

# **HOGEN<sup>®</sup> GC 300 and 600**

## **LABORATORY HYDROGEN GENERATORS**



### ***Installation, Operation & Maintenance Manual***

===== *Hydrogen By Wire<sup>™</sup>* =====



*HOGEN GC 300 and 600 Laboratory Hydrogen Generators Installation,  
Operation & Maintenance Manual  
Covering the following laboratory hydrogen generator models:*

Model	Proton Part Number
<b>HOGEN GC 300 cc/minute delivery rate</b>	54-0100-0001
<b>HOGEN GC 600 cc/minute delivery rate</b>	54-0100-0002

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Purchaser – please record your generator serial number in this space:

**Serial Number** \_\_\_\_\_

### **Disclaimer**

Proton Energy Systems, Inc. has written this manual to be an easy to use guide for the HOGEN<sup>®</sup> GC 300 and 600 Laboratory Hydrogen Gas Generators. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted. They are not intended to be, nor should they be understood to be, representations or warranties concerning the products described.

This hydrogen gas generator has been sold to subject to the limited warranties set forth in the warranty statement. Further, Proton reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

This laboratory hydrogen generator is designed for operation only by trained personnel familiar with the use of similar equipment and with safety requirements for the use of hydrogen and other industrial gases. Before operating this laboratory hydrogen generator, make sure to read and understand this information provided herein. If you have questions, please contact Proton Energy Systems or your generator supplier.

## **HOGEN GC 300 and 600 Laboratory Hydrogen Generators**

### **INSTALLATION, OPERATION & MAINTENANCE MANUAL**

*Prepared by*

PROTON ENERGY SYSTEMS, INC.

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This Installation, Operation & Maintenance Manual and the HOGEN GC 300 and 600 laboratory hydrogen generators use the following safety symbols and conventions to alert you to information intending to help you operate your laboratory hydrogen generators correctly and safely.

### Symbols



SHOCK HAZARD



GENERAL ALARM



<2VA

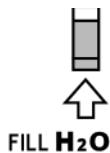
REMOTE ALARM CONTACTS



WARNING



HYDROGEN RELIEF



FILL WATER



HYDROGEN PRODUCT



**H<sub>2</sub>O** DRAIN

WATER DRAIN



FUSE

## Manual Conventions



**WARNING**

- Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury. The reader is in a situation that could cause bodily injury. Do not proceed beyond a Warning symbol until the indicated conditions are fully understood and met.



**CAUTION**

- Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. This could result in equipment damage or loss of data. Do not proceed beyond a Caution symbol until the indicated conditions are fully understood and met.



**NOTE**

- Notes contain helpful suggestions or references.

---



## 1 Introduction

Congratulations on your purchase of a HOGEN GC hydrogen generator. The HOGEN GC (Gas Chromatograph) 300 and 600 laboratory hydrogen generators are the most capable laboratory hydrogen generators available today. The ultimate cylinder alternatives, the HOGEN GC 300 and 600 laboratory hydrogen generators provide ultra high purity-grade hydrogen on demand, combining caustic-free PEM electrolysis technology with a maintenance-free palladium purifier. Designed to provide ultra-pure hydrogen for GC fuel and carrier gases, the HOGEN GC laboratory hydrogen generators can offer the following:

- Up to 600 cc/min flow rate
- Up to 200 psig delivery pressure
- Stable gas costs
- Reduced likelihood of contamination from cylinder changeout
- Elimination of cylinder upkeep
- No caustic or other hazardous materials
- Narrow footprint for enhanced laboratory space utilization
- Standard deionized (DI) water autofill or simple manual DI fill with built-in funnel
- User-friendly electronic control panel with both English and Metric units



**Figure 1-1 GC Control Panel**

---

Proton Energy Systems, Inc. (PROTON) provided these instructions to guide in the installation, operation, and maintenance of the HOGEN GC 300 and 600 laboratory hydrogen generators only. These instructions provide technical product information, installation requirements, and detailed mechanical and electrical interface specifications. Important safety information is also included in this manual. Please take time to familiarize yourself with the system and the manual.

This manual attempts to answer most of the frequently asked questions with regards to the operation of the unit. However, should you have any questions, the PROTON technical staff stands ready to answer them and support the successful deployment of this equipment. Please call (203) 949-8697 and ask for field service technical support or email [customerservice@protonenergy.com](mailto:customerservice@protonenergy.com). Please have the part number of your unit available.



**IT IS THE CUSTOMER'S RESPONSIBILITY TO CONSULT WITH THE LOCAL AUTHORITY HAVING JURISDICTION (AHJ) REGARDING LOCAL CODE REQUIREMENTS FOR INSTALLATION AND OPERATION OF THIS EQUIPMENT.**



**DO NOT USE THE HOGEN GC LABORATORY HYDROGEN GENERATOR IN A MANNER NOT SPECIFIED BY PROTON ENERGY SYSTEMS.**

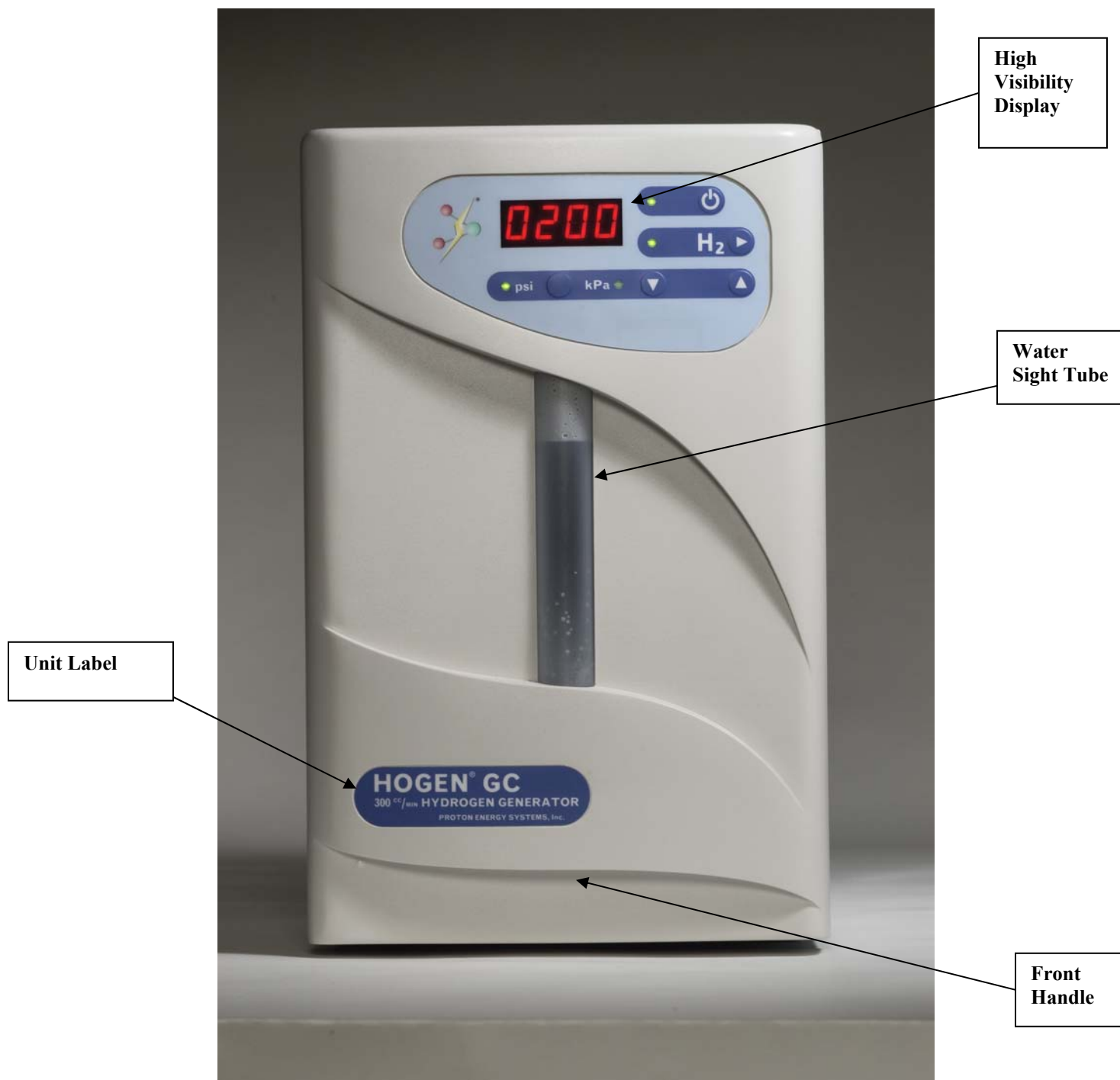


PROTON can offer a full range of installation services if you are not comfortable with installation of the HOGEN GC hydrogen generator.



There are no user serviceable parts inside the HOGEN GC laboratory hydrogen generator. Any interference with the internal parts will void the manufacturer's warranty.

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**Figure 1-2 HOGEN GC Hydrogen Generator Front Panel View**

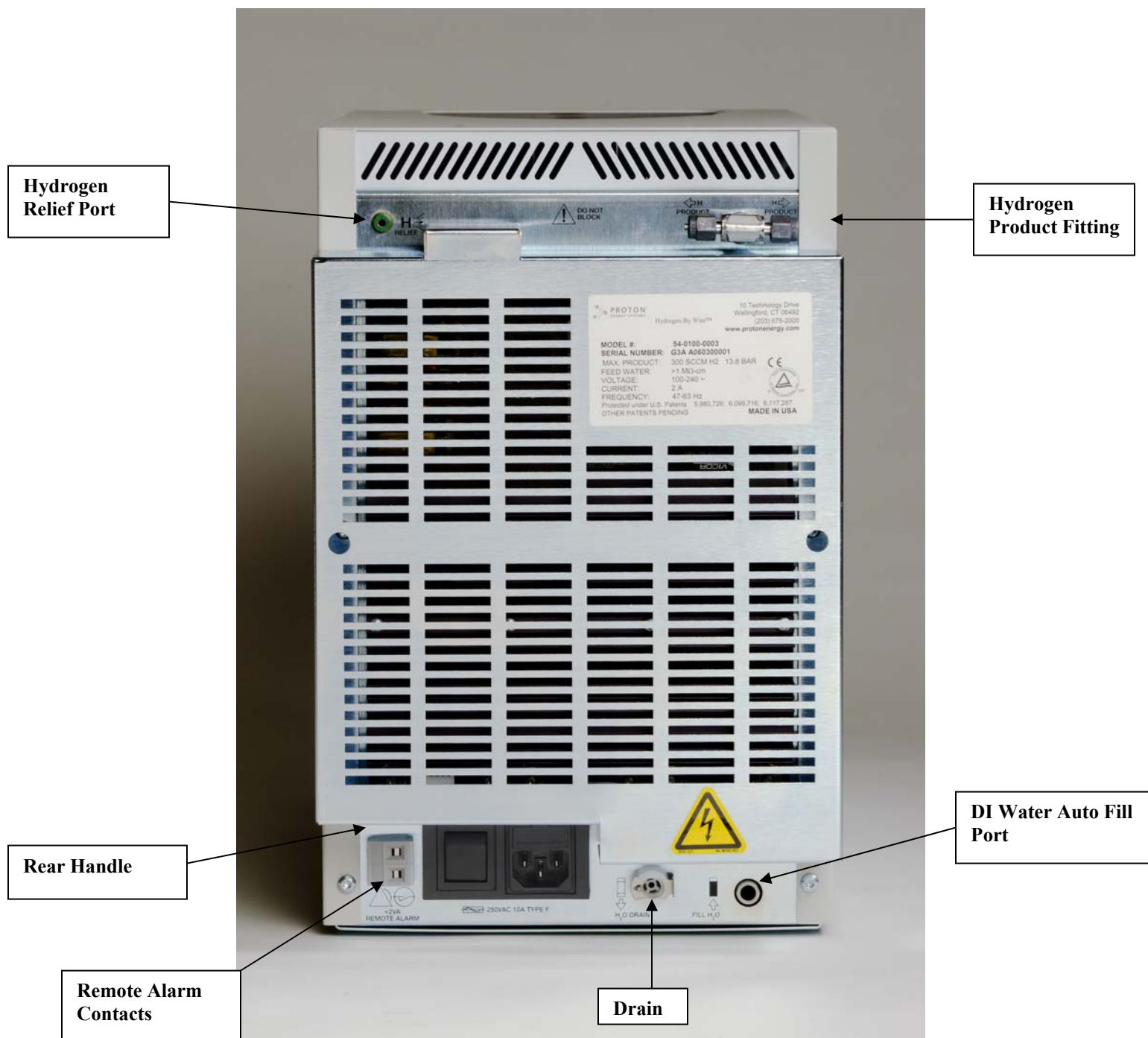


Figure 1-3 HOGEN GC hydrogen generator rear panel view

## 1.1 General Information

The HOGEN GC laboratory hydrogen generator, when connected to a suitable AC power source and fed with a suitable quality of DI water, produces a continuous stream of pressurized ultra high purity (UHP) hydrogen gas and automatically maintains a user-selected downstream pressure. The HOGEN GC hydrogen generator, available in either 300 or 600 cc/min hydrogen production capabilities, is suitable for use in laboratories and light industrial environments and is non-hazardous for transportation purposes.



The HOGEN GC hydrogen generator should be installed and running within six months of shipment from the manufacturer. An example of the serial number identification plate, attached to the back of the HOGEN GC hydrogen generator, is shown in Figure 1-4. The serial number contains an embedded date code, which is the date of manufacture of the system. The date of manufacture is formatted as "mm/yy." If the manufacture date code is more than six months prior to the date of startup of your system, please contact PROTON for instructions.

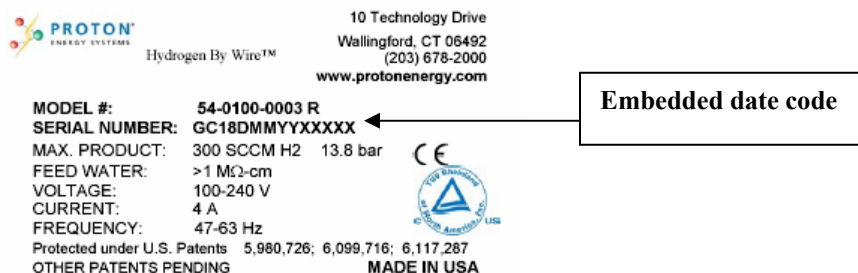


Figure 1-4 Serial Number Identification Plate



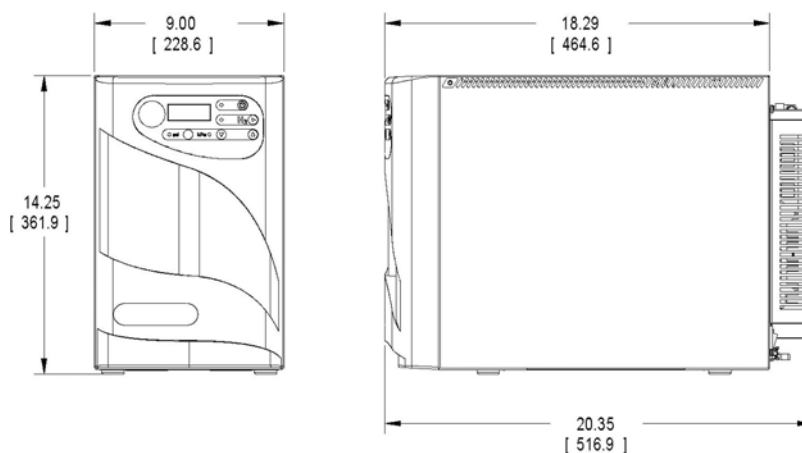
If you must ship the HOGEN GC hydrogen generator for any reason, please use the following instructions:

- Drain all the water from the DI water tank, remove the ion exchange resin bag, and reinstall the water tank cap.
- Properly package the unit and ship it in an upright position.
- Ship the unit in a manner to prevent freezing. Freezing can cause irreversible damage to the system. If you have discarded the original packaging, please contact Proton Energy Systems or your supplier for a replacement.

## 1.2 Product Specification

Maximum Hydrogen Flow Rate	0 - 300 cc/min	0 - 600 cc/min
Delivery Pressure, barg (psig)	3 – 13.8 barg (45-200 psig) @ ±5% Full Scale Output (FSO), < 0.5 ppm Water Vapor	
Product Assay	<1 ppm Oxygen, <10 ppm Water Vapor, <1 ppb Hydrocarbons /Halocarbons, Balance Hydrogen	
Contained Hydrogen Inventory	< 0.1 g Hydrogen Contained in System	
Deionized Water Feed Purity Specification	>1 megohm-cm (<1 microSiemen/cm) or Better, ASTM Type II Reagent Grade DI Water	
Deionized Water Feed Pressure Specification for Autofill Operation	>10 psi DI Water Feed Pressure Suggested for Autofill Operation	
DI Water Tank Capacity	1.9 liters (approx 0.5 gallon) - Full Level to Shutoff Level	
Water Consumption (approximate)	0.3 cc/min at Full Rated Output, Equivalent to 0.45 liters per 24 Hours of Operation	0.6 cc/min at Full Rated Output, Equivalent to 0.9 liters per 24 Hours of Operation
Water Tank Duration (full to shutoff)	>100 Hours of Continuous Full Rate Operation	>50 Hours of Continuous Full Rate Operation
Power Consumption	<1000 watts	<1200 watts
Power	100-240 VAC, 47/63 Hz	
Envelope W x D x H	23cm x 52cm x 37cm (9" x 20.5" x 14.5")	
Weight	23 kg (50 lbs)	
Location - Min/Max Ambient Temp	10°C / 35°C (50°F / 95°F)	
Location - Max Ambient Humidity	80% RH	
Location - Variation from Level	+/- 3° maximum	
Location – Ventilation Recommendation	>0.6 m³/min (>22 ft³/min)	
Location – Clearance Recommendation	4.75 inches Minimum on Right Side and Rear	
Over Voltage Category	(II)	
Pollution Degree	(2)	
Control	Adjustable Pressure Set Point, Remote Alarm Connector. Keypad Mode Parameter Adjustment	
Display	Pressure, Power, Generating, Fill Notification, Status (fault#)	
Shutdown	Poor Water Quality, Low Water Level, Cell Stack Voltage, Purifier Temperature, Loss of Cabinet Ventilation	
Warning	Fill Notification, Hydrogen Leakage Internal or External Detected by Time to Set Point	

**Table 1-1 HOGEN GC Hydrogen Generator Technical Specifications**



**Figure 1-5 CAD DWG of GC Unit with Dimension Call-Outs**

Substance	Flow Direction	Fitting	Mating Information	Fitting Location
Hydrogen Product	Out	1/8" (3.175 mm) Female Parker CPI <sup>™</sup> Compression Fitting	1/8" OD Stainless Steel Tubing	Top Rear
Hydrogen Vent	Out	1/8" (3.175 mm) Female Quick Connect	1/8" OD Metal or Plastic Tubing	Top Rear
Oxygen Vent	Out	None – Vented through Top of Water Container		
DI Water Inlet	In	1/4" Female Quick Connect	1/4" Parflex Plastic Tubing	Bottom Rear
DI Water Drain	Out	3/8" Female Quick Connect	3/8" Hose Inserted into Supplied Male Fitting	Bottom Rear
Alarm Contacts	Out	Two Screw Terminals	Normally Open Contact – Closes the Circuit on Alarm Actuation	Bottom Rear
AC Power In	In	Cord Set	Cord Set	Bottom Rear

**Table 1-2 Generator Gas and Liquid Inlet and Outlet Fittings**

Parker CPI<sup>™</sup> is the trademark of the Parker Hannifin Co. For additional information on making up the Parker CPI<sup>™</sup> compression fittings, please see the Parker instructions at [www.parker.com/icd/cat/english/4230.pdf](http://www.parker.com/icd/cat/english/4230.pdf).



## 2 Safety

The safety guidelines below may not cover all situations. If there are concerns or questions, please call PROTON or check with local authorities.



**THE HOGEN GC HYDROGEN GENERATOR IS A LABORATORY INSTRUMENT DESIGNED FOR OPERATION BY TRAINED PERSONNEL. UNSAFE CONDITIONS MAY RESULT IF THE GENERATOR IS OPERATED BY UNTRAINED PERSONNEL, OR PERSONNEL UNFAMILIAR WITH HYDROGEN SAFETY.**

### 2.1 Using Hydrogen Gas

Hydrogen is odorless, tasteless, colorless, and highly flammable. It is highly combustible in the presence of oxygen and burns with a colorless flame.

Leaking gas may be hot and pose a burn danger. If you are not in danger, stop the flow of gas and use water to cool the area. The lower flammability limit of hydrogen is 4 percent hydrogen in air by volume. If fire occurs, do not attempt to extinguish flames, allow the fire to burn out.

Prevent overexposure to hydrogen. Hydrogen is non-toxic, but it can act as a simple asphyxiant by displacing the oxygen in the air. Effects of oxygen deficiency, resulting from simple asphyxiants, include rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgment, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result.

The HOGEN GC hydrogen generator, in addition to generating pressurized hydrogen product, also produces a small flow of byproduct oxygen at just over atmospheric pressure. This oxygen is vented from an outlet in the top of the internal water tank and swept from the cabinet with the cooling air. The generator must be operated in an area with sufficient air circulation to allow this oxygen to disperse. The power switch and electrical disconnect (removable cord set) are located at the back of the unit and must be accessible at all times during operation of the generator. See the Technical Specifications Table (

Table 1-1) for ventilation recommendations.

---





**FIRE OR EXPLOSION; KEEP ALL SOURCES OF IGNITION AWAY FROM HYDROGEN.**



**ALL PERSONNEL HANDLING, USING OR MAINTAINING THIS GENERATOR MUST EMPLOY SAFE WORKING PRACTICES AND OBSERVE ALL RELEVANT LOCAL HEALTH AND SAFETY REGULATIONS.**

## 3 Unpacking & Placement

### 3.1 Unpacking the Generator



**Figure 3-1 Lifting Generator Out of Shipping Box**

Enclosed with the generator are the following items:

- An Appropriate Cord Set for your Electrical Supply Type
- A Spare Fuse for the Power Switch
- A Drain Male Fitting for the System Water Drain
- A CE Certificate of Conformity
- An Ion Exchange Resin Bag MSDS
- A hydrogen MSDS
- A Push-to-Lock Nylon Plug (For Manual Fill Operations)

It is important to lift your HOGEN GC hydrogen generator carefully out of its shipping box. Your HOGEN GC hydrogen generator weighs approximately 23 kgs (50 lbs). Get help lifting the unit if it is too heavy for you.

---

Please use the following instructions to unpack your HOGEN GC hydrogen generator:

1. Remove the HOGEN GC hydrogen generator from the box carefully by lifting it straight up while grasping underneath the generator from the front and back (See Figure 3-1).
2. Keep the generator in an upright position and place the generator carefully in the designated location for it.
3. Remove the tape holding the top entry door closed, slide the door open, remove the tape holding the screw-on tank cap, and remove the tank cap.
4. Close the sliding top entry door to prevent dust entry.



Unpack the generator and retain the tank cap, the shipping, and the packing materials in case it is necessary to ship it in the future.

---

## 3.2 Siting the Generator

The HOGEN GC hydrogen generator is designed for indoor, laboratory installation. AC power and deionized water that meets the specifications outlined in

Table 1-1 are the only utilities required. Ensure the generator is located so that it is in compliance with local safety regulations.

Use the following instructions to site your HOGEN GC hydrogen generator:

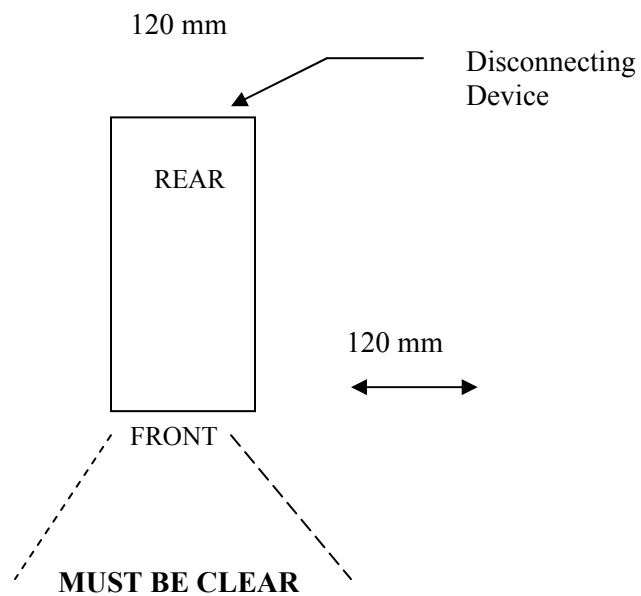
1. Place the generator in a location that meets the technical specifications from Table 1-1. Some specifications are highlighted below.
1. We recommend that the generator be placed as close to the gas application as possible.
2. Locate the unit, keeping in mind the continuing need for access to controls, water fill inlets, gas outlets, and power and control wiring.
3. Locate indoors in a clean environment with ventilation exceeding 0.6 m<sup>3</sup>/min (22 ft<sup>3</sup>/min).
4. Protect from water splashes.
5. Keep well away from sources of high heat, static electricity and flames.
6. Install on a level site (+/- 3° required).
7. Keep the front of unit clear.
8. Allow minimum clearance of 120 mm (4.75 inches) at the rear and on the right hand side of the generator for cabinet ventilation.
9. The power switch and electrical disconnect (removable cord set) are located at the back of the unit and must be accessible at all times during operation of the generator. Position the unit so that it is possible to operate the disconnecting device.
10. Ensure compliance with necessary ambient ventilation, temperature and humidity conditions.

Before filling the generator with DI water, always check the quality of the DI water and ensure it is equal to or better than the DI water feed specification of > 1 megohm cm and < 1 microSiemen/cm.

---



**Figure 3-2 Front View**



**Figure 3-3 Top View; Location Recommendation**



**Figure 3-4 HOGEN GC hydrogen generator top view**

## 4 Installation Procedure

### 4.1 Mechanical Setup

This section provides a detailed description of the mechanical setup requirements.

1. Determine which side of the generator connects to the hydrogen supply system tubing.
2. Remove the appropriate fitting cap from the hydrogen supply tee on the back of the generator.
3. Do not connect the hydrogen supply system tubing to the generator until the hydrogen supply system layout and fittings are finalized, purged with inert gas to remove oxygen, and leak checked. After leak checking, purge the hydrogen supply tubing with nitrogen or helium for at least 15 minutes to remove oxygen and any water vapor that may be in the tubing.
4. After the hydrogen supply system piping is purged, insert a 1/8" (3.175mm) OD hydrogen gas product line into the hydrogen supply fitting and tighten the fitting. Check the connection to ensure leak tightness. Hydrogen supply tubing must be capable of supporting 200psig (13.8 bar).
5. Make sure that the hydrogen supply piping is properly tightened to the tee. Make sure that the cap on the unused side of the tee is properly tight. Check that the cap did not become loose in transit.
6. Plumb the hydrogen relief port, located on the back of the generator, to a vent stack or hood. The relief valve is equipped with a quick connect fitting designed to be plumbed with 1/8" (3.175mm) OD soft copper or polypropylene tubing capable of 200 psig (13.8 bar) working pressure.



**Figure 4-1 Rear Mechanical Connections Port**

---

## 4.2 Electrical Setup

This section provides a detailed description of the mechanical setup requirements.

1. Determine the electrical supply outlet that will serve the generator.
2. Ensure that the electrical supply is properly grounded and the voltage corresponds with the generator rating plate.



Do not bypass ground pin.

3. PROTON recommends the use of an uninterruptible power supply in locations where power failures are common to assure reliable hydrogen generation.
4. Ensure that there is a good fuse in the power switch fuse drawer (located under the cordset female fitting). The proper fuse is rated 250VAC 10A, and is a type F.
5. Connect the supplied cordset to the back of the unit.
6. Plug the generator into the electric outlet.

## 4.3 Before Using the Generator for the First Time

1. Ensure that the water drain fitting is not placed in the lower rear of the generator. The water drain fitting opens the drain, which allows water to drain from the generator.
  2. Obtain a supply of the required quality of DI water (See Table 1-1). For manual fill, you must use a clean, non-metallic DI water container to avoid contaminating the DI water.
  3. For autofill, the DI water should be piped into the general area of the generator in a circulating water loop configuration.
  4. Rinse the water tank and internal water piping by filling and draining the tank of the generator three times with required quality of DI water. Fill the generator tank manually to the top of the sight tube and then empty the water out by inserting the drain fitting. Repeat for a total of three fills and drains. Remove the drain fitting after the final drain.
  5. If you plan to operate the generator in manual fill mode, fill the generator tank with DI water until the water level is visible toward the top of the sight
-



glass. Insert the Push-to-Lock nylon plug, which is shipped with the unit, into the Press-to-Lock DI inlet fitting to prevent debris from getting into the unit.

6. If you plan to operate the generator in autofill mode, flush a minimum of 1 liter (approximately one quart) of DI water through the DI water supply tubing before hooking the generator up to your water supply line. This ensures that the line is clean and free of debris. Next, connect the DI water supply tubing to the Press-to-Lock connection fitting for the generator water inlet. The Press-to-Lock connection for the water inlet is located on the bottom in the back of the generator.
7. Ensure that the ion exchange resin bag is inserted into the water tank.





## 5 Operation

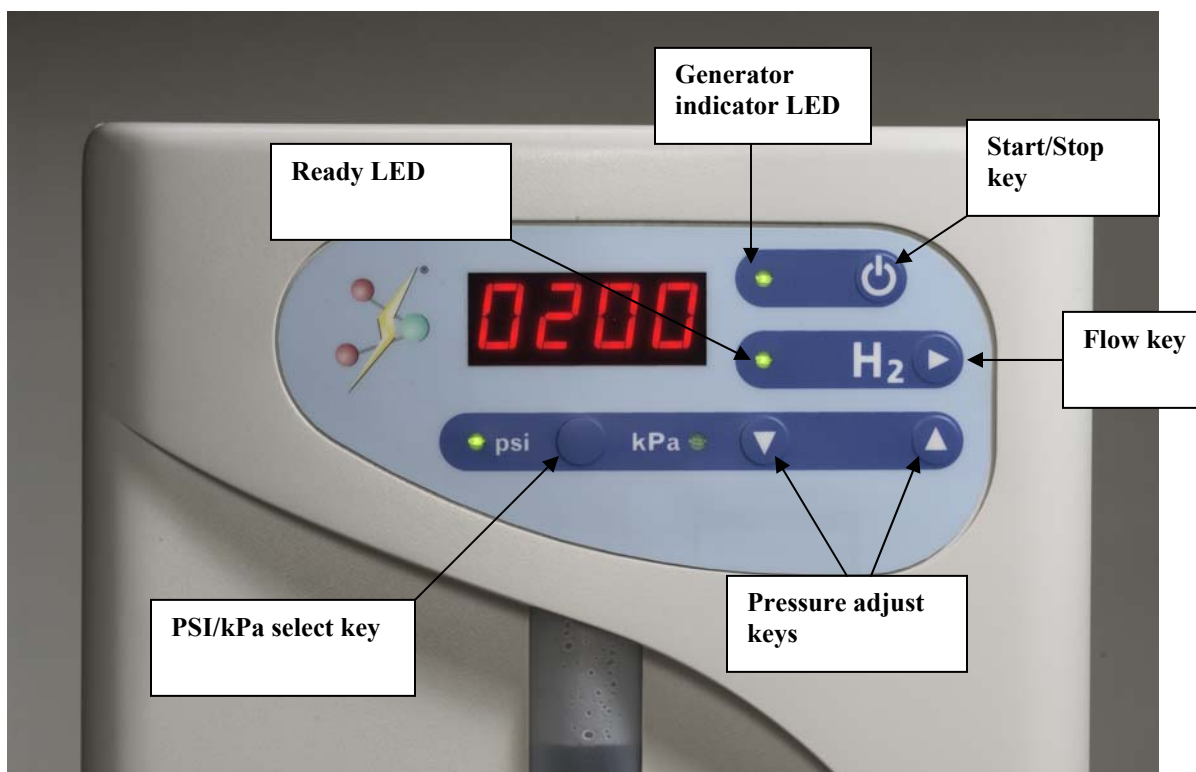
### 5.1 System Operation

1. Switch the power on using the power switch on the back of the unit.



When power is applied to the generator, it automatically goes through a system self-check. All of the LED's illuminate and then blank.

2. The firmware revision number (format x.xx) is shown in the numerical display for one second and then the display blanks.
  3. The default pressure set point is displayed in the numerical display, and the LED illuminates above the psig indicator indicating that the psig scale is in use. The scale in use can be changed to kPa using the “kPa/psi Select Key” at this time. Once hydrogen generation begins, (using the “start” key) the units displayed can no longer be changed until the generator is restarted.
  4. Adjust the pressure set point on the digital display to the desired pressure using the up or down arrow keys on the keypad.
  5. Press the “Start/Stop” key to initiate startup.
  6. During the startup sequence, the palladium diffuser purification system in the unit heats to operating temperature. During the heat up period, the digital pressure display shows scrolling bars, indicating that the unit is warming up and not yet supplying hydrogen. The scrolling speeds up as the diffuser nears operating temperature. From a cold startup, the heat up period is approximately one hour or less, depending on input voltage.
  7. Once the diffuser reaches operating temperature, the unit begins to generate hydrogen and internally pressurizes to the previously set pressure set point. During this time, the generator indicator on the LED flashes and the “Ready” LED remains off.
  8. When pressure reaches the set point, the “Ready” LED begins to flash. Press the “Flow” key to begin hydrogen delivery. During hydrogen delivery, the “Ready” LED illuminates continuously and the “Generator” indicator LED flashes at a rate proportional to the hydrogen production rate.
  9. The digital display panel always displays the actual hydrogen supply system pressure in the selected units (psi or kPa).
-



**Figure 5-1 GC Digital Display Panel; Front View**

## 5.2 Steady State Operation

PROTON recommends that you operate the HOGEN GC laboratory hydrogen generator at the highest pressure acceptable for your hydrogen supply piping system. Gas chromatographs, because they are generally equipped with gas pressure regulators at the instrument, should make it possible to operate the HOGEN GC generator at pressures well above 100 psig (6.9 bar), even in systems where the GC requires less than 100 psig.

The HOGEN GC system operates with the steadiest hydrogen output pressure at delivery pressures above 100 psig. The generator is capable of delivering hydrogen at pressures up to 200 psig (13.8 bar) with no sacrifice of hydrogen quality, hydrogen flow capacity, or generator lifespan.

Once the generator begins to supply hydrogen to the supply system, it automatically maintains the pressure set point  $\pm 5$  percent of full scale (approximately  $\pm 10$  psi) at all times.

**NOTE**

**For applications requiring pressure control tighter than  $\pm 5\%$ , Proton strongly recommends the use of a single stage line regulator between the generator and the application. The regulator should be Proton part number 02-2402-0000 or 02-2402-0001, or a functionally equivalent regulator rated for hydrogen service.**

The set point can be adjusted at any time using the “Pressure Adjust” up or down arrow keys as follows:

1. Depress either the up or down arrow “Pressure Adjust” key until the display flashes.
2. Continue to hold down the “Pressure Adjust” key until desired set point is displayed.
3. Release the “Pressure Adjust” key and the generator adjusts to the desired pressure.

To ensure that the hydrogen generator runs continuously and to prevent alarm conditions from occurring, regularly check the following:

- Water Quality (See Section 6.3)
- Water Level
- Numerical Display Panel for Delivery Pressure or Error Codes

### 5.3 Standby Mode

Standby Mode allows the HOGEN GC hydrogen generator to idle at the pressure set point without delivering the hydrogen product to your process. Standby Mode is ideal for short durations when hydrogen is not needed, such as overnight.

**NOTE**

If hydrogen is not needed for a longer period of time, such as a weekend, PROTON recommends, but does not require, completely shutting down the unit.

Use the following instructions for placing the unit in Standby Mode:

1. Press the “Flow” key to cease hydrogen delivery.
-

2. The “Ready” LED flashes while in Standby Mode.

This procedure cycles generation to maintain internal hydrogen pressure within the generator and to maintain all internal systems in a “hot” condition, which is when the generator is ready to deliver hydrogen instantly.

To restart hydrogen delivery, simply depress the “Flow” switch to open the hydrogen delivery valve.

## **5.4 Adjusting the Units Displayed**

On startup of the HOGEN GC hydrogen generator, the default pressure set point is displayed in the numerical display and the LED illuminates over the psig scale to indicate that the units displayed are psig. Using the “kPa/psi Select Key” prior to initiating generation changes the scale in use. Depress the “kPa/psi Select Key” to toggle between kPa and psig units.

Once hydrogen generation has begun (using the “Start” key), the units displayed can no longer be changed until the generator is restarted.

## **5.5 Shutdown**

Under normal circumstances, no special procedures are required for shutdown of the HOGEN GC hydrogen generator. Simply use the electronic controls as follows:

Normal shutdowns --To cease hydrogen flow and shut down all internal generation and purification systems:

1. Press the “Start/Stop” key to shut down the generator.
  2. This procedure shuts down generation and purification. The generator self-depressurizes instantly by opening a path to the hydrogen relief port located in the rear of the generator. All power to the generation and purification systems ceases (although the unit continues to apply power to the power supply). The Digital display panel displays Error Code E-00, which is the code for a manual shutdown, and a buzzer sounds.
-

3. To clear the error code and reinitiate hydrogen production, simply press the “Start/Stop” key again. This re-applies power to the generation and purification systems and initiates the startup sequence. If the purifier has cooled below the required operation temperature, the digital pressure display shows scrolling bars, indicating that the unit is warming up. The scrolling speeds up as the diffuser nears operating temperature. Once the purifier reaches operating temperature, the unit begins to generate hydrogen and pressurizes internally to the desired pressure set point, which appears on the LED display indicating that the unit is ready to supply. The “Ready” light flashes on the “Flow” key. Push the “Flow” key to begin hydrogen delivery. The “Ready” light illuminates continuously and the “Generating” indicator LED flashes at a rate proportional to the hydrogen production rate.

Emergency shutdown -- To power down the system entirely and depressurize the generator internal piping, simply:

- Shut off the power using the power switch in the back of the generator or pull the plug.

This procedure ceases generation and hydrogen flow and removes all power from all system components. The generator self-depressurizes instantly by opening a path to the hydrogen relief port located in the rear of the generator. To restart, plug in the unit and follow the instructions (See Section 5.1) for System Operation.

## **5.6 Troubleshooting**

If power to the generator is interrupted, hydrogen generation will cease and the unit will shut down. When electricity becomes available again, the water pump will automatically restart and begin to circulate water to re-establish purity and the numerical display will show the default pressure set point (in units of psig), but hydrogen generation will not begin automatically. To restart hydrogen generation, simply press the “Start/Stop” key to initiate the startup process (See Section 5.1).

### **5.6.1 Leak Detection**

The HOGEN GC hydrogen generator is designed to test for leaks either inside or outside of the generator. The status of the generator, when the leak signal is triggered, can assist in locating the leak either inside or outside the HOGEN GC box. If the generator is delivering gas at the time that the “LEAh” (leak) signal is

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triggered, then the leak is most likely to be in the system plumbing downstream (outside) of the HOGEN GC hydrogen generator. If the “LEAh” (leak) signal is triggered when the generator is in standby mode (pressurized, but not delivering gas), then the leak may be inside the hydrogen generator system box. Please contact PROTON for assistance in diagnosing and remedying hydrogen leaks. Hydrogen leaks should be remedied as soon as possible after detection.



All internal connections to the generator are automatically checked on a continuous basis. All external connections to the generator should be leak checked prior to operation.



**The HOGEN GC hydrogen generator is designed to signal the possibility of hydrogen leaks. If the HOGEN GC generator is unable to achieve or maintain the desired system pressure, the word “LEAh” (leak) appears in the numerical display readout and an audible alarm is triggered.**

Display Reading	Ready LED	Probable Diagnosis	Action
LEAh	Flashing (ready)	Leak Inside Generator	Contact Supplier
LEAh	Steady (delivering)	Leak Outside Generator	Leak Check All Hydrogen Supply System Piping

**Table 5-1 Leak Indicators**

## 5.6.2 Replacing Water

Use the following instructions if it becomes necessary to replace the water in the hydrogen generator due to poor water quality:

Switch off the unit and disconnect the power.

Drain the water using the system water drain fitting on the back of the system. The drain valve opens when the mating male fitting (supplied in the poly bag of parts) is inserted into the drain valve. If desired, you can attach a length of hose to the male drain valve fitting before inserting it into the drain valve – the required tubing is 3/8” OD, 1/4” ID.



The HOGEN GC generator contains approximately 1.9 liters (just over 2 quarts) of water. Never refill the generator with contaminated water that has been drained from the generator. We recommend that a generator that has a shutdown due to bad quality DI water be flushed three times (fill, drain, and refill) with Type II DI water before being restarted.

### 5.6.3 Gas Purification and Drying

The HOGEN GC hydrogen generator uses a maintenance-free palladium membrane purification device to remove water and other contaminants from the hydrogen produced in the PEM electrolytic cell. The device contains a heated palladium membrane, which absorbs and transmits only hydrogen, and rejects all other gases. The use of the palladium membrane dryer in the HOGEN GC hydrogen generator provides several user advantages:

- It Produces Highly Pure Hydrogen, Equal to or Better than the Cylinder Hydrogen often Utilized
- It Requires No Maintenance, Replacement, or Scheduled Service (Hence, no Additional Costs)

The palladium membrane dryer is maintenance free and cannot be serviced by users. In order to ensure that only on-spec hydrogen is delivered, the dryer requires a warm-up period before the system delivers hydrogen. The warm-up period is indicated by the scrolling bars in the pressure display – the faster the scroll, the closer the unit is to delivering hydrogen. As long as the power is not turned off, the unit remains hot and capable of instantly delivering on-spec hydrogen.

The palladium diffuser dryer emits a small puff of wet impure hydrogen gas from the relief port approximately once per minute. This is normal. It is the scavenge stream that ensures the hydrogen delivered to your instruments is the cleanest gas possible. You can hear a solenoid valve open and the short puff of vented gas approximately once per minute. As stated earlier, the relief port should be piped to an acceptable hydrogen vent line.



**Figure 5-2 HOGEN GC Hydrogen Relief Port**

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## 5.7 Errors Codes During Startup or Operation

The HOGEN GC hydrogen generator is equipped to detect problems that arise during startup or operation.

Code	Description	System Impact	Default Limit
E 00	Manual Shutdown	Shutdown	N/A
E 01	Cell Voltage High	Shutdown	>10 volts (600 cc/min model) >5 volts (300 cc/min model)
E 02	Poor Water Quality	Shutdown	Water Resistivity is Less than 1 megohm-cm
E 03	Water Tank Empty	Shutdown	Water Level Below Empty Level
E 04	Pressure Is Over Maximum	Shutdown	System Pressure Set Point + 25 psi
LEAh	System Leak Detected (Possible leak inside generator)	Warning	20 Minutes at Maximum Generation Rate (flow valve closed)
LEAh	Product Leak Detected (Possible leak outside of generator)	Warning	20 Minutes at Maximum Generation Rate (flow valve open)
E 06	Diffuser Temperature High	Shutdown	Palladium Diffuser Temp is Over 325°C
E 07	Water Quality Sensor Failed	Shutdown	Water Quality Sensor is Open
E 09	Diffuser Temperature Low	Shutdown	Palladium Diffuser Temp is Less Than 225°C
FILL	Water Tank Level Low	Warning	Water Level Below Low Level
E 11	Diffuser Thermocouple Failed	Shutdown	Palladium Diffuser Thermocouple is Open
E 12	Fan Error	Shutdown	Circulating Fan not Operating
E 13	Disable Error	Shutdown	Current Supply is Disabled

**Table 5-2 Error Codes**



## 6 Maintenance

### 6.1 Autofill

The HOGEN GC laboratory hydrogen generator is equipped with autofill as a standard feature. The generator water supply may be provided either by:

- Manually Filling with DI Water using the Fill Funnel Located Under the Top Cover
- Automatic Filling using a DI Water Supply Connected to the Autofill Water Inlet Press-to-Lock Fitting in the Back of the Generator

Autofill operates best with at least 10 psig (0.689 Bar) minimum of DI water supply pressure. Autofill operates on gravity-fed DI water as long as height of the water reservoir is at least 8 feet (2.5m) above the HOGEN GC system, however this extends tank refill time.

During autofill operation, the water level in the sight glass varies between just above top of the sight glass and the low water level, indicated by the display of the “FILL” word on the numeric display. Immediately upon indication of the word “FILL” on the display, the autofill supply valve opens and refills the tank, automatically and unattended.

To ensure continuous operation with manual fill systems, regularly check the water level and refill as necessary to maintain the water level between the top and bottom of the sight tube. When the water level falls below the low water level, the word “FILL” is displayed periodically on the numerical display and an audible tone is triggered a few seconds later. The tone sounds until water is added to the generator. If the water level is allowed to drop further below the level required for satisfactory operation, the HOGEN GC hydrogen generator shuts down the generation and displays error code E-03 – Water Tank Empty on the numeric display.



Before filling the generator with DI water, always check the quality of the DI water and ensure it is equal to or better than the DI water feed specification in the Technical Specifications table (See Table 1-1).

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**Figure 6-1 Water Level**

## 6.2 Ion Exchange Resin Bag

The HOGEN GC hydrogen generator is equipped with an ion exchange resin bag, which is similar in appearance to a teabag, and is used to ensure that the recirculated water within the generator is maintained as pure (i.e. ion-free) as possible. The ion exchange resin bag is attached to the water fill funnel-splash screen with a nylon tie and hangs in the water container. The ion exchange resin scavenges any remaining ions from the circulating water and helps to stop the water conductivity from rising during operation.

It is important to replace this ion exchange resin bag at the recommended intervals to ensure that it continues to provide its designed protection.



**NOTE**

The ion exchange resin bag cannot be used to clean impure water added to the generator - its ion capacity and ion exchange efficiency are designed only to maintain the quality of the Type II DI water recirculated within the system.

The bag should be replaced:

- If the conductivity is rising to alarming levels during operation when the same quality water is being used consistently
- At least every six months

Replacement bags are available from PROTON or from your generator supplier.

Use the following instructions to install a new ion exchange resin bag:

1. Cover your hands using powder-free latex or similar impermeable gloves when handling the ion exchange resin bag to protect the DI water system from contamination.

2. Remove the exhausted ion exchange resin bag by lifting straight up on the nylon tie – this causes the water fill funnel-splash screen to pop out of the funnel.
3. Remove the tie from the splash screen and discard the old ion exchange resin bag.
4. Thread the nylon tie from the new ion exchange resin bag through the splash screen.
5. Reinsert the fill funnel-splash screen in place – it should snap into place.
6. Call your supplier or distributor for MSDS sheets in reference for proper handling, storing, and disposal of resin.

### 6.3 Water Quality

The HOGEN GC hydrogen generator has a built in conductivity meter that helps to protect the electrochemical cell from damage due to substandard DI water. If the conductivity meter detects a water problem, the generator shuts down to minimize damage to the cell stack and the digital pressure display presents the error code E-02 – Poor Water Quality.

It is important to understand that many factors can affect the quality of DI water. Once it is dispensed from your laboratory DI water system, the DI water conductivity increases rapidly. Type II DI water dispensed and left sitting in an open container absorbs atmospheric carbon dioxide and may trigger the water conductivity sensor in the HOGEN GC, indicating poor water quality.

Please use fresh Type II DI water. Start the HOGEN GC unit up as soon as possible after filling it with Type II DI water that meets the requirements shown in the Technical Specifications Table (See

Table 1-1). Once the water is circulating within the HOGEN GC system, the ion exchange resin bag helps to keep it clean.



**The HOGEN GC hydrogen generator is designed to operate using ASTM Type II Reagent Grade DI water, which has a resistivity of 1 megohm-cm or better. This corresponds to conductivity of 1 microSiemen/cc or less. Please be aware that Type II DI water is not the same as distilled water – Type II DI water contains less than ½ part per million of total dissolved liquids and has most of the ions removed from it by ion exchange technology. The use of lower quality DI water or distilled water in your hydrogen generator irreversibly damages the hydrogen generating cell stack and voids the warranty.**

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## 6.4 Drain/Refill

Because residual ions can build up in the water recirculation system, PROTON recommends that you consider a monthly drain and refill for your HOGEN GC laboratory hydrogen generator. While this maintenance is not required in order to comply with the system warranty, a monthly drain and refill of the generator with fresh, high quality Type II DI water helps to ensure the longest possible life from the hydrogen generating cell stack.

Use the following instructions for the monthly drain and refill procedure:

1. Shut down the generator at a time when hydrogen is not needed.
  2. Switch off the unit and disconnect the power. If the unit is supplied by an autofill (piped) supply, shut off the DI supply to the generator.
  3. Drain the water from the generator by inserting the drain fitting located in the poly bag of parts. A 3/8" OD and 1/4" ID length of tubing may be attached to the barbed end of the fitting to aid in the draining.
  4. Refill the unit either manually or by turning on the piped DI water, with Type II DI water meeting the specifications provided in Technical Specification Table (Table 1-1).
  5. Initiate the restart of the unit.
-

## 6.5 Associated Parts and Components

Part	Proton Part number	Replacement cycle
Ion Exchange Resin Bags	KT-0200-0003	6 Months or as Needed
Drain Fitting	P-06360-47	Not Required
Cordset - US	10-0400-0000	Not Required
Cordset - Europe	10-0400-0002/UK 10-0400-0001	Not Required
Ion Exchange Resin Bag MSDS	PD-0800-0001, Part 06 KT	Not Required
250VAC 10A Type F Fuse	505 10A	Not Required
Hydrogen MSDS	TBD	Not Required
Push-Lock Nylon Plug	O2-0509-0001	Not Required

**Table 6-1 Parts List**

Material Safety Data Sheets for both hydrogen and the ion exchange resin bag are included with the unit. Additional copies are available in Adobe format for download from the PROTON website at [www.protonenergy.com](http://www.protonenergy.com) or [www.hogengc.com](http://www.hogengc.com).

## 6.6 Cleaning the Generator

Clean only the outside of the generator. Disconnect the generator power cord before cleaning the generator. Use a damp sponge or soft cloth and a mild soap solution to clean the outside of the generator.



**To avoid marring the plastic surfaces, do not use abrasive cleaners on the generator.**

## 7 Alarm Contact Output

The HOGEN GC hydrogen generator is equipped with a set of normally open dry alarm contacts to trigger an external alarm in case of any shutdown or warning condition. The alarm contacts close on any alarm condition (warning or shutdown) and may be wired to trigger an external (remote) alarm or warning light. The alarm contacts have a maximum capacity of 12 volts/1 amp (2 VA). The alarm contacts are a set of two screw terminals located in the rear bottom center of the cabinet.



**Figure 7-1 Alarm Output Contacts**

## 8 Frequently Asked Questions

### **What is a “LEAh” alarm?**

If the Hogen GC generator is unable to achieve or maintain the desired system pressures, the word “LEAh” (leak) appears in the numerical display read-out and an audible alarm is triggered.

### **If the leak alarm is triggered, how can I determine the specific leak points in my systems?**

If the generator is delivering gas at the time a “LEAh” (leak) signal is triggered, then the leak is most likely to be outside the generator system in the hydrogen supply piping. Check all piping and fittings from the hydrogen generator downstream to the instruments for leak tightness. Be aware that the leak alarm is a warning only and the system is unable to fill the supply piping to pressure within the allotted time. If the supply piping system is large in diameter or if the generator is located far from the instruments using the hydrogen, it is acceptable to ignore the alarm temporarily to see if the unit comes up to pressure and emerges from the alarm condition. To check for hydrogen leaks in piping outside of the HOGEN hydrogen generator, PROTON suggests using a liquid leak detector solution or a handheld combustible gas detector.



**If the “LEAh” (leak) signal is triggered when the generator is in Standby Mode (internal pressure), but not delivering gas, the leak is likely to be within the system. Call PROTON or your supplier for servicing information.**

### **What is the ion exchange resin bag?**

The ion exchange resin bag scavenges any remaining ions from the water recirculated within the system. The ion scavenging helps to stop the water conductivity from rising during operation. High ion levels in the water trigger the water quality shutdown to avoid irreversibly damaging the cell stack.

### **How often should this ion exchange resin bag be replaced?**

The ion exchange resin bag should be replaced at least every six months. All of the water must be drained and replaced with good quality DI water. The ion exchange resin bag must be replaced if the water quality sensor is triggered and the unit shuts down for poor quality (impure) water.

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**Every minute or so during operation, I hear a click and a short puff of gas. Is there something wrong?**

The palladium diffuser dryer emits a small puff of wet, impure hydrogen gas from the relief port approximately once per minute. This is normal. It is the scavenge stream that ensures the hydrogen delivered to your instruments is the cleanest gas possible. You should hear a solenoid valve open and the short puff of vented gas approximately once per minute.

**How do I stop hydrogen flow, but still maintain internal pressure without a complete unit shutdown?**

To stop hydrogen delivery, but maintain internal hydrogen pressure within the generator for instant restart, press the “Flow” button (“H”) to close the solenoid valve and cease hydrogen delivery.

**How do I perform a complete unit shutdown?**

To stop hydrogen delivery and depressurize the unit completely, press the “Start/Stop” button to shut down the generator. The digital display panel reads “E-00,” which is the error code for a manual shutdown.

For emergency shutdown, simply shut off the power using the power switch in the back of the generator or unplug the unit. Shutting off the power does not damage the system, but it takes time to reheat and begin producing hydrogen after the power is shut off.

**What is an E-02 error (Poor water Quality)?**

The HOGEN GC hydrogen generator is designed to operate using DI water that has a resistivity of 1 megohm-cm or better. If lower quality DI or distilled water is used in the unit, it shuts down the system and triggers the audible alarm and digital error code display. The water quality shutdown is designed to protect the hydrogen production cell stack in the system from irreparable damage due to the use of water that does not meet the specifications. Use of water that is not of the required quality may irreversibly damage the unit cell stack and will void the warranty.

**How often should I flush the water?**

For longest life, PROTON recommends that the water should be flushed on a monthly basis and refilled with the specified 1 megohm-cm or better rating.

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**Can I adjust my pressure setting during hydrogen delivery?**

Yes. During the operation stage, you can adjust your pressure settings by pressing and holding down the “Increase” or “Decrease” arrow button until the desired setting is displayed.

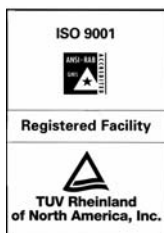


## 9 APPENDIX A - FORMS

**WARRANTY**

**CUSTOMER REGISTRATION FORM**

**ION RESIGN BAG FORM**



### CONTACT INFORMATION

Proton Energy Systems, Inc.

10 Technology Drive

Wallingford, CT 06492 USA

[customerservice@protonenergy.com](mailto:customerservice@protonenergy.com)

Phone: 203.949.8697 (Customer Service direct number)

Phone: 203.678.2000 (switchboard)

Fax: 203-949-8016

[www.hogengc.com](http://www.hogengc.com)

[www.protonenergy.com](http://www.protonenergy.com)

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## **Customer Registration Form**

### **HOGEN GC 300 and 600 Laboratory Hydrogen Generators**

Please fill in this form, tear it out of the manual, and fax it to Proton Energy Systems to ensure that your HOGEN GC hydrogen generator is properly registered. Proper registration is important for product support, and we can notify you automatically when routine maintenance is suggested. Proton Energy Systems fax #: 203-949-8016 (country code 1 for the US)

If you prefer, you may fill in the information on Proton Energy Systems' website at [www.protonenergy.com](http://www.protonenergy.com). Choose "Gas Products", and then follow the link to register your new generator.



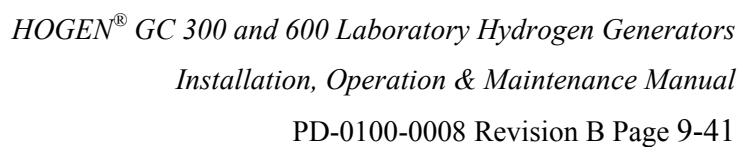
Please complete this table to register your hydrogen generator, and fax it to Proton Energy Systems at 203-949-8016 in the US:

<b>Generator Model Name</b>	
<b>Generator Serial Number</b>	
<b>From what supplier did you purchase the generator?</b>	
<b>Name of your company?</b>	
<b>Company website address?</b>	
<b>The application for your hydrogen generator?</b>	
<b>Your name?</b>	





<b>Your title?</b>	
<b>Your phone number with country code?</b>	
<b>Your fax number with country code</b>	
<b>Your e-mail address?</b>	
<b>The place where the generator is located (city, state, country)</b>	
<b>Are you the person responsible for the operation of the hydrogen generator?</b>	
<b>Do you have any questions at this time that you need Proton Energy Systems to answer?</b>	



### Recommended Change Interval – Six Months

[illegible]



## LIMITED WARRANTY

### **HOGEN® GC - HYDROGEN GAS GENERATOR SYSTEMS**

**LIMITED WARRANTY:** PROTON ENERGY SYSTEMS INC. ("PROTON") warrants that the ITEMS LISTED BELOW shall be free from defects in material and workmanship for the stated period of time commencing from date of shipment or as stated below.

HOGEN GC HYDROGEN GAS GENERATOR SYSTEM:

Two (2) years from shipment

Repair or replacement parts for Hydrogen Gas Generator System:

Ninety (90) days from shipment

**EXCLUDED FROM THIS LIMITED WARRANTY:** The following shall be excluded from the Limited Warranty:

- Parts and items considered consumable in normal operations, including those parts and items supplied with the Hydrogen Gas Generator System ("System") for maintenance.
- Any System and its parts that are not installed, operated, and maintained in accordance with the unit's manual supplied with the System.
- Damages due to accident, abuse, acts of God, acts of terrorism, misuse or negligence, or which result, in whole or in part, from improper or unauthorized use or repair of the System, or use of the System in a manner for which it was not designed, or by causes external to the System such as, but not limited to, power or air conditioning failure or voltage irregularities.

**REMEDY:** BUYER'S sole and exclusive remedy in the event of defect, and the liability of PROTON hereunder is limited to the adjustment, repair, or replacement of the defective item or part with a similar item or part free of defect.

Such adjustments, repairs, or replacements will be made at PROTON'S Wallingford, Connecticut, plant or, for Systems only, at the site of the System, if BUYER so elects. All costs for shipping equipment or parts shall be on the account of the BUYER whether to or from the point of manufacture. Labor costs associated with travel, expenses, and subsistence costs for field services shall be on the account of the BUYER.

**VOIDING OF THE LIMITED WARRANTY:** This Limited Warranty is immediately void upon:

- THE OPENING OR DISASSEMBLY OF THE SYSTEM CABINET (OR ANY PART THEREIN), OR
- THE SALE, ASSIGNMENT OR ANY OTHER TRANSFER OF TITLE BY BUYER OF THE ITEMS OR PARTS OTHERWISE COVERED UNDER THIS LIMITED WARRANTY

**WAIVER OF ALL OTHER WARRANTIES:** THE LIMITED WARRANTY PROVIDED HEREUNDER AND THE RIGHTS AND REMEDIES OF THE BUYER HEREUNDER ARE IN LIEU OF, AND BUYER EXPRESSLY WAIVES, ALL OTHER WARRANTIES, GUARANTEES, OBLIGATIONS, LIABILITIES, OR REMEDIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY AND NON-INFRINGEMENT, IMPLIED WARRANTIES ARISING FROM THE COURSE OF DEALING OR USAGE OF TRADE AND IMPLIED WARRANTIES OF SUITABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

**LIMITATION OF LIABILITY:** THE REMEDIES PROVIDED IN THIS LIMITED WARRANTY ARE EXCLUSIVE AND PROTON SHALL IN NO WAY BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER INCLUDING WITHOUT LIMITATION LOSS OF USE, REVENUE OR PROFIT.

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