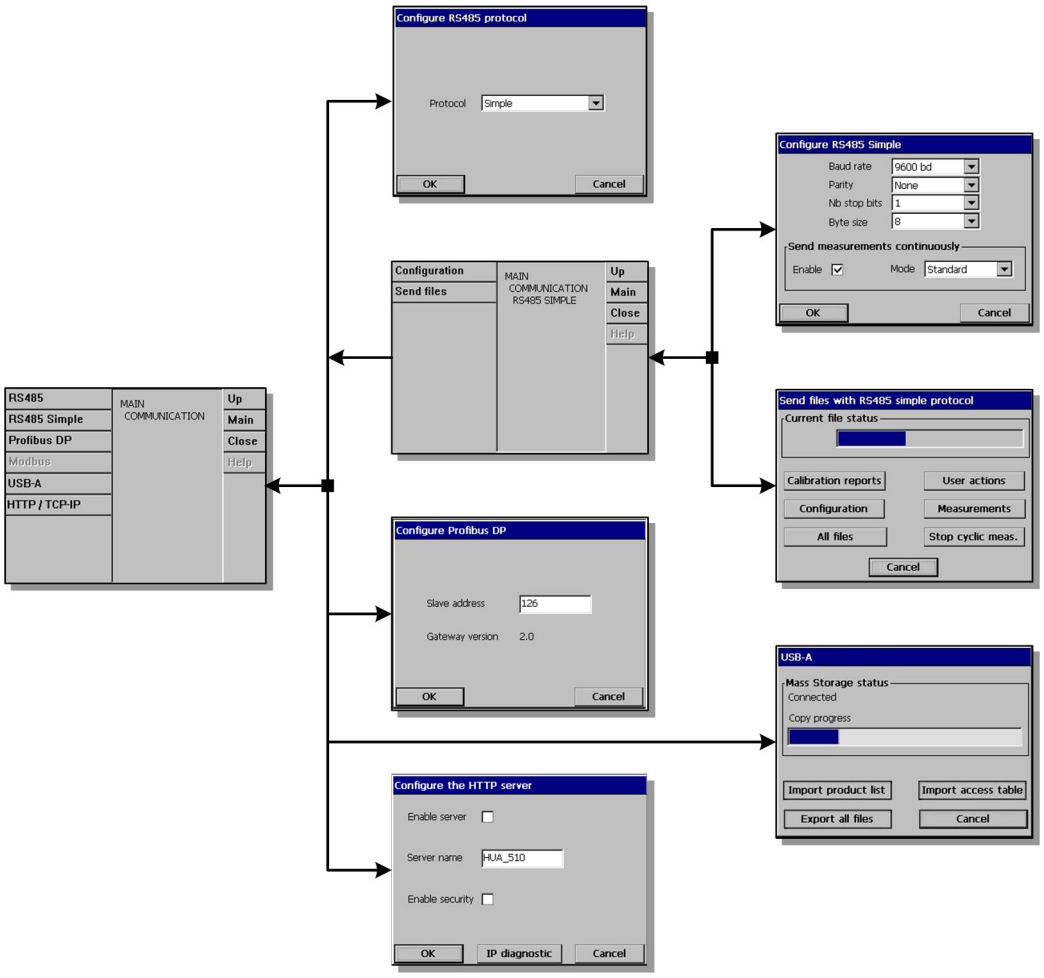
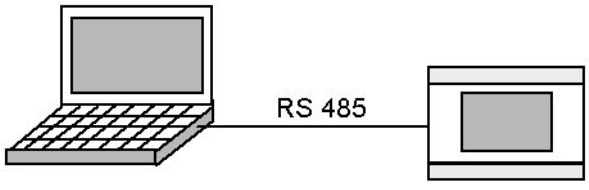


Figure 40 Communication menu

The external RS-485 port of the main board is directly connected to a RS-485 bus (single twisted pair). Optionally it can be connected to a fieldbus module (gateway).

The RS 485 menu allows to select between RS485 simple or Profibus DP communication protocol, depending on application.

- Press on the text box to select either the RS-485 simple or the PROFIBUS-DP communication protocol.



9.1 RS-485 simple mode configuration

This protocol allows the instrument to output data to an external device (PLC, SCADA, PC, etc.). The communication is unidirectional. The data are output on the RS-485 link as simple ASCII text. If for instance you use a PC, the data can be easily visualized and saved in a file using the "Hyperterminal" software.

To use this communications mode, on the instrument:

- Select the **RS-485** option from the **Communication** menu
- Choose the protocol **Simple** (default configuration) and press on **OK**
- Then select the **RS-485 Simple** option from the **Communication** menu:
  - "Baud rate", "Parity", "No of stop bits", "Byte size" Standard parameters of the RS-485 link.
  - "Enable" The measurements can be sent continuously (approximately every 2 sec.). This field allows enabling or disabling this feature.
  - "Mode" This is the format of the measurements sent continuously (see Cyclic measurements on page 77 of this document). In "Expert" mode, more data are sent. These additional data can be useful for diagnostic purpose.

Note: *In case of problem verify first that jumper J3 is not installed on the mother board (default configuration).*

Send data

This dialog box is used to send text files to an external device. The possible files are the following:

- Calibration reports
- User actions log file
- Instrument configuration
- Measurements stored in the instrument memory.

The button "Stop Cyclic meas." allows to stop and to restart the cyclic transmission of measurements. It is advised to stop the cyclic transmission in order not to mix cyclic measurements and data of the file being transmitted. This button has the same effect as the "Enable" checkbox of the "Communication/RS-485 Simple/Configuration" window.

After stopping the cyclic measurements, select the "Calibration Reports", "User Actions", "Configuration", "Measurements" button to send the corresponding file, or the "All files" button to send all these files in one shot.

Note: *The measurements file includes TPO or TPA measurements if these calculations are enabled.*

Once the button is pressed, the file is sent immediately. The field "Current file status" shows “Sending” alongside the file transmission progress bar. On completion this changes to “Sent”.

9.1.1 Data available

All individual data are separated by at least one tabulation character (ASCII code=0x09).

For the cyclic measurements, the data format is detailed. For the files, only one example for each file is given to explain the data format.

Cyclic measurements

1. If the option "Mode = standard" is chosen, the following message is sent for each active channel:

CHn\t	Gas\t	Gas Unit\t	Temperature\t	Temperature Unit\t	Barometric Pressure\t	Barometric Pressure Unit\t\	Event\t\r\n

with:

\t .....the ASCII tab character: code=0x09
\r .....the ASCII Carriage Return character: code=0x0D
\n .....the ASCII Line Feed character: code=0x0A
CHn .....the 2 ASCII characters "CH" + the channel no (from 1 to 3).
Gas.....the gas concentration.
Gas Unit .....the gas unit.
Temperature.....the temperature.
Temperature Unit.....the temperature unit.
Barometric Pressure.....the barometric pressure.
Barometric Pressure Unit .....the barometric pressure unit.
Event .....the event bit mask in hexadecimal format.

The values are not described here (see List of events and alarms on page 110).

- Example of one measurement:

CH1 697.176 mbar 20.1 °C 0.982 bar C00

2. If the option "Mode = expert" is chosen, the following message is sent:

CHn\t	Gas\t	Gas Unit\t	Temperature\t	Temperature Unit\t	BarometricPressure\t	Barometric Pressure Unit\t

Event\t	Current\t	µA\t	Partial pressure\t	bar\t	External Pressure\t	External Pressure Unit\t	Time\t	Index\r\n

with:

Current .....The current measured in [microA].
Partial pressure .....The partial pressure in [bar].
External Pressure .....The external pressure.
External Pressure Unit.....The external pressure unit.
Time .....The time of the measurement. Format "hh:mm:ss."
Index.....This is the index of the last measurement.

This number starts at 0 at power up of the program.

- Example of one measurement:

CH1 697.173 mbar 20.1 °C 0.982 bar C00 80.056229 µA 0.697 bar 1.000 bar 12:59:42 5923

K1200 gas sensor calibration report example

Calibration report nb 1
Calibration mode . . . . . .Manual high level adjustment
Date (yy.mm.dd - hh:mm) . . . . .15.02.17 - 18:40
Operator . . . . . .jp
Operator ID 3
Cal. sample . . . . . .In line sample
Medium . . . . . .Liquid
Gas unit. . . . . .ppb
Liquid. . . . . .Beer
Ref. value 1.500000
Cal. coefficient Phi0(Tcal) . . . . .25.974°
Cal. coefficient Tcal . . . . . .24.41°C
Cal. coefficient Ksv(25°C) . . . . .-0.1312 mbar-1
Cal. coefficient Tcal.Inst. . . . . .25.20°C
Standard deviation . . . . . .0.003 mbar
Fluor. amplitude. . . . . .0.834 V
Interferences . . . . . .Disable
Temperature . . . . . .20.1 °C
Calibration duration . . . . . .3 mn

TC gas sensor calibration report example

Calibration report nb 1
Date (yy.mm.dd - hh:mm) . . . . .15.02.18 - 15:20
Operator . . . . . .jp
Operator ID 3
Calibration coefficient . . . . . .18.23 mV/bar
Ratio with ideal membrane . . . .107.22 %
Ratio with last calibration . . . . .106.32 %
Stability . . . . . .0.337 %
Calibration value 965.000000
Gas unit. . . . . .mbar
Gas phase. . . . . .Gas
Liquid. . . . . .Water
Interferences . . . . . .Disable
Temperature . . . . . .26.44 °C
Barometric pressure . . . . . .0.962 bar
External pressure . . . . . .0.976 bar
Sensor slope . . . . . .18.797 mV/s

Barometric sensor calibration report example

Calibration report nb 1
Date (yy.mm.dd - hh:mm) . . . . .15.02.16 - 20:38
Operator . . . . . .jp
Operator ID 3
Former barometric pressure . . .0.970 bar
New Barometric pressure . . . . .0.971 bar

External pressure calibration report example

Calibration report nb 1
Date (yy.mm.dd - hh:mm) . . . . .15.02.16 - 21:37
Operator . . . . . .Armstrong
Operator ID 1007
Nb of cal. points 1
New slope . . . . . .45.454545 [bar/V]
New offset . . . . . .0.103926 [bar]
Former P1 value . . . . . .0.973 bar
New P1 value . . . . . .0.972 bar

User action log file example

The "User action log file" below contains 3 user actions.

Nr	*mm/dd*	*hh:mm:ss*	*User ID*	*User Name*	*Action ID*	*Description*
1	1/21	15:13:44	1007	Armstrong	140	Measurement config.
0	1/21	15:13:27	1007	Armstrong	132	Identification
2	1/21	15: 9:15	1007	Armstrong	132	Identification

Measurement file example

6 measurements are described below:

Nr	*mm/dd*	*hh:mm:ss*	*Gas [ppb]*	*Temp [°C]*	*Mask*	*Fluor. phi [°]*	*Barom [bar]*	*Ext P. [bar]*	*Index*
0	2/17	21:15:37	75.051	20.1	400	26.039	1.005	0.000	2271
1	2/17	21:15:27	75.043	20.1	400	26.045	1.005	0.000	2266
2	2/17	21:15:17	75.047	20.1	400	26.052	1.005	0.000	2261
3	2/17	21:14:57	75.044	20.1	400	26.041	1.005	0.000	2256
4	2/17	21:14:47	75.047	20.1	400	26.038	1.005	0.000	2251
5	2/17	21:14:37	75.050	20.1	400	26.054	1.005	0.000	2246

Configuration report example

INSTRUMENT CONFIGURATION
Measurement mode . . . . . .Continuous mode
Pressure unit. . . . . .[bar]
Temperature unit. . . . . .[°C]
Storage mode . . . . . .Rolling buffer
Storage RAM time. . . . . .10 [s]
Storage FLASH time. . . . . .3600 [s]

Channel 1
Membrane. 2956A
Medium . . . . . .Liquid
Gas unit. . . . . .mbar
Liquid . . . . . .Water
Resolution displayed. 3
Thermal cut off . . . . . .Enabled60.0 [°C]
Alarms
Low Low . . . . . .Disabled0.000000 [mbar]
Low . . . . . .Disabled0.100000 [mbar]
High. . . . . .Enabled5.000000 [mbar]
High High . . . . . .Disabled1.100000 [mbar]
Hysteresis . . . . . .1 [%]
Delay. . . . . .0 [s]
Filter State. . . . . .Disabled
Type . . . . . .Median
Depth 5
Central depth 3
Interferences
CO_2 or H_2S . . . . . .All disabled
Chlorinity/Salinity . . . . . .All disabled19.000000 [g/l]
H_2 . . . . . .Disabled0.100000 [bar]

9.1.2 Example of use

In this example we use:

- One PC with a RS232 port.
- One "RS-485<->RS232 converter"

Procedure:

1. Connect both RS-485 wires of the instrument to the "RS-485<->RS232 converter".
2. Connect the "RS-485<->RS232 converter" to the PC RS232 port using a standard cable (RS232 DB9 straight cable).

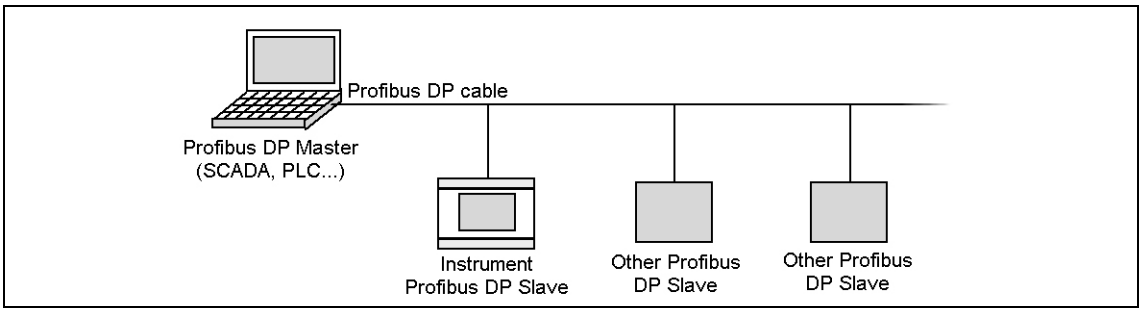
On the PC:

1. Run "Hyperterminal" on the PC.
2. Configure the PC COM port used (e.g. COM2). Menu "File/Properties/Configure".
3. Configure the parameters "Baud rate", "Parity", "Nb of stop bits", "Byte size" (Menu "File/Properties/Configure"). Use the same parameters for the instrument and the PC.
4. Configure the "Font = Courier 10" (Menu "View/Font").
5. Connect "Hyperterminal" (Menu "Call/Call").
6. Save the data received in the file of your choice (Menu "Transfer/Capture Text/Start").

On the instrument:

1. Use the menu "Communication/RS-485 Simple/Send files" and the button "All files". When the transfer is finished, close the file with "Hyperterminal" (Menu "Transfer/Capture Text/Stop"). Now, all the reports are saved in a text file on your PC.

9.2 PROFIBUS-DP communication



9.2.1 Installation

On the ORBISPHERE CD, there is an “Orbi3218.gsd” and an “Orbi3218.bmp” file available in the “Profibus DP” folder to help configure the PROFIBUS-DP. The GSD file contains the following elements:

- The module **Gateway Version >= 2.0 - n channel** for receiving data from the instrument, and where **n** is **1**, **2** or **3** relating to the number of channels in use.
  Note: *Gateway version >= 2.0 and user software version >= 2.15 are mandatory*
- The module **Gateway Version < 2.0** for receiving data from an instrument equipped with a profibus gateway version < 2.0 or user software < 2.15. In this case, data from 3 channels are sent whatever the number of channels configured for the instrument.

WARNING

Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

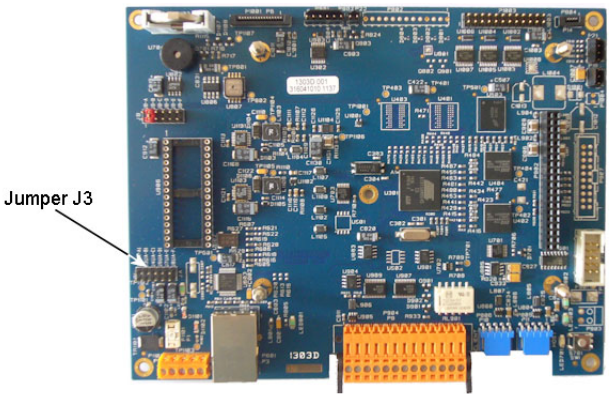
CAUTION

Personal Injury Hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

NOTICE

Potential Instrument Damage. Proper ESD (electrostatic discharge) protocols must be followed to prevent damage to the product. All fittings must be properly seated and tightened to prevent any water and dust ingress.

1. Install the PROFIBUS-DP module and the jumper J3 on the main board (location highlighted in the illustration below).



2. Select the menu "Configuration/RS-485" and choose "PROFIBUS-DP" as the protocol.
3. Select the menu "Configuration/PROFIBUS-DP", choose the slave address and restart the instrument.

9.2.2 Input/Output data

The main board:

- Writes the latest measurement data to the Profibus Input Buffer.
- Checks if a command written by the Profibus Master must be executed (Profibus Output Buffer). If a command is to be executed, the instrument executes it and writes the result (status, data, etc.) in the Profibus Input Buffer.

All numbers are coded in “Big Endian” format, and float values are coded according to IEEE Standards. The field types “Byte” and “Double Word” are unsigned.

Measurements

Measurements are formatted in the Profibus Input Buffer as follows:

Name	Type	Size	Offset
Barometric pressure	Input float	32 bits	0
Barometric pressure unit	Input byte	8 bits	4
Channel 1 gas concentration	Input float	32 bits	5
Channel 1 gas unit	Input byte	8 bits	9
Channel 1 temperature	Input float	32 bits	10
Channel 1 temperature unit	Input byte	8 bits	14
Channel 1 external pressure	Input float	32 bits	15
Channel 1 external pressure unit	Input byte	8 bits	19
Channel 1 events	Input double word	32 bits	20
Channel 1 measurement index	Input double word	32 bits	24
Channel 2 gas concentration	Input float	32 bits	28
Channel 2 gas unit	Input byte	8 bits	32
Channel 2 temperature	Input float	32 bits	33
Channel 2 temperature unit	Input byte	8 bits	37
Channel 2 external pressure	Input float	32 bits	38
Channel 2 external pressure unit	Input byte	8 bits	42
Channel 2 events	Input double word	32 bits	43
Channel 2 measurement index	Input double word	32 bits	47

Note: *The table above shows information for a 2-channel instrument. This will be adjusted according to the number of channels in use.*

The gas, temperature and barometric pressure unit values are coded as defined in the following tables:

Gas unit	Value
bar	0
mbar	1
Pa	2
kPa	3
hPa	4
psia	5
atm.	6
mbar->bar	9
Pa->KPa	10
%Vbar	12
ppm Vbar	13
%Vext	14
ppm Vext	15
ppm Vbar->%Vbar	16
ppm Vext->%Vext	17
ppm	18
ppb	19
g/l	20
mg/l	21
µg/l	22
$\%O_2$	23
%Air	24
g/kg	25
V/V	26
%W	27
cc/kg	28
ml/l	29

Temperature unit	Value
K	0
°C	1
°F	2

Barometric pressure unit	Value
bar	0
mbar	1
psia	2
atm.	3
Pa	4
kPa	5
hPa	6

Note: *For the field "Event", please see the column "Bit mask value" in* *Table 4 on page 110**.*

Note: *If the instrument stops sending measurement data to the module, then after 30 seconds the module sets the event mask to the value* ***PROFIBUS-DP value not updated*** *(0x80000000) bit mask.*

Commands

The “Command Output Buffer” is formatted as follows:

Name	Type	Size	Offset
Output command toggle (OCT)	Output byte	8 bits	0
Output command ID (OCI)	Output byte	8 bits	1
Output command data byte 1 (OCD1)	Output byte	8 bits	2
Output command data byte 2 (OCD2)	Output byte	8 bits	3
Output command data byte 3 (OCD3)	Output byte	8 bits	4
Output command data byte 4 (OCD4)	Output byte	8 bits	5

The “Command Input Buffer” is located just after the measurement data and is formatted as follows:

Name	Type	Size	Offset Channel 1	Offset Channel 2	Offset Channel 3
Input command toggle (ICT)	Input byte	8 bits	28	51	74
Input command status (ICS)	Input byte	8 bits	29	52	75
Input command data byte 1 (ICD1)	Input byte	8 bits	30	53	76
Input command data byte 2 (ICD2)	Input byte	8 bits	31	54	77
Input command data byte 3 (ICD3)	Input byte	8 bits	32	55	78
Input command data byte 4 (ICD4)	Input byte	8 bits	33	56	79

The following commands are available:

- Change product
- Set channel hold status

Change product command - output

Name	Value	Comment
OCT	1-2	
OCI	1	Command ID
OCD1	0	Channel number: 0 = Channel 1 1 = Channel 2
OCD2	0-99	Product number
OCD3	0-1	Erase measurement files: 0 = Never erase the measurement files. 1 = Erase measurement file if necessary (e.g. gas unit changes)
OCD4		Not used

Change product command - input

Name	Value	Comment
ICT	1-2	
ICS	0-3	0 = OK 1 = Unknown command ID 2 = Invalid parameter (e.g. invalid channel no or product number) 3 = Execution failure
ICD1		Not used
ICD2		Not used
ICD3		Not used
ICD4		Not used

Set channel hold status- output

Name	Value	Comment
OCT	1-2	
OCI	3	Command ID
OCD1	0	Channel number: 0 = Channel 1 1 = Channel 2
OCD2	0-1	Status: 0 = Channel enabled 1 = Channel on hold
OCD3		Not used
OCD4		Not used

Set channel hold status - input

Name	Value	Comment
ICT	1-2	
ICS	0-3	0 = OK 1 = Unknown command ID 2 = Invalid parameter (e.g. invalid channel no) 3 = Execution failure
ICD1		Not used
ICD2		Not used
ICD3		Not used
ICD4		Not used

9.3 USB-A port (host)

This option allows the export or import of data from an external mass storage device. The device must first be connected to the instrument through the USB-A port.

Select one of the two import options (product list or access table) to import data from the storage device. This is useful for transferring these files to additional instruments without the need of having to re-enter the data individually on each instrument.

Note: *The imported data will override any current settings on the instrument.*

Select the export option to export data from the instrument to the storage device. This will export all stored data: measurements, calibrations, product list, access table, etc.

For both import and export options, the progress bar is updated to give an indication of the progress of the selected option.

The USB-A port is also used to update the instrument software. If the software is present on the USB storage device, the update process starts automatically.

9.4 HTTP/TCP-IP

9.4.1 Overview

When activated this option downloads data from the instrument directly to a web page that can be accessed from a PC. To be able to use this option, the instrument must be connected to the network (specifically **Connector P3** - see details in Main board connections on page 30) and the network must have a DHCP server installed.

- Check the Enable server box to enable the web server communication link.
- Enter the Server name for the instrument. This is free format text and should typically be used to identify the instrument.
- Check the Enable security box if you require a password to be entered on the PC to access the web page.

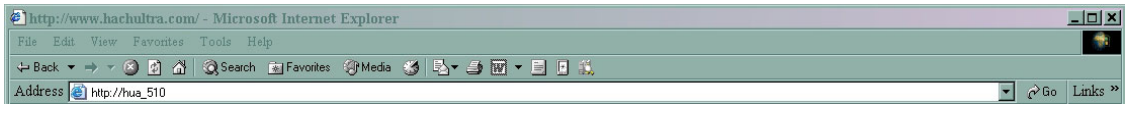
If any of the details on the previous screen have been changed, a warning message will be displayed as illustrated left.

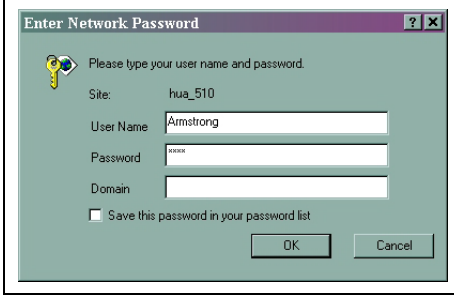
The changes must be confirmed, after which the instrument must be powered down and powered up again for the changes to take effect.

Note: *The IP Diagnostics button at the bottom of the screen is for use by experienced IT personnel only to help resolve any communications problems.*

9.4.2 PC interface

Once the server has been enabled and the interface information set up, access the information by launching an internet browser and typing "**http://**" followed by the server name that has been assigned to the instrument, in the address box as illustrated below:

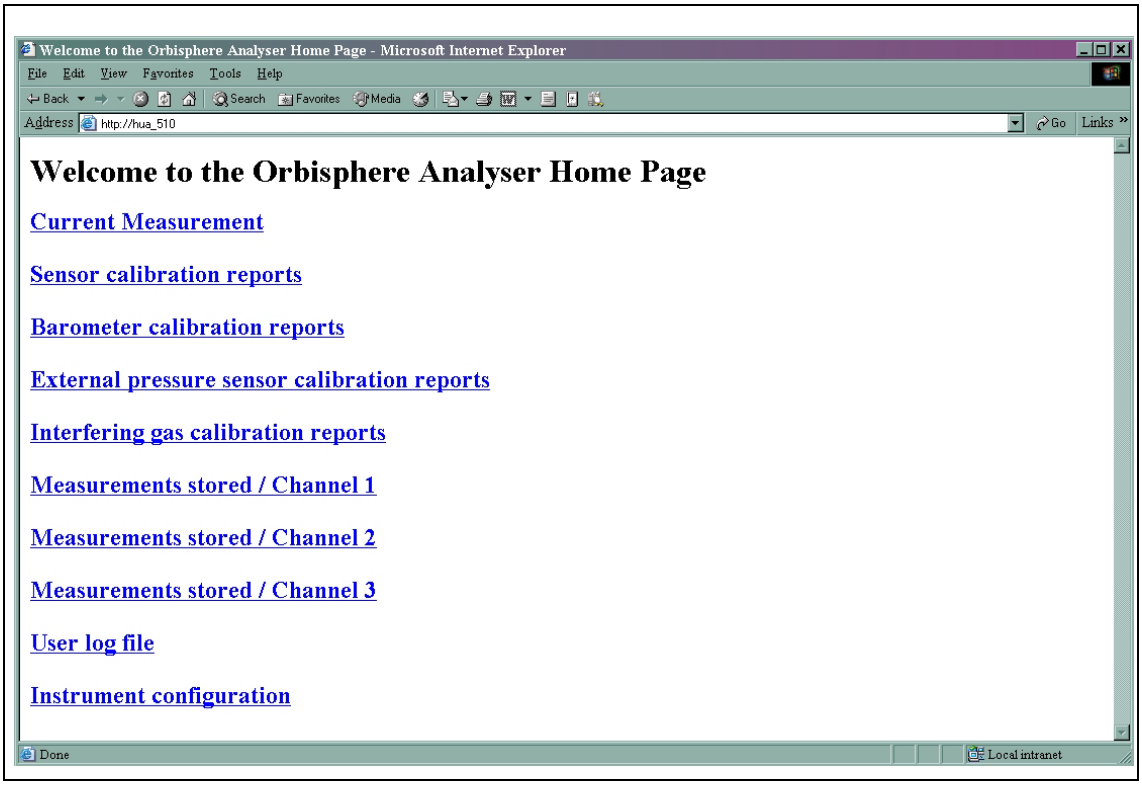




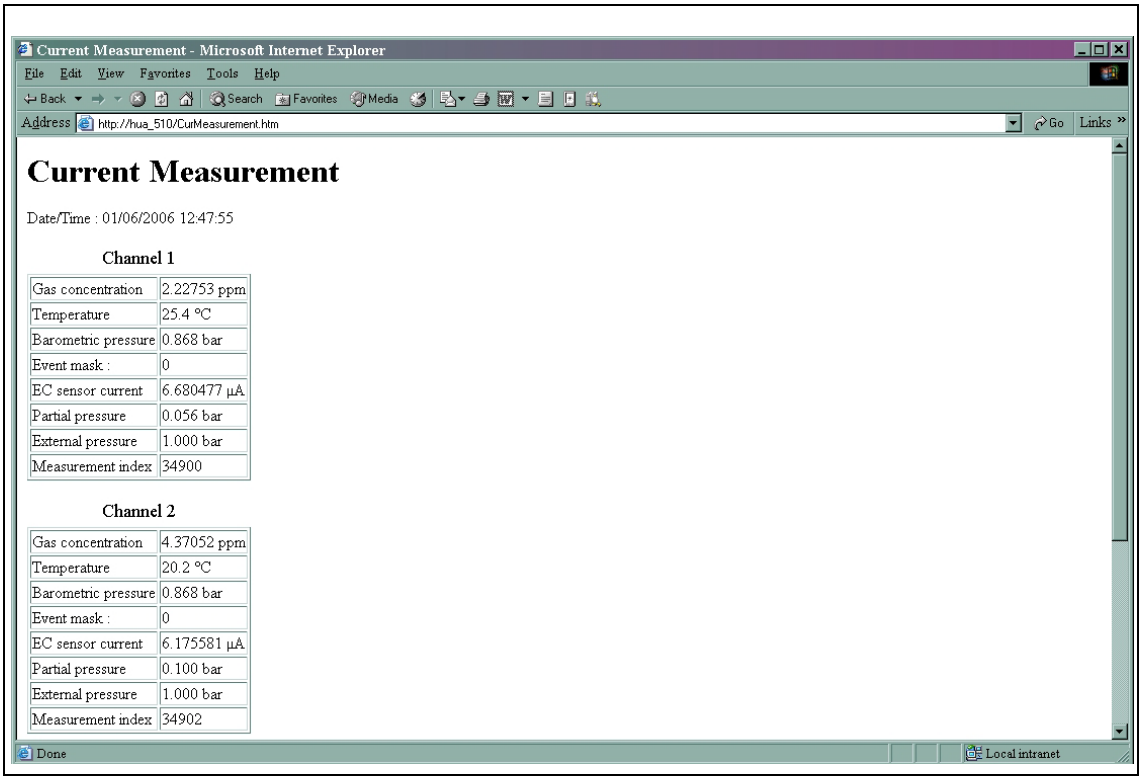
If the enable security option has been checked on the instrument, you will be required to enter a username and password on your PC to gain access to the web page.

The username and password must be a valid username/password combination that has been set up on the instrument (see also User management on page 92 on how to set up users on the instrument). Domain information is not required.

Once a valid username/password combination has been entered, the initial web page will be displayed giving a list of options:



Click on any of these options and the data will be displayed on the PC screen. The following shows an example of the screen when selecting the Current Measurement option:



9.5 Printer

This menu provides the facility to print a number of reports directly to a printer. The printer must be connected to the instrument through the instrument USB-A port.

The following information is available for printing:

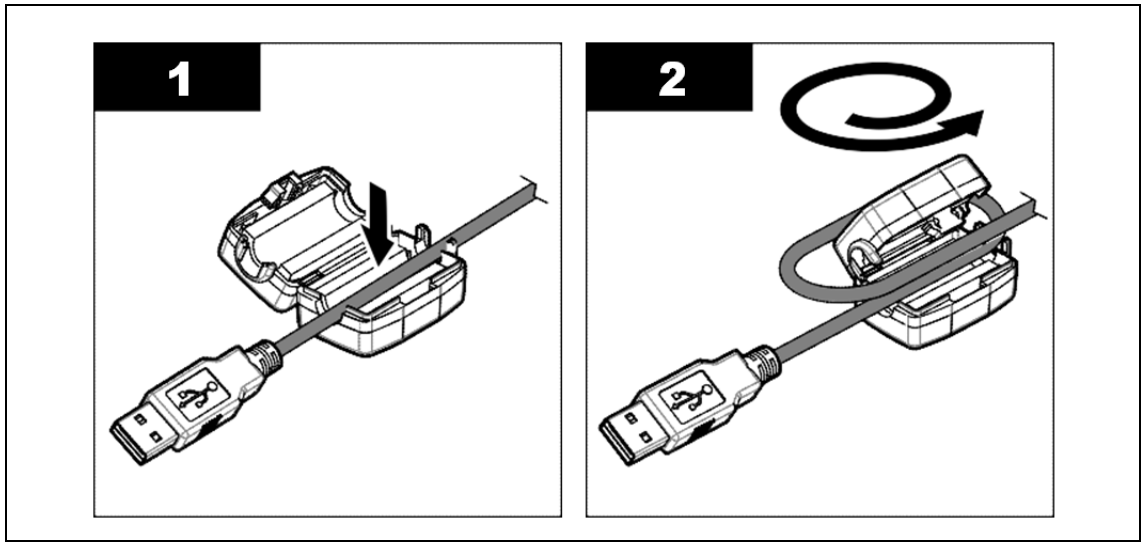
- Calibration reports
- User action log files
- Instrument configuration details
- Measurements stored in the instrument memory
- Cyclic measurements for continuous printing

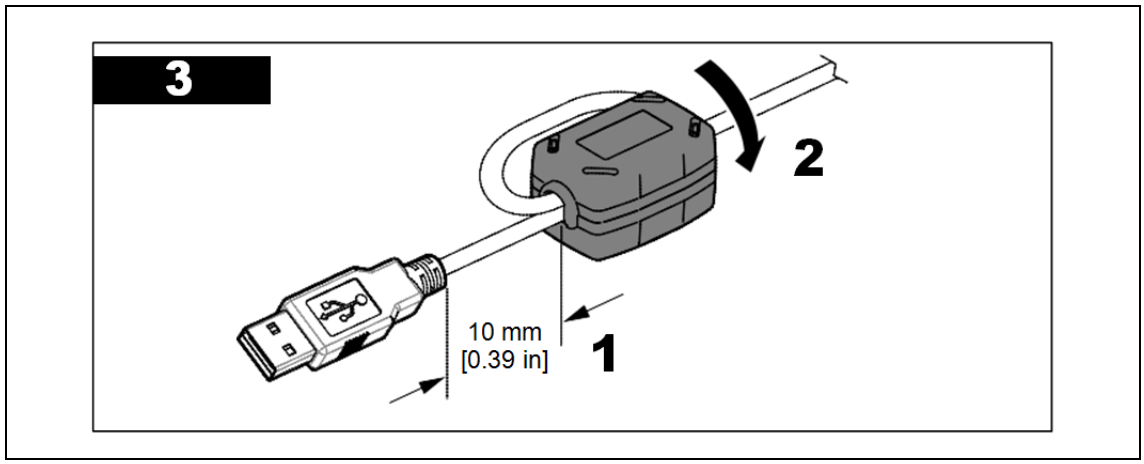
Configuration	
Printer configuration	Currently only the USB port is a valid printer connection.
Report configuration	**Calibration** - Choose the channel(s) for which calibration reports are required. Choose to print the last report or all reports for the selected channel(s). **User actions** - Define the date and time criteria for which user action logs are required. **Configuration** - Choose the channel(s) for which instrument configuration details are required. **Measurements** - Choose the channel(s) for which measurement reports are required. Define the start and end times for the measurement reports. **Cyclic measurements** - Check the enable continuous mode checkbox and choose the channel(s) for which cyclic measurements are required. **Cancel** - Exit the configuration option.

Send files
Choose the report (or **All**) to print the reports that match the configuration criteria. A status bar at the top of the screen shows printing progress. Push the **Cancel** button to cancel a print job.

9.5.1 Install ferrite on the printer cable

Refer to the following steps for the ferrite installation on the USB printer cable included with the LQV161.xx.20000 printer:





9.5.2 Printer error messages

Error message	Meaning
Printer not available	Indicates that no printer has been detected. Check that the printer is connected to the USB-A port and is powered on.
Paper out	Indicates that the printer is out of paper. In cyclic mode, it is necessary to activate cyclic printing after reloading paper in the printer. In other modes, printing can be restarted directly.
Unknown error	An unidentified error has been detected that prevents printing. If this error occurs, refer to the printer User Manual to identify the cause of the problem.

Note: *Cyclic measurement mode is automatically disabled when an error occurs. After the error is corrected, reactivate the cyclic mode in the report configuration option if cyclic measurements are required.*

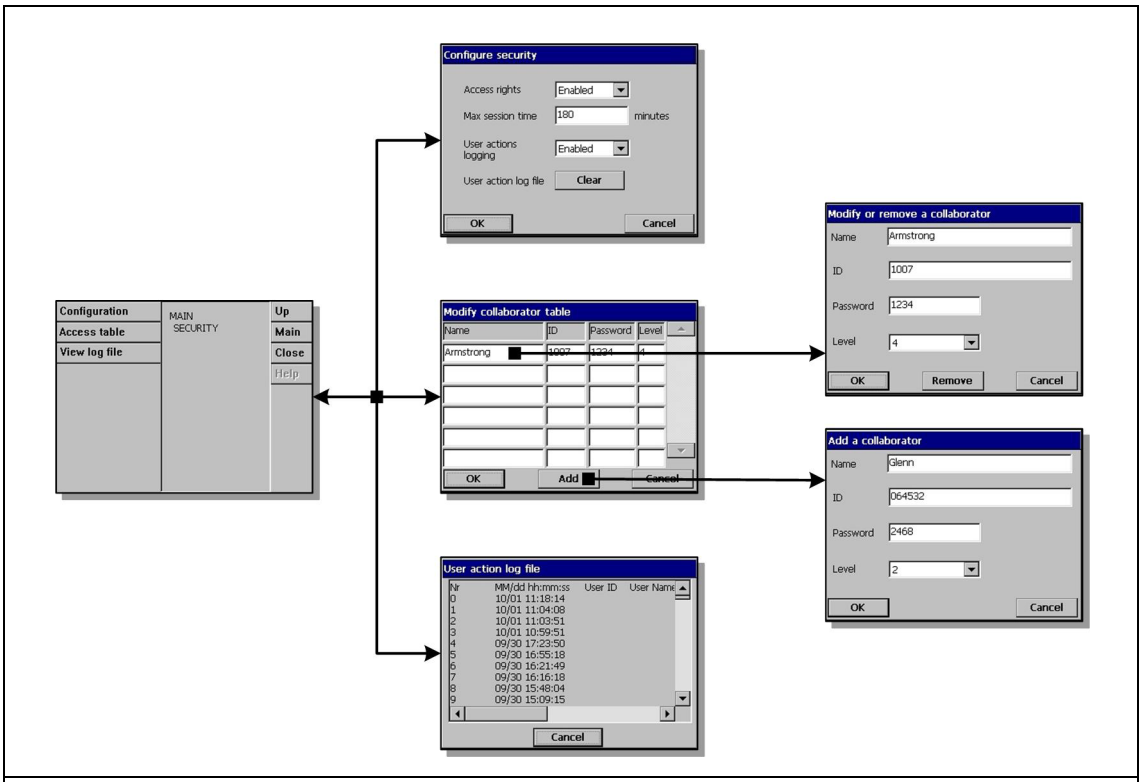


Figure 41 Security menu

Note: *When the instrument is started for the very first time, security is disabled by default. It is highly recommended that each user be entered into the system and given appropriate access rights as soon as possible to avoid any unauthorized access. Details of this process are described in this section.*

10.1 Access rights management

Access rights management
Each user has a unique ID and user password. The ID and password are used by the software to: • Allow or deny a user to perform specific actions. • To trace this action with his "ID" in a log file. Once the ID and password are entered, the user is allowed to perform actions according to the "Access level" that has been attributed to his ID by the Manager. See Security level table on page 16

Table 3 Access levels

Level	Typical rights	Comments
0	View parameters, change views	Press the unlock button and OK to access
1	+ Start / Stop measurements	
2	+ Calibration	
3	+ Modify parameters	
4	+ Modify table "User ←→ Access level" + Enable/Disable "Access right" features	There is at least one ID having the level 4

Note: *At startup, all the menus are locked. The user has to identify himself to get access beyond the different views (see Function keys on the header bar on page 42)*

10.2 Configure security

Configure security
This enables defining the users with their access level when the software starts for the first time. It is possible to configure several parameters related to confidentiality. This requires a user access level 4. ***Note:*** *Access rights are disabled by default.* • **Access rights**: When enabled, it is required to log in as a registered user (see User management on page 92) to access the menus. When disabled (default), all menu are access free, and the effect of leaving the text box blank in user login window is that there will be no name recorded for the action in the log file. • Enter a maximum session time in minutes for improved confidentiality. The user is logged out automatically when the set delay for inactivity is over. • **User action logging**: When enabled, every action from a logged on user is recorded in a user log file for traceability. • Clear all user actions log file. Confirm to clear the log file. This functionality is aimed at clearing demo or test logs for example. The log file is a rolling buffer recording the past 100 actions.

10.3 User management

User management
This window shows the list of registered users for the instrument. They are listed by name, ID, password and access level. ***Note:*** *The "User password" must be at least 4 characters long.* Pressing on an empty line, or pressing the Add button brings a window to add a new user. Name, ID, password and access level (from 1 to 4) must be entered. Pressing on a registered user line brings a window for editing or deleting the user data in the list. ***Note:*** *The list can contain up to 99 users*

10.4 User action log file

User action log file
Each time the user performs an important action, a record is written in the "User action log file". It is a rolling buffer which contains the last 1000 user actions. The "User Interface" will allow viewing this log file (Menu Security / View log file). This log file contains the following data: • line number • the action name • the user name and ID • the current date and time. ***Note:*** *Unsuccessful attempts to register are recorded in the log file without a user ID.*

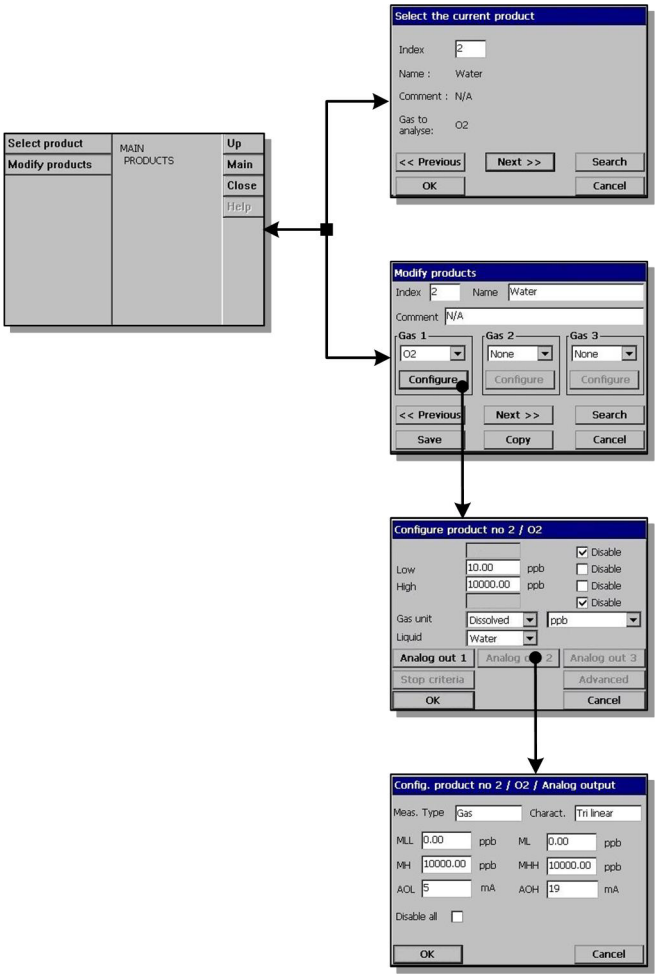


Figure 42 Products menu

Products	
This option allows users to save and/or use previously saved product configurations. A maximum of 100 different product configurations can be stored in the instrument. The basic measurement configuration (gas to analyze, gas unit, alarm limits, analog outputs, etc.) can be set up for a product and will be automatically used by the instrument when that product is selected. Product configurations can be moved from instrument to instrument if required. However, as the sensor only analyzes oxygen, only products configured to analyze oxygen can be selected on this instrument. Products configured to analyze other gases can, however, be set up on this instrument and easily transferred to other 410 or 51x instruments analyzing gases other than oxygen. For ease of use, where product configurations are identical or similar, a **Copy** facility exists on the modify product screen. This enables copying a stored configuration and storing it in one or more additional locations. Then use the modify product option to identify and/or modify the duplicate configurations.	
Select product	***Note:*** *If the PROFIBUS-DP communications protocol has been enabled, products can be selected for analysis using that facility (see Input/Output data on page 82 and specifically Change product command - output on page 84 for details).* • Select the product (0-99) to be analyzed, or use the **Next** and **Previous** buttons to scroll sequentially through the existing product list. Alternatively, use the **Search** facility to search for a product. Enter a full or partial search criteria. If only one match is found, this product is automatically selected. If a number of products match the search criteria, then a list of matches will be displayed. Select a product directly from the list of matching products. • Press **OK** to select the product or **Cancel** to exit.
Modify product	• Select the product (index 0-99) to modify, or use the **Next** and **Previous** buttons to scroll sequentially through the existing product list. Alternatively, use the **Search** facility to search for a product. Enter a full or partial search criteria. If only one match is found, this product is automatically selected. If a number of products match the search criteria, then a list of matches will be displayed. Select a product directly from the list of matching products. • Select the gas to analyze (up to three can be selected) from the drop down list. • After selecting a product and gas, press **Configure** to configure the product. Configure the product as required (refer to Measurement configuration on page 52 for additional information). • Press **Analog out** to configure the analog outputs. Configure the analog output as required (refer to Channel configuration on page 69 for additional information). • Press **OK** to accept the configuration, or **Cancel** to exit.

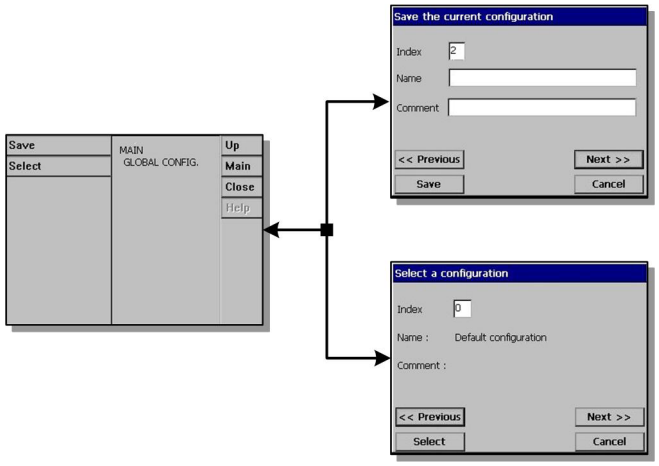


Figure 43 Global configuration menu

Global configuration	
The global configuration option allows users to save, and use previously saved, instrument configurations. A maximum of 10 configurations can be saved, with configuration 0 (zero) the instrument default. Once all the instrument parameters have been set up, use this option to save the configuration. Selecting pre-defined configurations avoids the need to re-enter all the parameters when using the instrument for a different application.	
Save	• Define the index (1-9) to save the current configuration. Use the ***Next*** and ***Previous*** buttons to scroll sequentially through existing configurations, to overwrite an existing configuration or save as a new one. • Enter a name to define the current configuration. • Enter any comments to associate with this configuration.
Select	• Select the configuration (index 0-9) to use on the instrument. Confirmation will be required for the selected configuration. The instrument must then be restarted (powered off and then back on) in order for the new configuration to take effect.

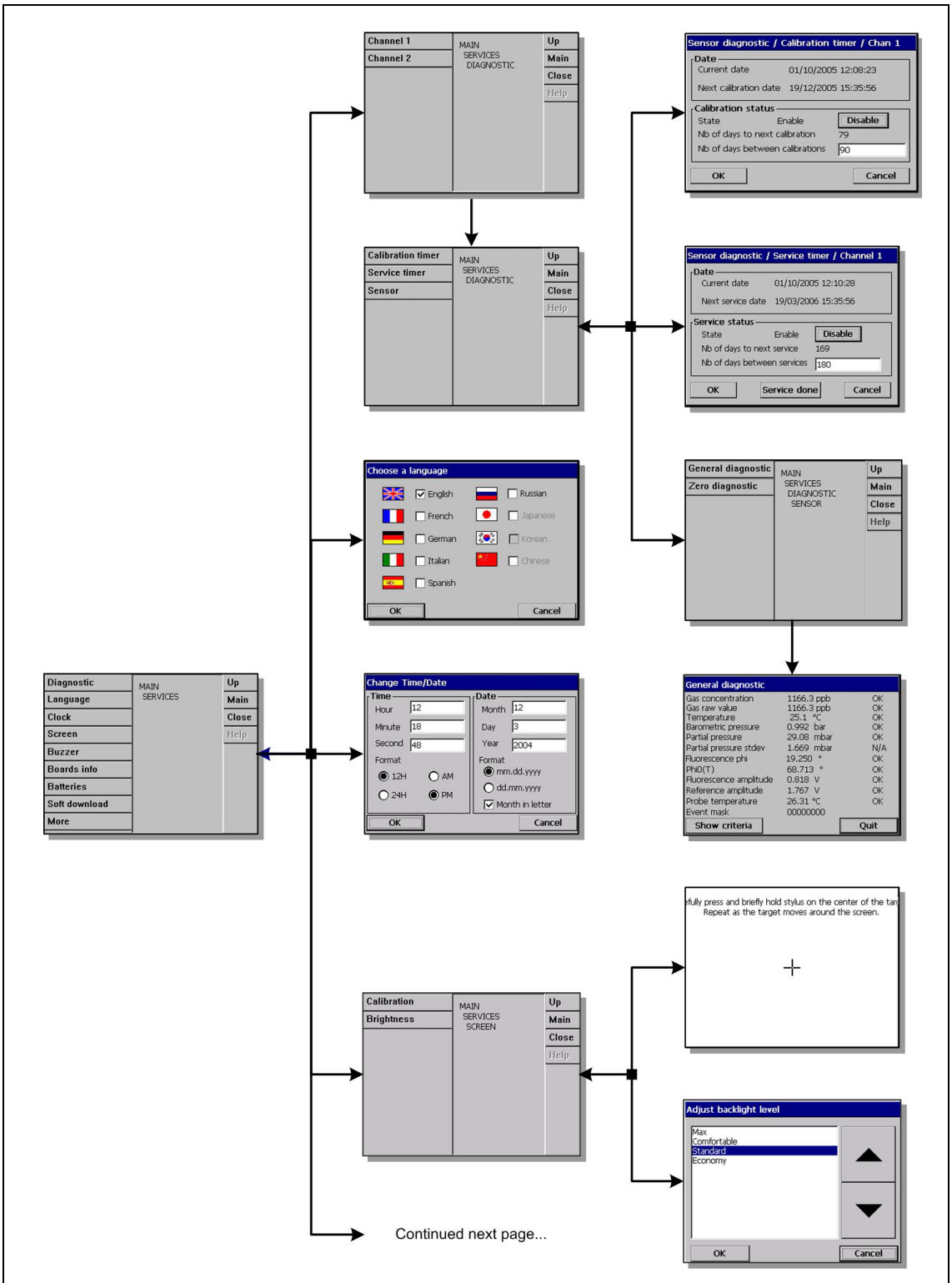


Figure 44 Services menu - Part 1

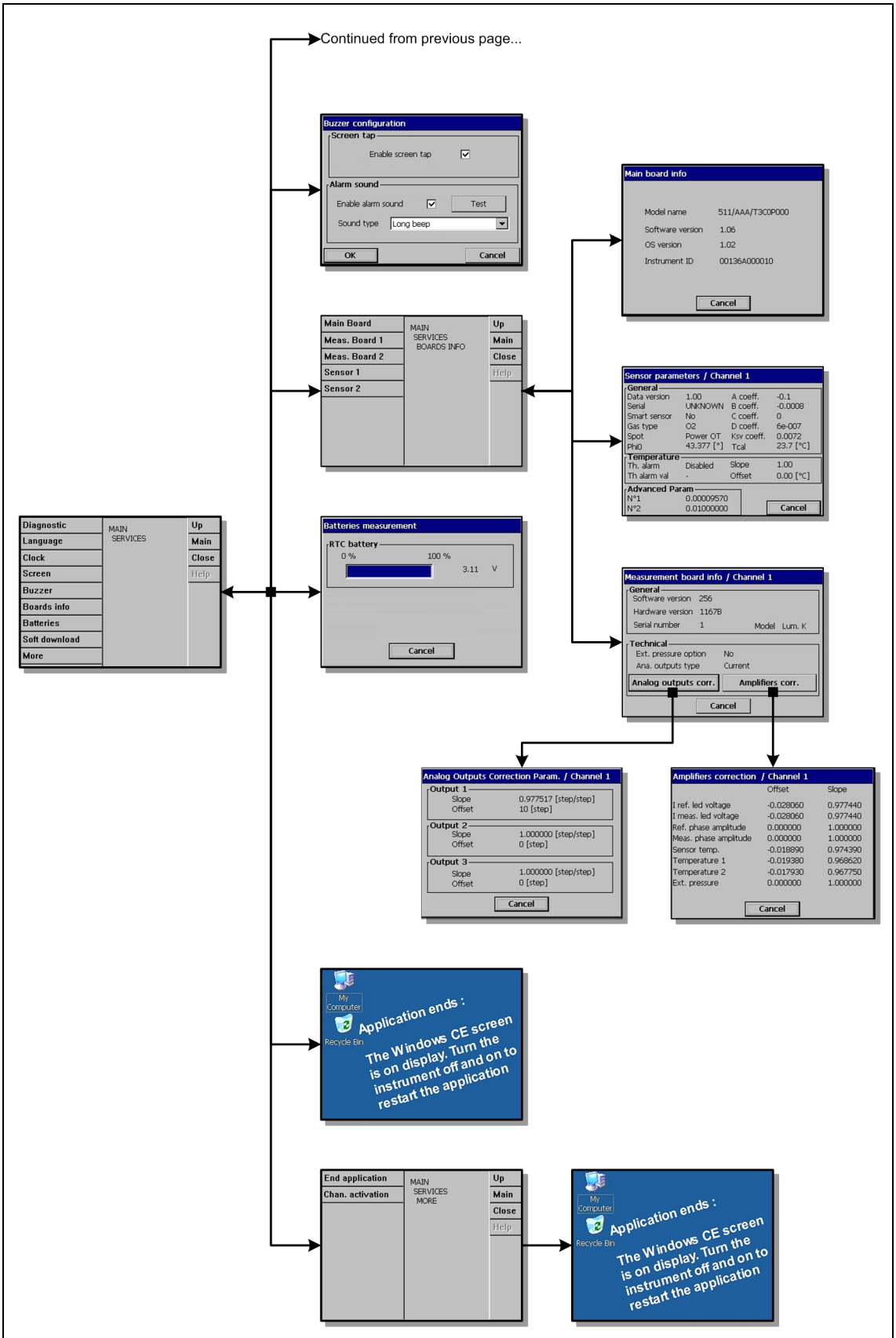


Figure 45 Services menu - Part 2

13.1 Sensor diagnostics

Sensor diagnostics	
Calibration timer	The instrument can automatically remind the user when the next sensor calibration is due. • Select measurement channel. • Select enable and enter a delay in days. • The display shows the current instrument date and time, next calibration due date and time, and the remaining days. The next calibration date is updated when the sensor is calibrated. The event “Cal. required” is generated when the delay has elapsed.
Service timer	The instrument can automatically remind the user when the next sensor service is due. • Select enable and enter a delay in days. This should be validated by a level 3 user. The display shows the current instrument date and time, the next sensor service due date and time, and the remaining days. The next service date is updated when the button **Service done** is pressed after a service. The event “Service required” is generated when the delay has elapsed. The sensor(s) attached to your instrument will require periodic servicing and maintenance. For more information on this, please refer to the manual(s) delivered with the sensor(s).
K1200 sensor	Select either **General** or **Zero diagnostic** from the menu. **General** will display values for the measurements in the sample, while **Zero** is used to display values when the gas concentration is at zero (e.g. during a zero calibration using pure nitrogen as the calibration medium). The screen layouts are identical for both diagnostic options, and show useful information for troubleshooting purposes. The first screen displays measurement information, with a status (OK or NOK) alongside. A status of NOK indicates the value is outside of the acceptable minimum or maximum value. To view the acceptable range limits press the **Show criteria** button. The criteria screen displays the acceptable range limits (minimum and maximum values) for more in-depth troubleshooting. ***Note:*** *If* ***Zero diagnostic*** *is selected, a warning message appears. Ensure the sensor has been calibrated in pure* N_2 *before selecting this option.*
TC sensor - Gas/Temperature	This feature allows you to check the ability of the TC measurement board to measure a range of currents and temperatures. To use this feature a TC sensor simulator (Part N° 29117) must be used in place of the sensor. • Depending on the operation(s) to be performed, select **V2**, **V3**, **Temp** or **Select All** and press **Start** The software performs each check in several steps and asks the user to select different values on the simulator. For each position, it applies different anode voltages. For each position and voltage applied: **1.** it waits some time (typically 1 minute for a null current) **2.** it displays if the values measured are acceptable (OK) **3.** it displays the current and temperature values measured If the current or the temperature is not acceptable, a solution may be the calibration of the "gas amplifier" or the "temperature amplifier", in which case please contact your Hach Lange representative.
TC sensor - Amplifiers	This feature will display the measured values for V2 and V3 along with the recommended values. It is advisable to put the sensor in continuous purge mode during this operation by pressing the **Continuous purge** button. If the measured and recommended values differ by a large margin, please contact your Hach Lange representative for advice.

13.2 Language selection

Language selection
Check the language as required and restart the instrument to apply the change. The instrument will restart in the language selected.

13.3 Clock

Clock
Type in each appropriate box the actual time and date, and select the display format for them.

13.4 Screen

Screen	
Screen calibration	This screen allows you to adjust the click position corresponding to the displayed buttons. Use it if ever the sensitive areas are no longer properly aligned with the buttons on display. Place the stylus right on the cross when asked and proceed. User will be asked to press on the screen to accept the new setting. If not, the new setting is not recorded and no change is made.
Screen brightness	Press the up or down arrow to increase or decrease the screen brightness. Four levels are pre-set: **Max**, **Comfortable**, **Standard** (default setting) and **Economy**. Press **OK** when finished. ***Note:*** *This can also be called through the brightness icon on the main display.* 

13.5 Buzzer

Buzzer
Adjust the sounds available on the instrument. When “screen tap” is enabled, a click sound is heard each time the screen is touched. The instrument alarm sound can be enabled or disabled to suit the application. The sound type can also be adjusted. Press the **Test** button to test the adjustment made. Press again to stop.

13.6 Boards info

Boards info	
Main board info	For reference, this display gives information on the instrument model, software version and instrument ID.
Measurement board info	For reference, this display gives information on the sensor measurement board hardware and software for the selected measurement channel. The **Model** field indicates if the sensor is an EC or TC sensor. Pressing the **Analog outputs corr.** button displays for each channel the correction factor that is applied to the analog outputs. Pressing the **Amplifiers corr.** button displays the value of the actual correction factor on the amplifiers.
Sensor parameters	For reference this display gives information on the sensor model and type, last calibration, settings and behavior.

13.7 Batteries

Batteries
On all instruments this display gives the real time clock battery charge level and voltage. ***Note:*** *A warning message (and icon) is displayed if the battery level becomes too low and needs to be replaced.*

13.8 Software download

Software download
For Hach Lange technician use only. Used when reloading the software for new versions. This ends the application. User must stop and restart the instrument to restart the program.

13.9 End application

End application
This ends the application. User must stop and restart the instrument to restart the program.

13.10 Channel activation

Channel activation (multi channel versions)
A channel can be enabled, or disabled when it is not used.

Section 14 Maintenance and Troubleshooting

14.1 Instrument maintenance

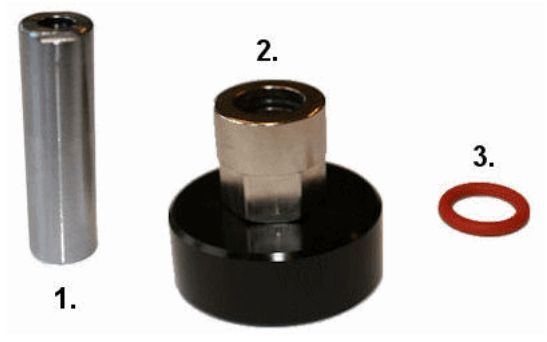
CAUTION
Personal Injury Hazard. Any instrument maintenance should be carried out by a qualified Hach Lange Service Technician. Please contact your local representative should you feel any maintenance or instrument adjustments are required

14.2 K1200 sensor maintenance

The sensor spot needs to be replaced about once a year The procedure is very simple and takes no more than a couple of minutes.

Important Note: *The shelf-life of the K1200 LDO spot is 2 years prior to first use.*

14.2.1 Equipment required

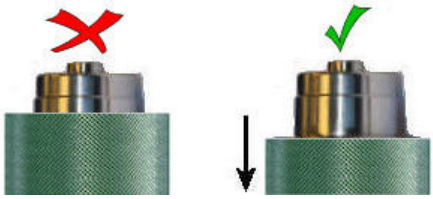
A replacement sensor spot (No. **1**) and O-ring (No. **3**) supplied with the sensor spot. The maintenance tool (No. **2**) which is delivered with the sensor.	

14.2.2 Sensor spot removal

1. Push the maintenance tool (square sides upmost) as far down as possible over the old sensor spot. Continue to push down on the tool and turn gently until the square sides of the tool and the square slots of the sensor spot engage. The tool should then drop into position.	
2. Turn the tool counter clockwise to unscrew the old sensor spot.	

3. When unscrewed completely simply lift out the old sensor spot. Pull off the maintenance tool and discard the old sensor spot. **4.** Check the red O-ring (position indicated right). If it appears damaged in any way, then using a pair of tweezers, remove and replace it with the new O-ring from the maintenance kit.	

14.2.3 Sensor spot replacement

NOTICE	
Avoid scratching or damaging the sensor spot (the black surface on the sensor head) during this process.	
1. Push the maintenance tool (square sides upmost) as far down as possible over the new sensor spot. Continue to push down on the tool and turn gently until the square sides of the tool and the square slots of the sensor spot engage. The tool should then drop into position.	
2. Make sure the sensor collar is as far down as it will go, so that the top of the collar is aligned with the base of the sensor head.	
3. Take the combined maintenance tool and sensor spot and place it in the end of the sensor.	

4. Turn the tool clockwise to screw in the new sensor spot, finger tight. Do not overtighten. Once secure, pull off the maintenance tool.	

14.3 TC sensor maintenance

NOTICE
Carry out the maintenance in a clean dry place in order to avoid damaging the sensor's precision components, and also to prevent water or humidity from getting into the sensor.

14.3.1 Maintenance schedule

Service includes membrane replacement and external cleaning to restore the original sensor sensitivity. This means low running costs and down time reduced to a minimum.

The membrane needs to be replaced once or twice a year depending on application conditions. This can be tailored accordingly.

Note: *If you are not familiar with ORBISPHERE sensor servicing, your Hach Lange representative will be glad to assist you*

14.3.2 Testing the sensor condition

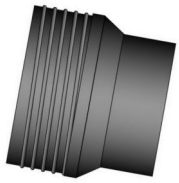
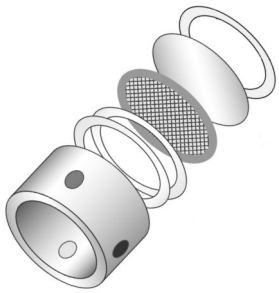
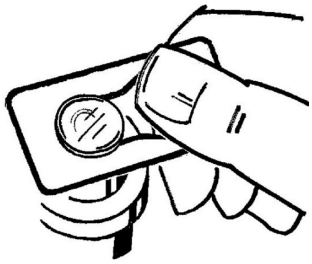
Periodically, inspect visually the sensor head for any deposits. Rinse it under clean tap water, and dry with a clean tissue.

To verify the sensor, check measurements vs. a known standard sample value:

- If reading deviation is ±1% of the expected value, no action needs to be taken.
- If deviation exceeds ± 1%, perform a new calibration.
- If deviation exceeds 10% of the original values, replace the membrane.

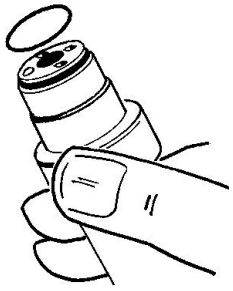
14.3.3 Membrane replacement

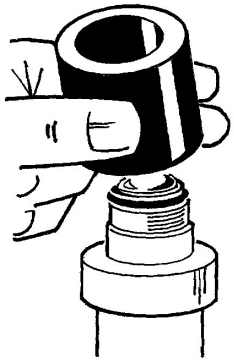
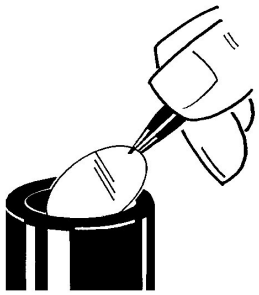
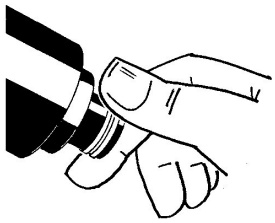
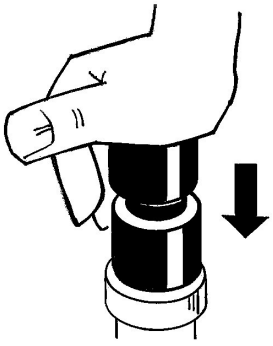
To remove the membrane, follow the steps below:

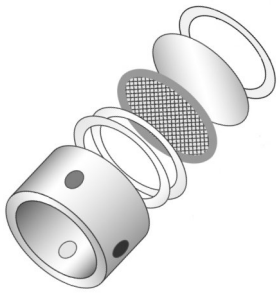
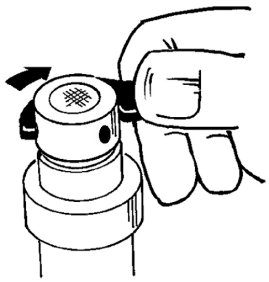
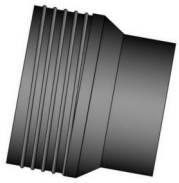
Place the thermal conductivity sensor vertical with the head up. Remove the plastic storage cap.	
Unscrew the protection cap, using the tool provided in the maintenance kit. ***CAUTION*** ***Never remove the protection cap, unless you plan to replace the membrane.***	
Pay attention to the components inside the protection cap (see TC sensor protection caps and related part kits on page 115). Note the assembly order of each item. ***Note:*** *The illustration on the right is an example only. Your configuration may differ.*	
Pull up the membrane holding ring with the tool provided in the maintenance kit. Remove membrane(s).	

Note: *For correct membrane selection, please refer to TC sensor on page 14.*

To install the new membrane(s), follow the steps below:

Note: *The membrane mounting surface must be clean and even (on top of the sensor, where the membrane and sensor have contact).* Replace the membrane O-ring on the sensor head with a new one. ***Note:*** *The 29039.0 Nitril O-ring can be reused if it is still in good condition. Membrane O-rings are part of the protection cap kit.*	

In the maintenance kit, pick up the two part membrane mounting tool. Install the sleeve over the sensor head (end with shoulder downwards). ***Note:*** *Once installed, a membrane cannot be reused. Avoid touching the membrane with bare fingers, as this may affect its sensitivity.*	
Take a few membranes out of the storage box. Using tweezers included in the kit, pick up one membrane from the stack, and gently place it on the sensor tip. Make sure it is centered. ***Note:*** *Distinguish the membrane from the protection paper:* *- Membrane is transparent (translucent).* *- Protection paper is opaque.* The membrane diameter is larger than the sensor head diameter. This is normal, as the membrane will fold over the sensor tip.	
Place the membrane holding ring on installation tool tip. ***CAUTION*** ***To avoid damaging the membrane, make sure that the tool tip is totally clean and its surface is even.***	
Insert the installation tool inside the guiding sleeve.	
Push the installation tool firmly downwards. This clasps the mounting ring onto the sensor head, folding the membrane(s) over the sensor tip. Remove the installation tool and guiding sleeve. Visually check for correct ring placement, try to push it down with your fingers. Check that the membrane is tight, with no wrinkles. ***Note:*** *Once installed, a membrane cannot be reused. Avoid touching membranes with bare fingers, as this may affect its sensitivity.*	

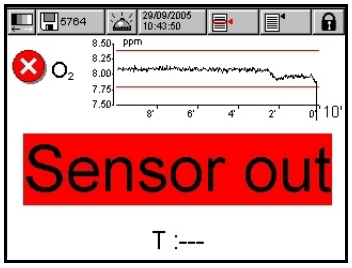
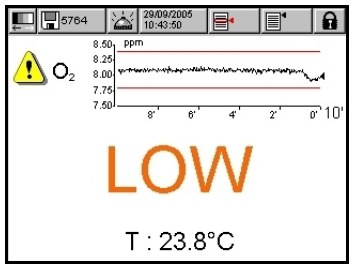
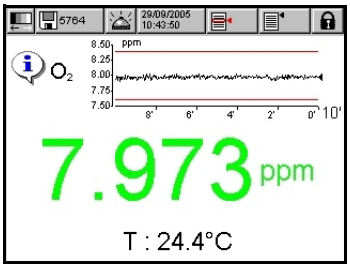
Prepare the protection cap for installation: All parts must be absolutely dry and clean. Replace all the parts inside the protection cap with new ones (except the grille), and place them in the order they were removed. The Tefzel washers, under the cap, should be slightly lubricated with silicone grease. ***Note:*** *The illustration on the right is an example only. Your configuration may differ.*	
Tighten the protection cap finger tight. Then, complete the process using the tool provided in the maintenance kit. Insert into each of the four holes in turn, and tighten as far as possible. Tighten each hole only once. ***Note:*** *The grille inside the protection cap should be free to move during tightening. Therefore, and to avoid damage to the membrane, do not touch the grille during the tightening process.*	
Always store the sensor in a dry environment, with the storage cap installed.	
Note: *A sensor that has been taken apart, or serviced must always be calibrated. Allow the sensor to settle for 30 minutes to allow measurements to stabilize and the membrane(s) to relax, before performing the sensor calibration.* Calibrate the sensor to check that the membrane has been installed correctly and not been damaged. If an error message (illustrated right) appears on your instrument, then the membrane has been damaged or incorrectly installed.	

14.4 Troubleshooting

The possible events, along with the text message displayed on the instrument numeric view screen, the reason for the event and its criticality are listed in Table 4 on page 110. An event is something which affects the measurement. In the numeric view, the current events are indicated with the gas concentration at the same place.

Whenever an abnormal event is met, a sign is displayed on the upper left of the screen. Pressing on the sign calls a window giving further details about the actual situation.

There are three levels of abnormal conditions:

	• **Alarm** - There is a severe problem causing the channel to be out of action, and the system alarm relay to be enabled
	• **Warning** - Events less critical than a system alarm (e.g. measurement alarm)
	• **Information -** For information only; no action is required

Note: *Use the Diagnostic view for troubleshooting (see Sensor diagnostics on page 99).*

	In addition to the above, if the RTC battery is running low and needs to be changed, the icon illustrated left is displayed in the bottom right corner of the numerical view screen.

Note: *If the RTC battery is running low, the date and time of the instrument are reset. Also, on startup the instrument will automatically reboot after the initial startup is complete.*

14.5 List of events and alarms

Table 4 List of Events			
Event type	**Name**	**Description**	**Bit mask value (32 bits long)**
Information	Measure	Normal measurement mode.	0x00000000
	Filter enabled	The gas measurements are filtered.	0x00000001
	Sample measurement	The sample measurement is started.	0x00000002
	Alarm snooze	The alarm snooze is ON.	0x00000004
	Autotest in progress	The autotest is running.	0x00100000
	Autotest failed	The autotest has failed.	0x00200000
	Out of range protection disabled	The out of range protection has been disabled.	0x00800000
	User offset activated	The user measurement offset is activated.	0x01000000
	Meas. not ready	The measurement is not ready (e.g. at startup)	0x80000000
Warning	Calibration	Channel in calibration.	0x00000008
	Alarm low low	The gas concentration below the Alarm LowLow limit.	0x00000010
	Alarm low	The gas concentration is below the Alarm Low limit.	0x00000020
	Alarm high	The gas concentration is above the Alarm High limit.	0x00000040
	Alarm high high	The gas concentration is above Alarm HighHigh limit.	0x00000080
	Calibration required	The calibration of the sensor is required.	0x00000100
	Service required	The sensor requires a service.	0x00000200
	Hold	The measurement is frozen.	0x00400000
	Out of range	Measurement is greater than the specified range of the sensor (2,000 ppb for low range sensors or 40 ppm for high range sensors).	0x02000000
	Low level zero calibration gas	The level of zero calibration gas is very low.	0x04000000
	Continuous purge on	Continuous purge is ON.	0x10000000
Alarm	Channel disabled	The channel has been disabled.	0x00000400
	Channel out	The measurement board has been disconnected (or does not answer).	0x00000800
	Sensor out	The sensor has been disconnected.	0x00001000
	Ext. pressure sensor out	The external pressure sensor is out.	0x00002000
	Thermal cut off	The temperature is above the thermal cut off.	0x00004000
	Interfering gas error	For this channel, an interfering gas is taken into account (i.e. O_2 over N_2). This interfering gas is measured by another channel. This event occurs when the other channel: • is in error (sensor out, thermal cut off, calibration, etc.) • does not exist anymore • does not measure the right gas (i.e. O_2)	0x00008000
	PROFIBUS-DP value not updated	The PROFIBUS-DP module has not received measurements from the instrument for 30 seconds.	0x00080000
	Ramp limit violated	V3 voltage outside range -3V to +8V	0x04000000

14.6 Storage, handling and transportation

Protect the instrument against the elements: rain, splashing, direct sunlight, etc.

A properly packaged instrument can be stored and transported at a temperature -20°C to +70°C and relative humidity up to 80%. Best practice for packing the instrument for transportation is to reuse the original packaging in which the instrument was first delivered. The instrument should be stored in suitable premises, free of dust, condensation and chemical evaporation.

In cold weather, avoid sudden temperature change (like when entering a warm room) and give the instrument enough time to adapt to the ambient temperature in order to avoid condensation inside.

To clean the instrument, wipe the housing clean with a cotton cloth or tissue. Always clean the instrument before storage. Pay attention not to scratch the surface of the display to retain good clarity over time.

NOTICE
Never use liquids such as oil, benzene, or detergents for cleaning the instrument. A mild glass cleaner can be used to remove greasy stains.

Section 15 Accessories and Spare Parts

15.1 Instrument

Part No.	Description
32531.03	Ethernet cable for wall and panel instruments including connectors, length = 3m
32531.10	Ethernet cable for wall and panel instruments including connectors, total length = 10 m
32531.20	Ethernet cable for wall and panel instruments including connectors, total length = 20 m
32534.03	PROFIBUS-DP cable including SUB-D 9 female connector (length = 3 m)
32534.MM	PROFIBUS-DP cable including SUB-D 9 female connector, total length = MM, price added per meter of length greater than 3 m
32959A	Converter RS232/RS-485
32963	Wall mounting kit
32964	Panel mounting kit
32965	Locking key for wall instruments
32970	Cap to protect USB connector
32972	Pipe mounting kit for wall instrument
32973	PROFIBUS-DP upgrade kit (includes board and software key)
32975	Power supply connector (10-30 VDC) for panel and wall instruments
33015	Pressure reducer for calibration gas bottles with 0.1 L/min. flow, 5/8" x 18 connection, max 70 bar
33092	Measurement board for K-type and M-type sensors
DG33263	IP65 sealing kit for 410 and 510 panel instruments
LQV161.52.20000	Thermal printer USB for 410/51x controller (EU)
LQV161.53.20000	Thermal printer USB for 410/51x controller (USA)
LQV161.66.20000	Thermal printer USB for 410/51x controller (AUS/NZ)
LQV161.80.20000	Thermal printer USB for 410/51x controller (CN)
LQV161.82.20000	Thermal printer USB for 410/51x controller (UK)
LZP273	Thermal printer paper (4 rolls)

15.2 K1200 sensor

Important Note: *The shelf-life of the K1200 LDO spot is 2 years prior to first use.*

Part No.	Description
K1200-S00	Luminescent oxygen sensor for on-line water applications, low range 0-2000 ppb, 28mm ORBISPHERE fitting
K1200-S00H	Luminescent oxygen sensor for on-line water applications, high range 0-40 ppm, 28mm ORBISPHERE fitting
32510.03	Sensor cable (3 m) to connect K1200 type sensors with ORBISPHERE 410/510 instruments
32510.05	Sensor cable (5 m) to connect K1200 type sensors with ORBISPHERE 410/510 instruments
32510.10	Sensor cable (10 m) to connect K1200 type sensors with ORBISPHERE 410/510 instruments
32510.15	Sensor cable (15 m) to connect K1200 type sensors with ORBISPHERE 410/510 instruments
32510.20	Sensor cable (20 m) to connect K1200 type sensors with ORBISPHERE 410/510 instruments
33087	O-ring kit for 28 mm K1200 type sensors
33103	K1200 spot mounting tool
28129	Protection cap for 28 mm sensors
K1200-H	High level spare optical spot for K1200 sensors
K1200-L	Low level spare optical spot for K1200 sensors

15.3 511 analyzer kits to order (KTO's)

Part No.	Description
DGK511FK-P1123	Kit containing K1200-S00 Oxygen sensor, 31250 Hydrogen sensor, 511FK0/P1C1P0N0 controller, 3m cables
DGK511FK-W1123	Kit containing K1200-S00 Oxygen sensor, 31250 Hydrogen sensor, 511FK0/W1C1P0N0 controller, 3m cables

15.4 TC sensor parts

Part N°	Description
28129	Delrin storage cap (sensor's storage cap)
28320	Membrane supporting disc with stainless steel grill. Thermal conductivity sensor
28614	Combined protection cap and membrane holding ring removal tool
29228	Stainless steel membrane holding ring (membrane thickness < 50µ)
29229	Stainless steel membrane holding ring (membrane thickness > 50µ)
2935A	Halar membranes, 25 µm, box of 25.
2952A	Tefzel membranes, 25 µm. box of 25.
29561A	PFA membranes, 25 µm. box of 25.
32920	Membrane mounting tool, including centering sleeve and plunger

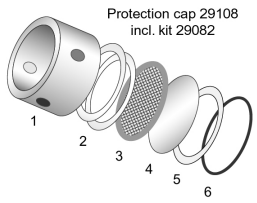
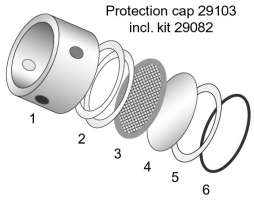
15.5 TC Sensor accessories

Part N°	Description
DG33647	Pressure sensor 0-50 PSIA / 0-3.5 bar absolute
29006.0	EPDM O-rings for flow chamber/sensor socket 28x2 and 32x2mm
32605	Safety Purge Backup Unit for TC sensors
32557	External temperature sensor for in-line use, supplied with 4 pin LEMO connector for TC sensors equipped with sensor adapter 32558. Sensor socket must be ordered separately.
32559.0	External temperature sensor for off-line use, supplied with 4 pin LEMO connector for TC sensors equipped with sensor adapter 32558. T piece for connection to 6mm tubing included.
32559.1	External temperature sensor for off-line use, supplied with 4 pin LEMO connector for TC sensors equipped with sensor adapter 32558. T piece for connection to 1/4" tubing included.
32560	External temperature sensor for fitting to Tuchenhagen Varivent with > or = 3 inch diameter (not included) and a TC sensor equipped with adapter 32558. Supplied with 1 meter of cable and 4 pin LEMO connector for the TC sensor.
32562	External temperature sensor for use with 32011 flow chamber and a TC sensor equipped with sensor adapter 32558. Supplied with a 4 pin LEMO and 1 meter of cable.
32563	External temperature sensor for in-line use, with liquid tight base in stainless steel. Supplied with 4 pin LEMO connector for TC sensors equipped with adapter 32558. Sensor socket to be ordered separately.

15.6 TC sensor maintenance kits

Part N°	Description
32739	Maintenance Kit for high pressure thermal conductivity sensor applications as well as certain hydrogen thermal conductivity cases. Includes membranes 29561A, membrane holding ring 29228.01, kit 29082, and tools for sensor maintenance.
32741	Maintenance Kit for hydrogen thermal conductivity sensors with 29108 protection cap. Includes membranes 2952A, membrane holding ring 29228.01, kit 29082, and tools for sensor maintenance.
32749	Maintenance Kit for carbon dioxide & nitrogen thermal conductivity sensors having the 29108 protection cap. Includes membranes 29561A, membrane holding ring 29228.01, kit 29082 for protection cap, and tools for sensor maintenance.
32760	Maintenance kit for carbon dioxide & nitrogen TC sensors with protection cap 29111. Includes membranes 29561A, membrane holding ring 29228.01, 28002 washers, and tools for sensor maintenance.

15.7 TC sensor protection caps and related part kits

Part N°	Protection Cap Design		Specific Spare Parts
29 108	Standard protection cap with honeycomb grille. Delivered with 29082 kit.		Kit 29082 includes: 2: 28002 Tefzel washer x 6 (2) 3: 29080 honeycomb grille 4: 29049 Dacron mesh x 10 (1) 5: 28003 silicon washer x 3 (1) 6: 29039.0 EPDM o-ring x 5 (1)
29 103	Standard protection cap with honeycomb grille for humid gases only. Delivered with 29082 kit.		Kit 29082 includes: 2: 28002 Tefzel washer x 6 (2) 3: 29080 honeycomb grille 4: 29031A Water separation filter x 3 (1) 5: 28003 silicon washer x 3 (1) 6: 29039.0 EPDM o-ring x 5 (1)
29 111	Protection cap with bonded stainless steel mesh, incl. 1 Tefzel washer.		Individual parts: 28002 Tefzel washers x 6 (1) 29039.0 EPDM o-ring x 5 (1)

Example:

- x 5 means 5 items are supplied
- (1) means only one is required

Note: *Depending on the application, O-rings are available in EPDM, Viton®, Kalrez®, Nitril®*

15.8 Insertion and sampling devices

Part No.	Description
29006.0	EPDM O-ring set for flow chamber 32001 and sensor socket 29501
29501.0	Stainless steel sensor socket with EPDM O-rings for welding to stainless steel pipe.
32001.010	Flow chamber in stainless steel (316) with 6 mm fittings. Supplied with EPDM O-rings.
32001.011	Flow chamber in stainless steel (316) with ¼" fittings. Supplied with EPDM O-rings.
32001.012	Flow chamber in stainless steel (316) with 8 mm fittings. Supplied with EPDM O-rings.
32002.010	Multi parameter flow chamber in stainless steel with 6 mm fittings. Supplied with EPDM O-rings.
32002.011	Multi parameter flow chamber in stainless steel with ¼" fittings. Supplied with EPDM O-rings.
32003	Sensor insertion and retraction valve for use with Tuchenhagen adapter.
32740	Replacement parts kit for 32003 insertion and retraction valve
33088	Calibration device for K-type and M-type sensors
33090	O-ring kit for 33088 calibration devices
33095	28 mm stationary housing for installation on Varinline® access units
33098	O-ring kit for 28 mm stationary housing for installation on Varinline® access units

Section 16 Glossary

16.1 Gas units

Unit	Meaning
% air	percentage, by weight. A concentration of 100% air corresponds to liquid saturated with air at current pressure and temperature. The equivalent concentration of O_2 is approximately 20% O_2 in normal conditions.
% O_2	percentage, by weight. A concentration of 100% O_2 corresponds to liquid saturated with pure O_2 at current pressure and temperature.
%Vbar	ratio in percent between the partial pressure of gas measured and the atmospheric pressure
%Vext	ratio in percent between the partial pressure of gas measured and the external pressure. Available when an external pressure sensor is present.
µg/L	micrograms per liter
atm	atmosphere
bar, mbar	bar, millibar
cc/kg	volume of gas per kg of liquid. The volume of gas is calculated considering normal conditions (T = 0°C, p = 1atm)
g/kg	grams per kilogram
g/m^3	grams per cubic meter
mg/L	milligrams per liter
ml/L	milliliters per liter
Pa, hPa, kPa	Pascal, hecto Pascal, kilo Pascal
ppb	parts per billion, by weight
ppm	parts per million, by weight (same as mg/kg)
ppm Vb	parts per million, per volume, barometric pressure referenced. = %Vbar / 10,000
ppm Ve	parts per million, per volume, external pressure referenced. = %Vext / 10,000
psia	pound per square inch, absolute
V / V	volume per volume (ratio)

16.2 Generic terms and definitions

Terms	Meaning
Absolute pressure	This is the total pressure in a system (i.e. relative pressure, plus atmospheric pressure)
Analog output	A voltage or current signal that is a continuous function of the measured parameter.
ASCII	American Standard Code for Information Interchange. A standard character-coding scheme used by most computers to display letters, digits and special characters.
Baud rate	Baud rate means transmission speed (Unit: bits per second, bps), especially for RS-232/422/485 interfaces.
CIP	Cleaning In Progress
Concentration	The relative content of a component in a gaseous or liquid media.
Conductivity	The reciprocal of electrical resistivity.
FIFO (First In First Out)	FIFO is a concept to describe the behavior of a buffer. It means the data which entered first will exit first.
Headspace	The empty volume above a liquid or solid in a closed container.

Master / Slave modes	A device operating as a master will poll one or more devices operating as a slave. This means a slave device cannot volunteer information; it must wait to be asked for it.
Parallel communication	Parallel communication represents a connection in a computer system in which the bits of a byte are transmitted over separate channels at the same time.
PLC	Programmable Logic Controller. It communicates with other process control components through data links. It is used in process control for simple switching tasks, PID control, complex data manipulation, arithmetic operations, timing and process and machine control.
PROFIBUS-DP	The PROFIBUS-DP (Decentralized Peripheral) fieldbus is designed especially for communication between automation control systems and distributed I/O at the device level. Each DP device has specific parameters such as device version, baud rate, data format, I/O length, user parameters, etc. These parameters are stored in a file with .GSD extension.
PROFIBUS-DP GSD files	The GSD file is provided by the manufacturer and is required for device configuration. A GSD file is a readable ASCII text file that contains both general and device-specific specifications for communication (Communication Feature List) and network configuration.
Relative pressure	Relative pressure is the over pressure in a system (i.e. absolute pressure less atmospheric pressure). This is the customary gauge reading.
Resistivity	The opposition offered by a body or substance to the passage through it of a steady electric current.
RS-232	RS-232 is a serial communication standard providing asynchronous communication capabilities with hardware flow control, software flow control, and parity check. Maximum transmission distance is up to 15 meters at a max. 20,000 bps. A converter is required to interface RS-232 with RS-422 or RS-485.
RS-422	RS-422 is intended for point-to-point communications. It provides much longer transmission distance but less signal line compares to RS-232. RS-422 adopts differential transmission technology and thus provides high-speed transmission up to 10mbps and maximum transmission distance up to 1.2km/110kbps.
RS-485	RS-485 is an enhanced version of RS-422 and is used for multi point communications, meaning that many devices may be connected to a single signal cable. It is compatible to RS-422 interface and provides 2 wire bus topology.
Serial communication	Serial communication represents a connection in a computer system in which the bits of a byte are transmitted sequentially over a single wire.
Single twisted pair	In this version, all devices are connected to a single Twisted Pair. Thus, all of them must have drivers with tri-state outputs (including the Master). Communication goes over the single line in both directions. It is important to prevent more devices from transmitting at once (software problem).
TPO and TPA	Total package oxygen (TPO) is a calculated value that combines dissolved and headspace oxygen (i.e. the mass of oxygen in the liquid plus the oxygen in the headspace, divided by the volume of liquid in the package). It is the amount of oxygen in a package that can react with the beverage in that package. Total package air (TPA) is the same combination but given in air content. This comes from early wet lab techniques that absorbed the CO_2 of the package. The volume of gas remaining was called “air”, but which is not strictly correct as the oxygen to nitrogen ratio is not identical to real air due to the oxygen consumption by sensitive compounds in the beverage.
USB	Universal Serial Bus. An external peripheral interface standard for communication between a computer and external peripherals over a cable using bi-serial transmission. The USB host uses a type A connector.

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