HY-OPTIMA™

HYDROGEN SPECIFIC MEASUREMENT SOLUTIONS

HY-OPTIMA™ 700B Series

In-line Hydrogen Process Analyzer

OPERATING MANUAL

H2scan

Hydrogen is the future, we can sense it! ™

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MISSION STATEMENT

Our Mission

Deliver unsurpassed value and optimize green initiatives with our one of a kind continuous hydrogen-specific sensing technology worldwide.

Our Value Propositions

Enable end-user customers to efficiently and effectively optimize:

- Electric utility power transformer fleet and other oil-filled assets (Grid)
- Petroleum refinery and other industrial process control
- Facility and equipment safety to minimize downtime

...at a much lower total costs of ownership than the competition.

Our Strategic Objectives

H2scan's technology accepted as the new gold standard in hydrogen sensors.

H2scan's business recognized for innovation and ingenuity, high quality products and systems, application - specific solutions, and exceptional customer service and satisfaction.

H2scan's success results from teamwork, strategic partnerships and market leadership leading to sales growth and improved profitability.

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700B series firmware revision at date of manual release: 3.66G

Chapter 1: Model Specifications and Certifications

Chapter 2: Installation

Chapter 3: Operation and Configuration

Chapter 4: Field Calibration

IMPORTANT NOTICES

⚠	Read and understand this operating manual before installing or using the unit. Only use cables from H2scan with this unit. If this equipment is used in a manner not specified by H2scan, the protection provided by this equipment may be impaired.
⚠	Hydrogen is flammable at 4% in air. Take indications seriously and be prepared to take action. In the event of detection of 4% or higher of a hydrogen gas concentration there is a high probability of a hazard to safety. Inform local emergency response personnel immediately.
⚠	Do not apply power to the analyzer if the sensing element is exposed to air. This could severely affect accuracy and stability.

LIMITATION OF LIABILITY - SELLER SHALL UNDER NO CIRCUMSTANCES BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL, PUNITIVE, OR OTHER DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF BUSINESS OR PROFIT, PROMOTIONAL OR MANUFACTURING EXPENSES, INJURY TO REPUTATION, OR LOSS OF CUSTOMER, BASED ON ANY ALLEGED NEGLIGENCE, BREACH OF WARRANTY, STRICT LIABILITY, BREACH OF CONTRACT, OR ANY OTHER LEGAL THEORY ARISING OUT OF THE USE, MISUSE, PURCHASE, SALE OR POSSESSION OF ITS GOODS OR ITS PERFORMANCE OF THIS CONTRACT TO THE EXTENT THAT SUCH LIABILITY EXTENDS SELLER'S OBLIGATIONS BEYOND THE PRICE PAID BY BUYER TO SELLER FOR THE ITEM ON WHICH SUCH CLAIM IS BASED. SELLER ADVISES BUYER TO PERFORM ACCEPTABLE TESTS ON ALL HARDWARE PRIOR TO DEPLOYMENT AND TO PERFORM MAINTENANCE AS DESCRIBED IN THE SELLER'S INSTRUCTION GUIDE. UNDER NO CIRCUMSTANCES SHALL THE EQUIPMENT PROVIDED HEREUNDER BE USED IN A MANNER WHERE IT IS THE SOLE PROTECTIVE SYSTEM FOR FACILITIES, EQUIPMENT AND PERSONNEL SAFETY; THE EQUIPMENT IS INTENDED FOR USE IN CONJUNCTION WITH OTHER APPROPRIATE PROTECTIVE SYSTEMS.

LIMITED WARRANTY

H2scan Limited Warranty: Each hydrogen instrument ("Product") will conform, as to all substantial operational features, to the Product specifications set forth in this Manual and will be free of defects which substantially affect such Product's performance for twelve (12) months from the ship date for such Product.

Must Provide Notice of Defect: If you believe a Product that you believe is defective, you must notify H2scan in writing, within ten (10) days of receipt of such Product, of your claim regarding any such defect.

Return Product to H2scan for Repair, Replacement or Credit: If the Product is found defective by H2scan, H2scan's sole obligation under this warranty is to either (i) repair the Product, (ii) replace the Product, or (iii) issue a credit for the purchase price for such Product, the particular remedy to be determined by H2scan on a case-by-case basis.

Voided Warranty: H2scan's 12 Month Limited Warranty is void for any of the following:

The unit is opened and the manufacturing seal is broken

Unauthorized repair work performed at the customer's location or carried out by anyone other than H2scan's factory trained technicians

Equipment or parts that have been tampered with, misused, neglected, mishandled, improperly adjusted, or modified in any way without the written consent of H2scan.

Equipment or parts that have been damaged due to shipping, misuse, accidents, mishandling, neglect, or problems with electrical power sources.

Repair work performed during the warranty period does not prolong the warranty period past the original period.

System operation in incorrect or inappropriate environments.

Usage that is not in accordance with system guidelines or an operator's failure to follow manual instructions.

LIMITATION OF WARRANTY: THE ABOVE IS A LIMITED WARRANTY AS IT IS THE ONLY WARRANTY MADE BY H2SCAN. H2SCAN MAKES NO OTHER WARRANTY EXPRESS OR IMPLIED AND EXPRESSLY EXCLUDES ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. YOUR SOLE REMEDY HEREUNDER IS REPAIR OR REPLACEMENT OF THE PRODUCT OR A CREDIT FOR THE PURCHASE PRICE FOR SUCH PRODUCT, THE PARTICULAR REMEDY TO BE DETERMINED BY H2SCAN ON A CASE-BY-CASE BASIS. H2SCAN SHALL HAVE NO LIABILITY WITH RESPECT TO ITS OBLIGATIONS UNDER THIS AGREEMENT FOR CONSEQUENTIAL, EXEMPLARY, OR INCIDENTAL DAMAGES EVEN IF IT HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE STATED EXPRESS WARRANTY IS IN LIEU OF ALL LIABILITIES OR OBLIGATIONS OF H2SCAN FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE DELIVERY, USE OR PERFORMANCE OF THE PRODUCTS.

Chapter 1: Model Specifications and Certifications

1.1 Description

The HY-OPTIMA™ 700B Series In-line Hydrogen Process Analyzer is designed to detect and/or measure hydrogen using a solid-state, non-consumable sensor that is configured to operate in process gas streams. The H2scan thin film technology provides a direct hydrogen measurement that is not cross sensitive to other gases. The hydrogen specific solid-state sensing element is designed for ease of use, interface flexibility and true process control. The analyzer contains all the circuitry necessary to operate the sensor and present calibrated hydrogen readings to an analog current output and an RS232 or RS422 digital output. The analyzer is ideal for hydrogen production and petrochemical applications where real-time measurements can enhance process plant efficiencies, diagnostics, and maintenance management.

1.2 Models

The HY-OPTIMA™ 700B Series product family includes sensor types that are designed for specific hydrogen ranges, corrosive gas tolerances and operation when no hydrogen is present. See the guide below for more details.

MODEL	Hydrogen Range Min	Max	Hydrogen MUST be present	CO Limit	H2S Limit	Calibration Background Gas	Max Pressure
710B	0.1%	10%	Yes	<100 ppm	<20 ppm	N2	2 atm
730B	0.5%	100%	Yes	<100 ppm	<1000 ppm	N2	2 atm
740B	0.5%	100%	Yes	20%	3%	N2	2 atm
720B	0.4%	5%	No[1]	0	0	O2, N2	2 atm

Notes:

1. 720B models operated in background streams in which H2 is not typically present and may be operated in an Air, O2, or N2 background.

1.2.1 Model 710B

The HY-OPTIMA™ 710B Process Hydrogen Analyzer has been specifically manufactured to operate in low hydrogen conditions with increased accuracy.

- Hydrogen Range:
  - 0.1% to 10% hydrogen by volume
- CO and H2S tolerance:
  - CO tolerance: 100 ppm
  - H2S tolerance: 20 ppm

1.2.2 Model 720B

The HY-OPTIMA™ 720B Process Hydrogen Analyzer has been specifically manufactured to operate in an air or inert background.

- Operation in background streams in which H2 is not typically present
- Calibration Background Gas: Air or Inert
- Hydrogen Sensitivity Range:
    - 0.4% to 5% hydrogen by volume at 1.0 atm
    - 10% to 125% hydrogen lower flammability limit

Note:

Please disregard all warnings and statements to avoid operation in air or oxygen background; these warnings and statements do not apply to the HY-OPTIMA™ 720B In-Line Process Hydrogen Analyzers which have been manufactured for implementation in background gas streams with air.

HY-OPTIMA™ 720B Process Hydrogen Analyzers operating in air do not require the conditioning procedure.

H2scan recommends the hydrogen gas concentrations for both the Field Verification and Field Calibration gases to be 1% and 2% hydrogen in a balance of air.

1.2.3 Model 730B

The HY-OPTIMA™ 730B Process Hydrogen Analyzer has been specifically manufactured to operate in full range (0.5% to 100%) hydrogen conditions with the following enhanced tolerances to CO and H2S in process gas streams:

- CO tolerance: 100 ppm
- H2S tolerance: 1000 ppm

1.2.4 Model 740B

The HY-OPTIMA™ 740B Process Hydrogen Analyzer has been specifically manufactured to operate in full range hydrogen conditions with the following enhanced tolerances to CO and H2S in process gas streams:

- CO tolerance: 20% by volume
- H2S tolerance: 3% by volume

1.3 Specifications

1.3.1 Performance Specifications

MODEL	Hydrogen Range		Hydrogen MUST be present	CO Limit	H2S Limit	T90 Response Time (sec)	Accuracy		Drift/Week		Repeatability		Linearity	
	Min	Max					Min to 10% H2	10 to Max% H2	Min to 10% H2	10 to Max% H2	Min to 10% H2	10 to Max% H2	Min to 10% H2	10 to Max% H2
710B	0.1%	10%	Yes	<100 ppm	<20 ppm	< 90	0.15%	N/A	0.15%	N/A	0.15%	N/A	0.15%	N/A
730B	0.5%	100%	Yes	<100 ppm	<1000 ppm	< 60	0.3%	1.0%	0.2%	0.4%	0.2%	0.4%	0.2%	0.4%
740B	0.5%	100%	Yes	20%	3%	< 90	0.3%	1.0%	0.2%	0.4%	0.2%	0.4%	0.2%	0.4%
720B	0.4%	5%	No[1]	0	0	< 60	0.3%	N/A	0.3%	N/A	0.3%	N/A	0.3%	N/A

Note: Sensor performance specifications are absolute and assume a dry process stream, an ambient temperature of 25°C, pressure compensation, and are in addition to any errors in the calibration gases used. The accuracy is specified for the serial port and digital display output only.

1. 720B models operated in background streams in which H2 is not typically present and may be operated in an Air, O2, or N2 background.

1.3.2 Operating Specifications

Sample Gas Flow Rate	0.1 to 10 slpm (1.0 slpm is recommended)
Pressure	Recommended Operating Pressure at Analyzer: 0.95 – 1.1 atm (14.0-16.1 psia) Maximum: 2 atm absolute (29.4 psia)*
Temperature	Gas Stream: -20°C to +60°C Operating: -20°C to +55°C Storage: -40°C to +80°C
Input Power	10 – 26VDC, 10W
Analog Output	**Current** 4 – 20mA Maximum load impedance: 650Ω - OR - **Voltage** 0 – 5VDC
Environmental	Indoor/Outdoor Use** Altitude up to 2000 meters Pollution degree 2 environment
Ingress Protection	IP64 capable**
Relay Contacts	Two programmable relays with both normally open (N.O.) and normally closed (N.C.) contacts. One relay with normally closed (N.C.) contacts. 1A @ 30VDC SPDT
Serial Communication	RS232 or RS422 19200 bps, no parity, 8 bit data, 1 stop bit, no handshaking
Weight	0.37kg (0.82lbs)

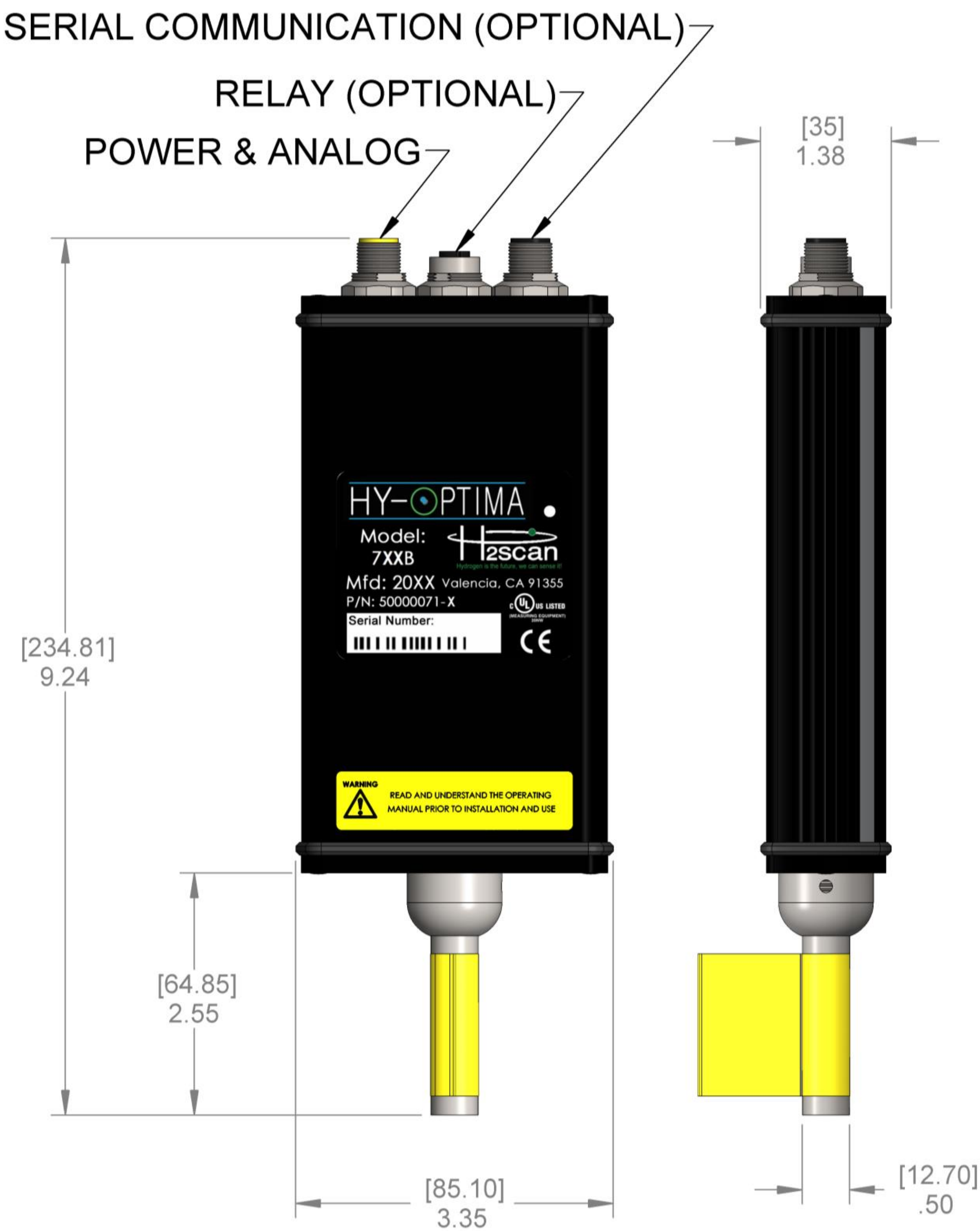
* Analyzers are factory calibrated at 1 atm

**UL did not test Outdoor Use or IP64 during 61010-1 evaluation.

1.4 Analyzer Certifications

Certifications: c UL US LISTED CE	**UL 61010-1** Safety Requirements For Electrical Equipment For Measurement, Control, And Laboratory Use - Part 1: General Requirements - Edition 2 - Revision Date 2008/10/28 **CSA C22.2 NO. 61010-1** Safety Requirements For Electrical Equipment For Measurement, Control, And Laboratory Use — Part 1: General Requirements - Edition 2 - Revision Date 2008/10/01 **EN61326-1:2006** Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements **EN55011** Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement - Class A Group 1 **EN61000-4-2** Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test **EN61000-4-3** Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test **EN61000-4-4** Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test **EN61000-4-6** Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - immunity to conducted disturbances, induced by radio-frequency fields **EN61000-4-8** Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test

1.5 Dimensions



[mm]
inches

Chapter 2: Installation

2.1 Analyzer Location

The analyzer can be mounted in any orientation or position. Mounting the analyzer above the process connection is preferred, especially in process streams containing liquids or potentially condensing gases. Mounting the sensor pointing upwards is not recommended, as debris, condensation, or other contaminants can accumulate in the sensor.

2.2 Wiring / Connections

2.2.1 Power / Analog Output

Supplied Cable – 4m (13 ft.) Other lengths are available.

Wire Color	Description
Brown	Power
White	Power Return
Black	Positive Analog Output
Blue	Analog Output Return

2.2.2 Relays

Optional Cable – 4m (13 ft.) Other lengths are available.

Wire Color	Description
Grey	Relay 1 Common
Pink	Relay 1 Normally Closed (NC)
Yellow	Relay 1 Normally Open (NO)
Brown	Relay 2 Common
Green	Relay 2 Normally Closed (NC)
White	Relay 2 Normally Open (NO)
Blue	Relay 3 Com
Red	Relay 3 NC

The current relay configuration and trip points can be viewed with the "**D1**" command and modified with the "**A**" command.

The Fault relay has a Power Fail Indicator feature that may be enabled or disabled.

Selection	Usage
Enabled	Under normal conditions the fault relay is energized with NC not connected to COM.
Disabled	Under normal conditions the fault relay is de-energized with NC connected to COM.

2.2.3 Serial Interface

Supplied Cable – 4m (13 ft.) Other lengths are available.

Wire Color	RS232 (standard)			RS422 (optional)		
	Description	DB9 Pin	DB25 Pin	Description	DB9 Pin	DB25 Pin
Brown	+6V (N.C.)					
White	TxD (Device Transmit)	3	2	TxD- (Device Transmit, Negative)	3	2
Blue	-	-	-	TxD+ (Device Transmit, Positive)	4	3
Black	RxD (Device Receive)	2	3	RxD- (Device Receive, Negative)	2	20
Grey	-	-	-	RxD+ (Device Receive, Positive)	6	8
Pink	Ground	5	7	Ground	5	7

2.3 Process Connection

H2scan offers a variety of fittings to mate the analyzer to a process stream. The following table lists our standard fitting selections. Others are available upon request.

½ in. MNPT thread

½ in. FNPT thread

-8 SAE/MS thread size

... and many other industry standards.

2.4 Warning Label

Remove the sensor tube warning label prior to using the analyzer.

2.5 Mounting

Mounting is achieved by securing the sensor tube into the supplied fitting directly in the process piping as shown below. H2scan recommends the housing be mounted vertically to prevent condensation from affecting the sensor with connectors on top and the sensor tube pointing downwards. Optional mounting brackets that attach to the instrument housing are also available.

WARNING: Do not cinch down or tighten ferrules outside of the Ferrule Region of the long tube or you will risk permanently damaging the long tube and sensor assembly within.

1.0 inches is the maximum distance that the fitting mount can be from the end plate of the HY-OPTIMA™ 700B analyzer. This is referred to as the Ferrule Region of the long tube which has a wall thickness of 0.065 in. Any distance exceeding 1.0 in. will be in the Sensor Assembly Region where the tube wall thickness is only 0.038 in. Cinching down a fitting outside the Ferrule Region and in the Sensor Assembly Region may result in permanent damage to the long tube and the sensor assembly within.

[mm]

inches

2.6 Startup

2.6.1 Models 710B, 730B, 740B

If the analyzer is being turned on from an off position, power on the analyzer before flowing gas across the sensor. The sequence of steps which are to be followed is:

1. Power on the analyzer and wait for the 5 minute warmup routine to complete. The status LED will be amber in color during warm-up and will change to green when the analyzer is ready. The following operations will be completed in this warm-up sequence:
    - Heat the sensor to operating temperature
    - Perform the Power-On-Self-Test (POST)
2. Apply the low span calibration gas to the analyzer and wait for the reading to stabilize (typically 2 hours on first startup). See Section 4.2 Calibration Gases for choosing the low and high span gas concentrations. Do not apply greater than 10% H2/N2 to the Model 710B.
3. Perform a Field Calibration (see Chapter 4: Field Calibration).

The analyzer can be exposed to oxygen for short periods of time without adverse effects if it is turned off. If it is stored in air for longer than a week, the analyzer may read higher than the true hydrogen concentration due to oxygen absorption on the sensor. Steady hydrogen exposure will slowly remove this absorbed oxygen and cause the analyzer reading to continually drift downward until it reaches the true hydrogen concentration.

If this drift behavior is observed refer to Section 5.1.3 Conditioning to Remove an Offset for instructions and more information.

2.6.2 Model 720B

If the analyzer is being turned on from an off position, power on the analyzer before flowing gas across the sensor. The sequence of steps which are to be followed is:

1. Power on the analyzer and wait for the 5 minute warmup routine to complete.
2. Apply air for 30 minutes.
3. Perform a Field Calibration (see Chapter 4: Field Calibration).

The analyzer is designed to be exposed to an air or inert background gas where hydrogen is normally absent. For optimal performance keep any hydrogen exposure to the sensor to less than one hour. If the hydrogen exposure exceeds this time, the sensor may need to be reconditioned by leaving it powered on in air for at least 24 hours.

2.7 Shutdown

1. Purge the system using gas with a hydrogen concentration of less than 5% H2 or with 100% N2.
2. Turn off all gas flow to the analyzer. Wait for 5 minutes.
3. Power off the analyzer.

Chapter 3: Operation and Configuration

3.1 Settings

Located on the front of the analyzer next to model number marking, a status indicator displays basic analyzer function as described below. The status LED will be amber in color during warm-up. It will become green, amber, or red when the analyzer is ready. Default amber and red Status Indicator LED settings are 1% and 2% hydrogen by volume, respectively.

Status	Indicator
Normal operation / Hydrogen detected is below 1% hydrogen by volume	GREEN
Warm-up / Hydrogen detected between 1% and 2% hydrogen by volume	AMBER
Hydrogen detected above 2% hydrogen by volume / Analyzer fault detected	RED

The analyzer's operational and output settings have been configured at the manufacturer with settings specified at the time of purchase. Settings may be changed through the Serial port.

3.2 Optimum Analyzer Performance

To maximize the performance of the analyzer:

- Verify that all electrical connections are made as recommended. Switching the polarity can cause damage to the analyzer.
- Verify the process gas stream is properly regulated with a stable pressure and flow between 0.1 and 10 slpm (1.0 slpm is recommended).
- After installation complete the conditioning steps described in the Section 2.6 Startup and perform a Field Calibration (Chapter 4: Field Calibration). Use two calibration gases for the Field Calibration for optimal results.

A back pressure controller can be installed to improve performance and stability.

3.2.1 Effect of Pressure

The analyzer is hydrogen specific and sensitive to only the hydrogen partial pressure in the gas stream. Since changes in total gas pressure will affect the hydrogen partial pressure, they will also affect the analyzer readings. At 1.0 atm, a 50% H2/N2 mixture will be reported as 50% by the analyzer. At 1.1 atm the reading will increase to 55% and 2.0 atm will result in a reading of 100%. The analyzer is capable of measuring multiple atmospheres of hydrogen, and readings above 100% H2 are interpreted as hydrogen pressures above 1.0 atm. For example, a reading of 150% H2 means 1.5 times the hydrogen pressure of a 100% H2 concentration at 1.0 atm. The analyzers are factory calibrated at 1.0 atm. Performing the Field Calibration at the operating pressure will correct the hydrogen reading for static pressures. For example, if the local atmospheric pressure is 0.97 atm, doing a Field Calibration will correct for this assuming the pressure remains static. Installing a back pressure controller can increase performance and stability of the analyzer.

3.2.2 Calibration Gas Bottle Accuracy

The inaccuracy of the gas bottle concentration will directly affect the measured accuracy by the analyzer. During factory calibration, the analyzers are calibrated with high accuracy gases (as high as +/- 0.02% accurate). It is strongly recommended that the user perform calibration with similar high accuracy gases to maintain the accuracy specified in the manual.

3.3 Analog Output

The analog output is derived from the final hydrogen value as shown on the serial display and is scaled to the hydrogen and current ranges desired. All of this is initially set to factory defaults as shown in the table below or per customer specifications at the time of order. They can also be changed with the "`H`" and "`I`" commands. If the distance between the high and low H2 range is reduced then more current resolution is obtained in the valid H2 region. This may be desirable if the system will only be operating in a specific concentration region, like 90-100% H2 concentration for example. The value of the low and high H2 current should be set according to the specifications of the measuring equipment. By default they are 4mA and 20mA, respectively, or 1V and 5V, respectively.

Variable	Label in Device	Default Value and Units
I_{H_2Lo} or V_{H_2Lo}	LowH2Current	4mA or 1V
I_{H_2Hi} or V_{H_2Hi}	HighH2Current	20mA or 5V
H_{2Hi}	LowH2Range	0% H2
H_{2Lo}	HighH2Range	100% H2

Use the following equation to calculate hydrogen from the analog output:

$$H_2\% = \frac{I_{meas} - I_{H_2Lo}}{I_{H_2Hi} - I_{H_2Lo}} \cdot (H_{2Hi} - H_{2Lo}) + H_{2Lo}$$

Where $H_2\%$ is the concentration of hydrogen measured as a percent, I_{H_2Hi} and I_{H_2Lo} are the high and low H2 currents measured in mA, and H_{2Hi} and H_{2Lo} are the upper and lower hydrogen concentration limits as a percent.

These values can be seen using the "`D1`"command.

After the analyzer is powered on the analog output will be at the Not Ready level indicating it is active but not able to report a hydrogen level yet. Once ready the analog output will report hydrogen values with output levels in the range specified. If an error condition is detected then the analog output is set to the Error level. These settings can be changed using the `I` and `H` commands.

Whether voltage or current is output is set at the factory and cannot be changed.

3.4 Serial Communication

The user can monitor and log the output and interface with the analyzer to perform calibration or adjust user settings via the serial communication connector. The serial communication is accomplished via the serial interface.

Serial Communications Software – Any serial port two-way communications software such as terminal emulators (H2scan uses Foxterm) and purpose-built software (using LabView, Visual Basic, C++, etc.) can be used to establish serial communication with the analyzer. See Appendix A: Foxterm Setup for instructions on setting up a serial connection.

3.4.1 Serial Commands Summary

Two communication modes are available:

Keystroke – This is the default mode which shows a continuous stream of output data until an ESC key is pressed. Then the H2scan prompt is displayed for the user to enter a command. After the command is finished the stream of output data continues.

Prompted – This mode is entered by executing =H2scan command at H2scan prompt. The analyzer continues with the H2scan prompt after completing each command. Enter the =0 command to end this mode and continue the stream of output data.

Keystroke Commands While Data Streams	
Keystroke	**Description**
ESC	Stops continuous display to enter a password or command. If in level zero, the continuous display will resume after executing one command.
Sp (spacebar)	Pressing the Space key while the serial output is active will display a label line showing the heading for each column of data.
C	Clear peak hydrogen value.

Prompted Commands @ H2Scan prompt	
Command	**Description**
=<password>	Enter the password to change security level. A null or invalid password returns to level 0. Level 0 password = "0" Level 1 password = "h2" Level 2 password = "scan"
A	Modify the Alarm set points
D <page>	Display Product Information. Enter page number 0-6 or A for all pages, default is page 0. 0 – Product information 1 – User configuration
G	Go, resume analyzer operation
H	Modify the hydrogen reporting range
I	Modify the DAC current output range
CI	Calibrate the analog output
T	Configure the data log
X	Clear field calibration data (returns to last factory calibration data).
F	Perform Field Calibration

3.4.2 A Command (Alarm Set Points)

Modify the alarm set points that control the relay and LED operation. Each relay can be configured to any of the following conditions:

Hydrogen level, Rate of change, or status (fault)

Typically the three relays are configured to indicate the following conditions:

Alert (Relay #1), Alarm (Relay #2), Fault (Relay #3)

The Alarm relay should be programmed to react to a higher hydrogen level than the Alert relay.

The hydrogen level uses Trigger and Hysteresis settings:

Trigger is the signal level that activates the relay.

Hysteresis determines how much below the Trigger level the signal must go before deactivating the relay.

The status sets the relay if any of the following error conditions occur:

- The PCB temperature is too high
- The Hres value is out of range
- Any required data are not valid
- The die heater is incorrect
- The die heater is off

An example using the "A" command is as follows:

```
H2scan: A

  Relay 1 Select mode:
    0 - Disable
    1 - Hydrogen level
    2 - Rate of Change
    3 - Analyzer Status
  selected 1
 Threshold: 1
  Hysteresis: .02

  Relay 2 Select mode:
    0 - Disable
    1 - Hydrogen level
    2 - Rate of Change
    3 - Analyzer Status
  selected 1
 Threshold: 2
  Hysteresis: .02

  Relay 3 Select mode:
    0 - Disable
    1 - Hydrogen level
    2 - Rate of Change
    3 - Analyzer Status
  selected 3
  Select Events:
    PCB temp too high (Y/N)? y
    Hres value out of range (Y/N)? y
    Required data not valid (Y/N)? y
    Heater Error (Y/N)? y
    Heater Off (Y/N)? y
    Power Failure Indication (Y/N)? y
...wait...
```

3.4.3 D Commands (Display Product Information)

Display Product Information. Enter page number 0-6 or A for all pages, default (no value) is page 0.

0 – Product information
1 – User configuration

```
H2scan: d0
H2scan hydrogen sensor
  Model Number:  730B
  Serial Number: A000001
    Sensor Number: B3.21.10167
  Firmware Rev:  2.19
  Table Version: 0.50
  Hardware Version: 1.00
  Latest Calibration
    Factory: 00/00/0000
    Field:   00/00/0000

H2scan: d1
User configuration is:
  Hydrogen reporting range .50000-100.0000% H2
  Isolated Output is enabled: 4.000 to 20.000 mAmps
    Error output is 3.000 mAmps
    Not-Ready output is 2.000 mAmps
  Relay #1 threshold is 1.00% Hydrogen
  Relay #2 threshold is 4.00% Hydrogen
  Relay #3 is Analyzer Status; Events are:
    PCB temp too high
    Hres value out of range
    Hcap value out of range
    Required data not valid
    Heater Error
    Heater Off
```

```
Power Failure Indication
```

3.4.4 G Command (Go, Stream Data)

The G command is used to resume analyzer operation and specify the arrangement of the data in columns. These columns are:

Header	Description
TimeSec	The time in seconds since power on.
PcbTemp	The internal electronics temperature.
SnsrTemp	The sensor temperature.
ResAdc	The raw hydrogen sensor measurement in ADC counts.
AdjRes	The adjusted sensor measurement: these adjustments include compensation for variations in sensor temperature, sensor electronics, and other parameters.
ResZero	Sensor reference value (not zero as implied).
%H2	The final hydrogen measurement
%H2_Pk	The peak hydrogen measurement
%H2_Res	The hydrogen resistor measurement
HCurrent	The current used to heat the sensor element
Messages	Some messages are displayed in this column
Average	Average indicates that several samples are being averaged

To change display format press ESC followed by G <fmt>; where <fmt> is a 4 digit hexadecimal number. Some common formats are listed below:

Command	Columns
G	Use default
G 80B0	TimeSec %H2
G B0C0	TimeSec PcbTemp SnsrTemp %H2 %H2_Pk
G B0B0	TimeSec PcbTemp SnsrTemp %H2
G B4C0	TimeSec PcbTemp SnsrTemp ResAdc AdjRes ResZero %H2_Res %H2 %H2_Pk
G F4F0	TimeSec PcbAdc TempAdc HCurrent ResAdc PcbTemp SnsrTemp ResAdc AdjRes ResZero %H2_Res %H2 %H2_Pk
G FFFF	Display All Columns

3.4.5 H Command (Modify H2 Reporting Range)

Modify the hydrogen reporting range.

```
H2scan: h
Hydrogen reporting range 0.0000-5.0000% H2
Enter new H2 low range: 1
Enter new H2 high range: 25
New Hydrogen reporting range 1 - 25% H2
Save these values (Y/N)? y
SAVED - Done
```

3.4.6 I Command (Modify Analog Output)

Modify the Isolated DAC output range.

```
H2scan: i
DAC range is 4.0mA to 20.0mA, error output is 2.0mA, not ready output is 3.0mA
Enter new low H2 output current: 4
Enter new high H2 output current: 20
Enter new error output current: 3
Enter new not ready output current: 2
New DAC range is 4.0mA to 20.0mA, error output is 3.0mA, not ready output is 2.0mA
```

```
Save these values (Y/N)? y
SAVED – Done
```

3.4.7 CI Command (Calibrate Analog Output)

Calibrate the Isolated DAC output range using a precision current meter and requires the level 2 password to be entered first (“=scan”). Connect the current meter to the 4-20mA output and enter “ci” at the H2scan prompt as follows:

```
H2scan: CI
Calibrate 4-20mA output
  Set to 3.000000mA, Enter actual value: 2.99
  Set to 19.000000mA, Enter actual value: 18.98
m=1.000625, b=0.008130

Test the output
  Set to 3.000000mA, Is this good (Y/N)? y
  Set to 19.000000mA, Is this good (Y/N)? y
...wait...
```

3.4.8 T Command (Data Log)

Display or clear the Data Log.
The built-in data log memory saves one year of sensor readings.

```
H2scan: t
Trace Functions:
c = clear log
d = display log
e = exit
Select function: d
=== Begin Log Data ===
Display ALL records? (Y/N)? y
=== End Log Data ===
```

3.4.9 X Command (Clear Field Cal)

Clear the field calibration data. See Section 4.3.1 Clear Field Calibration (Restore Factory Calibration).

3.4.10 F Command (Perform Field Cal)

Perform a field Calibration. See Chapter 4: Field Calibration for more details.

Chapter 4: Field Calibration

4.1 Calibration Interval

Calibrations do not cause any wear on the sensor and can be performed as often as desired.

The recommended interval between calibrations depends on the desired tolerance. For example, if the drift specification for a given model is 0.3% per week (absolute) and the desired tolerance requires no more than 1% of drift (absolute), then the analyzer should be calibrated every three weeks. If there is not a specific desired tolerance, H2scan recommends the calibration be performed every three months. See Section 1.3.1 Performance Specifications to find the drift specification for a given model.

A weekly or biweekly verification of the analyzer is recommended when high accuracy is desired. This can be performed by exposing the sensor to a calibration gas for 15 minutes and comparing the reported value to the calibration gas specification. If the analyzer is outside the desired tolerance then perform a field calibration to restore accuracy.

4.2 Calibration Gases

WARNING: DO NOT use gases with a hydrogen concentration exceeding 10% for the 710B or gases with a hydrogen concentration exceeding 5% at 1.0 atm for the 720B.

Two primary standard (±0.02%) gases are recommended. The option of using a single calibration gas is available if higher tolerances are acceptable and there are constraints preventing the use of two gases. However, the given accuracy specification of the analyzer does not include the error of the calibration gas certification and is only valid if two gases are used with an exposure time of at least 30 minutes per gas for all models except the 720B. The recommended exposure time for the 720B is 20 minutes per gas. It is recommended that the 720B be powered on in air for a minimum of three days before performing a calibration, keeping the H2 exposure minimized.

DO NOT use concentrations below 0.5% H2 as the low span calibration gas. If the process stream hydrogen concentration range is known then to obtain the highest accuracy use a low span calibration gas just below the lowest expected reading, and a high span gas just above the highest expected reading. For example, if the process stream is expected to operate between 61% and 78% H2, then calibration gases of 60% and 80% H2 would be ideal.

The recommended flow rate is 1.0 ± 0.2 slpm.

Gases are applied to the analyzer through user's plumbing.

4.2.1 Background Gases

Calibrate the analyzer in the proper background gas. For an analyzer operated in hydrogen with an inert gas background (710B, 730B, 740B), the following background gases are safe:

- N_2
- Alkanes / Alkenes / Alkynes
- CO_2
- He, Ar, etc. (Noble)

For an analyzer operated in hydrogen with an air gas background (720B), carry out calibration in hydrogen in an air background.

Contact H2scan for inquiries regarding potential background gases not listed above.

Field calibration kits are available from H2scan.

4.3 Calibration Procedure

Required materials:

- ☐ Two primary standard (±0.02%) calibration gases
- ☐ Flowmeter set to 1 slpm (~2 scfh)
- ☐ 30 minutes of time per gas (roughly 75 minutes total when including setup and gas switching)
- ☐ The plumbing and tools required to flow the gases to the sensor and switch between them when necessary
- ☐ A computer with terminal emulating software and required connecting equipment (including any necessary adapters)

Note: Deviating from the above materials may result in lower accuracy. See Section 4.2 Calibration Gases for information.

Connect the analyzer to the computer as described in Section 3.4 Serial Communication.

Press “Esc” to get the analyzer to the command prompt “H2scan:”

Field Calibration Steps	
Display	**User response**
`H2scan:`	Type “ f” to run field calibration
`Ready to Calibrate (Y/N)?`	Type “ y”
`Gas 1`	
`Cal Gas: X.XXX%H2 (Y/N)?`	Type “ n” if incorrect
`Enter gas:`	Enter the hydrogen concentration % by volume
`Cal Gas: X.XXX%H2 (Y/N)?`	Type “ y” if correct
`Settle time: X min (Y/N)?`	Type “ n” if incorrect
`Enter time:`	Enter the duration in minutes for gas #1
`Settle time: X min (Y/N)?`	Type “ y” if correct
`Apply X.XXX%H2: Ready (Y/N)?`	Apply gas and type “y” when flowing at 1 slpm (~2 scfh)
Streaming data…	
`Taking Average… res=x.xxxxx`	Calibration Gas #1 finished.
`Gas 2 (Y/N)?`	Type “ y” if desired (highly recommended)
`Cal Gas: X.XXX%H2 (Y/N)?`	Type “ y” if correct
`Settle time: X min (Y/N)?`	Type “ y” if correct
`Apply X.XXX%H2: Ready (Y/N)?`	Apply gas and type “y” when flowing at 1 slpm (~2 scfh)
Streaming data…	
`Taking Average… res=X.XXXX`	Calibration Gas #2 finished

4.3.1 Clear Field Calibration (Restore Factory Calibration)

If using the serial interface the **x** command restores the instrument to the last factory calibration.

Chapter 5: Supplemental Information and Troubleshooting

5.1 Storage

5.1.1 Storage Oxidation & Offsets

Analyzer readings will develop an offset when the sensor element is not exposed to hydrogen. This offset accumulates slowly while the sensor is in storage, and quickly while the sensor is powered on without being exposed to hydrogen. Try to minimize the time the sensor is powered on without being exposed to hydrogen.

This offset is due to oxidation of the sensing element; oxidation can be reversed (and sensor readings returned to normal) if the sensor is left powered on (conditioned) in an appropriate concentration of hydrogen gas.

5.1.2 Expected Oxidation Time and Recovery Time

The severity of sensor oxidation depends on the sensor's recent operation history.

Recent Operation History	Time Period	Oxidation	Conditioning Regime
Powered off or in storage	**Less** than 1 week	Mild	Apply conditioning gas until readings are stable. Typically less than 2 hours
Powered off or in storage	**Less** than 6 months	Mild to moderate (<1%)	Apply conditioning gas until readings are stable. Typically less than 24 hours
Powered off or in storage	**More** than 6 months	Significant (~1%)	Apply conditioning gas until readings are stable. Typically 24 - 48 hours
Powered on *without* hydrogen present	**Less** than 12 hours	Mild to moderate (<1%)	Apply conditioning gas until readings are stable. Typically less than 24 hours.
Powered on *without* hydrogen present	**More** than 12 hours	Significant (~1%)	Apply conditioning gas until readings are stable. Typically 24 - 48 hours

5.1.3 Conditioning to Remove an Offset

Generally, condition the sensor with a gas mixture that has about the same hydrogen concentration as what you expect during normal operation.

Note: **Do not ever** apply gas with greater than 10% H2 content to the Model 710B. This model is specially built for only low concentrations of hydrogen. Doing so will damage the sensor and void the warranty.

If you are not sure of the conditions the sensor will operate under, a hydrogen-nitrogen mix with a hydrogen concentration from 5% to 10% is a conservative (but effective) choice. Using gas with a slightly higher concentration of gas will remove the oxide layer (and the offset) slightly faster.

In all cases, **apply an appropriate conditioning gas until the hydrogen readings are stable**. Sensor readings may drift up or down during the conditioning process. In most cases, the readings stabilize after 48 hours.

Once stable, the analyzer should be checked for accuracy by performing a Field Verification; see Chapter 4: Field Calibration.

If the analyzer passes the Field Verification, the analyzer may be placed back into storage. If the analyzer fails the Field Verification, please perform a Field Calibration (Chapter 4: Field Calibration). If problems persist, contact H2scan for support.

5.1.4 Avoiding a Storage Oxidation Offset

Alternatively, some customers leave the backup analyzer in H2 gas (powered on) continuously, to eliminate any recovery time the analyzer may require. H2scan recommends this approach whenever it is feasible.

For a fee, H2scan will keep a customer's backup analyzers continuously powered on in hydrogen gas at our calibration facility, and ship out the fully conditioned backup sensor when it is needed.

5.2 Sensor Behavior

H2scan provides two different types of calibrations for sensors employed in process analyzer models. This includes sensors calibrated for continual H2 exposure (H2 measurement applications), and sensors calibrated for uncommon H2 exposure (H2 detection applications).

5.2.1 H2 Measurement

The sensors employed in Models 710B, 730B, and 740B are designed for continual H2 exposure, i.e. H2 measurement applications. The standard range of measurement for these models is 0.5% to 100% by volume or 0.1% to 10% for the 710B.

Because these sensors are designed to see H2, if they are left on for periods of time with no H2 present, an offset will develop in the reported H2. The more oxygen that is exposed to the sensor, the faster and stronger the offset will be. Oxygen offset varies by sensor.

5.2.1.1 Inert Backgrounds

Even small amounts of H2 (2000ppm, for example) should ensure no offset takes place (as long as there is no oxygen present).

If oxygen were to cause an offset to the indication of the sensor, it can be reversed by purging the sensor with H2 and performing a field calibration (See Section 5.3 - General Troubleshooting).

5.2.2 H2 Detection

The sensor employed in Model 720B is designed for brief H2 exposure of less than a few hours at a time, i.e. leak detection applications.

If continual H2 is exposed to this sensor, it will bond with the oxygen (on the sensor surface) and the indication of the sensor will be less than the H2 actually present.

Exposures to H2 for periods exceeding several hours may require overnight operation in H2-free air followed by a field calibration to obtain accurate readings. H2scan does not recommend use of the Model 720B unless there is generally no H2 exposure to the sensor.

5.2.3 Diurnal Effect

Temperature changes throughout the day may induce small changes to the H2 reading of the analyzer. As explained in Section 3.2.1 - A back pressure controller can be installed to improve performance and stability.

Effect of Pressure, the sensor measures the number of hydrogen molecules present which means pressure changes (brought on by temperature fluctuations) can create fluctuations in the reported H2 concentration. While the software in the analyzer corrects mostly for these effects it may still be observed in final reading. Figure 1 shows the diurnal effect across three days. Note the rise and fall in hydrogen concentration across each day correlating with the temperature. While these effects can be observed when highly zoomed in on the data plot, they are well within the specifications for the analyzer. **Adding a back pressure regulator can greatly reduce or remove this effect.**

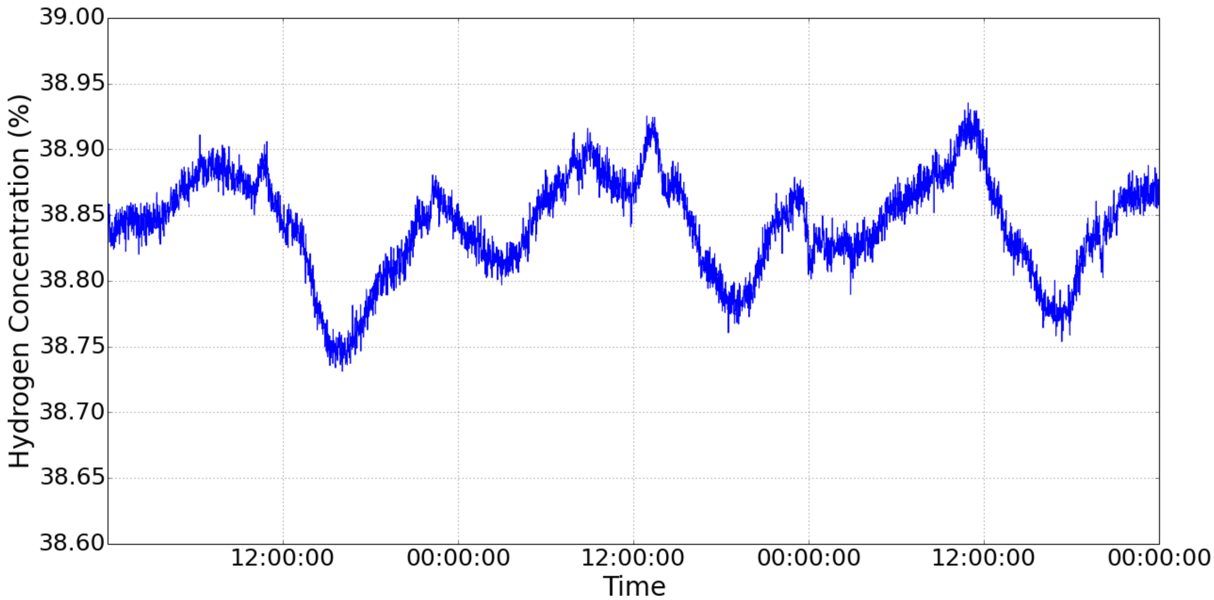


Figure 1: Diurnal Effect

5.3 General Troubleshooting

Here are some general questions to answer if problems are encountered with the analyzer.

1. Is the analyzer reporting %H2?
    - Check all connections and flow paths.
    - Reduce process or calibration gas stream pressure to 1.0 atm and power cycle the analyzer.
2. Is the pressure and the flow stable?
    - Unstable pressure or flow can cause the analyzer to behave erratically. Ensure the process gas stream is properly regulated. A back pressure controller can be installed to improve performance and stability. The analyzer is less sensitive to changes in flow but a flow rate of 1.0 slpm is recommended.
3. Is the sensor stable?
    - Expose the analyzer to a calibration gas (40-100% H2, but not exceeding 10% H2 in the model 710B) overnight while recording the %H2 reading from the serial port (most terminal software allows saving the session to a log file).
    - Plot the %H2 reading. (You may use spreadsheet software such as Microsoft Excel). Assuming a constant pressure, temperature, and flow rate, the %H2 line for the most recent data should be flat with no perturbations outside the defined specifications for the analyzer. If it is not yet stable, leave the analyzer exposed to the calibration gas for another 24 hours or until stability is observed.
    - Once the sensor is stable, perform a field calibration with two gases.
    - If the sensor does not stabilize, contact H2scan for support.

5.4 Command Terminal Messages

The last column in the display of the terminal shows status messages.

In this section _XXX refers to a number

ramp_up

This indicates the sensor temperature is ramping up to the operating temperature

Warmup_XXX

Warmup_XXX is displayed when the sensor is turned on or reset. It will start at a time programmed at the factory and count down to 0.

Settle

When the analyzer is waiting for the die temperature to stabilize, “Settle” is displayed. The settling time varies depending on the sensor and local conditions and could take up to five minutes.

Wait_XXX

This message usually appears counting down a delay.

For example, during field calibration the analyzer is expecting the gas to be applied for a certain length of time. In this case WAIT_XXX will appear counting down the remaining time.

Wait_100 continuously displayed is a special case. It appears when the analyzer is waiting for an event that will not occur at a particular time. Once this event occurs it changes to a counter initialized to some value (Wait_XXX) and counts down from there.

If it is displayed for more than five minutes, cycle the power to the analyzer. It should return to normal operation.

htroff

The “htroff” error could be caused by one of several error conditions that cause the analyzer to turn off the sensor heater. Sometimes the error occurs because of a transient condition (“glitch”). If “htroff” is displayed, cycle the power to the analyzer. It should return to normal operation. If the error is permanent, the analyzer must be returned to H2scan for examination.

Error_XXXX

The following table lists possible errors and the code numbers that could occur and be displayed during serial communication. These codes are hexadecimal numbers representing 16 bits with each bit representing an error. If more than one error occurs concurrently, their values add. For example, if the sensor temperature is out of range and there is a configuration error, the error code will be 4040. Many of these errors could lead to a “htroff” error.

Error	Code (hex)
PCB temperature is too high	8000
Sensor temperature is out of range	4000
H2 resistor value is out of range	2000
Data not valid	0800
Sensor temperature fault	0100
Configuration error	0040

5.5 Serial Communication Troubleshooting

This troubleshooting guide assumes the ICP DAS model 7561 USB adapter and FoxTerm terminal emulation program are used. More information can be found on-line at www.icpdas.com. It is important that the RxD, TxD, and Gnd connections for RS-232 communication are made correctly. Gnd must be connected to the DC ground line of the power supply. Avoid using a USB-Serial adaptor that has a long cable between the two ends as it can easily pick up electrical noise that will interfere with communications.

FoxTerm Error 015: The port 'COMx' does not exist: Determine which COM port is available for use.

Garbage Characters: If strange characters are seen in the FoxTerm window, either on their own or in response to pressing `Enter` then `ESC`. Verify the serial connections and FoxTerm Settings.

No H2scan: Prompt: If pressing `Enter` then `ESC` does not show the H2scan: prompt, and FoxTerm is connected to the correct COM, port refer to the Section 5.5.6 Analyzer Command Line for further instructions.

No Response to Pressing Enter: If the H2scan: prompt is present and command characters are echoed but pressing `Enter` has no affect then confirm the Newline Behavior setting for FoxTerm is "CRLF".

USB Adapter not recognized: If a USB adapter is used, Administrator Rights may be required for the computer to install and use it. Contact your network administrator to resolve this issue.

5.5.1 Connections

Review the wiring connections between the analyzer, power supply, and USB Adapter as indicated in the Operation manual. Then confirm that the power supply is on and within specifications with a voltmeter, and the LED is on. An amber LED immediately after turning on power is normal. The LED will change to green or red after the warm up period depending on hydrogen concentration.

5.5.2 COM Port Number

Administrator rights for the computer are required to examine or setup a COM port connection with the analyzer. Open Device Manager by right clicking on My Computer icon, selecting Manage and then choosing the Device Manager option in the left pane. In the right pane select Ports (COM & LPT) and determine which COM port is connected to the analyzer (e.g. COM6). The COM port should be labeled as I-756x (COM__). Make note of the COM port number shown in parenthesis for use in setting up FoxTerm. Note that the COM port number may be different when your computer is reconnected to the analyzer. For best results always use the same USB adapter and plug-in location on your computer.

To confirm that a particular COM port is actually connected to the analyzer: Open Device Manager; disconnect the USB connector from your computer and verify that the COM port disappears; then reconnect the USB connector and verify that the COM port re-appears. If the COM port is not displayed in Device Manager, unplug the USB cable and look for changes in Device Manager. Plug in the USB cable and see if a new COM port is added to the Ports (COM & LPT) section. If so, this is the COM port to use with FoxTerm.

5.5.3 USB Adaptor Device Driver:

If the COM port is not correctly displayed in the Device Manager then look for yellow warning symbols that indicate a device is not working correctly under the Universal Serial Bus (USB) controllers section. If this warning symbol goes away and returns as the USB cable is disconnected and reconnected then the device driver for the USB adapter is not installed correctly. To re-install the device driver, double click on the Warning line to bring up the properties window for the device; select the Driver tab and click on the Uninstall button. After the Uninstall is complete unplug the USB cable and reboot your computer. Re-install the driver from the CD (or internet) then plug in the USB cable and confirm that a new device is found and the driver is loaded without error. Go to the beginning of this section and determine which COM port has been assigned for the analyzer.

5.5.4 Rebooting

Sometimes when the connection between the Computer and the COM port cannot be established even after following the above procedures, the problem may be that the Computer has not released the COM port from a previous use. Reboot your computer and then use the above procedure in identifying the correct COM port number. In such cases it is best to avoid disconnecting and reconnecting the USB adaptor until the entire data download activity is complete.

5.5.5 Terminal Program

Problems with FoxTerm are best resolved by opening FoxTerm then issuing a (File|Close Session) command from the menu bar. This closes all open terminal windows and prepares FoxTerm to setup a new COM port connection. If prompted to `Save` the session select `No`. The next step is to issue the (File|New COM Port Connection…) command from the menu bar. Now fill out the New Connection dialog box with the correct COM port and settings. Click the OK button to open the terminal window. The title bar for the window shows the COM port and indicates whether it is Connected or Not Connected. If Not Connected there is something wrong with the COM port connection on the computer, or another program is using the COM port. Confirm the correct COM port is being used. Reboot the computer if the Not Connected message does not disappear. If the terminal window is connected continue to the next section to get an H2scan prompt.

5.5.6 Analyzer Command Line

The analyzer is sending data to the serial port as measurements are made which is typically every second.

Pressing the **Enter** then **ESC** keys should show the H2scan prompt. Sometimes the **ESC** key needs to be pressed twice to get the prompt. If the prompt is not displayed then press the following keys to establish communication with the analyzer:

N Enter

1 Enter

If the analyzer does not respond turn off power for 10 seconds before turning it back on. A Power-on-Reset message should be displayed in the terminal window when power is applied.

User commands like "**D0**" are issued from the H2scan prompt. These commands are followed by the **Enter** key to initiate the operation. If the prompt is displayed and the user command is echoed but pressing **Enter** doesn't initiate the command then the **"Newline Behavior"** setting in FoxTerm must be changed to "**CRLF"**.

5.6 Analog Output Troubleshooting

Sometimes the analog output shows unexpected values, such as negative hydrogen. Negative hydrogen values are never reported. This section assumes 4-20mA is the analog output. Systems with 0-5V have similar operations.

5.6.1 Verify the hydrogen values

Check the **%H2** column of the serial port output to read the actual hydrogen measurement. The analog output is derived from this hydrogen value. If the actual hydrogen measurement is OK, but the analog output does not agree with the **%H2** column check the following items.

5.6.2 Verify the H2 range

If the H2 range is set much wider than the operating range used, errors and noise can be exaggerated. Check the range with the **D1** command.

```
User configuration is:
  Hydrogen reporting range 0.0000-20.0000 %H2
  Isolated Output is enabled: 4.000 to 20.000 mAmps
    Error output is 3.000 mAmps
    Not-Ready output is 2.000 mAmps
```

In this example 4mA = 0ppm and 20mA=20%. This is an appropriate range if the hydrogen values of concern are between 0 and 20%. This would not be an appropriate range if the hydrogen values range from 1.5 to 10%.

If the range needs adjustment, use the **H** command and follow the prompts as shown below.

```
Hydrogen reporting range 0-0.2000 %H2
  Enter new H2 low range: 1.5
    Enter new H2 high range: 10
New Hydrogen reporting range 1.5000-10.000 %H2
  Save these values (Y/N)?
```

In this example the range was changed so 4mA=1.5% and 20mA=10%.

5.6.3 Verify the Analog Output

Disconnect the analog wires from the SCADA system. Using a calibrated meter, verify the current is correct. The equation is:

$$I = \frac{(H2read - H2low)}{(H2high - H2low)} * (AoutHigh - AoutLow) + AoutLow$$

where H2high is the H2 value at 20mA, H2low is the H2 value at 4mA, AoutLow is the lowest measurement analog output, AoutHigh is the highest measurement analog output, and H2read is the hydrogen measurement.

For example, for H2high=2%, H2low=0%, and H2read=1%, the current should be 12mA +/- 0.01mA.

5.6.4 Verify the SCADA analog input

If the current from the analyzer is correct, perhaps the analog input channel is measuring it incorrectly.

Inject a current from a calibrated source and verify the SCADA analog channel measures it correctly.

If it does not measure the current correctly, see the SCADA manual for information regarding calibration and adjustment.

5.6.5 Calibrate the Analog Output

If the range is correct and the analog output is inaccurate, it may require calibration.

Use the "`ci`" command.

Appendix A: Foxterm Setup

Installation

These instructions refer to FoxTerm, but the concepts are the same in all terminal emulators.

Download FoxTerm from www.foxterm.net.

Create a folder in “My Documents” called “H2scan”.

Unzip the FoxTerm files into the H2scan folder.

Setup

Start FoxTerm

Close the default session window (if needed).

Open a new session window.

Select the correct port as determined above (COM3 in this example).

Setup the session as shown below

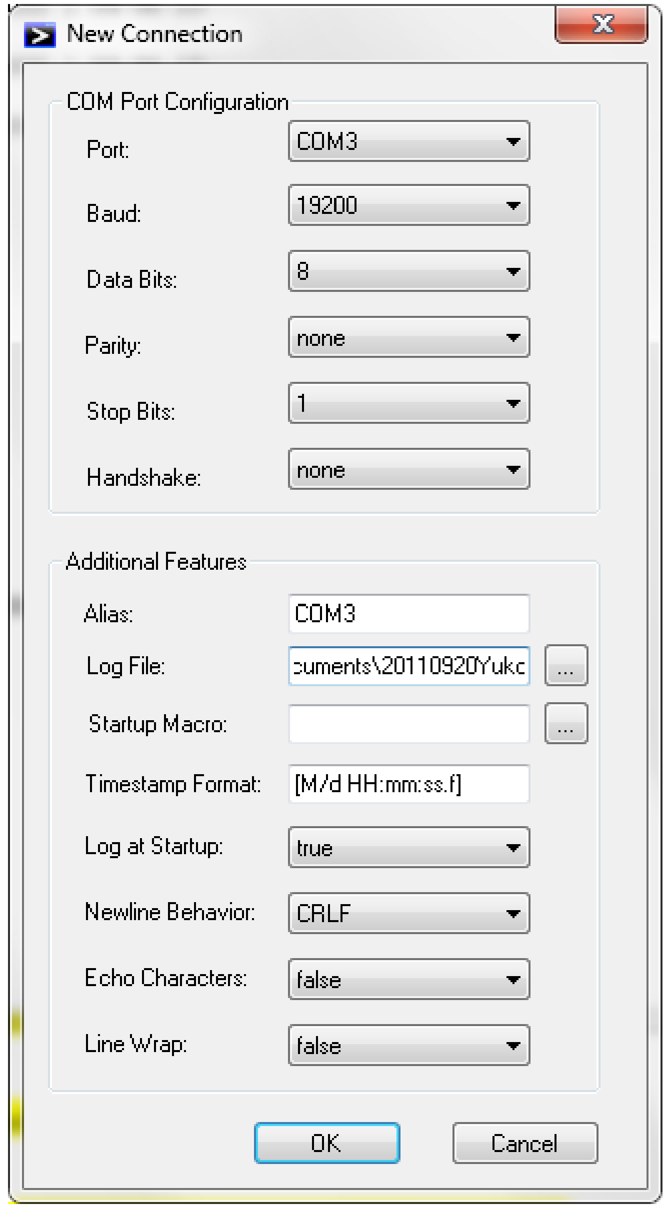
Select a log file name and location. The file name should start with the current date (YYYYMMDD) followed by any particular information required. This way, the files will be easy to sort. For example “20110920Yukon6.log” would be the file name for the “Yukon6” analyzer that had logging started September 20th, 2011. The “.log” extension is the default, but any extension could be used.

Newline Behavior must be set to “CRLF”.

Click OK.

Save the session as “H2scan.xml” in the FoxTerm program location.

The setup should look similar to that shown.



Appendix B: European Declaration of Conformity

Hydrogen is the future, we can sense it! ™

CE

European Declaration of Conformity

Directives Applied: EMC Directive 2004/108/EC

Standards to which Conformity is Declared:
EN61326-1: 2006
EN55011 Class A Group 1 Radiated Emissions
EN61000-4-2 Electro-Static Discharge (4KV CD / 8KV AD)
EN61000-4-3 Radiated Immunity 10V/M (80-1000MHz) 3V/M (1.4-2GHz) 1V/M (2-2.7GHz)
EN61000-4-4 Electrical Fast Transients (2KV AC/DC) (1KV I/O, sig, control)
EN61000-4-6 Conducted Immunity (3V .15-80MHz)
EN61000-4-8 Magnetic Field Immunity (30 A/M)

Standards comply with Requirements of the European Directives.

Manufacturer's Name:	H2Scan Corporation
Manufacturer's Address:	27215 Turnberry Lane, Suite A Valencia, CA 91355 (661)775-9575
Equipment Type:	Permanently Installed Hydrogen Gas Analyzer
Equipment Class:	Gas and Vapor Detection Equipment
Model Numbers:	6XX, 7XX, 6XXB, 7XXB, where XX can be 00 to 99.

I hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s)

Date of Issue: March 10, 2014
Place of Issue: Valencia, CA

Signature:
Full Name: Dennis Wayne Reid
Position: Chief Executive Officer

Tests carried out by DNB Engineering, and/or accredited testing laboratories.