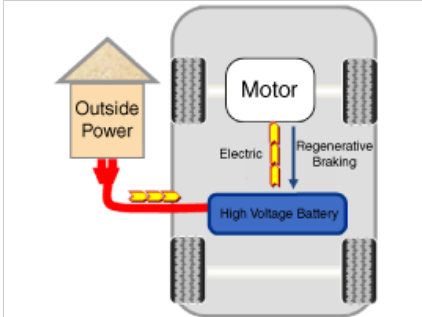


## Description and Operation

### IONIO Electric(AE EV) > 2020 > 100KW > Vehicle Control System

#### - Description

Electric vehicle is a vehicle that drives on electric energy. Unlike combustion engine vehicle, it does not use fossil fuel to generate drive force but uses the electric energy stored in the high voltage battery mounted in the vehicle to power the vehicle. While combustion engine vehicle generates emission gas, electric vehicle is an eco-friendly vehicle that has zero emission.

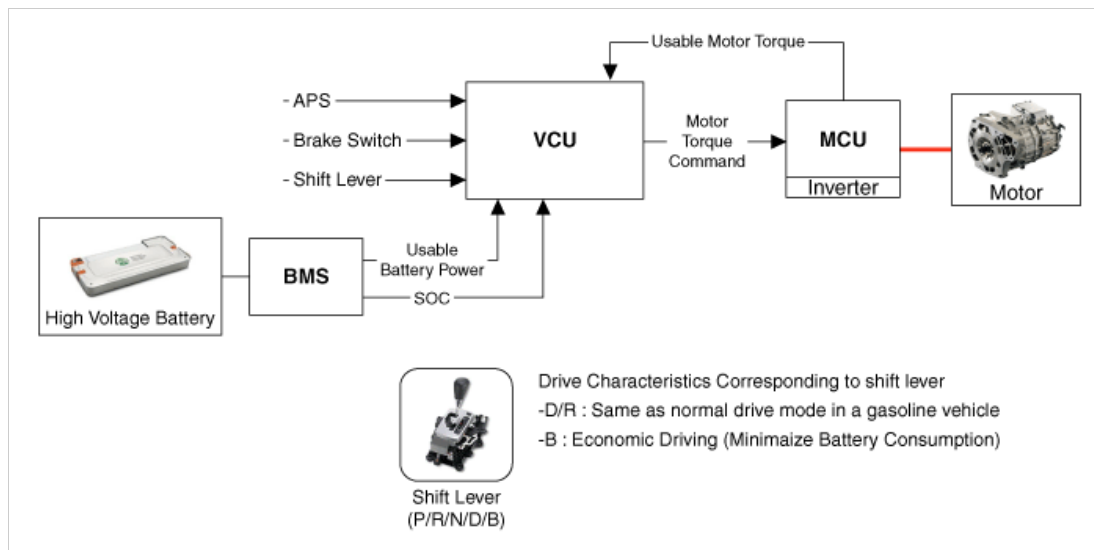


#### Electric vehicle operation principle and recharge method

| Drive Mode |                  |                                                                 |       |                |
|------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
|            | Start / Acceleration                                                                              | Deceleration                                                                                                                                     | Nomal Charge (AC Charge)                                                               | Quick Charge(DC Charge)                                                                          |
| Operation  | Motor                                                                                             | Regenerative Braking                                                                                                                             | High Voltage Battery Charge (5 Hours)                                                  | High Voltage Battery Charge (25 Minutes)                                                         |
|            | Drive force is generated from the drive motor by using the electric energy stored in the battery. | Instead of wasting the kinetic energy generated from deceleration, it is used to recharge the battery by using the drive motor as an alternator. | Battery is recharged by using 220V (recharge from 0~100% takes approximately 5 hours.) | Recharge by using externally mounted IBC (recharge from 0 ~ 80% takes approximately 25 minutes.) |

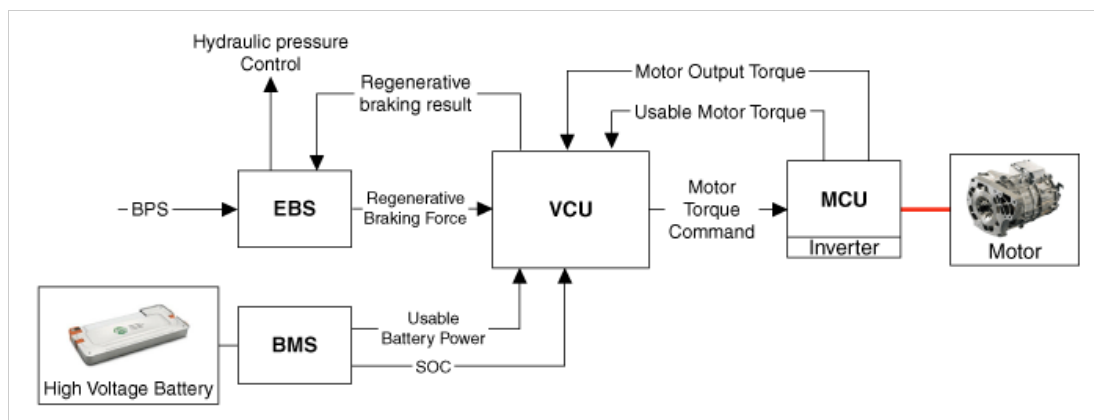
#### Motor Drive Control

- VCU : Calculates motor torque command considering the usable battery power, usable motor torque and driver demand (APS, Brake SW and Shift Lever).
- BMS : Provides usable battery power and SOC data for calculating motor torque command by VCU.
- MCU : Provides usable motor torque for calculating motor torque command by VCU.  
Creates Inverter PWM signal to generate motor torque command received from VCU.



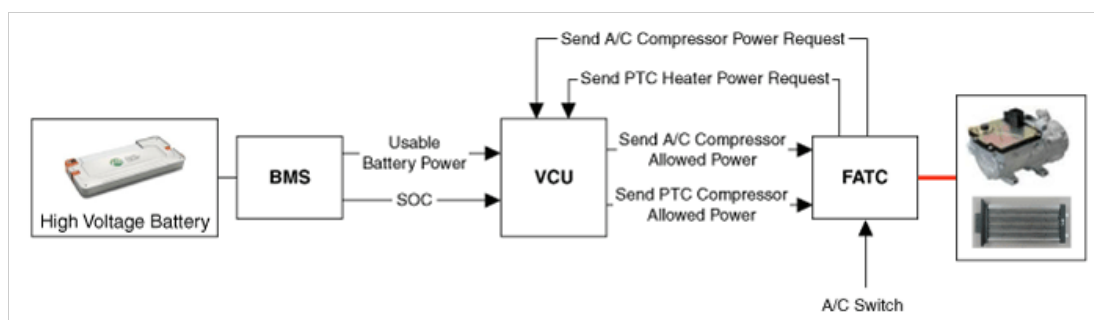
### Regenerative Brake Control

- AHB : Calculates total brake force based on driver demand (BPS) and then distributes as hydraulic brake force and demanded regenerative brake force. Monitors regenerative braking result (VCU) to compensate hydraulic brake force.
- VCU : Calculates motor recharge torque command for regenerative braking by considering demanded regenerative brake force (AHB), usable battery power (BMS), and usable motor torque, and calculates the actual regenerative brake force by using the actual motor output torque (MCU).
- BMS : Provides usable battery power and SOC data.
- MCU : Provides usable motor torque and actual motor output torque data. Creates Inverter PWM signal to generate motor torque command received from VCU.



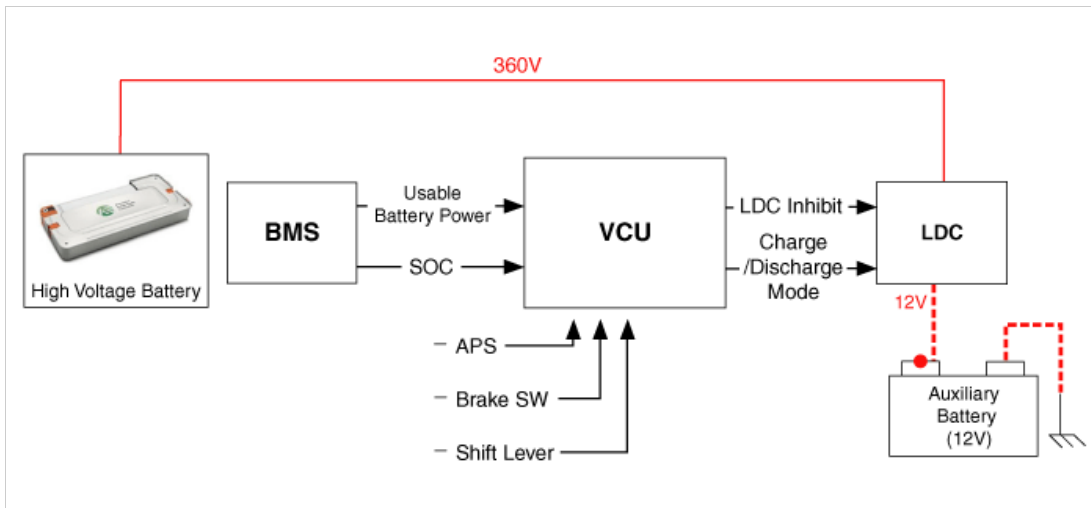
### A/C Load Control

- FATC : Sends AC/PTC power request to VCU when driver demands cooling/heating (AC SW). A/C load is controlled within the power range allowed by VCU.
- BMS : Provides usable battery power and SOC data.
- VCU : Sends final FATC allowed power by using the battery information and FATC requested power data.



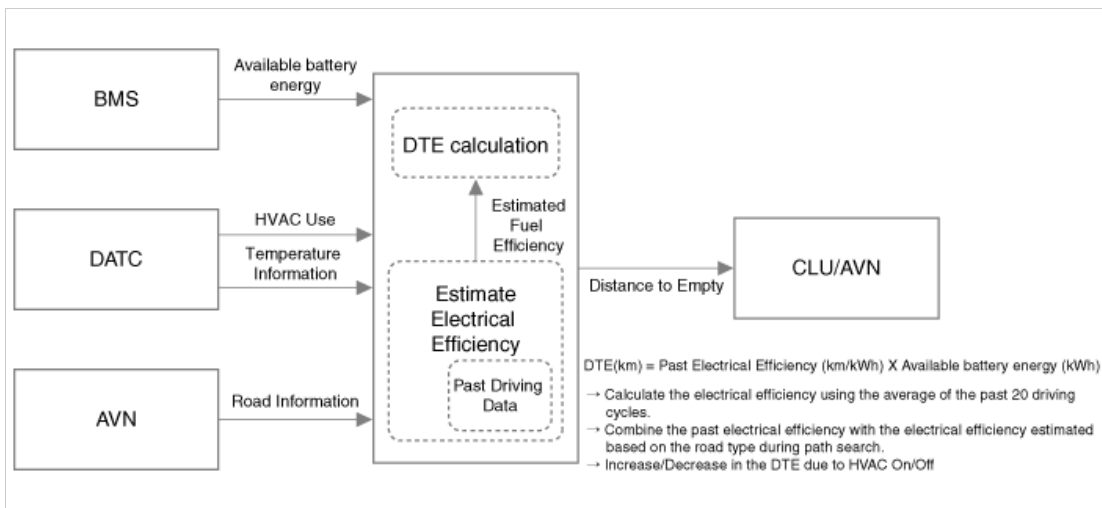
### Electric load power (12V) supply

- BMS : Provides usable battery power and SOC data.
- VCU : Determines LDC ON/OFF and operation mode based on the battery information and vehicle status.
- LDC : Converts high voltage into low voltage based on the command from VCU, and supplies power to vehicle's electric components (same function as an alternator).



### DTE (Distance To Empty)

- VCU : DTE calculation considering the available battery energy and road information
- BMS : Available battery energy
- AVN : Provides the road information up to the destination. Displays DTE.
- Cluster : Displays DTE



Portions of materials contained herein are sourced from the Hyundai Kia Automotive Group

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