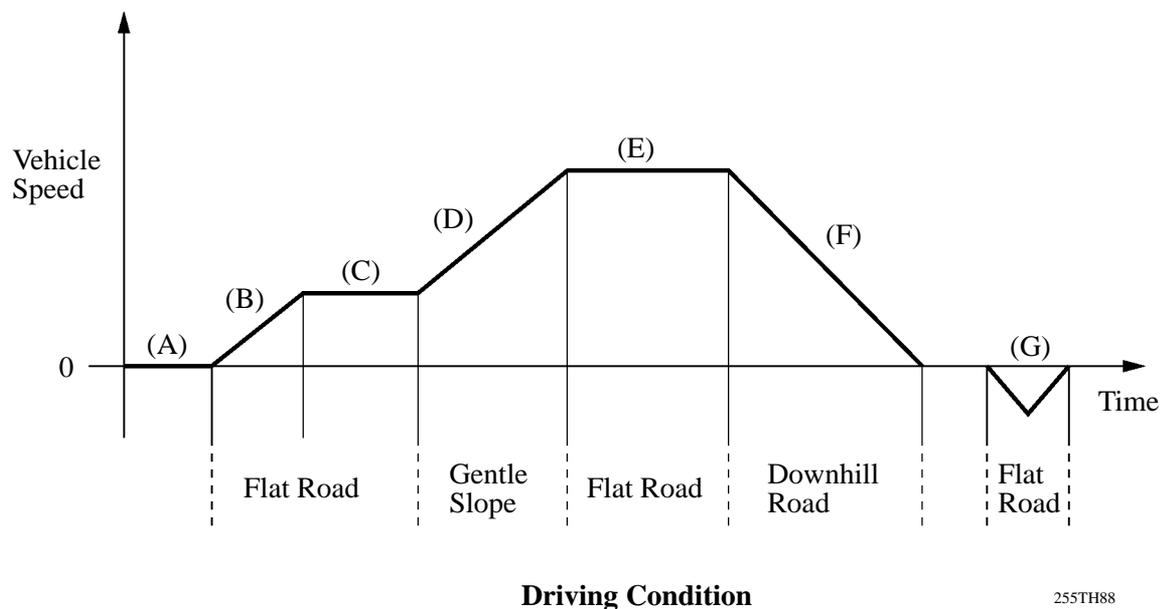


## ■ SYSTEM OPERATION

### 1. General

- The THS-II system uses the two types of motive forces provided by the engine and MG2, and uses MG1 as a generator. The system optimally combines these forces in accordance with the various driving conditions.
- The HV ECU constantly monitors the SOC condition, the battery temperature, the engine coolant temperature, and the electrical load condition. If any one of the monitoring items fails to satisfy requirements when the READY indicator is ON and the shift position is in the “P” position, or the vehicle is driven in reverse, the HV ECU demands to start the engine to drive MG1, and then charges the HV battery.
- Under the preheat operation of the coolant heat storage system on the '04 Prius, the engine does not start.
- The THS-II system drives the vehicle by optimally combining the operation of the engine, MG1, and MG2 in accordance with the driving conditions listed in the table below.



- (A): READY ON State (See Page TH-13)
- (B): Starting (See Page TH-15)
- (C): During Slight Acceleration with Engine (See Page TH-18)
- (D): During Low Load Cruising (See Page TH-19)
- (E): During Full Throttle Acceleration (See Page TH-20)
- (F): During Deceleration Driving (See Page TH-21)
- (G): During Reverse Driving (See Page TH-23)

- The nomographic chart below gives a visual representation of the planetary gear's rotational direction, rotational speed, and power balance. In the nomographic chart, the rpm of the 3 gears maintain a relationship in which they are invariably joined by a direct line. This nomographic chart describes the charging or generating conditions of MG1 and MG2, their direction of rotation, and torque conditions as indicated in the table below.

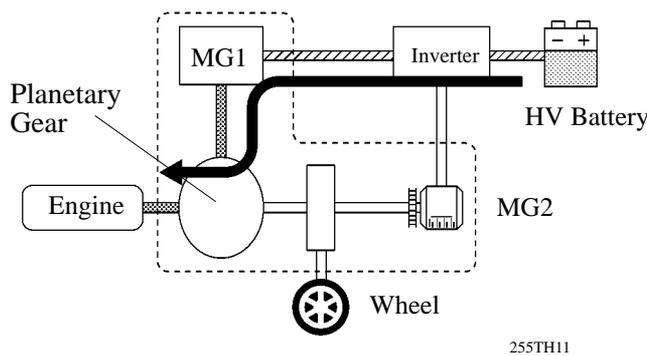
Condition	Rotation Direction	Torque Condition	Nomographic Chart Example
Discharging	Forward Revolution	Plus Torque	<p>↑ : Drive ↓ : Driven</p> <p>MG1 Engine MG2 rpm + 0 -</p> <p>255TH41</p>
	Reverse Revolution	Minus Torque	
Generating	Forward Revolution	Minus Torque	<p>MG1 Engine MG2 rpm + 0 -</p> <p>255TH43</p>

**2. READY ON State / (A)**

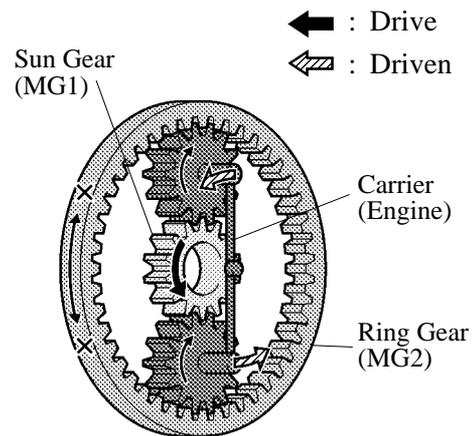
- On the '04 Prius, even if the driver presses on the POWER switch and the READY indicator turns ON, the engine will not start unless the proper engine coolant temperature, SOC conditions, battery temperature and electrical road conditions have been met. In this state, the engine, MG1, and MG2 are all stopped.
- After driving, if the driver stops the vehicle and moves the shift position to the “P”, the HV ECU will continue to operate the engine for a predetermined length of time and will bring the engine to a stop, provided that the proper engine coolant temperature, SOC conditions, battery temperature and electrical road conditions have been met. At this time, the engine, MG1, and MG2 are all stopped.

**Start The Engine**

- If any one of the items monitored by the HV ECU fails to satisfy requirements when the READY indicator is ON and the shift position is in the “P” position, or the vehicle is driven in reverse, the HV ECU activates MG1 to start the engine.
- During this operation, to prevent the reactive force of the sun gear of MG1 from rotating the ring gear of MG2 and driving the drive wheels, an electrical current is applied to MG2 in order to apply a brake. This function is called “reactive control”.

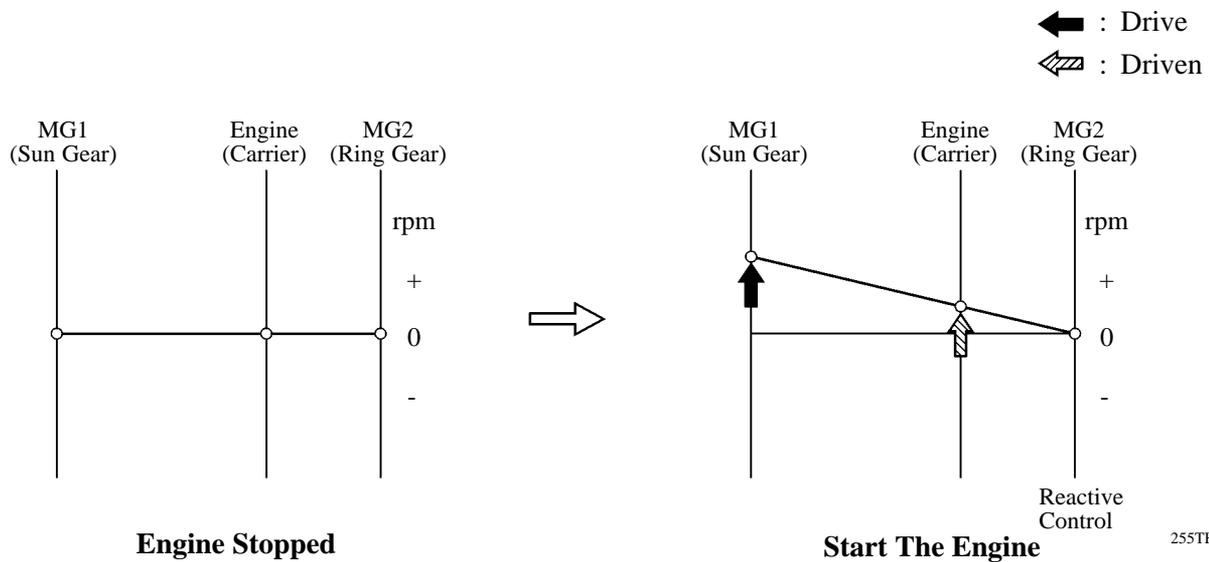


255TH11



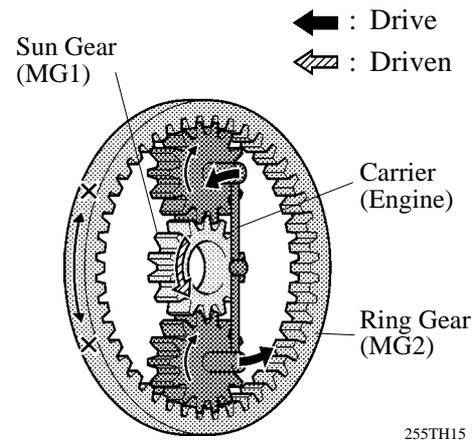
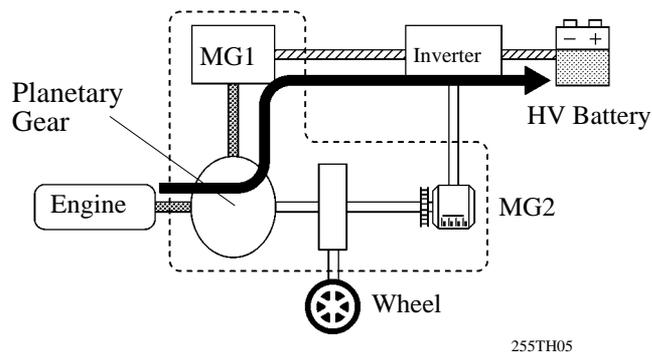
255TH12

**► Nomographic Chart of Planetary Gear Unit ◀**

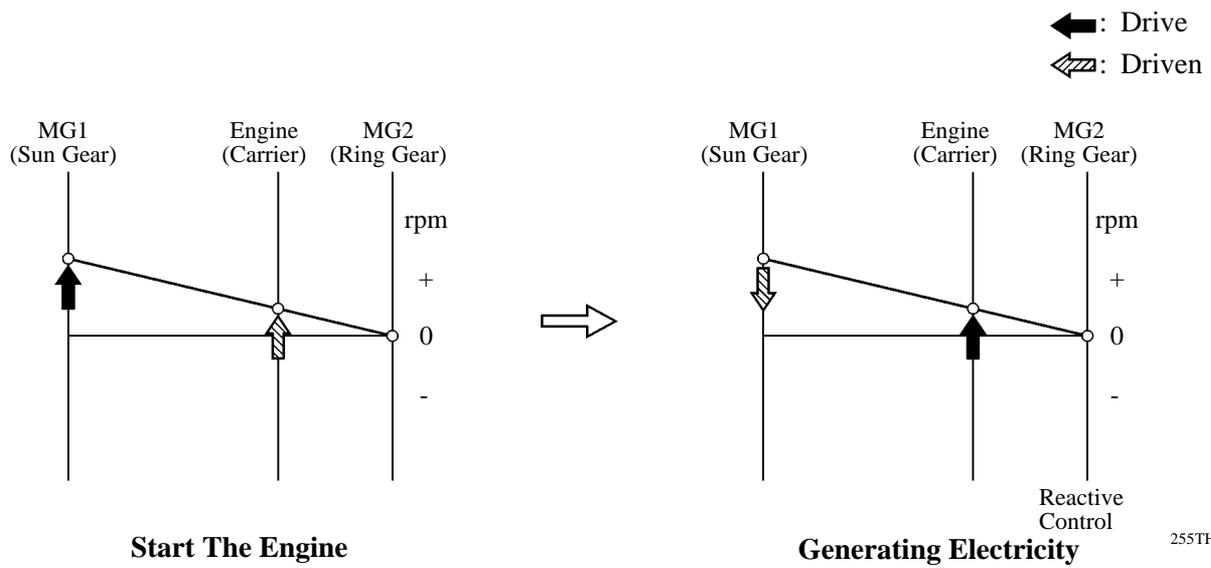


255TH13

- In the next state, the engine that is running starts to operate MG1 as a generator, which starts to generate the HV battery.



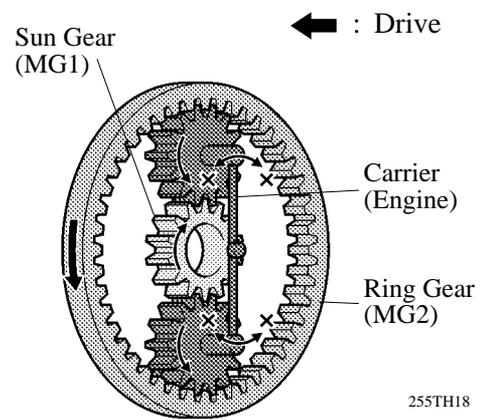
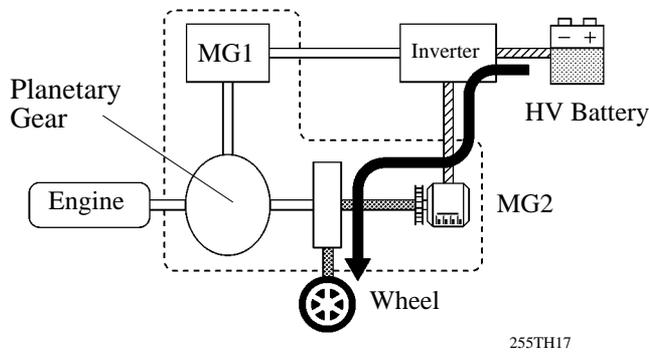
► Nomographic Chart of Planetary Gear Unit ◀



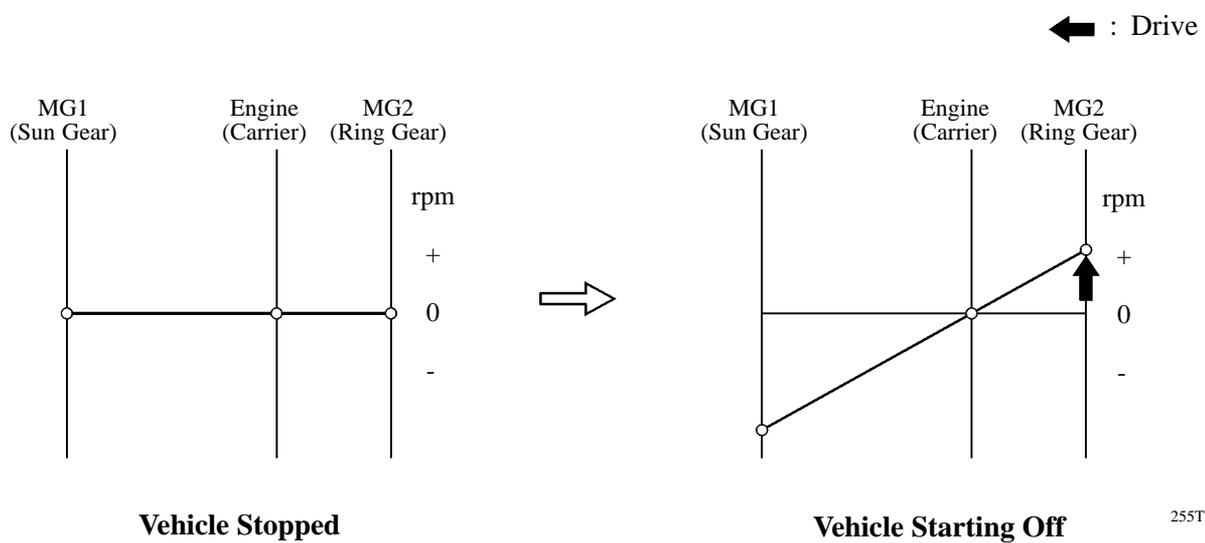
3. Starting / (B)

Driving With MG2

When the vehicle is started off, the vehicle operates powered only by MG2. At this time, the engine remains stopped, and MG1 is spinning in the opposite direction without generating electricity.

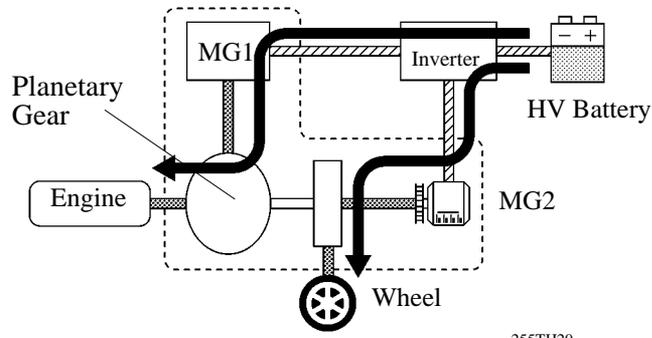


► Nomographic Chart of Planetary Gear Unit ◀

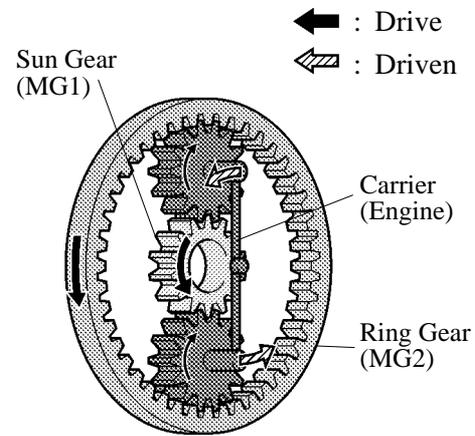


**Start The Engine**

- If the required drive torque increases when running with MG2 only, MG1 will be activated to start the engine. If, also, any one of the items monitored by the HV ECU such as the SOC condition, the battery temperature, the engine coolant temperature and the electrical load condition deviates from the specified level, MG1 will be activated to start the engine.

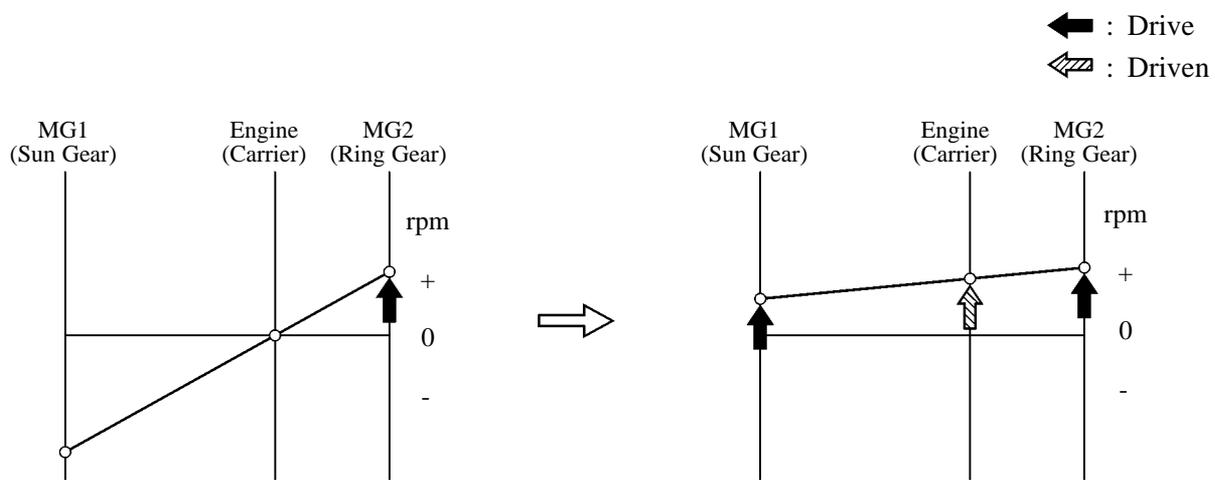


255TH20



255TH21

► **Nomographic Chart of Planetary Gear Unit** ◀

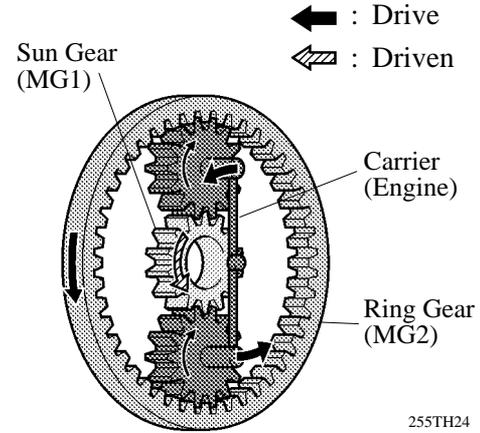
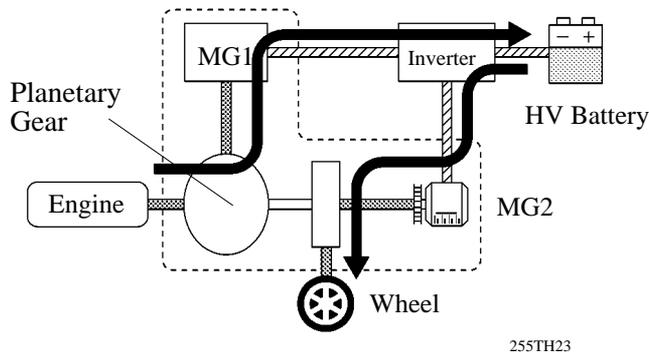


**Vehicle Starting Off**

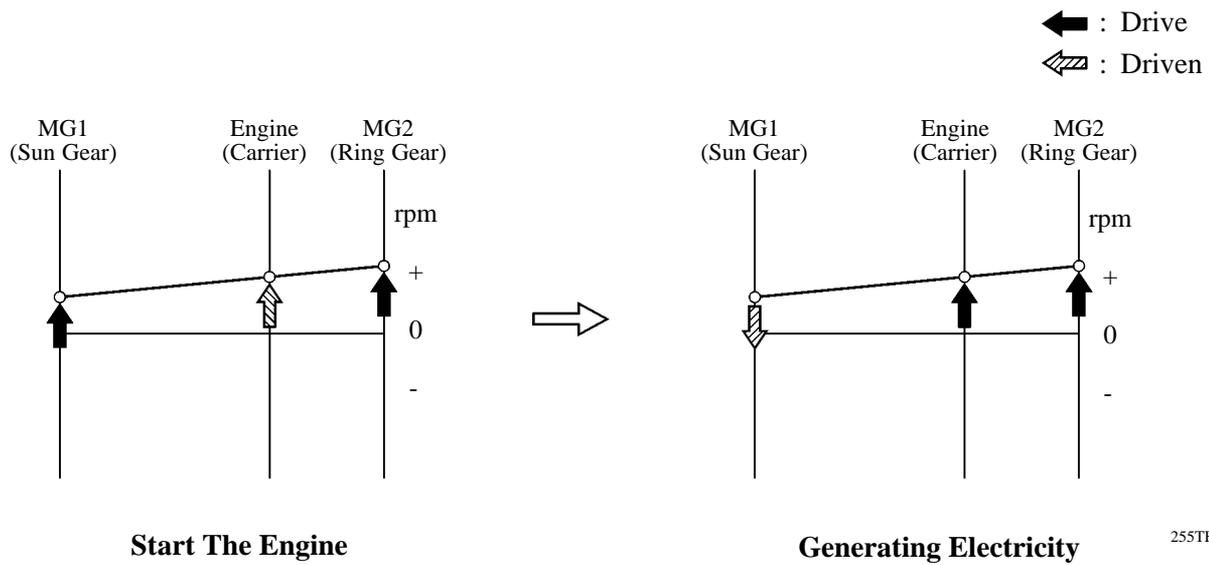
**Start The Engine**

255TH19

- In the next state, the engine that has been started will operate MG1 as a generator, in order to start charging the HV battery. If the required drive torque increases, the engine will start driving MG1 as a generator, in order to transfer to the “During Slight Acceleration with Engine” mode.

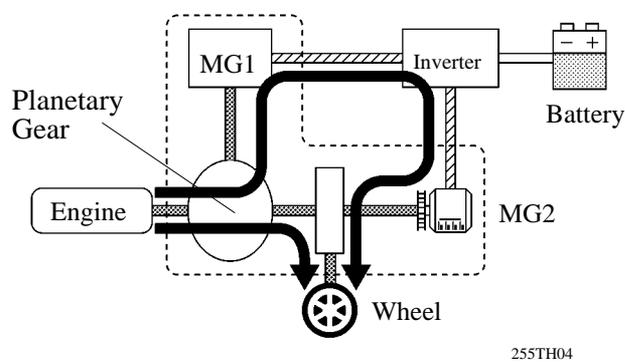


► Nomographic Chart of Planetary Gear Unit ◀

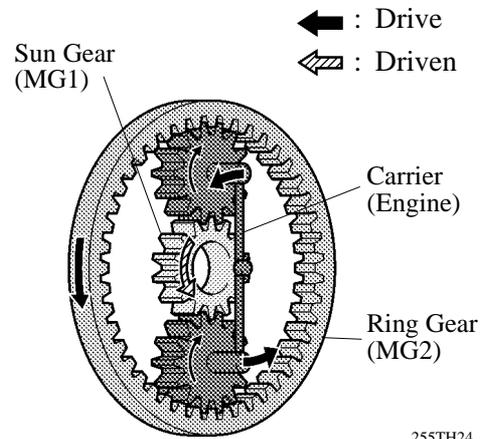


**4. During Slight Acceleration with Engine / (C)**

When the vehicle is during slight acceleration with engine, the motive force of the engine is divided by the planetary gears. A portion of this motive force is output directly, and the remaining motive force is used for generating electricity through MG1. Through the use of an electrical path of an inverter, this electrical force is sent to MG2 to be output as the motive force of MG2.

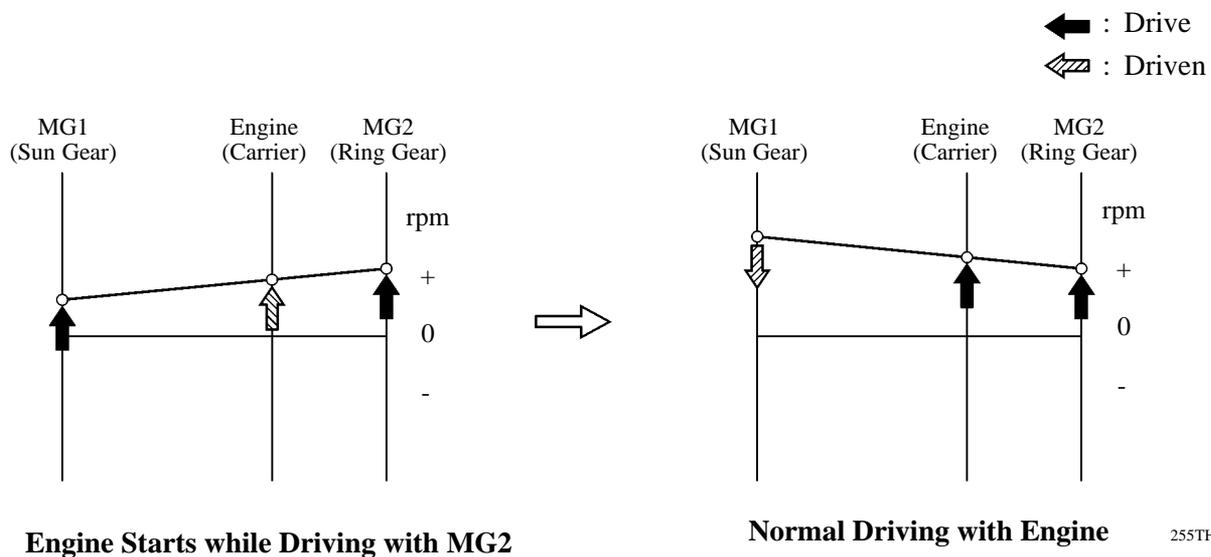


255TH04



255TH24

**► Nomographic Chart of Planetary Gear Unit ◀**



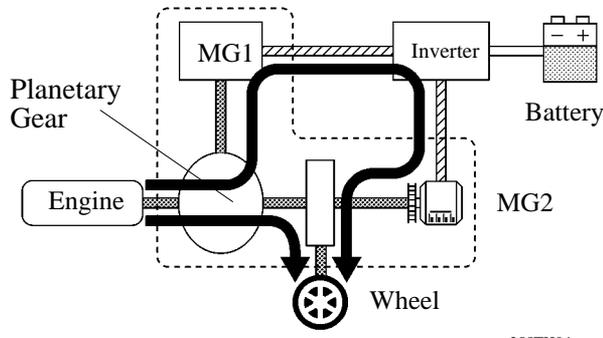
**Engine Starts while Driving with MG2**

**Normal Driving with Engine**

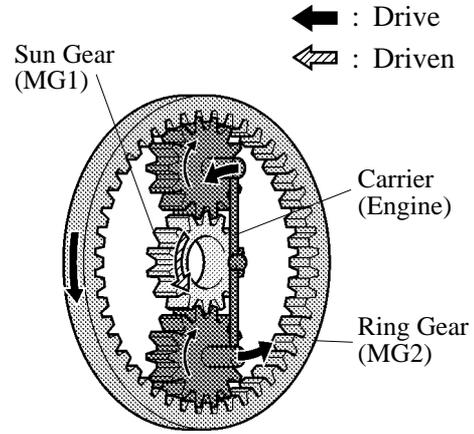
255TH25

**5. During Low Load Cruising / (D)**

When the vehicle is during low load cruising, the motive force of the engine is divided by the planetary gears. A portion of this motive force is output directly, and the remaining motive force is used for generating electricity through MG1. Through the use of an electrical path of an inverter, this electrical force is sent to MG2 to be output as the motive force of MG2.

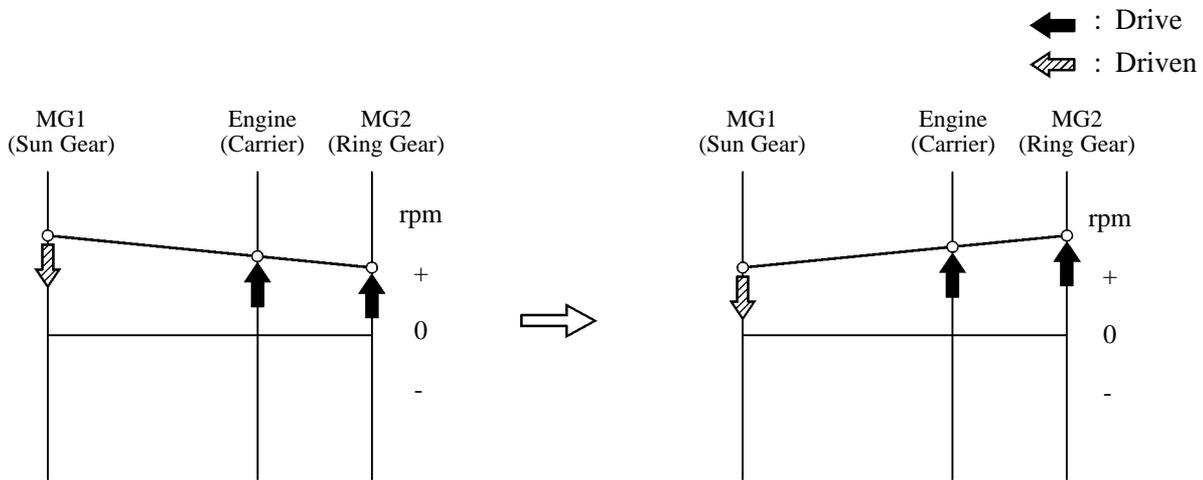


255TH04



255TH24

**► Nomographic Chart of Planetary Gear Unit ◀**



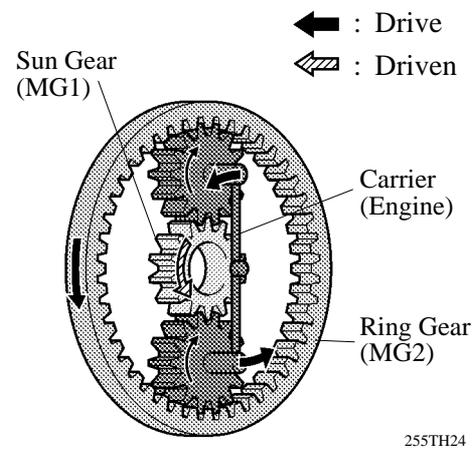
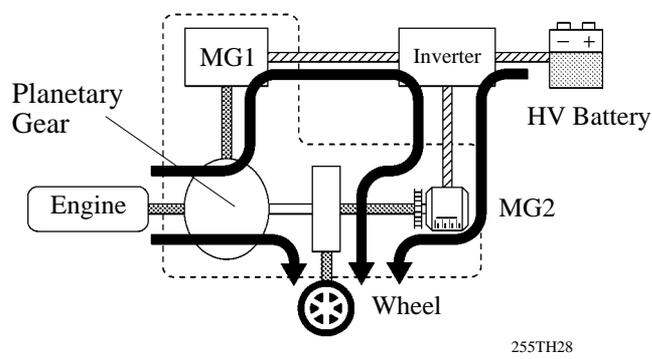
**Normal Driving with Engine**

**Low Load Cruising**

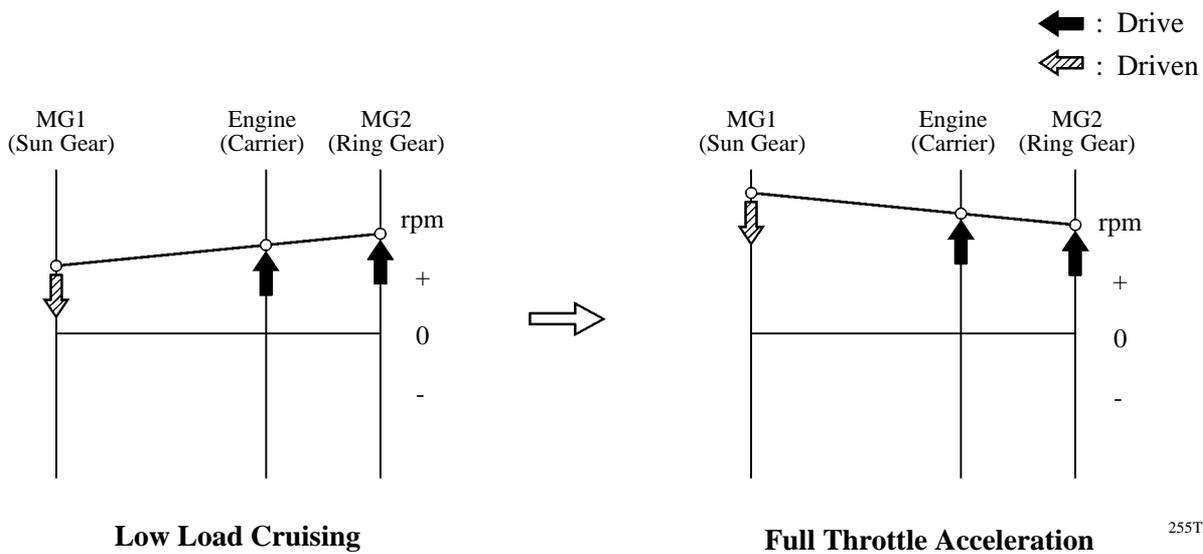
255TH26

**6. During Full Throttle Acceleration / (E)**

When the vehicle transfers from the low load cruising to the full-throttle acceleration mode, the system will add the electrical force of the HV battery to the motive force of MG2.



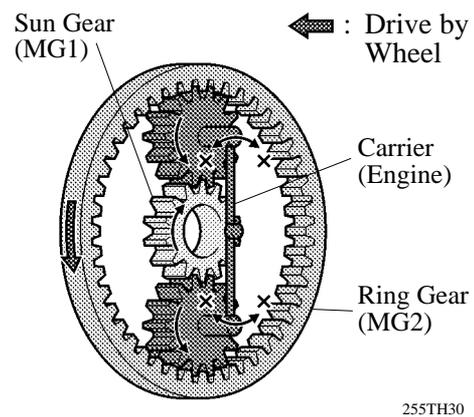
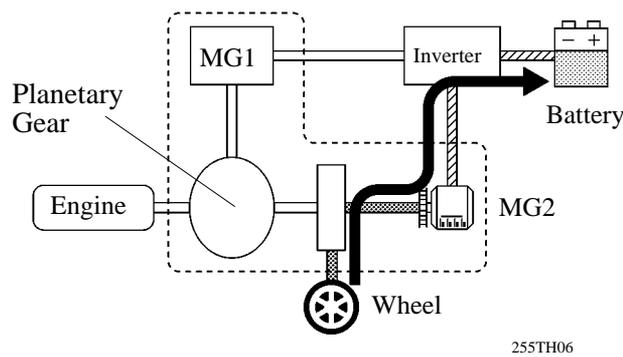
**► Nomographic Chart of Planetary Gear Unit ◀**



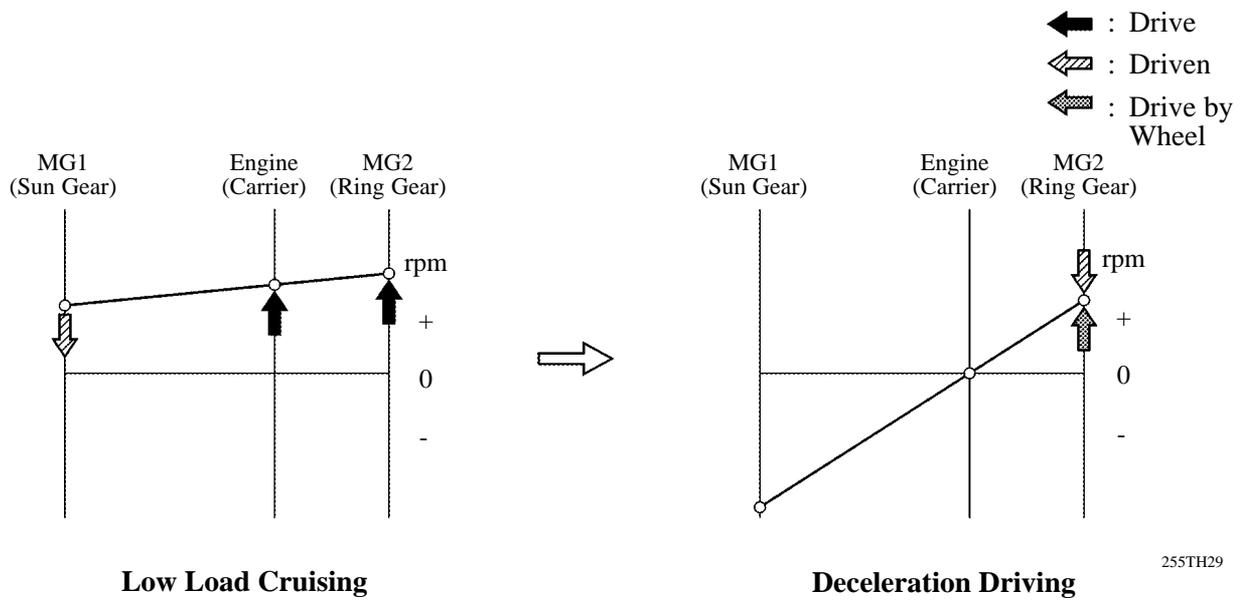
7. During Deceleration Driving / (F)

Deceleration in “D” Range

- While the vehicle is being driven with the shift position in the D, and decelerates, the engine turns OFF and the motive force will be zero. At this time, the wheels drive MG2, causing MG2 to operate as a generator and charge the HV battery.
- If the vehicle decelerates from a higher speed, the engine will maintain a predetermined speed without stopping, in order to protect the planetary gear unit.

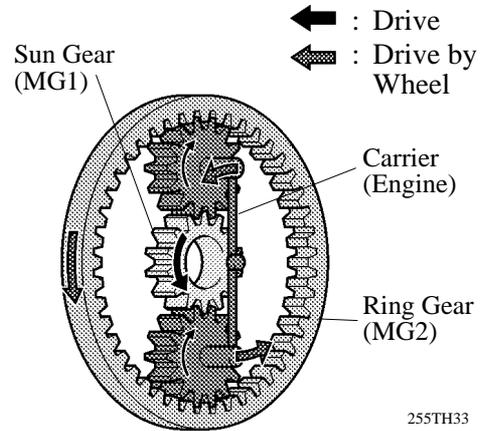
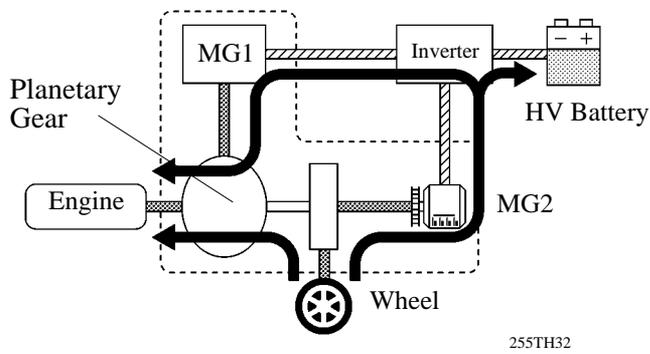


► Nomographic Chart of Planetary Gear Unit ◀

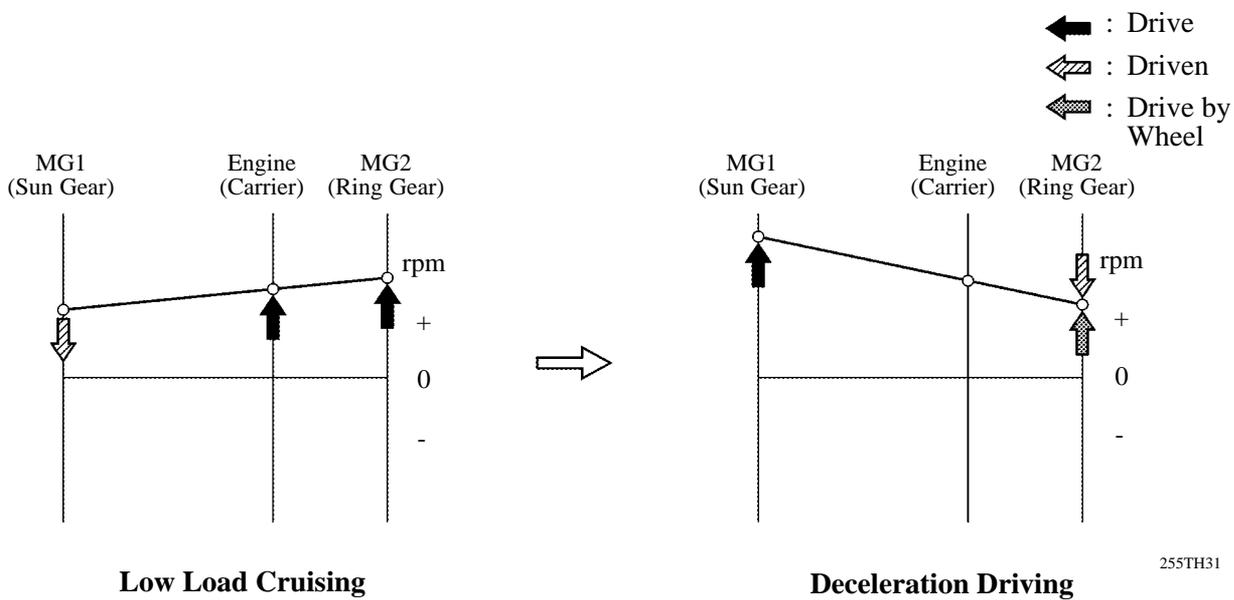


**Deceleration in “B” Range**

While the vehicle is being driven with the shift position in the B, and decelerates, the wheels drive MG2, causing MG2 to operate as a generator, charge the HV battery, and supply electrical power to MG1. Accordingly, MG1 maintains the speed of the engine and applies an engine brake. At this time, the fuel to the engine is cut.



► **Nomographic Chart of Planetary Gear Unit** ◀



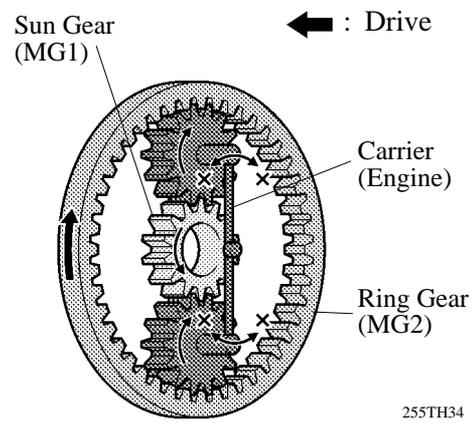
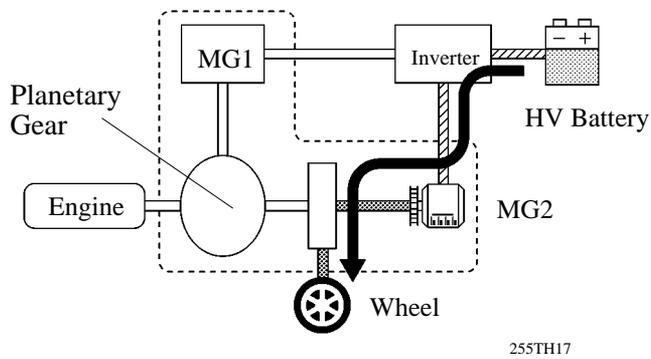
**During Braking**

While the vehicle is decelerating, if the driver presses the brake pedal, the skid control ECU calculates the required regenerative brake force and sends a signal to the HV ECU. Upon receiving this signal, the HV ECU increases the regenerative force within a range that suits the required regenerative brake force. As a result, MG2 will be controlled to generate an ample amount of electricity.

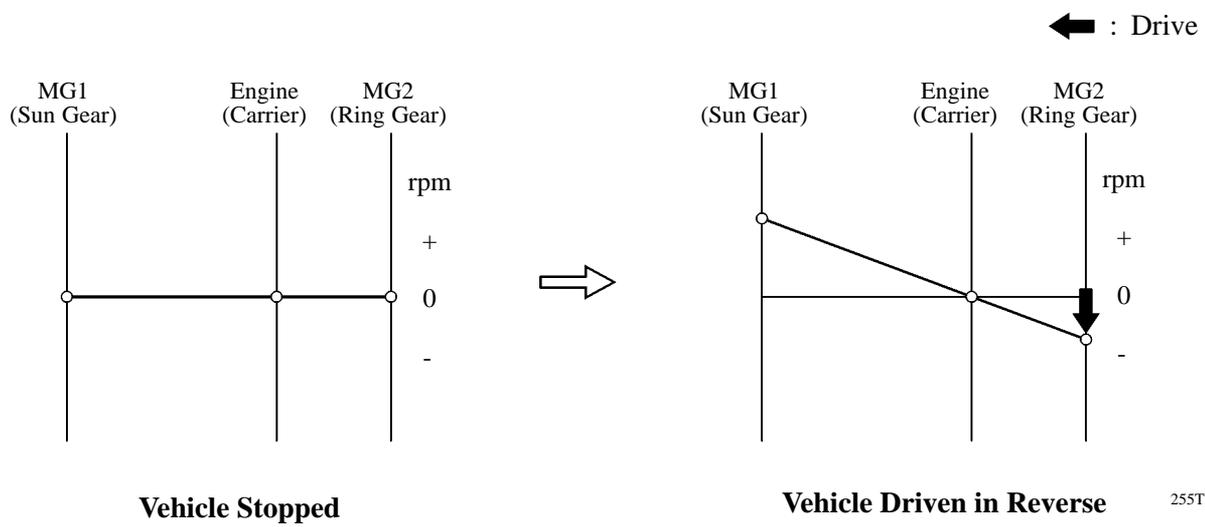
**8. During Reverse Driving / (G)**

**Driving With MG2**

When the vehicle is during reverse driving, the vehicle operates powered only by MG2. At this time, MG2 is spinning in the opposite direction, the engine remains stopped, and MG1 is spinning in the normal direction without generating electricity.

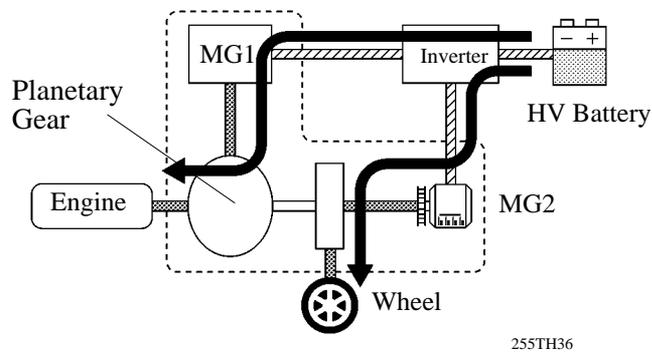


**► Nomographic Chart of Planetary Gear Unit ◀**

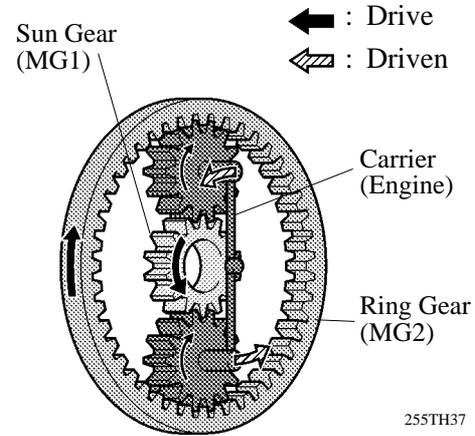


**Start The Engine**

- If, when running with MG2 only, any one of the items monitored by the HV ECU such as the SOC condition, the battery temperature, the engine coolant temperature and the electrical load condition deviates from the specified level, MG1 will be activated to start the engine.

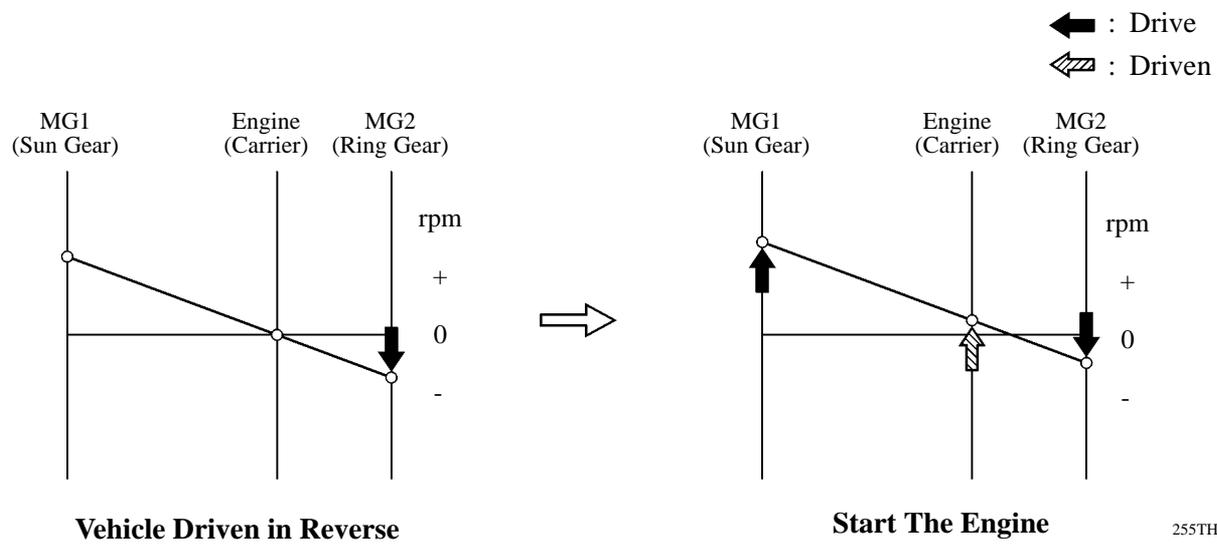


255TH36



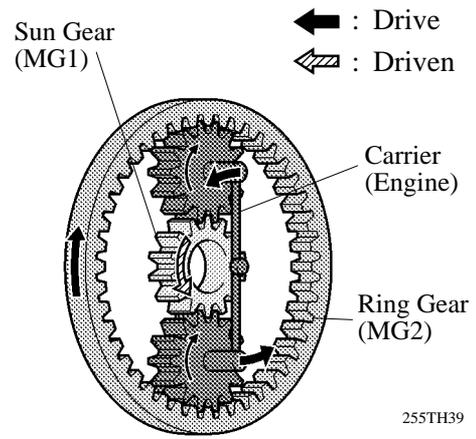
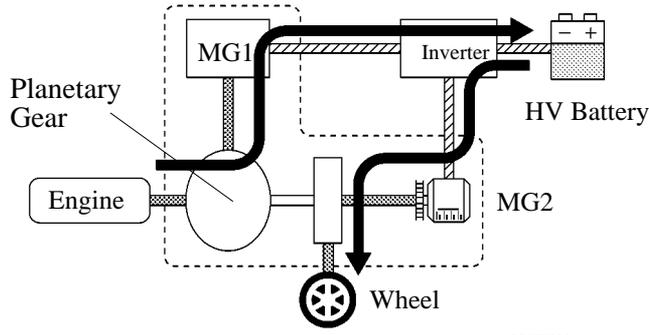
255TH37

► **Nomographic Chart of Planetary Gear Unit** ◀



255TH38

- In the next state, the engine that has been started will operate MG1 as a generator, in order to start charging the HV battery.



► Nomographic Chart of Planetary Gear Unit ◀

