

INTRODUCTION TO BATTERY MANAGEMENT SYSTEMS

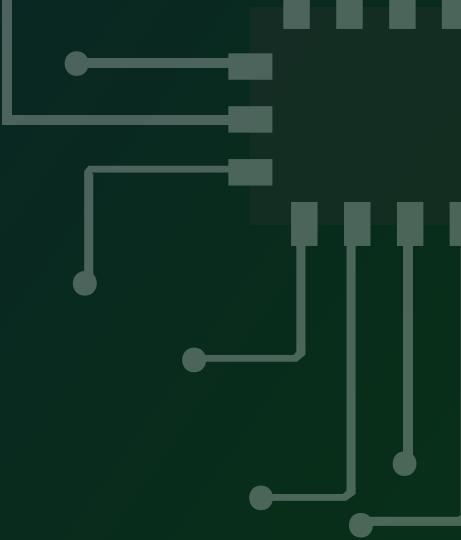


REQUIREMENTS OF AN EV BATTERY

Important Factors:

1. Safety
2. High Power Output
3. High storage capacity
4. Compact and Light
5. Long Battery Life
6. Low Overall Production+ Operation Cost

TYPES OF BATTERIES



Primary non-rechargeable

- Alkaline Batteries

Secondary rechargeable

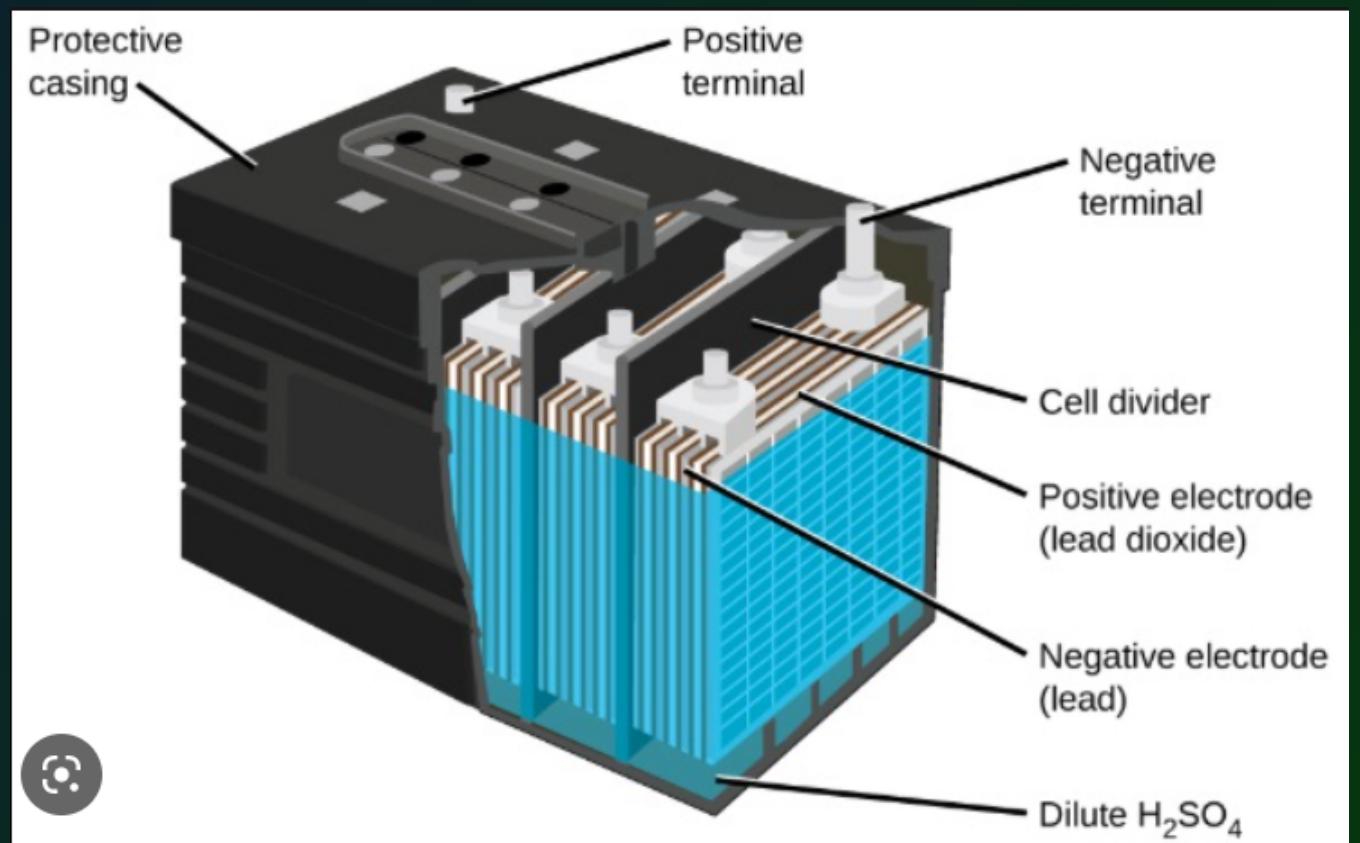
- Lead Acid
- Nickel-Metal Hydride
- Lithium-Ion



TYPES OF BATTERIES

LEAD-ACID

1. Flooded lead-acid batteries are cheap and readily available.
2. There are 2 types of lead-acid batteries: automobile engine starter and deep cycle batteries.
3. 25 to 50% of total vehicle mass.
4. Efficiency of 70-75%.



TYPES OF BATTERIES

NICKEL METAL HYDRIDE

1. Energy density of 30-80 Wh/kg, better than lead acid (25-35).
2. Battery life is exceptionally long, operating well even after 10 years and 160k km.
3. Poor efficiency, high-self discharge, unreliable charging, bad performance in cold weather.



TYPES OF BATTERIES

LITHIUM-ION

1. Lithium cobalt oxide cathode and graphite anode.
2. 200+Wh/kg energy density, good power density.
3. 80-90% charge efficiency.
4. Silicon nanowires and nanoparticles and tin nanoparticles multiply power density.



CHARGING OF EV BATTERIES

1. Charging time is limited by the capacity of the grid connection.
2. Most batteries have a set maximum charge rate, above which they will not accept, as it affects battery life and the discharge capacity.
3. Charging Power can be connected to the car in two ways:
Conductive Charging or Inductive Charging.

CHARGING OF EV BATTERIES

1. Conductive: A power mains lead is connected into a weatherproof socket through high voltage capacity connectors with safety connectors.
2. Inductive: A special 'paddle' is inserted into a slot in the car, which is one winding of a transformer, with the other one built into the car. Inserted paddle completes the magnetic circuit, which provides power to the battery pack.

CHARGING OF EV BATTERIES

1. Inductive charging is slightly safer as there is no chance of electrocution since the energy is being transferred in magnetic form.
2. However, with interlocks, special connectors and ground fault detectors have made conductive charging very safe as well.
3. Inductive charging also reduces vehicle weight by reducing the charging components required on-vehicle.

SWAPPING OF EV BATTERIES

1. It is the exchanging of drained/ unusable batteries with fully charged ones instead of recharging the same battery.
2. Reduces consumer's headache of battery cost, life cycle, maintenance, etc.
3. Much faster than charging, and specialised charging equipment used by companies is more efficient.
4. Swap stations increase distributed energy storage.

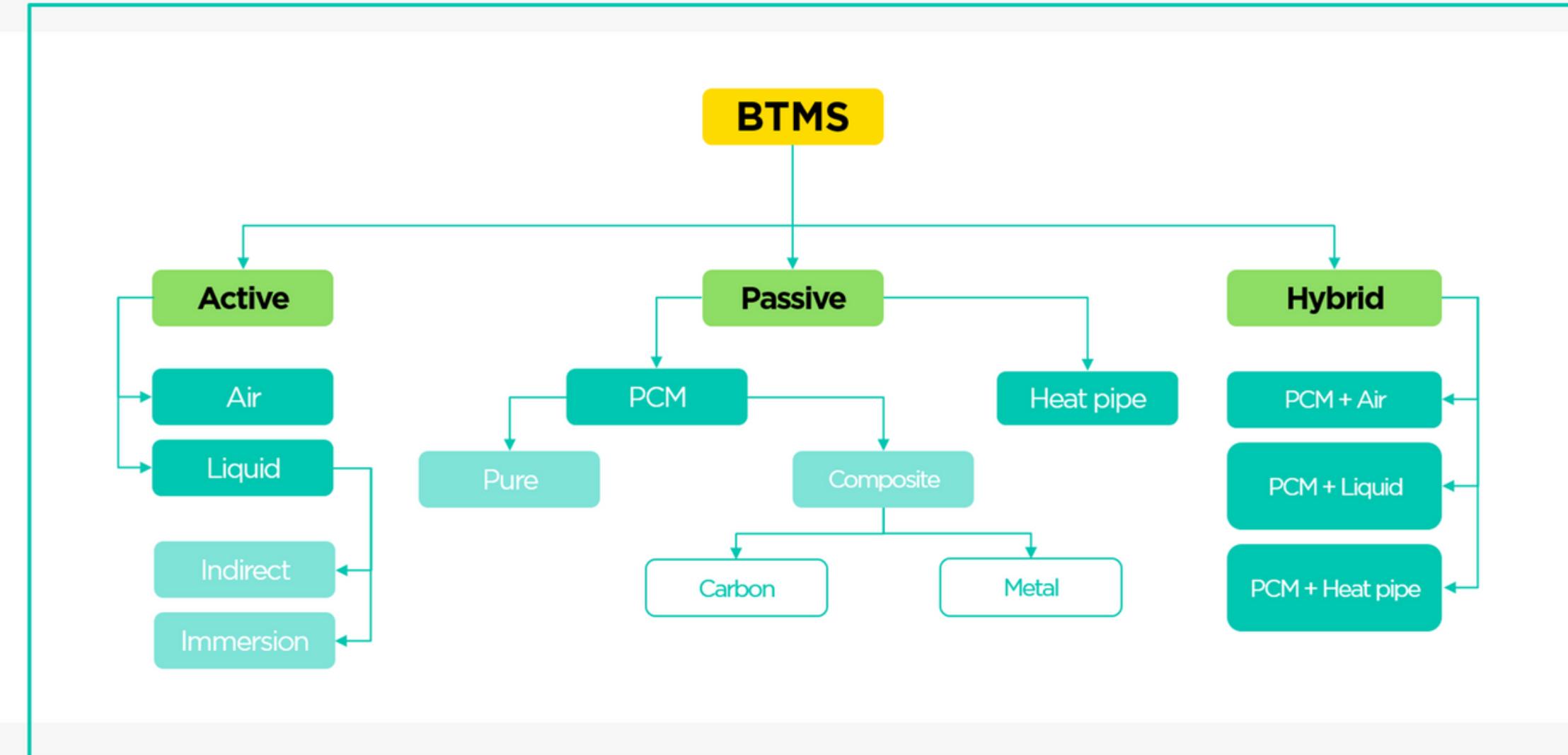
BATTERY THERMAL MANAGEMENT

1. The Battery Thermal Management System (BTMS) is the device responsible for managing/dissipating the heat generated during the electrochemical processes occurring in cells, allowing the battery to operate safely and efficiently
2. The BTMS's (Battery Thermal Management System) objective is to prevent accelerated battery deterioration by managing the heat generated by its components so that it operates continuously under optimum temperature conditions.

CONSTRUCTION

Leading BTMS technologies

CIC
energiGUNE
MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE



BATTERY PACKAGING



NEED FOR A BMS



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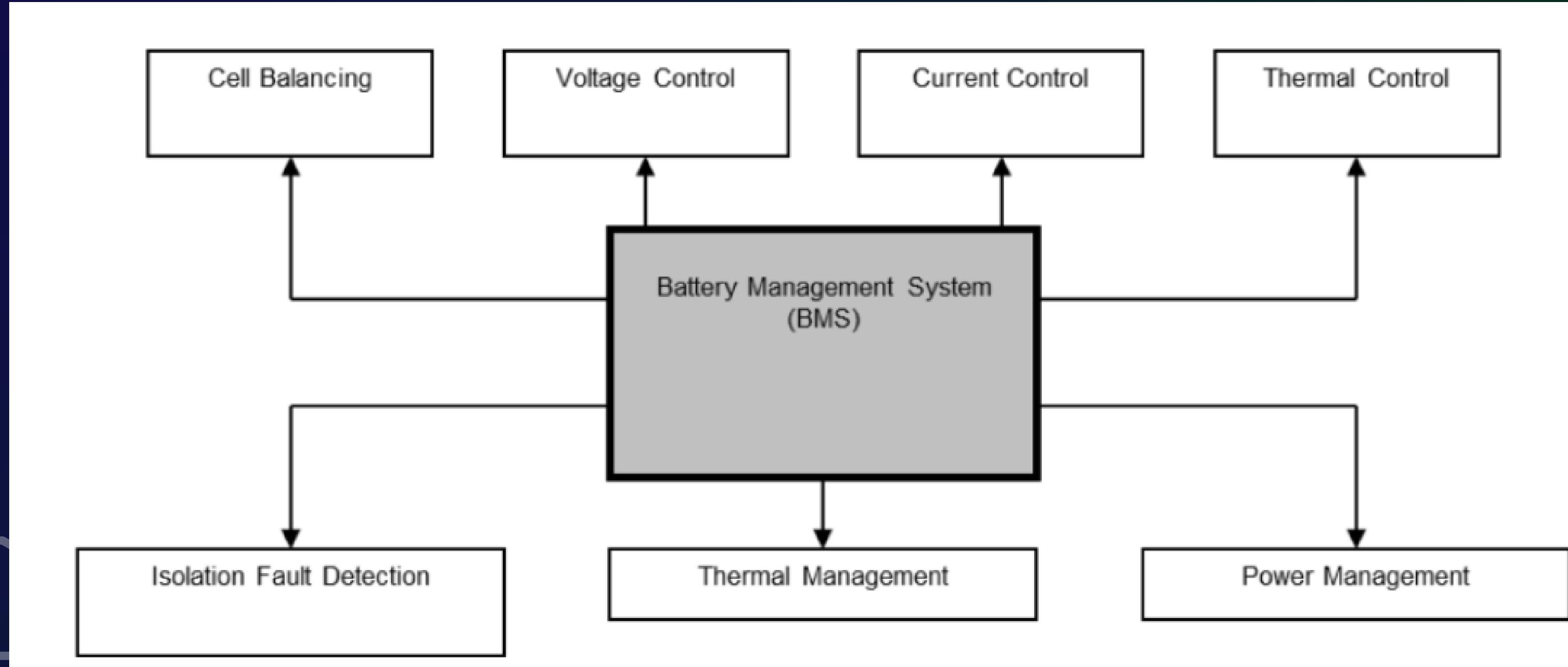
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PARAMETERS OF A BATTERY

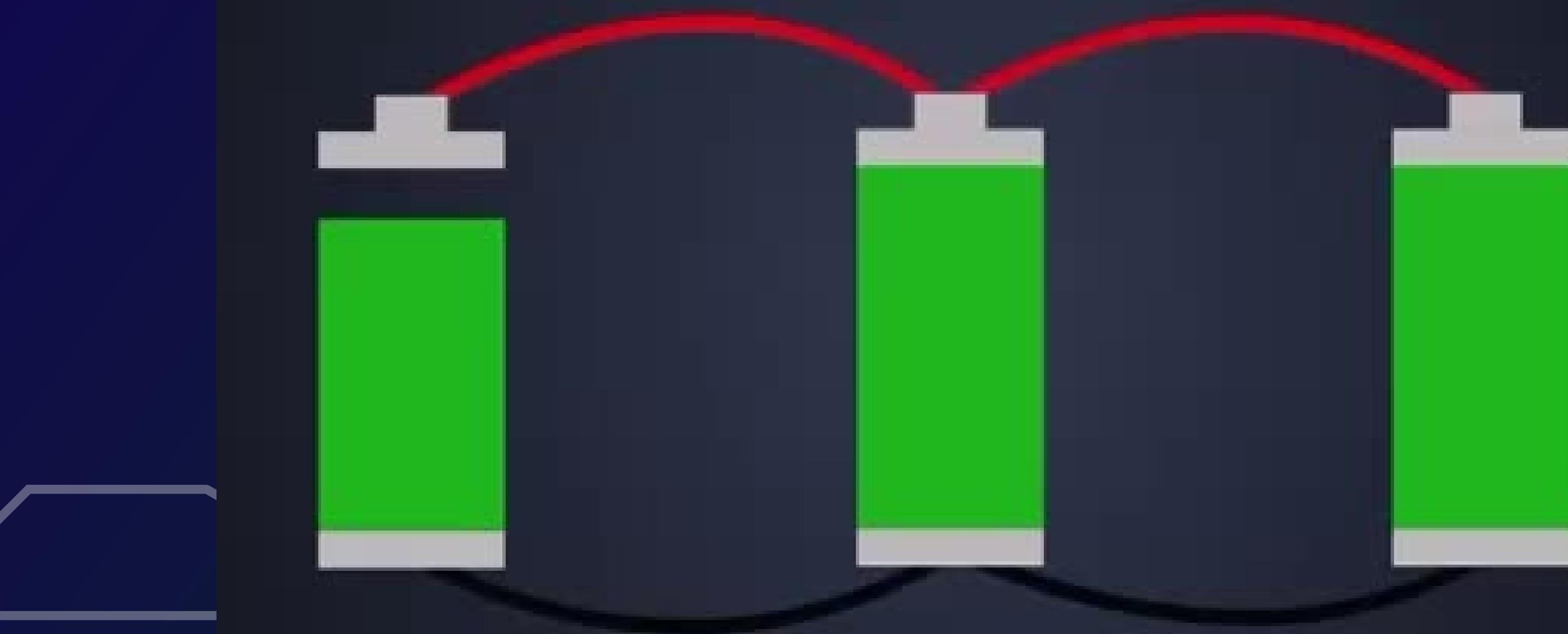
Important Parameters:

1. Capacity
2. State of Charge (SOC)
3. State of Health (SOH)
4. Coulombic efficiency
5. Energy Density
6. Cycle Life

BATTERY MANAGEMENT SYSTEM

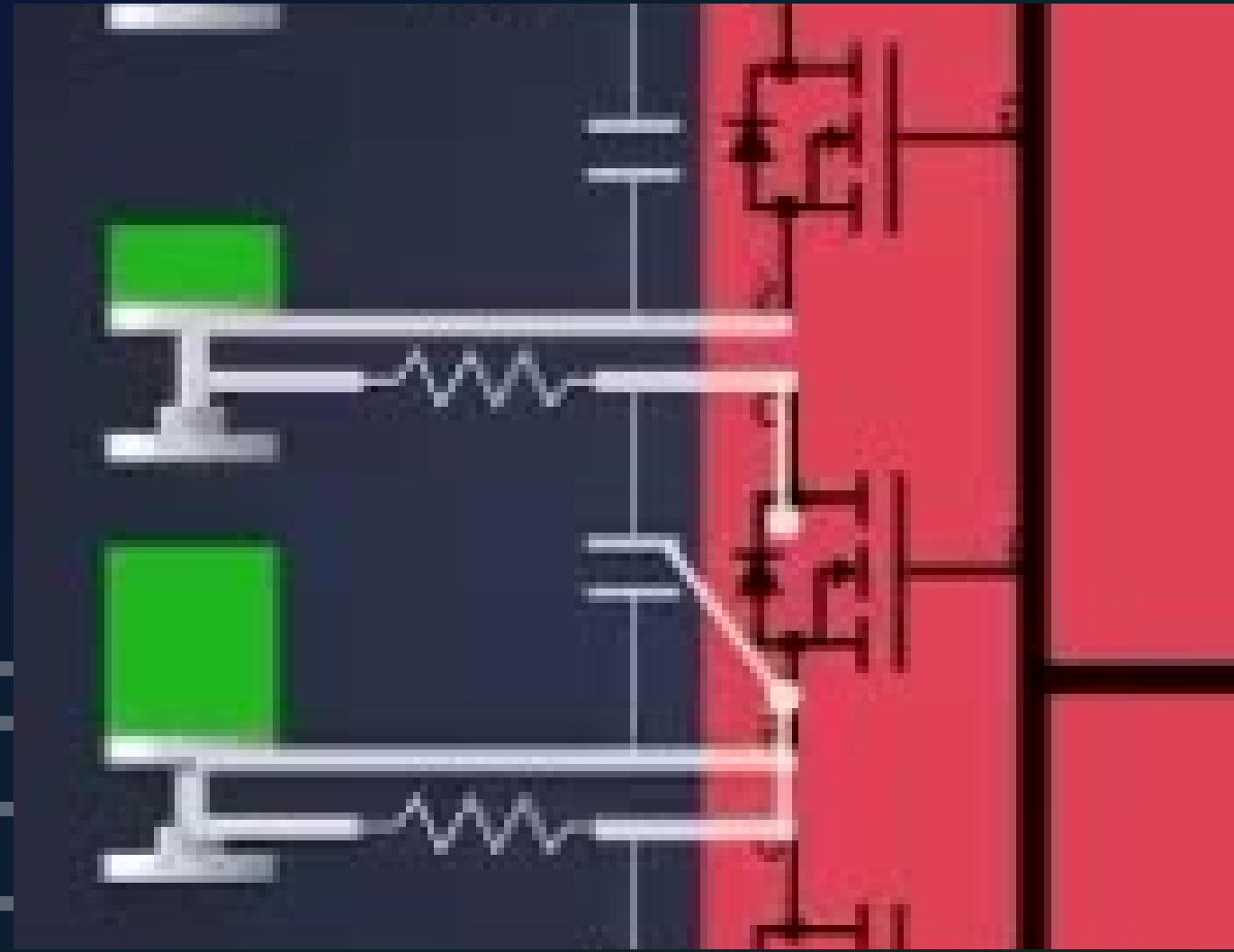


CELL BALANCING



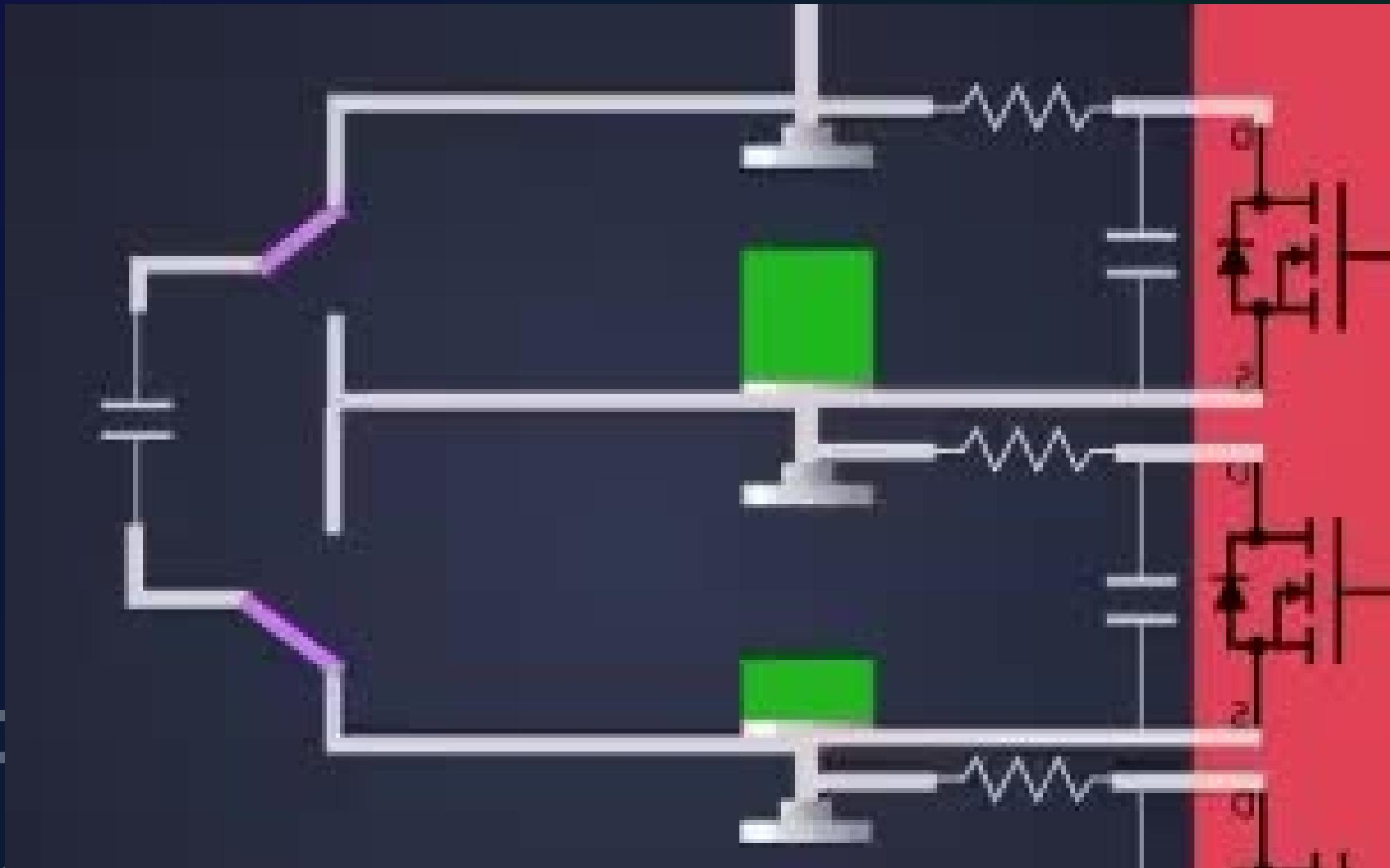
PASSIVE CELL BALANCING

It uses resistors called bypass registers to balance SoC. Hence it causes heat loss in the resistor. It is cheap and easy to implement.

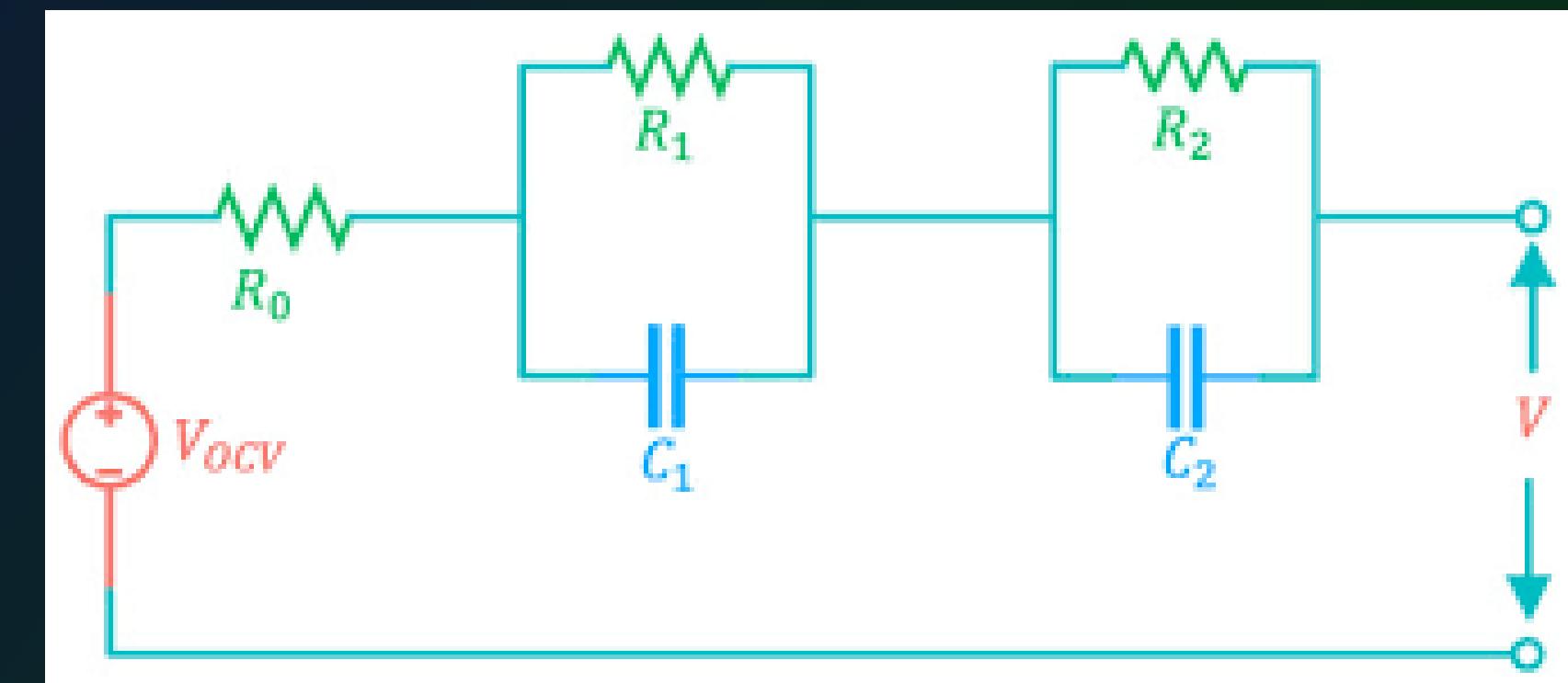
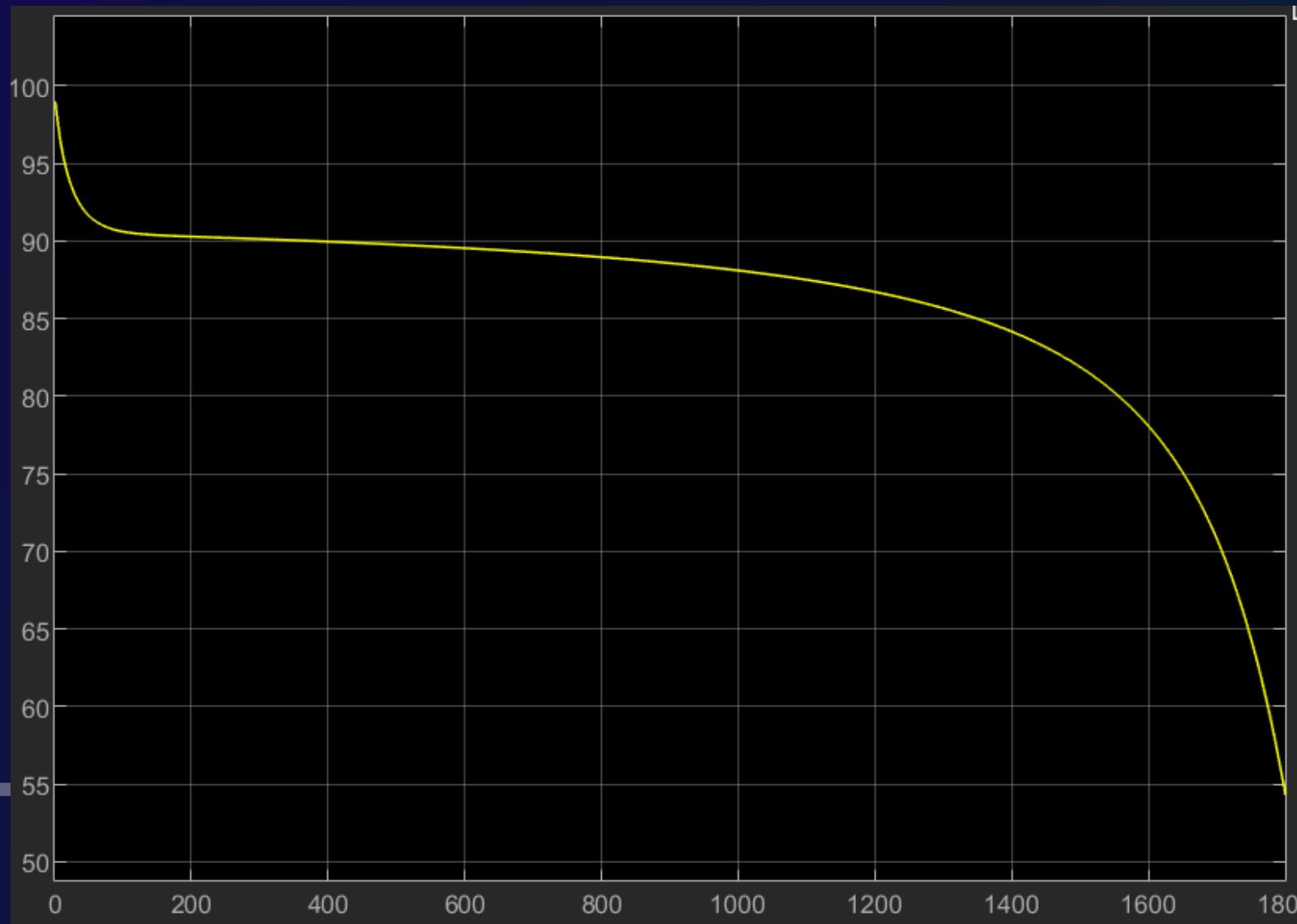


ACTIVE CELL BALANCING

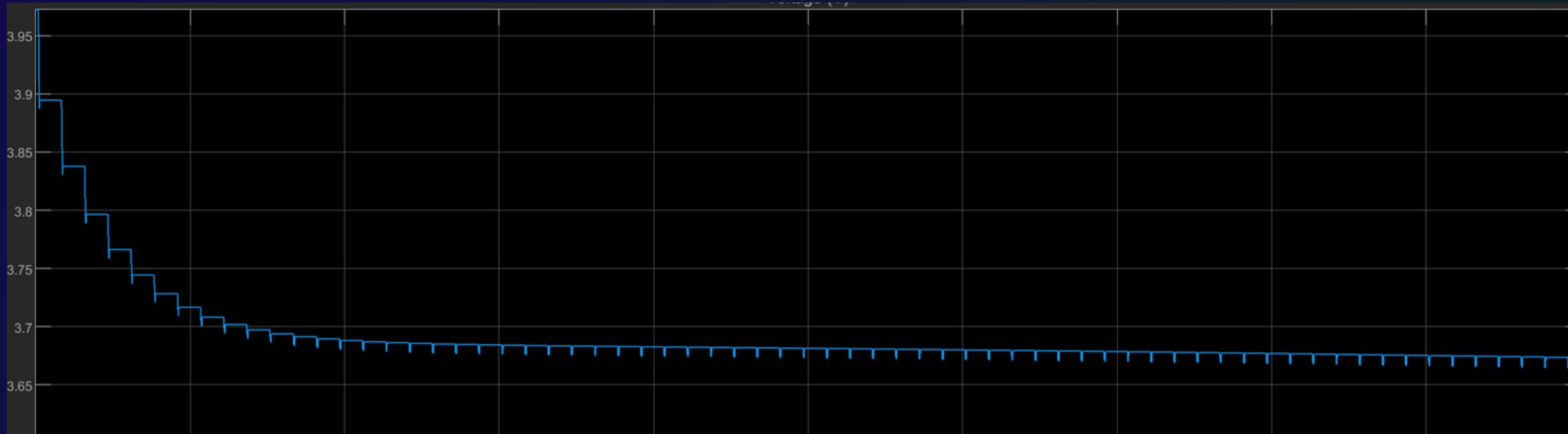
Uses capacitors called flying capacitor to store extra charge.



IN-DEPTH VIEW OF BATTERY

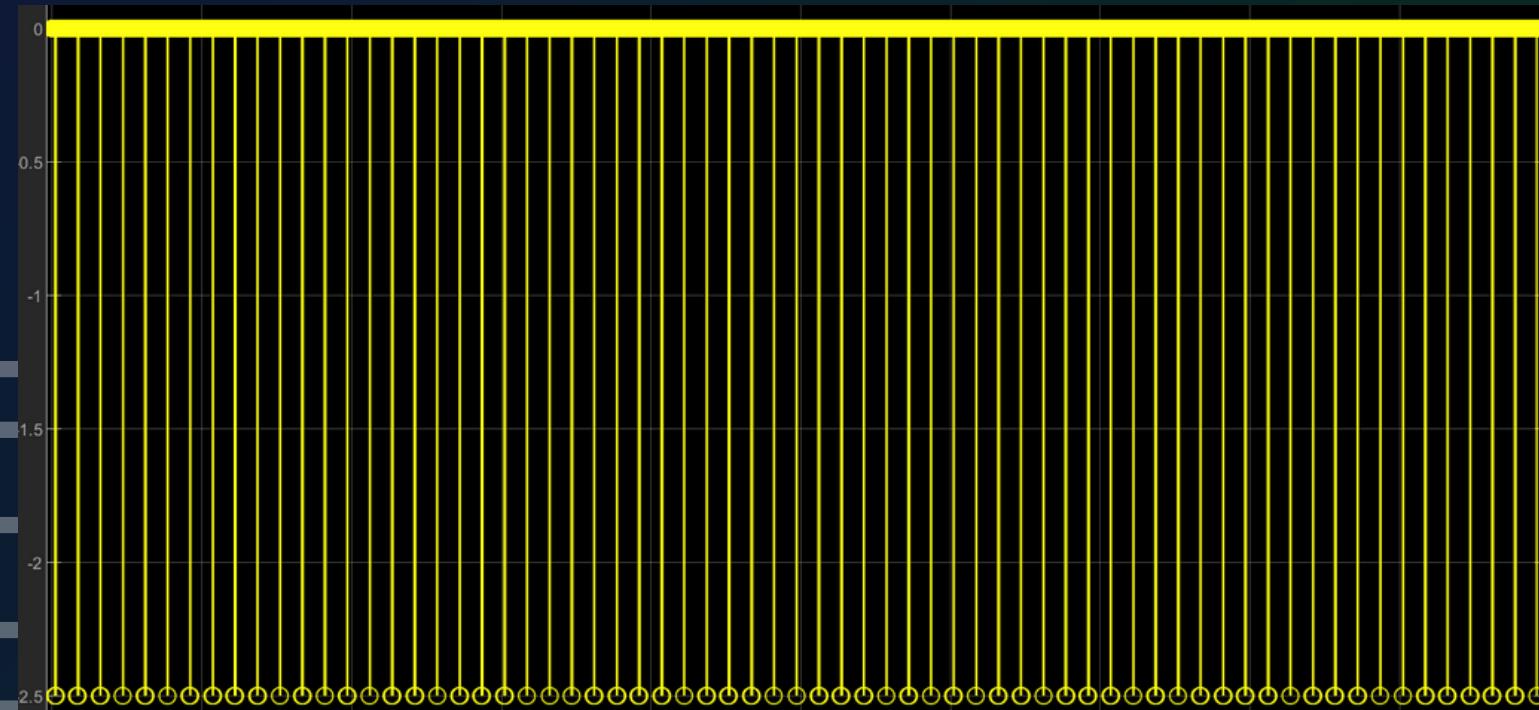


BATTERY CHARACTERISTICS



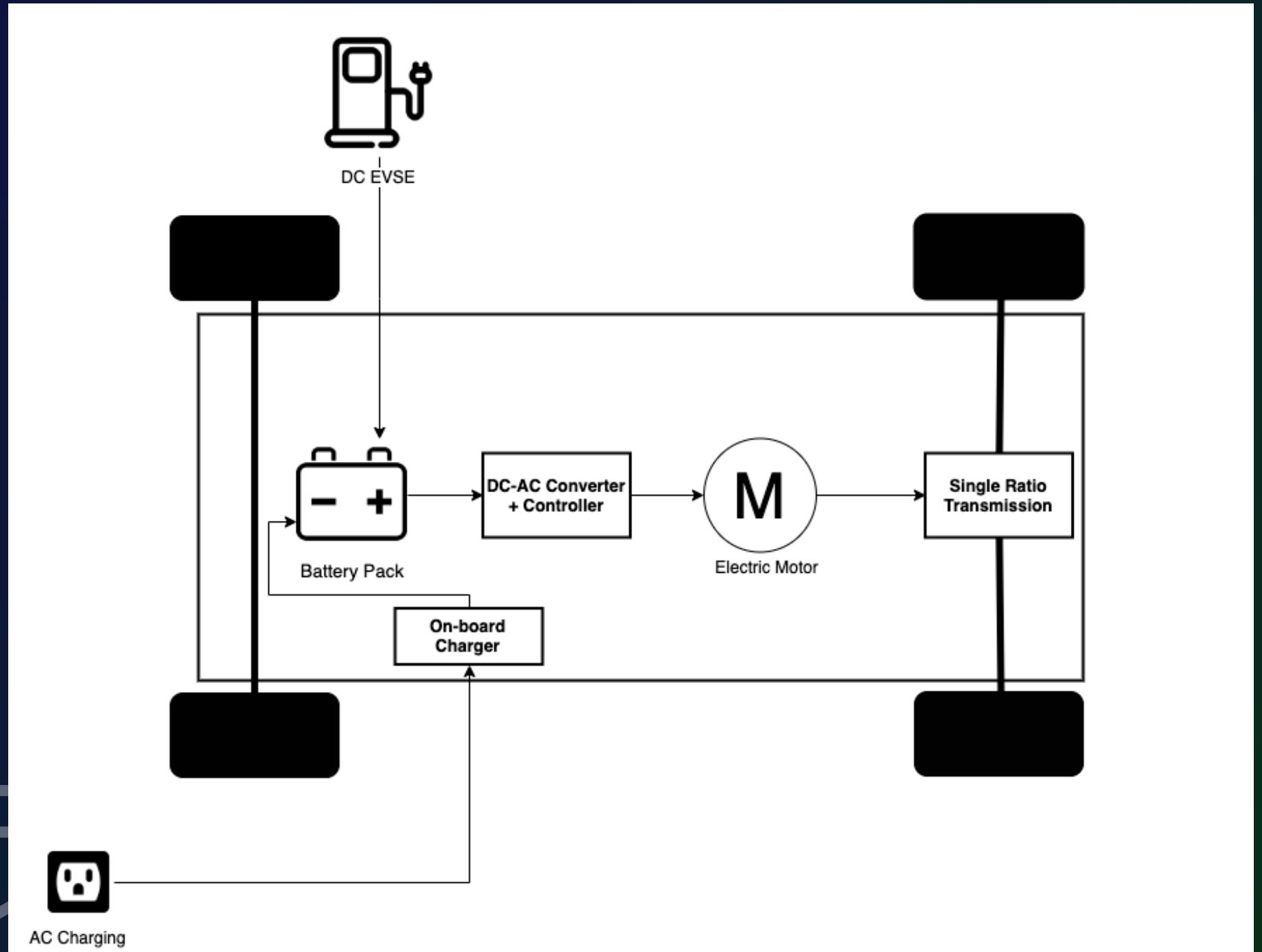
Voltage Measurements

Current Measurements



THANK YOU !





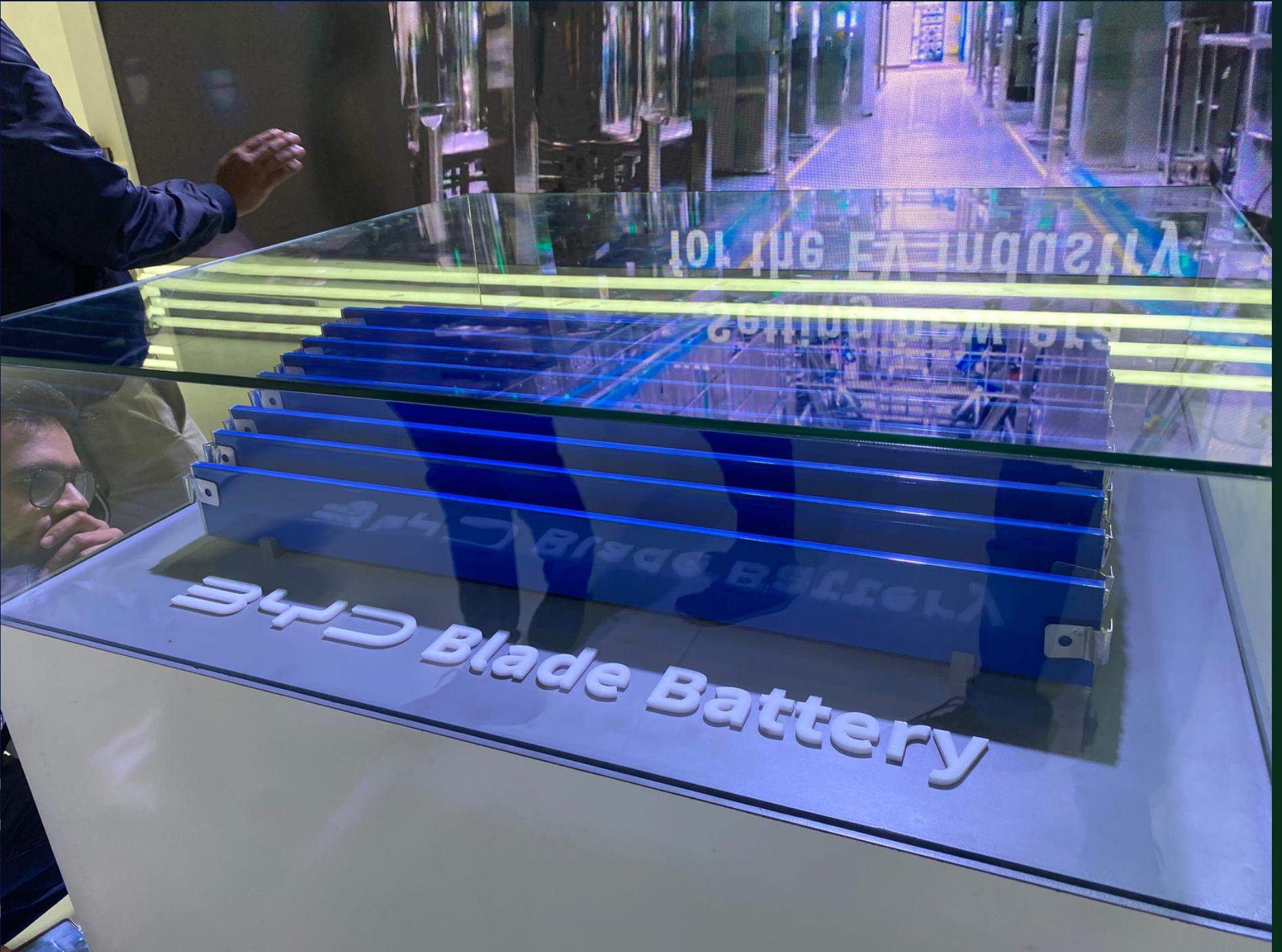
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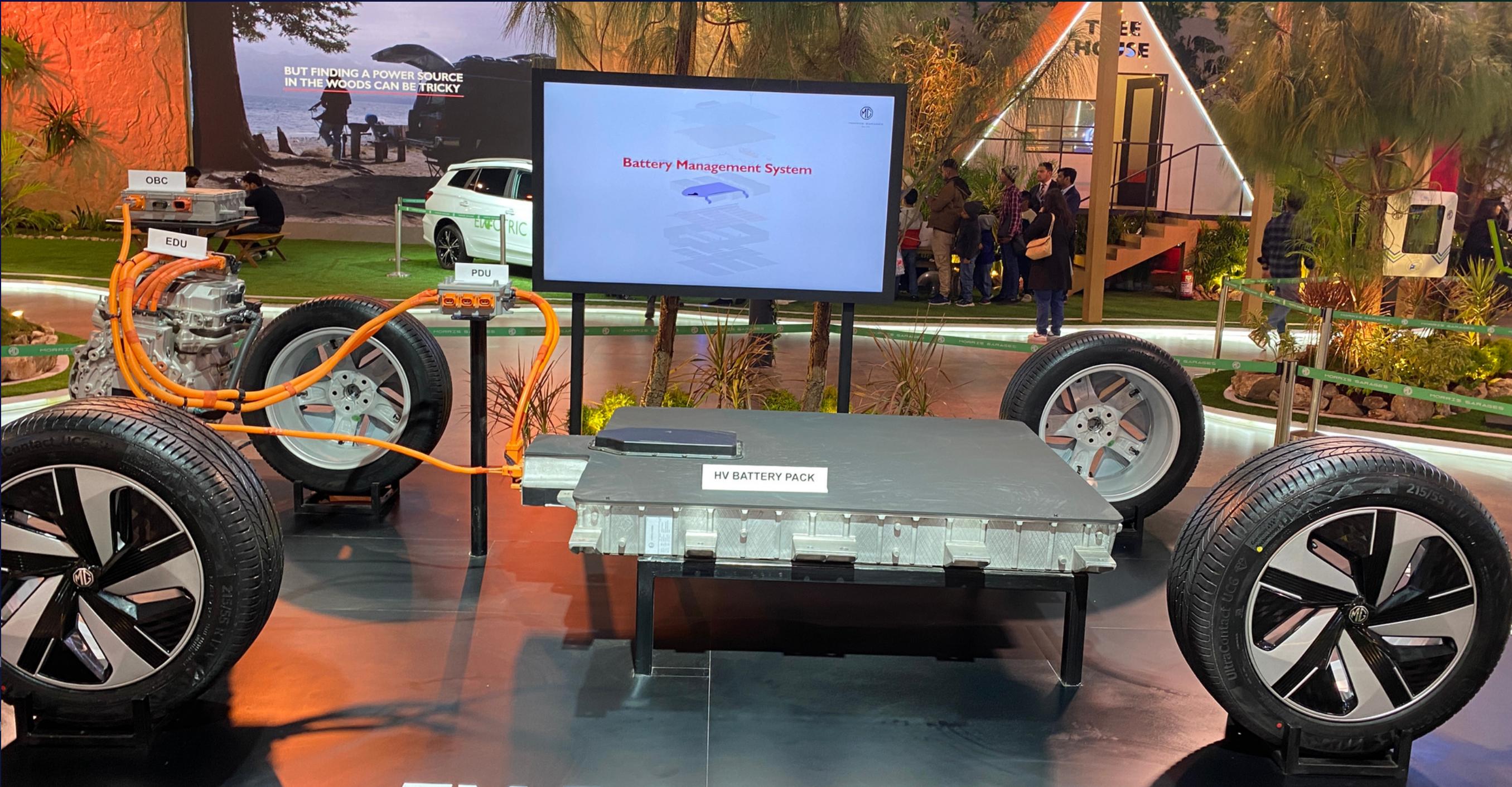
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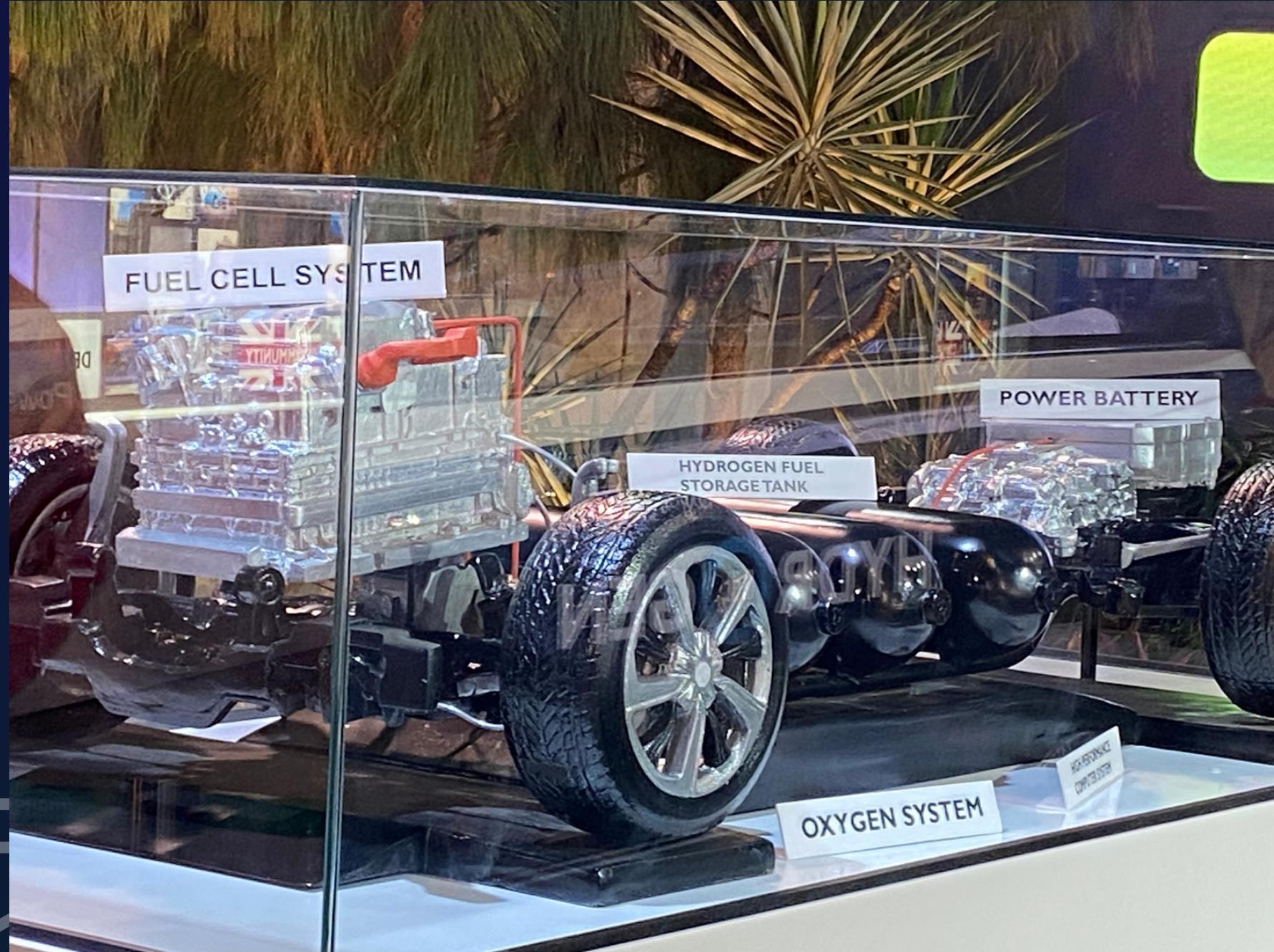
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