HY-ALERTA

HYDROGEN SPECIFIC LEAK DETECTION

HY-ALERTA™ 1600
Intrinsically Safe Area Hydrogen Monitor

OPERATING MANUAL

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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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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.

LIMITATION OF LIABILITY

IN THE EVENT OF A DEFECT IN A PRODUCT, H2SCAN SHALL NOT BE RESPONSIBLE FOR ANY DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING THEREFROM, INCLUDING, BUT NOT LIMITED TO, LOSS OF REVENUE AND/OR PROFIT.

LIMITED WARRANTY

H2scan Limited Warranty. Each hydrogen instrument ("Product") will conform, as to all substantial operational features, to the Product specifications set forth 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 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.

1 DESCRIPTION

The HY-ALERTA™ 1600 Intrinsically Safe Area Hydrogen Monitor is designed to detect and/or measure hydrogen as a component of air. The hydrogen specific solid-state sensing element is housed in a flameproof enclosure at the tip of the sensor tube, and ATEX certified for Zone 0 hazardous locations. The electronics assembly housed in a metal housing, which is permanently attached to the sensor tube, is ATEX certified for Zone 1 hazardous locations. The electronics contains all the circuitry necessary to operate the sensor and provides calibrated hydrogen readings to a 4-20 mA analog and RS422 digital outputs. The HY-ALERTA™ 1600 has no cross sensitivity to other combustible gases, eliminating false positive alarms and ensuring safety system reliability.

2 SPECIFICATIONS

Sensitivity Range:	0.4% to 5% hydrogen by volume at 1 ATM, 10% to 125% hydrogen lower flammable limit	
Accuracy:	± (0.03 x indication + 0.2) percent hydrogen by volume Example: accuracy at 1% H_2 is ±0.23% H_2	
Response Time:	T_{90} of 60 sec maximum	
Temperature:	Ambient Operating: Storage:	-20 to +40°C -40 to +50°C
Sensor Input Voltage:	Range: Intrinsically Safe:	5 VDC to 28 VDC 10 VDC, 6 W
Power Barrier Input Voltage:	Range: Nominal:	20 VDC to 28 VDC 24 VDC
Analog Output:	Isolated, Loop Powered 4-20 mA	
Serial Communication:	RS-422	
Dimensions:	See following figure (dimensions in inches)	
Weight:	1 lbs.	
Enclosure Rating:	At least IP20, capable of meeting IP64 Dust-tight, protected against water spray from any direction	
Approvals and Ratings:	CE 0359 ⟨Ex⟩ ITS07ATEX25634X	II 1 G, Ex ia II H2, db+db IIB T3 Ga II 2 G, Ex ib II H2, ib db IIB T3 Gb
Calibration Period:	3 months	
Product Life:	10 years	

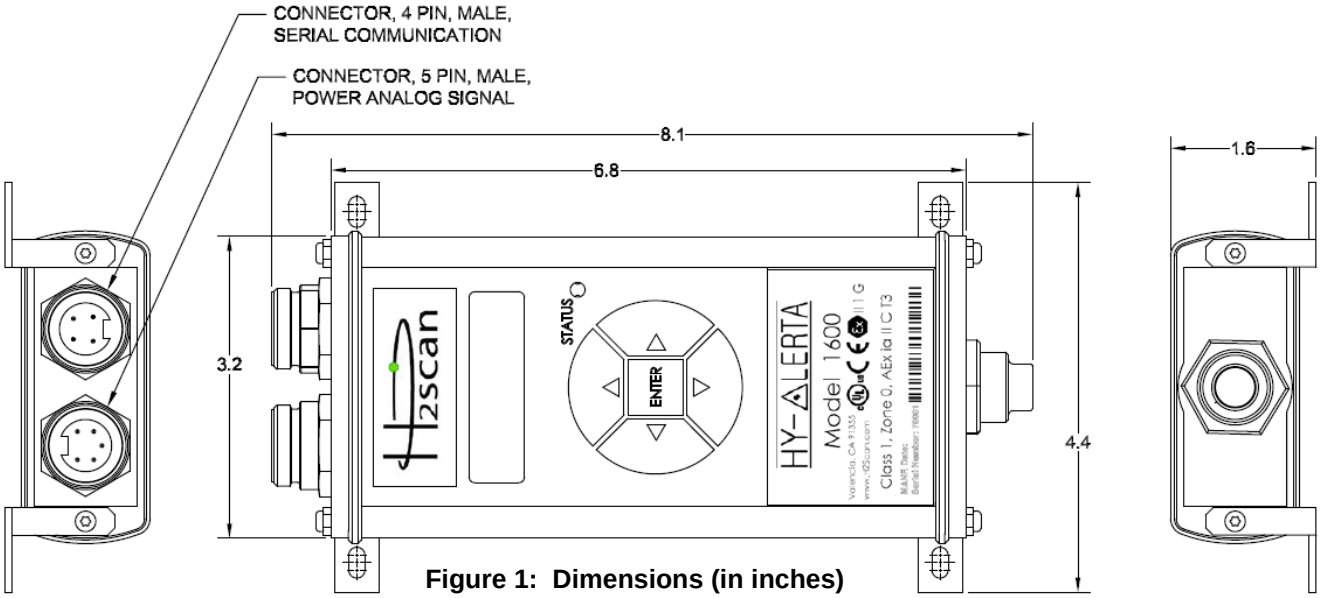


Figure 1: Dimensions (in inches)

3 ATEX RATING

The HY-ALERTA™ 1600 monitor is certified with a dual zone rating.

Electronics Assembly is Zone 1 (2 G Ex ib)

Probe Tip is Zone 0 (1 G Ex ib+d).

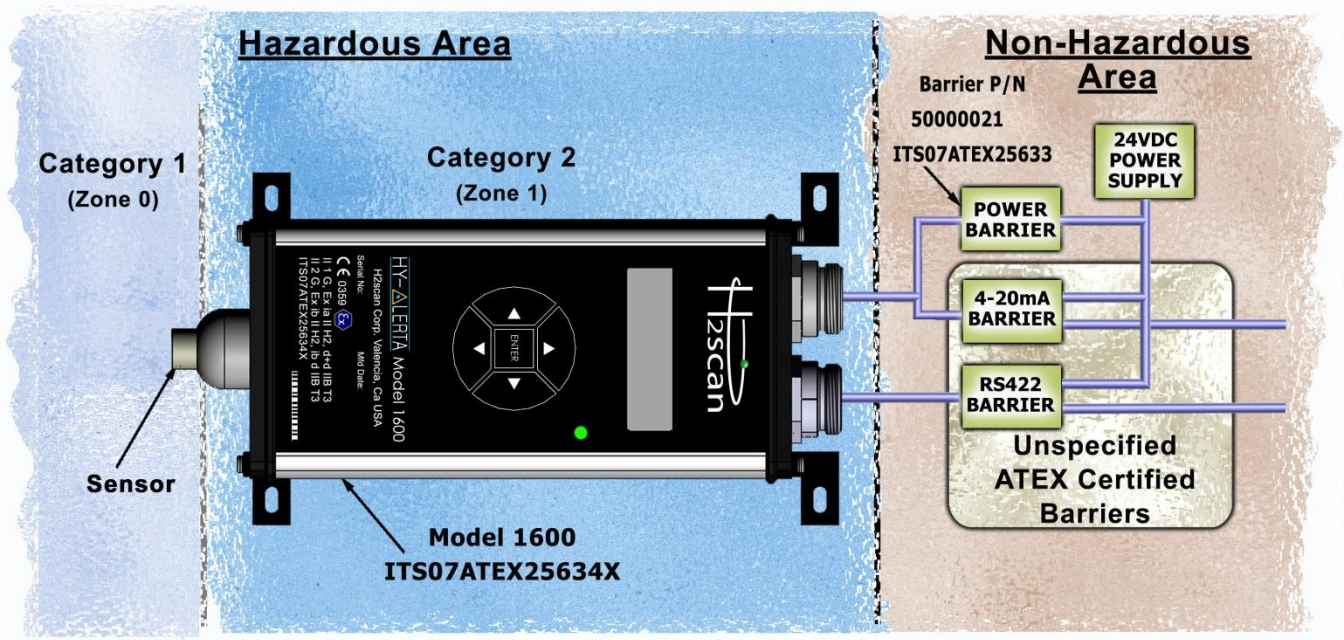


Figure 2: Hazardous Area and Associated Equipment

Table 1: Input and Output Parameters			
Parameter	**J1 Pins 2&3 (Power Supply)**	**J1 Pins 4&5 (4-20 mA loop)**	**J2 Pins 1&2, 3&4 (RS422 Rx&Tx)**
U_i	11.5 V	26.7 V	3.7 V
I_i	3.27 A	91 mA	2.25 mA
P_i	9.41 W	611 mW	206 mW
C_i	0	68.2 nF	0
L_i	0	0	0
U_o	n/a	n/a	5.9 V
I_o	n/a	n/a	238 mA
P_o	n/a	n/a	350 mW
C_o	n/a	n/a	1000 uF
L_o	n/a	n/a	2.5 mH
L_o/R_o	n/a	n/a	404 uH/Ω

4 INSTALLATION

WARNING: IF THE UNIT IS INSTALLED IN A CLASSIFIED LOCATION THEN IT IS THE RESPONSIBILITY OF THE USER AND INSTALLER TO MAKE CONNECTIONS TO RELATED EQUIPMENT IN A MANNER CONSISTENT WITH THE LOCATION CLASSIFICATION.

4.1 ASSOCIATED EQUIPMENT

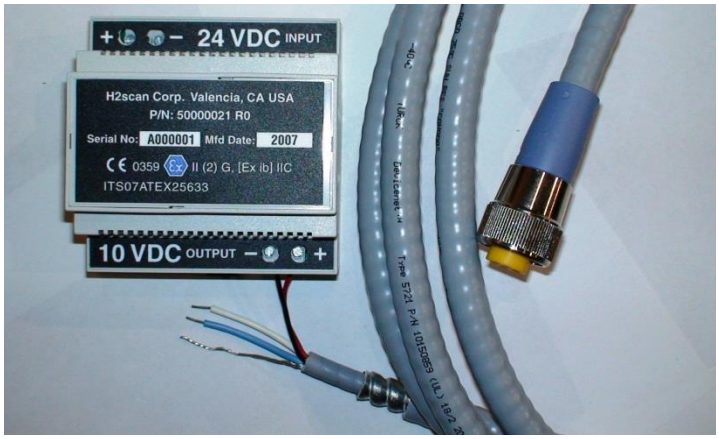
Only H2scan specified cables should be used with this Analyzer. The maximum length for intrinsically safe operation of both the Power/Analog Cable and the Serial Interface Cable is 10 meters. Refer to the Appendix for Control Drawings.

When operated in a hazardous area, the HY-OPTIMA™ 1700 Analyzer must be connected to appropriately certified barriers located in a non-hazardous area. The following barriers are approved for use with this device for an Intrinsically Safe implementation:

Intrinsically Safe Power Barrier: H2scan's custom designed barrier supplies 10VDC, 6W power to the sensor.

Intrinsically Safe Analog Output Barrier (4mA to 20mA): GM International D1054S or equivalent, One Channel Repeater Power Supply and Trip Amplifiers. Refer to the D1054S Operating Manual for installation and configuration of this barrier.

Intrinsically Safe Serial Interface Barrier (RS422): GM International D1061S or equivalent, RS422 / RS485 Fieldbus Isolating Repeater. Refer to the D1061S Operating Manual for installation and configuration of this barrier. This barrier also requires a null modem cable for communication between PC and Barrier.



4.2 MOUNTING

While the unit can be mounted in any orientation or position, it is important to consider the possible sources and areas of accumulation of hydrogen gas. Typical installations are near the ceiling level above equipment using or storing hydrogen. For earlier detection artificial means of accumulation such as flat plates or inverted trays can be installed at lower heights to allow hydrogen to reach the sensor more quickly.

WARNING: IT IS NOT THE INTENT OF THIS MANUAL TO SPECIFY MOUNTING LOCATION(S). IT IS THE REPONSIBILITY OF THE USER AND INSTALLER TO DETERMINE THE PROPER LOCATION(S) FOR HYDROGEN DETECTION BASED UPON THE PARTICULAR USES OF HYDROGEN AT THE INSTALLATION SITE.

Mounting is achieved by 4 mounting tabs that can be rotated to align with flat, angled or moderately curved surfaces. Mounting hardware should be a 4 mm screw (M4, #8 screw), appropriate for the surface being mounted upon. The unit can be mounted in any orientation or position.

4.3 CONNECTIONS

Power/Analog Output - Connector 1

Supplied Cable – 4 m (12 ft.) standard (Other lengths available).

Wire Color	Description
Red	+10 VDC
Black	10 VDC Return
White	+4 mA to 20 mA
Blue	4 mA to 20 mA Return
Bare	Case Ground

Serial Interface - Connector 2

Supplied Cable – 4 m (12 ft.) standard (Other lengths available).

Wire Color	Description
Black	+TxD RS422
Blue	-TxD RS422
White	+RxD RS422
Brown	-RxD RS422

4.4 SETTINGS

Located on the front of the unit next to model number marking, a Status Indicator displays basic unit functions as described below. Default amber and red Status Indicator LED settings are 1% and 2% hydrogen by volume, respectively.

Status	Indicator Color
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 / Unit fault detected	RED

The unit'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 use of serial port.

WARNING: If settings are changed from those set by the manufacturer then it is the user's responsibility to understand the implications to the connecting equipment monitoring the unit.

5 STARTUP

Power must be applied to the unit before connecting the serial cable. Power is connected via the Power/ Analog signal connector. The serial cable can be connected any time after power has been applied to the unit. Once power is applied, the unit executes a warm-up sequence lasting about 5 minutes. The status LED will be amber in color during warm-up. It will become green, amber, or red when the unit 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).

The analyzer is designed to be exposed to air with no hydrogen most of the time. 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 a few days.

5.1 SETTINGS

Located on the front of the unit next to model number marking, a Status Indicator displays basic unit function as described below. Default amber and red Status Indicator LED settings are 1% and 2% hydrogen by volume, respectively.

Status	Indicator Color
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 / Unit fault detected	RED

The unit'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.

WARNING:

IF SETTINGS ARE CHANGED FROM THOSE SET BY THE MANUFACTURER THEN IT IS THE USER'S RESPONSIBILITY TO UNDERSTAND THE IMPLICATIONS TO THE CONNECTING EQUIPMENT MONITORING THE UNIT.

Although the unit will respond to 90% or better of a concentration change within 60 seconds, the signal will continue to settle. This period varies with concentration and other conditions. For best

results in long-term monitoring, allow the unit to settle for a period of one (1) hour in the gas composition being monitored prior to use.

6 OPTIMUM UNIT PERFORMANCE

For maximizing the performance of the sensor, the following steps are recommended.

Verify that all electrical connections and made as recommended. Switching the polarity can cause damage to the unit. Ensure that the DC power supply utilized is appropriate and does not have large peak-to-peak noise.

Perform a Field calibration after the installation and conditioning steps described in the Start-up section are completed. DO NOT use 0% H2 as the lower calibration gas. Instead use hydrogen concentration that is slightly lower than the expected lowest hydrogen concentration (for e.g. if 1% is the expected lowest H2 concentration, then use 0.5% H2 as the lower calibration gas.

For the second calibration gas use a concentration that is slightly higher than the expected maximum H2 concentration.

If the analyzer gets exposed to extended periods of H2, condition the sensor as described in the Start-up section and follow-up with a Field calibration, if needed.

6.1 PRESSURE EFFECTS

The analyzer is hydrogen specific and sensitive to only the hydrogen partial pressure in the air. Since changes in total gas pressure will affect the hydrogen partial pressure, they will also affect the sensor readings. For instance, at one atmosphere pressure, a 2% H2 concentration will be reported as 2% from the unit. At .9 atm, the reading will decrease to 1.8%.

Normal atmospheric pressure fluctuations may also manifest as small hydrogen changes.

At the factory, the units are typically calibrated at one atmosphere pressure.

Performing the field calibration will compensate for altitude induced inaccuracy.

7 OPERATION

7.1 ANALOG OUTPUT

The following parameters are set at the factory per customer specification at time of order, however they are user configurable via the serial port.

The user can request for a specific output current or there are analog output ranges the user can select from, which are listed below. The analog output the user selects is scaled to the user's hydrogen range of interest. All of this is initially set at the factory per customer specification at the time of order. Below is the table for standard analog output current ranges:

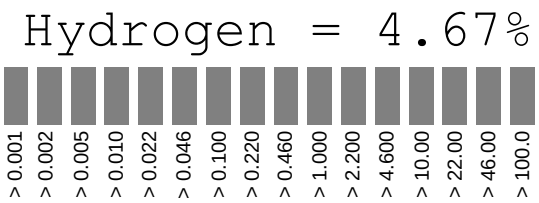
Current Range Selection	Analog Output Range	Power-On Self Diagnostic Output	Error Output
Standard	4 mA to 20 mA	22 mA	3 mA
Optional	0 mA to 20 mA	0 mA	20 mA

The selected Analog Output Range is scalable from the low to high levels of the hydrogen sensitivity range. The user can change to another current range of the analog output in the field. Please refer to the "I" command.

7.2 DISPLAY

The upper row of the LCD indicates a numerical value for the percent hydrogen concentration or peak hydrogen value. The lower row of the LCD is used to display the hydrogen meter, a logarithmic bar graph ranging from 0.001% (10 ppm) to 100% hydrogen by volume. An open box on

the bar indicates the last peak value obtained and filled boxes indicate current value. The following figure describes how to interpret the hydrogen meter:



7.3 KEYPAD

A 5 button keypad is used to alter the LCD, change settings and initiate special functions from the Configuration Menu:

Pressing ▲ (up arrow button) displays the peak hydrogen reading.

Pressing ▼ (down arrow button) displays the current percent hydrogen concentration.

Pressing ► (right arrow button) clears the peak hydrogen value.

Pressing and holding the **ENTER** button invokes the Configuration Menu.

Pressing ▼ (down arrow button) scrolls down through function menus or scroll down through a numerical range.

Pressing ▲ (up arrow button) scrolls up through function menus or scroll up through a numerical range.

Pressing the **ENTER** button or ► (right arrow button) selects the function.

Pressing ◄ (left arrow button) backs out of menus.

7.4 CONFIGURATION MENU

The following functions will be found in the Configuration Menu:

Information Disp – model information

Firmware Rev – firmware revisions

Serial Number – model serial number

Calibration Date – date of the last factory calibration

Set Alert/Alarm – Define hydrogen level that will trigger the alert and alarm signals.

Alert Level –the level of hydrogen that will cause the LED to turn amber

Alarm Level – the level of hydrogen that will cause the LED to turn red

Set H2 Range – Define hydrogen sensitivity range (standard factory setting: 0% to 5% hydrogen by volume).

Low H2 Range – The lowest level of hydrogen (standard factory setting: 0% hydrogen by volume) to correspond with the low range analog output setting.

High H2 Range – The highest level of hydrogen (standard factory setting: 5% hydrogen by volume) to correspond with the high range analog output setting.

Configure IDAC – define analog output range (standard factory setting: 4mA to 20mA)

Low Range – low level analog output (standard factory setting: 4mA) to correspond with lowest level of hydrogen range

High Range – high level analog output (standard factory setting: 20mA) to correspond with highest level of hydrogen range

Error – analog output (standard factory setting: 3mA) of error status

Not Ready –analog output (standard factory setting: 2mA) of self-diagnostic test

Field Calibrate

Calibrate Sensor – Field Calibration procedure

Clear Field Cal - restores the instrument to the last factory calibration

Exit – exit Configuration Menu to standard display output setting

8 SERIAL COMMUNICATION

The user can monitor and control the unit via serial communication via the serial interface.

8.1 SOFTWARE

Software that communicates over the serial port is typically called a “terminal emulator”. Any two-way terminal emulators (HyperTerminal, Telnet, etc.) or purpose-built software (using LabView, Visual Basic, C++, etc.) can be used to establish serial communication with the unit.

XP and previous versions of Windows came with a terminal emulator called “Hyper Terminal”. Newer versions of Windows do not. These versions require installing a third-party program. There are many inexpensive or free programs available. FoxTerm, a free program, is used extensively by H2scan.

8.2 CONNECTION

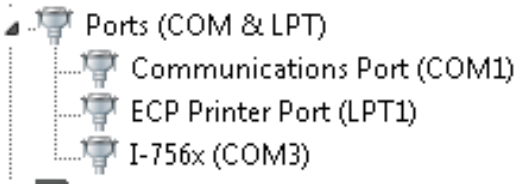
Connect the sensor to the serial port, using whatever barriers and adapters are required.

If a USB adapter is used, install the driver according to its instructions.

In Windows, look at the ports using the Device Manger.

A built-in port will be “COM1”.

The port assigned to the USB adapter could have any number, but it will be called something like “USB Serial Port (COM7)” or “I-756X (COM3)”. Below is an example.



Note the port number that Windows has assigned.

8.3 FORMAT AND SETTINGS

RS232 (RS422 optional)

19200 Baud

8 bit data

1 stop bit

No parity

No Handshaking

8.4 COMMAND LEVELS

The unit can be communicated with and configured via the use of commands as described below. Two levels of communication outputs are available:

Level 0 – Default level used for data monitoring and basic functions providing a continuous stream of data readings

Level 1 – Password protected level used for configuration of user-settable parameters; interactive single-line data output per command

8.5 COMMAND SUMMARY

The **RETURN** or **ENTER** key is the last character of the command string. If either key is pressed without a command string the result is an invalid command and will resume continuous display if in Level 0 or return to prompt if in Level 1.

Level 0 Commands	
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.
A	Average readings.
C	Clear peak hydrogen value.
=<password>	Enter the password to change security level. A null or invalid password returns to the default security level. Level 0 password = "**0"** Level 1 password = "**h2scan"**

Level 1 Commands	
Keystroke	**Description**
A <Alert> <Alarm>	Set the Alert and Alarm levels in %H2.
C	Clear peak hydrogen value.
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 2 – Manufacturing information 3 – Product configuration 4 – Sensor characterization data 5 – Hydrogen calibration data 6 – Temperature calibration data A – All of the above
F	Field Calibration
G < fmt> <opt>	Start or resume the sensor operation: if needed, heat the ASIC, setup the sensor, and output data on serial port; this restores default settings (refer to the FORMAT and OPTIONS section).
H <low> <high>	Set the hydrogen reporting range: <low> to <high> in %H2.
I <low> <high> <err> <not rdy>	Set the DAC current output range: <low> to <high>; error output <err>; and not ready output <not rdy> milliamps. Possible range from 0 to 20 milliamps.
L < fmt> <opt>	Print current hydrogen reading. Used to poll for hydrogen readings. Default format <fmt> is current setting (refer to the FORMAT <fmt> and OPTIONS <opt> sections).
P <atm>	Select atmospheric pressure of gas. Factory default pressure is 1 ATM.
S	Stop the sensor: turn off heater, set Bias to zero, set DAC outputs to zero, and stop reporting data on the serial output.
V <low> <high> <err> <not rdy>	Set the DAC voltage output range: <low> to <high>; error output <err>; and not ready output <not rdy> in volts. Possible range from 0 to 5 volts.
X	Clear field calibration data (returns to last factory calibration data).

Format <fmt> - The Format <fmt> string is a two character hexadecimal representation of an 8 bit value derived from the following table. The user determines which data are needed and selects that bit value. Once all selections are made the values are summed bitwise and then converted to a two place hexadecimal value. To aid in the conversion, a 4 bit to hexadecimal conversion table follows.

Format: Bit Value Identifiers

Serial output Format <fmt> parameter: select the desired columns of data from this list, add the bit value for each column bitwise, and convert into two hexadecimal characters using the 4 bit-to-Hexadecimal table in *EXAMPLE 3*.

Description	Bit Value							
Include time stamp	1	0	0	0	0	0	0	0
Include raw ADC values	0	1	0	0	0	0	0	0
Include PCB temperature	0	0	1	0	0	0	0	0
Include sensor temperature	0	0	0	1	0	0	0	0
Include resistor reading	0	0	0	0	0	1	0	0
Include overall hydrogen reading	0	0	0	0	0	0	1	0
Include peak hydrogen reading	0	0	0	0	0	0	0	1

Options <opt> - The Options <opt> string is a two character hexadecimal representation of an 8 bit value derived from the following table. The user determines which data are needed and selects that bit value. Once all selections are made the values are summed bitwise and then converted to a two place hexadecimal value. To aid in the conversion, a 4 bit-to-Hexadecimal conversion table follows.

Options: Bit Value Identifiers
Serial output Options <opt> parameter: select the desired status messages from this list which will appear in the MESSAGES column, add the bit value for each column bitwise, and convert into two hexadecimal characters using the 4 bit-to-Hexadecimal table in EXAMPLE 3.

Description	Bit Value							
Calculation Errors	0	0	0	0	0	1	0	0
Heater State	0	0	0	0	0	0	1	0

4 bit value	Hexadecimal Character
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A

1011	B
1100	C
1101	D
1110	E
1111	F

To implement the “G” command (“Go” command, refer to *LEVEL 1 COMMANDS* table) to have the following serial output columns reported from the monitor: Time Stamp, Overall Hydrogen Reading, the Peak Hydrogen Reading, Calculation Errors, and the Heater state.

From the *FORMAT <fmt>* table above, you identify your desired columns with its corresponding bit value:

<fmt> Descriptions	<fmt> Bit Value
Time Stamp	1000 0000
Overall Hydrogen Reading	0000 0010
PCB Temperature	0010 0000
Sensor Temperature	0001 0000
<fmt> 4 Bit Value Combination:	1011 0011

Now use the *4 BIT-TO-HEXADECIMAL* table above to convert this 4 bit value combination into a two place hexadecimal value:

<fmt> Two Place Hexadecimal Value : B3

From the OPTIONS <opt> table above, you identify your desired columns with its corresponding bit value:

<opt> Descriptions	**<opt> Bit Value**
Calculations Errors	0000 0100
Heater State	0000 0010
<opt> 4 Bit Value Combination:	0000 0110

Again, use the *4 BIT-TO-HEXADECIMAL* table to convert this 4 bit value combination into a two place hexadecimal value:

<opt> Two Place Hexadecimal Value : 06

To have the Time Stamp, Overall Hydrogen Reading, the Peak Hydrogen Reading, Calculations Errors and Heater State columns continuously reported, you will implement the “G” serial command as follows at the **H2scan:** command prompt:

```
H2scan: G B3 06
Time stamp  Pcb Temp    Snsr Temp   %H2        Messages
264         28.8530     124.50800   0.0000
280         29.1979     124.50910   0.0000
296         29.5169     124.51110   0.0000
```

9 MAINTENANCE

9.1 CLEANING

If the unit is exposed to debris, condensates or other material that may collect over the sensor tip then the unit should be cleaned by a gentle wiping with a clean lint-free cloth or paper.

10 CALIBRATION

Calibration can be accomplished through the serial port or the keypad. Calibrations do not cause any wear on the sensor and can be accomplished as often as desired. Analog outputs can be monitored.

10.1 FACTORY CALIBRATION –

Contact H2scan to make arrangements for a comprehensive Factory Calibration by H2scan's factory trained technicians; optional NIST traceable certificate available upon request. An annual Factory Calibration is advisable to optimize performance.

10.2 FIELD CALIBRATION

In the event the Field Calibration procedure seems to not be effective, H2scan recommends the unit be shipped back to the factory for a comprehensive evaluation and Factory Calibration.

11 FIELD CALIBRATION

11.1 CALIBRATION INTERVAL

H2scan recommends that the system calibration be carried out every 90 days.

11.2 GASES

Field Calibration requires the availability of ambient, hydrogen-free air and one or two certified gases with a nominal hydrogen value by volume in a balance of air. The flow rate required is 0.5 ± 0.2 slpm. One gas will correct any offset error while two gasses will also correct any gain error. It is recommended to use two gasses to obtain superior calibration accuracy.

DO NOT use 0% H2 as the lower calibration gas. Instead use hydrogen concentration that is slightly lower than the expected lowest hydrogen concentration. For the second calibration gas use a concentration that is slightly higher than the expected maximum H2 concentration.

Custom Field Calibration Kits are available from H2scan.

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

11.3 TIMES

Each calibration gas should be applied for at least 10 minutes for the most accurate results. Actual times required may vary.

11.4 GAS CONNECTION

Gases are applied to the unit via the gas application kit available from H2scan.

11.5 PROCEDURE

During the Field Calibration process any previously completed Field Calibrations are cancelled. As a result, during the routine the unit may display a hydrogen concentration that is different from the applied gas concentration. This is normal. Once the procedure is completed, the readings will be corrected to display the right concentrations for all subsequent exposures.

NOTE: Field calibration must ALWAYS be done at the customer's local atmospheric pressure.

11.6 CALIBRATION USING THE SERIAL INTERFACE

Press "**Esc**"

The unit will return the command prompt "**H2scan:**"

Type "**f**" then hit "**Enter**" and follow prompts to field calibrate the sensor with **two** gas concentrations

FIELD CALIBRATION STEPS	
Display	**User response**
H2scan:	Type " f" to run field calibration
Ready to Calibrate (Y/N)?	Type " y"
Gas1 for res (Y/N)?	Type " y" to proceed
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)? y	Type " y" if correct
Streaming data…	
Taking Average… cap=0.00000 res=x.xxxxx	Calibration Gas #1 finished.
Gas2 for res (Y/N)?	Type " y" if desired for better accuracy
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 #2
Settle time: X min (Y/N)?	Type " y" if correct
Streaming data…	
Apply X.XXX%H2: Ready (Y/N)?	Type " y" if correct
Taking Average… cap=0.00000 res=X.XXXX	Calibration Gas #2 finished. Calibration complete.
Cal Gas: 0%H2 (Y/N)?	Apply hydrogen-free air to the Sensor. Type "y".
Streaming data…	
Taking Average… cap=0.00000 res=0.0000	0%H2 finished
Cal Gas: 0%H2 (Y/N)?	Apply hydrogen-free air to the Sensor. Type "y".
Streaming data…	
Taking Average… cap=0.00000 res=0.000	0%H2 finished
Enter Month:	

Enter Day:	
Enter Year:	

11.7 CALIBRATION USING THE KEYPAD

See the appendix for the keypad field calibration procedure.

12 CLEAR FIELD CAL

The Clear Field Calibration function restores the instrument to the last factory calibration.

12.1 CLEAR FIELD CAL USING THE SERIAL INTERFACE

Press "**Esc**"

The unit will return the command prompt "**H2scan:**"

Type "**x**" then hit "**Enter**" and follow the prompt to clear the field calibration.

12.2 CLEAR FIELD CAL USING THE KEYPAD

See the appendix for the keypad clear field calibration procedure.

13 MESSAGES

In this section XXX refers to a number

13.1 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.

13.2 SETTLE

When the sensor is waiting for the die temperature to stabilize, "Settle" (truncated on the LCD) is displayed. The settling time varies depending on the sensor and local conditions and could take up to five minutes.

13.3 WAIT_XXX

This message usually appears counting down a delay.

For example, during field calibration the sensor 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 sensor 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.

During field calibration "Wait_100" commonly appears in the third stage in which it is waiting for 0% after 2% hydrogen. In this case the event for which it is waiting is 0% hydrogen, so it could display "Wait_100" between settling and 0%. If 0% occurs before the temperature settles, it will display "Settle" until the temperature is stable, then "Wait_XXX" which will count down to zero.

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

13.4 HTROFF

The "htroff" error could be caused by one of several error conditions that cause the 2605 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 unit. It should return to normal operation. If the error is permanent, the unit must be returned to H2scan for examination.

13.5 ERROR_XXX

The following table lists possible errors, the code numbers that could appear on the display, and their binary equivalents. These codes are hexadecimal numbers representing eight bits with each bit representing an error. If more than one error occurs concurrently, their values will add. For example if there is an error calculating hydrogen and the H2 resistor is out of range, the error code will be 90. Many of these errors could lead to a “htroff” error.

Error	Code (hex)
Error calculating hydrogen	80
PCB temperature is too high	40
Sensor temperature is out of range	20
H2 resistor value is out of range	10
Configuration error	04

14 APPENDIX 1 FOXTERM SETUP

14.1 FOXTERM 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.

14.2 FOXTERM 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

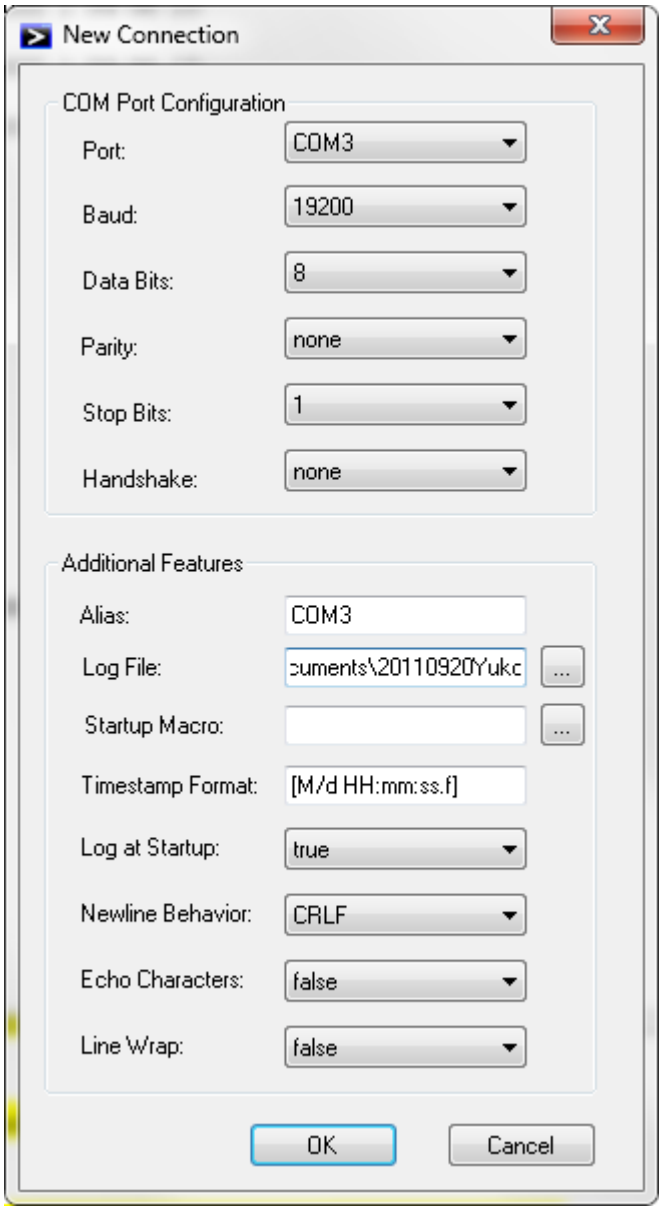
Select a log file name and location. The file name should start with the current date (YYYMMDD) followed by any particular information required. This way, the files will be easy to sort. For example “20110920Yukon6.log” would be the file name for the “Yukon6” sensor that had logging started September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

Newline Behavior must be set to “CRLF”.

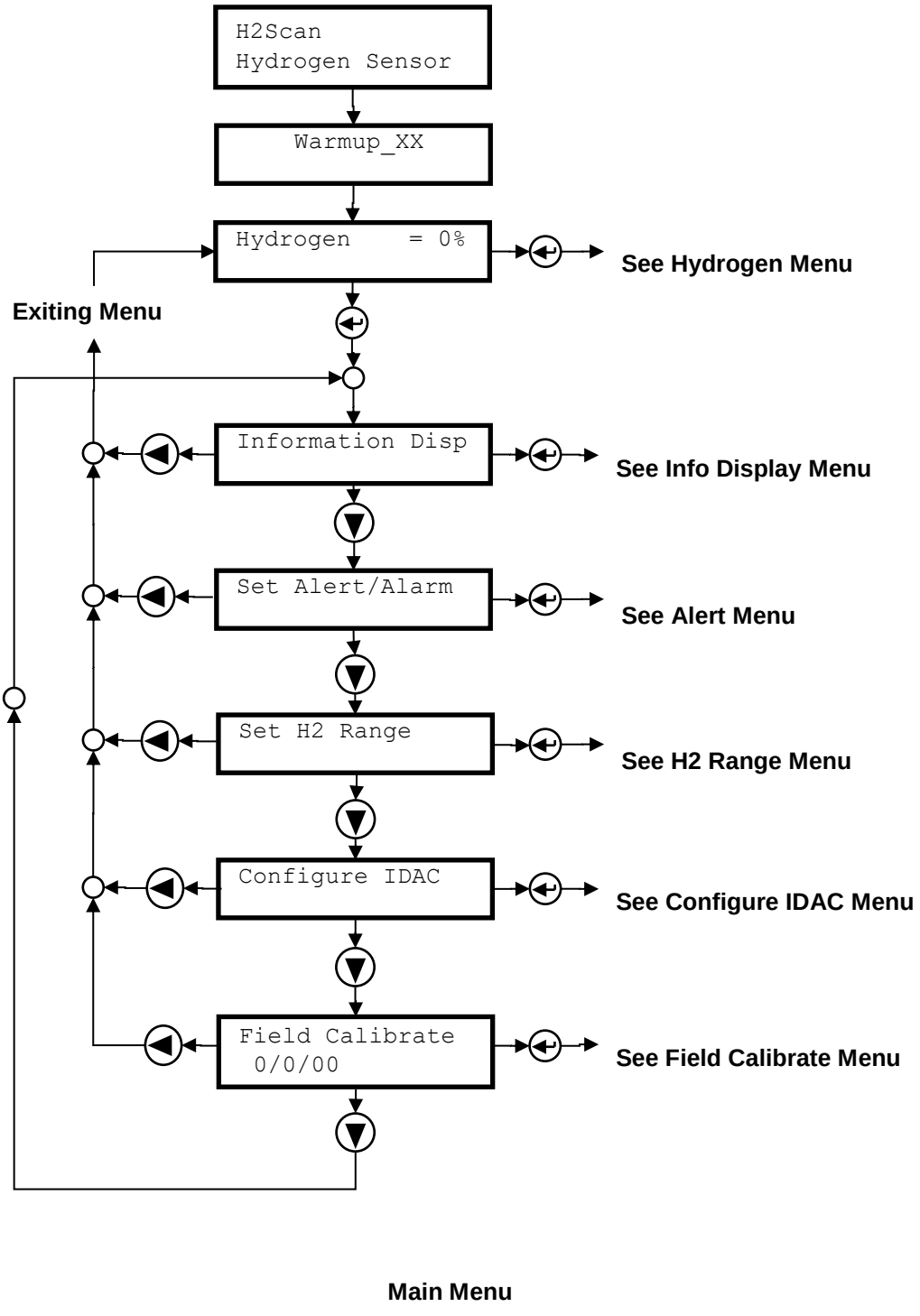
Click OK.

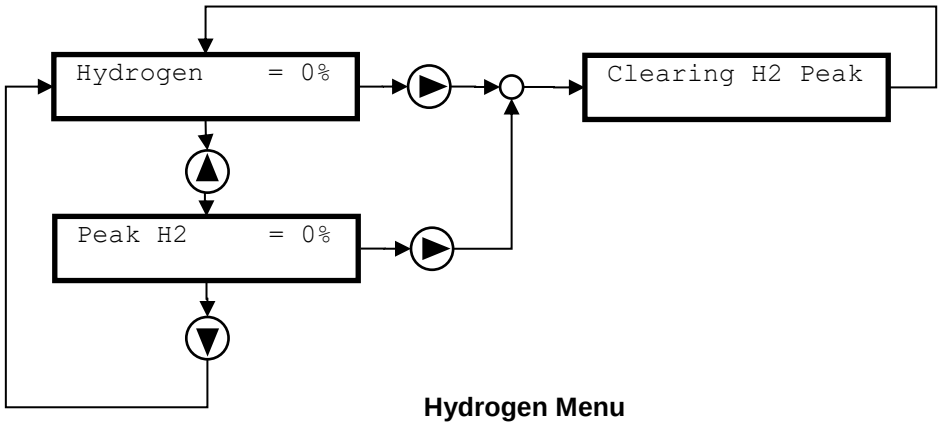
Save the session as “H2scan.xml” in the FoxTerm program location.

The setup should look similar to that shown.

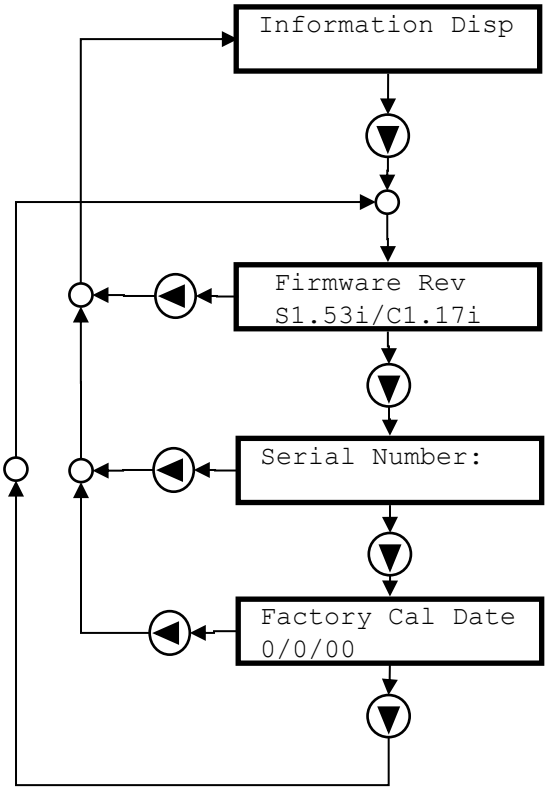


15 APPENDIX 2 - MENUS

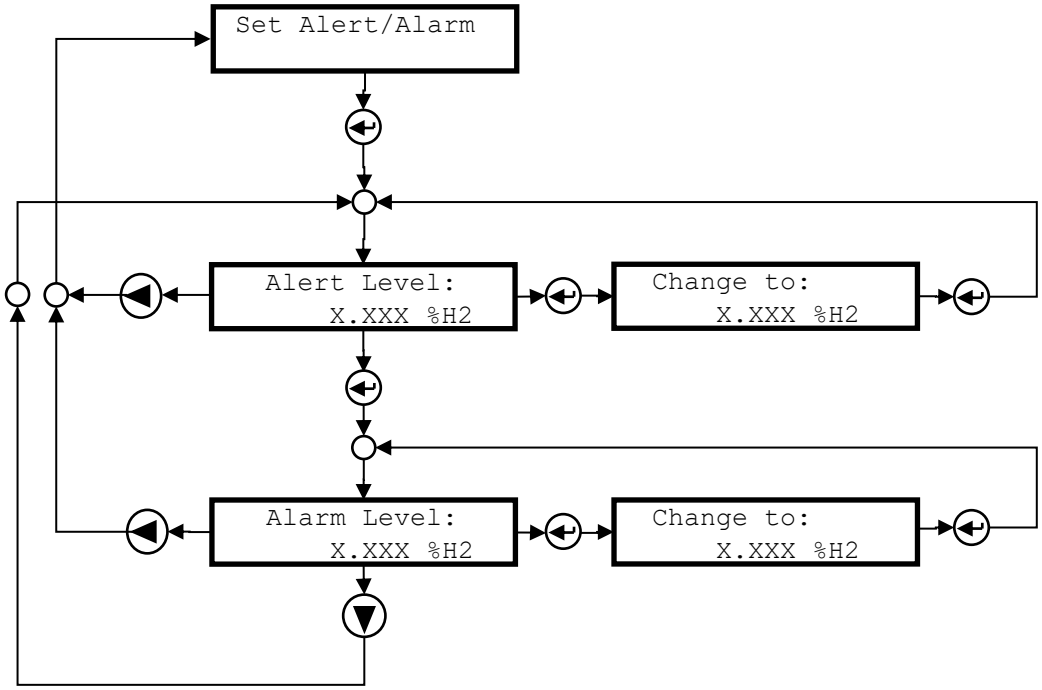




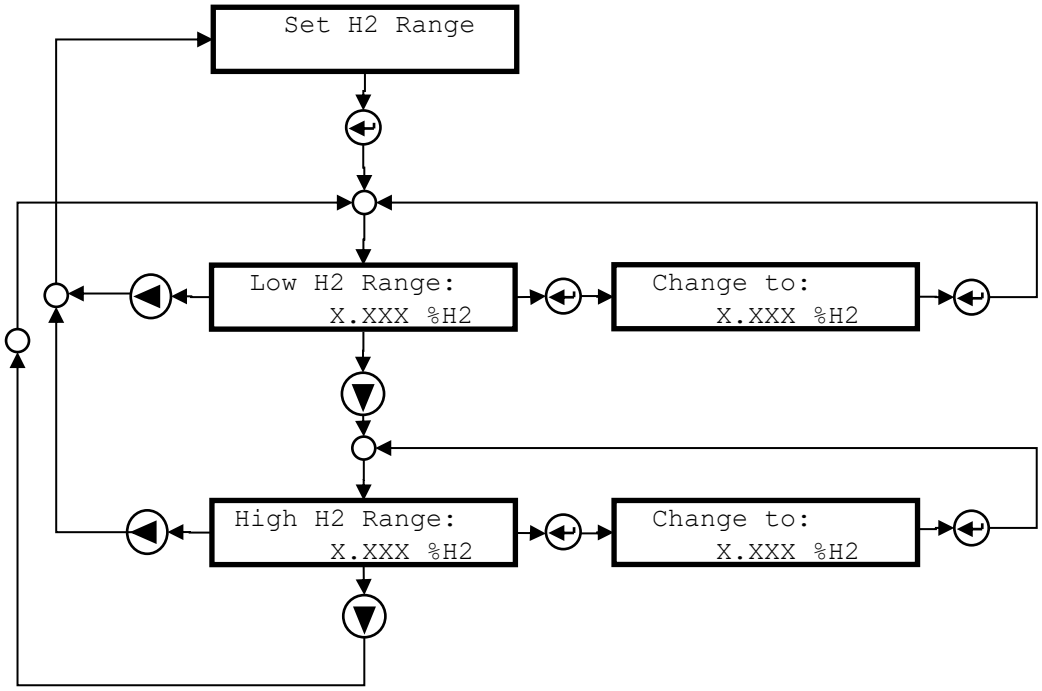
Hydrogen Menu



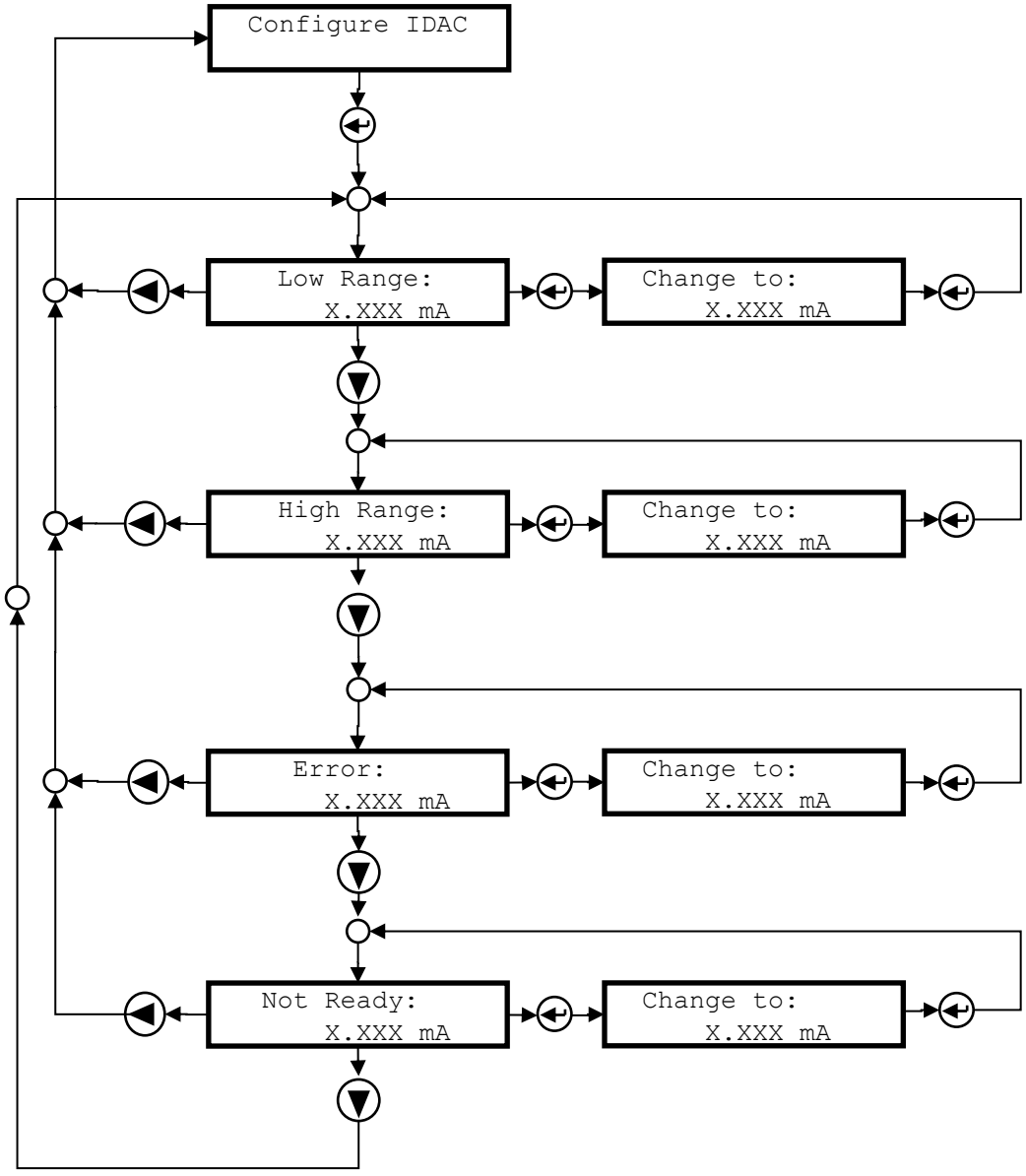
Information Display Menu



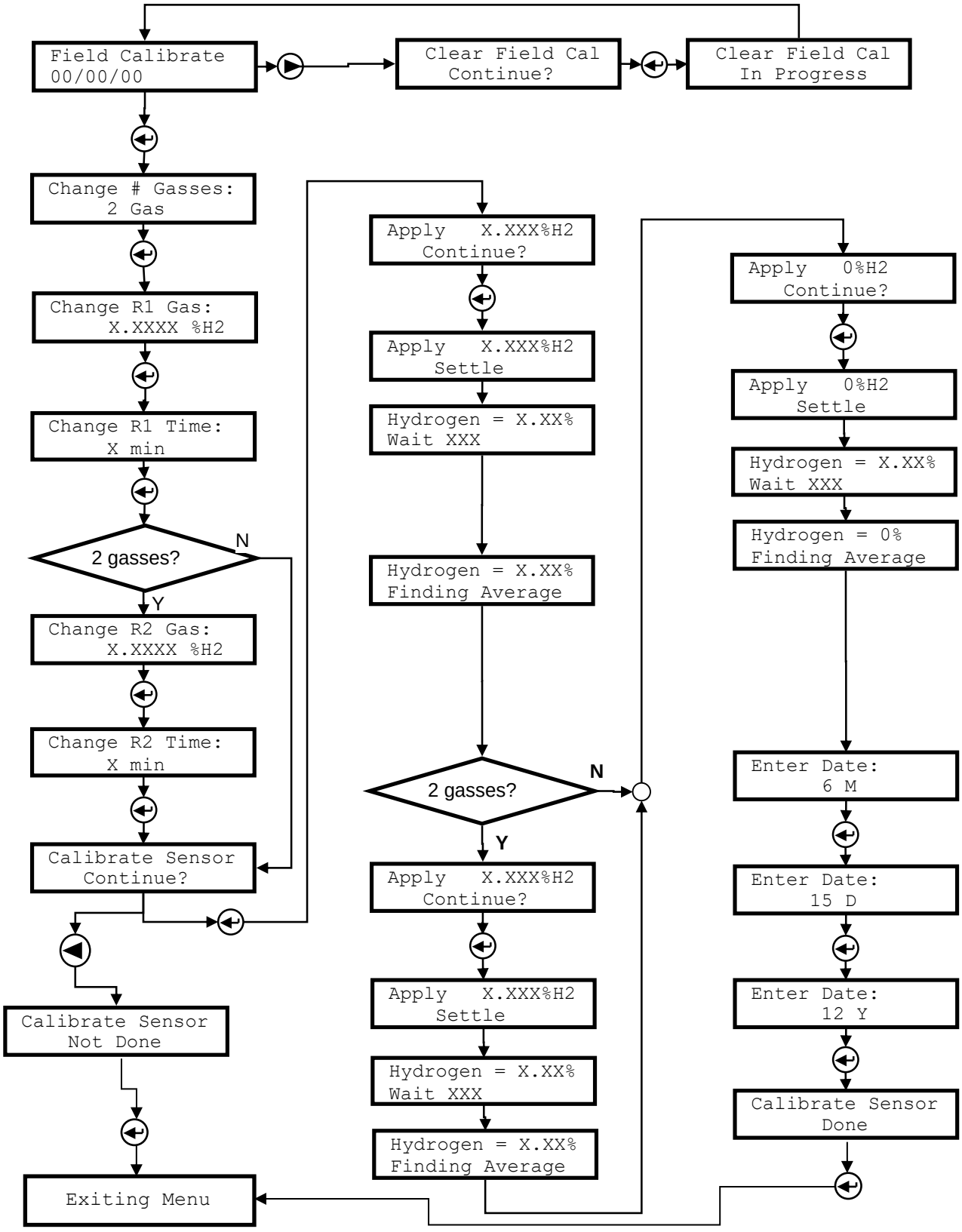
Configure Relay Menu



Set H2 Range Menu



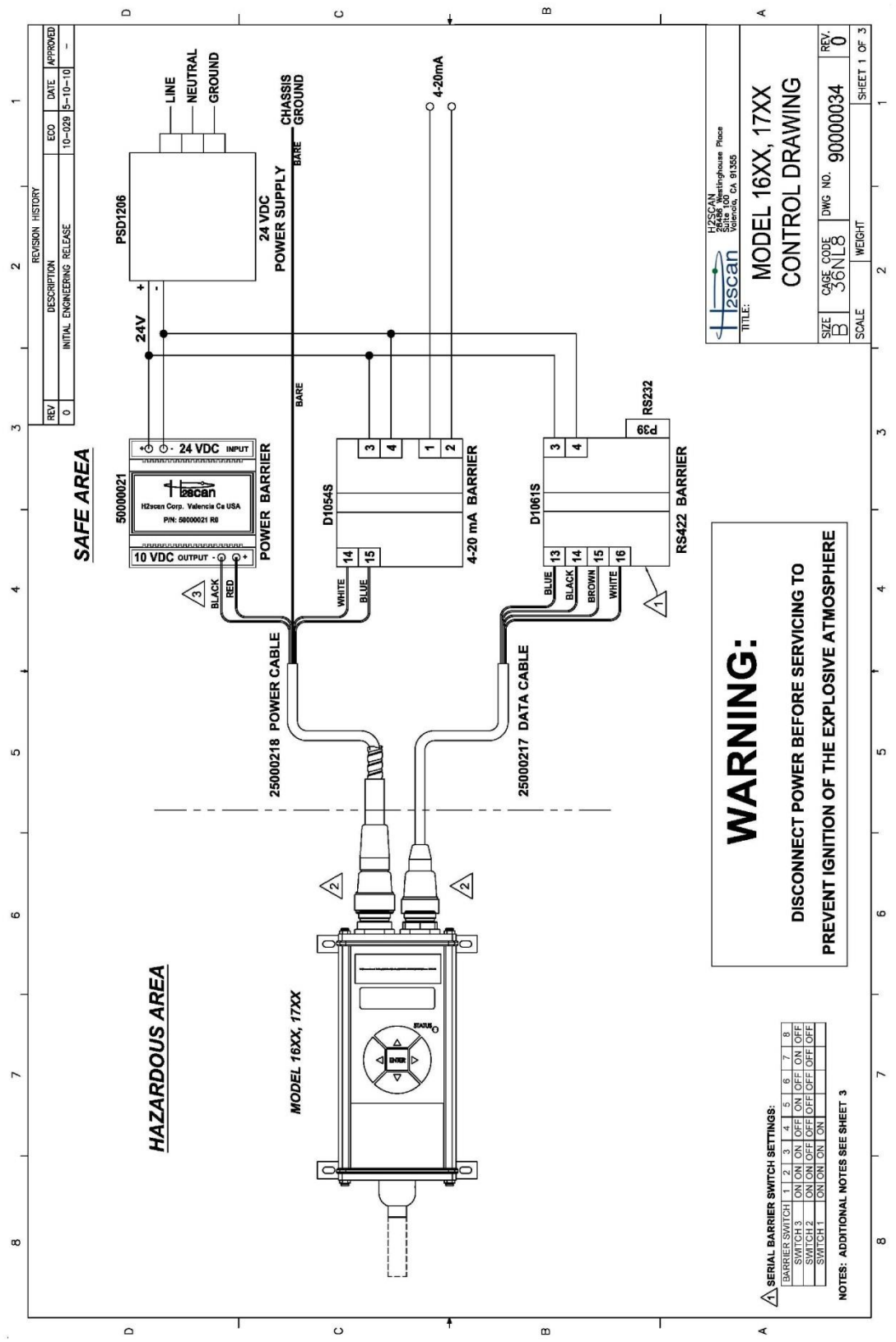
Configure IDAC Menu

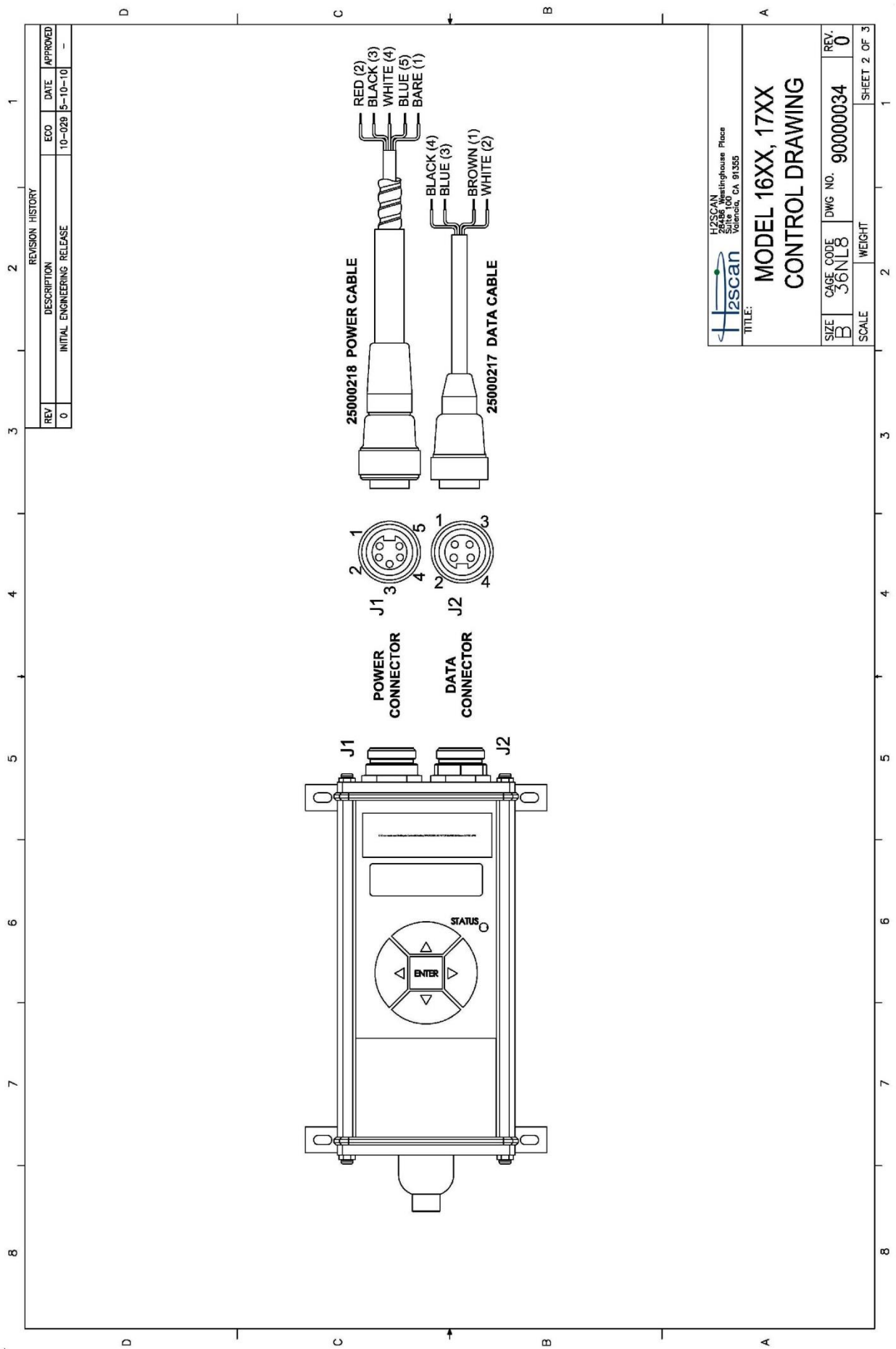


Field Calibrate Menu

16 APPENDIX 3

16.1 CONTROL DRAWING




REVISION HISTORY
REV
DESCRIPTION
ECO
DATE
APPROVED
0
INITIAL ENGINEERING RELEASE
10-029
5-10-10
-
RED (2)
BLACK (3)
WHITE (4)
BLUE (5)
BARE (1)
BLACK (4)
BLUE (3)
BROWN (1)
WHITE (2)
25000218 POWER CABLE
25000217 DATA CABLE
J1
J2
POWER CONNECTOR
DATA CONNECTOR
STATUS
ENTER
H2SCAN
26486 Westinghouse Place
Suite 100
Valencia, CA 91355
TITLE:
MODEL 16XX, 17XX
CONTROL DRAWING
SIZE
B
CAGE CODE
36NL8
DWG NO.
90000034
REV.
0
SCALE
WEIGHT
SHEET 2 OF 3

REVISION HISTORY				
REV	DESCRIPTION	ECO	DATE	APPROVED
0	INITIAL ENGINEERING RELEASE	10-029	5-10-10	-

NOTES:

2 Intrinsically Safe Device Entity Parameters: SEE TABLE 1

3 H2scan Associated Apparatus Entity Parameters: SEE TABLE 2

4. Associated apparatus output current must be limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

5. Associated apparatus may be in a Division 2 or Zone 2 location if so approved.

6. Selected associated apparatus must be third party listed as providing intrinsically safe circuits for the application, and have Voc or Vt not exceeding Vmax (or Uo not exceeding Ui), Isc or It not exceeding Imax (or Io not exceeding Ii), and the Po of the associated apparatus must be less than or equal to the Pmax or Pi of the intrinsically safe equipment, as shown in Table 3.

7. Capacitance and inductance of the field wiring from the intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in Table 3. Cable capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci, must be less than the marked capacitance, Ca (or Co), shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La or Lo, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60 pF/ft., Lcable = 0.2 µH/ft. If Po of the associated apparatus is not known, it may be calculated using the formula Po = (Voc * Isc)/4 = (Uo * Io)/4. SEE TABLE 3

8. Associated apparatus must be installed in accordance with its manufacturer's control drawing and Article 504 of the National Electrical Code (ANSI/NFPA 70) for installation in the United States, or Section 18 of the Canadian Electrical Code for installations in Canada.

8. When required by the manufacturer's control drawing, the associated apparatus must be connected to a suitable ground electrode per the National Electrical Code (ANSI/NFPA 70), the Canadian Electrical Code, or other local installation codes, as applicable. The resistance of the ground path must be less than 1 ohm.

10. Where multiple circuits extend from the same piece of intrinsically safe equipment to associated apparatus, they must be installed in separate cables or in one cable having suitable insulation. Refer to Article 504.30(B) of the National Electrical Code (ANSI/NFPA 70) and Instrument Society of America Recommended Practice ISA RP12.6 for installing intrinsically safe equipment.

11. Associated apparatus must not be used in combination unless permitted by the associated apparatus certification.

12. Control equipment must not use or generate more than 250 V rms or dc with respect to earth.

Table 1: Model 1600 - 1700 Entity Parameters

	Power Supply	4-20 mA loop	RS422 Rx&Tx	
Parameter	J1 Pins 2&3	J1 Pins 4&5	J2 Pins 1&2	J2 Pins 3&4
Vmax (or Ui)	11.5 V	26.7 V	3.7 V	n/a
Imax (or Ii)	3.27 A	91 mA	2.25 mA	n/a
Pmax (or Pi)	9.41 W	611 mW	206 mW	n/a
Ci	0	68.2 nF	0	n/a
Li	0	0	0	n/a
Voc (or Uo)	n/a	n/a	n/a	5.9 V
Isc (or Io)	n/a	n/a	n/a	238 mA
Po	n/a	n/a	n/a	350 mW
Co	n/a	n/a	n/a	1000 uF
Lo	n/a	n/a	n/a	2.5 mH
Lo/Ro	n/a	n/a	n/a	404 uH/Ohm

Table 2: P/N 50000021R0 Entity Parameters

Parameter	10VDC Output
Um	250 V
Voc (or Uo)	11.5 V
Isc (or Io)	3.27 A
Po	9.41 W
Co	11.2 uF
Lo	29 uH
Lo/Ro	33 uH/Ohm

TABLE 3: Compatability Rules

I.S. Equipment	Associated Apparatus
V max (or Ui)	≥ Voc or Vt (or Uo)
I max (or Ii)	≥ Isc or It (or Io)
P max (or Pi)	≥ Po
Ci + Ccable	≤ Ca (or Co)
Li + Lcable	≤ La (or Lo)

H2SCAN
28486 Westinghouse Place
Suite 100
Valencia, CA 91355

TITLE:
MODEL 16XX, 17XX
CONTROL DRAWING

SIZE	CAGE CODE	DWG NO.	REV.
B	36NL8	90000034	0
SCALE	WEIGHT	SHEET 3 OF 3	

16.2 SERIAL BARRIER SWITCH SETTINGS FOR RS232 CONNECTION TO PC

BARRIER SWITCH	1	2	3	4	5	6	7	8
SWITCH 3	ON	ON	ON	OFF	ON	OFF	ON	OFF
SWITCH 2	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
SWITCH 1	ON	ON	ON	ON				