ElectroChem believes that research should be without boundaries – limited only to a person's imagination

That is why we not only offer customization on our vast product line, but we *encourage* it.

What you see on our website and in our catalog is over 20 years of research and experience – and what has become the industry standard – but that doesn't mean you're limited to it.

Contact us at:

1-781-938.5300

or

sales@fuelcell.com

with your customization request

ElectroChem envisions a future where a sustainable global economy resides in harmony with a clean, healthful environment. Its mission is to provide the fuel cell technology and products that this society will require for its energy supply.

Dr. Radha Jalan, CEO

We were founded in 1986 as a company to provide leading edge research and development in the fuel cell industry.

Since then, we have modified our business focus to include market and product development for specifically fuel cell power systems, fuel cell test equipment and fuel cell research supplies. We hold many patents and a strong list of industry firsts.

Since 1992, we have introduced fifty product lines to the market. Today, our clients are worldwide and range from small businesses, to Fortune 500 companies, to universities and to governments.

A fuel cell is an electrochemical device that converts hydrogen fuel into energy and water.

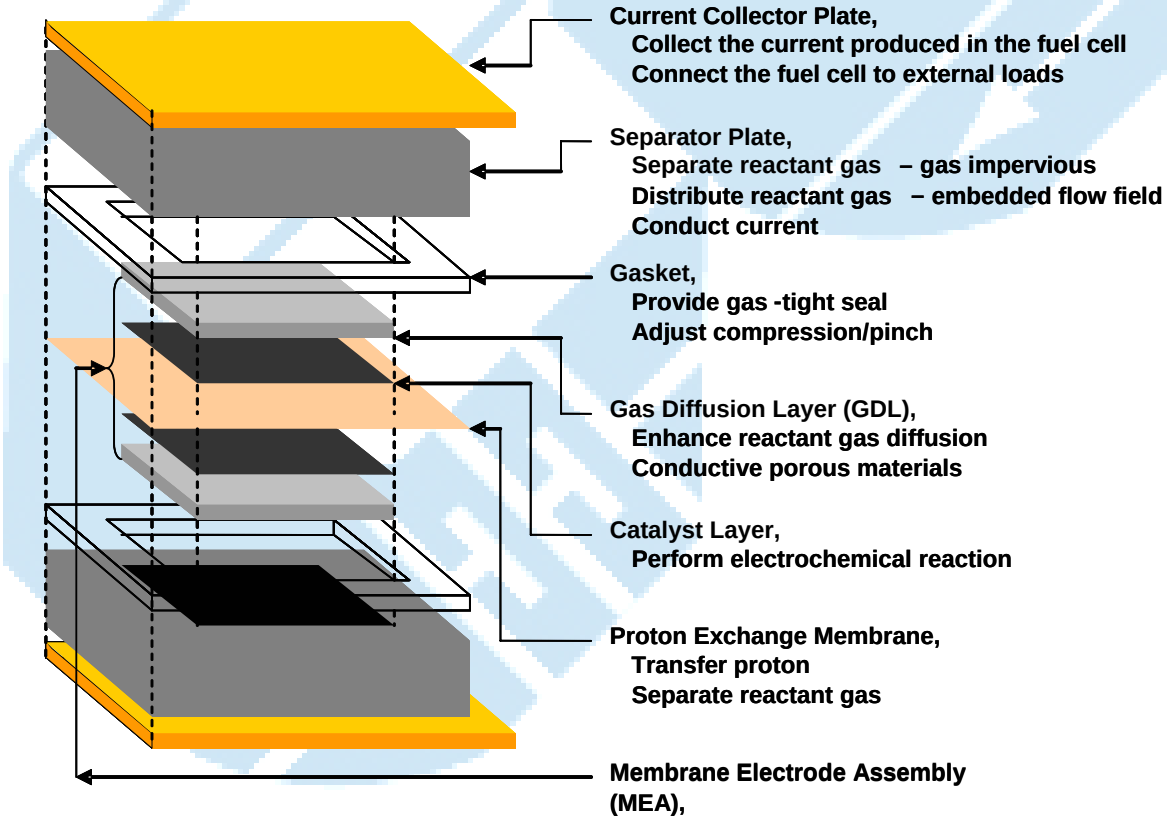
Since the fuel cell only emits water as a byproduct, there are virtually no emissions from the fuel cell.

Furthermore, a fuel cell does not use combustion to create energy, thus it is more efficient than other sources of energy.

A basic fuel cell hardware unit consists of separator plates, current collector plates, the membrane electrode assembly (MEA), gaskets, and possibly heaters. The fuel cell requires only hydrogen and oxygen gas, or air to generate electricity.

The flow fields in the graphite separator plates allow for flow of reactants and provide for excellent electrical contact. Special, low porosity, high purity graphite is used to guarantee a gas tight seal.

The gold-plated copper contact plates are connected to the fuel cell and collect the electrical current.



Energy is created by a fuel cell when hydrogen gas enters the anode (the negatively charged electrode) where a catalyst (often platinum in low temperature fuel cells) separates the gas into H^+ ions (i.e. individual protons) and electrons.

The protons are drawn directly through the membrane into the cathode (the positively charged electrode).

The electrons, at the same time, pass through a wire on the anode to the device that the fuel cell is being used to power and back to the cathode, completing the circuit.

Once the electrons and protons reach the cathode, they bond back together along with oxygen (O_2) gas to create water, the sole byproduct of a fuel cell.

The five primary forms of fuel cells are each named for the electrolyte that is used to carry the proton from the anode to the cathode of the fuel cell.

The **Polymer Electrolyte Membrane (PEM)** fuel cell including Direct Methanol fuel cell (DMFC) and the **Alkaline** fuel cell operate below 100°C (boiling point of water). The PEM fuel cell requires moisture in its membrane to conduct protons while the Alkaline fuel cell its potassium hydroxide electrolyte is in an aqueous solution.

The **Phosphoric Acid** fuel cell uses liquid phosphoric acid contained in a Teflon™ and silicone carbide matrix, as its electrolyte. This fuel cell also runs at a fairly low temperature (100°C-200°C).

The **Molten Carbonate** fuel cell and the **Solid Oxide** fuel cell operate at very high temperatures (650°C-1000°C) and require heavy thermal shielding to protect anyone nearby.

Compared to the low temperature fuel cells, the high temperature fuel cells require more time to begin supplying power after it is first turned on.

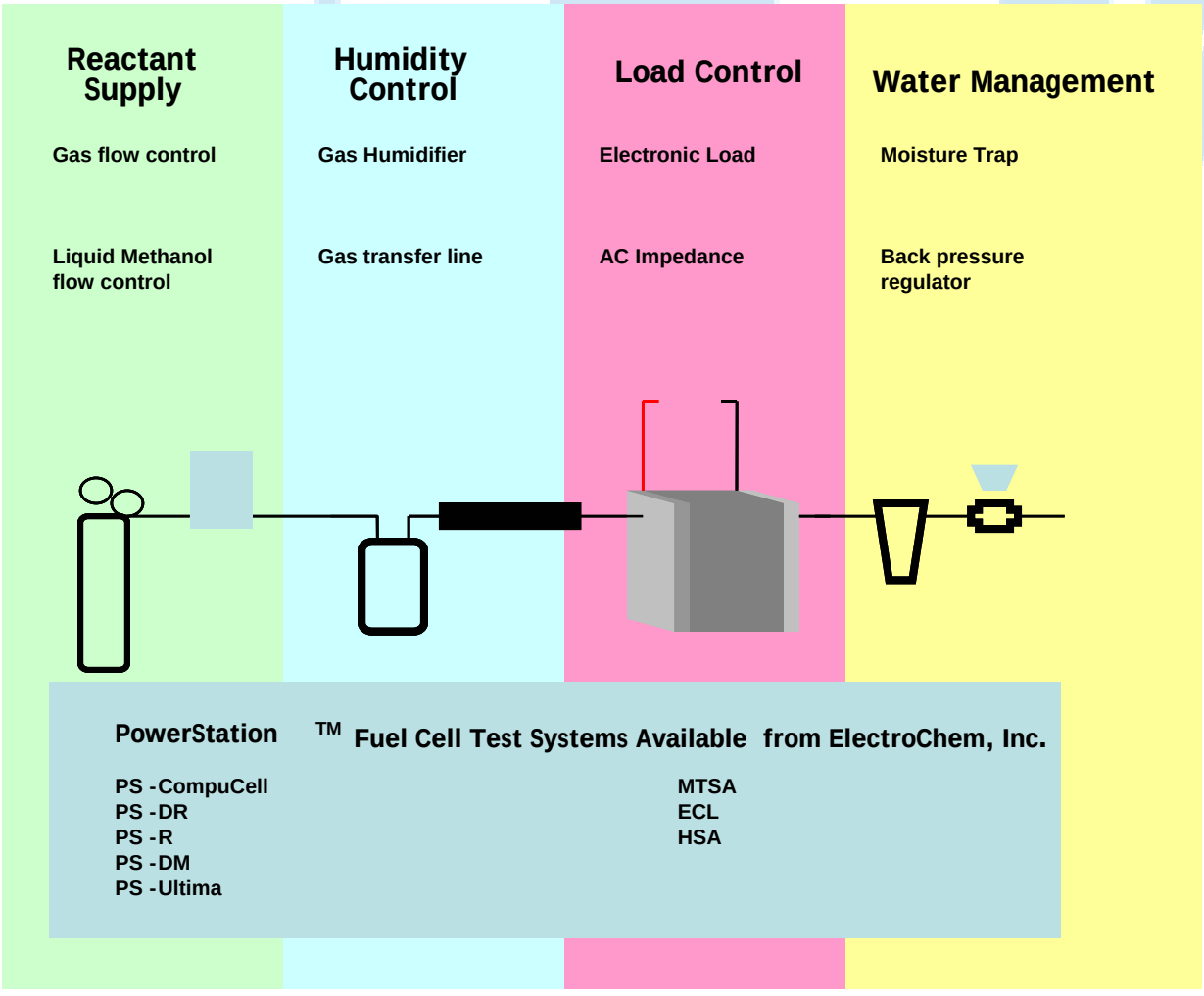
On the other hand, the high temperature fuel cells accept a more flexible variety of fuel.

With over 40 years of fuel cell development experience, ElectroChem is a leader in the manufacturing of hydrogen fuel cells for a variety of applications, including aero space, transportation, residential homes, back-up power supplies and laptops.

ElectroChem's Fuel Cell Test Stations are specifically designed for research professionals who require accurate measurements while maintaining control of the reactant gases under the range of conditions applicable to practical end-use scenarios.

Fuel cells need to be tested in an environment where the humidity content, flow rates, temperatures of the reactant gases and the temperatures of the cell can be controlled to ensure the balance of water supply, water removal, and reactant supply.

Water and gas flow management is critical in the determination of the performance limits of fuel cells.



Anode- The electrode on the negatively charged (emitting) end of the fuel cell.

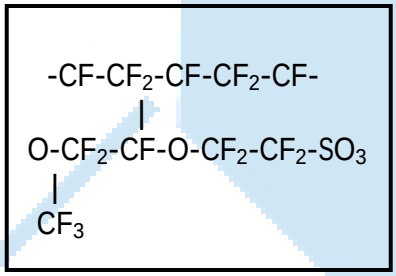
Catalyst- Any substance that reduces the amount of energy needed to induce a chemical reaction. In the case of PEM fuel cells, Platinum reduces the amount of energy needed to break apart and oxidize hydrogen gas.

Cathode- The electrode on the positively charged (collecting) end of the fuel cell.

Electrode- An electrically conductive material placed on the emitting or collecting end of a fuel cell.

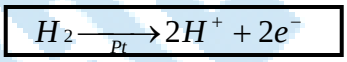
Electrolyte- An ionized chemical compound that is electrically conductive. In the case of fuel cells an electrolyte is used to carry hydrogen ions from the anode to the cathode.

Nafion™- A Teflon™-based substance that is used as an electrolyte in PEM fuel cells. Nafion™ contains the following structure:

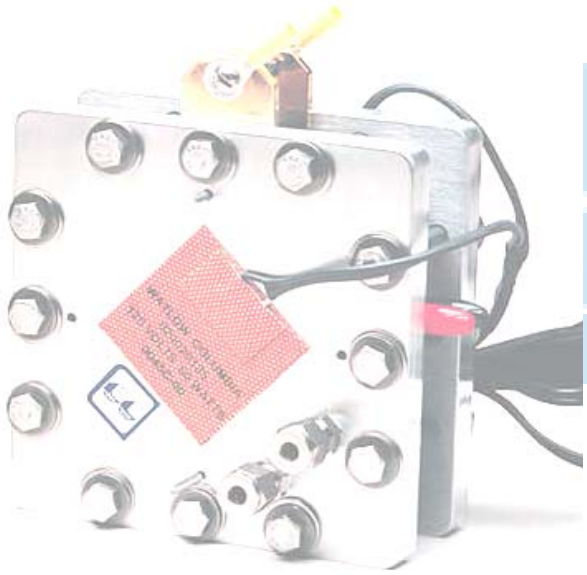


The fluorocarbon chain at the top is repeated hundreds of times to create a long polymer chain. The SO_3^- is the carrier for the H^+ ions.

Oxidization- The process by which an atom (hydrogen in the case of fuel cells) has an electron stripped from it. The oxidization reaction in a PEM fuel cell goes as follows:

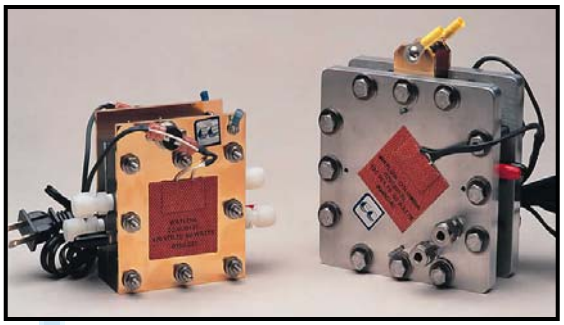


Fuel Cells



- PEM
- DMFC
- PAFC
- Single Cell
- Stacks

ElectroChem provides a durable PEM fuel cell hardware design which allows quick assembly and de-assembly. The through-bolt design provides guided alignment, low torque, and uniform constant force to the electrodes.



ElectroChem, Inc.'s fuel cell consists of a Nafion™-based MEA (manufactured by ElectroChem, Inc.) sealed between two gaskets mounted in between two graphite plates with a current collector plate on both ends.

Electrodes cap either side of the Proton Exchange Membrane and are responsible for carrying the electric current. An electrolyte between the electrodes carries the hydrogen ions while not letting the gas and electrons through.

Benefits of each of ElectroChem's fuel cells:

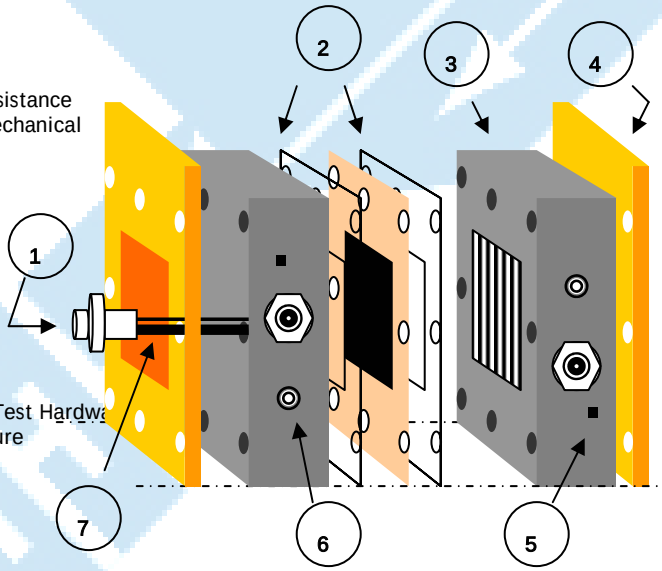
1 *Through-Bolt Assembly Design*
Quickly Assemble and Disassemble
Low Tightening Force Required
Create Uniformed Force Distribution

2 *Implement Pinch Adjustment Mechanism*
Capable of Applying Torque Equally to the Bolts Contain Flat Gaskets with High Precision Thickness

3 *Fuel Cell Grade Isotropic Graphite Plate*
Gas Non Permeable / Excellent Chemical Resistance
High Electrical/Thermal Conductivity and Mechanical Strength
Adaptable to Varied Flow Field Plate Design

4 *Current Collector Plate*
Gold Plated Copper Plate

5 *Thermocouple Insert Hole*
Reach Thermocouple at Center of Fuel Cell Test Hardwa
Precisely Control and Monitor the Temperature
Closest to the MEA



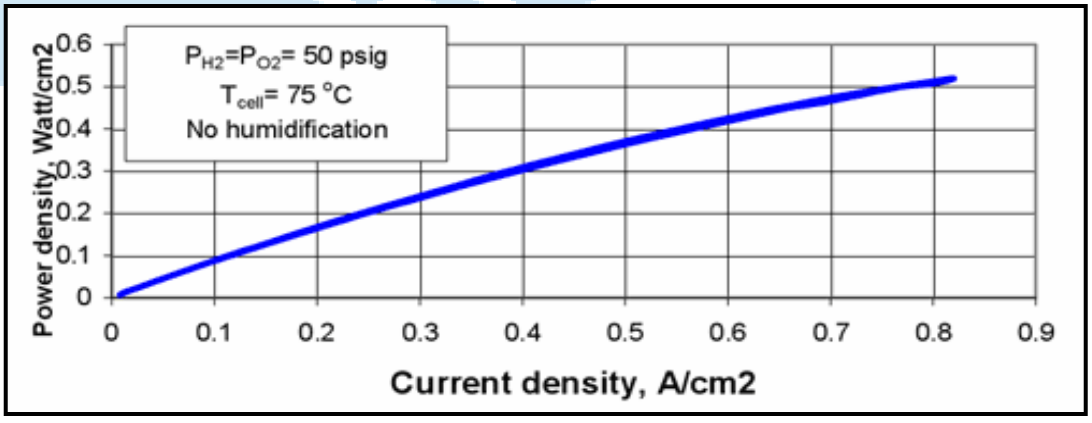
6 *Voltage Measurement Banana Plug*
Measure Exact Cell Voltage
(using the highly electrically conductive graphite plate)
Eliminate Voltage Drop due to Contact Resistance

7 *Silicone Rubber Heater*
Provide Highest Watt Density
Maintain Uniform Cell Temperature
(using the highly thermally conductive graphite plate)

ElectroChem, Inc. offers versatile fuel cells with different flow field designs and sizes on the graphite separator plates, which may be interchanged as needed (based on the same hardware), to meet a researcher's needs.

Flow Field Design	Item Number	Active Area
Column	FC-25-01	25cm²
Serpentine	FC-01-02	1cm²
	FC-05-02	5cm²
	FC-25-02	25cm²
	FC-50-02	50cm²
Parallel	FC-25-03	25cm²
	FC-50-03	50cm²
Serpentine with Reference Electrode	FC-05-02-REF	5cm²
	FC-25-02-REF	25cm²
Serpentine with H2 Reference Electrode	FC-05-02-H2R	5cm²

ElectroChem, Inc. can also provide each of the fuel cell hardware listed with our MEA's and gaskets. Every fuel cell unit that leaves ElectroChem tested and certified with a performance curve, and is ready for testing when you receive it.



ElectroChem's Phosphoric Acid fuel cell provides an easy assembly structure to install the electrode and fill the liquid phosphorus and electrolyte.

Flow fields machined into the blocks allow for the flow of reactants and provide excellent electrical contact to the phosphoric acid matrix assembly electrodes (ordered separately).

Current is collected by connection to copper contact plates; separate voltage connectors are provided directly in the cellblocks for maximum accuracy in iR measurement. Each unit includes resistive heaters and thermocouple wells for accurate temperature control.

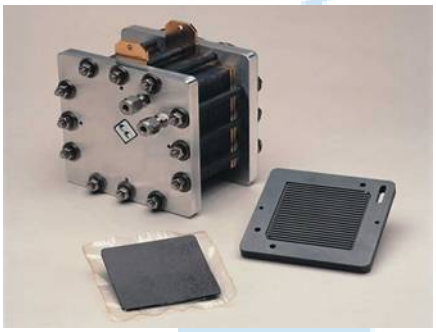
The cell is equipped with a reservoir for the continuous supply of phosphoric acid to electrodes

Since the electrolyte in a Phosphoric Acid fuel cell is a liquid, the solution must be soaked in a matrix so that it can be contained in the fuel cell.

ElectroChem, Inc. provides **phosphoric acid matrix assemblies** which consist of Pt Catalyst with silicone carbide coating matrix to carry hydrogen iron from the anode to the cathode. The operation temperature range is 100 to 200° C.

ElectroChem's Direct Methanol fuel cell (**DMFC**)

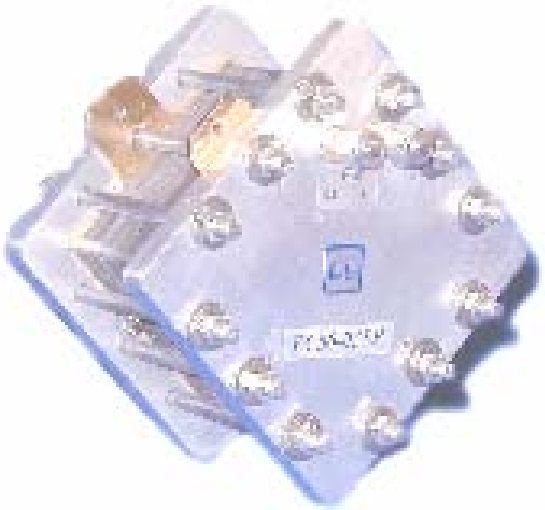
ElectroChem, Inc. also provides its fuel cell hardware with the compatibility of direct methanol applications.



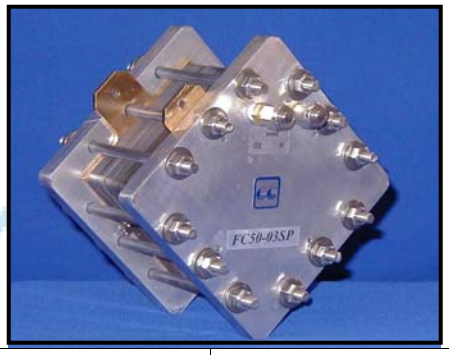
Flow Field Design	Item Number	Active Area
Column	FC-25-01-DM	25cm²
Serpentine	FC-01-02-DM	1cm²
	FC-05-02-DM	5cm²
	FC-25-02-DM	25cm²
	FC-50-02-DM	50cm²

ElectroChem, Inc.'s own Pt/Ru **MEA**'s are available customized to work with Direct Methanol research. Please Contact us for customization.

Fuel Cell Stacks



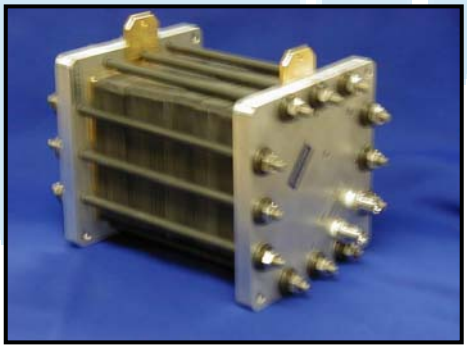
ElectroChem, Inc's PEM fuel cell stacks are designed for ease of use and assembly and disassembly.



The fuel cell stacks are classified by the amount of watts of power that they can generate: 50W, 100W and 200W. Below are the specifications of the three different stacks.

	50W	100W	200W
Nominal power output:	**50**	**100**	**200**
Dimensions:	**15 cm**	**19 cm**	**35 cm**
Net weight:	**4 kg (8.8 lbs.)**	**4.5 kg (10 lbs.)**	**6.4 kg (14 lbs.)**
Electrode Assembly:	**50 cm^2, 7 MEAs**	**50 cm^2 14 MEAs**	**50cm^2 28 MEAs**
Humidification:	**Dependent on O_2 or Air flow rates**		
Cooling:	**External fan recommended**		

We also offer **custom PEM fuel cell stacks** that allow you to modify the stack to meet the total output power of your need. It has a capacity of a minimum of 2 MEAs, and a maximum of 30 MEAs requirements per stack.

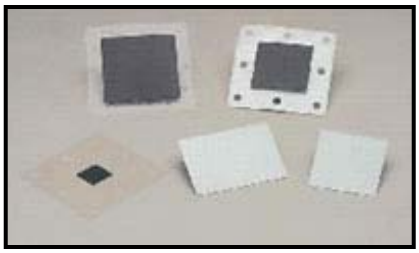


The total power output of the stack may vary based upon the environment (temperature, humidification, etc.) where the stack is operated. Below are the specifications for each PEM cell within a stack.

Nominal Cell Voltage:	**0.65 +/- 0.05 V**
Nominal Current Density:	**400 +/- 50 mA/cm^2**
Humidification:	**Dependent on O_2 or Air flow rates**
Cooling:	**External fan recommended**

Fuel Cell Materials

- **Membrane Electrode Assembly**
- **Proton Exchange Membrane**
- **Electrode**
- **Gas Diffusion Layer (GDL)**
- **Solutions (Nafion, TFE, FEP)**
- **Catalyst (Pt, Pt/Rw)**
- **Gaskets**
- **Separator Plates**



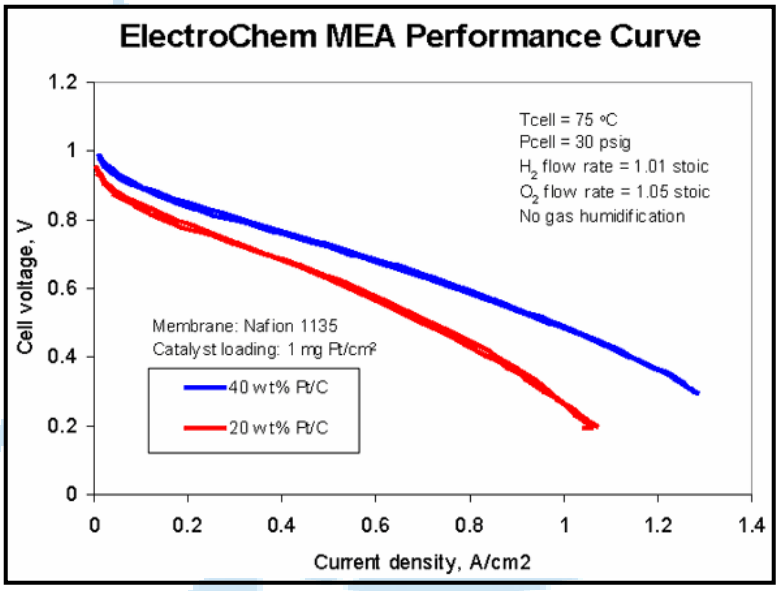
The **membrane electrode assembly (MEA)** is the core component of a fuel cell. It consists of the electrolyte membrane, anode and cathode catalysts, and the gas diffusion layers.

The electrochemical reactions occur when a fuel and oxidant are applied to the anode and cathode side of the catalysts.

The variables in MEA design include but are not limited to: size (active area), shape, materials and catalyst.

Along with its standard MEA, ElectroChem offers a wide range of customizations. (See the chart below)

Our line of MEAs is based on years of experience as well as our own proprietary manufacturing processes and quality control. We have developed a highly reliable product that is unmatched by others, which gives our customers the reliability they have come to expect.



Type	Membrane	Catalyst loading		GDL	Electrode size
		Cathode	Anode		
FC-MEA	Nafion NRE212	1 mg Pt/cm2	1 mg Pt/cm2	Carbon paper	1, 5, 25, 50 Sq. cm
FC-MEA-DM	Nafion 115	1 mg Pt/cm2	1.5 mg PtRu/cm2		

Options for MEA Customization

Membrane	Catalyst loading	GDL	Electrode size
Nafion NRE211 NRE212 115 117	0.3 < Pt < 4 mg/cm2 1.5 < PtRu < 6 mg/cm2	Carbon paper or cloth	11 in x 11 in (28 cm x 28 cm) Sq. cm max

In order for a PEM fuel cell to operate, a **Proton exchange membrane** is needed that will carry the hydrogen ions, protons, from the anode to the cathode without passing the electrons that were removed from hydrogen atoms.

At ElectroChem, we offer DuPont's **Nafion™ perfluorinated ion-exchange membranes** with different thickness.

Part number	Specification	Size
EC-NM-211	NRE211, 1 mil	12 in x 12 in (30 cm x 30 cm)
EC-NM-212	NRE212. 2 mils	
EC-NM-115	115, 5 mils	
EC-NM-117	117, 7 mils	

Nafion™ solution is a diluted liquid form of the same chemical as Nafion™ perfluorinated ion-exchange membranes.

It is typically applied to the electrode layer that drastically reduces the amount of platinum needed as a catalyst by exposing a larger fraction of the platinum to the proton conductive medium.

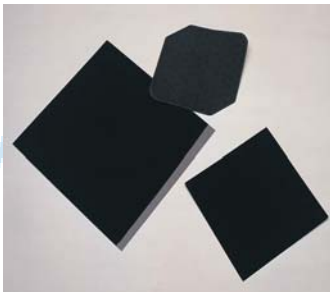
The Nafion™ solution also acts as a binding agent to hold the platinum, membrane, and carbon paper together. Nafion™ solution is perfluorinated ion-exchange solution, 5wt. % in a mixture of lower aliphatic alcohols and water (contains 15% to 20% water).

Both **Teflon PTFE** and **Teflon FEP** are hydrophobic polymers and are the key components used in fuel cells.

Teflon™, like the Nafion™, acts as a binding agent and changes the hydrophobic properties of the diffusion layer. By, coating the carbon paper with Teflon™, this prevents the paper from being saturated by liquid water, while still letting water vapor and gases through the pores.

These hydrophobic polymers can be used directly by mixing with catalysts or coat porous substrate (e.g. Carbon Paper or Carbon Cloth) to a variety of Teflon content.

Anode and cathode electrodes for a fuel cell consist of catalyst loaded onto a gas diffusion layer (GDL). We use carbon supported Pt or Pt/Ru catalyst for the best catalyst dispersion and utilization.



The electrode is hydrophobic to reduce flooding issue during fuel cell operation.

ElectroChem's gas diffusion electrodes are used in PAFC and PEM membrane electrode assemblies as well as in different types of batteries. We use Platinum/Carbon catalyst with various loadings laminated to a hydrophobic GDL.

Our standard electrode is made with 10wt% and 20 wt. % Pt/C and 30 wt% Pt/Ru catalyst on carbon paper. We also offer a selection of customized electrodes (see chart below).

Part number	Catalyst	Loading	GDL	Size
EC-10-05-Pt	10wt% Pt/C	0.5 mg Pt/cm2	Carbon paper	7 in x 7 in (17 cm x 17 cm)
EC-20-10-Pt	20wt% Pt/C	1.0 mg Pt/cm2		
EC-30-15-PtRu	30wt% PtRu/C	1.5 mg PtRu/cm2		

Options for Electrode Customization

Select a Catalyst	Select Loading	Size	Select GDL
-Carbon Supported Platinum -Carbon Supported Pt/Ru	Loading 0.1 – 4 mg/cm^2	Any size and shape from 1 to 784 cm^2 ($28cm^2$ x $28cm^2$)	-Toray™ Carbon Paper -Carbon Cloth

For a fuel cell, the **Gas Diffusion Layers (GDLs)** are fabricated with either carbon cloth or carbon paper. GDLs are porous materials which allow gases to pass through to the catalyst layer. Since carbon is conductive, it facilitates the transport of electrons.

ElectroChem's carbon fabrics are high modulus carbon fiber fabrics made from spun yarn. Fabric alterability results from controlling the yield on rovings and yarns, and allows for a variety of finished composite thicknesses. The carbon cloth is available in either untreated or pretreated form.

ElectroChem is an authorized distributor of Toray™ carbon paper, which is typically used as the gas diffusion layer.

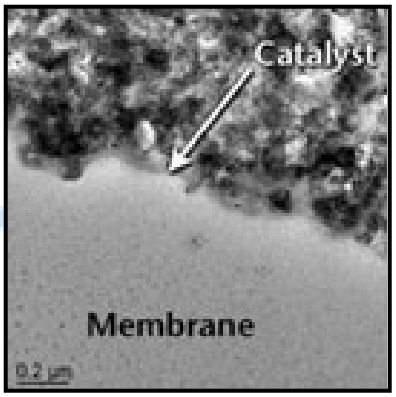
The Toray™ carbon papers are available in pretreated forms. The treated form becomes hydrophobic and prevents the GDLs from becoming saturated by liquid water, while still allowing reactant gas and water vapor to pass through the pores of the material. The normal loading for treated material is 30wt% Teflon™.

Part number	Thickness	Teflon content*	Size
EC-TP1-030T	0.11mm	30 wt%	7.5 in x 7.5 in (19 cm x 19 cm)
EC-TP1-060T	0.19mm		
EC-TP1-090T	0.28mm		
EC-TP1-120T	0.37mm		
* Customized Teflon content is also available			

Part number	Specification	Teflon content*	Size
EC-CC1-060	Carbon cloth	Non	7.5 in x 7.5 in (19 cm x 19 cm)
EC-CC1-060T	Carbon cloth	30 wt%	
* Customized Teflon content is also available			

ElectroChem, Inc. is also an authorized reseller / distributor of **Columbian Chemical's GDM and gas diffusion material**. GDM is a carbon paper based Gas Diffusion layer with Microporous carbon coating based on CC's carbon expertise and advanced deposition technology, The CC's GDM resolves the mass transport limitation in PEM fuel cell applications.

The fuel cell creates power by oxidizing a hydrogen atom into a proton and an electron on the anode electrode and reduced oxygen atom with proton on the cathode electrode.



In a PEM fuel cell, platinum is used as the **catalyst** on the anode and cathode. A direct methanol fuel cell uses a platinum/ruthenium alloy as the anode catalyst and the typical platinum catalyst on the cathode.

Atypical Pt catalysts for fuel cell applications contain 10%,20%,40% or 60% Pt on VULCAN XC-72R carbon support. Typical Electrochemical Area (ECA) for 20% Pt/C is 100 m^2/g. Typical ECA for 10% Pt/C is 140 m^2/g.

Carbon-monoxide-tolerant Pt/Ru catalyst for direct methanol fuel cell applications contains 20% Pt and 10% Ru (1:1 Atomic Ratio) on carbon support. 20% Pt and 10% Ru catalyst exhibits better resistance to CO poisoning and it is well suited for direct methanol conversion fuel cells. The catalyst can also be used in fuel cells operating in conjunction with gas reformers.

ElectroChem is an authorized distributor of **Columbian Chemical's DURA-lyst®** catalysts. These are advanced electrocatalysts for fuel cell applications developed under Columbian Chemical's (CC) unique core competence in carbon nanotechnology and world class technical resources and material laboratories.

The DURA-lyst® catalysts offer advanced durability and performance by improving the corrosion resistance of the carbon support to maintain consistent function of the electrode and enhancing metal stability on the carbon support to preserve the active catalyst surface area. The DURA-lyst® catalysts are available with most accepted metal loading.

ElectroChem offers pre-cut and bulk **gasket material** from four materials; silicone, graphite, Teflon, and fiberglass.

Silicone gasket materials are available in two grades, high precision and low precision. The high precision silicone gasket has a thickness tolerance of +/- 0.5 mils. The low precision silicone gasket has a thickness tolerance of +/- 1 mils.

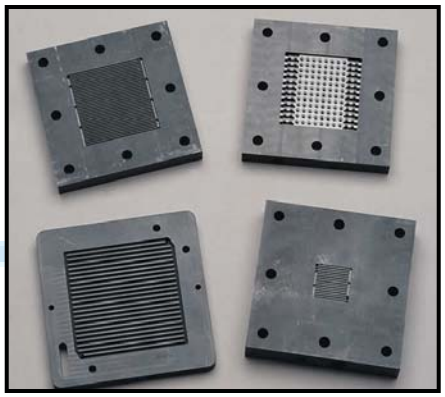
The Teflon and fiberglass reinforced Teflon is used in high temperature applications such as direct methanol fuel cell (DMFC) or phosphoric acid fuel cell.

Replacement gaskets are available for all ElectroChem cells and stacks. The raw gasket material is also available in 30cm x 30cm sheets.

Material (Abbreviation)		Thickness, Mils[1]	Compression %	Application
Silicon High precision (± 0.5 mils)	SIH	5, 10	5-10	normal temp <100 ^{o}C
Silicon Low precision (± 1.0 mils)	SIL	8, 10, 12, 16	5-10	normal temp <100 ^{o}C
Teflon	TFE	5,7,9,10,12,15	<1	high temp > 120 ^{o}C
Silicon coated Fiberglass	FGS	10	2-5	high temp > 120 ^{o}C
Teflon coated Fiberglass	FGT	10	2-5	high temp > 120 ^{o}C
Graphite	GRF	3,5,10	2-5	high temp > 120 ^{o}C

~1mil = 10^{-3} in, 1mil = 25.4micrometer

em: sales@fuelcell.com ph: 1.781.938.5300 fx: 1.781.935.6966



Graphite separator plates are attached on either side of the electrodes of a fuel cell.

These plates act as conductors and are gas impermeable. They distribute the flow of the reactant gas or liquid across the electrode covered by the flow field, making sure that the maximum amount of the gas and liquid comes in contact with the electrode.

The purpose of the flow field on the graphite separator plates is to establish uniform distribution and pressure drop of reactants across the fuel cell and to remove the product water/gas.

Various flow field design concepts have been developed to achieve optimized fluid dynamic requirements. Based on the advances in fuel cell separator plate design and operation on the past, We provide basic flow field patterns, typical types of Column, Serpentine, and Column to fulfill your different needs.

Flow Field Design	Item Number	Active Area
Column	FC25-01-MP	25cm²
Serpentine	FC-01-02-MP	1cm²
	FC-05-02-MP	5cm²
	FC-25-02-MP	25cm²
	FC-50-02-MP	50cm²
Parallel	FC-25-03-MP	25cm²
	FC-50-03-MP	50cm²
Serpentine with Reference Electrode	FC-05-02-REF-MP	5cm²
	FC-25-02-REF-MP	25cm²
Serpentine with H2 Reference Electrode	FC-05-02-H2R-MP	5cm²

Fuel Cell Components

Part number	Description	Details
EC-SWL-N	Nylon Swagelok Fittings	Provide Leak Proof/Torque Free Seal - Set of 4
EC-SWL-TFE	Teflon Swagelok Fittings	Provide High Temperature, Leak Proof/Torque Free Seal - Set of 4

Part number	Description	Details
EC-RPR	Repair Kit Available for: 5cm² 25cm² 50cm²	Our repair kits include: 8 bolts 8 nuts 16 washers 1 set of banana plugs (1 red, 1 black) 2 connectors 16 shoulder washers
EC-N-SW	Nylon Shoulder Washer	Set of 4
EC-RPR-BJP	Banana Jack and Plug	Red or Black
EC-RPR-NSW	Nylon Shoulder Washers	Box of 20
EC-RPR-TSW	Teflon Shoulder Washers (Tie Rod Insulators)	Box of 20
EC-H-SR1	Silcone Rubber Heater (2"x2") for 5cm², 25cm² and 50cm² Fuel Cells, 60W, 120V	Single Item

Fuel Cell Test Systems

- **PowerStation™**
- **Manual Testing Units**

What is the Power Station™?

The Power Station™ is an integrated family of laboratory modules that provide data acquisition, operational control, gas management, humidification, and temperature controls for fuel cell testing In each system there is a:

1) Power Station™ System Controller (and Load)

2) Integrated Power Station™ Software

3) One or more gas management units

4) Additional optional components (Direct Methanol Testing)

Compatible Modules and Accessories

•*CompuCell* - 2 humidified and controlled gas lines

•*PS-R* (Reformer) 6 Independently Controlled Gas Lines for Simulated Reformer Gas supply

•*PS-DR* - (Dual Range) 2 gas lines with 4 MFCs for high dynamic range

•*HSS* - System Controlled Humidifier (humidification for PS-R and PS-DR)

What is the PS-Ultima™?

The PS-Ultima™ is a special variation of the Power Station™ that provides the ability to test up to five fuel cells simultaneously while under independent gas management, humidification, and temperature controls. Its main modules are:

1) PS-Ultima™ System Controller (and Load),

2) CompuCell™ gas management unit,

3) Ultima gas management unit (humidified and controlled gas lines

4) Integrated PS-Ultima ™ Software.

Compatible Modules and Accessories

•*CompuCell™* - 2 humidified and controlled gas lines

•*DMFC* - Methanol reservoir and fuel pump. Computer Controlled for precision, variable condition, and unattended testing.

•*GTL* - Heated Gas Transfer Lines. Temperature controlled by the Power Station , guaranteeing gas conditions to the cell.

•*Moisture Traps* - Capture of downstream condensed water.

Controller	Gas Management	Accessories	Application	Config.
Power Station ™ System Controller and Software	CompuCell™	DMFC, GTL, & Water Traps	Testing of Catalysts, MEAs, Single Cells, Stacks, and Direct Methanol Fuel Cells	1
	PS-R (Reformer) & HSS (Humidifier)	GTL	Simulated Reformer Performance of Catalysts, MEAs, Single Cells and Stacks	2
	PS-DR (Dual Range) & HSS (Humidifier)	GTL	Wide dynamic Range Testing of Single Cells and Stacks	3

Common Power Station™ Configurations

PowerStation™ Equipment Configuration Chart

	PS-CompuCell	PS-Dual Range	PS-Reformate	PS-Ultima
System Configuration				
Number of Individual Cells	1	1	1	5
Maximum Power (W)	2000	2000	2000	800
Number of Internal Humidifiers[1]	2	2	2	10
Automatic Water Removal				
Automatic Water Refill[1]				
Heated Gas Lines[1]				
Computer, ethernet capable, CD R/W				
Power Station Software				
Programmable Duty Cycle				
Gas Management				
Low and High Oxidant Flow Rates				
Low and High Fuel Flow Rates				
Number of Oxidant Gas Flow Controllers	1	2	up to 2	5
Number of Fuel Gas Flow Controllers	1	2	up to 4	5
Pressure Transducers				
User Defined Flow Control Range				
Fuel & Oxidant Purge Lines				
Methanol supply line				
TDI Electronic Load Bank				
TDI Electronic Load Bank				
Dynaload-High Quality, Low Voltage Measurements				
Accuracy: ± .25% FS for med/high ranges				
± .50% FS for low range				
Accuracy: ± 3% FS for all ranges				
Resolution: .25% of full scale				
Measurements				
Cell Temperature, +/- 0.1 C				
Gas Temperature, +/- 0.1 C				
Gas Flow, +/- 2% FC				
Gas Pressure, 60 psig max.				
Cell Voltage, OCV to 0.05 V				
Cell Current				
Safety				
Low Gas Pressure Shutdown				
Isolated Purge Gas for Fuel & Oxidant				
Fuel Enable Interlock Switch Protection				
Programmable Fault Protection of Fuel Cell				
Safety Alarm and Push Button Instrument Shutdown				
Automatic High Temperature Shutdown				

[1] Available as an option

Power Station™ - Key Features

Features Common to all Gas Management Modules

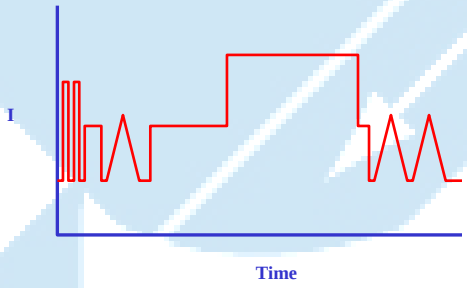
- 50 psig operation
- Manual backpressure regulators
- NEMA rated solenoid valves
  - Normally closed on reactant lines (for safety)
  - Normally open on purge lines (for safety)
- Reactant lines separated by leak-free solenoid valves
- Strategically located check valves prevent back-flow of reactant gases
- Precision, all stainless steel mass flow controllers (same as those used in the semiconductor industry)
- Under programmed control of the Power Station™
- Gas flow accuracy +/- 1% of full scale
- Gas flow precision +/- 0.2% of full scale
- Gas flow resolution 0.1% of full scale
- Seamless #316 stainless steel tubing throughout
- Factory leak-checked

Integrated Software for Safety and Flexibility

- Integral to the Power Station™
- Not based on general purpose lab test software
- Not adapted from battery test
- Not modified from a 3rd party product
- Safety Designed In - for Unattended Operation
- Quick and Easy Test Configuration
- Real-Time Graphic Data Output
- User Friendly Graphic User Interface

Very Wide Flexibility in Load Control Sequences

•Stepped, Ramped, Constant Load Control
•Simulates Real-World Power Applications

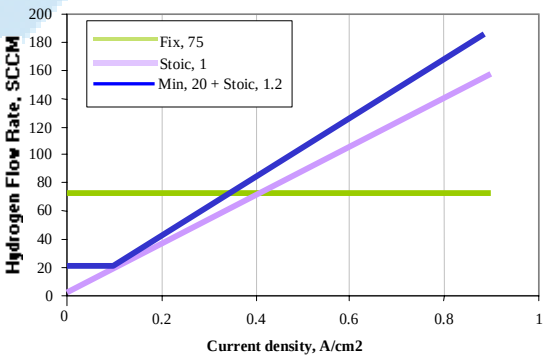


System Control Features

Independent Control of Each Mass Flow Controller Pressure switches sense gas supply pressure defines safe operation for reactant and purge gas supplies Pressure transducers sense back pressure senses gas leak for safety shutdown PID Temperature control software provides precision temperature control of humidifier sand fuel cells

Fixed, Load Following, and Combination Gas Flow Control Options

a) Fixed Flow
b) Stoichiometric Load Following
c) Fixed minimum plus load Following



State of the Art Humidification Control

•Proprietary design

•Dual reservoir construction

•Complete saturation at 75°C and 2 liters/min.

•No erratic flow or water slugs in gas supply to cell.

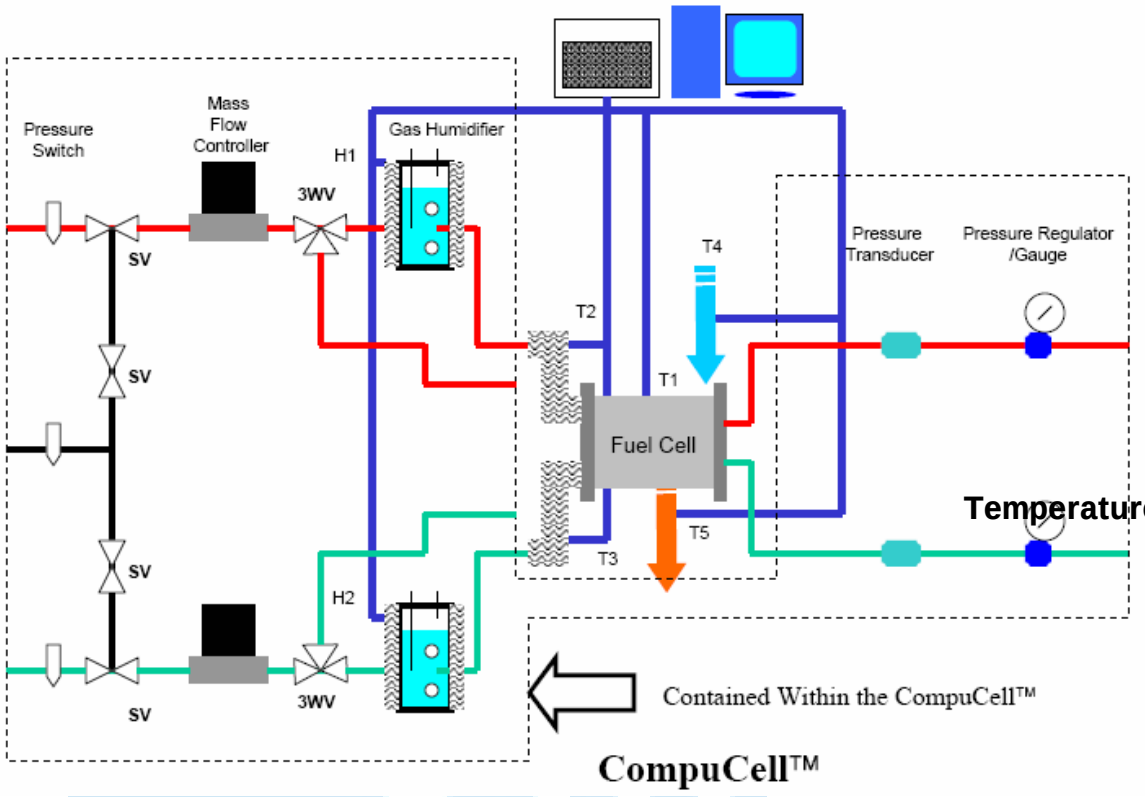
•Front panel sight tubes indicate water level

•Controlled by PID temperature control algorithm (parameters set in Power Station™ Software)

•Contact thermostats provide high temperature automatic cutoff for safety (automatically reset)

•Front panel sight tubes indicate water level

•Easy refill of water reservoirs



Temperature Control Schematic

H1: Anode humidifier temperature
H2: Cathode humidifier temperature

T1: Fuel cell temperature
T2: Anode gas inlet temperature
T3: Cathode gas inlet temperature
T4: Coolant inlet temperature
T5: Coolant outlet temperature

MTSA-150 Fuel Cell Test System

MTS-A-150™

2 Precision Calibrated Mass Flow Controllers
- Key pad programmed for a wide range of gases
- Digital Flow Rate Display (sccm)
- 1000 sccm capacity

2 Back Pressure Regulators
- Analog Pressure Display (psi)

1 Temperature Controller
- Precision PID algorithm
- 330 Watt AC output

Specifications

Pressure
- Maximum Backpressure 60 psig (2.3 Bar)

Digital Fluid Flow Display
- 4 digit display, minimum resolution 1 sccm
- Flow Accuracy, 1.5% of Full Scale

Fluid Connections
- 1/4" Swagelok™ Tubing Connectors
- Front Panel
  - Output to Fuel Cell 2
  - Return from Fuel Cell 2
- Rear Panel
  - Input Reactant Gases 2
  - Vent of Reactant Gases 2

Electrical Accessories
- Type K Thermocouple
- 2 prong AC Heater Cord

Temperature Controller
- Front Panel Readout and Control
- 330 W PID Controller (AC)

Physical Characteristics
- 19" W x 5.25" H x 13" D
- (48 cm x 14 cm x 33 cm)
- 20 lbs. (9 kg)

Electrical Requirements
- 110 VAC 5A (or 220 VAC 2.5A)

For Complete Information and Pricing go to: www.fuelcell.com

em: sales@fuelcell.com ph: 1.781.938.5300 fx: 1.781.935.6966

DMFC™ Direct Methanol Unit

ElectroChem's Direct Methanol Unit provides a controlled source of high purity methanol or methanol/water solution for testing of methanol powered fuel cells.

•Safe Operation with any methanol concentration.

•Operating pressure up to 20 psig.

•Temperature controlled methanol supply.

•Digital readout and setting of temperature

•Digital readout of flow rate

•Storage capacity 1 liter.

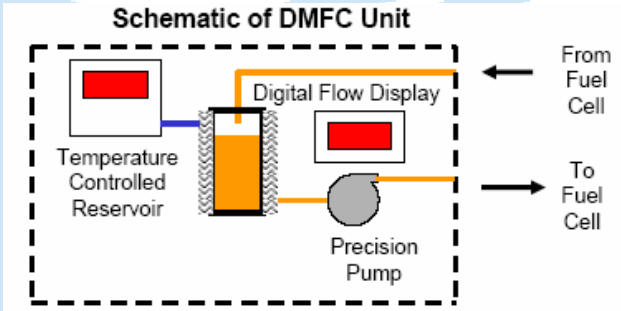
•All Stainless Steel Internal Plumbing

Automatic or Manual Flow Control

Automatic - flow rates under control of Power Station™

Compatible with Heated Gas Transfer Lines to maintain fluid temperature control

Manual - 10 Turn Potentiometer Flow Control



Specifications

Pressure

Maximum Bottle Pressure 20 psig (2.3 Bar)
(Pressure relief valve set at 20 psig for safety.)

Fluid Capacity

1 liter bottle

Pump Characteristics

Flow Rate 0.017 ml.rev. 68 ml/min max flow rate.
Max. differential pressure 20 psi.

Digital Fluid Flow Display

4 digit display, minimum resolution 0.01 ml/min

Fluid Connections

1/4" Swagelok™ Tubing Connectors
Front Panel

Output Methanol Reactant	1
Return of Reactant to Bottle	1
Ports for Refill of Bottle	1
Ports for Drain of Bottle	1

Temperature Controller

Front Panel Readout and Control
(Bottle temperature is not controlled by Power Station™)

Physical Characteristics

5" W x 18" H x 12" D
(44 cm x 31 cm x 47 cm)
20 lbs. (9 kg)

Electrical Requirements

110 VAC 4A (or 220 VAC 2A)

Manually Operated Independent Humidifier Units

Three Configurations Available

- **Highest Quality Humidification Capacity**
- **Two Independent Gas Lines**
- **A Decade of Product Refinement**

“State of the Art” Humidification Control

- **Proprietary design**
- **Dual reservoir construction**
- **Complete saturation at 100°C and 20 liters/min.**
- **No erratic flow or water slugs in gas supply to cell.**
- **All stainless steel construction**
- **Controlled by independent programmable PID temperature controllers**
- **Contact thermostats provide high temperature automatic cutoff for safety (automatically reset)**
- **Front panel sight tubes indicate water level**
- **Easy refill of water reservoirs**

The HSA™ humidifier unit is used to provide humidification to two reactant gas supply lines for the electrochemical testing of PEM, alkaline, and phosphoric acid fuel cells. It provides enough capacity for single cells and fuel cell stacks. This unit is often used to support the

MTS-150™, MTS-A-150™, and ECL-150™ units to provide manually controlled fuel cell testing.

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Suggested Accessory

GTL - Heated Gas Transfer Lines. Temperature controlled by the Power Station, guaranteeing gas conditions to the cell.

Specifications

Pressure

Maximum Operating Pressure 50 psig (4.5 Bar)

Humidifiers (each)

100% saturation at 75°C for Input Gas Flow of

2000 ml/min.

2 liter water bottles (max. fill capacity 1.6 liters)

Physical Characteristics

17 1/2" W x 12 1/4" H x 18 1/2" D

(44 cm x 31 cm x 47 cm)

20 lbs.. (9 kg)

Gas Connections

1/4" Swagelok™ Tubing Connectors

Front Panel

Input Reactant Gases	**2**
Output Humidified Reactant Gases to Fuel Cell	**2**
Ports for Refill of Humidifier Bottles	**2**

Electrical Requirements

110V AC (or 220V AC)

HSA™	**7A (or 3.5A)**
HSA-TC™	**10A (or 5A)**
HSA-TC-GTL™	**10A (or 5A)**

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Fuel Cell Test Equipment Components

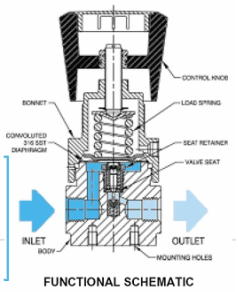
Mass Flow Controller

The Mass Flow Controller is designed to measure and control the flow of gases in a wide variation of flow capacity. The control valve is normally closed. For fuel cell operation, the mass flow controller can be programmed to provide controlled flow rates based on a constant rate or a stoichiometric ratio.

Moisture Trap

ElectroChem's moisture trap is designed to provide automatic water removal from fuel cell exhaust streams. The moisture trap prevents flooding of the backpressure regulators and allows recirculation of water into humidifiers water supply vessel. The moisture trap can be operated nattended indefinitely.

Back Pressure Regulator



FUNCTIONAL SCHEMATIC

A back pressure regulator is used to control the upstream of pressure in a fuel cell test system, while allowing gases to flow through a diaphragm. The diaphragm operates like a sensitive adjustable relief valve so that the fuel cell system pressure can be kept constant at varied gas flow conditions. These back pressure regulators can work up to a **200° C** environment with a control pressure of **0 to 50psig**; and have a flow capacity of **0.3Cu**.

Part number	Description	Details
EC-MFC	Mass-Flo Controller	Measure and Control the Flow of Gases
EC-MT1	Moisture Trap	Water Trap and Drain
EC- BPR1	Back Pressure Regulator	Gas Flow Back Pressure Regulator