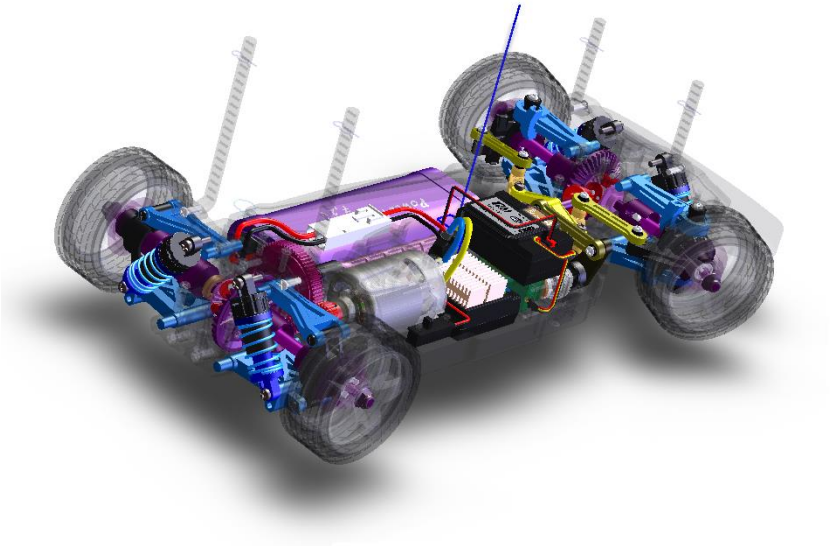
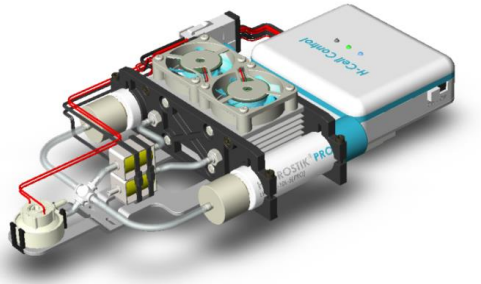
FCAT – 30
H2Hybrid Fuel Cell Automotive Trainer
Product Presentation

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

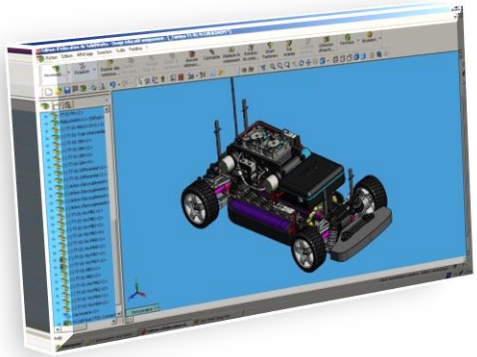
EN

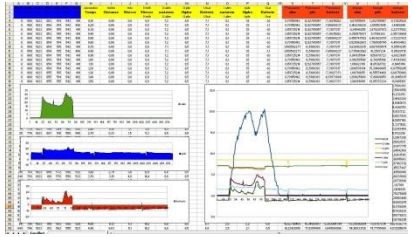


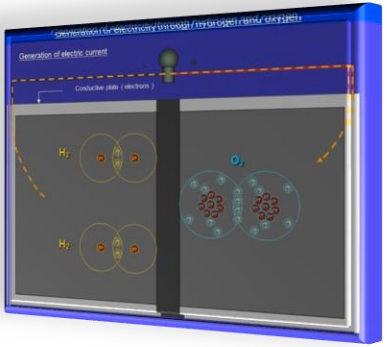


Horizon Educational

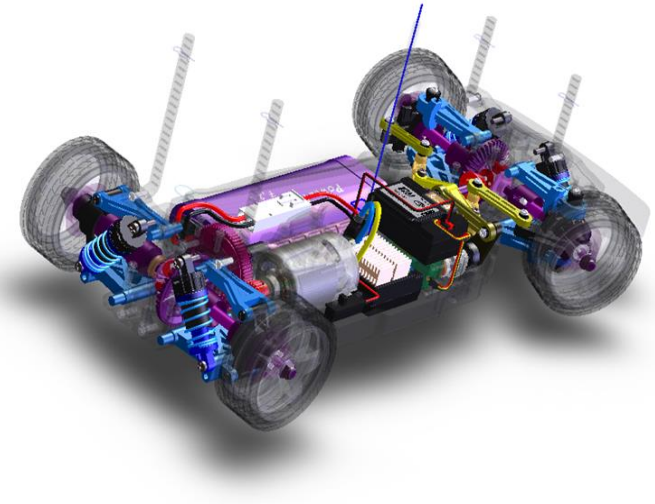
Easy Navigation



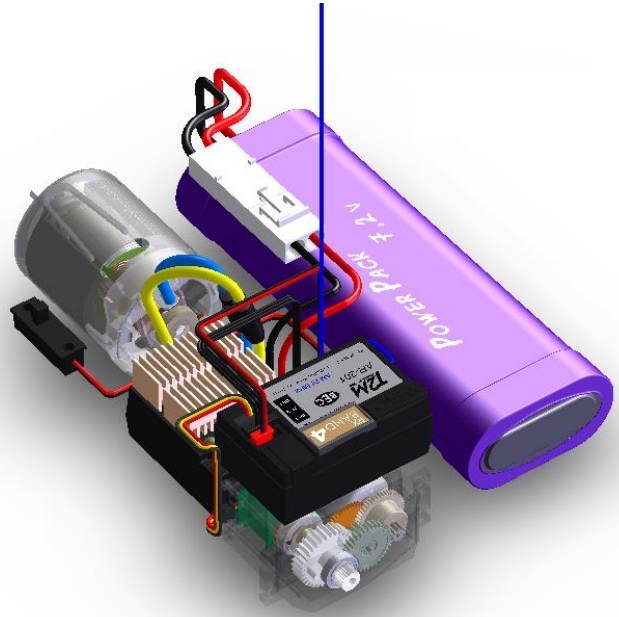




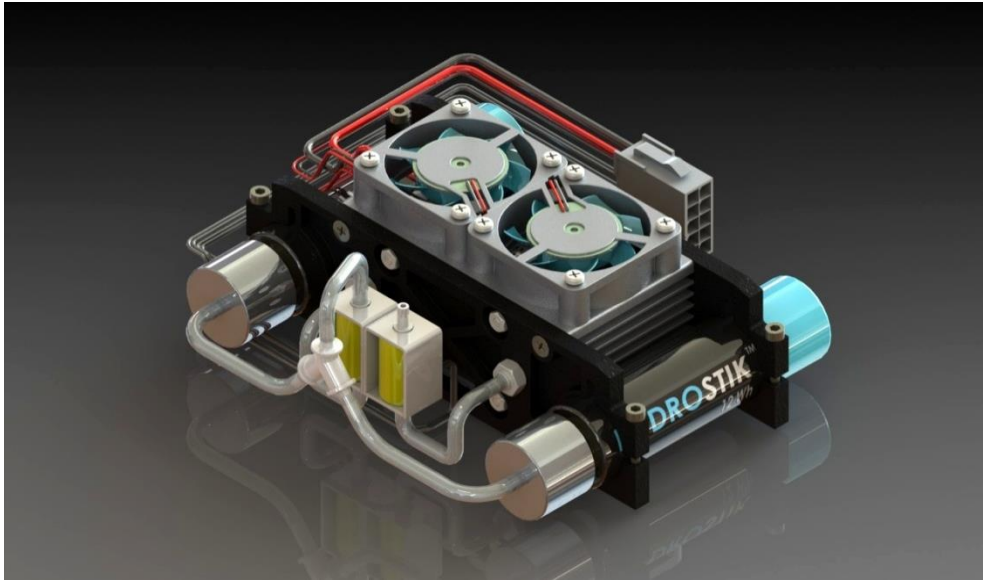
- Mechanical studies
- Electronic struture
- Hcell studies
- Battery
- Electronic measures
- Energy MIX, hybrid Energy sources
- Chemical & physical applications
- Real cars and tamiya comparison



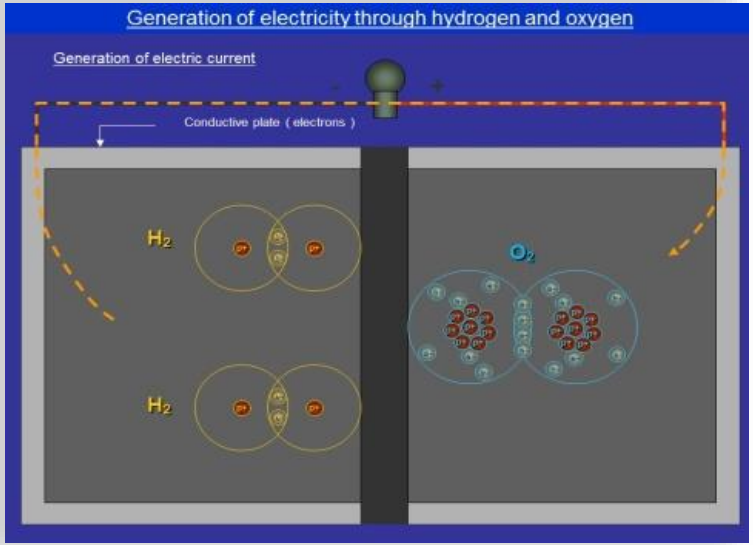
- Mechanical Systems



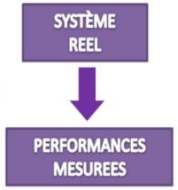
Electronic Systems



- H-cell System



- Chemical & physical applications



- Dimensions, weight
- Energy, power,
- Performances
- In-board energy and autonomy

- Real cars and tamiya comparison

VERSION 2 IMPROVED

On FCAT-30:

- New car 4 wheels drive in the market, spare parts available for a long time
- Arduino Yun microcontroler board with built-in web server
- shield board compatible Arduino without display, no risk to brake display during the trial
- Plexiglass part to protect the board
- Inhibited reverse gear to avoid a measuring board broken during the track tests
- Communication via wifi for PC, tablets and smartphones
- On track, communication http using internet browser (php5)
- Data storage directly in the car
- data saved on PC, tab, smartphone on .csv format compatible with spreadsheet
- socket key on measuring board to avoid connections error
- External power supply to avoid power consumption in measuring curves data

VERSION 2 IMPROVED

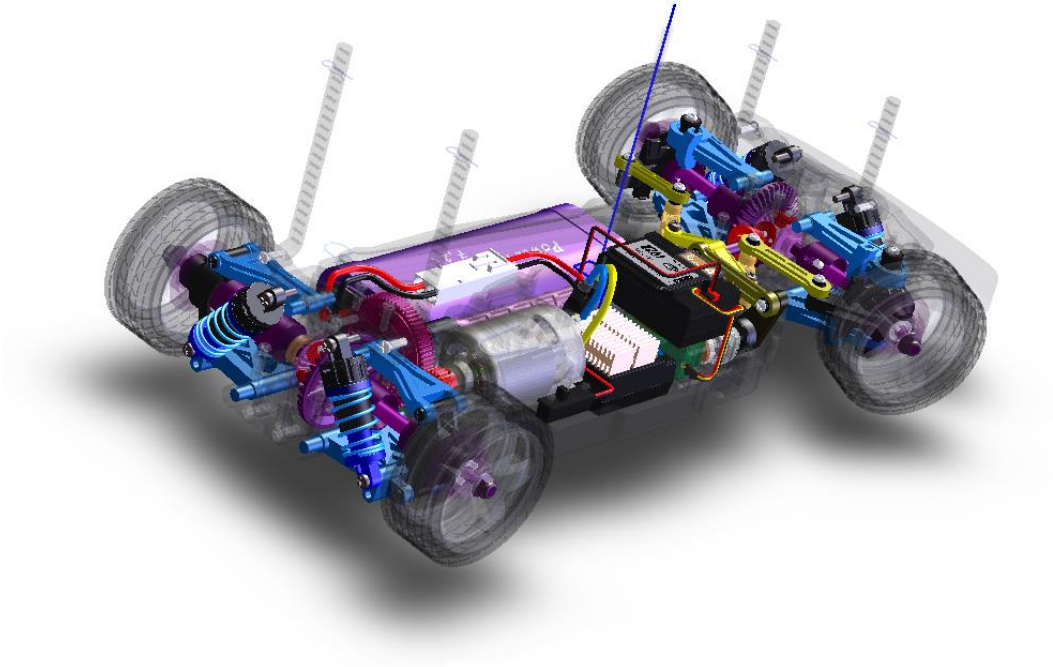
On the bench :

Aluminum bearing housing, no risk to brake during transportation

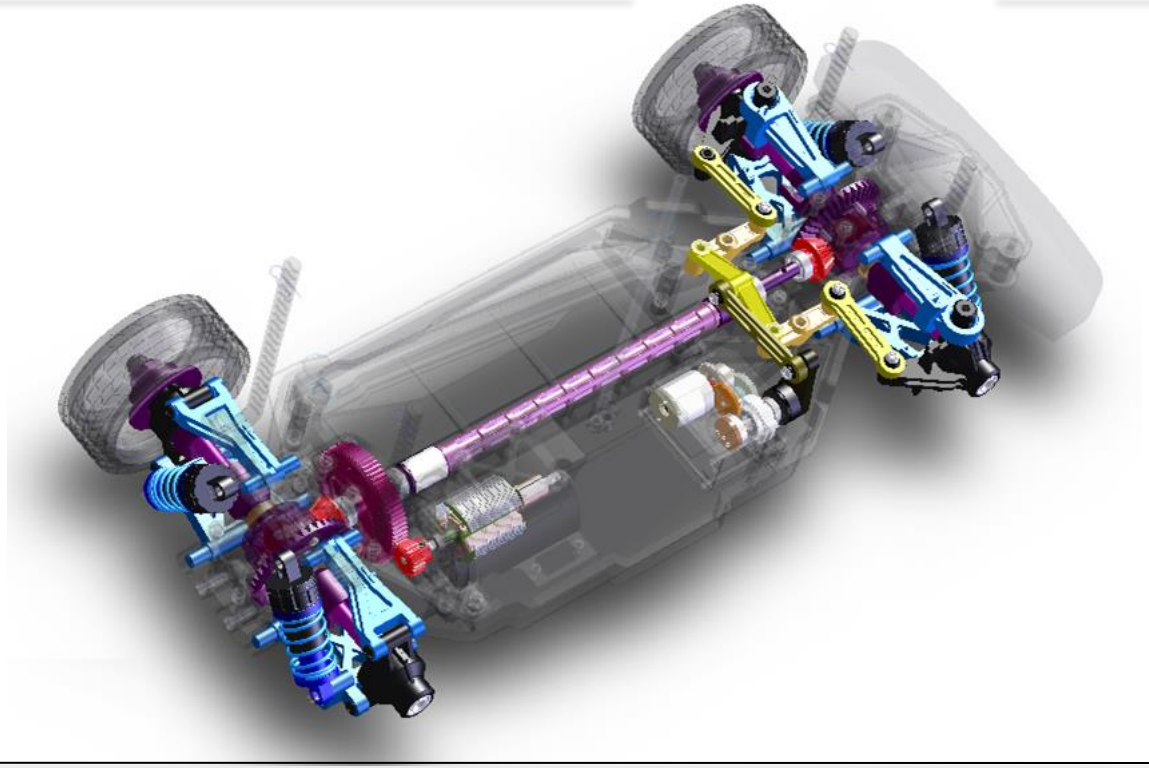
New brake sensor, stronger and reliable than previous one

New brake system, reliable and better appearance than V1 version

Improved wires trunk to connect the car

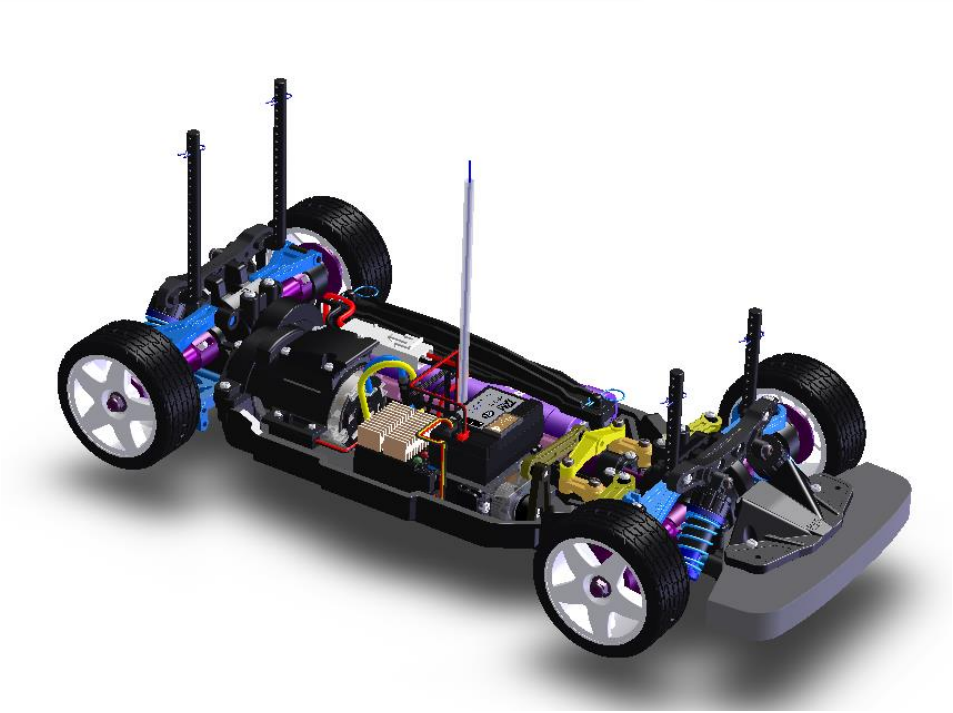


1A - TT-02 basic model



1A - TT-02 basic model

- New model TT02
- Long life time system
- Strong build
- Reliable parts
- Easy to find worldwide

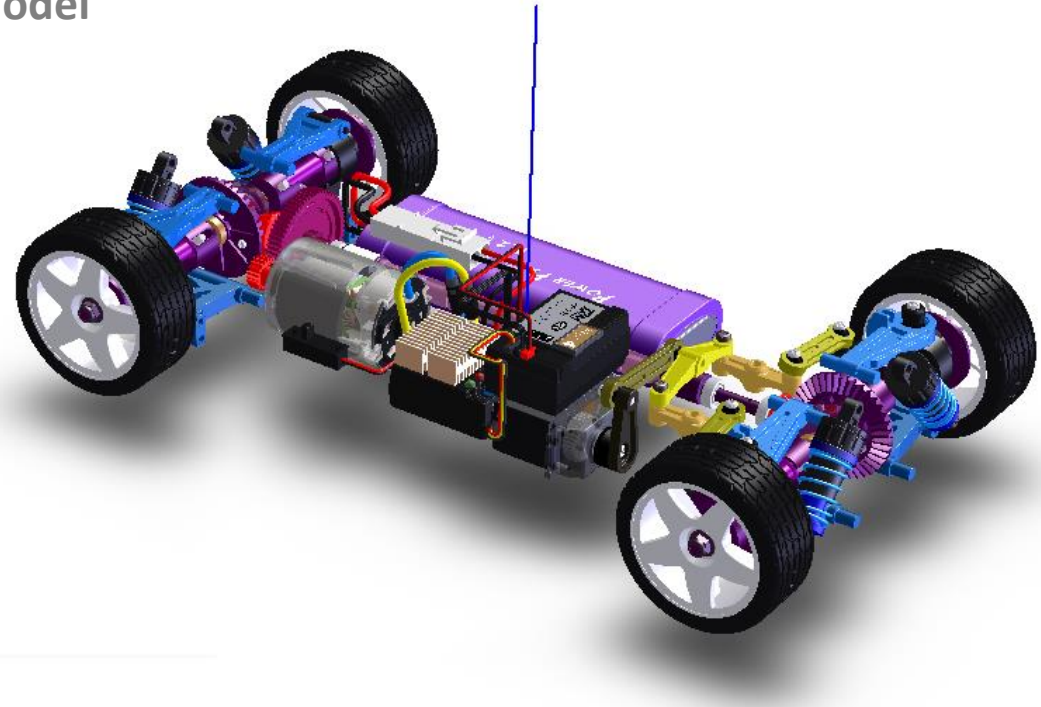


1A - TT-02 basic model

- 1/10 scale
- 4 wheels drive car
- Current drive motor - mabuchi 540
- Remote control - 2.4Ghz
- Battery - Ni-Mh 7.2V – 4200mAh
- Standard connections - Deans

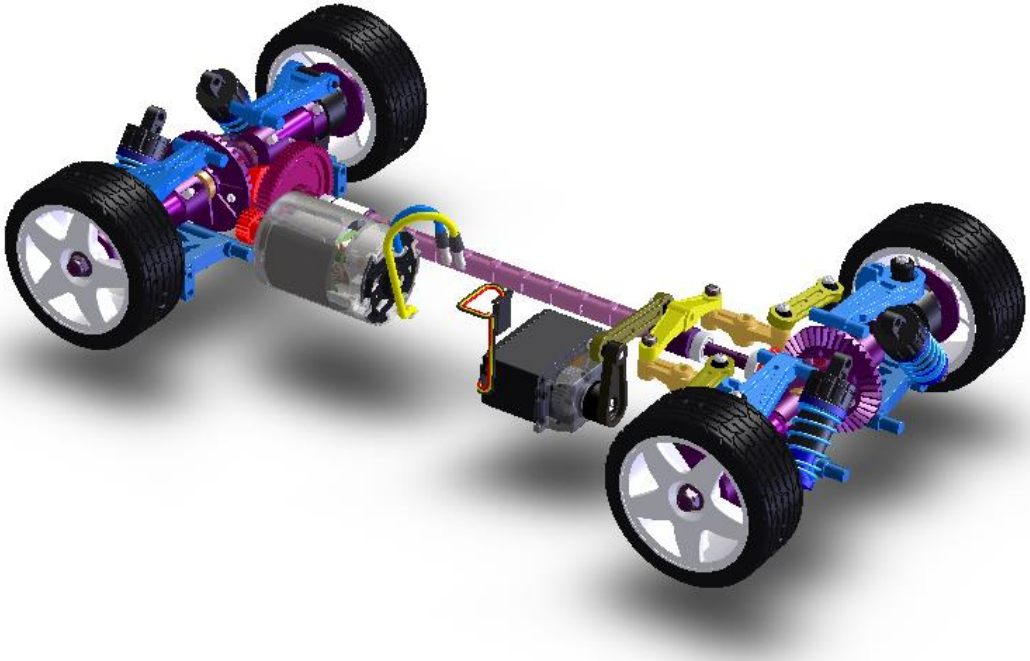
And the bench ?

1A - TT-02 basic model



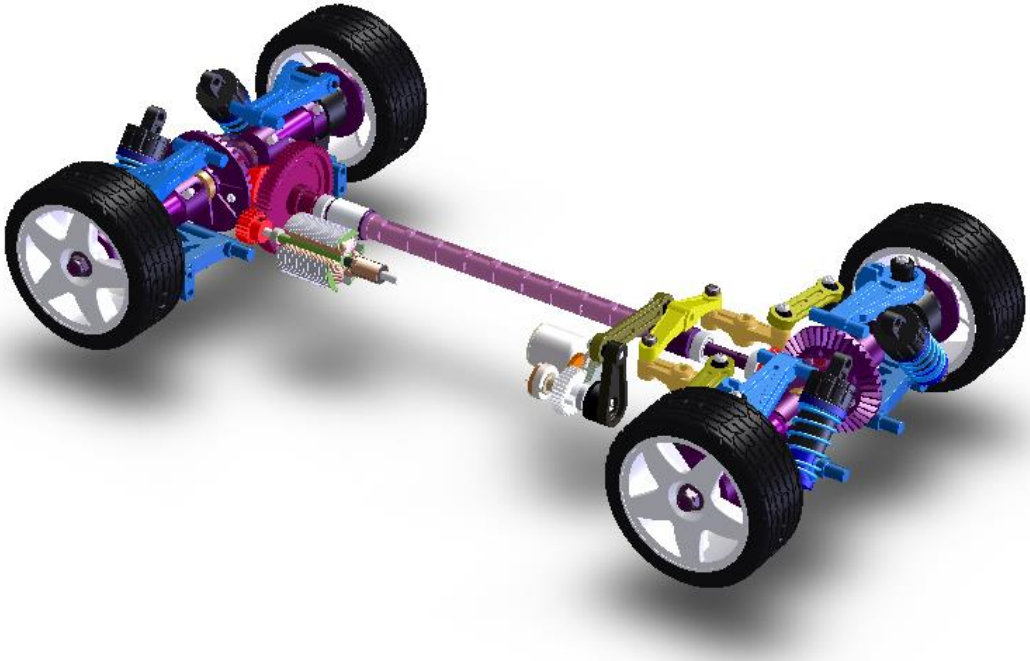
HOMOTHETIC WITH REAL CARS

1A - TT-02 basic model



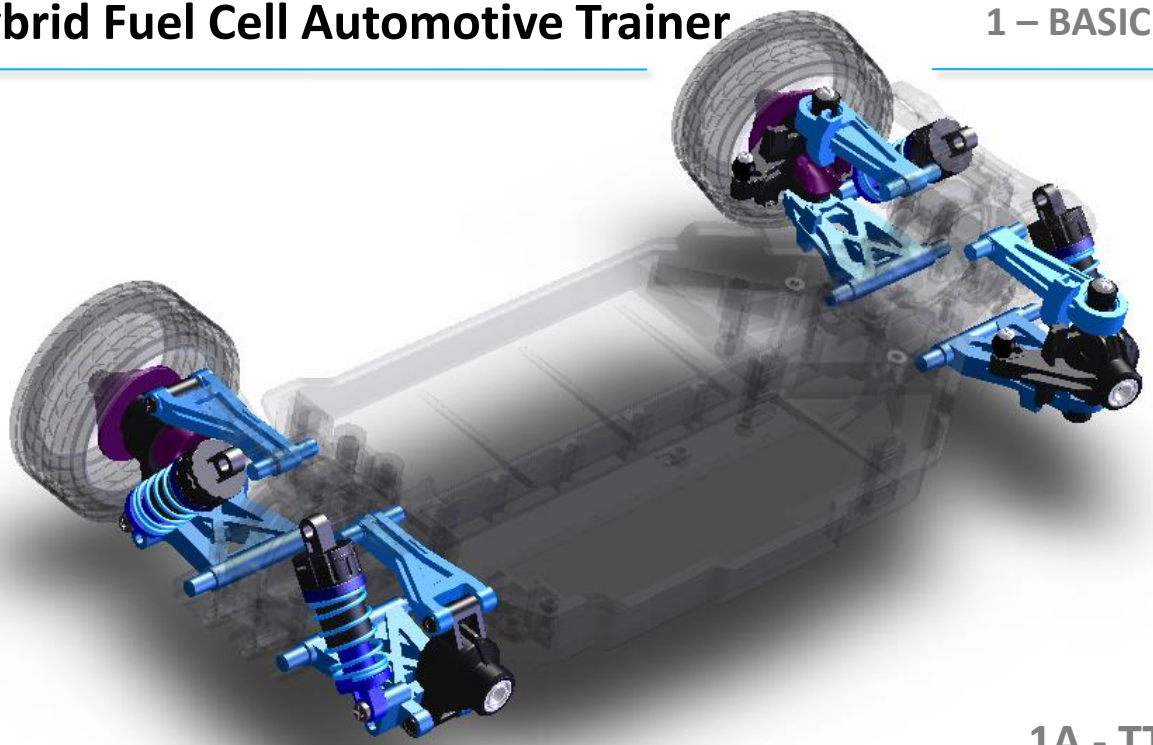
MECHANICAL
RESSOURCES
AVAILABLE

1A - TT-02 basic model



Suspension

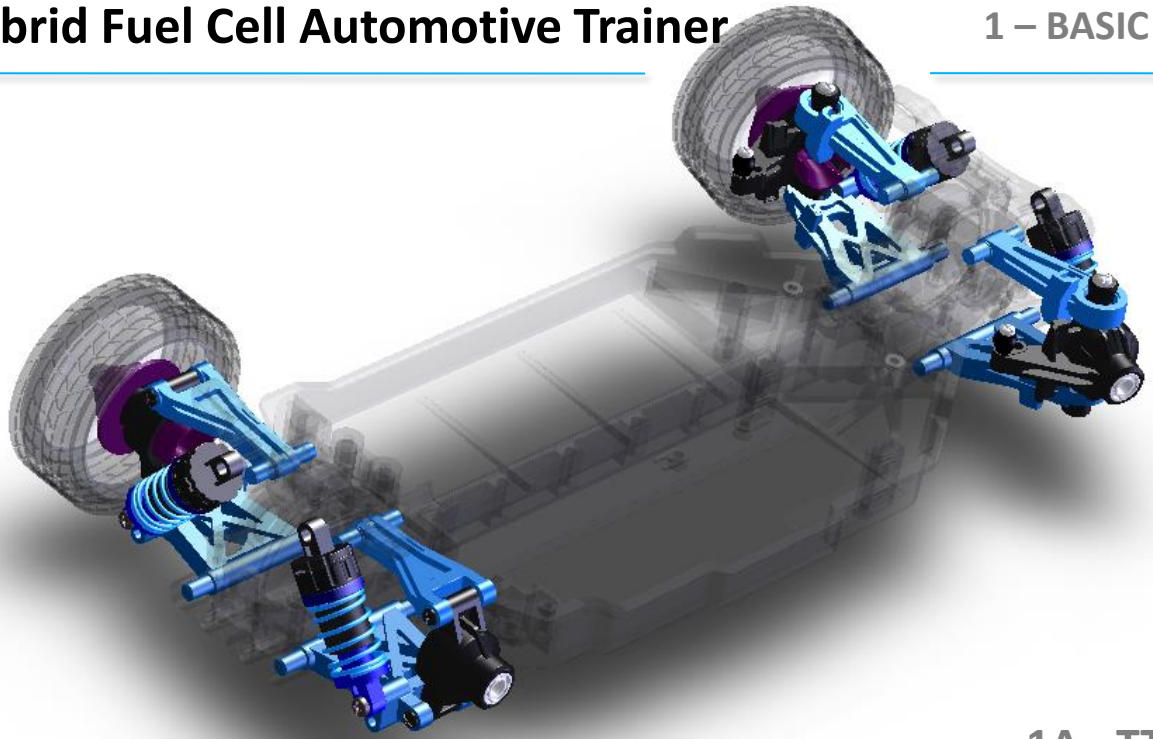
Animation



1A - TT-02 basic model

Suspension

Animation



1A - TT-02 basic model

Steering system

Animation

1A - TT-02 basic model

Steering system

Animation

1A - TT-02 basic model

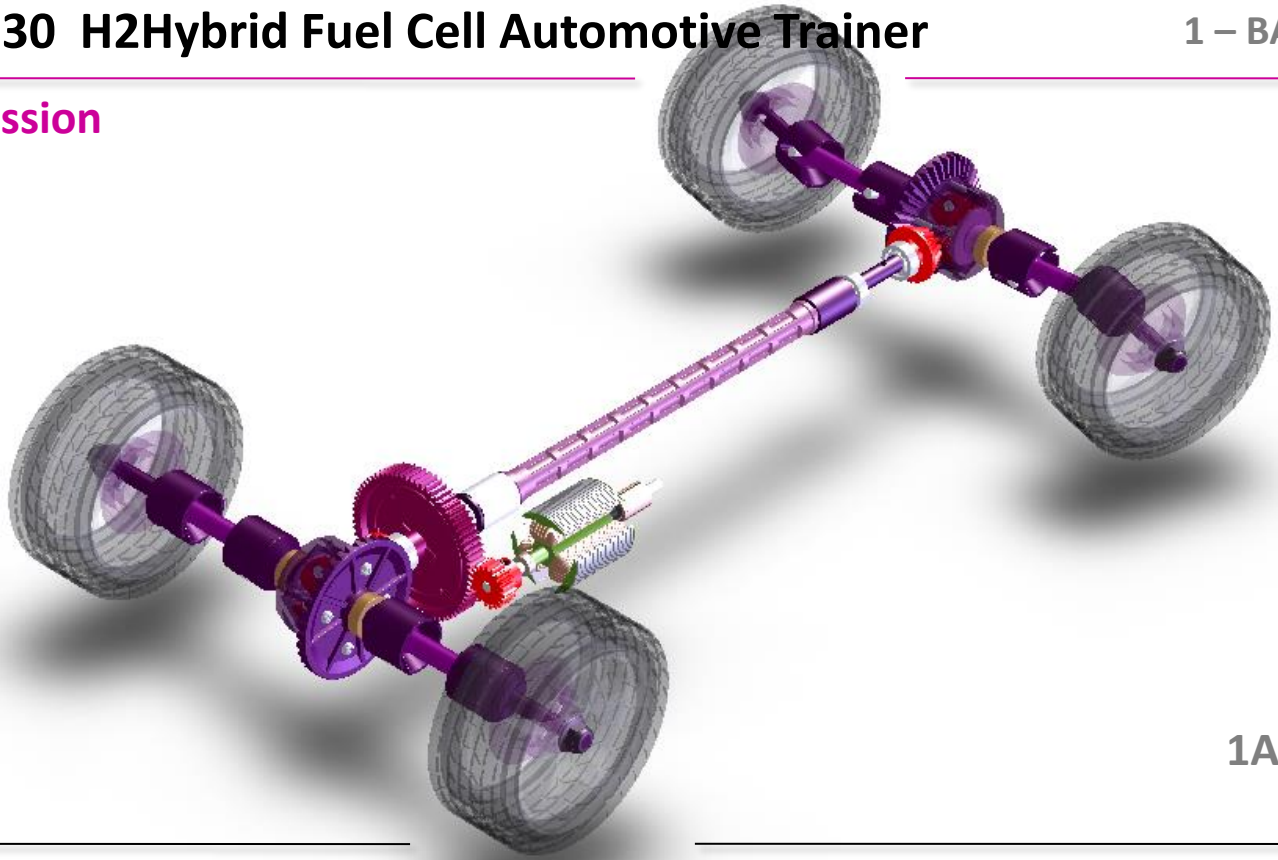
Steering system

Animation

1A - TT-02 basic model

Transmission

Overview

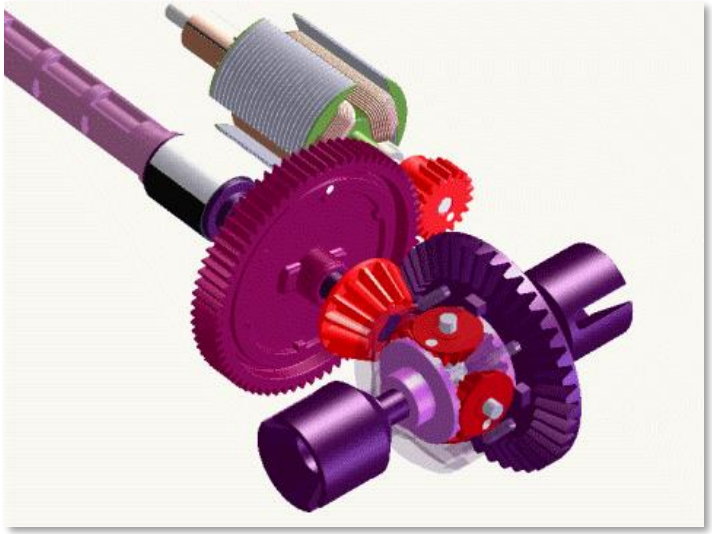


1A - TT-02 basic model

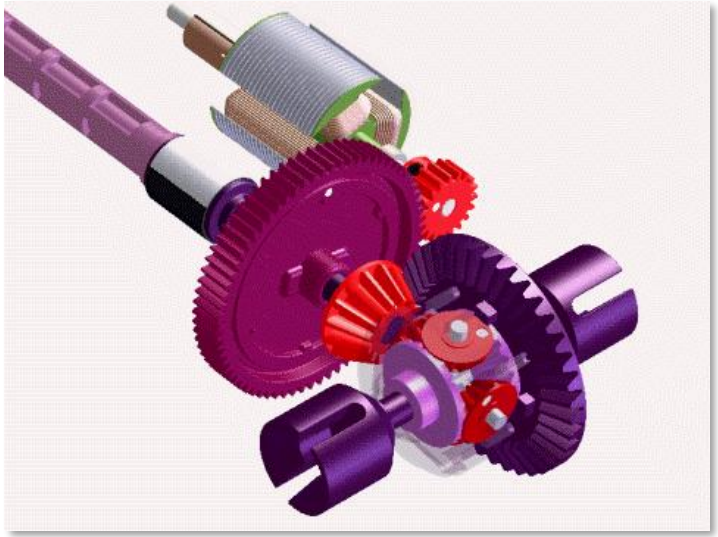
Transmission

Differential gear animations

1A - TT-02 basic model



Driving in right curve

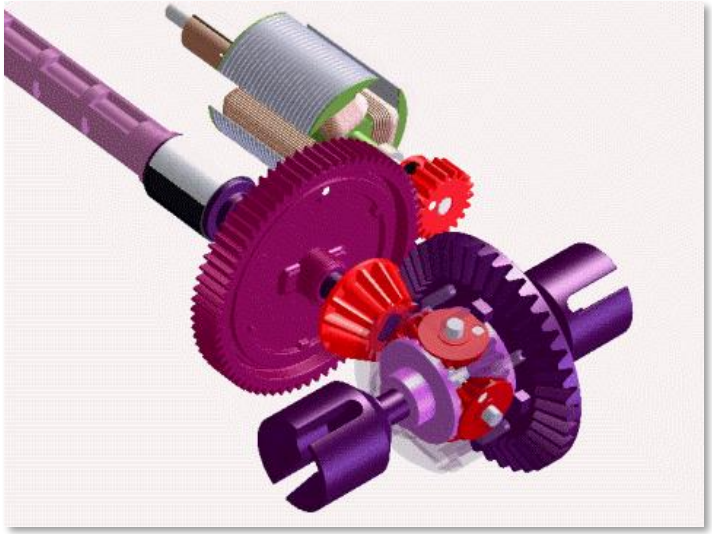


Driving in straight line

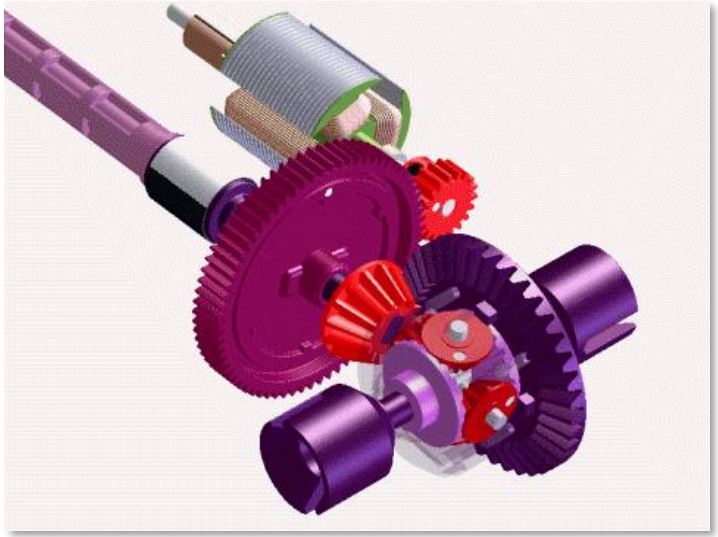
Transmission

Differential gear animations

1A - TT-02 basic model



Right wheel stopped

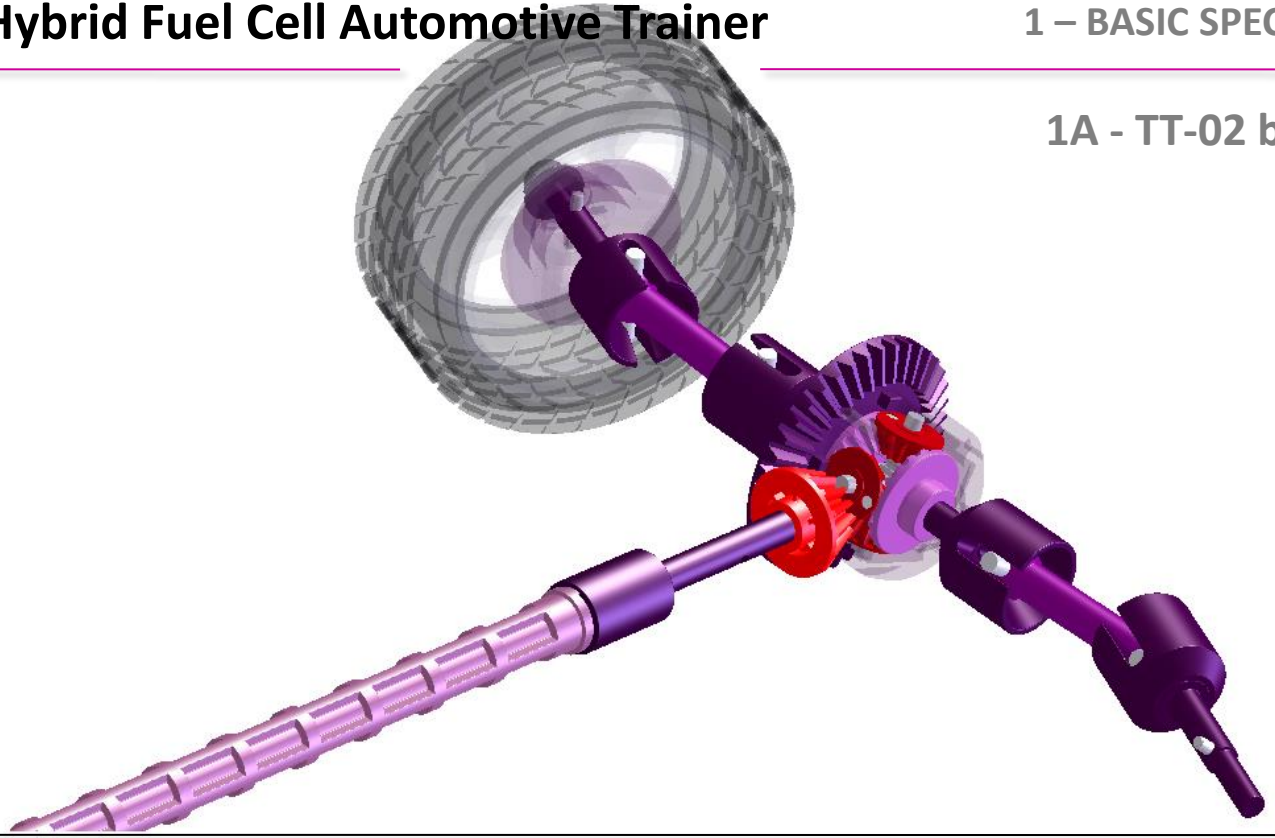


Motor stopped

Transmission

Gear details

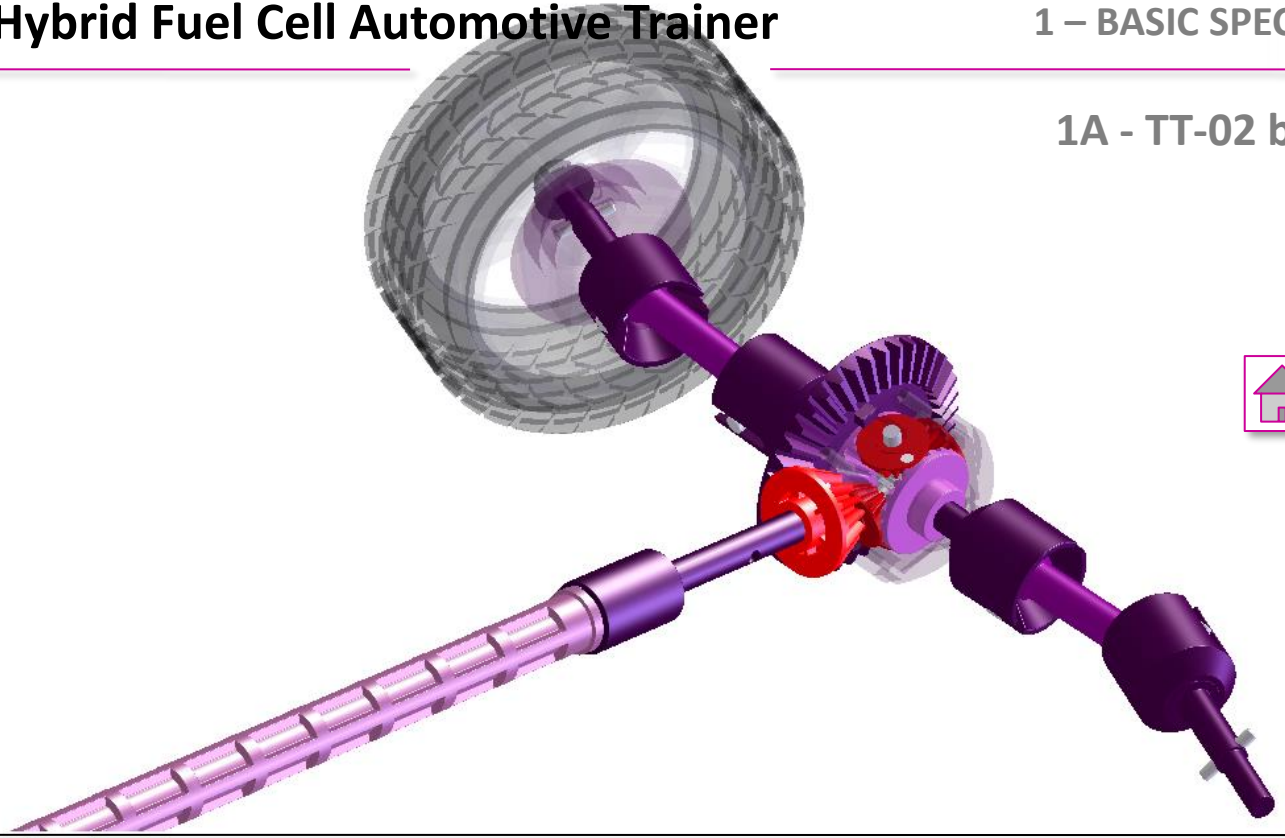
1A - TT-02 basic model



Transmission

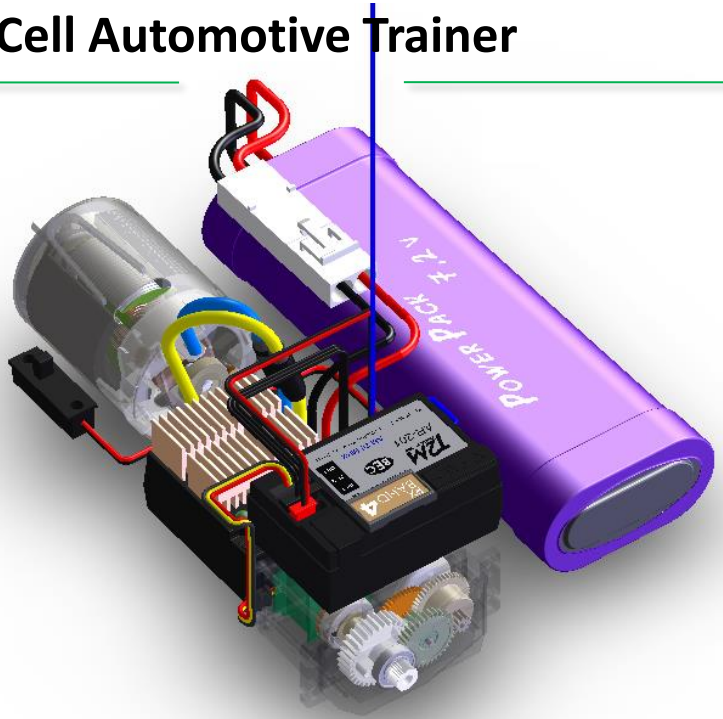
Gear details

1A - TT-02 basic model



Basic connections

1A - TT-02 basic model



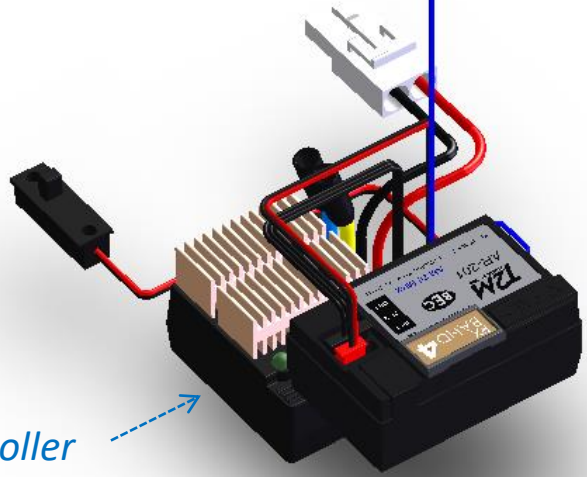
Basic connections

1A - TT-02 basic model

Radio receiver

Basic connections

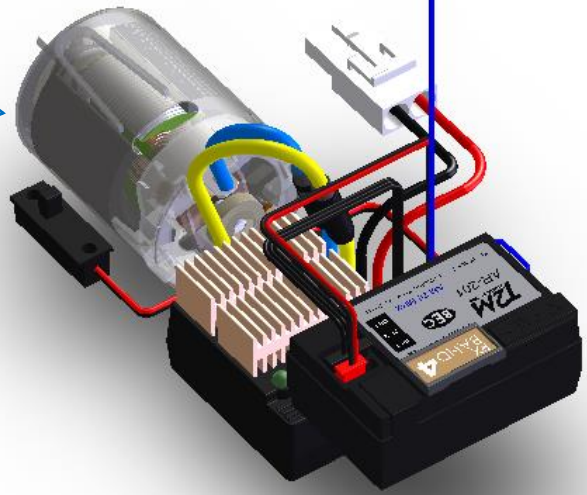
1A - TT-02 basic model



Basic connections

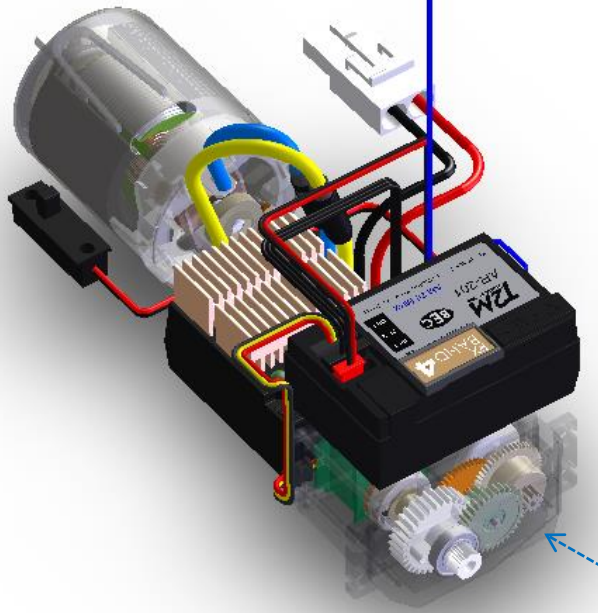
1A - TT-02 basic model

Motor



Basic connections

1A - TT-02 basic model

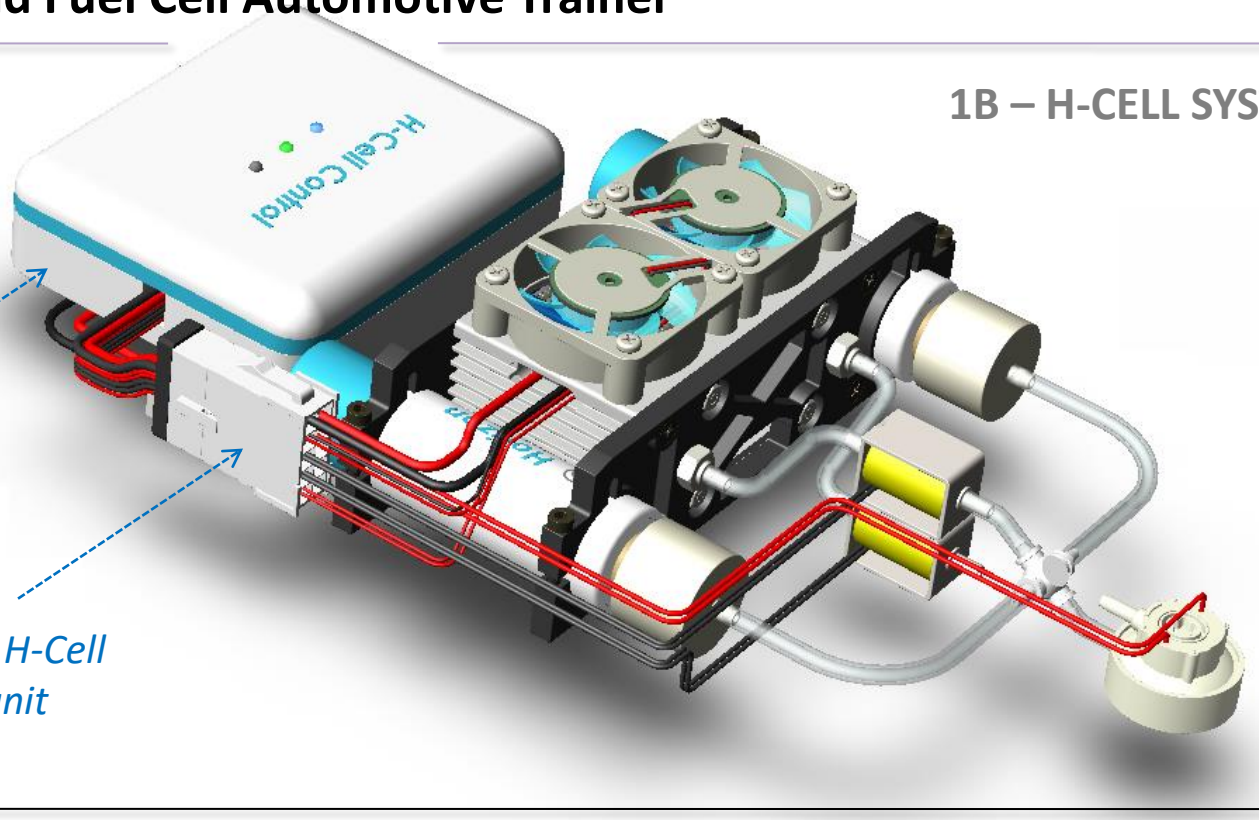


Servo motor

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

External structure

1B – H-CELL SYSTEM

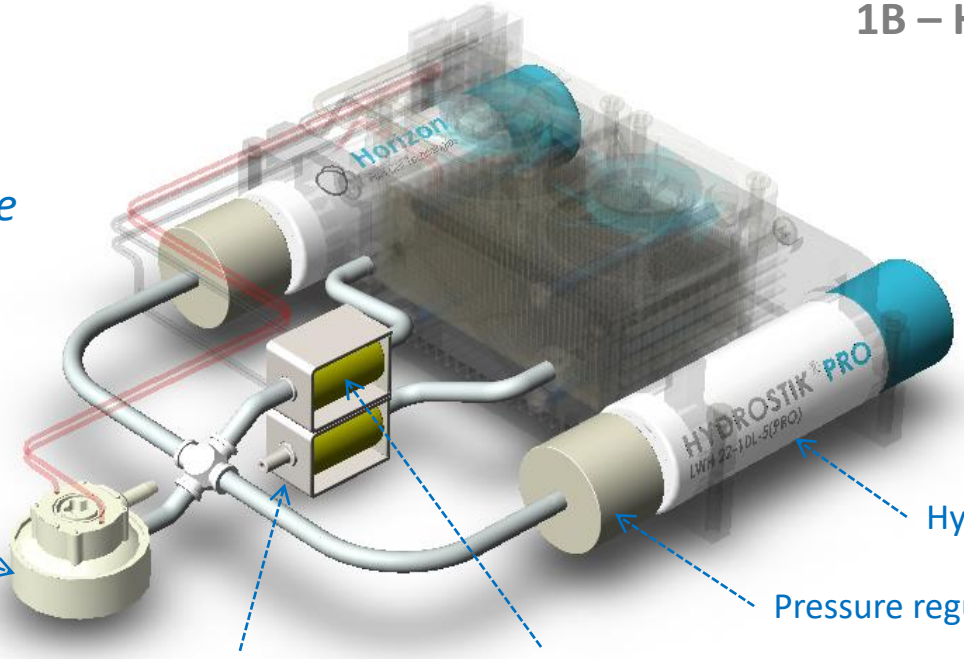


Horizon Educational

External structure

1B – H-CELL SYSTEM

Supplying hydrogen device



Detection of low Hydrogene pressure

Hydrostik cartridge

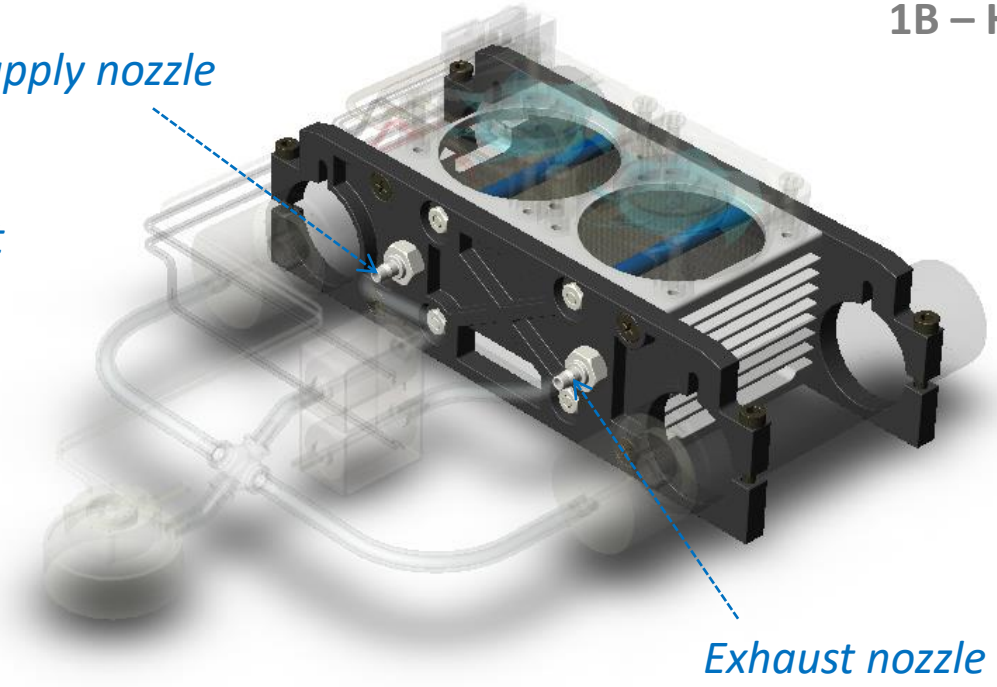
Pressure regulator valve

Exhaust solenoid valve

Supplying solenoid valve

External structure

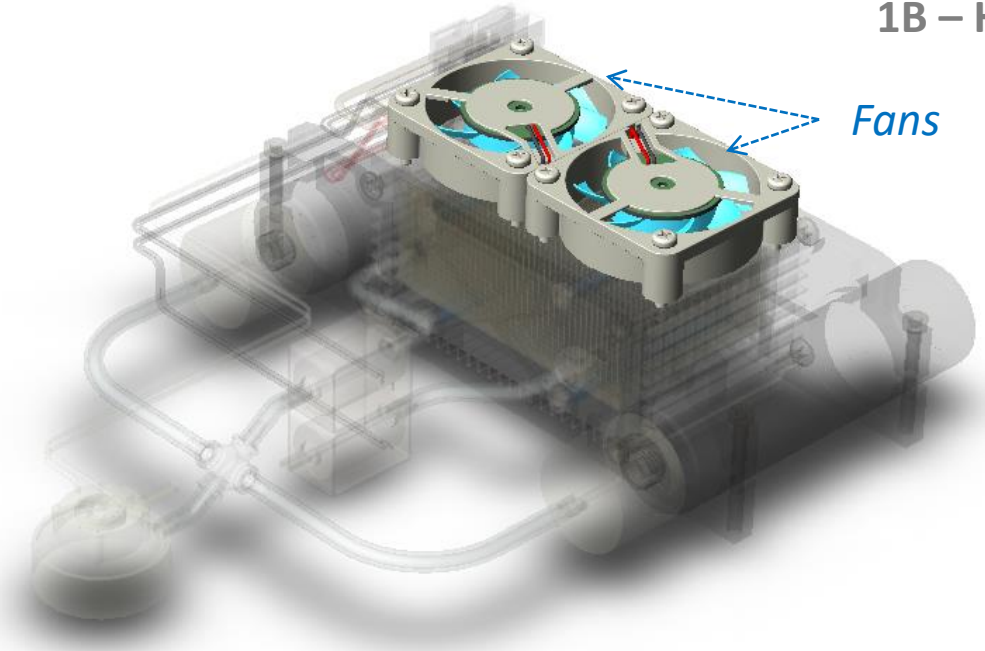
1B – H-CELL SYSTEM



External structure

1B – H-CELL SYSTEM

Oxygen supply from external fans

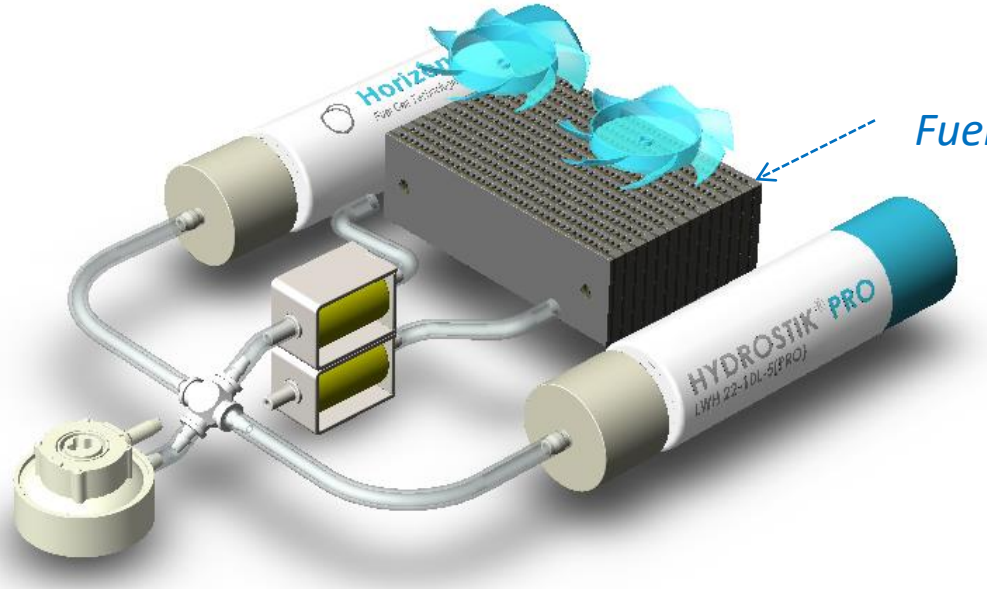


FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1B – H-CELL SYSTEM

External structure

Fuel cell implant

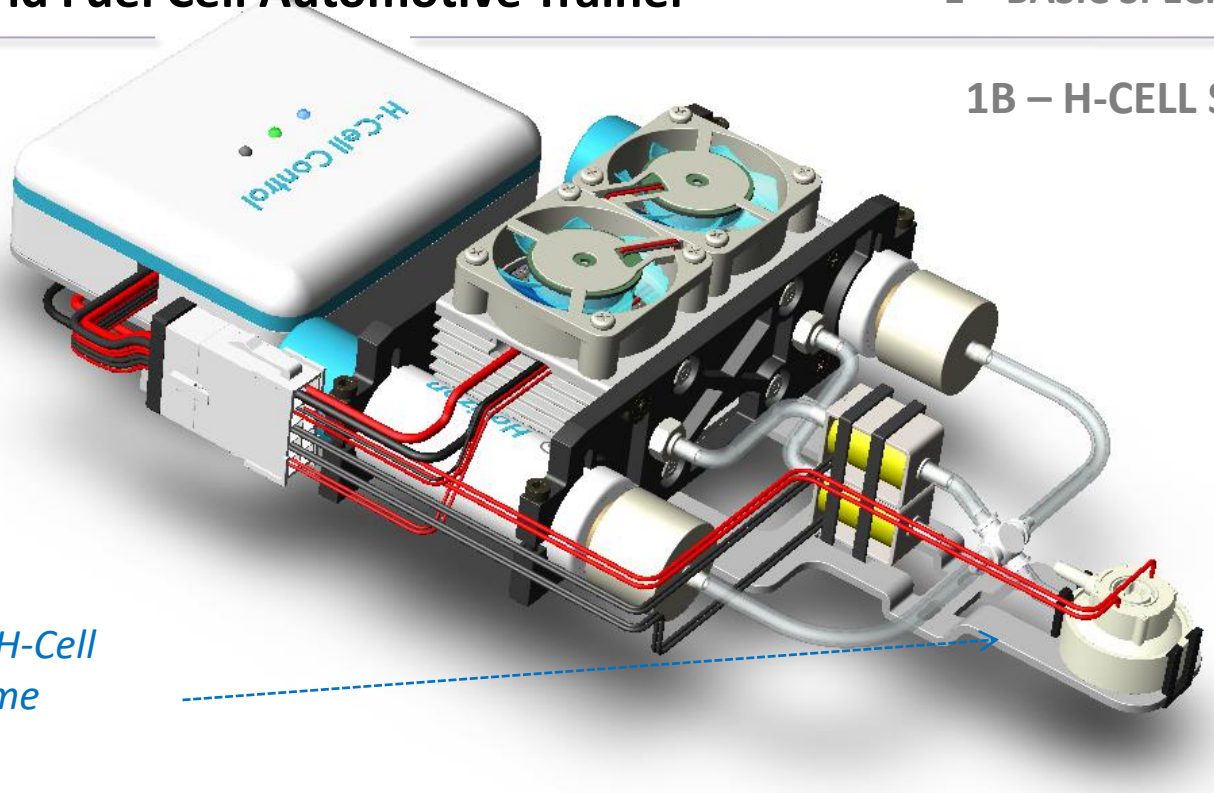


Fuel Cell « p.e.m.f.c. » technology

(pemfc : Proton Exchange Membrane Fuel Cell)

External structure

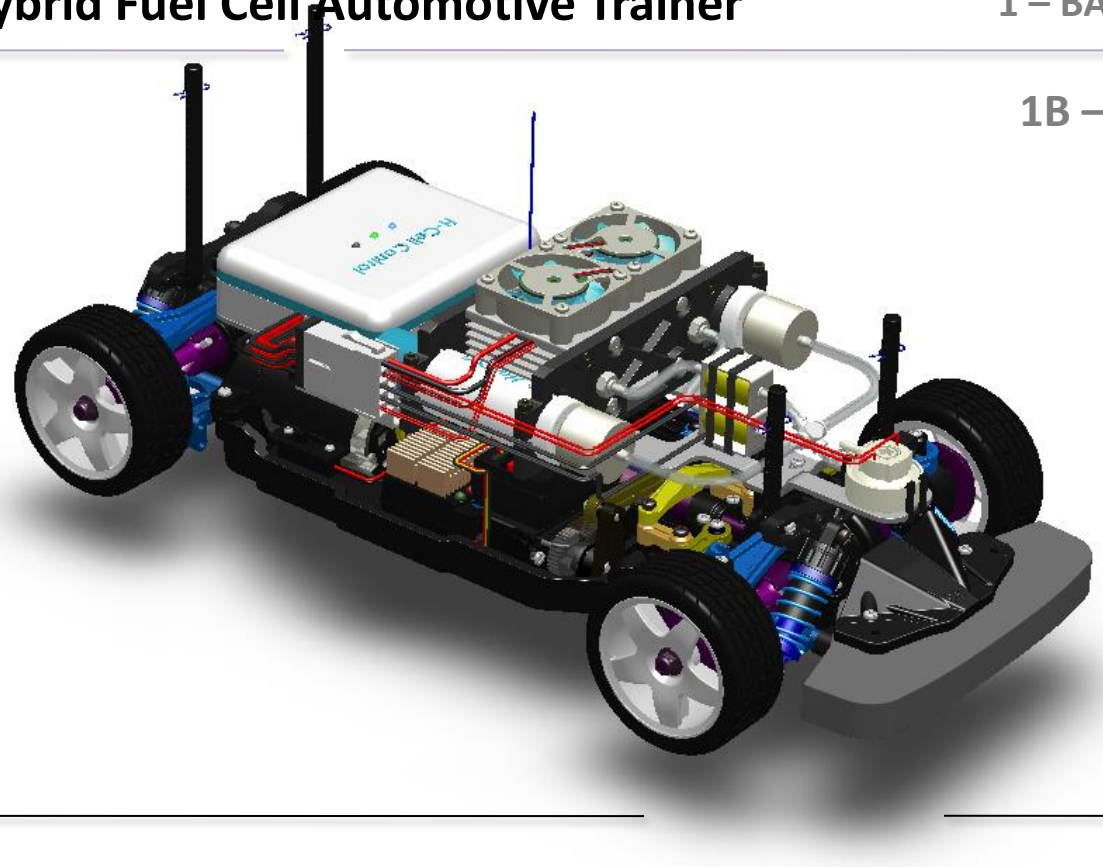
1B – H-CELL SYSTEM



Mounting plate of H-Cell group on TT-02 frame

External structure

1B – H-CELL SYSTEM

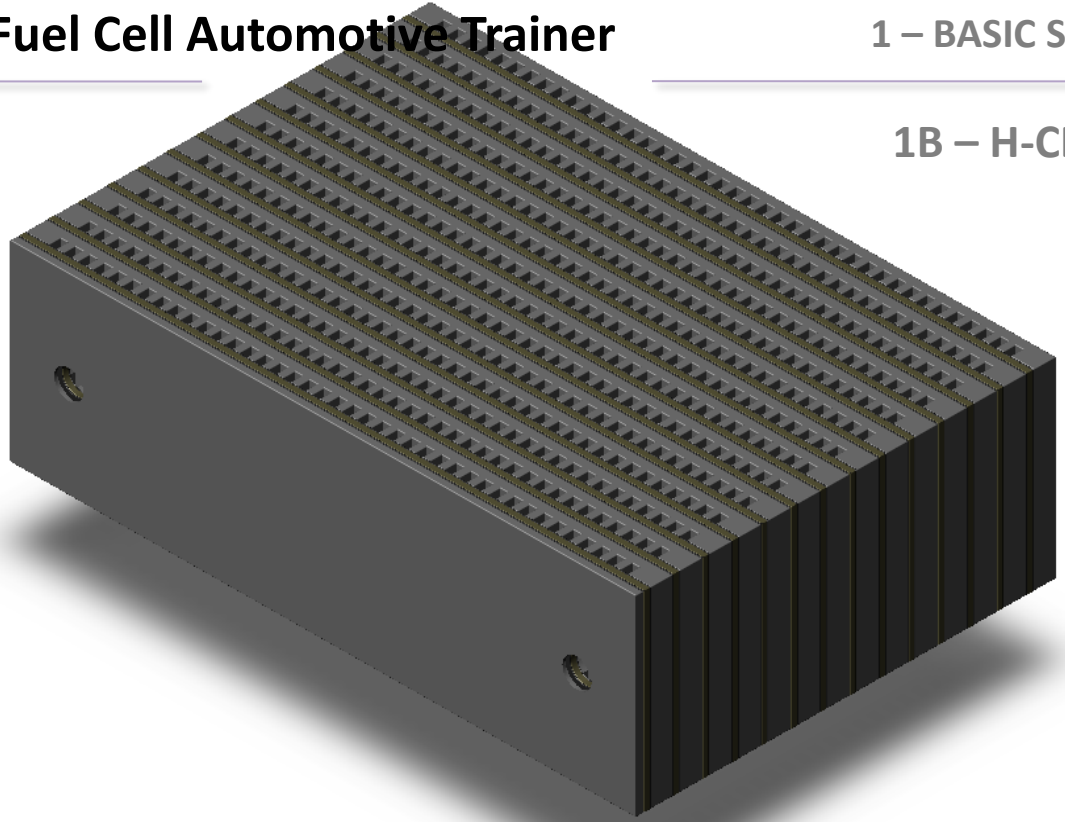


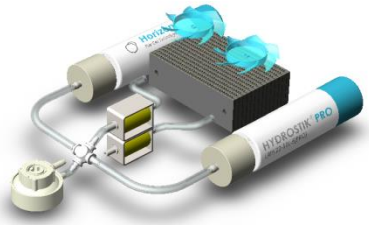
Implant on
TT-02 Frame

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1B – H-CELL SYSTEM

Internal structure



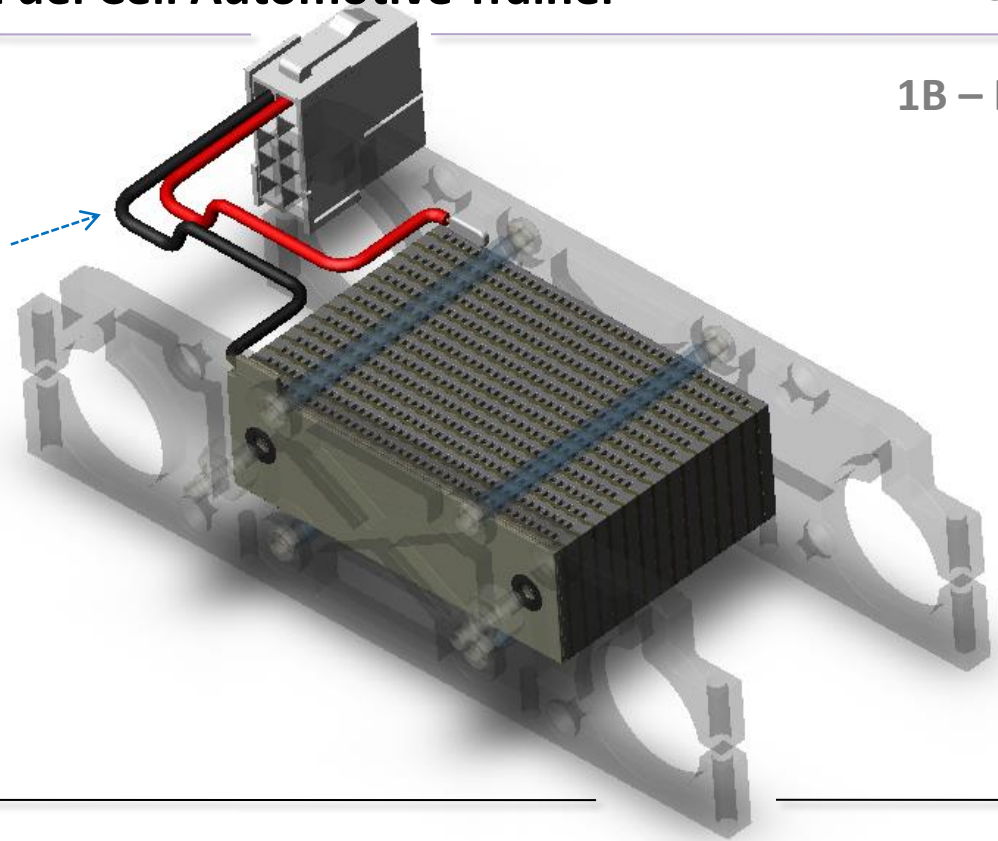


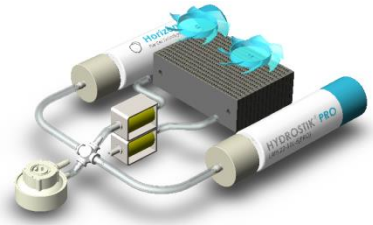
Horizon Educational

Easy Navigation

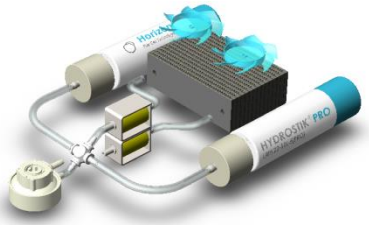
Internal structure

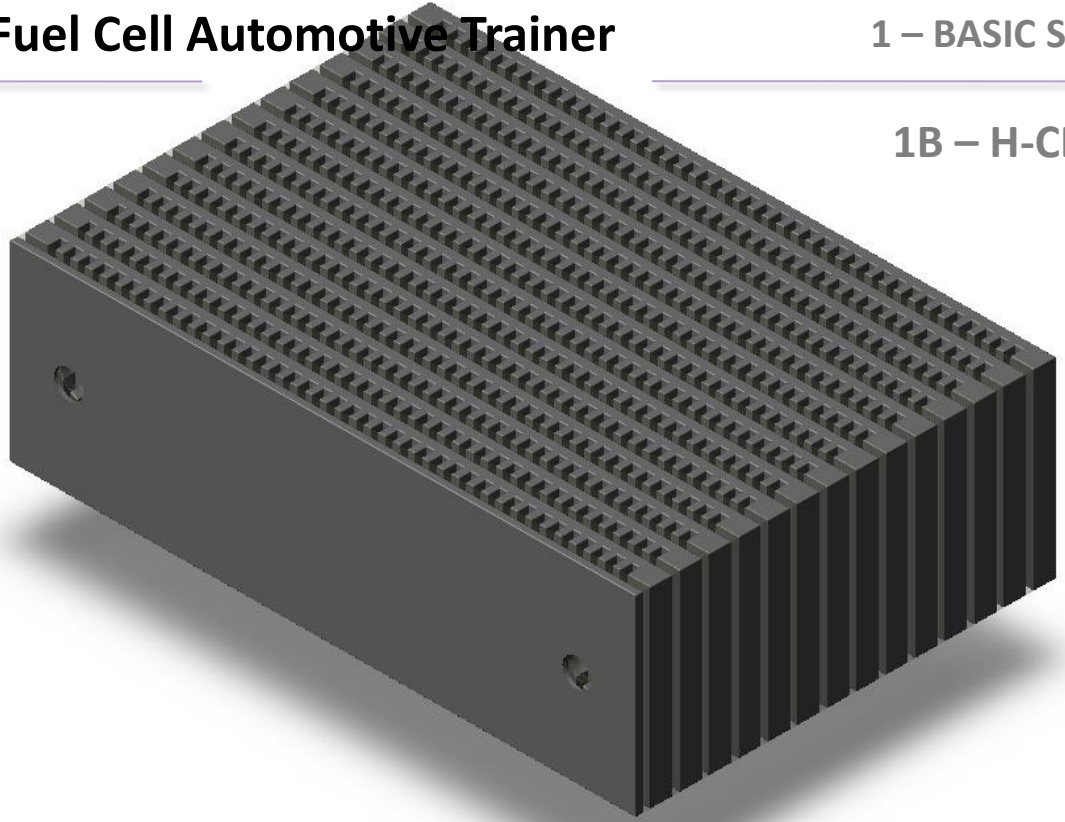
Recovery circuit for electric energy, from the chemical reaction within the fuel cell.





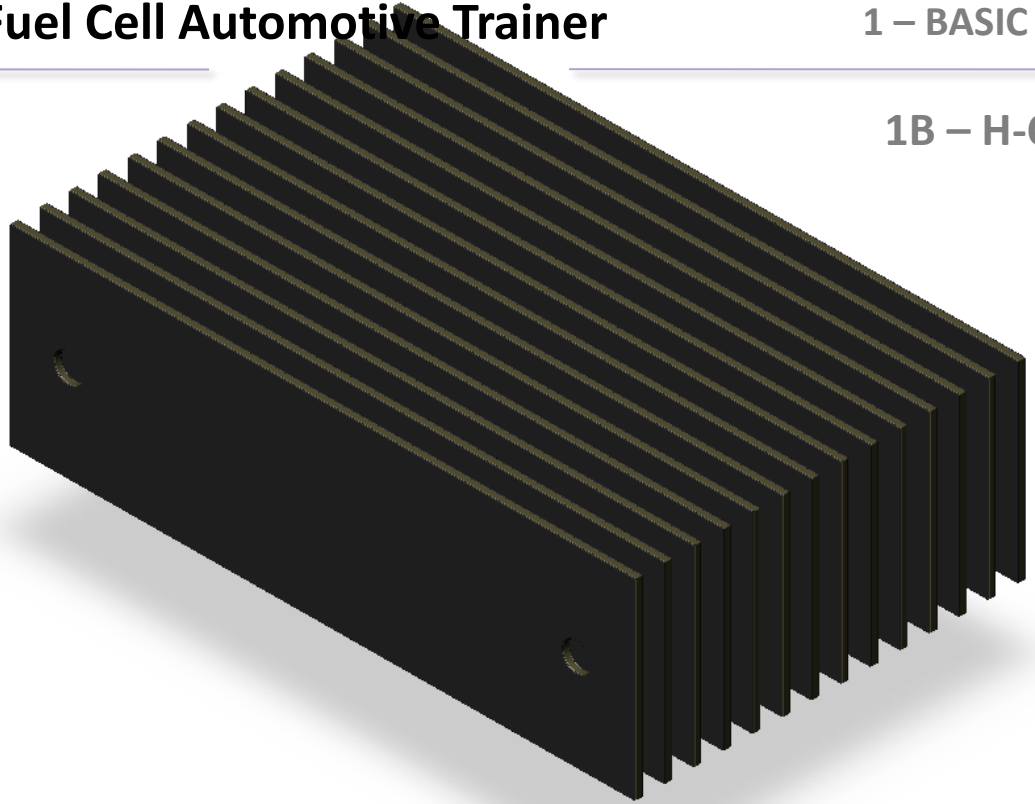
Grounding plates



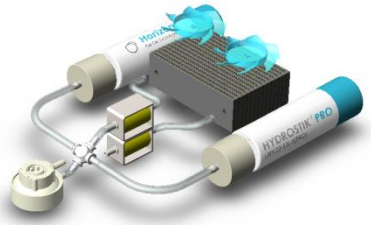


FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1B – H-CELL SYSTEM



Proton exchange membranes inserted between plates

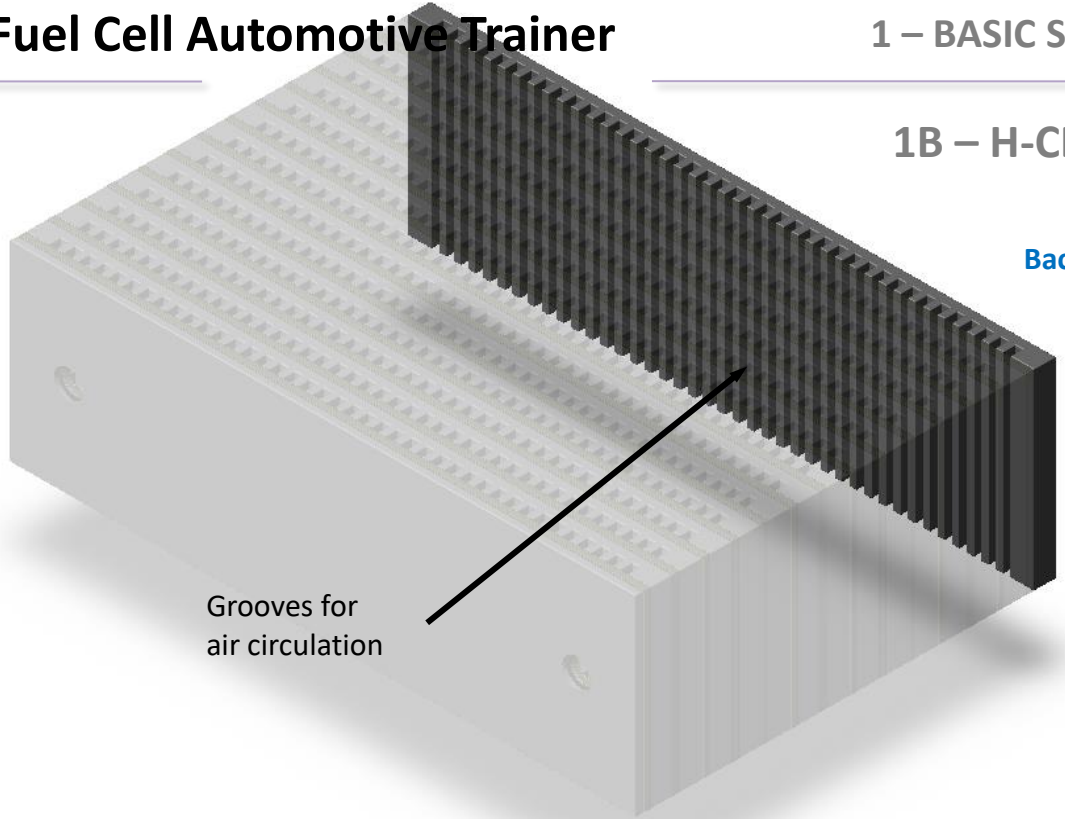


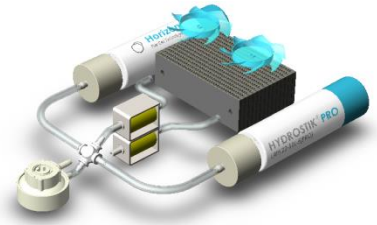
Horizon Educational

Easy Navigation

1B – H-CELL SYSTEM

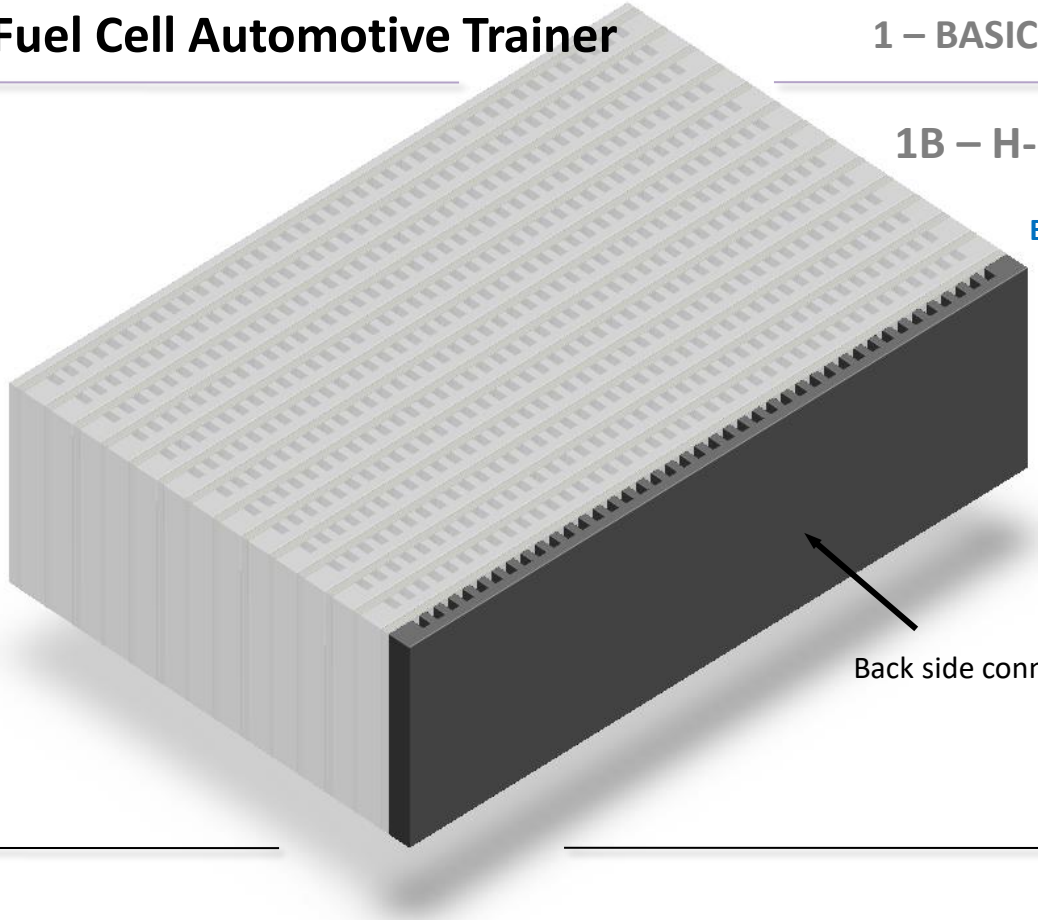
Back unipolar plate



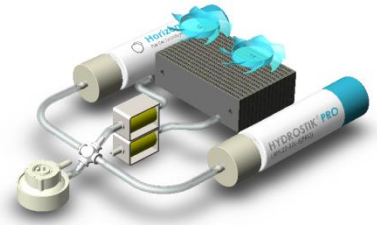


1B – H-CELL SYSTEM

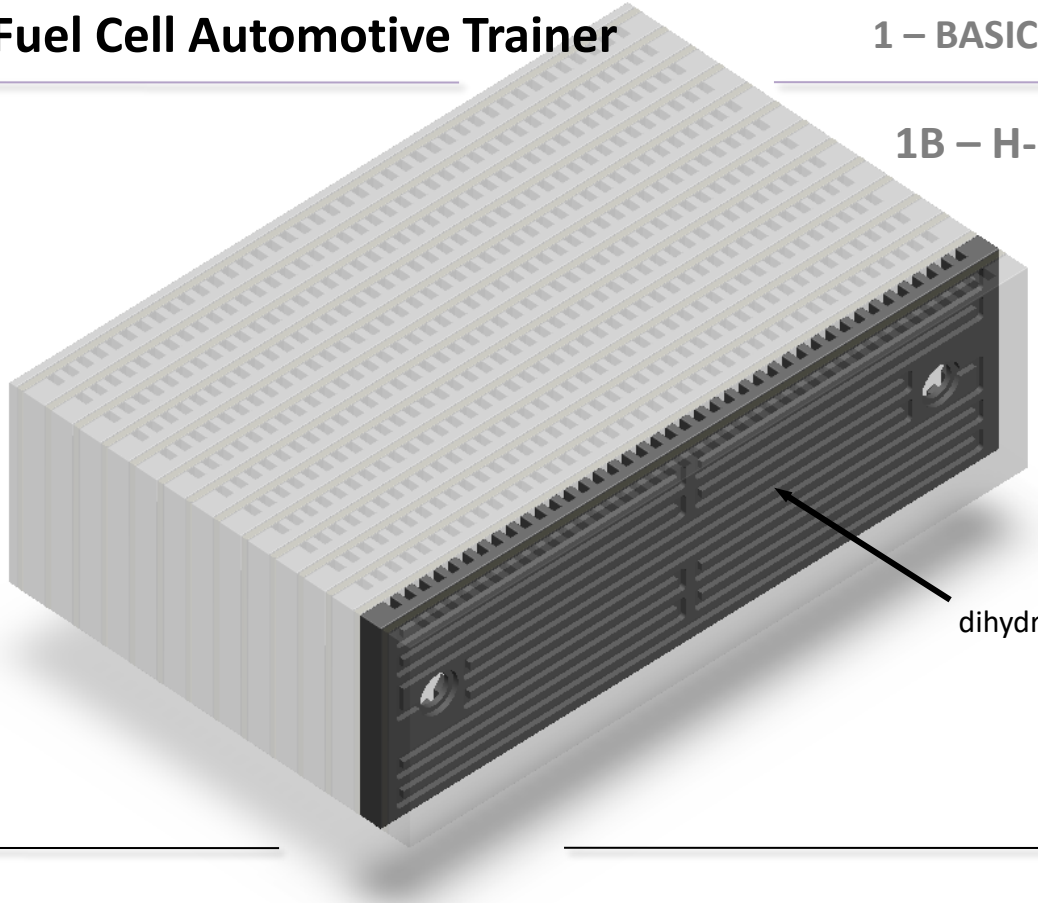
Back unipolar plate

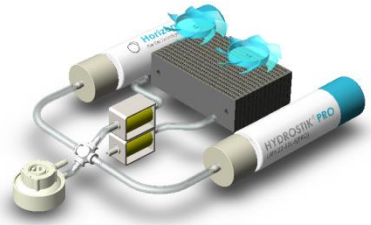


Back side connected with line + (red)



1B – H-CELL SYSTEM





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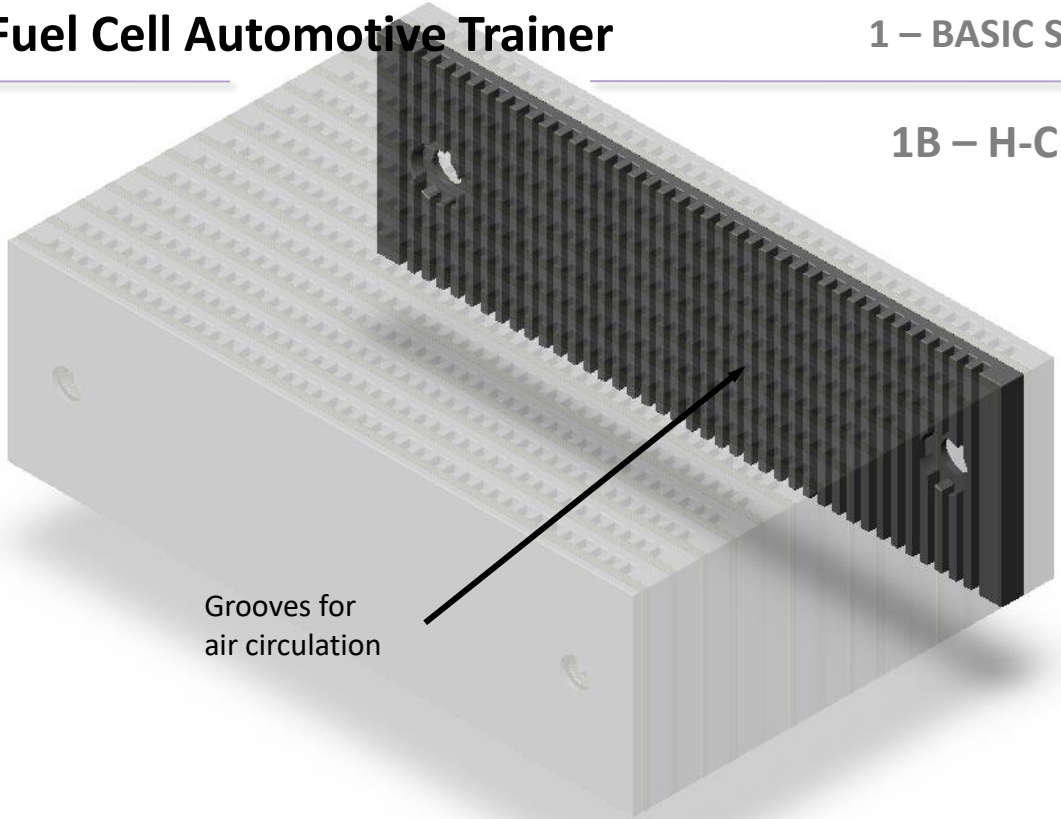
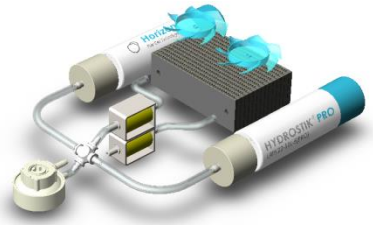
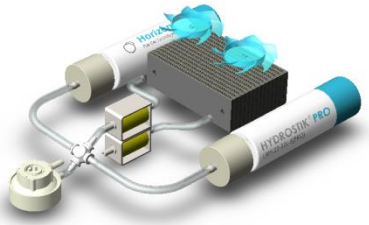
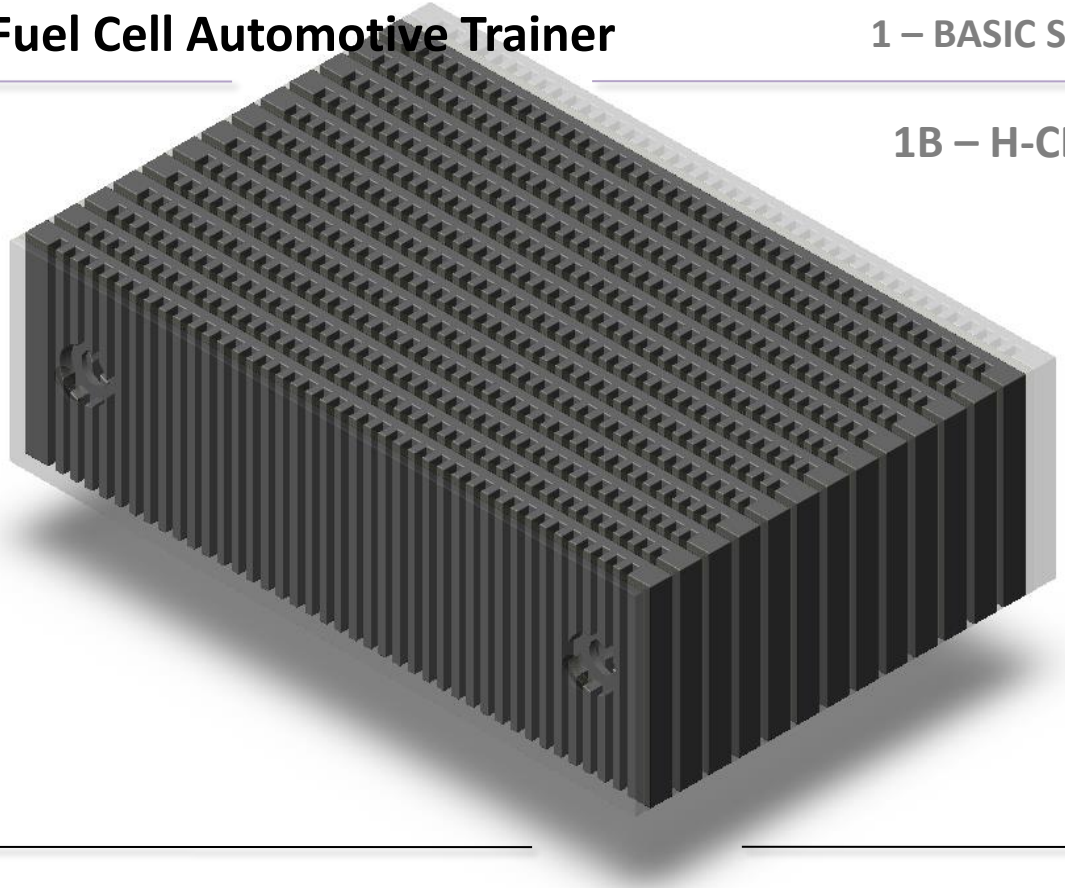




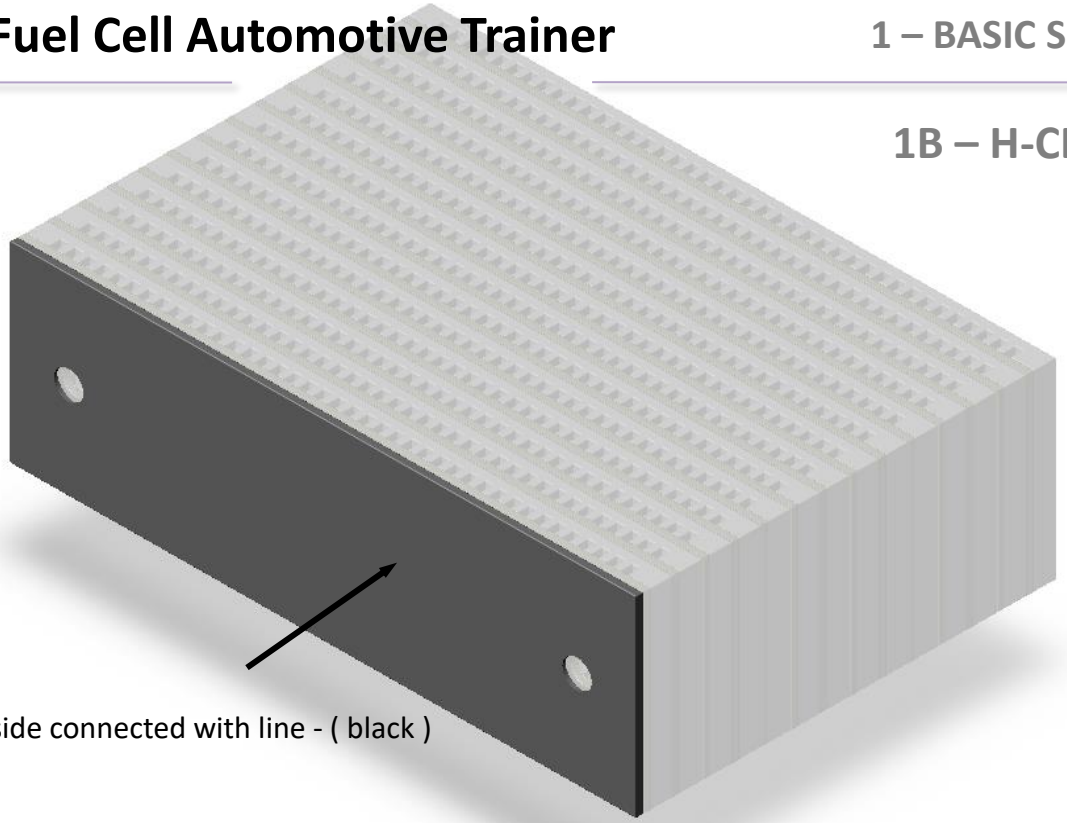
1B – H-CELL SYSTEM

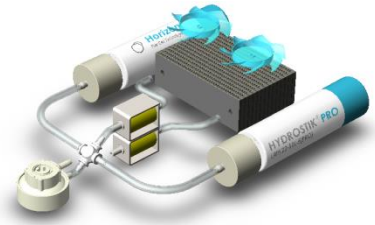




Bipolar plates

Front unipolar plate



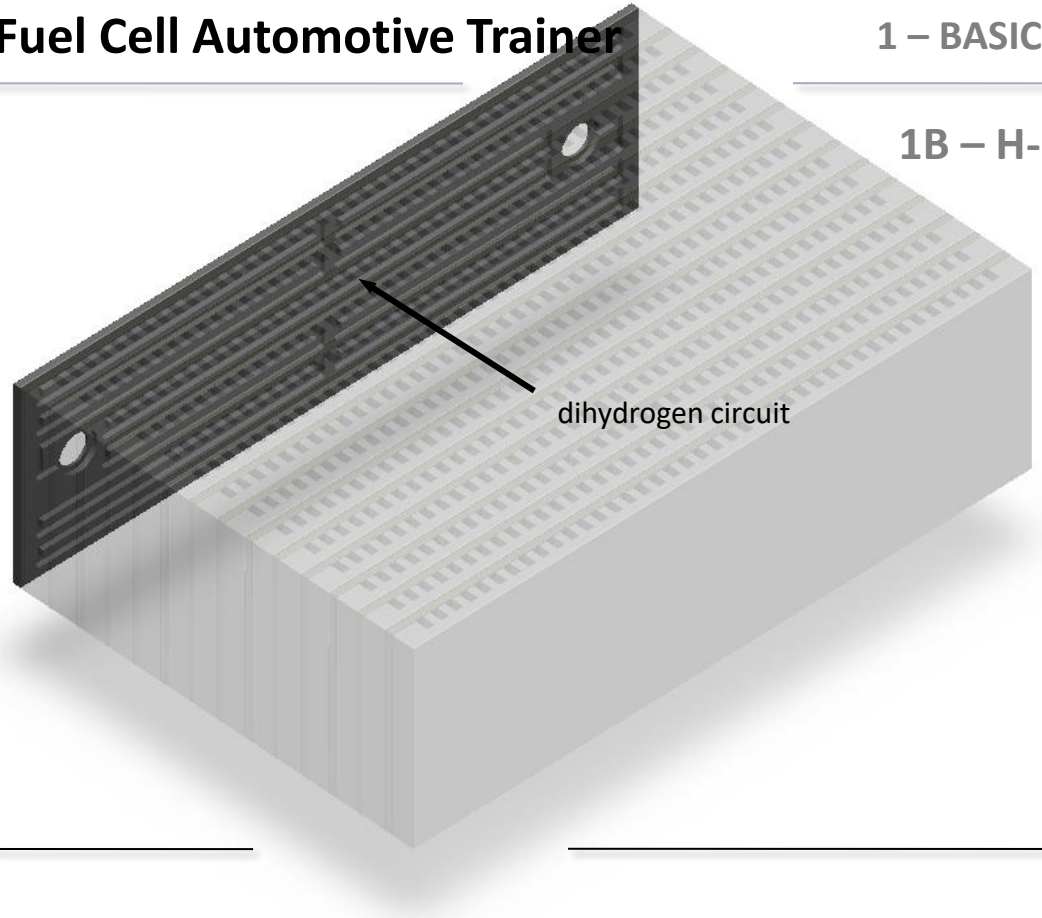


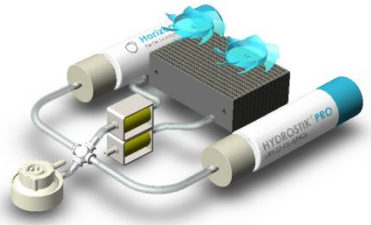
Back side connected with line - (black)

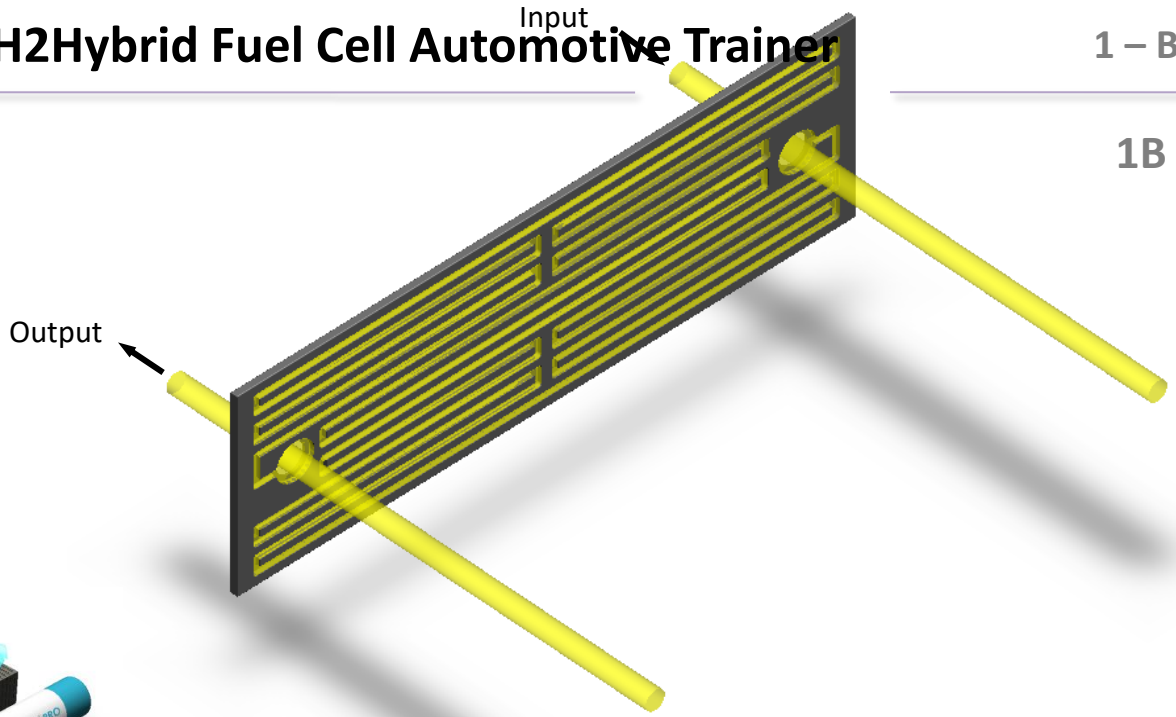
FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

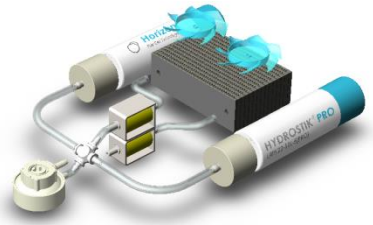
1B – H-CELL SYSTEM

Front unipolar plate





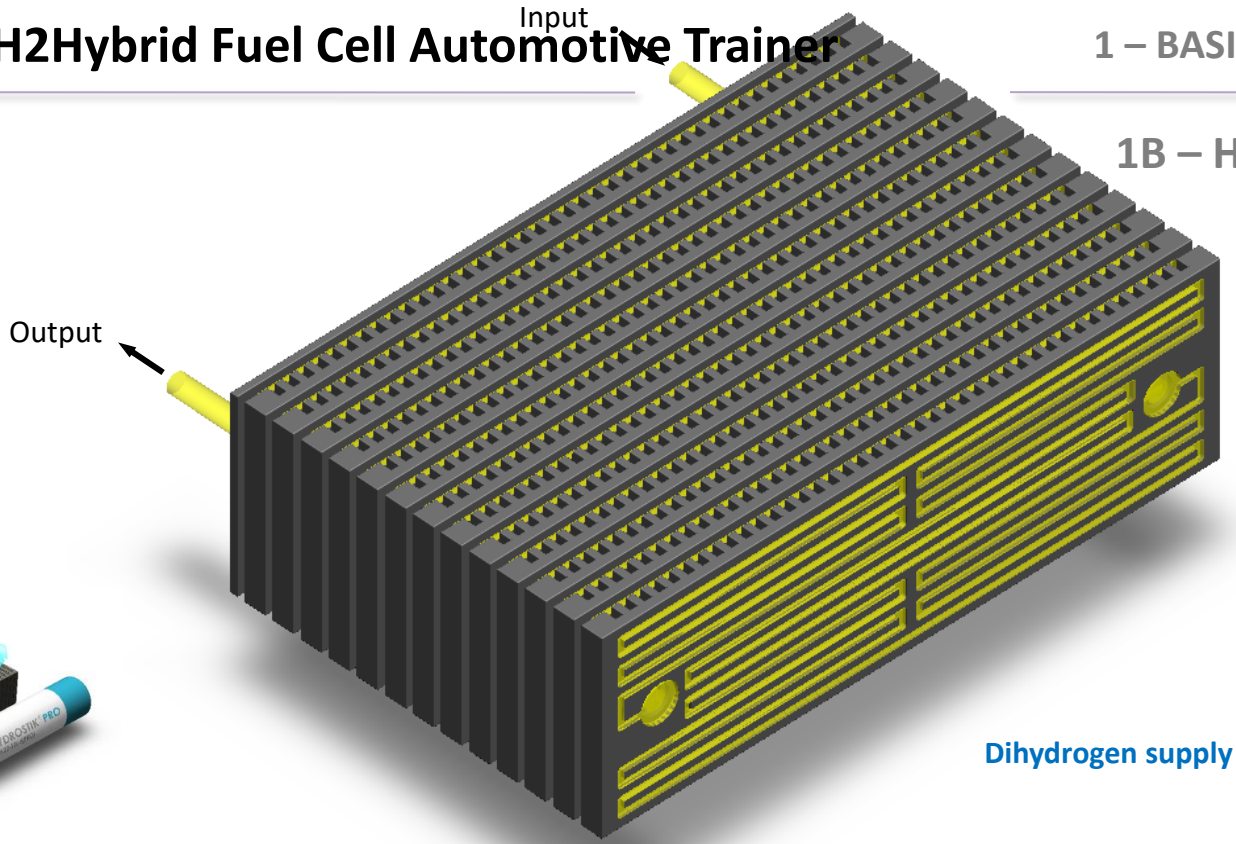


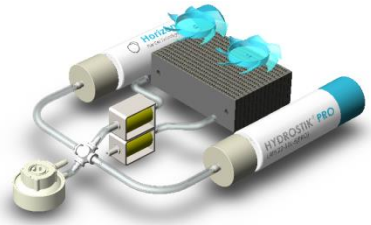


Dihydrogen supply

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1B – H-CELL SYSTEM



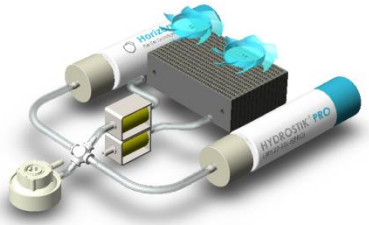


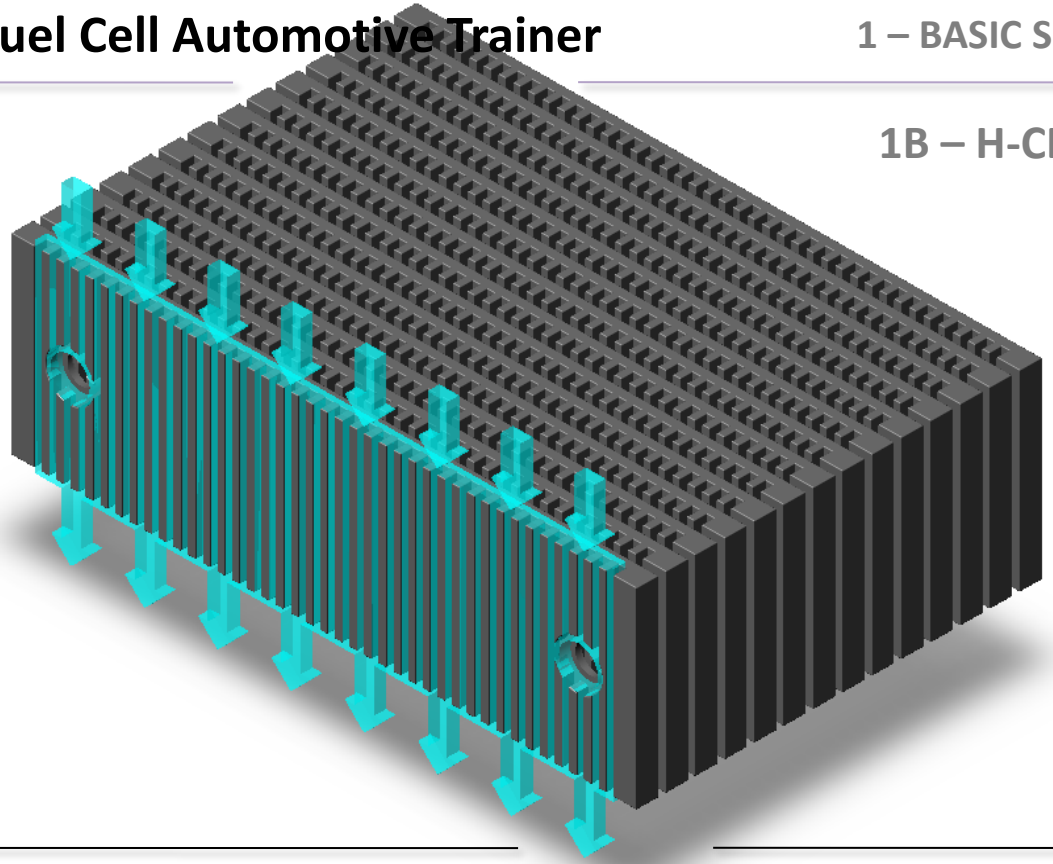
Dihydrogen supply

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1B – H-CELL SYSTEM

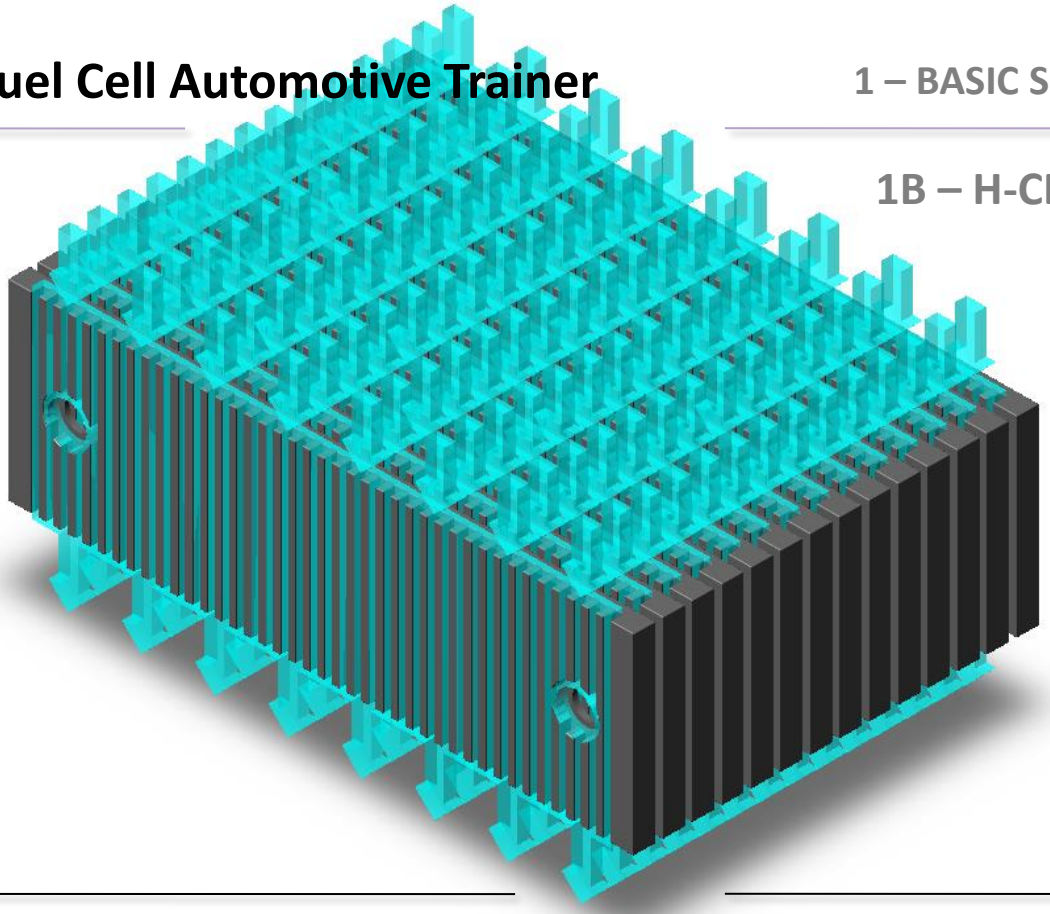
Dioxygen from
ambient air supply



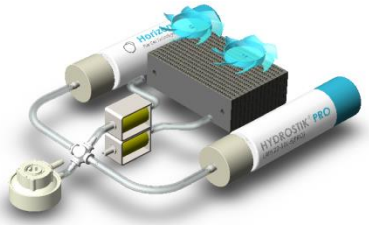


FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1B – H-CELL SYSTEM



Dioxygen from ambient air supply



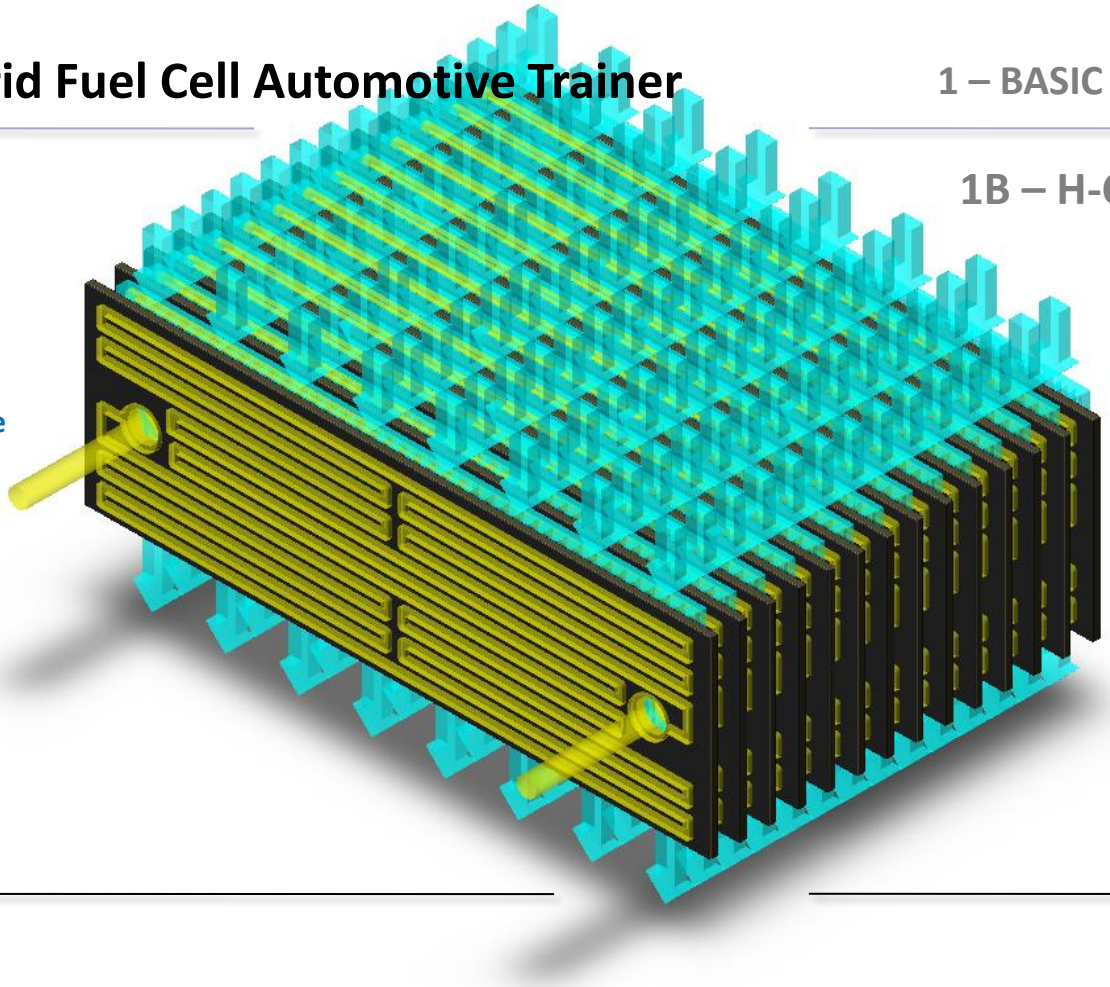
Horizon Educational

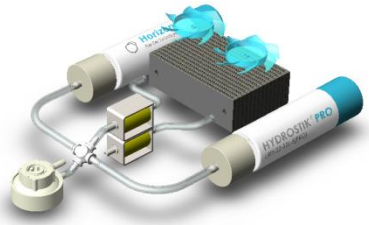
Easy Navigation

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1B – H-CELL SYSTEM

Dihydrogen and dioxygen separated by proton exchange membranes before the chemical reaction





Horizon Educational

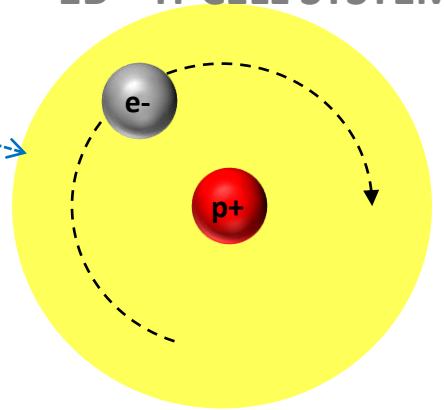
Easy Navigation

Principle of PEMFC

Basic chemical reaction

1B – H-CELL SYSTEM

Hydrogen atom :
1 proton, 1 electron



Different types of particles :

Proton(s) : positively charged particles

électron(s) : negatively charged particles

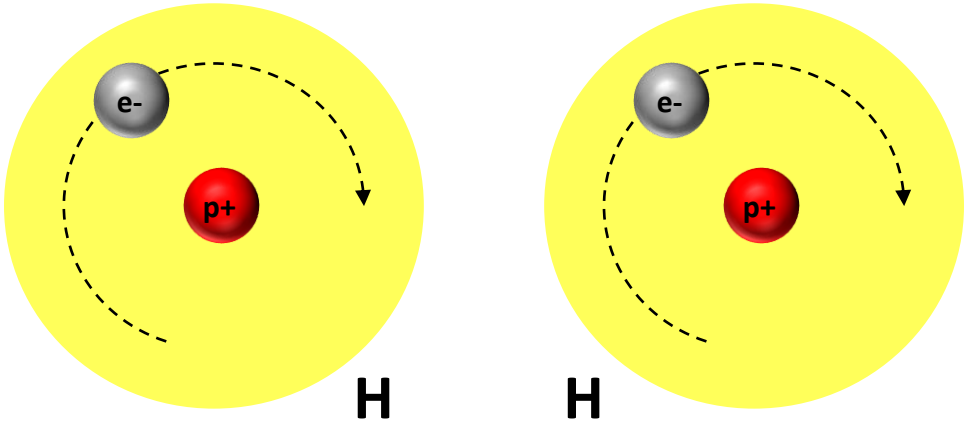
neutrons : uncharged particle, unshawed on drawing

The Atom: constituted by at least one proton and one rotating electron, and possibly several other neutrons. The atom is neutral, that is balanced in number of protons and electrons.
The Ion: constituted by at least one proton and possibly by several rotating electron (s) and by neutron (s). He is not neutral, thus not charged positively or negatively (more electrons than protons)
The Molecule: element constituted by several atoms and/or ions bound between them by connections constituted by motionless electrons.

Principle of PEMFC

Basic chemical reaction

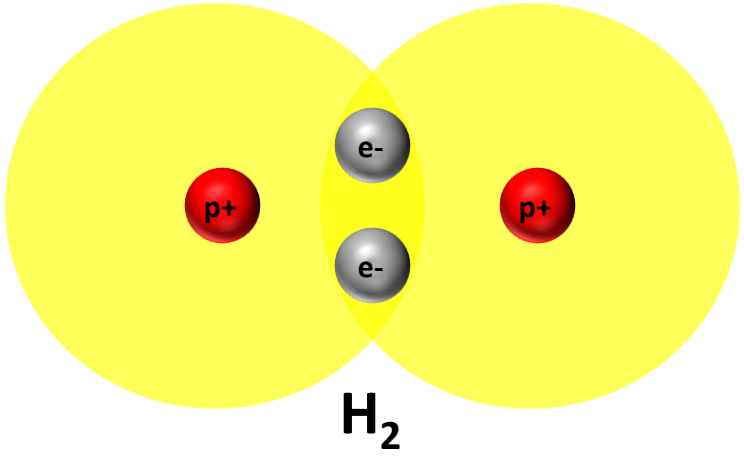
Two hydrogen atoms…



Principle of PEMFC

Basic chemical reaction

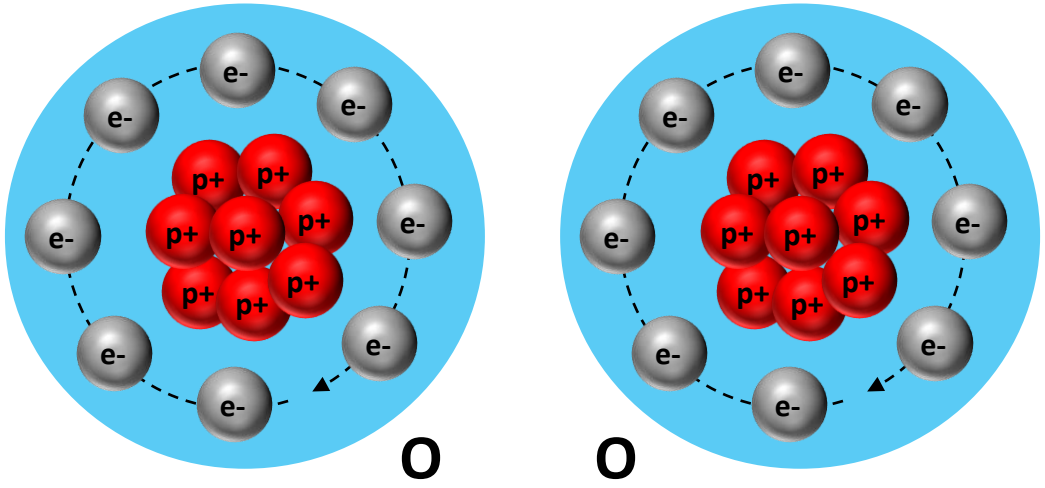
Create a dihydrogen molecule



Principle of PEMFC

Basic chemical reaction

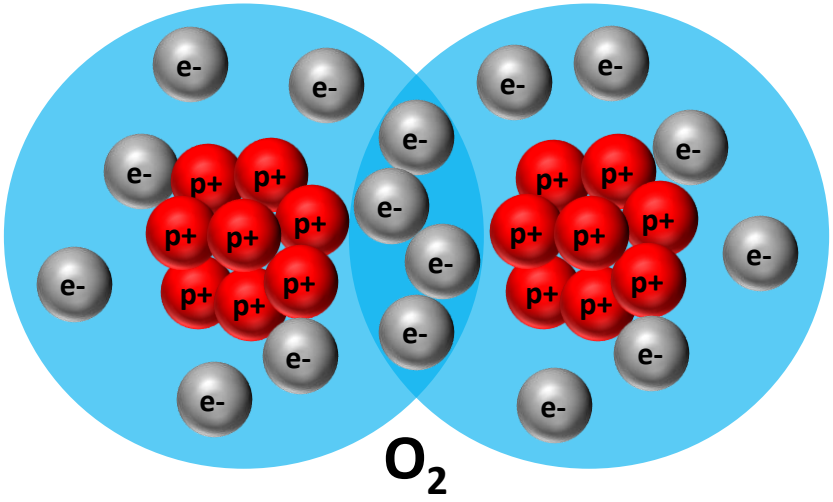
Two oxygen atoms…



Principle of PEMFC

Basic chemical reaction

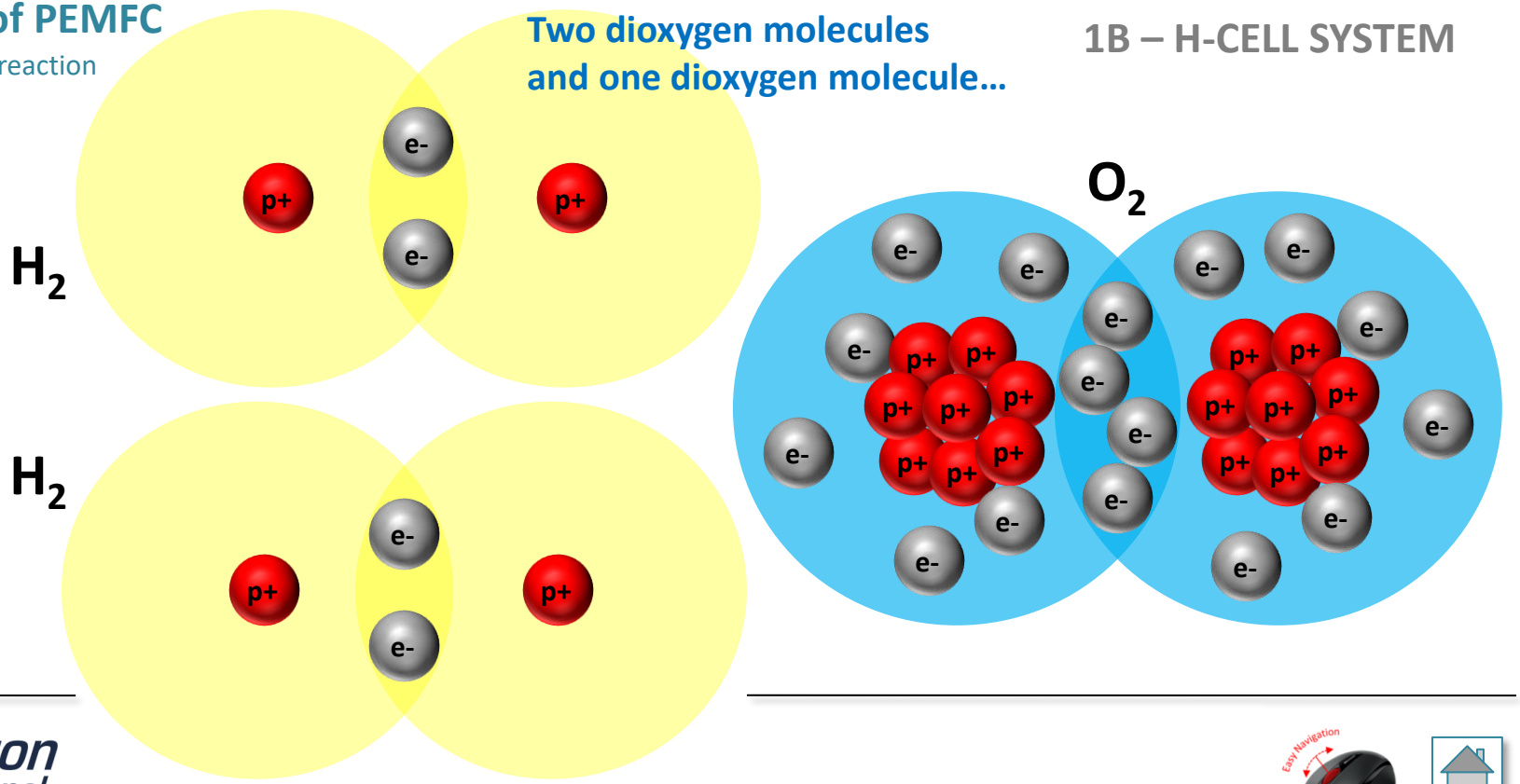
Create a dioxygen molecule



Principle of PEMFC

Basic chemical reaction

1B – H-CELL SYSTEM

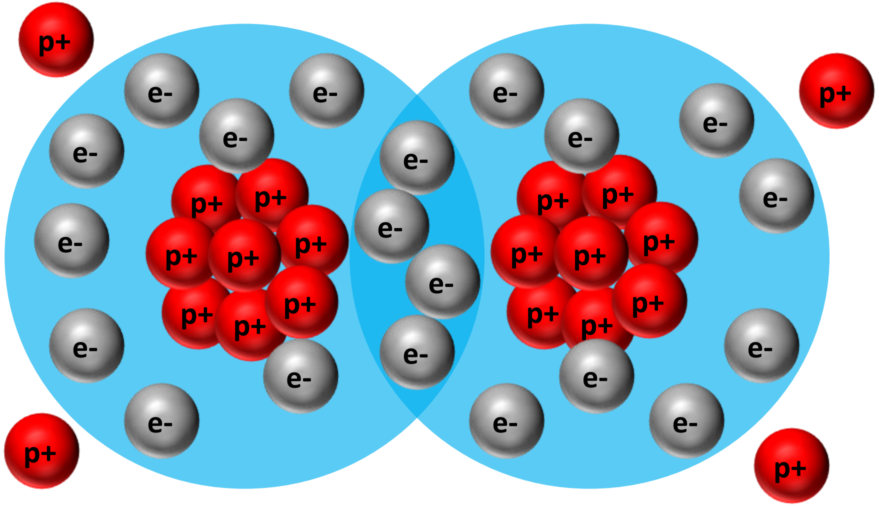


Principle of PEMFC

Basic chemical reaction

Two dioxygen molecules and one dioxygen molecule…

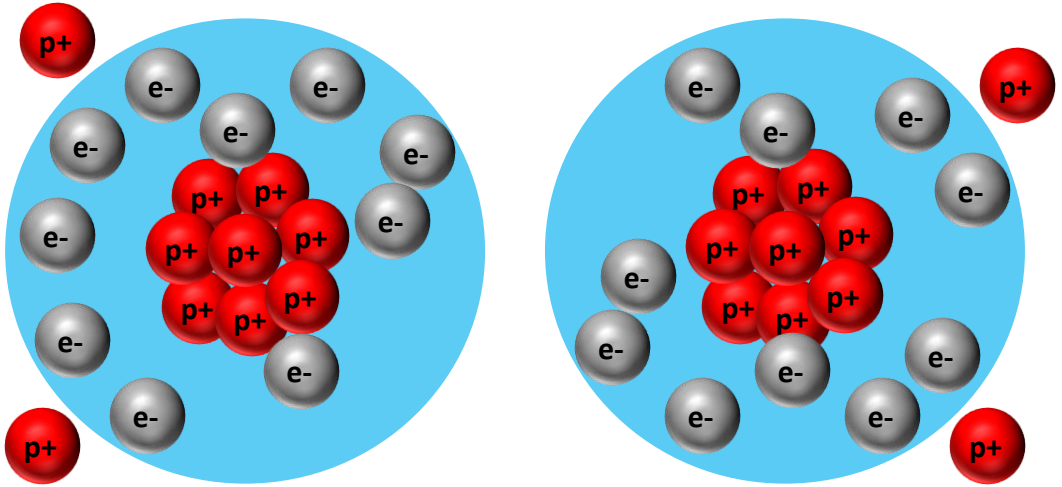
1B – H-CELL SYSTEM



Principle of PEMFC

Basic chemical reaction

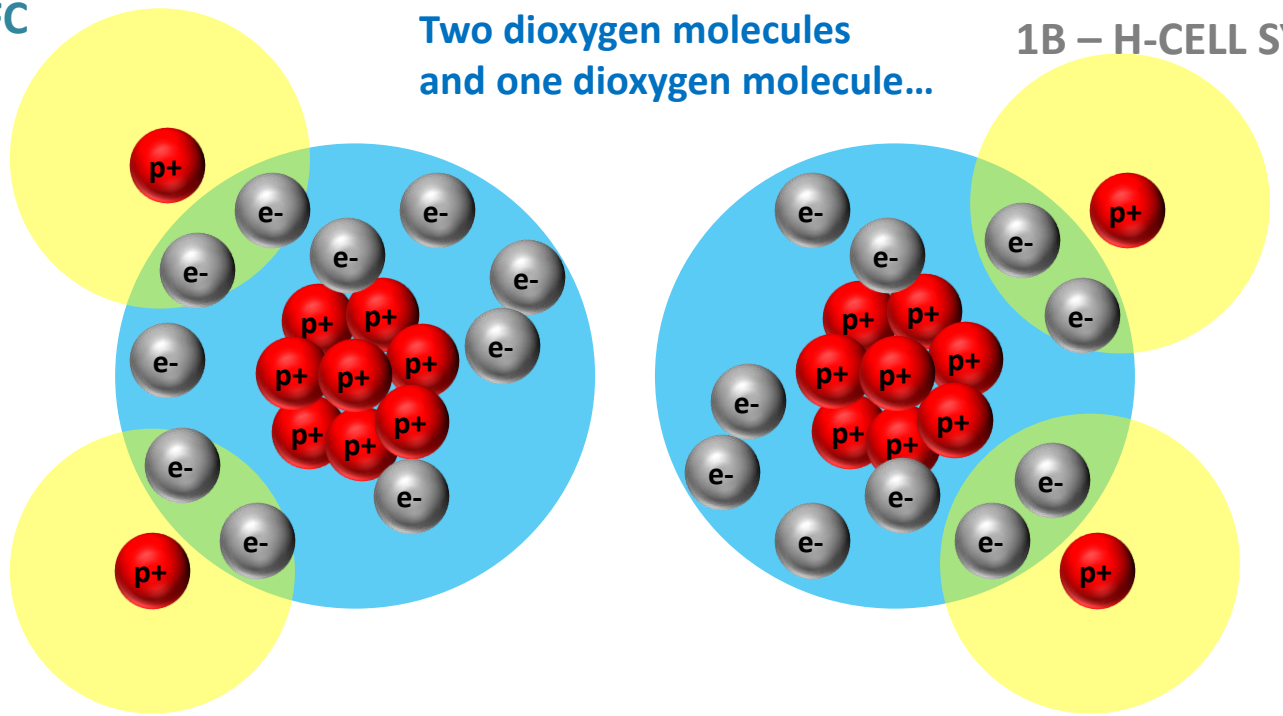
Two dioxygen molecules and one dioxygen molecule…



Principle of PEMFC

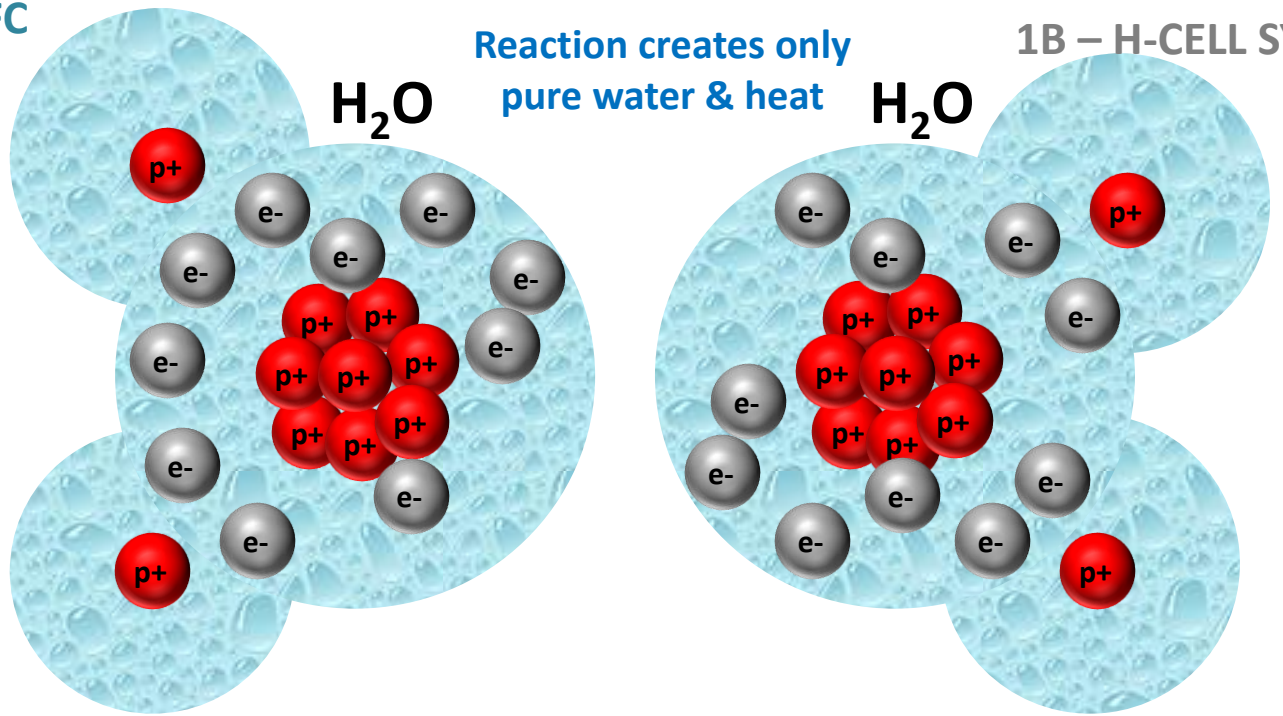
Basic chemical reaction

Two dioxygen molecules and one dioxygen molecule…



Principle of PEMFC

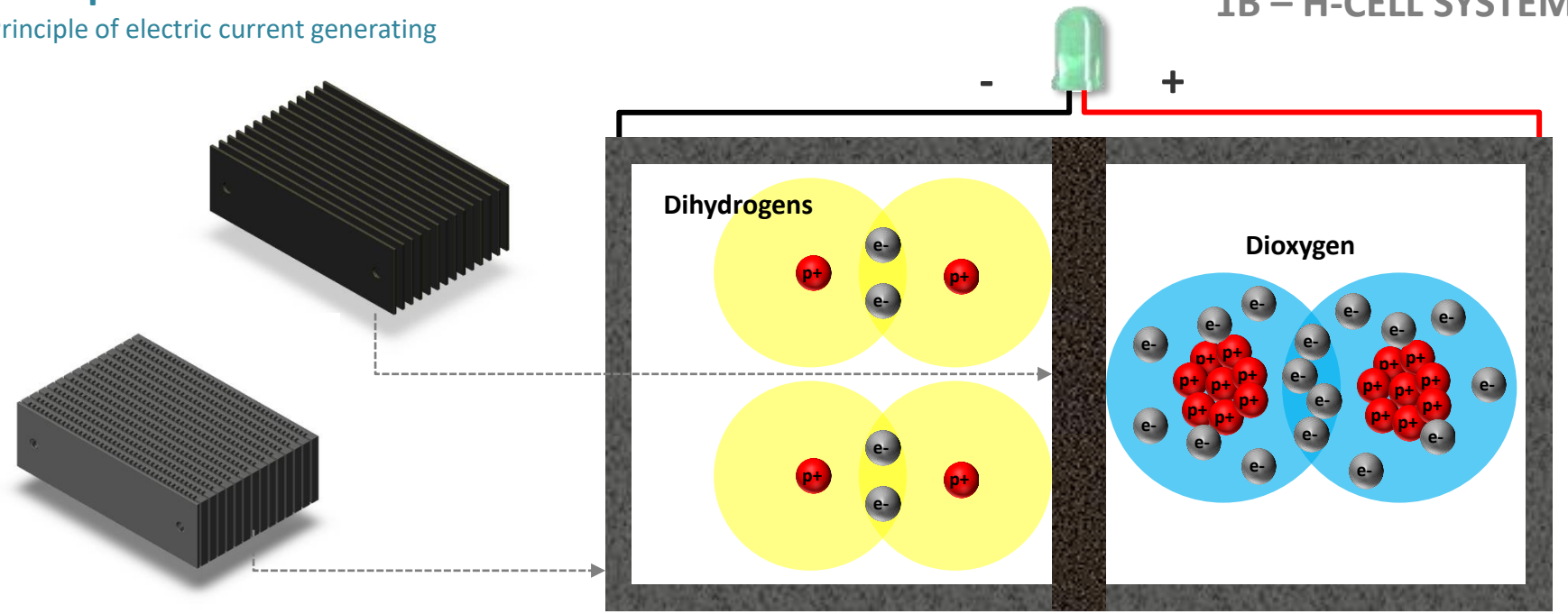
Basic chemical reaction



Principle of PEMFC

Principle of electric current generating

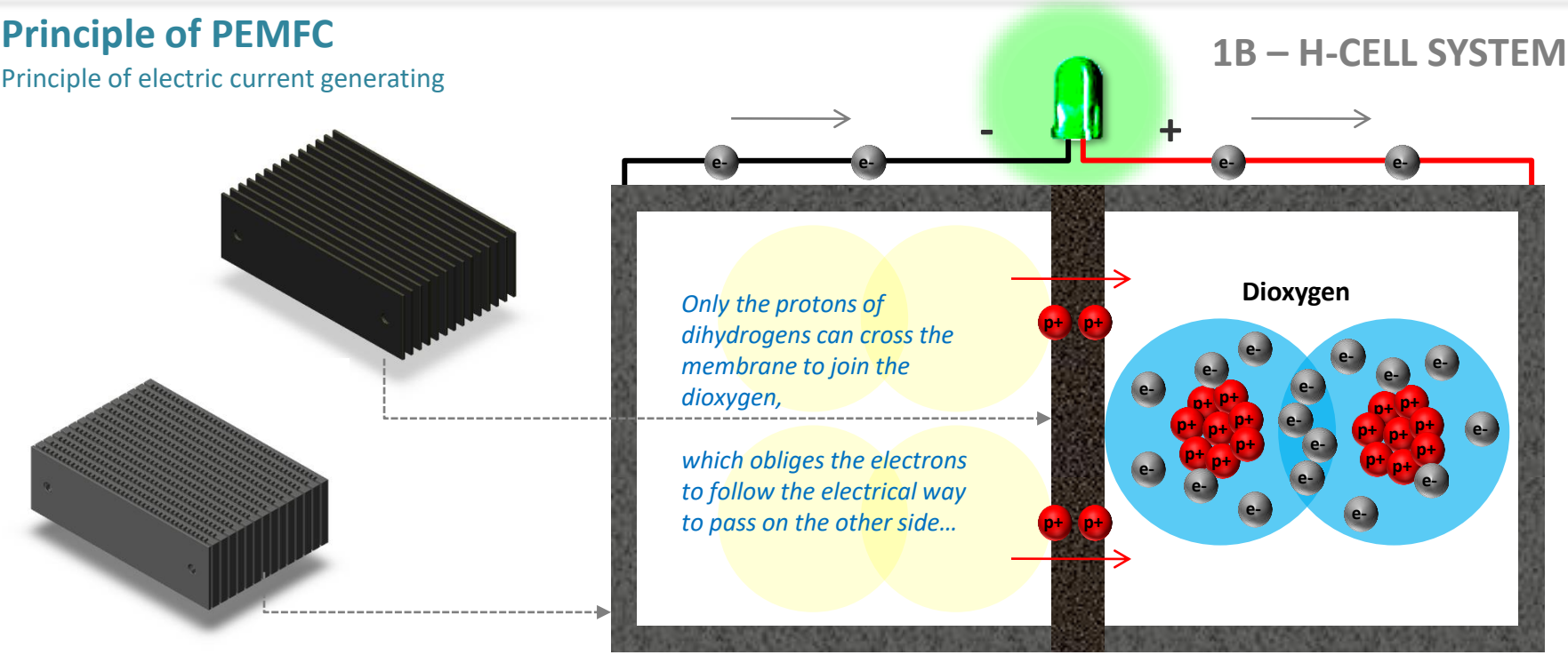
1B – H-CELL SYSTEM



Principle of PEMFC

Principle of electric current generating

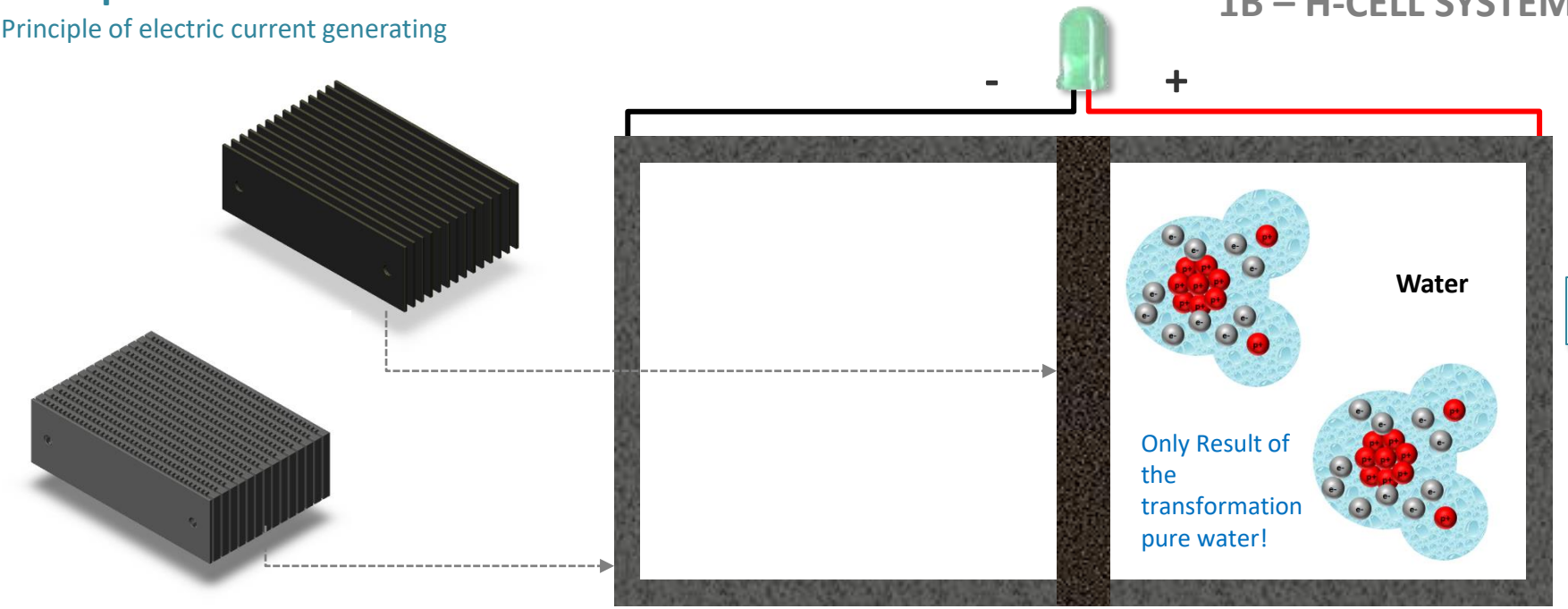
1B – H-CELL SYSTEM



Principle of PEMFC

Principle of electric current generating

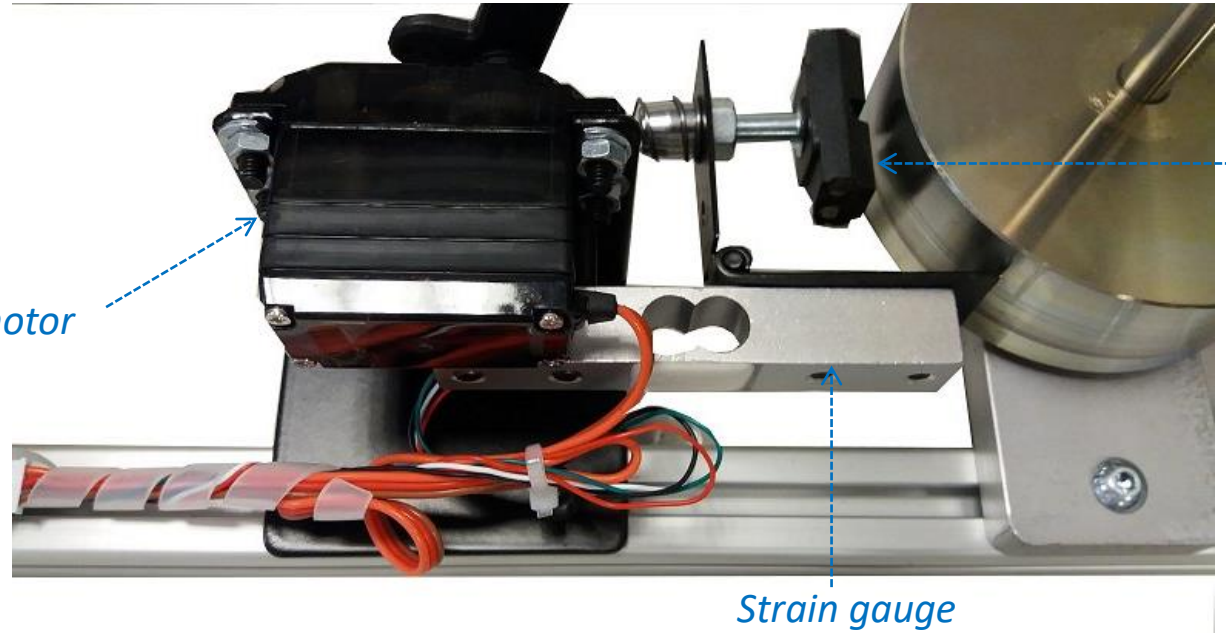
1B – H-CELL SYSTEM



1C – MEASURING BENCH

- 4 inertial wheels
- Stub axes
- Aluminium bearing housing
- Strong and reliable

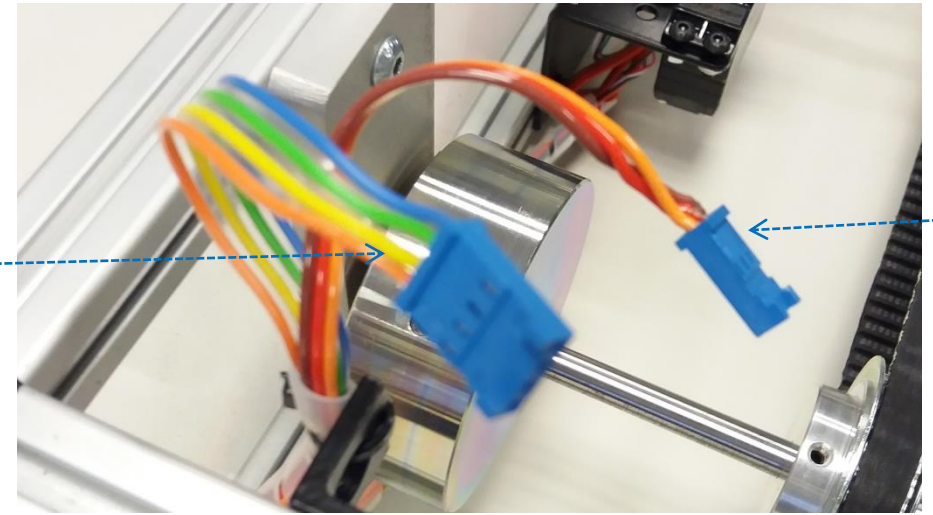
1C – MEASURING BENCH



- Standard parts
- Bicycle brake
- Tamiya servo
- Strain gauge

1C – MEASURING BENCH

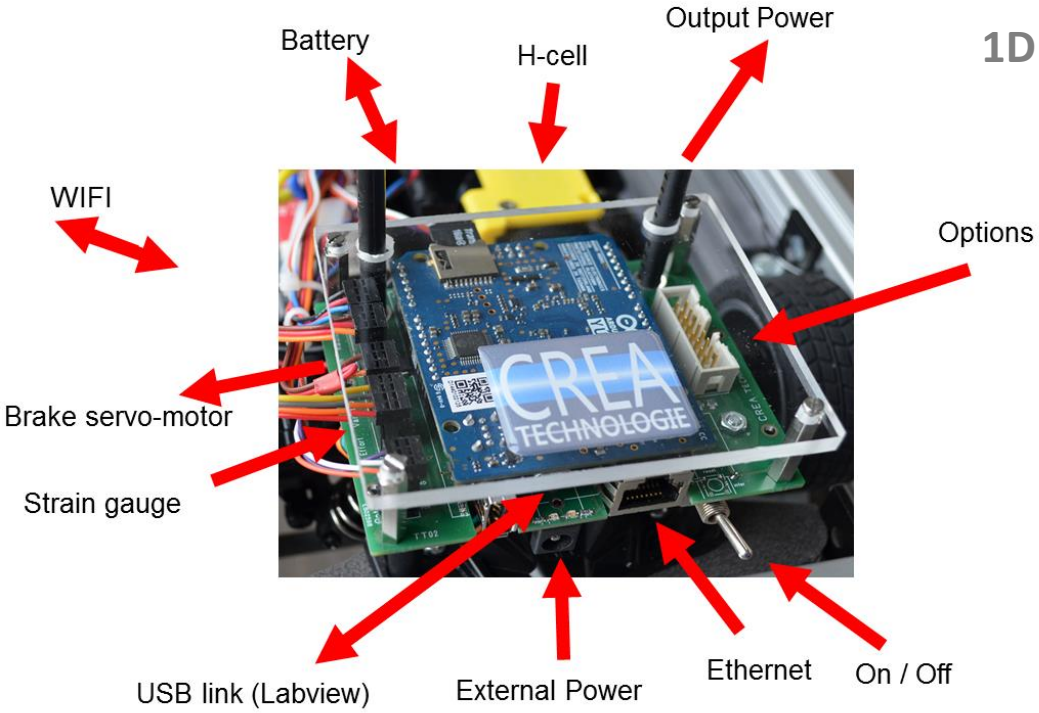
Strain gauge connector



Brake Servo-motor connector

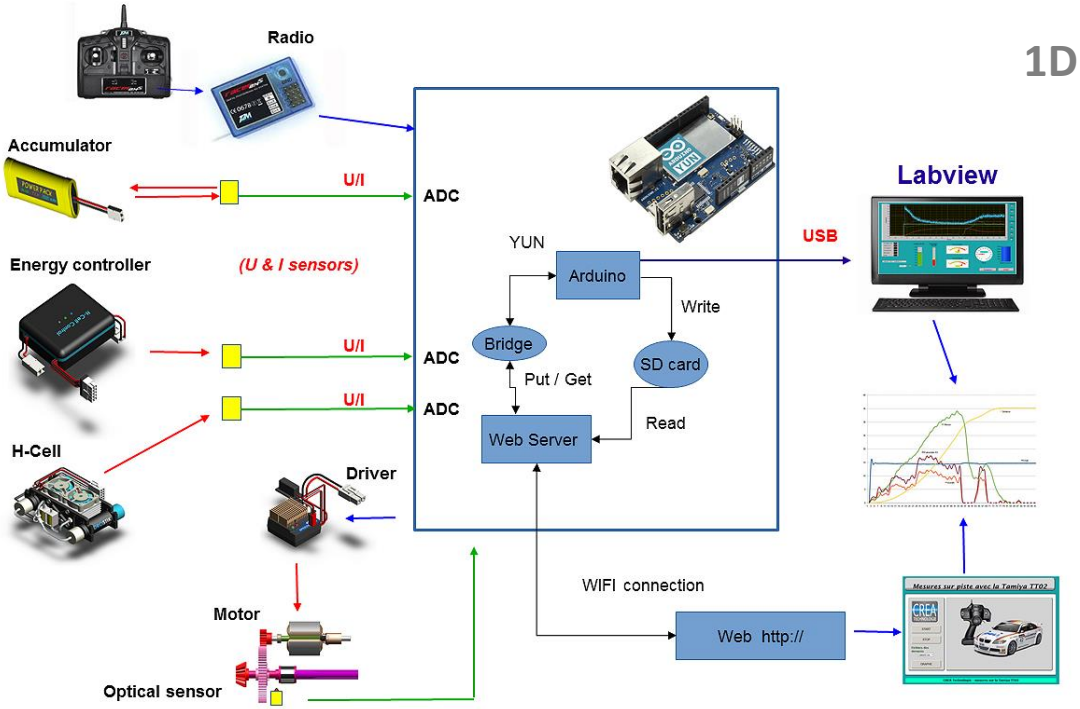
And measuring board ?

1D – MEASURING BOARD



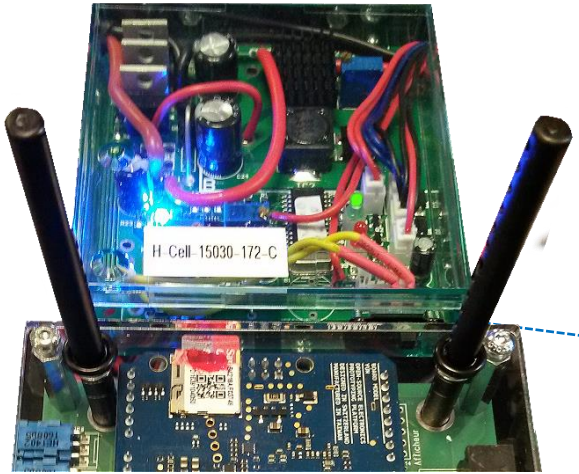
FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

1D – MEASURING BOARD



START THE CAR, MEASURES

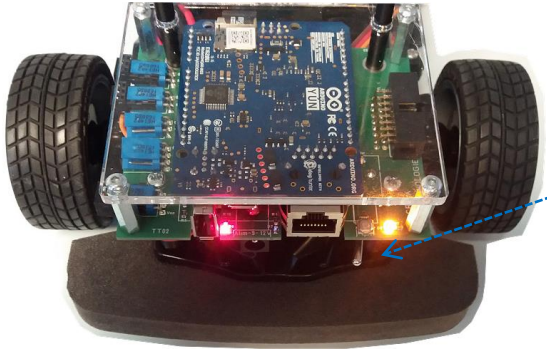
- Turn remote controler on



switch

- Turn Hcell on
- Wait for green fixed hcell LED light

2A – ON TRACK

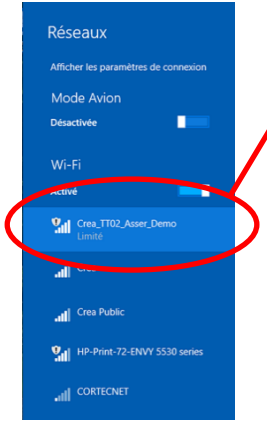


switch

- Turn Hcell on
- Turn car on
- Wait for yellow fixed light

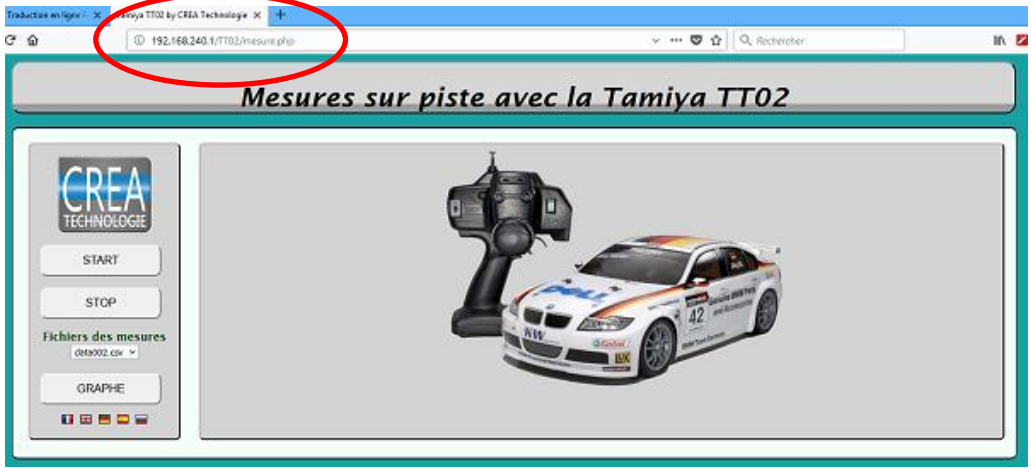
FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

START THE CAR, MEASURES



1 *Wifi connection*

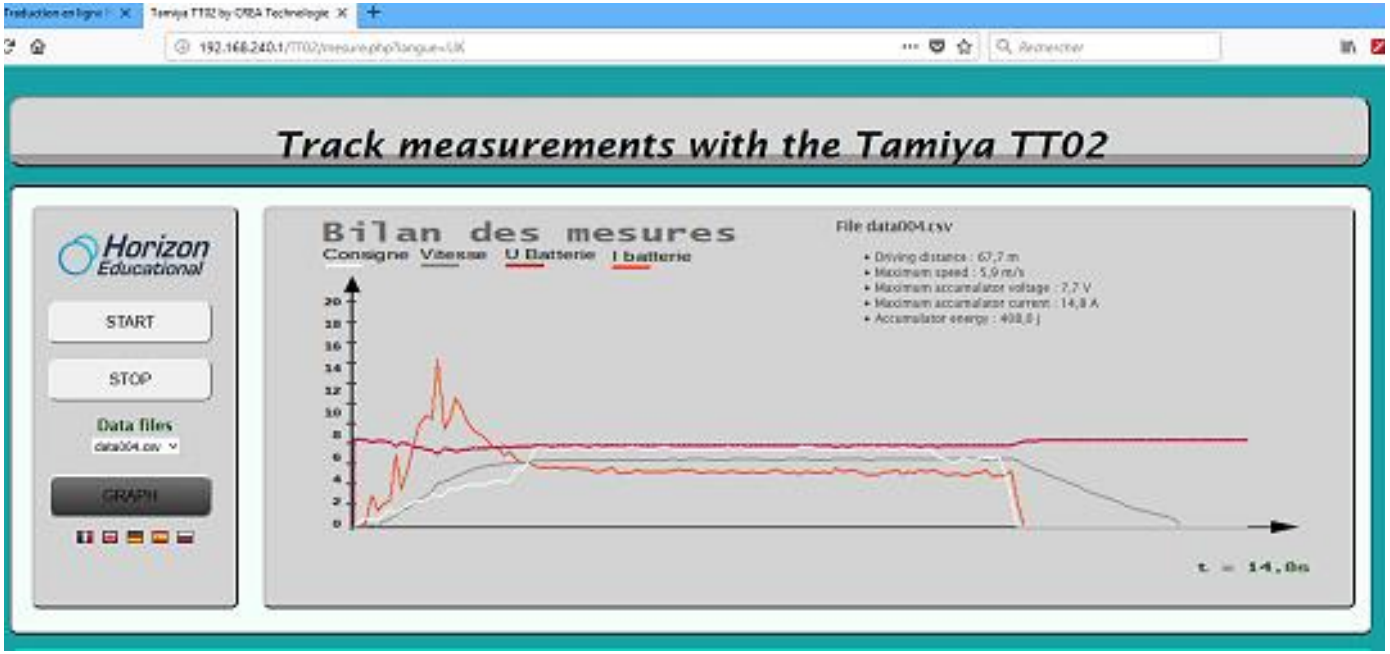
2 *IP address 192.168.240.1/TT02*



2B – WEB INTERFACE

- Easy to use
- Multi-language
- No software required
- Smartphone, tabs and PC compatible
- On board HMI
- Remote measurement
- Ideal on track

Horizon Educational



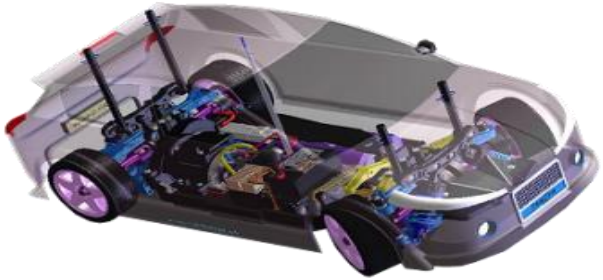
2B – WEB INTERFACE

- Easy to use
- Multi-language
- No software required
- Smartphone, tabs and PC compatible
- On board HMI
- Remote measurement
- Ideal on track

Horizon Educational

START THE CAR, MEASURES

2C - LABVIEW INTERFACE - TT02 ON THE BENCH



1. How to connect the car with the Bench
   A. Brake sensor connection
   B. Brake servomotor connection
   C. Brake servomotor power supply
   D. USB communication with PC

2. Labview dashboard
   A. Installation on PC
   B. Using labview with the car
   C. Data records and data treatment

1. How to connect the car with the Bench
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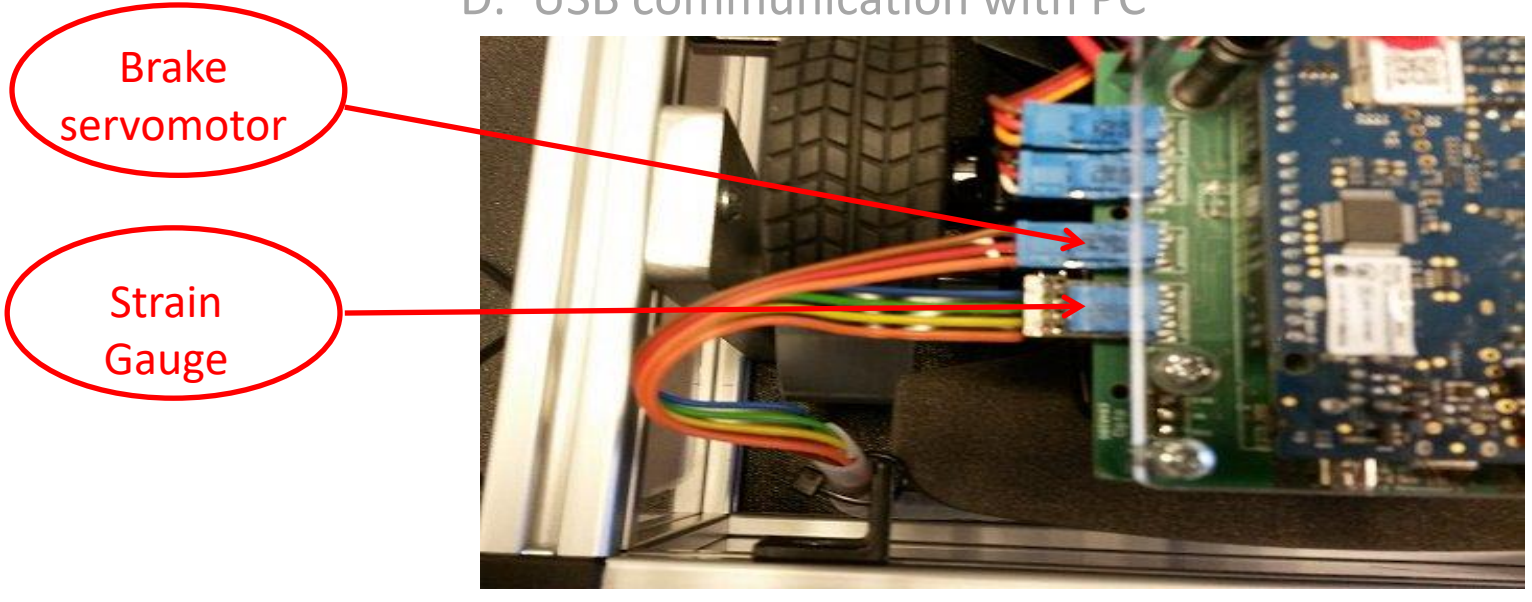
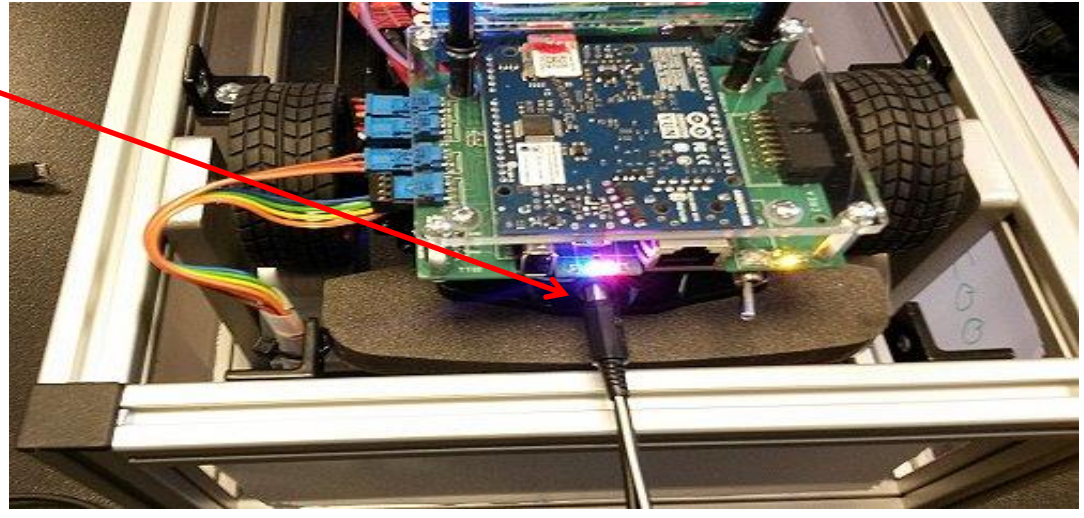


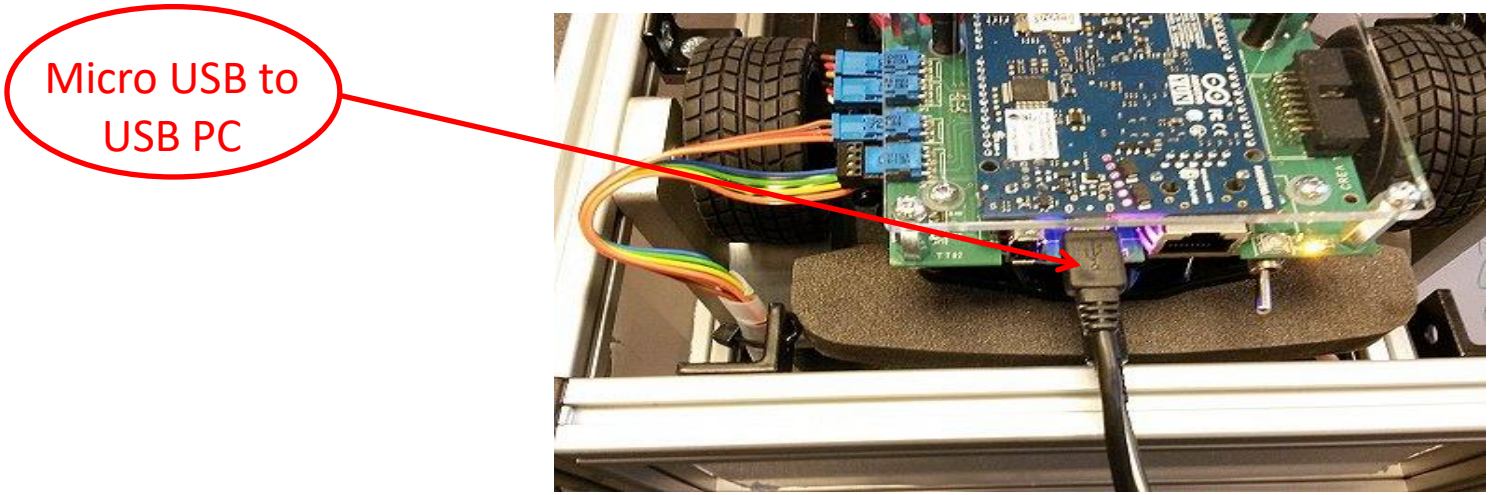
1. How to connect the car with the Bench
   A. Brake sensor connection
   B. Brake servomotor connection
   C. Brake servomotor power supply
   D. USB communication with PC

Power supply servomotor



VERY IMPORTANT ! IT SHOULD BE CONNECTED BEFORE TURNING THE CAR ON

1. How to connect the car with the Bench
   A. Brake sensor connection
   B. Brake servomotor connection
   C. Brake servomotor power supply
   D. USB communication with PC



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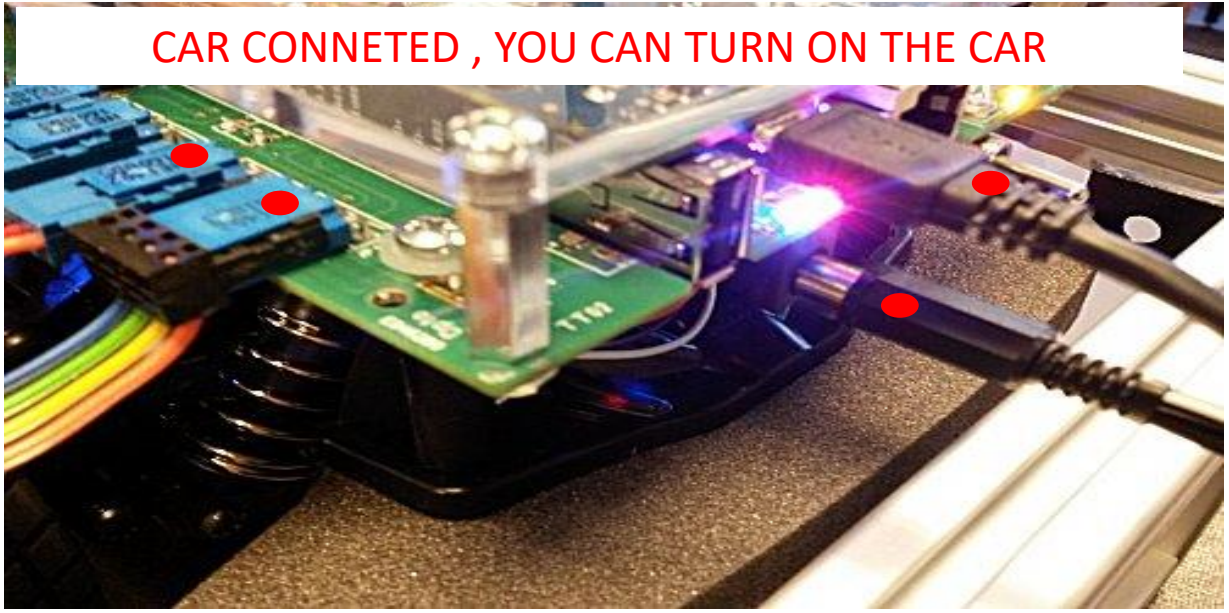
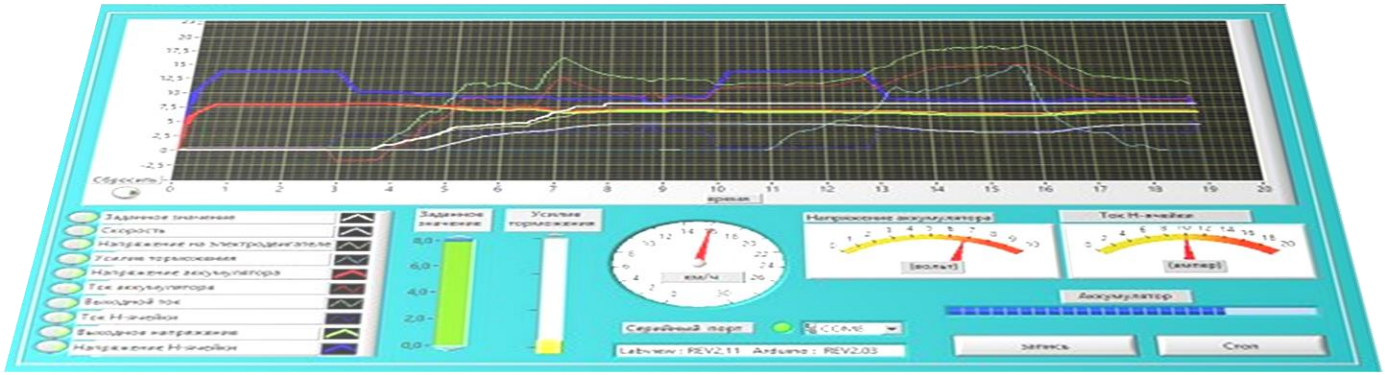
   A. Brake sensor connection
   B. Brake servomotor connection
   C. Brake servomotor power supply



2. Labview dashboard

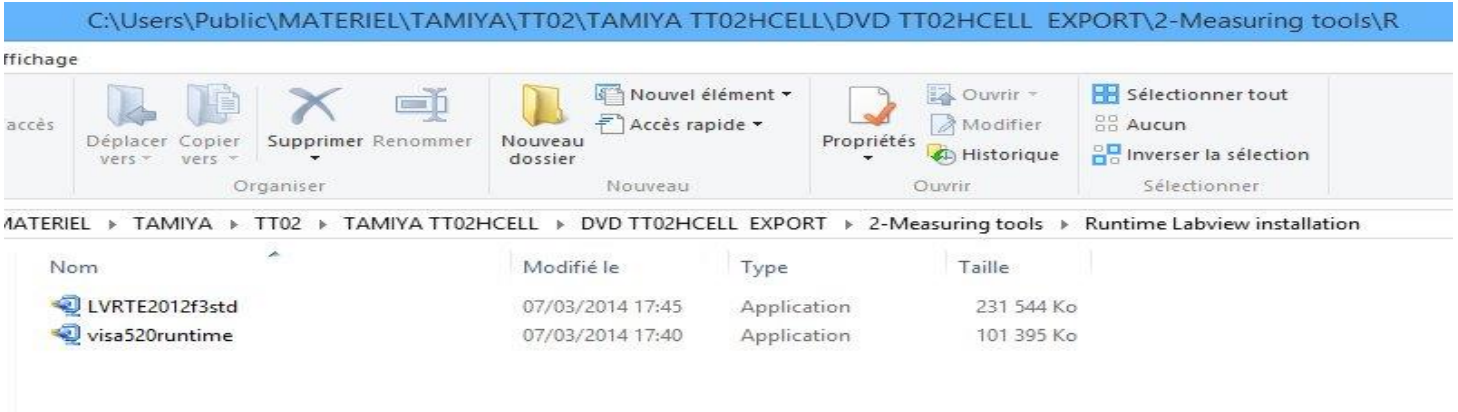
A. Labview files installation on PC
B. Arduino installation on PC
C. Using labview with the car
D. Data records and data treatment



2. Labview dashboard

A. Labview files installation on PC
B. Arduino installation on PC
C. Using labview with the car
D. Data records and data treatment

The dashboard has been developped with labview software (National Instruments). The full software is not needed on your computer. You just need to install the following free applications :



2. Labview dashboard

A. Labview files installation on PC

B. Arduino installation on PC

C. Using labview with the car

D. Data records and data treatment

The measuring board of the car is using a microcontroler board model YUN of Arduino. This board should be recognized by the PC. You need to instal Arduino Freeware :

https://www.arduino.cc/en/Main/Software

2. Labview dashboard

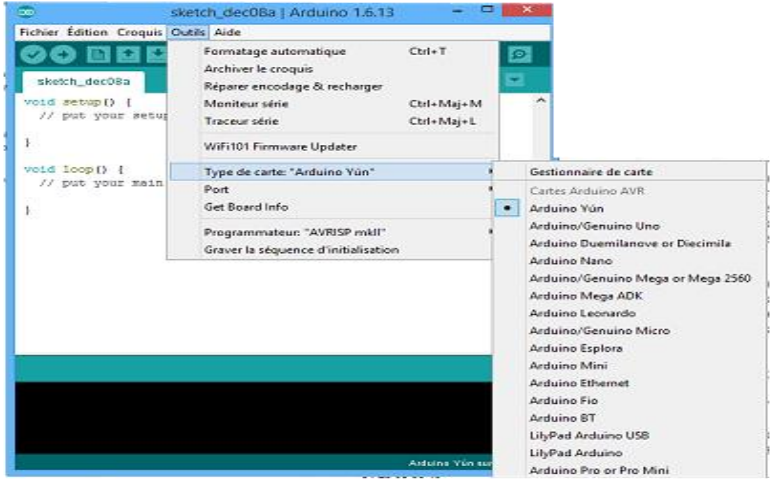
A. Labview files installation on PC

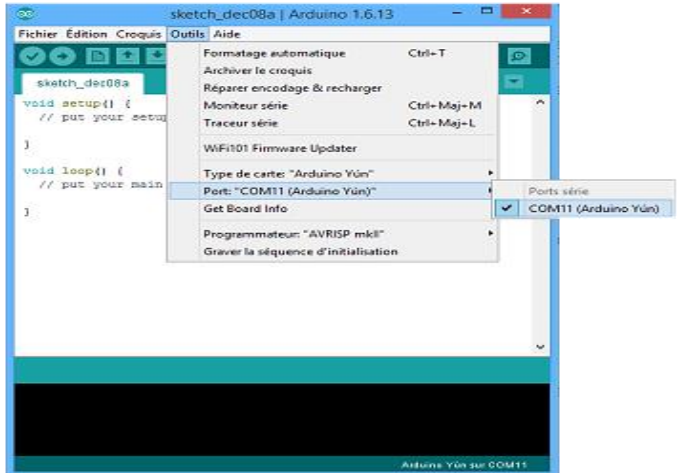
B. Arduino installation on PC

C. Using labview with the car

D. Data records and data treatment

After Arduino installation software, and with USB cable connected , the COM port used by the PC can be shown as follow :

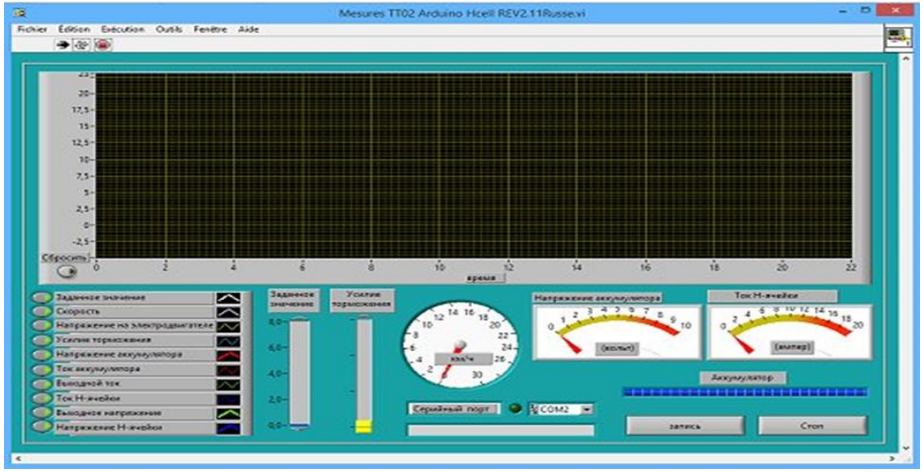




2. Labview dashboard

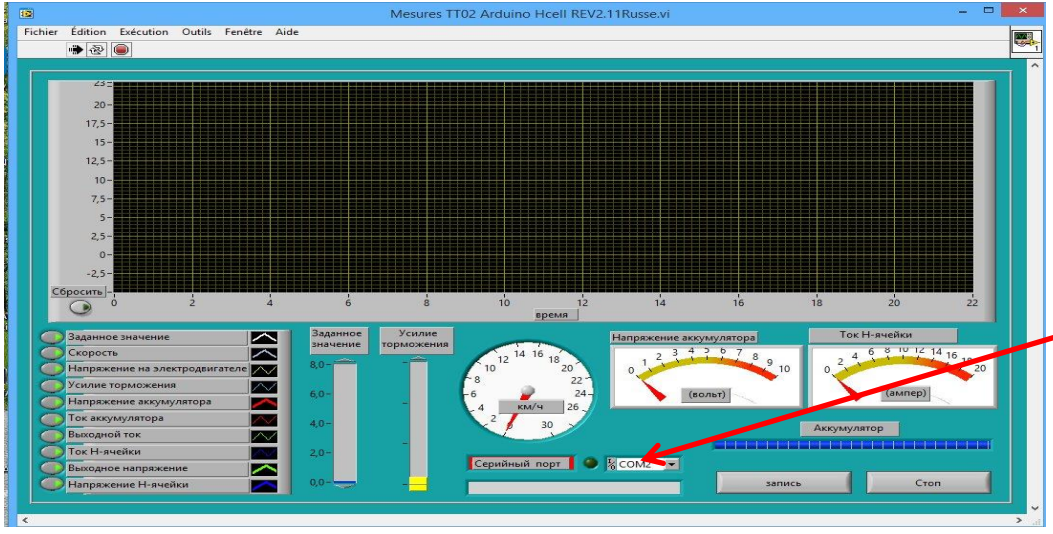
A. Labview files installation on PC
B. Arduino installation on PC
C. Using labview with the car
D. Data records and data treatment

The car is connected to PC and recognized on COM port 11 (exemple). The dashboard can be openned in doubleclicking on ‘’measures TT02’’. You should obtain the following screen :



2. Labview dashboard

A. Labview files installation on PC
B. Arduino installation on PC
C. Using labview with the car
D. Data records and data treatment



Select Com port, the measurement can start after few seconds

2. Labview dashboard

A. Labview files installation on PC
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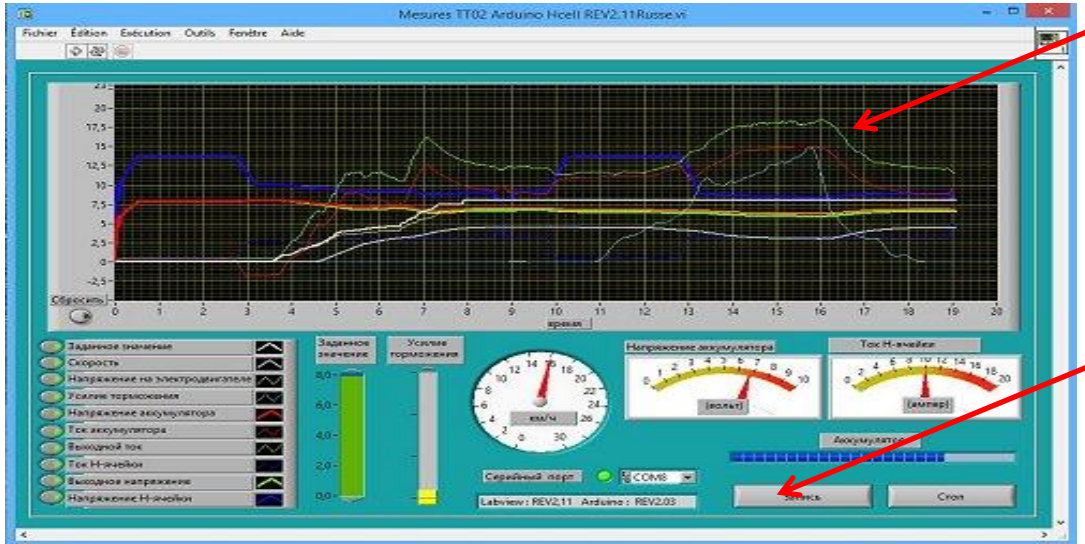

2. Labview dashboard

A. Labview files installation on PC
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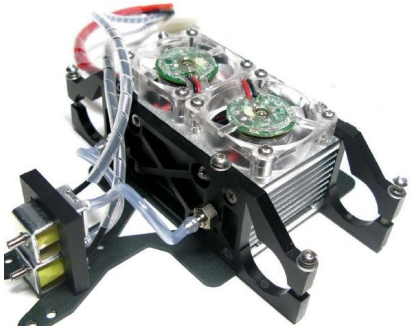
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	время	Период	Заданное значение	Ускорение	Ускорение	Напряжение аккумулятора	Ток аккумулятора	Напряжение Н-ячейки	Выходное напряжение	Ток Н-ячейки	Выходной ток		время	Протяженность следования	Скорость	Скорость (км/ч)	Напряжение аккумулятора	To аккумул
2													seconde	mètre	m/s	Km/h	Volt	Amp
3	Cpt	Période	Consigne	ACC	ACC	Tension	Courant	Tension	Tension	Courant	Courant		Temps	Distance	Vitesse	Vitesse	tension Batterie	cour batte
4	imp	imp µs	radio	X	Y	Batterie	Batterie	Pile	Utile	Pile	Utile							
5																		
6	0	310500	25	0	0	582	0	738	585	36	2		0,1	#VALEUR!	0,3	0,9	7,8	#VALI
7	0	310500	58	0	0	426	353	612	413	70	360		0,2	#VALEUR!	0,3	0,9	5,7	17
8	1	310500	85	0	0	401	442	586	366	74	455		0,3	0,1	0,3	0,9	5,4	21
9	3	48412	90	0	0	419	412	601	391	70	449		0,4	0,2	1,6	5,8	5,6	20
10	7	31175	90	0	0	436	379	618	415	67	415		0,5	0,5	2,5	9,1	5,8	18
11	10	26588	90	0	0	452	333	630	432	64	389		0,6	0,8	3,0	10,6	6,1	16
12	14	23496	90	0	0	466	295	643	448	61	349		0,7	1,1	3,3	12,0	6,2	14
13	18	21420	90	0	0	477	264	652	459	59	325		0,8	1,4	3,7	13,2	6,4	12
14	24	19536	90	0	0	486	238	659	471	58	302		0,9	1,9	4,0	14,5	6,5	11
15	29	18468	90	0	0	493	218	666	479	56	280		1,0	2,3	4,3	15,3	6,6	10
16	34	17688	90	0	0	498	202	671	487	54	257		1,1	2,7	4,4	16,0	6,7	9,
17	40	17024	90	0	0	504	187	675	492	55	242		1,2	3,1	4,6	16,6	6,8	9,
18	47	16388	90	0	0	510	170	678	498	52	223		1,3	3,7	4,8	17,2	6,8	8,
19	53	16076	90				167	679	501	51	219			4,2	4,9	17,6	6,8	8,
20	59	15744	90					680	501	51					5,0	17,9	6,9	8,
21	65	15456						683	507	51					5,1	18,3	6,9	7,
22	71	15244						685	510							18,5	7,0	7,
23	79	15112						685	510							18,7	7,0	7,
24	85	15008						686	513							18,8	7,0	6,

Open your data file with raw values, copy and past here

Values are calculated. Curves can be dertermined

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

AFTER SALES SERVICE



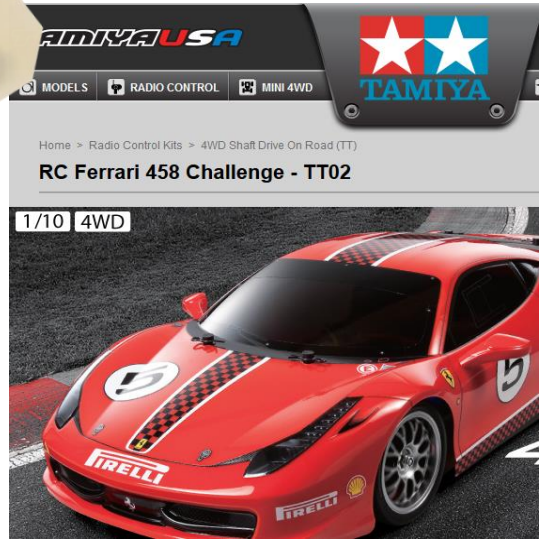
- The TT02 car
- The measuring board
- The H-cell
- The hydrofill
- The hydrosticks
- The bench
- The software

Horizon Educational

Easy Navigation

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

AFTER SALES SERVICE



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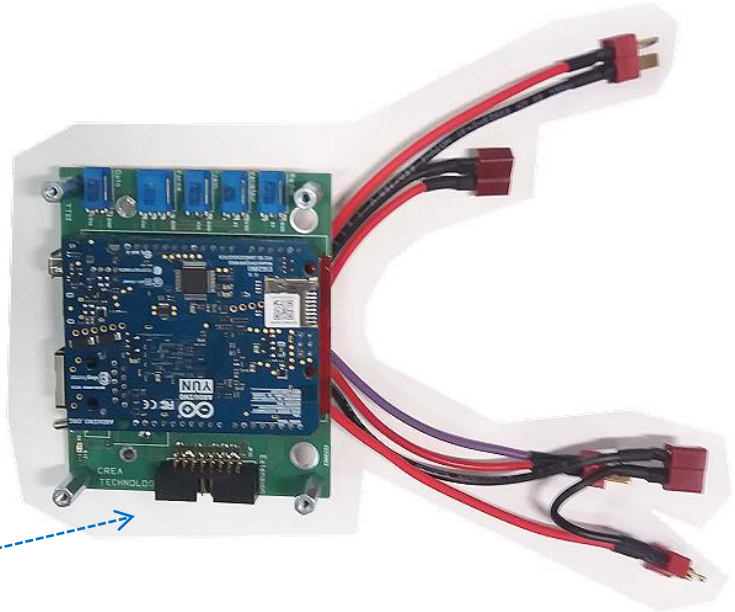
FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

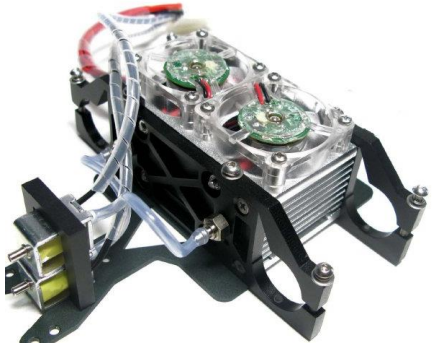


Circuit board ready to use with terminal connections

- The TT02 car
- The measuring board
- The H-cell
- The hydrofill
- The hydrosticks
- The bench
- The software

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

AFTER SALES SERVICE



- The TT02 car
- The measuring board
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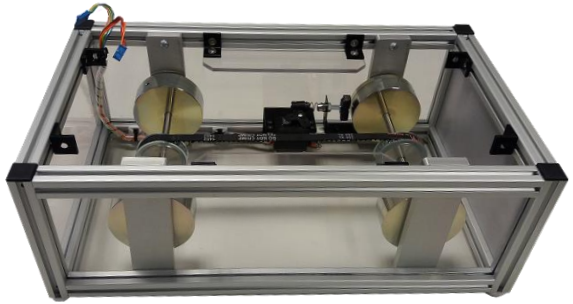
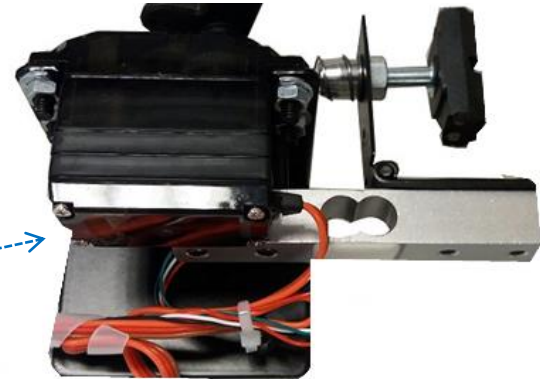
- The software

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer



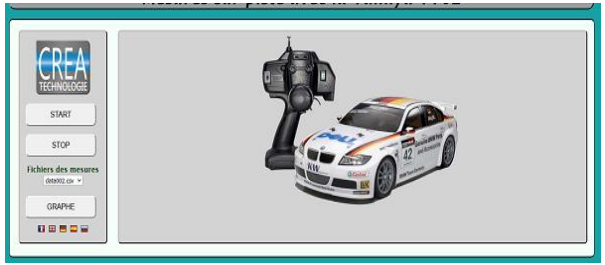


Complete brake system with terminal connections

- The TT02 car
- The measuring board
- The H-cell
- The hydrofill
- The hydrosticks
- The bench
- The software

FCAT – 30 H2Hybrid Fuel Cell Automotive Trainer

Arduino YUN



Microcontroler program
On measuring board

HTML WEB server program
On measuring board

Labview Interface
On DVD, can be updated

- The TT02 car
- The measuring board
- The H-cell
- The hydrofill
- The hydrosticks
- The bench
- The software