PROTIUM-300 FUEL CELL SYSTEM

USER GUIDE

VERSION 4.1 MAY 2019

SAFETY, HANDLING & SUPPORT

WARNING: Failure to follow these safety instructions could result in fire, electric shock, or other injuries, or damage to PROTIUM-300 Fuel Cell System (PROTIUM-300) or other property. Read all the safety information below before using PROTIUM-300.

Handling Handle PROTIUM-300 with care. It is made of thin sheet metal, graphite, and plastic and has sensitive electrochemical membrane and components inside. PROTIUM-300 is not designed for extreme conditions, rough handling, vibration, shock or drop. Keep PROTIUM-300 away from heat, flame, strong sunlight, water, dust, soil or mud. Do not use a damaged PROTIUM-300.

Repairing Do not troubleshoot, disassemble or tamper with PROTIUM-300. Do not attempt to repair or replace any component by yourself.

Hydrogen Use only high purity (99.999%) dry Hydrogen gas with PROTIUM-300. Follow all local rules and regulations for safe handling, storage and usage of Hydrogen gas. Do not smoke when operating PROTIUM-300.

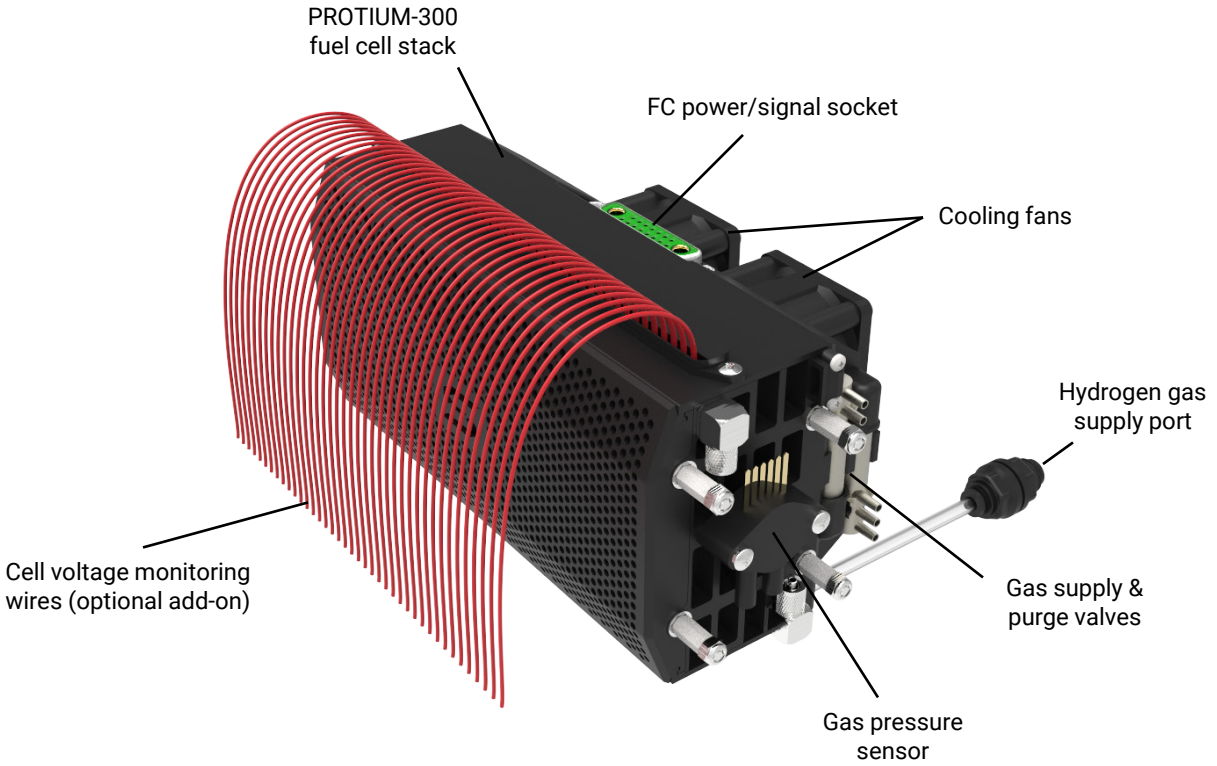
Connectors, ports and buttons Never force a connector into a port or apply excessive pressure to a button. If the connector and port do not join with reasonable ease, they probably do not match. Check for obstructions and ensure that the connector matches the correct port.

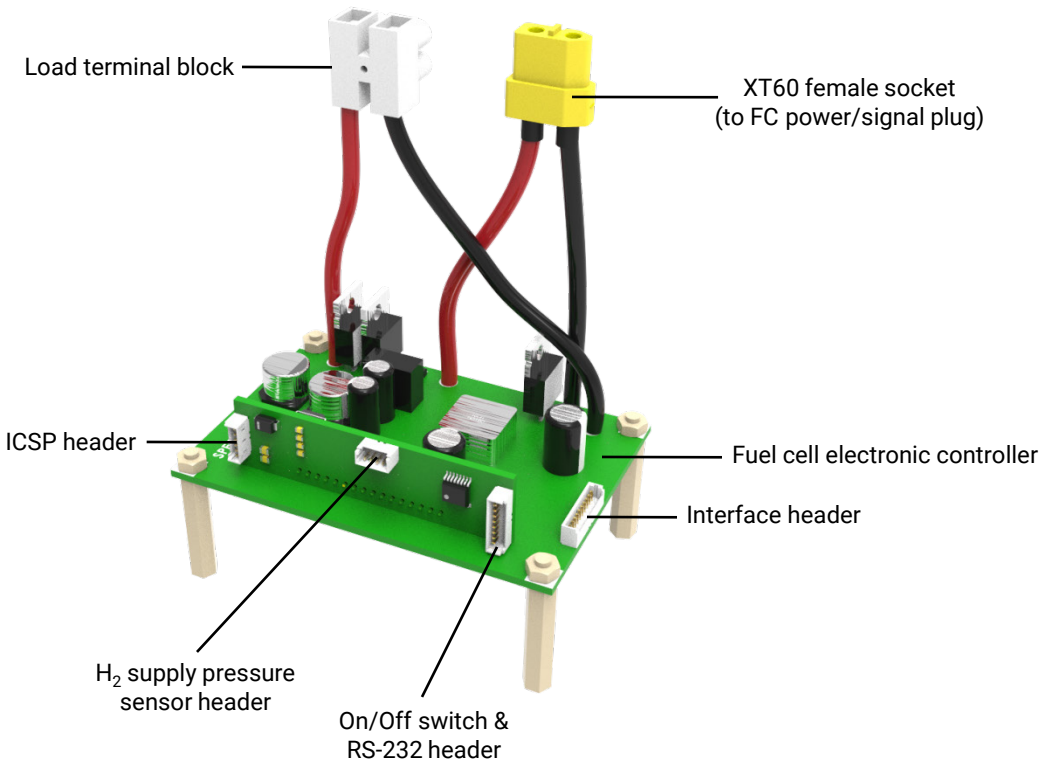
Disposal and recycling As PROTIUM-300 contains electronic components and a battery, it must be disposed of separately from household waste. When PROTIUM-300 reaches its end of life, follow local laws and regulations for proper disposal and recycling options.

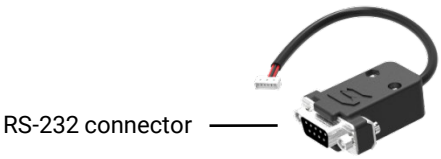
High-consequence activities PROTIUM-300 is a customized system with pending safety tests and certifications. It is not intended for use where the failure of the system could lead to death, personal injury or severe environmental damage.

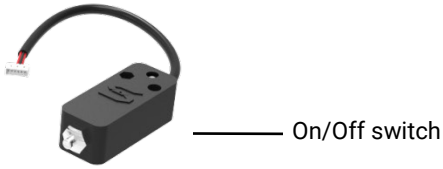
Disclaimer Every effort has been made to ensure that the information in this manual is accurate. This manual serves to adequately recommend safe operating procedures, but shall not be treated as comprehensive. Do not use PROTIUM-300 in any other way than the one recommended in this manual. We reserve the right to change system specifications, appearance or discontinue the product at any time.

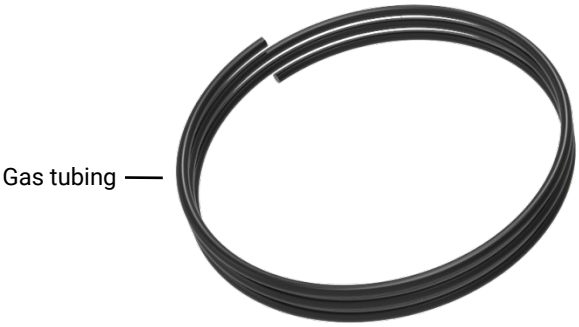
What's in the Box

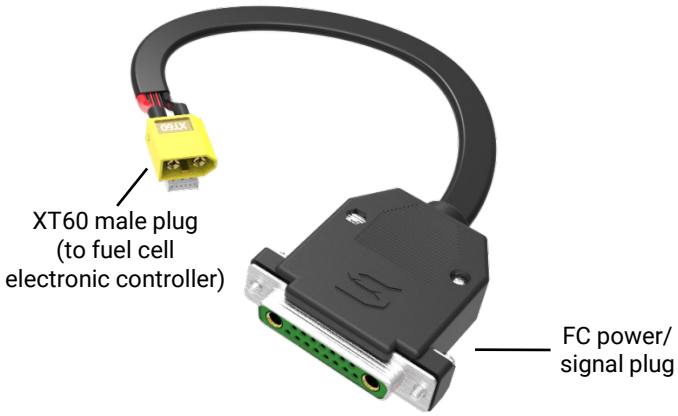




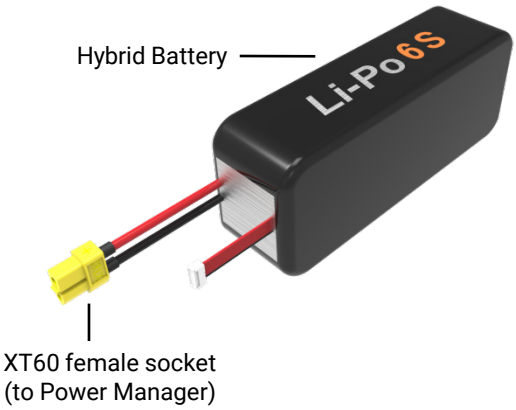


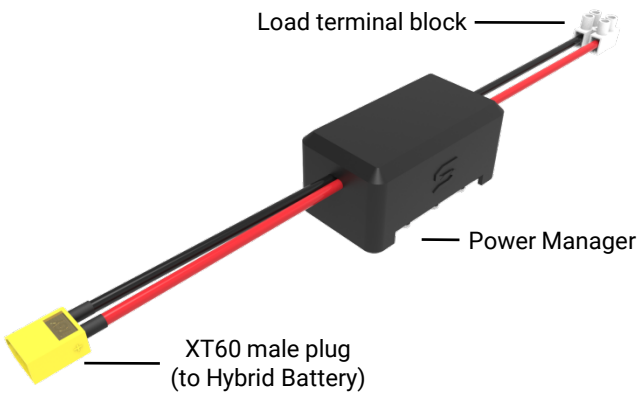






Optional Accessories





SPECIFICATIONS 2

Fuel Cell System	Type	PEM, 40 cells
	Flow Field	S-flow technology
	Cooling	2x 12V fan, pwm controlled
	Operating Ambient Temperature	1-40^{o}C
	Power Interface	Terminal block, max 40A
	Fuel Cell Dimension	179 x 101 x 84 mm
	Fuel Cell Weight	765g
	Electronic Controller	FLY driver board version 3.1
	Electronic Controller Dimension	80 x 55 x 25 mm
	Electronic Controller Weight	105g
Nett Performance	Rated Power	300W (12.5A @ 24V)
	Peak Power (only with Hybrid Battery)	Dependent on capacity
	Voltage Range	24-36V
	Start-up Time	5s
	Efficiency	48% (based on LHV of H_2)
Fuel Supply	Hydrogen Gas	Dry, 99.999% purity
	Delivery Pressure	0.4-0.7bar (6-10psig)
	Max Consumption	3.8L/min @ 300W
	Gas Tubing Requirement	PU, 4mm OD
	Supply & Purge Control	Solenoid valves
Protections & System Monitoring	Low Voltage Shutdown	20V
	High Temperature Shutdown	65^{o}C
	Low Battery Warning	<21V
	Low Hydrogen Shutdown	<0.2bar
	Data Acquisition, Graphic User Interface	RS232/USB
Hybrid Battery & Power Manager (optional)	Hybrid Battery Type	Lithium Polymer 6S
	Hybrid Battery Capacity	User specified
	Hybrid Battery Dimension	Dependent on capacity
	Hybrid Battery Weight	Dependent on capacity
	Power Manager Settings	0-60V, 0-5A
	Power Manager Dimension	61 x 37 x 22 mm
	Power Manager Weight	120g

Preparing the Hybrid Battery

1. The Hybrid Battery is not charged when you receive them. Follow the safety instructions provided with the Hybrid Battery for charging. Tip: We recommend using Thunder Power LiPo battery in conjunction with Thunder Power charger and balancer.

2. You can also charge the Hybrid Battery using the Power Manager. Caution: the Power Manager is factory set to 24V and 1A, use only 6S LiPo battery above 2000mAh.

3. Connect the load terminal block of the Power Manager to an external DC power supply and the XT60 male plug into its female socket at the Hybrid Battery.

4. Set the DC power supply to (25V, 2A) and turn it on. The Hybrid Battery will start charging.

5. When the Hybrid Battery is full, the Current reading on the DC power supply will be close to 0A. Turn off the DC power supply and disconnect the Hybrid Battery.

The Hybrid Battery is now ready.

Setting up PROTIUM-300

1. Connect the FC power/signal plug into the socket on the PROTIUM-300 fuel cell stack. Connect the receptacles and XT60 male plug into their respective headers and XT60 female socket on the fuel cell electronic controller. Tip: the receptacles are designed to have different number of pins and can only fit into their mating headers on the electronic controller. Only the ICSP header should be free.

2. Plug in your load into the load terminal block of the electronic controller. Check that the polarity is correct. Tip: for safety, ensure that your load has a switch and is switched off at this stage.

3. Connect your hydrogen gas supply tubing into the gas supply port.

4. Connect the load terminal block of the Power Manager in parallel to the same load in step #2.

5. Connect the XT60 male plug of the Power Manager into the XT60 female socket of the Hybrid Battery. Caution: the load terminal is now live.

PROTIUM-300 fuel cell & Hybrid Battery systems are now ready.

Turning ON

1. Turn on the hydrogen gas supply. Tip: check that gas supply is regulated to 6-10psi (0.4-0.7bar). Do not exceed 10psi.

2. Press the On/Off button. The LED will light up, followed by gas purging and cooling fans turning. The system is now live.

3. Switch on your load and draw power as per normal.

Note

• Do not draw power (Constant Power mode) in excess of the fuel cell rated power (300W). If the Hybrid Battery is connected, you can draw a maximum of 1000W for 3mins if the Hybrid Battery is fully charged. The peak power is dependent on the capacity of Hybrid Battery used.

• If the fuel cell has excess power beyond powering your load, it will also automatically be charging the Hybrid Battery, unless the Hybrid Battery is full.

• If you did not purchase the Hybrid Battery and Power Manager, you can connect an external DC power supply in lieu of the Hybrid Battery. Set the DC power supply voltage to 24V. The maximum power you can draw is now limited to the maximum Current of your power supply.

• Alternatively, a small power supply (24V,1A) is sufficient if you are drawing load in Constant Voltage mode. Do not set the load below 24V.

Reminder

• Ensure all gas tubing and electrical wire connections are firm and secure.

• Do not block the purge outlet. Keep the outlet pointed to open space. Do not bring flame or electric spark close to it.

• Check the delivery pressure of the hydrogen gas supply. Insufficient pressure will affect PROTIUM-300's performance while excessive pressure might rupture its membrane electrode assembly and cause permanent damage.

PROTECTIONS & WARNING MESSAGES 4

PROTIUM-300 has in-built system protections. During normal running phase, the LED will be solid white and a continuous buzzer sound can be heard. When an error is detected, the LED will flash, the buzzer sound will become intermittent, and a message will appear. The message can be viewed on a PC using our Graphic User Interface (GUI) data acquisition software. Link up a PC via the RS232 connector.

Note: instruction on how to use the GUI is separately listed in the GUI user guide.

Follow the basic troubleshooting guide below. Most errors should be rectified once the suggested action has been done and the system restarted.

If the error persists, contact us at contact@scimaterials.cn

During start-up

Message	Corrective Action
Low H_2 supply	Check and ensure sufficient hydrogen supply and correct delivery pressure.
High temperature	Disconnect everything and wait for system to cool down. Restart after 10 min.
Error: Temperature	Internal temperature sensor might have been compromised. Contact us.
Error: Low voltage	Check and ensure sufficient hydrogen supply and correct delivery pressure. Restart after 1 min.

In Operation

Message	Corrective Action
High temperature	Fuel cell temperature has reached 60°C, load is temporarily auto-disconnected. Reduce load.
Error: High temperature	Disconnect everything and wait for system to cool down. Restart after 10 min. If system fails to restart, internal temperature sensor might have been compromised. Contact us.
Low voltage	Fuel cell is overloaded and the load is temporarily auto-disconnected. Reduce load.
Error: Low voltage	User has drawn power way beyond the fuel cell capacity. Restart the system and reduce load.
Low H_2 supply	Hydrogen gas supply is depleted, reduce load or prepare to end operation.
Error: Low H_2 supply	Hydrogen gas supply is way too low to support operation. Refill the supply and restart the system.
Low battery	Hybrid Battery voltage is low. Reduce load or prepare to end operation.

MAINTENANCE & STORAGE 5

Maintenance for PROTIUM-300

When not in use, we recommend that PROTIUM-300 is reconditioned at least once a month.

1. Follow the steps in Chapter 3, using a DC electronic load in lieu of your regular load and an external DC power supply (24V,1A) instead of the Hybrid Battery.
2. Set a constant voltage (CV) load of 24V and run the system for 1 hour.
3. PROTIUM-300 is now ready for usual operation or can be stored again for future use.

Storage

Keep PROTIUM-300 in an open, cool (standard room temperature of 25^{o}C) and dry place.