United PROCESS CONTROLS

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H_2SMART^{TM}

USER MANUAL

Version 17

Manual #: 003

Rev No: 017
Date: 30 March 2015

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CE Conformity (Europe)

This product conforms to 73/23/EEC, the Low Voltage Directive, and 89/336/EEC, the EMC Directive.

AMS Conformity (North America)

This product conforms to SAE Aerospace Material Specifications AMS 2759/10 for nitriding and 2759/12 for nitrocarburizing

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1. INTRODUCTION

1.1 Overview

The *H₂Smart*™ is an integrated thermal conductivity sampling system designed to measure the concentration of a gas sample in binary or quasi-binary mixtures. It is especially suitable to measure hydrogen content or dissociation level with high accuracy in nitriding and nitrocarburizing atmospheres and to calculate the parameters necessary for nitriding process control. A unique measuring cell design and advanced electronics eliminate the need for a reference gas cell, thus simplifying the installation.

An integrated sampling pump with variable output and a flow monitoring circuit with pump saturation warning and flow alarm insure fresh and reliable sampling flow. The pump provides a continuously controlled flow despite possible sampling line obstructions or filter contaminations, thus assuring accurate measurements and better process control.

A sample gas pump with variable output and a digital flow regulator are used to form a closed loop sampling system that ensures constant gas flow through the analyzer.

The measuring block is maintained at a preset temperature with high accuracy to provide stable measuring conditions and protect the system from moisture formation and cell contamination during nitrocarburizing.

The system status and measured results are displayed on a large, easy to read alphanumerical display.

2. SPECIFICATIONS

2.1 Physical

Width (including mounting bracket):	205 mm / (8.1”)
Height:	201 mm / (8.3”)
Depth:	193 mm / (7.6”)
Weight:	4 kg / (8.8 lbs)

2.2 Performance

Accuracy:	+/- 0.5% of reading plus +/- 0.3% of full scale
Linearity:	< 0.5% of full scale
Repeatability:	< 0.5% of full scale
Zero drift:	< 0.5% of full scale per month
Sampling flow:	0.5 lpm / (1 cfh) controlled
Response time:	95% in 30 sec @ 0.5 lpm / (1 cfh)

2.3 Operating

Power requirements:	24VDC, 2.5 Amps max. Use only well regulated power supply
Outputs:	2 x analog, sourcing with **common positive supply** 4 – 20 mA (R<500 Ohm) 1 x digital, PWM output 24 VDC (to control SSR) 2 x digital, 24 VDC, 1.0 A max. (alarms)
Inputs:	1 x analog, dedicated temperature sensor (optional) 2 x digital, 24 VDC
Working pressure:	ambient +/- 70mbar (1PSI)
Ambient Temperature:	< 57°C (<135°F)
Sampling pump:	Maximum Continuous Vacuum generated 350mbar - abs (5 psi) Maximum Continuous Pressure generated 1.4barg / (20 psig)

2.4 Recommended Calibration

Polynomial calibration	12 months

3. INSTALLATION

3.1 Overview

The *H2Smart*™ unit is to be installed away from the furnace and the sample gases are tapped from the exhaust lines. Ensure that the source and dump lines are at the same pressure.

CAUTION

The sampling gas temperature entering the *H2Smart*™ must be < 90°C (195F°). Usually this condition is easily accomplished by selecting the proper length and heat dissipation condition of the sampling supply line. Necessary heat dissipation for the sampling flow of 0.5 lpm (1 cfh) and temperature difference 500°C (932°F) is less than 10 W (35 Btu/hr) and depend on the sampling gas composition.

CAUTION

Handle with care, do not drop. The sensor is susceptible to shock, and it is a static sensitive device, use proper handling procedures

CAUTION

Installations with dirty exhausts (powder residues, injections, Malcomizing, masking, furnaces with oil seals) require a supplementary pre-filter, we suggest a 5um (or as required for your particular condition) with a surface area of not less than 200 cm^2 (30 in^2).
For ferritic nitrocarburizing, we suggest that this pre-filter is also heat traced.
End user must ensure that gases entering the unit are free of contaminants such as water, oil or other.

3.2 Physical Characteristics

BOTTOM VIEW

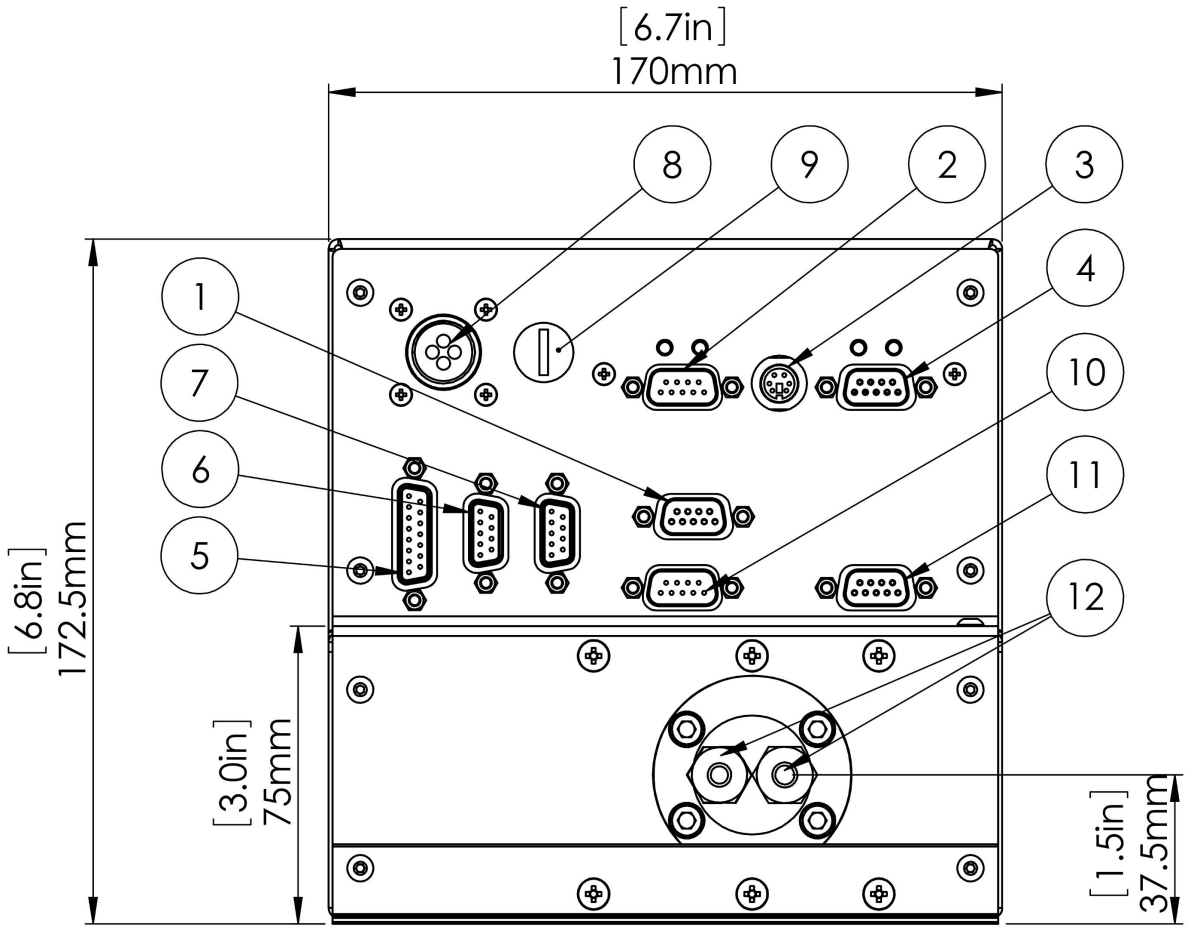


Figure 1 - Bottom View

1	Optional Interface for Profibus or Modbus
2	CAN
3	SVC (service)
4	LAN
5	Digital I/O
6	Analog Out

7	Taux (temp sensor)
8	Power
9	Voltage Fuse
10	Oxygen probe (signal)
11	Oxygen probe (thermocouple)
12	In-Out Connectors

FRONT VIEW

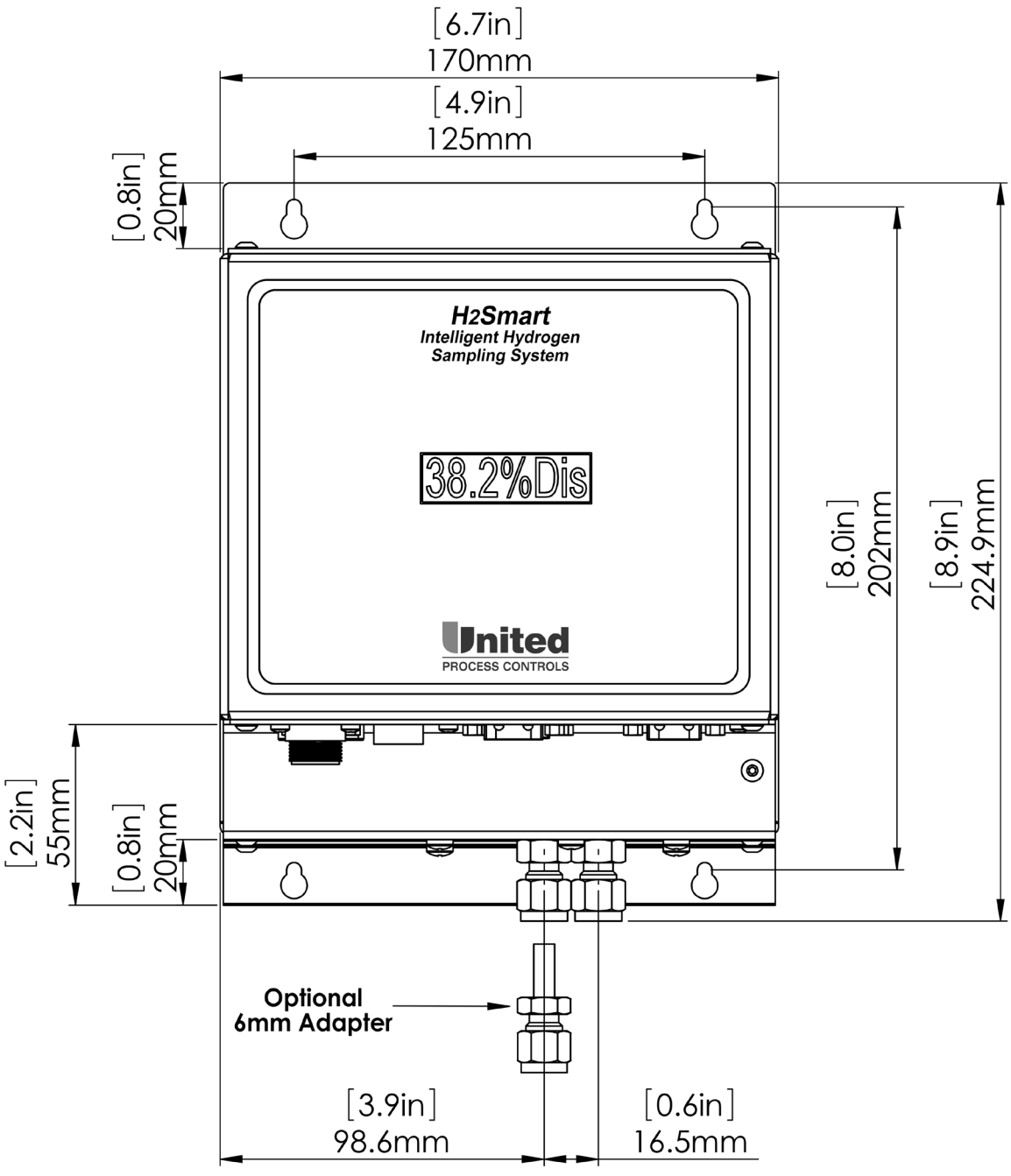


Figure 2 Front View

SIDE VIEW "V"

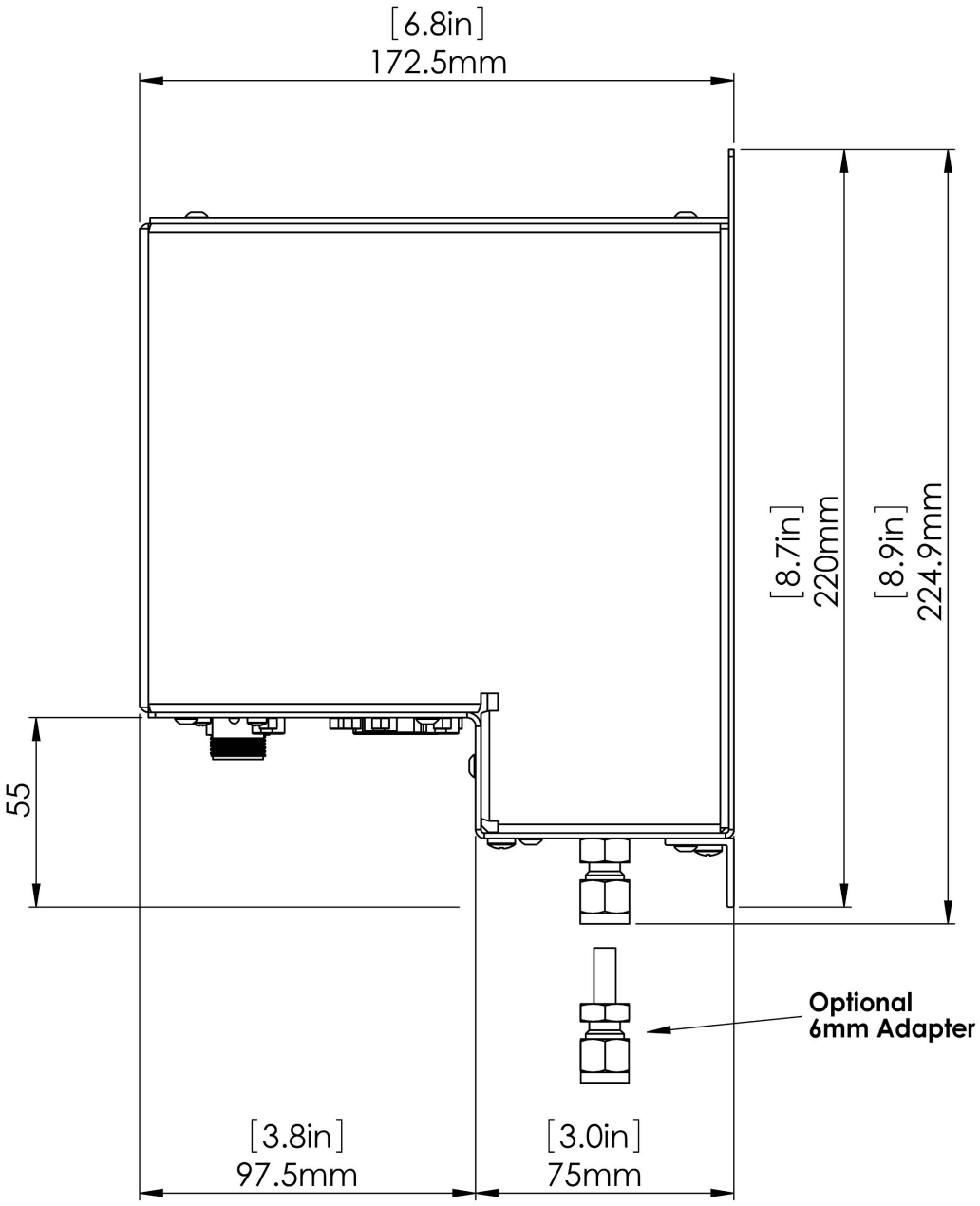


Figure 3 Side View

3.3 Installations Steps

3.3.1 Step 1

Two support brackets and four screws are used to secure the *H2Smart™* unit. Attach unit to a panel wall using four #10 (M5) screws

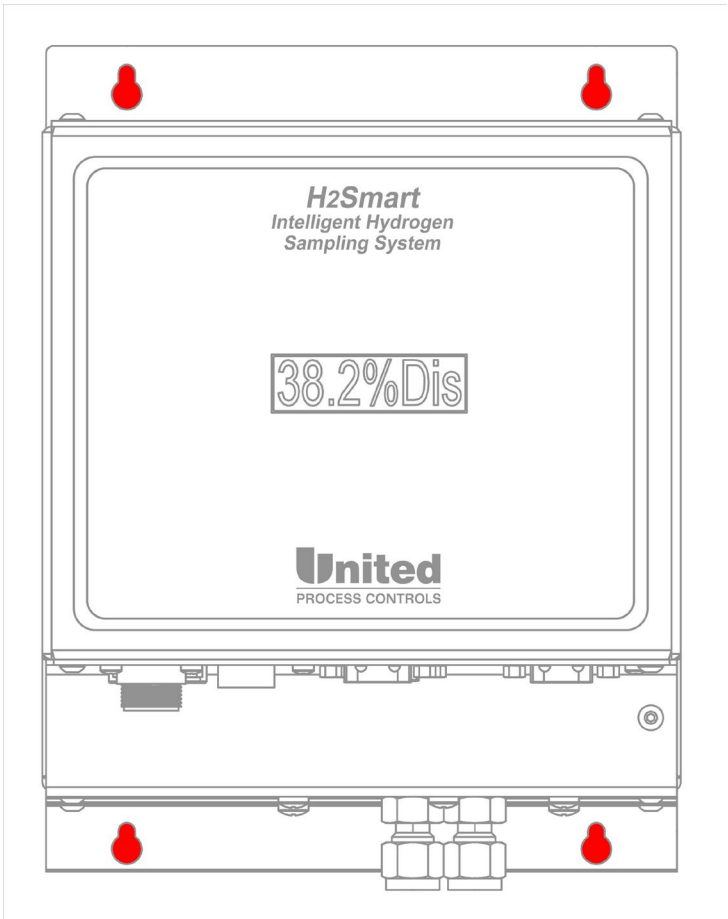


Figure 4 Step 1

3.3.2 Step 2

Pre measure and bend the tubing accordingly.

Pre-swage Swagelok ferrules to the tubing's using Swagelok Pre-swaging tool or spare Swagelok fitting

CAUTION

Do not swage the tubing in the H2Smart™ connectors!

Attach tubing to Exhaust

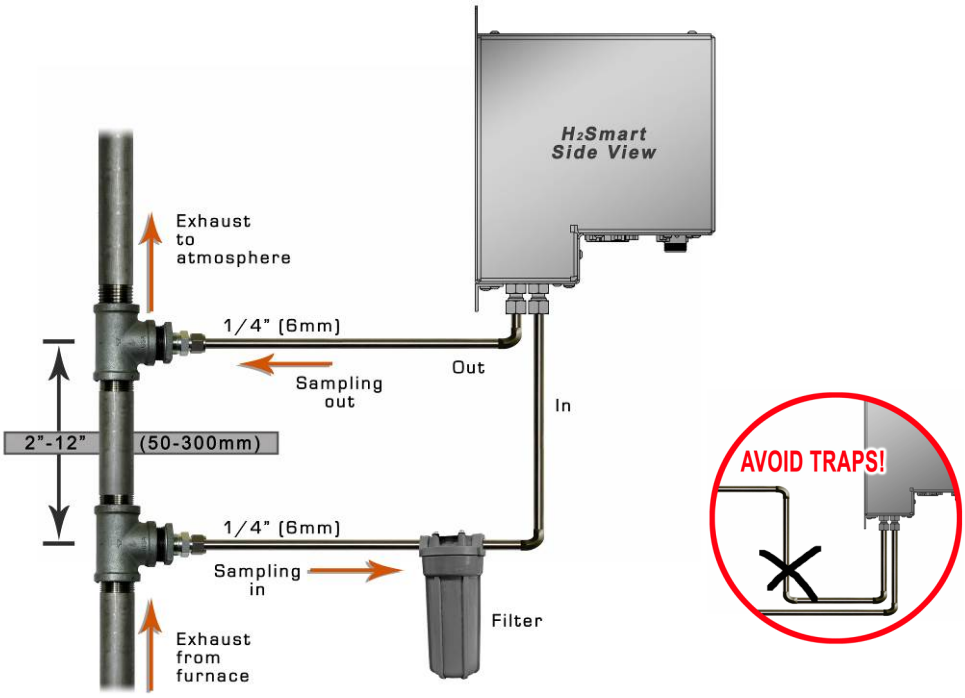


Figure 5 Step 2

3.3.3 Step 3

Connect 1/4” tubing to Swagelok connector using a 9/16” wrench or metric equivalent - **do not over tighten**

* **Follow Swagelok instruction to assemble piping with tube fitting.**

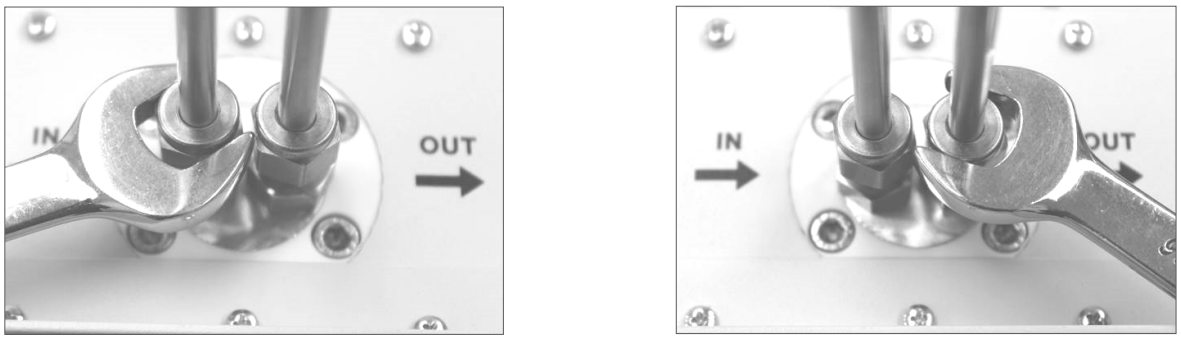


Figure 6 Step 3

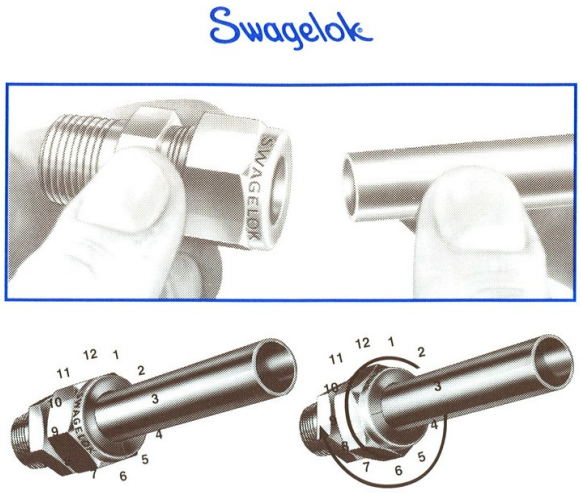


Figure 7 Step 3

Assembly Instructions

a. Insert tubing into the Swagelok tube fitting
b. Make sure that tubing rests firmly on the shoulder of the tube fitting body and that the nut is finger-tight
c. Scribe the nut at 6 o'clock position
d. While holding fitting body steady, tighten the nut 1 1/4 turns to the 9 o'clock position

Reassembly Instructions

a. Insert tubing with pre-swaged ferrules into fitting body until the front ferrule seats.
b. Rotate the nut with a wrench to the previously pulled-up position. At this point, a significant increase in resistance will be encountered.
c. Tighten slightly with the wrench. Note: don't use the gap inspection gauge with reassembled fittings.

3.3.4 Step 4

Heat tracing the sample gas tubes for Ferritic Nitrocarburizing furnace

In order to avoid clogging of the sample gas tubes by ammonium carbonate and condensation, the sample tubing / piping should be kept at temperatures within the range of 85 – 90°C (185 - 195°F) by external heat tracing. For this purpose typically, a heat trace cable is run close to the tube bundle, tightly pressed against the tubes by appropriate cable ties. The whole assembly is then wrapped in thermal insulation material.

Use pipe insulation whenever you run heat tracing!

Try to run the in and out tubing side by side such that the heat tracing sensor and the cable all fit nicely in one tightly packed bundle. This will ease the installation of the insulation and maximize efficiency.

Mount the optional heat tracing temperature sensor to the tube bundle inside the thermal insulation, at a distance of 30 - 60 cm / (1 - 2 ft) from the *H₂Smart™* connectors.
Use an appropriate solid state relay controlled by the heat tracing control output to switch power to the heat tracing cable.

Figure 8 Step 4

Due to the high probability of “dirty gas”, sharp bends in the piping should be avoided. Try to keep the piping as smooth and as straight as possible as this will aid in the heat tracing / insulation later. Avoid unnecessary **loops, fittings or traps in piping**.

See the wiring diagram section for more information.
The *H2Smart™* will regulate the heat tracing temperature to 149°F (65°C) as long as it is powered up without further user action.

Important consideration

- Digital I/O’s and H2 Smart main power shall be powered from the same source
- Arrange the heat tracing cables and the temperature sensor as shown
- 20 W/foot (60 W/meter) is good for typical installations with average insulation
- Heating cable has to be placed up to the inlets plate of the *H2Smart™*
- Cable has to heat both (inlet and outlet) connectors
- Thermal insulation shall be **in contact** with inlets plate and be **properly sealed**
- No gap shall exist between inlets plate and the insulation
- Temperature sensor has to be attached to the tubing only, it should not touch the heating cable

Note: Heat tracing insulation not shown

Figure 8 Heat trace cable installation

4. ELECTRICAL INSTALLATION

Connect the system to a well regulated 24VDC power supply capable of supplying 2.5A minimum (3A typical).

Connect power cable to 24 V power supply

Figure 9 Electrical Installation

CAUTION

The *H₂Smart™* will be permanently damaged if connected to 115 or 230VAC

Within the specified limits, the value of the supply voltage will not influence the accuracy, but a power supply with bad stability may increase measurement noise of the system. Use a well regulated power supply and do not operate other heavy loads from the same supply.
The specified power consumption is only true during start-up, after operating temperature is reached, the power consumption will decrease to 20% - 40% of the specified value, depending on ambient temperature

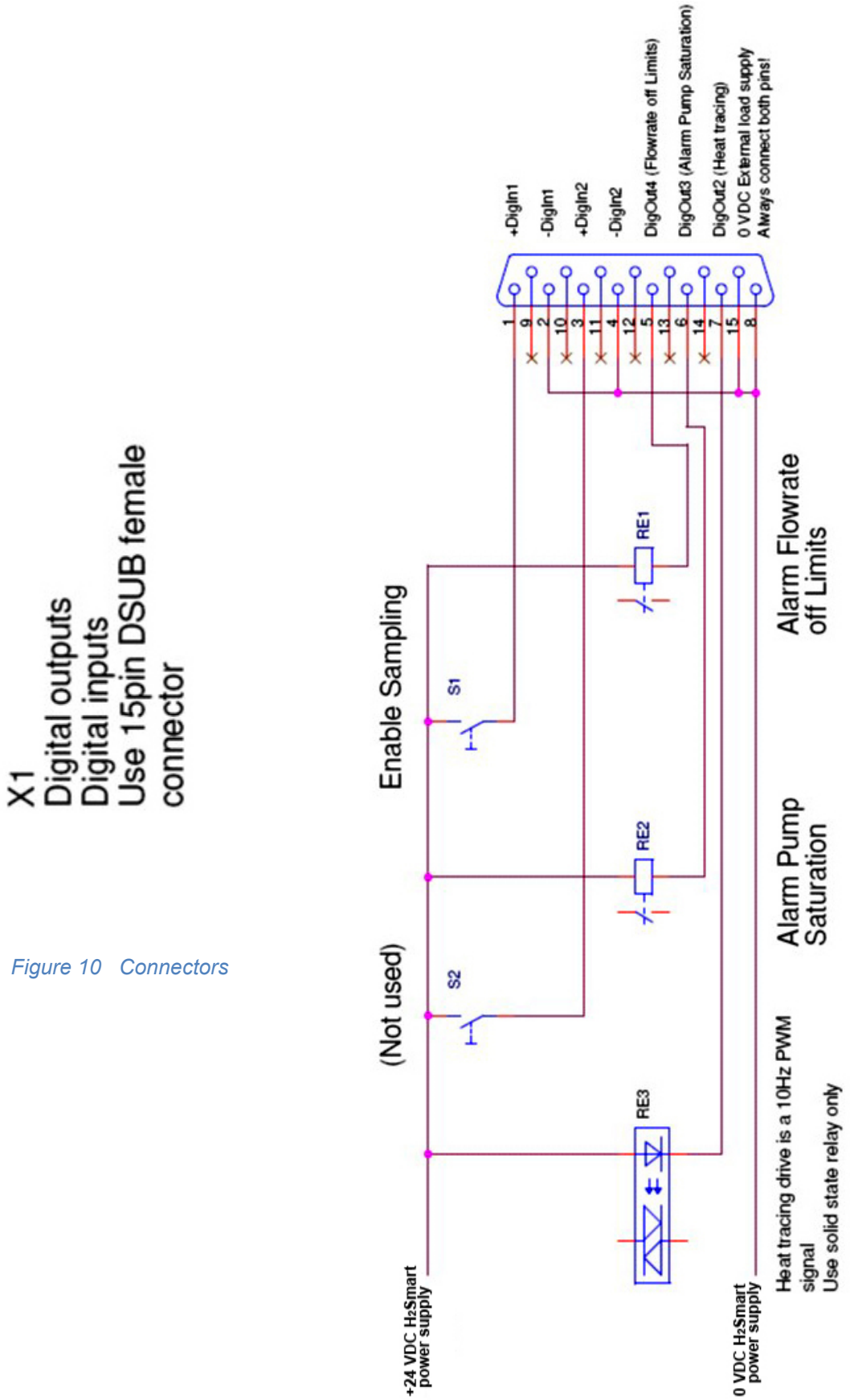
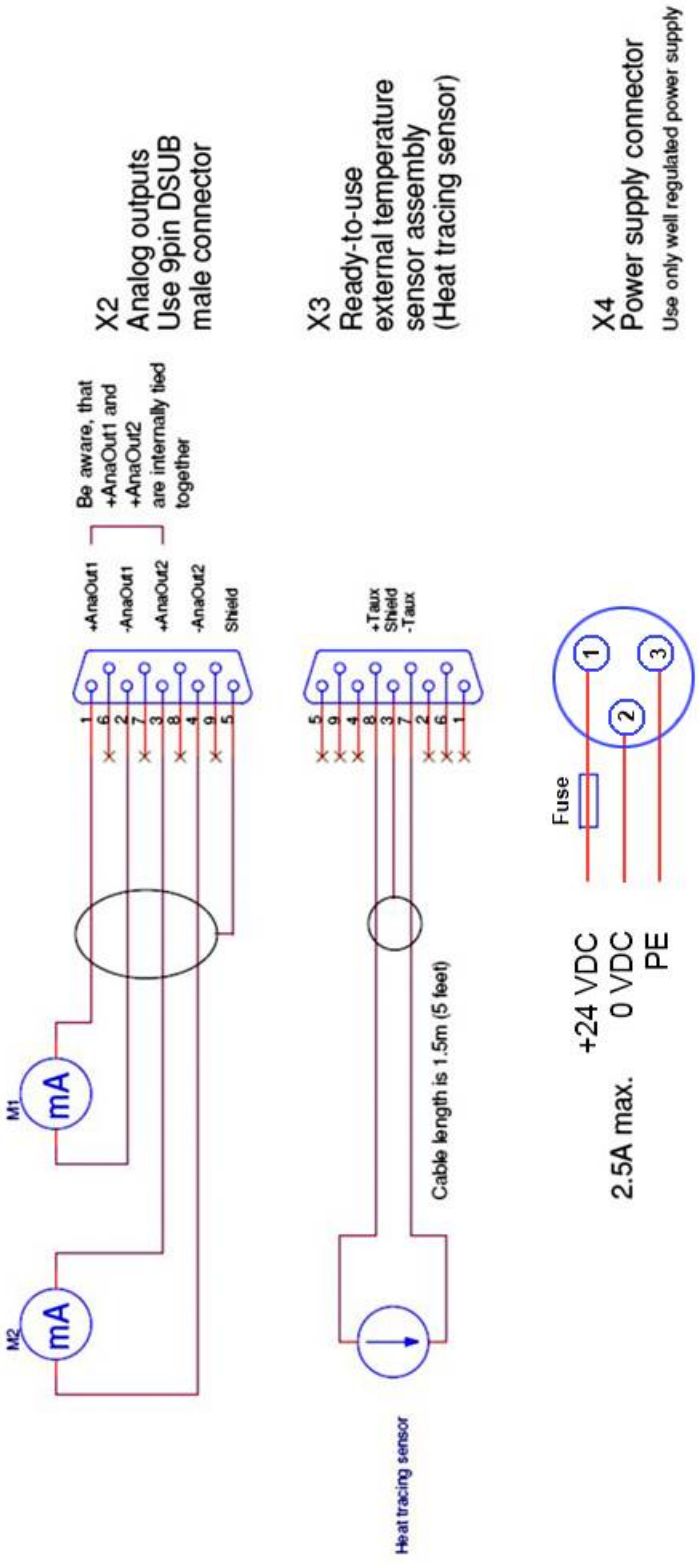


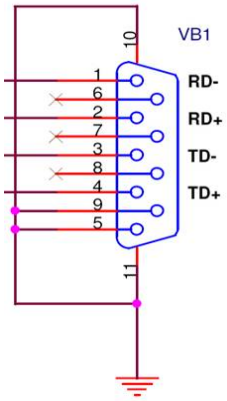
Figure 10 Connectors



Note that the 3AMP fuse is customer responsibility.

Power cable
Ver 3:
Pin
1 +24VDC
2 0V
PE YELLOW/GREEN

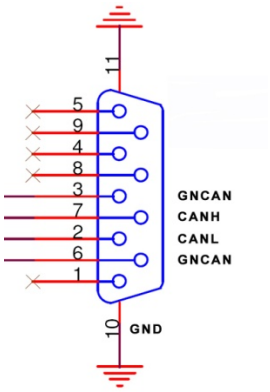
Figure 11 Connectors



LAN 10BaseT Female DB-9 Connector

Figure 12 LAN Connector

Figure 13 CAN Connector



CAN Cable Female DB-9 connector

Ver 1:

Pin	Colour
2	RED
7	BLACK
3	WHITE
N/A	BLACK
5	SHIELD

Note: There is a 120Ω across 2-7.

4.1 H2Smart™ digital input and output signals

Connector X1 is a 15pin DSUB male connector

Pin	Signal name	Signal function
1	+DigIn1	A 24VDC signal on DigIn1 enables sampling.
2	-DigIn1	
3	+DigIn2	Reserved
4	-DigIn2	
5	DigOut4	Open collector output. A low output signal indicates the status "Flow rate off limits" (flow alarm).
6	DigOut3	Open collector output. A low output signal indicates a pump saturation status (pump alarm).
7	DigOut2	Open collector output. Outputs a 10Hz pulse width modulated signal used to control the power of the heat tracing heater via a solid state relay. ***Caution Do not use an electromechanical relay for this purpose***
8	0V external load supply	Connect to negative terminal of the external load power supply.
9	Reserved	Pins are reserved for future use, make no connections to them.
10	Reserved	
11	Reserved	
12	Reserved	
13	Reserved	
14	Reserved	
15	0V external load supply	Connect to negative terminal of the external load power supply.

Digital inputs are electrically isolated from ground and each other.
-Max. Input voltage is 28VDC
-input Current is 6mA@24VDC.

Digital outputs are open collector outputs referred to pins 8 and 15 of connector X1 (0V external load supply). Be aware that pins 8 and 15 of X1 are internally connected to 0V of the system power supply input.

4.2 H2Smart™ analog outputs

Connector X2 is a 9pin DSUB female connector

Pin	Signal name	Signal function
1	+AnaOut1	Analog output 1
2	-AnaOut1	
3	+Anaout2	Analog output 2
4	-AnaOut2	
5	Shield GND	Cable shield connection, connected to PE
6	Reserved	Pins are reserved for future use, make no connections to them.
7	Reserved	
8	Reserved	
9	Reserved	

Caution

+AnaOut1(Pin 1) and +Anaout2(Pin 3) are internally connected.
To avoid interference between both outputs, do not connect externally

The analogue outputs of *H₂Smart™* are internally powered 4 - 20mA current sources with common positive supply, able to drive a maximum loop resistance of 500 ohms. Output assignment, scaling and electrical output range (0 - 20mA or 4 - 20mA) may be configured using the *H₂Smart™* service software. To ensure proper functioning, isolated analogue inputs shall be used to read *H₂Smart™* analogue signals.

Factory default configuration:

Analog output 1	Output value	Measurement result (as ordered)
	Scaling	0 -100%
	Range	4 - 20mA
Analog output 2	Output value	Sample gas flow rate [l/min]
	Scaling	0 – 1 l/min
	Range	4..20mA

4.3 Heat tracing sensor connector (optional)

Connector X3 is a 9pin DSUB male connector. It is exclusively used for the optional heat tracing temperature sensor that enables *H2Smart™* to control the temperature of the sample gas tube heat tracing. Do not connect anything else to this connector.

Note that the power source of the heat tracing circuit may require GFCI rating. Please consult local laws with regards to this protection.

4.4 Oxygen Probe card (optional)

The optional oxygen probe card has two DB9 connectors; one for the O_2 Probe T/C and one for the O_2 Probe mV Signal connector. These (DB9) are used to directly connect an oxygen probe to the H2 Smart, thus receiving the appropriate signals via optional serial data. The wiring diagram is as described:

	O_2 Probe mV (db9 female on cable)		O_2 Probe T/C (db9 male on cable)	
PIN	signal	colour	signal	colour
1				
2	- (mV)	Depends on probe		
3				
4	+ (mV)	Depends on probe		
5				
6				
7			+ (T/C)	Depends on type
8			- (T/C)	Depends on type
9				

Note that the Oxygen Probe card's thermocouple input can be configured as type K or S. It is crucial that the appropriate setting is factory configured. Please inform your sales rep.

5. OPERATING INSTRUCTIONS

After power on, the system heats up the measuring cell to operational temperatures, nominally 65°C. Flow measurement is disabled and the sampling pump is off during heat up to avoid contamination of the system with condensation. Depending on ambient temperature, heat up takes about 30 minutes. Full accuracy is reached after 1h. It is recommended to keep the system powered up at all times and use the "Sampling enable" digital input or digital communication to activate or deactivate the sampling flow.
When the operating temperature is reached, the "Sampling enable" digital input or digital communication command must be active to start sample gas pump, enable sampling flow control and gas composition measurement.

Display

The display shows the following information, depending on the system status:

Display shows:	Status
Flashes: Temp/ Pump Off	Heat up or sampling disabled
Process Variable i.e. % diss., K_N, etc.	Sampling enabled
Filter	Sampling pump nearing saturation, most probably due to a clogged gas filter or sampling line contamination
Alarm	Sampling enabled, but the sample gas flow is outside the flow tolerance band

KN and KC Calculation

The KN and KC calculations run internally in the unit based on the furnace volume, the inlet gas flows, and the reading from the *H2Smart™* sensor. To ensure a correct furnace atmosphere calculation, the process flows into the furnace must be updated whenever they are changed. The updates must be made at all times during the recipe, even during non nitriding stages. These changes can be made via the communication adaptor (MODBUS, ProfiBus or CANBus) or via the *H₂Smart™* software. The communication data register assignments can be found in the respective communication appendix. The furnace atmosphere is continually updated based on the flow rates and the stored furnace volume.

Valid KN and KC calculated values require the furnace to be at nitriding temperature, as well as the *H2Smart™* sampling enabled. When the sampling is disabled, the KN and KC calculations are disabled and will return a 0.00 value. If sampling is enabled under non nitriding conditions, the KN and KC calculations will not return valid KN and KC values.

6. PREVENTIVE CARE

All maintenance and preventive care must be carried out by trained personal only in compliance with the applicable safety standards.

6.1 Sample gas pump

Maintenance period	The life time of the sample gas pump is dependent on the composition of the gas.
Action	Send the unit in for service in case of a pump failure.

WARNING

Prevent liquids such as water or oil from entering the sampling line.

WARNING

Never use sharp objects (wire, screwdriver, etc.) to check or unblock the *H₂Smart™* sampling Swagelok connectors and internal lines. Never use compressed air to clean the *H₂Smart™*. This may create a health hazard and permanent instrument damage.

7. CONFIGURATION

Field configuration of the *H2Smart™* is limited to setting the IP parameters, selecting the temperature display unit (°C or °F) and configuring the analog outputs.

All configurations are done using the *H2Smart™* service software installed on a PC running Windows® XP, Vista O/S.

To connect to the *H2Smart™*:
Use the LAN port on your computer with a special adapter (included).

H2Smart™ IP address is displayed during instrument power up procedure.

8. CUSTOMER SUPPORT

In the event of any major emergency situation, please call United Process Controls customer support department.

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Reach us at www.group-upc.com

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