Mitsubishi Plug-in Hybrid EV System

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Features of the plug-in hybrid EV system

- 3 operation modes
- Twin motor 4WD system using front and rear wheel motor
- Large-capacity battery
- When the charge equipment isn't available, how do you charge it?
Features of the plug-in hybrid EV system

- Large-capacity drive battery and high power motor realize the enough cruising range and acceleration performance as an EV.
- An engine and a generator are equipped. It's possible to continue driving, even if a battery is discharged.
- At high-speed driving, engine operates to improve fuel economy and motor assists the engine to accelerate smoothly.
Three operation modes of the plug-in hybrid EV system

- Optimum operation mode is selected automatically according to the situation.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EV</strong></td>
<td>Only electric motor operates for propulsion.</td>
<td><img src="image" alt="EV Diagram" /></td>
</tr>
<tr>
<td><strong>Series</strong></td>
<td>Electric motor operates for propulsion and engine generates electricity.</td>
<td><img src="image" alt="Series Diagram" /></td>
</tr>
<tr>
<td><strong>Parallel</strong></td>
<td>Engine operates for propulsion and electric motor assists.</td>
<td><img src="image" alt="Parallel Diagram" /></td>
</tr>
</tbody>
</table>
Example of operation mode of the plug-in hybrid EV system

**Urban Drive**

**Stopping**
Engine and motor are stopping

**Starting/Traveling**
Start and travel by motors

**Climbing**
Driven by motor and engine generates electricity

**Deceleration**
Kinetic energy is regenerated and battery is charged

**Stopping**
Engine and motor are stopping
Example of operation mode of the plug-in hybrid EV system

Long Drive (Urban - Country)

- **Urban (High SOC)***: EV operation
- **Urban (Low SOC)**: Driven by motors while engine generates electricity
- **High speed (High SOC)**: Up to 120 km/h, EV operation can be performed
- **High speed (Low SOC)**: Driven by engine while engine generates electricity
- **Passing at high speed**: Driven by engine and motor assists
- **Parallel**
- **Series**

* SOC: state of charge
Environmental performance of the plug-in hybrid EV system

Better environmental performance is achieved by selecting three operation modes of a plug-in hybrid EV system according to the driving situation.

<table>
<thead>
<tr>
<th></th>
<th>New OUTLANDER PHEV *1</th>
<th>New OUTLANDER 2.4L 4WD *1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EV driving Range</strong></td>
<td>55km or more</td>
<td>–</td>
</tr>
<tr>
<td>(JC08 mode)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Overall driving range</strong></td>
<td>880km or more</td>
<td>860km or more</td>
</tr>
<tr>
<td>*2 (JC08 mode)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Combined FE</strong></td>
<td>61km/Lor more</td>
<td>–</td>
</tr>
<tr>
<td>*3 (JC08 mode)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1: All numerical values are targets
*2: Total driving range of EV and HV
*3: Average fuel economy which is compounded fuel economy operated as EV and the fuel economy operated as HV, which is defined by MLIT
Twin motor 4WD system which are equipped with high power front and high power rear motor is adopted.

- Quicker response at start
- Continue higher acceleration

**Twin Motor 4WD System**

**Accelerator feeling by motor**

- **Front Motor**: 60kW
- **Rear Motor**: 60kW

![Graph showing acceleration comparison between engine and motor](image)

- Continue higher acceleration
- Quicker response
To improve turning performance, traction and driving stability, twin motor 4WD distributes driving force of front and rear wheels, AYC system distributes driving force of left and right wheel.

### Twin Motor 4WD System (S-AWC)

<table>
<thead>
<tr>
<th>Twin Motor 4WD</th>
<th>AYC (Brake)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open diff.</td>
<td>Motor</td>
</tr>
<tr>
<td>Motor</td>
<td>Open diff.</td>
</tr>
<tr>
<td>Engine</td>
<td></td>
</tr>
</tbody>
</table>

### Driving force distribution of Fr. & Rr. (Twin motor 4WD)

- **Normal control**: Turning performance, high-speed stability
- **Slip control**: Keep driving stability, traction

- Detect lengthwise slip and side slip

### Driving force distribution of L & R (AYC: Braking control)

- **Braking inner wheel to suppress under-steer**
- **Braking outer wheel to suppress over-steer**

<table>
<thead>
<tr>
<th>Distribution of Fr. and Rr.</th>
<th>Twin Motor 4WD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution of R and L</td>
<td>AYC (Active Yaw Control)</td>
</tr>
<tr>
<td>Controlling Mech.</td>
<td>Brake</td>
</tr>
</tbody>
</table>
Utilization of large capacity battery (mode SW)

- It's possible to save consumption of charged electric power at “battery save” mode. Driver can select EV drive or HV drive.
- At “battery charge” mode, engine operates and generates electricity and charges battery actively during traveling.

<table>
<thead>
<tr>
<th>Mode SW</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Save</td>
<td>Keep state of charge (Hybrid operation)</td>
</tr>
<tr>
<td>Battery Charge</td>
<td>Engine starts &amp; generate (Hybrid operation)</td>
</tr>
</tbody>
</table>
Utilization of large capacity battery (AC100V outlet)

- AC100V power supply outlet is equipped so that the electric power which is charged in large-capacity lithium ion battery can be utilized in various situations.
  - It's possible to supply the electric power for about 1 day at ordinary home by a full charge.
  - If the electric generation by engine is added, it's possible to supply the electric power for about 10 days.

<for example>
- for emergency
- for outdoor cooking
- for outdoor concert
When the charge equipment isn't available, how do you charge it?
EV drive or HV drive is possible generating electricity by engine, if charging equipment is not available.

As traction torque is mainly generated by motor, smooth drive feeling is almost equal to EV drive.

External charge has potential of further reduction of CO₂ and running cost.

- **w/o external charge**
  - Supply electricity by engine generating
  - Motor torque brings better accel. feeling

- **w/ external charge**
  - Reduction of CO₂
  - Reduction of running cost
Battery charge at home easily

自宅のコンセントや、外出先での充電が可能。
ガソリン代を節約することができます。
EV as daily use

買い物や通勤など、日常での使用に十分なEV走行距離を確保。排出ガスゼロで、エコロジーかつエコノミーな毎日を過ごせます。
As a HV for comfortable long range drive

長距離／高速走行では、エンジンを発電用や動力源として使用。低燃費で、ツインモーター４WDによる力強い走りを存分に楽しめます。
Enjoy beautiful nature with silent and clean EV

バッテリーセーブ／チャージモードで電気を残しておくと、ドライブ先でもEV走行が可能です。
Convenient and comfortable outdoor life

大容量バッテリーをAC電源として使用し、キャンプや趣味も楽しめます。
Drive@earth

MITSUBISHI MOTORS