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# User Manual

*DVLS<sup>3</sup> Simply, Smart Sensor*

Date: 12/11/2013

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# 1 About Da Vinci Laboratory Solutions

As a versatile partner for analytical applications and authorized distributor of world-leading instrument manufacturers Da Vinci Laboratory Solutions (DVLS) is able to provide an expert advice and offers an extensive range of chromatographic systems, software, services and supplies.

For information visit: [www.davinci-ls.com](http://www.davinci-ls.com) or contact us at:

## Da Vinci Laboratory Solutions

Cairostraat 10

3047 BC Rotterdam, The Netherlands

Postbus 12103

3004 GC Rotterdam, The Netherlands

T: +31-(0)10 258 1870

F: +31-(0)10 258 1879

E: [solutions@davinci-ls.com](mailto:solutions@davinci-ls.com)

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**Note:** In no event will Da Vinci Laboratory Solutions be liable for any loss or damage including incidental, indirect, special or consequential damages arising from the use of the DVLS<sup>3</sup> Simply, Smart Sensor.

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**Note:** Information, descriptions and specifications in this publication are subject to change without notice.

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## 2 DVLS<sup>3</sup> Simply, Smart Sensor Scope

The DVLS<sup>3</sup> Simply, Smart Sensor, hereafter referred to as **DVLS<sup>3</sup>**, is a multiple-purpose device capable to support up to four sensors. The multi-sensor capability includes sensors for Hydrogen, Hydrogen leak detector, temperature, barometric pressure and level (liquid) weight.

Detection of Hydrogen in chromatography instrumentation is one of the main DVLS<sup>3</sup> applications. The content of this manual is focused on installation for Hydrogen safety detection in GC solutions. In case you would like to receive information concerning the use of the DVLS<sup>3</sup> for other purposes, please contact your local Da Vinci representative.

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## 3 Safety information

Hydrogen is a colorless, odorless, flammable gas. Hydrogen poses a serious fire hazard when it is accidentally released. Hydrogen poses a number of hazards to human safety, from potential detonations and fires when mixed with air to being asphyxiating in its pure, oxygen-free form. Hydrogen gas leaking into external air may spontaneously ignite. Moreover, hydrogen fire, while being extremely hot, is almost invisible, and thus can lead to accidental burns.

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**Note:** Only trained and authorized personnel are allowed to open the Controller covers.

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## 4 Requirements

Power and gas requirements are listed below. Periodic testing and / or calibration can be performed by Da Vinci Laboratory Solutions, authorized distributors, or by the user. See the last Chapter for part numbers of testing and calibration gas. The GasMix™ dilution instrument is an optional calibration device.

<i>Item</i>	<i>Requirement</i>
Power:	AC 100-240V 50-60Hz 0.5A
Gas testing mixture:	Mixture of: 2% Hydrogen, balance Air, with a pressure reducing valve capable of generating an approx. flow of 300 ml/min.
Calibration gas:	Certified mixture of: 2% Hydrogen, balance Air, with a pressure reducing valve capable of generating an approx. flow of 300 ml/min.
GasMix™ supply gases:*	Hydrogen 99.995% purity, Instrument air 99.995% purity
Gas Sampling Bag	Volume ≥ 1 liter, with tubing (no silicon!) for connection to the Hydrogen sensor (see the Section about Calibration, later in this manual).

\*only applicable if the GasMix™ dilution unit is included.

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## 5 Dimensions and specifications

Maximum altitude:	2000 m
Operating humidity range:	20 to 90%
Controller operating temperature range:	10 to 40 °C
Calibrated range H <sub>2</sub> sensor:	0 to 50% LEL (0 to 2% Hydrogen in Air)
Sensor signal cable length:	≤ 3 m
Controller dimensions:	L x W x H: 12.0 cm x 14.2 cm x 6.3 cm
IP Class	IP 40

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## 6 Principle of Operation

### 6.1 General

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An increasing number of laboratories decides to reduce costs and improve quality of a GC analysis by switching from the more expensive Helium carrier gas to the significantly lower priced Hydrogen gas. Hydrogen is, however, an explosive gas at a level of 4.1% in the air. This level is also known as 100% LEL (Lowest Explosion Limit).

Da Vinci developed a Hydrogen sensor suitable for use with the DVLS<sup>3</sup> unit.

The DVLS<sup>3</sup> constantly monitors the Hydrogen level in the GC oven. As soon as the Hydrogen concentration reaches the user defined level, typically between 25% and 50% LEL (equal to 1% - 2% by Vol Hydrogen), the alarm is triggered which will execute:

- An acoustic alarm
- A visible alarm on the LCD display of the controller
- Optional: an SMS alarm text message
- A valve switch to direct a safe carrier gas to the instrument
- A not-ready signal to the GC to stop the instrument sequence

At any time, it is possible to switch off the acoustic alarm. Both the display, valve and not-ready alarm status will remain until the Hydrogen concentration has dropped to an acceptable level.

Both the alarm level and safe level are adjustable.

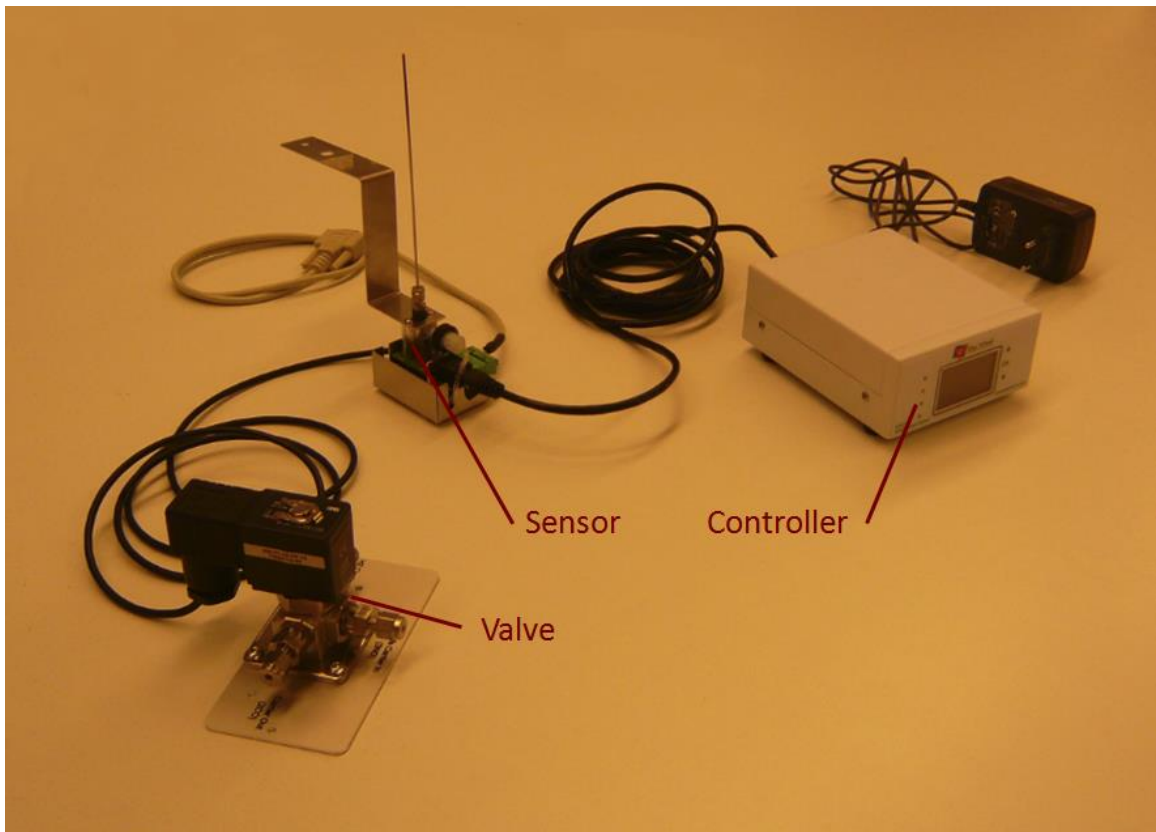


## 6.2 Hardware description

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The DVLS<sup>3</sup> consists of three main items:

- Sensor assembly including GC mounting plate
- Valve assembly including GC mounting plate
- Controller



For installation is referred to the Installation manual. Both the valve and sensor assembly are mounted on the GC, the position depends on the type of GC used.

The open end of the sensor tube protrudes through the oven wall in the oven (example see below).



The controller box is normally placed on top of the GC, but may be installed in the near area as well.

A hardcopy of the User Manual is included as well.

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# 7 Controller

## 7.1 Main controller screens

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The controller exists of 2 main screens:

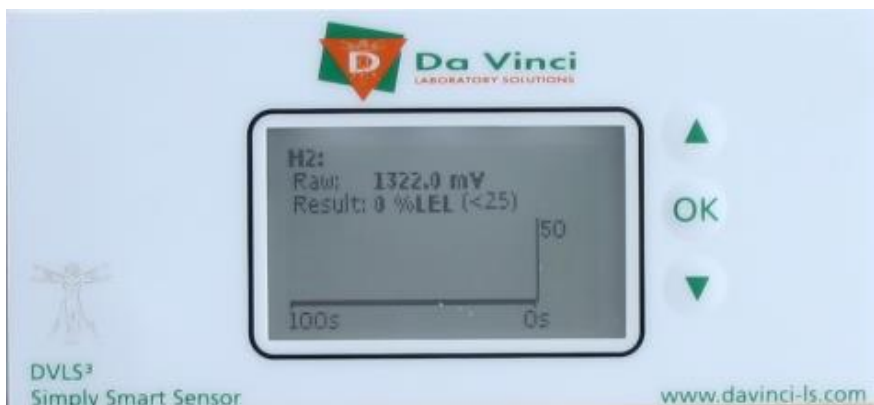
- The *Summary* view
- The *Settings* view

By default, the *Settings* view is protected with a pin code (factory set at 1000).

After connection of the Power cable, the Controller will shortly warm up. After a few seconds, the *Summary* view of the 4 sensors is displayed:



Submenus are accessed by using the arrows next to the display. When an individual sensor is accessed, the following screen becomes available:



The Raw data figure corresponds to the actual signal from the sensor. The Result value is a relative measure of the actual Hydrogen level. Between parentheses the default alarm level is shown.

By further selecting the arrow buttons, the controller general status view is accessed:



The first row shows the fixed or DHCP IP address, if the optional LAN communication is used.

## 7.2 Settings menu and pin code protection

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All configuration parameters are available under the *Settings* menu. To access the *Settings* menu, hold the OK button **while the display shows the *Summary* view**. This will trigger a pin code authorization:



After entering the default factory set pin code (1000), the *Settings* menu becomes available:



To return to the *Summary* menu, hold the OK button.

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**Note:** It is strongly recommended to lock the *Settings* menu before returning to the *Summary* menu, otherwise calibration settings may be changed, as described in the following chapters.

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To return to the main *Settings* view from any *Settings submenu*, hold the OK button as well.

## 7.3 Initial setup

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After power up: it is recommended to verify or change the following configuration parameters:

Pin code: The default pin code is 1000, and may be changed from the *Settings* view. Select Pin code and press OK to enter your own pin code number.



Menu timeout: The default time the menu remains in the sensor trend menu. During calibration, it is recommended to temporarily increase the timeout value to 1000.



Ethernet: if the optional LAN data communication is to be used, enter DHCP or fixed IP address requirements.



Ethlog Intr: The frequency of real-time data logging (in microseconds) applicable if the data communication option is used.



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## 8 Calibration

Each sensor can individually be calibrated at 2 levels:

- Zero level
- Cal level

Calibration at Zero level results in an Offset value stored in the device. The Zero level is calibrated using air.

Calibration at Cal level results in a multiply value stored in the device. The Cal level is calibrated using a 2% Hydrogen in air mixture, which corresponds to 50% LEL.

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**Note:** It is important that the correct Cal level is entered in the settings menu for the individual sensor. The Cal level should be equal to the %LEL of the gas used for calibration.

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Both the Offset and Multiply values are stored per individual sensor. Between Zero level and Cal level 50% LEL the sensor response is linear.

Sensors that are purchased with a controller, are factory calibrated with that specific controller.

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**Note:** The Offset and Multiply values on the accompanying Test Checklist apply to the factory calibration of the sensor with the specified serial number connected to the specified controller channel. If a sensor is connected to another channel than specified on the Test Checklist, the Offset and Multiply values on the Test Checklist do not apply. Recalibration is required.

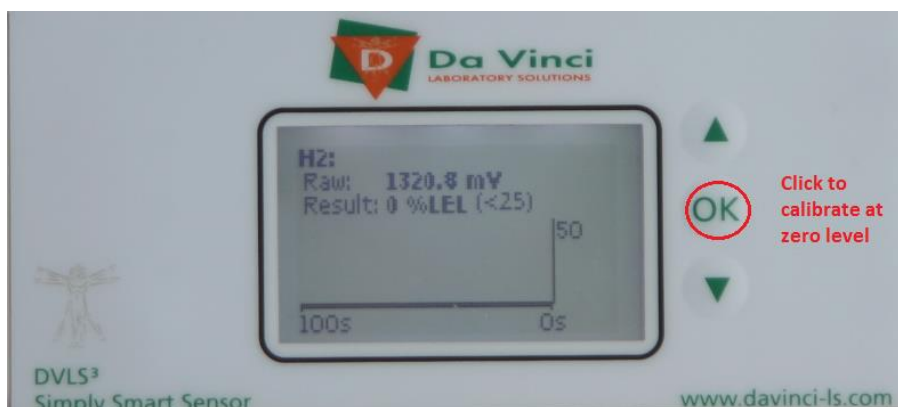
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Calibration can be repeated at the time of installation of the Hydrogen sensor, and may be repeated once a year, or according to internal laboratory policies. Additional calibrations may also be carried out in case of signal drift, or after power outages. If a certified calibration gas is not available, it can be considered to only verify the calibration and alarm using either a 1% or 2% Hydrogen in air mixture following the verification procedure.

#### Zero Level calibration:

- Ensure no Hydrogen is present near the sensor. To be certain, shut off the GC oven fan and GC Hydrogen supply modules.
- From the *Summary* view of the controller, hold the OK button and enter the pin code to unlock the Settings menu.
- Return from the *Settings* view to the *Summary* view by holding the OK button.
- Scroll down to the sensor to be calibrated.
- Observe the Raw signal for stability. **Click the OK button shortly (do not hold).** By shortly clicking OK, the sensor will be calibrated for the zero level Hydrogen.



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**Note:** Clicking the OK button in protected mode will not have impact on the calibration.

**Note:** The Result value should read a number close to 0 after the Zero Level has been calibrated.

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**Cal Level calibration:**

- From the *Summary* view of the controller, hold the OK button and enter the pin code (this step can be skipped if the menu is still in unprotected mode).
- After entering the *Settings* menu, select the active sensor(s) and change the Alarm level temporarily to a level higher than the default alarm level of 25% LEL, to prevent an unwanted alarm during calibration:



- Return to the *Summary* view by holding the OK button.
- Scroll down to the sensor to be calibrated.
- Fill a gas sampling bag with the calibration gas.
- Connect the gas sampling bag to the sensor.

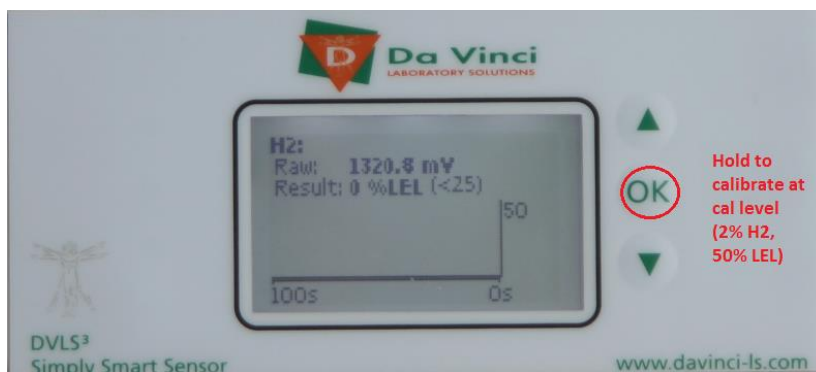



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**Note:** Do not use any silicon hose for connection of the gas sampling bag to the sensor!

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- Wait for signal stabilization and then **hold the OK button**. By holding the OK button the calibration at Cal level is executed.




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**Note:** Holding the OK button in protected mode will not have impact on the calibration.

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**Note:**After Cal Level calibration, the Result value should read a number close to 50.

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- Record the new stored Offset and Multiply (calibration) values in the instrument logbook or quality control program. In case of a major difference between the current and the previous or factory calibration values, repeat the calibration procedure, or contact your local Da Vinci representative for assistance.



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**Note:**Due to the nature and electronics of the Hydrogen sensor, the Multiply factor normally reads negative (a raw signal drop is observed when Hydrogen is detected).

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- Set the Alarm for the calibrated sensor back the default value of 25.



- From the main *Settings* menu, protect the calibration by setting the Lock function to "On".



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## 9 Verification

### 9.1 Calibration and Alarm

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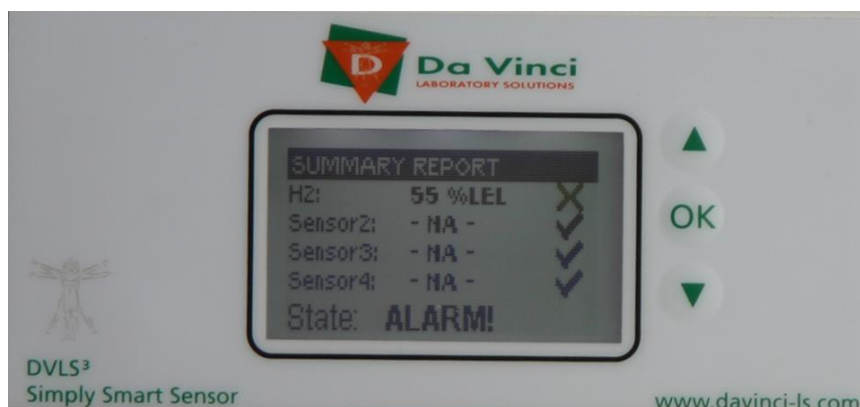
- Inform the responsible laboratory supervisor that sensor alarm will be tested.
- Access the *Summary* menu and scroll to the calibrated sensor.
- Verify the Result value of the calibrated sensor; it should read close to zero.
- Connect a gas sampling bag with Hydrogen in air (1% H<sub>2</sub> in air = 25%LEL or 2% H<sub>2</sub> in air = 50%LEL) to the sensor. Both the acoustic and display alarms should be triggered.

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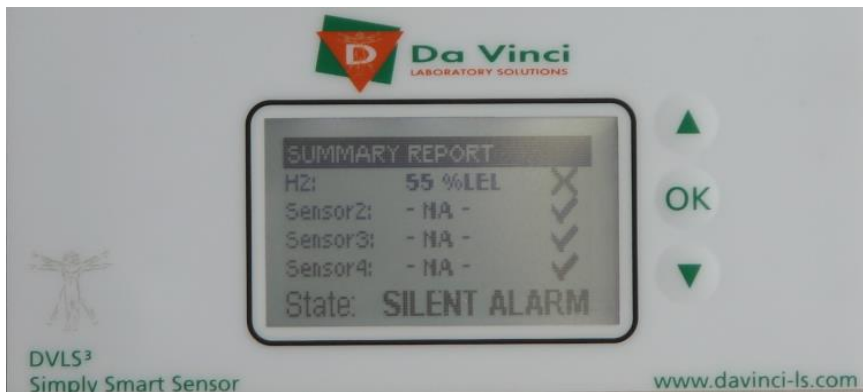
**Note:** Do not use any silicon hose for connection of the gas sampling bag to the sensor!

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- Verify the Result value of the calibrated sensor. At signal stabilization, it should read close to the %LEL of the gas that is in the gas sampling bag.



- Turn off the acoustic alarm by clicking the OK button. Now the *Summary* display will read "SILENT ALARM".



- Disconnect the calibration gas. Wait for the signal to drop at the Alarm Off level, and verify the *Summary* display returns to <OK> state.

## 9.2 Valve

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The valve is tested during factory calibration and this is usually repeated at the time of installation. It may be repeated once a year, or according to internal laboratory policies.

- Make sure the DVLS3 is calibrated and not in (silent) alarm.
- Shut off the supply of Hydrogen carrier gas.
- Disconnect the Hydrogen carrier gas from the 1NC port
- Disconnect the Carrier Out line from port 2CO.
- Make sure the supply of Safe carrier gas is opened.
- Connect a flow meter to the 2CO port and measure the flow. There should be no flow.
- Connect the gas sampling bag with the 2% H2 calibration gas to the Sensor.
- When the DVLS3 goes in alarm, turn off the acoustic alarm by clicking the OK button. Now the *Summary* display will read "SILENT ALARM".
- Measure the flow from port 2CO. Now there must be flow (of safe carrier) coming out of this port.

- Disconnect the gas sampling bag from the Sensor.
- Check if the flow from port 2CO stops when the actual %LEL reaches the Alarm Off level (set to 20 %LEL during set up of the Controller).
- Close the Safe carrier gas supply and disconnect it from port 3NO.
- Connect the Safe carrier gas line to port 1NC and open the supply of Safe carrier gas.
- Make sure the DVLS3 is not in (silent) alarm.
- Measure the flow from port 2CO. There must be flow coming out of this port.
- Connect the gas sampling bag with the 2% H<sub>2</sub> calibration gas to the Sensor.
- When the DVLS3 goes in alarm, turn of the acoustic alarm by clicking the OK button. Now the *Summary* display will read "SILENT ALARM".
- Check if the flow from port 2CO stops when the actual %LEL reaches the Alarm On level (set to 25 %LEL during set up of the Controller).
- Disconnect the gas sampling bag from the Sensor.
- Check if there is flow again from the Carrier Out when the actual %LEL reaches the Alarm Off level.
- Close the Safe carrier gas supply.
- Disconnect the Safe carrier from port 1NC and reconnect it to port 3NO.
- Reconnect the Hydrogen gas supply to port 1NC.
- Reconnect the Carrier Out line to port 2CO.
- Open the Hydrogen carrier supply and the Safe carrier gas supply and verify that all connections on the valve and GC inlet are leak free using an appropriate leak detector.



## 9.3 Connection Loss Alarm

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The connection loss alarm is tested during factory calibration and is usually repeated at the time of installation. Tests may be repeated once a year, or according to internal laboratory policies.

- Make sure the DVLS3 is not in (silent) alarm.
- Make sure the GC is in Ready state (do not start an analysis).
- Label each sensor cable with the number of the connector of the controller to which it is connected.
- Disconnect all sensor cables from the Controller. Now the DVLS3 should go into alarm and the *Summary* display should read "NO SENSORS" and the valve should switch from Hydrogen gas to Safe carrier gas.
- Reconnect each sensor cable to the same connector on the controller as to which it was connected during calibration.

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**Note:** The calibration applies to 1 specific sensor connected to 1 specific channel. After the test each sensor cable should be reconnected to the same connector on the Controller as to which it was connected during calibration. If the cable is connected to a different connector, the calibration is not valid anymore. The sensor should be regarded uncalibrated.

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## 9.4 GC Remote

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The GC remote function is tested during installation. Tests may be repeated once a year, or according to internal laboratory policies.




- Make sure the DVLS3 is not in (silent) alarm.
- Make sure the GC is in Ready state (do not start an analysis).
- Force an Alarm by connecting the gas sampling bag with the 2% H<sub>2</sub> calibration gas to the sensor.
- Check if the GC goes to the Not Ready state and if the valve switches from the Hydrogen carrier gas to the Safe carrier gas.
- Press the OK button to switch off the alarm.
- Remove the gas sampling bag from the sensor.
- This will cause the valve to switch back from Safe carrier gas to Hydrogen carrier gas.
- The DVLS<sup>3</sup> is now ready for use.

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## 10 Parts replacement list

Da Vinci Product code	Description
DM-S3-78-H2-11	DVLS3 Hydrogen sensor for Agilent 7890GC complete
DM-S3-68-H2-11	DVLS3 Hydrogen sensor for Agilent 6890GC complete
DM-S3-XX-CO-10	DVLS3 Multisensor controller complete
DM-S3-X8-VK-10	DVLS3 Valve kit for H2 sensor for Agilent 7890GC or 6890GC
DVE-094401	Control gas 2% Hydrogen in Air 17 liter (for verification only)
DVE-094402	Regulator for Control gas, including flow adapter.
DVE-094407	Calibration gas: Air balance, Hydrogen 2% (50% LEL) 5 liter H2 steel cylinder, including brass valve adjustable flow (DVE-094408).
DVE-094408	Regulator Single-Stage General Purpose, Adjustable Flow Model for Calibration gas DVE-094408.

# 11 Declaration of Conformity

	<b>DECLARATION OF CONFORMITY</b> According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014	
<b>Manufacturer's Name</b> : Da Vinci Laboratory Solutions B.V.		
<b>Manufacturer's Address</b> : Cairostraat 10 3047 BC ROTTERDAM The Netherlands		
<b>Declares under sole responsibility that the product as originally delivered</b>		
Product Name : Simply Smart Sensor		
Model Number : DVLS <sup>2</sup>		
Products Options : -		
<b>Complies with the essential requirements of the following European Directives, and carries the CE marking accordingly:</b>		
Low Voltage Directive : 2006/95/EC		
EMC Directive : 2004/108/EC		
RoHS : 2011/65/EU		
<b>and conforms with the following Product Standards:</b>		
<b>EMC Standards:</b>		
Emission : EN 61326-1 (2006) Class B		
Immunity : EN 61326-1 (2006) Basic		
Emission : EN55011 (2009) + A1 (2010) Class B		
Emission : EN 61000-3-2 (2006) + A1 (2009) + A2 (2009) Class A, Harmonics		
Emission : EN 61000-3-3 (2008), Flicker		
Emission : EN 301 489-1 V1.9.2. / EN 301 489-3 V1.4.1		
Immunity : EN 301 489-1 V1.9.2. / EN 301 489-3 V1.4.1		
<b>Safety Standards:</b>		
EN 61010-1: 2010		
<b>Supplementary Information :</b>		
Emission : 47 CFR 15 Class A		
This declaration only applies to those products manufactured after the date shown below.		
Rotterdam, July 2013		
		Jaap Schaap Director Operations