PRIUS

New Car Features 2004

For More Effective Sales and Service Activities

TOYOTA

<u>Directory of Chapters in 'PRIUS New Car Features' Book</u>

FOREWORD

To assist you in your service activities, this manual explains the main characteristics of the new Prius, in particular providing a technical explanation of the construction and operation of the new mechanisms and new technology used.

Applicable models: NHW20 series

This manual is divided into 3 sections.

1. **New Model Outline** – Explanation of the product to give a general understanding of its features.
2. **Technical Description** – Technical explanation of the construction and operation of each new system and component.
3. **Appendix** – Major technical specifications of the vehicle.

CAUTION, NOTICE, ***REFERENCE*** and **NOTE** are used in the following ways:

CAUTION	A potentially hazardous situation which could result in injury if instructions are ignored.
NOTICE	Damage to the vehicle or components may occur if instructions are ignored.
REFERENCE	Explains the theory behind mechanisms and techniques.
NOTE	Notes or comments not included under the above 3 titles.

For detailed service specifications and repair procedures, refer to the following Repair Manuals:

Manual Name		Pub. No.
• 2004 Prius Repair Manual	Vol. 1	RM1075U1
	Vol. 2	RM1075U2
	Vol. 3	RM1075U3
• 2004 Prius Electrical Wiring Diagram		EWD555U

All information contained herein is the most up-to-date at the time of publication. We reserve the right to make changes without prior notice.

TOYOTA MOTOR CORPORATION

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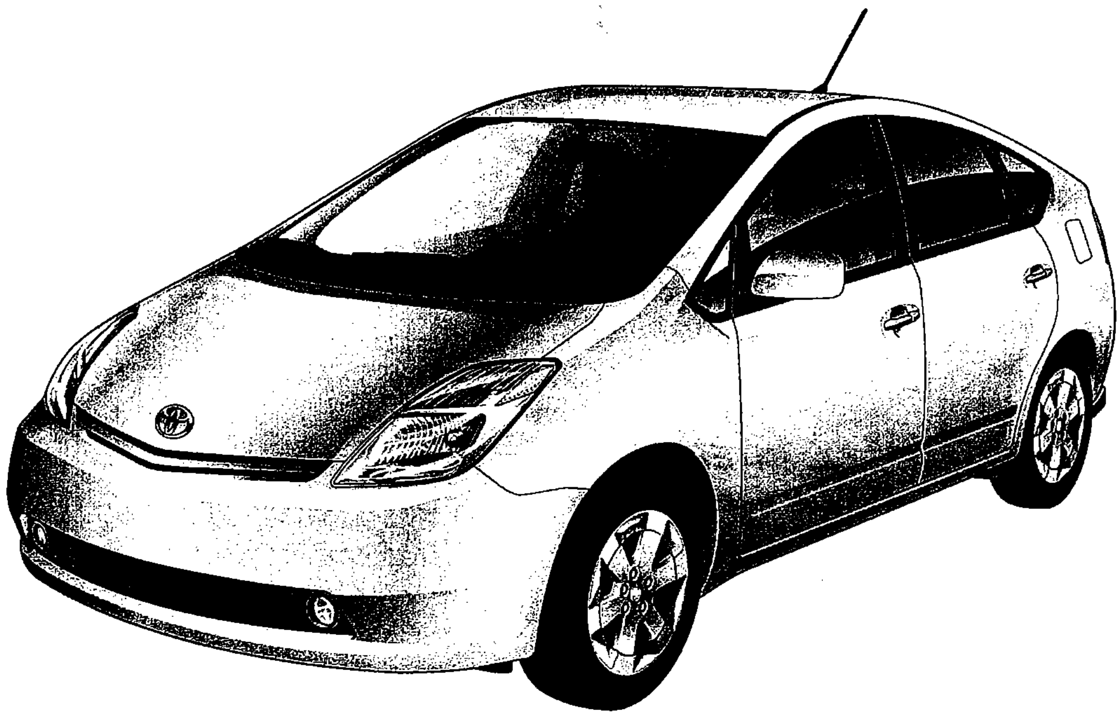
Third Printing: Oct. 13, 2003 03-031013-00-3

1. New Model Outline

MO

EXTERIOR APPEARANCE

Front View



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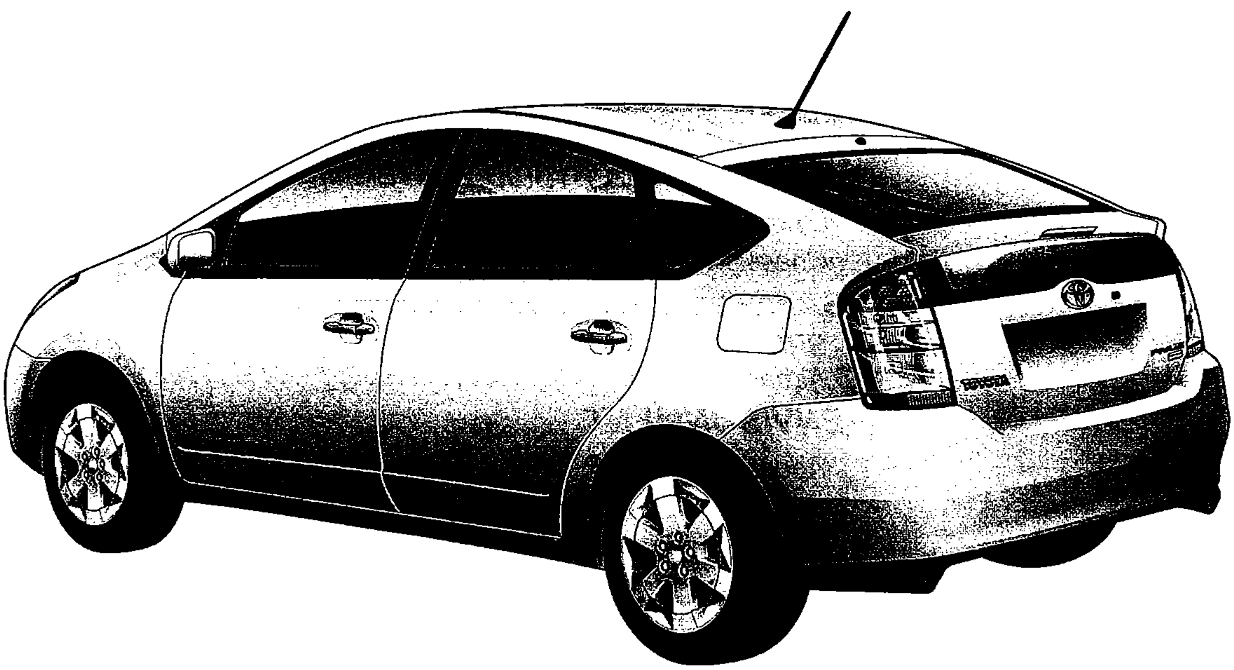
Rear View



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MODEL CODE

NHW20 L – A H E E B A

1 2 3 4 5 6 7 8

1	BASIC MODEL CODE
	NHW20 : With 1NZ-FXE Engine

2	STEERING WHEEL POSITION
	L : Left-Hand Drive

3	MODEL NAME
	A : Prius

4	BODY TYPE
	H : 4-Door Hatchback

5	GEAR SHIFT TYPE
	E : Automatic

6	GRADE
	E : Standard

7	ENGINE SPECIFICATION
	B : Atkinson

8	DESTINATION
	A : U.S.A. K : Canada

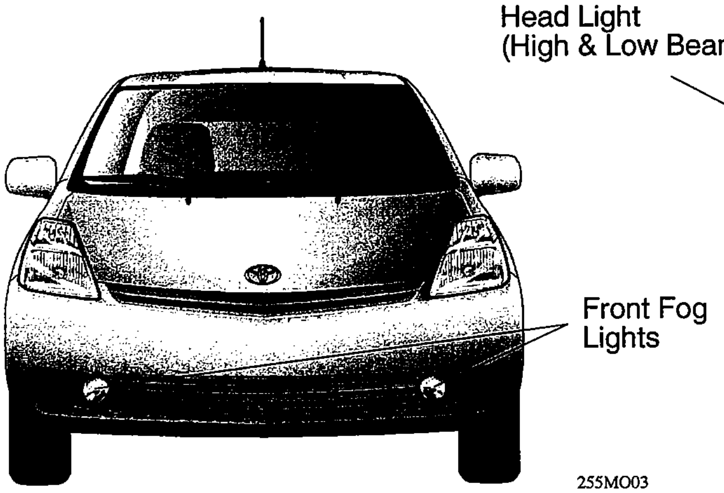
MODEL LINE-UP

Destination	Drive Type	Engine	Transaxle	Model Code
			Automatic	
U.S.A.	2WD	1NZ-FXE	P112	NHW20L-AHEEBA
Canada				NHW20L-AHEEBK

EXTERIOR

Front View

- The front face of the new-generation Prius consists of an engine hood surface that emphasizes the center that converges towards the Toyota symbol, and a bumper with a clean surface that is shaped with a sharp bend at the center.
- The short nose and the slanted headlight configuration are reminiscent of the first-generation Prius, while inheriting the Prius identity in a sophisticated manner.
- The headlights consist of a simple, vertical two-level box shape, which gives the vehicle an intelligent and refreshing look.



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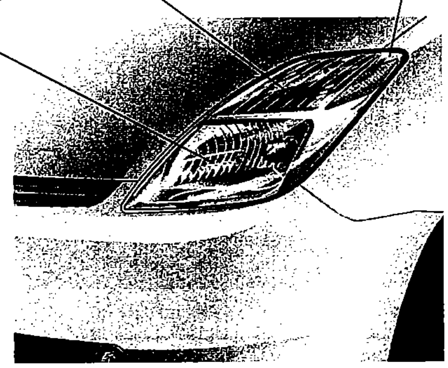

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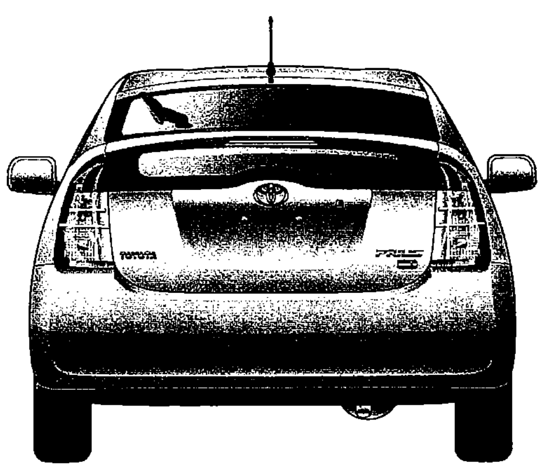
Rear View

- The rear view consists of a high-deck hatchback design. The tail end is shaped into a spoiler, and a sub-window has been located on the underside of the backdoor, thus achieving a unique look.
- The rear design, which extends continuously from the sub-window to the rear combination lights, helps to emphasize the vehicle's wide look.
- Reflective LED stoplights, which have been newly constructed, have been adopted in the rear combination lights.
  They have an entirely different appearance when they are ON or OFF. Together with the crystal-like taillights, turn signal lights, and backup lights, they provide a futuristic and cool look.



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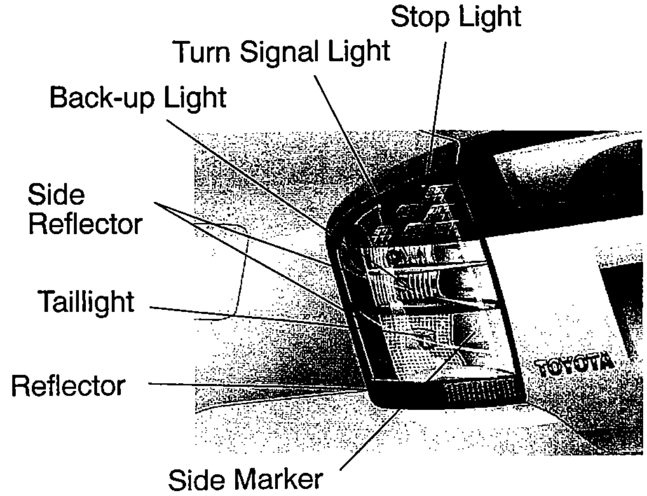

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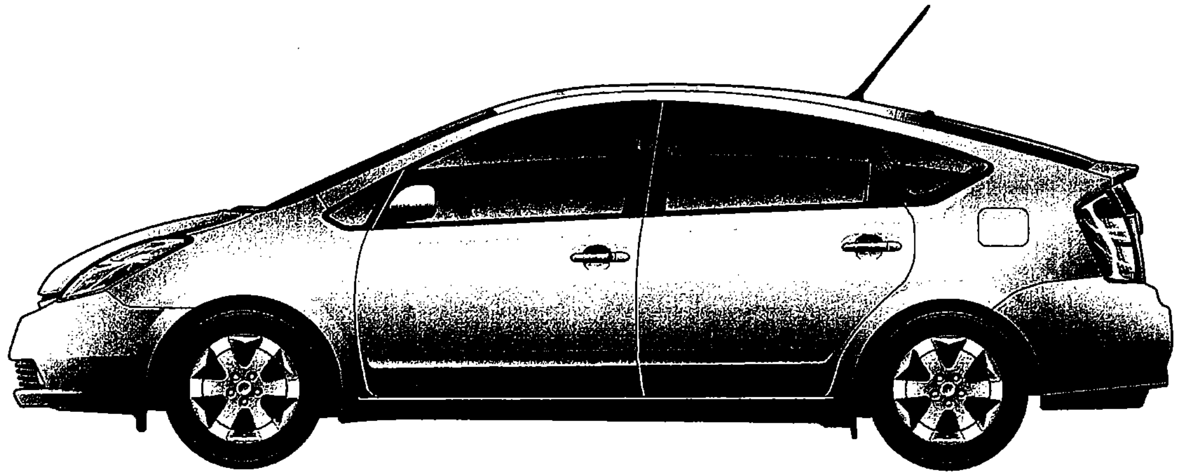
Side View

A futuristic style has been achieved with a triangle monoform motif with the cabin in the center.



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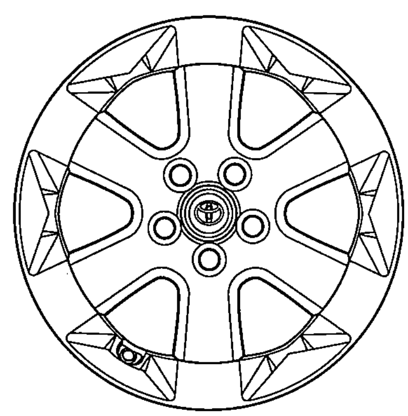
Color List

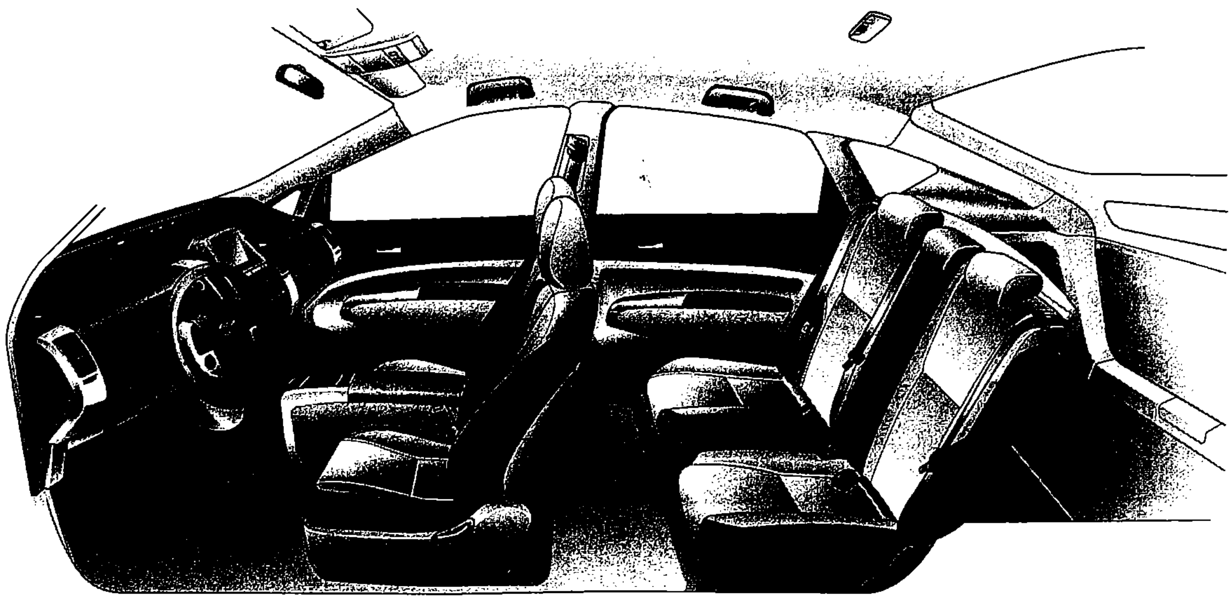
Color No.	Color Name	Color No.	Color Name
040	Super White 2	4S2	Bronze Mica Metallic
1C0	Silver Metallic	6S9	Jade Green Mica Metallic
202	Black	8S2	Blue Mica Metallic
3Q3	Dark Red Mica Metallic		

Tire & Disc Wheel

Tire	Size	P185/65R15
Disc Wheel	Size	15 × 6 JJ
	Material	Aluminum
	P.C.D.*	100 mm (3.9 inch)
	Off Set	45 mm (1.8 inch)
Design (With Wheel Cap)		 255MO08

*: Pitch Circle Diameter

INTERIOR



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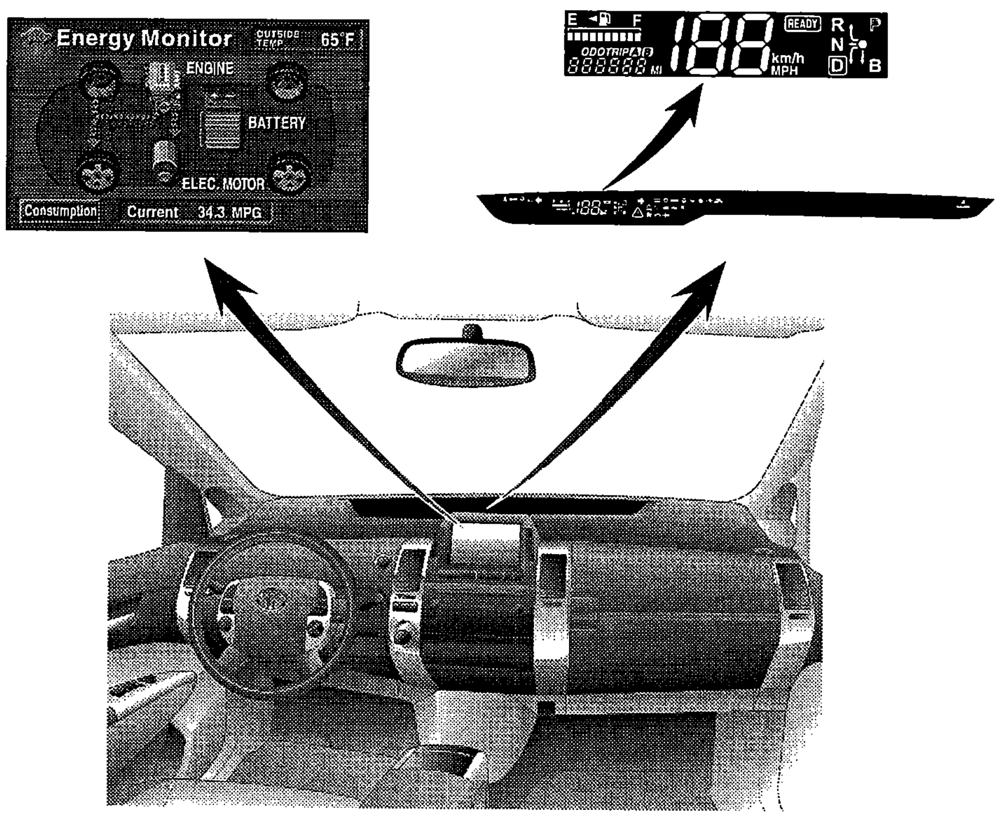
Instrument Panel

- Four vertical bands with a metallic look accentuate the design of the instrument panel, and emphasize a futuristic look with an innovative layout of a new operation system and a display system.
- The center of the instrument panel has adopted a sophisticated design through the combination of a multi-display and a black-smoke motif audio unit.
- The combination meter, which consists of center meters that require a minimal amount of eye movement, has adopted a VFD (Vacuum Fluorescent Display) for the display panel.
- The airbag door for the front passenger has been made invisible to realize a streamlined look.

Multi Display **Combination Meter**



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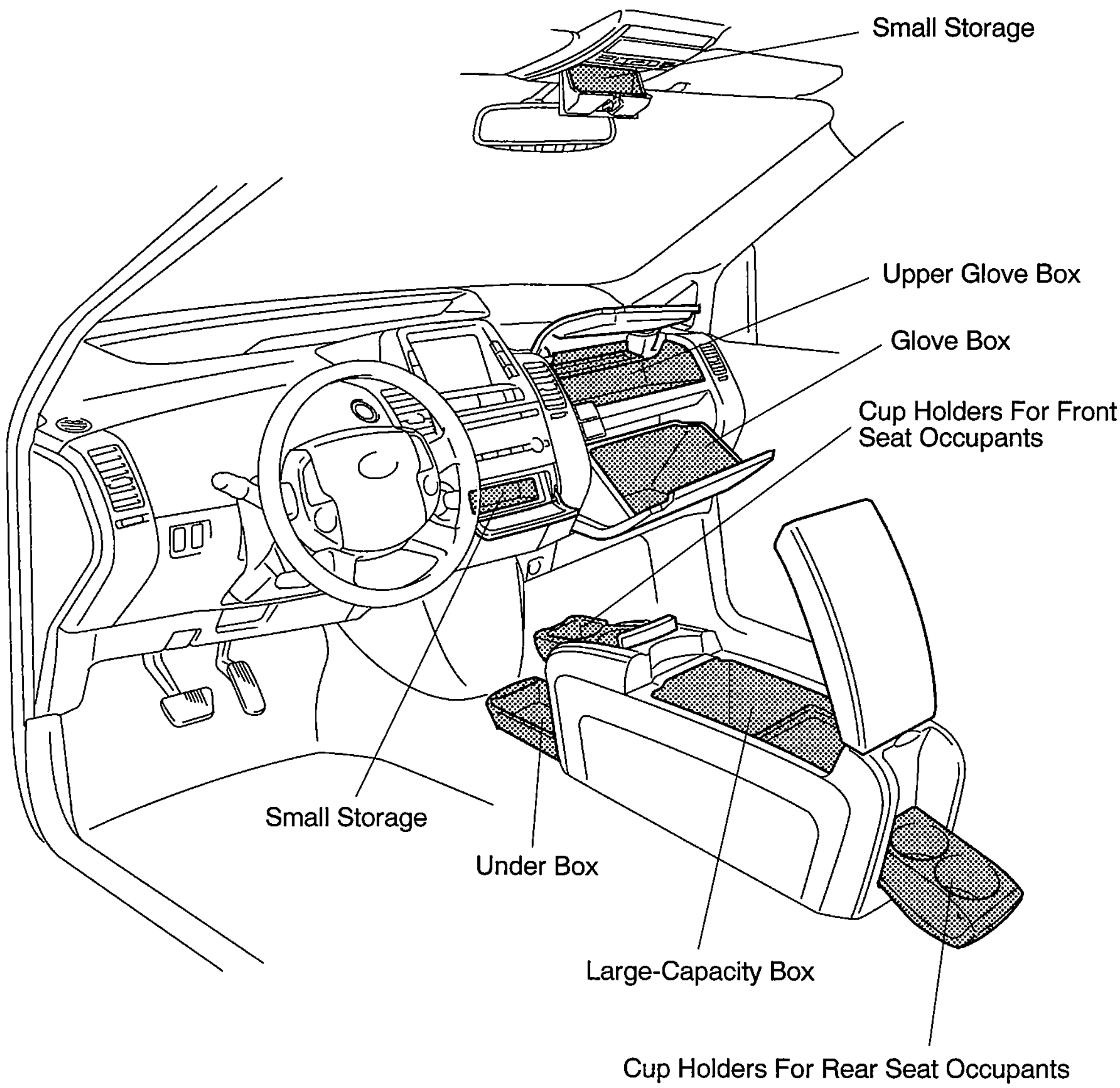
Storage Space

- Storage spaces with ample capacity have been effectively allocated in the instrument panel and the center console.
- The center console has been made approximately 130 mm (5.1 in.) taller than in the '03 Prius, thus enhancing its use as an armrest.



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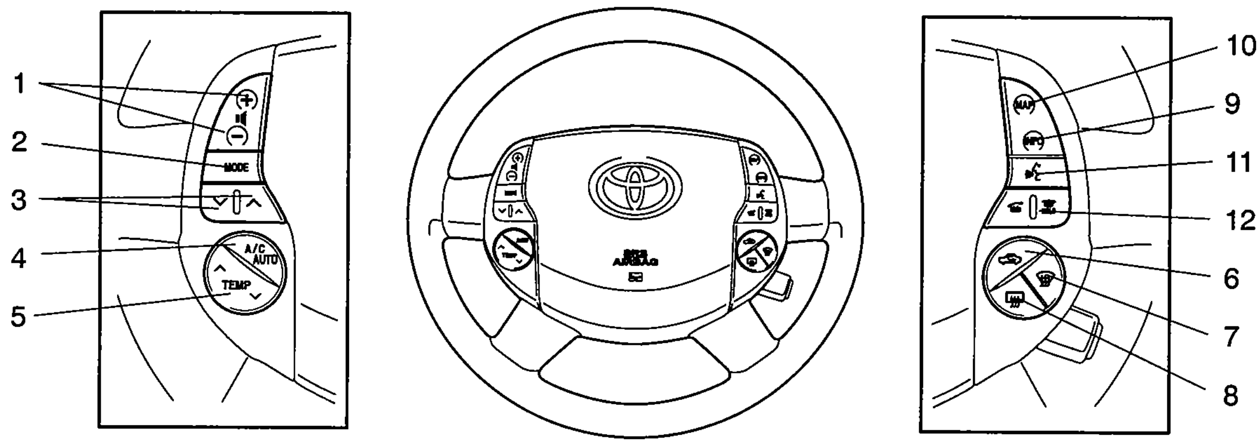
Steering Wheel

- The vehicle is provided with a four-spoke urethane steering wheel. It has a slightly oval shape to improve the visibility of the center meter.
- For convenience, the following switches have been installed on the steering wheel: audio unit, navigation, vehicle information, voice recognition, air conditioning, cruise control, and telephone operation.



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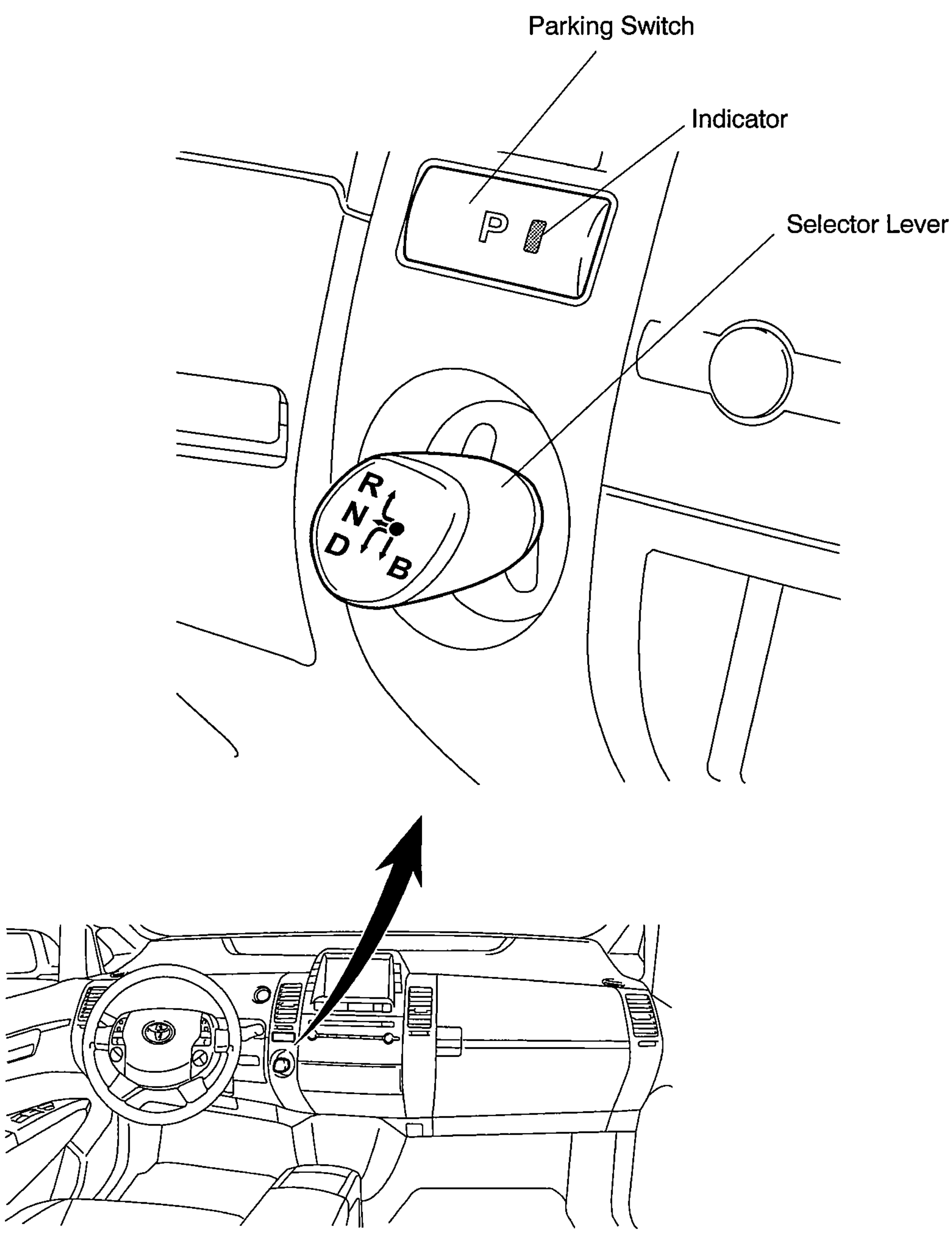
Steering Pad Switch Function

<table>
<tr><th colspan="2">Name of Switch</th><th>Button</th><th colspan="3">Function</th></tr>
<tr><td rowspan="6">Audio</td><td>Volume</td><td>1</td><td colspan="3">UP/DOWN for audio system volume</td></tr>
<tr><td>Mode</td><td>2</td><td colspan="3">Switch AM/FM of radio or Tape or CD</td></tr>
<tr><td rowspan="4">Seek</td><td rowspan="4">3</td><td>Item</td><td>Press for a short period</td><td>Press for a long period</td></tr>
<tr><td>Radio</td><td>Channel UP/DOWN</td><td>UP/DOWN to select a station</td></tr>
<tr><td>CD</td><td>Track UP/DOWN</td><td>Disc UP/DOWN</td></tr>
<tr><td>Tape</td><td>Search FF/REW</td><td>FF/REW</td></tr>
<tr><td rowspan="5">Air Conditioning</td><td>A/C AUTO</td><td>4</td><td colspan="3">ON/OFF for the automatic air conditioning system</td></tr>
<tr><td>TEMP</td><td>5</td><td colspan="3">Air conditioning temperature setting UP/DOWN</td></tr>
<tr><td>FRESH/RECIRC</td><td>6</td><td colspan="3">FRESH/RECIRC selection</td></tr>
<tr><td>Front Defogger</td><td>7</td><td colspan="3">Front defogger ON/OFF</td></tr>
<tr><td>Rear Defogger</td><td>8</td><td colspan="3">Rear defogger ON/OFF</td></tr>
<tr><td colspan="2">INFO</td><td>9</td><td colspan="3">Switching trip information</td></tr>
<tr><td rowspan="2">Navigation (Optional)</td><td>Map</td><td>10</td><td colspan="3">Map including present vehicle position on multi display</td></tr>
<tr><td>Voice Recognition</td><td>11</td><td colspan="3">Voice recognition ON/OFF</td></tr>
<tr><td colspan="2">Telephone (Optional)</td><td>12</td><td colspan="3">Receive or hang up telephone call</td></tr>
</table>

Selector Lever

- A compact selector lever (transmission shift assembly), which has been designed under a new concept, has been adopted in the instrument panel.
  It is a momentary shift type that returns to the home position when the driver's hand is released from the selector lever after a shifting operation. It can be shifted with a fingertip, and the ergonomically designed shifting pattern offers excellent ease of operation.
- A shift-by-wire technology has been adopted for shift control.
- The '04 Prius has adopted a parking lock mechanism that is electrically operated, in the same way as the shift control. It can be shifted to the "P" position by simply pressing the parking switch provided above the selector lever.



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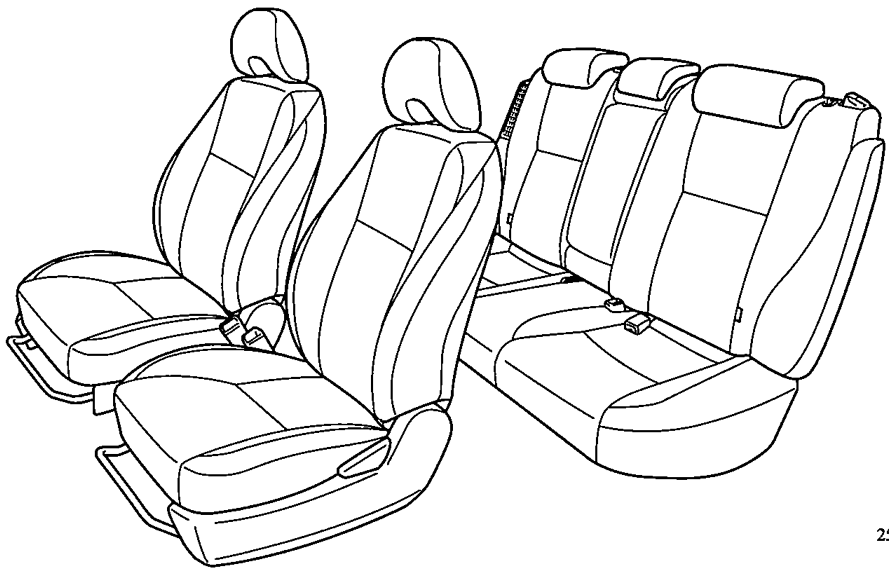
Seat

- Both the front and rear seats have adopted a slim and innovative design consisting of gentle curves.
- Each front seatback has a concave shape to give more legroom, and a pocket is provided for enhanced utility.



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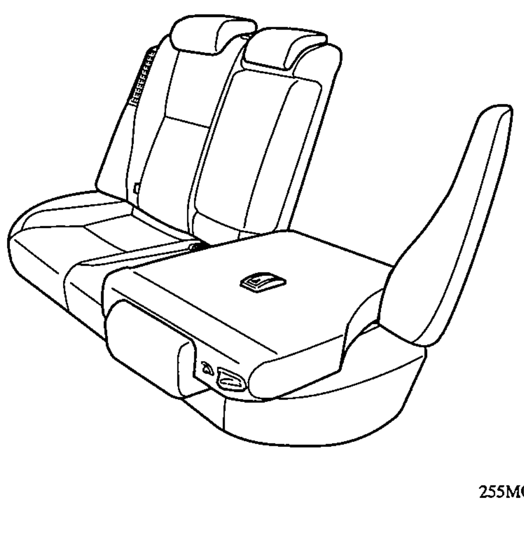
- The rear seat is a fixed seat with seatback that split into two at a 60/40 ratio. Furthermore, the rear seatbacks easily fold forward, enabling the rear seat to be used as a flat cargo deck.



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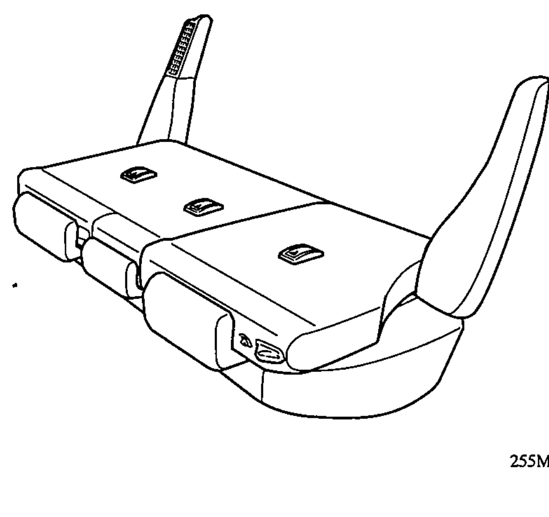

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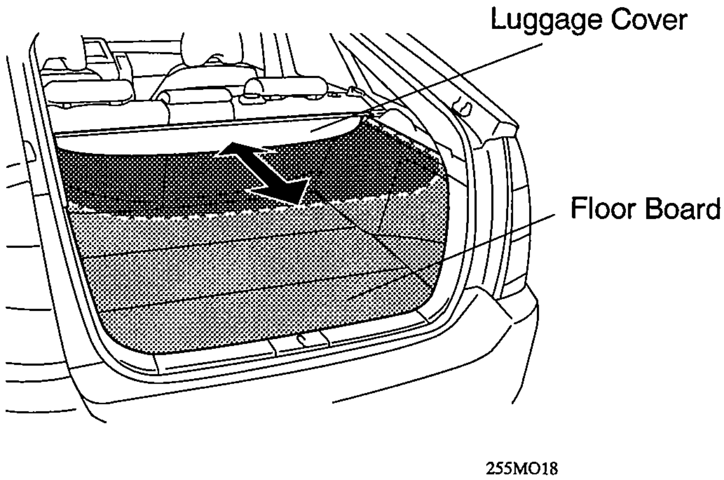
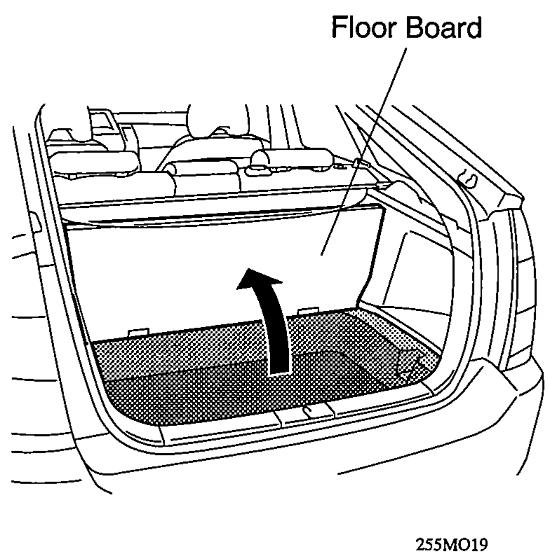
Luggage

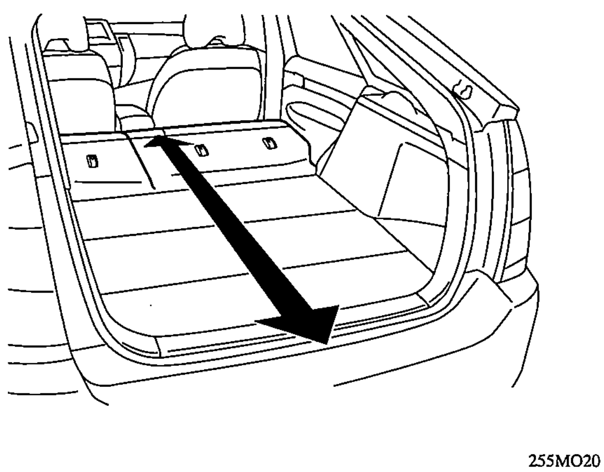
- The luggage space with a high-deck hatchback design is both spacious and easy to use. The rear seatbacks can be folded to provide a flat, spacious cargo area.
- This area accommodates multiple uses through the combination of a luggage cover and a foldable floorboard.



Standard use condition



Taller objects can be accommodated by opening the floorboard.

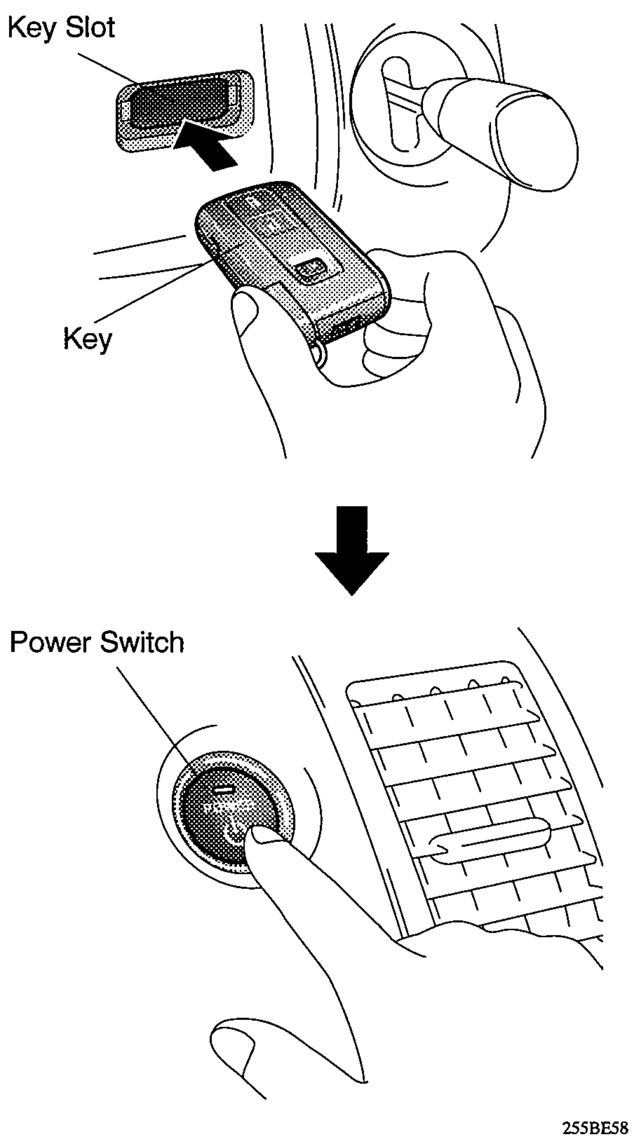


Flat, spacious cargo area

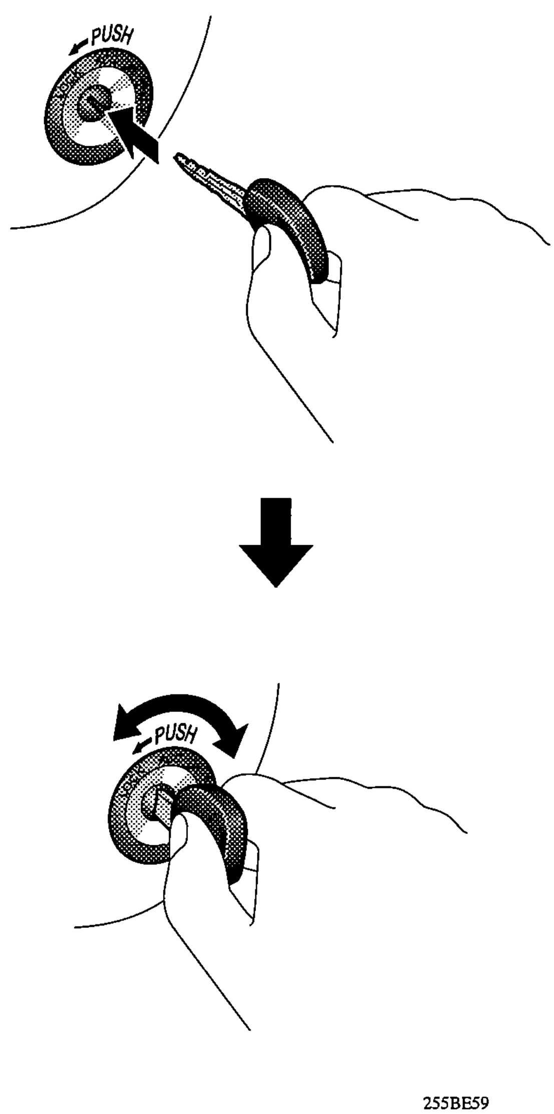
EQUIPMENT

Push Button Start System

- On the previous model, an ignition key is used to operate the key cylinder (containing an ignition switch), in order to switch the power mode of the vehicle and start the system. In contrast, the '04 Prius has adopted a push button start system with which the driver operates the power switch by inserting a key in a key slot or by keeping a key in his/her possession (models with Smart Entry & Start System). Thus, the ease of switching the power mode and starting the hybrid system has been improved.
- This system is standard equipment on all models.
- A power mode (OFF, ACC, IG-ON, or READY) can be selected by pressing the power switch. The indicator on this switch indicates the power mode, which varies by whether the brake pedal is depressed or not depressed while the switch is operated.



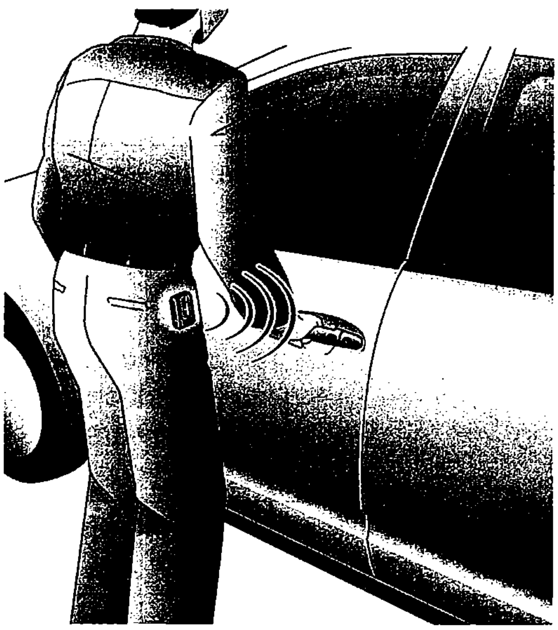
Push Button Start System ('04 Prius)



Conventional System ('03 Prius)

Smart Entry & Start System

- In addition to the conventional mechanical key function and the wireless door lock remote control function, this system provides a smart key with a bi-directional communication function.
  Accordingly, by enabling the smart ECU to recognize the presence of the smart key within the detection area, this system can lock or unlock the doors, or start the hybrid system without the use of the key, as long as the user has the smart key in his/her possession.
- The Smart Entry & Start System is optional equipment on all models.



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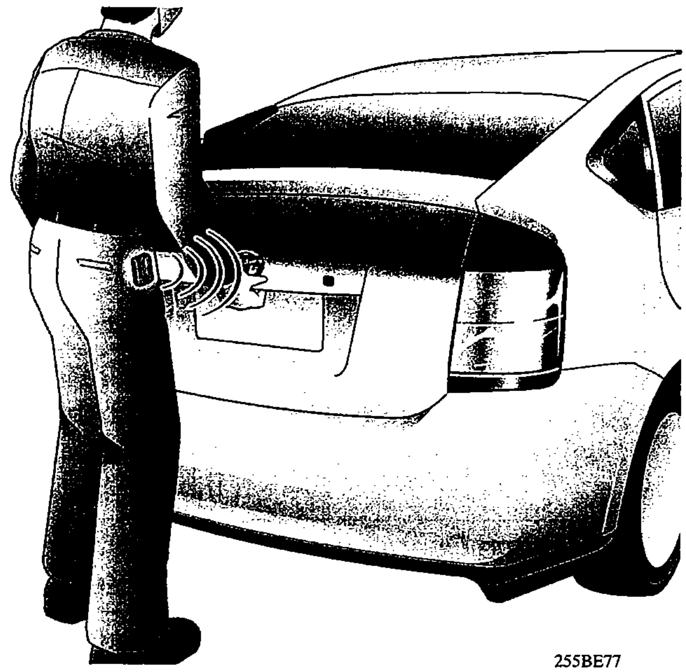
Door Open



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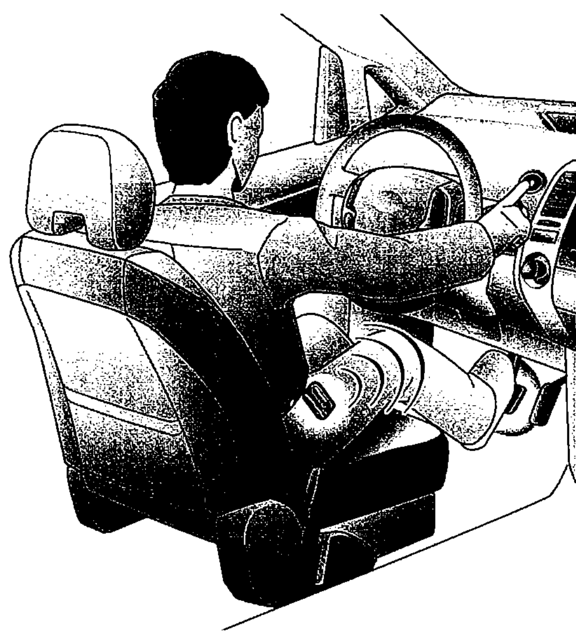
Back Door Open



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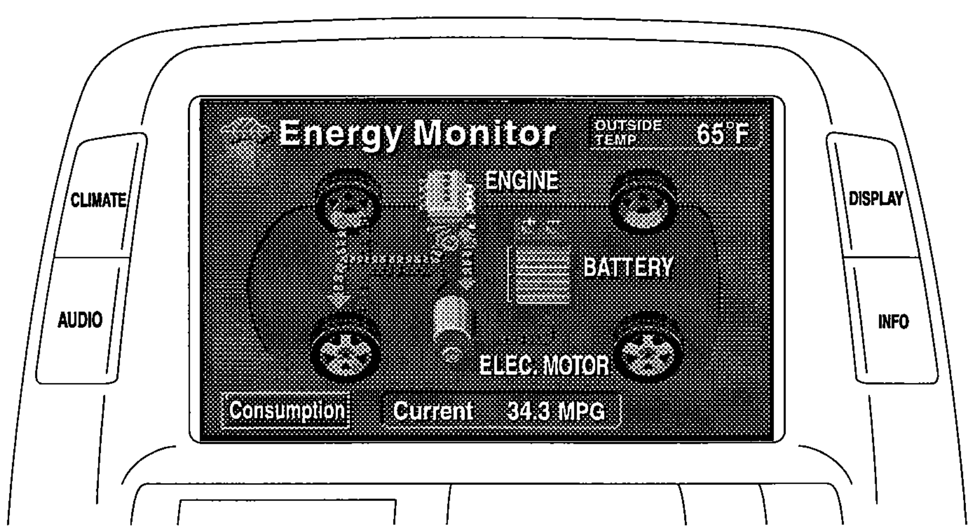
Hybrid System Start

Multi Display

- A multi display has been provided on the center cluster panel as standard equipment. The display, which consists of a wide 7.0-inch LCD (Liquid Crystal Display) screen with a pressure sensitive touch panel, offers improved ease of use.
- Items listed below are the main functions of the multi display.
- The multi display is made by Fujitsu Ten.

Main Function	Outline
Navigation Screen Display (optional)	Through the use of the GPS and map data in a DVD, the navigation system analyzes the position of the vehicle and indicates that position on the map that is displayed on this screen.
Information Display	• Energy Monitor Screen Display • Fuel Consumption Screen Display
Audio Screen Display	Status of audio equipment and audio operation screen indication.
Warning Screen Display	Multi Display shows warning screen whenever master warning light blinks in combination meter.
Air Conditioning Screen Display	The operation and control of the air conditioning system can be effected through the use of the automatic air conditioning display of the multi display and the touch switch that appears on the display.
Telephone Operation Screen Display (Optional)	Enables the user to make or receive calls and talk hands-free on Bluetooth-compatible cellular telephones.
Language Selector Screen Display	The language of the text displayed on the multi display and of the voice guidance can be selected from 2 languages: English, French.



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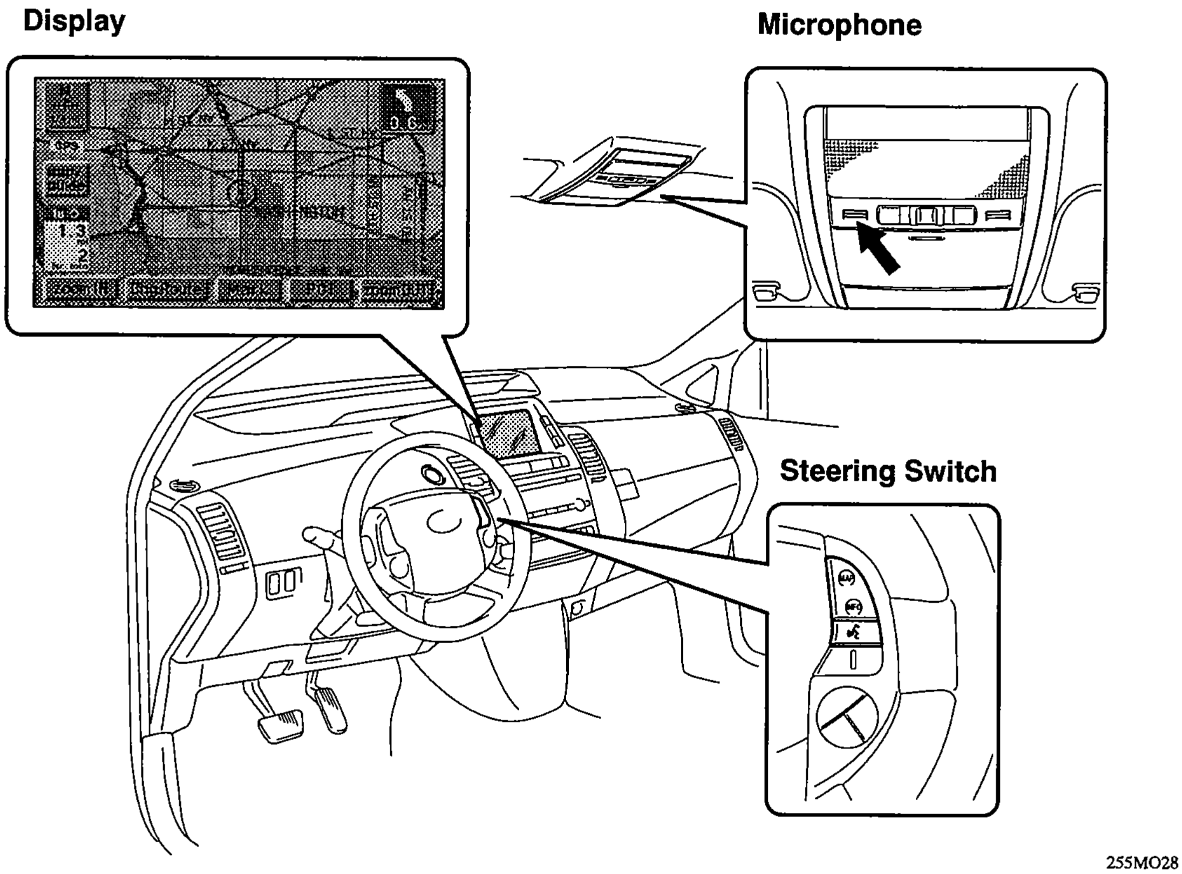
Navigation System

- Through the use of the GPS (Global Positioning System) and the map data in a DVD(Digital Versatile Disc), this navigation system analyzes the position of the vehicle and indicates that position on the map that is displayed on the screen. Additionally, it provides voice instructions to guide the driver through the route to reach the destination that has been selected.
- The languages of voice navigation can be selected from among 2 languages: English and French.
- The screen design has been completely revised to achieve a new, sophisticated screen that is easy to use.
- The navigation system employs a voice recognition function with a voice recognition microphone installed in the overhead console. The voice recognition function can be turned on and off using the steering switch on the steering wheel.
- The Navigation ECU is made by DENSO.



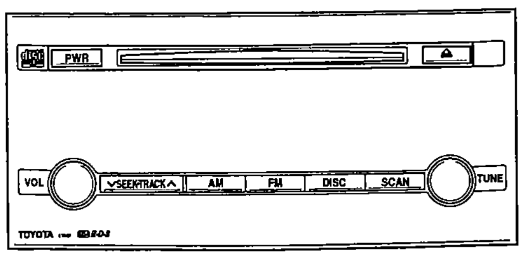
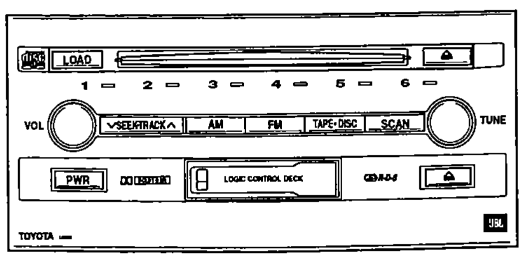
Bluetooth Hands-Free System

- Bluetooth is a high-speed wireless data communication system that uses the 2.4 GHz frequency band prescribed by the Bluetooth SIG (Special Interest Group), with communication at a speed of 1 Mbps. By merely bringing a cellular telephone that has been pre-registered on the multi display into the vehicle, the user can talk hands-free. Thus, it is no longer necessary to connect the telephone to a hands-free connection device as in the past.
- A Bluetooth hands-free system, which enables the user to make and receive calls and talk hands-free by operating the switches on the screen display or the steering pad, is provided on the multi display as optional equipment.
- The Bluetooth hands-free system consists of a multi display, a microphone in the overhead console, and the switches on the steering pad.

Audio System

- The front fascia of the audio unit has adopted a black-smoke motif to achieve a modern and high-quality look.
- The volume knob and the tune knob have adopted a popup construction in order to streamline flush with the front design.
- A JBL Premium Sound System is available as optional equipment.

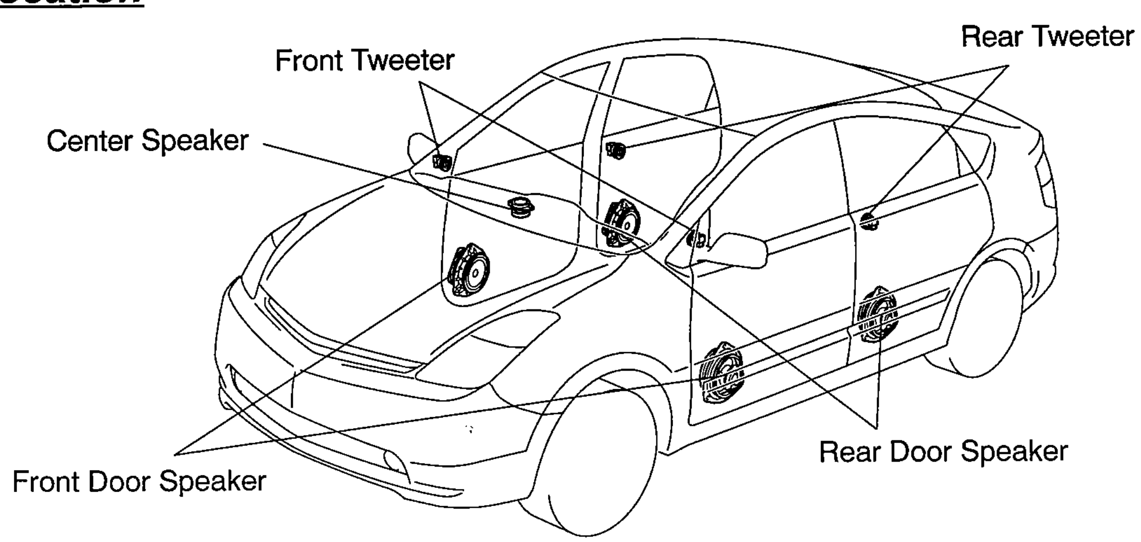
Head Unit Specifications

Design	Specifications	Provided
 255MO29	• AM/FM Tuner • CD Player • DSP • Amplifier Power: 40 W × 4-Ch. • 6-speaker System • RDS function • Manufacturer: Panasonic	Standard
 255MO30	• AM/FM Tuner • Cassette Player • In-dash- 6-CD Changer • ASL • RDS function • Amplifier Power: 45 W × 4-Ch. • 9-speaker System • Manufacturer: JBL (Amplifier, Speaker) Panasonic (Head Unit)	Option (Premium)

Speaker Specifications

Speaker		Standard		Option	
		Caliber	Impedance	Caliber	Impedance
Instrument Panel Center Speaker		—	—	6.5 cm (2.6 in.)	2 Ω
Front Door	Tweeter	3.8 cm (1.5 in.)	4 Ω	2.0 cm (0.8 in.)	6 Ω
	Full Range	16 cm (6.3 in.)	4 Ω	16 cm (6.3 in.)	2 Ω
Rear Door	Tweeter	—	—	2.0 cm (0.8 in.)	6 Ω
	Full Range	16 cm (6.3 in.)	4 Ω	16 cm (6.3 in.)	3 Ω

Location



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Air Conditioning System

- An electric inverter compressor that operates the air conditioning system without depending on the operating condition of the engine has been adopted. This enables stable air conditioning operation regardless of the engine speed (even if the engine is stopped). Thus, both comfortable air conditioning and low fuel consumption have been realized at high levels.
- A humidity sensor has been added to the room temperature sensor. By optimally controlling the amount of dehumidification during air conditioning, both comfort and energy-savings have been achieved.
- In addition to the switches that are integrated on the touch panel of the multi display unit, the main operations of the air conditioning system can be controlled at the switches on the steering pad. As a result, the ease of operation of the air conditioning system has been improved.
- In addition to the conventional functions of the automatic air conditioning system consisting of blower outlet temperature and blower speed control, a function that automatically selects the blower outlet has been included in order to enhance comfort.
  Furthermore, fuzzy control has been added to control the automatic air conditioning system. As a result, air conditioning control that matches the sensory perception of the occupants has been realized.

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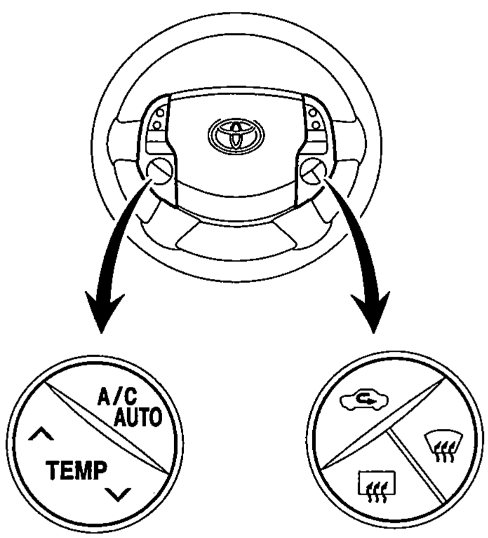
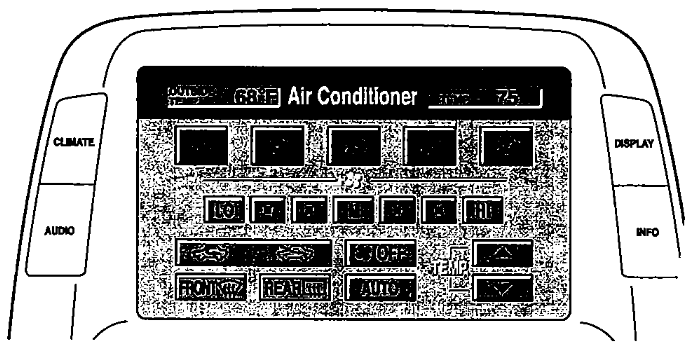


Steering Pad Switch



Multi Display

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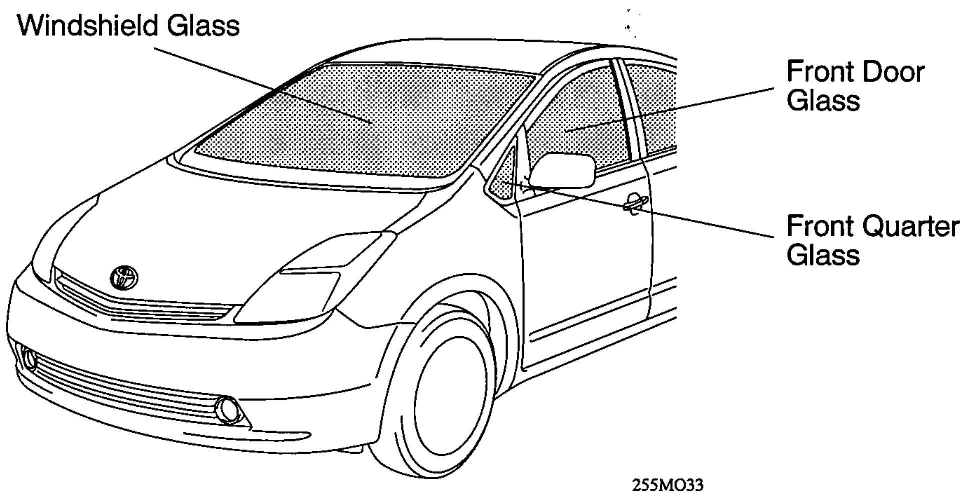
Windshield & Door Glass

UV (Ultraviolet) cut glass containing properties which blocks the ultraviolet and infrared rays in the sunlight has been adopted to prevent sunburn caused by ultraviolet rays and to reduce the scorching hot sensation caused by infrared rays.



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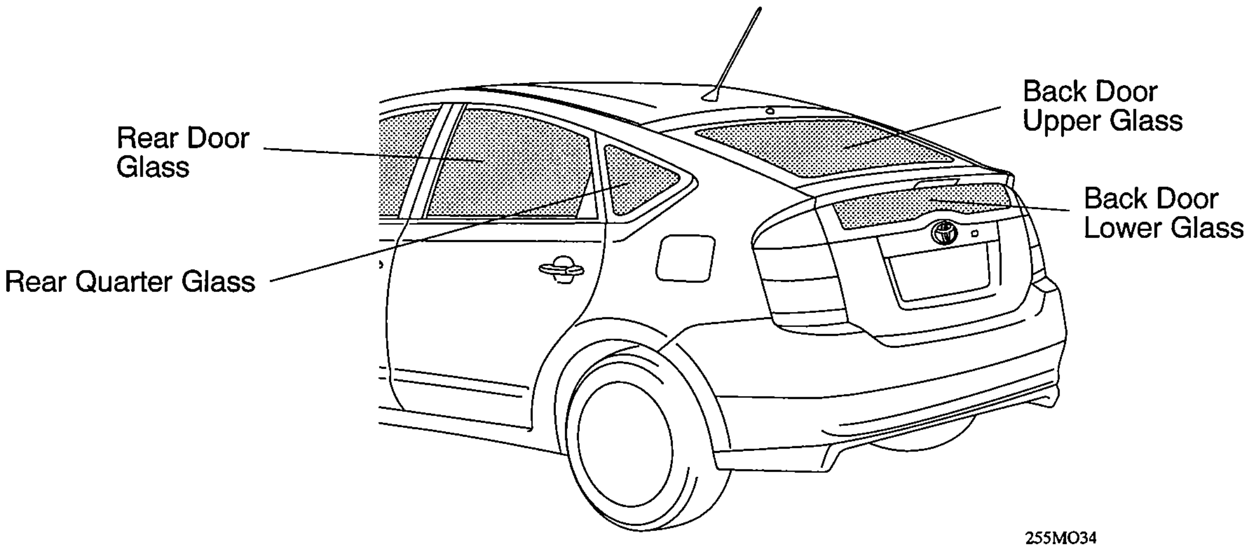

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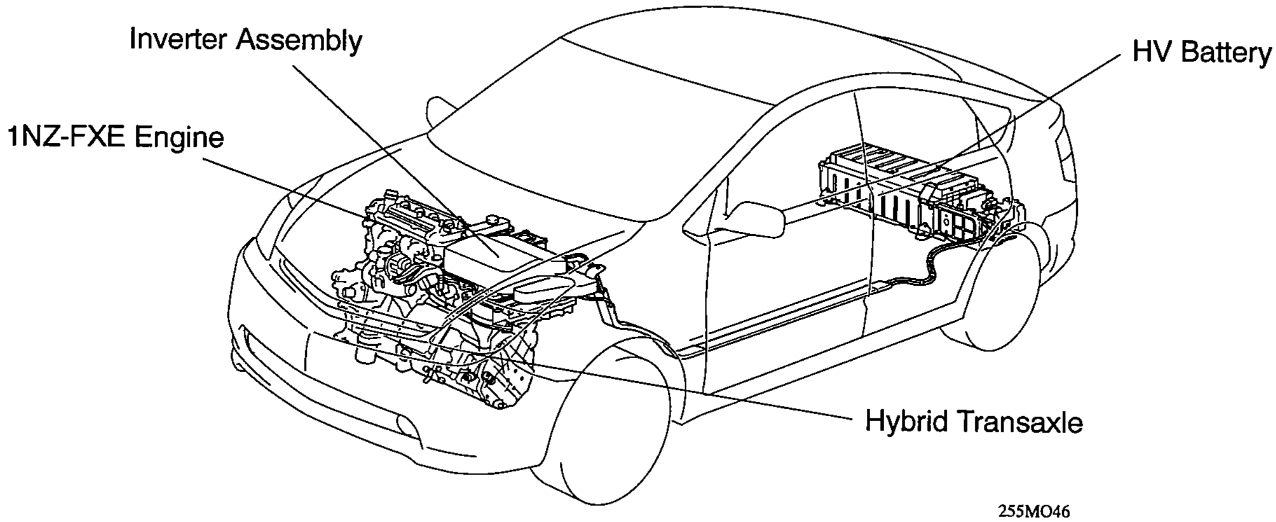
Glass Portion		Glass Type	UV Reduction Rate (%) (as reference)	Visible Light Penetration (%) (as reference)
Windshield		Green Laminated	100	78.3
Front Quarter		Green	91.8	72.8
Front Door		Green	91.8	72.8
Rear Door		Green	90	75.4
Rear Quarter		Green	89	77
Back door	Upper	Green	89	77
	Lower	Privacy (Dark Gray)	93.7	27.9

PERFORMANCE

THS-II (TOYOTA HYBRID SYSTEM-II)

- The hybrid system is a type of power-train that uses a combination of two types of motive forces, such as an engine and a motor [MG2 (Motor Generator No.2)]. This system is characterized by its skillful use of two types of motive forces according to the driving conditions. It complements weakness of motive forces each other to maximize the motive force of the vehicle.
- The '04 Prius is powered by a new-generation Toyota Hybrid System called "THS-II", which has been developed under a "Hybrid Synergy Drive" concept to pursue better environmental performance and to realize "fun to drive" feeling. Under this concept, the THS-II has achieved significant advances in control systems, which aim for synergy between the power of the electric motor and the power of the engine. By greatly boosting the power supply voltage, this system has achieved a high level of balance between environmental performance and power.



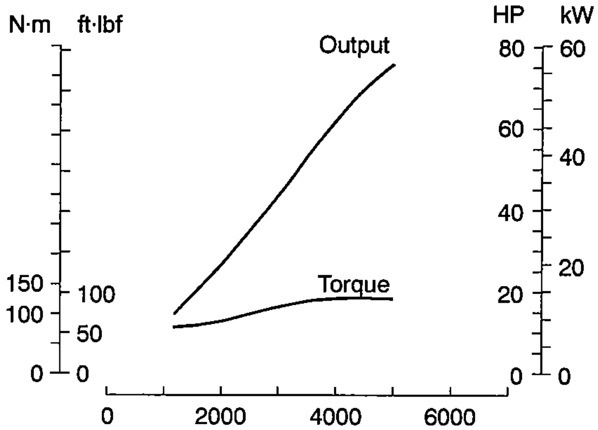
Engine

Model	'04 Prius	'03 Prius
Type	1NZ-FXE High Expansion Ratio Cycle Engine, Certified ATPZEV*1	1NZ-FXE High Expansion Ratio Cycle Engine, Certified SULEV*2
Displacement	1497 cm^3	1497 cm^3
Max. Output	57 Kw/5000 rpm (76 HP/5000 rpm)	52 Kw/4500 rpm (70 HP/4500 rpm)
Max. Torque	111 N·m/4200 rpm (82 ft·lbf/4200 rpm)	111 N·m/4200 rpm (82 ft·lbf/4200 rpm)

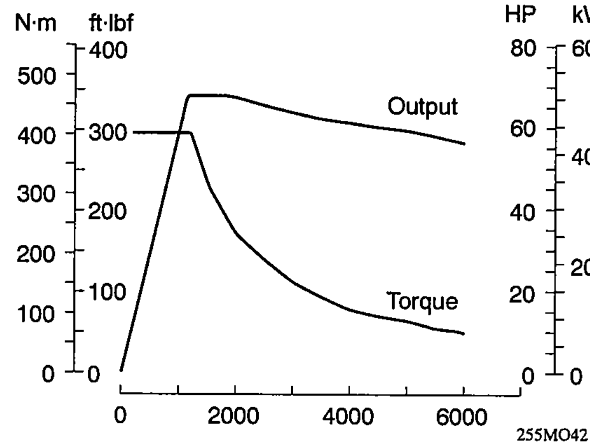
*1: Advanced Technology Partial Zero Emission Vehicle
*2: Super Ultra Low Emission Vehicle

Motor and Generator

Item	MG1	MG2	
		'04 Prius	'03 Prius
Type	Permanent Magnet Motor	Permanent Magnet Motor	Permanent Magnet Motor
Function	Generate, Engine Starter	Generate, Drive Wheels	Generate, Drive Wheels
Max. Voltage [V]	AC 500	AC 500	AC 273.6
Max. Output kW (HP)/(rpm)	—	50 (68)/(1200 ~ 1540)	33 (45)/(1040 ~ 5600)
Max. Torque N·m (ft·lbf)/(rpm)	—	400 (295)/(0 ~ 1200)	350 (259)/(0 ~ 400)

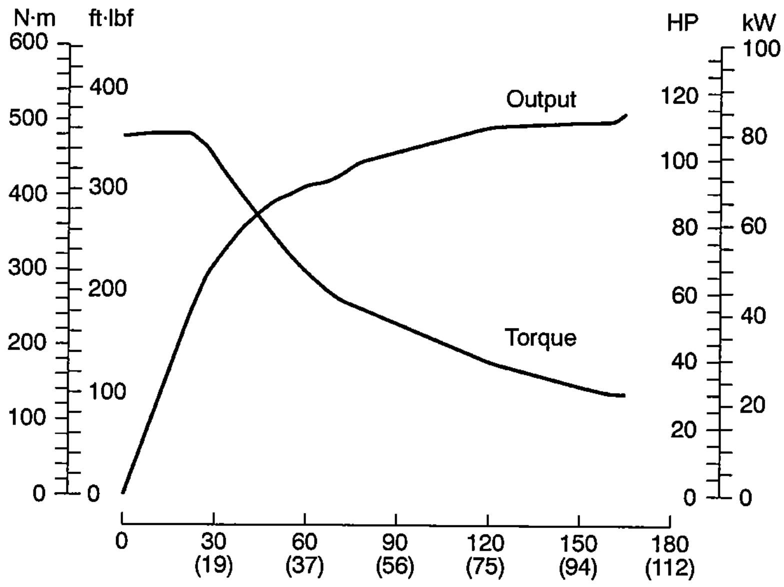


Engine Performance Curve



255MO42

Motor Performance Curve



255MO43

System Performance Curve

Fuel Economy

- The '04 Prius has achieved 15% reduction in fuel consumption, comparing with the '03 Prius, to be in top level of the world. It is due to the adoption of THS-II and load reduction on the vehicle.
- Improvement Items in THS-II:
  (1) A high-voltage power circuit has been adopted between the motor and the generator, in order to greatly reduce the energy loss during power transmission and deliver optimal energy in an efficient manner.
  (2) As a result of increasing the power output of the motor 1.5 times, the THS-II significantly increases the use of the electrical motor. Under conditions in which the efficiency level of the engine is low, this system stops the engine, allowing the vehicle to run using only the power provided by the electric motor.
  (3) The amount of energy regenerated during deceleration and braking has been significantly increased in order to increase energy efficiency.
- Load Reduction Items on Vehicle:
  (1) Reduction of air resistance
  (2) Reduction of friction at various components: Examples: Engine, transaxle oil, etc.
  (3) Reduction of electrical loads: Example: Adoption of LED stoplight
  (4) Adoption of electric inverter air conditioning system

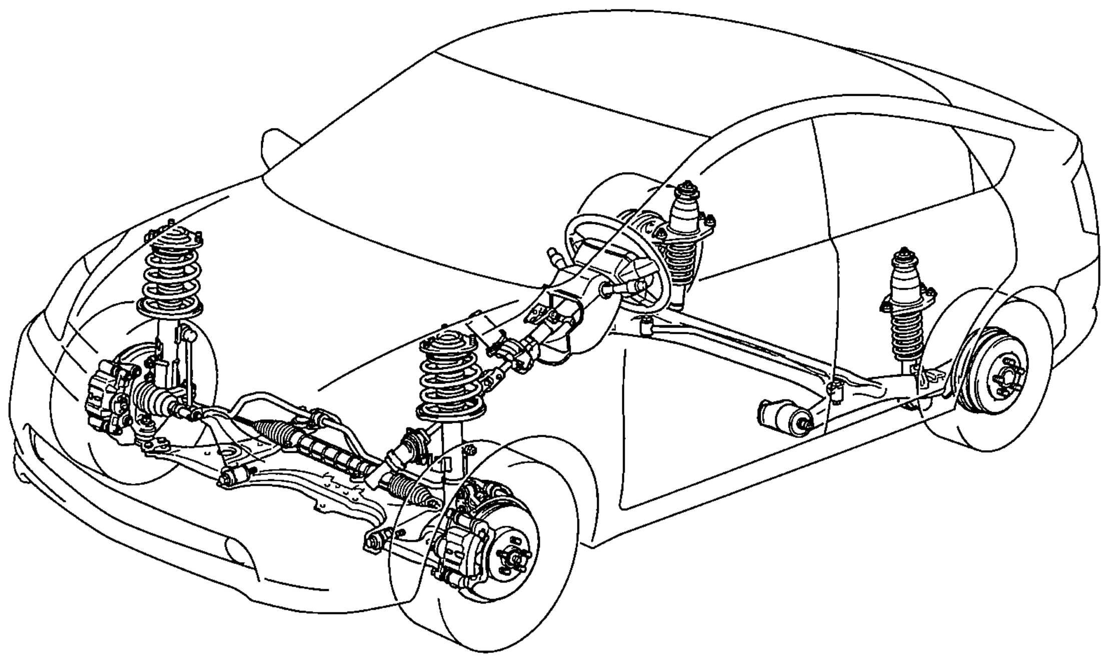
Chassis

Front Suspension

Type	MacPherson Strut Type Independent Suspension

Rear Suspension

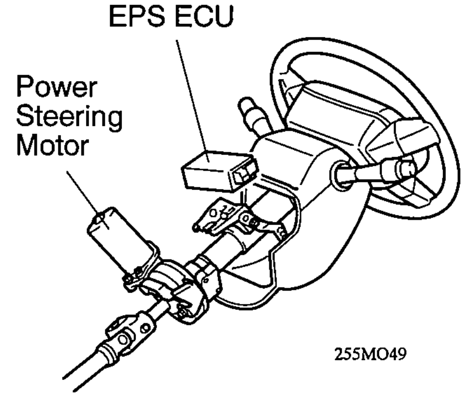
Type	Torsion Beam Type Suspention with Toe-correct Bushings



255MO44

Steering

Type	EPS (Electric Power Steering) • This system offers excellent fuel economy characteristics because this motor consumes energy only when power assist is required. • On the '04 Prius, the motor has been relocated above the steering column.



255MO49

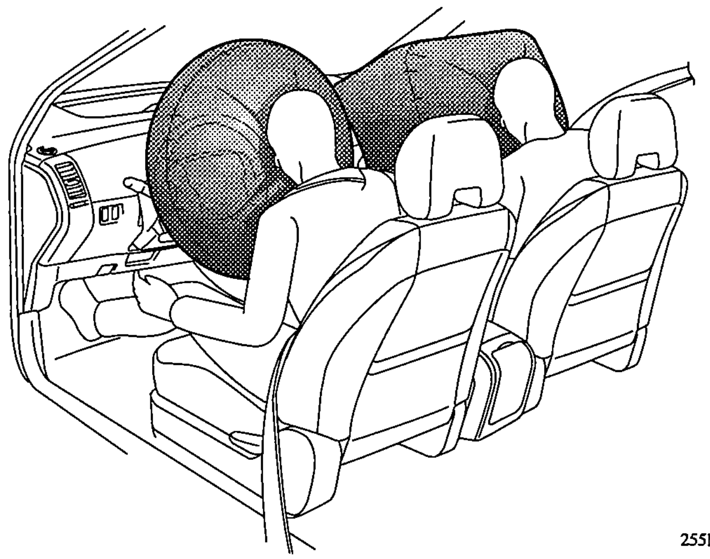
Brake

Front Type	Ventilated Disc
Rear Type	Leading Trailing Drum
Brake Control System	ECB (Electronically Controlled Brake) System; • Regenerative Cooperative Brake, ABS with EBD, Brake Assist • Enhanced VSC (Vehicle Stability Control) (Optional)

SAFETY

SRS (Supplemental Restraint System) Airbag System

- The Dual-stage SRS airbags are standard equipment for the driver and front passenger seats. In the event of a severe frontal collision, the airbags function with the seat belts to help reduce the impact on the driver's and front passenger's head and chest.



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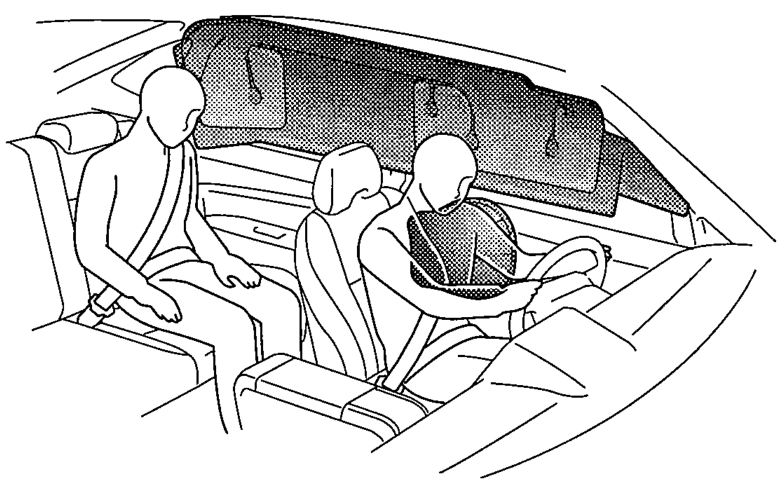
- The SRS side airbags (driver/front passenger seats) which help ease side impacts, are optional equipment.
- The SRS curtain shield airbags (front/rear seats) that help ease side impacts are optional equipment.



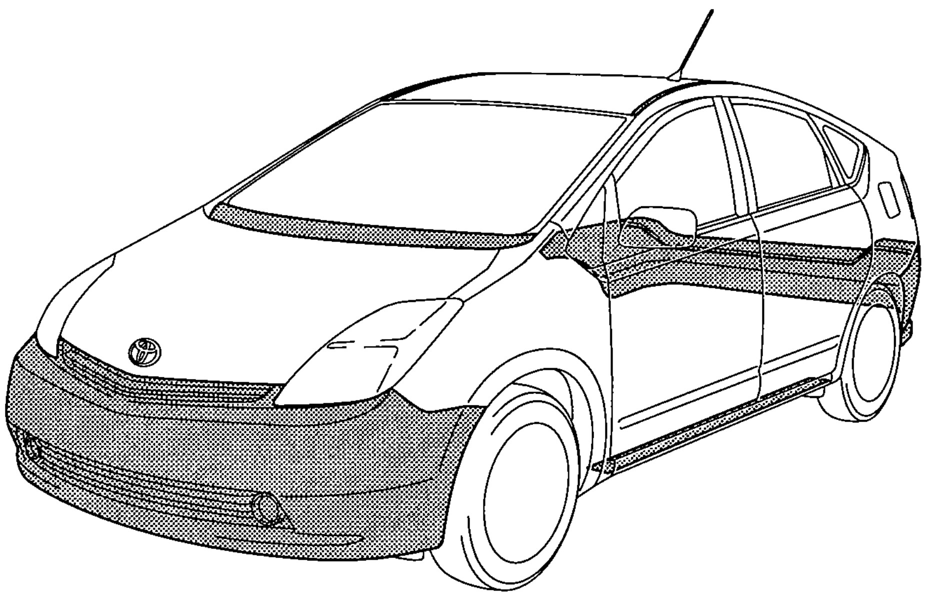
255MO36

ENVIRONMENT

Adoption of TSOP, TPO & PP

TSOP (Toyota Super Olefin Polymer), TPO (Thermoplastic Olefin) and PP (Polypropylene), which have superior recyclability, are actively utilized while the use of chlorine has been reduced as much as possible.

: Parts Adopted TSOP, TPO & PP



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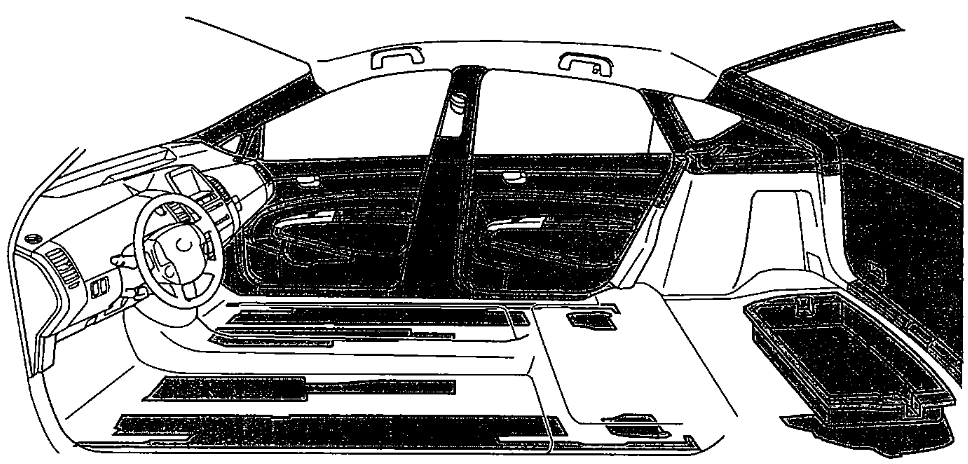


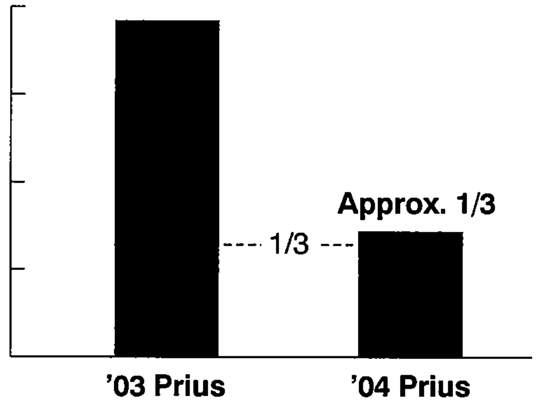
255MO38

Reduced Use of Lead

To help protect the environment, the amount of lead used has been reduced and thorough development of lead-free parts has been implemented.
The amount of lead used in one '04 Prius has been reduced to about one-third of the average amount of lead used in '03 Prius.

Main lead-free parts:

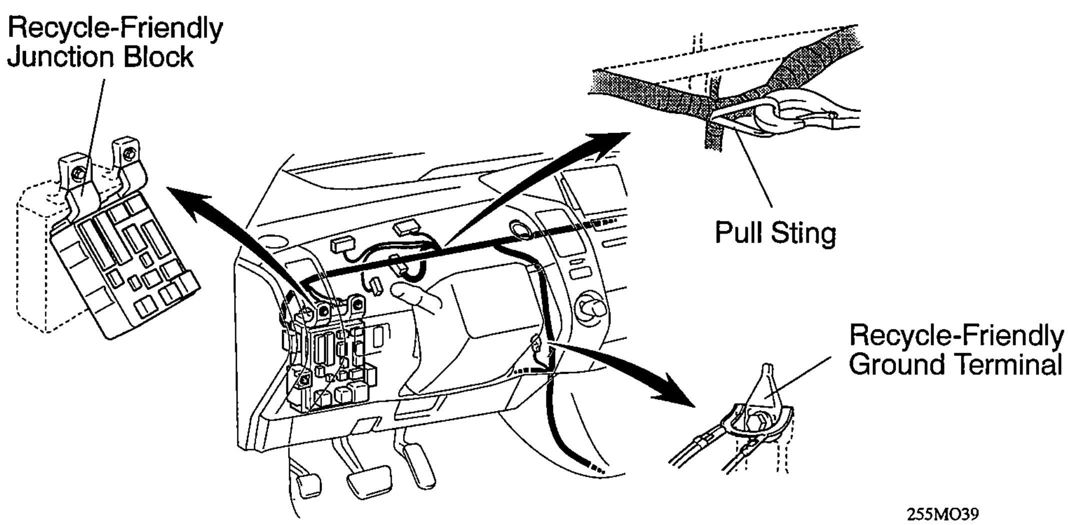
- Radiator
- Heater Core
- Wiring Harness
- Window Glass Black Coating
- Wheel Balance Weight
- Fuel Tank



199MO101

Improvement of Wiring Harness Recyclability

- In all wiring harnesses, the wires and the protective insulation materials have been made halogen-free (chlorine and bromine) to facilitate recycling.
- During the dismantling of the end-of-life vehicles, the wiring harnesses must be removed from the vehicle. The items listed below have been improved to facilitate the recycling operation.
  1. A pull string has been attached to the major wiring harnesses to facilitate their recycling. During the dismantling of the vehicle, the dismantler can pull on these strings to remove the wiring harnesses from the vehicle.
  2. During the removal of wiring harnesses from the vehicle during dismantling, a considerable amount of time is spent in detaching the ground terminals, which makes recycling difficult. For this reason, easily recyclable ground terminals have been adopted. These terminals, which do not pose any problems during normal operation, can be detached easily when an especially large force is applied to them during dismantling.
  3. To facilitate the removal of the junction block during dismantling, the area of the junction block that would be broken off during dismantling has been weakened to facilitate the dismantling operation.



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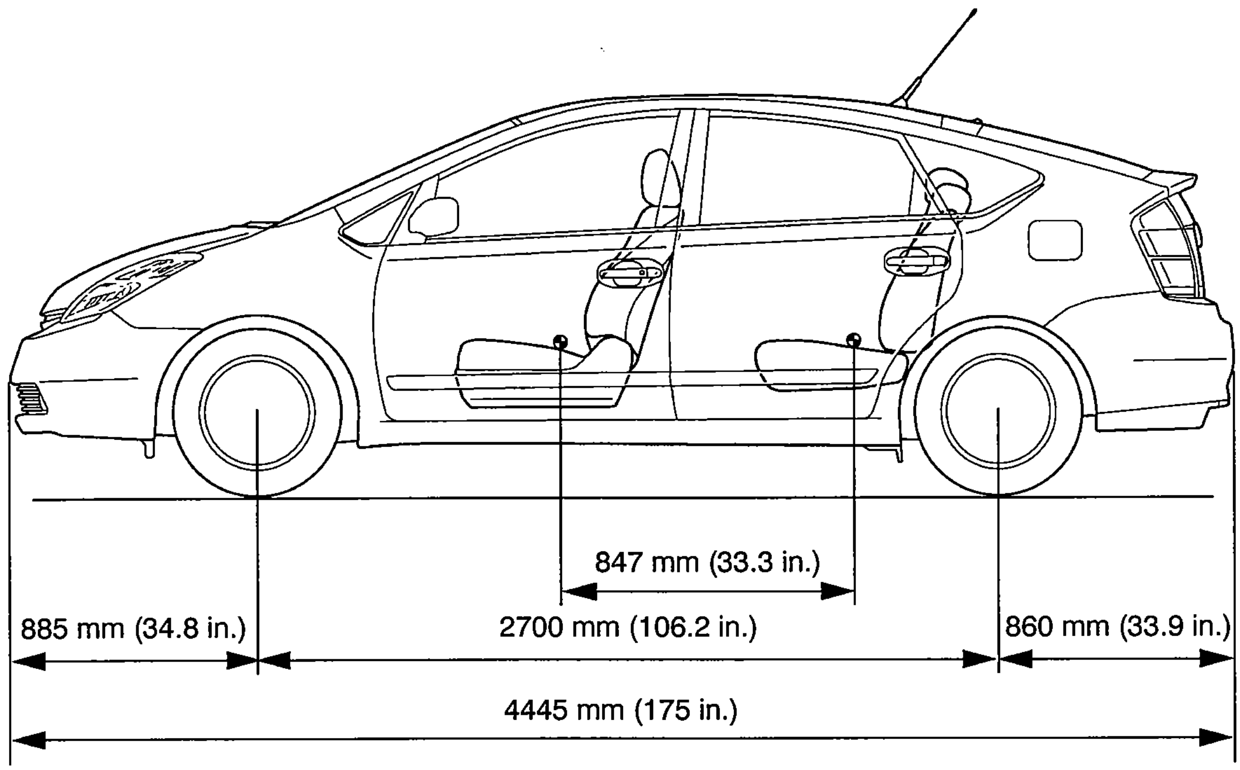
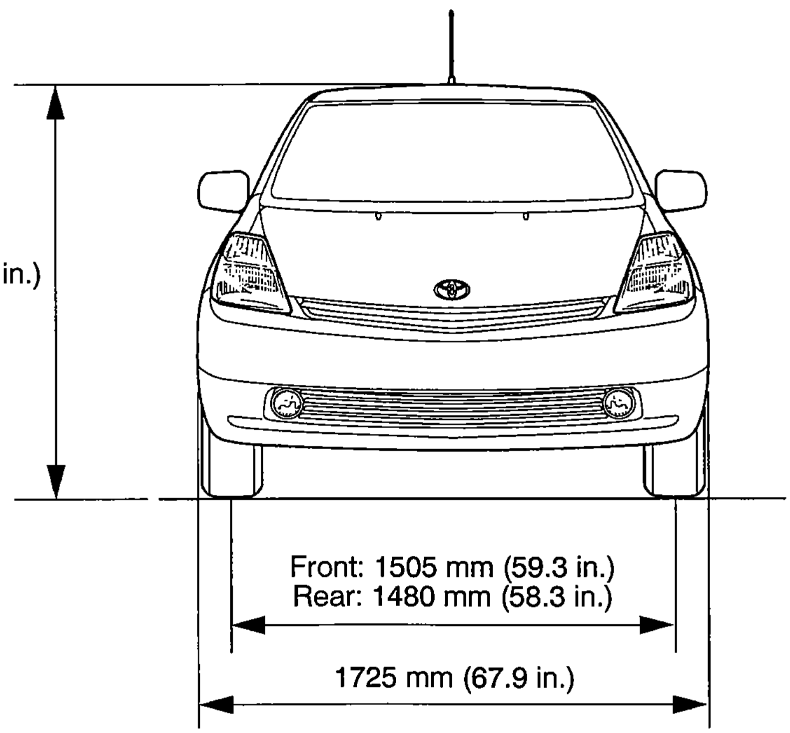
DIMENSIONS





255MO48

EQUIPMENT LIST

Exterior

●: Standard OP: Option

		U.S.A.	Canada
Windshield & Door Glass	UV (Ultraviolet) Cut Glass	●	●
Rear Spoiler		●	●
Rear Bumper Spoiler		●	●

Chassis

Tire	P185/65R15	●	●
Disc Wheel	15 × 6JJ	●	●
Brake Control System	ABS*1 with EBD*2, Brake Assist	●	●
	Regenerative Braking System	●	●
	Enhanced VSC*3	OP	OP
Steering	Electric Power Steering System	●	●
	Manual Tilt Steering	●	●

Body

Seat Cover	Jersey & Tricot	●	●
Seat Belt	Pre-tensioner & Force-limiter	●	●
	Front Seat: ELR*4 Rear Seat: ELR*4/ALR*5	●	●
CRS (Child Restraint System) Anchor System		●	●

Body Electrical

Headlight	Halogen	●	●
	HID (High Intensity Discharge) & Automatic Headlight Beam Level Control System	OP	—
Daytime Running Light System		OP	●
Front Fog Light		OP	OP
Front Window Wiper	Washer-linked Wiper Function	●	●
Rear Window Wiper		OP	OP
Automatic Air Conditioning System		●	●
Push Button Start System		●	●
Smart Entry & Start System		OP	OP
Multi Display		●	●
Navigation System		OP	—
Bluetooth Hands-free System		OP	—

*1: Anti-lock Brake System
*2: Electronic Brake force Distribution
*3: Vehicle Stability Control
*4: Emergency Locking Retractor
*5: Automatic Locking Retractor

Body Electrical

●: Standard OP: Option

		U.S.A.	Canada
Audio System	AM/FM/CD/6-Speaker	●	●
	AM/FM/Cassette/In-dash 6-CD Changer /9-Speaker	OP	OP
Cruise Control System		●	●
Power Window System		●	●
Power Door Lock Control System		●	●
Wireless Door Lock Remote Control System		●	●
Theft Deterrent System	With Security Horn	OP	OP
HV Immobilizer System		●	●
SRS Airbag System	Driver & Front Passenger Airbags	●	●
	Side & Curtain Shield Airbags	OP	OP
Outside Rear View Mirror	Electrical Remote Control Function	●	●
	Internal Mirror Heater Function	●	●
Inside Rear View Mirror	Manual Glare-Resistant Type	●	●
	Automatic Glare-Resistant EC (Electrochromic) Type	OP	OP
Electrical Back Door Outside Handle		●	●
Garage Door Opener		OP	OP

THS-II
(TOYOTA HYBRID SYSTEM-II)

THS-II (TOYOTA HYBRID SYSTEM-II)

THS-II (TOYOTA HYBRID SYSTEM-II)

■ DESCRIPTION

- The '04 Prius operates under THS-II (Toyota Hybrid System-II), which has carried over the basic components of the THS (Toyota Hybrid System) from the '03 Prius. To further enhance efficient performance, the controls for the engine, MG1 (Motor Generator No.1), MG2 (Motor Generator No.2), and the battery have been optimized.
- On this model, the capacity of the HV battery has been set to the nominal voltage of DC 201.6 V, the number of the cells has been reduced, and furthermore, boosting the voltage up to the maximum of DC 500 V inside the inverter has been achieved. The boosted direct current is converted into an alternating current inside the inverter in order to drive MG1 and MG2. As a result, a downsized, lightweight and high-power system has been realized.
- The table below describes the newly adopted items.

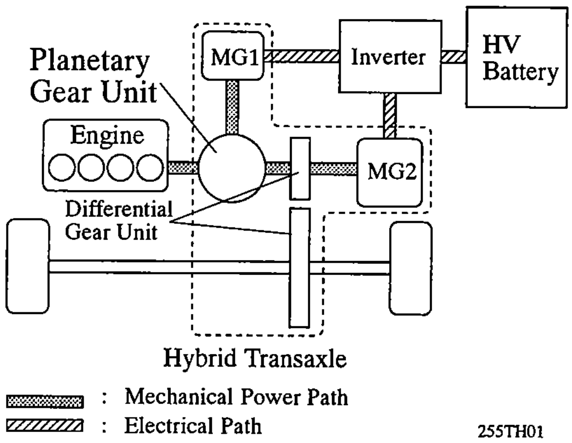
▶ Major Differences ◀

Item	Outline
HV Battery	• The HV battery of the '03 Prius consists of 228 cells ({1.2V x 6 cells} x 38 modules) with a nominal voltage of DC 273.6 V. In contrast, the HV battery of the '04 Prius consists of 168 cells ({1.2V x 6 cells} x 28 modules) with a nominal voltage of DC 201.6 V. A compact and lightweight battery configuration has been achieved through these internal improvements. • On the '03 Prius, the connection between the cells of the HV battery consists of one spot. In contrast, the cells on the '04 Prius are connected with two spots. The internal resistance of the battery has been reduced by this improvement.
Inverter Assembly	• A boost converter has been included in the inverter. This boosts the nominal voltage of DC 201.6 V that is output by the HV battery to maximum voltage of DC 500 V. • The bridge circuits for MG1, MG2, and the signal processor/protective function processor have been integrated and made compact into an IPM (Integrated Power Module) for driving purposes. • An A/C inverter, which supplies power for driving the electric inverter compressor of the A/C system, has been included in the inverter assembly. • A radiator that integrates an inverter radiator and engine radiator has been adopted to optimize the space it occupies.
MG1	Accompanied by enhancing the rotor robustness of MG1, its rpm range for the maximum possible output has been increased from 6,500 to 10,000 rpm, therefore the charging capability has been enhanced.
MG2	• Structure of each built-in permanent magnet inside the rotor of MG2 has been optimized by redesigning it to V shaped structure, and improvement of its power output and torque has been realized. • For MG2 control, a newly developed over-modulation control system has been adopted to the medium-speed range.
HV ECU	• The HV ECU has been made to efficiently control the systems and functions that have been newly adopted on the '04 Prius. • The HV ECU has been changed from 16-bit CPU to 32-bit CPU to increase the speed for processing the signals.
ECM	The ECM has been changed from 16-bit CPU to 32-bit CPU to increase the speed for processing the signals.
Battery ECU	• The battery ECU has been made more compact through optimized construction. • The battery ECU has been changed from 16-bit CPU to 32-bit CPU to increase the speed for processing the signals.
Skid Control ECU	The skid control ECU has been changed from 16-bit CPU to 32-bit CPU to increase the speed for processing the signals.
Communication	CAN (Controller Area Network) communication has been adopted to establish communication among the principal ECUs (HV ECU, battery ECU, ECM, and skid control ECU) that are associated with THS-II control.

■ FEATURES OF THS-II

1. General

- The hybrid system is a type of power-train that uses a combination of two types of motive forces, such as an engine and a MG2. This system is characterized by its skillful use of two types of motive forces according to the driving conditions. It maximizes the strengths of each of the motive forces and complements their weaknesses. Thus, it can achieve a highly responsive, dynamic performance, as well as a dramatic reduction in fuel consumption and exhaust gas emissions. The THS-II can be broadly divided into two systems: the series hybrid system, and the parallel hybrid system.



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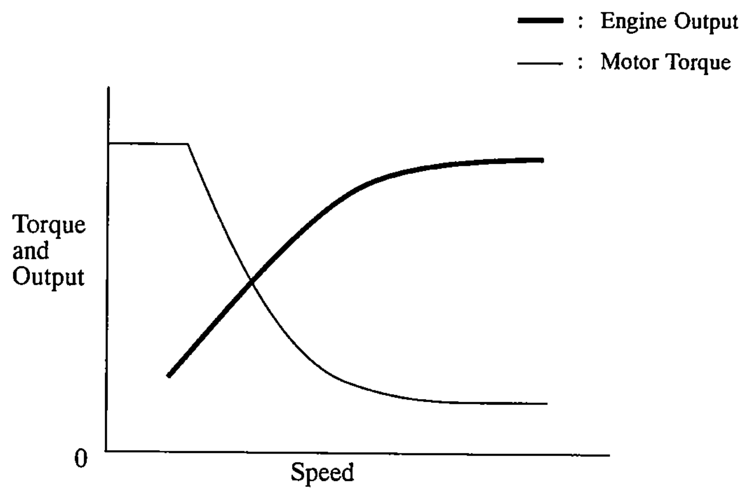


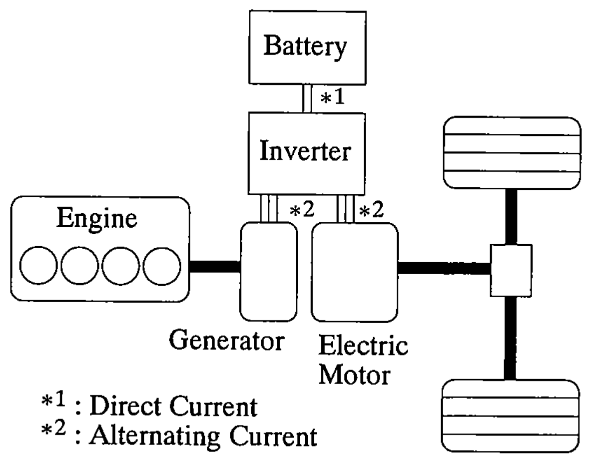
Diagram of the Conceptual Image of the System Performance Curve

255TH02

— *REFERENCE* —

Series Hybrid System

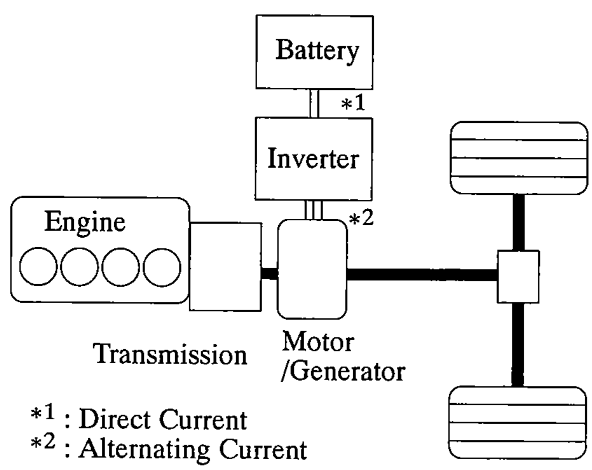
In the series hybrid system, the engine runs a generator, and the generated electricity enables the electric motor to drive the wheels. This type of vehicle can be described as an electric car that is equipped with an engine-driven generator.
Equipped with a low-output engine, the engine is operated at a practically constant speed in its most effective range, in order to efficiently recharge the battery while the vehicle is in motion.



182TH01

Parallel Hybrid System

This system uses both the engine and the electric motor to directly drive the wheels is called the parallel hybrid system. In addition to supplementing the motive force of the engine, the electric motor in this system can also serve as a generator to recharge the battery while the vehicle is in motion.

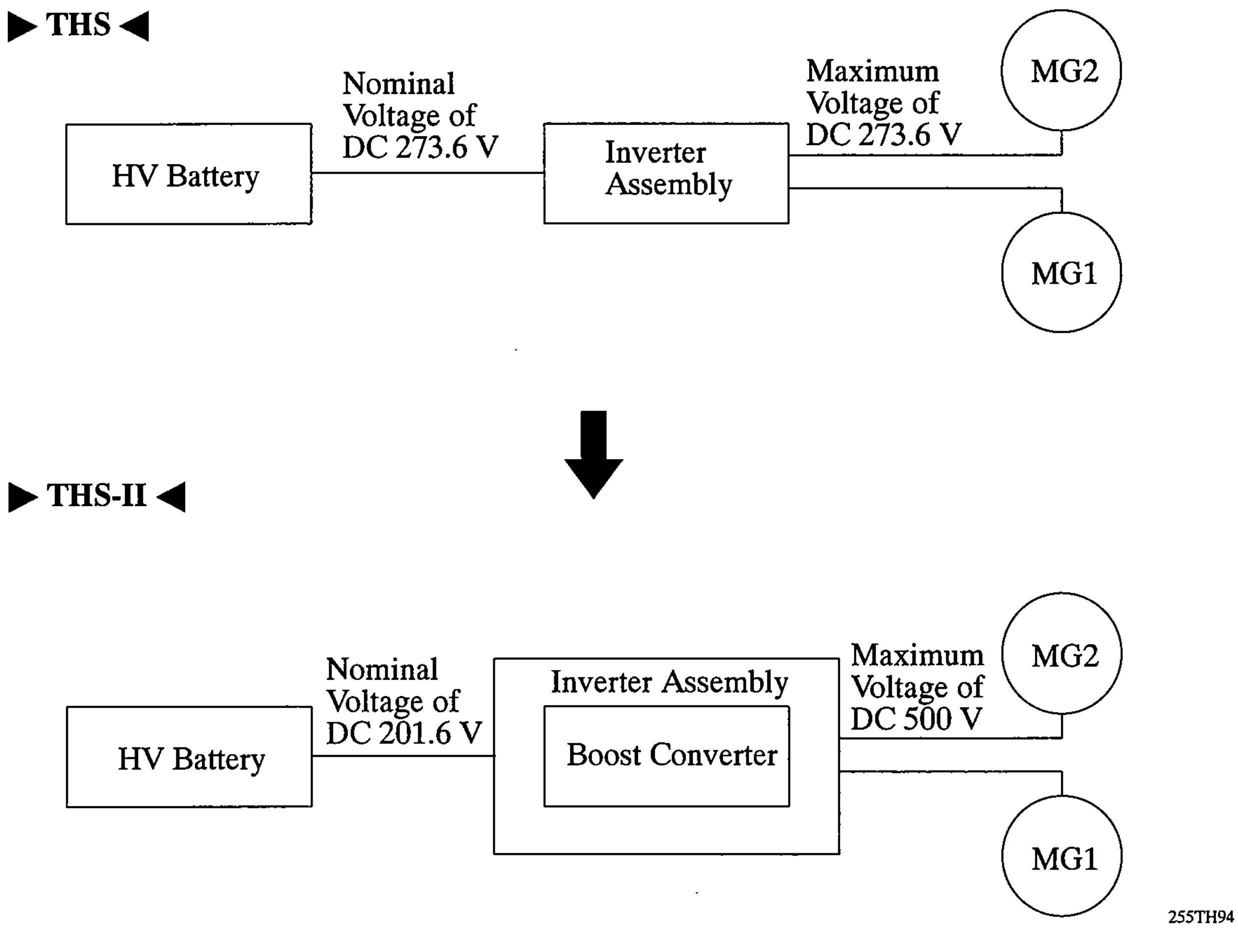


182TH02

2. High-voltage Power Supply System

General

In the THS-II of the '04 Prius, a boost converter has been newly adopted inside the inverter assembly. The boost converter enables the THS-II to provide the power source voltage of 500V at a maximum to MG1 and MG2 (the maximum of the THS on the '03 Prius is 273.6V), thus electric power is supplied with lower current and high efficiency is realized.



Power Calculation

Power (P) = Voltage (V) × Current (I)

- Power, which expresses the work performed by electricity within a give amount of time, is calculated by multiplying voltage by current. If the power necessary for driving the motor is held constant, the above formula indicates that doubling the voltage reduce the current by 1/2.
- Next, by following Joule's Law (Calorie = Current^2 × Resistance), the power loss in terms of calories is reduced to 1/4 (1/2 Current × 1/2 Current) if the resistance is held constant. The high-voltage power circuit (boost converter) in THS-II increases power by increasing the voltage while keeping the current constant. Furthermore, for the same power level, increasing the voltage and reducing the current reduces energy loss, resulting in high efficiency.

3. Hybrid Transaxle

General

- While this system efficiently combines and operates the two types of motive forces, the engine and MG2, in accordance with the driving conditions of the vehicle, the basic motive force is provided by the engine. The motive force of the engine is divided into two areas: the motive force applied to the wheels by the planetary gear unit in the hybrid transaxle, and the motive force to operate MG1 as a generator.
- The hybrid transaxle, which contains MG1, MG2, and a planetary gear unit, uses these units to achieve a smooth drive realized through stepless shifting.
- The engine, MG1, and MG2 are mechanically joined via the planetary gear unit.
- MG2 and the differential gear (for the drive wheels) are joined via a drive chain and gears.

For details, refer to P112 Hybrid Transaxle on page CH-2.

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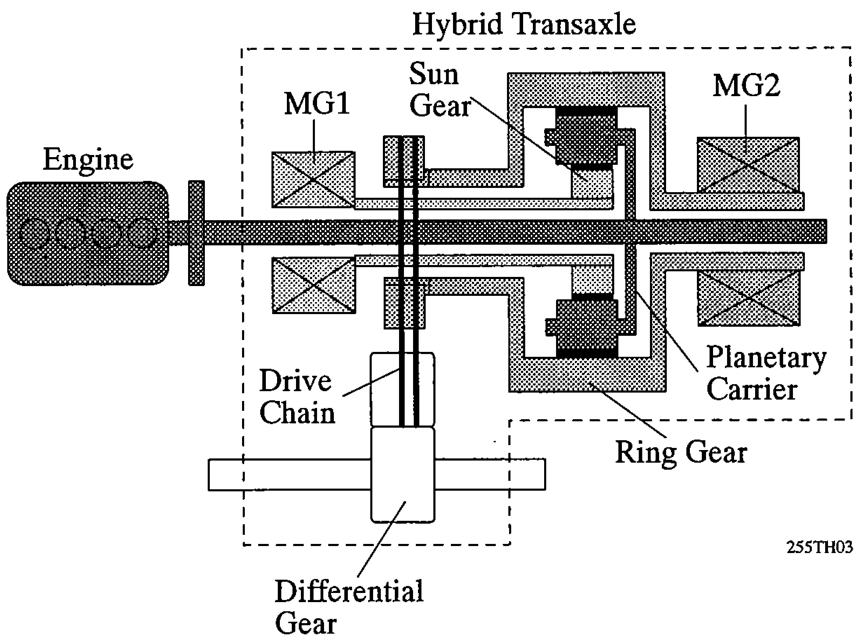


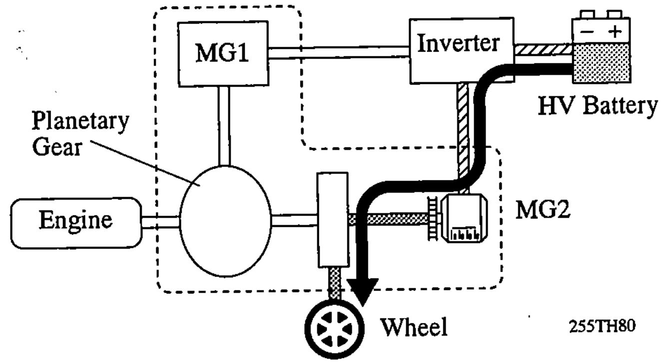
Clutch-Less System

A clutch-less system has been adopted to mechanically link the front wheels and MG2 via gears and a chain. To disengage the motive force in the neutral position, the shift position sensor outputs an N position signal to turn OFF all the power transistors in the inverter (which connects MG1 and MG2). As a result, the operation of MG1 and MG2 shuts down, thus rendering the motive force at the wheels to zero. In this state, even if MG1 is rotated by the engine or MG2 is rotated by the drive wheels, no generation of electricity occurs because both MG1 and MG2 are inactive. As a result, the SOC (state of charge) of the HV battery decreases as the shift position remains in the "N" position.

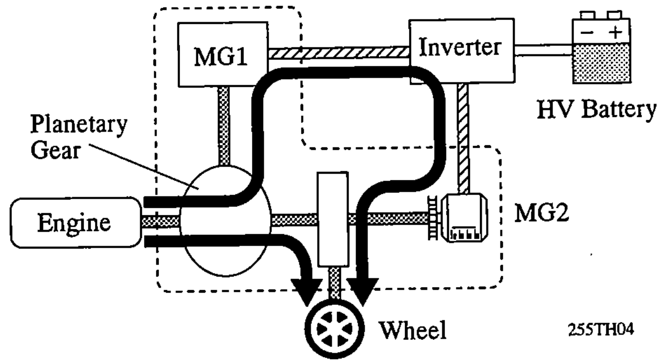
4. Basic Operation

- This system controls the following modes in order to achieve the most efficient operations to match the driving conditions:

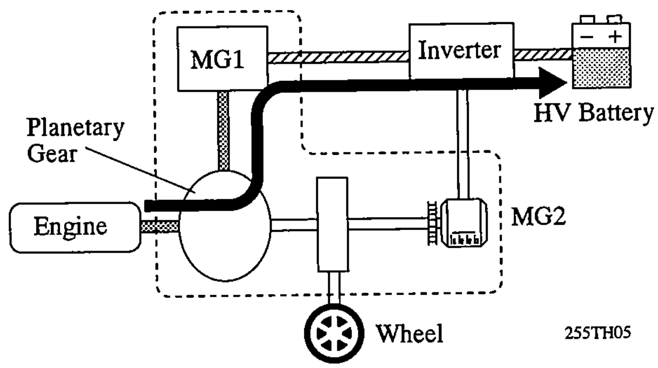
(1) Supply of electrical power from the HV battery to MG2 provides force to drive the wheels.



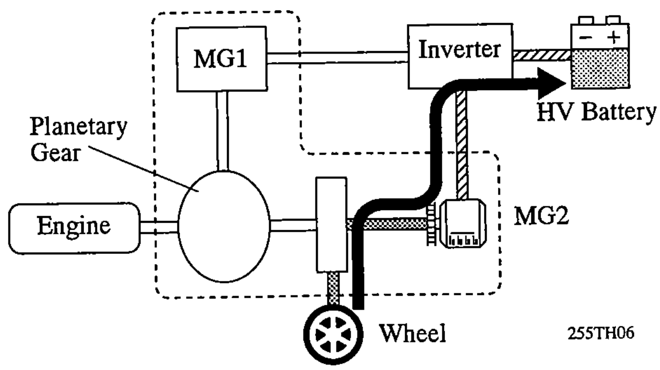
(2) While the wheels are being driven by the engine via the planetary gears, MG1 is rotated by the engine via the planetary gears, in order to supply the generated electricity to MG2.



(3) MG1 is rotated by the engine via the planetary gears, in order to charge the HV battery.



(4) When the vehicle is decelerating, kinetic energy from the wheels is recovered and converted into electrical energy and used to recharge the HV battery by means of MG2.



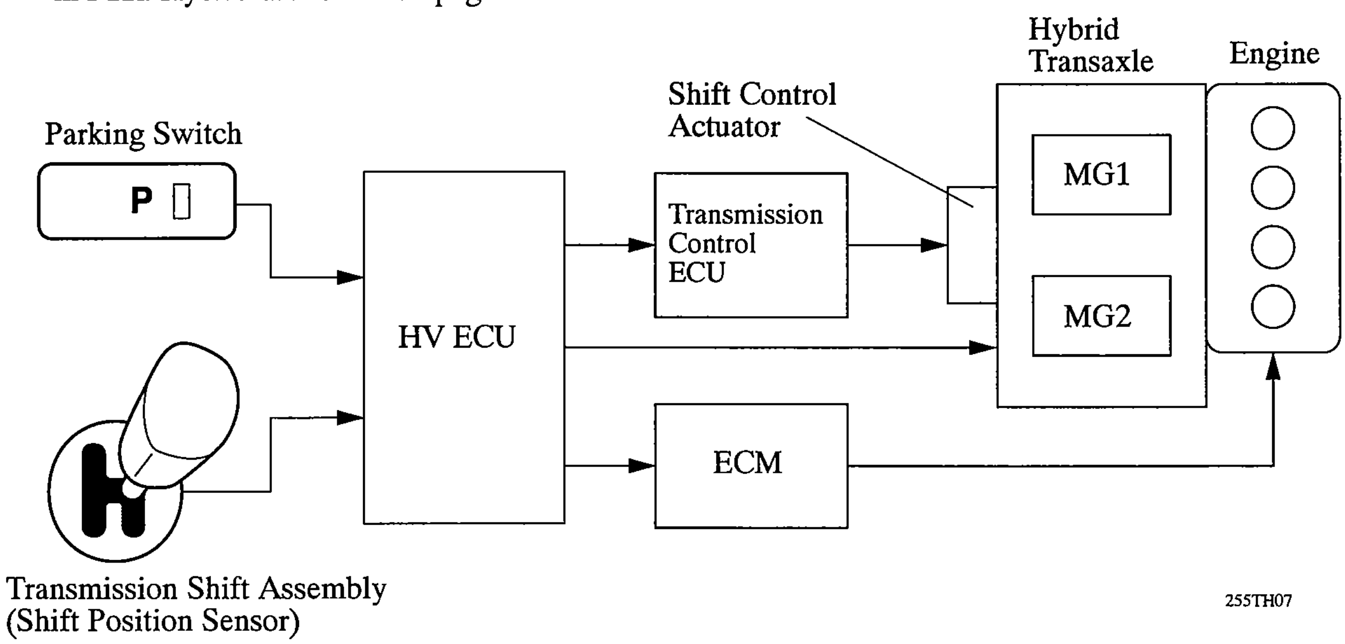
- The HV ECU switches between these modes ((1), (2), (3), (1)+(2)+(3), or (4)) according to the driving conditions. However, when the SOC (State of Charge) of the HV battery is low, the HV battery is charged by the engine by turning MG1.
  As a result, it achieves far greater fuel economy compared to conventional gasoline engine vehicles, at a reduced level of exhaust gas emissions. Furthermore, this revolutionary power-train has eliminated the constraints that are associated with electric vehicles (such as their short cruising range or their reliance on external recharging units).

5. Regenerative Brake

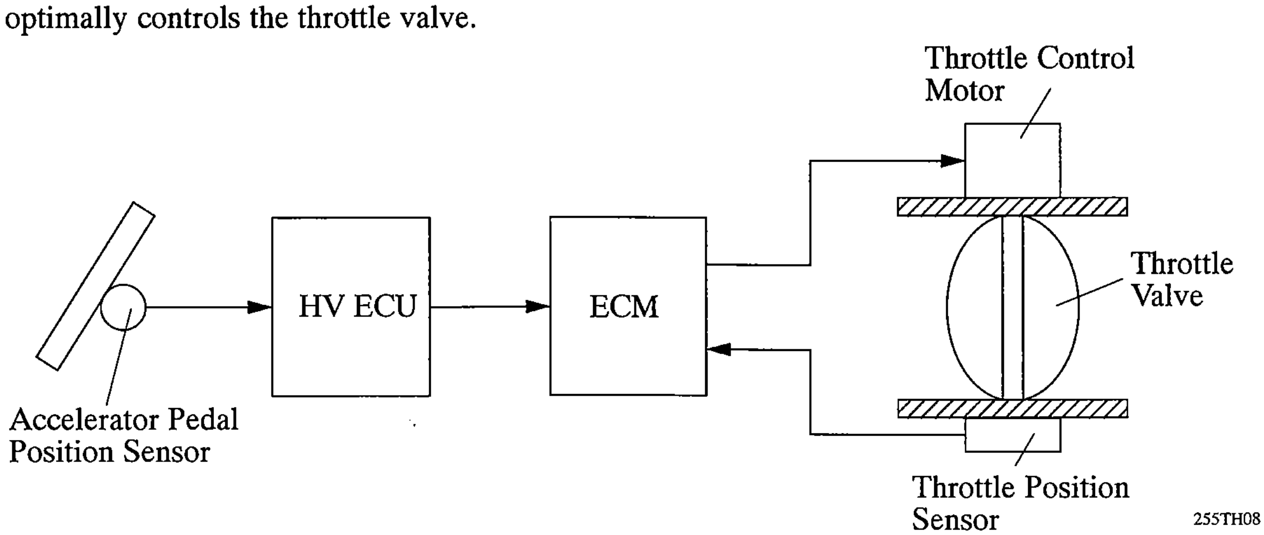
The regenerative brake function operates MG2 as a generator while the vehicle is decelerating or braking and stores this electrical energy in the HV battery. At the same time, it utilizes the operating resistance, which MG2 exerts during the generation of electricity, as a braking force. For details, refer to the Outline of Regenerative Brake Cooperative Control in the Brake Control System, on page CH-36.

6. Link-Less

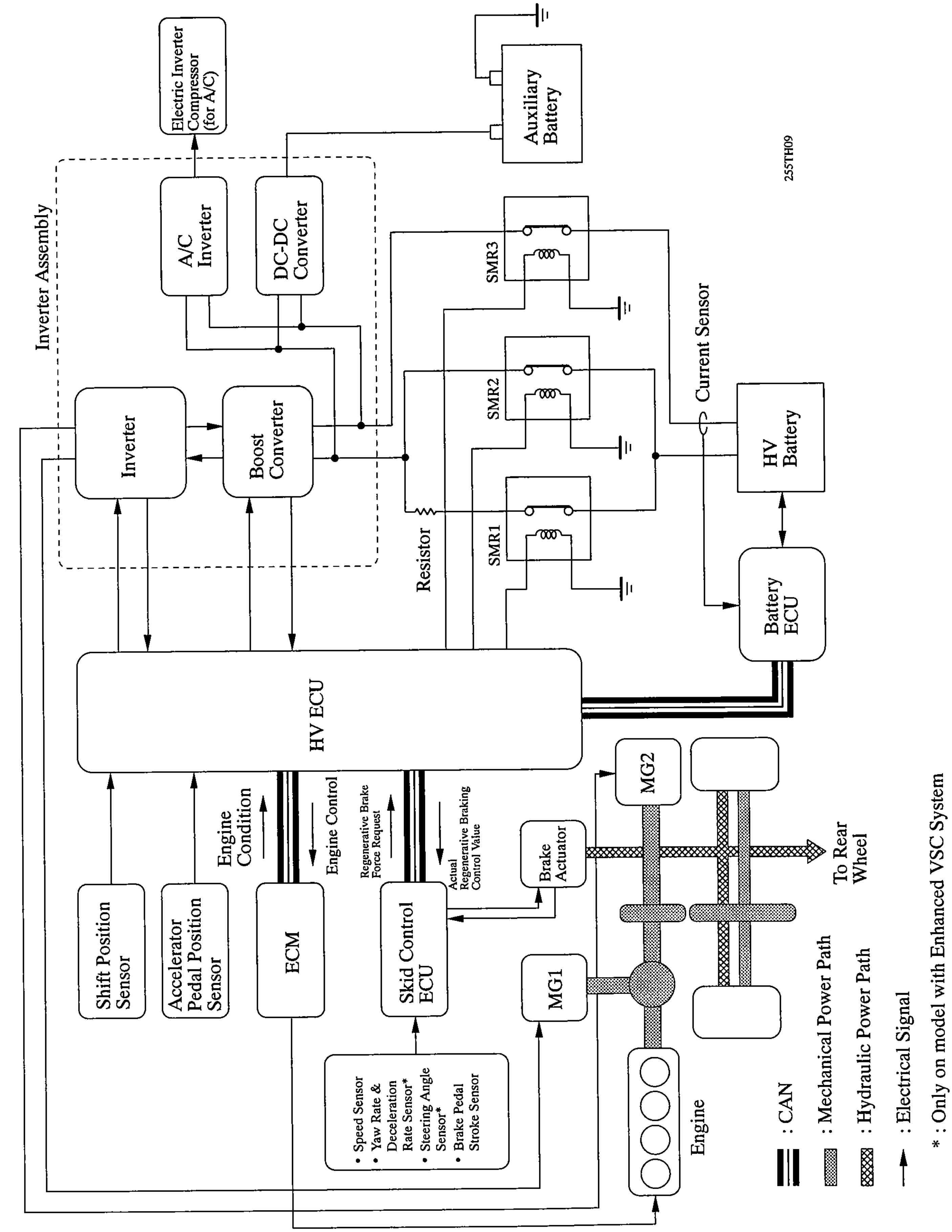
- As on the '03 Prius, the '04 Prius has adopted the shift-by-wire technology. This is a link-less type that does not use a shift cable. A shift position sensor is provided in the transmission shift assembly to detect the shift position and send a corresponding signal to the HV ECU. Upon receiving this signal, the HV ECU optimally combines the operation of the engine, MG1, and MG2, in order to produce the respective shift positions ("R", "N", "D", and "B").
  When the driver presses the Parking switch located on the top of the transmission shift assembly, the "P" position control actuates the shift control actuator located in the hybrid transaxle in order to mechanically lock the counter driven gear, which engages the parking lock. For details, refer to Shift Control Actuator in P112 Hybrid Transaxle on page CH-14.



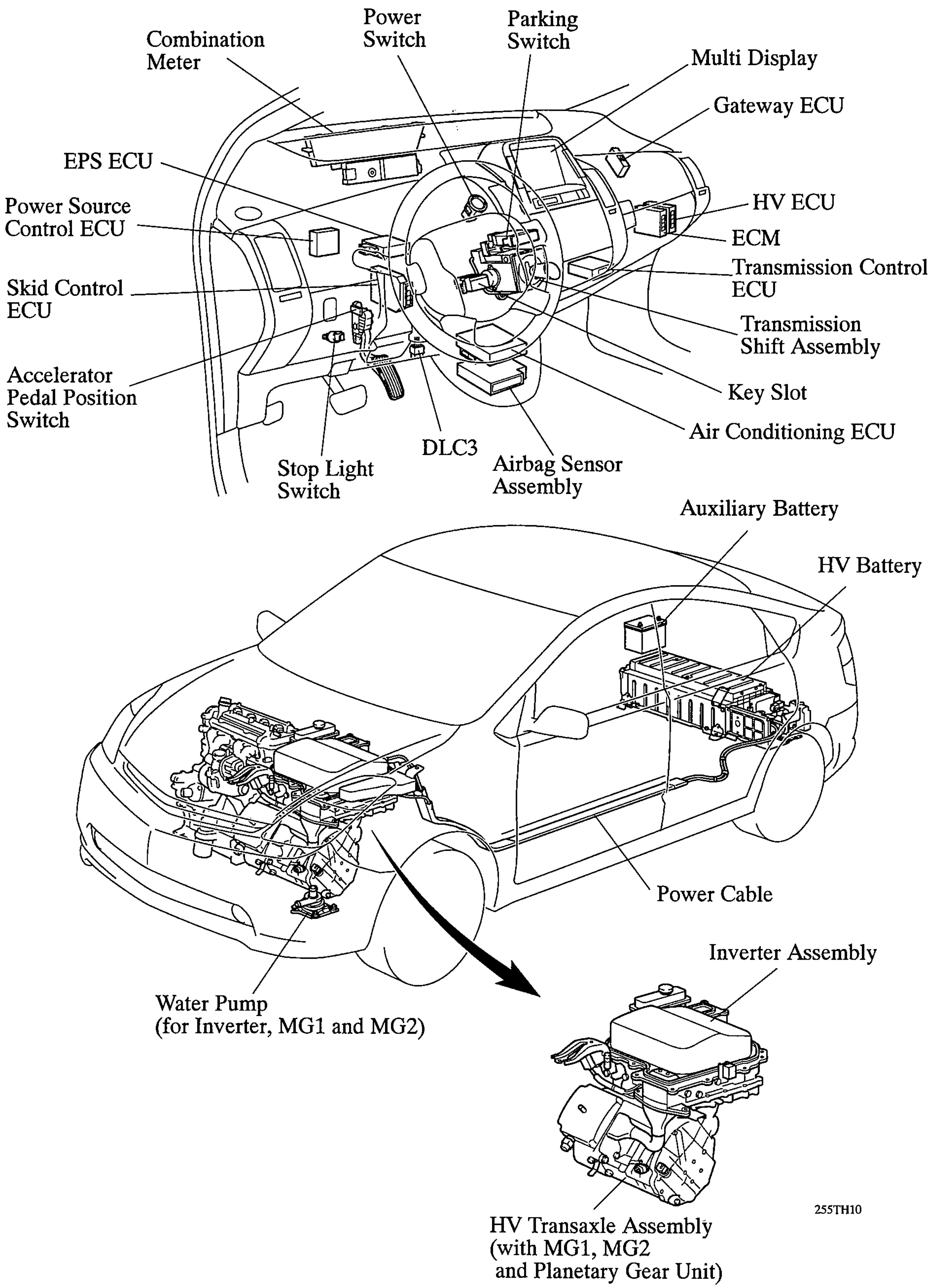
- As on the '03 Prius, the '04 Prius has adopted the ETCS-i (Electronic Throttle Control System-intelligent). This is a link-less system that does not use an accelerator cable. Instead, it uses an accelerator pedal position sensor and a throttle position sensor to detect the accelerator pedal position and the throttle position.
  The HV ECU calculates the target engine speed and required engine motive force in accordance with the signals provided by the accelerator pedal position sensor, vehicle driving conditions, and the SOC (state of charge) of the battery, and sends a control signal to the ECM. Based on the control signal, the ECM optimally controls the throttle valve.



■ SYSTEM DIAGRAM



■ LAYOUT OF MAIN COMPONENTS



■ FUNCTION OF MAIN COMPONENTS

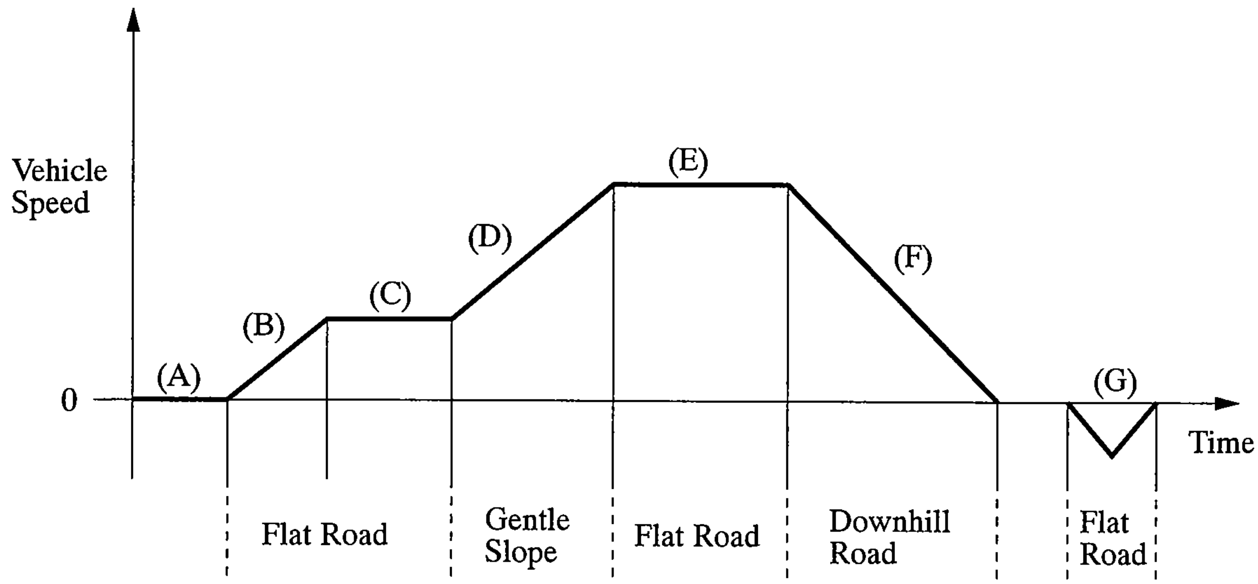
Item		Outline
Hybrid Transaxle	MG1	MG1, which is rotated by the engine, generates high-voltage electricity in order to operate MG2 or charge the HV battery. Also, it functions as a starter to start the engine.
	MG2	• Driven by electrical power from MG1 or HV battery, and generates motive force for the vehicle. • During braking, or when the accelerator pedal is not depressed, it generates electricity to recharge the HV battery (Regenerative brake control).
	Planetary Gear Unit	Distributes the engine's drive force as appropriate to directly drive the vehicle as well as the generator.
HV Battery		Supplies electric power to the MG2 during start-off, acceleration, and uphill driving recharged during braking or when the accelerator pedal is not depressed.
Inverter Assembly		A device that converts the high-voltage DC (HV battery) into AC (MG1 and MG2) and vice versa (Converts AC into DC).
	Boost Converter	Boosts the maximum voltage of the HV battery from DC 201.6 to DC 500V and vice versa (drops DC 500V to DC 201.6V).
	DC-DC Converter	Drops the maximum voltage of DC 201.6 V into DC12 V in order to supply electricity to body electrical components, as well as to recharge the auxiliary battery (DC 12 V).
	A/C Inverter	Converts the nominal voltage of DC 201.6 V of the HV battery to AC 201.6 V and supplies power to operate the electric inverter compressor of the A/C system.
HV ECU		Information from each sensor as well as from the ECU (ECM, Battery ECU, skid control ECU, and EPS ECU) is received, and based on this the required torque and output power is calculated. The HV ECU sends the calculated result to the ECM, inverter assembly, battery ECU and skid control ECU.
ECM		Activates the ETCS-i (Electronic Throttle Control System-intelligent) in accordance with the target engine speed and required engine motive force received from the HV ECU.
Battery ECU		Monitors the charging condition of the HV battery.
Skid Control ECU		Controls the regenerative brake that is effected by the MG2 and the hydraulic brake so that the total braking force equals that of a conventional vehicle that is equipped only with hydraulic brakes. Also, the skid control ECU performs the brake system control (ABS with EBD, Brake Assist, and Enhanced VSC*) conventionally.
Accelerator Pedal Position Sensor		Converts the accelerator angle into an electrical signal and outputs it to the HV ECU.
Shift Position Sensor		Converts the shift position into an electrical signal and outputs it to the HV ECU.
SMR (System Main Relay)		Connects and disconnects the high-voltage power circuit between battery and inverter assembly, through the use of a signal from the HV ECU.
Interlock Switch (for Inverter Cover and Service Plug)		Verifies that the cover of both the inverter and the service plug have been installed.
Circuit Breaker Sensor		The high-voltage circuit is intercepted if a vehicle collision has been detected.
Service Plug		Shuts off the high-voltage circuit of the HV battery when this plug is removed for vehicle inspection or maintenance.

* : Only on model with Enhanced VSC System

■ 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.

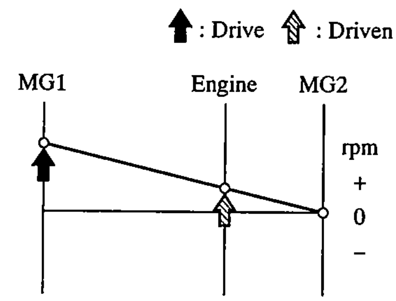
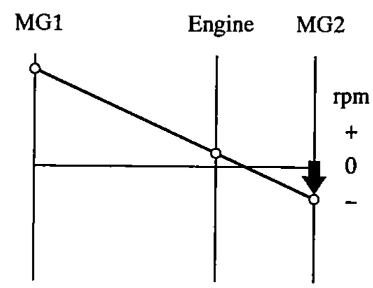
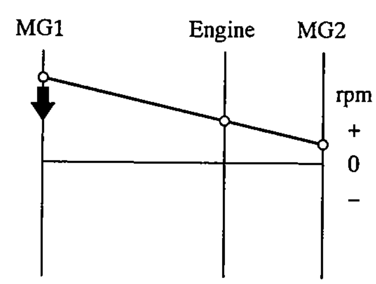


Driving Condition

255TH88

(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 relation ship 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.

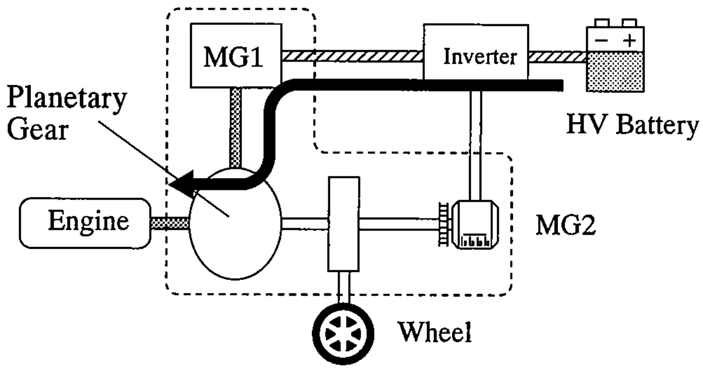
Condition	Rotation Direction	Torque Condition	Nomographic Chart Example
Discharging	Forward Revolution Plus Side	Plus Torque Upward Arrow	 255TH41
	Reverse Revolution Minus Side	Minus Torque Downward Arrow	 255TH42
Generating	Forward Revolution Plus Side	Minus Torque Downward Arrow	 255TH43

2. READY ON State / (A)

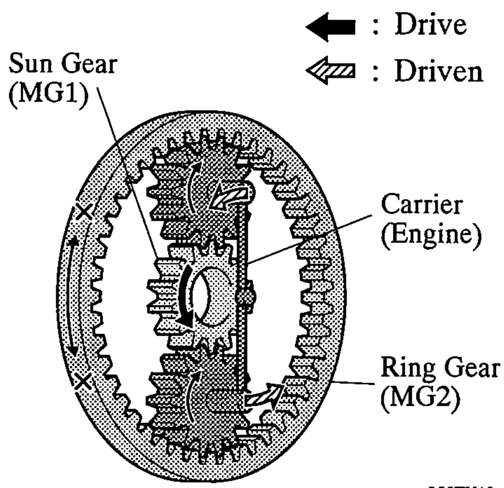
- On the '04 Prius, even if the driver presses on the POWER switch and the READY indicator turns ON, the engine will not start unless the proper engine coolant temperature, SOC conditions, battery temperature and electrical road conditions have been met. In this state, the engine, MG1, and MG2 are all 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".

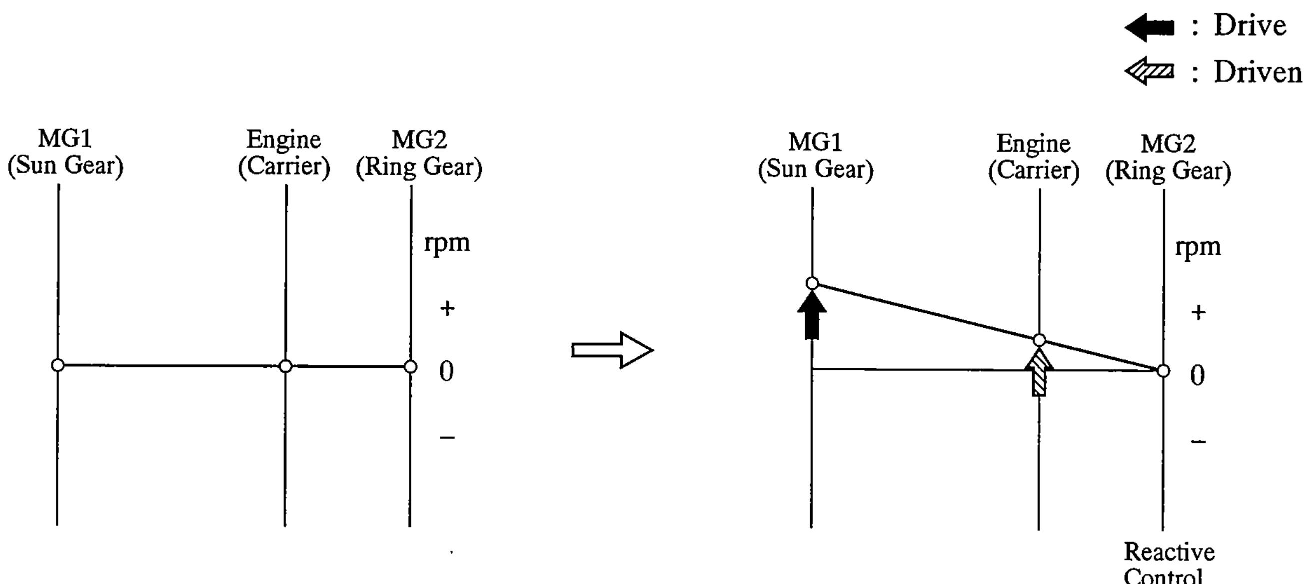


255TH11



255TH12

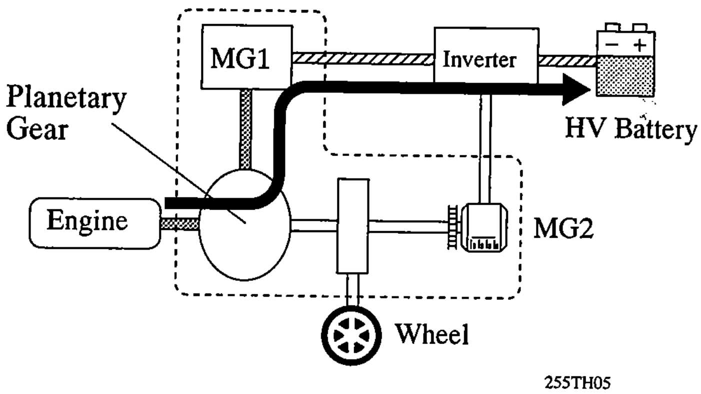
▶ Nomographic Chart of Planetary Gear Unit ◀

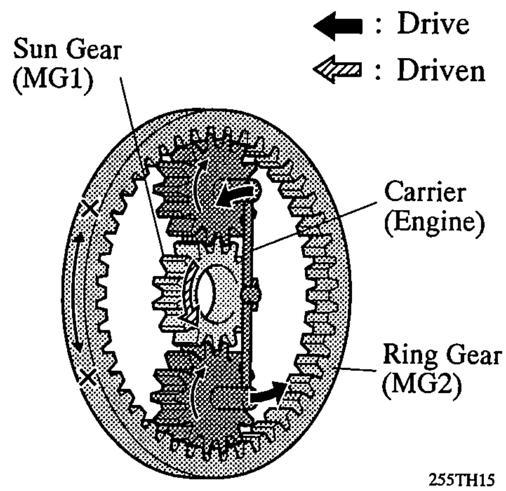


Engine Stopped **Start The Engine**

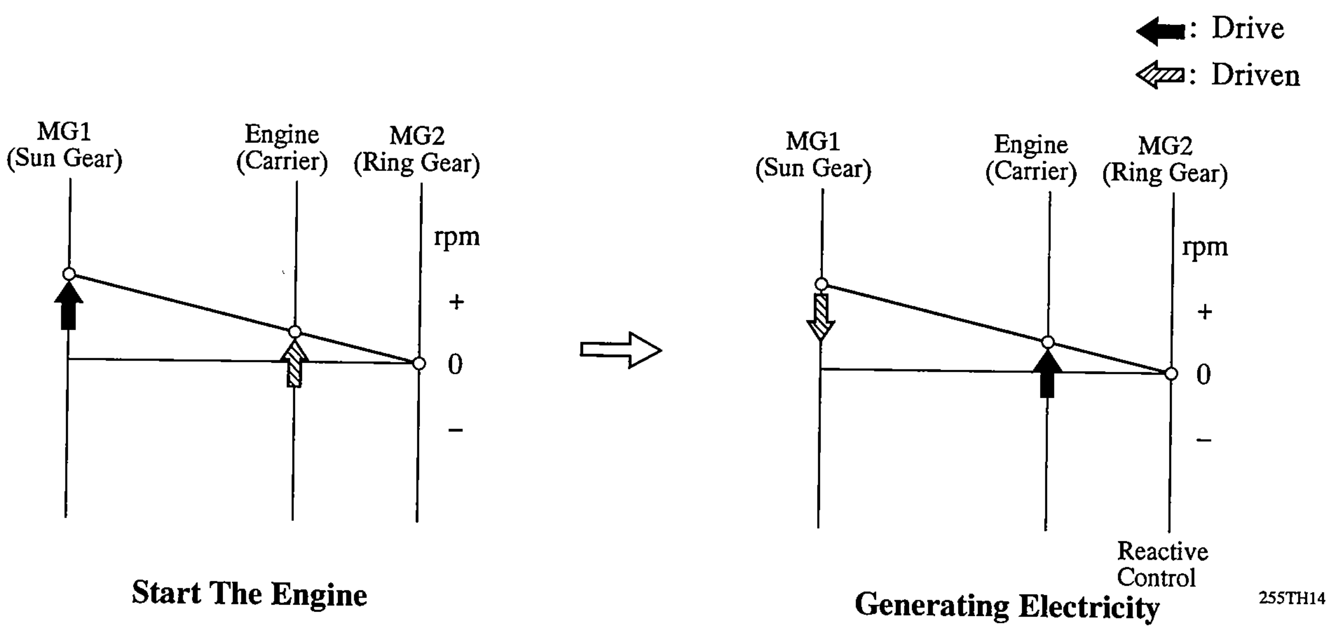
255TH13

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





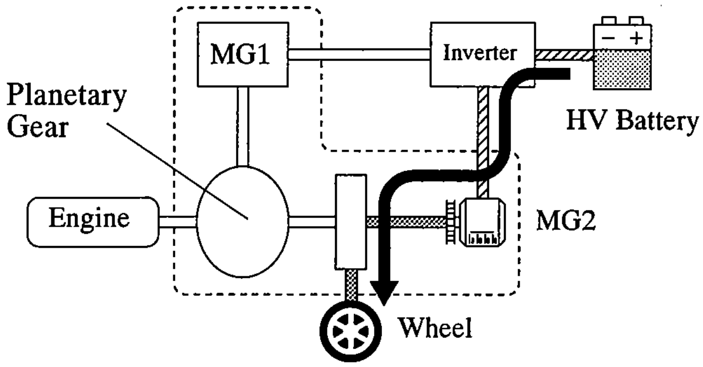
▶ Nomographic Chart of Planetary Gear Unit ◀



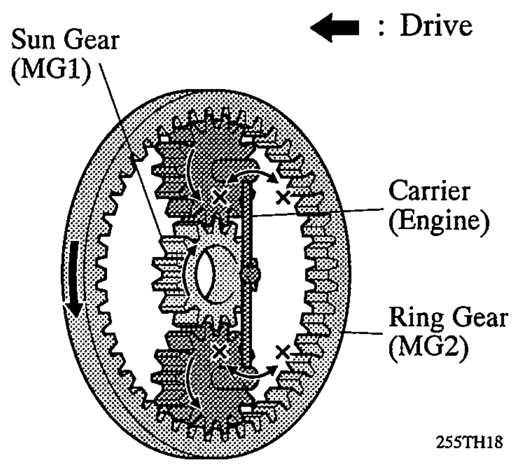
3. Starting / (B)

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.

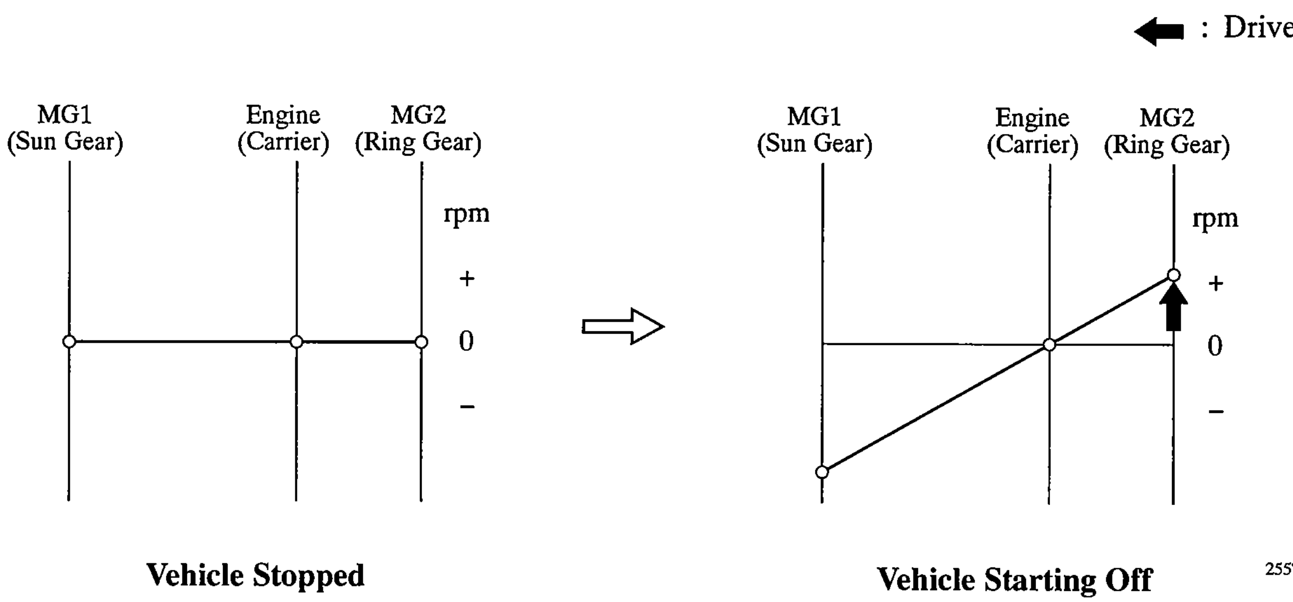


255TH17



255TH18

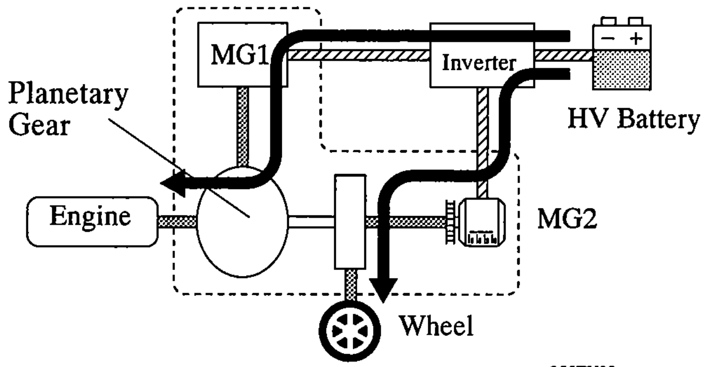
▶ Nomographic Chart of Planetary Gear Unit ◀



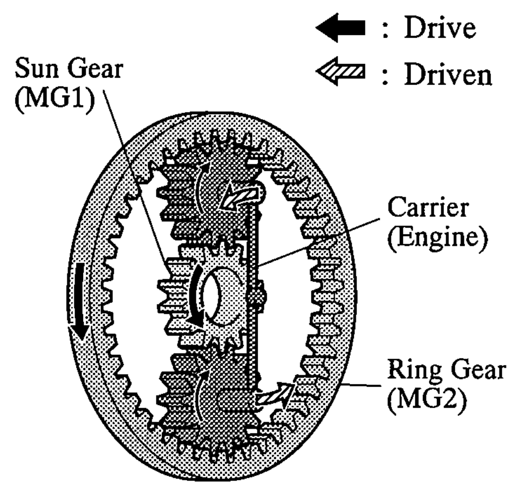
255TH16

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.

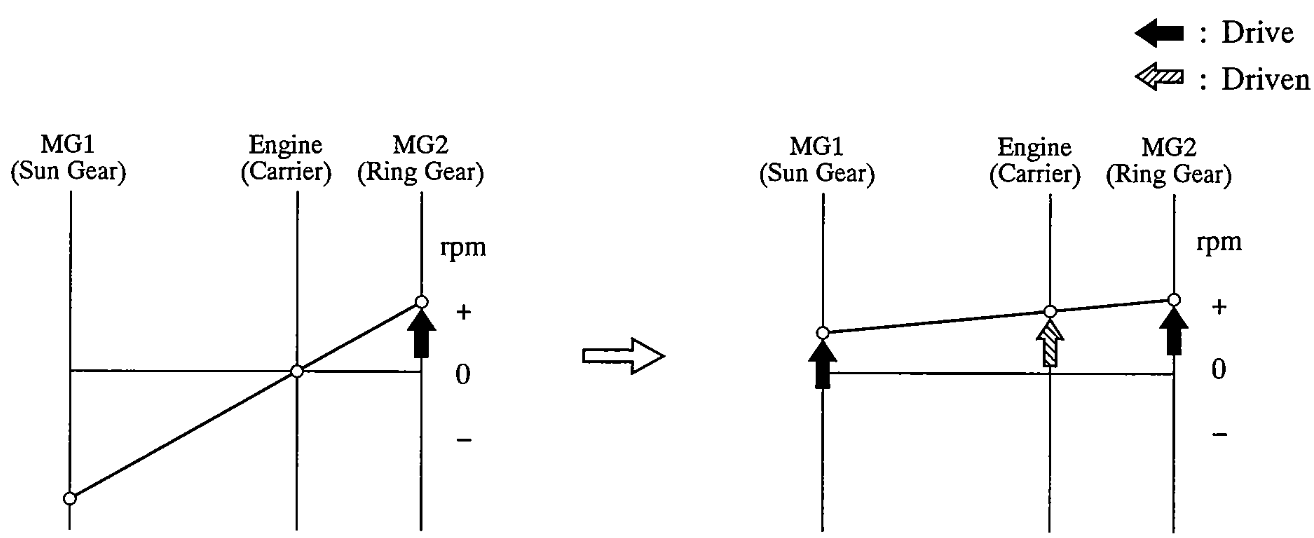


255TH20



255TH21

▶ Nomographic Chart of Planetary Gear Unit ◀

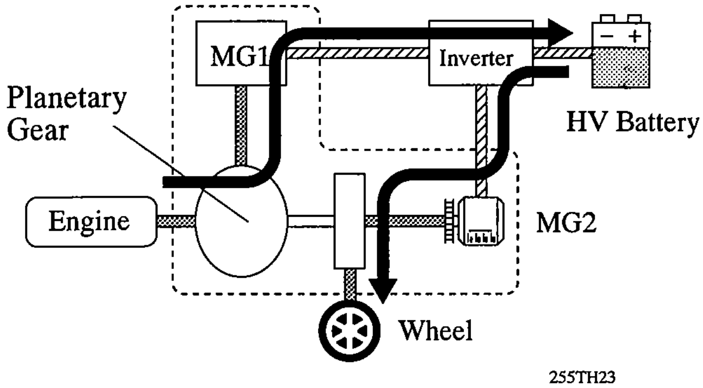


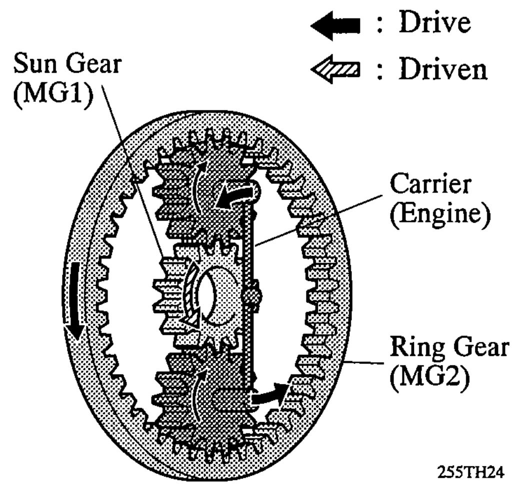
Vehicle Starting Off

Start The Engine

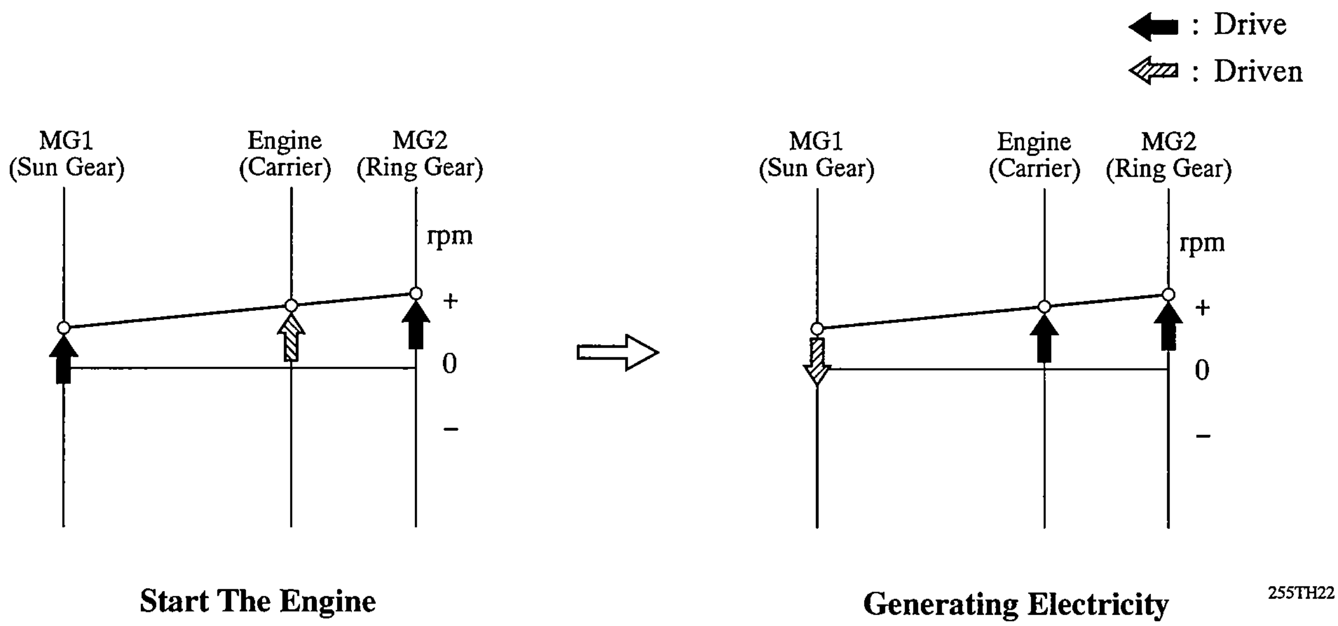
255TH19

- 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.



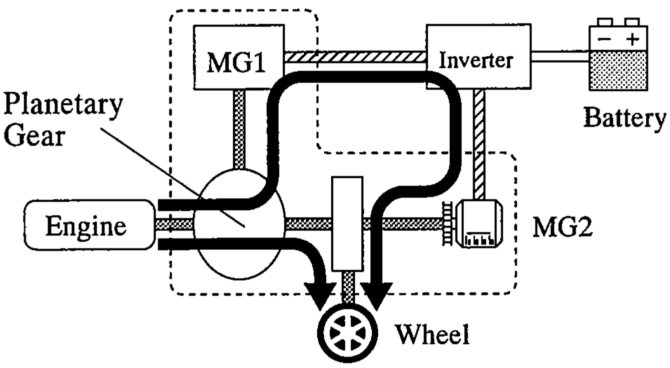


▶ Nomographic Chart of Planetary Gear Unit ◀

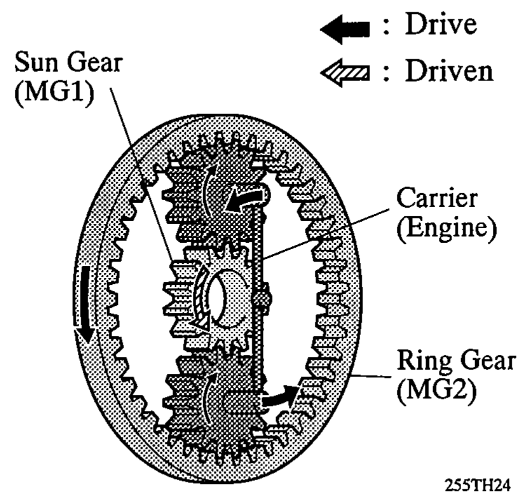


4. During Slight Acceleration with Engine / (C)

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.

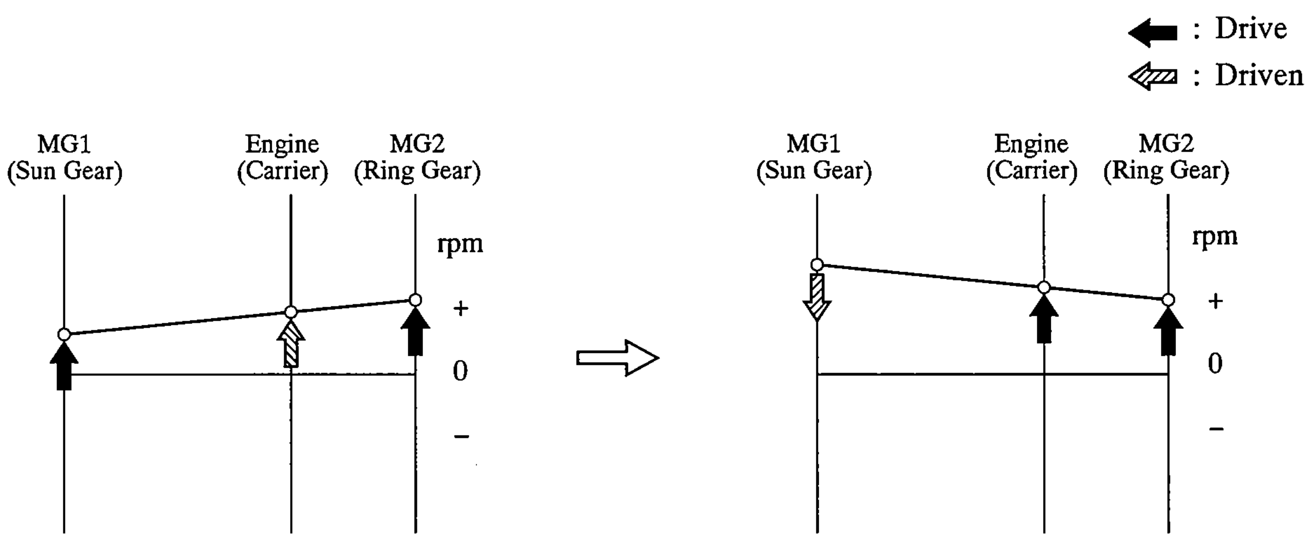


255TH04



255TH24

▶ Nomographic Chart of Planetary Gear Unit ◀



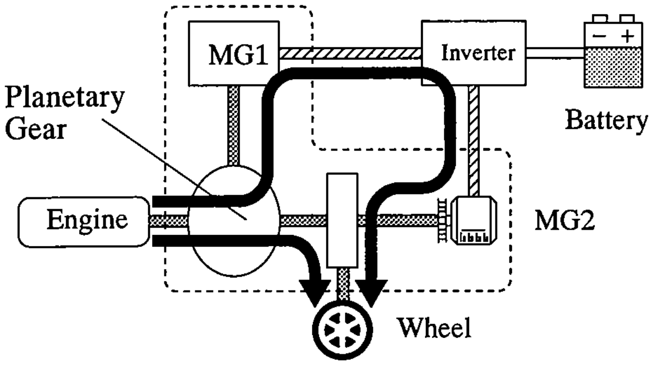
Engine Starts while Driving with MG2

Normal Driving with Engine

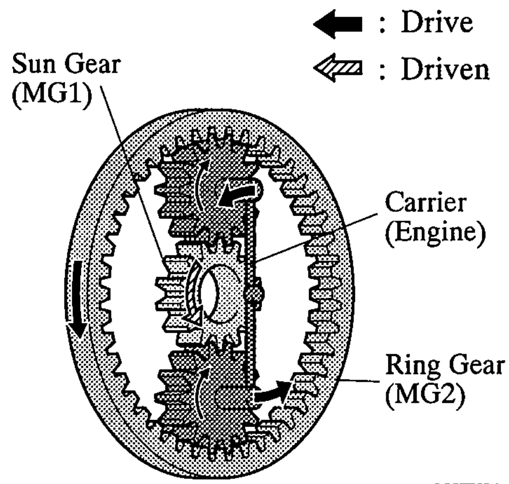
255TH25

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.

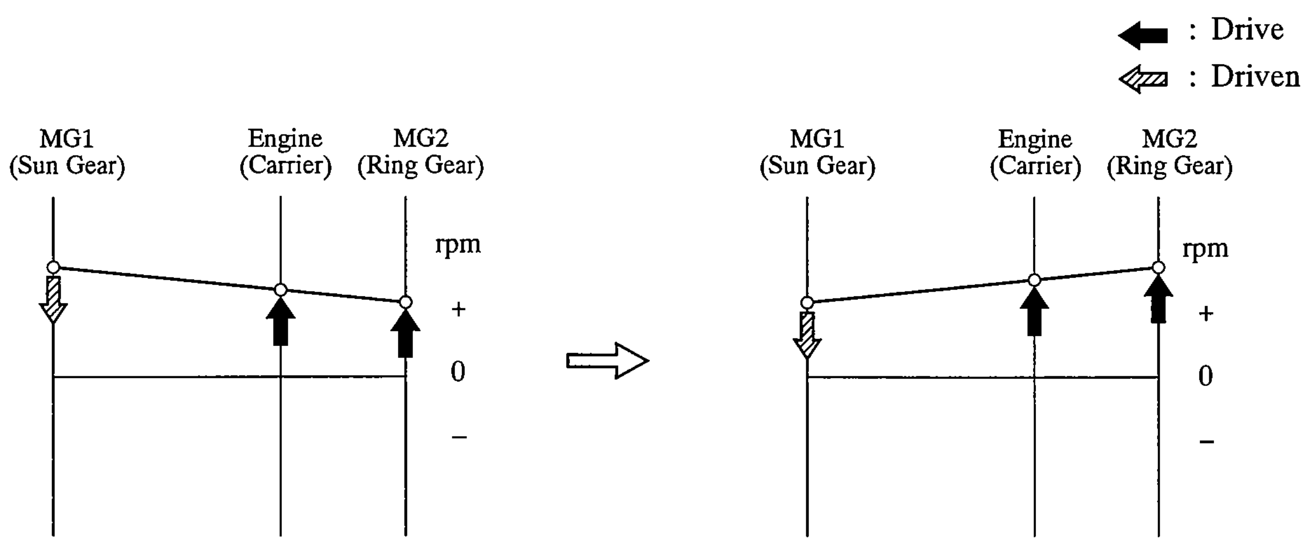


255TH04



255TH24

▶ Nomographic Chart of Planetary Gear Unit ◀

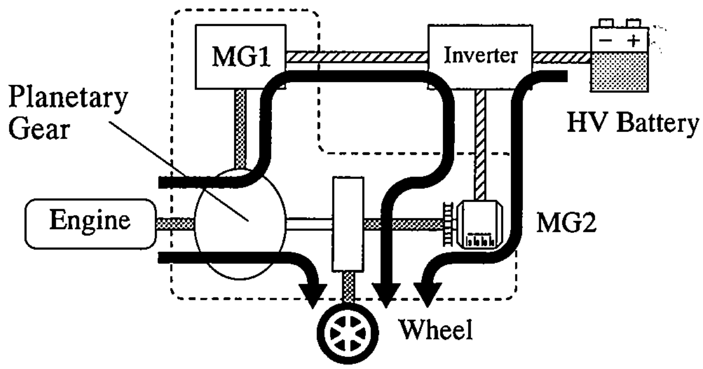


Normal Driving with Engine **Low Load Cruising**

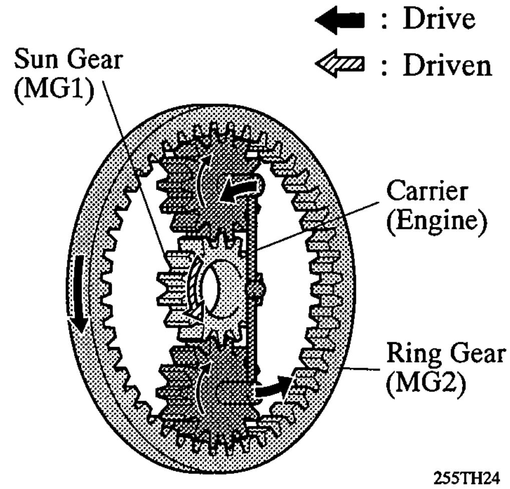
255TH26

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.

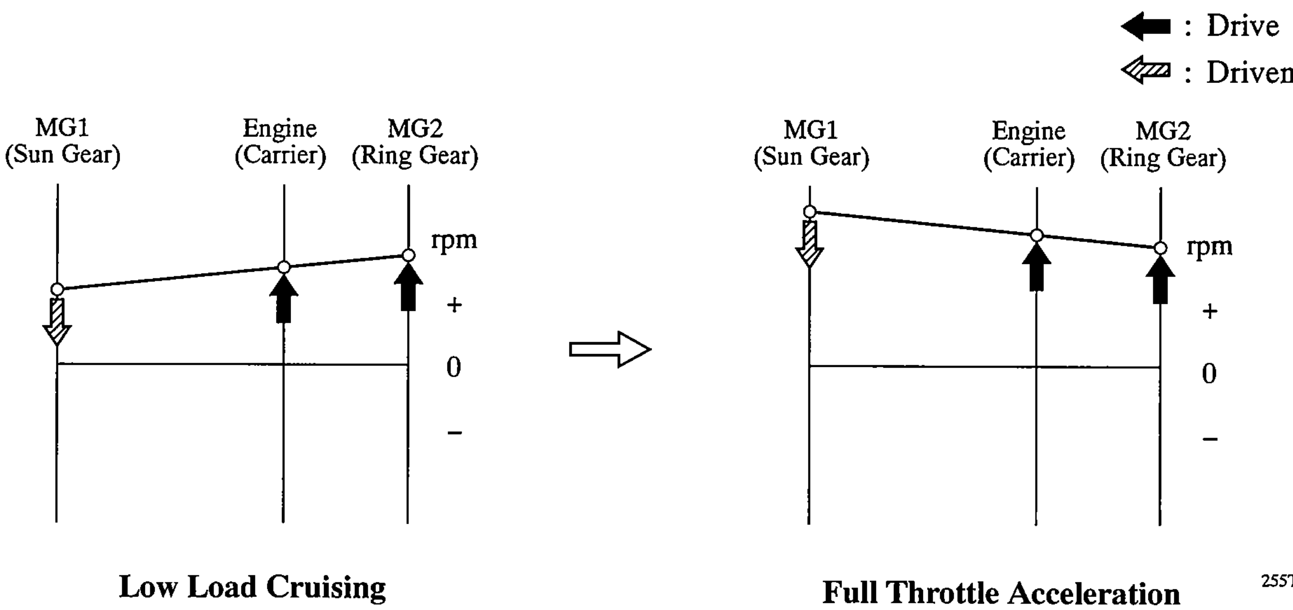


255TH28



255TH24

▶ Nomographic Chart of Planetary Gear Unit ◀

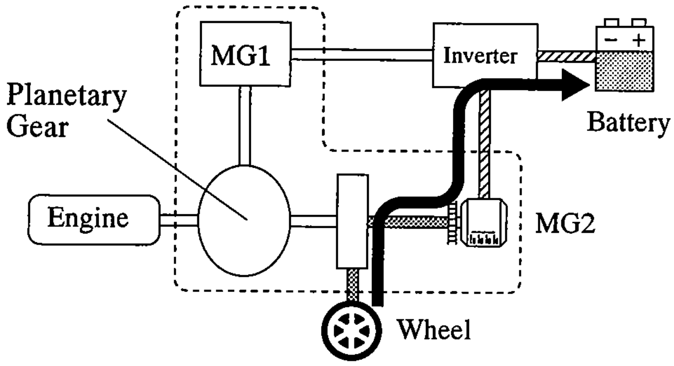


255TH27

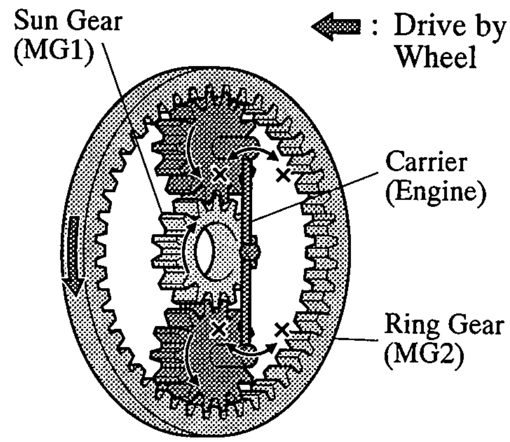
7. During Deceleration Driving / (F)

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.

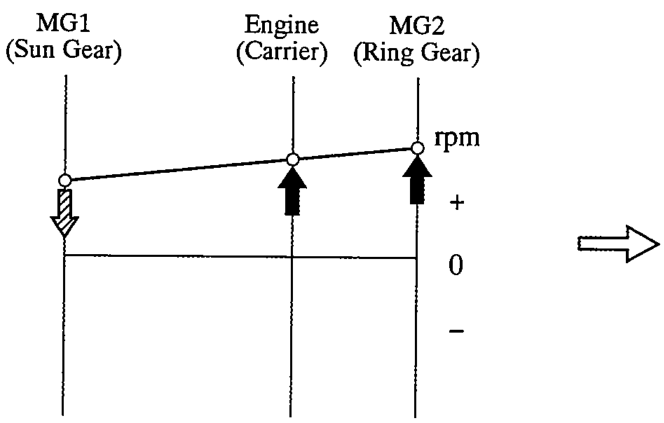


255TH06

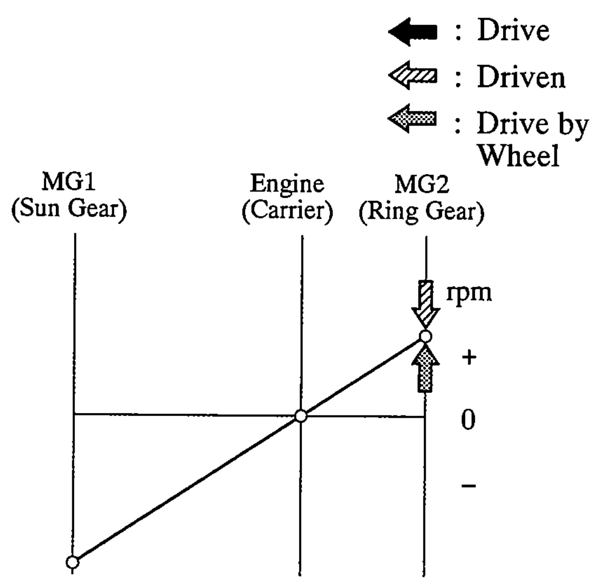


255TH30

▶ Nomographic Chart of Planetary Gear Unit ◀



Low Load Cruising

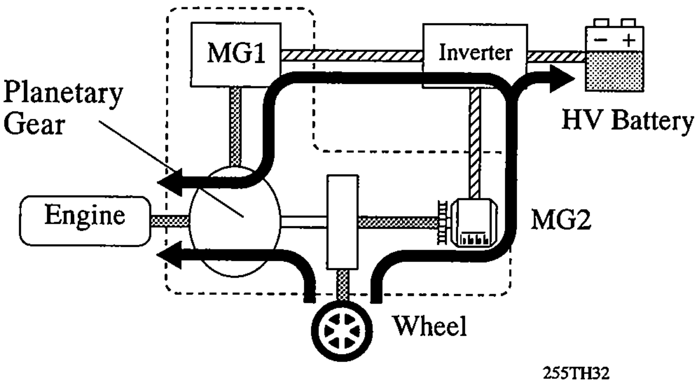


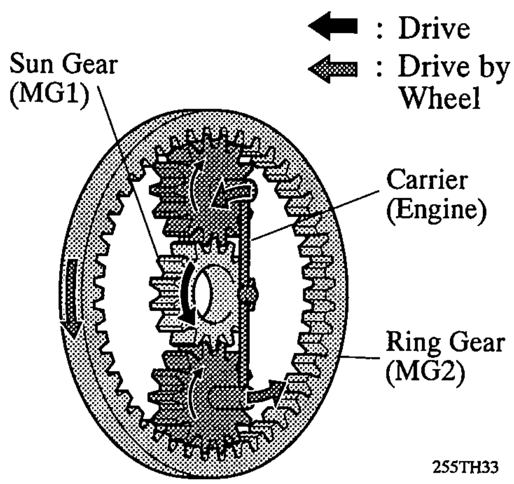
Deceleration Driving

255TH29

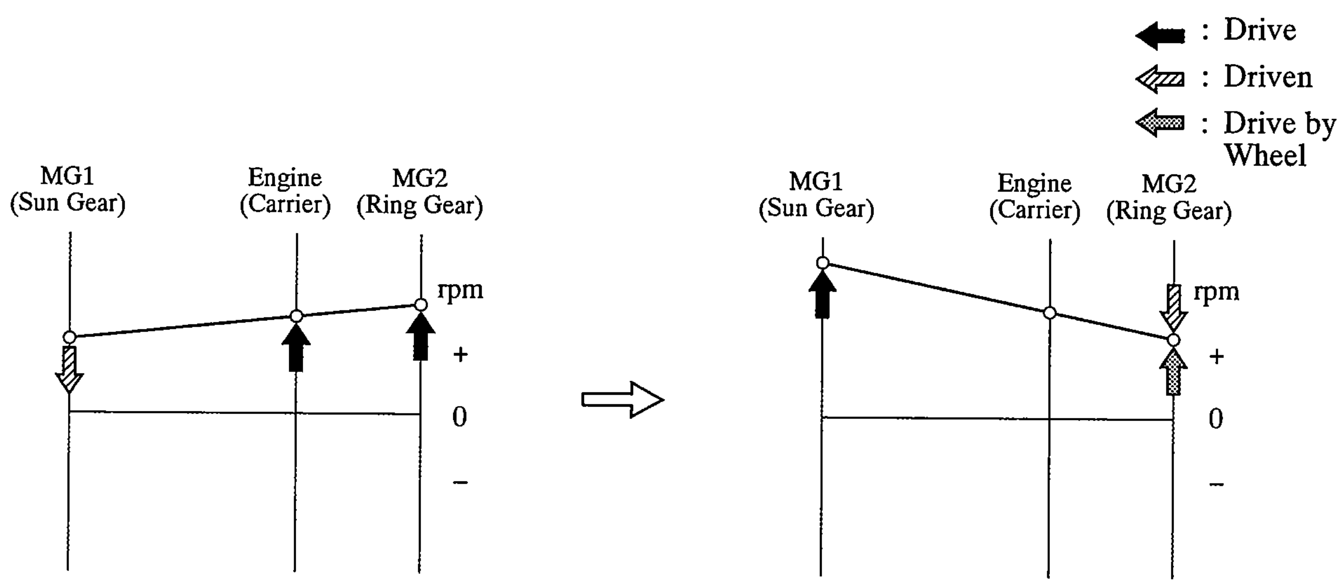
Deceleration in "B" Range

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 ◀



Low Load Cruising **Deceleration Driving**

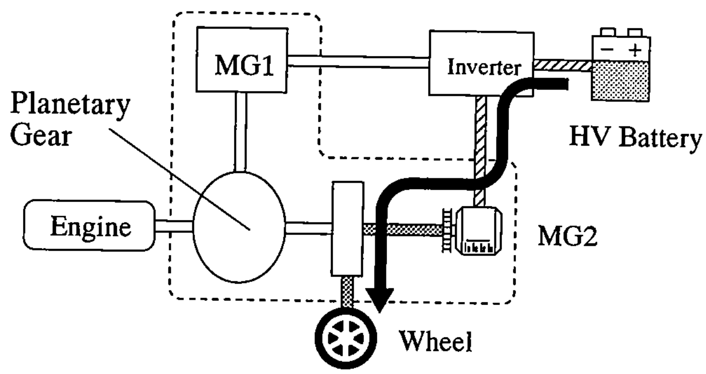
During Braking

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.

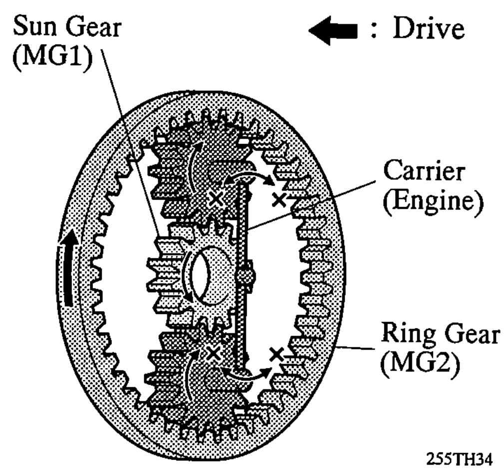
8. During Reverse Driving / (G)

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.

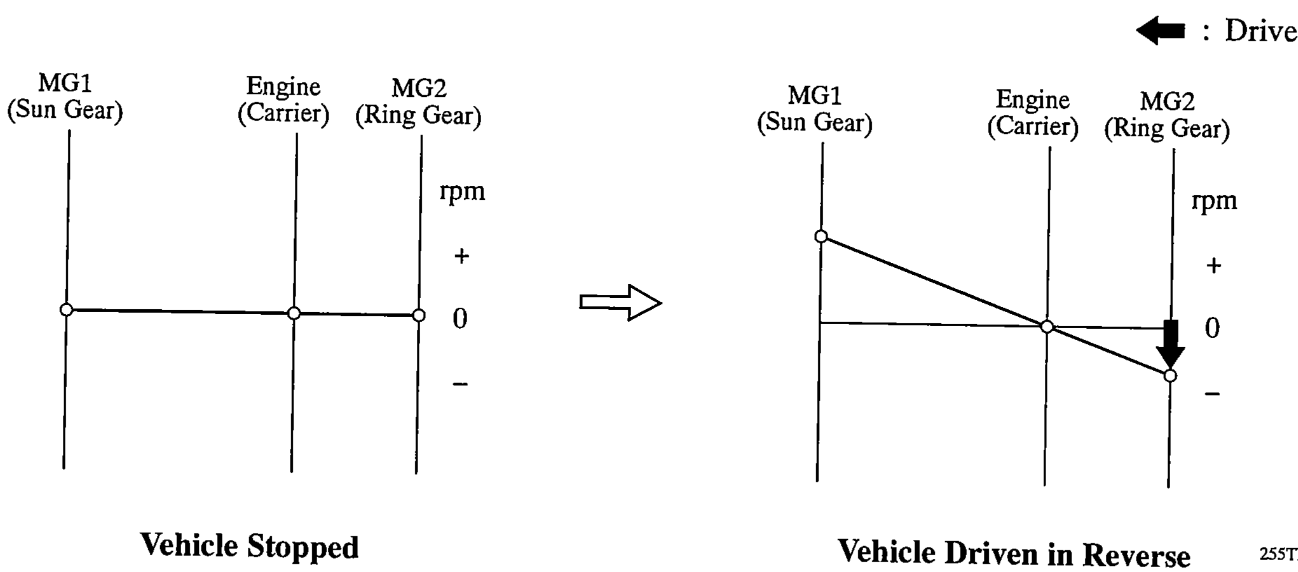


255TH17



255TH34

▶ Nomographic Chart of Planetary Gear Unit ◀



255TH35

■CONSTRUCTION OF MAIN COMPONENTS

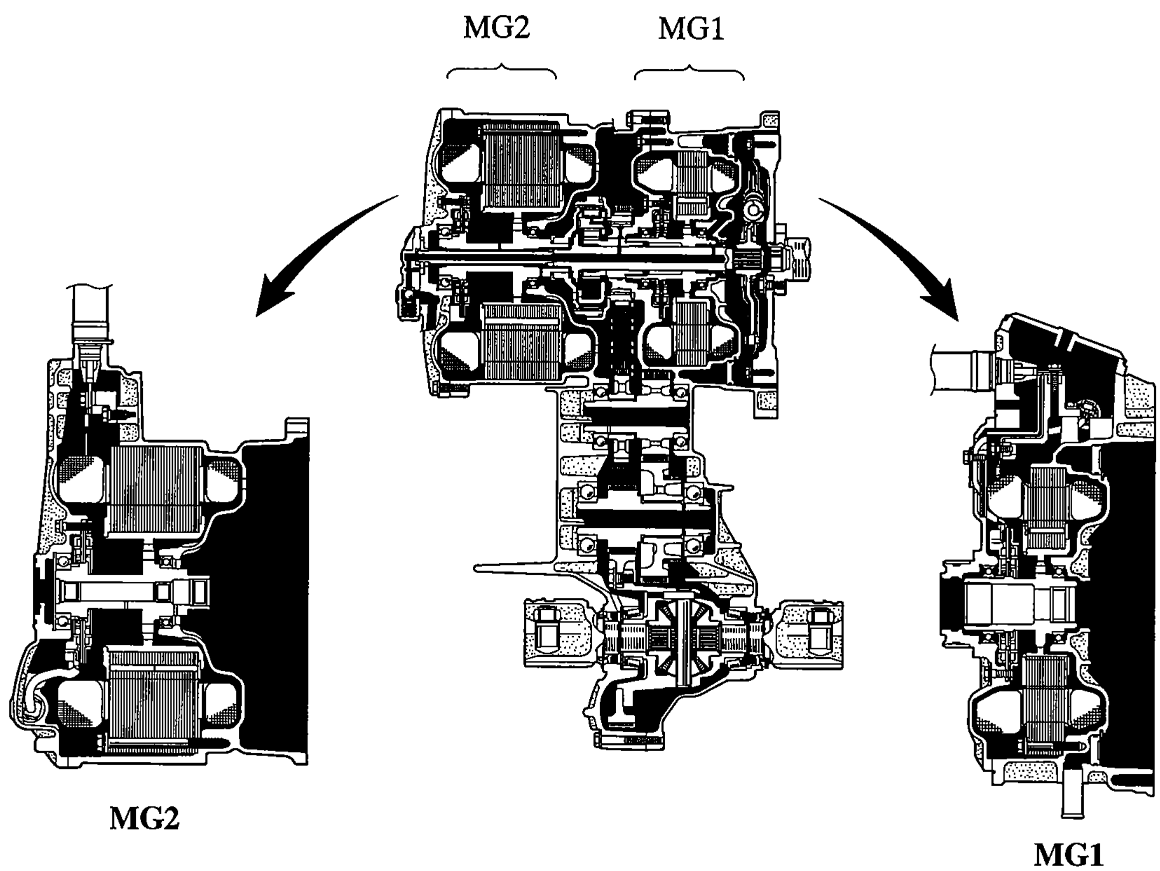
1. MG1 and MG2

General

- Both the MG1 (Motor Generator No. 1) and the MG2 (Motor Generator No. 2) are compact, lightweight, and highly efficient alternating current permanent magnet synchronous type.
- Serving as the source of supplemental motive force that provides power assistance to the engine as needed, the electric motor helps the vehicle achieve excellent dynamic performance, including smooth start-offs and acceleration. When the regenerative brake is activated, MG2 converts the vehicle's kinetic energy into electrical energy, which is then stored in the HV battery.
- MG1 recharges the HV battery and supplies electrical power to drive MG2. In addition, by regulating the amount of electrical power generated (thus varying the generator's rpm), MG1 effectively controls the continuously variable transmission function of the transaxle. MG1 also serves as the starter to start the engine.
- A cooling system via water pump for the MG1 and MG2 has been added. For details, refer to cooling system (for Inverter, MG1 and MG2) on page TH-34.

— Main Changes from '03 Prius —

- Accompanied by enhancing the rotor robustness of MG1, its rpm range for the maximum possible output has been increased from 6,500 to 10,000 rpm, therefore the charging capability has been enhanced.
- Structure of each built-in permanent magnet inside the rotor of MG2 has been optimized by redesigning it to V shaped structure, and improvement of its power output and torque has been realized.
- For MG2 control, a newly developed over-modulation control system has been adopted to the medium-speed range.



255TH49

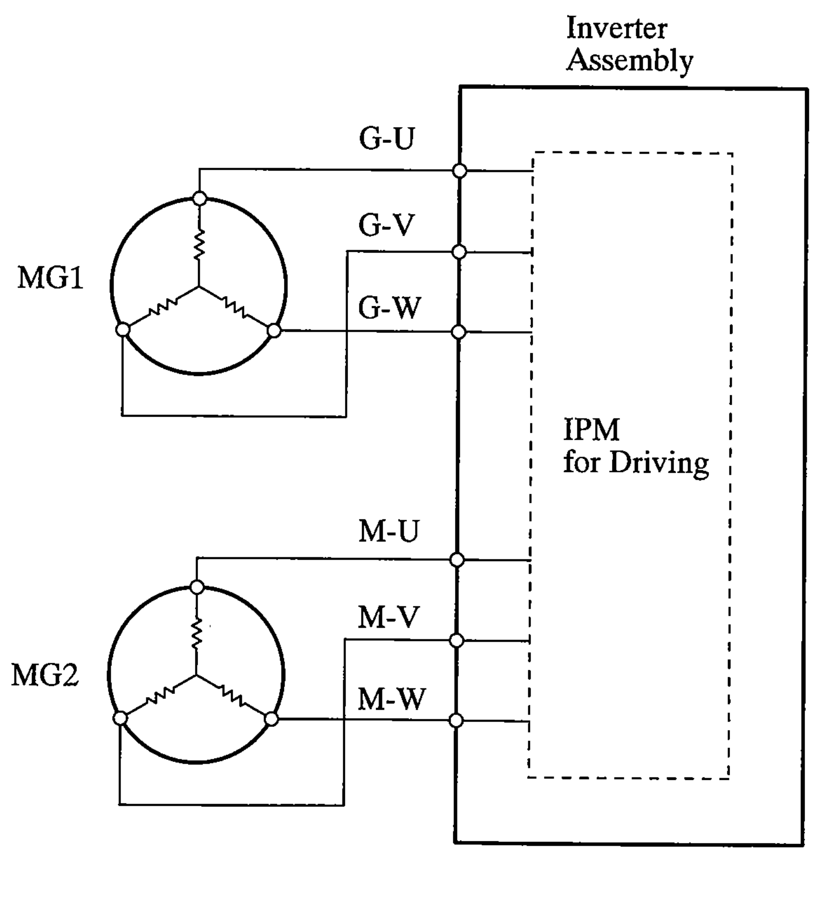
▶ MG1 Specifications ◀

Item		'04 Model	'03 Model
Type		Permanent Magnet Motor	←
Function		Generate, Engine Starter	←
Maximum Voltage	[V]	AC 500	AC 273.6
Cooling system		Water-cooled	←

▶ MG2 Specifications ◀

Item		'04 Model	'03 Model
Type		Permanent Magnet Motor	←
Function		Generate, Drive Wheels	←
Maximum Voltage	[V]	AC 500	AC 273.6
Maximum Output	kW (PS) / rpm	50 (68) / 1,200 ~ 1,540	33 (45) / 1,040 ~ 5,600
Maximum Torque	N·m (kgf·m) / rpm	400 (40.8) / 0 ~ 1,200	350 (35.7) / 0 ~ 400
Cooling system		Water-cooled	←

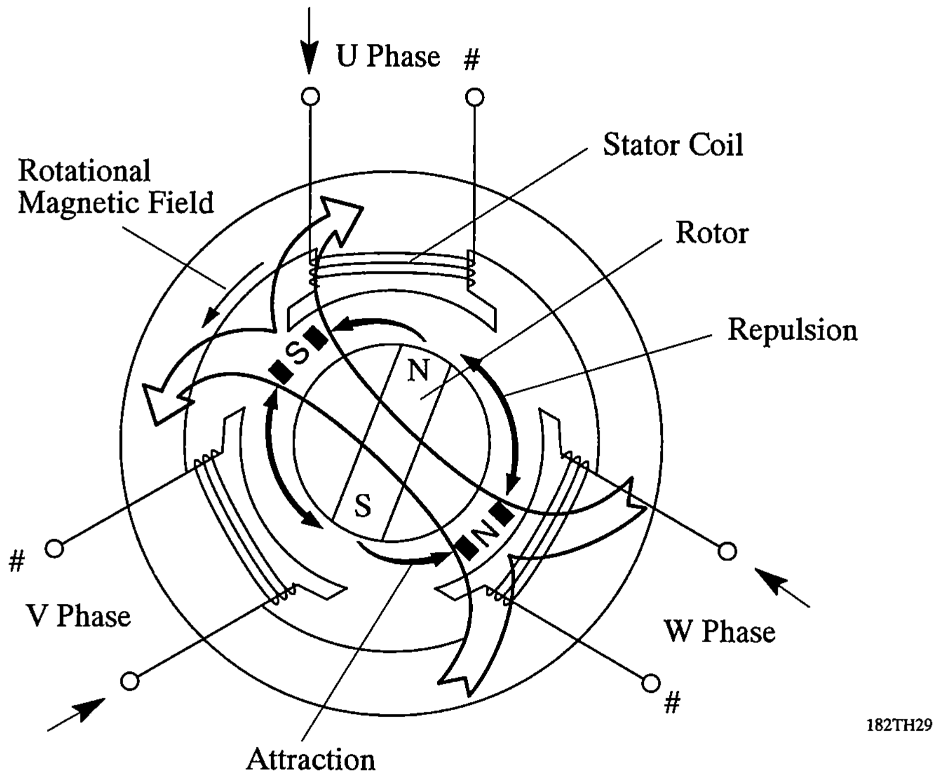
▶ System Diagram ◀



TH

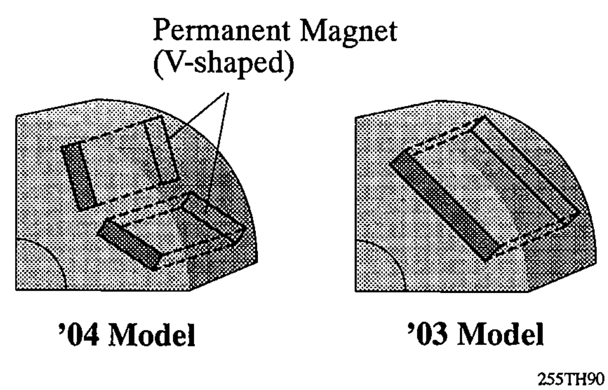
Permanent Magnet Motor

- When a three-phase alternating current is passed through the three-phase windings of the stator coil, a rotational magnetic field is created in the electric motor. By controlling this rotating magnetic field according to the rotor's rotational position and speed, the permanent magnets that are provided in the rotor become attracted by the rotating magnetic field, thus generating torque.
  The generated torque is for all practical purposes proportionate to the amount of current, and the rotational speed is controlled by the frequency of the alternating current.
  Furthermore, a high level of torque, all the way to high speeds, can be generated efficiently by properly controlling the rotating magnetic field and the angles of the rotor magnets.

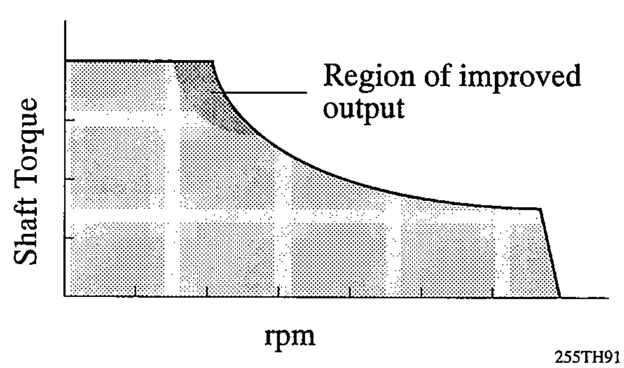


→ : From inverter
\# : Connected internally in the motor

- On '04 Prius, structure of each built-in permanent magnet inside the rotor of MG2 has been optimized by redesigning it to V-shaped structure to improve both power output and torque of the rotor. By power output, it has been improved by approximately 50 % more power as the one of '03 Prius.

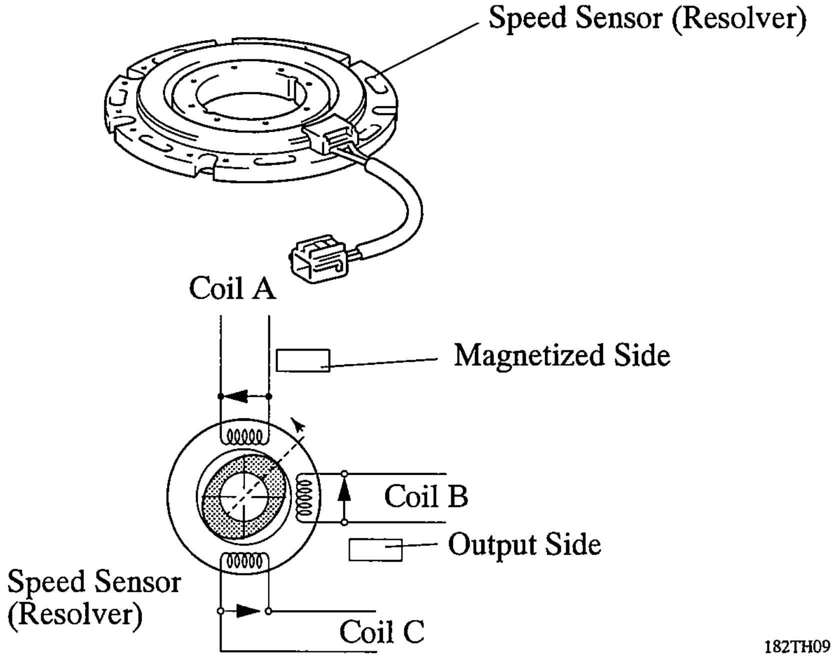


- For MG2 control, a newly developed over-modulation control system has been adopted to the medium-speed range, in addition to the existing low- and high-speed control methods. By improving the pulse width modification method, the output in the medium-speed range has been increased by a maximum of approximately 30 %.



Speed Sensor / Resolver

This is an extremely reliable and compact sensor that precisely detects the magnetic pole position, which is indispensable for ensuring the efficient control of MG1 and MG2.
The sensor's stator contains 3 coils as illustrated, and output coils B and C are electrically staggered 90 degrees. Because the rotor is oval, the distance of the gap between the stator and the rotor varies with the rotation of the rotor. Thus, by passing an alternating current through coil A, output that corresponds to the sensor rotor's position is generated by coil B and C. The absolute position can then be detected from the difference between these outputs.
In addition, the amount of positional variance within a predetermined time is calculated by the HV ECU, thus enabling this sensor to be used as an rpm sensor.



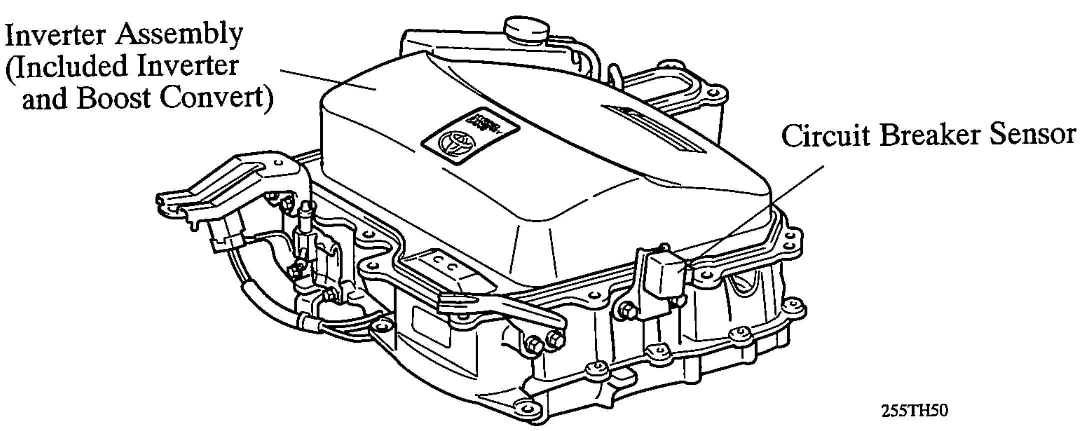
2. Inverter Assembly

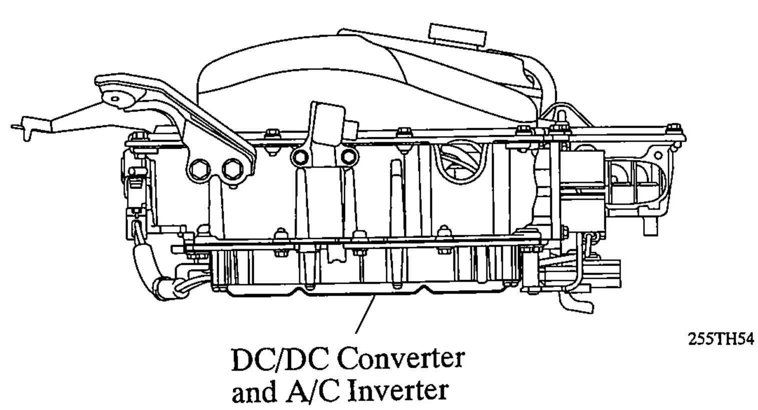
General

- The inverter converts the high-voltage direct current of the HV battery into three-phase alternating current for driving MG1 and MG2.
- The activation of the power transistors is controlled by the HV ECU. In addition, the inverter transmits information that is needed for current control, such as the output amperage or voltage, to the HV ECU.
- Together with MG1 and MG2, the inverter is cooled by the dedicated radiator of the coolant system that is separate from that of the engine.
- In the event of a collision involving the vehicle, the circuit breaker sensor, which is installed in the inverter, detects a collision signal in order to stop the system. For details, refer to During Collision Control on page TH-56.

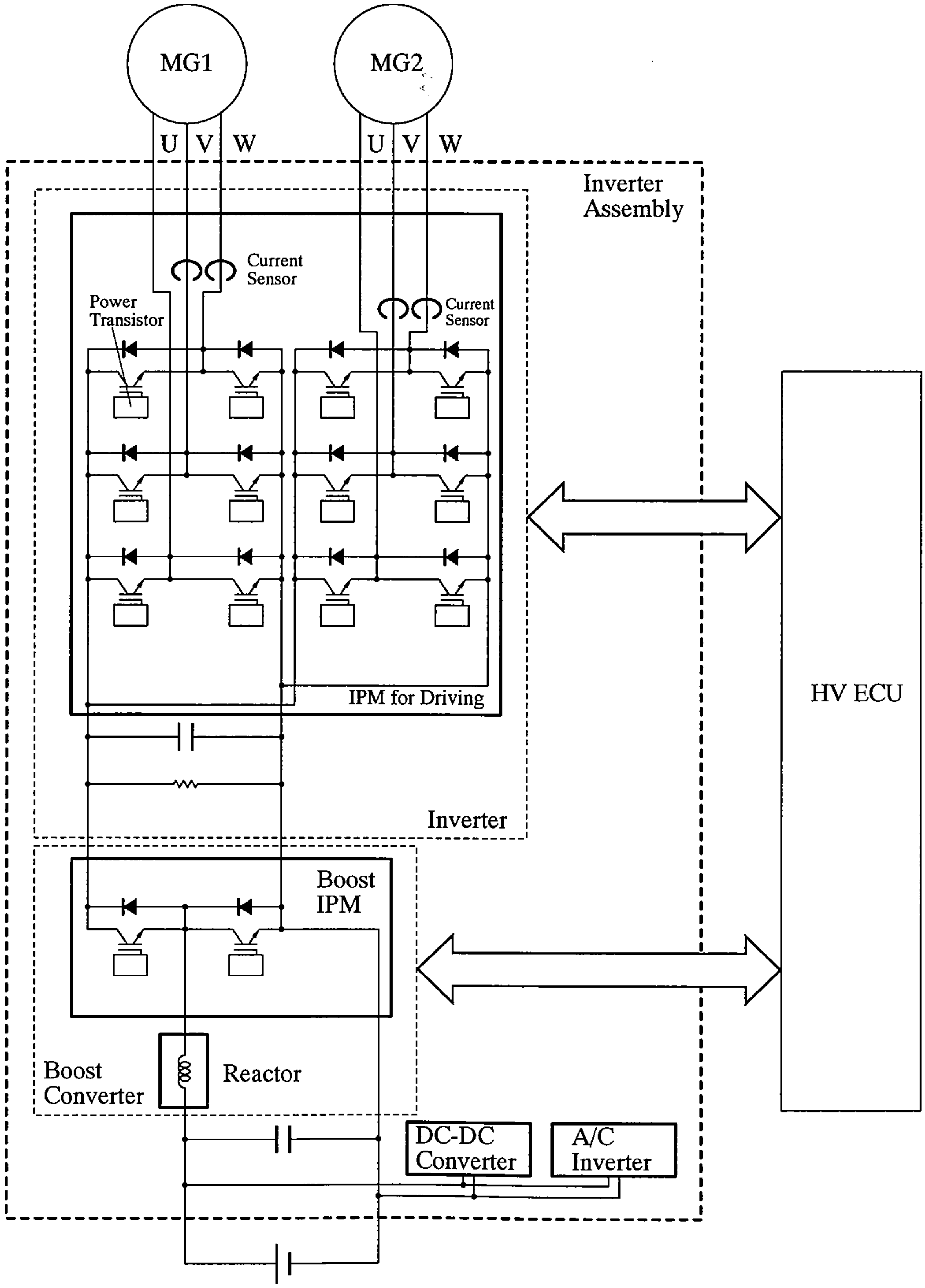
— Main Changes from '03 Prius —

- A boost converter has been adopted in the inverter assembly, in order to boost the nominal voltage output by the HV battery from DC 201.6 V to maximum voltage of DC 500 V. After the voltage is boosted, the inverter converts the direct current into an alternating current.
- The bridge circuits for MG1 and MG2 (each consisting of 6 power transistors), and the signal processor/protective function processor have been integrated into a compact IPM (Intelligent Power Module) for driving the vehicle.
- An A/C inverter that supplies power to drive an electric inverter compressor for the A/C system has been included in the inverter assembly.
- A radiator that integrates an inverter radiator and engine radiator has been adopted to optimize the space it occupies.





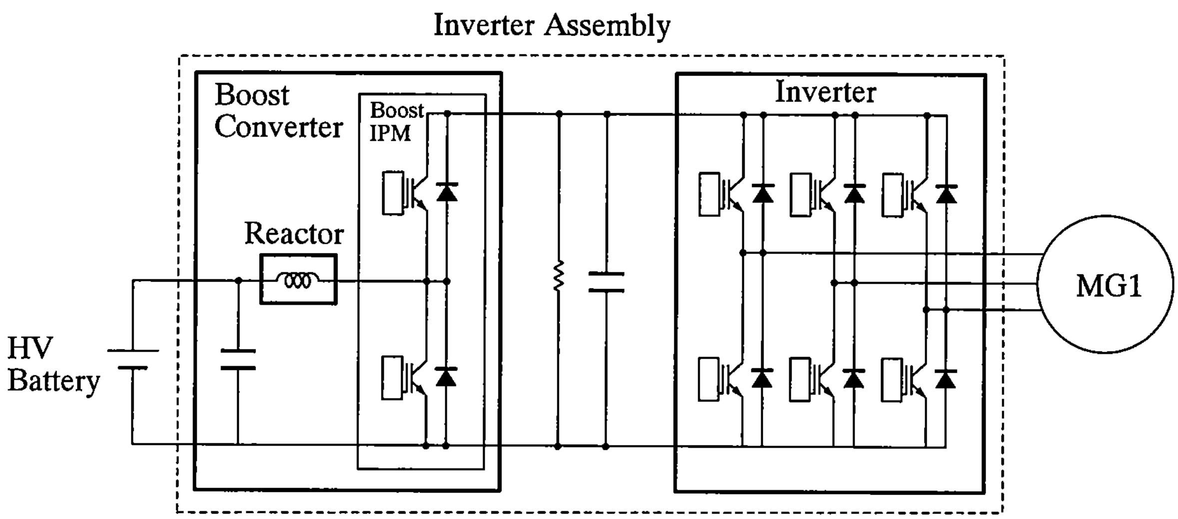
▶ **System Diagram** ◀



Boost Converter

- This boost converter boosts the nominal voltage of DC 201.6 V that is output by the HV battery to the maximum voltage of DC 500 V. The converter consists of the boost IPM (Integrated Power Module) with a built-in IGBT (Insulated Gate Bipolar Transistor) which performs the switching control, and the reactor which stores energy. By using these components, the converter boosts the voltage.
- When MG1 or MG2 acts as the generator, the inverter converts the alternating current (range of 201.6 to 500 V) generated by either of them into the direct current, and then the boost converter drops it to DC 201.6 V, thus the HV battery is charged.

▶ System Diagram ◀

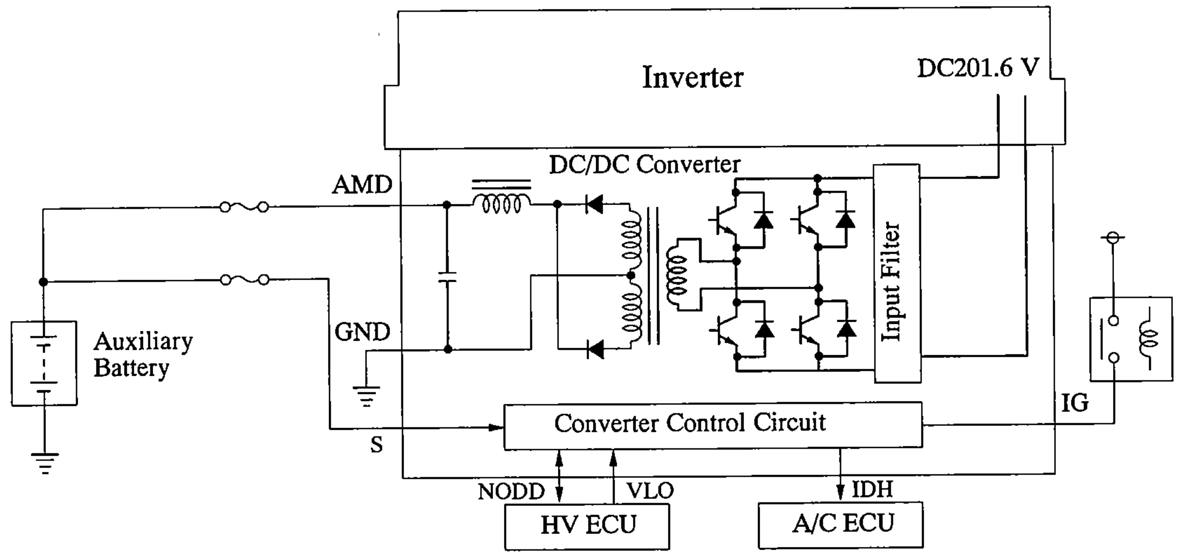


255TH52

DC/DC Converter

The power source for auxiliary equipment of the vehicle such as the lights, audio system, and the air conditioning system (except A/C compressor), as well as the ECUs, is based on a DC 12 V system. Because the THS-II generator outputs at nominal voltage of DC 201.6 V, the converter is used to transform the voltage from DC 201.6 V to DC 12 V in order to recharge the auxiliary battery. The converter is installed on the underside of the inverter.

▶ System Diagram ◀

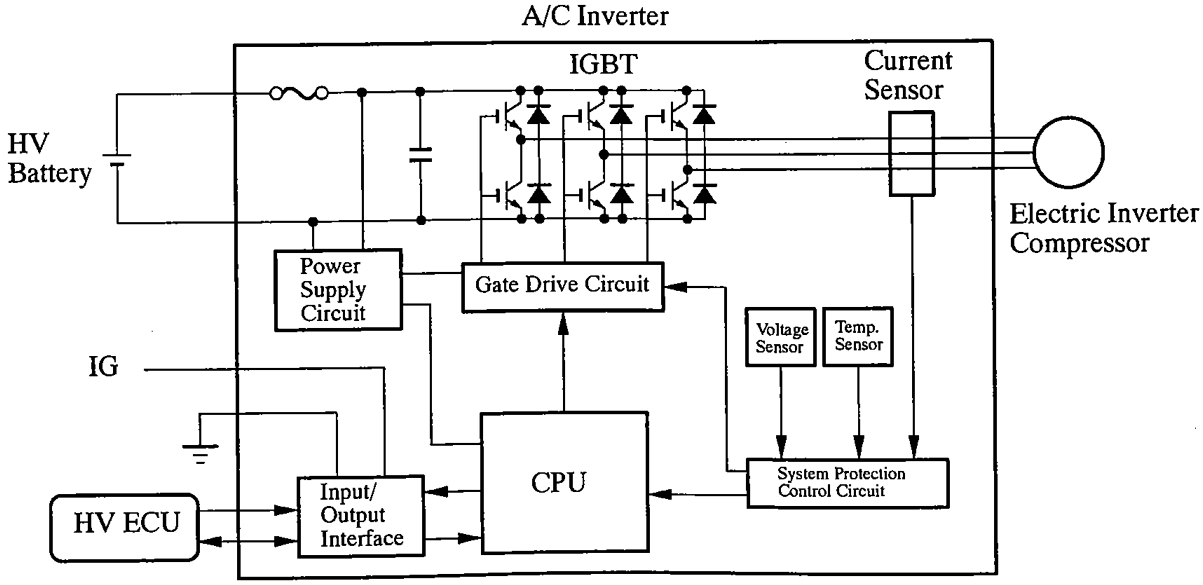


255TH92

A/C Inverter

An A/C inverter, which supplies power for driving the electric inverter compressor of the A/C system, has been included in the inverter assembly.
This inverter converts the HV battery's nominal voltage of DC 201.6 V into AC 201.6 V and supplies power to operate the compressor of the A/C system.

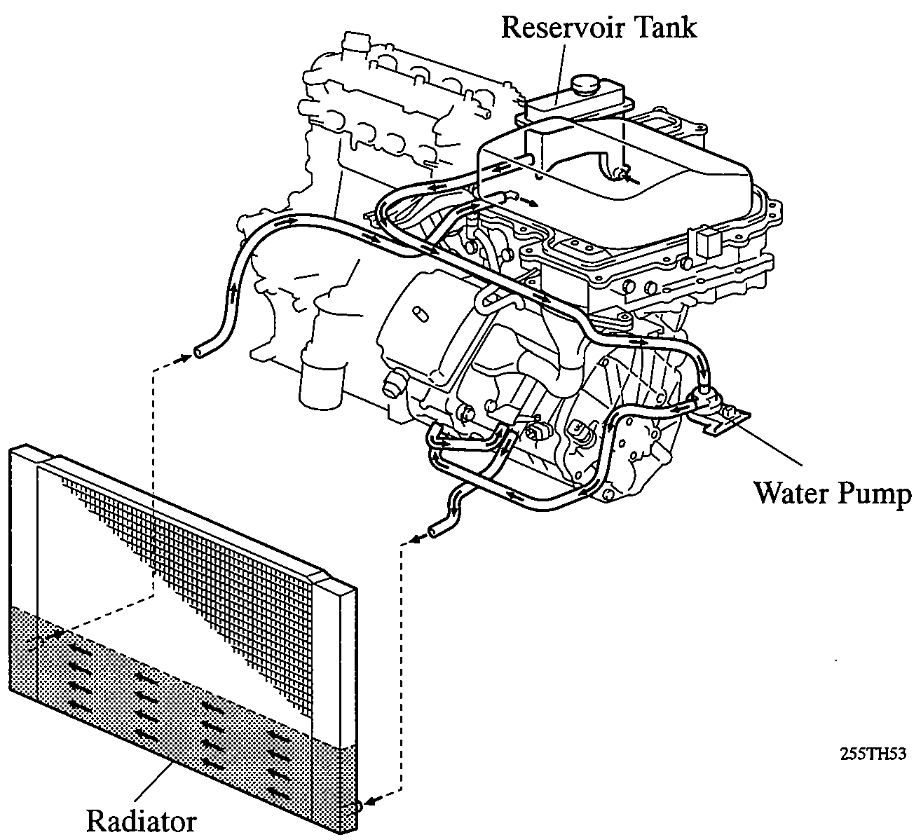
▶ System Diagram ◀



255TH93

3. Cooling System (for Inverter, MG1 and MG2)

- A cooling system via water pump for the inverter, MG1 and MG2 has been adopted. It is separated with the engine cooling system.
- This cooling system activates when the power supply status is switched to IG.
- The radiator for the cooling system is integrated with the radiator for the engine. Accordingly, the radiator has been simplified and the space it occupies has been optimized.



▶ Specifications ◀

Water Pump	Discharge Volume	liter / min.	10 or above (65 °C (149 °F))
Coolant	Capacity	liters (US qts, Imp. qts)	2.7 (2.9, 2.4)
	Type		TOYOTA Genuine Super Long Life Coolant (SLLC) or Equivalent
	Color		Pink
	Maintenance Intervals	First Time	100,000 mile (160,000 km)
		Subsequent	Every 50,000 mile (80,000 km)*

*: Applied only when SLLC (pink-colored) is used. If LLC (red-colored) is used, the maintenance interval would be 25,000 mile (40,000 km) or 24 months whichever comes first.

Service Tip

- When replacing SLLC, drain old coolant from the drain plug located on the lower potion of the hybrid transaxle. For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).
- The above-mentioned maintenance intervals become inaccurate in those cases where coolant other than SLLC has been used to replenish coolant levels between interval periods.
- You can also apply the new maintenance interval (every 50,000 mile (80,000 km)) to vehicles initially filled with LLC (red-colored), if you use SLLC (pink-colored) for the coolant change.

4. HV Battery

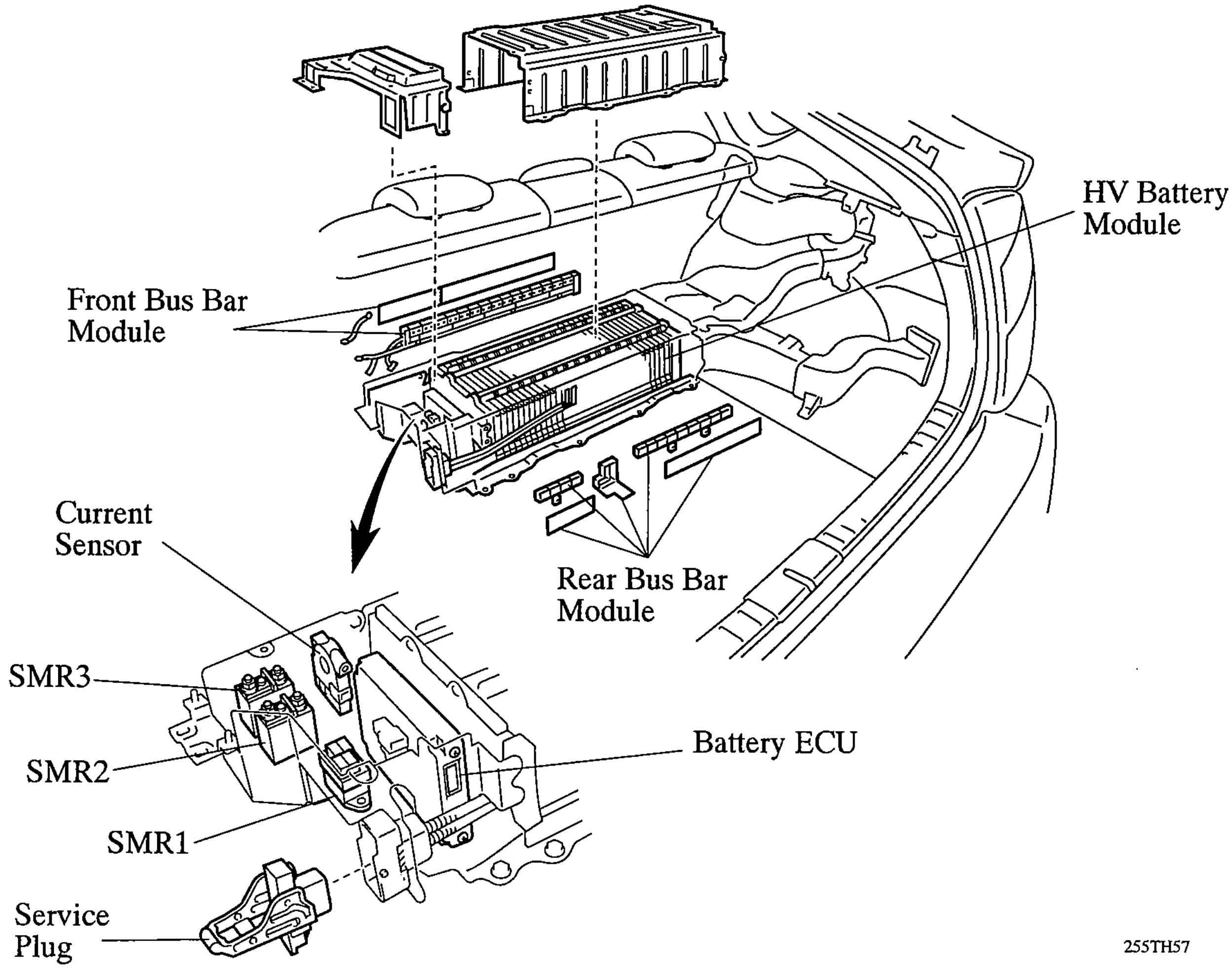
General

- As on the '03 Prius, the '04 Prius has adopted sealed nickel hydride (Ni-MH) batteries for the HV battery. This HV battery has a high power density, it is lightweight, and it offers longevity to match the characteristics of the THS-II system. Because the THS-II system effects charge/discharge control to maintain the HV battery at a constant level of SOC (state of charge) while the vehicle is operating normally, it does not rely on the use of external recharges.
- The HV battery, battery ECU, and SMR (System Main Relay) enclosed in a signal case and placed in the luggage compartment behind the rear seat to make more effective use of vehicle space.
- A service plug that shuts off the circuit is provided in the middle of the 28 modules (Between No.19 module and No.20 module). Before servicing any portion of the high-voltage circuit, make sure to remove the service plug.
- To ensure the HV battery's performance considering the heat that is generated in the HV battery during charging and discharging, the battery ECU controls the operation of the cooling fan.

— **Main Changes from '03 Prius** —

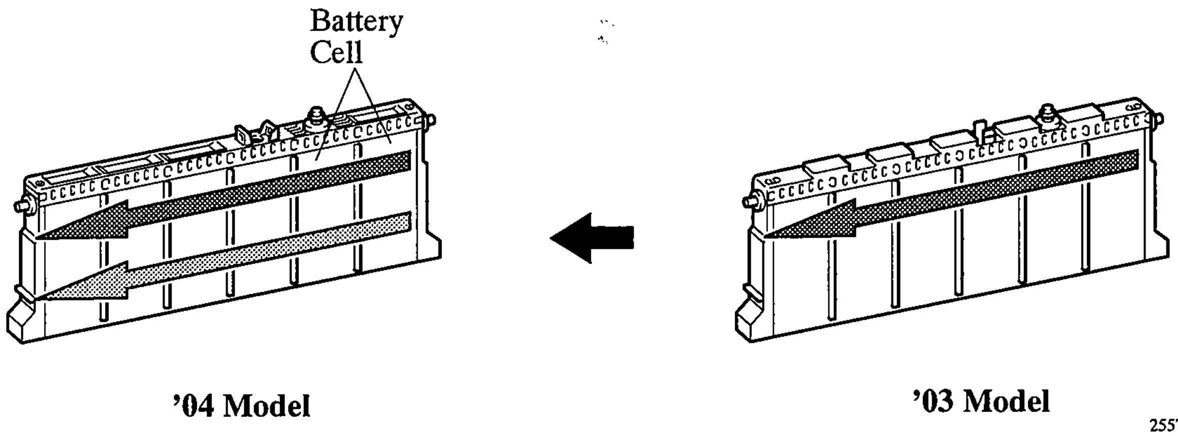
- The HV battery of the '03 Prius consists of 228 cells ({1.2V x 6 cells} x 38 modules) with a nominal voltage of DC 273.6 V. In contrast, the HV battery of the '04 Prius consists of 168 cells ({1.2V x 6 cells} x 28 modules) with a nominal voltage of 201.6V. A compact and lightweight battery configuration has been achieved through these internal improvements.
- On the '03 Prius, the connection between the cells of the HV battery consists of one spot. In contrast, the cells on the '04 Prius are connected with two spots. The internal resistance of the battery has been reduced by this improvement.

Layout of Main Components



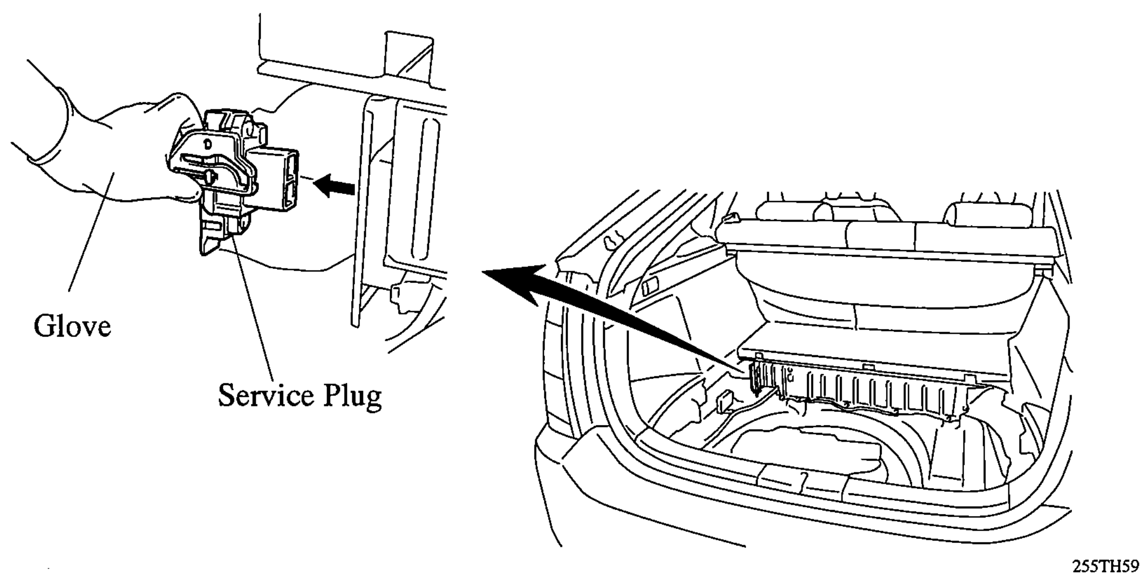
HV Battery Module

On the '03 Prius, the connection between the cells of the HV battery consists of one spot at the upper part of the cells. In contrast, the cells on the '04 Prius are connected with two spots, with an additional connection at the lower part of the cells. The internal resistance of the battery has been reduced by this improvement.



Service Plug

By removing the service plug before performing any inspection or service, the high-voltage circuit is shut off at the intermediate position of the HV battery, thus ensuring safety during service.
The service plug assembly contains a lead switch for interlock. Lifting the clip lock up turns OFF the lead switch, which shuts off the SMR. However, to ensure safety, make sure to turn OFF the ignition switch before removing the service plug.
The main fuse for the high-voltage circuit is provided inside of the service plug assembly.
For further details on how to handle the service plug and other safety cautions, refer to the '04 Prius Repair Manual (Pub. No. RM1075U).

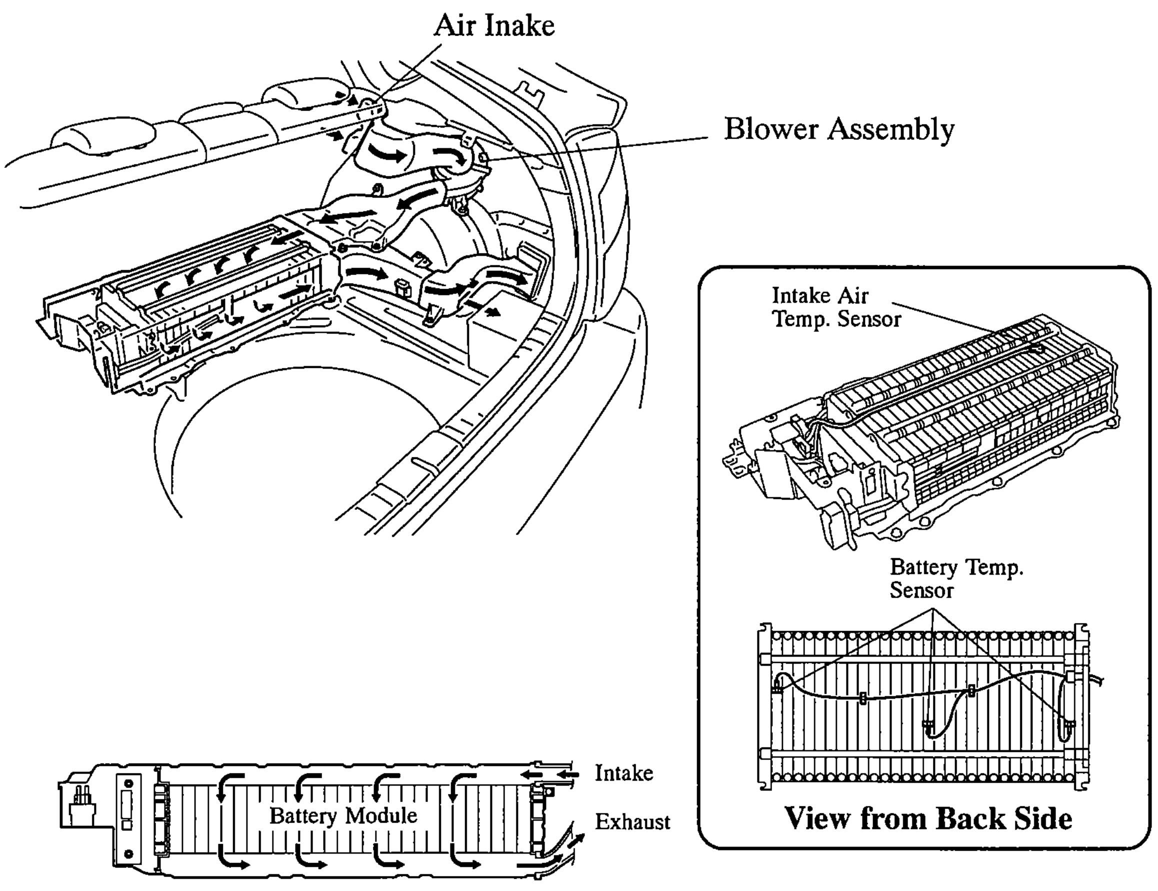


Service Tip

After the service, please do not start the system until the service plug is connected. The battery ECU may break down.

HV Battery Cooling System

- To ensure the proper performance of the HV battery while it generates heat during the repetitive charge and discharge cycles, a dedicated cooling system for the HV battery has been adopted.
- A cooling fan is provided on the right side of the luggage compartment, in order to draw the cabin air by way of the air intake located at the right side of the rear seat. Thereafter, the intake air that has entered from the top right area of the battery flows between the battery modules from the top to the bottom to cool the battery modules. Then, the air flows through the exhaust duct and the cabin, in order to be discharged outside of the vehicle.
- The battery ECU controls the operation of the cooling fan. The battery ECU controls the temperature of the HV battery to an appropriate level in accordance with the signals provided by the three battery temperature sensors that are built into the HV battery, and one intake air temperature sensor. For details, refer to the Battery ECU Control on page TH-53.



View from Back Side

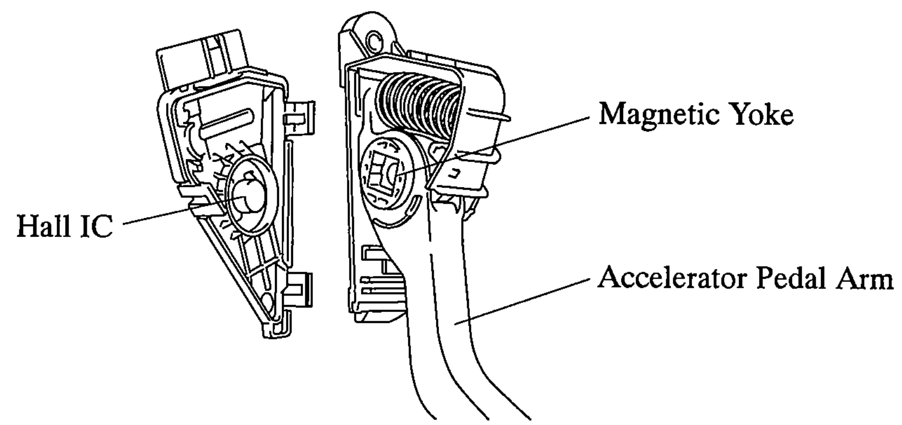
Cross Section of HV Battery

▶ Specifications ◀

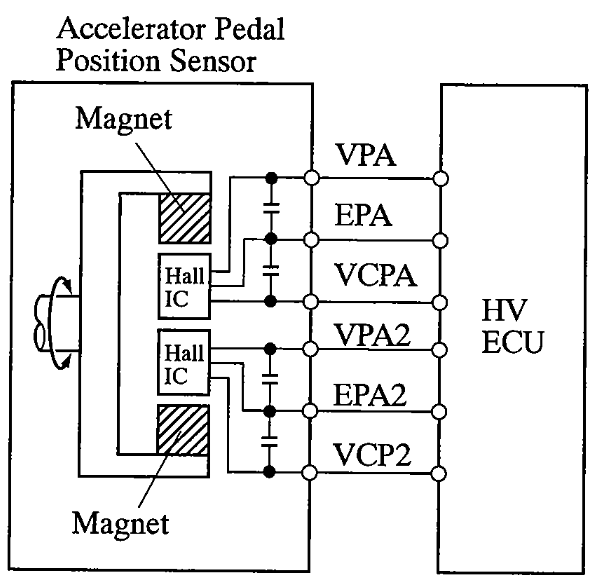
Model		'04 Prius		'03 Prius	
Type		Sirocco Fan		←	
Fan Size Dia. × H	mm (in.)	100 × 50 (4.0 × 2.0)		100 × 40 (4.0 × 1.6)	
Motor Type		DC Motor		←	
Air Flow Volume	m^3/h	Step-less Control		3-step Control	
		Min.	40	Lo	50
				Mid	100
		Max.	150	Hi	150
Power Consumption	W	50 or less		60	

5. Accelerator Pedal Position Sensor

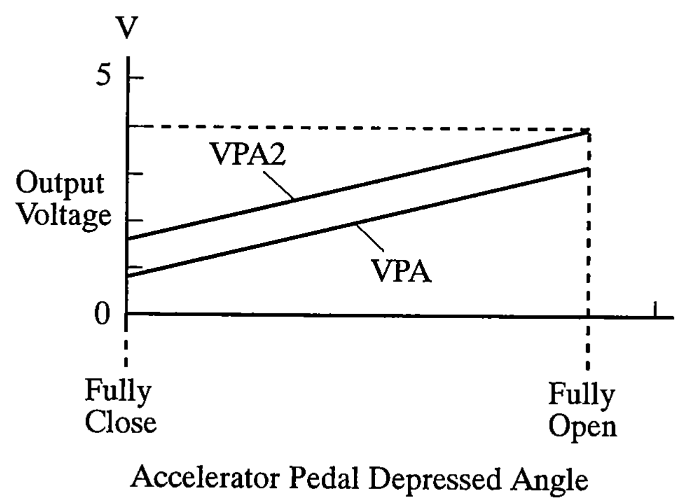
The magnetic yoke that is mounted at the base of the accelerator pedal arm rotates around the Hall IC in accordance with the amount of effort that is applied to the accelerator pedal. The Hall IC converts the changes in the magnetic flux that occur at that time into electrical signals, and outputs them in the form of accelerator pedal effort to the HV ECU.



228TU23



228TU24



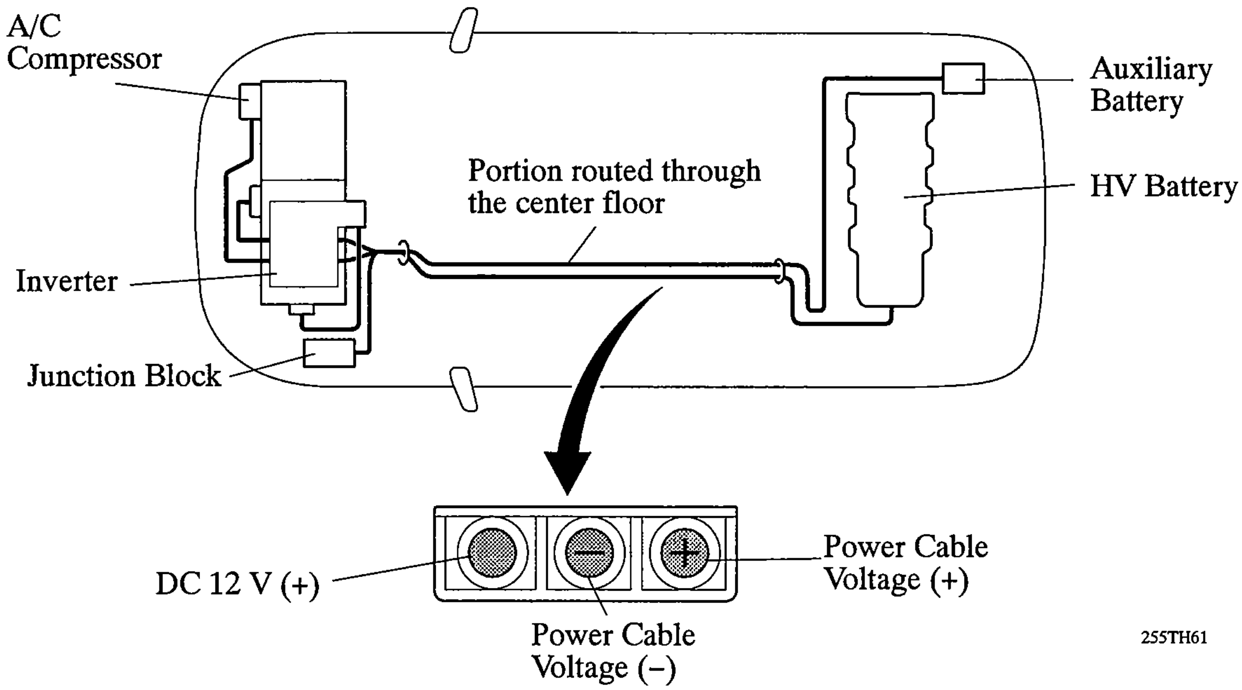
228TU25

Service Tip

The inspection method differs from the conventional accelerator pedal position sensor because this sensor uses a hall IC. For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U.)

6. Power Cable

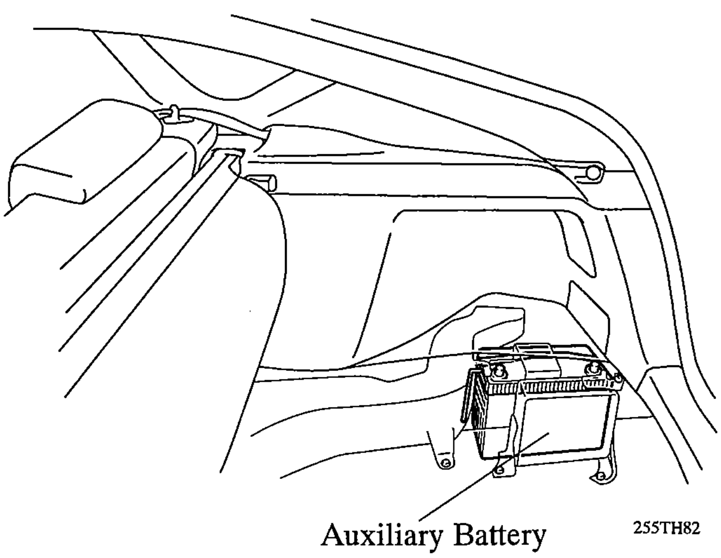
The power cable is a high-voltage, high-amperage cable that connects the HV battery with the inverter, the inverter with MG1 and MG2, and inverter with A/C compressor. Starting from the connector at the left front of the HV battery located in the luggage compartment, the power cable is routed under the rear seat, through the floor panel, along the under-the-floor reinforcement, and connects to the inverter in the engine compartment. A shielded cable is used for the power cable in order to reduce electromagnetic interference. The DC 12 V (+) wiring of the auxiliary battery also follows the same route.
For identification purposes, the high-voltage wiring harness and connectors are color-coded orange to distinguish them from those of the ordinary low-voltage wiring.



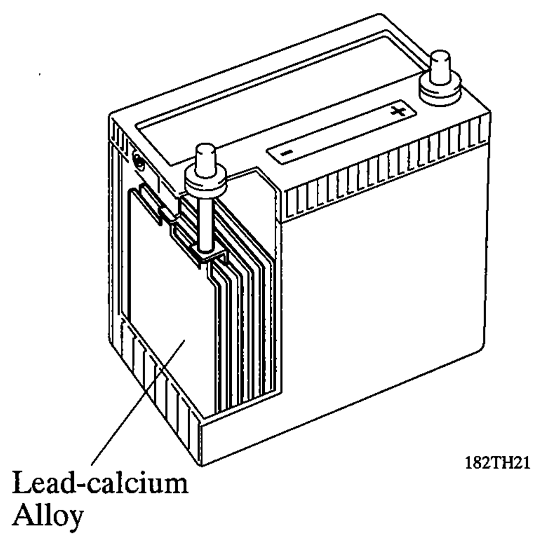
255TH61

7. Auxiliary Battery

The '04 Prius uses a shielded, maintenance-free DC 12 V battery as the auxiliary battery. Depending on a destination or equipment items, either of the battery types, S34B20R or S46B24R, will be equipped.



255TH82



182TH21

Service Tip

Battery fluid is filtered into separators in order to reduce hydrogen gas released which occurs when the battery is charged.
Therefore, battery fluid does not need to be replaced, as long as the specified battery is used.

■ THS-II CONTROL SYSTEM

1. General

The THS-II control system contains the following components.

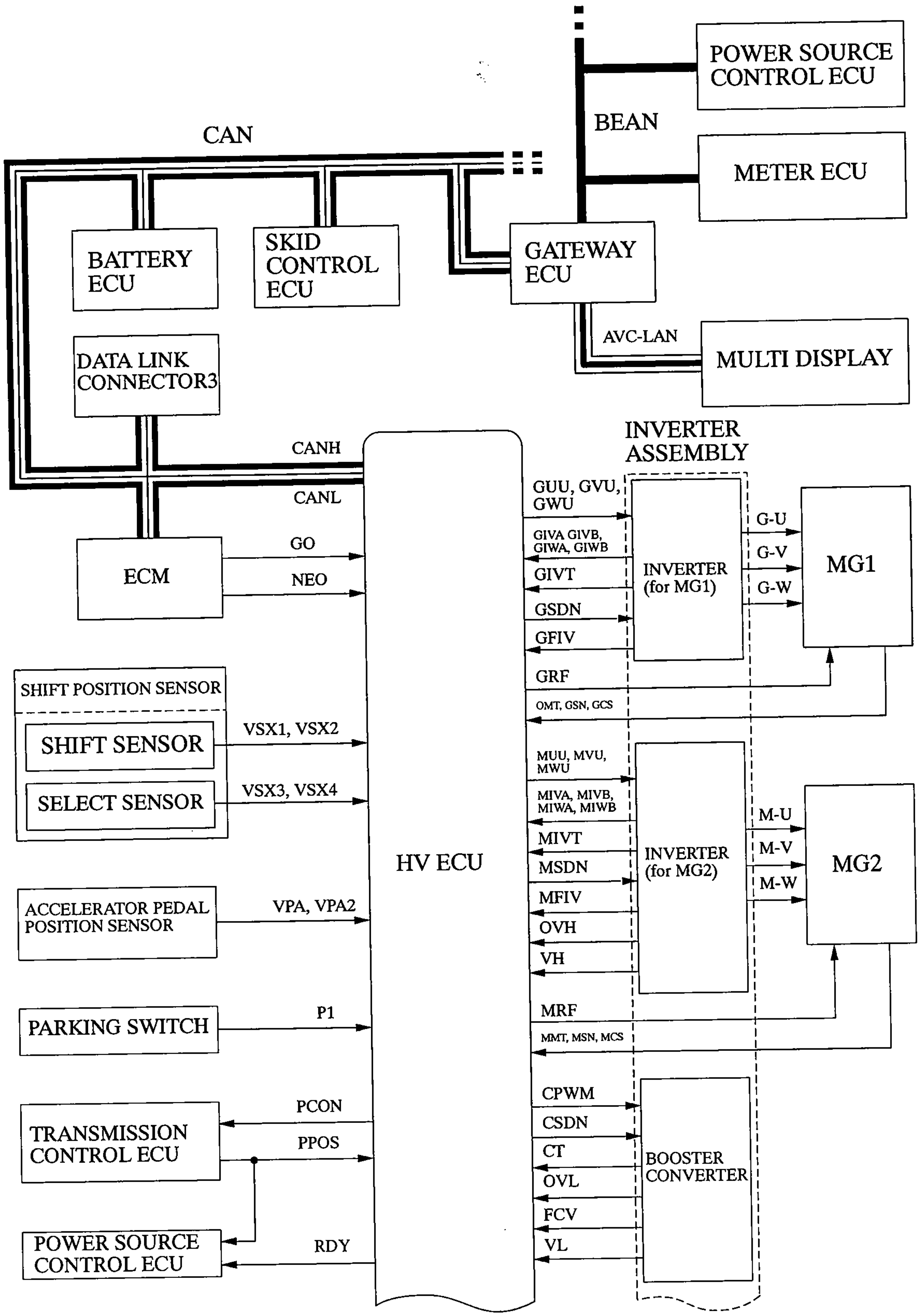
Item	Outline
HV ECU Control (See page TH-44)	• Control the MG1, MG2 and the engine according to the demand torque, regenerative brake control and the SOC (State of Condition) of HV battery. These factors are determined by the shift position, the degree which the accelerator pedal is depressed and vehicle speed. • The HV ECU monitors the SOC of the HV battery and the temperature of the HV battery, MG1, and MG2, in order to optimally control these items. • When the shift position is in the "N" position, the HV ECU effects shut down control to electrically stop MG1 and MG2. • The uphill assist control prevents the vehicle from sliding downward when the brake is released during startup on a steep slope. • If the drive wheels rotate without traction, the HV ECU performs the motor traction control that provides a restraint on a rotation of MG2, in order to protect the planetary gear unit and prevent MG1 from generating excessive electricity. • For the purpose of protecting the circuit from high voltage and ensuring the reliability of the circuit shut down, the HV ECU effects SMR control through the use of 3 relays to connect and shut down the high-voltage circuit.
ECM Control (See page TH-50)	The ECM receives the target engine speed and required engine motive force, which were sent from HV ECU, and controls the ETCS-i system, fuel injection volume, ignition timing and VVT-i system.
Inverter Control (See page TH-51)	• In accordance with the signals provided by the HV ECU, the inverter converts a direct current from HV battery into an alternating current for MG1 and MG2, or vice versa. In addition, the inverter supplies the alternating current from MG1 power to the alternating current for MG2. • The HV ECU sends the signal to the power transistor in the inverter for switching the U, V and W phase of the MG1 and MG2 in order to drive the MG1 and MG2. • The HV ECU shuts down if it receives an overheating, over-current, or fault voltage signal from the inverter.
Boost Converter Control	• In accordance with the signals provided by the HV ECU, the boost converter boosts the nominal voltage of DC 201.6 V (for HV battery) up to the maximum voltage of DC 500 V. • The maximum voltage of AC 500 V generated by MG1 or MG2 is converted into a direct current by the inverter, the boost converter drops the DC 500 V to DC 201.6 V (for HV battery) based on the signals from the HV ECU.
Converter Control	• Drops the nominal voltage of DC 201.6 V into DC 12 V in order to supply electricity to body electrical components, as well as to recharge the auxiliary battery (DC 12 V). • This converter controls the voltage of the auxiliary battery to a constant voltage.
A/C Inverter Control	Converts the nominal voltage of DC 201.6 V of the HV battery to AC 201.6 V and supplies power to operate the electric inverter compressor of the A/C system.

(Continued)

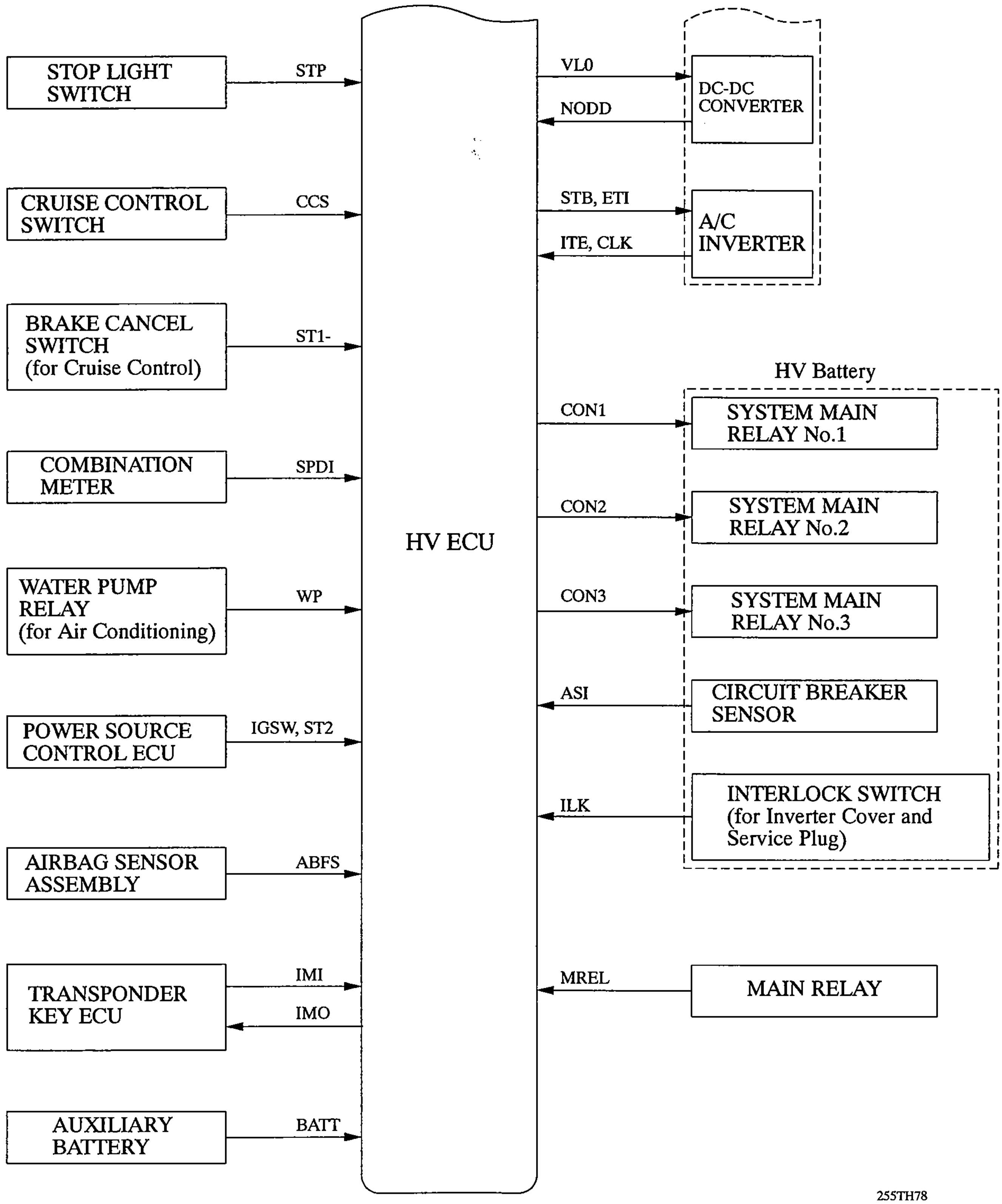
Item	Outline
MG1 and MG2 Main Control	• MG1, which is rotated by the engine, generates high voltage (maximum voltage of AC 500V) in order to operate MG2 and charge the HV battery. Also, it functions as a starter to start the engine. • Driven by electrical power from MG1 or HV battery, and generates motive force for the vehicle. • During braking, or when the accelerator pedal is not depressed, it generates electricity to recharge the HV battery (Regenerative brake control). • Speed sensors (resolver) detect the speed and position of MG1 and MG2 and output them to the HV ECU. • A temperature sensor mounted on MG2 detects the temperature and transmits it to the HV ECU
Skid Control ECU Control (See page TH-52)	During braking, the skid control ECU calculates the required regenerative brake force and transmits it to the HV ECU. Upon receiving this signal, the HV ECU transmits actual regenerative brake control value to the skid control ECU. Based on this result, the skid control ECU calculates and executes the required hydraulic pressure brake force.
Battery ECU Control (See page TH-53)	The battery ECU effects monitor control to monitor the conditions of the HV battery and cooling fan control to keep the HV battery at a predetermined temperature. Thus, it optimally controls these components.
Shift Control (See page CH-8)	• The HV ECU detects the shift position ("R", "N", "D" or "B") in accordance with the signal provided by the shift position sensor, and controls MG1, MG2, and the engine, in order to create the driving conditions that suit the selected shift position. • The transmission control ECU detects that the driver has pressed the parking switch through a signal provided by the HV ECU. Then, it operates the shift control actuator in order to mechanically lock the transaxle.
During Collision Control (See page TH-56)	During a collision, if the HV ECU receives an airbag deployment signal from the airbag sensor assembly or an actuation signal from the circuit breaker sensor located in the inverter, it turns OFF the SMR (System Main Relay), in order to shut off the entire power supply.
Cruise Control System Operation Control	When the cruise control ECU that is enclosed in the HV ECU receives a cruise control switch signal, it regulates the motive forces of the engine, MG1 and MG2 to be an optimum combination in order to obtain the targeted vehicle speed by a driver's demand.
Indicator and Warning Light Illumination Control (See page TH-57)	Illuminates or blinks the lights to inform the driver of the vehicle conditions or system malfunctions.
Diagnosis (See page TH-58)	When the HV ECU detects a malfunction, the HV ECU diagnosis and memorizes the values corresponding to the failure.
Fail-Safe (See page TH-58)	When the HV ECU detects malfunction, the HV ECU stops or controls the actuator and ECUs according to the data already stored in memory.

2. Construction

The configuration of the THS-II control system in the '04 Prius is shown in the following chart.



255TH77


STOP LIGHT SWITCH
STP
CRUISE CONTROL SWITCH
CCS
BRAKE CANCEL SWITCH (for Cruise Control)
ST1-
COMBINATION METER
SPDI
WATER PUMP RELAY (for Air Conditioning)
WP
POWER SOURCE CONTROL ECU
IGSW, ST2
AIRBAG SENSOR ASSEMBLY
ABFS
TRANSPONDER KEY ECU
IMI
IMO
AUXILIARY BATTERY
BATT
HV ECU
VLO
NODD
DC-DC CONVERTER
STB, ETI
ITE, CLK
A/C INVERTER
HV Battery
CON1
SYSTEM MAIN RELAY No.1
CON2
SYSTEM MAIN RELAY No.2
CON3
SYSTEM MAIN RELAY No.3
ASI
CIRCUIT BREAKER SENSOR
ILK
INTERLOCK SWITCH (for Inverter Cover and Service Plug)
MREL
MAIN RELAY

255TH78

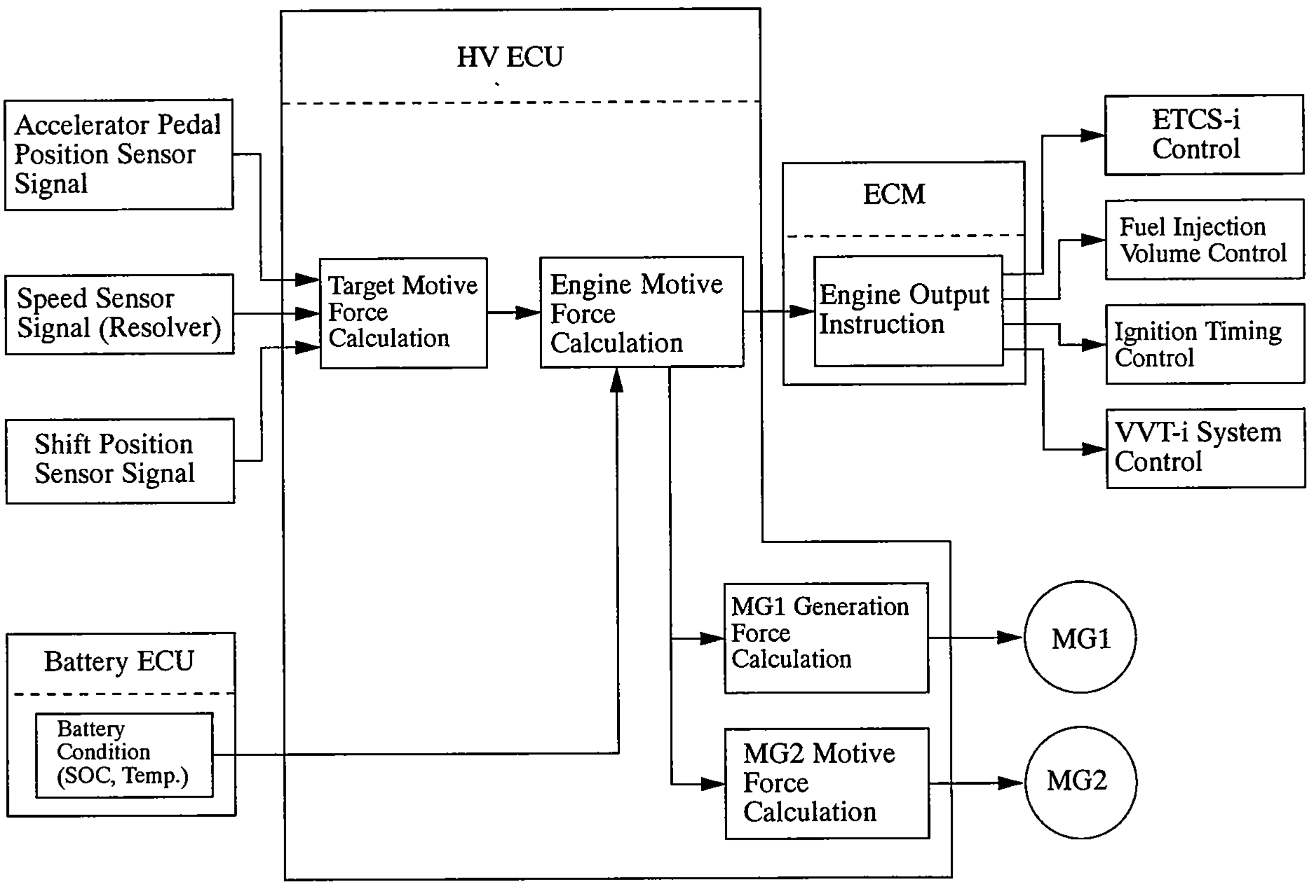
3. HV ECU Control

General

The HV ECU detects the amount of effort applied to the accelerator pedal in accordance with the signals provided by the accelerator pedal position sensor. The HV ECU receives the vehicle speed signals from the speed sensor (resolver) in the MG1 and MG2, and detects the shift position signal from the shift position sensor. The HV ECU determines the driving conditions of the vehicle in accordance with these pieces of information, and optimally controls the motive forces of MG1, MG2, and the engine. Furthermore, the HV ECU optimally controls the output and torque of these motive forces in order to realize lower fuel consumption and cleaner exhaust emissions.

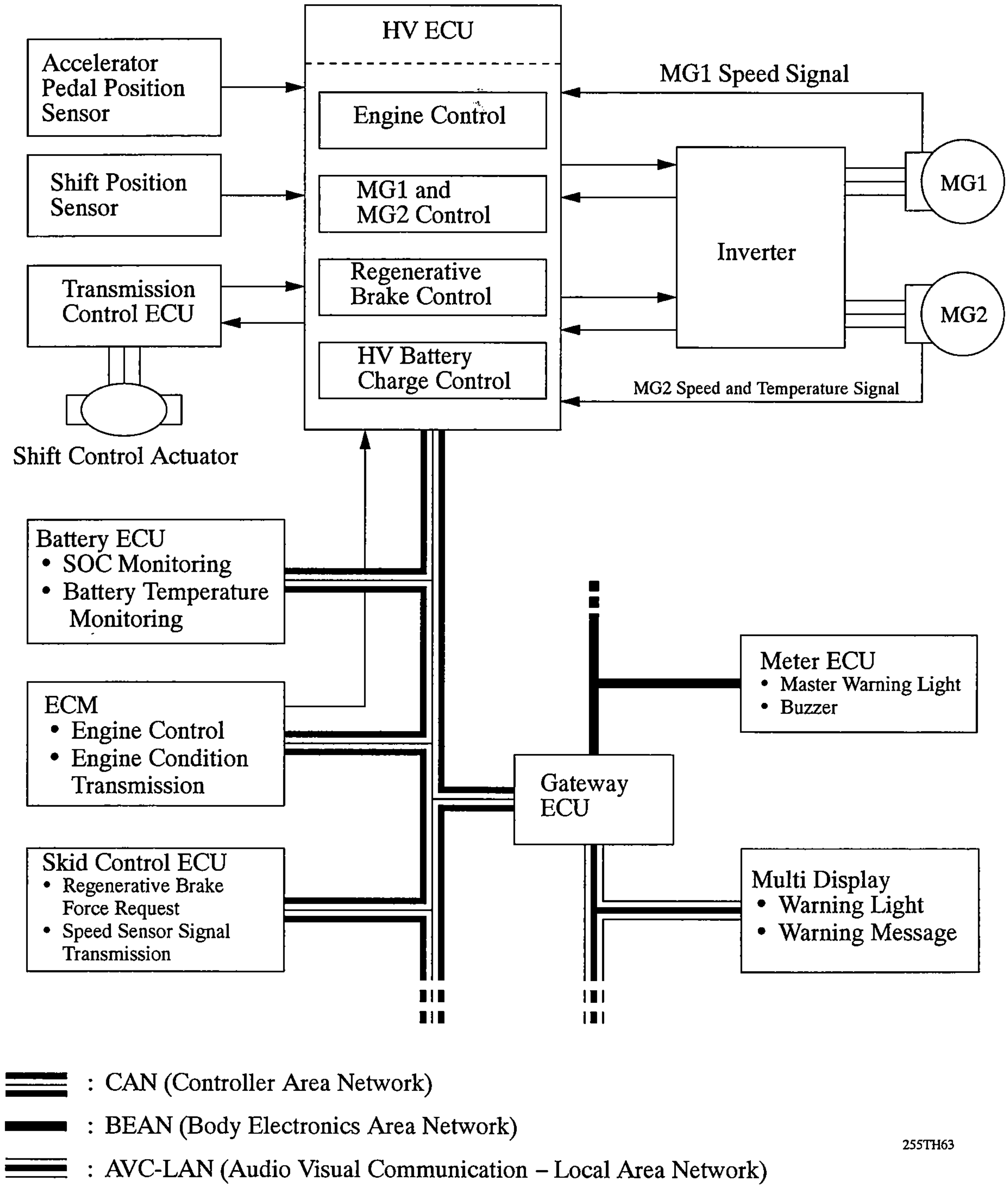
▶ Flow of Motive Force Calculation ◀

(Target Motive Force) – (Engine Motive Force) = (MG2 Motive Force)



255TH62

▶ System Diagram ◀



System Monitoring Control

- The battery ECU constantly monitors the SOC (state of charge) of the HV battery, and transmits the SOC to the HV ECU. When the SOC is below the lower level, the HV ECU increases the power output of the engine to operate MG1, which charges the HV battery. When the engine is stopped, MG1 operates to start the engine; then, the engine operates MG1 to charge the HV battery.
- If the SOC is low, or the temperature of the HV battery, MG1, or MG2 is higher than the specified value, the HV ECU restricts the motive force applied to the drive wheels until it is restored to the normal value. A temperature sensor that is built into MG2 directly detects the temperature of MG2. The HV ECU calculates the temperature of MG1.

Shut Down Control

Generally, MG1 and MG2 are shut down when the shift position is in the "N" position. This is because MG1 and MG2 must be stopped electrically as a means of shutting down the motive force, since MG2 is mechanically joined to the front wheels.
However, the shut down function is canceled under the following exceptions:

- During driving, if the brake pedal is depressed and a wheel lock up, the ABS with EBD is activated. After this, low torque is requested from the MG2 to provide supplemental power in order to restart the rotation of the wheel. Even if the shift position is in the "N" position at this time, the shut down function is canceled to allow the wheel to rotate. After the wheel rotation has been restarted, the system resumes its shut down function.
- When the vehicle is driven in the "D" or "B" position and the brake pedal is depressed, the regenerative brake operates. At this time, as the driver moves the shift position to the "N" position, the brake hydraulic pressure increases while the request torque of the regenerative brake decreases gradually so as not to create a sluggish brake feel. After this, the system effects the shut down function.
- When MG1 and MG2 operate at higher speed than the specified level, the shut down function is canceled.

Uphill Assist Control

- This control prevents the vehicle from sliding downward when the brake is released during startup on a steep slope. Because the motor has a highly sensitive speed sensor, it responsively senses the angle of the slope and vehicle's decent and ensures safety by increasing the motor's torque.
- If the uphill assist control is applied, the brakes might be applied to the rear wheels to prevent the vehicle from receding backwards. At this time, the HV ECU transmits a rear brake actuation signal to the skid control ECU.

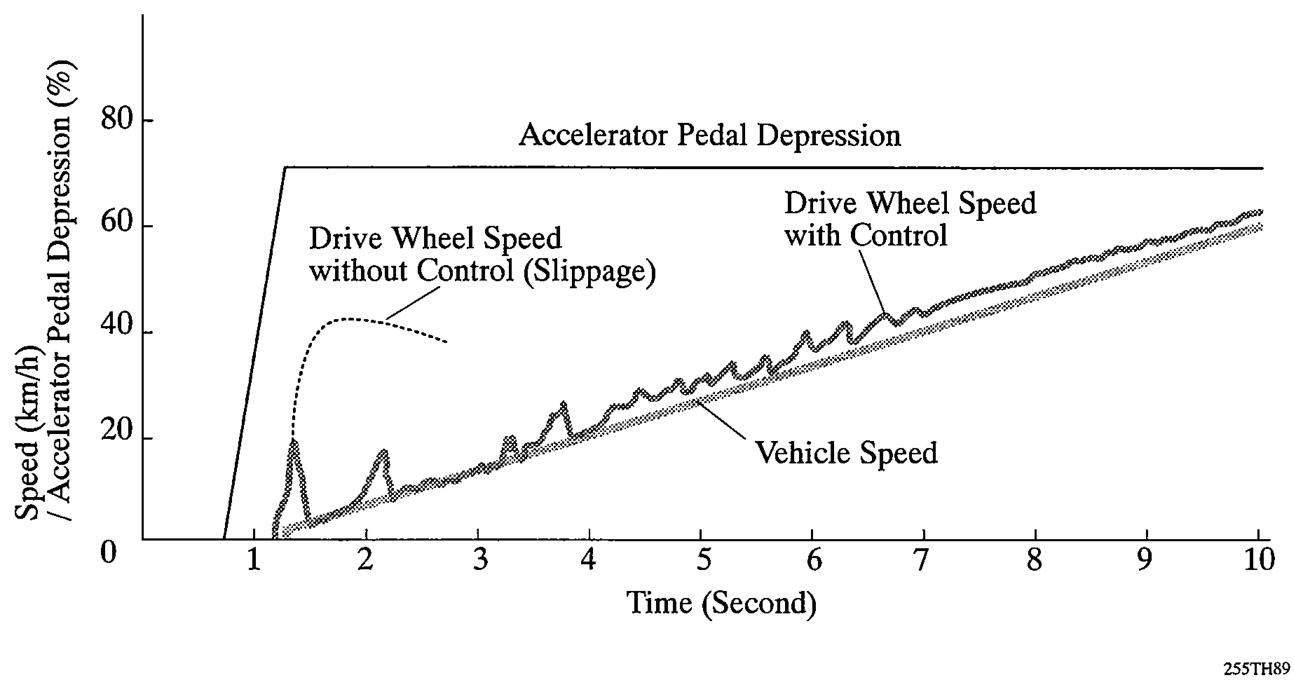
Motor Traction Control

1) General

- If a drive wheels slips while the vehicle is being driven on a slippery road surface, MG2 (which is coupled directly to the wheels) will spin excessively, causing the relative rotational speed of the planetary gear unit to increase. This condition could damage the areas that support the parts in the planetary gear unit, such as through seizure. In some cases, this condition could cause MG1 to generate an excessive amount of electricity. For this reason, if the HV ECU determines that MG2 is spinning excessively upon monitoring a sudden change in rotational speeds by way of speed sensor signals, the HV ECU applies a brake force to suppress the rotation, in order to protect the planetary gear unit.
- Furthermore, if only one of the drive wheels spins excessively, the HV ECU will monitor the speed difference between the right and left wheel by way of the speed sensors of the respective wheels, and the HV ECU will transmit a command to the skid control ECU in order to apply a brake to the wheel that is spinning excessively.

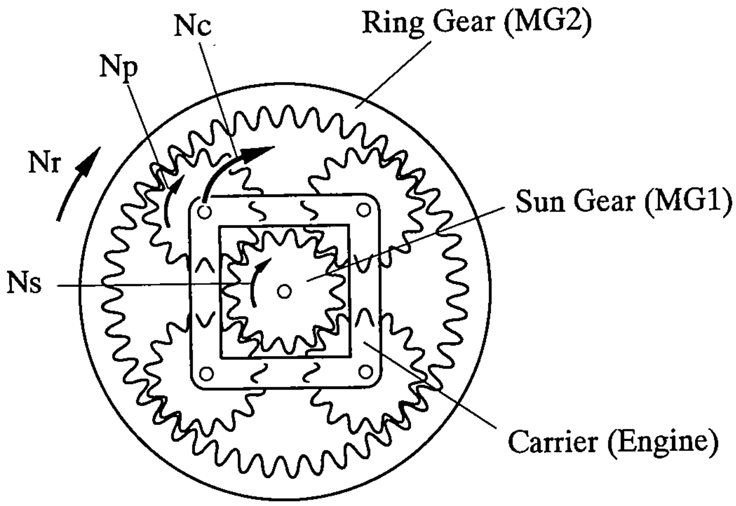
These controls achieve the same effect as the TRAC of the brake control system.

▶ Drive wheel speed behavior at Start-up a snowy road ◀

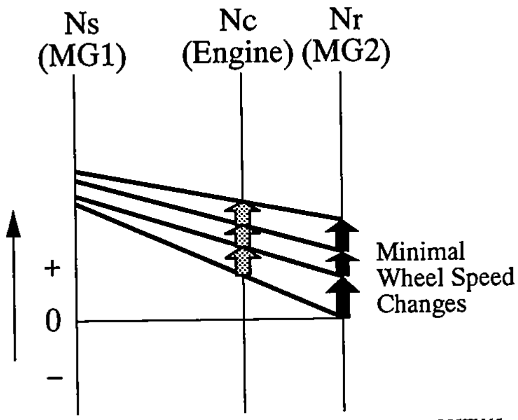


2) Operation

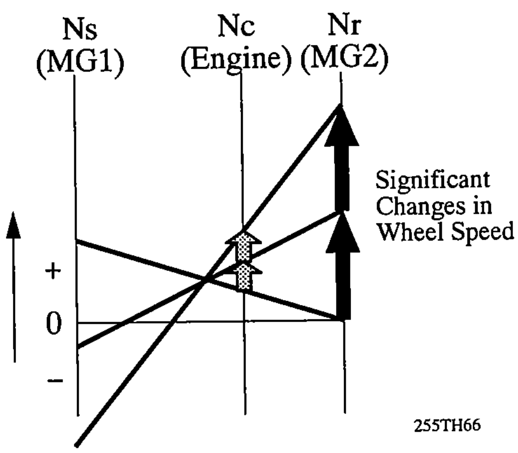
- The following describes the mechanism that generates the excessive rotation. For example, if the drive wheels have a normal grip, the changes in the rotational speed of MG2 (drive wheels) are minimal, as shown in Figure (a). Thus, the proper balance is maintained between them and the engine with minimal changes in speed, resulting in minimal differences in the relative rotational speeds of the planetary gear unit as a whole.
- If the drive wheels are in the state of loss of traction, a rotation speed of MG2 (drive wheels) varies largely as shown in Figure (b). As a result, difference of the relative rotation speeds in the whole planetary gear unit becomes larger, because the engine that has a small rotating variation cannot follow the rotation of MG2.



Planetary Gear Unit Schematic Diagram

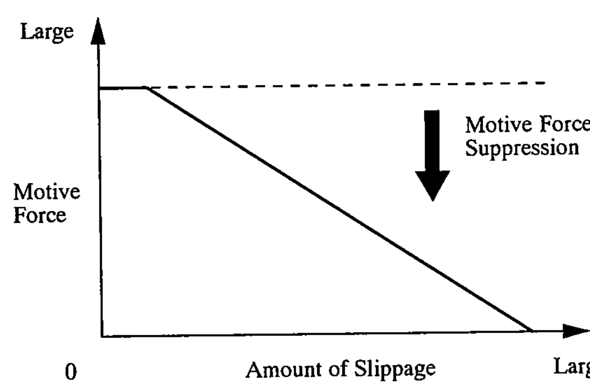


(a) Drive Wheels Gripping



(b) Drive Wheels Slipping

- The HV ECU monitors sudden changes in speed through the speed sensor signals provided by MG2, in order to calculate the amount of slippage of the drive wheels. The HV ECU controls the motive force by suppressing the rotation of MG2 in accordance with the calculated amount of slippage.



Conceptual Image of Motor Traction Control

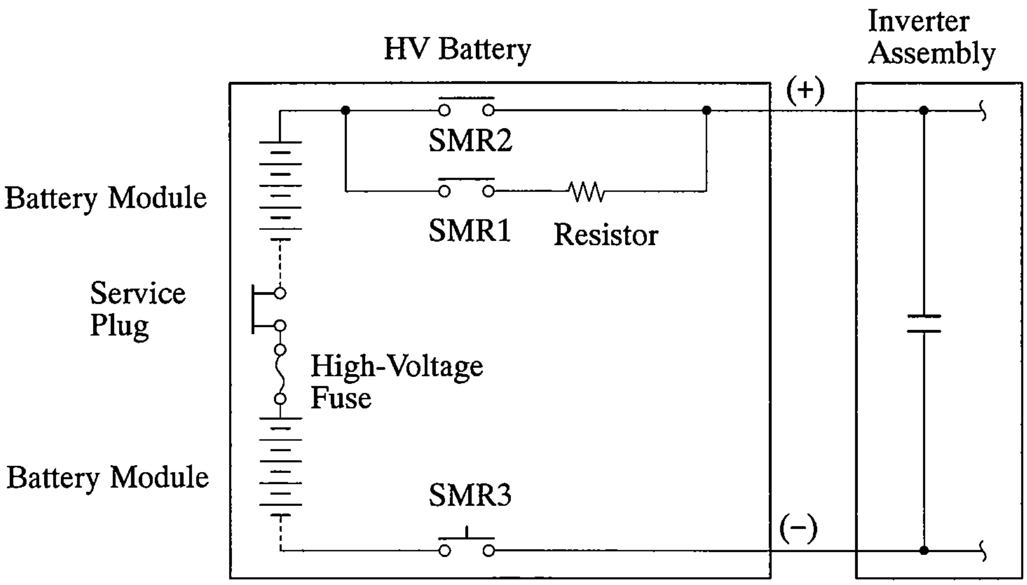
255TH67

SMR (System Main Relay) Control

1) General

The SMR is a relay that connects and disconnects the power source of the high-voltage circuit upon receiving a command from the HV ECU. A total of 3 relays, one for the negative side, and two for the positive side, are provided to ensure proper operations.

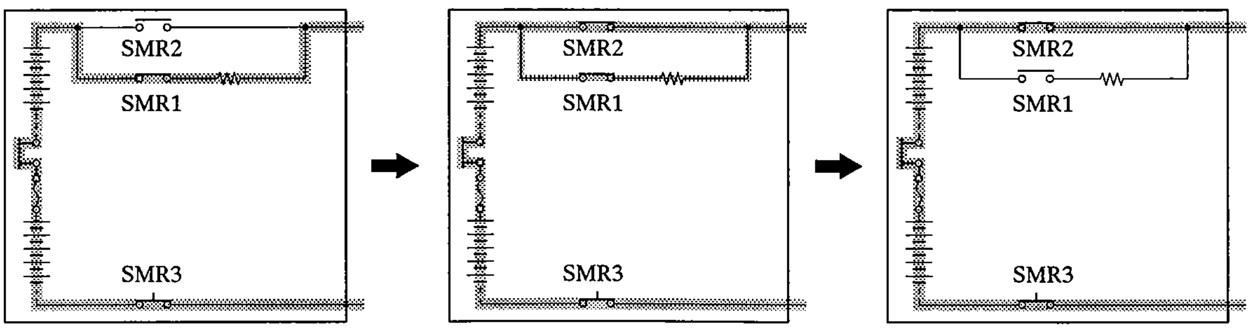
▶ System Diagram ◀



256TH56

2) Power is ON

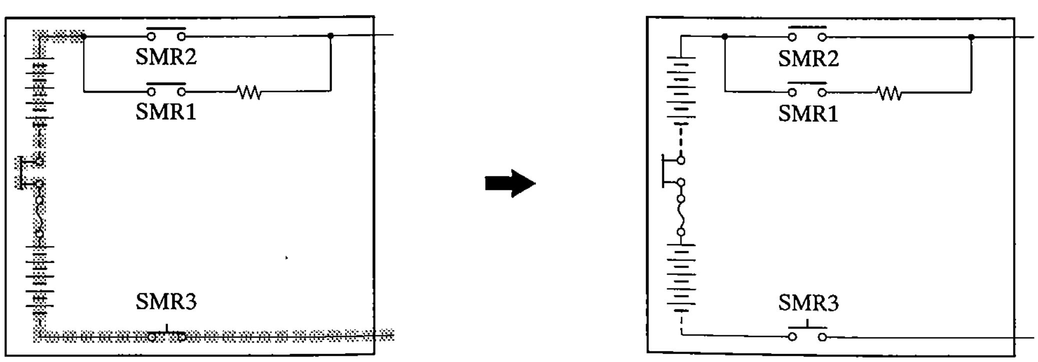
SMR1 and SMR3 turn ON when the circuit is connected; subsequently, SMR2 turns ON and SMR1 turns OFF. As the controlled current is initially allowed to pass through a resistor in this manner, the contact point in the circuit is protected from damage that could be caused by a rush current.



255TH85

3) Power is OFF

SMR2 and SMR3 turn OFF when the circuit is disconnected, in that order. Then, the HV ECU verifies that the respective relays have been properly turned off. Accordingly, the HV ECU is able to determine if SMR2 is stuck.

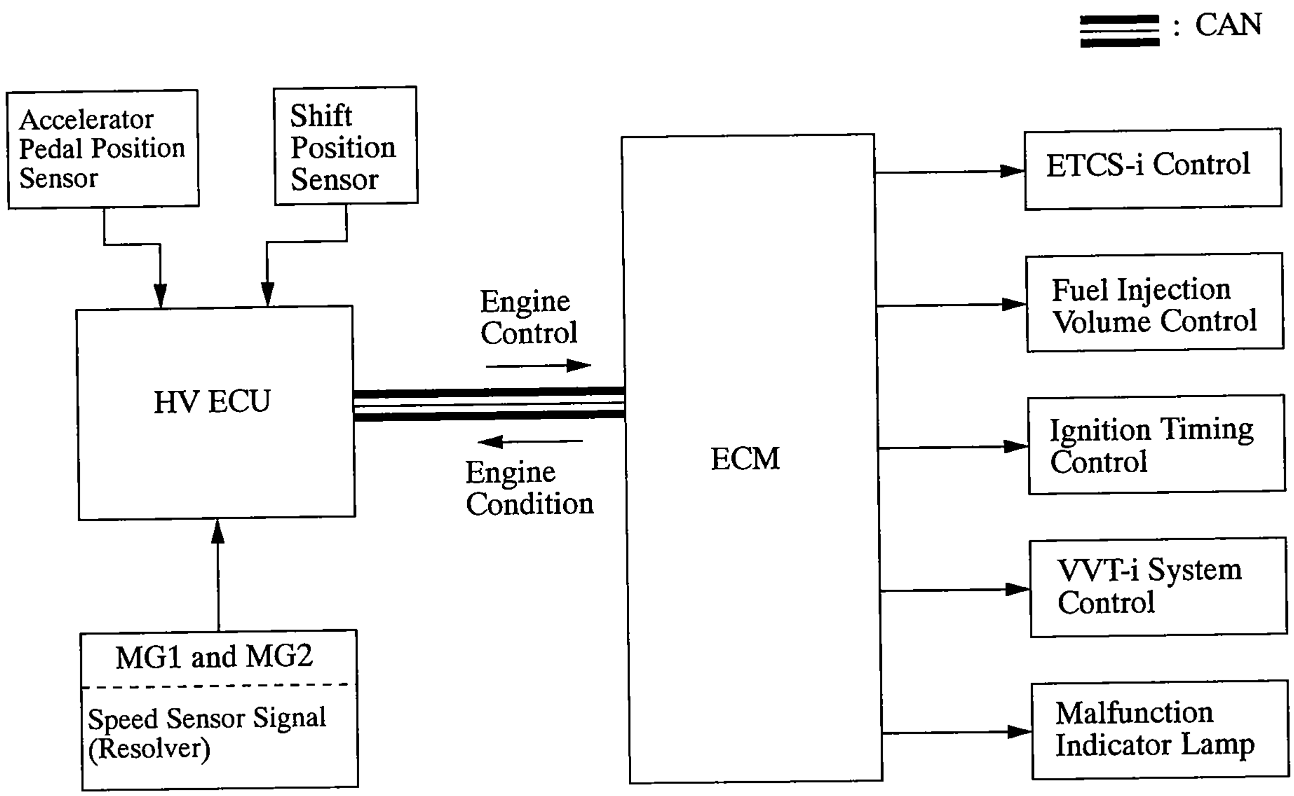


255TH86

4. ECM Control

- The ECM receives the target engine speed and required engine motive force, which were sent from HV ECU, and controls the ETCS–i system, fuel injection volume, ignition timing and VVT–i system.
- The ECM transmits the operating condition of the engine to the HV ECU.
- Upon receiving an engine stop signal from the HV ECU in accordance with the basic THS-II control, the ECM will stop the engine.
- When a malfunction occurs in the system, the ECM activates MIL via the directions from the HV ECU.

▶ System Diagram ◀

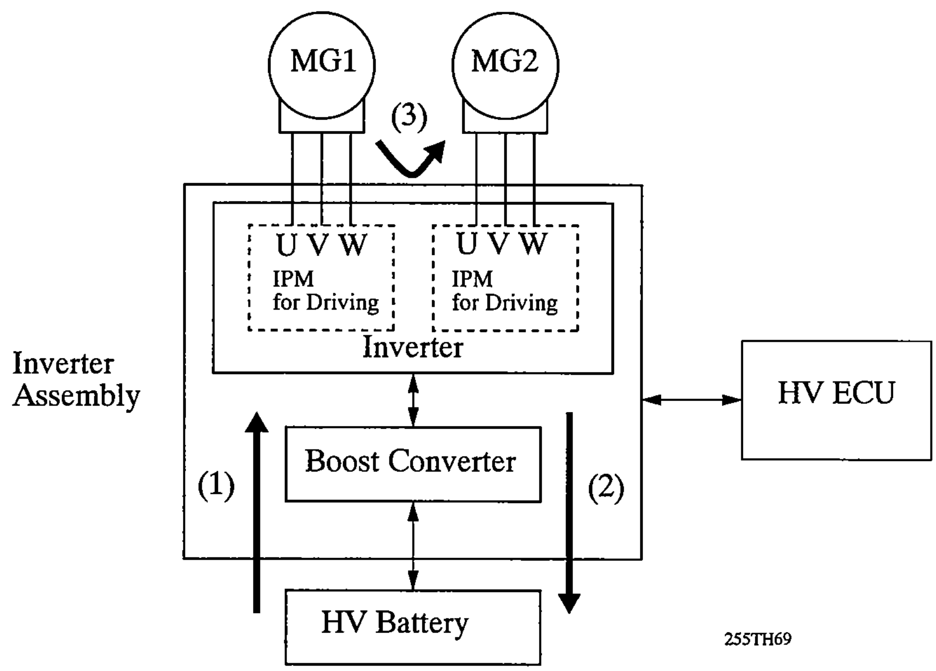


255TH68

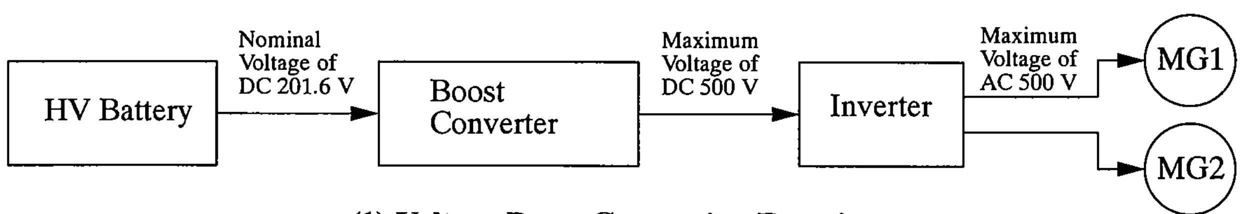
5. Inverter Control

- In accordance with the signals provided by the HV ECU, the inverter converts a direct current from HV battery into an alternating current for MG1 and MG2, or vice versa. In addition, the inverter supplies the alternating current from MG1 power to the alternating current for MG2. However, when electricity is supplied from MG1 to MG2, the electricity is converted into DC inside the inverter.
- The HV ECU transmits a signal to the power transistor in the inverter for switching the U, V and W phase of the stator coil of MG1 and MG2, based on the rotor position information sent from MG1 and MG2 and the SOC of the HV battery sent from the battery ECU. When shutting down the current to MG1 and MG2 a signal is sent to the inverter from the HV ECU.

▶ System Diagram ◀

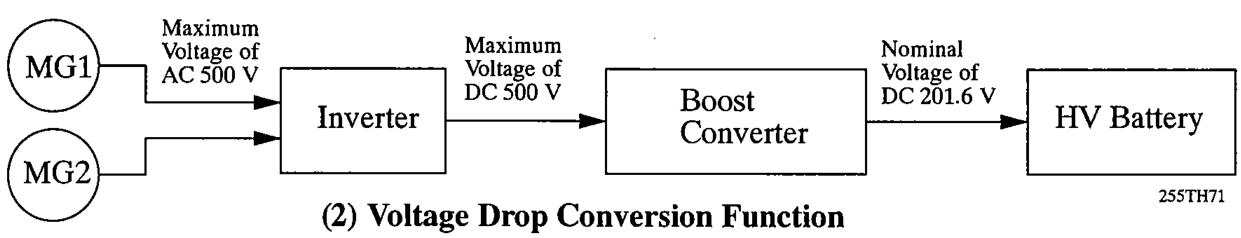


255TH69



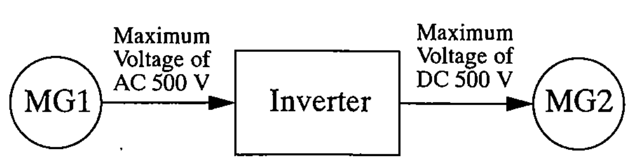
(1) Voltage Boost Conversion Function

255TH70



255TH71

(2) Voltage Drop Conversion Function



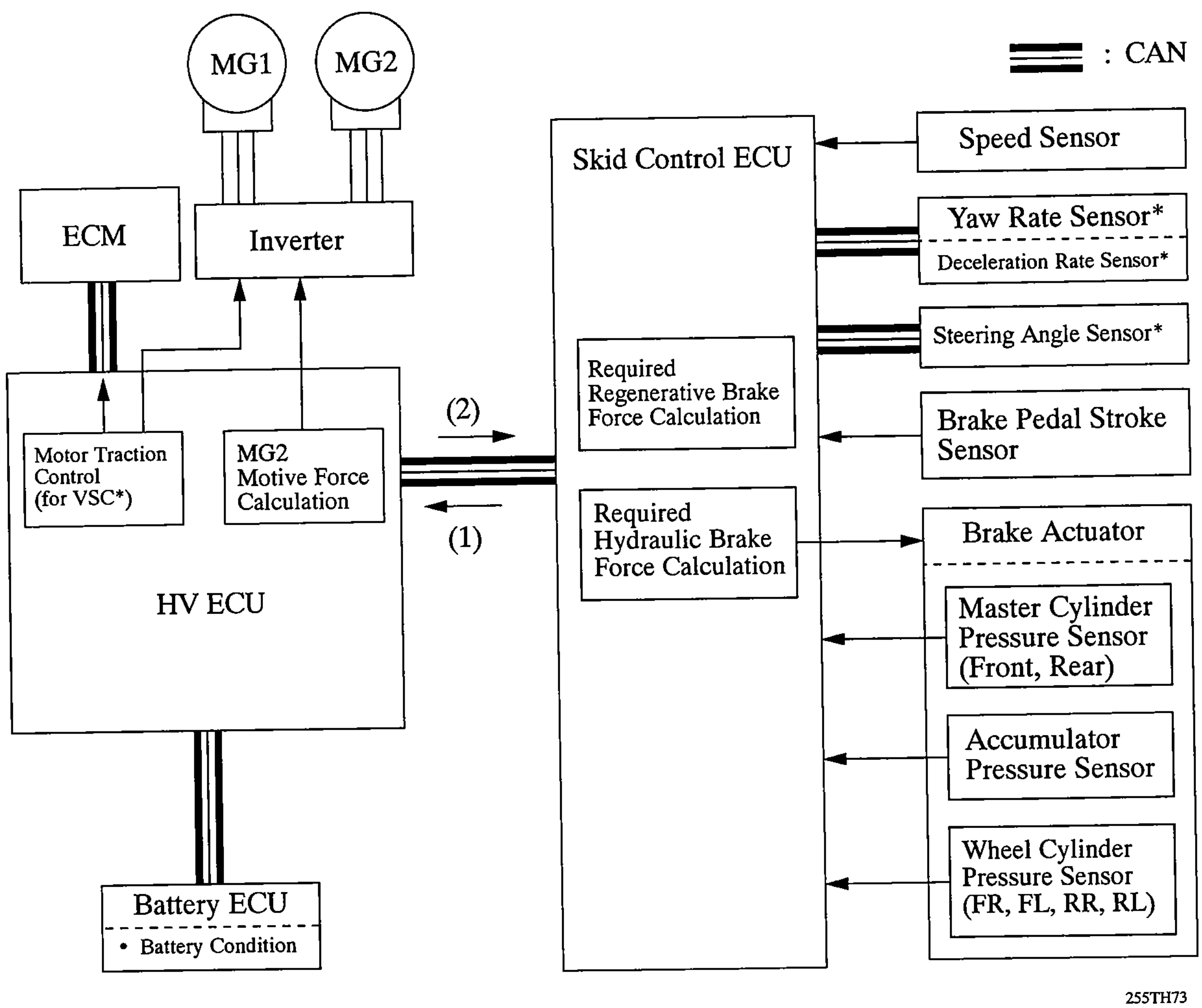
255TH72

(3) Electrical Power Supply Function

6. Skid Control ECU Control

- The skid control ECU calculates the total braking force needed, based on the master cylinder pressure in the brake actuator and brake pedal stroke sensor generated when the driver depresses the brake pedal.
- The skid control ECU computes a part for the required regeneration brake force from the total braking force, and sends the result to the HV ECU.
- The HV ECU executes to the minus torque to MG2, and carries out the regenerative brake functions. The skid control ECU controls the brake actuator solenoid valves and generates the wheel cylinder pressure, which is the actual regenerative brake control value subtracted from the total braking force.
- On a model with Enhanced VSC system, the skid control ECU outputs a request to the HV ECU to effect motor traction control while the vehicle is operating under Enhanced VSC system control. The HV ECU controls the engine, MG1, and MG2 in accordance with the present driving conditions in order to suppress the motive force.

▶ System Diagram ◀



(1): • Regenerative Brake Force Request
• Motor Traction Control Request (for Enhanced VSC System)

(2): • Actual Regenerative Brake Control Value
• Hydraulic Brake Control Request (for Uphill Assist Control)

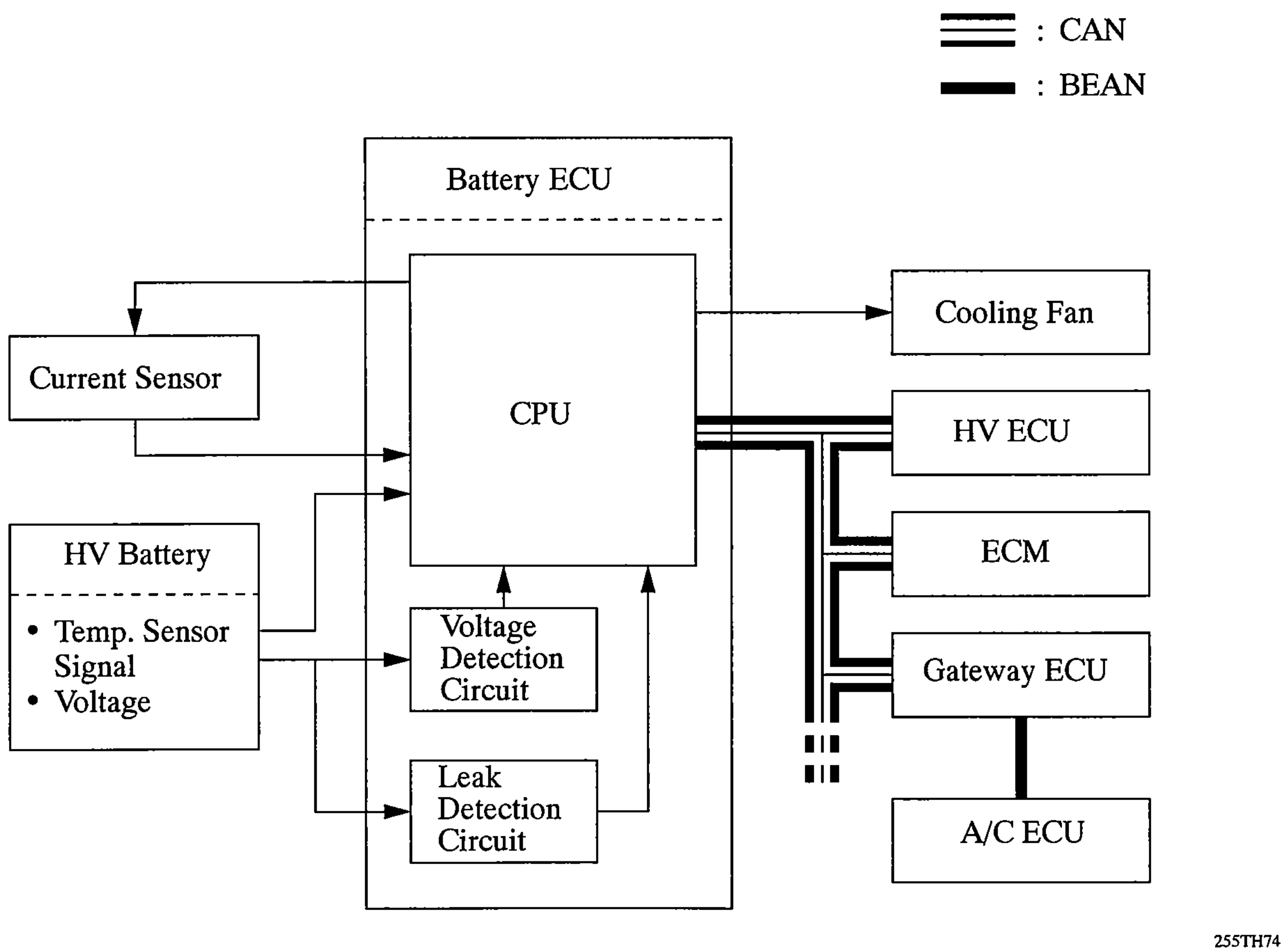
* : Only on model with Enhanced VSC System

7. Battery ECU Control

General

- The battery ECU detects the SOC (state of charge), temperature, leak, and the voltage of the HV battery, and sends this information to the HV ECU.
- The battery ECU detects the temperature of the battery via the temperature sensor located in the HV battery, and operates a cooling fan to control the temperature.

▶ **System Diagram** ◀



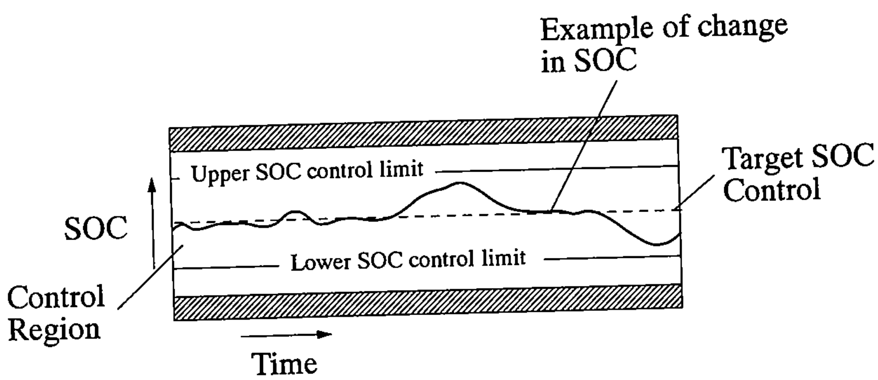
HV Battery Condition Monitoring Control

1) General

- The battery ECU constantly monitors the items listed below and transmits their information to the HV ECU.
  - Detects the HV battery temperature via the temperature sensor in the HV battery.
  - Detects the leak in the HV battery via the leak detection circuit in the HV battery.
  - Detects the voltage of the HV battery via the voltage detection circuit in the HV battery.
  - Detects the amperage via the current sensor.
- The HV battery calculates the SOC by estimating the charging and discharging amperage.

2) SOC Control

While the vehicle is in motion, the HV battery undergoes repetitive charging / discharging cycles, as it becomes discharged by the MG2 during acceleration and charged by the regenerative brake during deceleration. The battery ECU calculates the SOC based on charging/discharging levels detected by the current sensor, and transmits the calculated SOC value to the HV ECU. The HV ECU performs the charging/discharging control based on the received value in order to steady the SOC at its target level anytime.

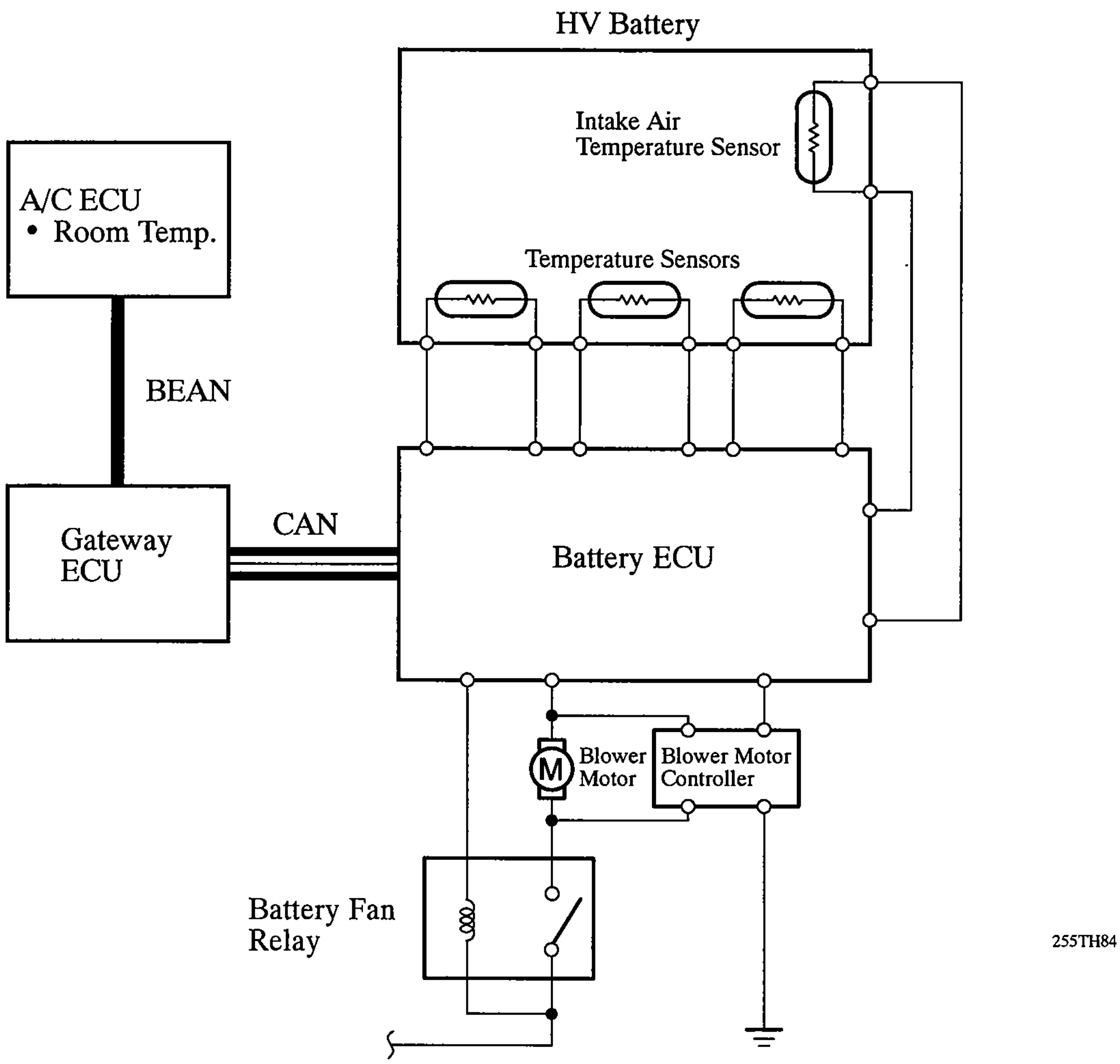


182TH12

Cooling Fan Control

- The battery ECU detects the rise in the battery temperature via the three temperature sensors in the HV battery and one intake air temperature sensor. Then, the battery ECU steplessly actuates the cooling fan under duty cycle control, in order to maintain the temperature of the HV battery within the specified range.
- While the air conditioning system is operating and cooling down the cabin, and if there is any leeway in the HV battery temperature, the battery ECU turns the cooling fan OFF or fixes it to the LO speed. The purpose of this control is to give priority to cooling down the cabin, because the air intake of the cooling system is provided in the cabin.

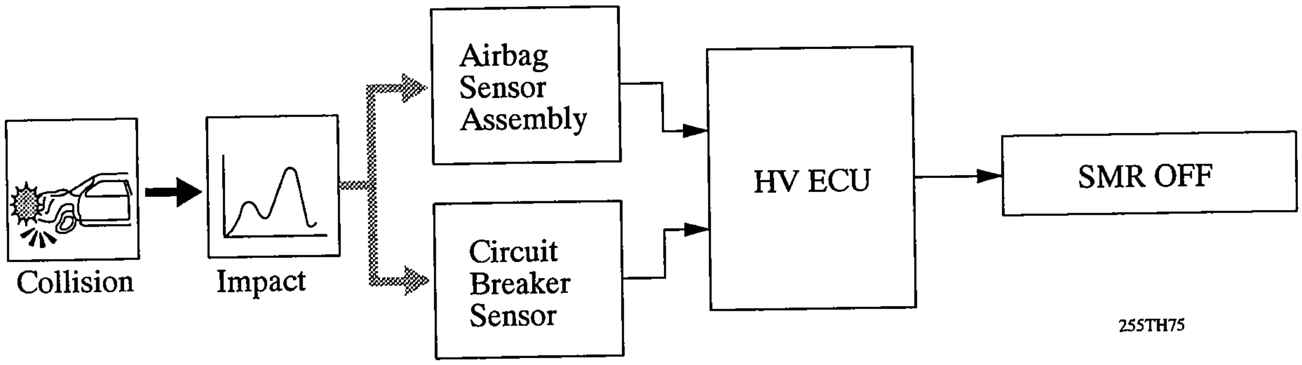
▶ System Diagram ◀



8. During Collision Control

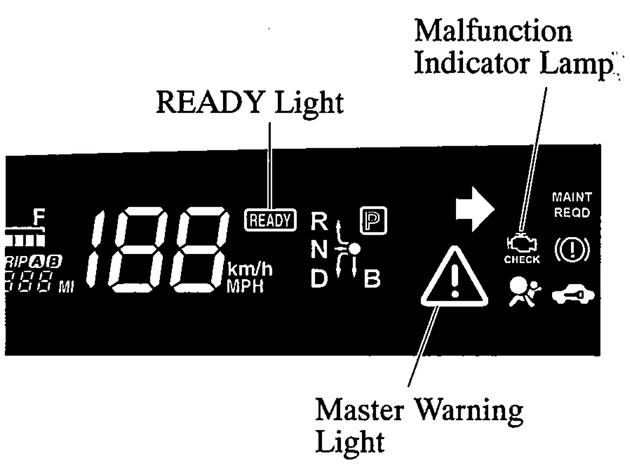
If the HV ECU receives an airbag deployment signal from the airbag sensor assembly or an actuation signal from the circuit breaker sensor located in the inverter during a collision, the HV ECU will shut down the entire power supply by turning the SMR (System Main Relay), in order to ensure safety.

▶ System Diagram ◀



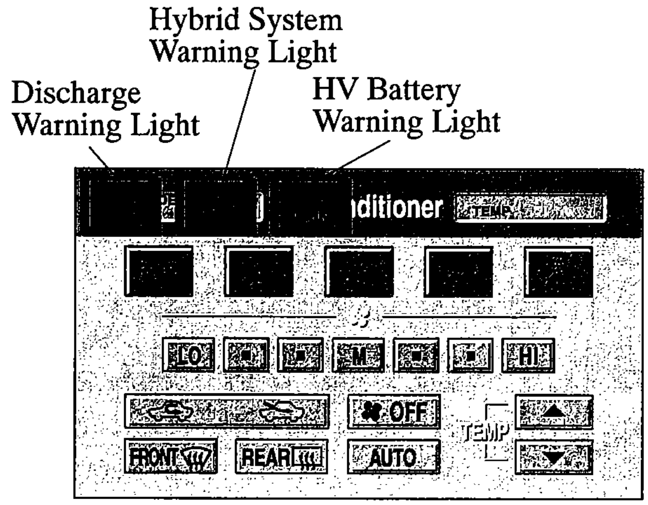
9. Indicator and Warning Light

- The warning lights of the '04 Prius are different from those on the previous model. In particular, the indicator and warning lights associated with the THS-II system are described below.



Combination Meter

255TH64

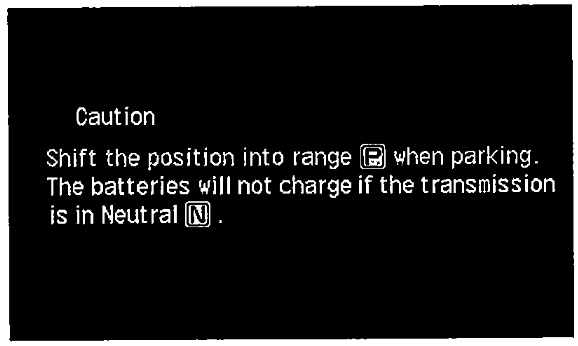


Multi Display

255TH76

Item	Outline
READY Light	This light blinks when the driver simultaneously presses the brake pedal and the push start switch while the shift position is in the "P" position. Thereafter, the light changes to illumination when the system starts. Thus, it informs the driver whether the vehicle is drivable.
Master Warning Light	• The primary function of this warning light, which illuminates simultaneously with the sounding of a warning buzzer, is to inform the driver in case of a malfunction in the THS-II system or when the SOC of the HV battery is lower than the standard. • Besides the foregoing conditions, this light illuminates and the buzzer sounds to inform the driver in case of an abnormal engine coolant temperature, abnormal oil pressure, a malfunction in the EPS system, or a malfunction in the transmission control ECU.
Malfunction Indicator Lamp	Turns on when there is a malfunction in the engine control system.
Discharge Warning Light	Turns on when there is a malfunction in the DC 12 V charging system (converter assembly). At the same time, the master warning light will illuminate.
HV Battery Warning Light	This warning light illuminates to inform the driver that the SOC is lower than the minimum standard value (%). At the same time, the master warning light will illuminate.
Hybrid System Warning Light	This indicator light illuminates to inform the driver of a malfunction in the THS-II system. At the same time, the master warning light will illuminate.

- When any of the conditions described below is present, the message prompt as shown appears in the multi display, accompanied by the illumination of the master warning light and the continuous sounding of the buzzer.
  - ♦ The READY light is illuminated, the shift position is in the "N" position, and the HV battery is discharged.
  - ♦ The READY light is illuminated, the shift position is in the "N", "B" or "D" position, and the driver's door is open.



255TH95

10. Diagnosis

- In the THS-II system, if the HV ECU, ECM, or the battery ECU detects a malfunction, the ECU performs a diagnosis and memorizes failed sections. Furthermore, to inform the driver of the malfunction, the ECU illuminates or blinks the MIL (Malfunction Indicator Lamp), master warning light, or HV battery warning light, which pertains to the ECU.
- The HV ECU, ECM, and the battery ECU will restore the respective DTCs of the malfunctions.
- Three-digit information codes have been provided in the conventional DTC as subset of a primary five-digit code. This enables the troubleshooting procedure to further narrow down a trouble area to identify a problem.
- The DTCs can be accessed through the use of the hand-held tester with CAN extension module.
- All the DTCs have been made to correspond to the SAE controlled codes. Some of the DTCs have been further divided into smaller detection areas than in the past, and new DTCs have been assigned to them. Additionally, DTCs have been added to correspond to items, which had been newly adopted.

For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

11. Fail-Safe

If the HV ECU detects a malfunction in the THS-II system, it will control the system in accordance with the data that is stored in its memory.

For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

ENGINE

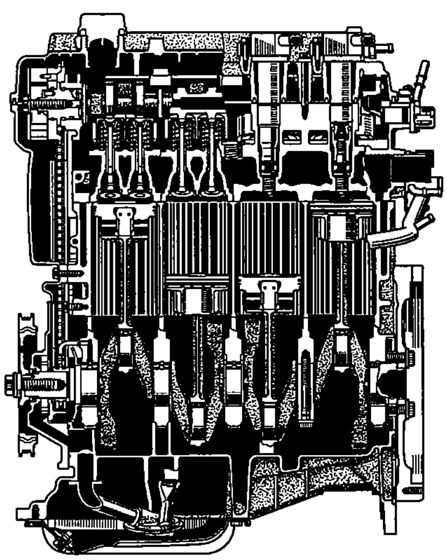
1NZ-FXE ENGINE

ENGINE

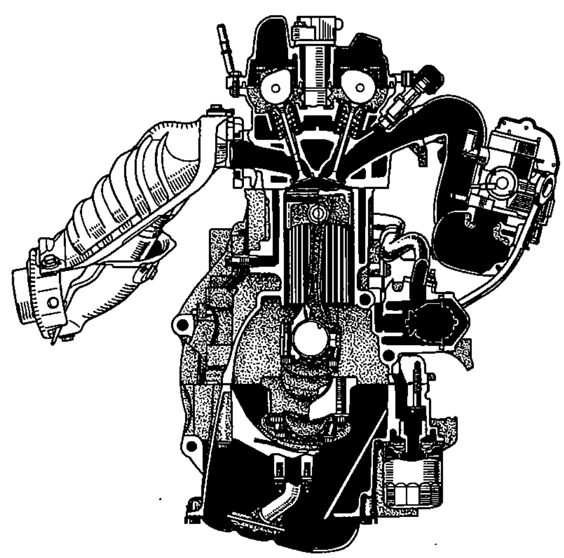
1NZ-FXE ENGINE

■ DESCRIPTION

- As on the '03 Prius, the '04 Prius continues to use the 1NZ-FXE engine that has been developed for the hybrid system application.
- This engine uses a high-expansion ratio Atkinson cycle, VVT-i (Variable Valve Timing-intelligent) system and ETCS-i (Electric Throttle Control System-intelligent) to realize high performance, quietness, fuel economy and clean emissions.
- In this engine, various areas of the pistons have been changed to reduce friction and improve combustion efficiency, in order to realize further improvements in fuel economy and low exhaust emissions.
- This engine complies with the AT-PZEV (Advanced Technology-Partial Zero Emission Vehicle) regulations. This has been achieved as a result of the changes that have been made in the engine control logic, as well as the adoption of the coolant heat storage system. The coolant heat storage system recovers the hot coolant that has been heated by the engine and stores it in a tank. Then, the system supplies the hot coolant to the engine at the time the engine is started cold. Thus, this system reduces the amount of HC emissions during cold starting.
- For the main changes made to this engine from the '03 Prius, see page EG-4.



255EG01



255EG02

▶ Engine Specifications ◀

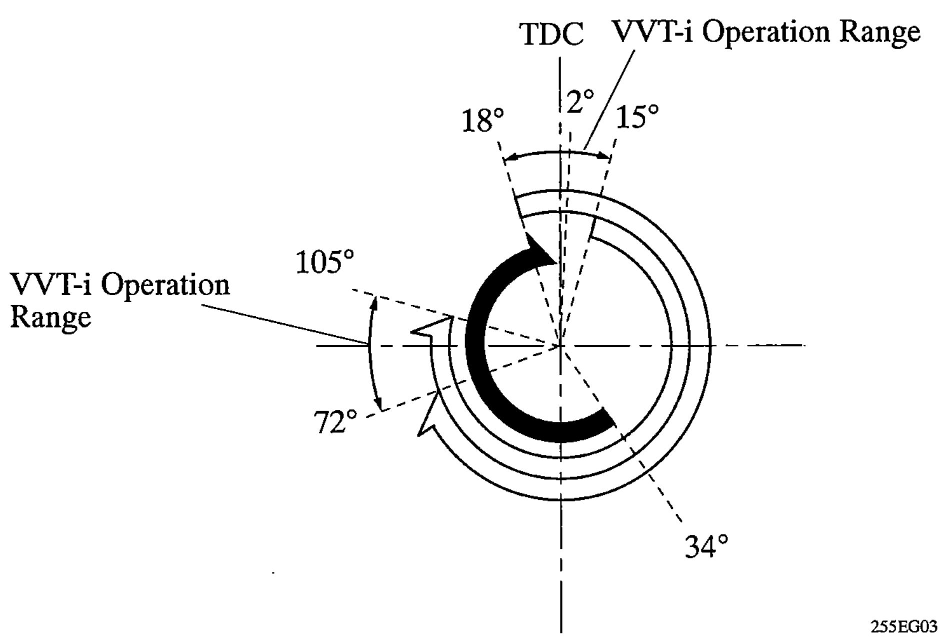
Model			'04 Prius	'03 Prius
Engine Type			1NZ-FXE	←
No. of Cyls. & Arrangement			4-Cylinder, In-line	←
Valve Mechanism			16-Valve DOHC, Chain Drive (with VVT-i)	←
Combustion Chamber			Pentroof Type	←
Manifolds			Cross-Flow	←
Fuel System			SFI	←
Displacement cm^3 (cu. in.)			1497 (91.3)	←
Bore × Stroke mm (in.)			75.0 × 84.7 (2.95 × 3.33)	←
Compression Ratio			13.0 : 1	←
Max. Output (SAE-NET)			57 kw @ 5000 rpm (76 HP @ 5000 rpm)	52 kw @ 4500 rpm (70 HP @ 4500 rpm)
Max. Torque (SAE-NET)			111 N·m @ 4200 rpm (82 ft·lbf @ 4200 rpm)	←
Valve Timing	Intake	Open	18° ~ −15° BTDC	18° ~ −25° BTDC
		Close	72° ~ 105° ABDC	72° ~ 115° ABDC
	Exhaust	Open	34° BBDC	←
		Close	2° ATDC	←
Firing Order			1-3-4-2	←
Research Octane Number			91 or higher	←
Octane Rating			87 or higher	←
Engine Service Mass* (Reference) kg (lb)			86.1 (189.8)	86.6 (190.9)
Oil Grade			API SJ, SL, EC or ILSAC	API SH, SJ, EC or ILSAC
Tailpipe Emission Regulation			SULEV	←
Evaporative Emission Regulation			AT-PZEV, ORVR	LEV-II, ORVR

*: Weight shows the figure with the oil and engine coolant fully filled.

▶ Valve Timing ◀

: Intake Valve Opening Angle

: Exhaust Valve Opening Angle



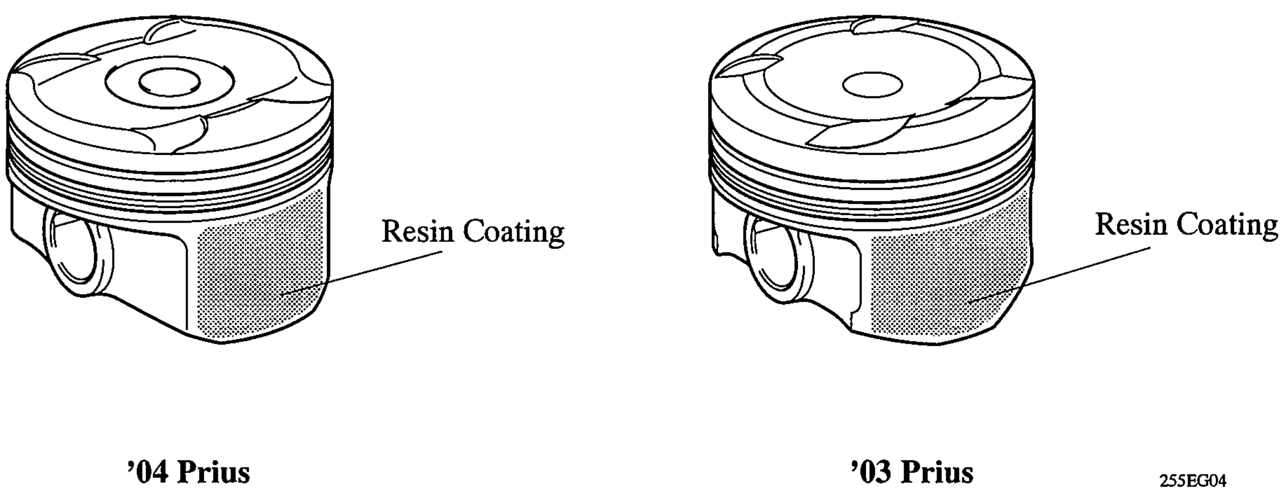
■MAJOR DIFFERENCE (from '03 Prius)

System		Features
Engine Proper	Piston	• The shape of the piston head has been changed. • The wall thickness in various areas of the piston has been optimized for weight reduction. • The area of the piston skirt has been reduced. • The thickness of the resin coating on the piston skirt has been increased. • The width of the piston ring has been reduced and its tension has been further reduced.
Cooling System		• Along with the adoption of the coolant heat storage system, the coolant pipes have been changed. • The radiator for the engine and the radiator for the inverter have been integrated. • The radiator reservoir tank and the fan shroud have been integrated. • The TOYOTA genuine super long life coolant has been adopted.
Intake and Exhaust System		• Adoption of a carbon filter for absorbing HC (Hydrocarbons) in the air cleaner cap. • A resonator has been provided at the air cleaner inlet. • The wall thickness of the exhaust manifold has been reduced. • The TOYOTA HCAC (HC Adsorber and Catalyst) system has been discontinued.
Fuel System		• The pipe layout of the evaporative emission control system has been changed. • The maximum flow rate of the purge VSV has been changed (40 L/min. to 60 L/min.). • A main fuel tube and a purge tube made of aluminum have been adopted. • The quick turn & ratchet construction type fuel tank cap has been adopted.
Engine Control System		• Change of the ECM (16-bit → 32-bit) • The flat type knock sensor has been adopted. • The no-contact sensor has been adopted in the accelerator pedal position sensor. For details, see page TH-38. • In place of the heated oxygen sensor (bank 1, sensor 1), a heated air fuel ratio sensor has been adopted. • The maximum retard closing timing of the intake valve by the VVT-i (Variable Valve Timing-intelligent) system has been changed from 115° to 105° ABDC (After Bottom-Dead-Center). • The coolant heat storage system has been adopted. • CAN (controller Area Network), which networks the ECUs of the vehicle control systems (engine electrical, chassis electrical, and hybrid system) and establishes communication among the ECUs, has been newly adopted. • The diagnosis communication has been changed from serial communication (ISO9141) to CAN communication. • All the DTC (Diagnostic Trouble Code) have been made to correspond to the SAE controlled codes.
Other		Configuration and structure are the same as the '03 Prius.

■ENGINE PROPER

1. Piston

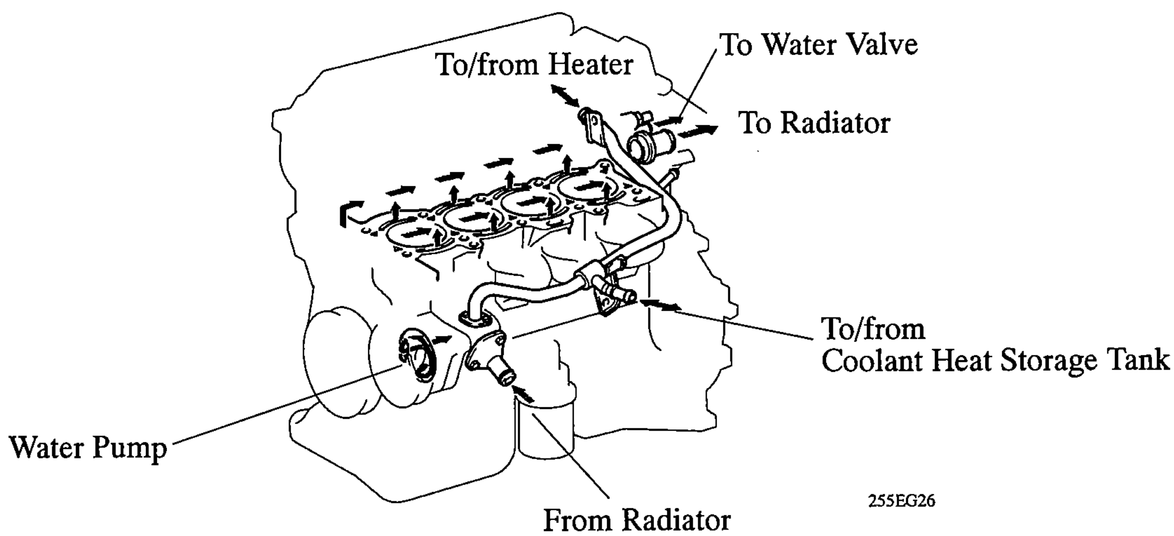
- The shape of the combustion chamber on the piston head has been changed from round to oval. As a result, the combustion efficiency has been improved.
- The following changes have been made to the piston in order to reduce weight and sliding resistance.
  - The wall thickness in various areas of the piston has been optimized for weight reduction.
  - The area of the piston skirt has been reduced.
  - The thickness of the resin coating on the piston skirt has been increased.
  - The width of the piston ring has been reduced and its tension has been further reduced.

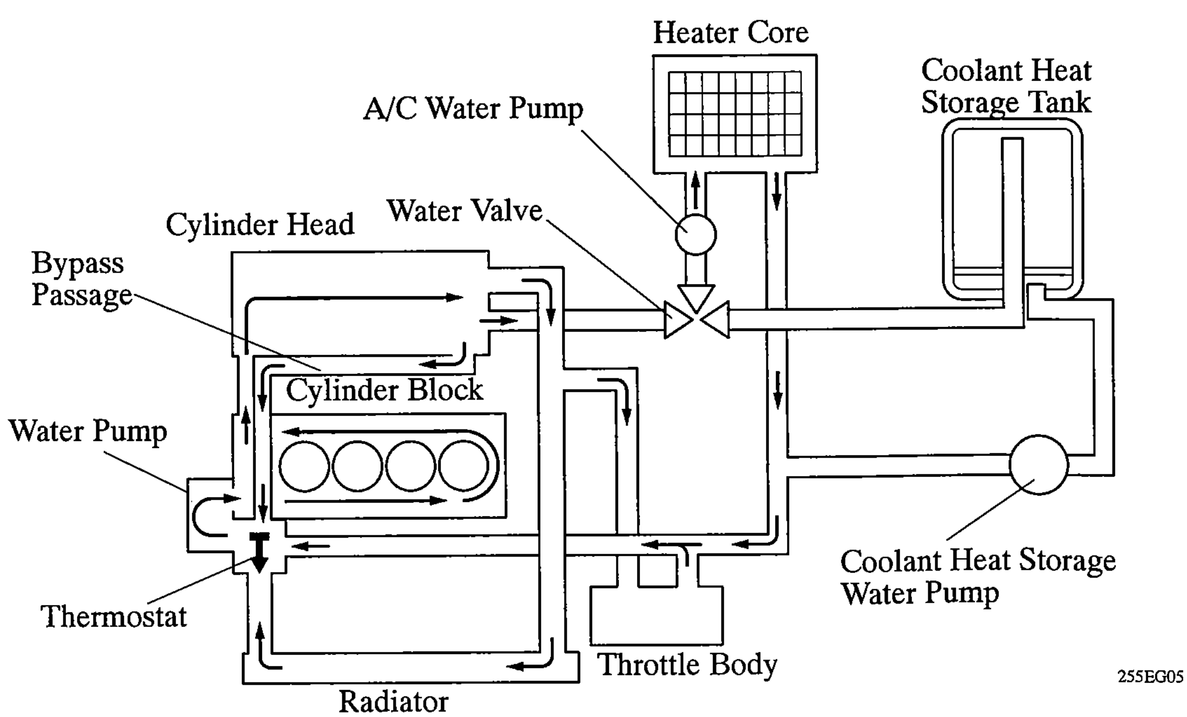


■COOLING SYSTEM

1. General

- Along with the adoption of the coolant heat storage system on the '04 Prius, a coolant heat storage tank, coolant heat storage water pump, and a water valve have been provided in the cooling system piping. For details on the coolant heat storage system control, see page EG-22.
- The radiator for the engine and the radiator for the inverter have been integrated to minimize the space they occupy in the engine compartment. Furthermore, the A/C condenser has been integrated with the radiator through the use of brackets.
- The radiator reservoir tank and the fan shroud have been integrated.
- The TOYOTA genuine super long life coolant (SLLC) has been adopted. As a result, the maintenance interval has been extended.





- SLLC is pre-mixed (50% coolant and 50% distilled water), so no dilution is needed when adding or replacing SLLC in the vehicle.
- If LLC is mixed with SLLC, the interval for LLC (every 25,000 miles / 40,000 km or 24 months) should be used.
- You can also apply the new maintenance interval (every 50,000 miles/ 80,000 km) to vehicles initially filled with LLC (red-colored), if you use SLLC (pink-colored) for the engine coolant change.

▶ Specifications ◀

<table>
<tr><td colspan="3">Model</td><td>'04 Prius</td><td>'03 Prius</td></tr>
<tr><td rowspan="5">Engine Coolant</td><td colspan="2">Capacity
liters (US qts, Imp. qts)</td><td>8.6 (9.1, 7.6)</td><td>4.9 (5.2, 4.3)</td></tr>
<tr><td colspan="2">Type</td><td>TOYOTA Genuine
Super Long Life Coolant
(SLLC)
or Equivalent</td><td>TOYOTA Genuine
Long Life Coolant (LLC)
or Equivalent</td></tr>
<tr><td colspan="2">Color</td><td>Pink</td><td>Red</td></tr>
<tr><td rowspan="2">Maintenance Intervals</td><td>First Time</td><td>100,000 mile (160,000 km)</td><td rowspan="2">U.S.A. Model:
Every 30,000 miles or 24 months whichever come first
Canada Model:
Every 32,000 km or 24 months whichever come first</td></tr>
<tr><td>Subsequent</td><td>Every 50,000 mile (80,000 km)</td></tr>
<tr><td>Thermostat</td><td colspan="2">Opening Temperature
°C (°F)</td><td>80 - 84 (176 - 183)</td><td>←</td></tr>
</table>

Service Tip

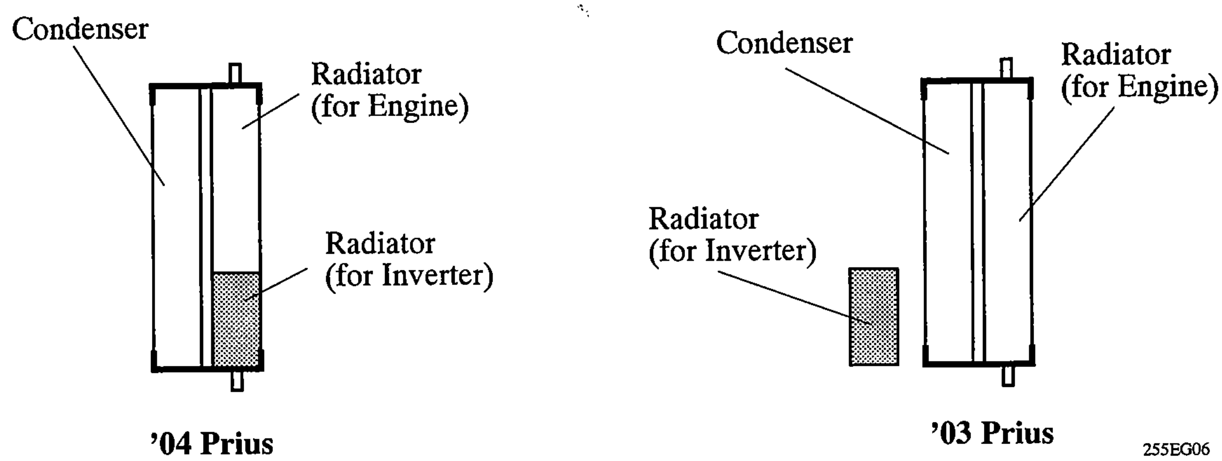
The engine coolant in the coolant heat storage tank is kept hot even if the engine and the radiator are cold. To verify the thermal insulation of the coolant heat storage tank and abnormality in the coolant heat storage water pump, the ECM may cause the coolant heat storage water pump to actuate even when the power switch is OFF (IG-OFF). Therefore, the user should never attempt to change the engine coolant. Because of the reason above, the engine coolant change method has been changed on the '04 Prius. An outline of the change as follow:

- Remove the coolant heat storage water pump connector prior to replacement, in order to prevent the pump from activating when draining the engine coolant.
- Drain the engine coolant from the coolant heat storage tank.
- When refilling engine coolant, operate the coolant heat storage water pump to help the inflow of the coolant into the coolant heat storage tank.
- Due to the aforementioned function of the ECM, the ECM may operate the coolant heat storage water pump while the engine coolant is being changed. If this occurs, the ECM will determine that a failure has occurred in the coolant heat storage system, it will record DTC P1151 or P2601 in its memory, and illuminate the MIL (Malfunction Indicator Lamp). However, this condition is not actual system fail. If the MIL has illuminated, make sure to delete the DTC after changing the engine coolant.

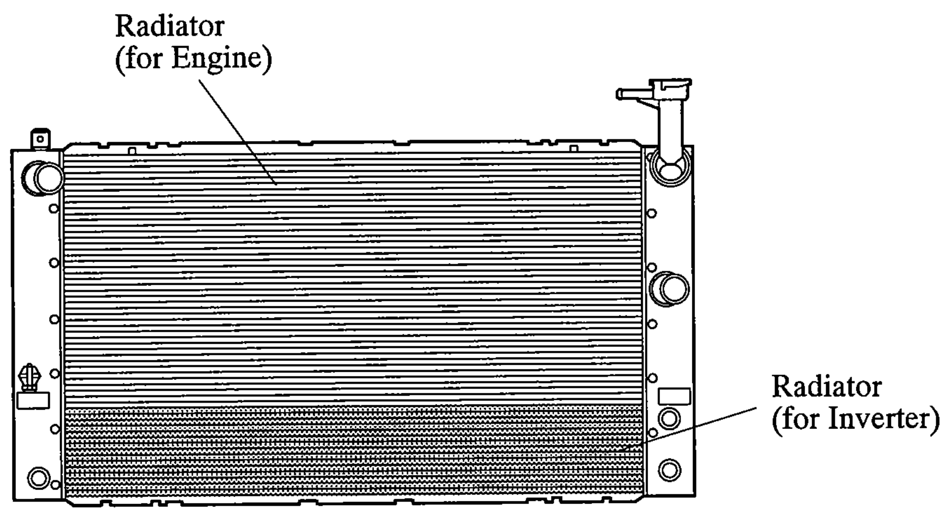
For detailed information of changing the engine coolant, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

2. Radiator

On the '03 Prius, the cooling module integrates the radiator for the engine and the A/C condenser. Instead, the '04 Prius has adopted a cooling module in which a radiator (which integrates the radiators for both the engine and the inverter) is integrated with an A/C condenser through the use of brackets. As a result, the space they occupy in the engine compartment has been minimized.



255EG06

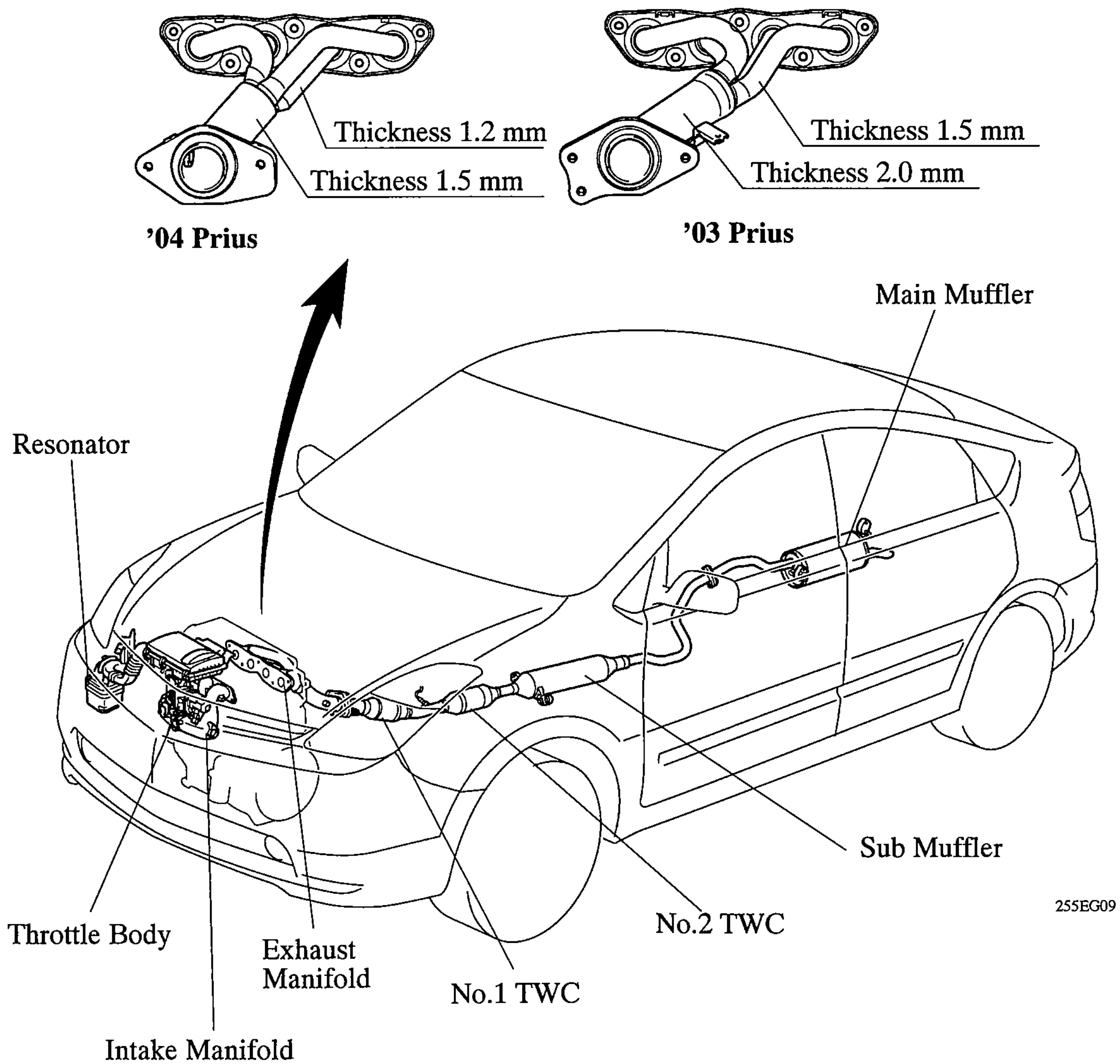


255EG07

■ INTAKE AND EXHAUST SYSTEM

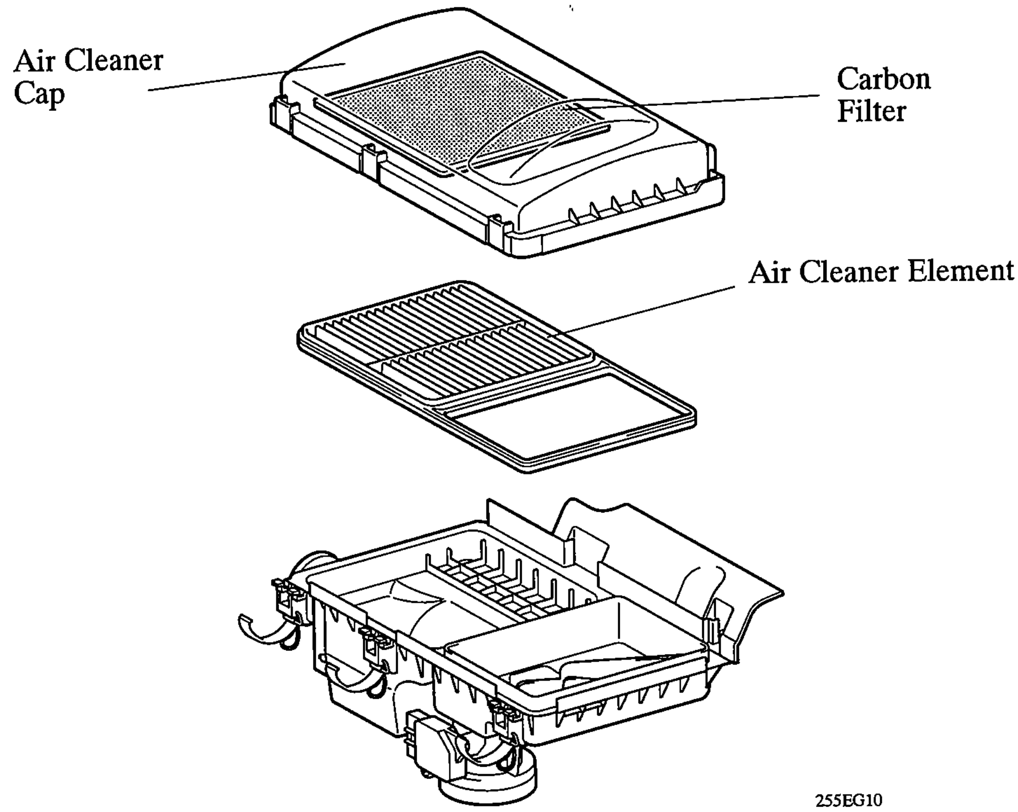
1. General

- The ETCS-i (Electronic Throttle Control System-intelligent) continues to be used from the '03 Prius.
- The link-less type throttle body is used.
- A carbon filter, which absorbs the HC that accumulates in the intake system when the engine is stopped, has been adopted in the air cleaner cap.
- A resonator has been provided at the air cleaner inlet in order to reduce the air intake noise.
- The shape of the exhaust manifold has been changed and its wall thickness has been reduced in order to improve the warm-up performance of the TWC (Three-Way Catalytic Converter) and weight reduction.
- The Toyota HCAC (HC Adsorber and Catalyst) system has been discontinued. Accordingly, the HC adsorber in the No. 2 TWC has been discontinued.



2. Air Cleaner

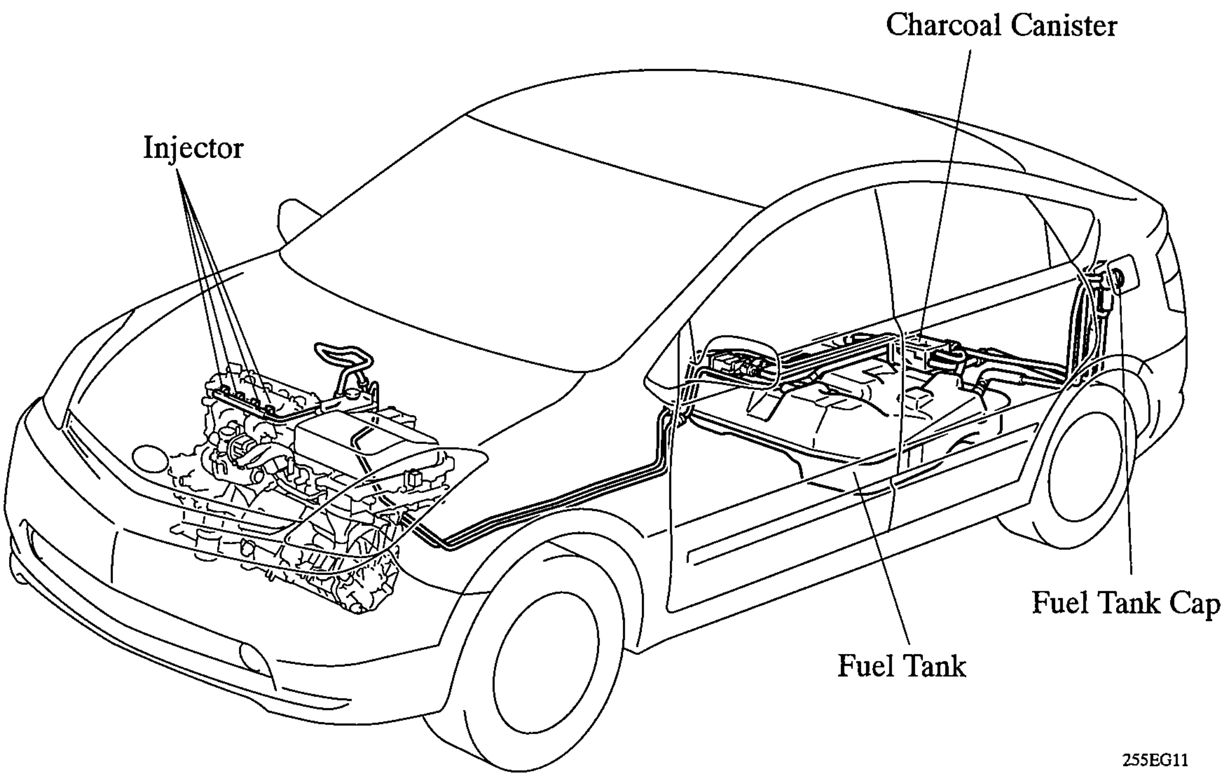
A carbon filter, which adsorbs the HC that accumulates in the intake system when the engine is stopped, has been adopted in the air cleaner cap in order to reduce evaporative emissions. This filter is maintenance-free.



■ FUEL SYSTEM

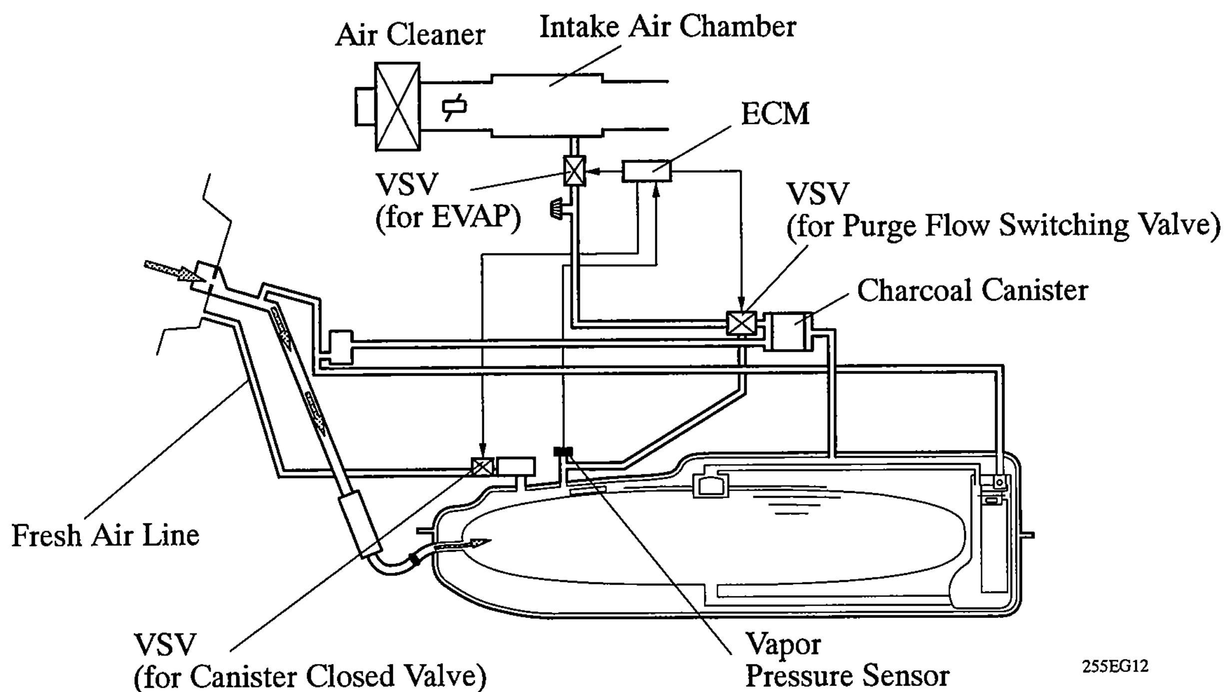
1. General

- A fuel returnless system is used to reduce evaporative emissions.
- A compact 12-hole type injector is used to improve the atomization of fuel.
- The vapor reducing fuel tank system, which reduces the amount of fuel vapor generated when the vehicle is parked, during refueling, or while driving, has been carried over from the '03 Prius. This system provides a vapor reducing fuel tank that expands or contracts in accordance with the volume of the fuel in the fuel storage area in the fuel tank. By thus reducing the space in which fuel can evaporate, the generation of fuel vapor is minimized.
- The ORVR (On-Board Refueling Vapor Recovery) system is used. On the '04 Prius, the fresh air line inlet of the ORVR system has been relocated from the air cleaner to the fuel inlet. However, its basic operation is the same as the '03 Prius.
- The maximum flow rate of the purge valve has been changed from 40 L/min. to 60 L/min. As a result, the evaporative emissions have been reduced.
- The quick turn & ratchet construction type fuel tank cap has been newly adopted to improve usability.
- A main fuel tube and a purge tube made of aluminum have been adopted for weight reduction.

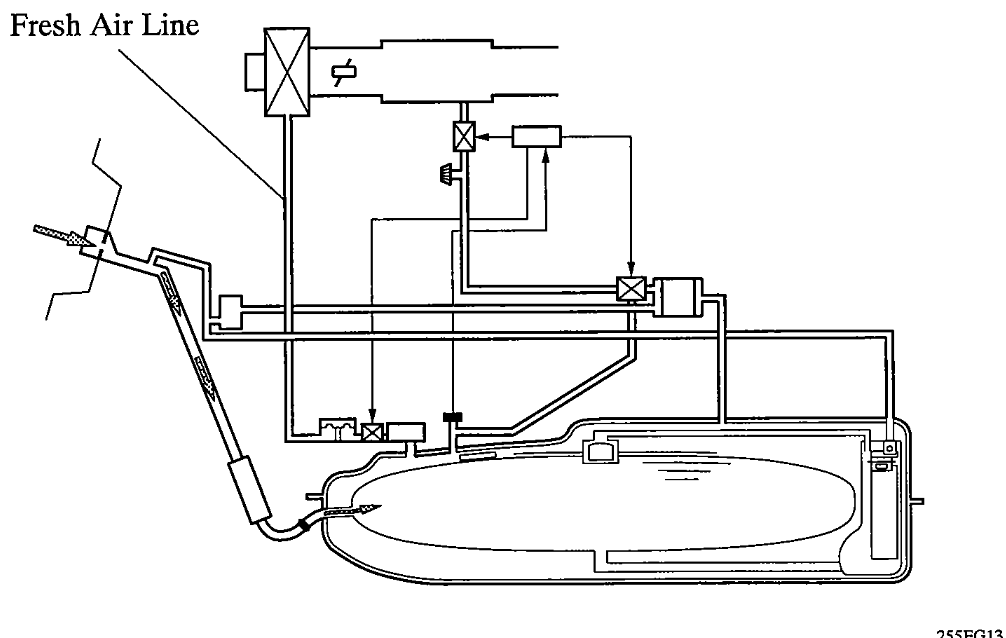


2. ORVR System

- The ORVR (On-Board Refueling Vapor Recovery) is a system that uses a charcoal canister, which is provided onboard, to recover the fuel vapor that is generated during refueling. This reduces the discharge of fuel vapor into the atmosphere.
- On the '04 Prius, the fresh air line inlet has been relocated from the air cleaner to the vicinity of the fuel inlet.



'04 Prius



'03 Prius

■ENGINE CONTROL SYSTEM

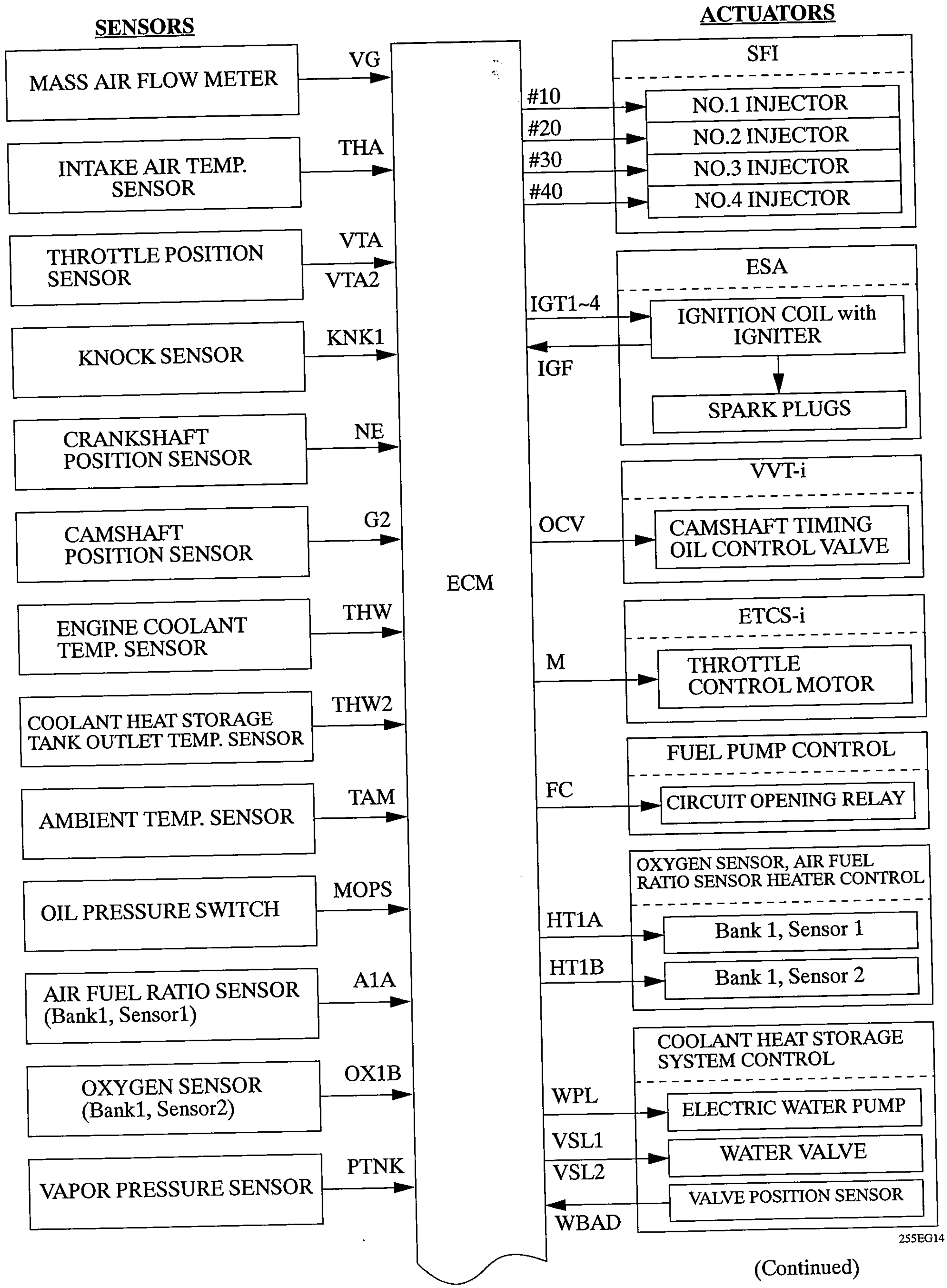
1. General

The engine control system of the 1NZ-FXE engine on the '04 Prius has following system.

System	Outline	'04	'03
SFI (Sequential Multiport Fuel Injection)	An L-type SFI system directly detects the intake air mass with a hot wire type mass air flow meter.	○	○
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM based on signals from various sensors. The ECM corrects ignition timing in response to engine knocking.	○	○
ETCS-i (Electronic Throttle Control System-intelligent)	The ECM optimally controls the throttle valve opening in accordance with the engine conditions and the ETCS-i control request received from the HV ECU.	○	○
VVT-i (Variable Valve Timing-intelligent)	Controls the intake camshaft to an optimal valve timing in accordance with the engine conditions and the control request received from the HV ECU.	○	○
	The maximum retard closing timing of the intake valve has been changed from 115° to 105° ABDC (After Bottom-Dead-Center). As a result, the cold-starting performance of the engine has been improved.	○	—
Coolant Heat Storage System (See page EG-22)	The ECM actuates a electric water pump in the coolant heat storage system to recover the coolant heated by the engine, store the hot coolant in the coolant heat storage tank, and supply it to the engine before starting a cold engine. This optimizes the combustion performance of the engine during cold-starting and reduces HC exhaust emissions.	○	—
Air Fuel Ratio Sensor, Oxygen Sensor Heater Control	Maintains the temperature of the air fuel ratio sensor or oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	○	○
Fuel Pump Control	• Fuel pump operation is controlled by signal from the ECM. • A fuel cut control is adopted to stop the fuel pump when the airbag is deployed during front or side collision.	○	○
Air Conditioning Cut-off Control	By turning the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.	—	○
Cooling Fan Control	The ECM steplessly controls the speed of the fans in accordance with the engine coolant temperature, vehicle speed, engine speed, and air conditioning operating conditions. As a result, the cooling performance has been improved.	○	○
Evaporative Emission Control	The ECM controls the purge flow of evaporative emission (HC) in the charcoal canister in accordance with engine conditions.	○	○
TOYOTA HCAC System	The ECM controls the VSV (for TOYOTA HCAC System) to improve the clean emission performance of the exhaust gas when the temperature of the TWC is low.	—	○
HV Immobiliser	Prohibits fuel delivery, ignition, and starting the hybrid system if an attempt is made to start the hybrid system with an invalid card key (ignition key).	○	○
Diagnosis (See page EG-32)	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.	○	○
	All the DTCs (Diagnostic Trouble Codes) have been made to correspond to the SAE controlled codes.	○	—
Fail-Safe (See page EG-32)	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.	○	○

2. Construction

The configuration of the engine control system in the 1NZ-FXE engine is shown in the following chart.



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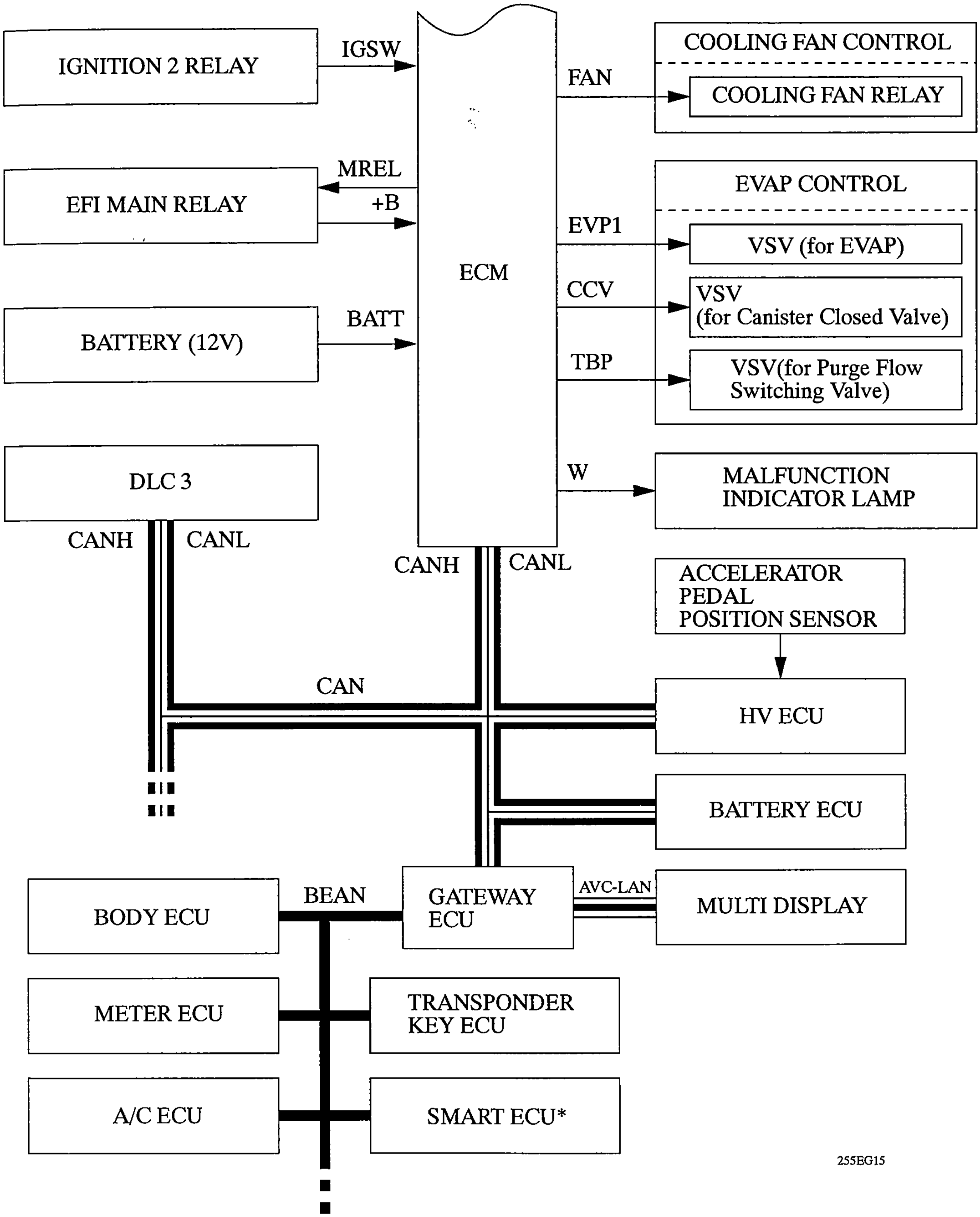
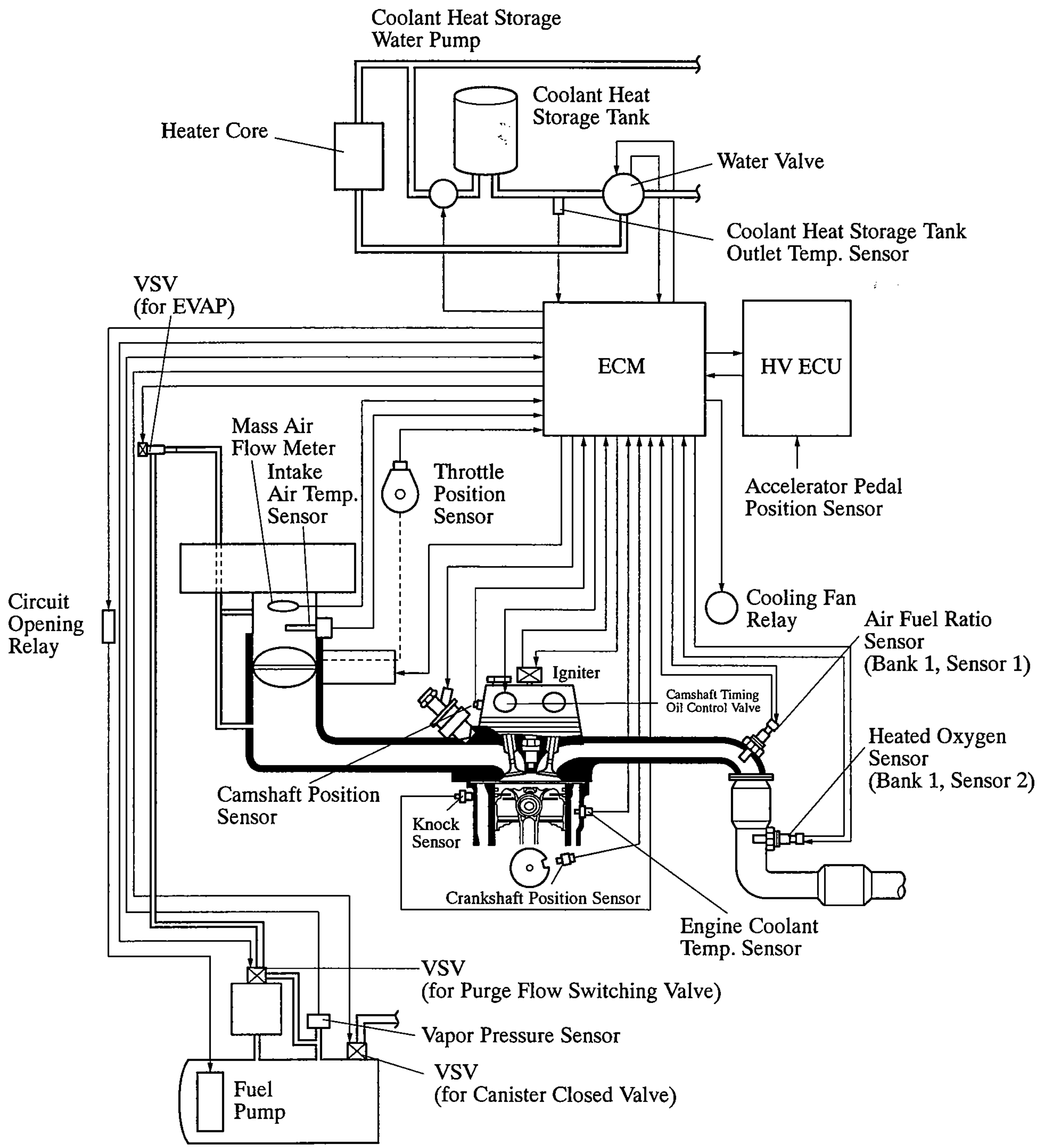


*: Models with Smart Entry & Start System

▶ MPX Communication ◀

Type	ECU	Signals Exchanged with ECM	
		Transmission Signals	Reception Signals
CAN	HV ECU	• Inspection mode • Required engine motive force • Fuel cut request • Target engine speed • Forced cranking request • Forced A/F (Air Fuel Ratio) learning authorization • MIL illumination request • Radiator fan actuation request • Shift condition • READY condition • Engine start request	• Fuel cut being executed • Crankshaft position sensor failure • Engine coolant temperature sensor failure • Engine unable to start detection (ran out of fuel) • Ambient temperature sensor • Intake air temperature sensor • Radiator fan actuation • Engine warm-up request • TWC warm-up request • Engine speed
	Battery ECU	—	• Crankshaft position sensor failure • Engine coolant temperature sensor failure • TWC warm-up request • Engine speed
BEAN	Body ECU	—	• Engine speed • Test mode
	Meter ECU	• Fuel Sender Gauge Level	• Engine coolant Temp. sensor • Engine speed • Fuel injection volume • Engine oil pressure switch • Test mode
	A/C ECU	—	• Engine coolant Temp. sensor • Engine speed • Ambient Temp. sensor • Water valve actuation
	Transponder Key ECU	—	• Engine speed
	Smart ECU	—	• Engine speed
AVC-LAN	Multi Display	—	• Engine coolant Temp. sensor • Engine oil pressure switch • Test mode

3. Engine Control System Diagram



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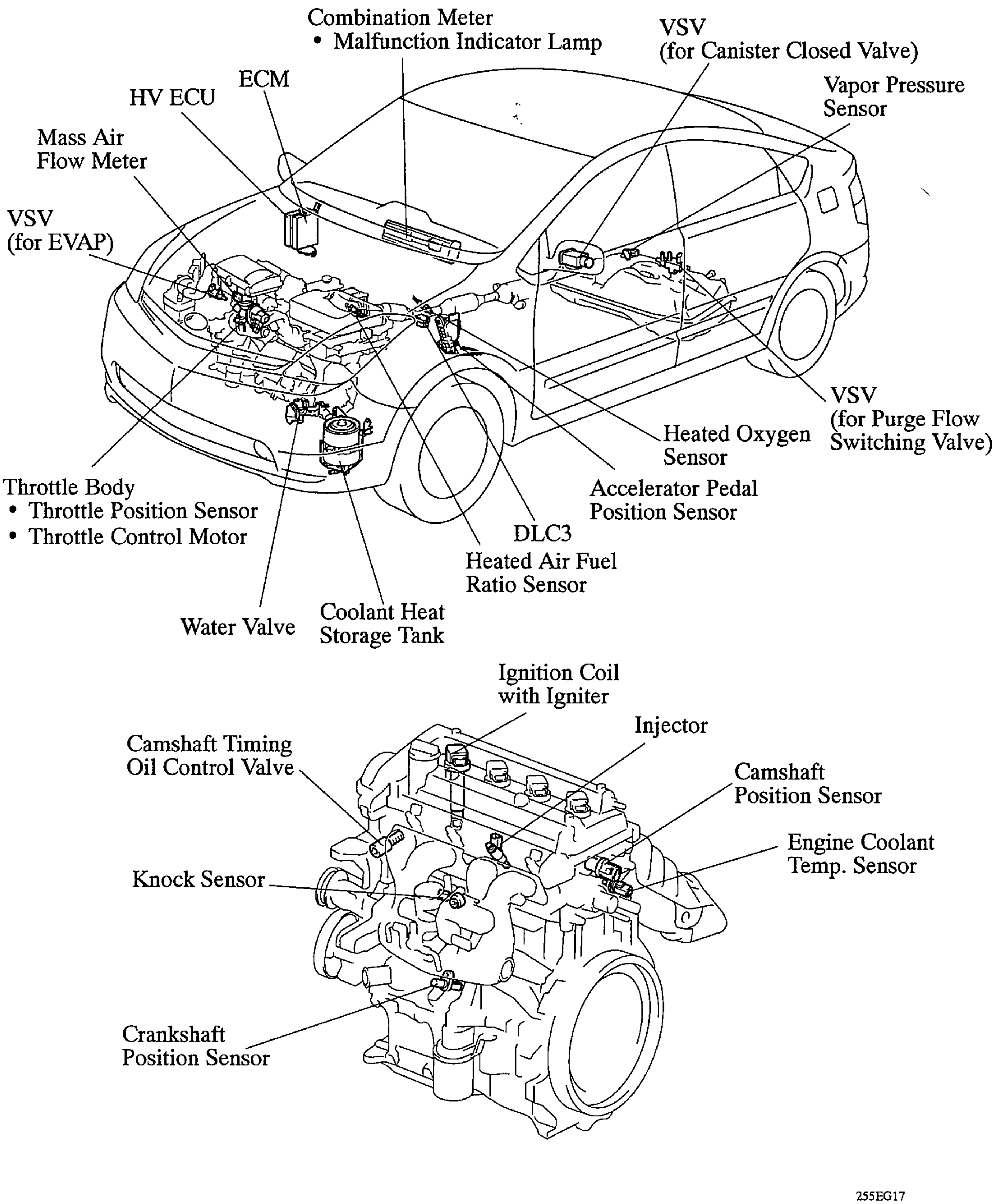
4. Layout of Main Components



5. Main Components of Engine Control System

General

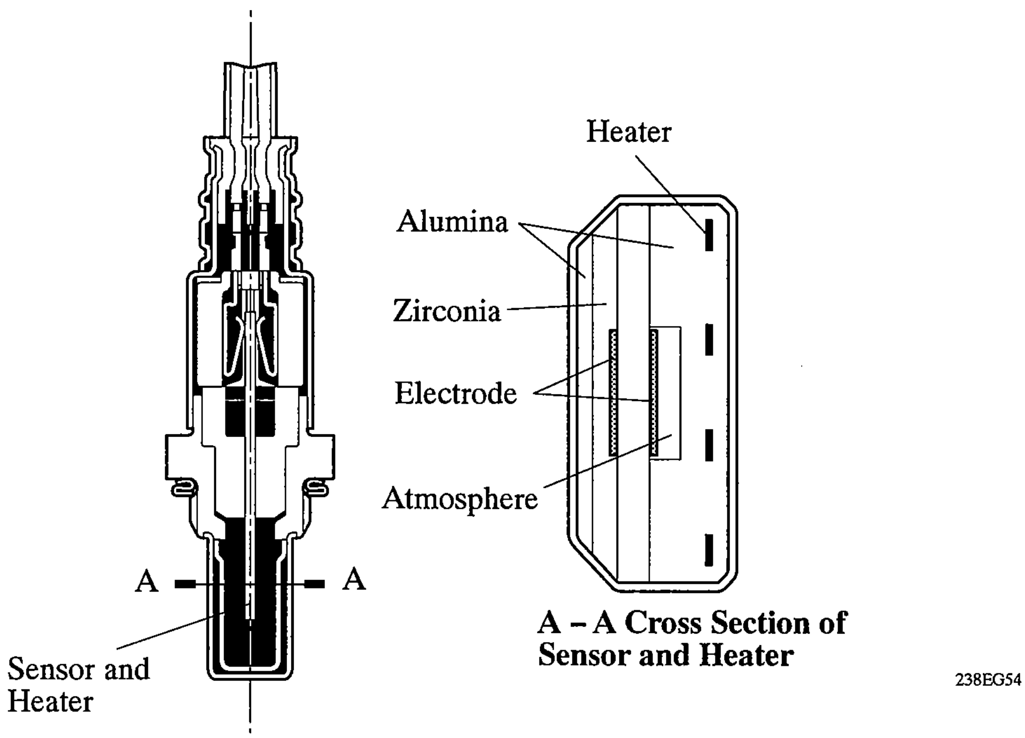
The following table compares the main components.

Components	'04 Prius		'03 Prius	
	Outline	Quantity	Outline	Quantity
ECM	32-bit CPU	1	16-bit CPU	1
Air Fuel Ratio Sensor	with Heater Type (Planar Type)	1	—	
Oxygen Sensor	with Heater Type (Cup Type)	1	with Heater Type (Cup Type)	2
Mass Air Flow Meter	Hot-wire Type	1	←	
Crankshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (36-2)	1	←	
Camshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (3)	2	←	
Knock Sensor	Built-in Piezoelectric Type (Flat Type)	1	Built-in Piezoelectric Type (Conventional Type)	1
Throttle Position Sensor	Linear Type	1	←	
Injector	12-Hole Type	4	←	

EG

Air Fuel Ratio Sensor

The air-fuel ratio sensor is the planar type. Compared to the conventional type (cup type), the sensor and heater portions of the planar type are narrower overall. Because the heat of the heater acts directly on the alumina and zirconia (of the sensor portion) it accelerates the activation of the sensor.



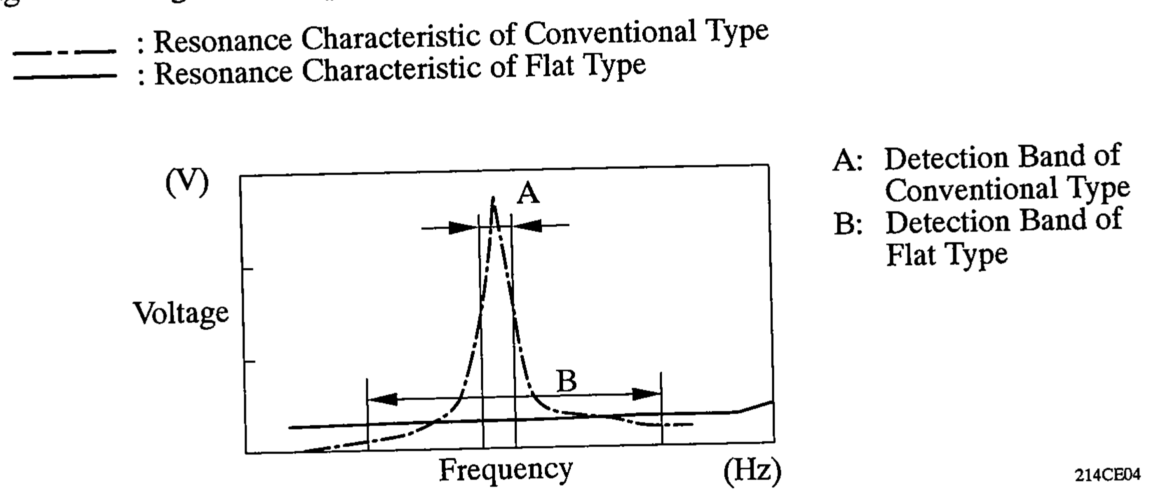
Air Fuel Ratio Sensor

Knock Sensor (Flat Type)

1) General

In the conventional type knock sensor (resonant type), a vibration plate which has the same resonance point as the knocking frequency of the engine is built in and can detect the vibration in this frequency band. On the other hand, a flat type knock sensor (non-resonant type) has the ability to detect vibration in a wider frequency band from about 6 kHz to 15 kHz, and has the following features.

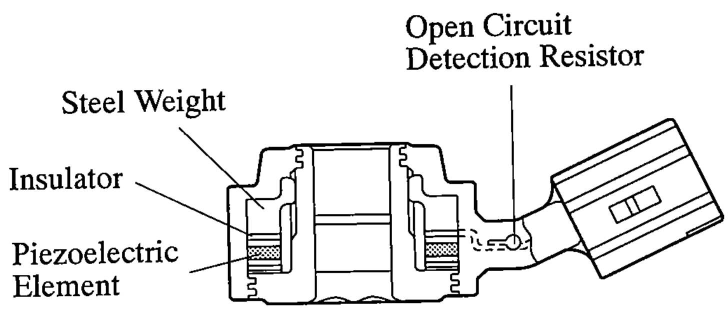
- The engine knocking frequency will change a bit depending on the engine speed. The flat type knock sensor can detect the vibration even when the engine knocking frequency is changed. Thus the vibration detection ability is increased compared to the conventional type knock sensor, and a more precise ignition timing control is possible.



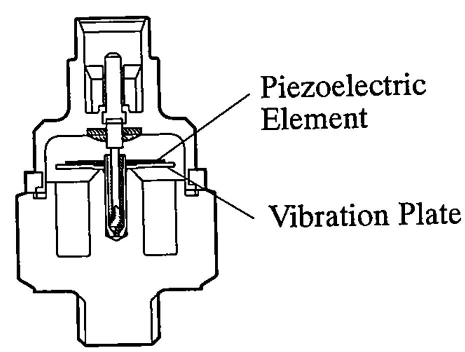
Characteristic of Knock Sensor

2) Construction

- The flat type knock sensor is installed on the engine through the stud bolt installed on the cylinder block. For this reason, a hole for the stud bolt is running through in the center of the sensor.
- Inside of the sensor, a steel weight is located on the upper portion and a piezoelectric element is located under the weight through the insulator.
- The open/short circuit detection resistor is integrated.



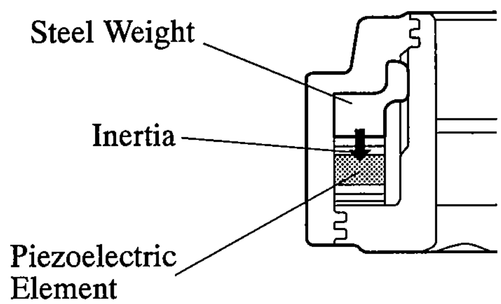
Flat Type Knock Sensor (Non-Resonant Type) 214CE01



Conventional Type Knock Sensor (Resonant Type) 214CE02

3) Operation

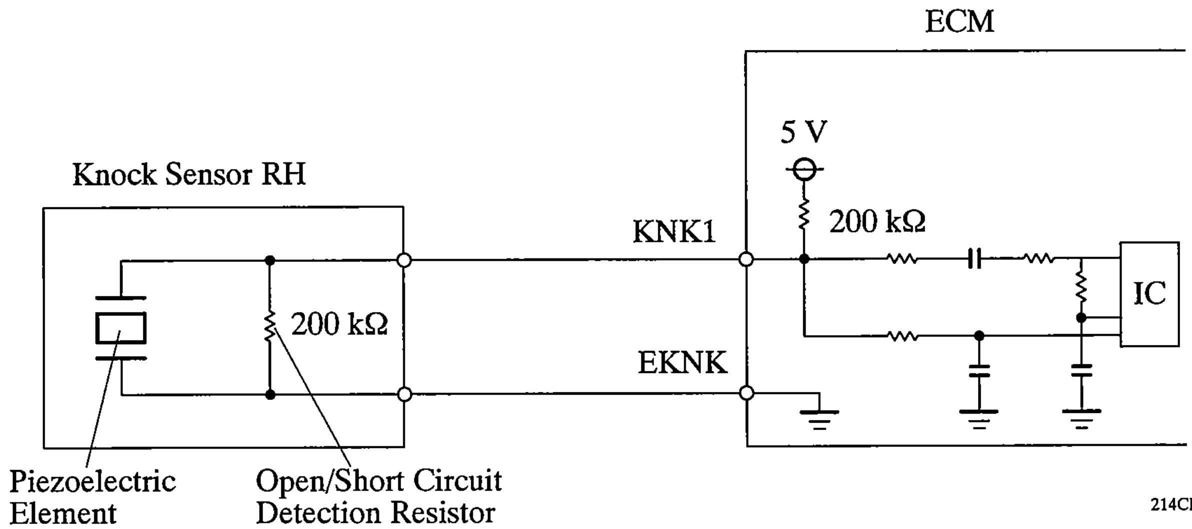
The knocking vibration is transmitted to the steel weight and its inertia applies pressure to the piezoelectric element. The action generates electromotive force.



214CE08

4) Open/Short Circuit Detection Resistor

When the ignition is ON, the open/short circuit detection resistor in the knock sensor and the resistor in the ECM keep the voltage at the terminal KNK1 of engine constant.
An IC (Integrated Circuit) in the ECM is always monitoring the voltage of the terminal KNK1. If the open/short circuit occurs between the knock sensor and the ECM, the voltage of the terminal KNK1 will change and the ECM detects the open/short circuit and stores DTC (Diagnostic Trouble Code).



214CE06

Service Tip

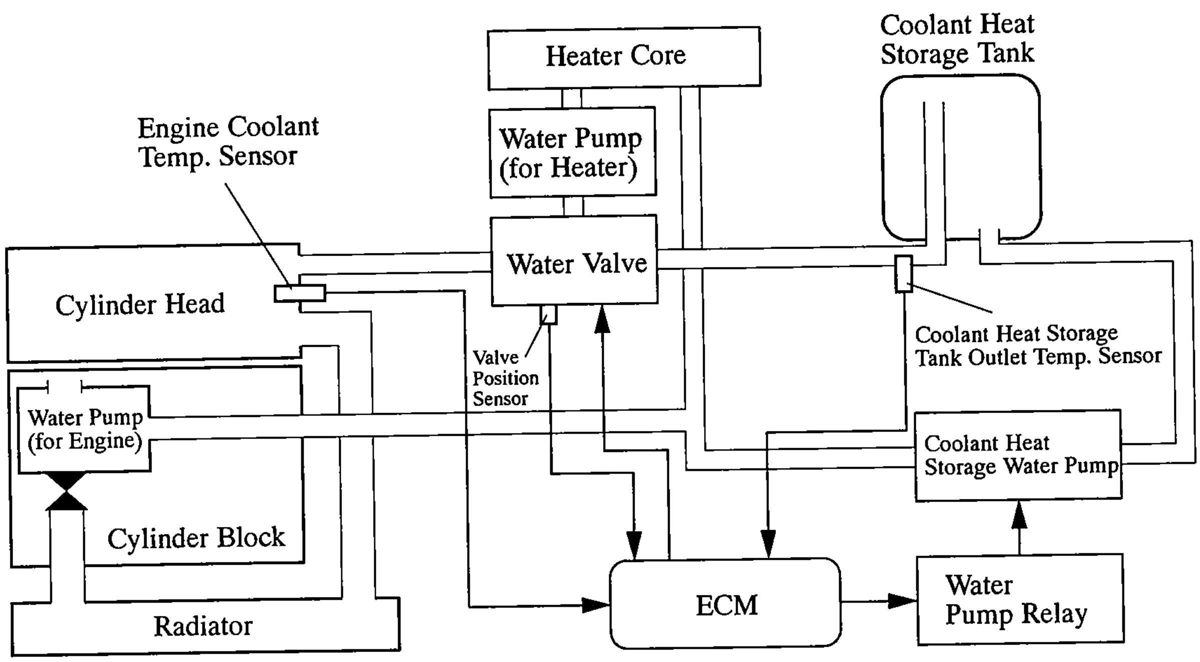
In accordance with the adoption of open/short circuit detection resistor, the inspection method for the sensor has been changed. For details, refer to 2004 Prius Repair Manual (Pub. No. RM1075U).

6. Coolant Heat Storage System

General

- The coolant heat storage system recovers the engine coolant that has been heated by the engine and stores it in the coolant heat storage tank. Then, the system supplies the hot coolant to the engine before starting a cold engine, in order to preheat the intake port of the engine. This effectively reduces the fuel injection volume during cold starting, minimizes the adhesion of fuel onto the intake port wall surface, and reduces HC exhaust emissions.
- This system consists primarily of a coolant heat storage tank, coolant heat storage water pump, water valve, coolant heat storage tank outlet temperature sensor and ECM.

▶ System Diagram ◀



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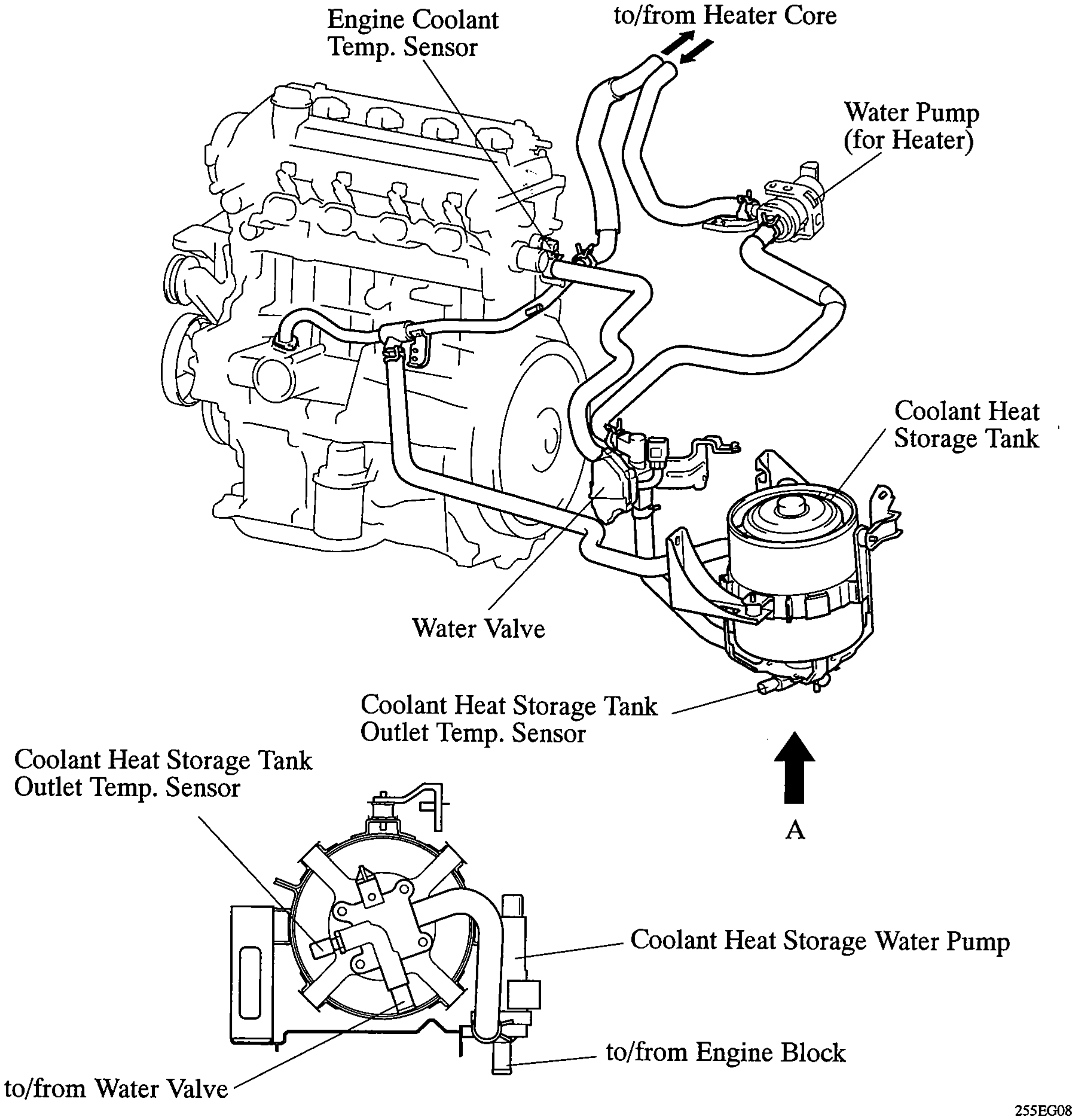
Layout of Main Components



View from A

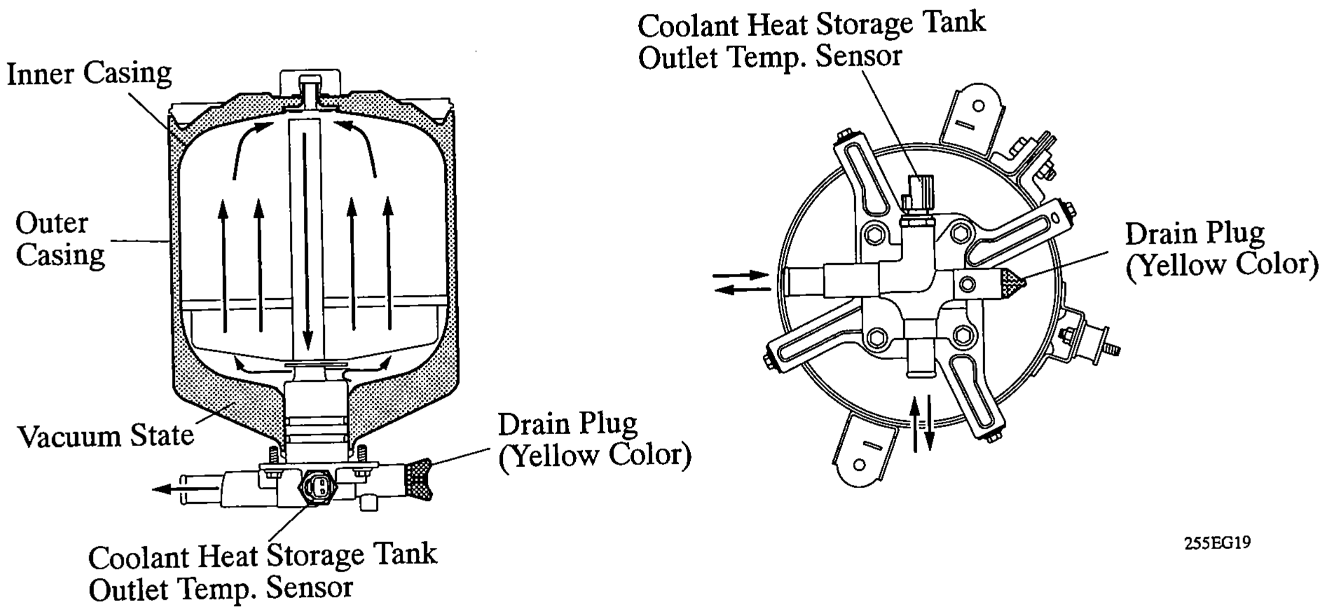
Function of Main Components

Components	Function
Coolant Heat Storage Tank	Stores the engine coolant that has been heated by the engine, and keeps it warm.
Coolant Heat Storage Water Pump	Actuated by the ECM via a relay, this pump supplies coolant from the coolant heat storage tank to the engine and recovers coolant from the engine and stores it to the coolant heat storage tank.
Water Valve	Actuated by the ECM, this valve switches the engine coolant passages in accordance with the system control conditions.
Coolant Heat Storage Tank Outlet Temp. Sensor	Located at the engine coolant inlet/outlet of the coolant heat storage tank, this sensor transmits the engine coolant temperature measured at the inlet/outlet of the coolant heat storage tank to the ECM.
ECM	The ECM effects preheat control (to supply hot coolant to the engine) and hot coolant recovery control through the water pump and the water valve.

Construction and Operation

1) Coolant Heat Storage Tank

- The coolant heat storage tank is a heat insulation container made of stainless steel, and has a dual vacuum construction. It can store approximately 3 liters of engine coolant and keep it warm. The basic construction of this tank is the same as the household Thermos bottle.
- The bottom area of the coolant heat storage tank contains 2 water paths for the engine coolant, a coolant heat storage tank outlet temperature sensor, and a drain plug.



Coolant Heat Storage Tank Cross Section **View from the Bottom Side**

Service Tip

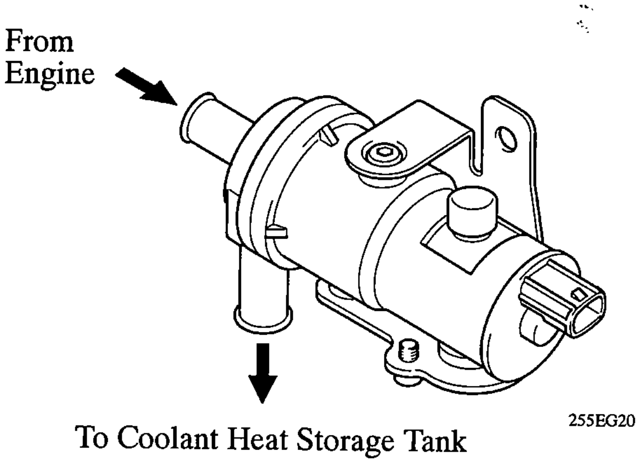
The engine coolant in the coolant heat storage tank is kept hot even if the engine and the radiator are cold. To verify the thermal insulation of the coolant heat storage tank and abnormality in the coolant heat storage water pump, the ECM may cause the coolant heat storage water pump to actuate even when the power switch is OFF (IG–OFF). Therefore, the user should never attempt to change the engine coolant. Because of the reason above, the engine coolant change method has been changed on the '04 Prius. An outline of the change as follow:

- Remove the coolant heat storage water pump connector prior to replacement, in order to prevent the pump from activating when draining the engine coolant.
- Drain the engine coolant from the coolant heat storage tank.
- When refilling engine coolant, operate the coolant heat storage water pump to help the inflow of the coolant into the coolant heat storage tank.
- Due to the aforementioned function of the ECM, the ECM may operate the coolant heat storage water pump while the engine coolant is being changed. If this occurs, the ECM will determine that a failure has occurred in the coolant heat storage system, it will record DTC P1151 or P2601 in its memory, and illuminate the MIL (Malfunction Indicator Lamp). However, this condition is not actual system fail. If the MIL has illuminated, make sure to delete the DTC after changing the engine coolant.

For detailed information of changing the engine coolant, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

2) Coolant Heat Storage Water Pump

- This water pump contains a DC brush motor that is driven with a 12V~14V power supply.
- The ECM actuates a relay to operate the water pump in order to supply the hot coolant from the coolant heat storage tank to the engine (pre-heat operation), and recover the hot coolant to be stored in the coolant heat storage tank while the vehicle is stopped (IG-OFF).



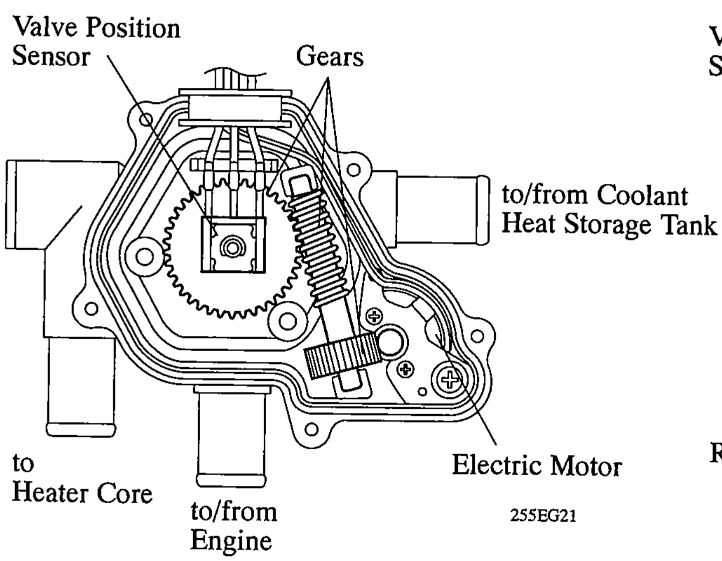
▶ Specifications ◀

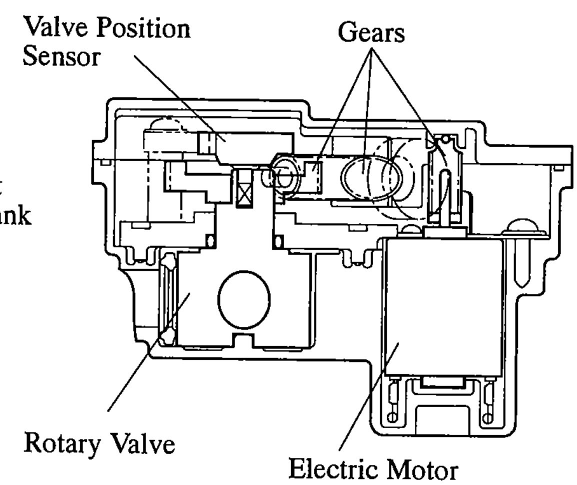
Pump Type		Centrifugal Pump
Motor Type		DC Brush Motor
Flow Volume	14 V	23.5L/min
	12 V	21.0L/min
Discharge Pressure	14 V	32 kPa (4.6 psi)
	12 V	25.5 kPa (3.7 psi)

3) Water Valve

a. General

- The water valve is located in the engine coolant passage between the engine, heater core, and the coolant heat storage tank. It switches the engine coolant passages when the position of the rotary valve, which is built into the water valve, is switched.
- The water valve consists of a rotary valve, valve position sensor, reduction gear, and an electric motor.
- This sensor, which is located above the rotary valve, outputs a voltage that corresponds to the rotation of the rotary valve to the ECM.

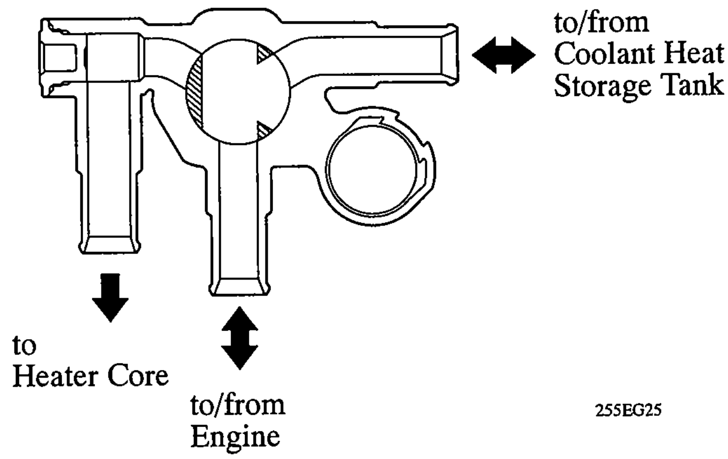




Cross Section

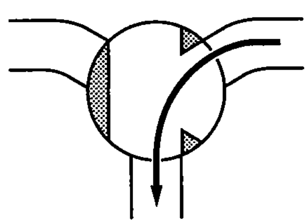
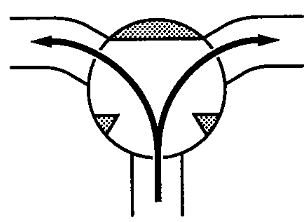
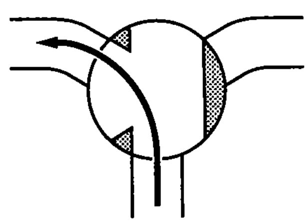
b. Rotary Valve

- The ECM determines the present position of the rotary valve in accordance with the voltage that is being output by the valve position sensor. To switch the position of the rotary valve in order to switch the engine coolant passages, the electric motor operates the rotary valve.
- The ECM switches the rotary valve to the 3 positions indicated below, in accordance with the control mode of the coolant heat storage system.



Rotary Valve Cross Section

▶ **Rotary Valve Position** ◀

		
• Preheat Operation • Storage Operation (After Power Switch OFF) • Power Switch OFF	• Storage Operation (During Driving)	• No Storage Operation (Engine Running)

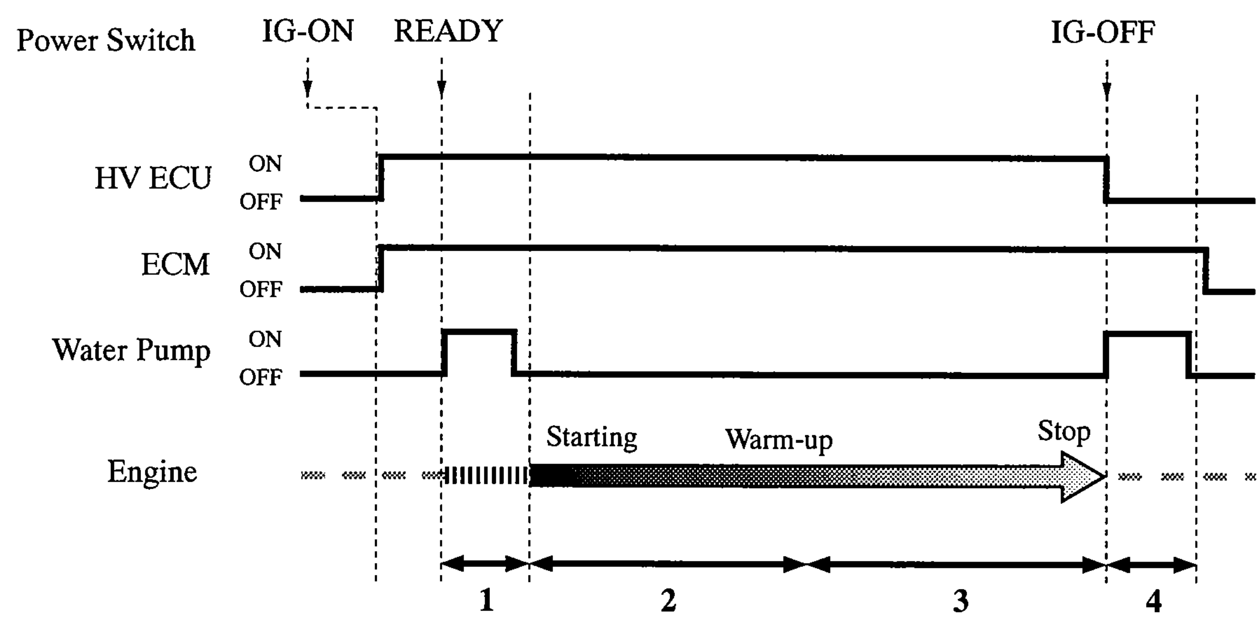
255EG24

System Operation

1) General

- Before starting a cold engine, the coolant heat storage system supplies the hot coolant that is stored in the coolant heat storage tank to the engine in order to preheat the cylinder head. After the engine has been warmed up, this system recovers the hot coolant from the engine.
- The ECM controls this system by performing the following functions in accordance with the timing chart described below: preheat operation, engine warm-up operation, storage operation (during driving), and storage operation (IG-OFF).
- To verify the thermal insulation of the coolant heat storage tank and abnormality in the coolant heat storage water pump, the ECM may cause the coolant heat storage water pump to actuate approximately 5 hours after the power switch has been turned OFF even when the power switch is OFF (IG-OFF).

▶ Timing Chart ◀

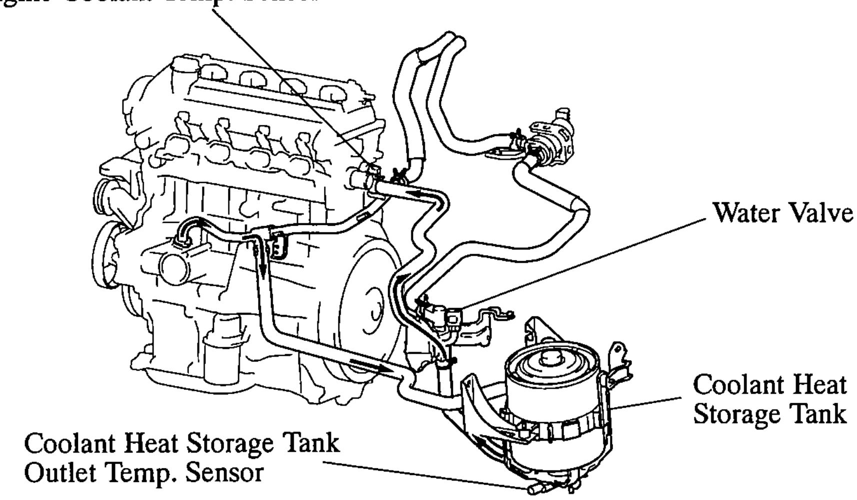


1: Preheat Operation
2: Engine Warm-Up Operation
3: Storage Operation (During Driving)
4: Storage Operation (IG-OFF)

NOTE: After 5 hours have elapsed with the power switch OFF, the actuating sound of a motor may be heard from the engine compartment. As described previously, this is the normal actuating sound of the water pump (for the coolant heat storage system), which occurs when the ECM checks the heat storage performance of the coolant heat storage tank.

2) Preheat Operation

- Provided that the engine is cold when the hybrid system is being started, the ECM actuates the coolant heat storage water pump and operates the water valve in order to switch the engine coolant passages. Thus, the preheat operation starts, with the hot coolant stored in the coolant heat storage tank being pumped into the engine. The ECM will not perform the preheat operation if condition is other than above.
- As a rule, the engine does not operate during a preheat operation, allowing the vehicle to be driven only in the EV mode. However, preheating may be canceled and the engine may start during the preheat operation.
- The preheat operation is completed in several seconds.



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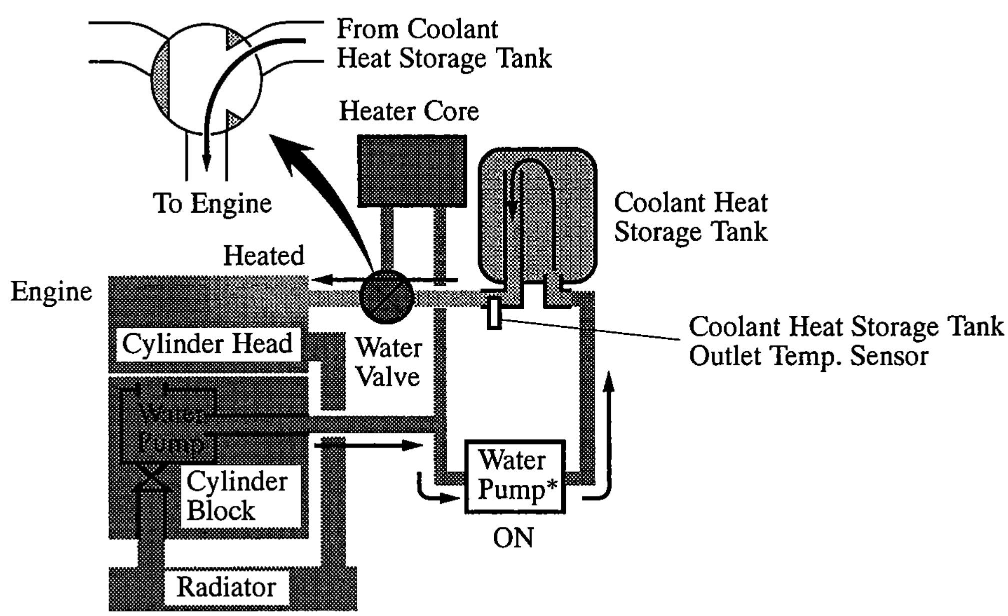
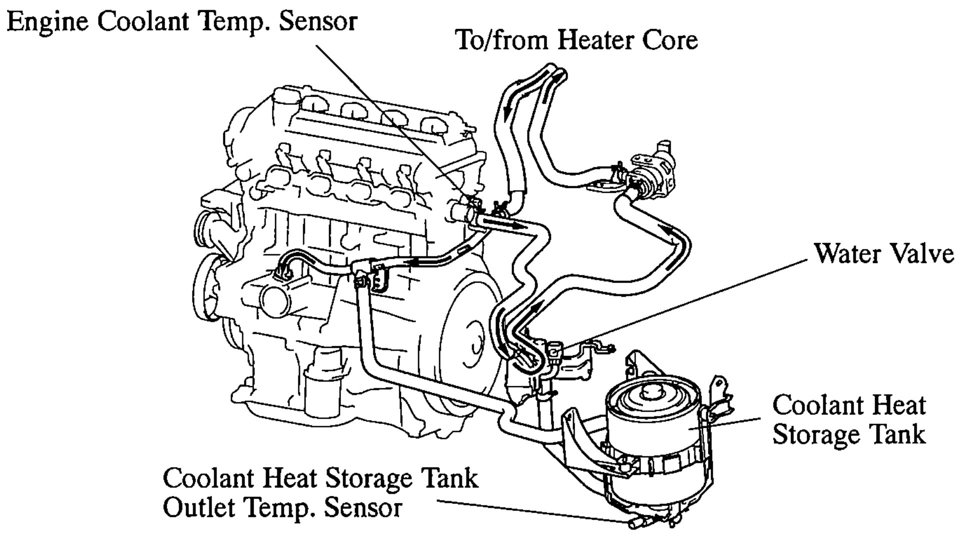


*: Coolant Heat Storage Water Pump

255EG29

3) Engine Warm-Up Operation

- After the preheat operation has been completed, the ECM stops the coolant heat storage water pump, and operates the water valve to switch the engine coolant passages, in order to stop the flow of the coolant from the coolant heat storage tank to the engine. At this time, the ECM starts the engine via the HV ECU.
- As a result, inflow of the engine coolant into the coolant heat storage tank is interrupted, and a usual engine warm-up begins.



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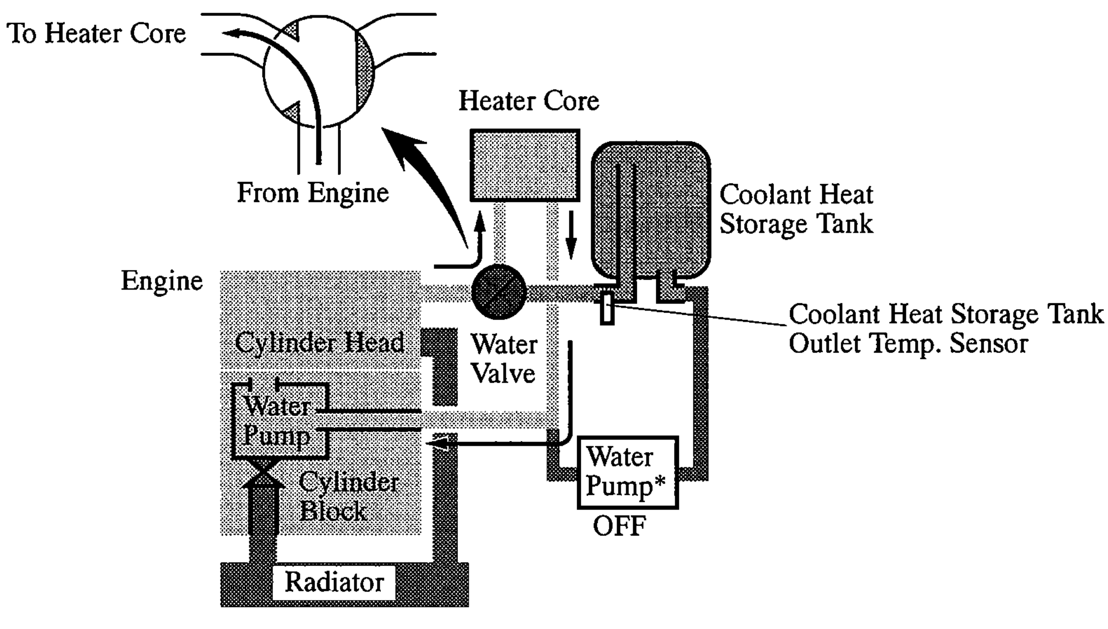

*: Coolant Heat Storage Water Pump

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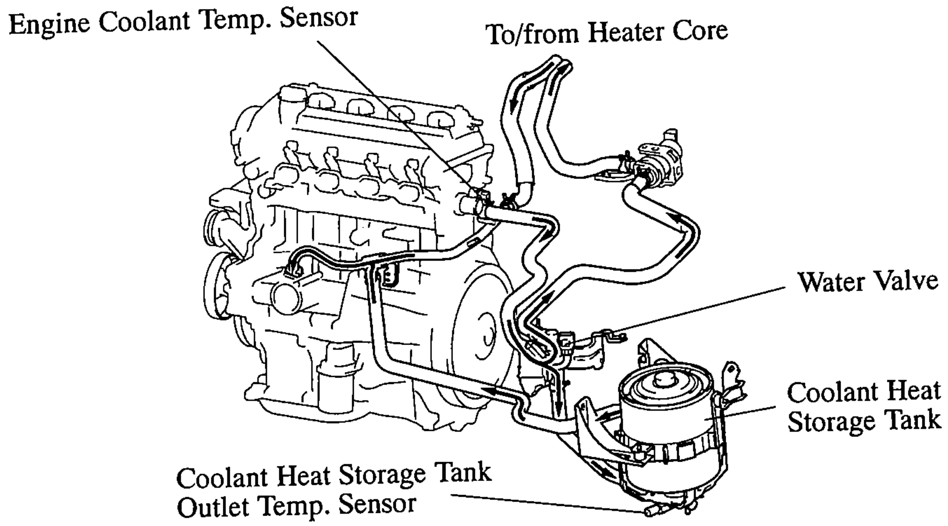
4) Storage Operation (During Driving)

- After the engine warm-up has been completed, the ECM operates the water valve to switch the engine coolant passages, in order to send the hot coolant heated by the engine into the heater core (for the heater) and the coolant heat storage tank (for storing the hot coolant).
- During the storage operation, the coolant heat storage water pump is in a stop, thus the engine coolant is circulated by the mechanical water pump driven by the engine.
- Once the coolant heat storage tank is filled with hot coolant, the ECM switches the coolant passages by operating the water valve (provides the same water valve position as that of the engine warm-up operation), and stops the storage operation.



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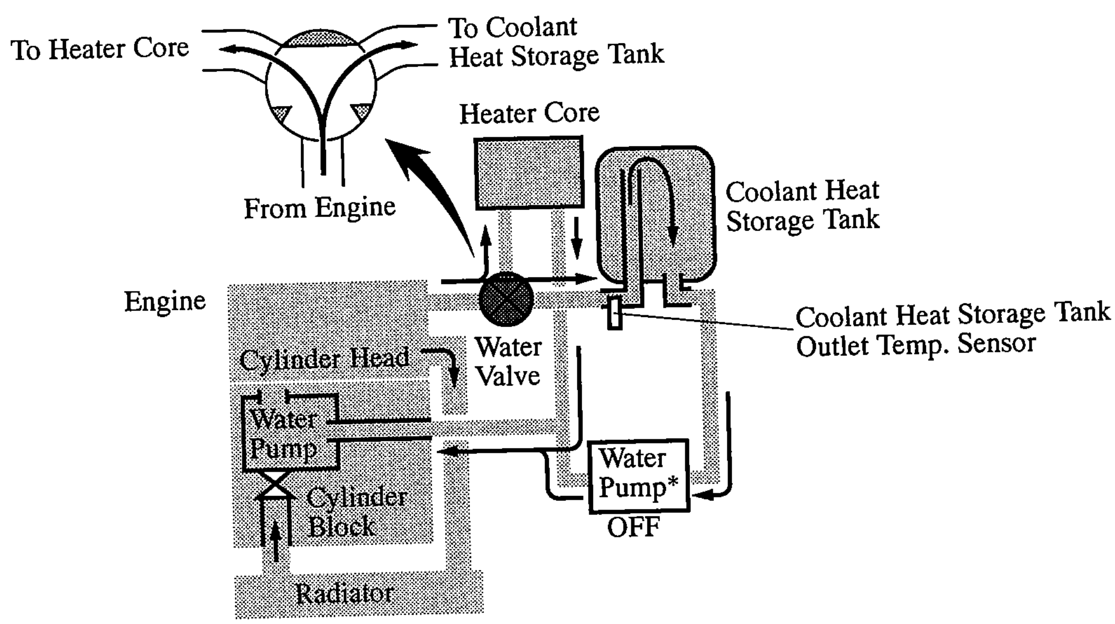
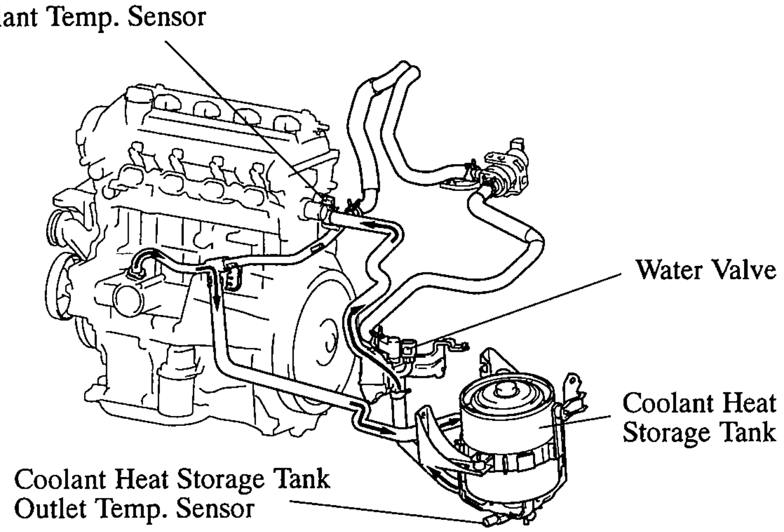


*: Coolant Heat Storage Water Pump

255EG33

5) Storage Operation (IG-OFF)

- If the power switch has been turned OFF (IG-OFF) before the recovery of the hot coolant has been completed during driving, the ECM actuates the coolant heat storage water pump and operates the water valve to switch the engine coolant passages, in order to store the hot coolant into the coolant heat storage tank. However, this operation will not be done if the engine warm-up is insufficient.
- This operation stops after it continues for several seconds.



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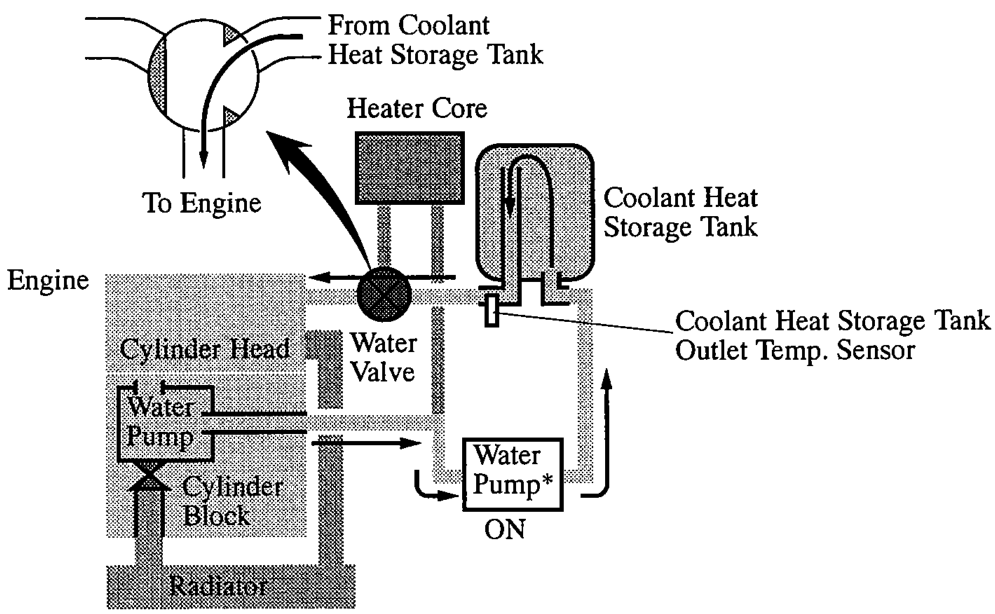


*: Coolant Heat Storage Water Pump

255EG35

7. Diagnosis

- When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section. Furthermore, the MIL (Malfunction Indicator Lamp) in the combination meter illuminates or blinks to inform the driver.
- The ECM will also store the DTCs of the malfunctions.
- The diagnosis communication has been changed from serial communication (ISO9141) to CAN communication. As a result, a dedicated adapter (CAN VIM) must be attached to the conventional hand-held tester in order to read the DTCs of the ECM. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).
- To comply with the OBD-II regulations, all the DTCs (Diagnostic Trouble Codes) have been made to correspond to the SAE controlled codes. Some of the DTCs have been further divided into smaller detection areas than in the past, and new DTCs have been assigned to them. For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

Service Tip

To clear the DTC that is stored in the ECM, use a hand-held tester or disconnect the battery terminal or remove the EFI fuse for 1 minute or longer.

8. Fail-Safe

When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.

▶ Fail-Safe Chart ◀

DTC No.	Fail-Safe Operation	Fail-Safe Deactivation Conditions
P0031, P0032, P0037, P0038	The heater circuit in which the abnormality is detected is turned off	Power switch OFF
P0100, P0102, P0103	Ignition timing is calculated from engine speed and a throttle angle	"Pass" condition detected
P0110, P0112, P0113	Intake air temp. is fixed at 20°C (68°F)	"Pass" condition detected
P0115, P0117, P0118	Engine coolant temp. is fixed at 80°C (176°F)	"Pass" condition detected
P0120, P0122, P0123	Fuel cut intermittently	Power switch OFF
P0121	Fuel cut intermittently	"Pass" condition detected and power switch OFF
P0325	Max. ignition timing retardation	Power switch OFF
P0351, P0352, P0353, P0354	Fuel cut	"Pass" condition detected
P1115, P1117 P1118	Engine coolant temp. is fixed at 80°C (176°F)	"Pass" condition detected
P1120, P1122 P1123	Water valve position is fixed at position when DTC is detected	"Pass" condition detected
P2102, P2103	VTA is fixed at about 16% and fuel cut intermittently	Power switch OFF
P2119	VTA is fixed at about 16% and fuel cut intermittently	"Pass" condition detected and power switch OFF

CHASSIS

CLUTCH

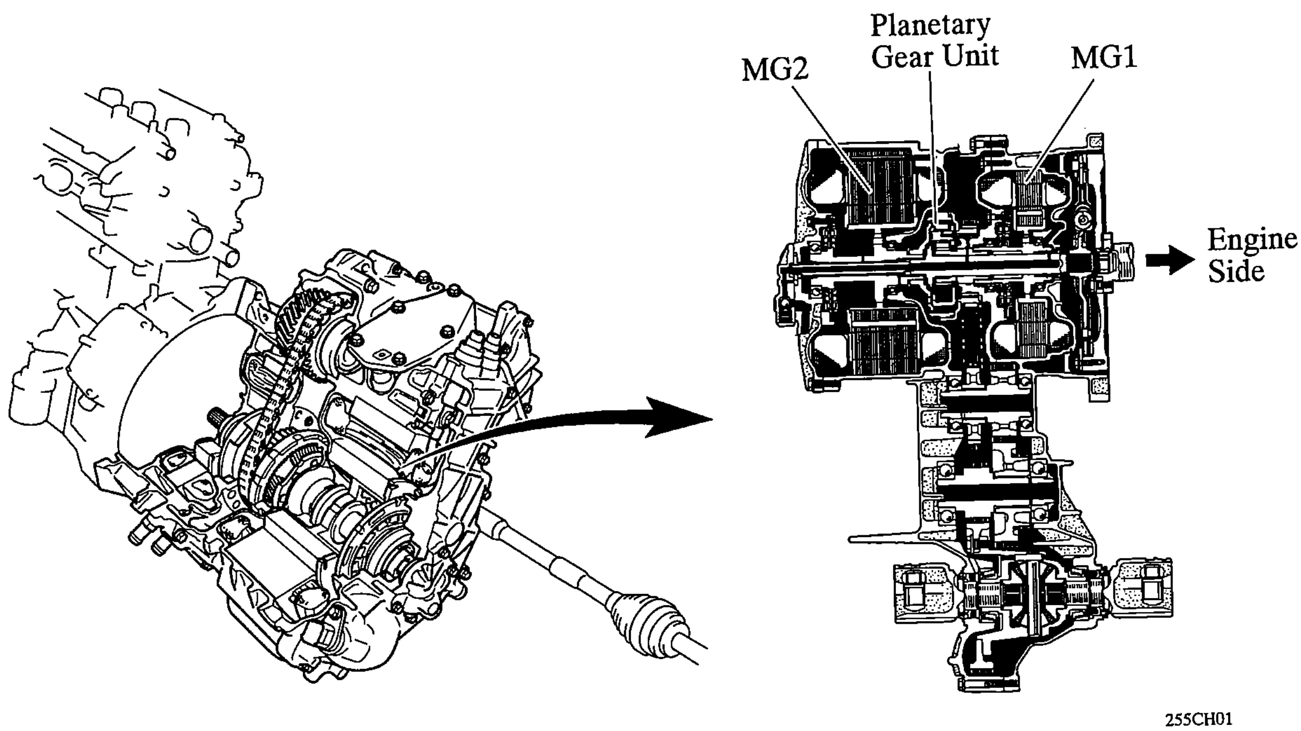
P112 HYBRID TRANSAXLE

■ DESCRIPTION

- The P112 hybrid transaxle has been newly developed on the '04 Prius. Containing a MG2 (Motor Generator No.1) for driving the vehicle and a MG1 (Motor Generator No.1) for generating electrical power, this hybrid transaxle uses a continuously variable transmission mechanism with planetary gear unit that achieve smooth and quiet operation.
- This hybrid transaxle is based on the P111 hybrid transaxle of the '03 Prius. The main changes that have been made to this transaxle to realize higher efficiency and performance are listed below.

— Main Changes from P111 Hybrid Transaxle —

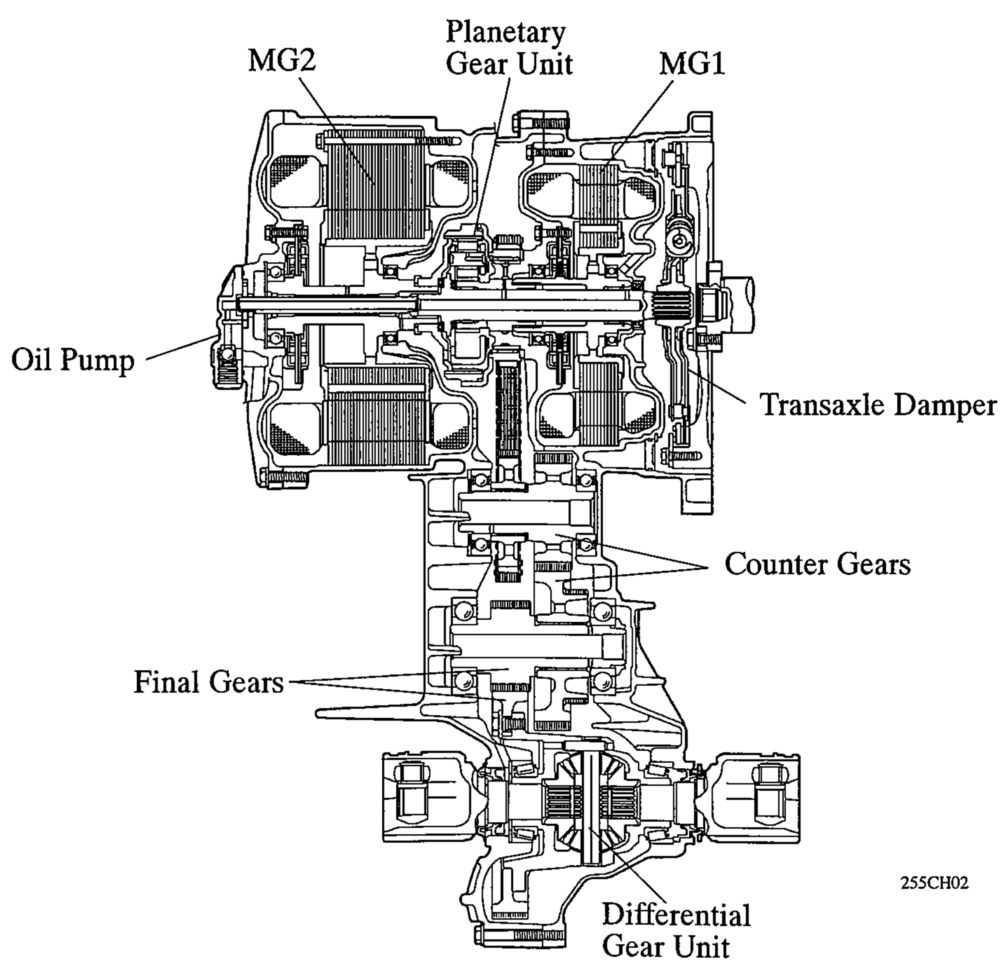
- The spring characteristics of the coil spring of the transaxle damper have been changed.
- A low-viscosity type transaxle fluid (ATF WS) has been newly adopted.
- The oil pan has been discontinued.
- An aluminum sprocket support, which is integrated on the MG1 cover, has been adopted.
- Ball bearings have been adopted to support the counter driven gear shaft.



▶ Specifications ◀

Model		'04 Model	'03 Model
Transaxle Type		P112	P111
Planetary Gear	The No. of Ring Gear Teeth	78	←
	The No. of Pinion Gear Teeth	23	←
	The No. of Sun Gear Teeth	30	←
Differential Gear Ratio		4.113	3.905
Chain	The NO. of Links	72	74
	The NO. of Drive Sprocket Teeth	36	39
	The NO. of Driven Sprocket Teeth	35	36
Counter Gear	The NO. of Drive Gear Teeth	30	←
	The NO. of Driven Gear Teeth	44	←
Final Gear	The NO. of Drive Gear Teeth	26	←
	The NO. of Driven Gear Teeth	75	←
Fluid Capacity	Liters (US qts, Imp.qts)	3.8 (4.0, 3.3)	4.6 (4.9, 4.0)
Fluid Type		ATF WS or equivalent	ATF Type T-IV or equivalent
Weight (Reference)*	kg (lb)	107 (236)	—

* : Weight shows the figure with the fluid fully filled.



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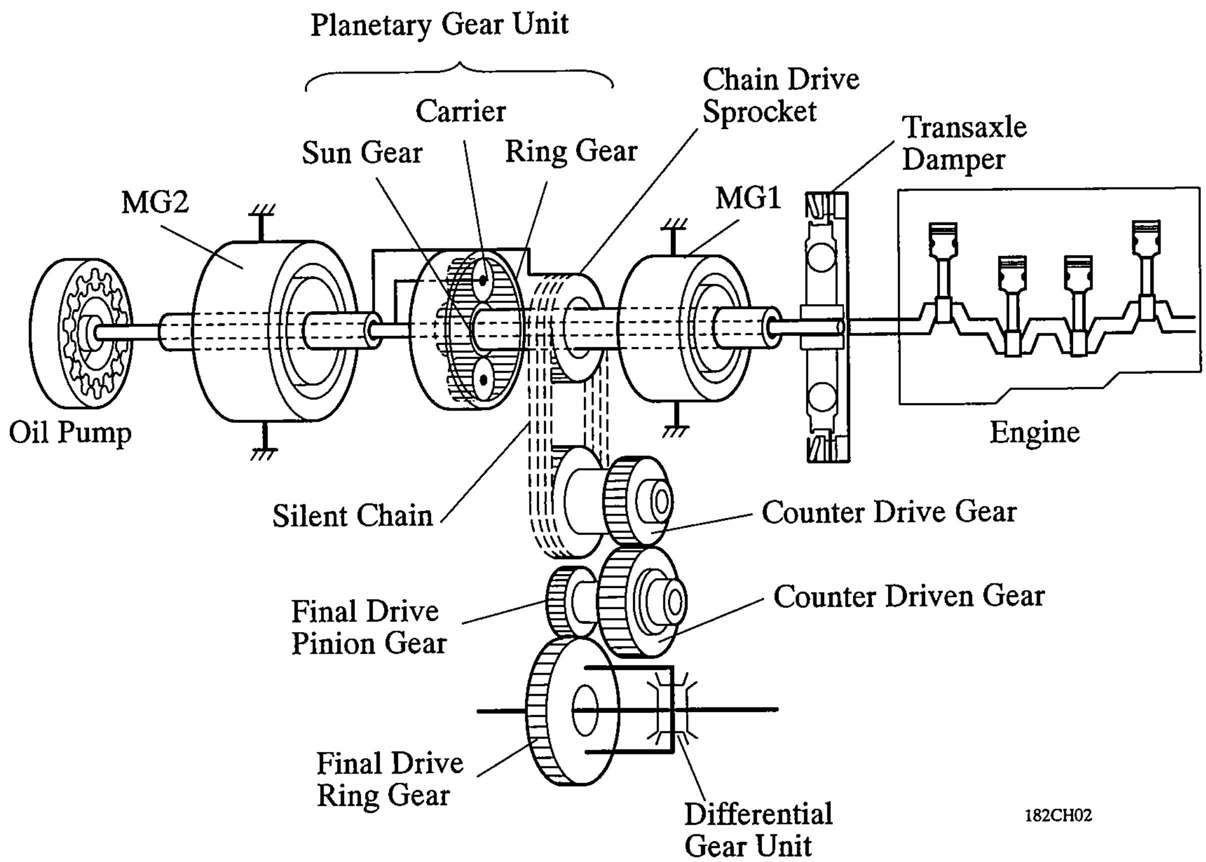
■TRANSAXLE UNIT

1. General

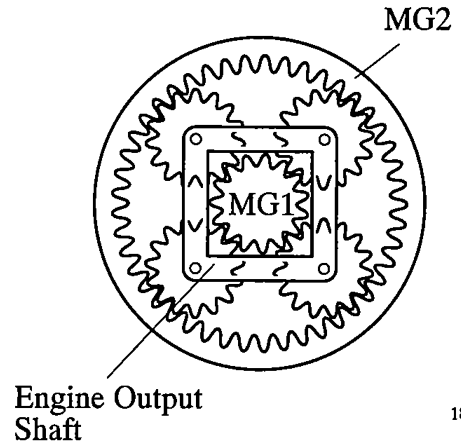
- The transaxle unit consists primarily of a transaxle damper, MG1, MG2, planetary gear unit and a reduction unit (containing a silent chain, counter drive gear, counter driven gear, final drive pinion gear, and final drive ring gear).
- The planetary gear unit, MG1, MG2, transaxle damper, and the chain drive sprocket are located coaxially, and the motive force is transmitted from the chain drive sprocket to the reduction unit via a silent chain.



2. Planetary Gear Unit

- The power output of the engine, which is transmitted via the planetary gear unit, is divided into the motive force directed to the drive wheels and the drive force to MG1 for generating electricity.
- As part of the planetary gear unit, the sun gear is connected to MG1, the ring gear is connected to MG2, and the carrier is connected to the engine output shaft. The motive force is transmitted via the chain to the counter drive gear.

Item	Connection
Sun Gear	MG1
Ring Gear	MG2
Carrier	Engine Output Shaft



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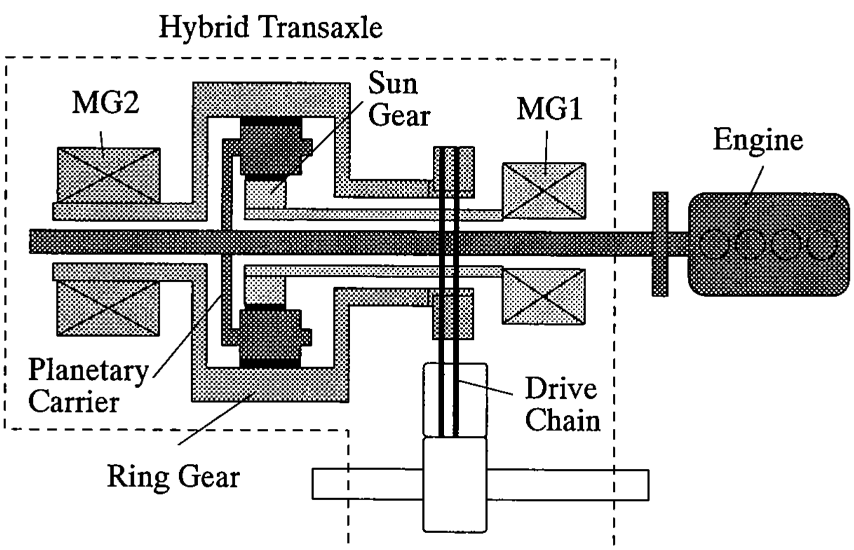

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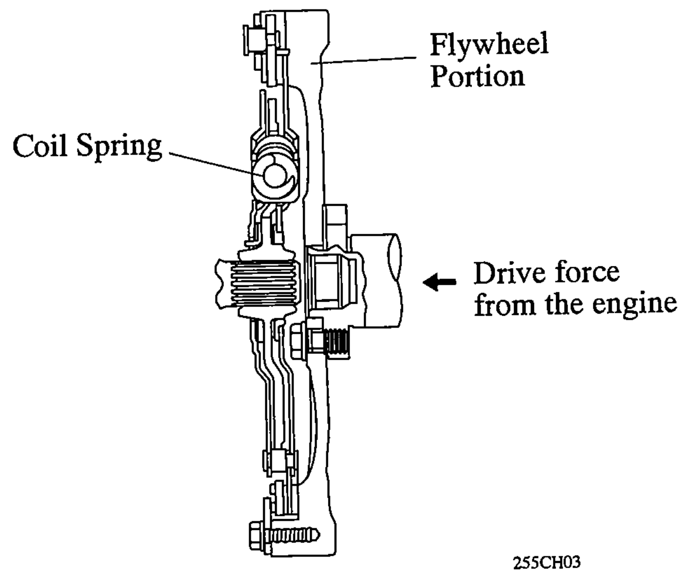
3. Transaxle Damper

- As on the '03 model, the '04 Prius uses a coil spring with low torsional characteristics in the transaxle damper, to which the following changes have been made:
  - ♦ The spring rate characteristics of the coil spring have been reduced further to improve its vibration absorption performance.
  - ♦ The shape of the flywheel portion has been optimized for weight reduction.
- This transaxle damper, which transmits the drive force of the engine, contains a torque fluctuation absorption mechanism that uses a dry, single-plate friction material.



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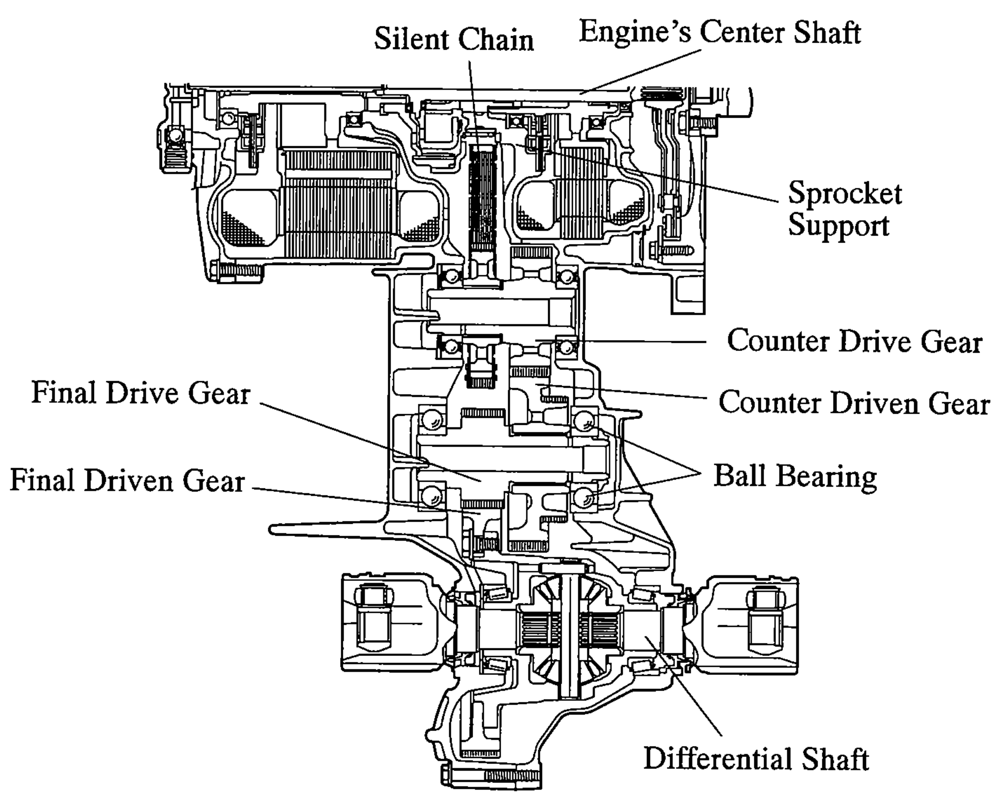
4. MG1 and MG2

MG1 and MG2 are located coaxially at each end of the planetary gear unit.
MG1 connects to the sun gear of the planetary gear unit, and MG2 connects to the ring gear. For detailed characteristics of MG1 and MG2, refer to MG1 and MG2 in THS-II, on page TH-26.

Service Tip
Do not disassemble MG1 and MG2 because they are precision components. If malfunction is found on these components, replace them on the hybrid transaxle assembly basis.

5. Reduction Unit

- As on the '03 model, the '04 Prius uses a reduction unit, to which the following changes have been made:
  - ♦ An aluminum sprocket support, which is integrated on the MG1 cover, has been adopted.
  - ♦ Ball bearings have been adopted to support the counter driven gear shaft.
- The reduction unit consists of the silent chain, counter gears and final gears.
  A silent chain with a small pitch width has been adopted to ensure quiet operation, and the overall length has been reduced in contrast to the gear-driven mechanism.
  The counter gears and final gears teeth have been processed through high-precision honing and their tooth flanks have been optimized to ensure extremely quiet operation.
  The final gears have been optimally allocated to reduce the distance between the engine's center shaft and the differential shaft, thus resulting in a transmission with a compact package.



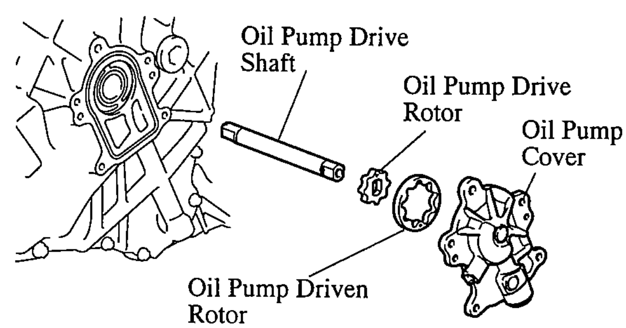
255CH04

■ DIFFERENTIAL GEAR UNIT

For the differential gear unit, a 2-pinion type that is similar to the differential unit of the conventional transaxle has been adopted.

■ LUBRICATION UNIT

A force-feed lubrication system using a trochoid pump has been adopted for lubrication of the planetary gear unit and the beatings on the main shaft.
The same type of oil is used for both the reduction unit portion and the differential portion.



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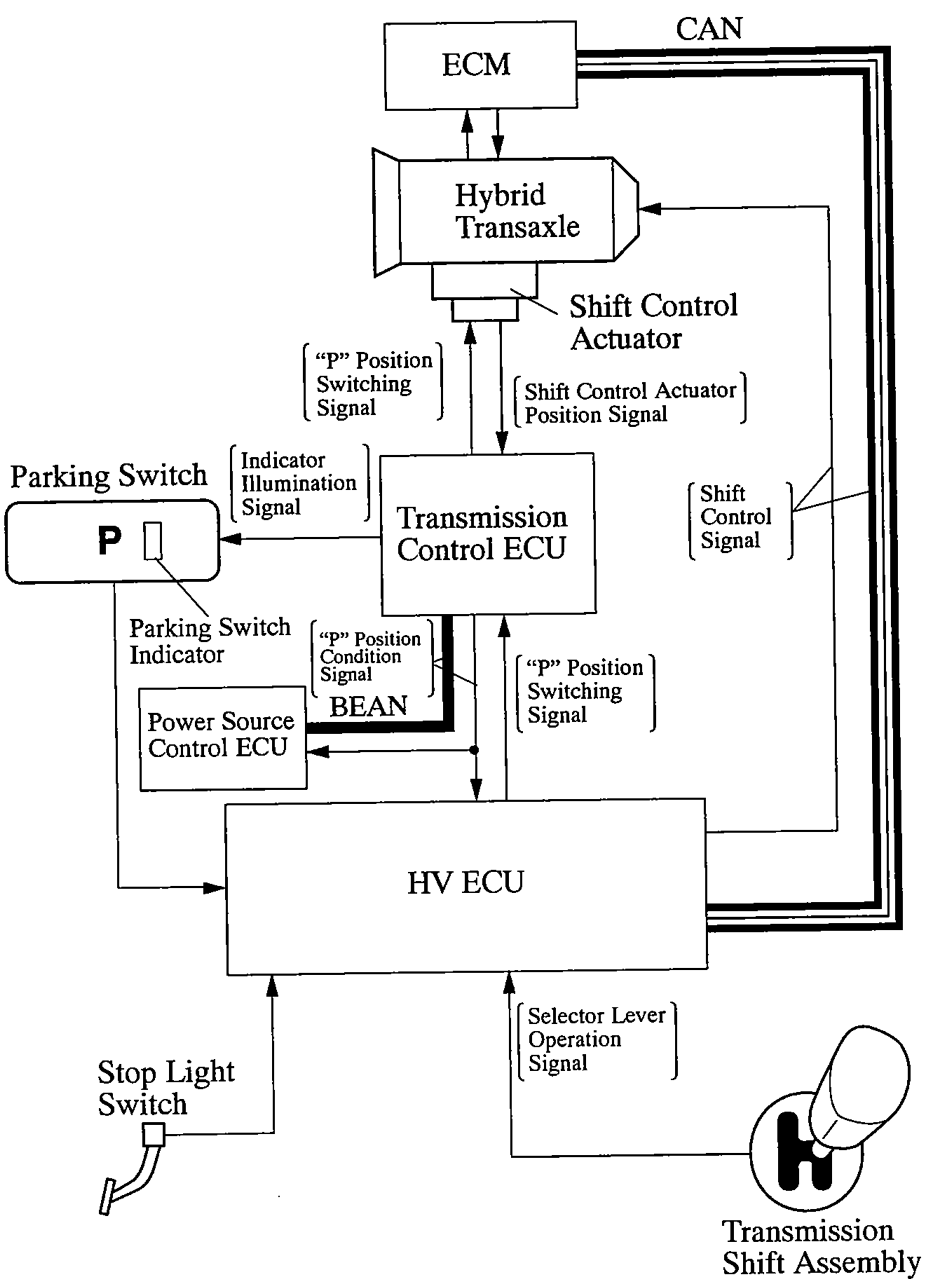
■SHIFT CONTROL SYSTEM

1. General

- A compact selector lever (transmission shift assembly), which has been designed under a new concept, has been adopted in the instrument panel. It is a momentary shift type that returns to the home position when the driver's hand is released from the shift knob after a shifting operation. It can be shifted with a fingertip, and the ergonomically designed shifting pattern offers excellent ease of operation.
- A shift-by-wire technology has been adopted. A shift position sensor provided in the transmission shift assembly detects the shift position ("R", "N", "D", or "B") and sends a corresponding signal to the HV ECU. The HV ECU controls the speed of the engine, MG1, and MG2, in order to produce an optimal gear ratio.
- The parking lock mechanism of the '03 Prius is operated through a linkage. In contrast, the '04 Prius has adopted an electrical control in the same way as the shift control.
  With this mechanism, when the driver presses the Parking switch located on the top of the transmission shift assembly, the "P" position control actuates the shift control actuator located in the hybrid transaxle in order to mechanically lock the counter driven gear, which engages the parking lock.

▶ **System Diagram** ◀



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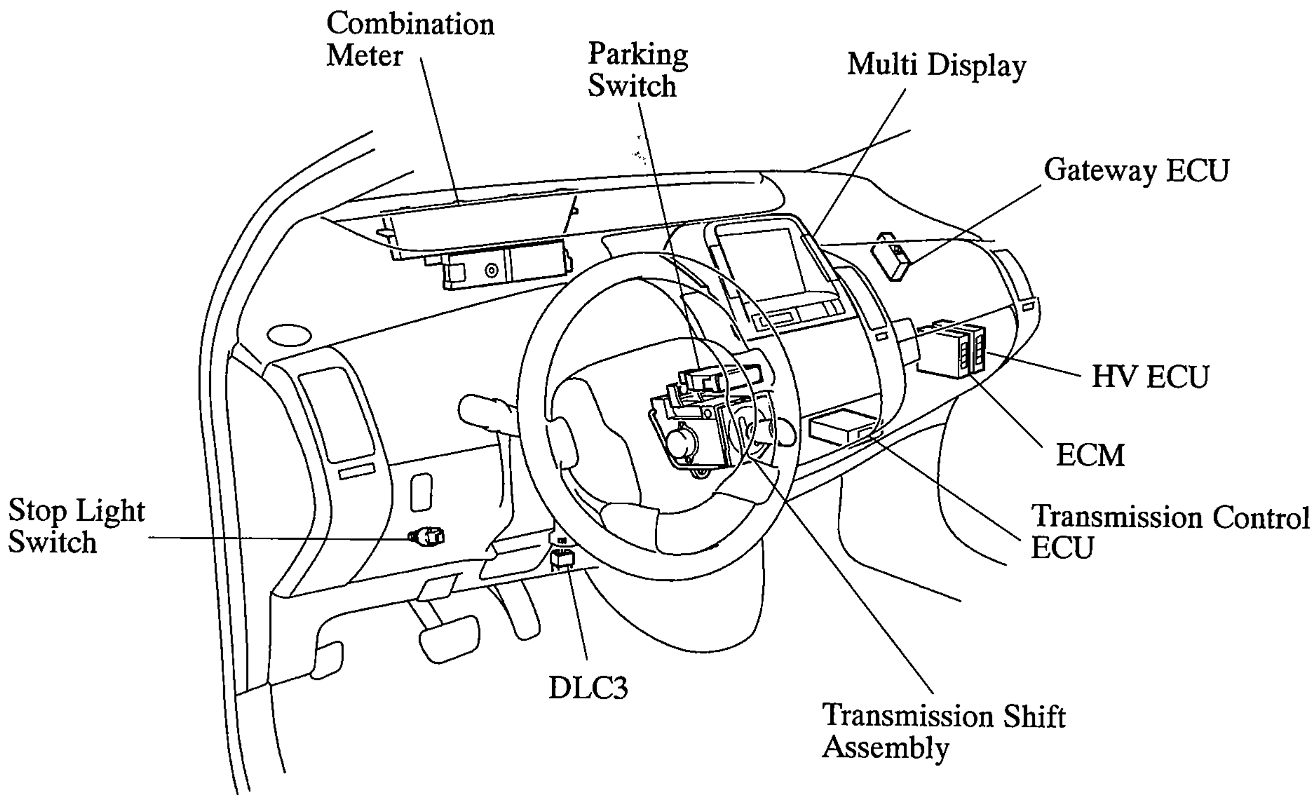
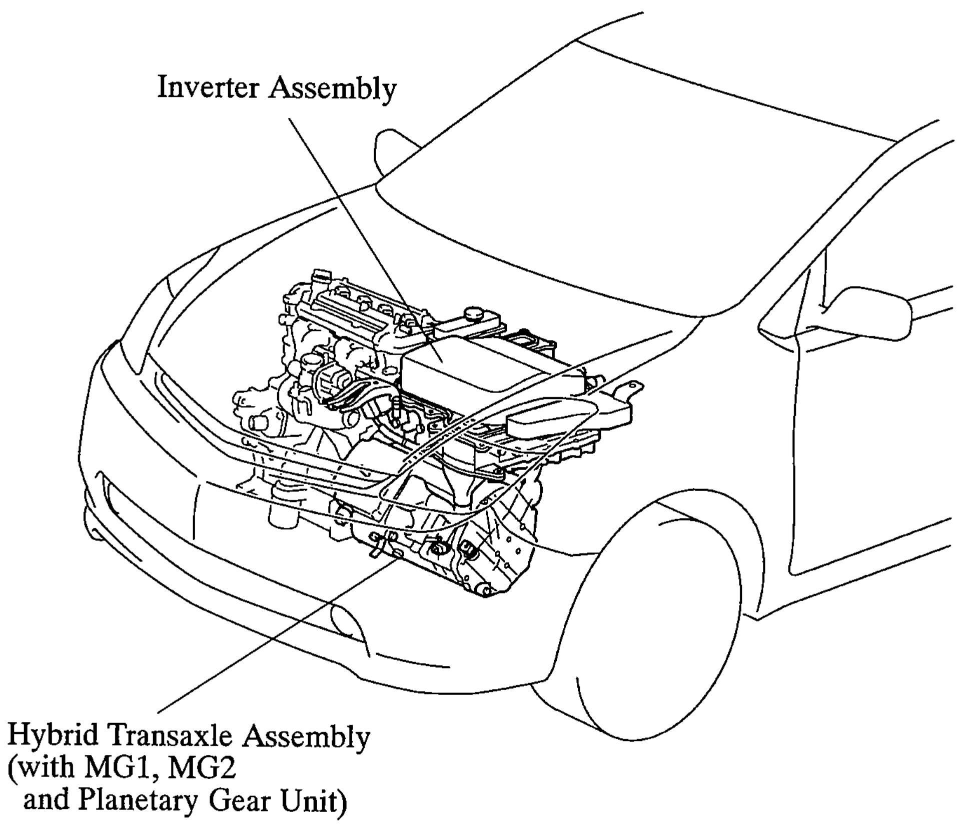
2. Layout of Main Components





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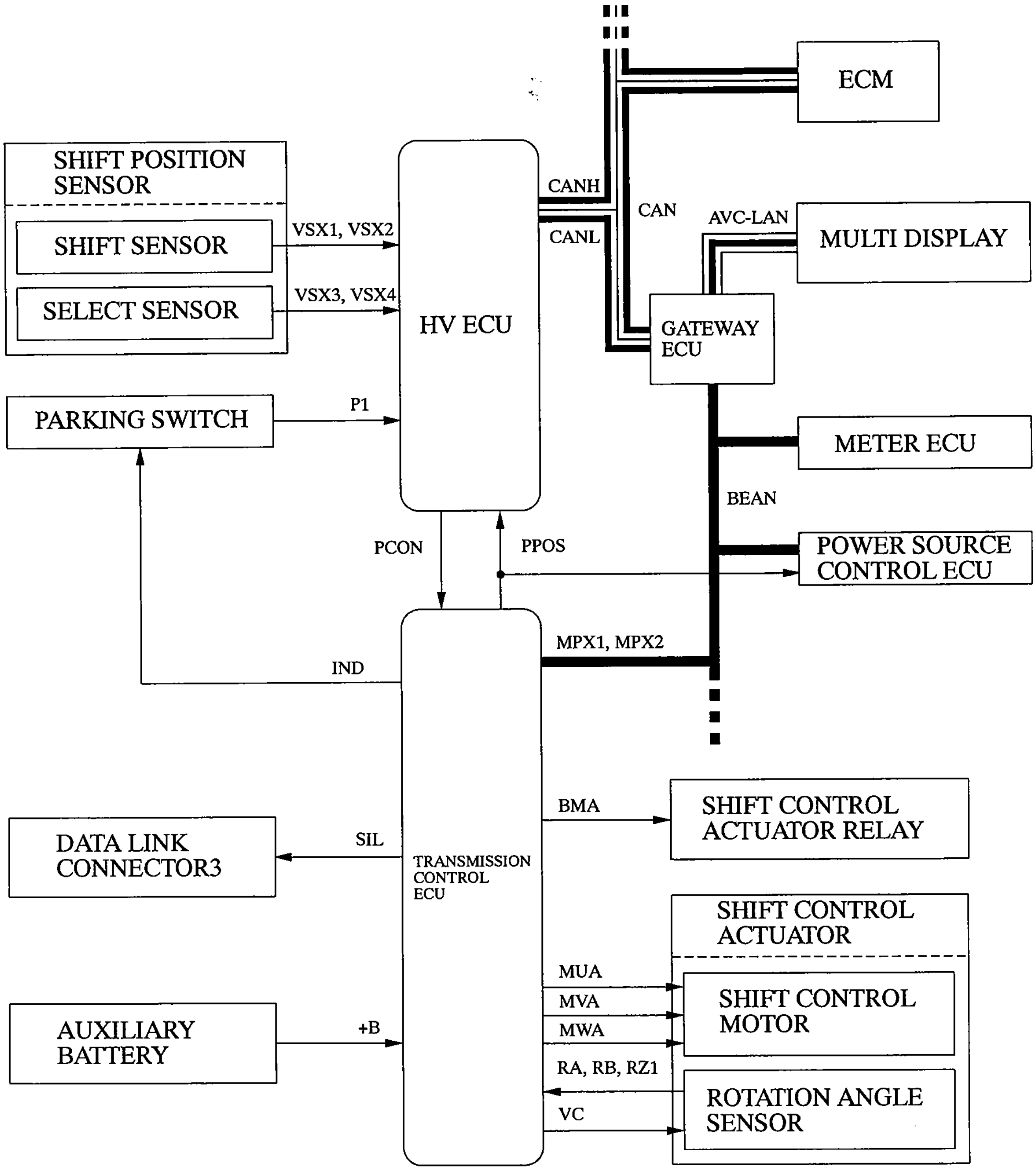
3. Construction

The configuration of the shift control system in the ’04 Prius is shown in the following chart.



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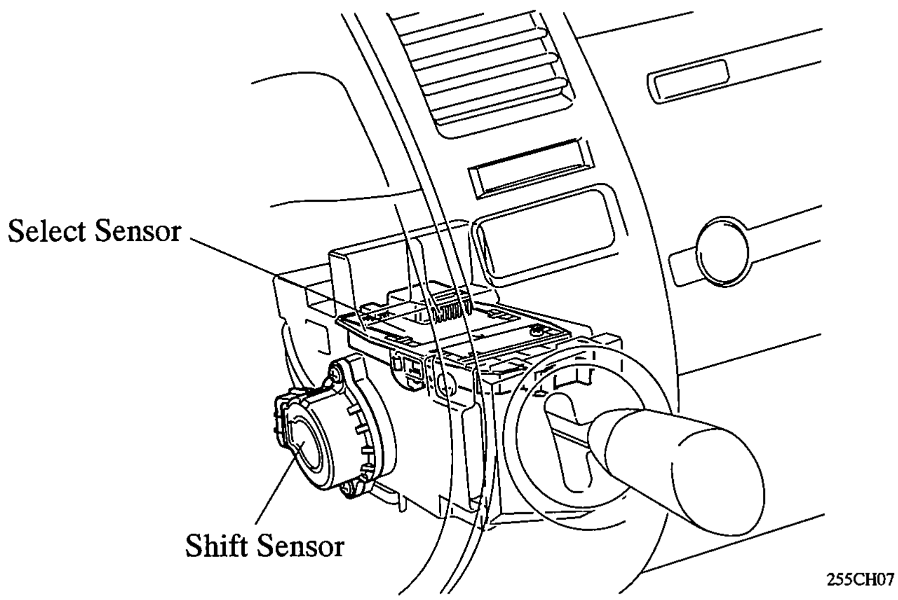
4. Function of Main Components

Item	Outline
Shift Position Sensor	This sensor, which is installed in the Transmission shift assembly, detects the shift positions ("R", "N", "D", and "B"), and transmits the positions to the HV ECU.
Shift Control Actuator	• When the Parking switch is pressed, the shift control actuator operates to engage the parking lock in the hybrid transaxle. • When the shift position is in the "P" and the brake pedal is pressed, if the driver operates the selector lever, this actuator operates to unlock the parking lock in the hybrid transaxle.
Parking Switch	• As this switch turns ON or OFF, it detects the driver's operation of the P position, and sends it to the HV ECU. • This is a momentary type switch, and indicates a status whether the parking lock is applied or not with an indicator light on the switch.
Transmission Control ECU	• Transmission Control ECU, Upon receiving an ON signal of the Parking switch from the HV ECU, the transmission control ECU actuates the shift control actuator. • It illuminates the P position indicator light in accordance with the switching condition of the P position.
HV ECU	• Upon receiving an ON signal from the Parking switch, the HV ECU determines whether the conditions for shifting into the P position have been met, and transmits a shift control actuator control signal to the transmission control ECU. • The shift position sensor installed on the transmission shift assembly detects the shift position ("R", "N", "D", or "B") and sends a signal to the HV ECU. The HV ECU produces an optimal gear ratio by controlling the speeds of the engine, MG1, and MG2. • If the HV ECU receives a vehicle power supply OFF signal from the power supply ECU when the parking lock in the hybrid transaxle is not engaged, the HV ECU transmits a P position switching signal to the transmission control ECU in order to engage the parking lock.
ECM	The ECM receives from the HV ECU an engine control signal that suits the shift position that the driver has selected, in order to optimally control the engine.
Power Source Control ECU	• Transmits a signal to the HV ECU, indicating that the vehicle power supply has been turned ON or OFF. • Transmits a request signal to the transmission control ECU, commanding that changes the shift position to the "P" position. This signal is transmitted only if the shift position is in other than the "P" position when the POWER switch is turned OFF.
Stop Light Switch	Detects the brake pedal depressing signal.
Combination Meter	• Illuminates the shift position indicator, which the driver has selected, in accordance with the signal from the HV ECU. • Illuminates the master warning light if abnormality has occurred in the transmission control ECU.
Multi Display	• Displays a warning message to alert the driver in accordance with a signal provided by the transmission control ECU.

5. Transmission Shift Assembly

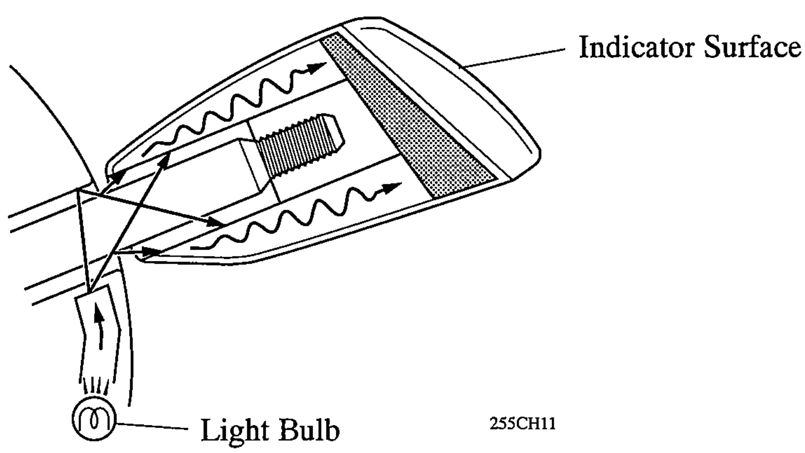
General

- A compact selector lever, which has been designed under a new concept, has been adopted. It is a momentary shift type in which the reactive force of a spring returns the lever to its home position when the driver's hand is released from it after a shifting operation.
- The transmission shift assembly has built-in shift position sensors (select sensor and shift sensor) to detect the shift position ("R", "N", "D", and "B").
- When the taillights are turned ON, a light bulb that is provided in the housing indirectly illuminates the shift knob indicator surface, in order to enhance its nighttime visibility.



Shift Knob Indicator

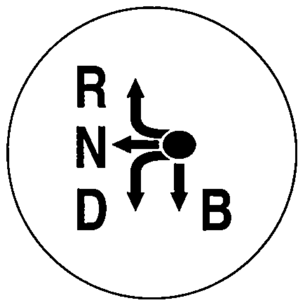
The shift knob indicator is constructed in such a way that when a light bulb that is provided in the housing illuminates, its light beam passes through a light guide housing and is reflected on the selector lever's pole and the light transmission area, thus illuminating the indicator surface from underneath the knob.



Shift Position Sensor

- The shift position sensors consist of a select sensor that detects the lateral movement of the selector lever, and a shift sensor that detects the longitudinal movement. A combination of these signals is used to detect the shift position.
- The sensor portion of both the select and shift sensors contains a Hall IC.

Select Sensor Detection Position (Lateral Direction)	Shift Sensor Detection Position (Longitudinal Direction)	Selected Shift Position
R, N, D	Up	R
	Center	N
	Down	D
B, Center	Down	B



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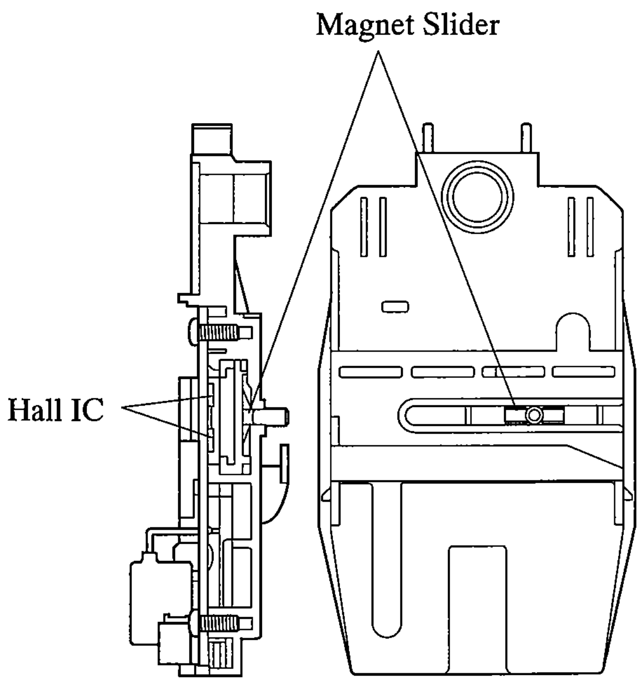
Shift Pattern



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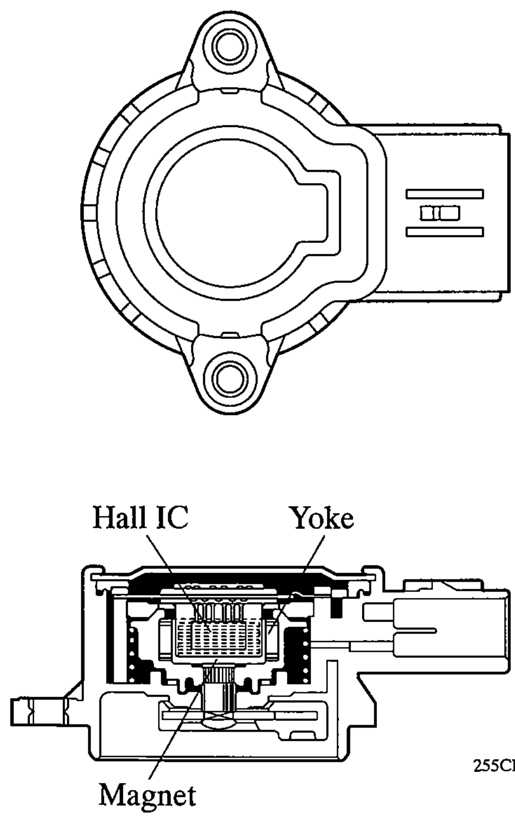
Select Sensor



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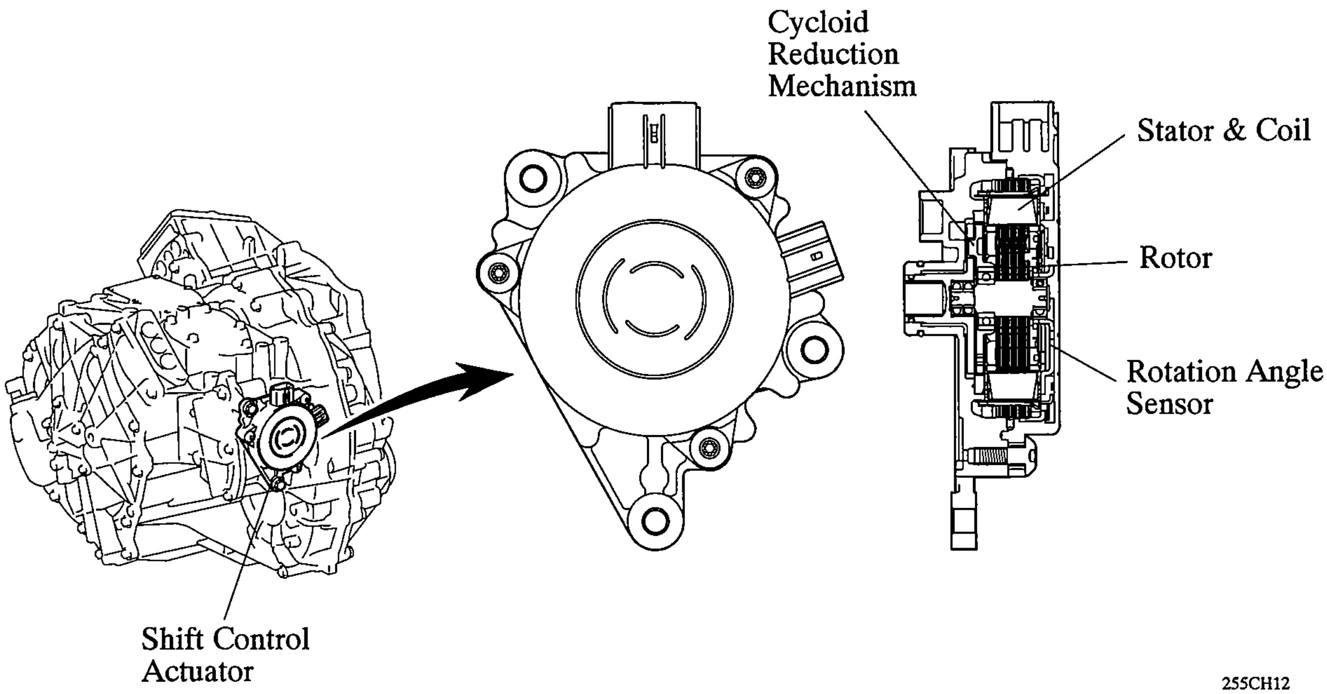
Shift Sensor

6. Shift Control Actuator

General

- The shift control actuator is mounted on the side of the hybrid transaxle. Upon receiving an actuation signal from the transmission control ECU, the motor in the actuator rotates to move the parking lock rod, which slides the parking lock pawl, thus causing the parking lock pawl to engage with the parking gear that is installed on the counter driven gear. As a result, the hybrid transaxle is locked or unlocked mechanically.
- The shift control actuator mainly consists of a brush-less motor and a cycloid reduction mechanism. The motor mainly consists of a rotation angle sensor, coil, stator, and a rotor.
- The rotation angle sensor consists of three Hall ICs. The two of them, called phases A and B, are used to detect the rotation angle of motor. The rest, called phase Z, is used to correct the rotation angle detection control.

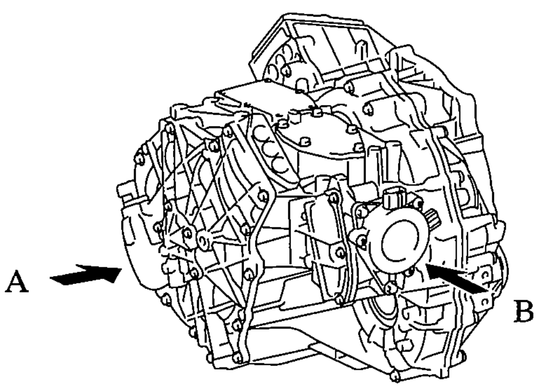


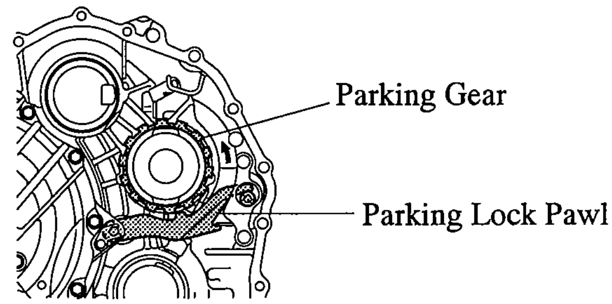
Service Tip

- This actuator is a precision instrument. Do not strike it with a plastic hammer or the like during installation.
- This actuator detects its own position when a battery is reinstalled. Thus, it does not require initialization.

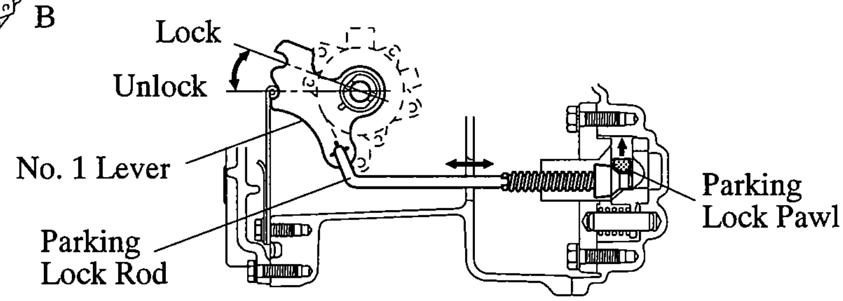
Parking Lock Mechanism

- A mechanical parking lock mechanism has been provided in the counter driven gear.
  The engagement of the parking lock pawl with the parking gear that is integrated with the counter driven gear locks the movement of the vehicle.
- Upon receiving a lock or unlock signal from the transmission control ECU, the shift control actuator rotates the No. 1 lever to slide the parking lock rod, which pushes on the parking lock pawl. As a result, the parking lock pawl meshes with the parking gear, thus engaging the parking lock.





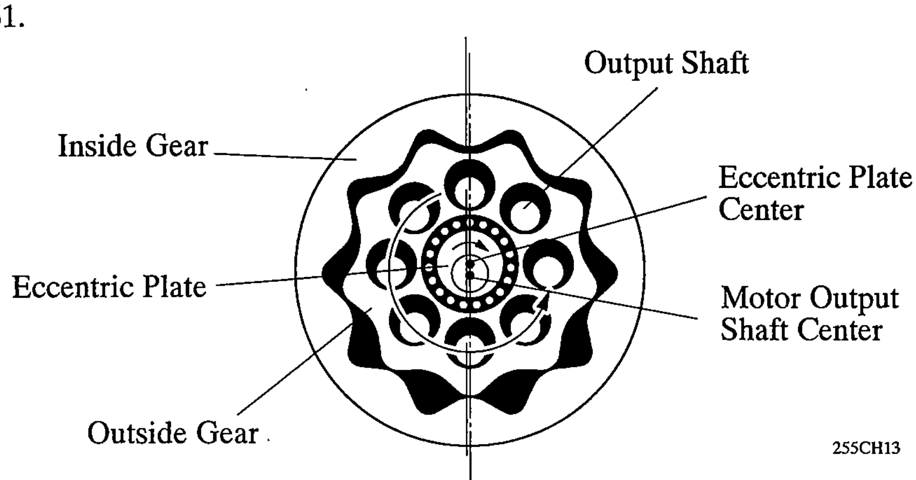
Cross Section of View from A



Cross Section of View from B

Cycloid Reduction Mechanism

- The cycloid reduction mechanism ensures the complete releasing operation for the parking lock when the vehicle is parked on a sloping road in which requires a high torque, since it amplifies the torque of the motor output shaft.
- This mechanism consists of an eccentric plate that is mounted on the motor output shaft, an inside gear (61 teeth) that is secured to the housing, an outside gear (60 teeth), and an output shaft that rotates in unison with the outside gear.
- Along with the rotational movement of the eccentric plate, which rotates in unison with the motor output shaft, the inside gear pushes against the outside gear, while meshing. The outside gear, which has 1 tooth less than the inside gear, rotates 1 tooth less per rotation of the eccentric plate. As a result, the output shaft, which rotates in unison with the outside gear, outputs the rotational movement of the motor at a reduction ratio of 61.

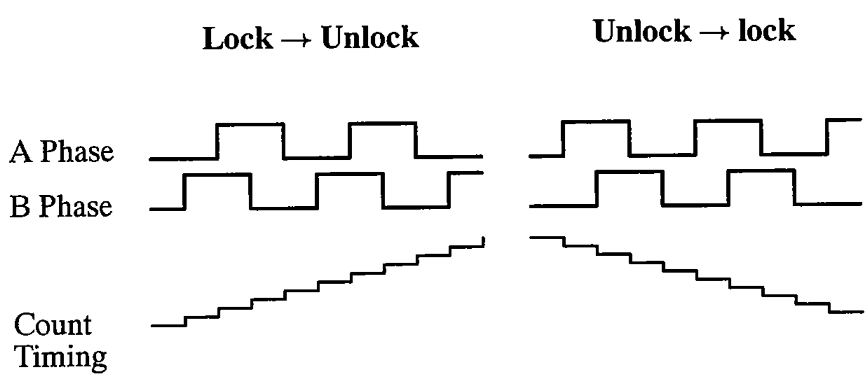


Imaginary Diagram

Motor Control

- This motor rotates to lock or unlock parking. The transmission control ECU detects the present shift position (Parking locked or unlocked) in accordance with the rotation angle sensor signal, which detects the extent of rotation of the motor.
- The transmission control ECU detects the direction of the motor rotation, the extent of the rotation, and its moving range through the combination of the pulses and the counting of the two Hall ICs with staggered phases (A phase and B phase), which are located in the rotation angle sensor.
  Once the moving range is detected, it is stored in the ECU memory. However, it will be deleted if a battery terminal is disconnected.

Item	Pulse Changes	
	A Phase	B Phase
Count-up (Lock → Unlock)	OFF → OFF	OFF → ON
	OFF → ON	ON → ON
	ON → ON	ON → OFF
	ON → OFF	OFF → OFF
Countdown (Unlock → Lock)	OFF → ON	OFF → OFF
	OFF → OFF	ON → OFF
	ON → ON	OFF → ON
	ON → OFF	ON → ON



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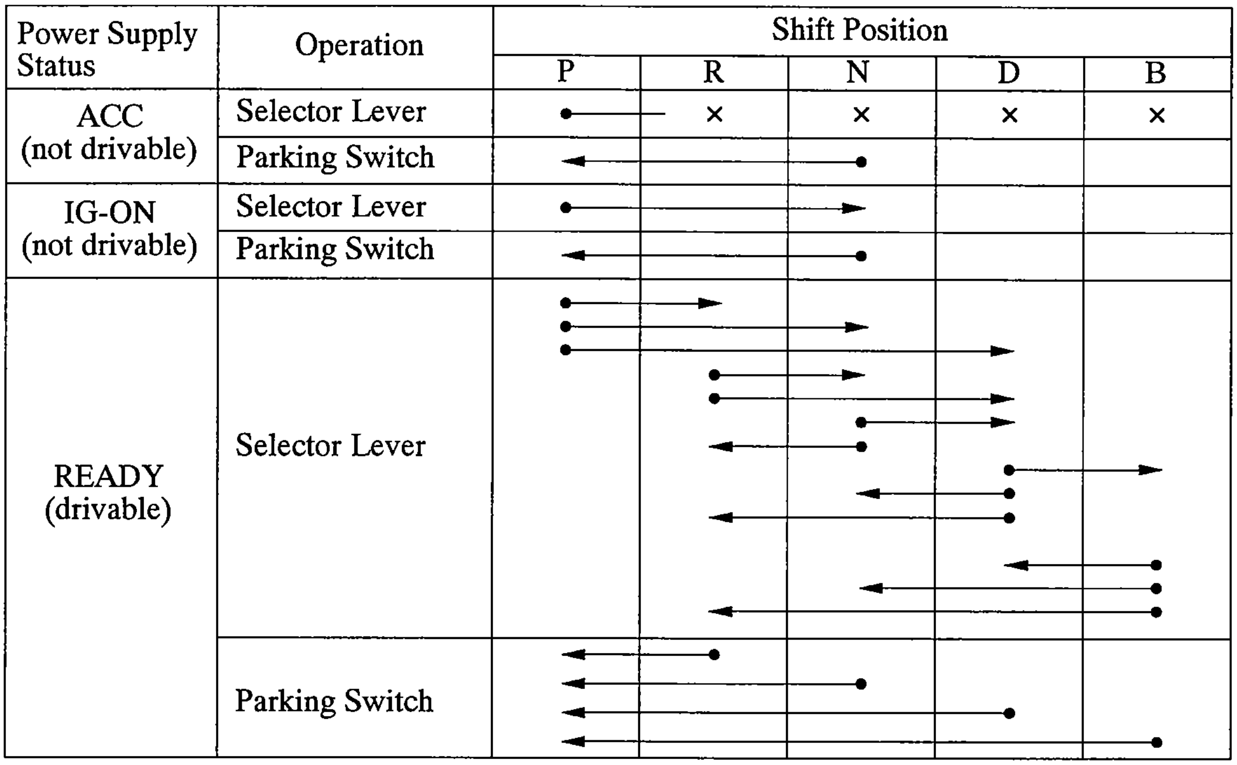
- The parking lock position and unlock position, which provide the values to establish control criteria, are detected and stored in memory at the time the transmission control ECU is started or the battery is reconnected. Initially, the transmission control ECU causes the motor to rotate to the position that engages the lock, in order to store the parking lock position in memory. Then, the ECU causes the motor to rotate in reverse, in order to store the unlock position in memory. However, if the ECU has stored the moving range of the previous operation in its memory, it detects one of the present positions, and calculates the other position from the moving range stored in memory. These processes make it unnecessary for the system to be initialized after the actuator or the ECU is replaced or the battery terminal is reconnected.

7. Shift Control

General

- In this system, the HV ECU determines the general conditions of the vehicle and switches the shift position and lock or unlock parking
- This system contains a reject function. When the vehicle is being driven under normal conditions, the shift position can be moved to all positions, provided that the reject function has not been tripped.
- The table below shows how the selector lever operation and the Parking switch operation are controlled at each shift position.



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- In this system, when the power supply to the transmission control ECU is restored, the ECU starts the control by estimating the present shift position (Parking lock or unlock) based on the previous shift position that is stored in memory.
  If a previous shift position is unavailable, the control will start in accordance with the position determined by the HV ECU through the vehicle speed.

Previous Parking Lock Condition		Value Determined by HV ECU	Estimated Value
Parking Lock		—	Parking Lock
Parking Unlock		—	Parking Unlock
Unavailable	Vehicle was stopped	Parking Lock	Parking Lock
	Vehicle was running	Parking Unlock	Parking Unlock

Reject Function

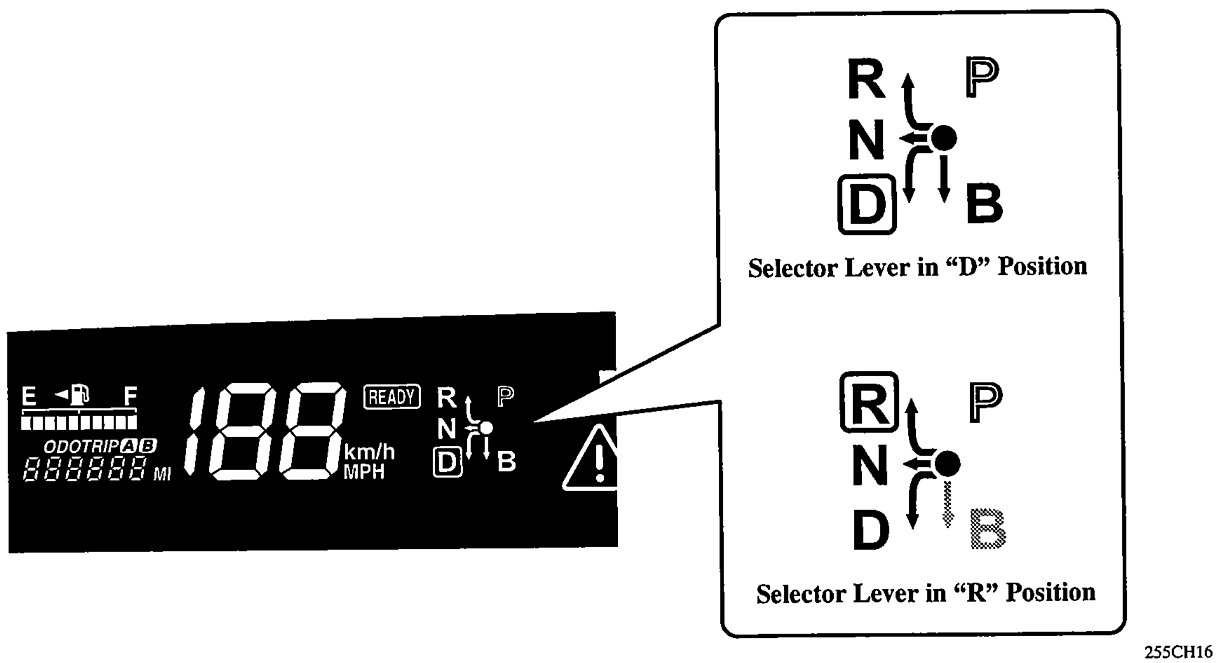
To ensure safety, this system might not change the shift position even if the driver operates the selector lever or parking switch. In that case, it sounds a buzzer to alert the driver. The table below shows the situations that trip the reject function.

Operation Causing the Reject Function to Trip	Corresponding Operation of HV ECU
During system operation, the driver changes the shift position out of the "P" position without pressing the brake pedal.	Maintains the "P" position.
While driving, the driver changes the shift position to the "P" position with the parking switch operation.	Shifts to the "N" position.
While driving, the driver changes the shift position from the "D" to "R" position, or from the "R" to "D" position.	
The driver changes the shift position to the "B" position from a position other than "D".*	

*: In this system, the "B" position operates in the engine brake range. Therefore, the shifting to the "B" position from a position other than "D" is prohibited.

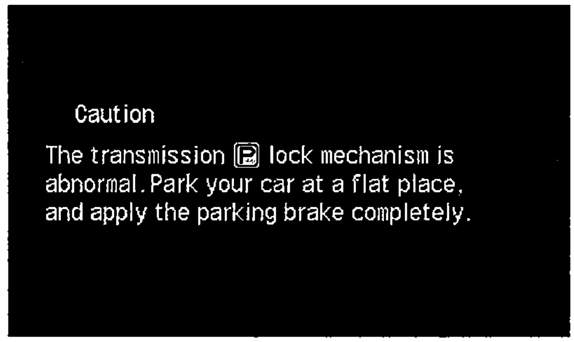
Shift Position Indicator

- The selector lever is designed to always return to its home position. Therefore, the shift position that is currently selected can be checked on the shift position indicator, which is provided in the combination meter.
- In this system, the "B" position operates in the engine brake range. Therefore, the shifting to the "B" position from a position other than "D" is prohibited. Accordingly, if the selector lever is in a position other than "D" or "B", the "B" position indicator will turn OFF to prevent the driver from inadvertently shifting into the "B" position.



■ DIAGNOSIS

- If the transmission control ECU detects a malfunction in the shift control system, the ECU performs a diagnosis and memorizes the failed section.
  Furthermore, it causes the parking switch indicator to blink, the master warning light to illuminate, and display a warning message on the multi display to inform the driver.



255CH20

- The transmission control ECU will also store the DTCs (Diagnostic Trouble Codes) of the malfunctions.
- The DTCs can be accessed the use of the hand-held tester with CAN extension module.
- Some DTCs have been newly added to this system. For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

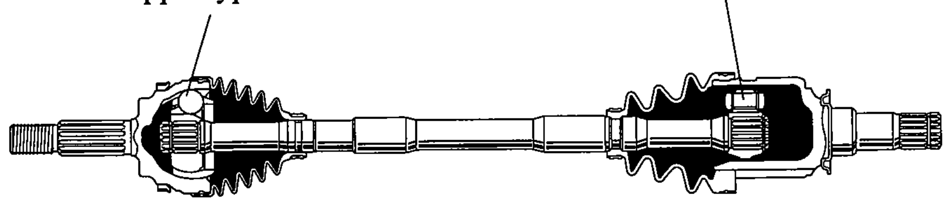
■ FAIL-SAFE

If the transmission control ECU detects a malfunction in the system, the transmission control ECU controls the system according to the data already stored in memory.
For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

DRIVE SHAFT

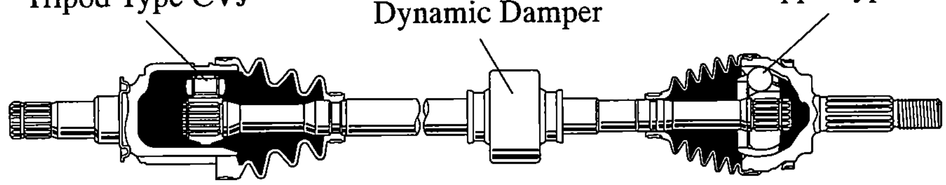
■ DESCRIPTION

- The front drive shaft uses the tripod type CVJ (Constant Velocity Joint) on the front differential side, and Rzeppa type CVJ on the wheel side.
- A dynamic damper has been provided on the front right drive shaft to reduce vibration and noise.



Left-Hand

255CH101



Right-Hand

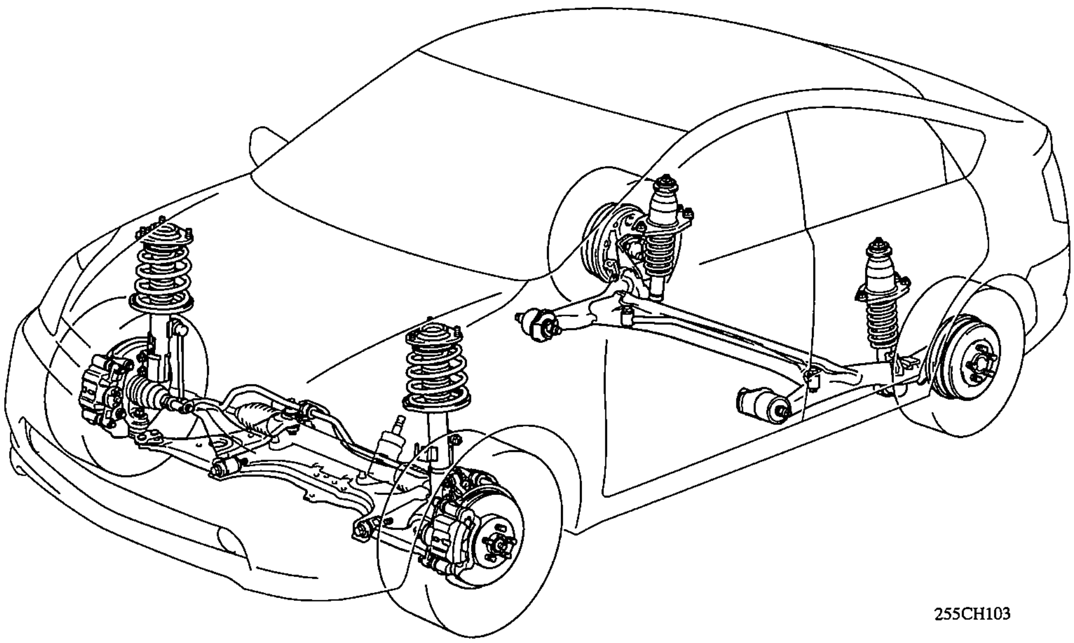
255CH102

SUSPENSION AND AXLE

■ SUSPENSION

1. General

- A MacPherson strut type independent suspension with L-shaped lower arms is used for the front.
- A torsion beam type suspension is used for the rear. In contrast to the toe-control link type used on the '03 Prius, the rear suspension of the '04 Prius has been changed to a toe-correction bushing type.



255CH103

▶ Specifications ◀

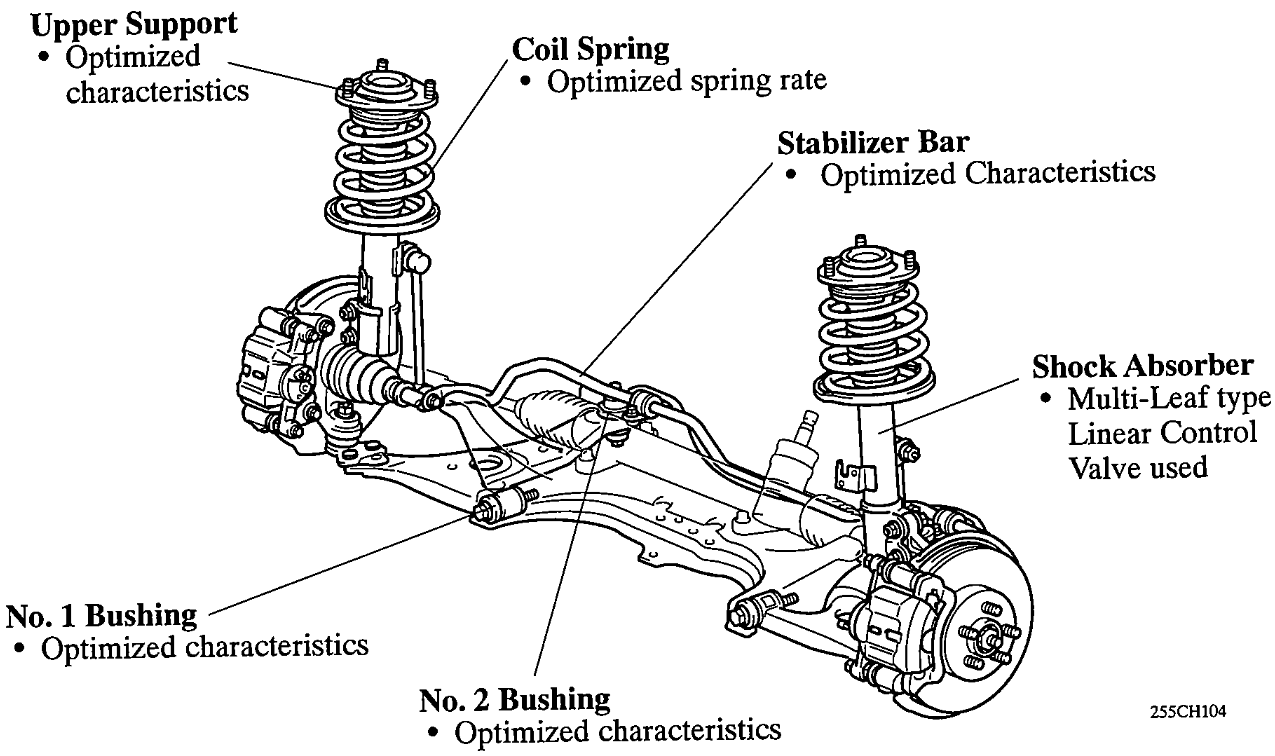
Model			'04 Prius	'03 Prius
Front Wheel Alignment	Type		MacPherson Strut	←
	Tread*	mm (in.)	1505 (59.3)	1480 (58.3)
	Caster*	degrees	3° 10'	1° 02'
	Camber*	degrees	– 0° 35'	– 1° 26'
	Toe-in*	mm (in.)	0 (0.00)	1 (0.04)
	King Pin Inclination*	degrees	12° 35'	9° 52'
Rear Wheel Alignment	Type		Torsion Beam	←
	Tread*	mm (in.)	1480 (58.3)	1478 (58.2)
	Camber*	degrees	– 1° 30'	←
	Toe-in*	mm (in.)	3 (0.12)	1 (0.04)

*: Unloaded Vehicle Condition

2. Front Suspension

General

Through the optimal allocation of components, the front suspension realizes excellent riding comfort and controllability.

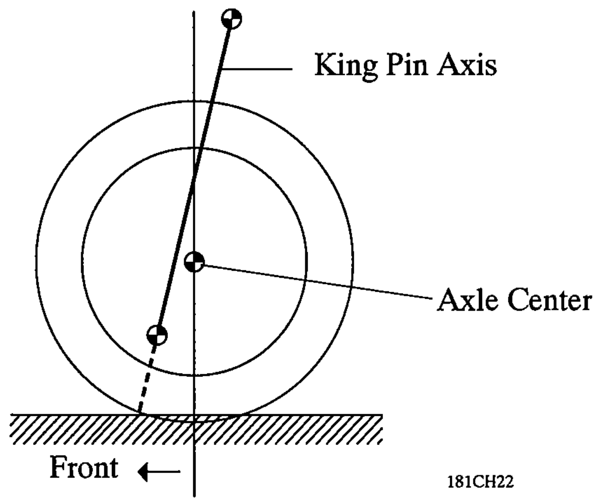


Service Tip

To adjust the camber of the front suspension, change the location of the bolts and nuts fastened onto the lower side of the shock absorber and front axle. For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

Nachlauf Geometry

The front suspension adopts the nachlauf geometry in which the king pin axis is located ahead of the axle carrier. As a result, excellent straightline stability has been realized and the steering feeling has been improved.

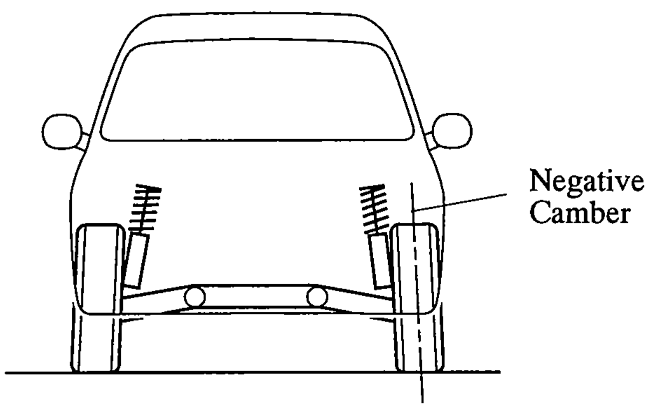


181CH22

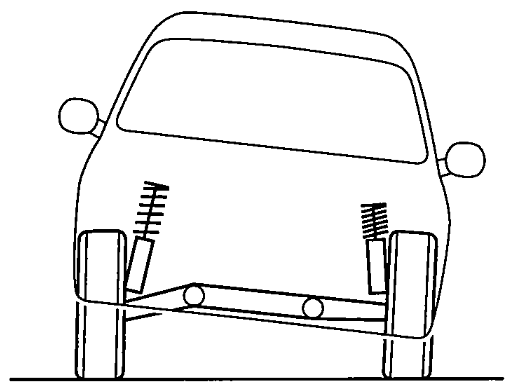
Negative Camber

The front suspension adopts negative camber to reduce the ground contact camber angle of the outer wheel at the time of turning (cornering), which is caused when the vehicle posture changes during cornering, thus realizing excellent cornering performance.

▶ **During Cornering** ◀



181CH23



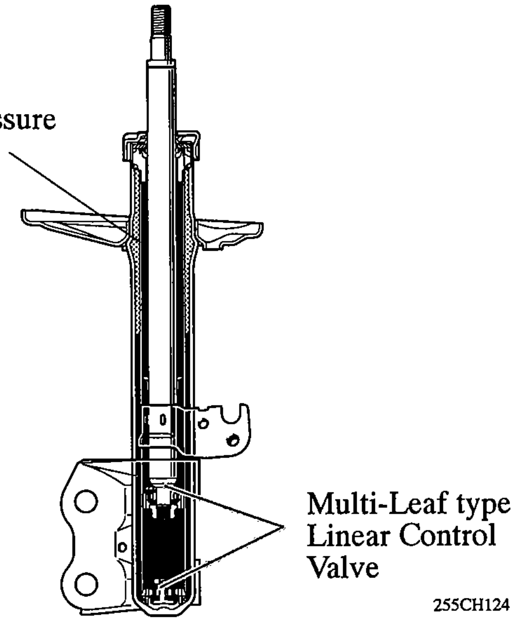
181CH24

Shock Absorber

1) General

The shock absorber has adopted the two functions listed below to realize both driving stability and riding comfort.

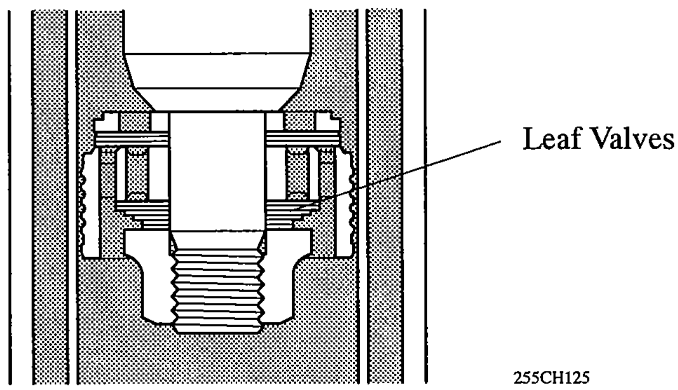
- A low-pressure (N_2) gas sealed type construction has been adopted to suppress cavitation.
- A multi-leaf type linear control valve has been adopted to attain linear damping force characteristics.



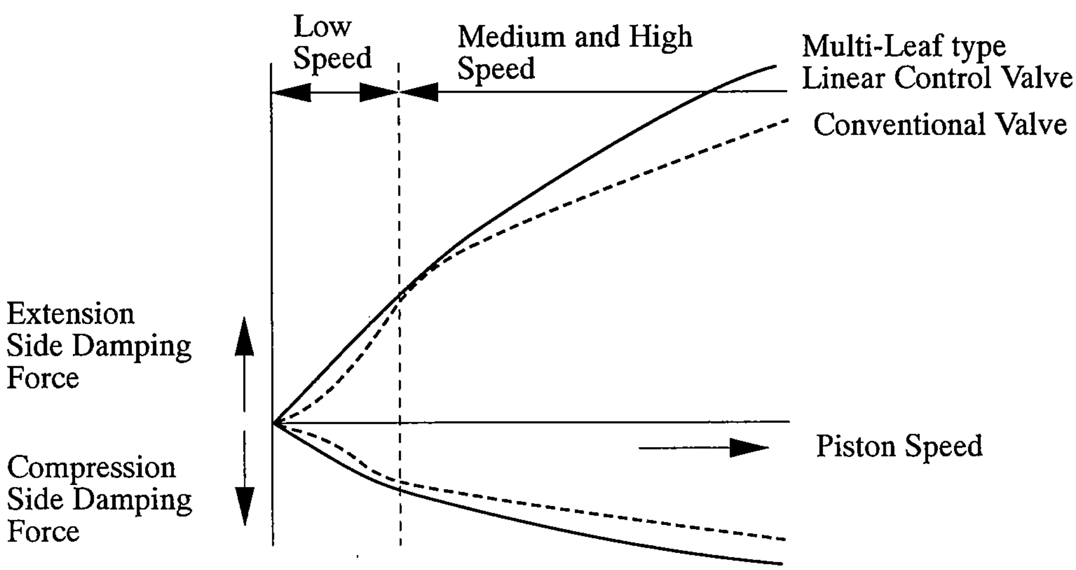
255CH124

2) Construction of Multi-Leaf type Linear Control Valve

The multi-leaf type linear control valve has a structure of several layered leaf valves with different diameter. With the adoption of the multi-leaf type linear control valve, the changes in the damping force are made constant at low piston speeds, thus realizing the excellent riding comfort and controllability.



255CH125



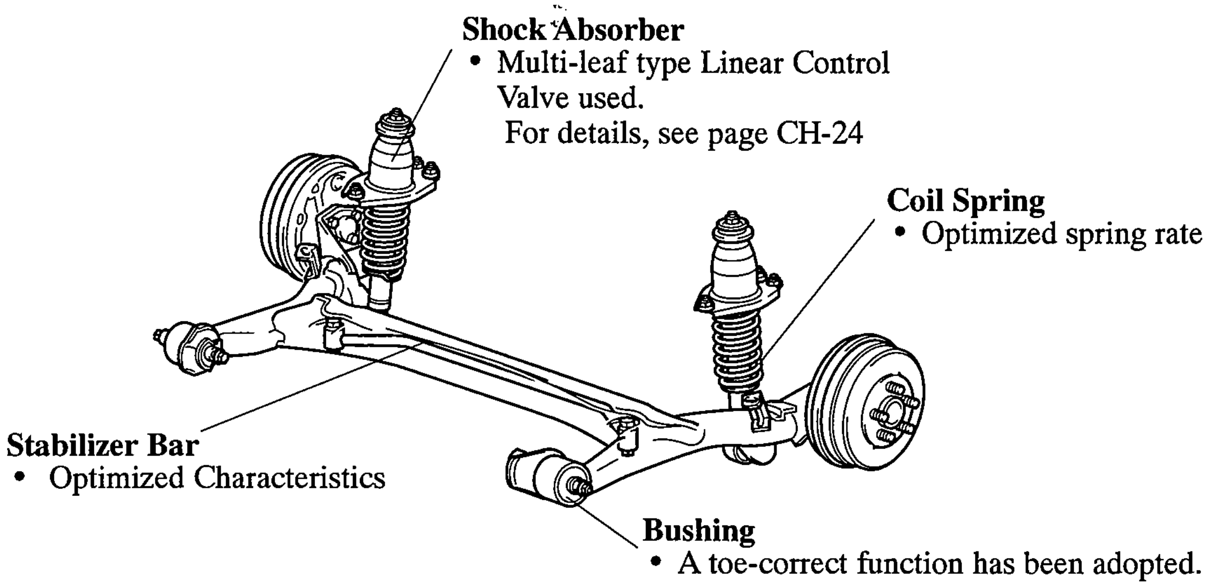
Damping Force Characteristics

199CH110

3. Rear Suspension

General

Through the optimal allocation of components, the rear suspension realizes excellent stability and controllability.



255CH105

NOTICE

Be sure to use the jack-up points that are provided on the body when raising the vehicle on the jack. Never apply a jack under the axle beam, trailing arm, or the bushing of the rear suspension.

Toe and Camber Change

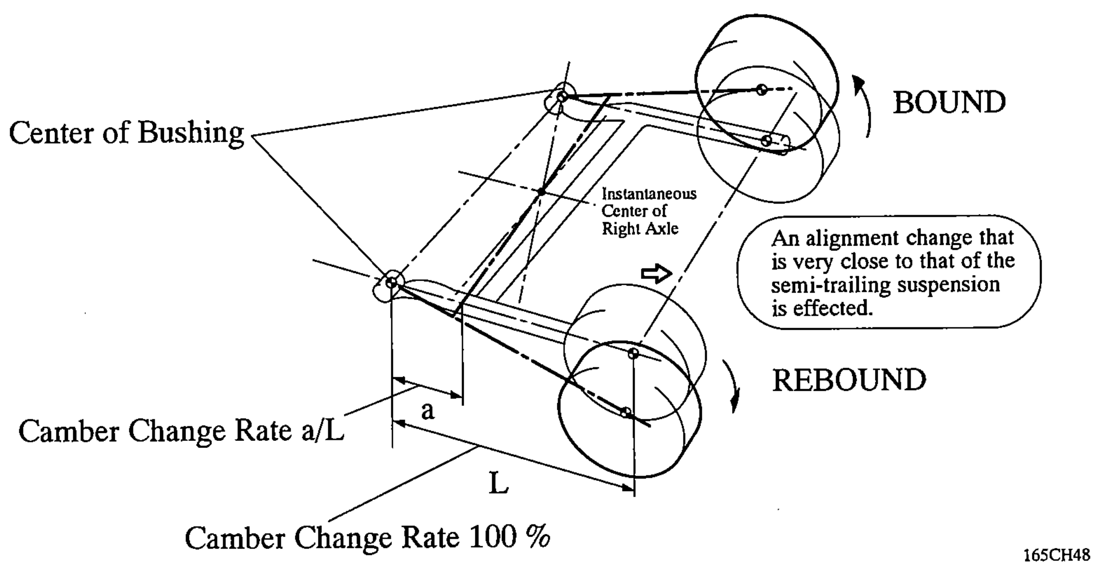
In a torsion-beam type suspension, the camber angle and the toe change differ between the bouncing case and the tramping case, offering both straight-line stability and excellent cornering stability.

1) Bouncing Case

Similar to the full-trailing arm type suspension, the axis that joins the center of the right and left trailing arm bushings is the center of the movement.

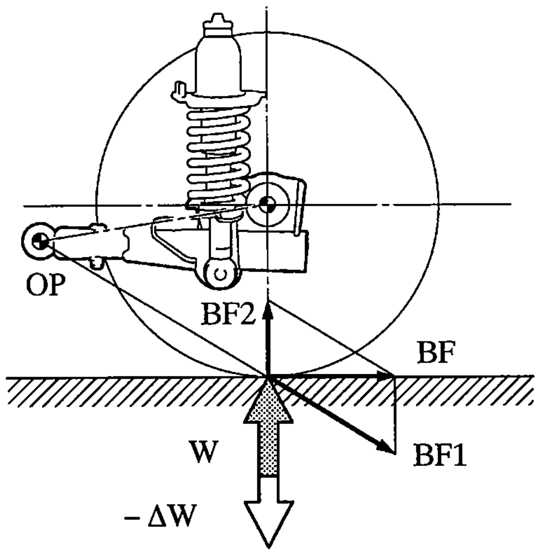
2) Tramping Case

During tramping case, or if a difference in suspension travel is created between the right and left wheels, the torsion beam twists with its shearing center as the center of its rotation.
Also, camber changes in relation to the suspension travel are determined by the ratio of the distance between the No.1 trailing arm bushing and the axle center and the shearing center ('a' in the Fig. Below) and distance between the No.1 trailing arm bushing and the axle beam ('L' in the Fig. Below).
Consequently, through the optimal allocation of the axle beam, the changes in the camber angle in relation to the suspension travel have been optimized, thus ensuring excellent cornering performance.



Anti-Lift Geometry

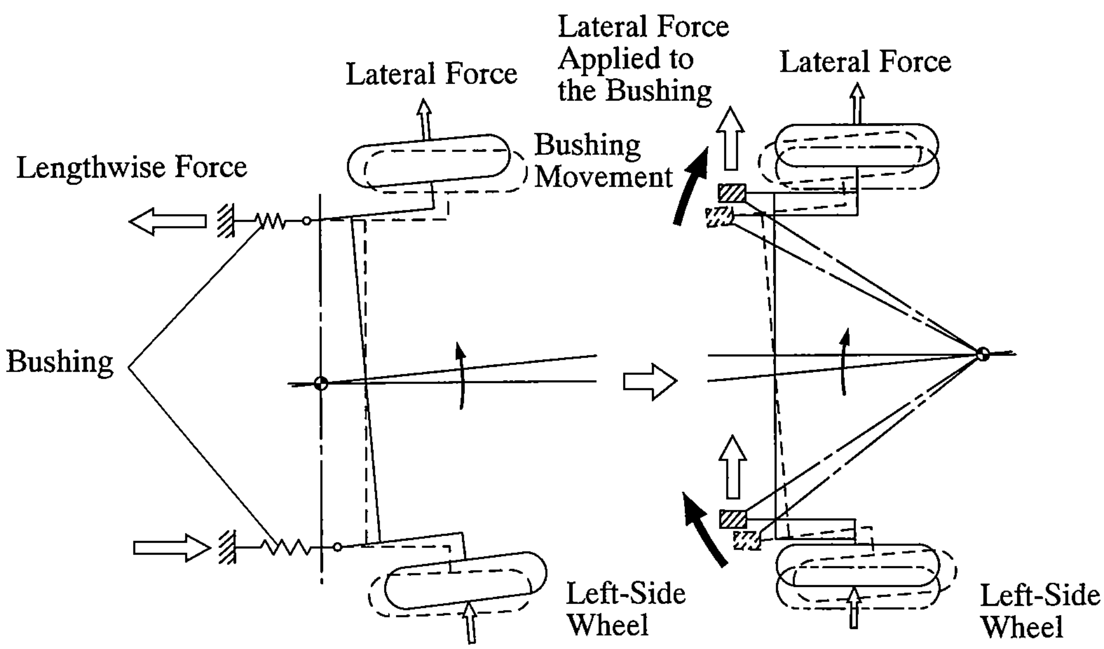
The lifting of the rear end of the vehicle during braking occurs due to the shifting of the center of gravity caused by inertia.
The intersecting point (OR) supports the braking force (BF) and generates a force (BF1) in the direction of the intersecting point and a component force (BF2) in the direction of the ground contact.
The BF1 force can change the height of the intersecting point OR. When OR is set high, it acts in the opposite direction (-W) of the load fluctuation (W), in order to restrain the lift.



216CH16

Toe-Correct Function

The longitudinal and lateral forces that are created in the vehicle during cornering causes the bushings in the trailing arms to deform.
On a right turn, the right trailing arm moves forward and the left trailing arms moves rearward, creating a tendency for the left wheel to toe out.
In this situation, the bushings that are installed in the trailing arms are designed to utilize the lateral force, which is applied to the bushings during cornering, to correct the left trailing arm towards the toe-in direction.
As a result, excellent stability and controllability are realized.

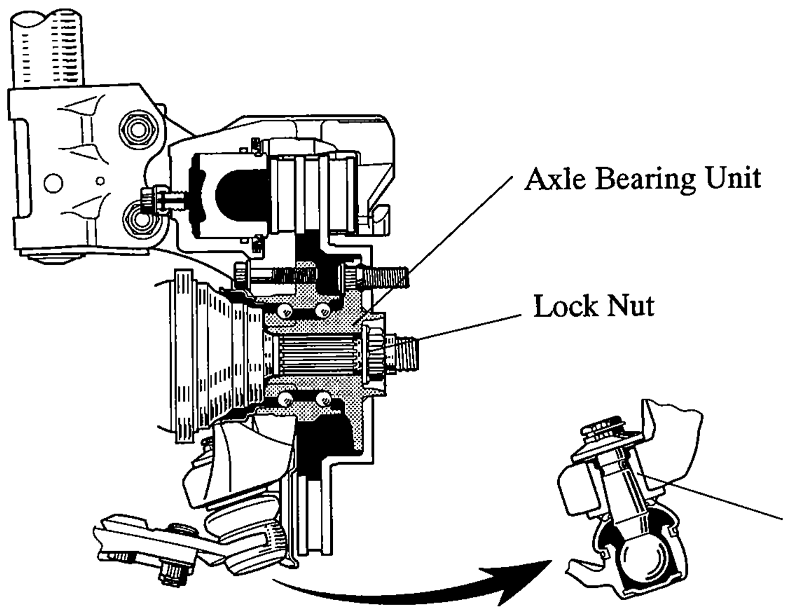


181CH35

■ AXLE

1. Front Axle

- To reduce the weight of the steering knuckles on the front axle, the '04 Prius has adopted steering knuckles made of aluminum.
- Along with the adoption of the steering knuckles made of aluminum, axle bearing units in which the axle bearing is integrated with the hub flange have been adopted. The axle bearing units use double-row angular ball bearings that offer low rolling resistance.
- The area of the steering knuckle that mounts to the lower ball joint is provided with a steel collar, which uses the same joining construction as in the past.
- A lock nut (12-point) has been adopted and staked for tightening the axle hub in order to ensure the tightening performance. This nut cannot reused.

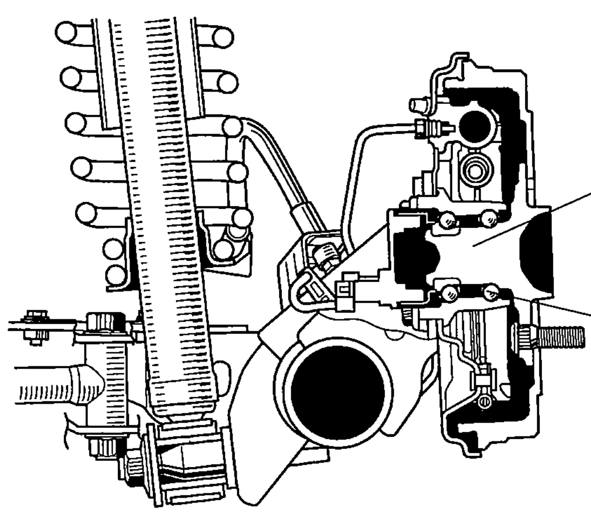


255CH106

Service Tip
The torque for tightening the steering knuckle made of aluminum differs from the conventional type. For details, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

2. Rear Axle

- The rear axle use a double-row angular ball bearing which offers low rolling resistance.
- Part of the inner race is integrated with the shaft, optimizing rigidity.



255CH107

BRAKE

■ DESCRIPTION

1. General

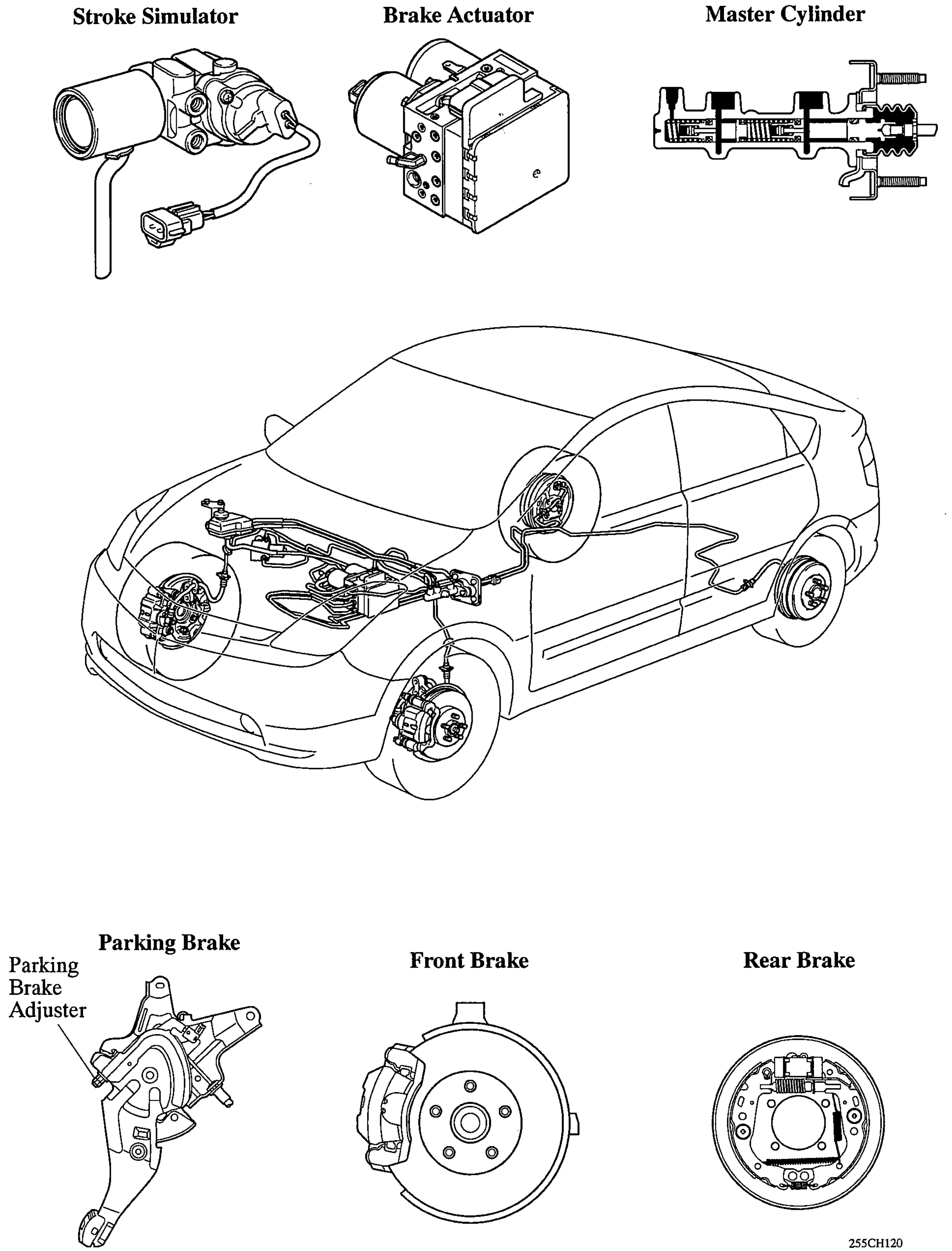
The '04 Prius has a brake system with the following specifications:

Model		'04 Prius	'03 Prius
Front Brake	Type	Ventilated Disk	←
	Rotor Size	For 14 in. wheel	←
Rear Brake	Type	Leading Trailing Drum	←
	Drum Inner Diameter mm (in.)	200 (7.87)	←
Regenerative Brake Cooperative Control & ABS with EBD & Brake Assist		Standard	—
Regenerative Brake Cooperative Control & ABS with EBD & Brake Assist & Enhanced VSC		Option	—
Regenerative Brake Cooperative Control & ABS with EBD		—	Standard
Parking Brake Lever Type		Pedal	←

▶ **Specifications** ◀

Model		'04 Prius	'03 Prius
Master Cylinder	Type	Single	←
	Diameter mm (in.)	19.05 (0.75)	22.22 (0.78)
Brake Booster	Type	—	Hydraulic
Front Disk Brake	Caliper Type	PE54C	PE54C
	Wheel Cylinder Diameter mm (in.)	54.0 (2.13)	←
	Rotor Size (D × T) mm (in.)	255 × 22 (10.04 × 0.87)	←
	Pad Material	PS558H-FF	PN540H-FG
Rear Drum Brake	Wheel Cylinder Diameter mm (in.)	19.05 (0.75)	20.64 (0.81)
	Drum Inner Diameter mm (in.)	200 (7.87)	←
	Lining Material	LN521-FF	LA509-EE
Parking Brake	Type	Leading Trailing Drum	←
	Drum Inner Diameter mm (in.)	200 (7.87)	←
	Lever Type	Pedal	←

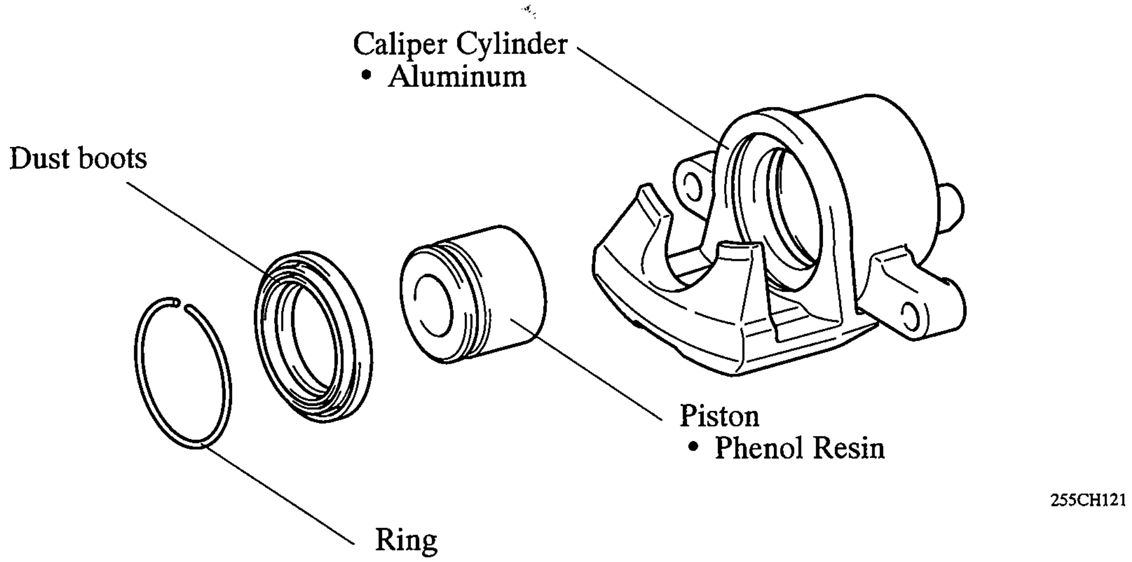
2. Component of Brake System



■ FRONT BRAKE

1. Brake Caliper

For weight reduction, the front brake caliper of the '04 Prius has adopted a caliper cylinder made of aluminum and a caliper piston made of phenol resin. Its basic construction is the same as the previous model.



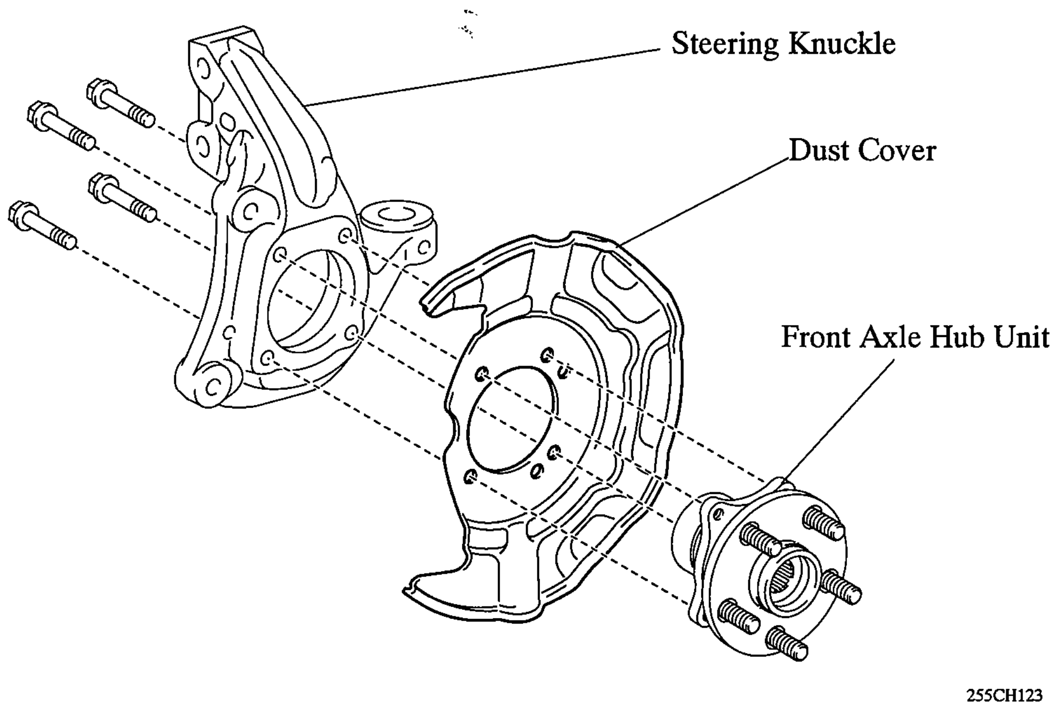
Service Tip

- Be sure to protect the piston with piece of the wood wrapped in a shop rag when disassembling the front brake caliper. Since compressed air is used to pull the piston out, the piston will be pushed out of the cylinder with great force and damage to the piston may result.
- Prior to assembly, be sure to check the piston for damage.

For assembling procedures, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

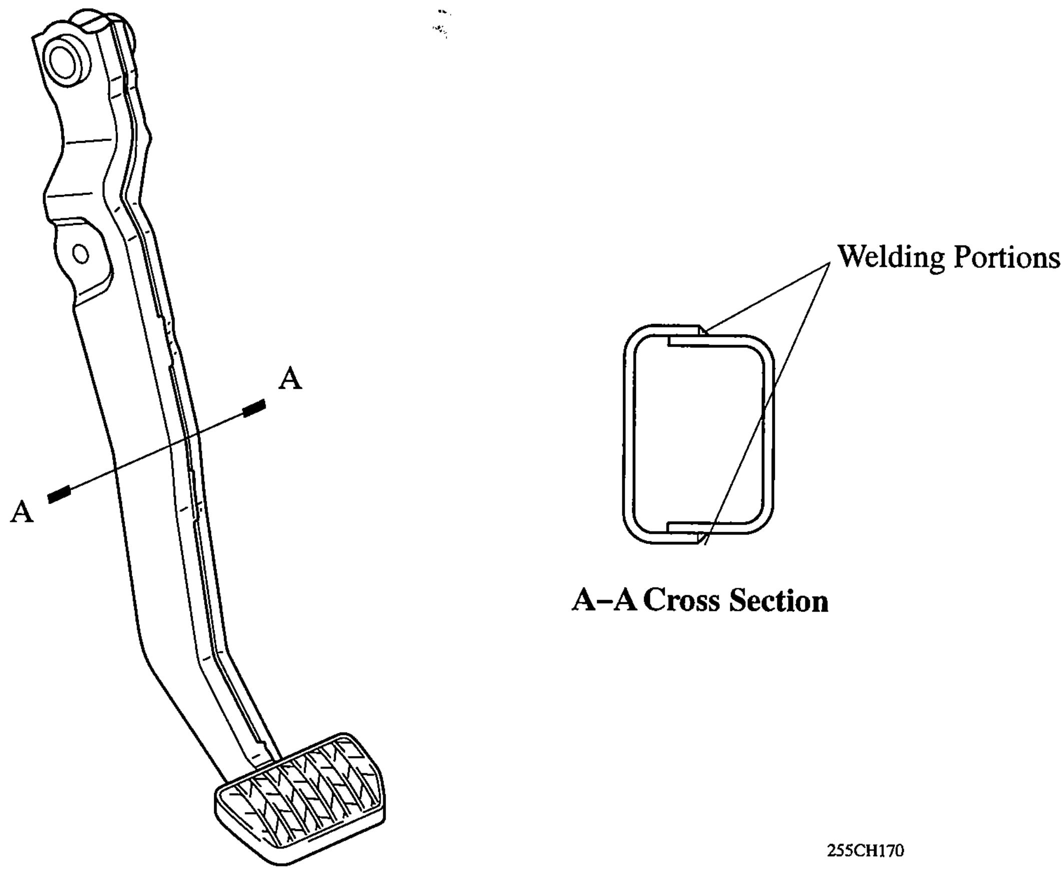
2. Dust Cover

Along with the adoption of steering knuckles made of aluminum, the front dust covers are mounted together with the front axle hub units.



■ BRAKE PEDAL

The hollow type brake pedal has been adopted on the '04 Prius. This pedal has reduced about 12% of its mass and enhanced about 10% of its intensity compared to that of the previous model.



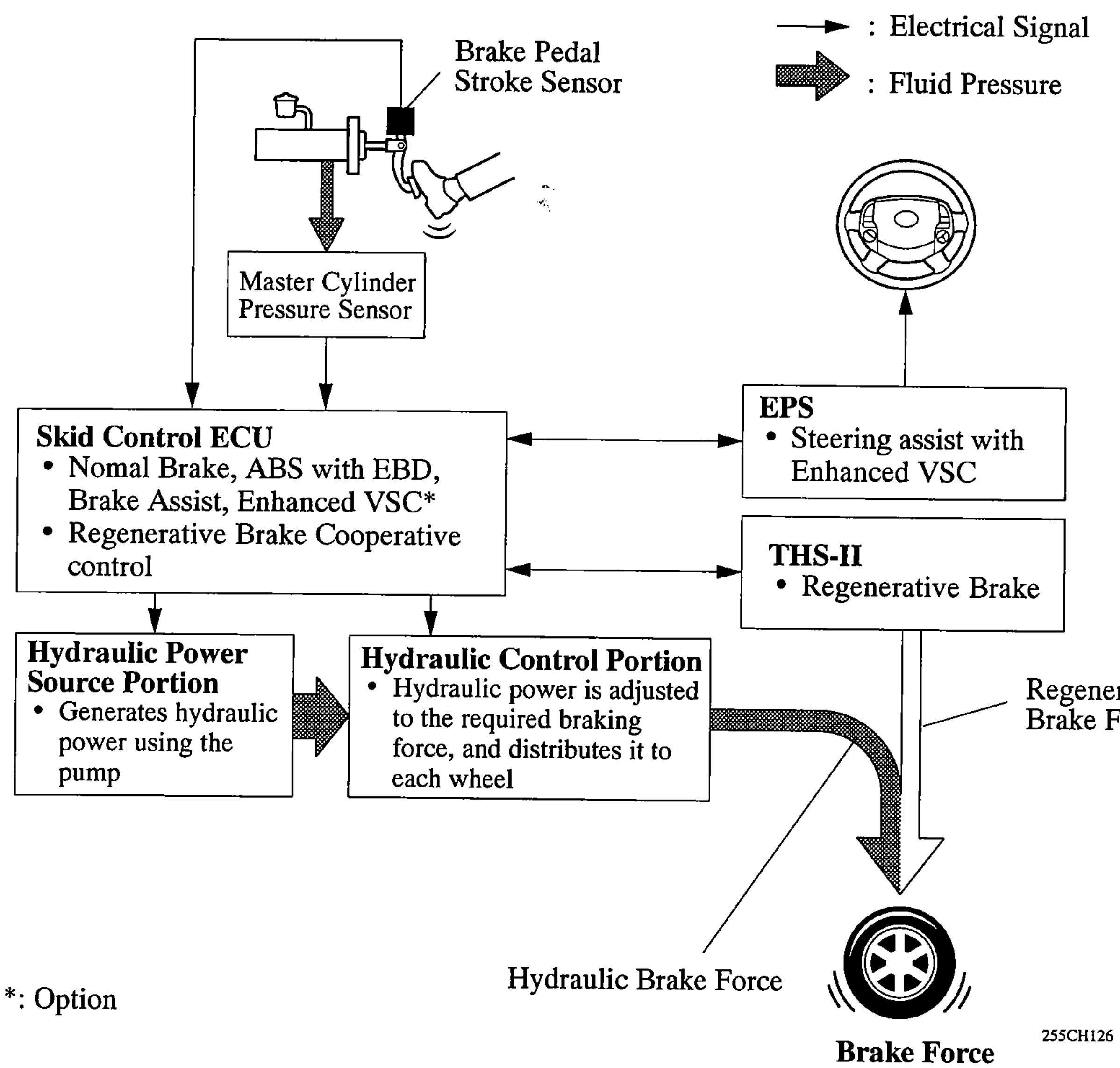
■ BRAKE CONTROL SYSTEM

1. General

- An ECB (Electronically Controlled Brake) system has been adopted in the brake control system of the '04 Prius. The ECB system calculates the required braking force based on the amount of pedal effort and force applied by the driver. Then, this system applies the required braking force (which consists of a regenerative brake force generated by MG2 and a brake force generated by the hydraulic brake system) and effectively absorbs the energy.
- The ECB ECU, which controls this system, is integrated into the skid control ECU, and effects comprehensive control together with the hydraulic brake control system (consisting of ABS with EBD, brake assist and Enhanced VSC*).
- A brake control system warning light has been newly adopted accompanied by the adoption of the ECB system.
- The Enhanced VSC* system provides the steering assist in order to facilitate steering operation of the driver depending on vehicle situations by effecting cooperative control in conjunction with EPS, in addition to the VSC system that gives the general braking control function.
- On the '04 Prius, the motor traction control system has been adopted. This system minimizes a slippage of the drive wheels and generates the appropriate drive force for road surface condition by applying the hydraulic brake control to the wheels in slipping, in addition to the control function protecting the planetary gear and the motor that has been provided by the THS system on the previous model.
  For details, refer to HV ECU control in THS-II section on page THS-46.
- On the '04 Prius, the conventional brake booster portion has been discontinued. Instead, it consists of brake input, power supply, and hydraulic pressure control portions.
  During normal braking, the fluid pressure generated by the master cylinder does not directly actuate the wheel cylinders, but serves as a hydraulic pressure signal. Instead, the actual control pressure is obtained by regulating the fluid pressure of the hydraulic power source in the brake actuator, which actuates the wheel cylinders.
- The brake system of the '04 Prius starts with one of the actions the power switch is turned ON, etc.
- The skid control ECU maintains communication with the EPS ECU and the HV ECU via CAN (Controller Area Network). For details, refer to Multiplex Communication on page BE-47.
- The skid control ECU has been changed from 16-bit CPU to 32-bit CPU to increase the for processing the signals.

*: Option

▶ Outline of Brake Control System ◀



The brake system of '04 Prius has a following function:

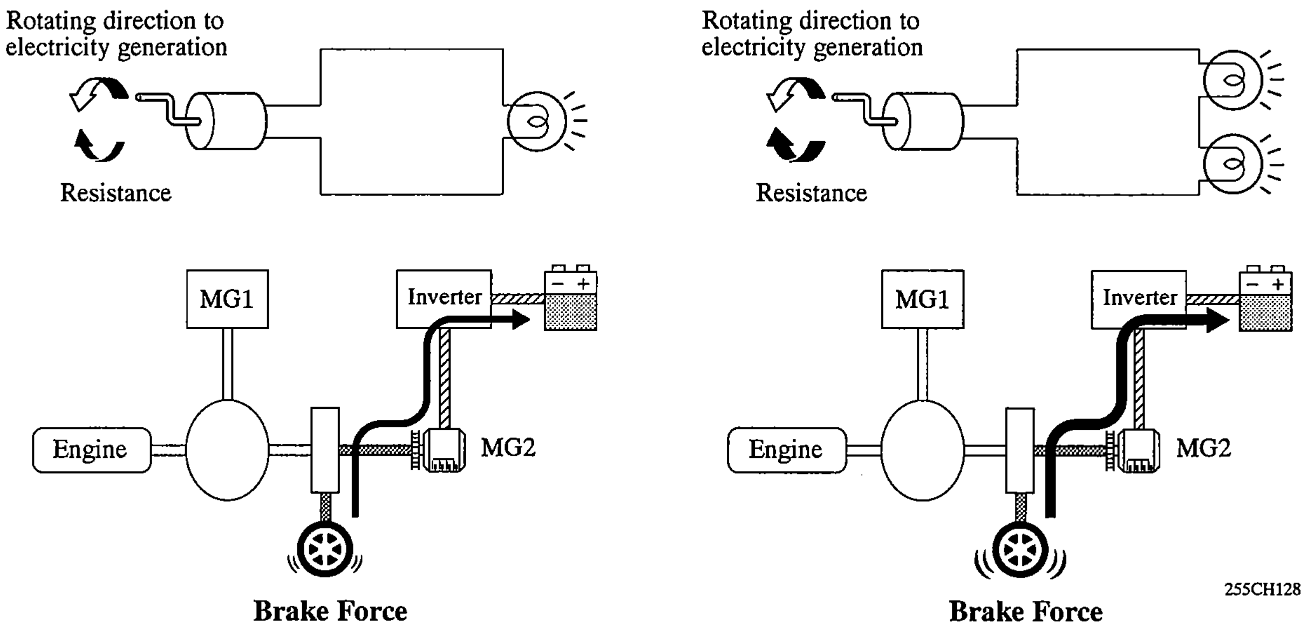
Brake Control System	Function	Outline
ECB System	Regenerative Brake Cooperative Control	Controls the hydraulic brake in order to recover the electrical energy by utilizing the regenerative brake of the THS-II system as much as possible.
	Enhanced VSC* (Enhanced Vehicle Stability Control)	• The Enhanced VSC system helps prevent the vehicle from slipping sideways as a result of strong front wheel skid or strong rear wheel skid during cornering. • Effects cooperative control with the EPS ECU in order to provide steering assist in accordance with the operating conditions of the vehicle.
	ABS (Anti-lock Brake System)	The ABS helps prevent the wheels from locking when the brakes are applied firmly or when braking on a slippery surface.
	EBD (Electronic Brake force Distribution)	The EBD control utilizes ABS, realizing the proper brake force distribution between front and rear wheels in accordance with the driving conditions. In addition, during cornering braking, it also controls the brake forces of right and left wheels, helping to maintain the vehicle behavior.
	Brake Assist	The Brake Assist has two functions: • To increase the braking force if the brake pedal operation is not sufficient when urgent braking is needed. • To increase the braking force if stronger brake force is required.

*: Option

2. Outline of Regenerative Brake Cooperative Control

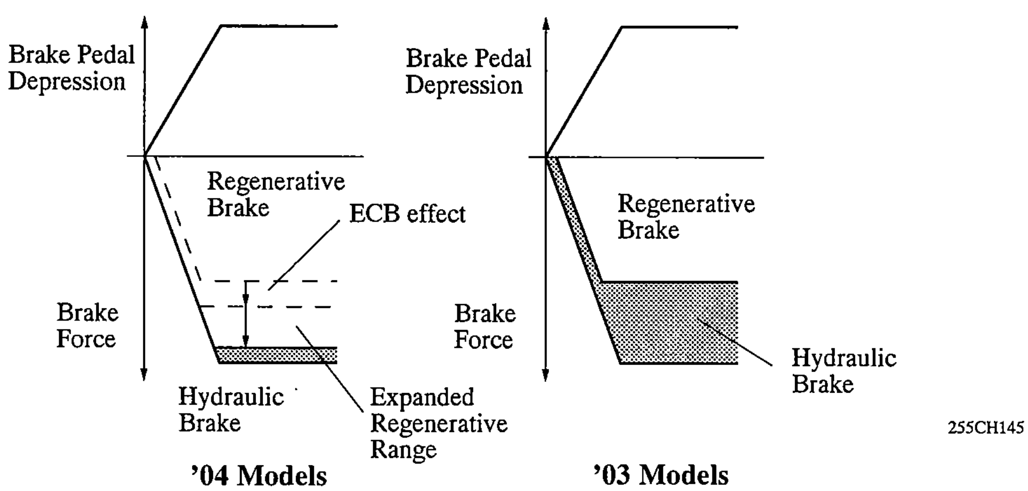
General

- Regenerative brake consists of a resistance force that is generated at the rotational axle in the reverse direction of the rotation of the generator (MG2) that is generating electricity. The greater the generated amperage (battery charging amperage), the greater will be the resistance force.



- The drive axle and MG2 are joined mechanically. When the drive wheels rotate MG2 and cause it to operate as a generator, a regenerative brake force of MG2 is transmitted to the drive wheels. This force is controlled by the THS-II system, which controls the generation of electricity.
  The regenerative brake cooperative control does not rely solely on the braking force of the hydraulic brake system to supply the brake force required by the driver. Instead, by effecting cooperative control with the THS-II system, this control provides a joint braking force provided by the regenerative brake and the hydraulic brake. As a result, this control minimizes the loss of the kinetic energy associated with the normal hydraulic brake, and recovers this energy by converting it into electrical energy.
- On the '04 Prius, the power output of MG2 has increased through the adoption of the THS-II system, which has resulted in improving the regenerative brake force. In addition, the distribution of the brake force has been improved through the adoption of the ECB system, effectively increasing the use range of the regenerative brake. These attributes enhance the system's ability to recover electrical energy, which contributes to fuel economy.

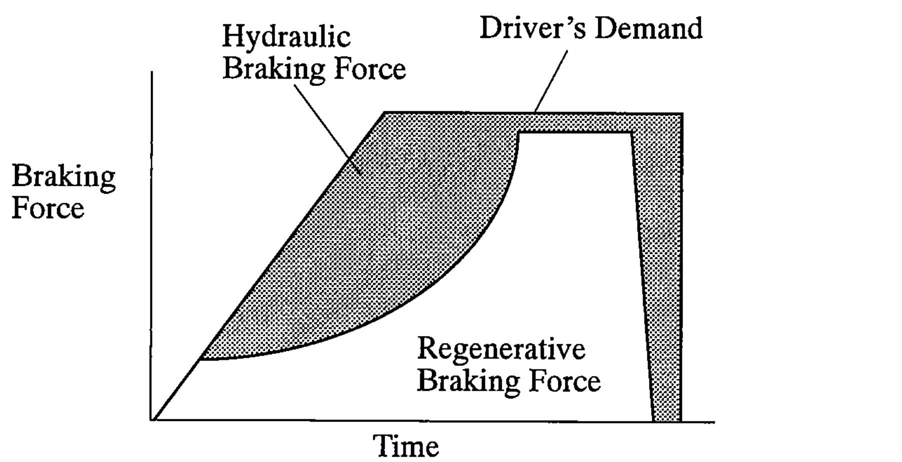
▶ Improved Regenerative Brake ◀



Apportioning of the Brake Force

- The apportioning of the brake force between the hydraulic brake and the regenerative brake varies by the vehicle speed and time.
- The apportioning of the brake force between the hydraulic brake and the regenerative brake is accomplished by controlling the hydraulic brake so that the total brake force of the hydraulic brake and the regenerative brake matches the brake force required by the driver.
- If the regenerative brake becomes inoperative due to a malfunction in the THS-II system, the brake system effects control so that the entire brake force required by the driver is supplied with the hydraulic brake system.

▶ Imagery Drawing ◀



Changes in Braking Force Apportionment

3. Outline of EBD Control

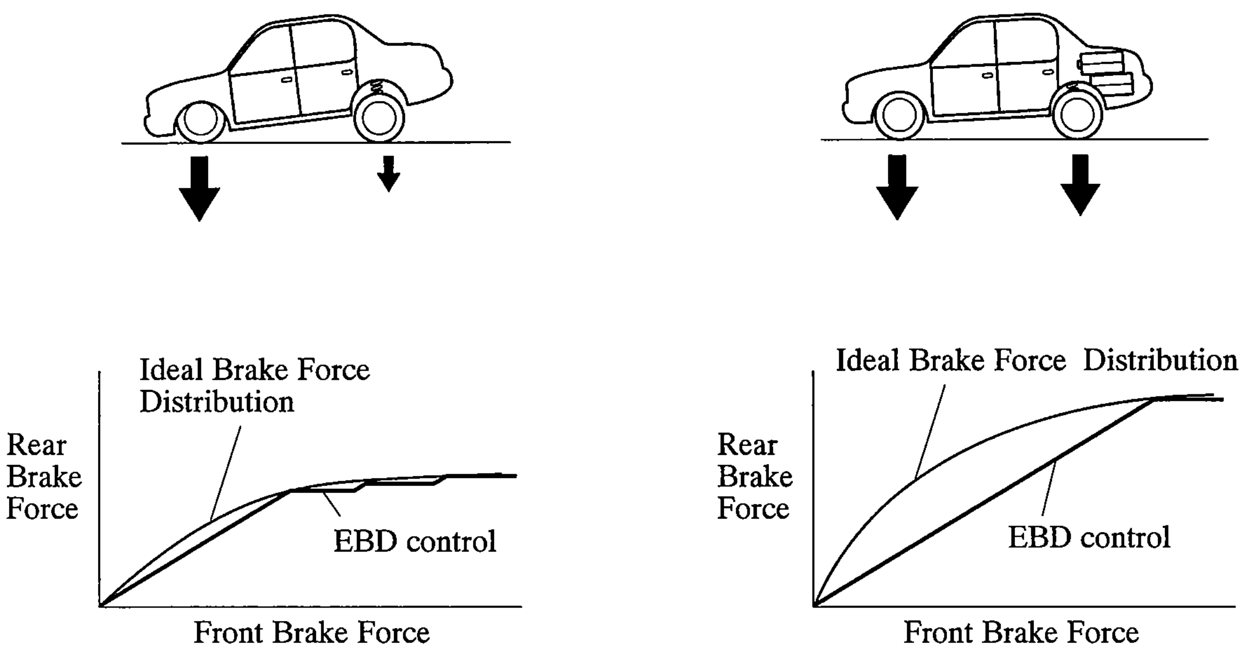
General

The distribution of the brake force, which was performed mechanically in the past, is now performed under electrical control of the skid control ECU, which precisely controls the braking force in accordance with the vehicle's driving conditions.

Front/ Rear Wheels Brake Force Distribution

If the brakes are applied while the vehicle is moving straight forward, the transfer of the road reduces the load that is applied to the rear wheels. The skid control ECU determines this condition by way of the signals from the speed sensor, and the brake actuator regulates the distribution of the brake force of the rear wheels to optimally control.
For example, the amount of the brake force that is applied to the rear wheels during braking varies whether or not the vehicle is carrying a load. The amount of the brake force that is applied to the rear wheels also varies in accordance with the extent of the deceleration.
Thus, the distribution of the brake force to the rear is optimally controlled in order to effectively utilize the braking force of the rear wheels under these conditions.

▶ EBD Control Concept ◀



Without Load in Rear **With Load in Rear**

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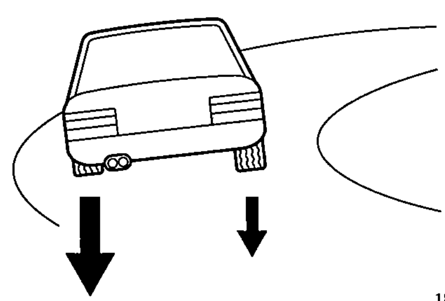
Right/Left Wheels Brake Force Distribution (During Cornering Braking)

When the brakes are applied while the vehicle is cornering, the load that applied to the inner wheel decreases to the outer wheel increases.
The skid control ECU determines this condition by way of the signals from the speed sensor, and the brake actuator regulates the brake force in order to optimally control the distribution of the brake force to the inner wheel and outer wheel.



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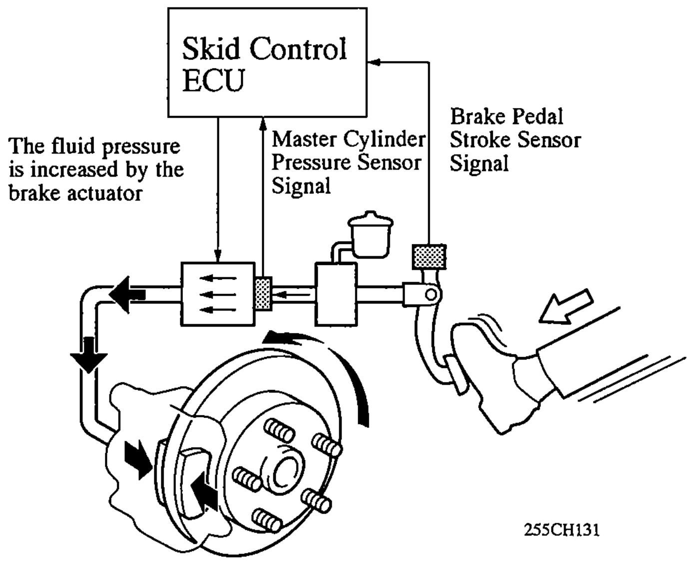
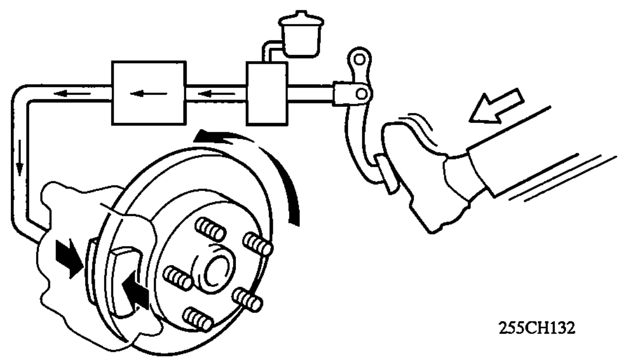
4. Outline of Brake Assist System

- The Brake Assist System interprets a quick push of the brake pedal as emergency braking and supplements the braking power applied if the driver has not stepped hard enough on the brake pedal. In emergencies, drivers, especially inexperienced ones, often panic and do not apply sufficient pressure on the brake pedal. Based on the signals from the master cylinder pressure sensors and the brake pedal stroke sensor, the skid control ECU calculates the speed and the amount of the brake pedal application and then determines the intention of the driver to make an emergency braking. If the skid control ECU determines that the driver intends emergency braking, the system activates the brake actuator to increase the brake fluid pressure. The Brake Assist System in combination with ABS helps ensure the vehicle's brake performance.
  A key feature of Brake Assist system is that the timing and the degree of braking assistance are designed to ensure that the driver does not discern anything unusual about the braking operation. When the driver intentionally eases up on the brake pedal, the system reduces the amount of assistance it provides.
- In case that the vehicle is fully loaded, stronger brake force may be required even if the brakes are not applied quickly. Then, the brake assist system also operates to increase brake force.

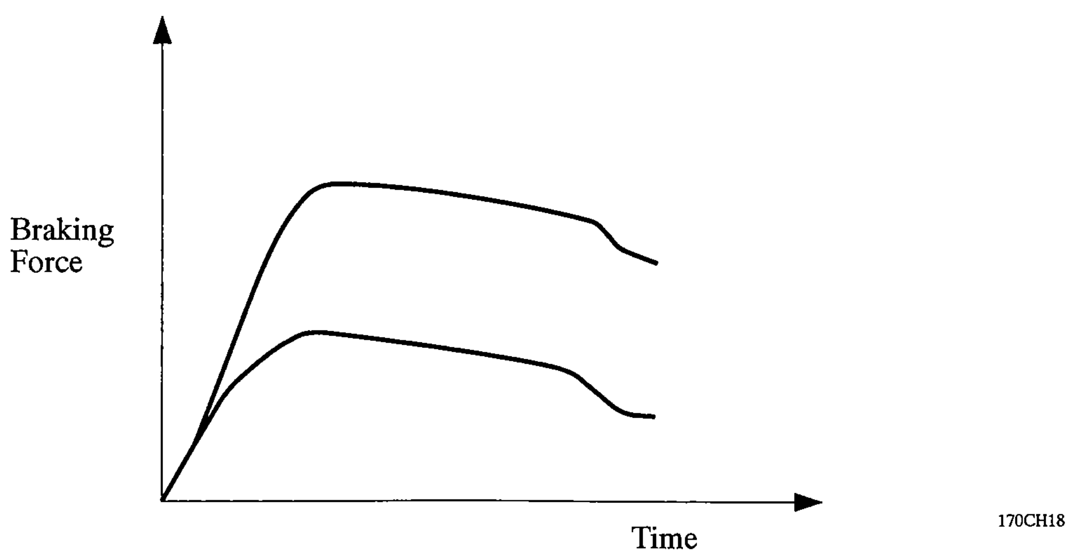


with Brake Assist System



without Brake Assist System

◆: There is no difference of the maximum brake performance between the vehicles with and without brake assist system.

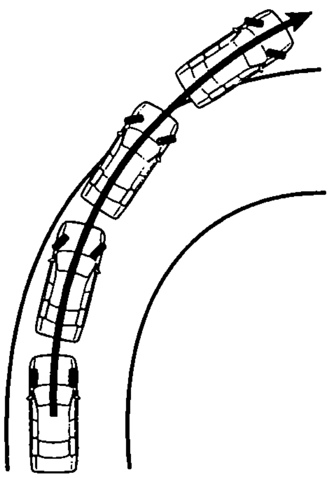


5. Outline of Enhanced VSC System

General

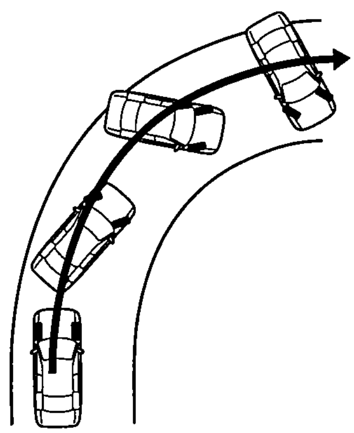
The followings are two examples that can be considered as circumstances in which the tires exceed their lateral grip limit.
The Enhanced VSC system is designed to help control the vehicle behavior by controlling the motive force and the brakes at each wheel when the vehicle is under one of the conditions indicated below.

- When the front wheels lose grip in relation to the rear wheels (front wheel skid tendency).
- When the rear wheels lose grip in relation to the front wheels (rear wheel skid tendency).



151CH17

Front Wheel Skid Tendency



189CH100

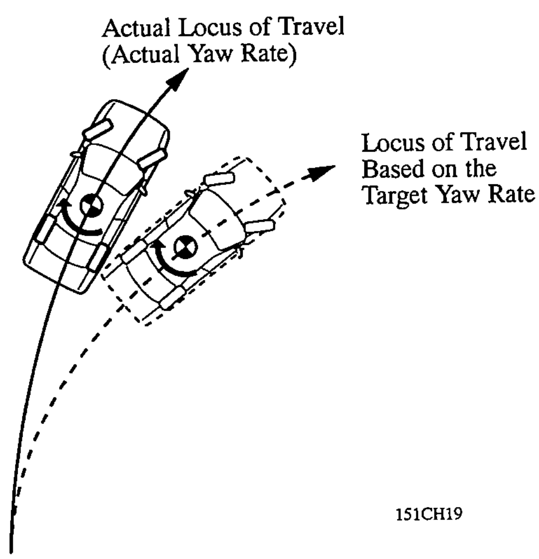
Rear Wheel Skid Tendency

Method for Determining the Vehicle Condition

To determine the condition of the vehicle, sensors detect the steering angle, vehicle speed, vehicle's yaw rate, and the vehicle's lateral acceleration, which are then calculated by the skid control ECU.

1) Determining Front Wheel Skid

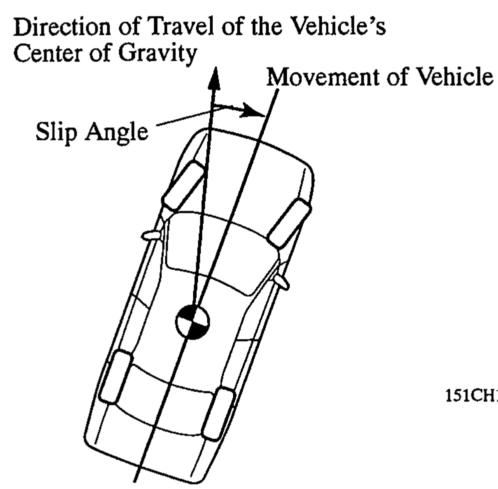
Whether or not the vehicle is in the state of front wheel skid is determined by the difference between the target yaw rate and the vehicle's actual yaw rate.
When the vehicle's actual yaw rate is smaller than the yaw rate (a target yaw rate that is determined by the vehicle speed and steering angle) that should be rightfully generated when the driver operates the steering wheel, it means the vehicle is making a turn at a greater angle than the locus of travel.
Thus, the skid control ECU determines that there is a large tendency to front wheel skid.



151CH19

2) Determining Rear Wheel Skid

Whether or not the vehicle is in the state of rear wheel skid is determined by the values of the vehicle's slip angle and the vehicle's slip angular velocity (time-dependent changes in the vehicle's slip angle). When the vehicle's slip angle is large, and the slip angular velocity is also large, the skid control ECU determines that the vehicle has a large rear wheel skid tendency.



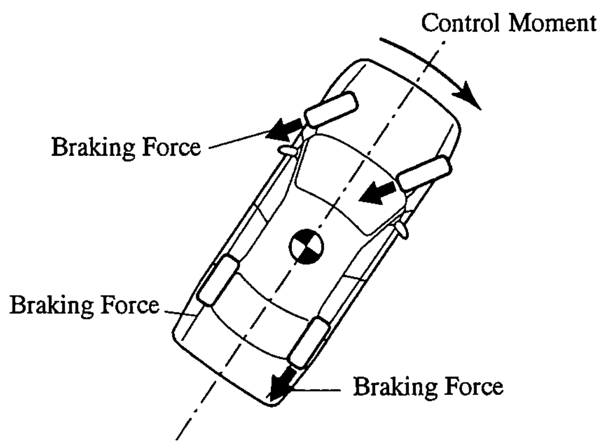
151CH18

Method for Enhanced VSC Operation

When the skid control ECU determines that the vehicle exhibits a tendency to front wheel skid or rear wheel skid, it decreases the engine output and applies the brake of a front or rear wheel to control the vehicle's yaw moment.
The basic operation of the Enhanced VSC is described below. However, the control method differs depending on the vehicle's characteristics and driving conditions.

1) Dampening a Front Wheel Skid

When the skid control ECU determines that there is a large front wheel skid tendency, it counteracts in accordance with the extent of that tendency. The skid control ECU controls the motive power output and applies the brakes of the front wheel of the outer circle in the turns and rear wheels in order to restrain the front wheel skid tendency.

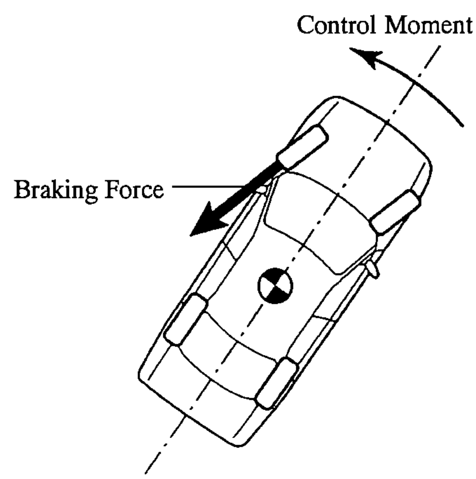


161ES30

Making a Right Turn

2) Dampening a Rear Wheel Skid

When the skid control ECU determines that there is a large rear wheel skid tendency, it counteracts in accordance with the extent of that tendency. It applies the brakes of the front wheel of the outer circle of the turn, and generates an outward moment of inertia in the vehicle, in order to restrain the rear wheel skid tendency. Along with the reduction in the vehicle speed caused by the braking force, the excellent vehicle's stability is ensured.
In some cases, the skid control ECU applies the brake of the rear wheels, as necessary.

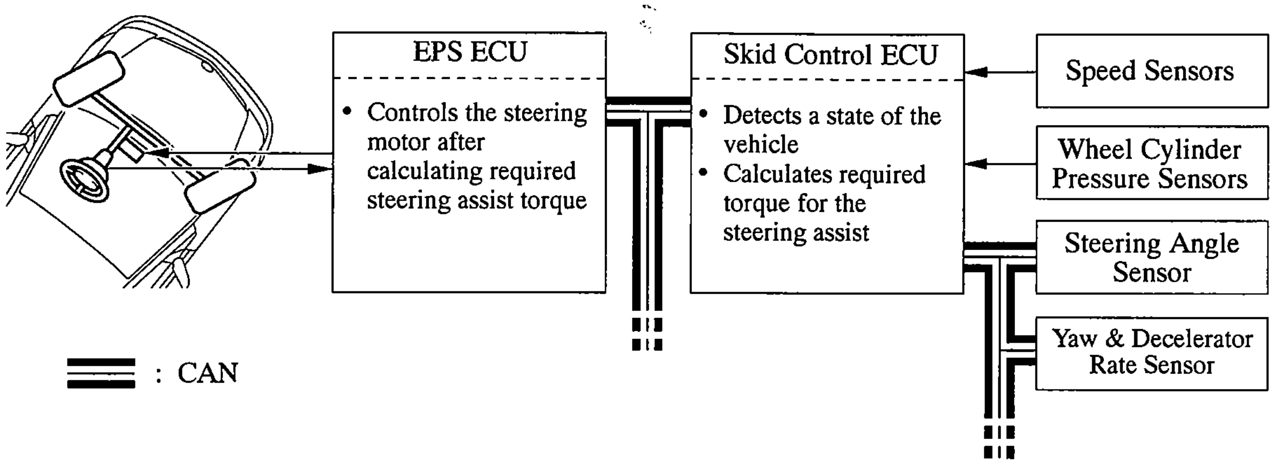


204CH15

Making a Right Turn

Cooperative Control with EPS

Enhanced VSC provides the steering assist in order to facilitate steering operation of the driver depending on vehicle situations by coordination of cooperative control with EPS, in addition to the general VSC control.



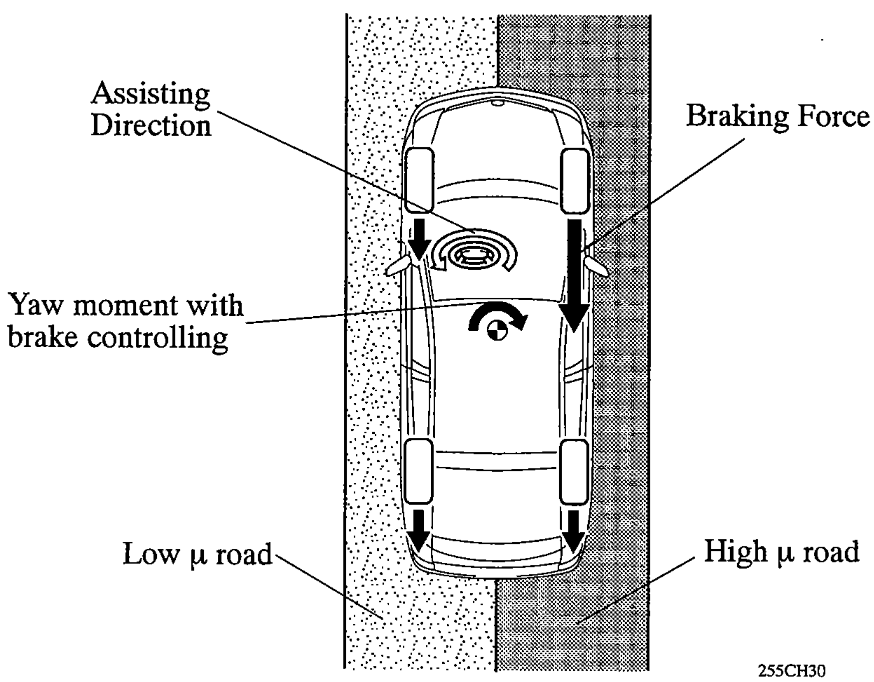
255CH165

Operation in a wheel skid tendency

- When the rear wheels lose grip, this system control the brake force and the motive force. At the same time, the system controls the steering torque to facilitate the steering effort of the driver.
- When the front wheels exhibit the tendency to skid, the driver could turn the steering wheel excessively, which could worsen the situation. To prevent this, Enhanced VSC provides steering torque assist.

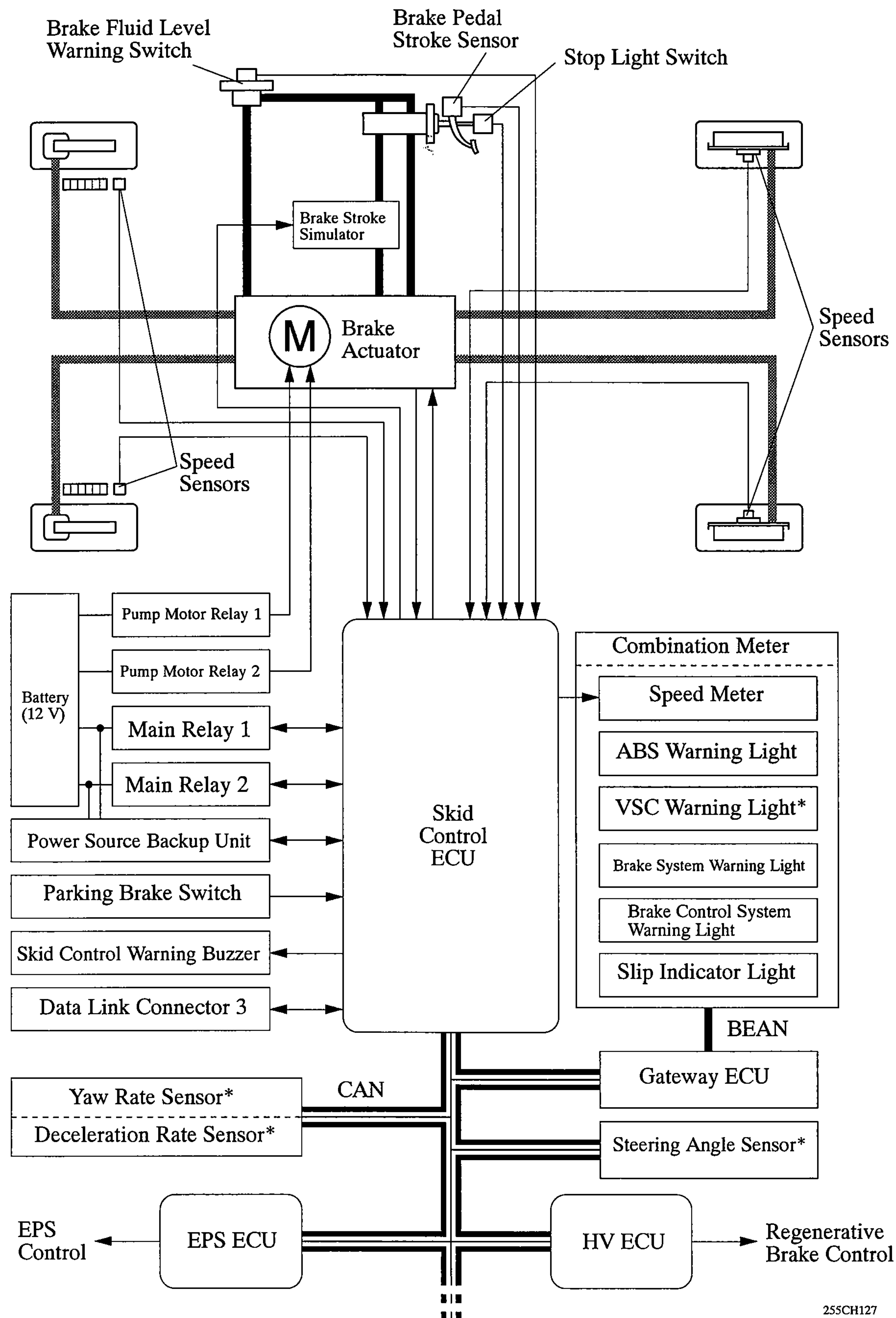
Operation in braking when surface resistance differs to both sides of the wheels

If the vehicle is braking while its right and left wheels are on surfaces with a different resistance, a difference will be created in the braking force applied to the right and left wheels, depending on the strength of the braking force. This will generate a yaw moment, which could require a steering maneuver. In this situation, S-VSC can effect cooperative control jointly with the EPS ECU, and provide a steering torque assist in the direction to cancel out the generated moment. By operating the EPS in this manner and facilitating the steering effort of the driver, Enhanced VSC helps to make the vehicle stable.



255CH30

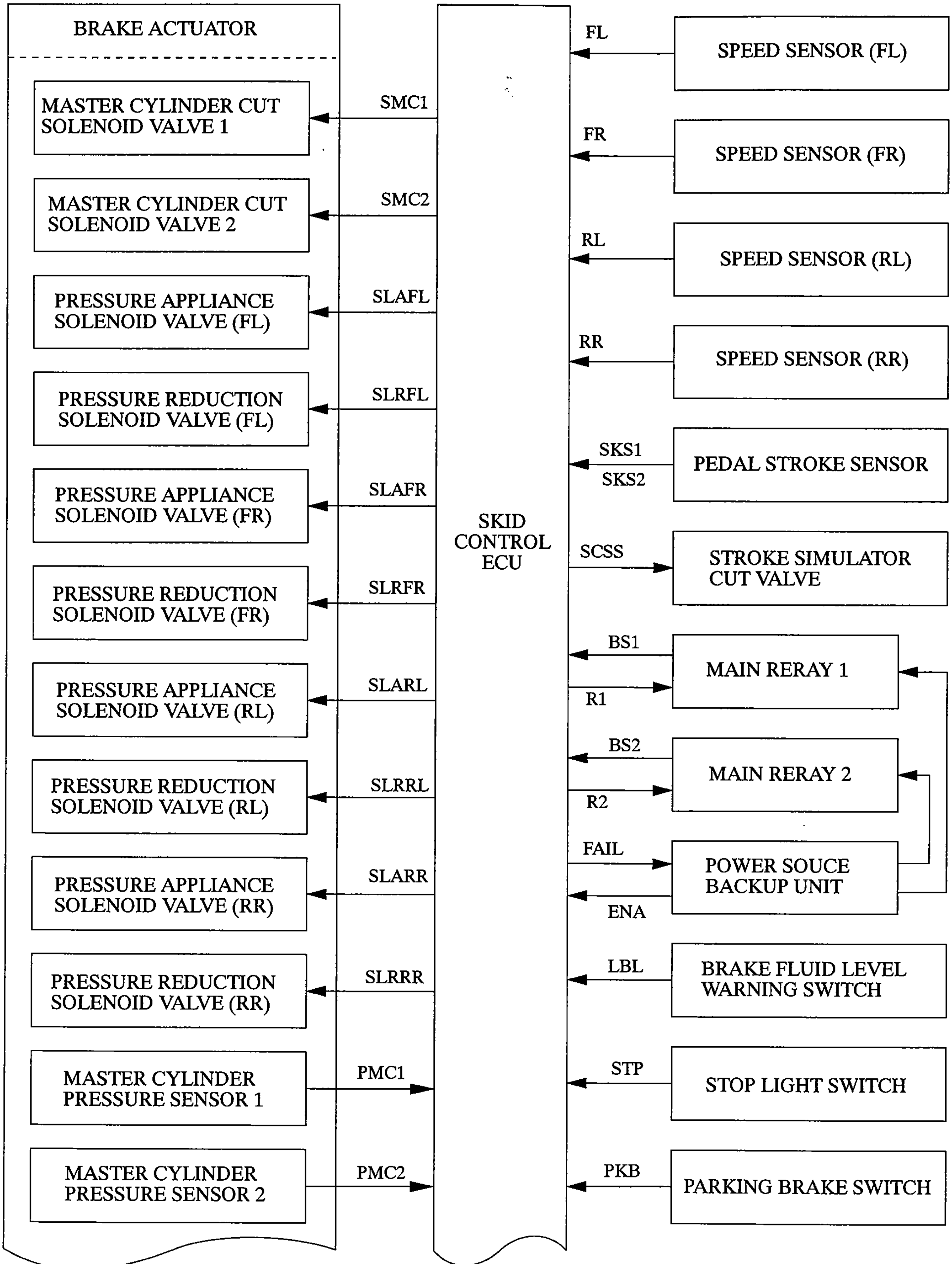
6. System Diagram



*: Only on model with Enhanced VSC system

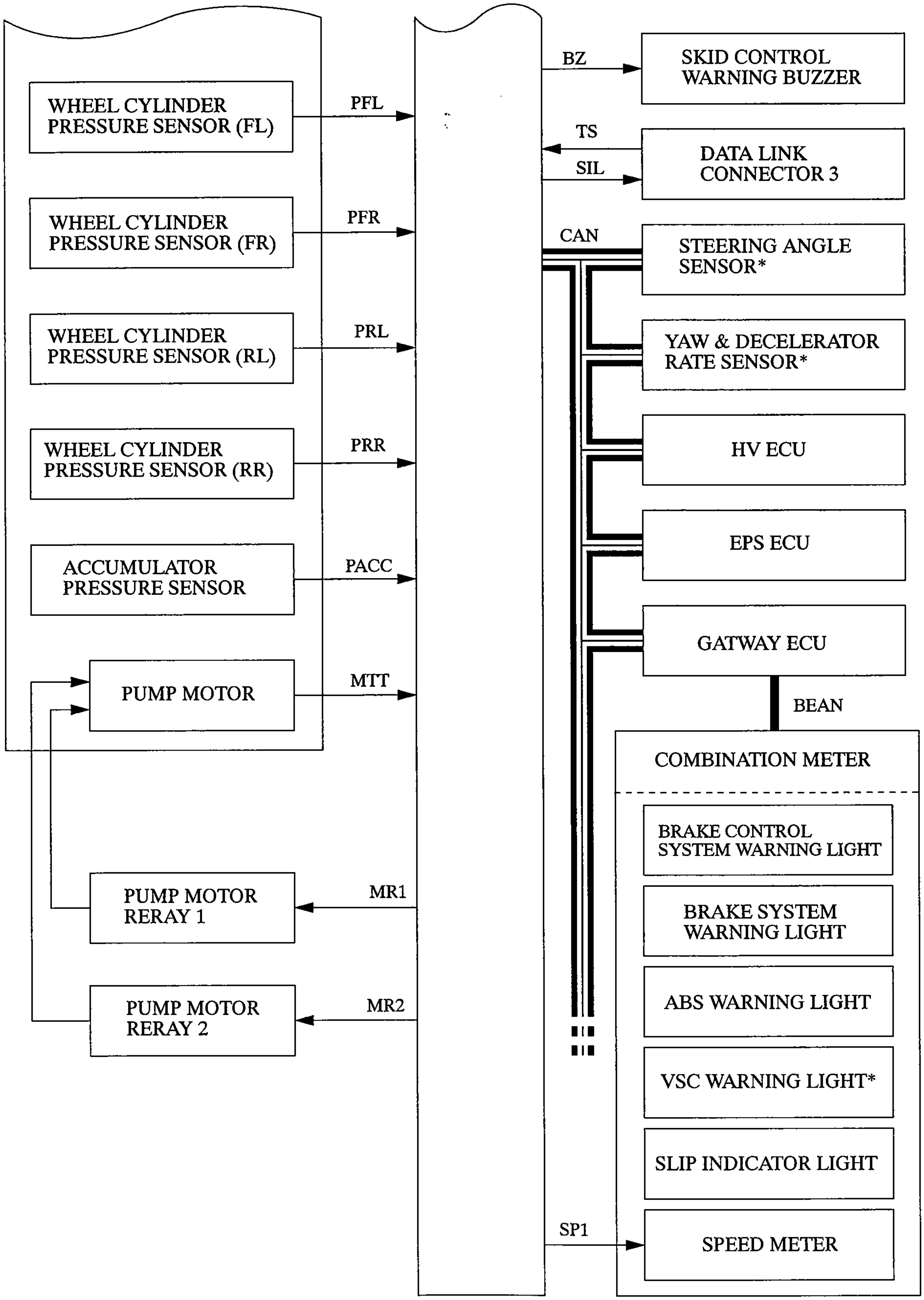
7. Construction

The configuration of the brake control system on the '04 Prius is as shown in the following chart.



(Continued)

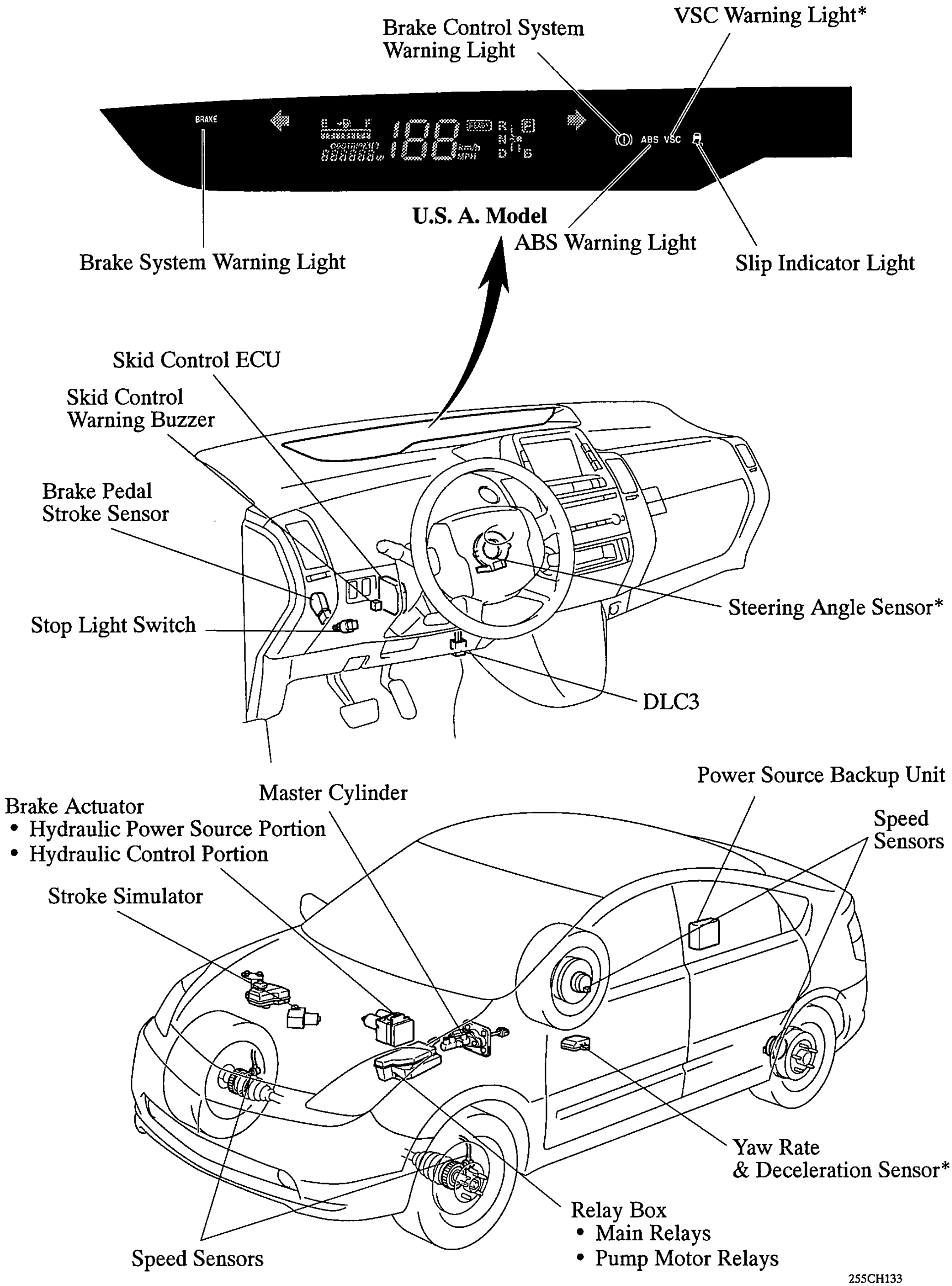
255CH162



*: Only on model with Enhanced VSC system

255CH163

8. Layout of Main Component



*: Only on model with Enhanced VSC system

9. Function of Main Components

Component		Function
Brake Actuator	Hydraulic Power Source Portion	• Consisting of a pump, pump motor, accumulator, relief valve, and accumulator pressure, the hydraulic power source portion generates and stores the hydraulic pressure, which the skid control ECU uses for controlling braking. • The accumulator pressure sensor is installed in the brake actuator.
	Hydraulic Control Potion	• Consists of 2 master cylinder cut solenoid valves, 4 pressure appliance solenoid valves, and 4 pressure reduction solenoid valves. • The 2 master cylinder cut solenoid valves, which are the two-position type, are controlled by the skid control ECU to open and close the passage between the master cylinder and the wheel cylinders. • The 4 pressure appliance solenoid valves and the 4 pressure reduction solenoid valves are the linear type. They are controlled by the skid control ECU to increase and decrease the fluid pressure in the wheel cylinders. • The master cylinder pressure sensors and the wheel cylinder pressure sensors are installed in the brake actuator.
Skid Control ECU		• Processes various sensor signals, regenerative brake signal, to execute control of the regenerative brake coordination control, the ABS with EBD, Enhanced VSC, Brake assist, and normal brake. • Judges the vehicle driving condition based on signals from each sensor, and control the brake actuator.
Brake Master Cylinder		When a malfunction occurs in the power supply portion, the brake master cylinder supplies the fluid pressure (which is generated by the brake pedal effort) directly to the wheel cylinders.
Brake Pedal Stroke Sensor		Directly detects the extent of the brake pedal stroke operated by the driver.
Stroke Simulator		Generates a pedal stroke during braking in accordance with the driver's pedal effort.
Combination Meter	ABS Warning Light	Lights up to alert the driver when the skid control ECU detects the malfunction in the ABS, EBD, or Brake Assist system.
	VSC Warning Light*	Lights up to alert the driver when the skid control ECU detects the malfunction in the Enhanced VSC system.
	Slip Indicator Light	Blinks to inform the driver when the ABS system, the Enhanced VSC system or the motor traction control is operated.
	Brake Control System Warning Light	Lights up to alert the driver when a minor malfunction occurs in the brake system, which does not affect the braking force (such as a malfunction in the regenerative brake).
	Brake System Warning Light	• Lights up to alert the driver when the skid control ECU detect the malfunction in the apportioning of the brake. • Lights up to inform the driver when the parking brake is ON or the brake fluid level is low.

*: Only on model with Enhanced VSC system

(Continued)

Component		Function
Skid Control Warning Buzzer		• This buzzer sounds continuously to inform the driver when there is a malfunction in the hydraulic pressure or a failure in the power supply. • On a model equipped with the Enhanced VSC, this buzzer sounds intermittently to inform the driver that the S-VSC is active.
HV ECU		• Actuates the regenerative brake on receiving signal from the skid control ECU. • Sends the actual regenerative brake control value to the skid control ECU. • Controls the motive force based on output control request signal from the skid control ECU when the Enhanced VSC system is operating. • Sends the rear brake actuation signal to the skid control ECU when brake control is required during the up hill assist control.
Reservoir Tank		Stores the brake fluid.
	Brake Fluid Level Warning Switch	Detects the low brake fluid level.
Stop Light Switch		Detects the brake pedal-depressing signal.
Yaw Rate & Decelerator Rate Sensor*		• Detects the vehicle's yaw rate. • Detects the vehicle's acceleration in the forward, rearward, and lateral.
Steering Angle Sensor*		Detects the steering direction and angle of the steering wheel.
Pump Motor relay 1,2 relays. (See Page CH-51)		• Two types of pump motor relays with different pump actuation speeds. • If one relay fails, the other relay operates to actuate the pump.
Main Relays		Controlled by the skid control ECU, the main relay supplies or cuts off power to the solenoid valves in the brake actuator and the skid control ECU.
Power Source Backup Unit		• An auxiliary power supply to provide stable power to the brake system. • Complements the supply of power to the brake system by discharging the electric charge that is stored in the unit when the voltage of the (12 V) power supply of the vehicle is low.

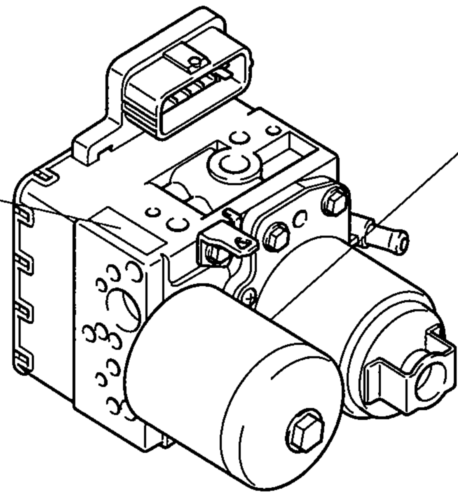
*: Only on model with Enhanced VSC system

10. Construction and Operation of Main Component

Brake Actuator

1) General

- The brake actuator of the '04 Prius consists of hydraulic control and hydraulic power source portions.
- The two master cylinder pressure sensors, four wheel cylinder pressure sensors, and an accumulator pressure sensor are installed in the brake actuator.



▶ Function of Main Components ◀

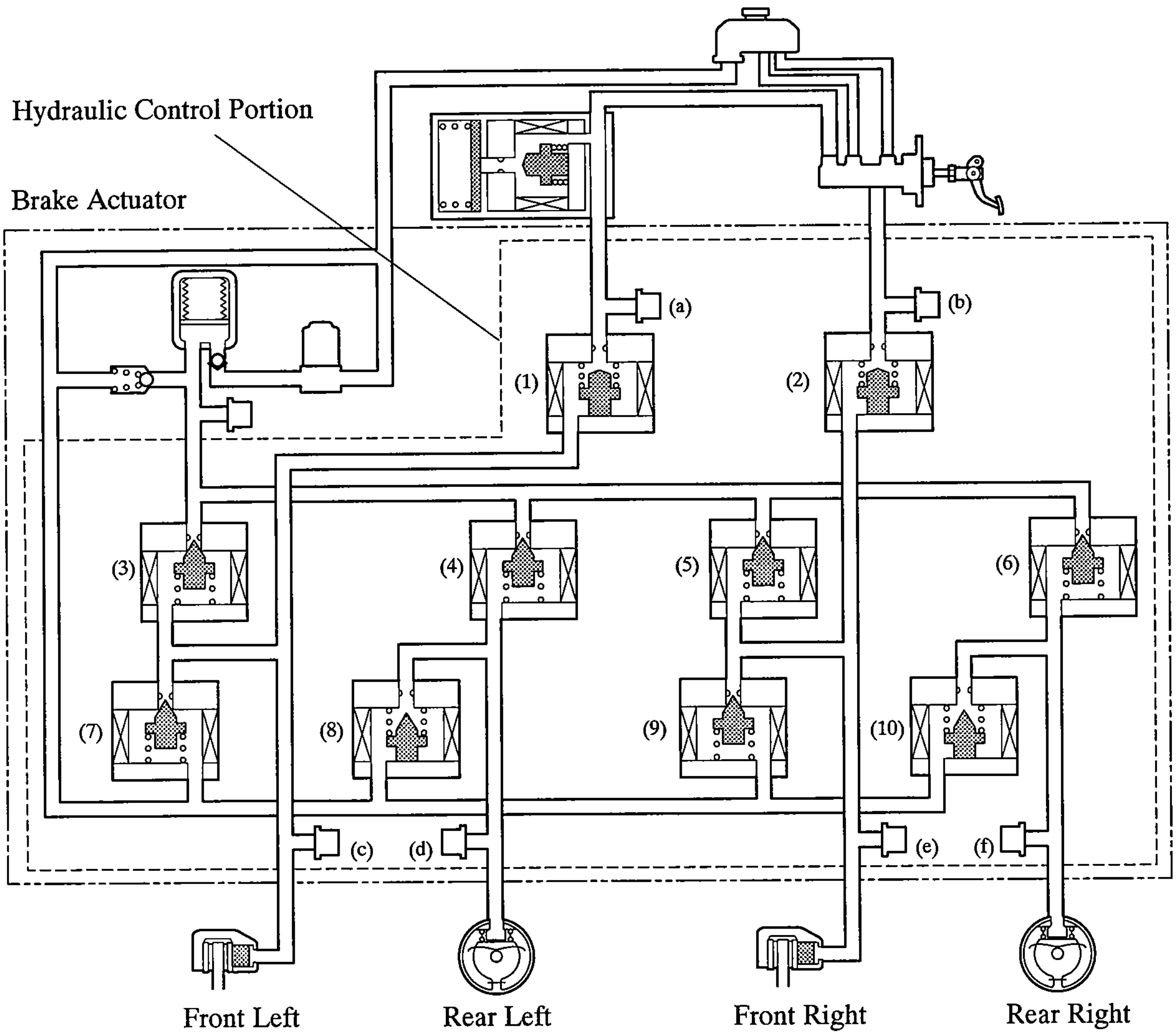
Component	Function
Master Cylinder Cut Solenoid Valve (2-position Type)	• When the brake system is started, this valve cuts the hydraulic passage between the master cylinder and the wheel cylinder. • When the brake system is stopped or a failure occurs in the hydraulic power source portion, the valve opens to maintain the hydraulic passage to the front wheel cylinders and ensure braking. However, a greater effort than normal is required to press the brake pedal.
Pressure Appliance Solenoid Valve (Linear Type)	This valve, which is controlled by the skid control ECU, regulates the fluid pressure from the accumulator in order to amplify the fluid pressure to the wheel cylinder.
Pressure Reduction Solenoid Valve (Linear Type)	This valve, which is controlled by the skid control ECU, regulates the fluid pressure in order to reduce the fluid pressure to the wheel cylinder.
Master Cylinder Pressure Sensors	The master cylinder pressure sensor converts the fluid pressure generated by the master cylinder into electrical signals and transmits them to the skid control ECU. Accordingly, the skid control ECU determines the braking force required by the driver.
Wheel Cylinder Pressure Sensors	These sensors detect the fluid pressure that acts on the respective wheel cylinders and transmits them to the skid control ECU in the form of feedback. Accordingly, the skid control ECU monitors the fluid pressure of the wheel cylinders and controls the pressure appliance solenoid valve and the pressure reduction solenoid valve, in order to achieve the optimal wheel cylinder pressures.
Accumulator Pressure Sensor	The accumulator pressure sensor constantly detects the brake fluid pressure in the accumulator and transmits the signals to the skid control ECU. Accordingly, the skid control ECU controls the pump motor.
Pump and Pump Motor	Draws up the brake fluid from the reservoir tank and provides high hydraulic pressure to the accumulator.
Accumulator	Stores the hydraulic pressure that was generated by the pump. The accumulator is filled with high pressure nitrogen gas.
Relief Valve	Returns the brake fluid to the reservoir tank to prevent excessive pressure if the pump operates continuously due to a malfunction of the accumulator pressure sensor.

2) Hydraulic Control Portion

The 10 solenoid valves and 6-pressure sensors consists of the following:

- 2 master cylinder cut solenoid valves [(1), (2)]
- 4 pressure appliance valves [(3), (4), (5), (6)]
- 4 pressure reduction valves [(7), (8), (9), (10)]
- 2 master cylinder pressure sensor [(a), (b)]
- 4 wheel cylinder pressure sensor [(c), (d), (e), (f)]

▶ Hydraulic Circuit ◀



255CH135

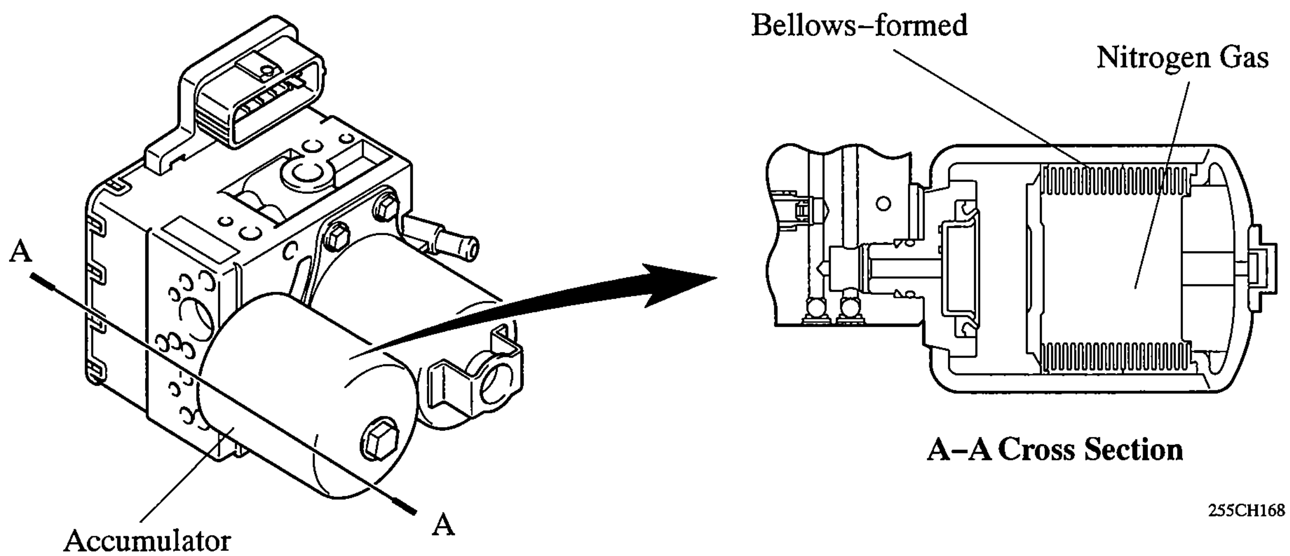
3) Hydraulic Power Source Portion

a. General

The hydraulic power source portion consists of pump, pump motor, accumulator, relief valve, 2 motor relays, and accumulator pressure sensor.

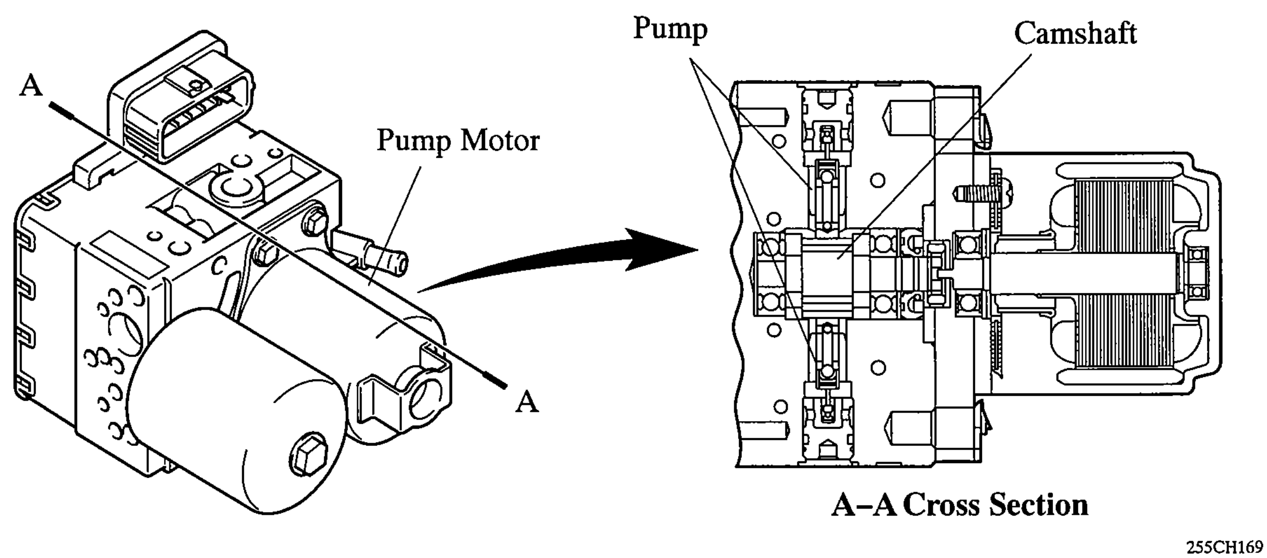
b. Accumulator

Inside the accumulator of the '04 Prius, as same as the '03 Prius, the high-pressurized nitrogen gas is charged and sealed. On the '04 Prius, metallic bellows-formed tube has been adopted, in order to enhance the gastight performance of the accumulator.



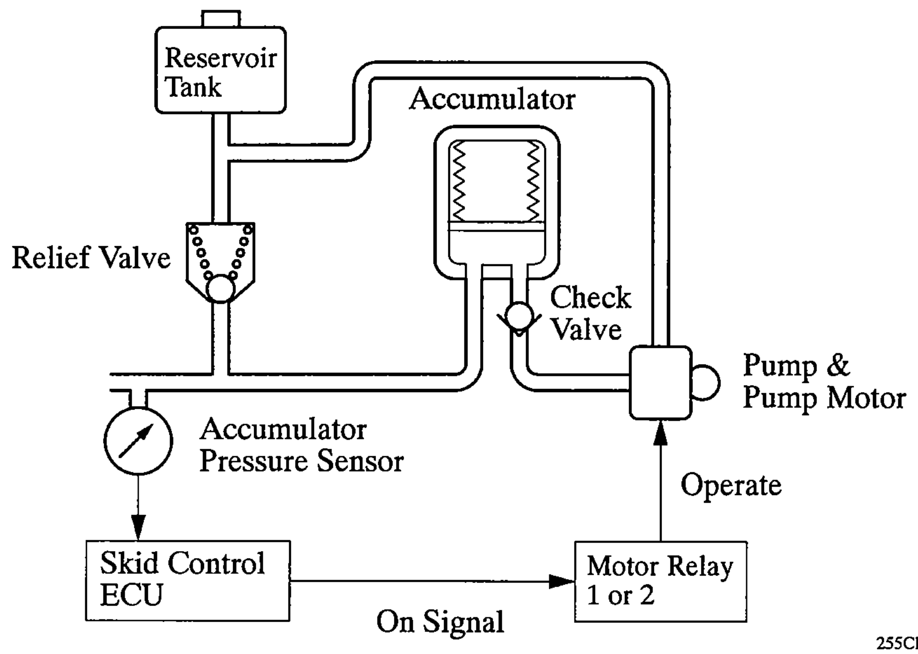
c. Pump and Pump Motor

A plunger type pump has been adopted. This pump is operated by the rotation of the camshaft driven by the motor, and then supplies high-pressurized fluid to the accumulator.



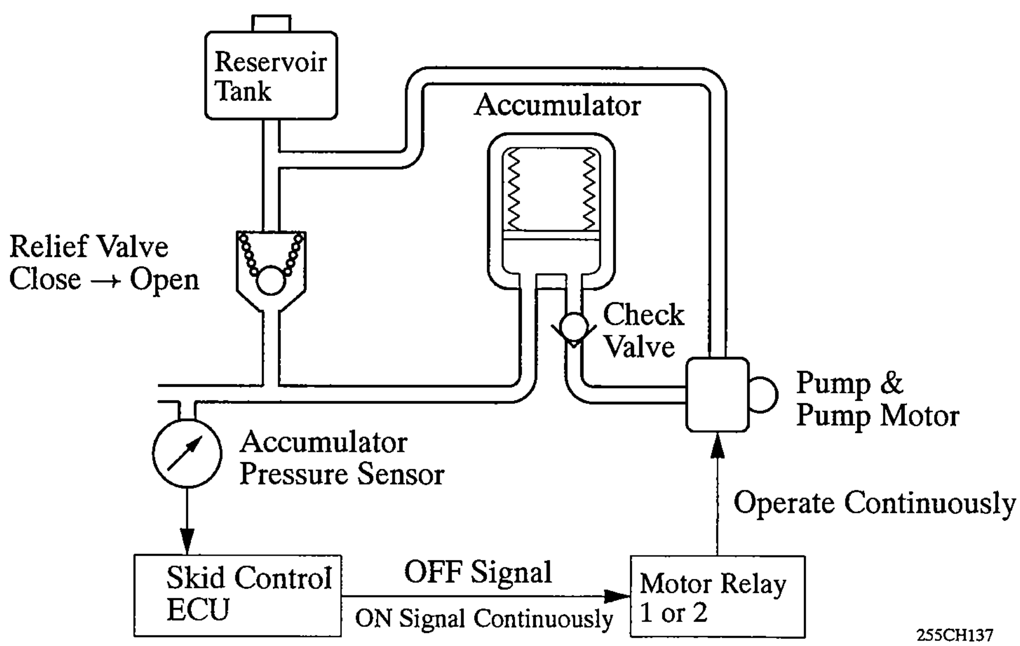
d. Operation

- The brake fluid that is discharged by the pump passes through the check valve and is stored in the accumulator. The hydraulic pressure that is stored in the accumulator is used for providing the hydraulic pressure that is needed for normal braking and for operating the brake control.
- The motor relays consist of the following relays with different pump actuation speeds: relay 1 (low speed) and relay 2 (high speed). Normally, relay 1 with the slow pump speed is used. When the fluid pressure drops quickly because more fluid pressure is required, such as in ABS fluid pressure control, relay 2 with the fast pump speed is used. If one of the relays malfunctions, the other is used for actuating the pump.
- The accumulator pressure sensor constantly monitors the pressure in the accumulator and transmits it to the skid control ECU. If the accumulator pressure drops below the set pressure, the skid control ECU sends an activation signal to the motor relay in order to actuate the pump motor until the pressure in the accumulator reaches the set pressure.



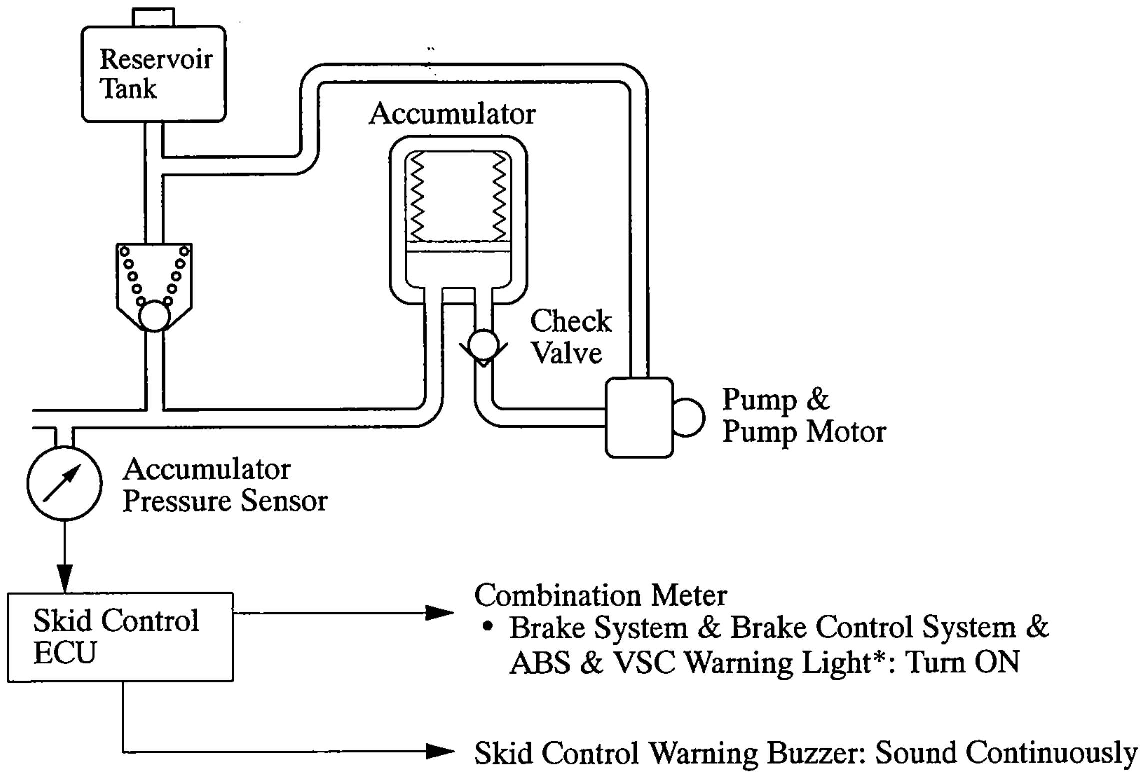
255CH136

- If the pump and the pump motor continue to operate unintendedly, creating a high pressure in the accumulator, and accumulator pressure sensor faild, the relief valve opens to return the brake fluid to the reservoir tank, in order to reduce the accumulator pressure.



255CH137

- If the accumulator pressure drops abnormally to a level below the pressure set at the ECU, the skid control ECU illuminates the brake system warning light, brake control system warning light, ABS warning light, and the VSC warning light* and sounds a warning buzzer to alert the driver of the abnormal fluid pressure.

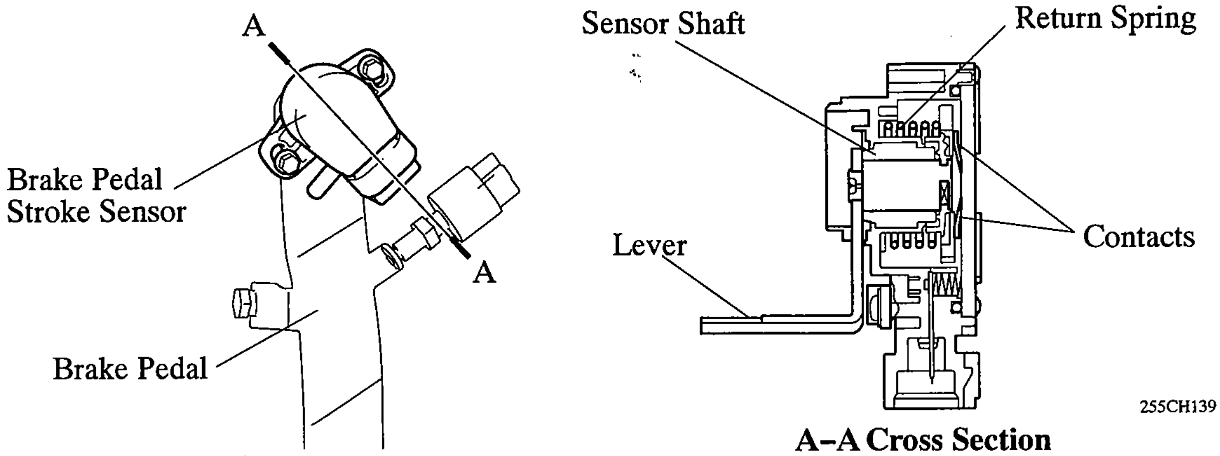


255CH138

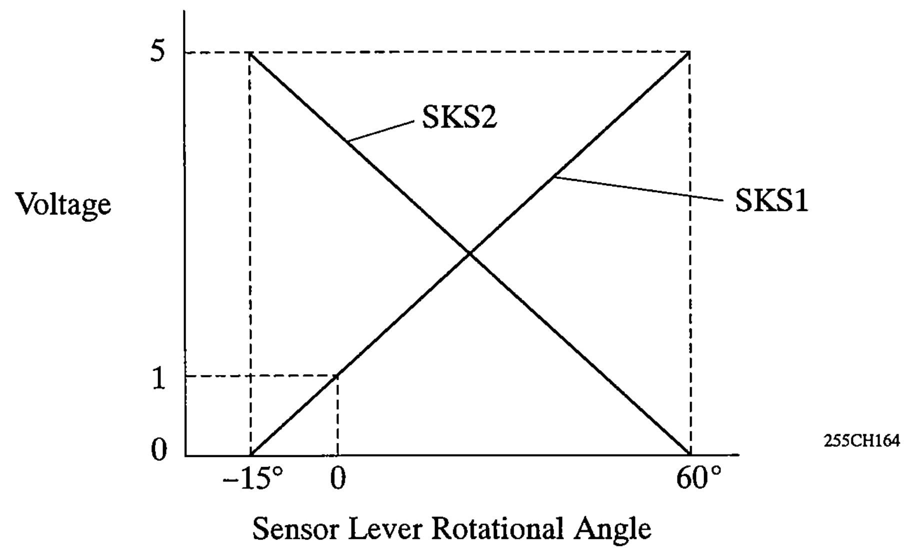
*: Only on model with Enhanced VSC system

Brake Pedal Stroke Sensor

This sensor, which contains a contact type variable resistor, detects the extent of the brake pedal stroke and transmits it to the skid control ECU.



A–A Cross Section



Service Tip

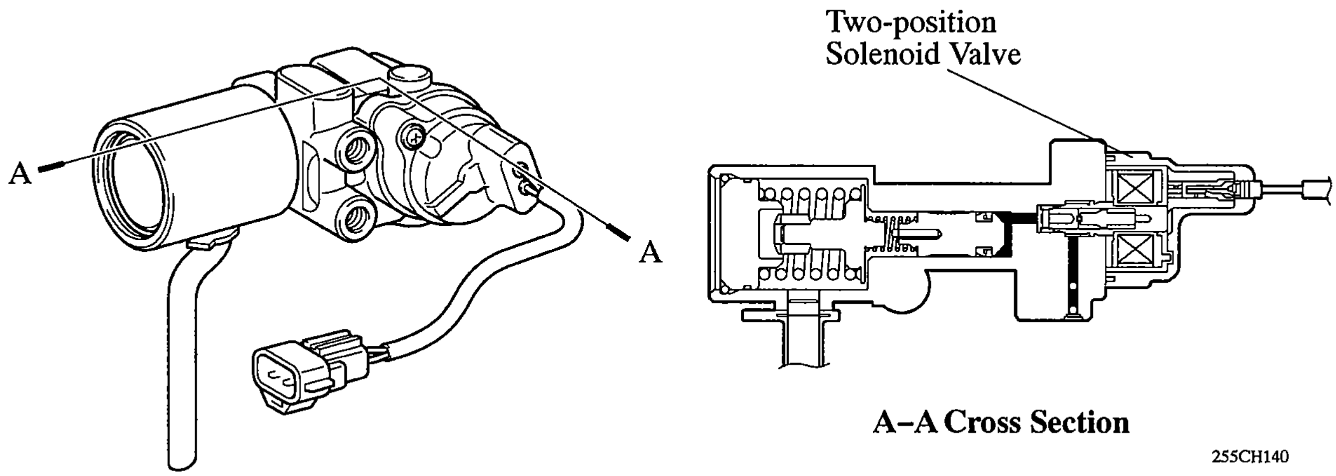
To install a brake pedal stroke sensor, which is available as a service part, perform as follows:

- The sensor lever is secured with a pin to "0" stroke. (Do not detach the pin until the installation has been completed.)
- In this state, install the sensor on the brake pedal (in the OFF state) on the vehicle.
- After completing the installation, firmly press the brake pedal once to break off the pin that is securing the sensor in place.
- Make sure the broken pin does not remain in the sensor lever.

For the actual procedure, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

Stroke Simulator

The stroke simulator is located between the master cylinder and the brake actuator. It generates a pedal stroke in accordance with the driver's pedal effort during braking. Containing 2 types of coil springs with different spring constants, the stroke simulator provides pedal stroke characteristics in 2 stages in relation to the master cylinder pressure.

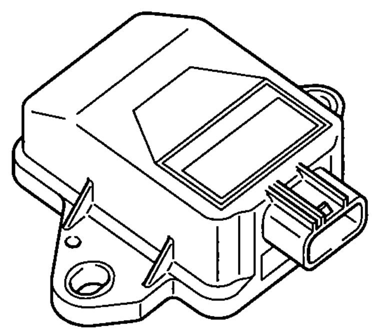


A–A Cross Section

255CH140

Yaw Rate Sensor (With Enhanced VSC system)

A deceleration rate sensor is built into the yaw rate sensor. This sensor detects the yaw rate and lateral acceleration, and sends this signal to the skid control ECU.



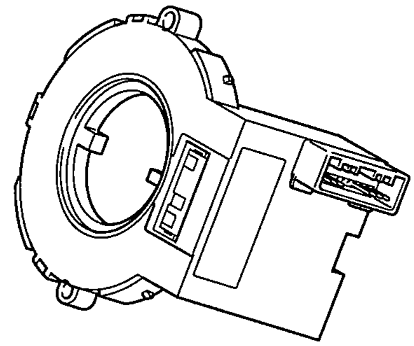
255CH141

Service Tip

After replacing the yaw rate sensor or the skid control ECU, initialization of both deceleration sensor and yaw rate sensor must be required on the skid control ECU side.
For the initialization procedure, refer to the 2004 Prius repair manual (Pub. No. RM1075U).

Steering Angle Sensor (With Enhanced VSC system)

This steering angle sensor detects the steering direction and angle, and sends this signal to the skid control ECU.
The sensor contains 3 photo interrupters with phases, and a slotted disk interrupts the light to turn the photo IC ON and OFF to detect the steering direction and angle.

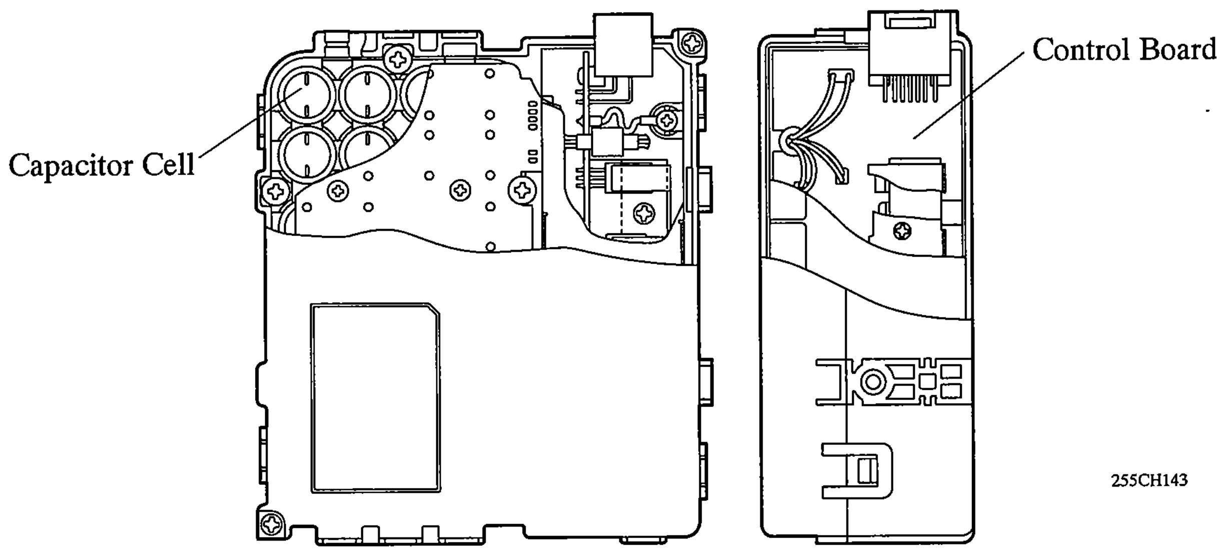


255CH142

Service Tip
The steering angle sensor will be automatically calibrated after repairing or replacing the steering angle sensor or steering column assembly.

Power Source Backup Unit

- The power source backup unit has been adopted as an auxiliary power source, in order to supply power to the brake system in a stable manner
- This unit contains 28 capacitor cells, which store an electrical charge provided by the (12 V) vehicle power supply. When the voltage of the (12 V) vehicle power supply drops, the electrical charge stored in the capacitor cells is used as an auxiliary power supply to the brake system.
- The electrical charge stored in the capacitor cells becomes discharged when the HV system stops operating after the power switch is turned OFF.



255CH143

Service Tip
Immediately after the power switch is turned OFF, this unit is in the discharging state, and some voltage remains in the capacitors. Therefore, make sure to check for residual voltage and discharge it if necessary, before removing the power source backup unit from the vehicle or opening and inspecting the inside of the power source backup unit case.
For details, refer to 2004 Prius Repair Manual (Pub. No. RM1075U).

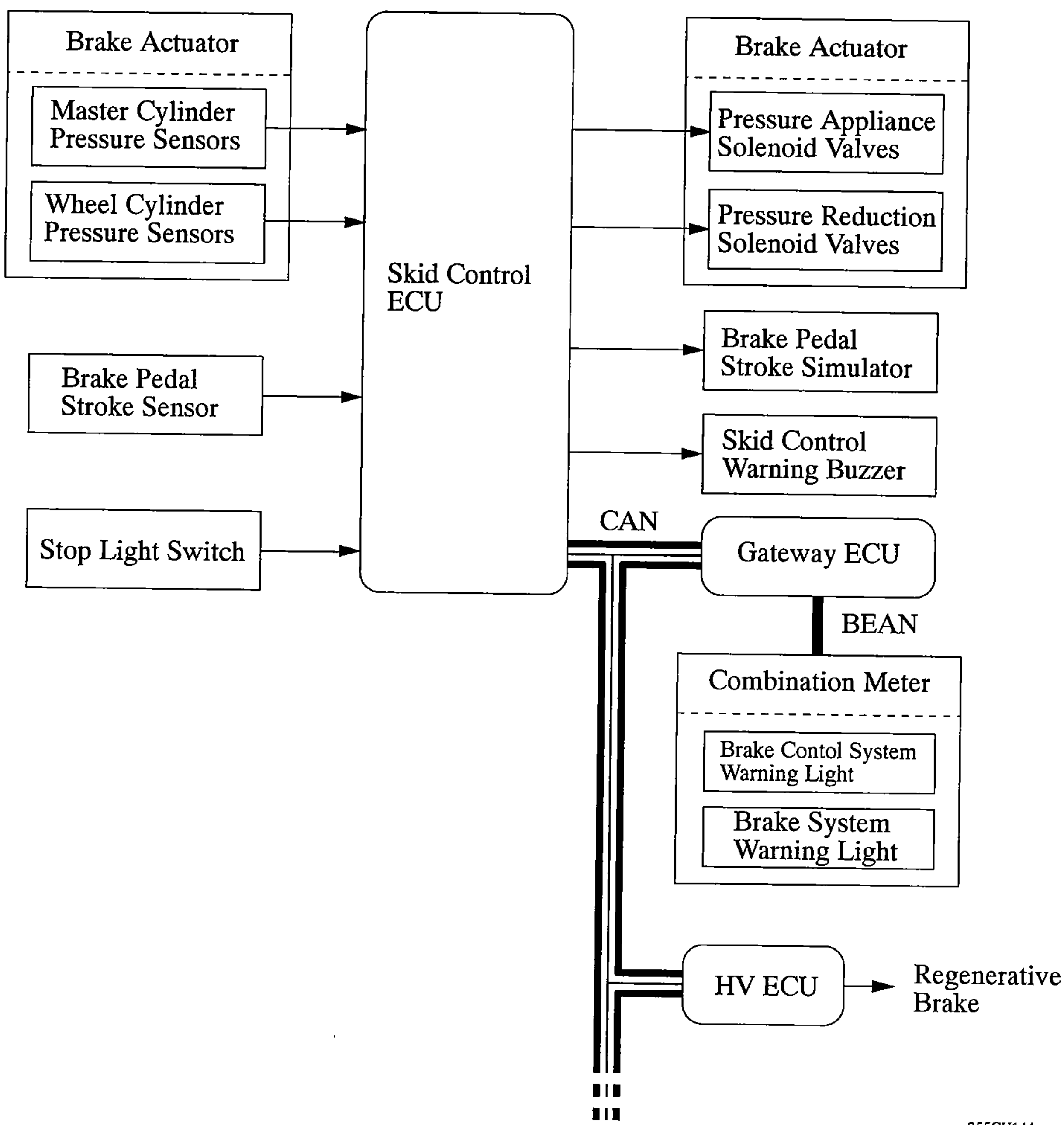
11. System Operation

Normal Brake Operation (With Regenerative Brake Cooperative Control)

1) General

- During normal braking, the master cylinder cut solenoid valves are closed and the fluid pressure circuits to the wheel cylinders remain independent. Accordingly, the fluid pressure generated by the master cylinder will not directly cause the wheel cylinders to actuate.
- The skid control ECU calculates the braking force required by the driver in accordance with the signals received from the master cylinder pressure sensors and the brake pedal stroke sensor. Then, the skid control ECU calculates the regenerative brake force value out of the required brake force and transmits the calculated value to the HV ECU. Upon receiving the value, the HV ECU generates a regenerative brake force. At the same time, the HV ECU transmits the actual regenerative brake force value to the skid control ECU. The skid control ECU controls the solenoid valves in order to cause the hydraulic brake system to generate a brake force value (which is obtained by subtracting the regenerative brake force from the brake force value required by the driver).

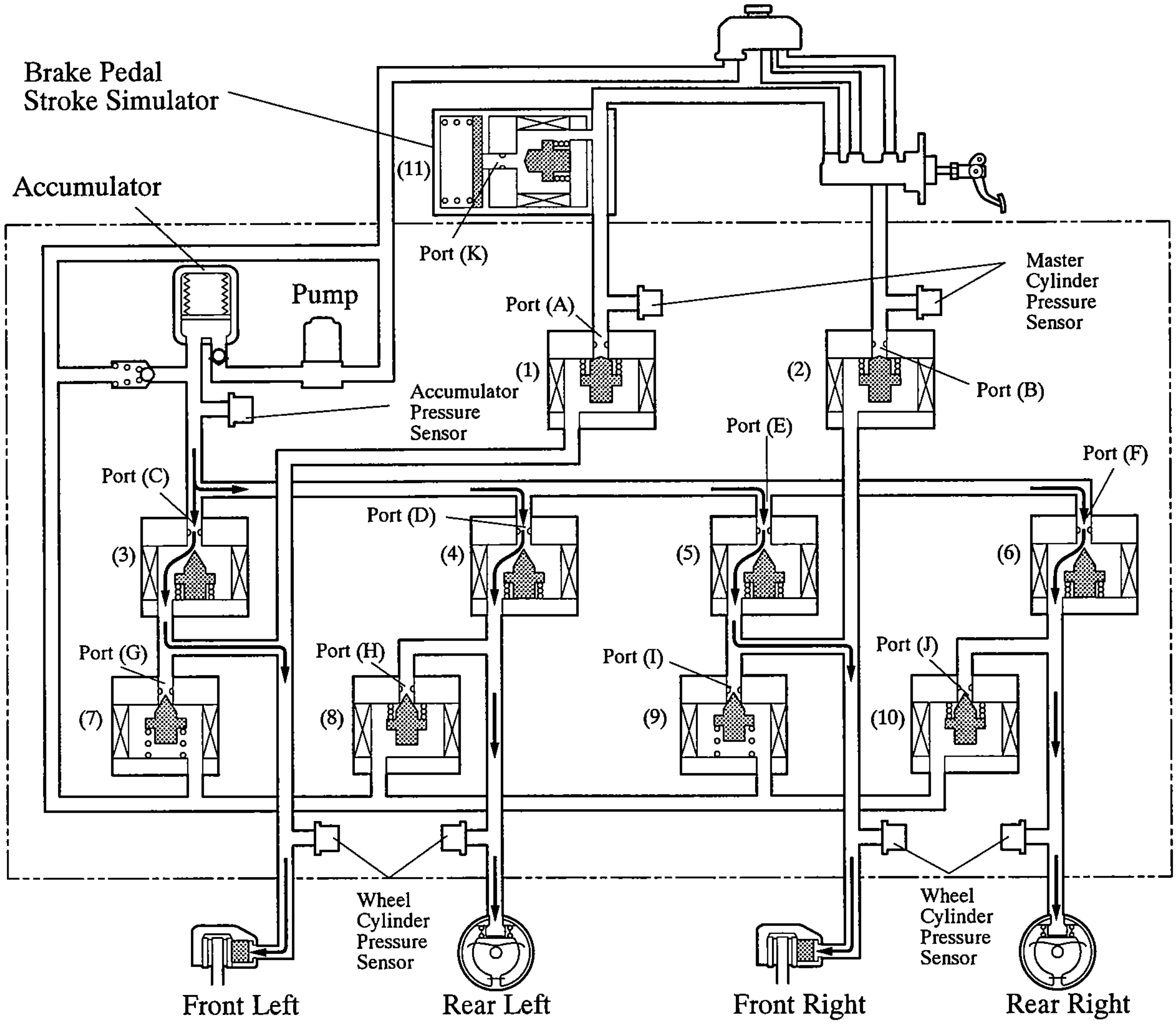
▶ System Diagram ◀



255CH144

2) Pressure Increase

The skid control ECU calculates the target wheel cylinder pressure (equivalent to the brake force required by the driver) in accordance with the signals received from the master cylinder pressure sensor and the brake pedal stroke sensor. The skid control ECU compares the wheel cylinder pressure sensor signal and the target wheel cylinder pressure. If the target wheel cylinder pressure is lower, the skid control ECU boosts the pressure in the brake actuator. Accordingly, the fluid pressure in the accumulator is fed into the wheel cylinder. Moreover, this operation is the same when the hydraulic brake force must be increased in order to effect cooperative control in accordance with the changes in the regenerative brake force.



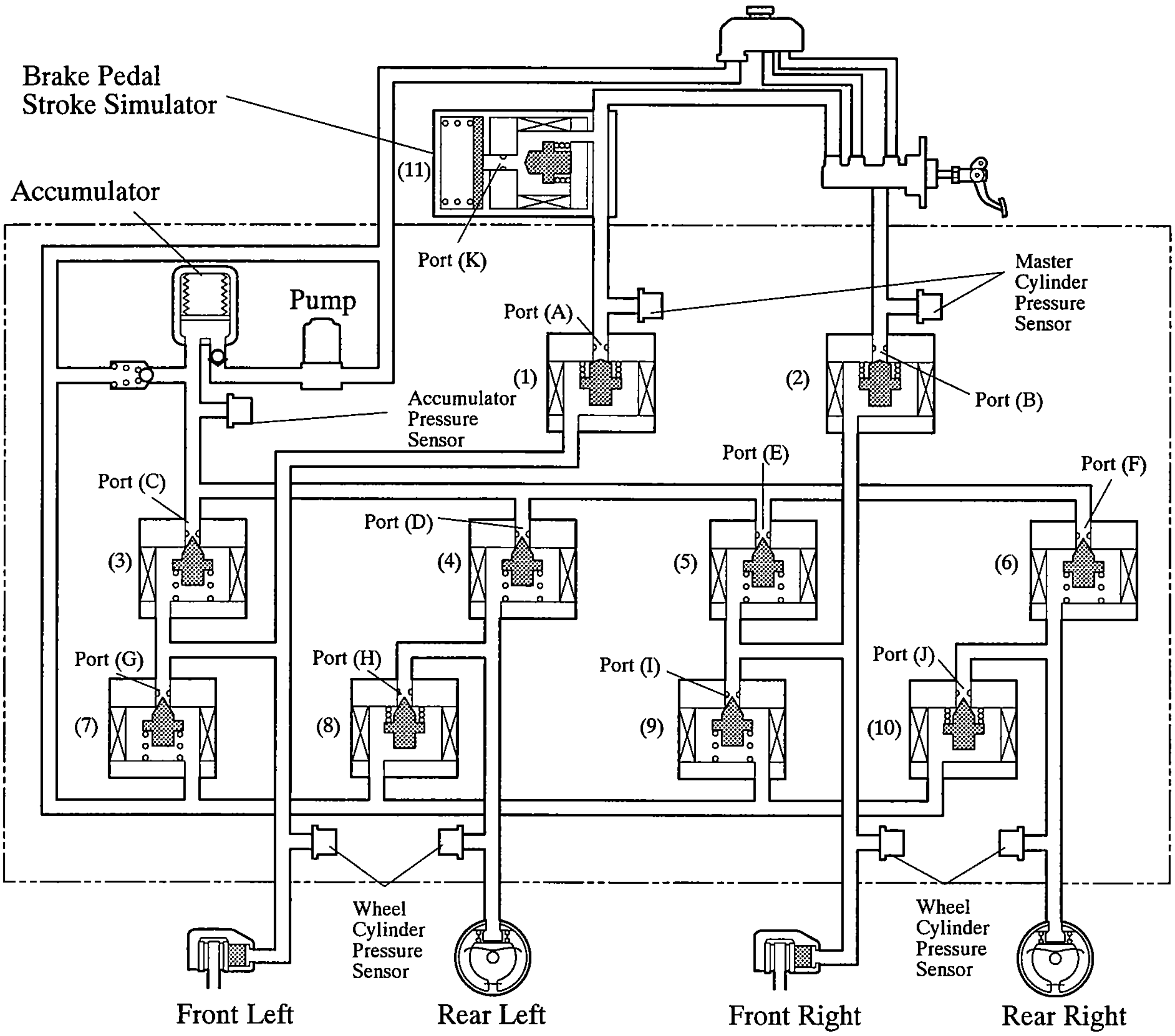
255CH146

Item		Normal Braking Increase Mode
(1), (2)	Master Cylinder Cut Solenoid Valve	ON (Close)
	Port: (A), (B)	
(3), (4), (5), (6)	Pressure Appliance Solenoid Valve	ON (Half-Open*)
	Port: (C), (D), (E), (F)	
(7), (9)	Pressure Reduction Solenoid Valve	OFF (Close)
	Port: (G), (I)	
(8), (10)	Pressure Reduction Solenoid Valve	ON (Close)
	Port: (H), (J)	
(11)	Stroke Simulator Cut Solenoid Valve	ON (Open)
	Port: (K)	

*: The solenoid valve constantly regulates the amount of opening of the port in accordance with the use conditions in order to control the fluid pressure.

3) Holding

The skid control ECU calculates the target wheel cylinder pressure (equivalent to the brake force required by the driver) in accordance with the signals received from the master cylinder pressure sensor and the brake pedal stroke sensor.
The skid control ECU compares the wheel cylinder pressure signal with the target wheel cylinder pressure. If they are equal, the skid control ECU controls the brake actuator in the hold state.
Accordingly, the wheel cylinder will be held at a constant pressure.



255CH147

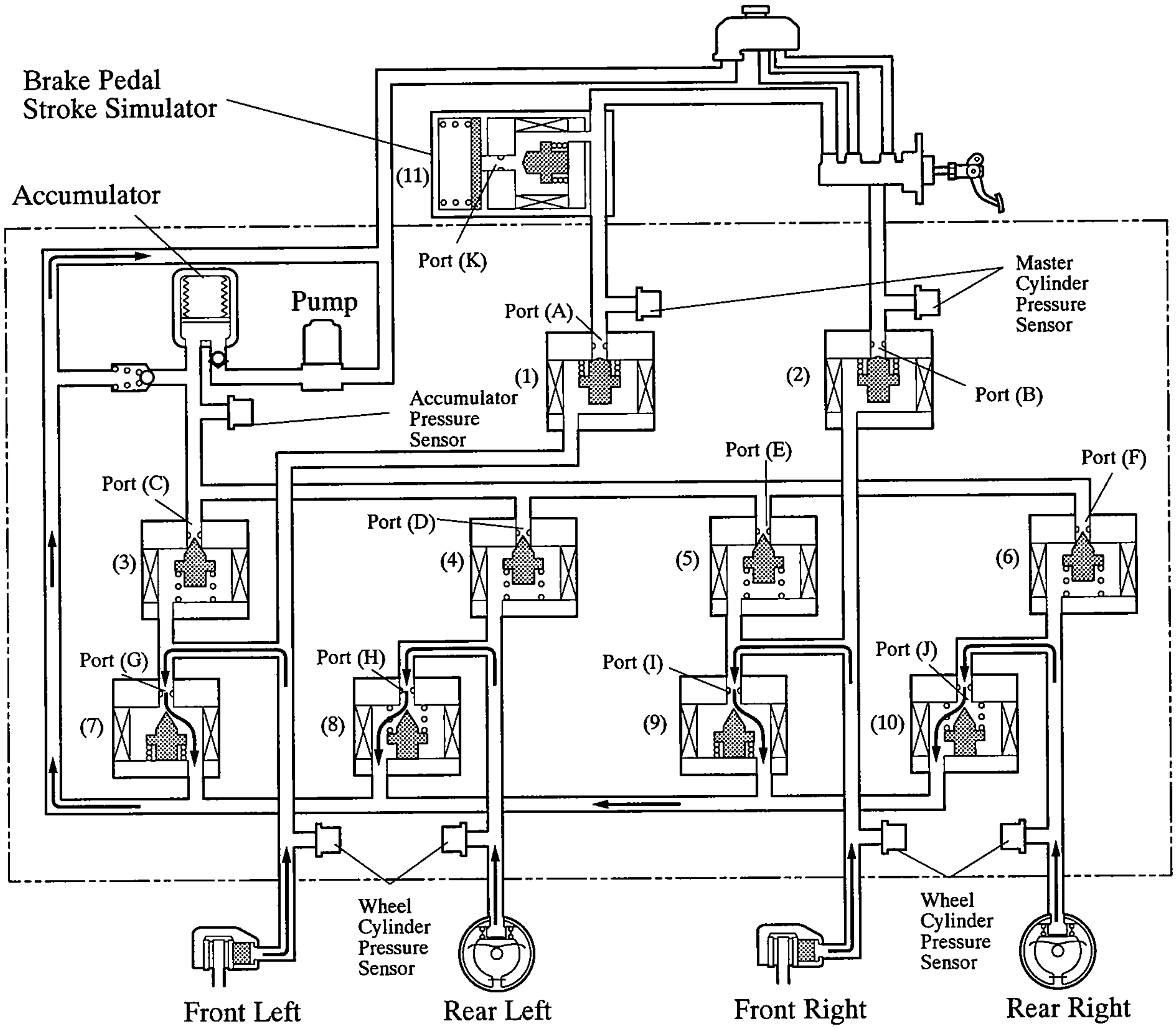
Item		Normal Braking Hold Mode
(1), (2)	Master Cylinder Cut Solenoid Valve Port: (A), (B)	ON (Close)
(3), (4), (5), (6)	Pressure Appliance Solenoid Valve Port: (C), (D), (E), (F)	OFF (Close)
(7), (9)	Pressure Reduction Solenoid Valve Port: (G), (I)	OFF (Close)
(8), (10)	Pressure Reduction Solenoid Valve Port: (H), (J)	ON (Close)
(11)	Stroke Simulator Cut Solenoid Valve Port: (K)	ON (Open)

4) Pressure Reduce

The skid control ECU calculates the target wheel cylinder pressure (equivalent to the brake force required by the driver) in accordance with the signals received from the master cylinder pressure sensor and the brake pedal stroke sensor.

The skid control ECU compares the wheel cylinder pressure signal with the target wheel cylinder pressure. If the target wheel cylinder pressure is higher, the skid control ECU reduces the pressure in the brake actuator. Accordingly, the pressure in the wheel cylinder decreases.

Moreover, this operation is the same when the hydraulic brake force must be decreased in order to effect cooperative control in accordance with the changes in the regenerative brake force.



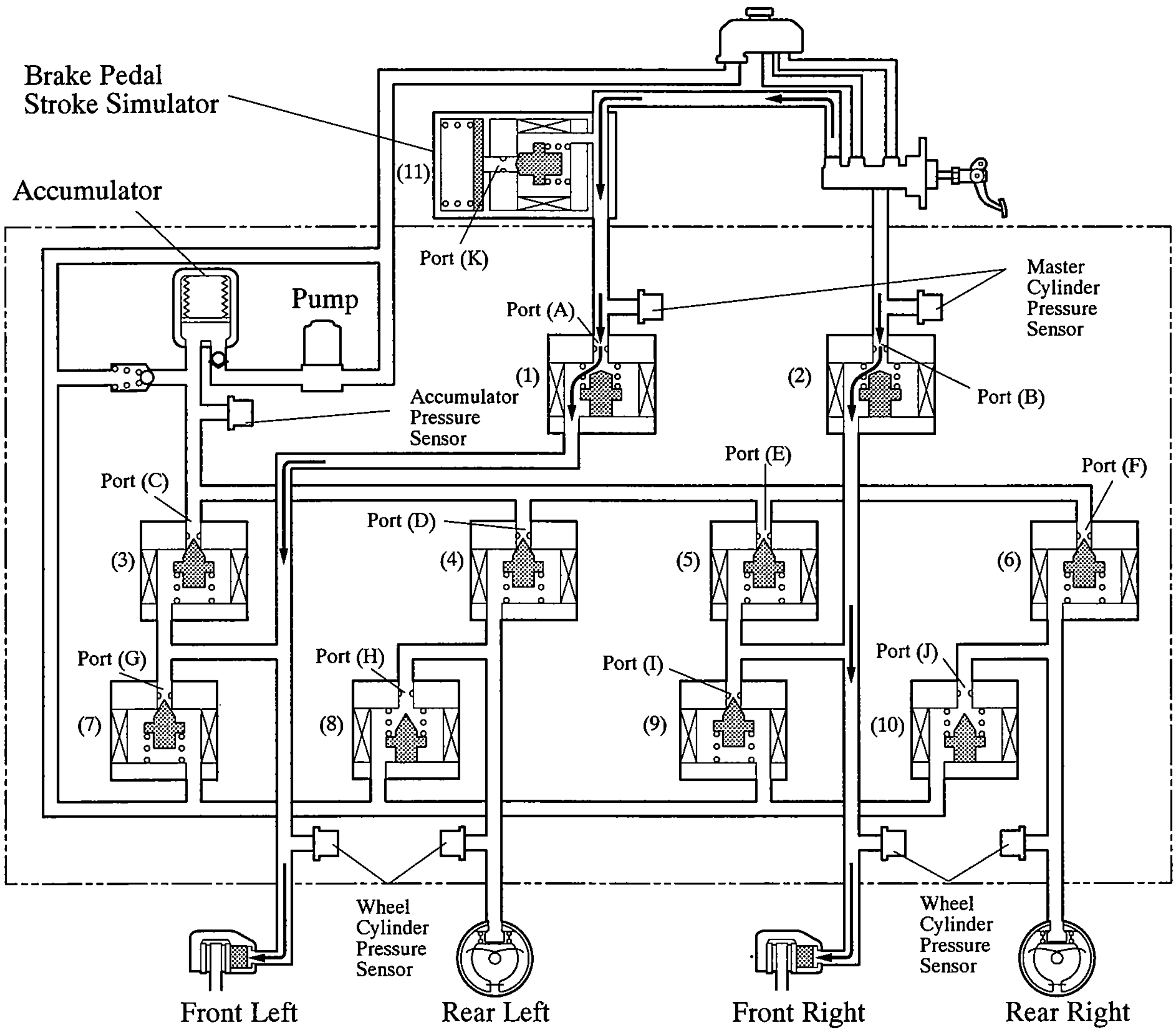
255CH148

Item		Normal Braking Reduce Mode
(1), (2)	Master Cylinder Cut Solenoid Valve	ON (Close)
	Port: (A), (B)	
(3), (4), (5), (6)	Pressure Appliance Solenoid Valve	OFF (Close)
	Port: (C), (D), (E), (F)	
(7), (9)	Pressure Reduction Solenoid Valve	ON (Half-Open*)
	Port: (G), (I)	
(8), (10)	Pressure Reduction Solenoid Valve	ON (Half-Open*)
	Port: (H), (J)	
(11)	Stroke Simulator Cut Solenoid Valve	ON (Open)
	Port: (K)	

*: The solenoid valve constantly regulates the amount of opening of the port in accordance with the use conditions in order to control the fluid pressure.

5) Brake System Stops or During Power Supply Malfunction

If the brake system stops or no accumulator pressure is supplied due to some malfunction, the skid control ECU operates the fail-safe function. This function opens the master cylinder solenoid valve in the brake actuator, in order to secure a fluid passage between the master cylinder and the wheel cylinder. Thus, the brakes can be applied by operating only the front wheel cylinders under the fluid pressure generated by the master cylinder. At this time, port (K) of the stroke simulator cut solenoid valve closes in order to prevent the fluid pressure generated by the master cylinder from being negatively affected by the operation of the stroke simulator.



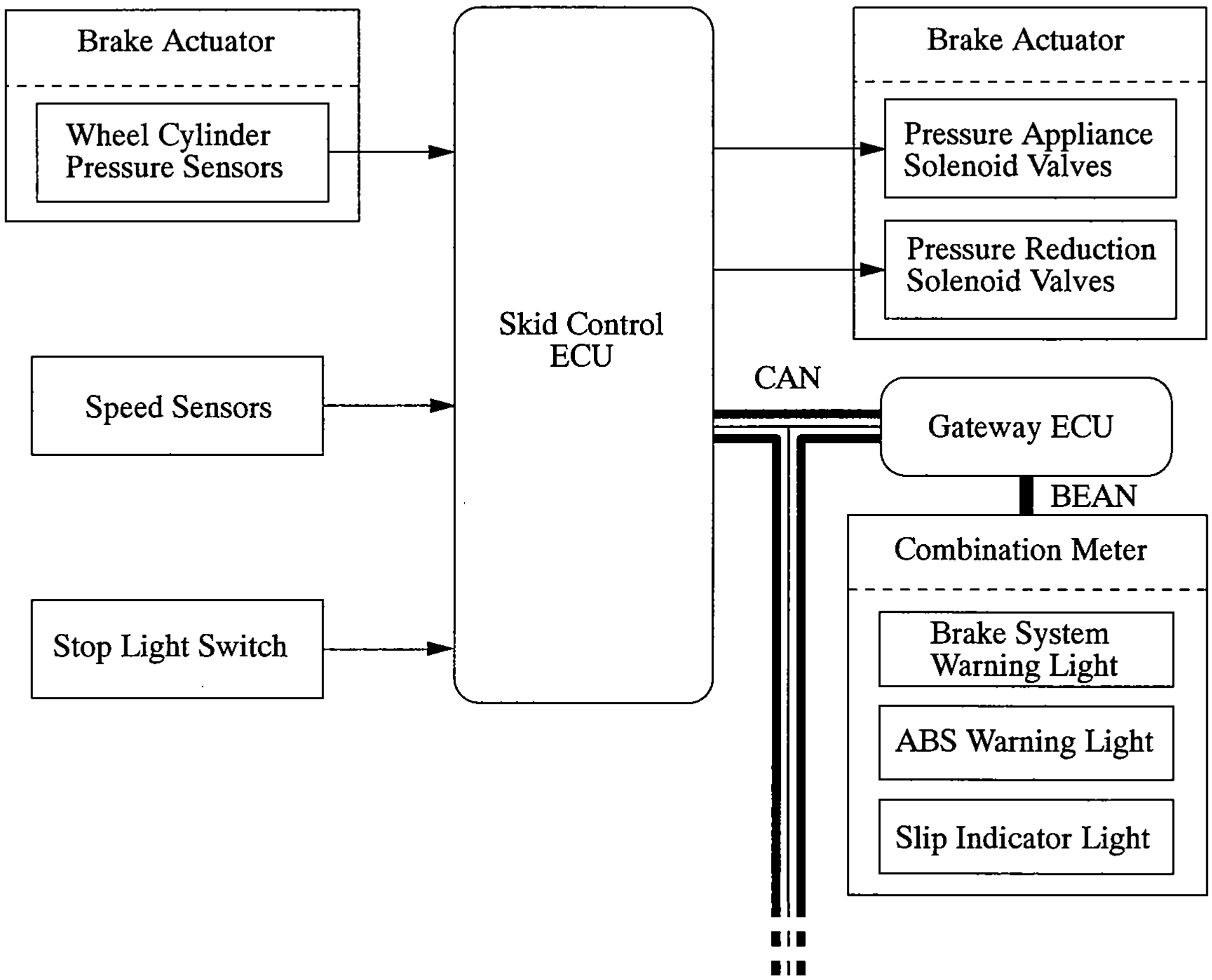
255CH149

Item		System OFF & Fail-Safe Mode
(1), (2)	Master Cylinder Cut Solenoid Valve Port: (A), (B)	OFF (Open)
(3), (4), (5), (6)	Pressure Appliance Solenoid Valve Port: (C), (D), (E), (F)	OFF (Close)
(7), (9)	Pressure Reduction Solenoid Valve Port: (G), (I)	OFF (Close)
(8), (10)	Pressure Reduction Solenoid Valve Port: (H), (J)	OFF (Open)
(11)	Stroke Simulator Cut Solenoid Valve Port: (K)	OFF (Close)

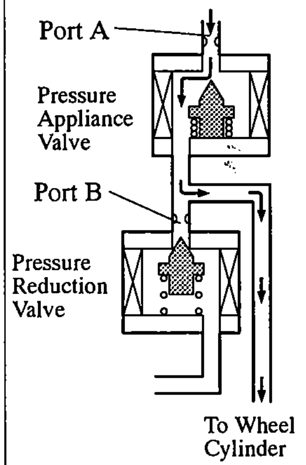
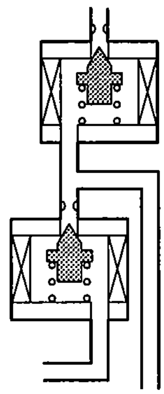
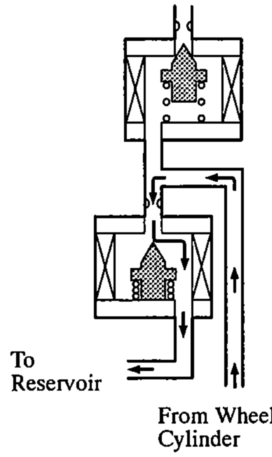
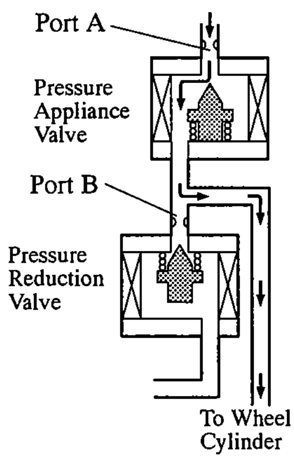
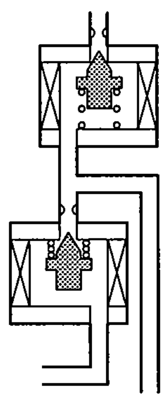
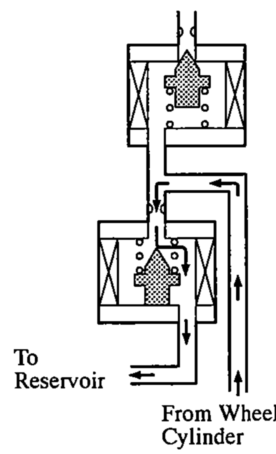
ABS with EBD Operation

Based on the signals received from the 4wheel speed sensors, the skid control ECU calculates each wheel speed and deceleration, and checks wheel slipping conditions. And according to the slipping condition, the skid control ECU controls the pressure increase valve and pressure reduction valve in order to adjust the fluid pressure of the each wheel cylinder in the following 3 modes: pressure reduction, pressure holding, pressure increase modes.

▶ System Diagram ◀



255CH150

Not Activated		Normal Braking	—	—
Activated		Increase Mode	Holding Mode	Reduction Mode
Hydraulic Circuit		 255CH151	 255CH152	 255CH153
Front	Pressure increase Solenoid Valve (Port A)	ON (Half-Open*)	OFF (Close)	OFF (Close)
	Pressure Reduction Solenoid Valve (Port B)	OFF (Close)	OFF (Close)	ON (Half-Open*)
Hydraulic Circuit		 255CH159	 255CH160	 255CH161
Rear	Pressure increase Solenoid Valve (Port A)	ON (Half-Open*)	OFF (Close)	OFF (Close)
	Pressure Reduction Solenoid Valve (Port B)	ON (Close)	ON (Close)	ON (Half-Open*)
Wheel Cylinder Pressure		Increase	Hold	Reduction

*: The solenoid valve constantly regulates the amount of opening of the port in accordance with the use conditions in order to control the fluid pressure.

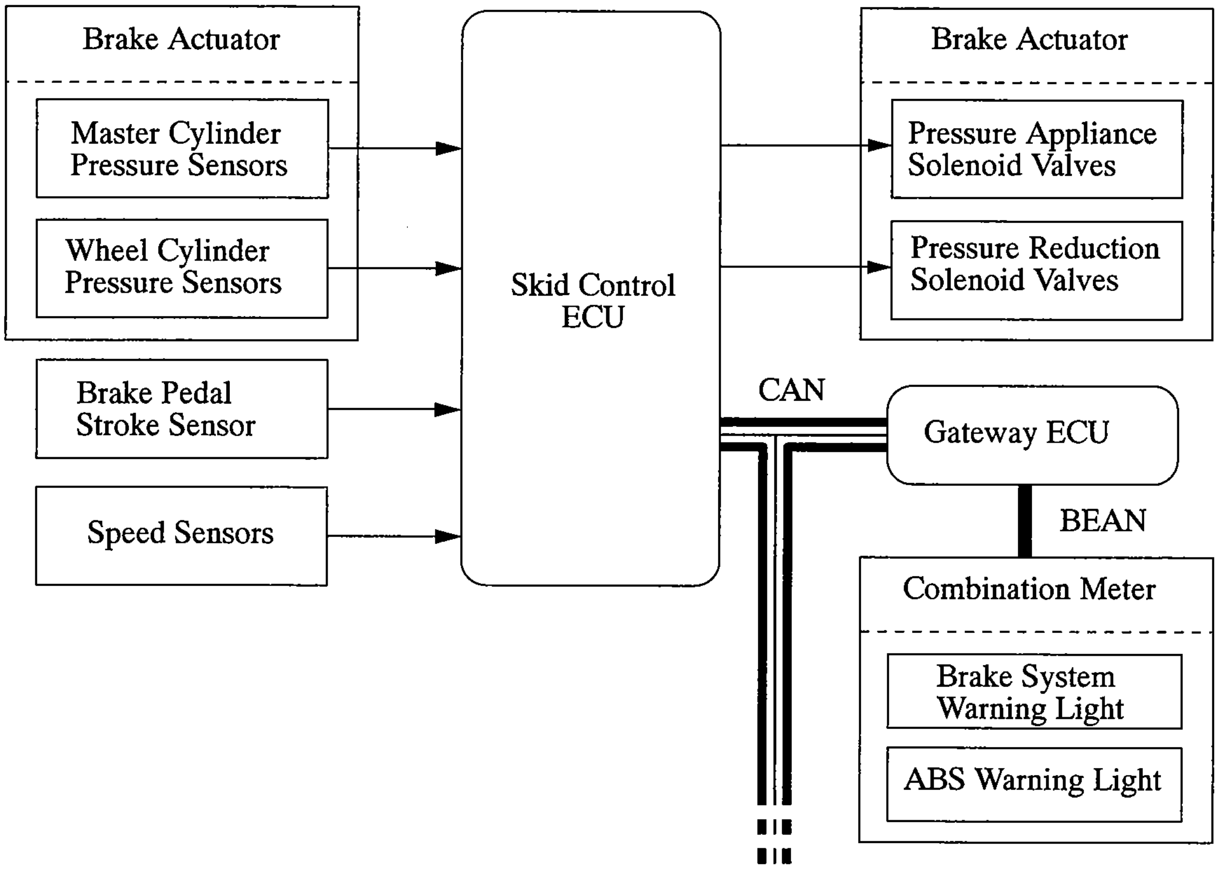
CH

Brake Assist Operation

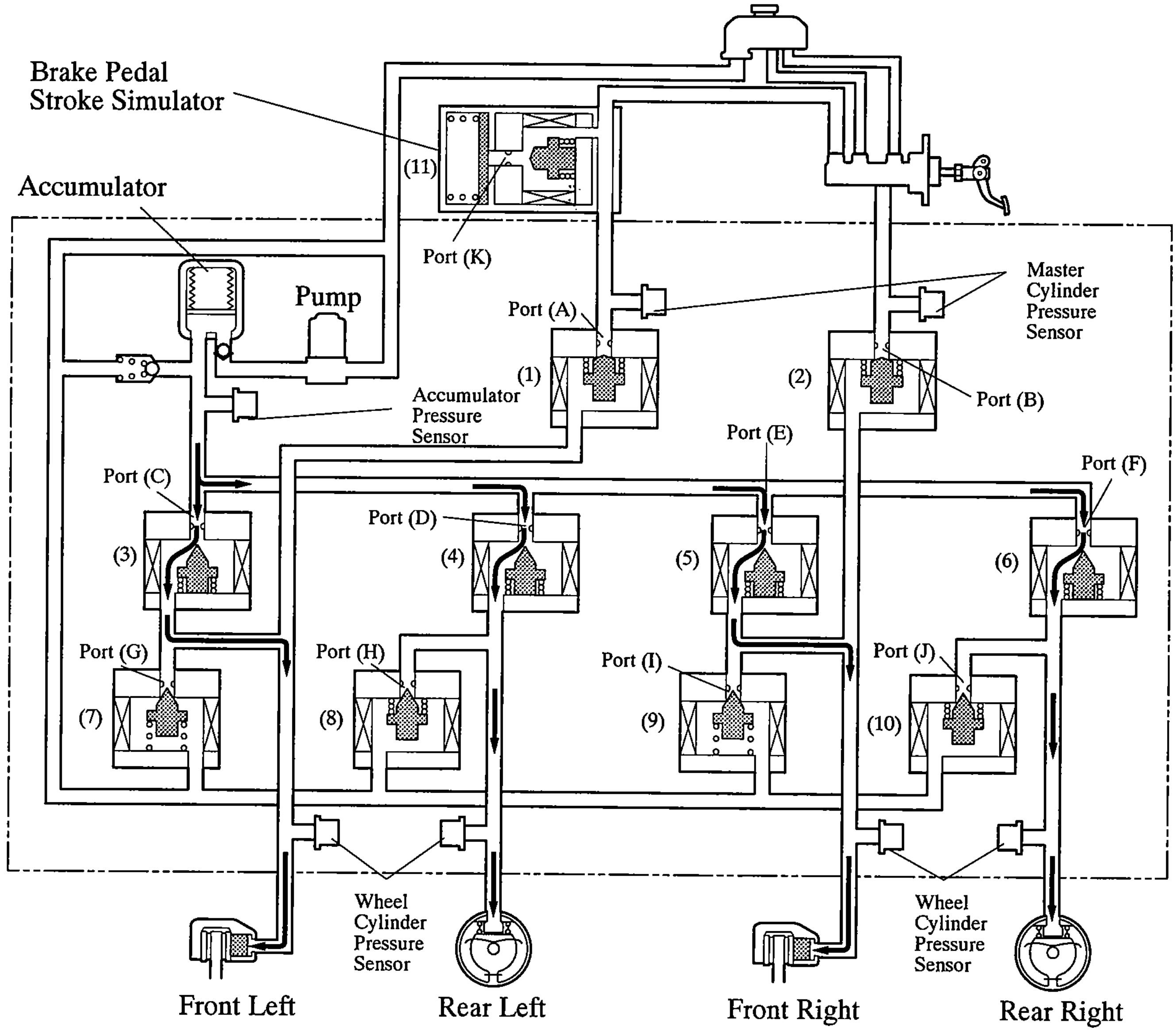
In the event of emergency braking, the skid control ECU detects the driver's intention based on the speed of the pressure increase in the master cylinder determined by the pressure sensor signal. If the ECU judges the need for the additional brake assist, the fluid pressure is generated by the pump in the actuator and directed to the wheel cylinder to apply a greater.
Also in the following cases, the skid control ECU provides brake assist.

- In the event the vehicle is fully loaded, the skid control ECU detects the condition using the master cylinder pressure sensor and vehicle speed signal.

▶ System Diagram ◀



255CH154



Item		Normal Braking Increase Mode	Brake Assist Activated
(1), (2)	Master Cylinder Cut Solenoid Valve Port: (A), (B)	ON (Close)	ON (Close)
(3), (4), (5), (6)	Pressure Appliance Solenoid Valve Port: (C), (D), (E), (F)	ON (Half-Open*)	ON (Half-Open*)
(7), (9)	Pressure Reduction Solenoid Valve Port: (G), (I)	OFF (Close)	OFF (Close)
(8), (10)	Pressure Reduction Solenoid Valve Port: (H), (J)	ON (Close)	ON (Close)
(11)	Stroke Simulator Cut Solenoid Valve Port: (K)	ON (Open)	ON (Open)

*: The solenoid valve constantly regulates the amount of opening of the port in accordance with the use conditions in order to control the fluid pressure.

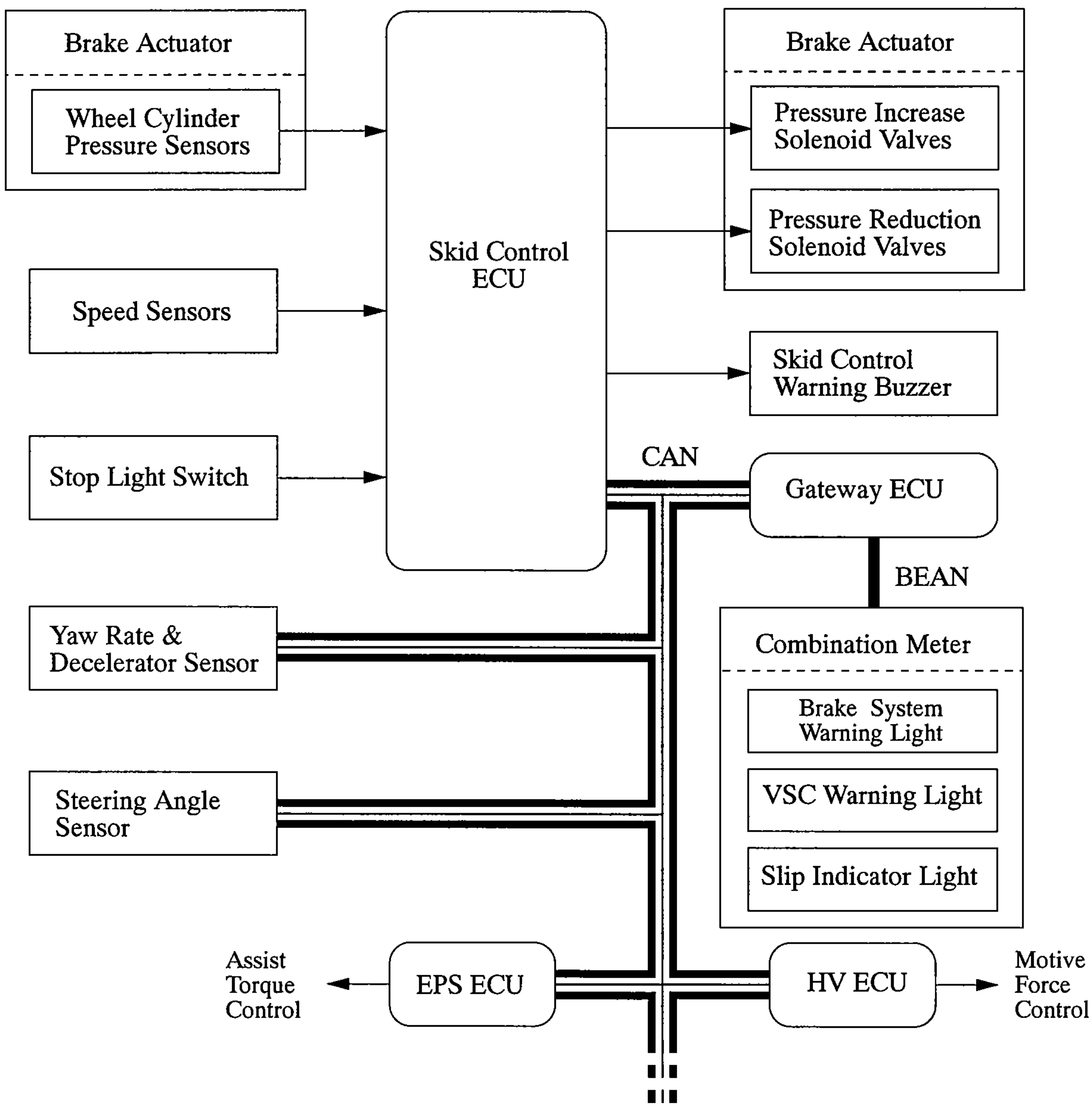
CH

Enhanced VSC Operation

1) General

The Enhanced VSC system controls the solenoid valves in order to send the fluid pressure stored in the accumulator to the brake wheel cylinders at the respective wheels, through routes that are different from those used during normal braking. Thus, the system operates in the following 3 modes: pressure reduction, pressure holding, and pressure increase. As a result, the tendency of the front wheels or the rear wheels to skid is restrained.

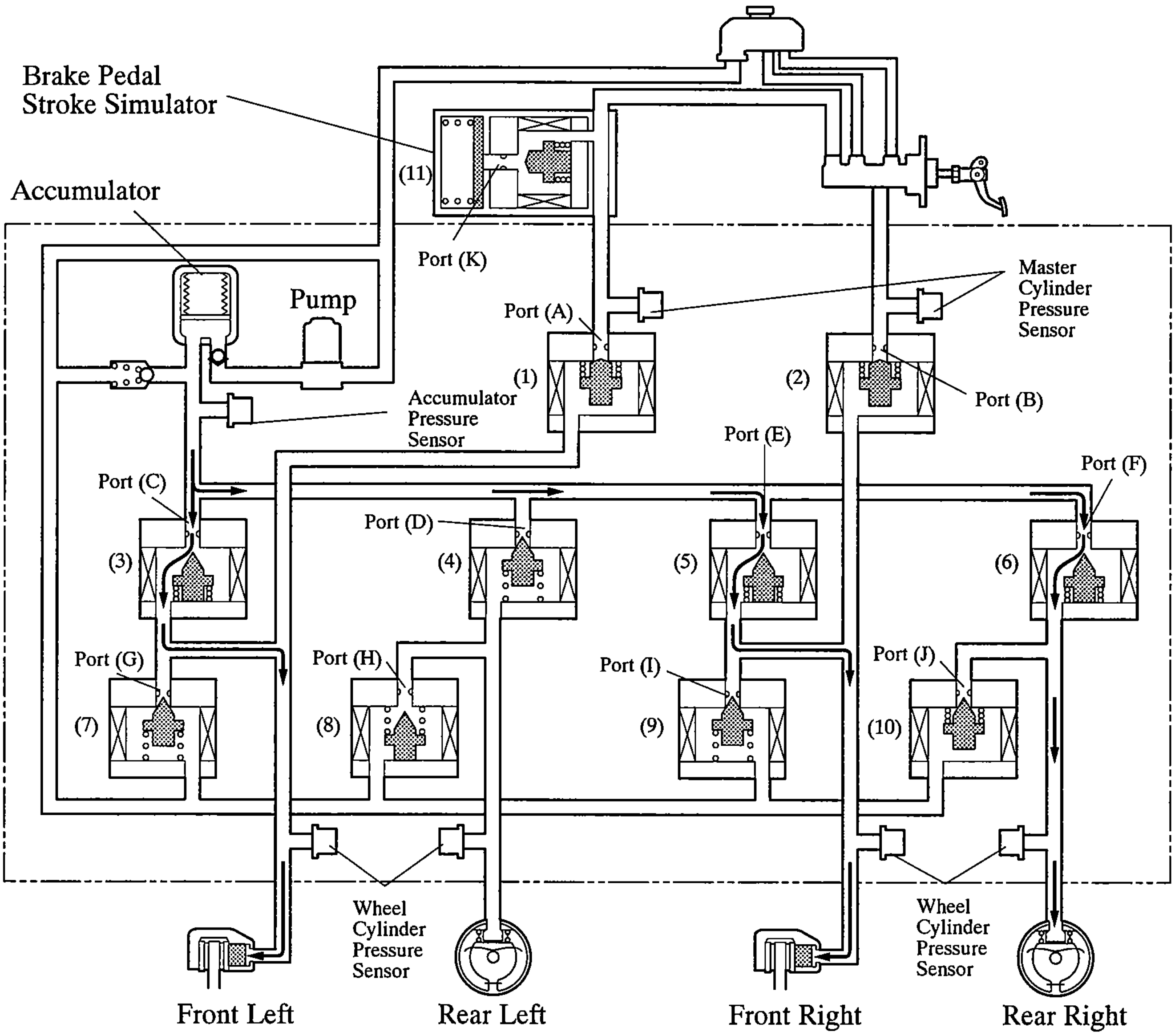
▶ **System Diagram** ◀



255CH156

2) Front Wheel Skid Restraining (Turning to the Right)

In the front wheel skid control, the brake of the front wheels and rear wheel of the inner side of the turn is applied.
Also, depending on whether the brake is ON or OFF and the condition of the vehicle, there are circumstances in which the brake might not be applied to the wheels even if those wheels are targeted for braking.
The diagram below shows the hydraulic circuit in the pressure increase mode, as it restrains the front wheel skid condition while the vehicle makes a right turn.
The pressure Appliance valve and the pressure reduction valve are turned ON/OFF according to the ABS operation pattern.



Increase Mode

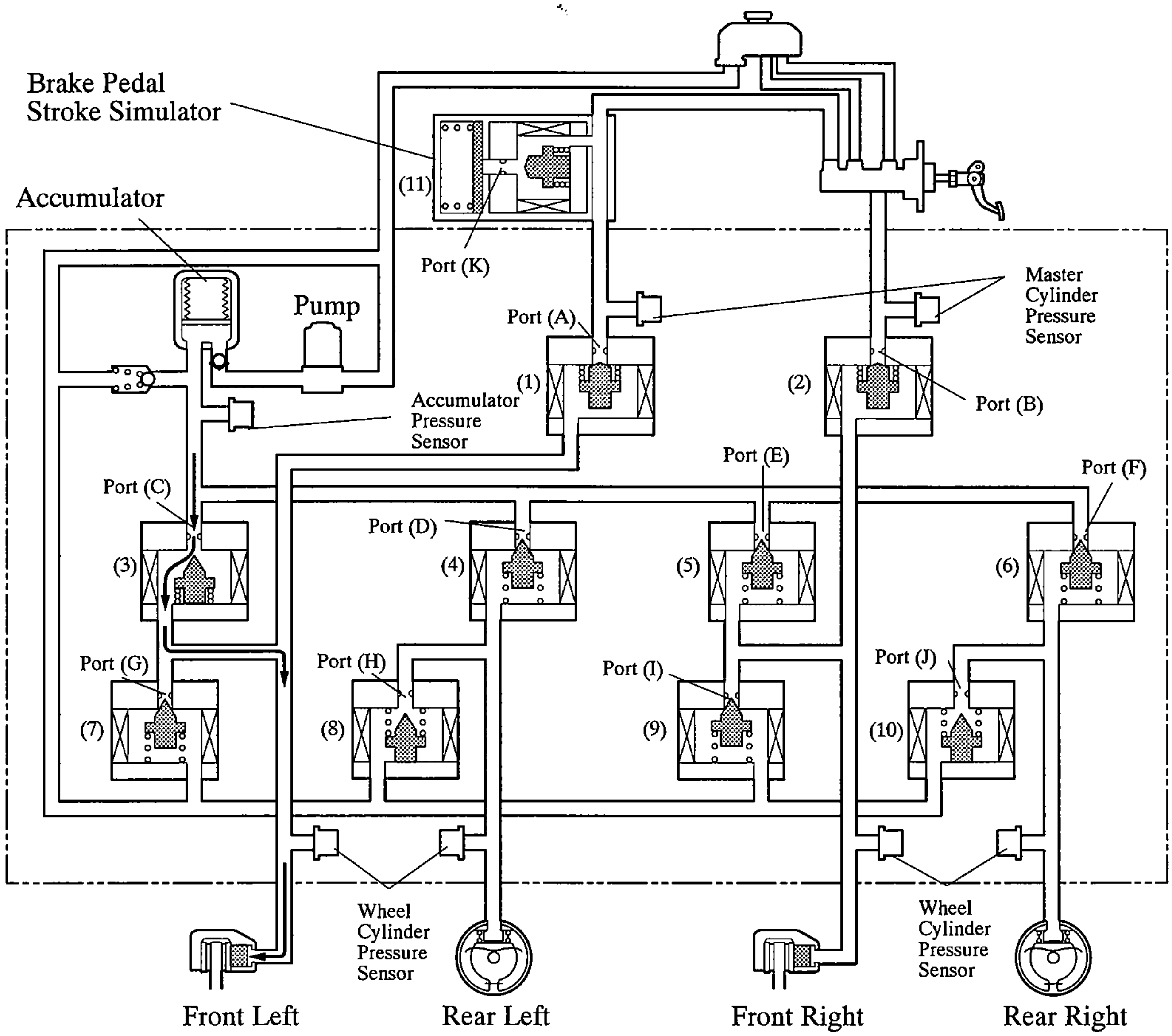
255CH157

Item			Enhanced VSC not Activated	Enhanced VSC Activated		
				Increase Mode	Hold Mode	Reduction Mode
(1), (2)	Master Cylinder Cut Solenoid Valve		ON (Close)	ON (Close)	ON (Close)	ON (Close)
	Port: (A), (B)					
Front Brake	(3)	Pressure Appliance Solenoid Valve	OFF (Close)	ON (Half-Open*)	OFF (Close)	OFF (Close)
		Port: (C)				
	(5)	Pressure Appliance Solenoid Valve	OFF (Close)	ON (Half-Open*)	OFF (Close)	OFF (Close)
		Port: (E)				
	(7)	Pressure Reduction Solenoid Valve	OFF (Close)	OFF (Close)	OFF (Close)	ON (Half-Open*)
		Port: (G)				
	(9)	Pressure Reduction Solenoid Valve	OFF (Close)	OFF (Close)	OFF (Close)	ON (Half-Open*)
		Port: (I)				
	Wheel Cylinder Pressure	Right	—	Increase	Hold	Reduction
		Left				
Rear Brake	(4)	Pressure Appliance Solenoid Valve	OFF (Close)	OFF (Close)	OFF (Close)	OFF (Close)
		Port: (D)				
	(6)	Pressure Appliance Solenoid Valve	OFF (Close)	ON (Half-Open*)	OFF (Close)	OFF (Close)
		Port: (F)				
	(8)	Pressure Reduction Solenoid Valve	OFF (Open)	OFF (Open)	OFF (Open)	OFF (Open)
		Port: (H)				
	(10)	Pressure Reduction Solenoid Valve	OFF (Open)	ON (Close)	ON (Close)	ON (Half-Open*)
		Port: (J)				
	Wheel Cylinder Pressure	Right	—	Increase	Hold	Reduction
		Left	—	—	—	—
(11)	Stroke Simulator Cut Solenoid Valve		ON (Open)	ON (Open)	ON (Open)	ON (Open)
	Port: (K)					

*: The solenoid valve constantly regulates the amount of opening of the port in accordance with the use conditions in order to control the fluid pressure.

3) Rear Wheel Skid Restrain (Turning to the Right)

In rear wheel skid restrain, the brake of the front and rear wheels of the outer circle of the turn is applied. As an example, the diagram below shows the hydraulic circuit in the pressure increase mode, as it restrains the rear wheel skid condition while the vehicle make a right turn.
As in front wheel skid restrain the pressure Appliance valve and the pressure reduction valve are turned ON/OFF according to the ABS operating pattern.



Increase Mode

255CH158

Item			Enhanced VSC not Activated	Enhanced VSC Activated: Increase Mode	Enhanced VSC Activated: Hold Mode	Enhanced VSC Activated: Reduction Mode
(1), (2)	Master Cylinder Cut Solenoid Valve Port: (A), (B)		ON (Close)	ON (Close)	ON (Close)	ON (Close)
Front Brake	(3)	Pressure Appliance Solenoid Valve Port: (C)	OFF (Close)	ON (Half-Open*1)	OFF (Close)	OFF (Close)
Front Brake	(5)	Pressure Appliance Solenoid Valve Port: (E)	OFF (Close)	OFF (Close)	OFF (Close)	OFF (Close)
Front Brake	(7)	Pressure Reduction Solenoid Valve Port: (G)	OFF (Close)	OFF (Close)	OFF (Close)	ON (Half-Open*1)
Front Brake	(9)	Pressure Reduction Solenoid Valve Port: (I)	OFF (Close)	OFF (Close)	OFF (Close)	OFF (Close)
Front Brake	Wheel Cylinder Pressure	Right	—	—	—	—
Front Brake	Wheel Cylinder Pressure	Left	—	Increase	Hold	Reduction
Rear Brake	(4)	Pressure Appliance Solenoid Valve Port: (D)	OFF (Close)	OFF (Close) [ON (Half-Open *1)]*2	OFF (Close)	OFF (Close)
Rear Brake	(6)	Pressure Appliance Solenoid Valve Port: (F)	OFF (Close)	OFF (Close) [ON (Half-Open *1)]*2	OFF (Close)	OFF (Close)
Rear Brake	(8)	Pressure Reduction Solenoid Valve Port: (H)	OFF (Open)	ON (Close)	ON (Close)	ON (Close) [ON (Half-Open *1)]*2
Rear Brake	(10)	Pressure Reduction Solenoid Valve Port: (J)	OFF (Open)	ON (Close)	ON (Close)	ON (Close) [ON (Half-Open *1)]*2
Rear Brake	Wheel Cylinder Pressure	Right Left	—	—	—	—
(11)	Stroke Simulator Cut Solenoid Valve Port: (K)		ON (Open)	ON (Open)	ON (Open)	ON (Open)

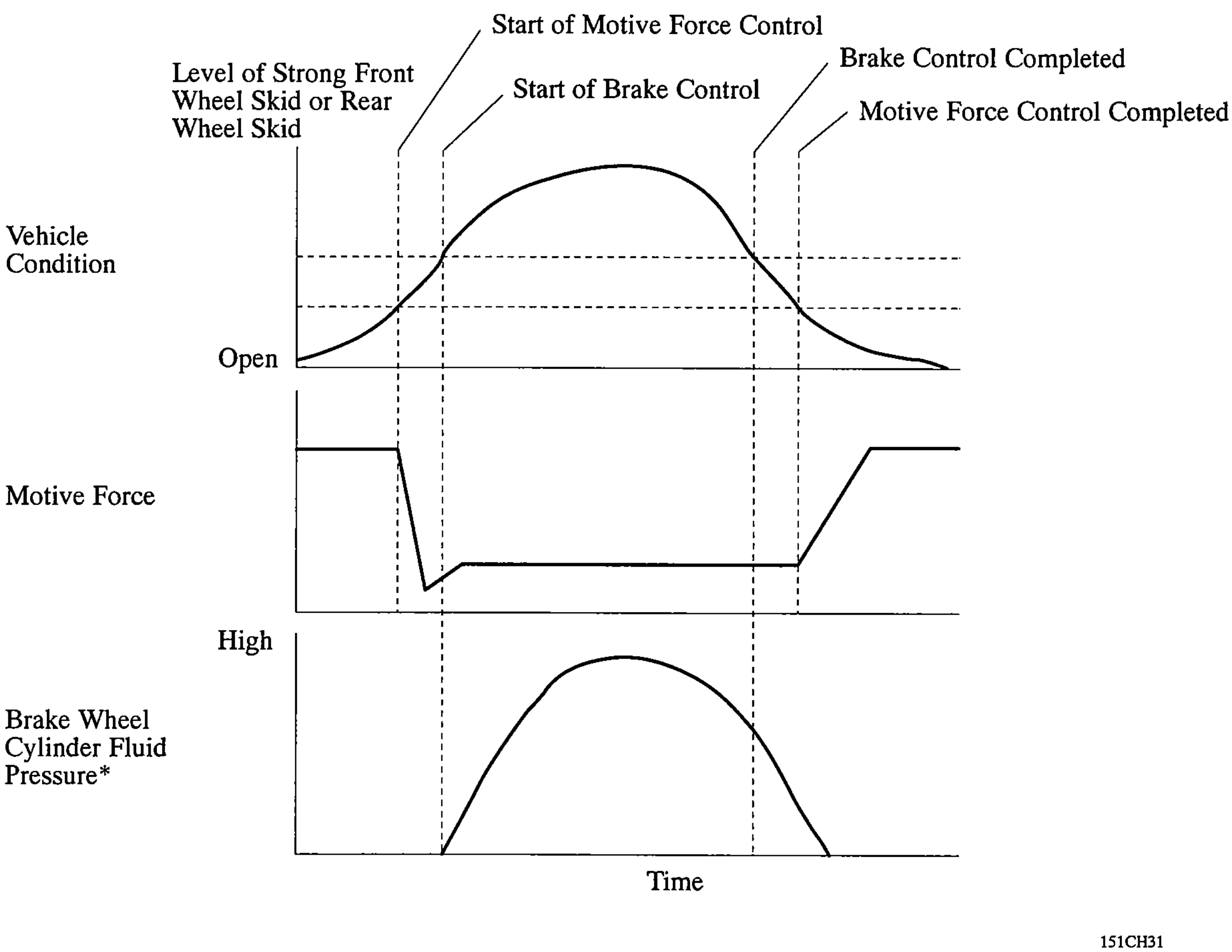
*1: The solenoid valve constantly regulates the amount of opening of the port in accordance with the use conditions in order to control the fluid pressure.

*2: In some cases, the skid control ECU applies the brake of the rear wheel, as necessary.

12. Skid Control ECU

Enhanced VSC (Option)

Based on the 4 type of sensor signals received from the speed sensors, yaw rate sensor, deceleration sensor and steering sensor, the skid control ECU calculates the amount of vehicle condition.
If a strong front wheel skid or rear wheel skid tendency is created during an emergency avoidance maneuver or cornering, and the skid control ECU determines that the amount of vehicle condition exceeds a prescribed value, it controls the motive force and the brake fluid pressure according to the amount of the vehicle condition.



*: The wheel cylinder that activates varies depending on the condition of the vehicle.

Self-Diagnosis

- If the skid control ECU detects a malfunction in the ECB, Regenerative Brake, ABS with EBD, Brake Assist, and Enhanced VSC*1 systems, the brake control system, ABS, brake system, and VSC*1 warning lights that corresponds to the function in which the malfunction has been detected indicates or lights up, as indicated in the table below, to alert the driver of the malfunction.

○: Light ON —: Light OFF

Item	Regenerative Brake Cooperative Control	ABS	EBD	Brake Assist	Enhanced VSC*1	ECU
Brake Control system Warning Light	○	○	○	○	—	○*2
Brake System Warning Light	—	—	○	○	—	○
ABS Warning Light	—	○	○	○	—	○
VSC*1 Warning Light	—	○	○	○	○	○*2

*1: Option
*2: May not be illuminated

- At the same time, the DTC (Diagnostic Trouble Code) are stored in memory. The DTC can be read by connecting the SST (09843-18040) between the Tc and CG terminals DLC3, and observing the blinking of the brake control system warning light, ABC warning light, and VSC warning light or by connecting a hand-held tester with CAN extension module.
- This system has a sensor signal check (test mode) function. This function is activated by connecting the SST (09843-18040) between the Ts and CG terminals of the DLC3 or by connecting a hand-held tester with CAN extension module.
- If the skid control ECU detects a malfunction during a sensor check, it stores the DTC in its memory. This DTC can be read during a sensor signal check operation by connecting the Tc and CG terminals of the DLC3 and observing the blinking of the brake control system warning light, the ABS warning light and the VSC warning light, or on a hand-held tester with CAN extension module.
- If the CAN has communication error ECU or sensors, multiple DTCs (Diagnostic Trouble Codes) are output simultaneously to indicate the malfunction location.
- All the DTCs have been made to correspond to the SAE controlled codes. Some of the DTCs have been further divided into smaller detection areas than in the past, and new DTCs have been assigned to them. Additionally, DTCs have been added to correspond to items, which had been newly adopted.
- Three-digit information codes have been provided in the conventional DTC as subset of a primary five-digit code. This enables the troubleshooting procedure to further narrow down a trouble area to identify a problem.

For details on the DTC that are stored in skid control ECU memory and the DTC that are output through the sensor signal check function, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

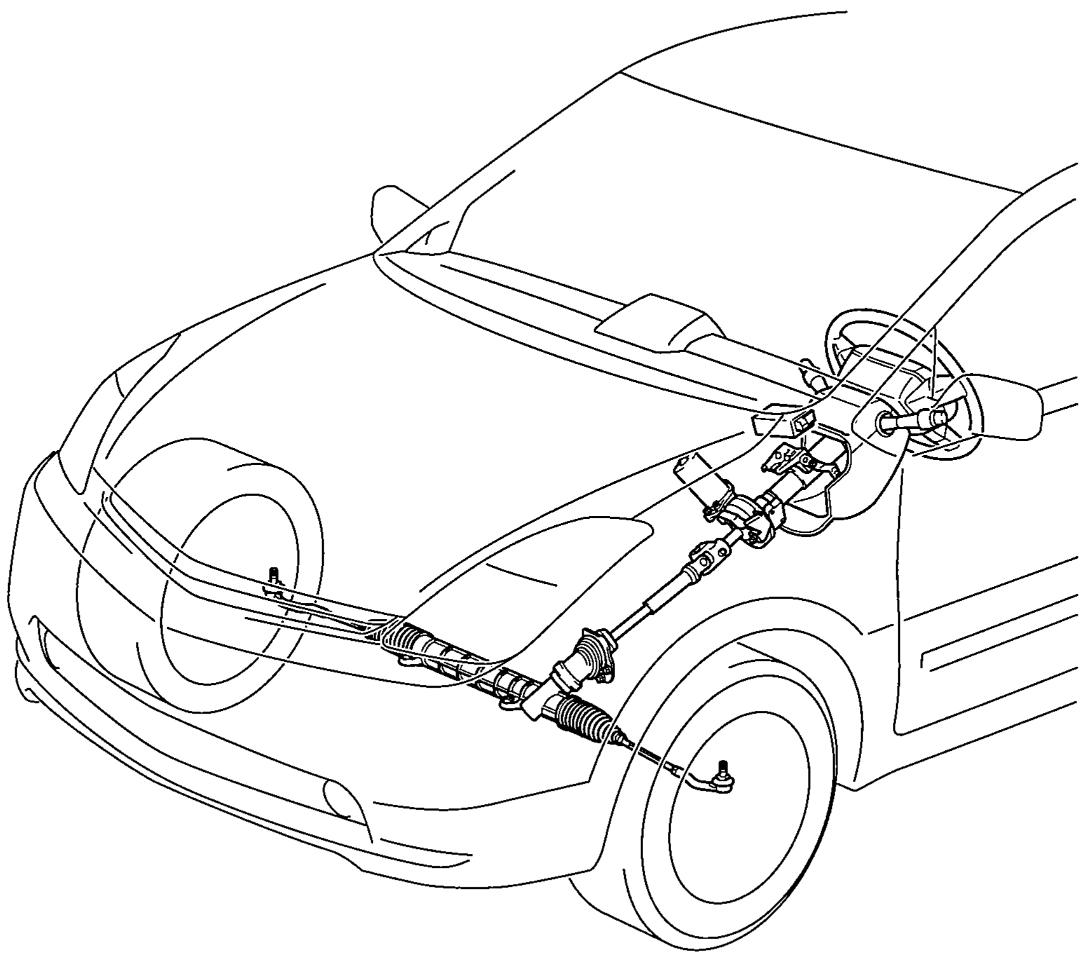
Fail-Safe

- In the event of a malfunction in the THS-II and/or Enhanced VSC, the skid control ECU prohibits the Enhanced VSC operations.
- In the event of a malfunction in the ABS and/or Brake Assist, the skid control ECU prohibits the ABS with EBD, Brake Assist, and Enhanced VSC operations.
- In the event of the malfunction in the EBD control, skid control ECU prohibits the EBD control. Thus, the brake and fuel injection cut off control will be opened in the same condition as in condition without the ABS with EBD, Brake Assist, and Enhanced VSC.

STEERING

■ DESCRIPTION

- As on the '03 Prius, a rack and pinion type steering gear is used.
- As on the '03 Prius, the '04 Prius uses a vehicle-speed sensing type EPS (Electric Power Steering) as standard equipment on all models. However, on the '04 Prius, the mounted position of the motor and the type of torque sensor have been changed.
- The step less tilt steering is used on all models.
- An energy absorbing mechanism has been adopted in the steering column.



255CH108

▶ **Specifications** ◀

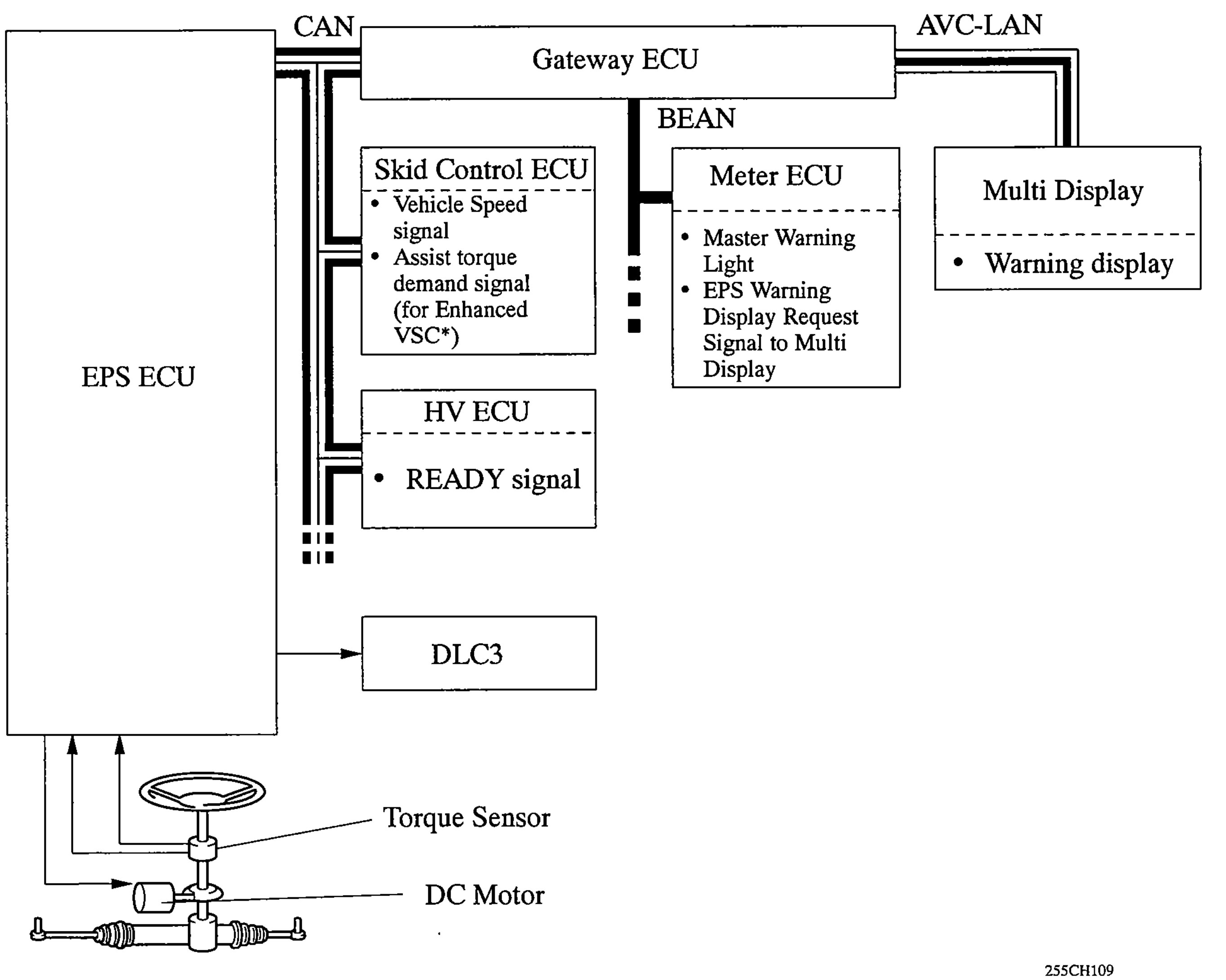
Model	New	Previous
Gear Ratio	19.1	16.4 ~ 18.3
No. of Turns Lock to Lock	3.61	3.99
Rack Stroke mm (in.)	144.4 (5.7)	149.6 (5.9)

■ EPS (ELECTRIC POWER STEERING)

1. General

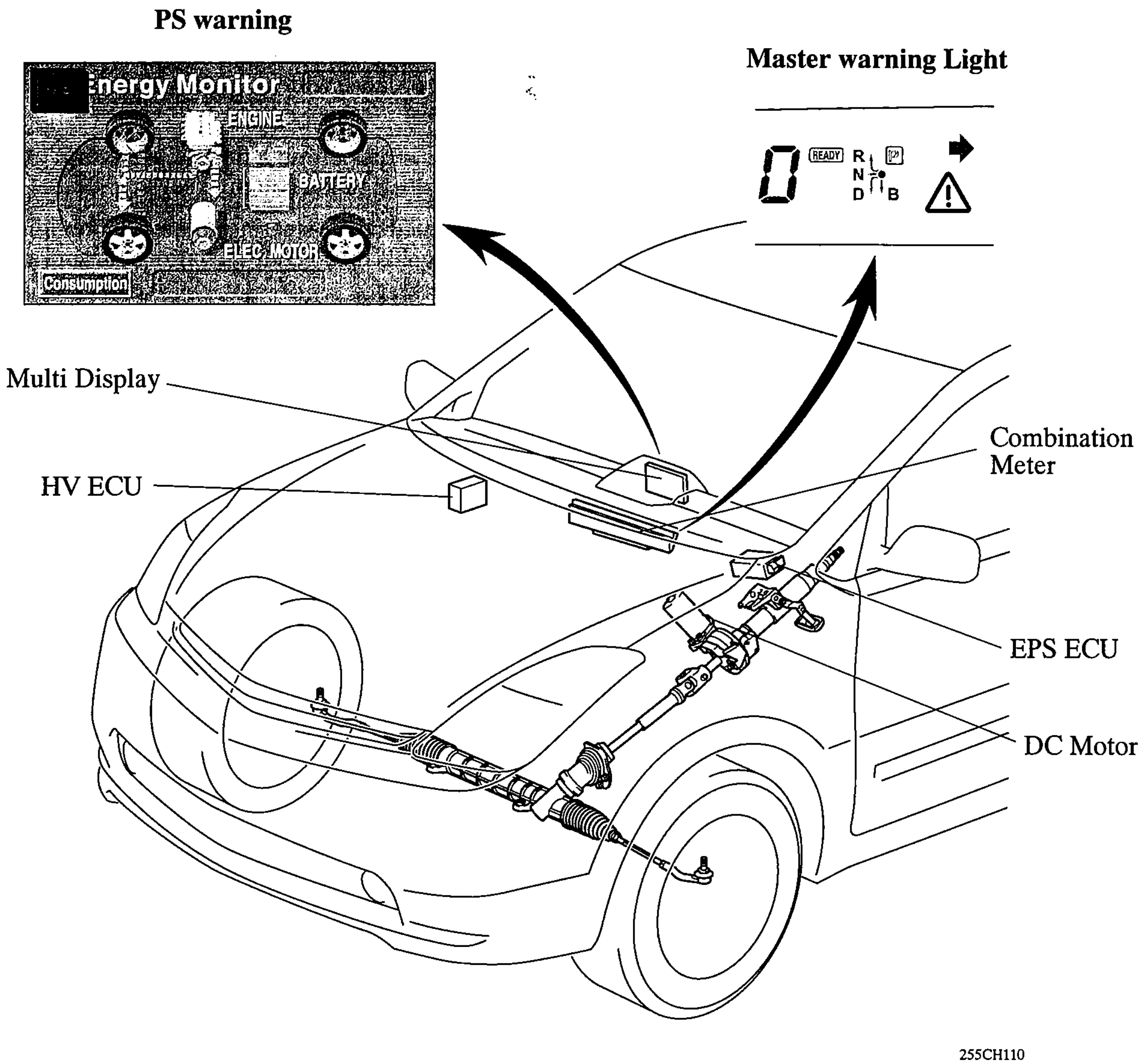
- This system generates torque using a DC motor and a reduction mechanism that are mounted on the steering column to assist the driver's steering effort. The EPS ECU calculates the amount of power assist in accordance with the signals provided by the sensors and the ECUs.
- The EPS ECU maintains communication with the skid control ECU, HV ECU, and Gateway ECU via CAN. In addition, the EPS ECU maintains communication with the Meter ECU through the Gateway ECU, via BEAN. For details, refer to Multiplex Communication on page BE-47.
- The EPS ECU has been changed from 16-bit CPU to 32-bit CPU to increase the speed for processing the signals.
- The Enhanced VCS system, which controls steering assist torque when the VSC system is operating, has been adopted. While the Enhanced VSC system is operating, the EPS ECU controls the assist torque of the DC motor upon the received assist torque demand signal from the skid control ECU. For details, refer to outline of Enhanced VSC, refer on page CH-40.
- This system offers excellent fuel economy characteristics because power assist is provided by the DC motor that is mounted on the steering column, and this motor consumes energy only when power assist is required.
- Unlike the conventional hydraulic power steering system, this system excels in serviceability because it dose not require pipes, vane pump, pulley and power steering fluid.

▶ System Diagram ◀



*: Option

2. Layout of Main Components



3. Function of Main Components

Components		Function
Steering Column	Torque Sensor	Detects the twist of the torsion bar with, this it calculates the torque that is applied to the torsion bar by changing it into an electrical signal, and outputs this to the EPS ECU.
	DC Motor	Generates power assist in accordance with a signal received from the EPS ECU.
	Reduction Mechanism	Reduces the speed of the DC motor through the use of a worm gear and a wheel gear and transmits it to the column shaft.
EPS ECU		Actuates the DC motor mounted on the steering column to providing power assist, based on the signals received from various sensors and vehicle speed sensor.
HV ECU		Transmits a READY signal to the EPS ECU, in order to inform the EPS system that it is ready to generate electricity.
Skid Control ECU		• Outputs speed sensor signals to the EPS ECU. • When Enhanced VSC* (Enhanced Vehicle Stability Control) is operating, the skid control ECU transmits an additional torque signal (which it has calculated in accordance with the signals from the sensors for the purpose of effecting cooperative control) to the EPS ECU.
Meter ECU		• Upon receiving a signal from the EPS ECU in the event of a system malfunction, the meter ECU illuminates the master warning light and simultaneously transmits a PS warning display request signal to the multi-information display.
Multi Display		In case of a malfunction in the system, displays the PS warning

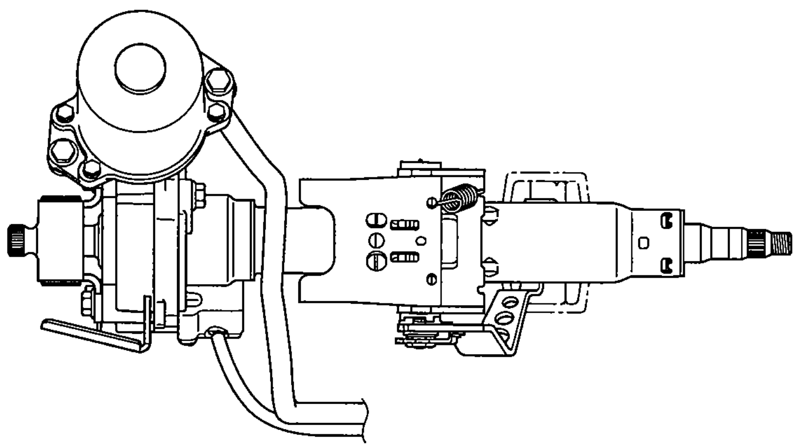
*: Option

4. Construction and Operation

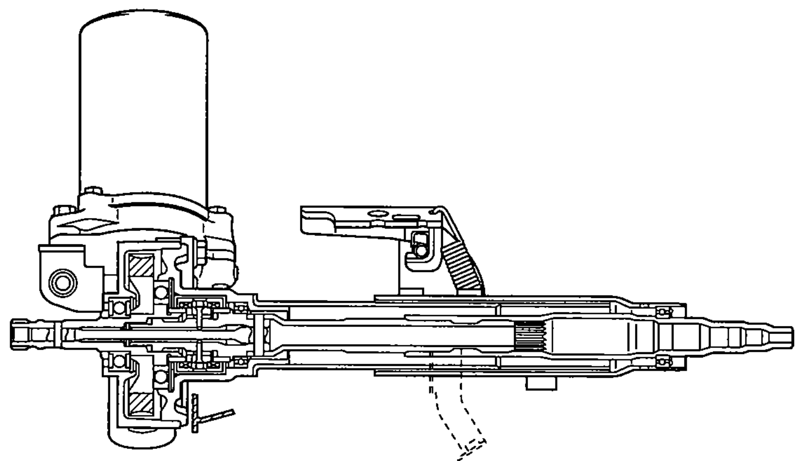
Steering Column

1) General

- The DC motor, reduction mechanism, and torque sensor, which are mounted on the steering gear on the '03 Prius, have been relocated to the steering column on the '04 Prius.
- The torque sensor, which consists of a contact type variable resistor on the '03 Prius, has been changed to an inductance type on the '04 Prius.



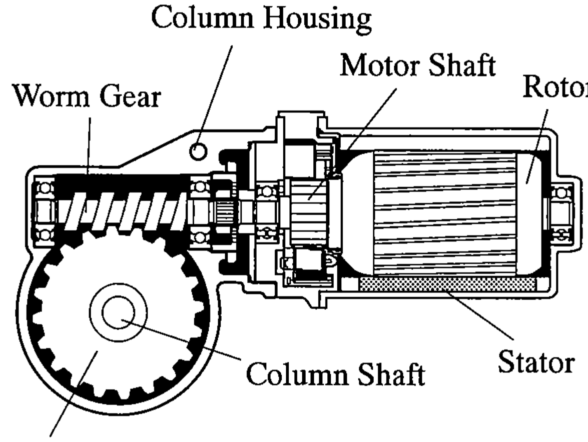
Top View



Cross Section

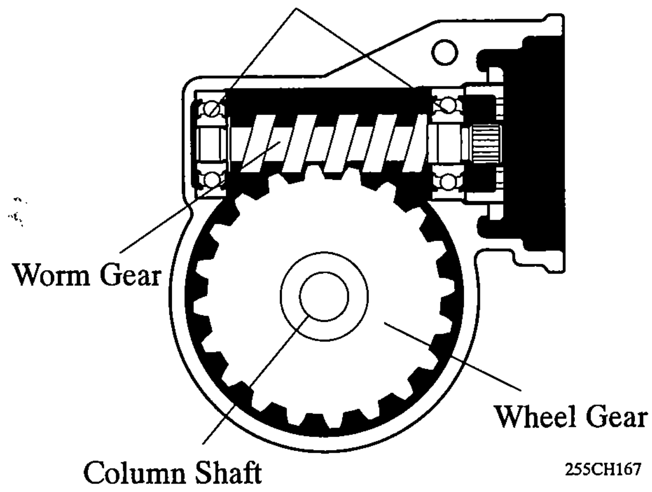
2) DC Motor

The DC motor consists of the rotor, stator, and motor shaft.
The torque that is generated by the motor is transmitted via the joint to the worm gear.
Then this torque is transmitted via the wheel gear to the column shaft.



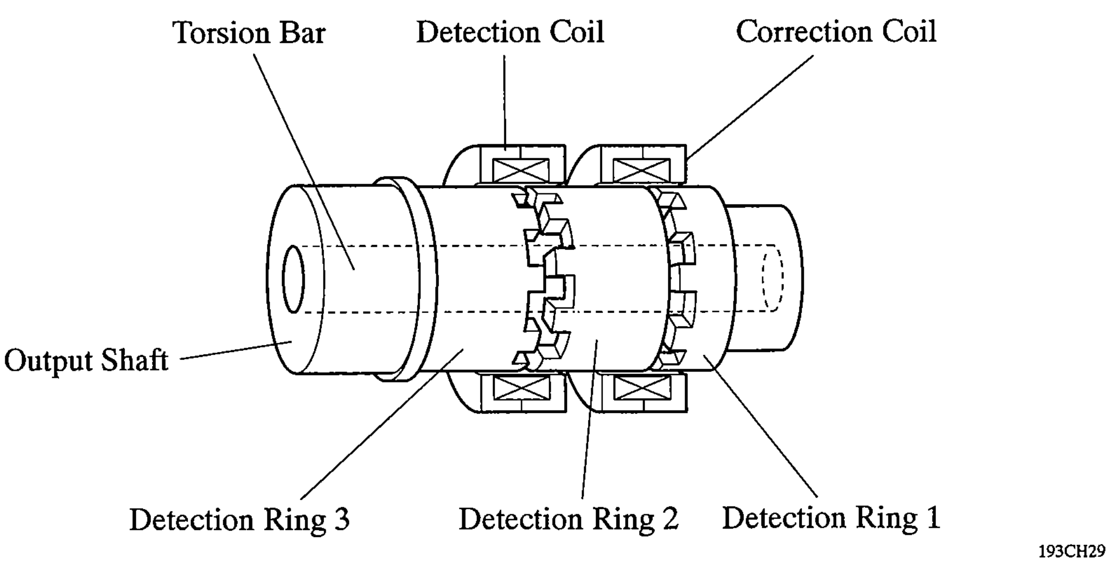
3) Reduction Mechanism

This mechanism reduces the speed of the DC motor via the worm gear and the wheel gear, and transmits it to the column shaft.
The worm gear is supported by the ball bearing in order to reduce noise and frictions.



4) Torque Sensor

- The torque sensor detects the twist of the torsion bar with this, it calculates the torque that is applied to the torsion bar by changing it into an electrical signal, and outputs this signal to the EPS ECU.
- Detection ring 1 and detection ring 2 are mounted on the input shaft, and detection ring 3 is mounted on the output shaft. The input shaft and the output shaft are jointed by the torsion bar. A detection coil and a correction coil are placed on the outside of the respective detection rings to complete an excitation circuit without making a contact.
- The function of detection ring 1 and 2 is to correct temperature. They detect the temperature changes that occur in the correction coil and correct the deviation that is caused by the temperature changes.
- The detection coil consists of a dual circuit that outputs two signals, VT1 (Torque Sensor Signal 1) and VT2 (Torque Sensor Signal 2). The ECU controls the assist amount based on there two signals and at the same time detects a sensor malfunction.



Service Tip
If the steering wheel, steering column, or steering gear is removed and reinstalled the zero point of the torque sensor must be adjusted. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U)

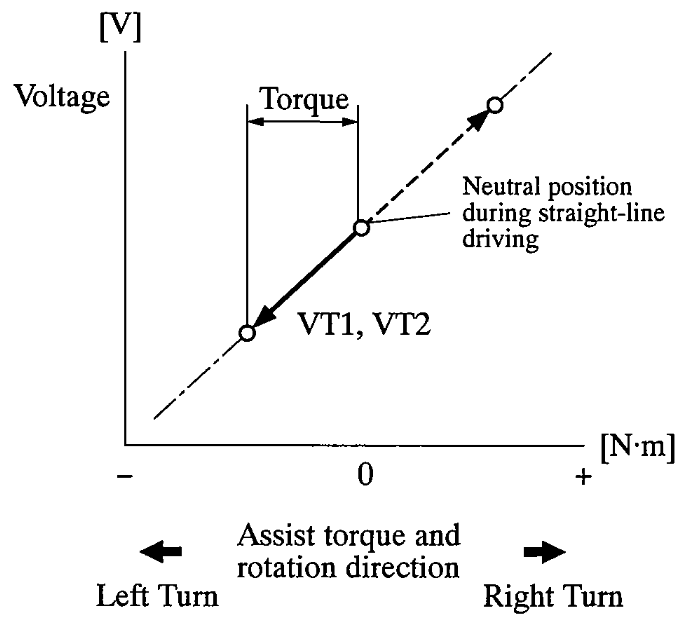
	Initialization	Calibration
Steering Wheel, Column and Gear	○	○
ECU	—	○

a. Straight-line Driving

If the vehicle is driven straight and the driver dose not turn the steering wheel, the specified voltage that is output at this time is determined by the ECU to indicate the neutral position of the steering. Therefore, it dose not apply current to the DC motor.

b. When Steering

When a driver turns the steering wheel to the right or left, the twist that is created in the torsion bar creates a relative displacement between detection ring 2 and detection ring 3.
This change is then converted into two electrical signals, VT1 and VT2, and sent to the EPS ECU.
When the steering wheel is turned to the left, a voltage that is lower than the neutral is output as shown in the diagram on the right.
The direction of the turn is thus detected according of steering assist is determined by the magnitude of the output value.



193CH30

EPS ECU

1) EPS Control

- The EPS ECU receives signals from various sensors, judges the current vehicle condition, and determines the assist ampere to be applied to the DC motor accordingly.
- On models equipped with the Enhanced VSC (Enhanced Vehicle Stability Control) system, the EPS ECU effects cooperative control with the skid control ECU, in order to control the steering assist torque in accordance with information received from the skid control ECU. This facilitates the steering operation of the driver, thus realizing a high level of vehicle stability.
  For an outline of Enhanced VSC, refer to CH-40.

2) EPS ECU Temperature Sensor

A temperature sensor is provided in the EPS ECU to detect if the ECU overheats.
If the sensor detects that the ECU has overheated, the assist current to the DC motor is reduced in order to lower the temperature.

3) Diagnosis

- If the EPS ECU detects a problem in the EPS system, the master warning light that corresponds to the function in which the malfunction has been detected light up to alert the driver of the malfunction.
- At the same time, the DTCs (Diagnosis Trouble Codes) are stored in memory. The DTCs can be accessed the use of the hand-held tester with CAN extension module.

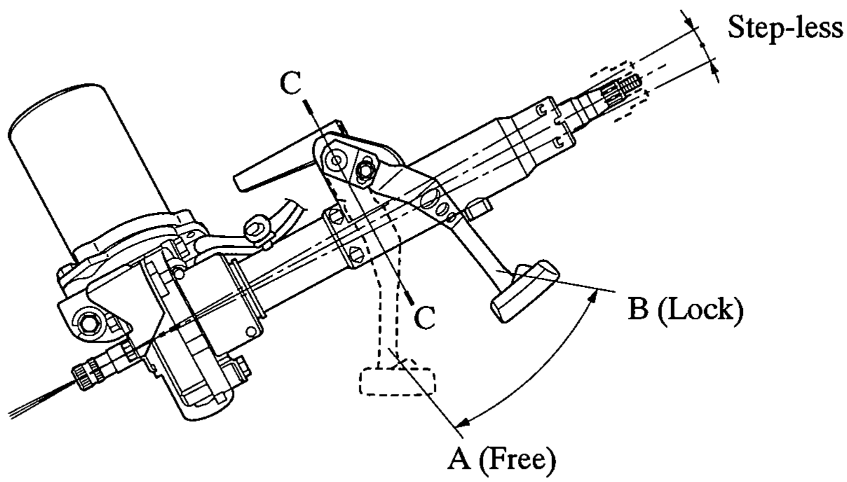
For details of the DTCs that are stored in EPS ECU memory, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

4) Fail-Safe

- If the EPS ECU detects a malfunction in the EPS system, it turns ON the master warning light on the combination meter and sounds a buzzer. At the same time, the EPS ECU causes a PS warning to appear on the multi-information display to inform the driver, and enters the fail-safe mode. As a result, the EPS system operates in the same manner as manual steering.
- In case of a malfunction, the fail-safe function activates and the ECU effects various controls. For details refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

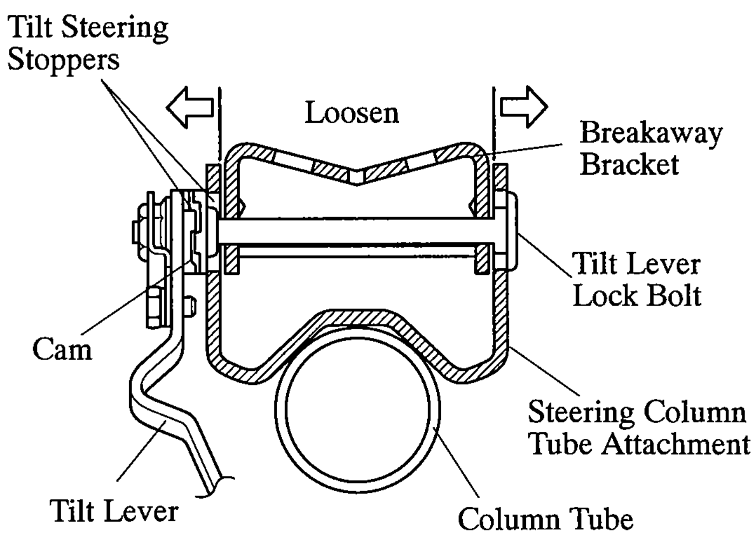
Tilt Mechanism

The tilt mechanism mainly consists of a tilt lever, steering column tube attachment, breakaway bracket, tilt lever lock bolt and tilt steering stoppers.
When the tilt mechanism is in its locked state, the tilt lever at B position causes the cam of the tilt steering stoppers to tighten the steering column tube attachment.
When the tilt mechanism is in its free state, the tilt lever at A position causes the cam of the tilt steering stoppers to loosen the steering column tube attachment.



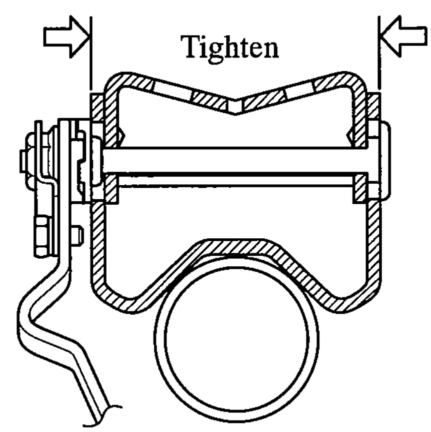
255CH113

▶ C – C Cross Section ◀



Free

255CH114



Lock

255CH115

Energy Absorbing Mechanism

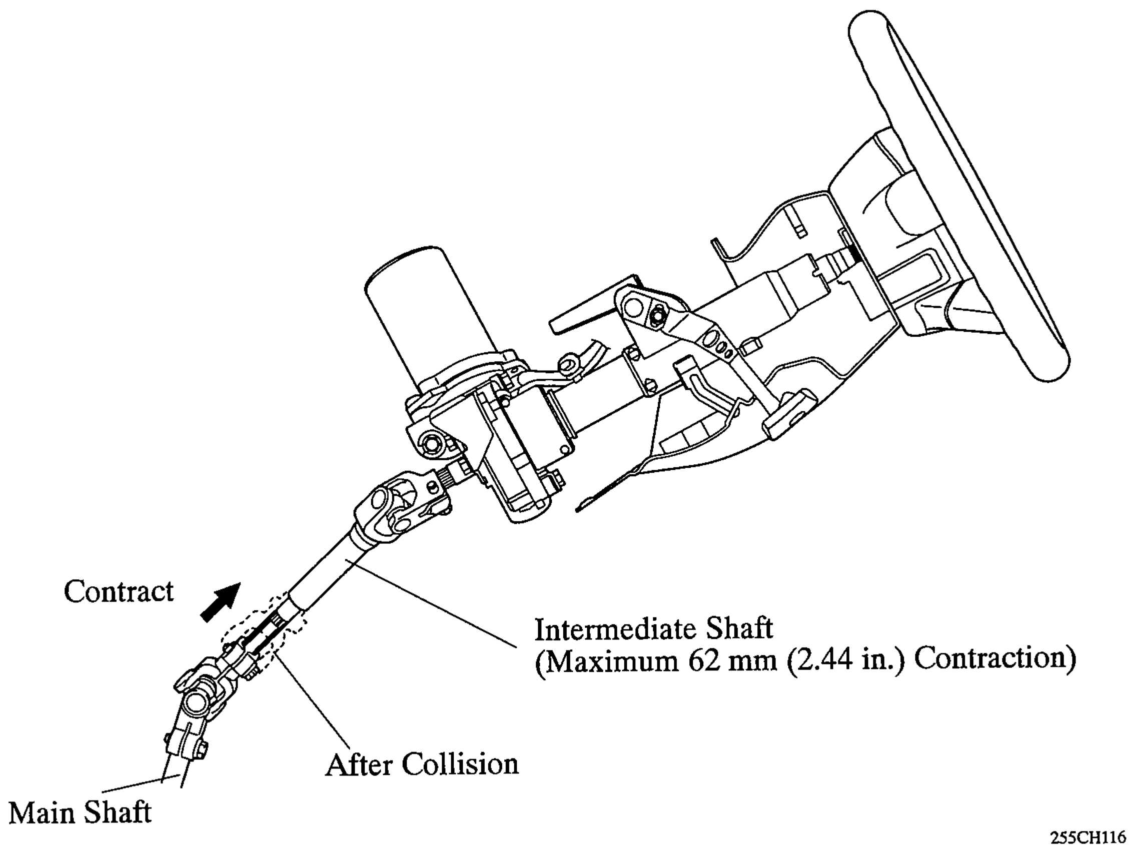
1) Constriction

The energy absorbing mechanism in the steering column consists of breakaway bracket, intermediate shaft, main shaft, and column tube. The steering column is mounted onto the instrument panel reinforcement via a breakaway bracket. The steering column and the steering gear box are connected with a contractile intermediate shaft.

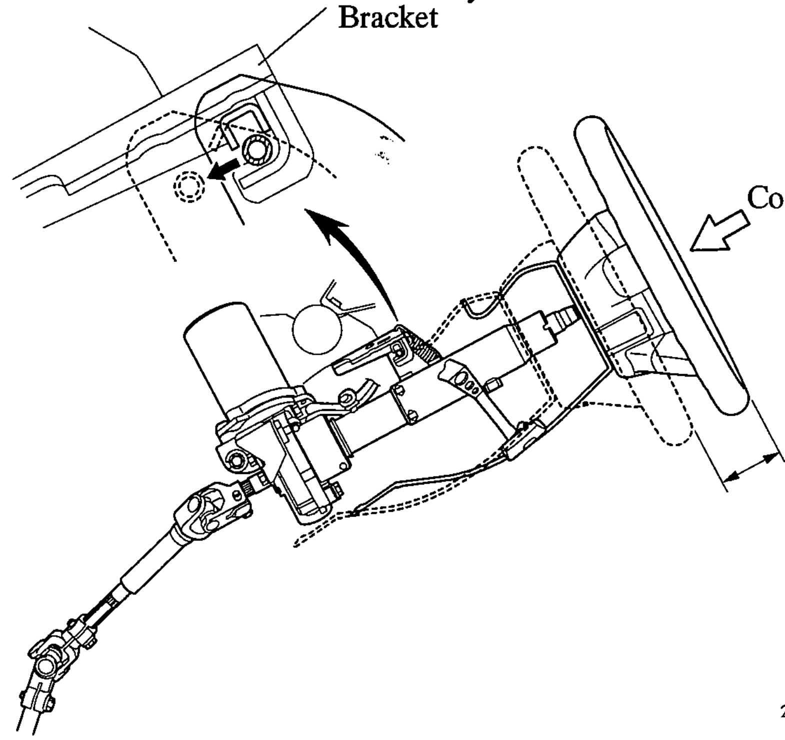
2) Operation

When the steering gear box moves during a collision (primary collision), the intermediate shaft contracts, thus reduces the chance that the steering column and the steering wheel protrude into the cabin.
When an impact is transmitted to the steering wheel in a collision (secondary collision), the steering wheel and the driver's airbag help absorb the impact. In addition, the breakaway bracket separates, and the column tube contracts. At this time, the friction resistance of the sliding portion, which is staked to the column tube, absorbs the energy. This sequential energy absorbing mechanism helps absorb the impact of the secondary collision.

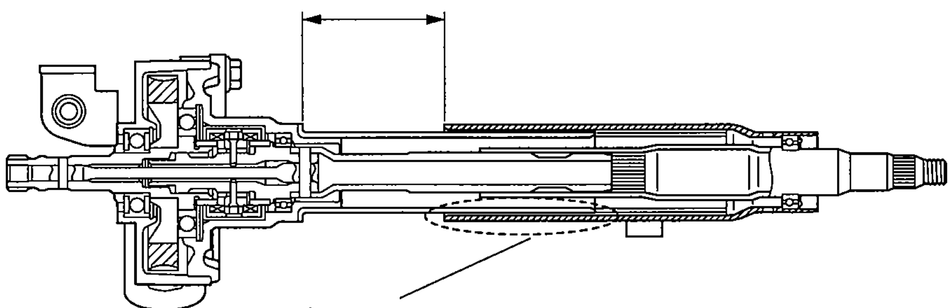
▶ Primary Collision ◀



▶ **Secondary Collision** ◀

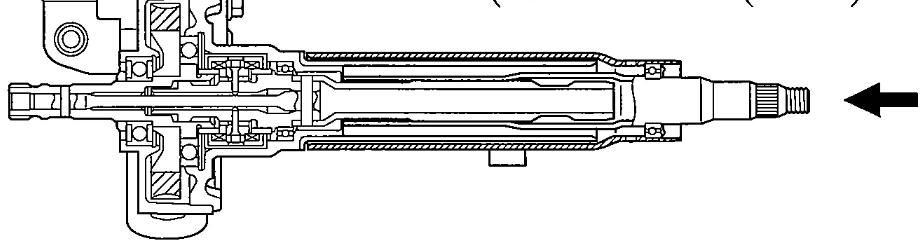


255CH117



255CH118

Before Collision



After Collision
(Maximum Contraction)

255CH119

BODY

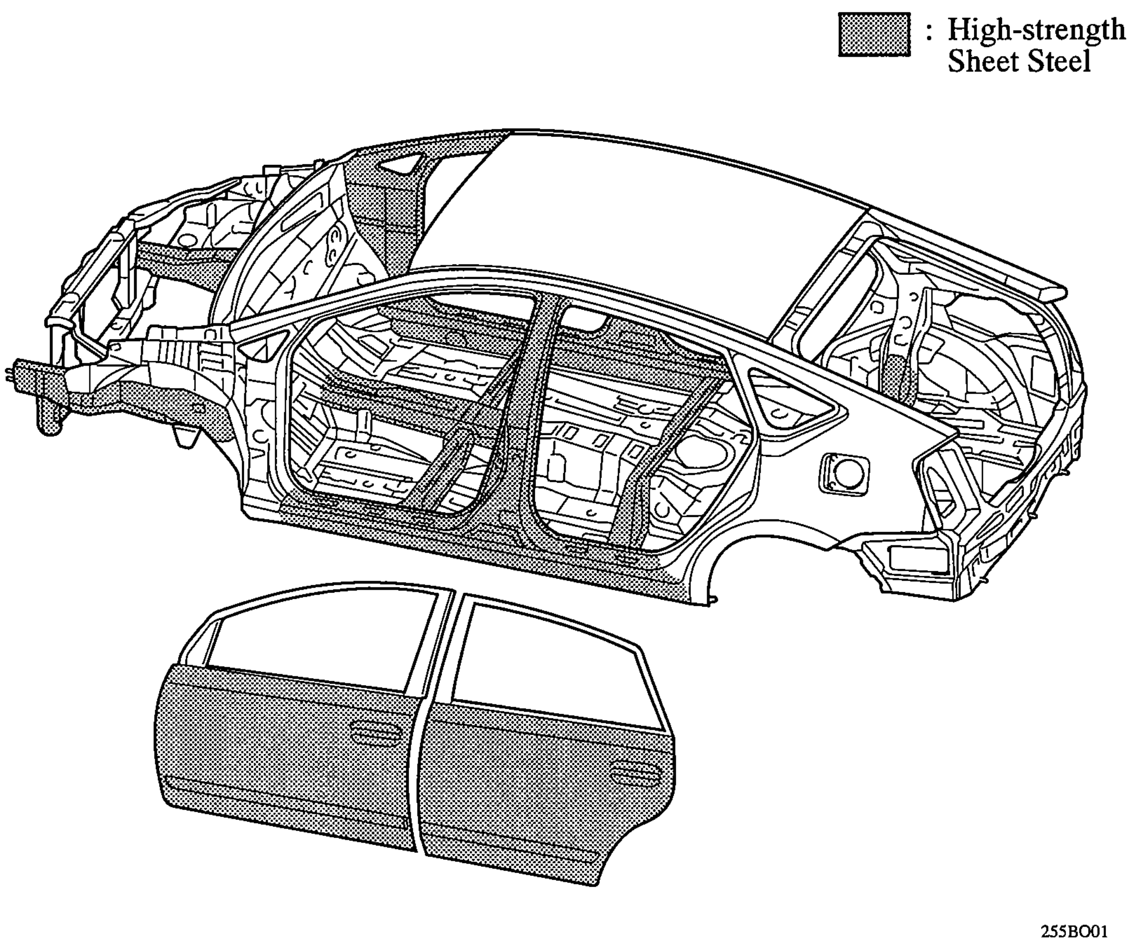
BODY

BODY STRUCTURE

■ LIGHTWEIGHT AND HIGHLY RIGID BODY

1. High Strength Sheet Steel

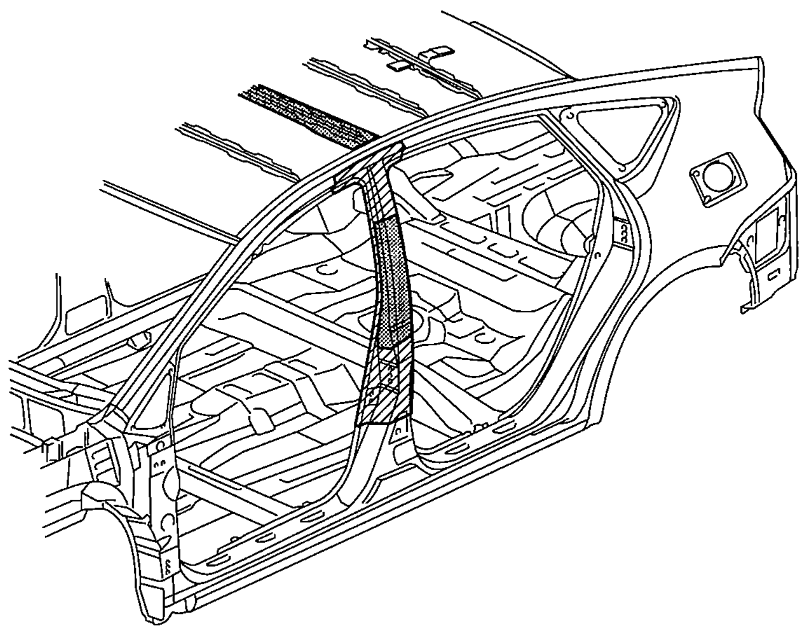
- '04 Prius has high-strength sheet steel in order to realize excellent body rigidity and a lightweight body.



- Ultra high-strength sheet steel and hot-stamp material have been adopted in the center pillar reinforcements and roof cross members in order to realize a lightweight body.
- Ultra high-strength sheet steel has approximately 1.6 times the strength of conventional high-strength sheet steel. Furthermore, the hot-stamp material is approximately 2.5 times stronger. Therefore, to provide the same strength of high-strength sheet steel, a weight reduction of approximately 40% can be realized with ultra high-strength sheet steel, and approximately 60% with the hot-stamp material.

: Ultra High-strength Sheet Steel

: Hot-stamp Material



255BO02

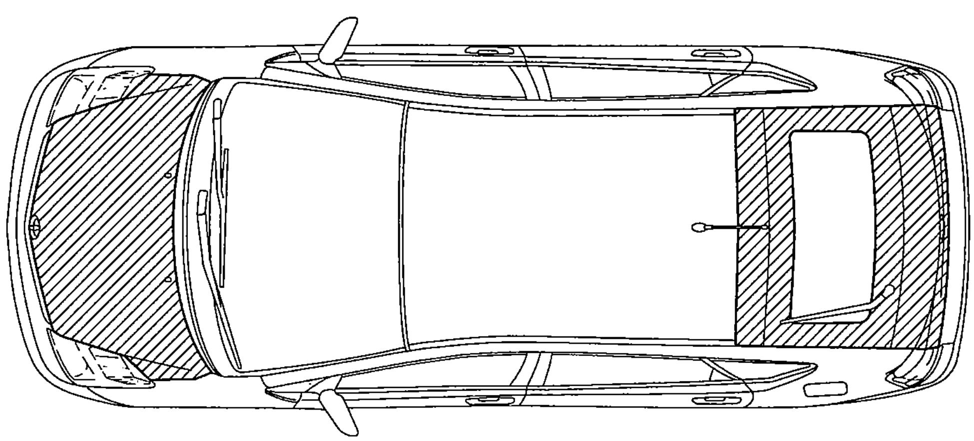
—*REFERENCE*—

Hot-stamp material: Heated high-strength sheet steel is stamped in a water-cooled stamping die and simultaneously quenched to achieve this high-strength sheet steel.

2. Engine Hood and Back Door

Aluminum has been adopted as the material for the engine hood and the back door panel. As a result, a weight reduction of 36% (3.2 kg, 7.0 lb.) has been realized with the engine hood, and 43% (6.0 kg, 13.2 lb.) with the back door, as compared to the same parts made of steel.

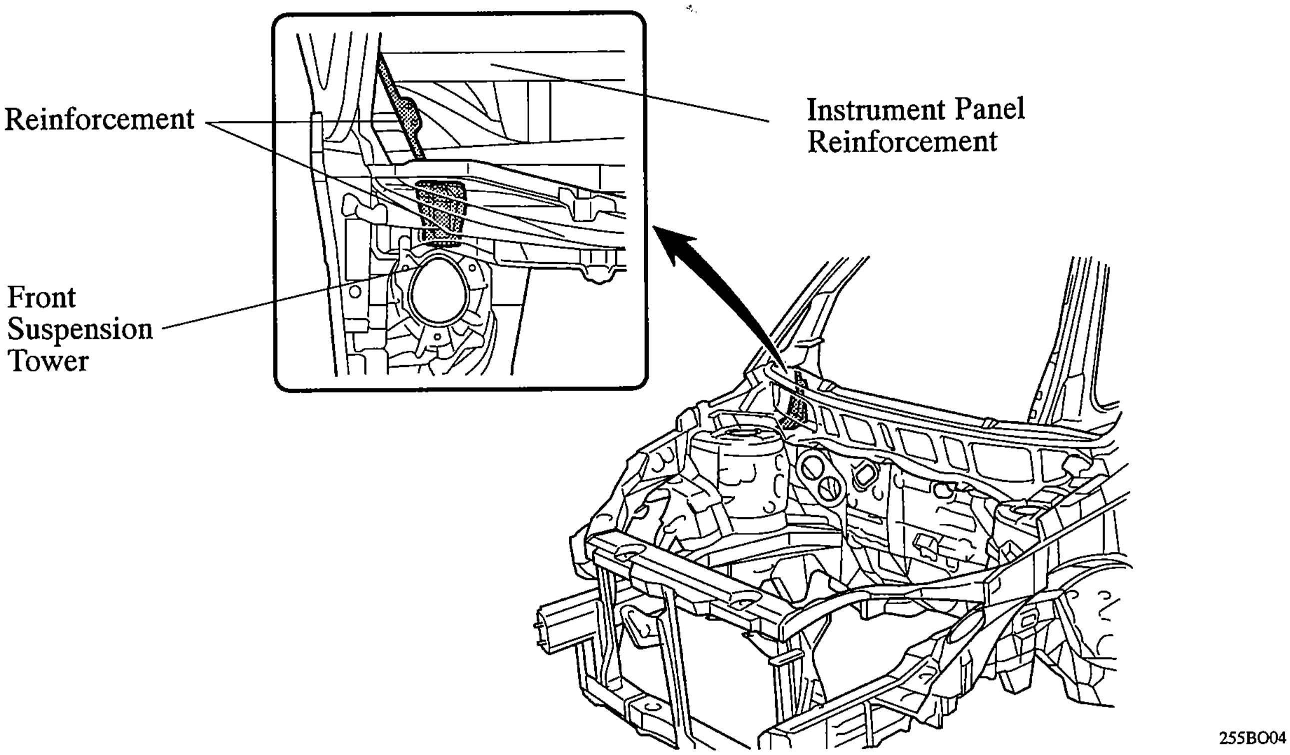
: aluminum



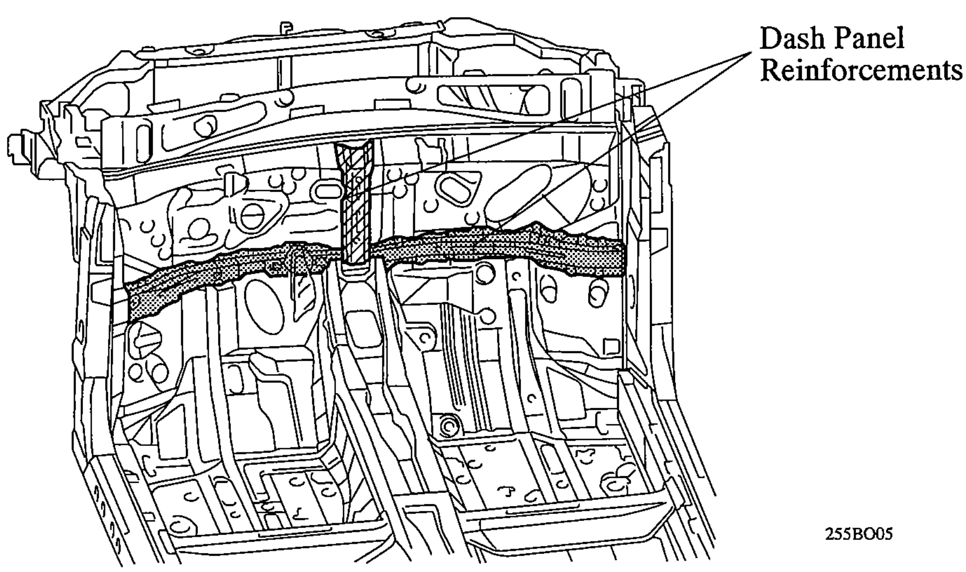
255BO02

3. Body Shell Construction

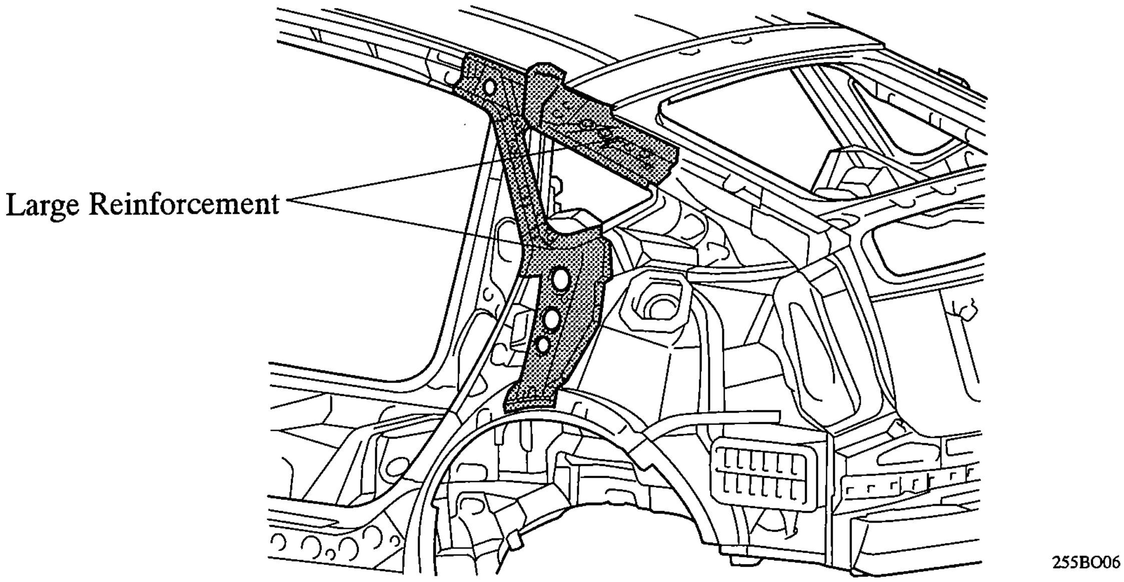
- '04 Prius has realized excellent driving stability and a highly rigid body by optimizing the allocation of the frames and panels and their joining construction.
- To increase the rigidity around the cowl, reinforcements have been provided to join the front suspension tower and the instrument panel reinforcements, with the front cowl placed between them.



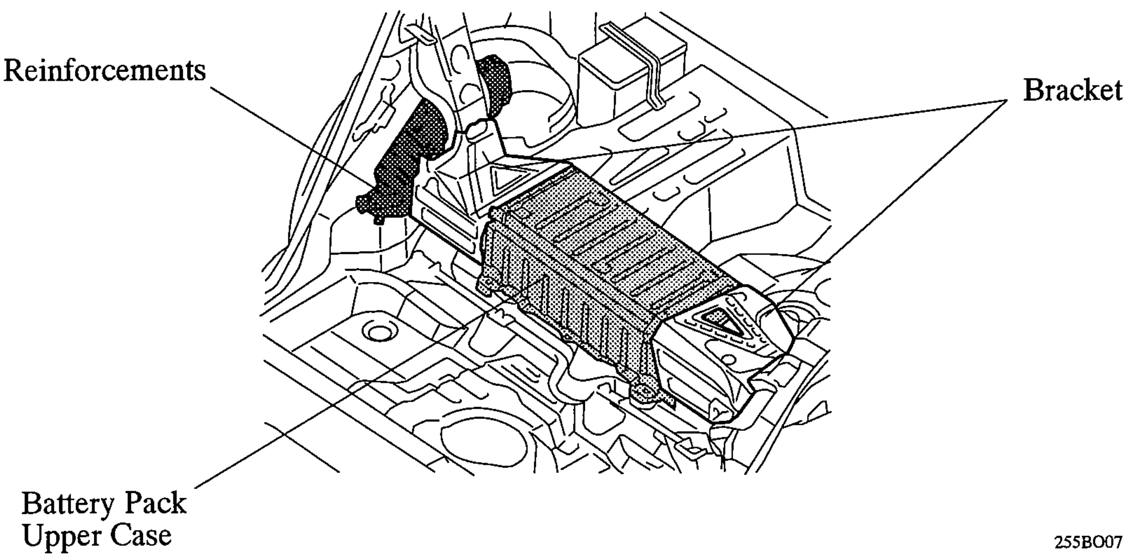
- The dash panel reinforcements join the cowl with the upper area of the floor tunnel, as well as the right and left front side members. This improves the rigidity of the cowl and restrains the vibration of the dash panel.



- Large reinforcements have been provided around the quarter window to achieve a construction that dissipates the force that is applied from the rear suspension tower, thus realizing a highly rigid body.



- Reinforcements have been provided around the rear wheel house. In addition, brackets to join this area to the upper battery case have been adopted in order to improve the torsional rigidity of the vehicle. As a result, the excellent driving stability has been realized.



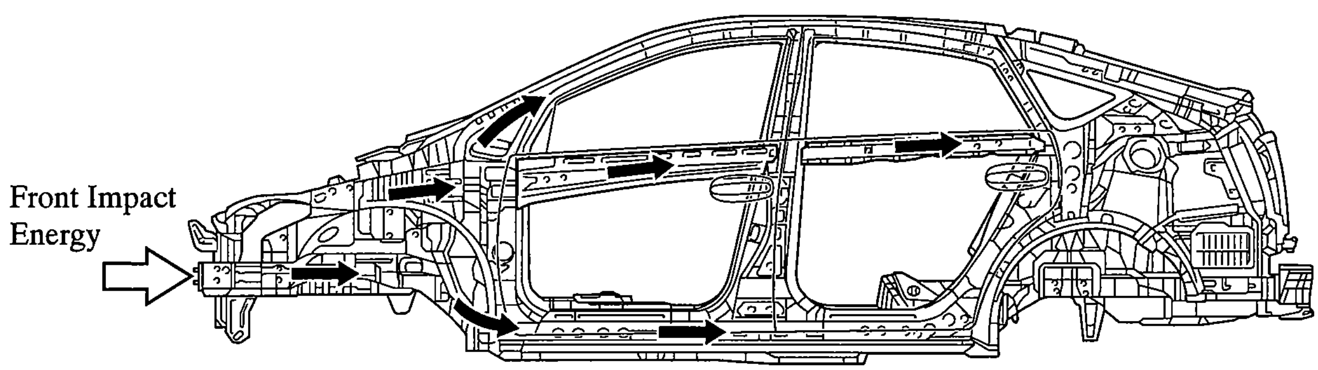
■ SAFETY FEATURES

1. General

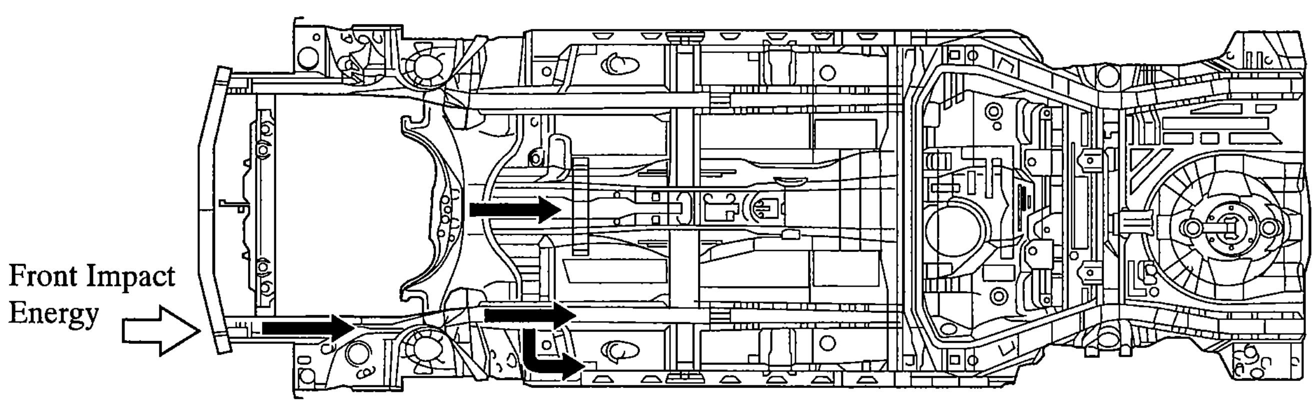
The impact absorbing structure of the '04 Prius can effectively help absorb the energy of impact in the event of a front or side collision. This structure also realizes high-performance occupant protection through the use of reinforcements and members that help minimize cabin deformation.

2. Impact Absorbing Structure for Frontal Collision

The front bumper reinforcements, under reinforcements, floor tunnel reinforcements, and the reinforcements on the rocker door belt line effectively dissipate the impacts applied by the front side reinforcements in order to minimize the deformation of the cabin during a collision.



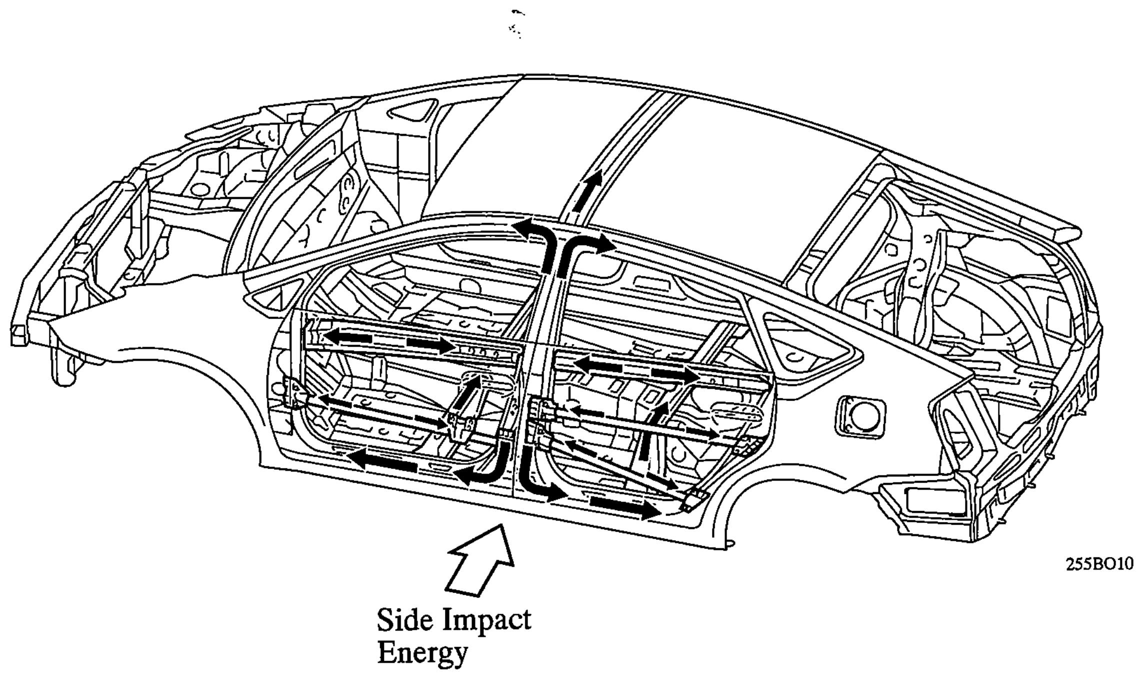
255BO08



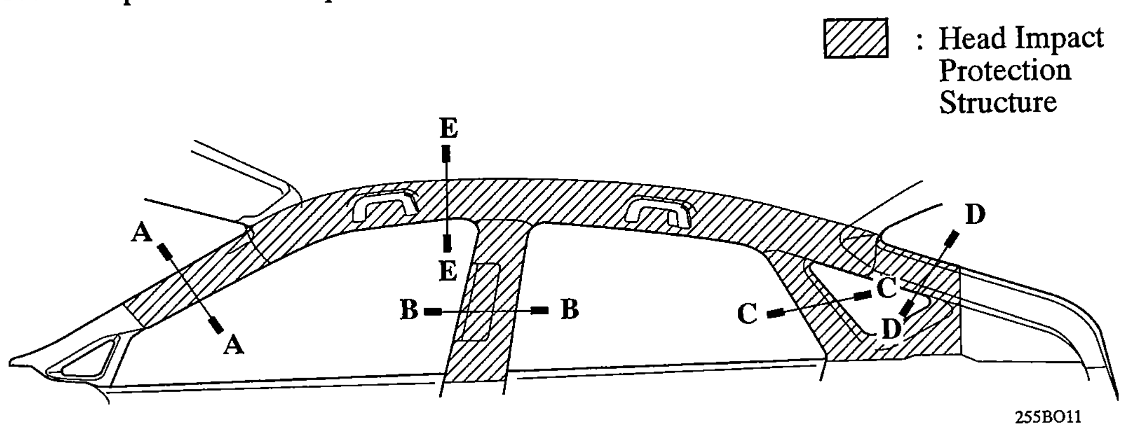
255BO09

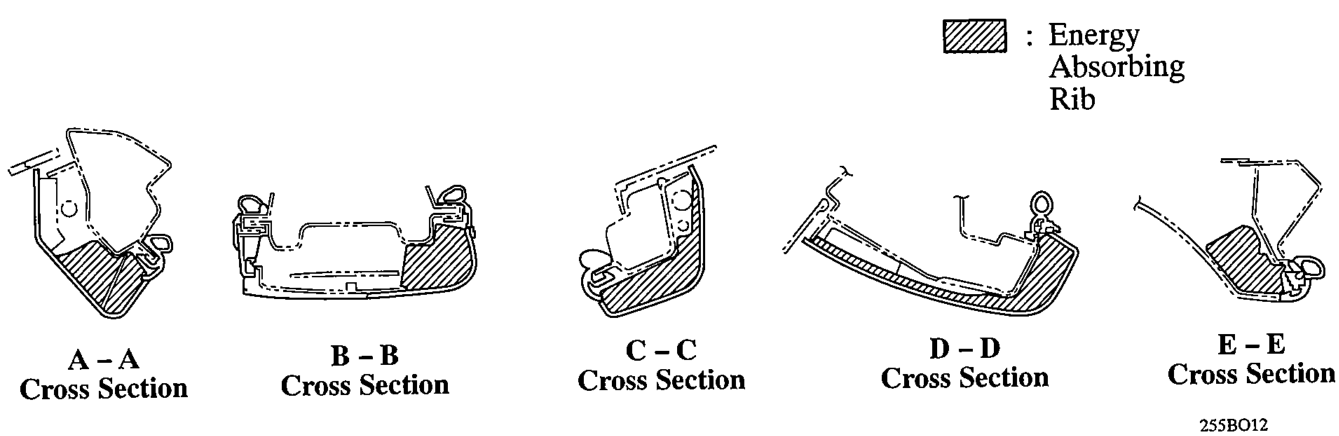
3. Impact Absorbing Structure for Side Collision

- Impact energy of a side collision directed to the cabin area is dispersed throughout the body via pillar reinforcements, side impact protection beams, and floor cross member.
- This dispersion of energy helps keep the energy directed to the cabin to minimum level. As a result, the deformation of the cabin is minimized.



- A Head Impact Protection Structure is used. With this type of construction, if the occupant's head hits against the roof side rail and pillar in reaction to a collision, the inner ribs of the roof side rail and pillar collapses to help reduce the impact.





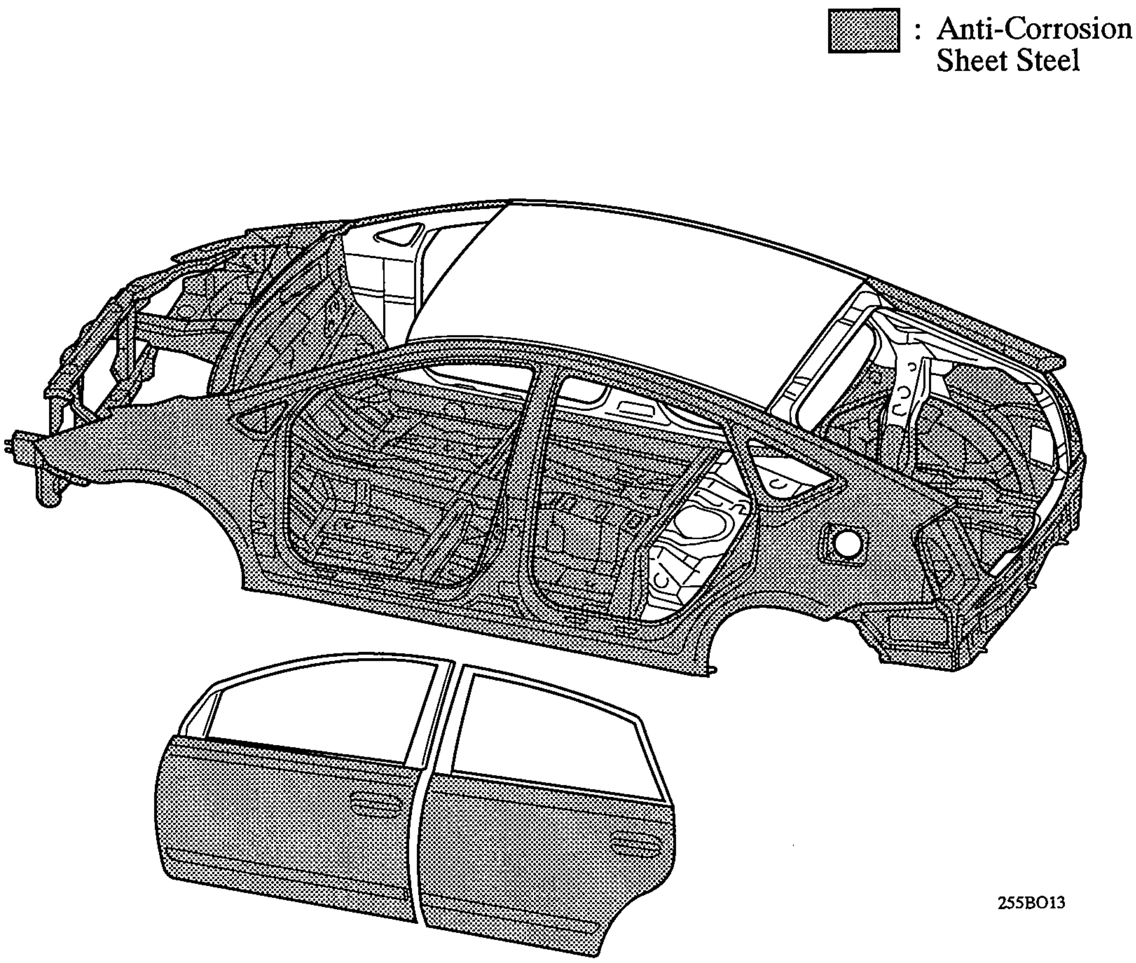
■ RUST-RESISTANT BODY

1. General

Rust-resistant performance is enhanced by extensive use of anti-corrosion sheet steel, as well as by an anti-corrosion treatment, which includes the application of anti-rust wax, sealer and anti-chipping paint to easily corroded parts such as the doors and rocker panëls.

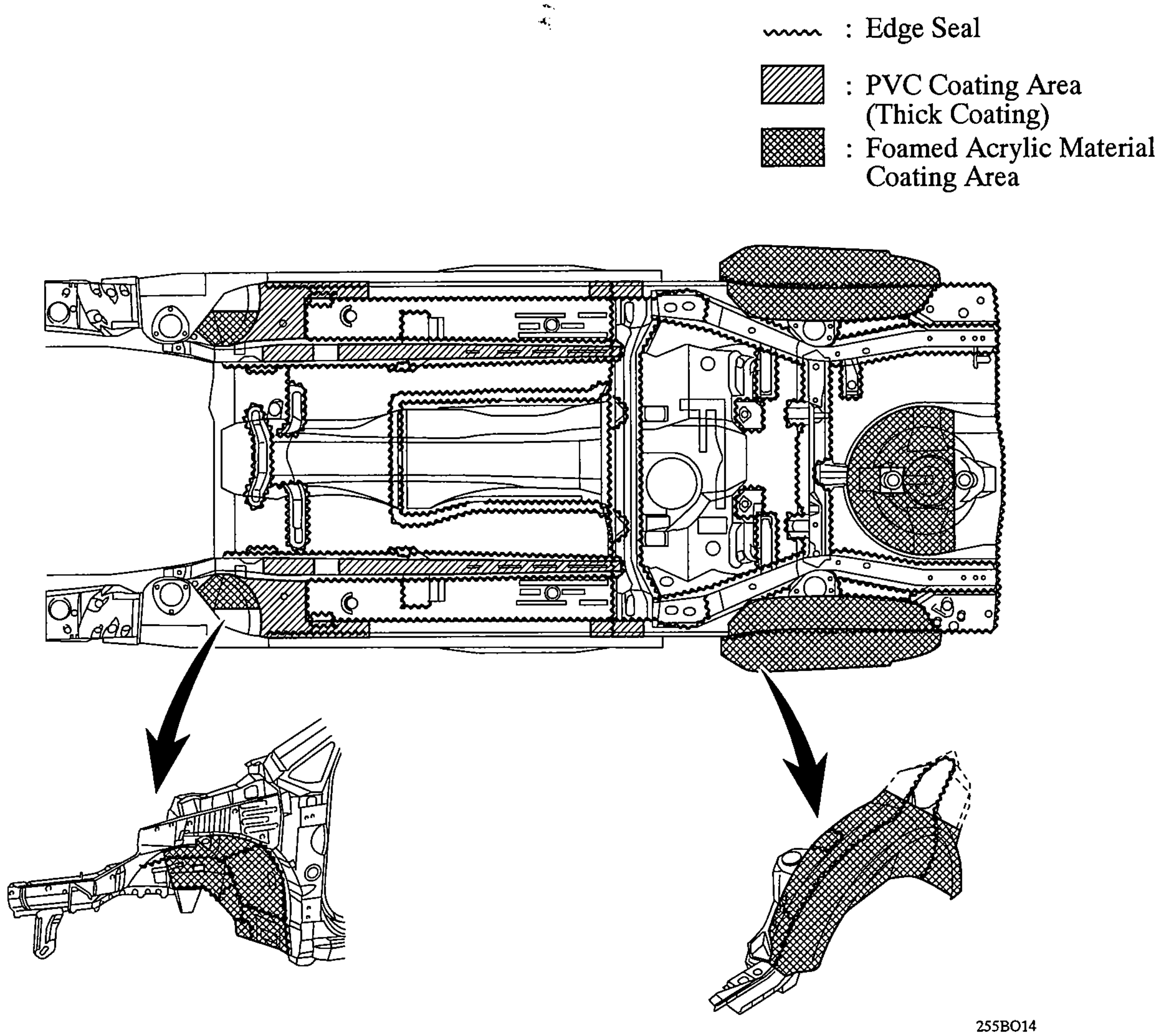
2. Anti-Corrosion Sheet Steel

Anti-corrosion sheet steel is used as the following illustration.



3. Under Coat

PVC (Polyvinyl Chloride) and foamed acrylic material are applied to the underside of the body and other parts that are susceptible to stone chipping damage in order to improve the rust-resistance performance of these areas.



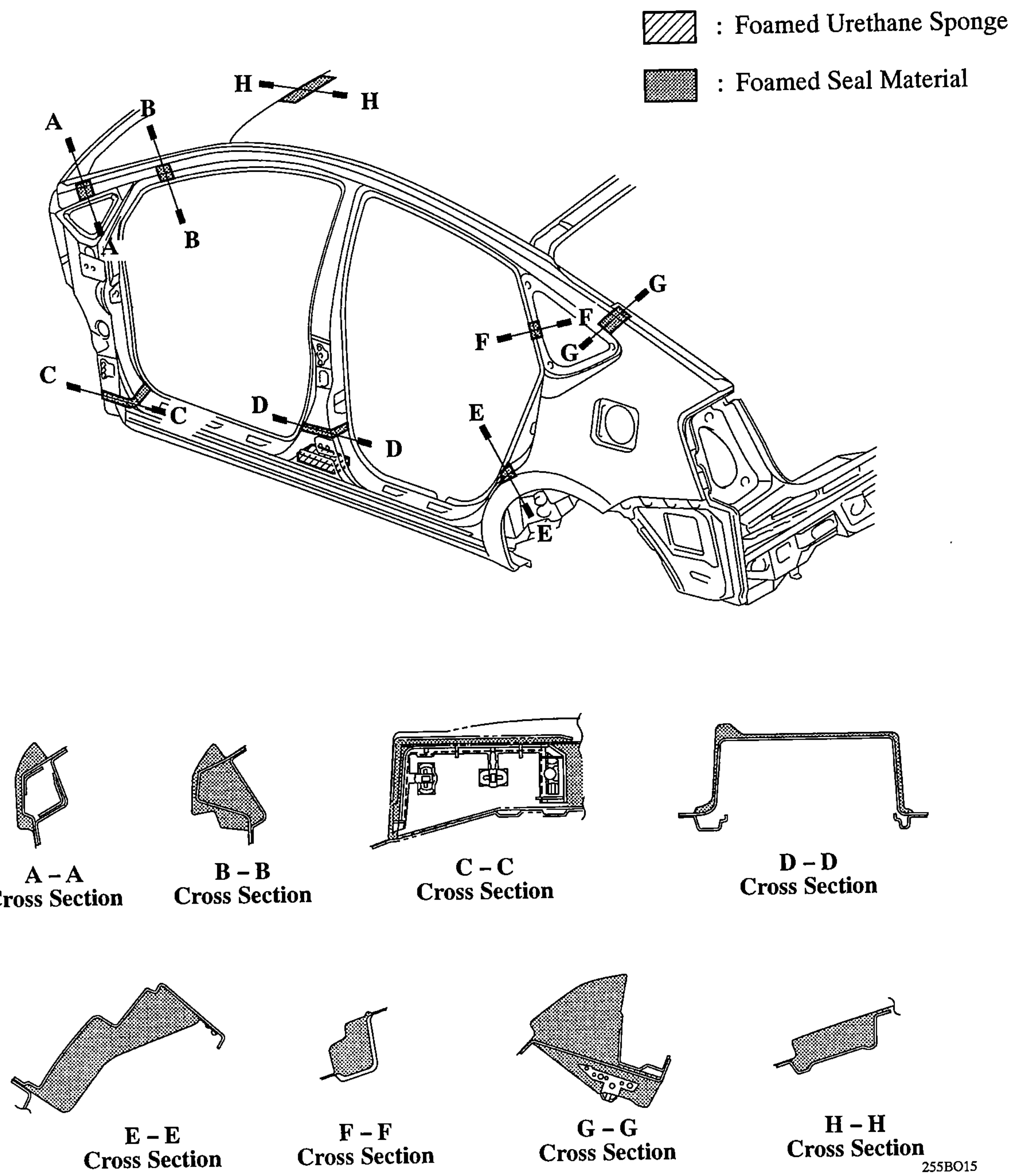
■ LOW VIBRATION AND LOW NOISE BODY

1. General

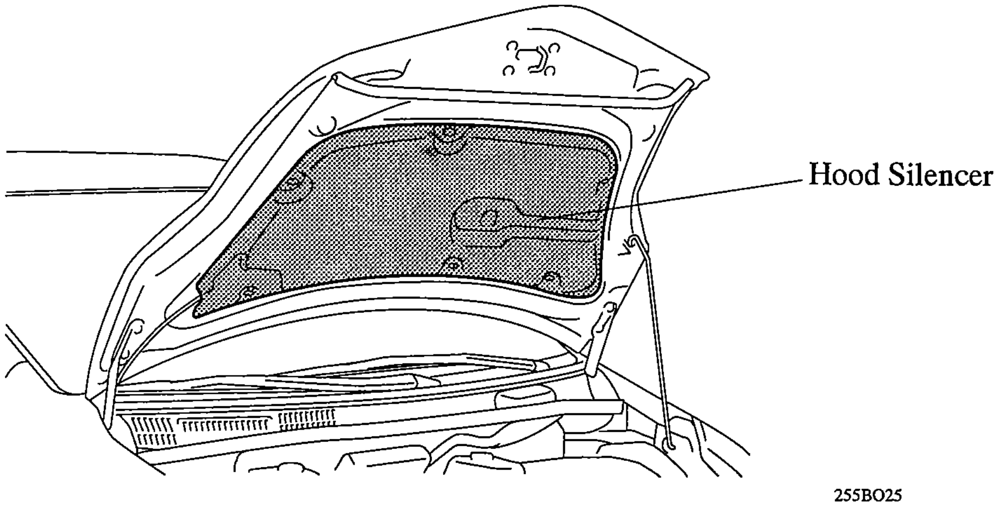
An effective application of vibration damping and noise suppressant materials reduces engine and road noise.

2. Sound Absorbing and Vibration Damping Materials

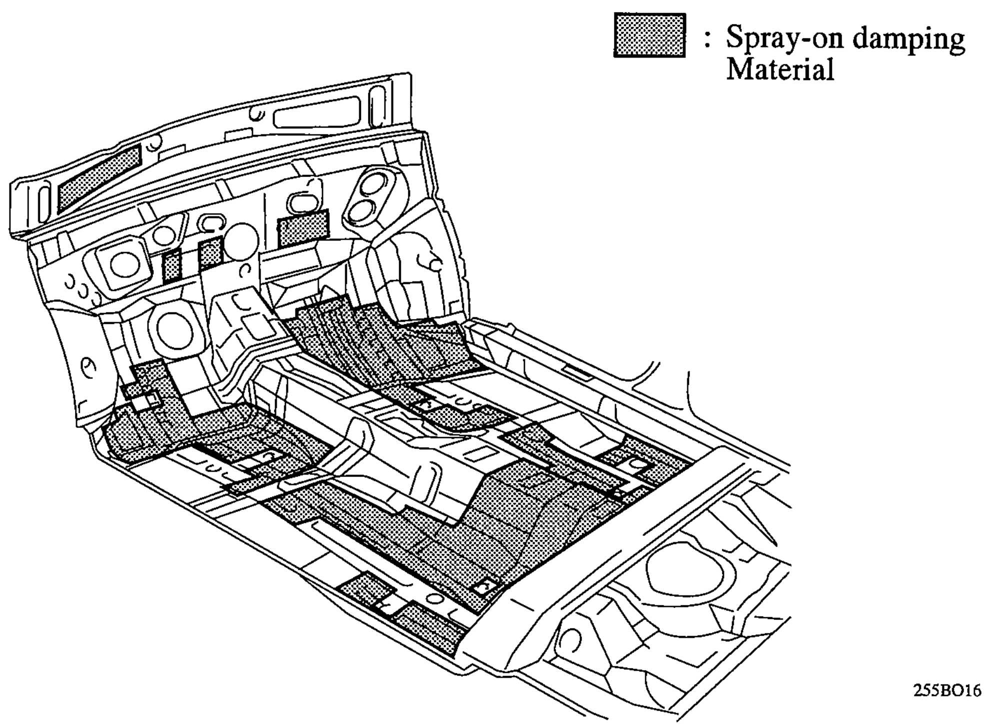
- Foamed urethane pad and foam material are applied onto the roof panel and pillars to reduce wind and road noise.



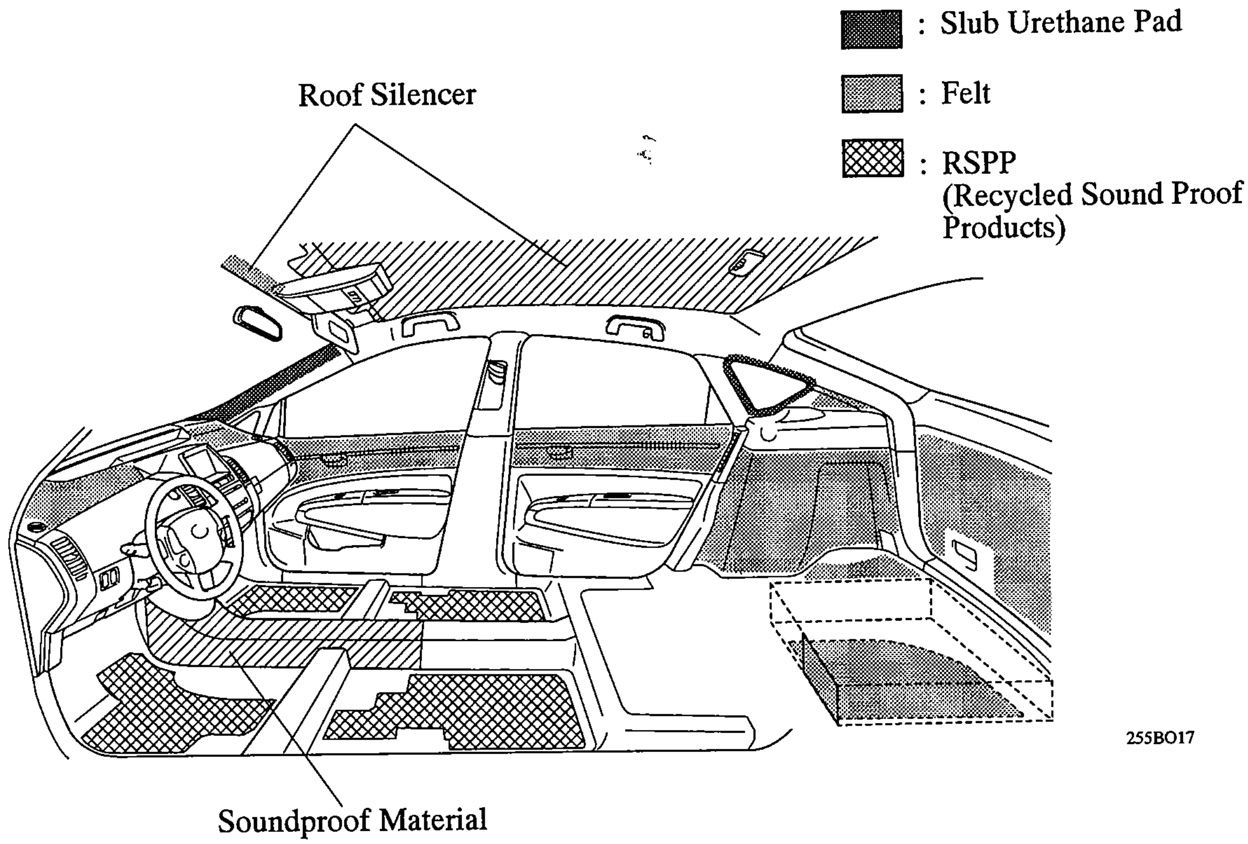
- The hood silencer has been provided to reduce the engine and the road noise.



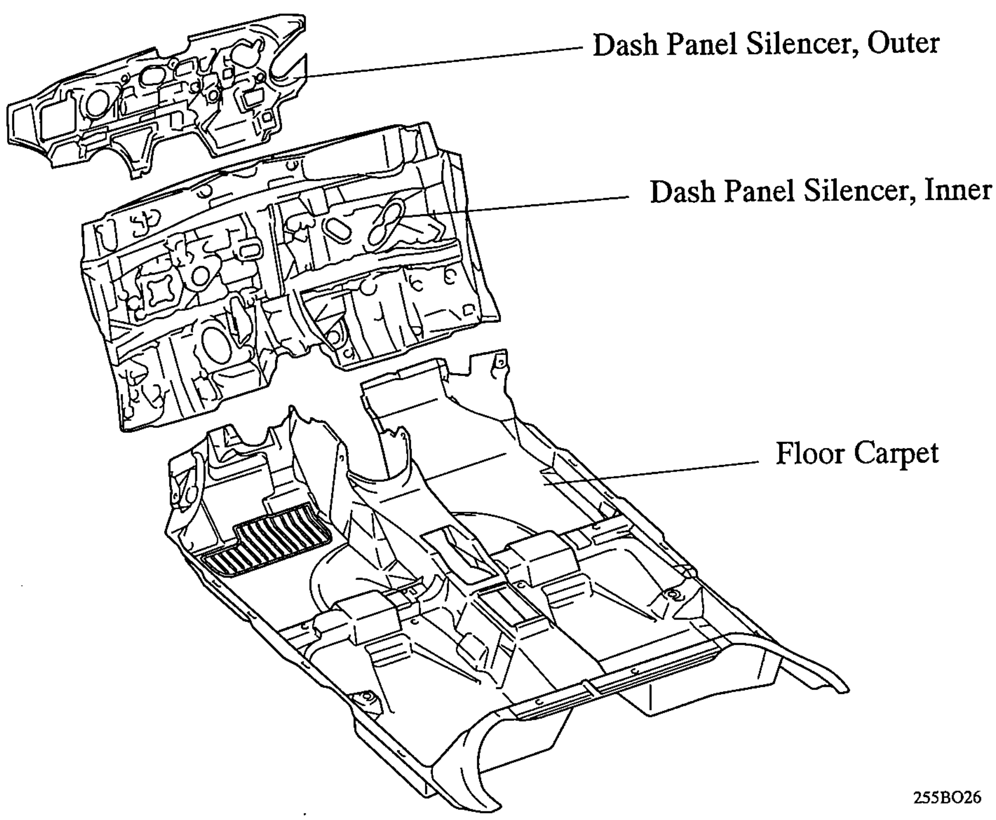
- In place of the asphalt sheet used on the '03 Prius, the '04 Prius has adopted a spray-on damping material that foams and adheres to the floor to reduce road noise.



- To ensure quietness in the cabin, materials that provide high sound absorption performance have been effectively allocated in the roof, front pillar, door trim, luggage room, and floor areas.



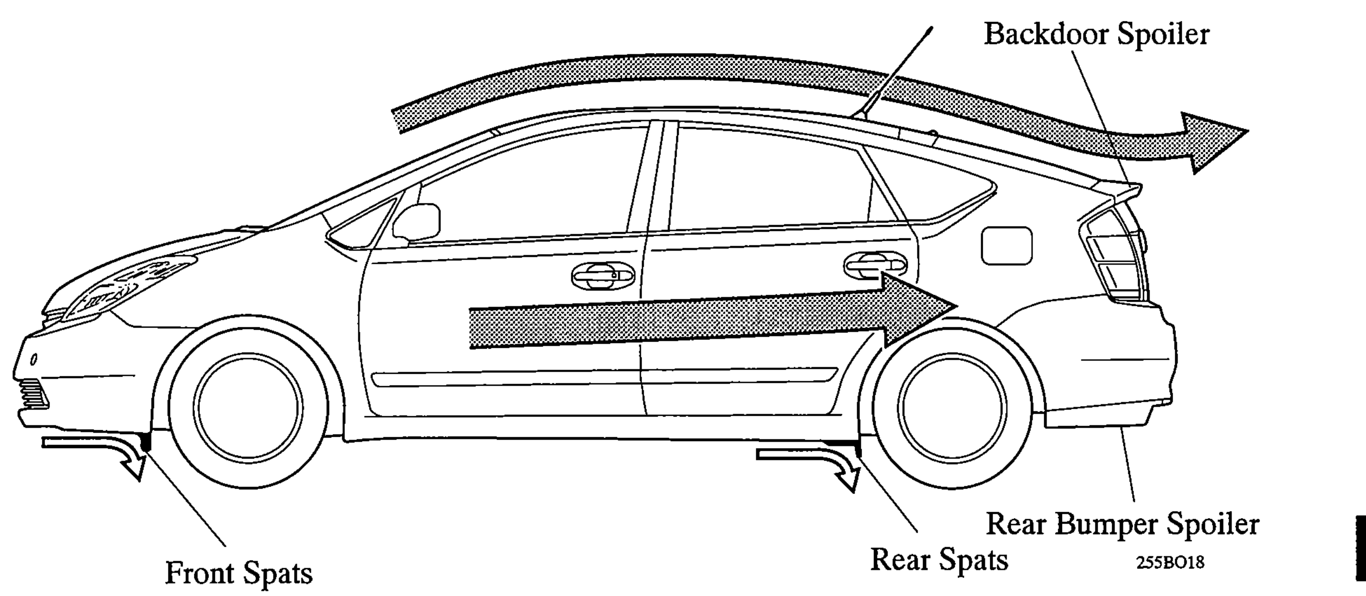
- The dash panel silencers and floor carpet have been provided on the sides of dash panel facing the cabin interior and exterior to reduce the engine and the road noise.
  In addition, felt has been provided in the floor, center tunnel, and rear upright surface areas of the floor carpet to realize a high level of sound insulation performance.

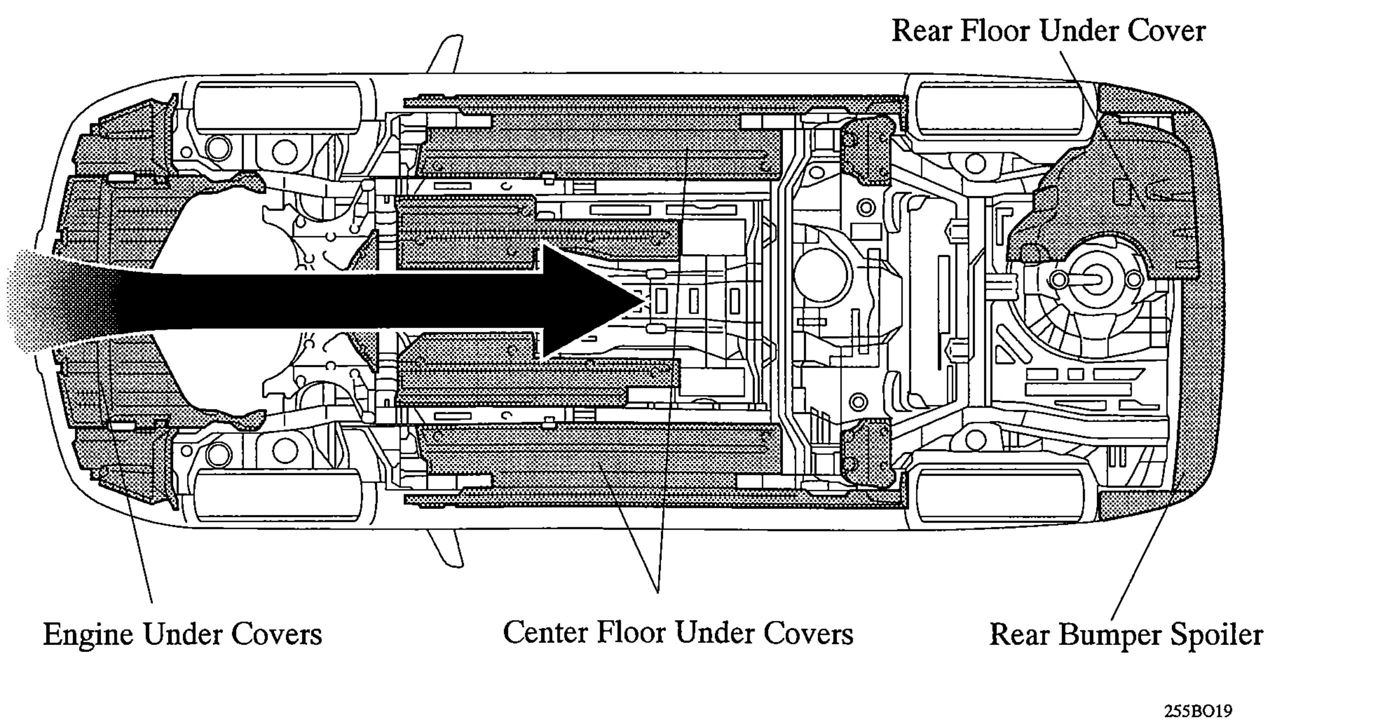


■ AERODYNAMICS

To improve aerodynamic performance, the following features have been taken. As a result, an aerodynamic resistance coefficient with a Cd value of 0.26 has been achieved.

- A rear spoiler that is integrated with the back door has been adopted.
- To aerodynamically regulate air after the rear tire, the bumper spoiler has been provided under the rear bumper.
- The engine under cover and front fender liner has been redesigned to the aerodynamically optimum shape.
- The spats and front spoiler are provided to smooth out the airflow around the tires and reduce the air resistance while the vehicle is in motion.



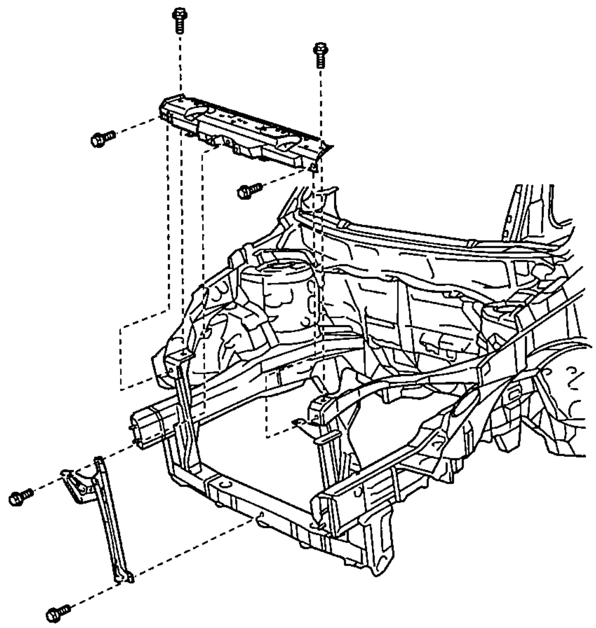


ENHANCEMENT OF PRODUCT APPEAL

■PARTS WITH LOW REPAIR COSTS

1. Radiator Support

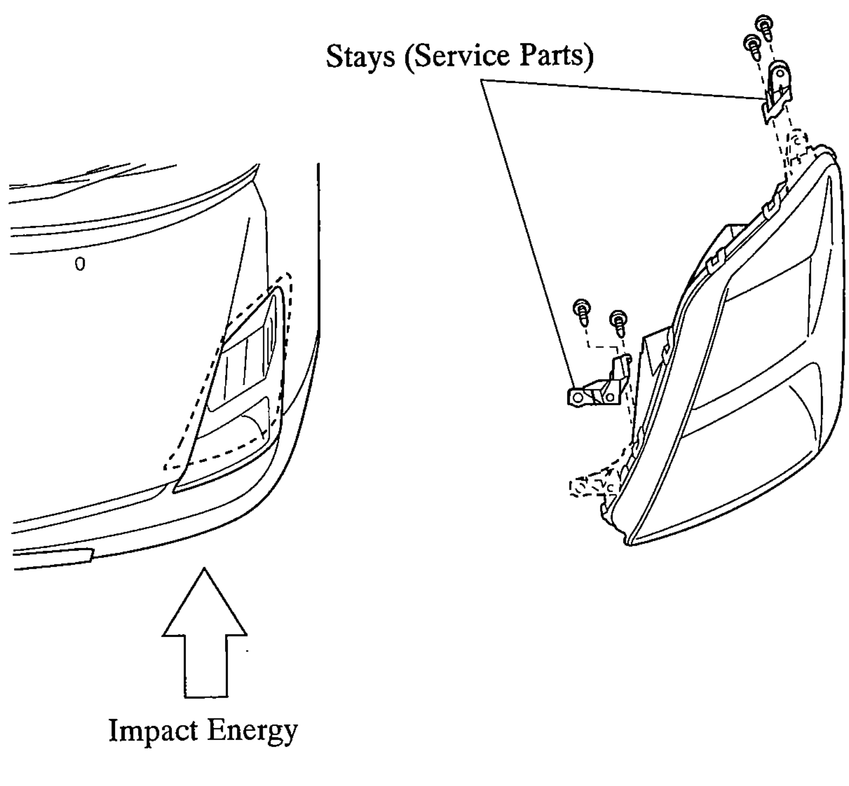
The radiator support and the center brace, which were previously welded, have been changed to the bolt-on type, in order to facilitate repair in case of damage.



255BO20

2. Headlight

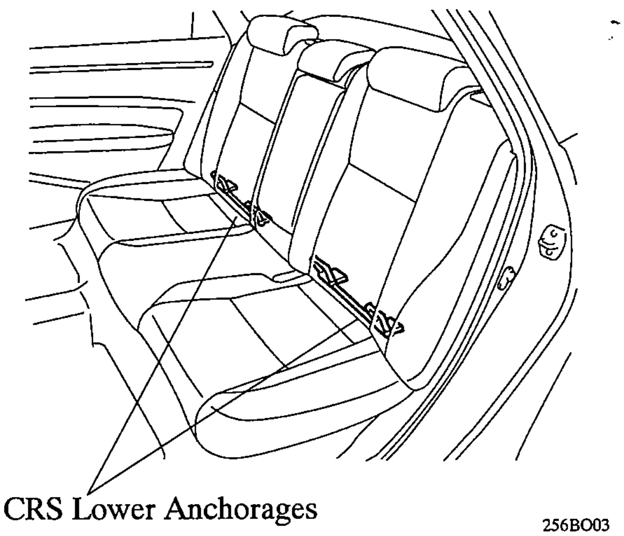
- Retaining stay for the headlights have been provided separately from the headlights housing to help protect them from severe damage in a minor collision.
- Retaining stays have been made available as service parts. The replacement stay is secured with the screws.
- The headlights housing can be reused replacing the damaged retaining stay with a new one.
- For details on the retaining stay replacement, refer to the 2004 Prius Repair Manual (Pub.No.RM1075U).



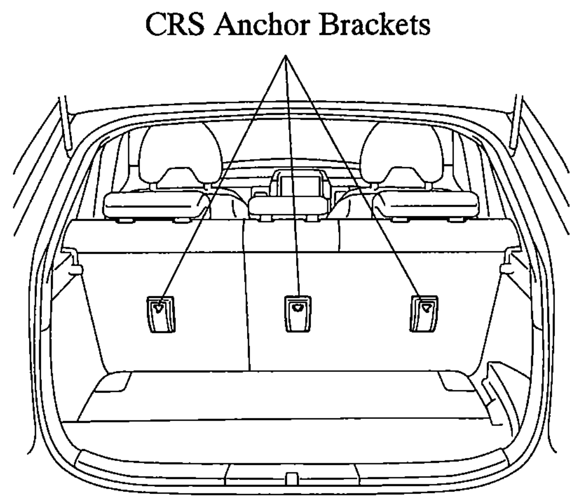
255BO21

■ REAR SEAT

CRS (Child Restrain System) lower anchorage for securing child seats has been provided behind the seat cushion of the rear seat.
Three CRS anchor bracket for securing a child seat have been provided behind the rear seat backrest.



256BO03



256BO05

■ SEAT BELT

1. General

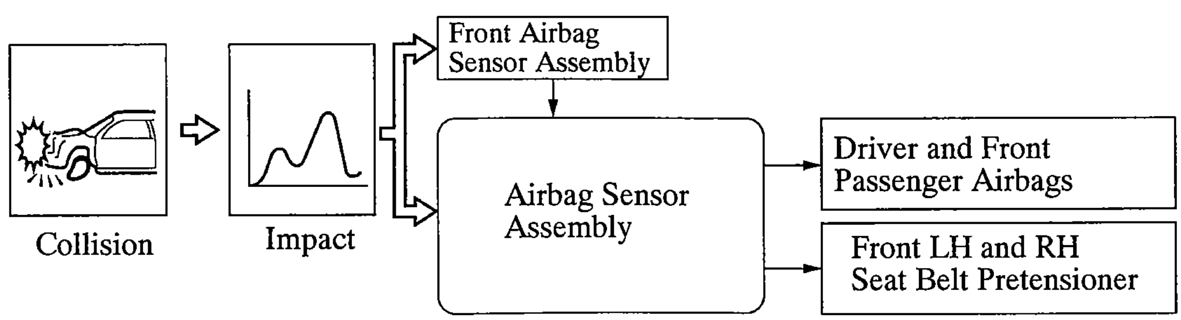
Seat belts are provided with the function listed below:

Seat	Seat Belt Type	Remarks
Driver	3-point ELR*1	Electrical Sensing type Pretensioner & Force Limiter
Front Passenger	3-point ELR*1 & ALR*2	
Rear Passenger	3-point ELR*1 & ALR*2	—

*1: Emergency Locking Retractor
*2: Automatic Locking Retractor

2. Pretensioner and Force Limiter

In accordance with the ignition signal from the airbag sensor assembly, the seat belt pretensioner activates simultaneously with the deployment of SRS airbag for the driver and front passenger.
In the beginning of the collision if the tension of the seat belt applied to the occupant reaches a predetermined level, the force limiter activates to control the force.



255BO24

BODY ELECTRICAL

BODY ELECTRICAL

PUSH BUTTON START SYSTEM

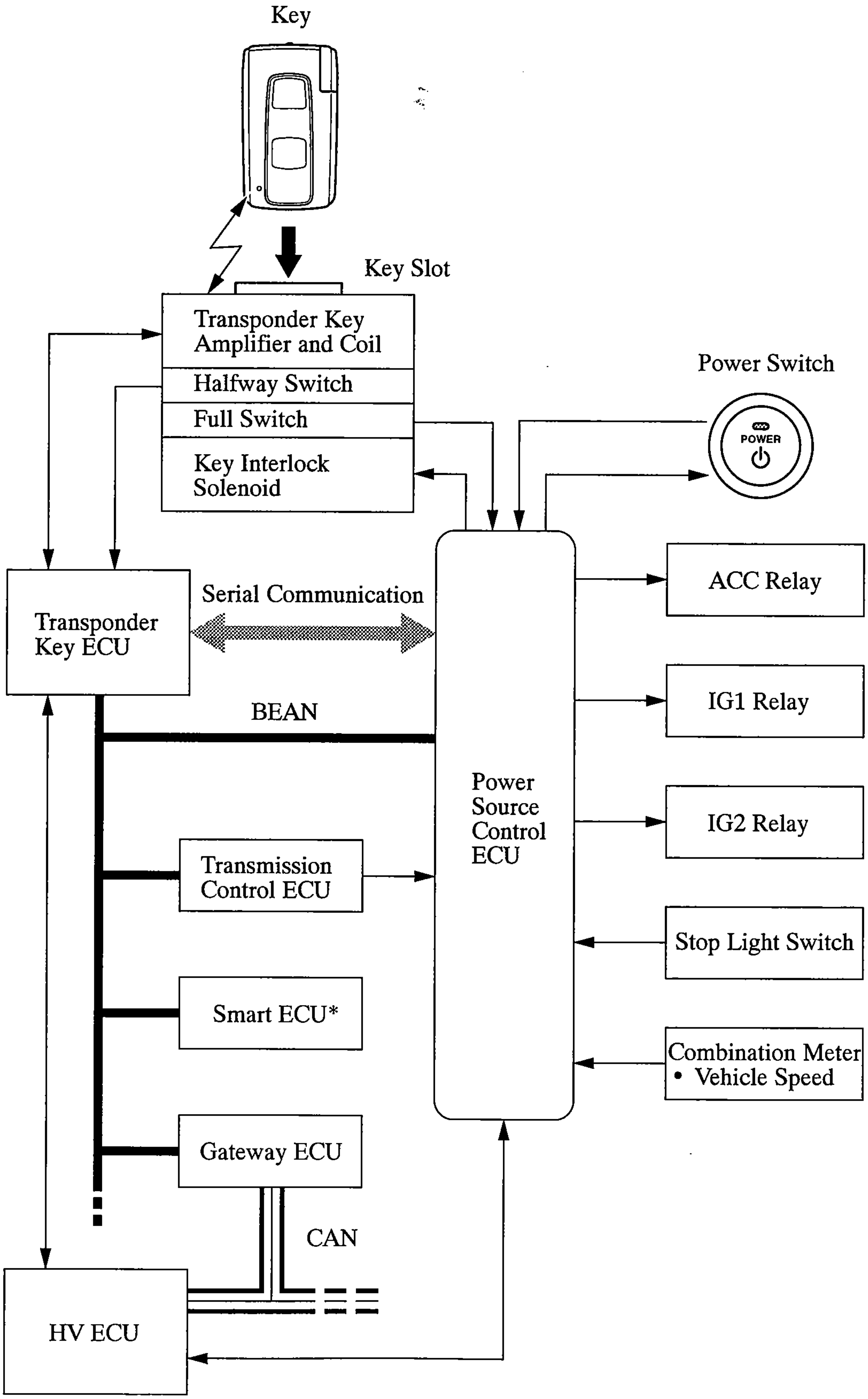
■ DESCRIPTION

- On the previous models, the driver inserted an ignition key into the key cylinder (containing an ignition switch) in order to switch on the power of the vehicle and start the system. On the '04 Prius, however, this has been replaced by a push-type power switch, which the driver operates by inserting a key in the key slot or by merely keeping the key in the driver's possession*. This improves the ease of switching on the power and starting the hybrid system.
- This system is standard equipment on all models.
- This system consists primarily of an power source control ECU, power switch, key slot, key, ACC relay, IG1 relay, IG2 relay, and transponder key ECU. The power source control ECU controls the system.
- The push button start system operates in cooperation with the HV immobilizer system and the smart entry & start system*.
- The table below shows the transition of the power modes that is accomplished through the operation of the power switch, which depends on whether the brake pedal is pressed or released.

Brake Pedal	Power Switch Operation
Released	The power switches OFF → ACC → IG-ON → OFF, each time the power switch is pressed.
Pressed	The power switches to READY from any power mode.

*: Models with Smart Entry & Start System

▶ System Diagram ◀



*: Models with Smart Entry and Start System

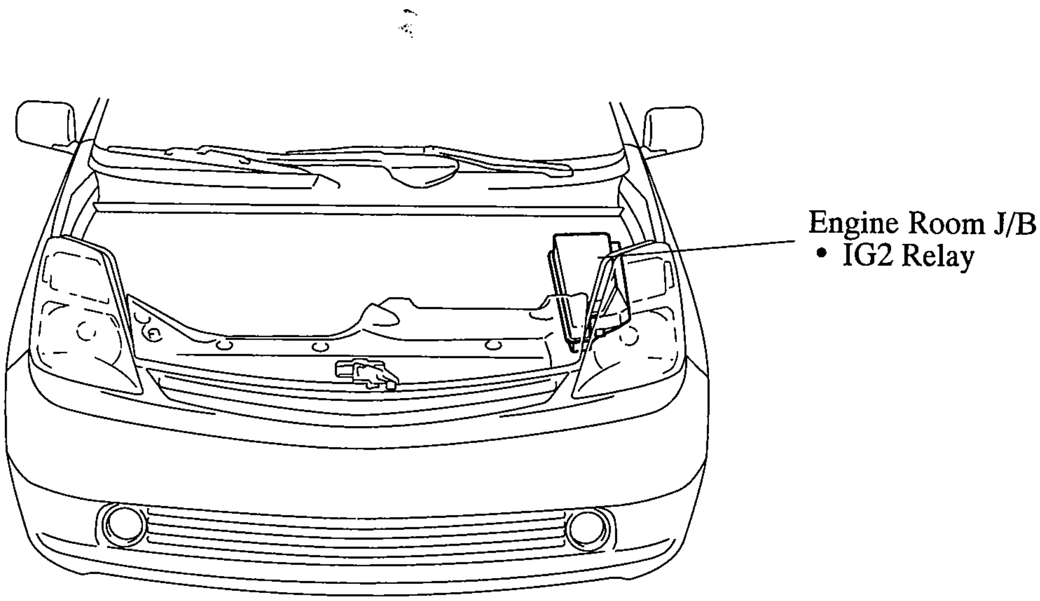
255BE60

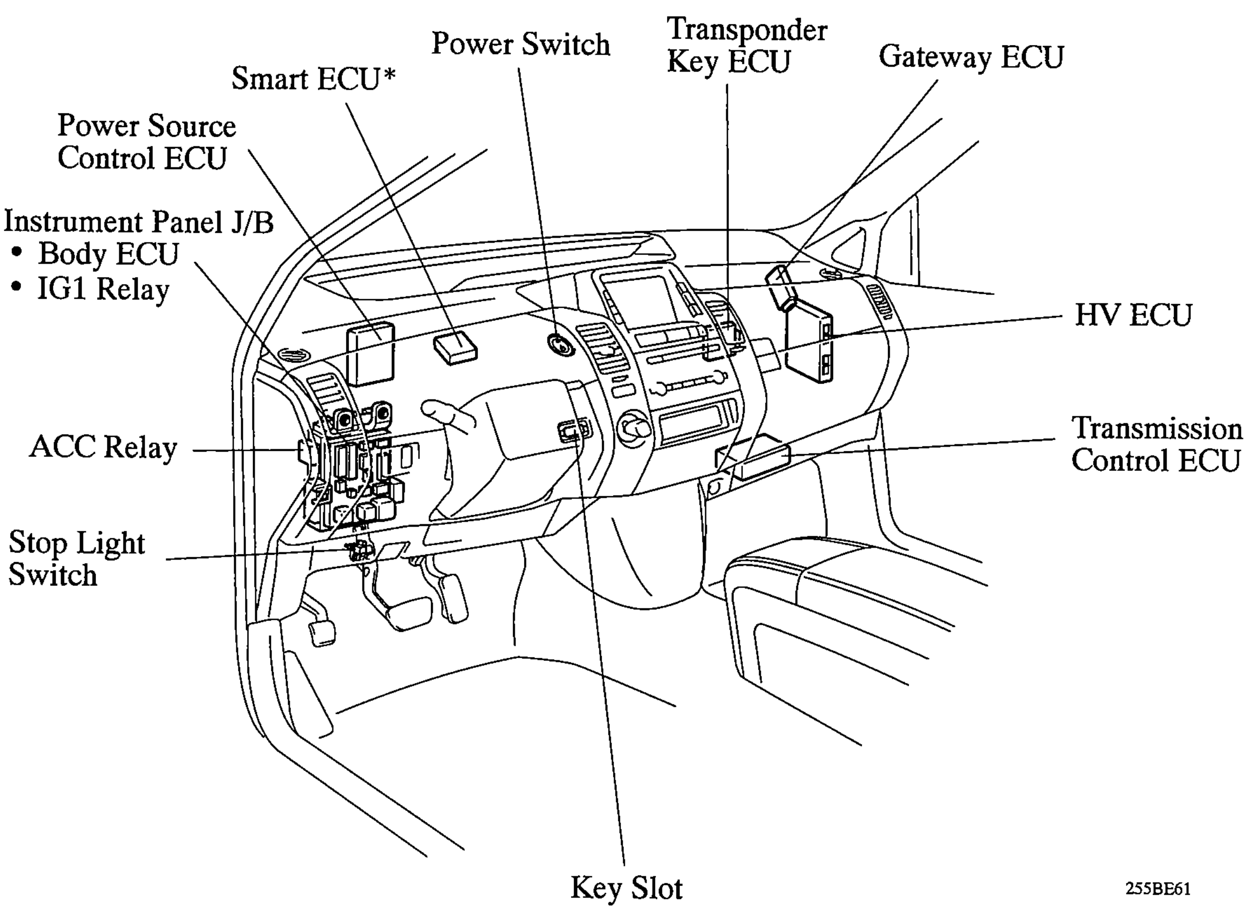
■ MAJOR DIFFERENCE

The major difference between push button start system and conventional ignition key type are the following.

Item	'04 Prius Push Button Start System	'03 Prius Conventional Ignition Key Type
Ignition Key	A key with a built-in transponder chip for the HV immobilizer system.	A mechanical key with a built-in transponder chip for the HV immobilizer system.
Key Cylinder	Key Slot	Ignition Key Cylinder
	An electric key interlock mechanism that operates in accordance with the mode of the power switch and the shift position.	An electronic key interlock mechanism that operates in accordance with the shift position.
	Two position switches for detecting whether a key is inserted.	A key unlock warning switch that detects whether the ignition key is inserted.
	Transponder key amplifier and coil	←
Power Relay Control	The power source control ECU controls the IG1, IG2, and ACC relays in accordance with the mode of the power switch and the shift position.	A contact point type ignition switch that operates in unison with the movement of the key cylinder controls IG1, IG2, and ACC relay.
Security	Restricts the operation of the power switch (OFF to ACC, IG-ON, or READY) unless the transponder key ECU recognizes the ID code of the key.	Restricts the starting of the system (READY) unless the transponder key ECU recognizes the ID code of the key.
	Restricts the unlocking of the parking lock (for shifting to a position other than P) unless the transponder key ECU recognizes the ID code of the key.	A steering lock mechanism mechanically restricts the movement of the steering in unison with the movement of the key cylinder.
Power Mode Check	Checks the power mode in accordance with the illuminating state of the indicator light on the power switch and the illuminating state of the READY light in the combination meter.	Checks the power mode in accordance with the position of the ignition key and the illuminating state of the READY light in the combination meter.

■ LAYOUT OF MAIN COMPONENTS





*: Optional Equipment

■FUNCTION OF MAIN COMPONENTS

Components		Function
Key		When the driver inserts a key into the key slot, the built-in transponder chip transmits an ID code signal to the transponder key amplifier, which is provided in the key slot.
		• On a model with the smart entry & start system, if the driver operates the power switch while the driver has a key in his/her possession, the key receives the signals from the oscillators and responds with an ID code to the wireless door lock receiver. • For details on the smart entry & start system, see page BE-22.
Key Slot	Halfway Switch	Detects whether the key is inserted and outputs a signal to the transponder key ECU.
	Full Switch	Detects whether the key is inserted and outputs a signal to the power source control ECU.
	Transponder Key Amplifier and Coil	Receives the ID code signal from the transponder chip, which is built into the key, and outputs it to the transponder key ECU.
	Key Interlock Solenoid	The power source control ECU operates this solenoid in accordance with the power switch mode and the shift position, in order to keep the key locked in the key slot.
Power Switch		• Switches the power modes in four stages (OFF, ACC, IG-ON, and READY) in accordance with the shift position and the state of the stoplight switch. • The power mode or the abnormal condition of the push button start system can be discerned from the illumination state of the indicator light on the switch.
IG1 Relay		Operates in accordance with the power source control ECU in order to supply power to the respective system.
IG2 Relay		
ACC Relay		
Stop Light Switch		Outputs the state of the brake pedal to the power source control ECU.
Shift Control Actuator		• Operates in accordance with the signals from the transmission control ECU in order to actuate the parking lock mechanism. • Detects the actuation state of the parking lock (whether the shift position is in the P position or some other position) and outputs it to the transmission control ECU. • For details on the construction and operation of the shift control actuator, see the P112 Hybrid Transaxle Section on page CH-14.
Power Source Control ECU		Controls the push button start system in accordance with the signals received from the switches and ECUs.
Transponder Key ECU		• Controls the HV immobilizer system by recognizing the key ID code transmitted by the transponder key amplifier. • Receives the results of the ID code check from the smart ECU*. • Transmits the results of the key ID code check to the power source control ECU. • Transmits an HV system start authorization signal to the HV ECU.
Transmission Control ECU		• Actuates the shift control actuator upon receiving a power switch OFF signal from the power source control ECU. • Transmits the actuation state of the parking lock (whether the shift position is in the P position or some other position) to the power source control ECU.
HV ECU		• Starts the hybrid system in accordance with the system start signal received from the power source control ECU. • Receives the hybrid system start authorization signal from the transponder key ECU.
Smart ECU*		Checks the ID code received from the wireless door lock receiver and transmits the check results to the transponder key ECU.

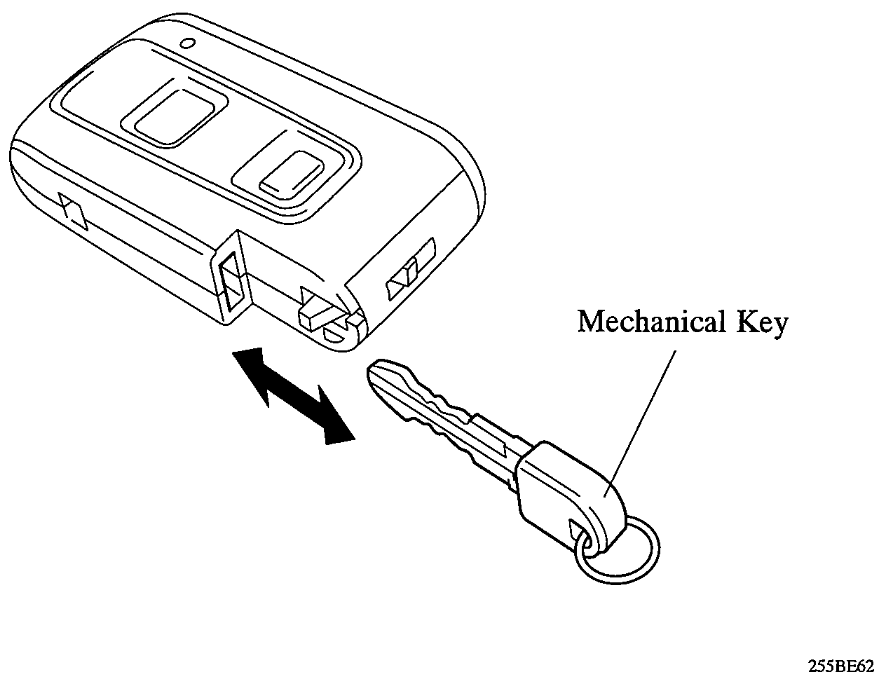
*: Models with smart entry & start system

■ CONSTRUCTION AND OPERATION

1. Key

- The key performs the function of the ignition key in a conventional system. Unless the transponder key ECU or the smart ECU* recognizes the ID code of the key, the switching of the power modes, the starting of the hybrid system, or the unlocking of the parking lock (to operate the shift lever) through the use of the power switch will not be authorized.
- The key transmits the ID code of the key to the transponder key ECU when the key is inserted in the key slot.
- On the model with smart entry & start system, the key transmits the ID code of the key to the smart ECU when the power switch is operated while the key is in the driver's possession.
- A mechanical key, which can be used in the event of an emergency due to a failure in the wireless door lock remote control system (due to a depleted transmitted battery, for example), is also provided. The mechanical key can be used to unlock the driver's door lock in case the wireless door lock remote control system is inoperative.

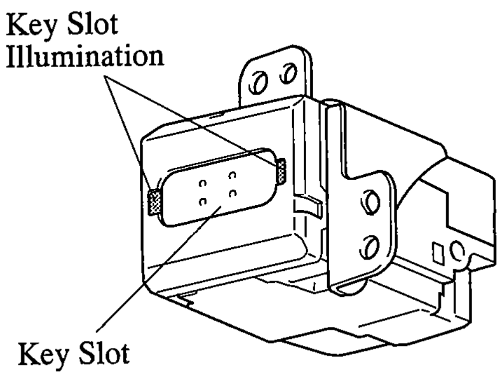
*: Models with Smart Entry & Start System



2. Key Slot

General

- The key slot consists of a transponder key coil, transponder key amplifier, LEDs for key slot illumination, halfway switch, full switch, and key interlock solenoid.
- The halfway switch, which is used by the system to detect the inserting state of the key, is wired to the transponder key ECU and the body ECU. The transponder key ECU and the body ECU use the signal from the halfway switch in order to check the key ID code and control the body electrical system.
- As with the halfway switch, the full switch is also used by the system to detect the inserting state of the key. This switch is wired to the power source control ECU. The power source control ECU controls the push button start system in accordance with the signals from this switch.



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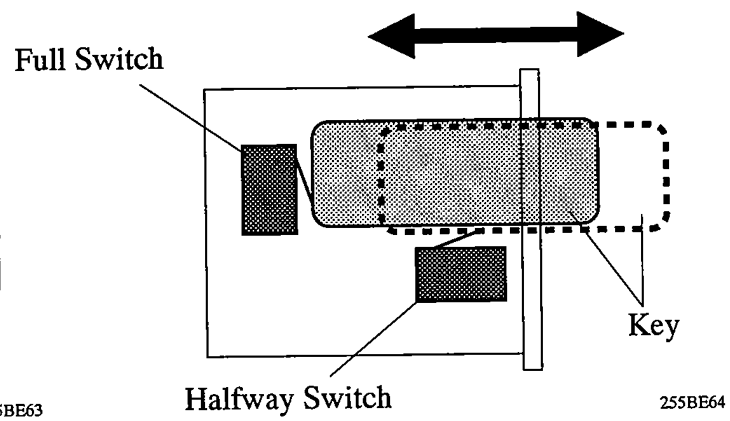

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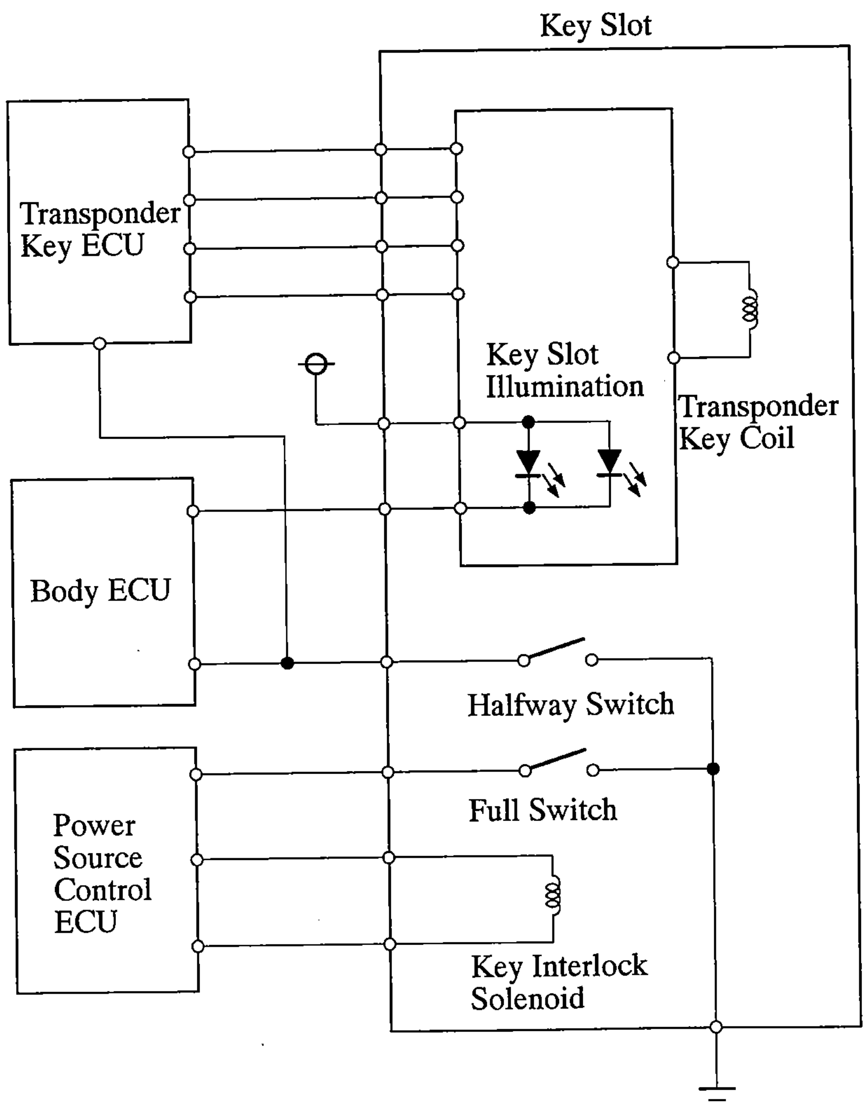

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CAUTION

Do not put fingers into the key slot. Fingers might be injured.

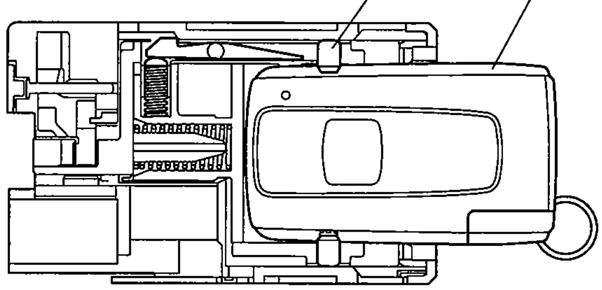
NOTICE

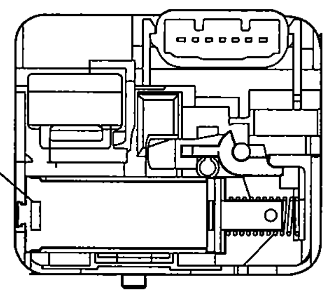
Observe the following instructions, or the key mechanism might be damaged and will not work properly.

- The key should be operated with a clean hand and fingers.
- Do not insert the key forcefully.
- Do not insert any key other than genuine formal keys into the key slot.
- Do not pull out the key forcefully when it cannot be removed.
- Do not put water, oil, foreign objects, etc. into the key slot.
- Do not insert a wet, oily or damaged key into the key slot.
- Do not stick a seal on the key.
- Do not insert the key in the wrong way.
- Do not pull out the key ring when removing the key out of the key slot.

Key Interlock Solenoid

- The power source control ECU actuates the key interlock solenoid in accordance with the power mode and the shift position (whether the shift lever is in the P position or some other position), in order to lock the key in the key slot and prevent it from being pulled out.
- The actuation of the key interlock solenoid causes the pin, which was engaged in the key locking hole on the side of the key, to lock. As a result, the key becomes locked in the key slot.





Backside Cross Section

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▶ Key Interlock Solenoid Condition ◀

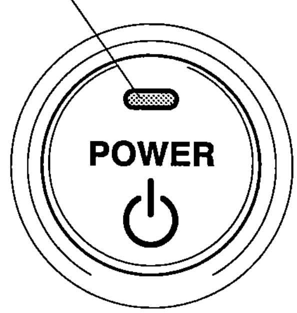
Shift Position	Power Switch Condition			
	OFF	ACC	IG-ON	READY
P Range	OFF	OFF	ON	ON
Except P Range	—	ON	ON	ON

3. Power Switch

- Power switch is the momentary type switch.
- The power modes change in three stages (OFF → ACC → IG-ON → OFF) each time the power switch is pressed. If the driver presses on the power switch while pressing on the brake pedal (which causes the stoplight switch to turn ON), the power mode will change to READY regardless of the previous power mode. For details on the power switch operation, see page BE-15.
- The power switch is provided with an indicator light. Thus, the driver can check the present power mode in accordance with the illumination state of the indicator light.

▶ Indicator Light Condition ◀

Power Switch	Indicator Light
OFF	OFF
ACC	ON (Green)
IG-ON	ON (Amber)
READY	OFF
Push Button Start System Malfunction	Blink (Amber)



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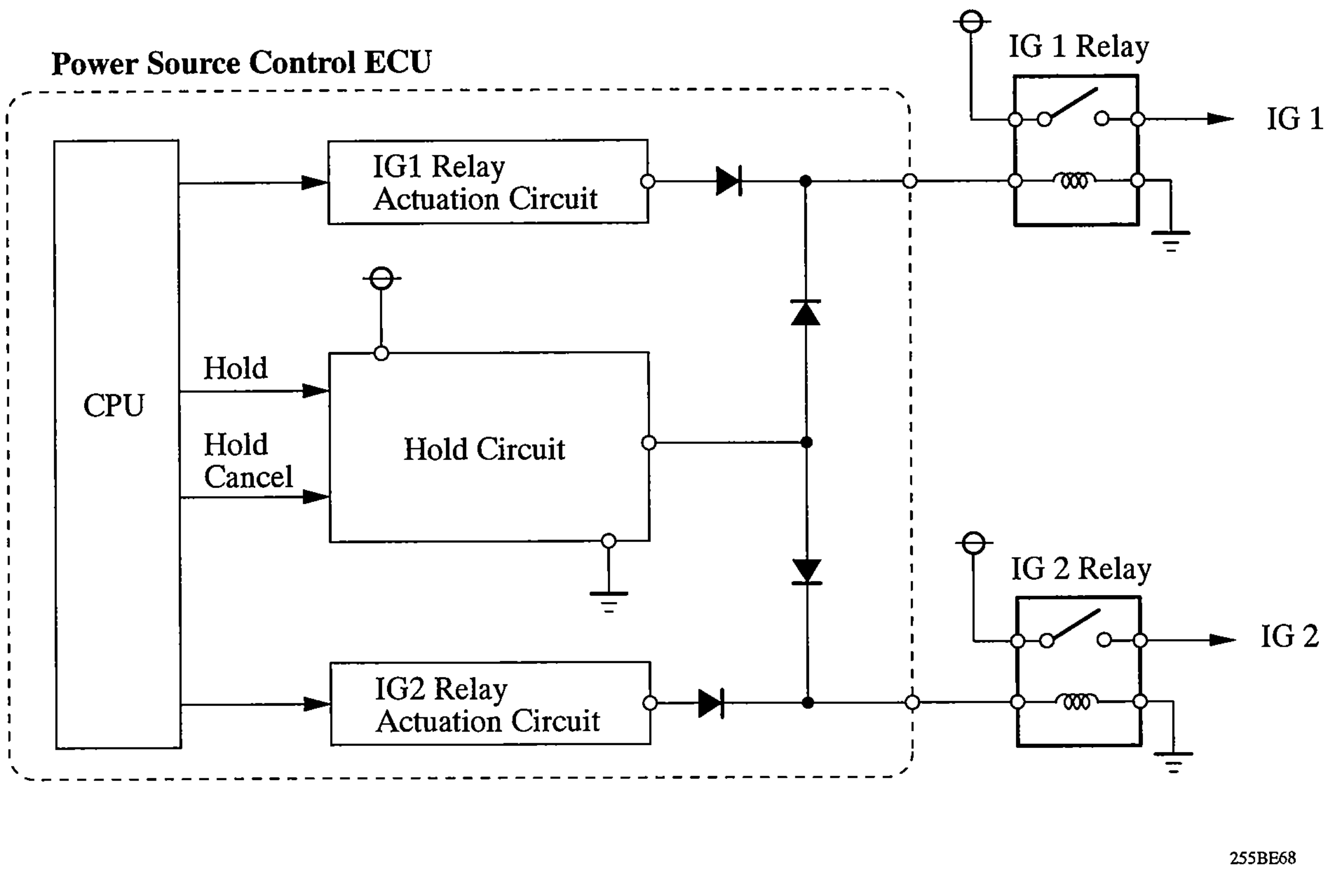
4. Power Source Control ECU

- Power source control ECU controls the push button start system in accordance with the signals received from the switches and ECUs.
- The power source control ECU maintains communication with the transponder key ECU, transmission control ECU, and the smart ECU* via the BEAN (Body Electronics Area Network). In addition, it has a dedicated serial communication line for independently maintaining communication with the transponder key ECU.
- The power source control ECU is provided with a hold circuit that maintains the actuation of the IG1 and IG2 relays in the event of a failure in the IG1 and IG2 relay actuation circuits. This prevents the power from being cut off if the IG1 and IG2 relay actuation circuits fail while the vehicle is being driven.

*: Models with Smart Entry & Start System

▶ Hold Circuit ◀



Service Tip

The power source control ECU constantly stores the present power mode in its memory. Therefore, if the power to the power source control ECU is interrupted due to the removal of the auxiliary battery, the power source control ECU restores the power mode after the auxiliary battery is reconnected.
For this reason, if the auxiliary battery is removed when the power switch mode is other than OFF, the power will be restored to the vehicle at the same time the power is restored to the power source control ECU (by reconnecting the auxiliary battery).
Therefore, before removing the auxiliary battery, make sure to turn the power switch OFF and remove the key from the key slot.

■ SYSTEM OPERATION

1. General

The electronic control of the push button start system has following control.

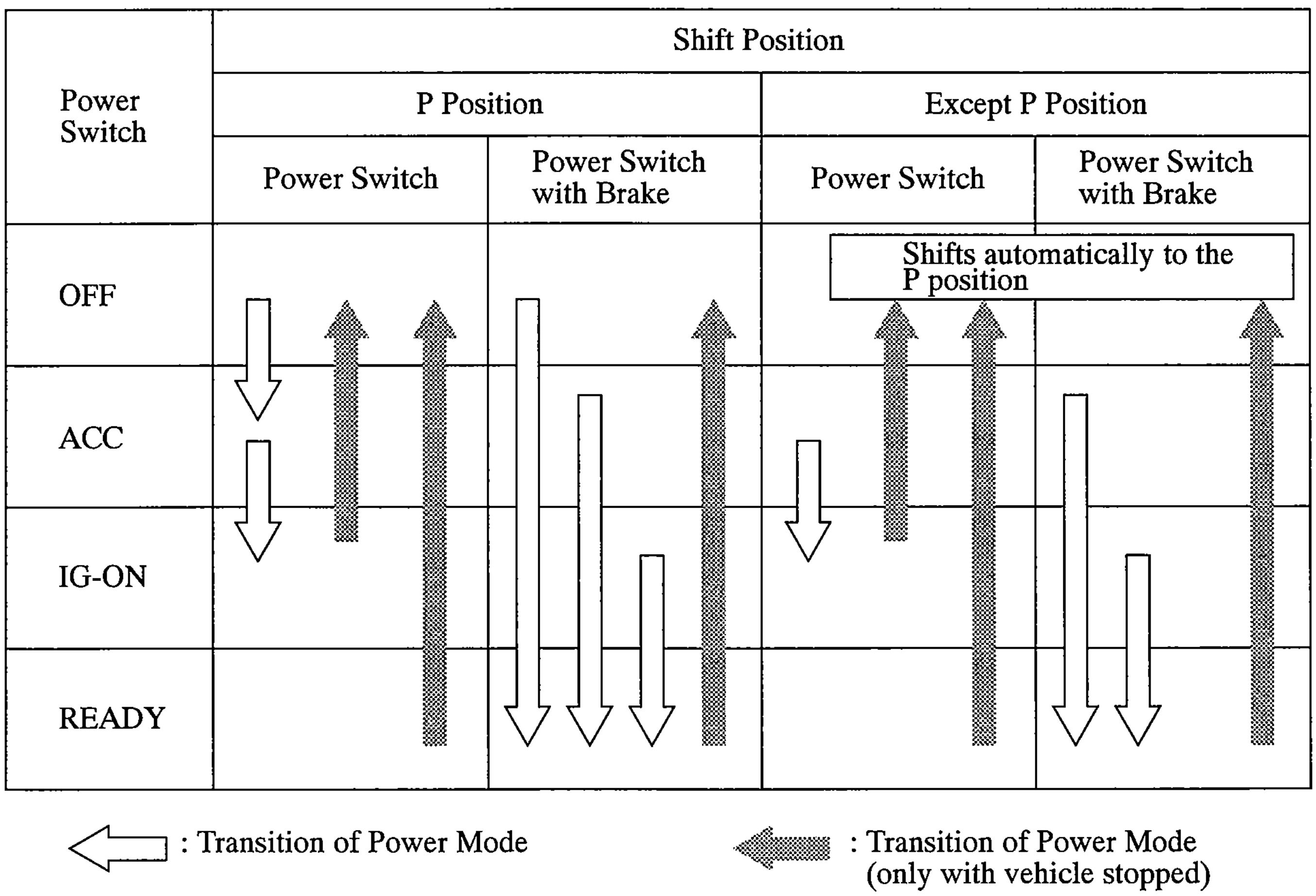
Control	Outline
Power Switch Control (with Key)	The transponder key ECU checks the ID code when a key is inserted in the key slot. The power source control ECU verifies the check results and authorizes the operation of the switch.
Power Switch Control (with Smart Key)	• If the driver operates the power switch with a key in his/her possession, the power source control ECU starts the room oscillator, which transmits a request signal to the key. Upon receiving this signal, the key transmits an ID code signal to the smart ECU. • The transponder key ECU verifies the check results received from the smart ECU via the BEAN and sends them to the power source control ECU. Based on these results, the power source control ECU authorizes the operation of the power switch. • For details on the power switch control with smart key, see page BE-37.
Auto P Control	If the power switch is turned OFF when the shift position is other than P, the transmission control ECU activates the shift control actuator on a command from the HV ECU in order to change the shift position to the P position.
Diagnosis	When the power source control ECU detects a malfunction, the power source control ECU diagnoses and memorizes the failed section.

2. Power Switch Control (with Key)

General

- When a key is inserted in the key slot and the transponder key ECU recognizes the ID code of the key, the power source control ECU authorizes the operation of the power switch. As a result, the power changes to the mode selected at the power switch.
- The power modes change in three stages (OFF → ACC → IG-ON → OFF) each time the power switch is pressed. If the driver presses on the power switch while pressing on the brake pedal (which causes the stoplight switch to turn ON), the power mode will change to READY regardless of the previous power mode.
- After approximately 1 hour elapses with the power switch at ACC and the shift lever in the P position, the power source control ECU will automatically turn OFF the power.
- The table below shows the transition of the power modes.

▶ Transition of Power Mode ◀



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NOTE: Normally, the operation of the power switch is disabled while the vehicle is being driven. However, if the hybrid system must be stopped in an emergency while the vehicle is in motion, the driver can press the power switch for approximately 3 seconds or more to stop the hybrid system. (The power switch changes from READY → ACC).

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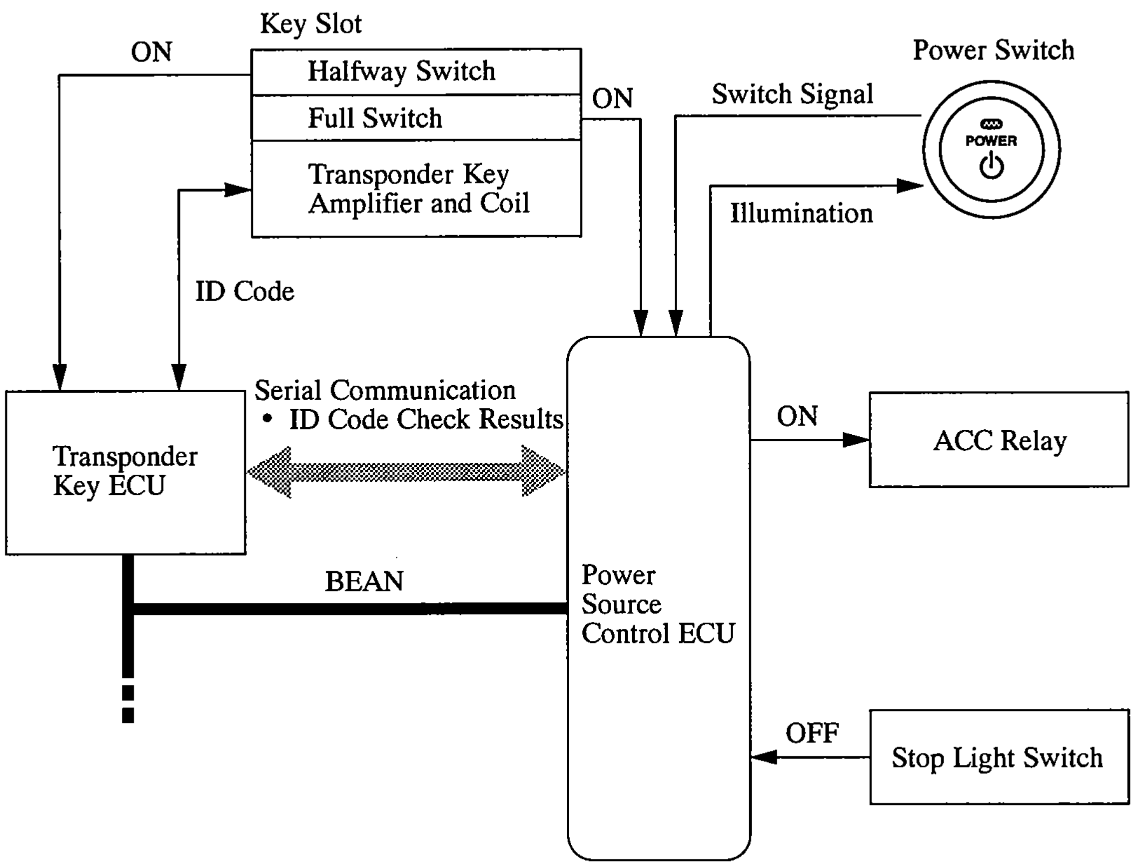
OFF→ACC

- When the driver inserts a key in the key slot, the transponder key ECU checks the ID code of the key.
- In this state, if the driver presses the power switch once without pressing the brake pedal, the power source control ECU verifies the check results of the key ID code provided by the transponder key ECU.
- When the check results reveal that the ID code is legitimate, the power source control ECU turns ON the ACC relay and starts the ACC power supply.
- At this time, the power source control ECU illuminates a green indicator light on the power switch in order to inform the driver of the ACC power mode.



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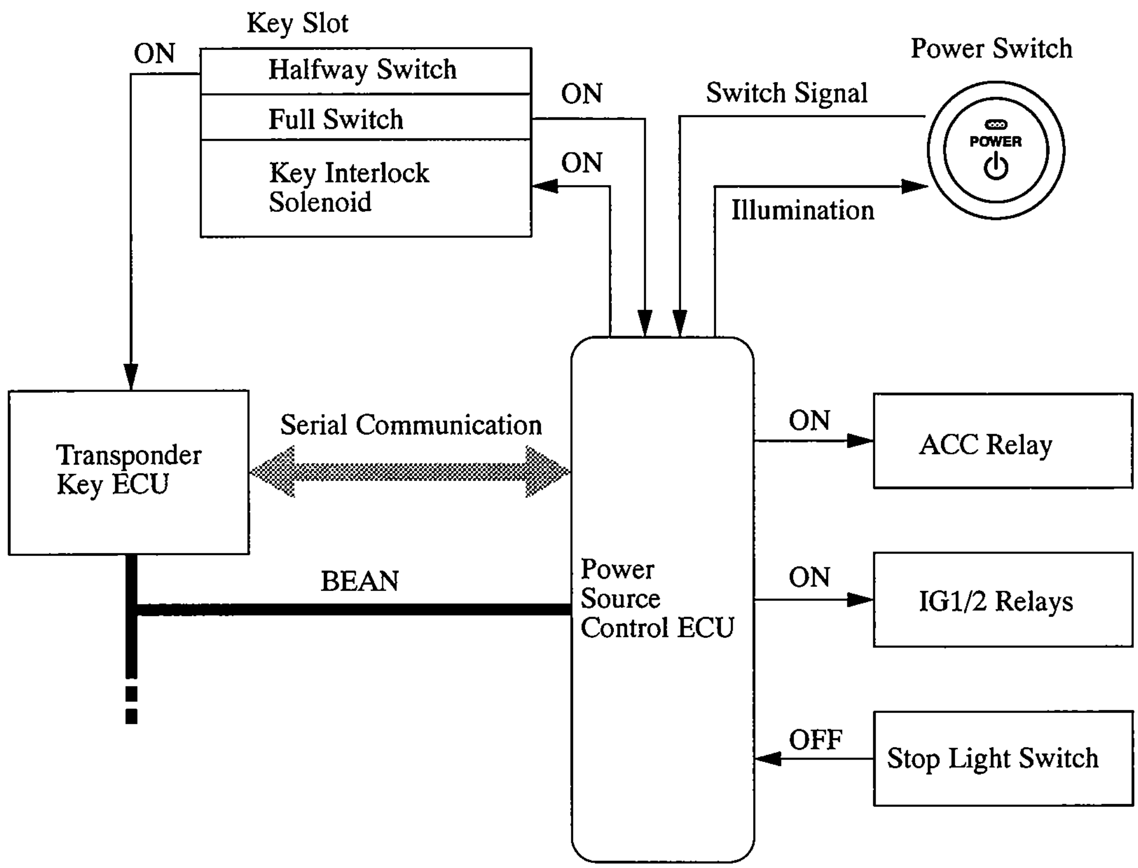
ACC→IG-ON

- When the power switch is at ACC and the driver presses the power switch once without pressing the brake pedal, the power source control ECU will turn ON the IG1 and IG2 relays in order to start the supply of IG power. At this time, the ACC relay remains ON.
- At this time, the power source control ECU will illuminate an amber indicator light on the power switch in order to inform the driver of the IG-ON mode.



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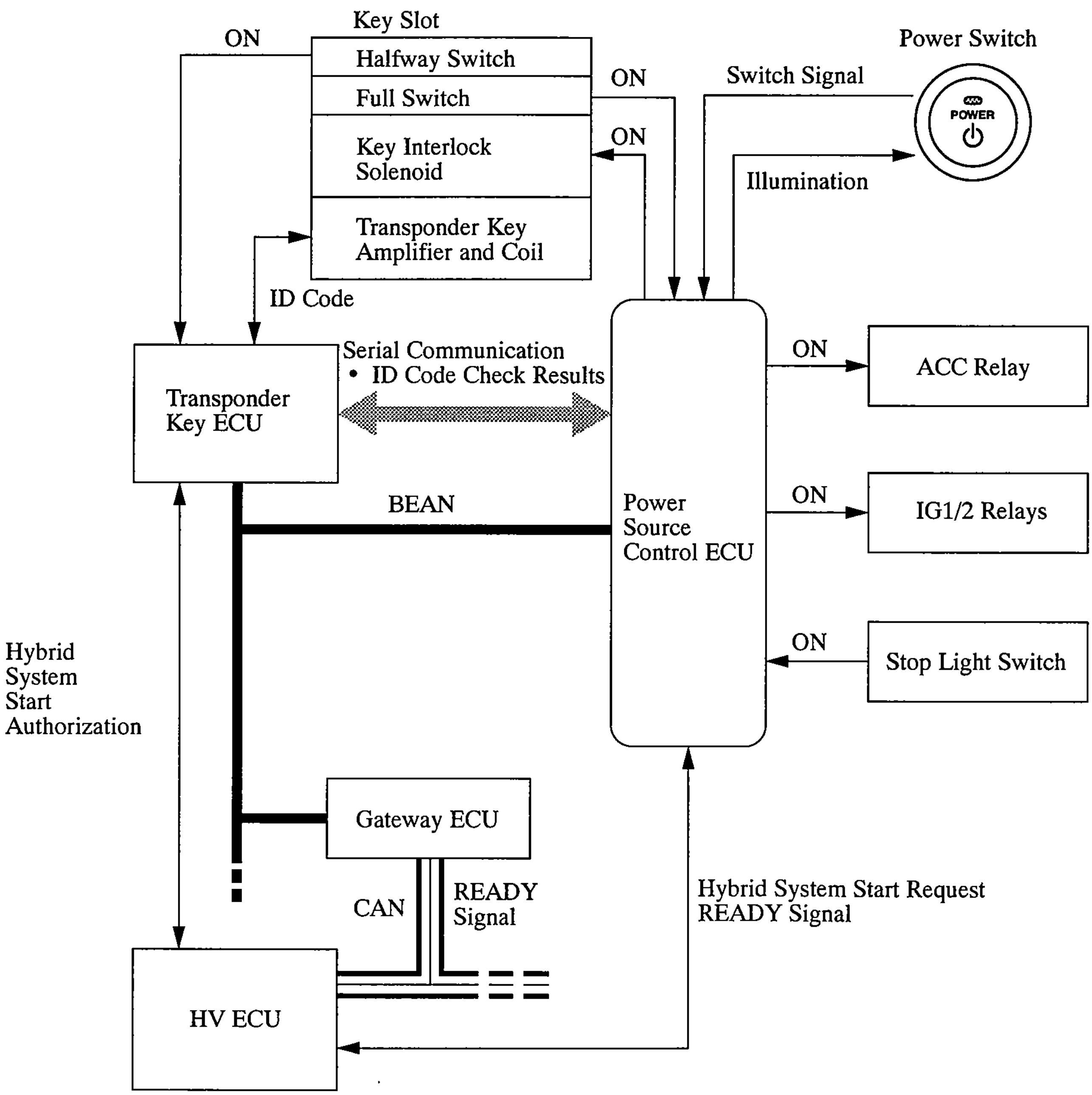
OFF→READY

- The transponder key ECU checks the ID code of the key when a key is inserted in the key slot.
- In this state, if the driver presses the power switch once while pressing the brake pedal, the power source control ECU verifies the key ID code check results provided by the transponder key ECU.
- When the check results reveal that the ID code is legitimate, the power source control ECU turns ON the IG1 and IG2 relays in order to start the supply of IG power.
- At this time, the power source control ECU will illuminate an amber indicator light on the power switch in order to inform the driver of the IG-ON mode.
- After illuminating the indicator light, the power source control ECU will transmit a hybrid system start instruction signal to the HV ECU.
- Upon receiving this signal, the HV ECU verifies the key ID code check results provided by the transponder key ECU.
- When the check results reveal that the ID code is legitimate, the HV ECU starts the hybrid system.
- At this time, the power source control ECU will turn OFF the indicator light on the power switch, in order to inform the driver of the READY mode.



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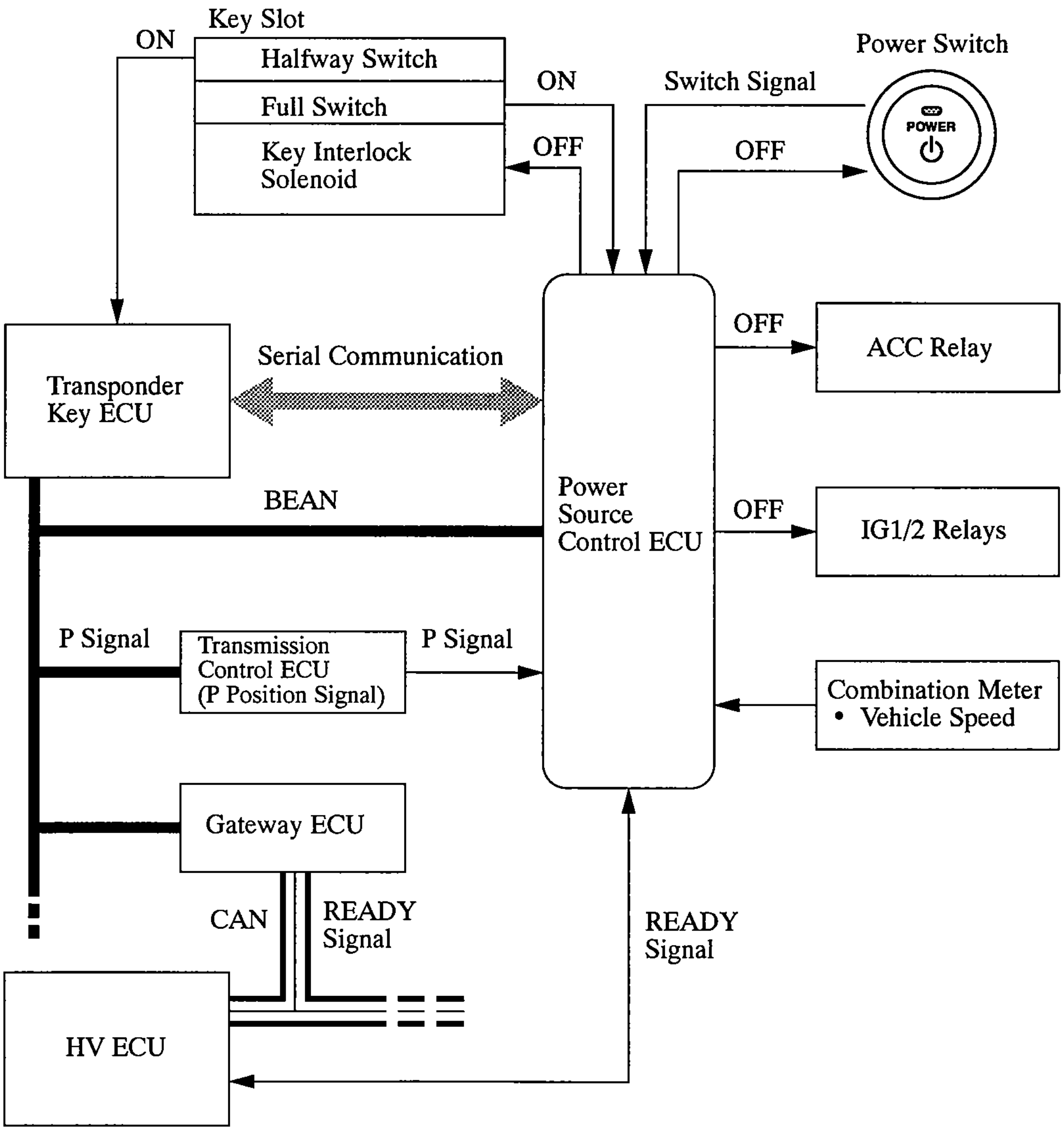
READY or IG-ON→OFF

- If the driver presses power switch (while the vehicle is stopped and the shift position is in the P position) in order to change the power mode from READY or IG-ON to OFF, the power source control ECU will check with the transmission control ECU, via BEAN, whether the shift position is in the P position.
- Accordingly, if the power source control ECU determines that the shift position is in the P position, it will turn the ACC, IG1, and IG2 relays OFF, in order to stop the power supply.
- When the power mode changes from IG-ON to OFF, the power source control ECU turns OFF the indicator light on the power switch in order to inform the driver of the OFF mode.



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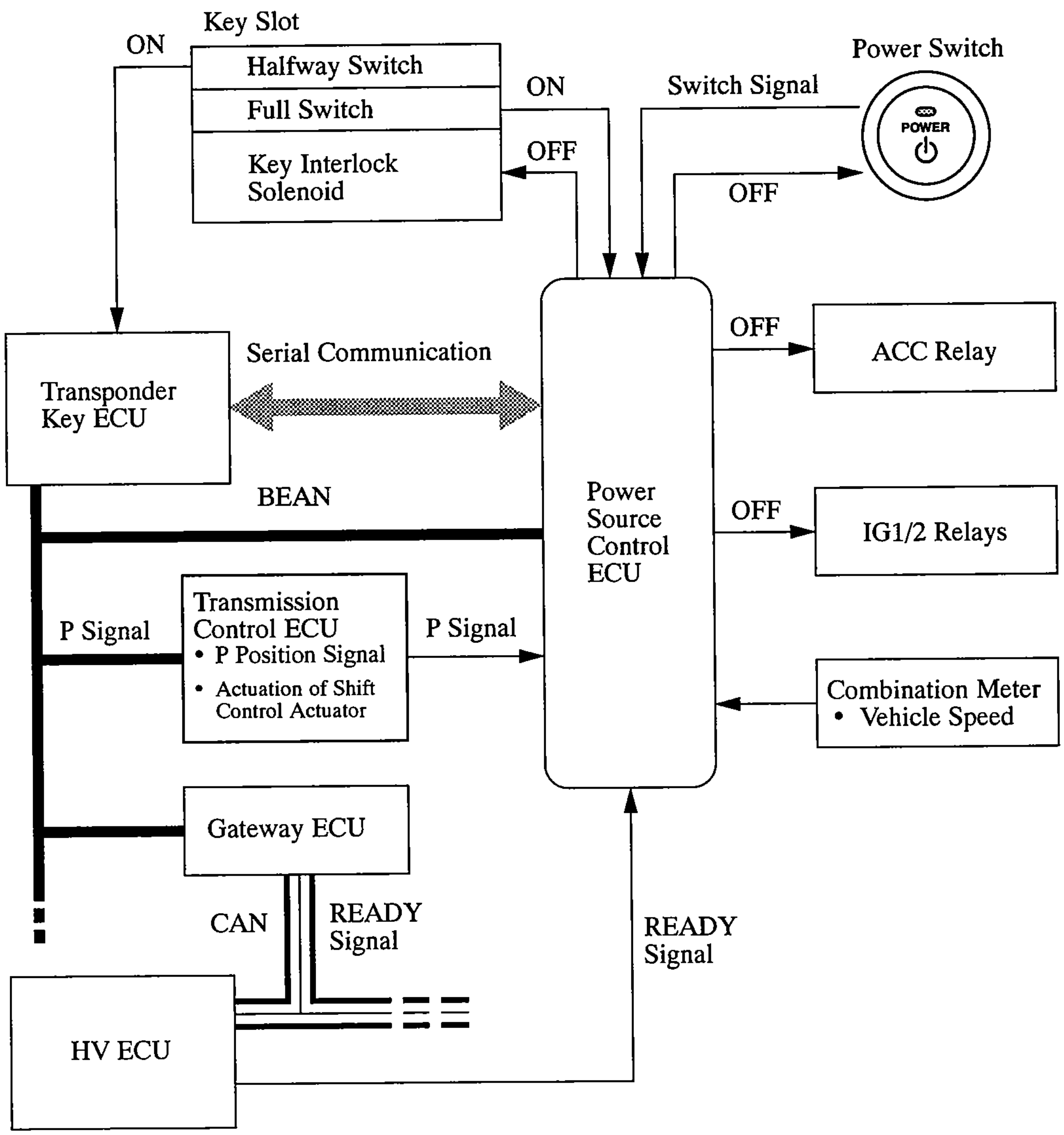
3. Auto P Control

- If the driver presses power switch (while the vehicle is stopped and the shift position is in a position other than the P position) in order to change the power mode from READY or IG-ON to OFF, the power source control ECU will check with the transmission control ECU, via BEAN, whether the shift position is in the P position.
- Accordingly, if the power source control ECU determines that the shift position is in other than the P position, the power source ECU transmits the vehicle power supply OFF signal to the HV ECU via the transmission control ECU.
- On the signal from the power source control ECU, the HV ECU transmits the shift control actuator operate command signal to the transmission control ECU. The transmission control ECU then activates the shift control actuator in order to change the shift position to the P position.
- After the shift position has been changed to the P position, the power source control ECU will turn the ACC, IG1, and IG2 relays OFF, in order to stop the power supply.
- When the power mode changes from IG-ON to OFF, the power source control ECU turns OFF the indicator light on the power switch in order to inform the driver of the OFF mode.



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4. Diagnosis

- If a malfunction occurs in the IG circuit, the power source control ECU will effect the controls listed in the table below and record a DTC (Diagnostic Trouble Code).

IG Circuit Malfunction	Detail
Malfunction occurring during IG-ON mode	• The hold circuit in the power source control ECU continues to supply power to the IG1 and IG2 relays. At this time, the power source control ECU will blink an amber indicator light on the power switch. • When the hybrid system is stopped (IG-ON → OFF), the power source control ECU will continue blinking the indicator light on the power switch for 15 seconds after the power switch has been turned OFF, and then it will turn OFF the indicator light. • The hybrid system cannot be restarted.
Malfunction occurring during ACC or OFF mode	• A malfunction can be detected, when the power mode changes to IG-ON by pressing the power switch (the power mode changes to OFF). • The power source control ECU will blink an amber indicator light on the power switch. (The light will continue to blink for 15 seconds after the power switch has been turned OFF, and then it will turn OFF.) • The hybrid system cannot be restarted.

- The DTC can be accessed the use of the hand-held tester. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).
- The table below indicates the DTC that are associated with this system.

DTC No.	Detection Item	DTC No.	Detection Item
B2271	Ignition Hold Monitor Malfunction	B2281	P Signal Malfunction (Cable-information does not match to BEAN-Information)
B2272	Ignition 1 Monitor Malfunction	B2282	Vehicle Speed Signal Malfunction (Cable-information does not match to BEAN-Information)
B2273	Ignition 2 Monitor Malfunction	B2284	Brake Signal Malfunction (Cable-information does not match to BEAN-Information)
B2274	ACC Monitor Malfunction	B2286	READY Signal Malfunction
B2275	STSW Monitor Malfunction	B2287	LIN Communication Master Malfunction
B2277	Detecting Vehicle Submersion	B2289	Key Collation Waiting Time Over
B2278	Main Switch (power switch) Malfunction (Starter switch 1 signal does not match to starter switch 2 signal)	—	—

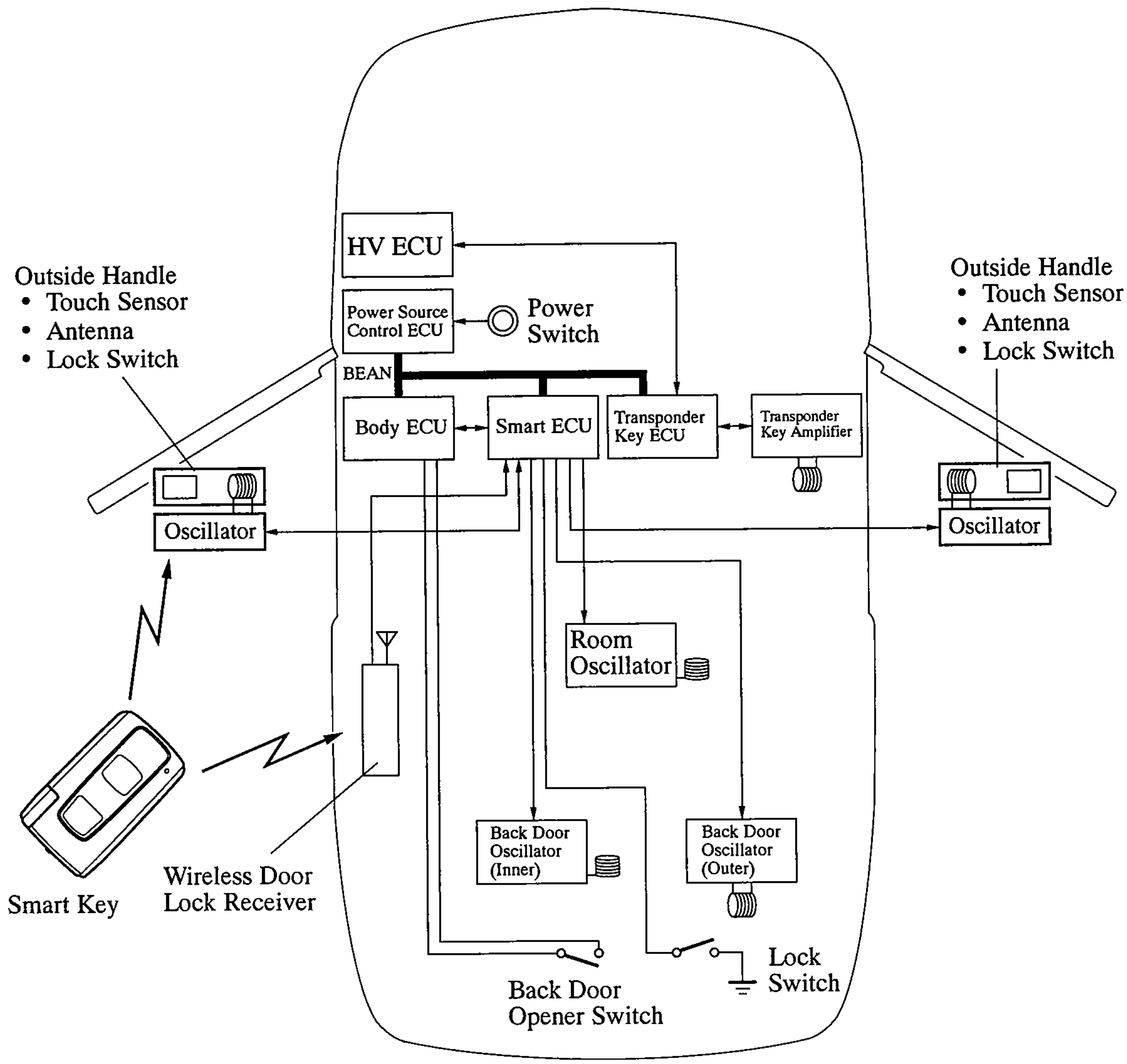
SMART ENTRY & START SYSTEM

■ DESCRIPTION

- In addition to the conventional mechanical key function and the wireless door lock remote control function, this system provides the smart key with a bi-directional communication function. Accordingly, by enabling the smart ECU to recognize the presence of the smart key within the detection area, the system can lock or unlock the doors, or start the hybrid system without the use of the smart key, as long as the user has the smart key in his/her possession.
- The smart entry & start system is optional equipment on all models.
- This system consists primarily of a smart key ECU, power source control ECU, transponder key ECU, body ECU, smart key, 5 oscillators, 5 antennas, 2 touch sensors, 3 lock switches, and a wireless door lock receiver. The smart ECU controls the system.
- The smart entry & start system operates in cooperation with the push button start system, the HV immobilizer system and the wireless door lock remote control system.

■ SYSTEM DIAGRAM

1. Overview of Parts Layout



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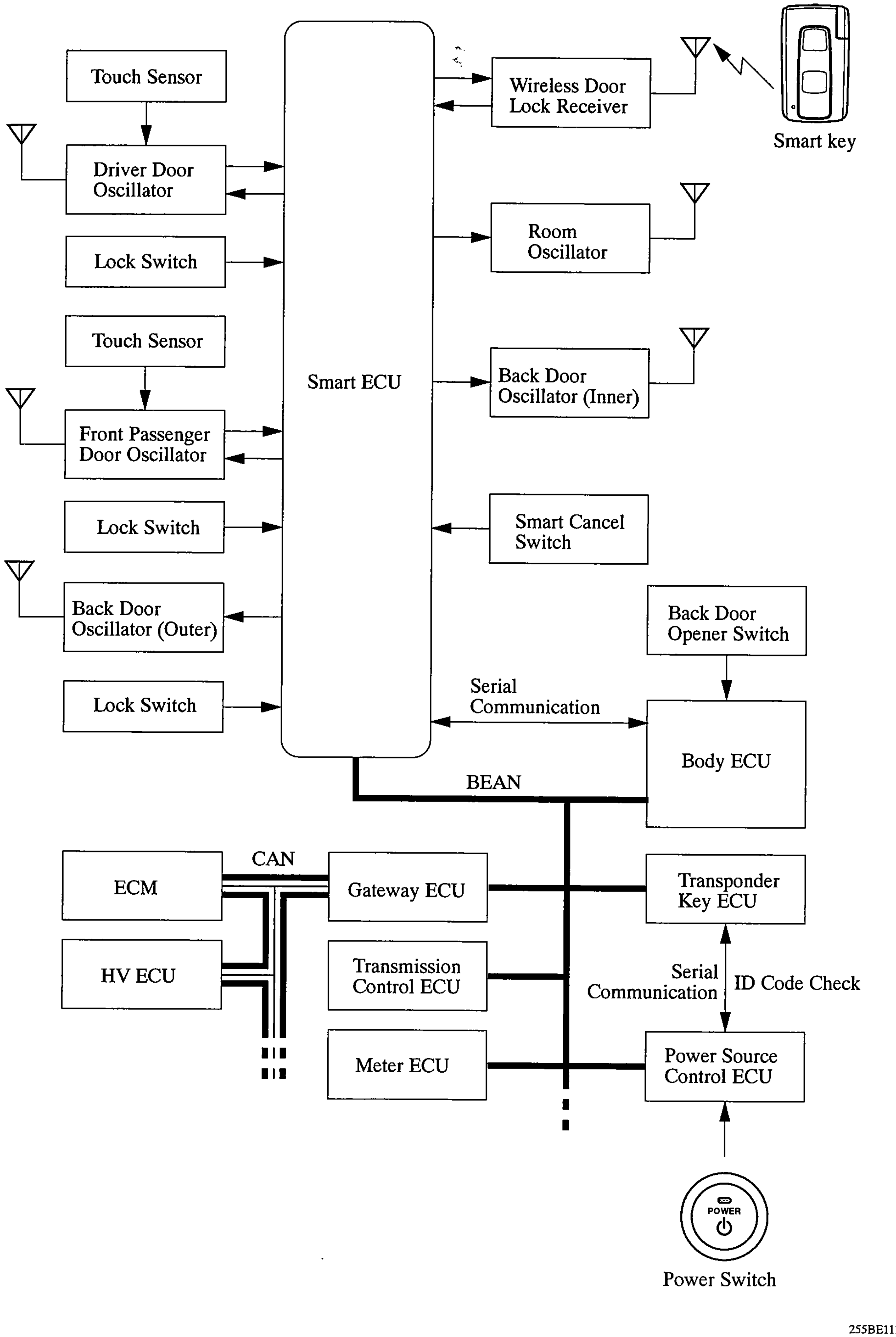
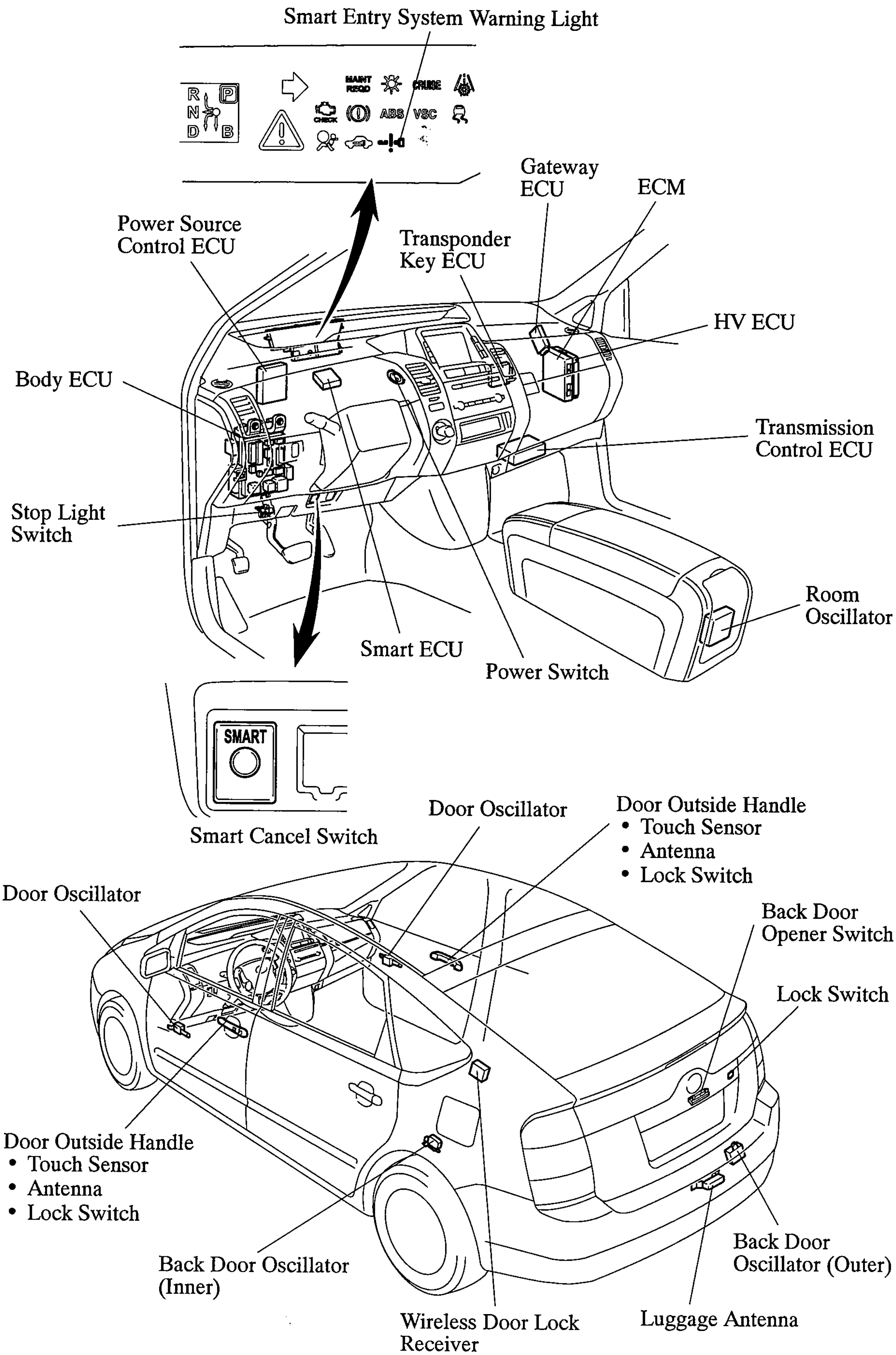
2. Input and Output Signals



▶ MPX Communication ◀

Protocol	ECU	Signals Exchanged with Smart ECU
BEAN	Body ECU	• Transmits power ON mode • Transmits Door Key Lock Unlock Switch Signal • Transmits Door Lock Position Switch Signal • Transmits Back Door Opener Switch Signal • Transmits Courtesy Switch Signal
	Transponder Key ECU	• Transmits ID Code Signal (for smart ignition) • Receives Results of the ID Code Check of the Smart Key
	Meter ECU	• Transmits Vehicle Speed Signal • Receives information whether smart key is in vehicle interior (for smart entry system warning light) • Receives buzzer sounding request
	Power Source Control ECU	• Transmits ID code check request • Transmits insertion state of smart key in key slot • Receives ID code check results
	Transmission Control ECU	• Transmits state of parking lock
CAN	ECM	• Transmits Engine Speed Signal
	HV ECU	• Transmits Shift Position P
Serial Communication (Local Protocol)	Body ECU	• Receives door lock/unlock request • Receives information whether smart key is in vehicle interior (for wireless door lock buzzer sounding control)

■ LAYOUT OF MAIN COMPONENTS



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■ FUNCTION OF MAIN COMPONENTS

Components		Function
Smart key		Receives the signals from oscillators and returns the ID code to the wireless door lock receiver.
Door Oscillator (Driver and Front Passenger Doors)		Intermittently transmits key detection signals within the detection area around each door, upon receiving a transmission request signal from the smart ECU.
Room Oscillator		Transmits a key detection signals within the detection area in the vehicle interior upon receiving a transmission request signal from the smart ECU.
Back Door Oscillator	Inner	Transmits a key detection signals within the detection area in the luggage room upon receiving a transmission request signal from the smart ECU.
	Outer	Transmits a key detection signals within the detection area around the back door upon receiving a transmission request signal from the smart ECU.
Luggage Antenna		Transmits a back door oscillator signal.
Door Outside Handle (Driver and Front Passenger)	Touch Sensor	Detects when a person touches an outside handle inside.
	Antenna	Transmits door oscillator signal.
	Lock Switch	Transmits a door lock request signal to the smart ECU.
Back Door Lock Switch		Transmits a door lock request signal to the smart ECU.
Back Door Opener Switch		Transmits a back door open request signal to the smart ECU via the body ECU.
Wireless Door Lock Receiver		Receives the ID code from the smart key and transmits it to the smart ECU.
Power Switch		Switches the vehicle power modes in four stages (OFF, ACC, IG-ON, and READY) in accordance with the position of the shift lever, the state of the stoplight switch, and the check results of the smart key.
Smart Key Cancel Switch		Turns the smart entry & start system ON/OFF.
Stop Light Switch		Outputs the state of the brake pedal to the power source control ECU.
Combination Meter	Smart Entry System Warning Light	The smart ECU illuminates the smart entry system warning light and sounds the buzzer to alert the driver that the smart key is being moved out of the vehicle while the hybrid system is in operation, the door locks are being operated, or the smart key is being left in the vehicle, in order to prevent these conditions from occurring.
	Buzzer	
Wireless Door Lock Buzzer		The smart ECU sounds the wireless door lock buzzer to alert the driver that the smart key is being moved out of the vehicle while the hybrid system is in operation, the door locks are being operated, or the smart key is being left in the vehicle, in order to prevent these conditions from occurring.

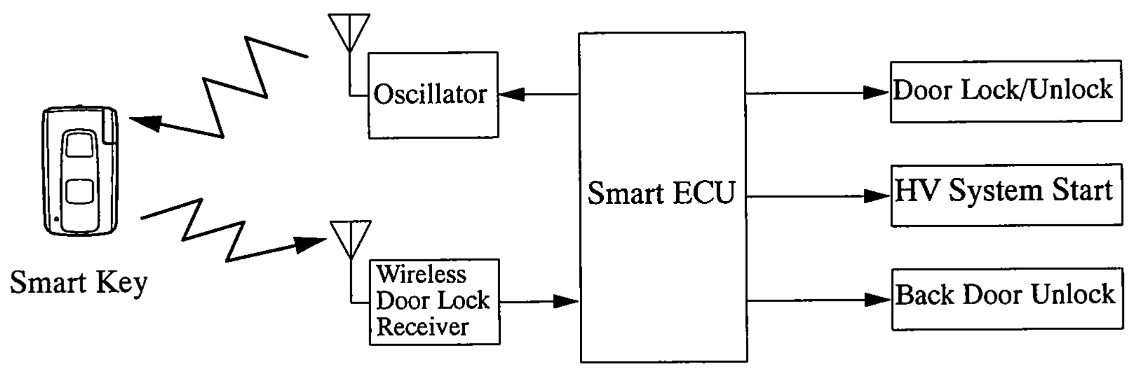
(Continued)

Components	Function
Smart ECU	• Identifies and checks the ID codes from the wireless door lock receiver, then transmits signals to the ECUs if the ID codes match. • Upon receiving signals from the switches, it transmits an intermittent transmission request signal to the door oscillators and a transmission request signal to other oscillators in accordance with the conditions.
Power Source Control ECU	Effects primary control of the push button start system. It receives the results of the ID code check of the smart key provided by the smart ECU via the transponder ECU. When the check results reveal that the ID code is legitimate, the power source control ECU authorizes the transition of the power modes through the operation of the power switch.
Transponder Key ECU	• Effects primary control of the HV immobilizer system. It transmits the results of the ID code check of the smart key provided by the smart ECU to the power source control ECU. • Transmits a hybrid system start authorization signal to the HV ECU.
Transmission Control ECU	• Actuates the shift control actuator upon receiving the power switch OFF signal from the power source control ECU. • Transmits the state of the parking lock operation (whether the shift position is in the P position or some other position) to the power source control ECU.
HV ECU	• Starts the hybrid system upon receiving a system start signal from the power source control ECU (READY ON). • Receives a hybrid system start authorization signal from the transponder key ECU.
Body ECU	• Transmits body control system signals (courtesy switch, door key lock/unlock switch, door lock position switch, halfway switch signals, etc.) to the smart ECU, via the BEAN • Receives a door lock/unlock request signal from the smart ECU via a dedicated serial communication line (with local protocol), which is used between the body ECU, smart ECU, and wireless door lock receiver.

■CONSTRUCTION AND OPERATION

1. Smart Key

- The smart key has a built-in transceiver. Upon receiving a smart key ID code check request signal (approximately 134 kHz) transmitted by the oscillator, this transceiver transmits an ID code signal (approximately 312 MHz) to the wireless door lock receiver. As a result, a wireless ID code check of the smart key in the driver's possession is made possible.
- The smart entry & start system is disabled if it is stopped through the operation of the smart cancel switch, or if the smart key operation battery has been depleted. However, the driver's door can be locked or unlocked by the mechanical key that is built into the smart key, and the system can be started by inserting the smart key in the key slot (and operating the power switch).



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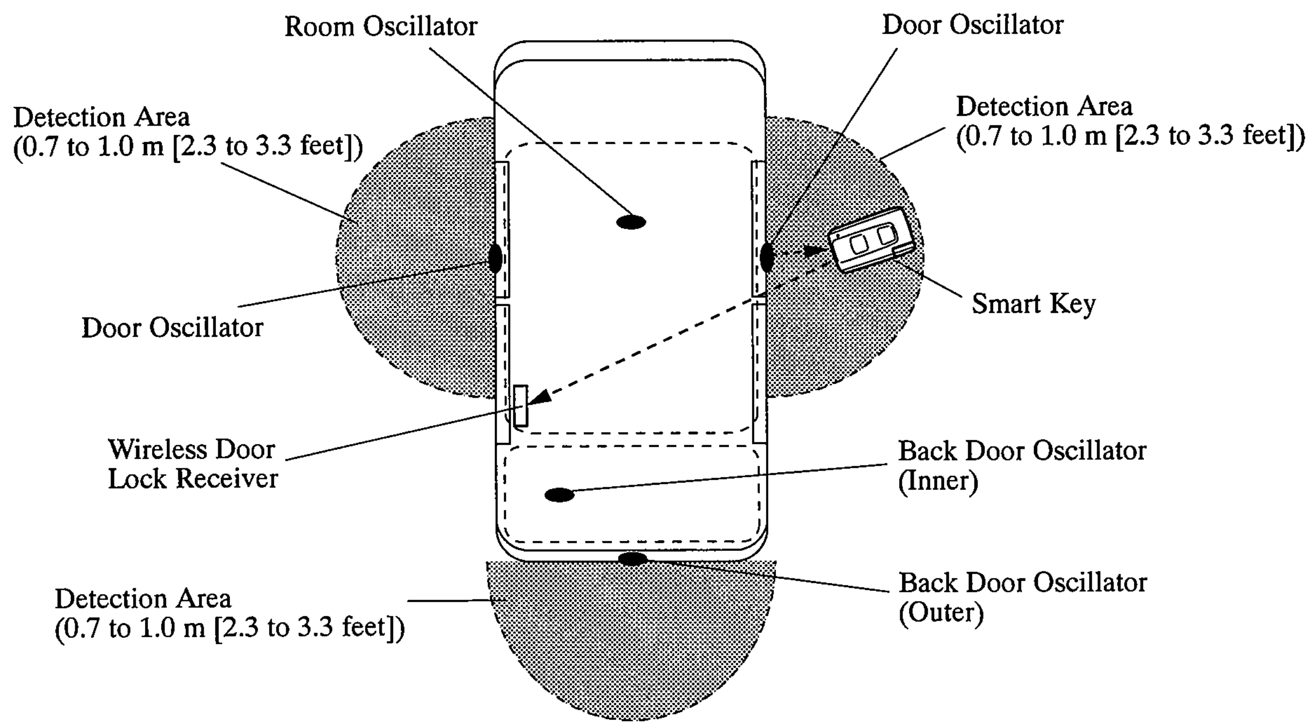
NOTE: Handling Precaution for Smart Key

- The smart key is constantly in the reception mode in order to maintain communication with the vehicle. For this reason, the battery in the smart key will be depleted in 1 to 3 years, regardless of the operating conditions of the smart key.
- The smart key receives radio signals of approximately 134 kHz. Therefore, the presence of an electronic device that emits strong radio signals with the same frequency in the vicinity of the smart key can accelerate the depletion of the battery in the smart key than under normal conditions. Therefore, do not store the smart key in the vicinity of electrical equipment such as a television or personal computer.
- When the doors are locked and the smart key is located within the detection areas of the driver and front passenger door oscillators, the smart key and the vehicle will maintain regular communication. If this situation continues for a prolonged length of time, the battery in the smart key and the auxiliary battery of the vehicle will be depleted. Therefore, do not leave the smart key in the vicinity of the vehicle (within approximately 5 meters [16.4 feet]) when the vehicle is not being operated.

2. Oscillator (Driver/Front Passenger Door, Room, Back Door Inner/Outer)

- With all doors locked, the driver and front passenger door oscillators form a smart key detection area outside of the vehicle by emitting smart key detection signals on a regular basis. Accordingly, the smart ECU will be able to check the ID code of a smart key in the detection areas.
- With all doors locked, if a user presses the back door opener switch, the back door oscillator starts to form a smart key detection area outside of the vehicle by emitting signals. Accordingly, the smart ECU will be able to check the ID code of a smart key in the detection area.
- With all doors closed, if a user presses the lock switch on the outside door handle, the smart ECU will cause all the oscillators to emit signals in order to form smart key detection areas outside of the vehicle. Accordingly, the smart ECU determines that the smart key has been taken out of the vehicle.
- If a user operates the power switch while the smart key is in the user's possession, the smart ECU outputs a request signal to cause the room oscillator to emit signals in order to form a smart key detection area in the vehicle interior. Accordingly, the smart ECU will be able to check the ID code of the smart key, even if the smart key is not inserted in the key slot.

▶ Detection Area ◀



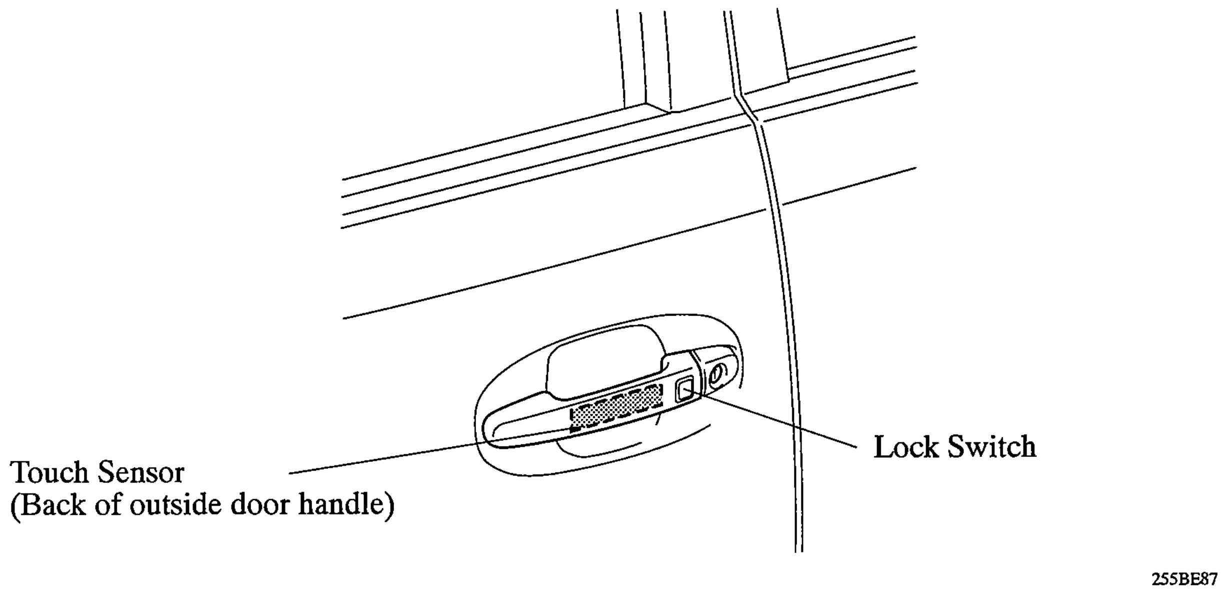
NOTE: Handling Precaution for Oscillators

- With all doors locked, the driver and front passenger door oscillators emit smart key detection signals on a regular basis in order to check the ID code of the smart key. For this reason, the auxiliary battery of the vehicle will become depleted if the vehicle is not operated for a prolonged length of time. Therefore, operate the smart cancel switch to disable the smart entry & start system if the vehicle will not be operated for a prolonged length of time.
- When the doors are locked and the smart key is located within the detection areas of the driver and front passenger door oscillators, the smart key and the vehicle will maintain regular communication. If this situation continues for a prolonged length of time, the battery in the smart key and the auxiliary battery of the vehicle will become depleted. Therefore, do not leave the smart key in the vicinity of the vehicle (within approximately 5 meters [16.4 feet]) when the vehicle is not being operated.

3. Door Outside Handle (Driver and Front Passenger)

- The outside door handle consists of a touch sensor, antenna, and lock switch.
- The driver's outside door handle contains a key cylinder. Thus, when the smart entry & start system is inactive, the user can lock and unlock the driver's door through the use of a mechanical key.
- The touch sensors are integrated with the antennas for the door oscillators. They are connected to the respective oscillators. If the user touches the touch sensor portion of the outside door handle, the smart ECU unlocks the door via the body ECU, provided that the smart ECU has checkd the ID code of the smart key.
- When the driver or the passenger touches the outside door handle, the electrostatic capacity* of the touch sensor, which is built into the handle, changes. The oscillator, which is connected to the touch sensor, converts the changes in the electrostatic capacity into voltage and outputs it to the smart ECU.

Electrostatic Capacity*: The capacity of an object to store an electric charge. The unit used to represent this capacity is F (Farad).



■ SYSTEM OPERATION

1. General

The electronic control of the smart entry & start system has following control.

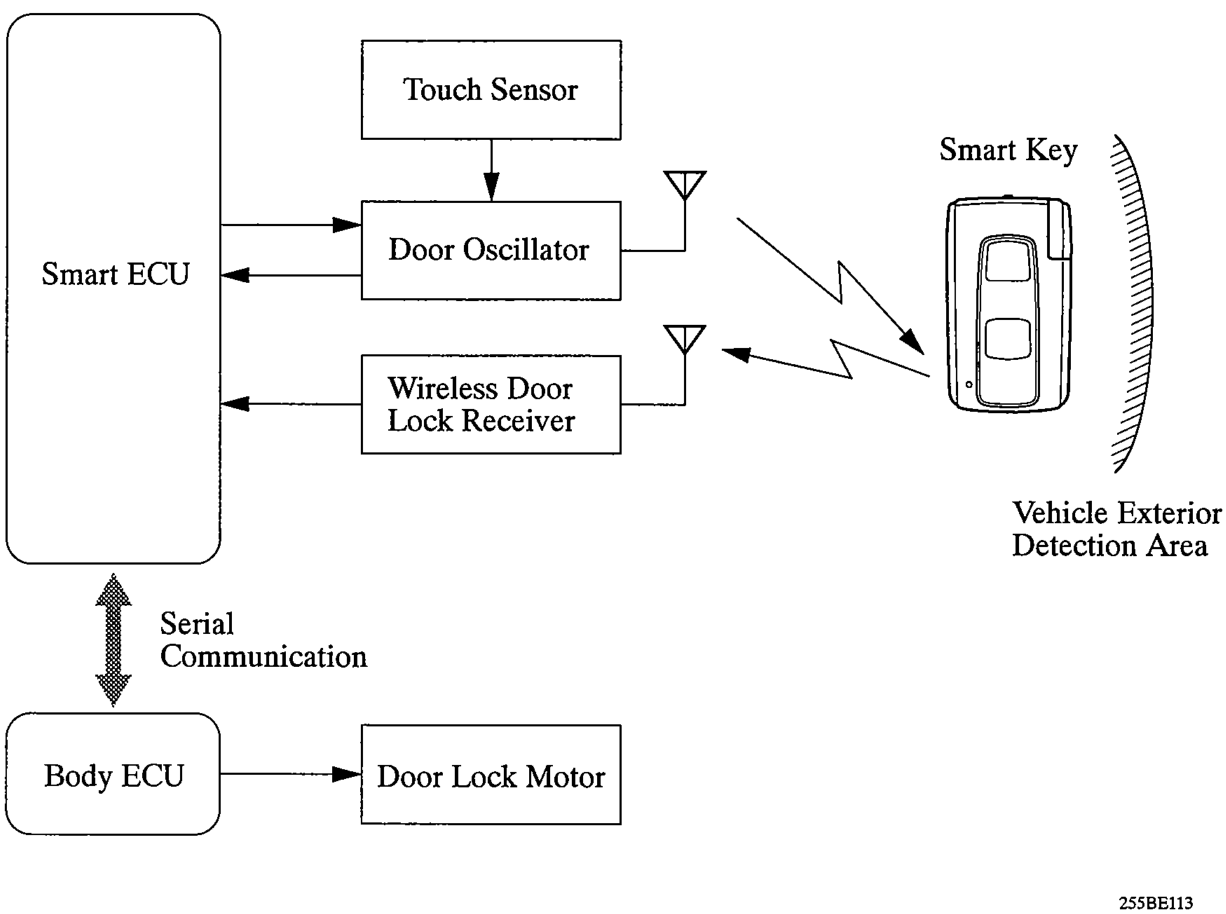
Item	Outline
Smart Unlock (see page BE-32)	Provided that the doors are locked and the check results of the smart key by the smart ECU reveal that the ID code is legitimate, if the user touches the outside door handle, the smart ECU unlocks the door via the body ECU.
Smart Back Door Unlock (see page BE-34)	Provided that the doors are locked and the check results of the smart key by the smart ECU reveal that the ID code is legitimate, if the user presses the back door opener switch, the smart ECU unlatches the back door lock via the body ECU.
Smart Lock (see page BE-35)	Provided that all doors are closed and the smart key has been taken outside of the vehicle, if the user presses the lock switch on the outside door handle, the smart ECU checks for a smart key inside and outside of the vehicle. If the check results outside of the vehicle reveal that the ID code is legitimate, the smart ECU locks the door via the body ECU.
Smart Ignition (see page BE-37)	Provided that the smart key is in the user's possession and the user operates the power switch, the smart ECU checks the smart key, and if the check results reveal that the ID code is legitimate, the smart ECU authorizes the operation of the power switch (to change the power mode).
Warning Function (see page BE-40)	When any of the conditions indicated below occur, the smart entry & start system causes the smart ECU to illuminate the smart entry system warning light and sound the buzzer in the combination meter and the wireless door lock buzzer in order to alert the driver. • The smart key has been taken outside of the vehicle when the power switch is in a mode other than OFF (ACC, IG-ON, or READY). • The smart lock is operated when the power switch is in a mode other than OFF. • The doors are locked with the smart key in the vehicle. • The capacity of the battery in the smart key is low. • The power switch is operated when the smart key is located outside the detection area of the room oscillator. • The smart lock is operated, with any of the doors open.
Smart Unlock Mode Selector Function (see page BE-43)	When the power switch is OFF, and the smart key's lock switch and panic switch remain depressed for approximately 5 seconds, the smart unlock mode can be switched.
Power-Saving Function (see page BE-44)	To protect the auxiliary battery and the battery in the smart key, the smart ECU stops the smart entry & start system or delays the operation intervals of the driver and front passenger door oscillators under the conditions indicated below. • The smart ECU has not received any ID code signals from a smart key for14 days or more. • The smart entry & start system maintains communication with a smart key for more than 10 minutes.

2. Smart Unlock

- To detect the location of the smart key, the doors of the vehicle must be locked. The door oscillators transmit key detection signals at prescribed intervals in order to form vehicle exterior detection areas (approximately 0.7 to 1.0 m [2.3 to 3.3 feet] around each front outside door handle).
- When the smart key enters a detection area, the system automatically checks the ID codes. When this is completed, the door that has detected the smart key assumes the unlock standby condition in accordance with the prescribed unlock mode. In this condition, if a person touches the touch sensor on the outside door handle, the door becomes unlocked.

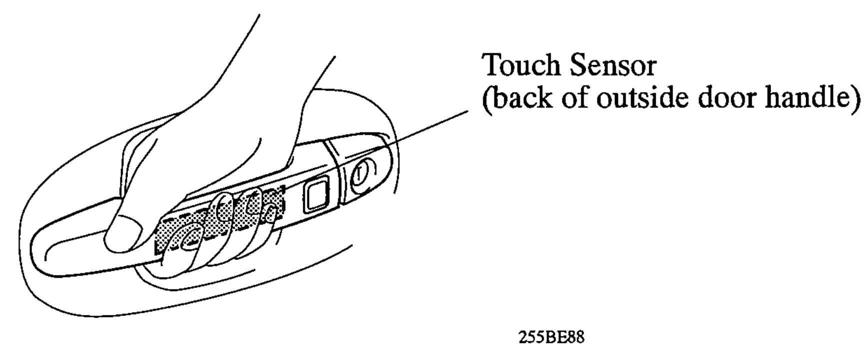
Mode	Unlock Standby Door	Door to be Unlocked
Individual Door Unlock	Driver	Driver Door Only
	Front Passenger	All Doors
	Back Door	Back Door Only
All Door Unlock	Driver	All Doors
	Front Passenger	
	Back Door	
Driver's Door Unlock*	Driver	Driver Door Only
	Front Passenger	All Doors
	Back Door	

*: This is the default setting. The smart unlock mode can be changed by pressing the lock and panic switch on the smart key for approximately 5 seconds. For details, see page BE-43.



NOTE: Handling Precaution for Smart Unlock

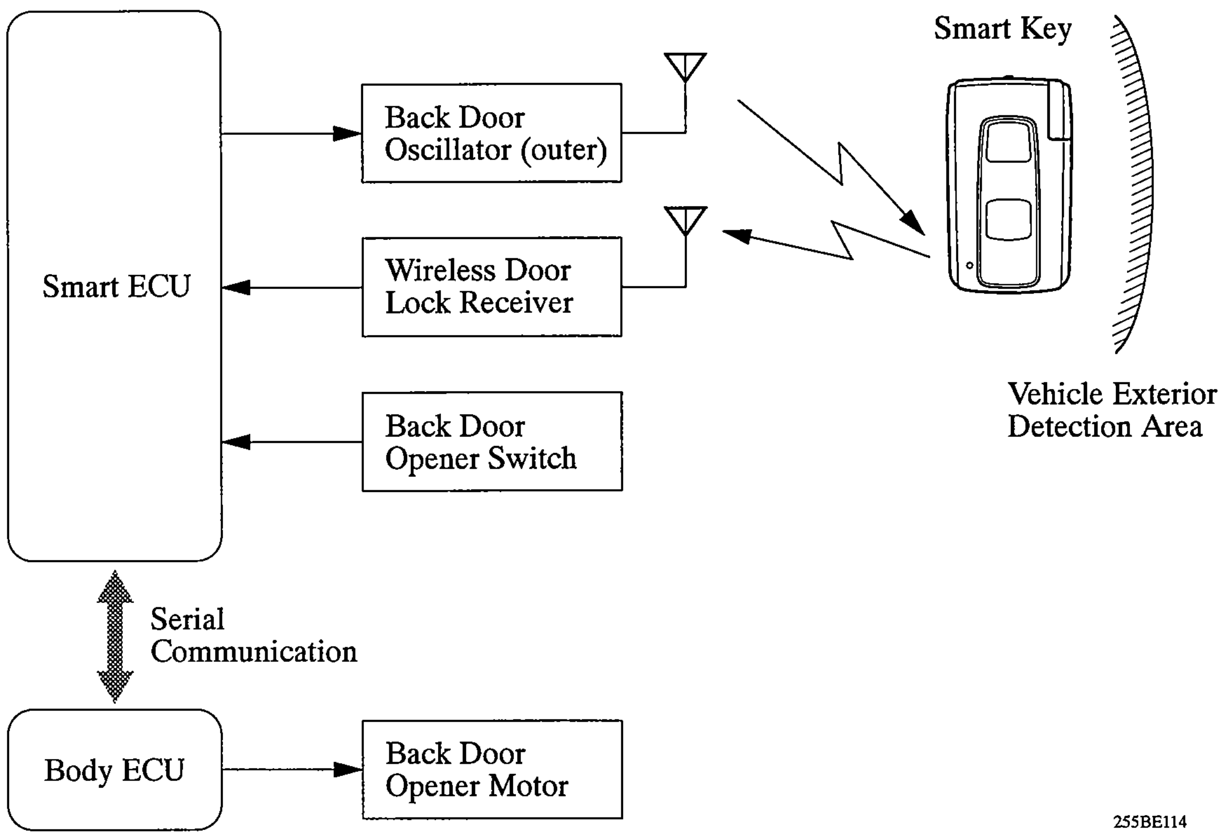
- To perform a smart unlock, make sure to touch the surface area of the door handle as shown in the illustration below. Its response may be delayed or inoperate if the door handle is touched by a hand wearing a leather glove or a ski glove.
- When performing a smart unlock, verify that the door has been unlocked (answer back by the wireless door lock buzzer and hazard light) before pulling on the door handle.
  The door might not unlock if the user approaches it suddenly or pulls on the door handle suddenly. If a door could not be unlocked, the system retries unlocking it four times, at 750 ms intervals. However, if the user is pulling on the handle during a retry, it might not be possible to unlock the door due to mechanical constraints. In this case, return the door handle one time to its original position.
- If the smart key is placed near the door handle, it might not be possible to smart unlock the door at times.
- As long as the smart key is within the vehicle exterior detection area, the door will unlock even if a person who does not have the smart key touches the door handle. However a door other than the door that resulted in check OK will not be unlocked.
- When the smart key is within the vehicle exterior detection area, the door might smart unlock if a large amount of water is splashed on the door handle, such as during a car wash or in heavy rain. However, if the door is not opened or closed within approximately 30 seconds, it will lock automatically as a theft preventive measure.
- In the individual or driver's door unlock mode, if you get into the vehicle from the driver's door carrying the smart key, all the smart unlocking controls activated by the smart key will be stopped for security. If you get out of the vehicle from the driver's door carrying the smart key and get out of the effective range of the smart function, unlocking control by the smart key will be possible. However, unlocking control may not be carried out for 5 seconds after you get out from the vehicle. In this case, operate unlock control again after 5 seconds.



3. Smart Back Door Unlock

With all doors locked, if the user who has the smart key presses the back door opener switch, the (outer) back door oscillator emits a smart key detection signal. The smart ECU checks the ID code, and after the check is completed, the smart ECU unlocks* the back door via the body ECU. At this time, if the user continues to press the back door opener switch, the back door lock latch will be released.

*: If the default of the smart unlock is set to the individual door unlock mode, only the back door will be unlocked. If the default is set to the all door unlock mode, all doors will be unlocked.



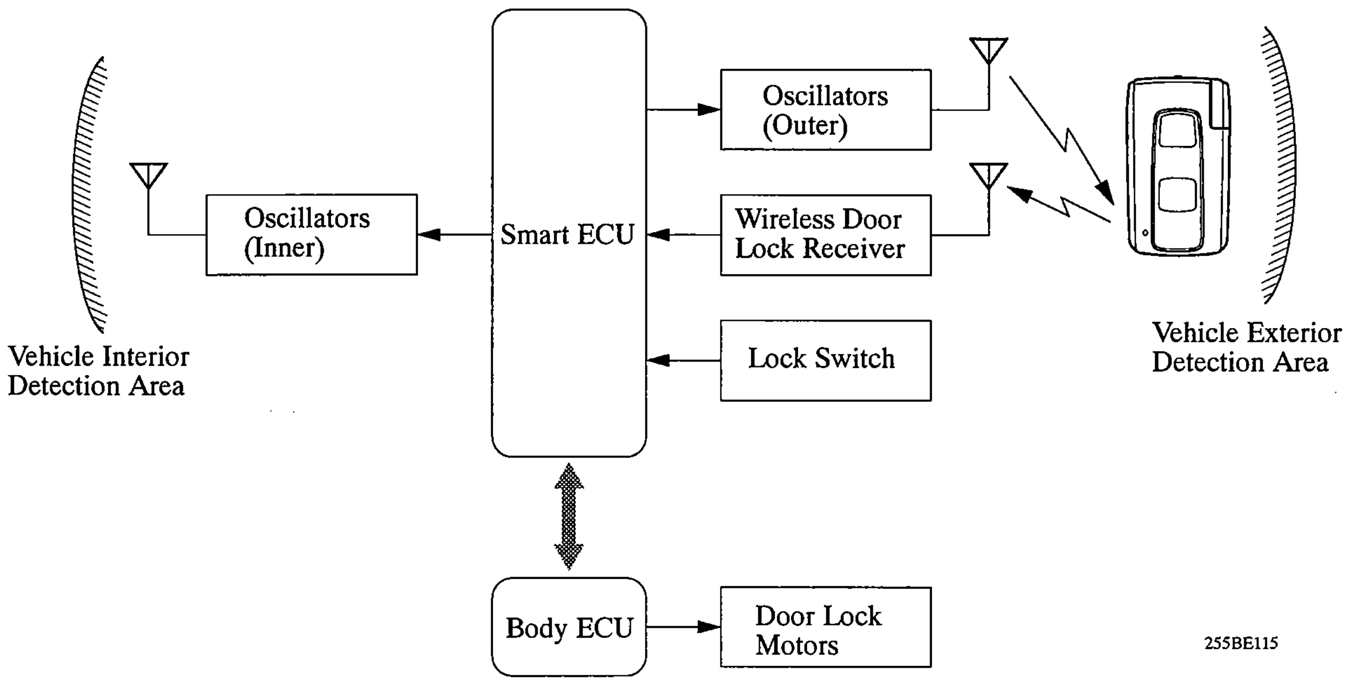
NOTE: Handling Precaution for Smart Back Door Unlock

Smart back door unlock function may not operate if the smart key is placed near the center of a bumper.

4. Smart Lock

- When the smart key is located outside of the vehicle and all the doors are closed, if the user presses the lock switch on the outside door handle or the lock switch on the back door, the smart ECU will actuate all oscillators and start checking for the ID code of a smart key.
- At this time, if an oscillator outside of the vehicle (driver/front door oscillators or back door outer oscillator) determines that the ID code of the smart key is legitimate, the smart ECU determines that the smart key has been taken outside the vehicle and locks the doors via the body ECU.
- A smart unlock operation will not be authorized for approximately 3.0 seconds* after the doors have been locked.

*: The setting of this duration can be changed using the customized body electronics system. For details, refer to the Customized Body Electronics System section on page BE-64.



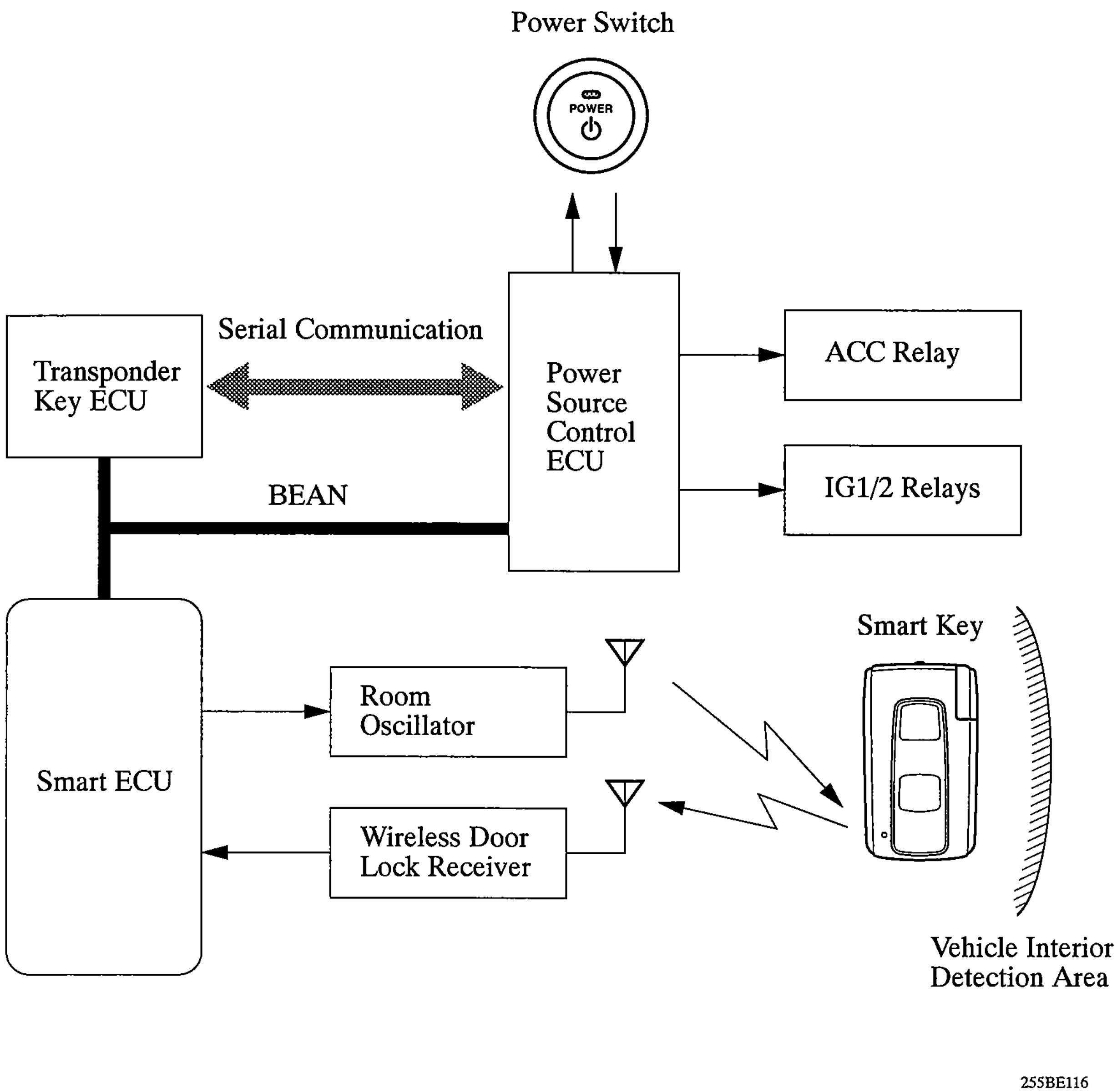
NOTE: Handling Precaution for Smart Lock

- If the key is in the vehicle, do not perform door locking operation, or the key might be locked inside the vehicle.
- To lock a door, make sure to press the lock switch on the outside handle. The door might not lock if it is depressed too quickly.
- It might not be possible to smart lock the door if the smart key is placed near the vehicle interior (window or door handle).
- Even if the smart key is within the vehicle exterior detection area, if the lock switch is depressed without turning OFF the power switch, a warning will be issued to alert the driver that the power switch has not been turned OFF (by emitting a beep sound outside of the vehicle), without being able to smart lock the door.
- When the smart key is within the vehicle interior detection area, pressing the lock switch will cause the system to issue a key confinement warning (by emitting a beep sound outside of the vehicle), without being able to smart lock the door.
  Even if the smart key is located outside of the vehicle, the warning buzzer could beep if the smart key is placed near a window or door handle. In this case, take the smart key slightly away from the door and press the lock switch.
- If the smart key is placed on the instrument panel, in the glove box, or on the floor, the key confinement prevention function might not activate, causing the doors to lock through the smart lock operation. Therefore, make sure to keep the smart key in your possession.
- Even if the smart key is located within the vehicle interior detection area in the state of the power switch OFF, it is possible to perform a wireless lock, manual lock, or key-linked lock. However, after a door is locked in this manner, it is prohibited from being smart unlocked. (After a wireless lock, manual lock, or key- linked lock, it is possible to smart unlock the door as long as the smart key is not located within the vehicle interior detection area.)
- After a smart lock, the door cannot be smart unlocked for approximately 3 seconds.

5. Smart Ignition

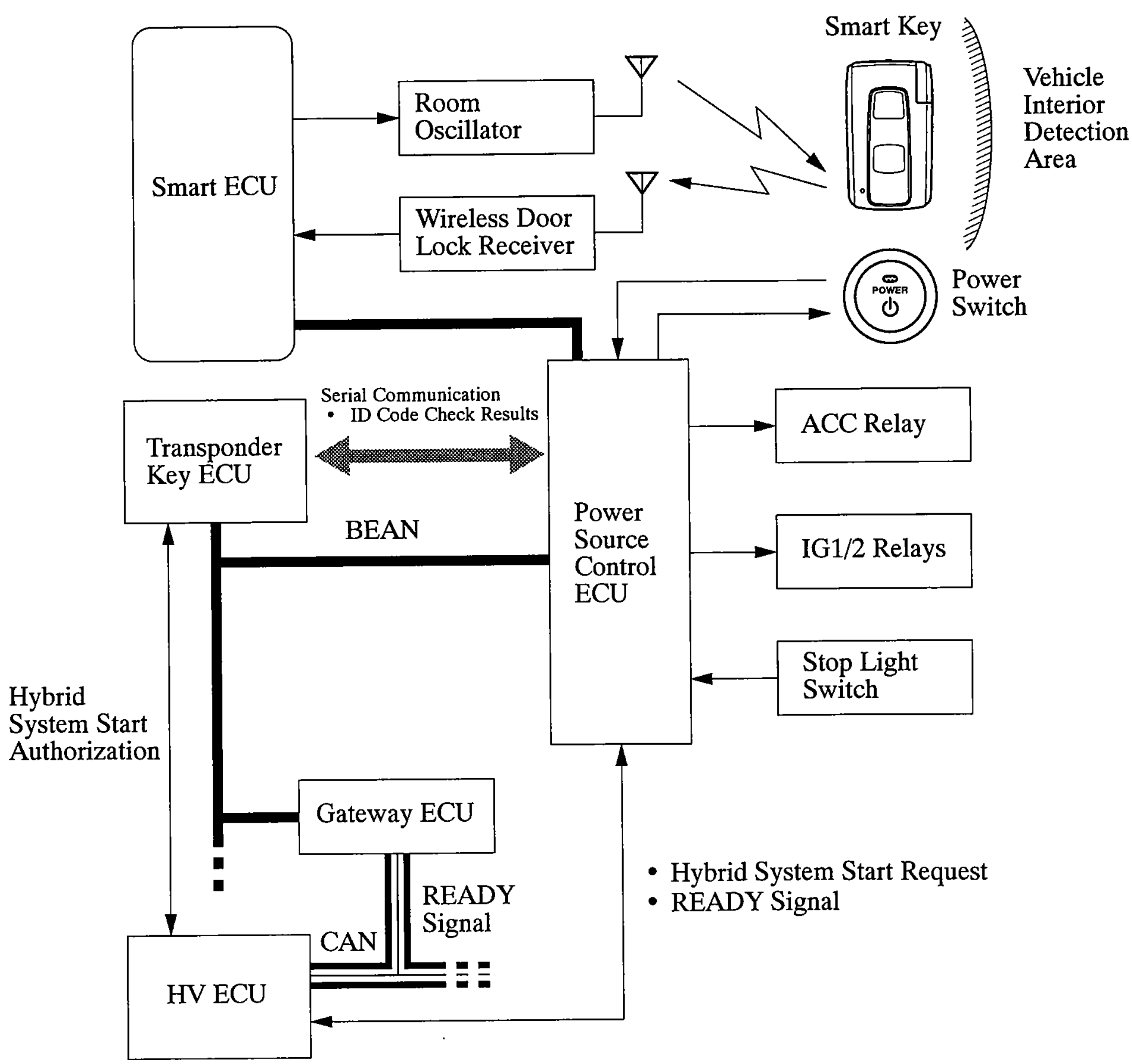
OFF → ACC → IG-ON

- If the driver presses the power switch once without pressing the brake pedal, the room oscillator forms a smart key detection area inside the vehicle by emitting smart key detection signals in accordance with the request signal received from the smart ECU. Accordingly, the smart key sends an ID code signal to the smart ECU via the wireless door lock receiver. The smart ECU checks the ID code of the smart key and transmits the check results to the transponder key ECU.
- The transponder key ECU transmits the check results to the power source control ECU. If the check results reveal that the ID code is legitimate, the power source control ECU will turn ON the ACC relay and start the ACC power supply. At this time, the power source control ECU illuminates a green indicator light on the power switch in order to inform the driver of the ACC power mode.
- After the transition to the ACC power mode, if the driver presses the power switch again, the power source control ECU will turn ON the IG1 and IG2 relays and start the IG power supply. At this time, the power source control ECU illuminates an amber indicator light on the power switch in order to inform the driver of the IG-ON power mode.



OFF → READY

- If the driver presses the power switch once while pressing the brake pedal, the room oscillator forms a smart key detection area inside the vehicle by emitting smart key detection signals in accordance with the request signal received from the smart ECU. Accordingly, the smart key sends an ID code signal to the smart ECU via the wireless door lock receiver.
- The smart ECU checks the ID code of the smart key and transmits the check results to the transponder key ECU.
- The transponder key ECU transmits the check results to the power source control ECU. If the check results reveal that the ID code is legitimate, the power source control ECU will turn ON the ACC, IG1 and IG2 relays and start the ACC and IG power supply.
- At this time, the power source control ECU illuminates an amber indicator light on the power switch in order to inform the driver of the IG-ON power mode.
- After the indicator light has illuminated, the power source control ECU transmits a hybrid system start request signal to the HV ECU.
- Upon receiving this signal, the HV ECU verifies the check results of the smart key ID code provided by the transponder key ECU.
- If the check results reveal that the ID code is legitimate, the HV ECU starts the hybrid system.
- At this time, the power source control ECU will turn OFF the indicator light on the power switch in order to inform the driver of the READY mode.



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NOTE: Handling Precaution for Smart Ignition

- If the power switch is pressed while the smart key is not located within the vehicle interior detection area, the smart entry system warning light will illuminate and a buzzer will beep inside the vehicle.
- The hybrid system can be started (READY) if the smart key is located in the vehicle interior. Before exiting the vehicle, return to the power switch to the OFF position, and carry the smart key in your possession.
- If the smart key is taken out of the vehicle without returning the power switch to the OFF position, and if any door that is open is subsequently closed, the following warning will be issued to alert the driver that the power switch has not been turned OFF: the buzzer in the combination meter and the wireless door lock buzzer sound. At the same time, the smart entry system warning light will illuminate.
- The genuine formal key (smart key) can be inserted in the IG-ON mode or with the hybrid system starting (READY). Do not insert any key other than the genuine formal key.

6. Warning Function

General

Because the smart entry & start system is so convenient, the driver could become unaware of the presence of this key, which could lead to human errors.

Examples: 1. The driver is unaware that the smart key has been taken out of the vehicle by an occupant.
2. The driver exits the vehicle while the hybrid system is operating.
3. The driver exits the vehicle with its shift position in a position other than “P”.

If the situations described above occur, they could lead to a serious problem, such as an inability to restart the hybrid system once it has been turned OFF or the possible theft of the vehicle.
For this reason, the system is equipped with warning functions against possible human errors (as well as some non-human errors) assuming the situations described below.

- Warning against the driver taking the smart key outside the vehicle with its shift position in “P”.
- Warning against the driver taking the smart key outside the vehicle with its shift position in a position other than “P”.
- Warning against an occupant taking the smart key outside the vehicle.
- Warning against operating the smart lock while the hybrid system is in operation.
- Warning against operating the door lock while the smart key remains inside the vehicle.
- Warning on the low capacity of the battery in the smart key.
- Warning against operating the smart ignition outside the detection area of the room oscillator.
- Warning against operating the door lock while any of the doors is open.

Warning Against the Driver Taking the Smart Key Outside the Vehicle With Its Shift position in “P”

<table>
<tr><td colspan="2">Possible Effects without Warning</td><td>Vehicle theft or inability to restart the hybrid system</td></tr>
<tr><td colspan="2">Detection Conditions</td><td>If all the conditions listed below are met and the result of the smart key ID code check by the room oscillator is NG, a warning will be issued.
• Shift position is in the P position.
• Power switch is in a position other than OFF.
• Driver door that is opened and is closed.</td></tr>
<tr><td rowspan="3">Warning</td><td>Smart Entry System Warning Light</td><td>Illuminates upon detection, and turns OFF if the power switch is turned OFF or the result of the smart key ID code check by the room oscillator is OK.</td></tr>
<tr><td>Buzzer (Combination Meter)</td><td>Sounds once upon detection. Sounds once again if the vehicle is started to be driven in this state.</td></tr>
<tr><td>Wireless Door Lock Buzzer</td><td>Sounds 3 times upon detection and stops if the power switch is turned OFF or the result of the smart key ID code check by the room oscillator is OK.</td></tr>
</table>

Warning Against the Driver Taking the Smart Key Outside the Vehicle With Its shift position In A Position Other Than "P"

Possible Effects without Warning		Vehicle theft or inability to restart the hybrid system.
Detection Conditions		If all the conditions listed below are met and the result of the smart key ID code check by the room oscillator is NG, a warning will be issued. • Shift position is not in the P position. • Power switch is in the ACC, IG-ON or READY position. • Driver door that is opened and closed.
Warning	Smart Entry System Warning Light	Illuminates upon detection, and turns OFF if the power switch is turned OFF or the result of the smart key ID code check by the room oscillator is OK. The warning message is displayed in the multi display.
	Buzzer (Combination Meter)	Sounds continuously upon detection, and stops if the power switch is turned OFF, the shift position is changed to "P", or the result of the smart key ID code check by the room oscillator is OK.
	Wireless Door Lock Buzzer	Sounds continuously upon detection, and stops if the power switch is turned OFF, the shift position is changed to "P", or the result of the smart key ID code check by the room oscillator is OK.

Warning Against an Occupant Taking the Smart Key Outside the Vehicle

Possible Effects without Warning		Inability to restart the hybrid system.
Detection Conditions		If all the conditions listed below are met and the result of the smart key ID code check by the room oscillator is NG, a warning will be issued. • Power switch is in a position other than OFF. • A door other than the driver door that is opened and is closed.
Warning	Smart Entry System Warning Light	Illuminates upon detection, and turns OFF if the power switch is turned OFF or the result of the smart key ID code check by the room oscillator is OK.
	Buzzer (Combination Meter)	Sounds once upon detection. Sounds once again if the vehicle is started to be driven in this state.
	Wireless Door Lock Buzzer	Sounds 3 times upon detection, and stops if the power switch is turned OFF or the result of the smart key ID code check by the room oscillator is OK.

Warning Against Operating the Smart Lock While the Hybrid System is in Operation

Possible Effects without Warning		Vehicle theft or inability to restart the hybrid system.
Detection Conditions		If all the conditions listed below are met, the result of the smart key ID code check by the room oscillator is NG, and the result of the smart key ID code check by the door oscillator is OK, a warning will be issued. • Shift lever is in the P position. • Power switch is in a position other than OFF. • All door are closed. • Lock switch on the outside door handle is ON.
Warning	Smart Entry System Warning Light	Illuminates upon detection, and turned OFF if the power switch is turned OFF or the result of the smart key ID code check by the room oscillator is OK.
	Buzzer (Combination Meter)	—
	Wireless Door Lock Buzzer	Sounds for 2 seconds.

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Warning Against Operating the Door Lock While the Smart Key Remains in the Vehicle

Possible Effects without Warning		Vehicle theft.
Detection Conditions		If all the conditions listed below are met and the result of the smart key ID code check by the room oscillator is OK, a warning will be issued. • Power switch is in the OFF position. • All door are closed. • Lock switch on the outside door handle is ON.
Warning	Smart Entry System Warning Light	—
	Buzzer (Combination Meter)	—
	Wireless Door Lock Buzzer	Sounds for 2 seconds.

Warning on the Low Capacity of the Battery in the Smart Key

Possible Effects without Warning		Smart control is suddenly disabled.
Detection Conditions		If the condition given below is met, and the smart ECU receives a code indicating the voltage drop of the smart key battery while the room oscillator checks the smart key ID code. • The power switch has been turned OFF after 20 or more minutes have elapsed after the hybrid system has been started.
Warning	Smart Entry System Warning Light	—
	Buzzer (Combination Meter)	Sounds once upon detecting.
	Wireless Door Lock Buzzer	—

Warning Against Operating the Smart Ignition Outside the Detection Area of the Room Oscillator

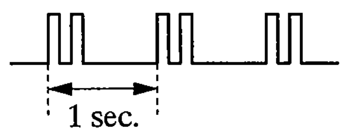
Possible Effects without Warning		User is perplexed
Detection Conditions		If the condition given below is met and the result of the smart key ID code check by the room oscillator is NG, a warning will be issued. • Power switch is pushed.
Warning	Smart Entry System Warning Light	Illuminates for 5 seconds upon detection.
	Buzzer (Combination Meter)	Sounds once upon detecting.
	Wireless Door Lock Buzzer	—

Warning Against Operating the Door Lock While Any of the Doors is Open

Possible Effects without Warning		Vehicle theft.
Detection Conditions		If all the conditions listed below are met, a warning will be issued. • Power switch is in the OFF position. • Any of the doors is open. • Lock switch on the outside door handle is ON.
Warning	Smart Entry System Warning Light	—
	Buzzer (Combination Meter)	—
	Wireless Door Lock Buzzer	Sounds for 10 seconds, and stops when 10 seconds have passed or if the door is closed.

7. Smart Unlock Mode Selector Function

- When the power switch is OFF, and the smart key's lock switch and panic switch remain depressed for approximately 5 seconds, the smart unlock mode can be switched as follows: individual door unlock → driver's door unlock → all door unlock → individual door unlock.
- The control for informing the user of the conditions at this time is effected as described below.

Unlock Mode	Wireless Door Lock Buzzer	Buzzer (in Combination Meter)
Individual Door	 189BE178	Sounds once
All Door	 255BE130	Sounds once
Driver's Door (Default Setting)	 189BE180	Sounds once

NOTE:
- This function only switches the unlocking modes of the smart entry & start system. It dose not switch the unlocking of the wireless door lock remote control system.
- When changing the mode, be sure to push both LOCK and PANIC buttons firmly, or panic alarm may be activated.

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8. Power Saving Function

- When the doors are locked, the door oscillators emit signals outside of the vehicle at prescribed intervals (300 msec). Therefore, the auxiliary battery could be drained if the vehicle remains parked for a long time.
- If the smart key is constantly located within the vehicle exterior detection area, the system maintains periodic communication with the smart key. Therefore, if the vehicle remains parked in the state for a long time, the smart key and the auxiliary battery could be drained.

To prevent the smart key battery and the auxiliary battery from being depleted in the conditions indicated above, the smart entry & start system effects the controls listed in the table below.

<table>
<tr><th>Condition</th><th>Control</th><th>Reinstatement Condition</th></tr>
<tr><td>Vehicle remains parked for a long time.
• No response from smart key for more than 5 days</td><td>Signal transmission interval is extended from 300 msec. to 600 msec.</td><td rowspan="3">• A wireless door lock remote control signal (lock or unlock) is input and the ID code matches.
• A lock switch signal is input.
• A door is locked or unlocked in unison with the movement of the mechanical key.</td></tr>
<tr><td>Vehicle remains parked for a long time.
• No response from smart key for more than 14 days</td><td>Automatically deactivates the smart entry & start system</td></tr>
<tr><td>Vehicle remains parked for a long time.
• Smart key is located in the vehicle exterior detection area for longer than 10 minutes.</td><td>Automatically deactivates the smart entry & start system</td></tr>
</table>

■SMART ENTRY & START SYSTEM OPERATION PRECAUTIONS

1. Smart Functions in General

Functions and Operation Ranges:

The functions will not operate if the smart key is not present within the detection areas described below. Furthermore, the functions may not operate or their operating range may decrease if the battery is drained or in the presence of strong radiowaves or noise. There are also areas in which the functions may not operate properly due to the shape of the vehicle body.

- Smart lock and smart unlock: Applicable within approximately 0.7 to 1.0 m (2.3 to 3.3 feet) radius from each front door handle.
  However, this function may not operate near the windows or door handles.
- Smart ignition: Applicable within vehicle interior.
  This function may not operate if the smart key is placed on the instrument panel, on the rear tray, in the grove box, or on the floor; therefore, do not place the smart key in those areas. If the smart key is placed in the luggage compartment, the hybrid system cannot be started. Even if the smart key is placed outside of the vehicle, this function may not operate if the smart key is placed near a window.
- Smart back door unlock: Applicable within approximately 0.7 to 1.0 m (2.3 to 3.3 feet) radius from the back door opener switch.
  However, this function may not operate if the smart key is placed near the center of a rear bumper.

The smart entry & start system uses very weak radiowaves:

The smart functions and the wireless door lock remote control functions may not operate properly (unable to operate the smart lock, unlock, ignition, and back door unlock functions, or a false alarm is issued) in the situations described below. In this case, use the enclosed mechanical key to lock or unlock the driver's door and insert the smart key to start the hybrid system.

- The presence of a facility that generates strong radiowaves nearby, such as a TV tower, electric power plant, or broadcasting station.
- The user has a wireless communication device such as a wireless transmitter or portable telephone along with the smart key.
- The smart key is covered with a metal object or is placed near a metal object.
- A radiowave type wireless door lock remote control is being used in the vicinity.
- When placing by electrical appliances etc.

2. Smart Entry & Start System Inoperative Condition

The smart function will not operate under the conditions listed below. Make sure to check them in case the smart functions do not operate at all.

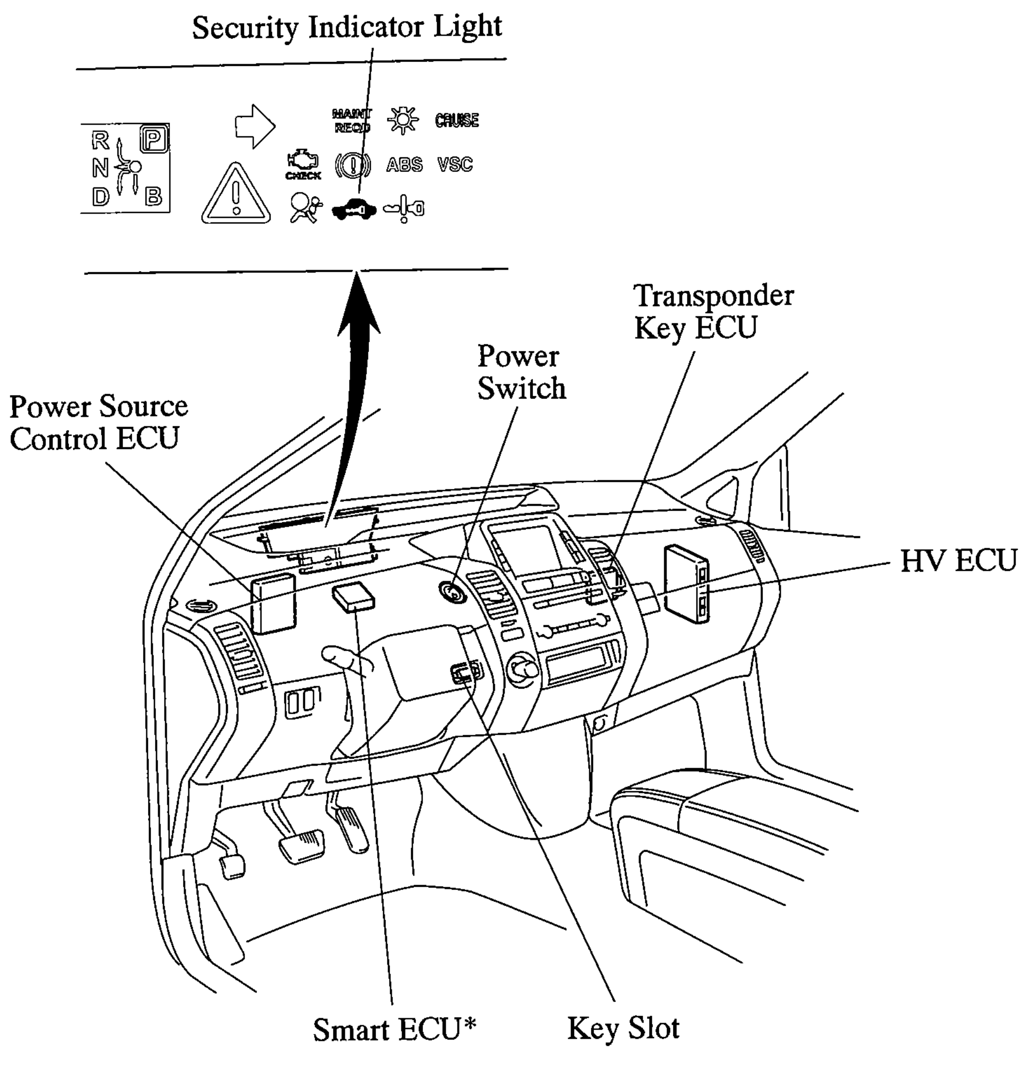
- The smart cancel switch provided below the driver's side instrument panel is turned ON.
- The smart key is inserted in the card slot.
- There is no battery in the smart key (the indicator light dose not flash even if the buttons on the smart key are depressed).

HV IMMOBILIZER SYSTEM

■ DESCRIPTION

- This system has been provided as standard equipment on all models.
- The HV immobilizer system is a theft deterrent system that disables the THS II (TOYOTA Hybrid System II) from starting using the key with an ID code that is matched to the pre-registered code in the vehicle.
- The HV immobilizer system compares the ID code that is registered in the transponder key ECU with the ID code of the transponder chip that is embedded in the key. The HV immobilizer system unsets if these ID codes do not match. Thus, the transponder key ECU maintains communication with the HV ECU, power source control ECU, and smart ECU* in order to authorize the starting of the hybrid system (READY) and the transition of the power mode through the operation of the power switch.

▶ Layout of Main Component ◀



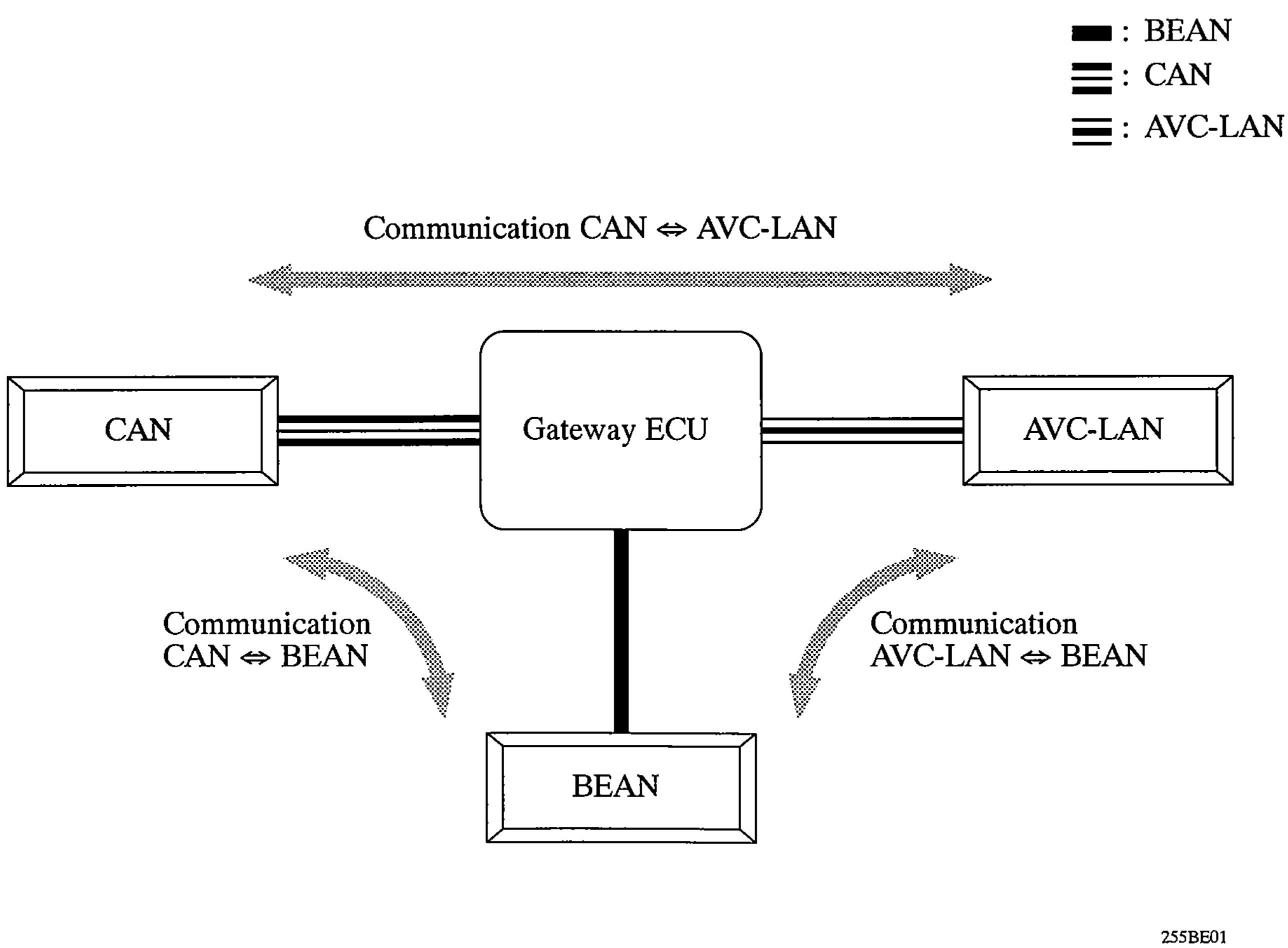
*: Models with Smart Entry and Start System

Service Tip
In case of making new key due to the loss of it, it is necessary to register recognition code. Refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

MULTIPLEX COMMUNICATION

■ DESCRIPTION

- The '04 Prius primarily uses the three types of multiplex communication systems described below in order to achieve a slimmer wiring harness configuration.
  - CAN (Controller Area Network), which networks the vehicle control systems (engine electrical, chassis electrical, and hybrid system) and maintains communication between the ECUs, has been newly adopted.
  - BEAN (Body Electronics Area Network), which networks the ECUs of the body electric system control and maintains communication between the ECUs, continues to be used.
  - AVC-LAN (Audio Visual Communication - Local Area Network), which networks the ECUs of the audio visual system and the audio visual devices, and maintains communication between the devices and the ECUs, continues to be used.
- These three types of multiplex communication systems are connected to the gateway ECU. The gateway ECU, which is provided with communication circuits that support the three types of multiplex communication systems, enables communication among the multiplex communication systems that are connected to the gateway ECU.
  For example, to enable air conditioning control, the air conditioning ECU receives the engine coolant temperature signal that is input into the ECM via CAN, gateway ECU, and BEAN. Thus, a slimmer wiring harness configuration can be realized.



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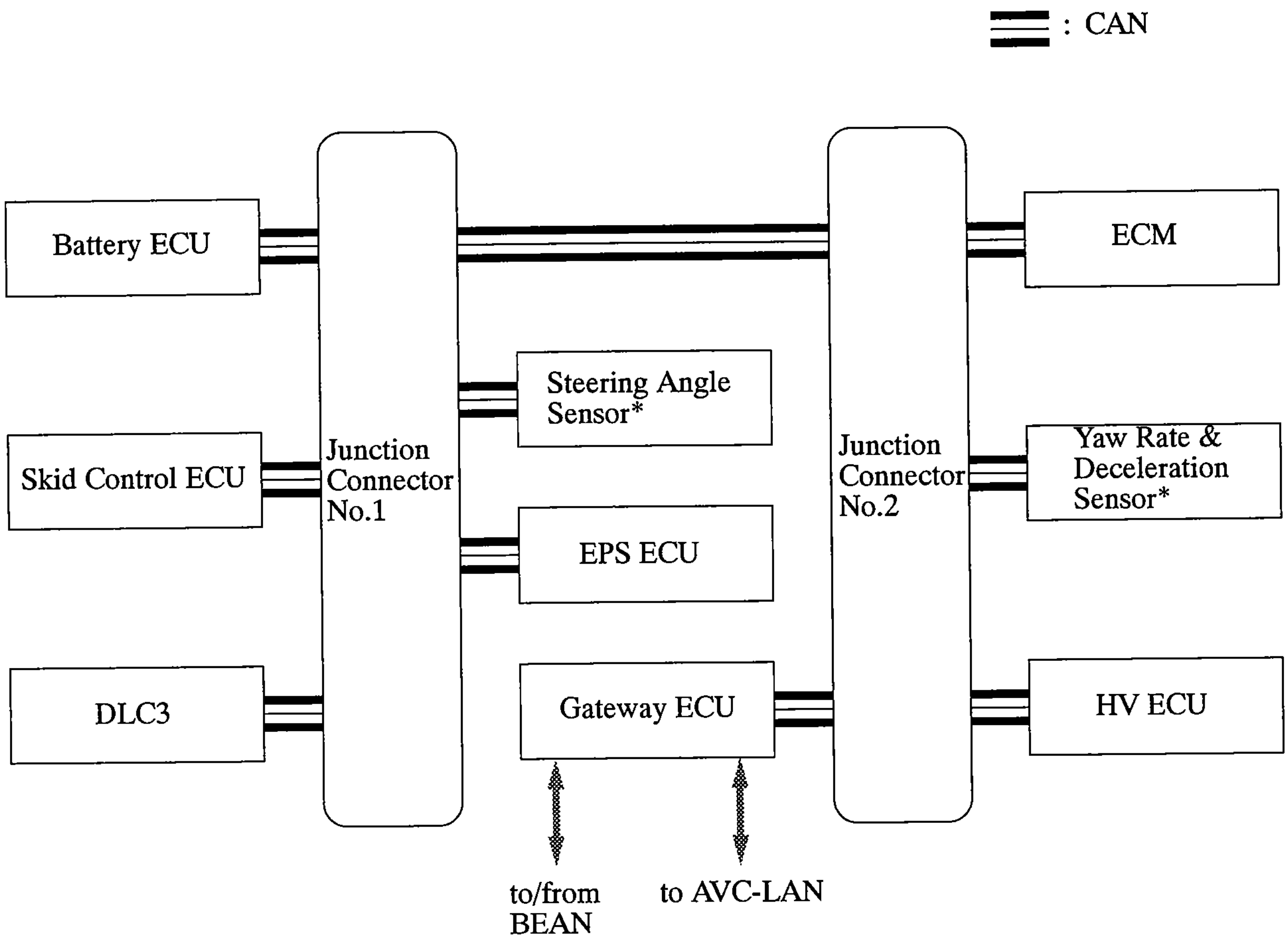
- The CAN in the '04 Prius is established among the HV ECU, battery ECU, EPS ECU, ECM, skid control ECU, steering angle sensor, yaw rate & deceleration sensor, gateway ECU and DLC3.

▶ CAN System Diagram ◀



*: with Enhanced VSC System

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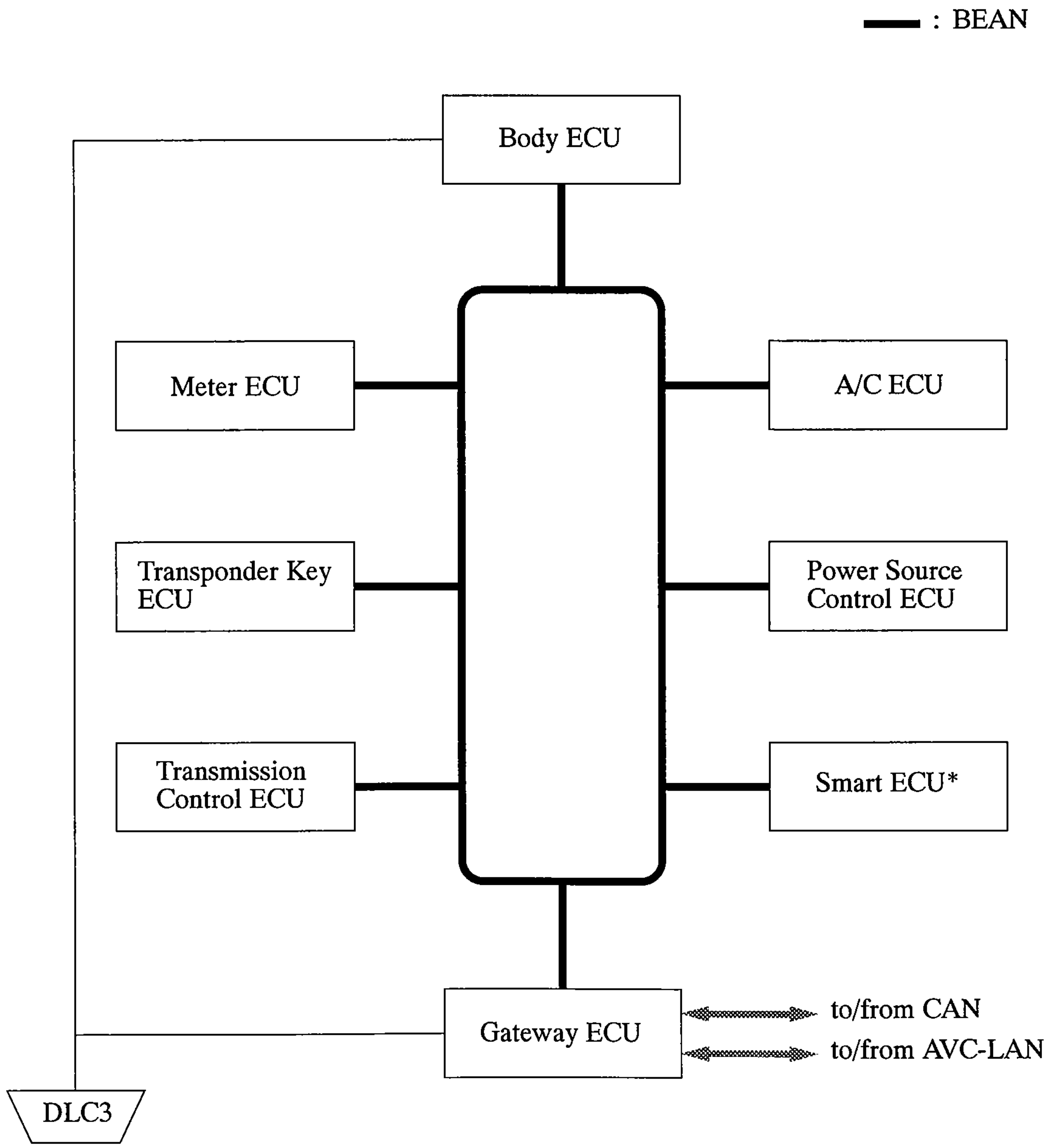
- The configuration of the BEAN has been changed in accordance with the addition of equipment.
- The BEAN in the '04 Prius is established among the body ECU, meter ECU, air conditioning ECU, transponder key ECU, power source control ECU, transmission control ECU, smart ECU* and gateway ECU.
- A customized body electronic system has been adopted, enabling the control functions of the ECUs comprising the BEAN to be set using a hand held tester. For details, see page BE-64 of the customized body electronic system section.

▶ BEAN System Diagram ◀



*: Optional Equipment

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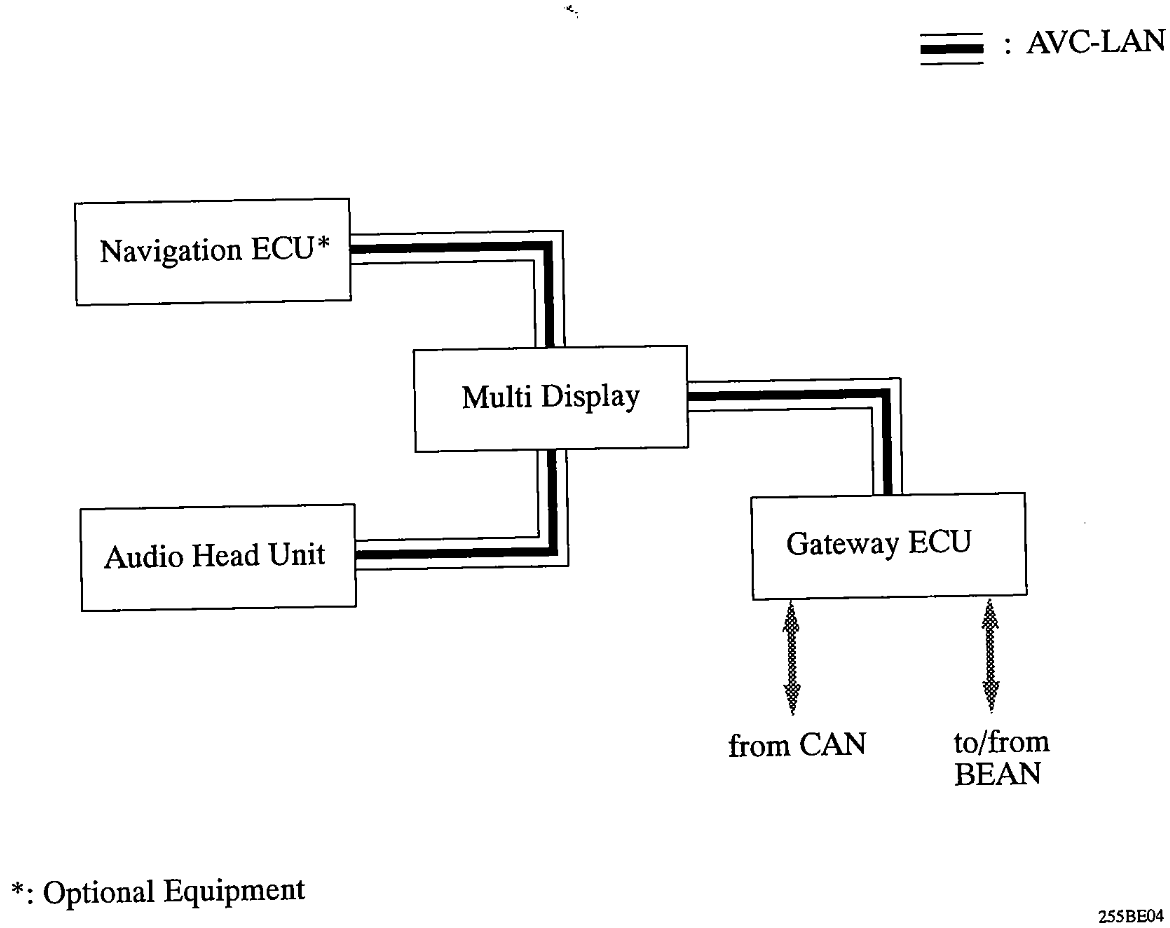
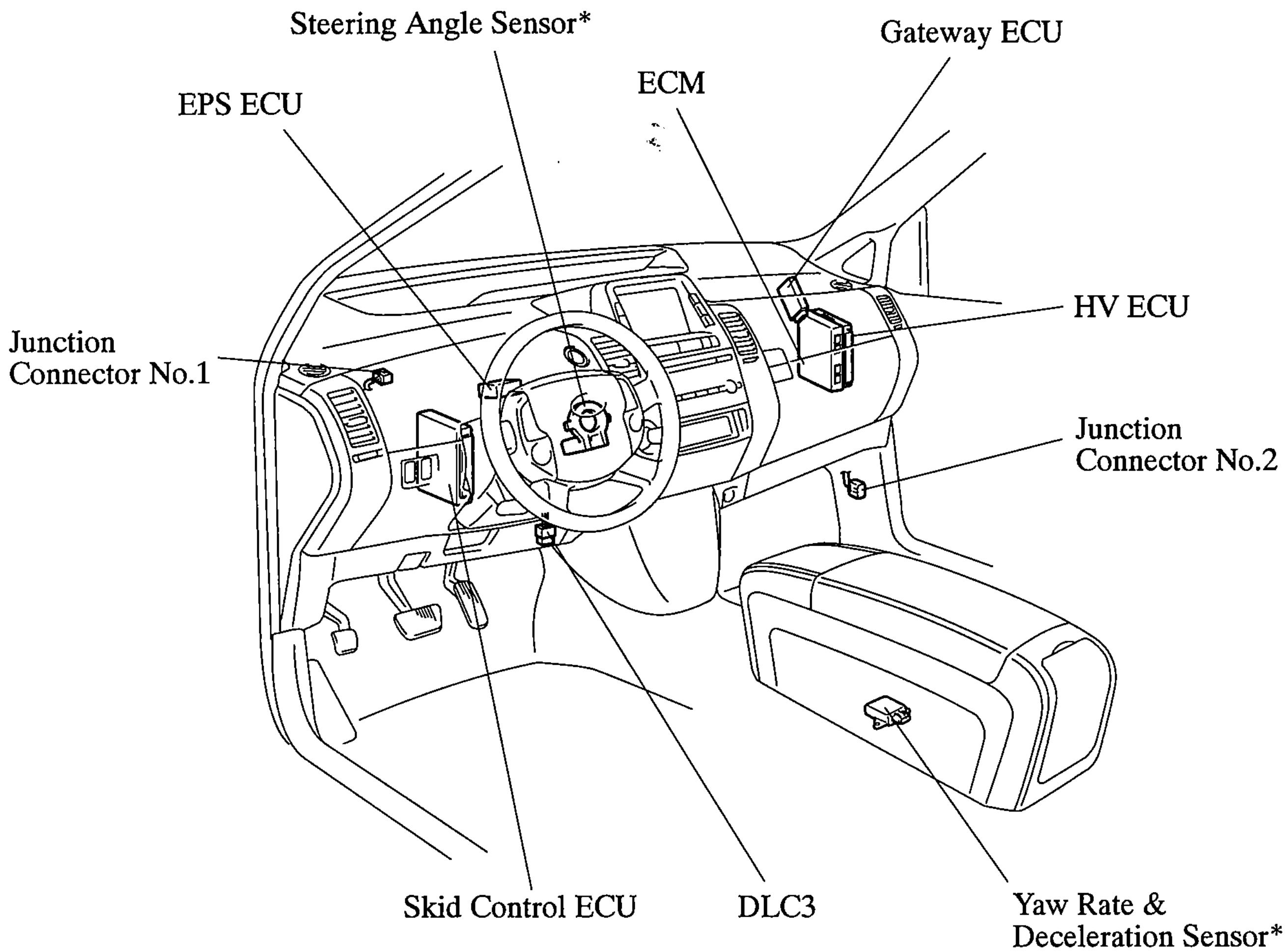
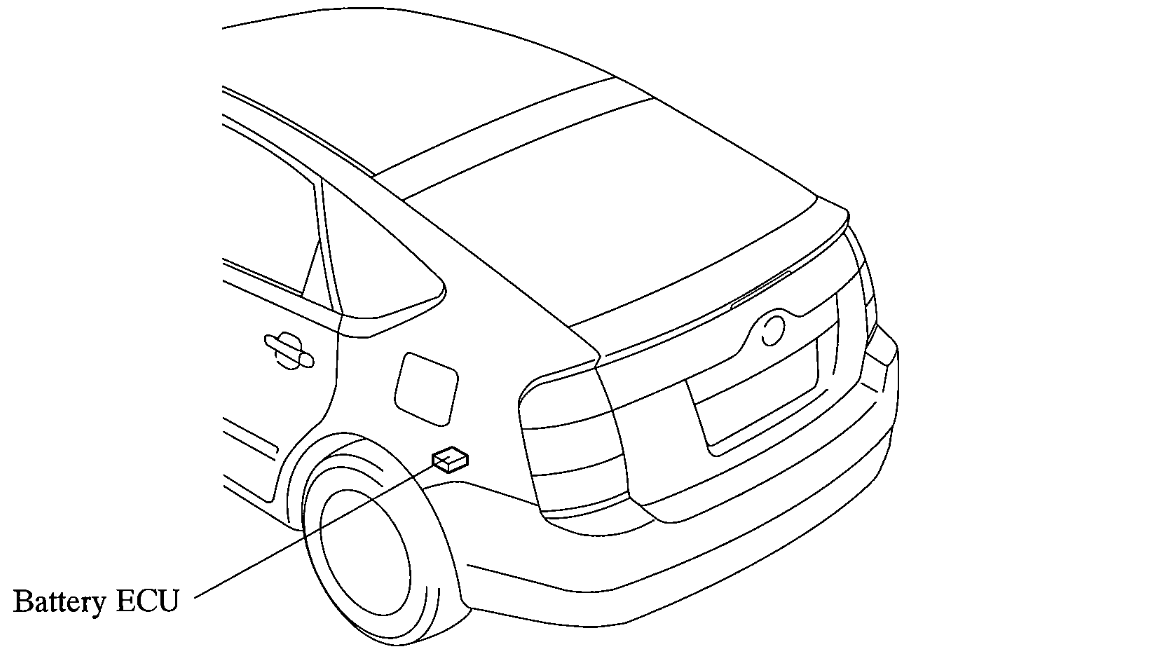
- The AVC-LAN is established among the multi display, audio head unit, navigation ECU* and gateway ECU.

▶ AVC-LAN System Diagram ◀



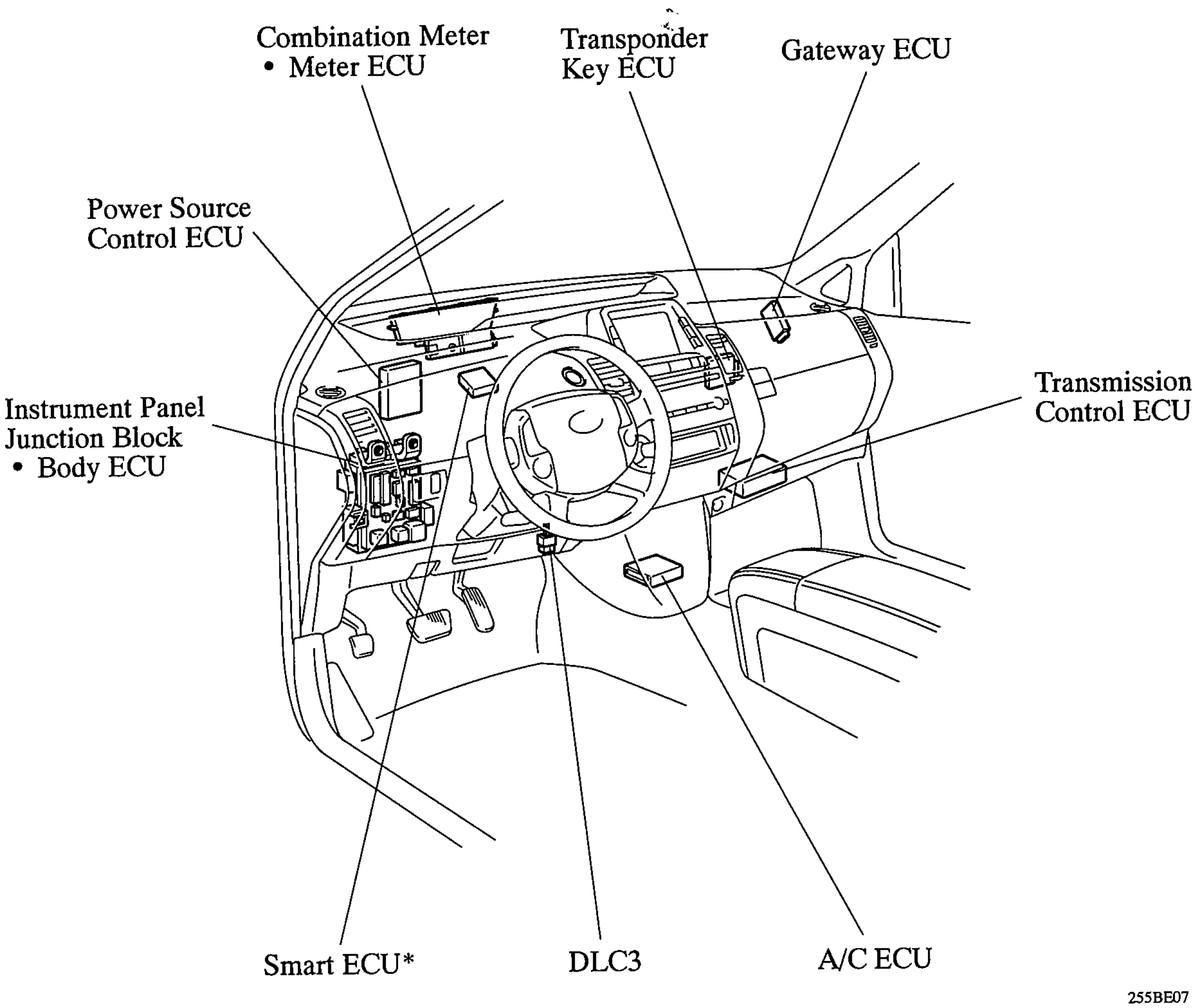
■ LAYOUT OF CAN COMPONENT





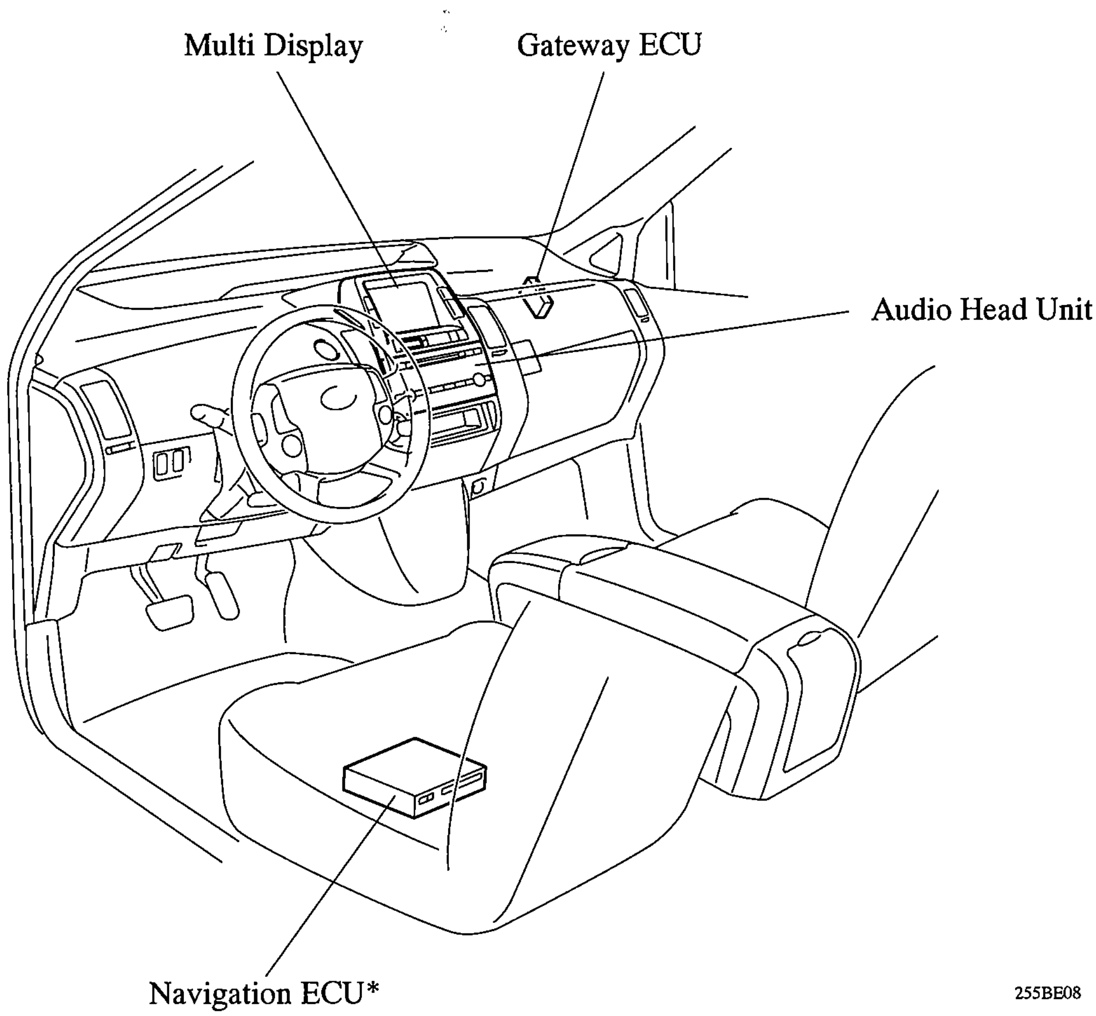
*: with Enhanced VSC System

■ LAYOUT OF BEAN COMPONENT



*: Optional Equipment

■ LAYOUT OF AVC-LAN COMPONENT



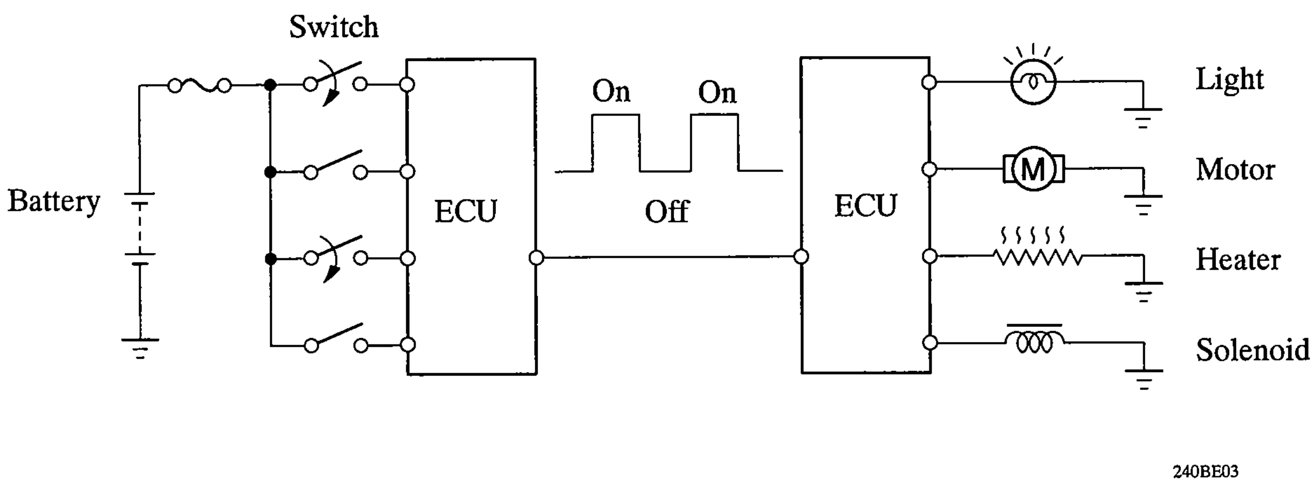
*: Optional Equipment

■ BASIC OF MPX (MULTIPLEX COMMUNICATION)

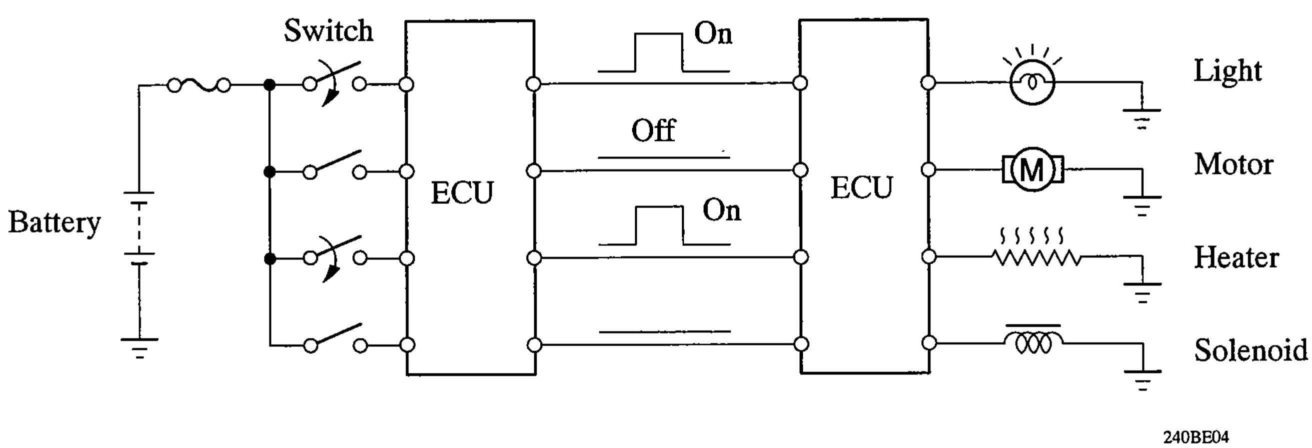
1. General

In the conventional system, parallel communication is used to exchange information between ECUs. To transmit four pieces of information, for example, parallel communication requires four communication wires. In contrast, multiplex communication is used on serial communication, which converts multiple pieces of information into serial communication data. Thus, they can be transmitted through a single communication wire.

▶ Conceptual Drawing ◀

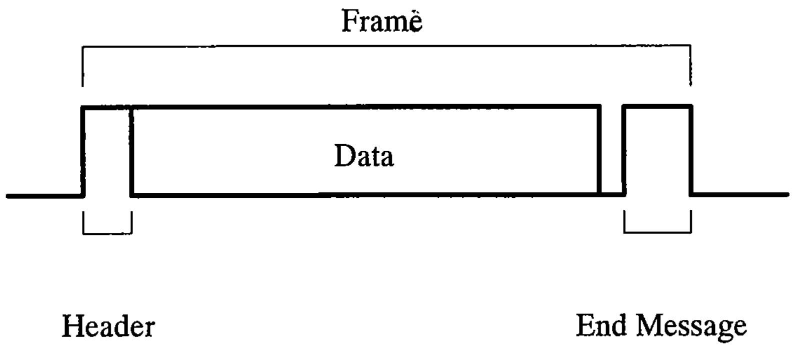


Serial Communication



Parallel Communication

- Serial communication data consists of bits and frames. A bit is the basic unit that represents the amount of information. A bit is represented by binary values "0" or "1". A frame is a body of data that is transmitted together. A frame contains a header that indicates the beginning, and an end message that indicates the end.



240BE05

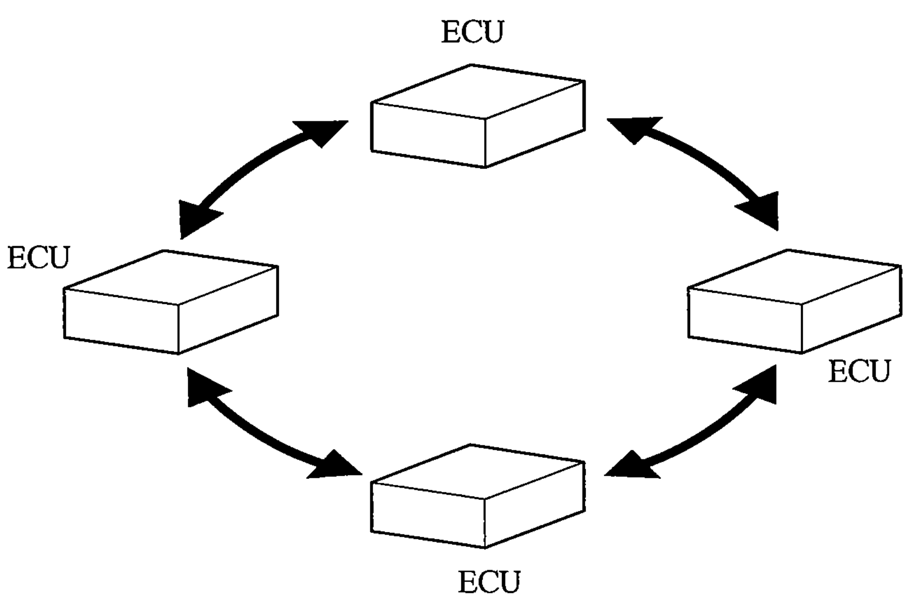
2. Network Style

General

Based on serial communication, various ECUs are connected on a network to exchange various pieces of information. Such a system is called "Multiplex Communication". There are three styles of networks: ring, star, and bus.

Ring Style

In this style of network, the ECUs are connected in a ring form. A feature of this style is that a signal that is output by a transmitting ECU circles the ring and returns to its original ECU.



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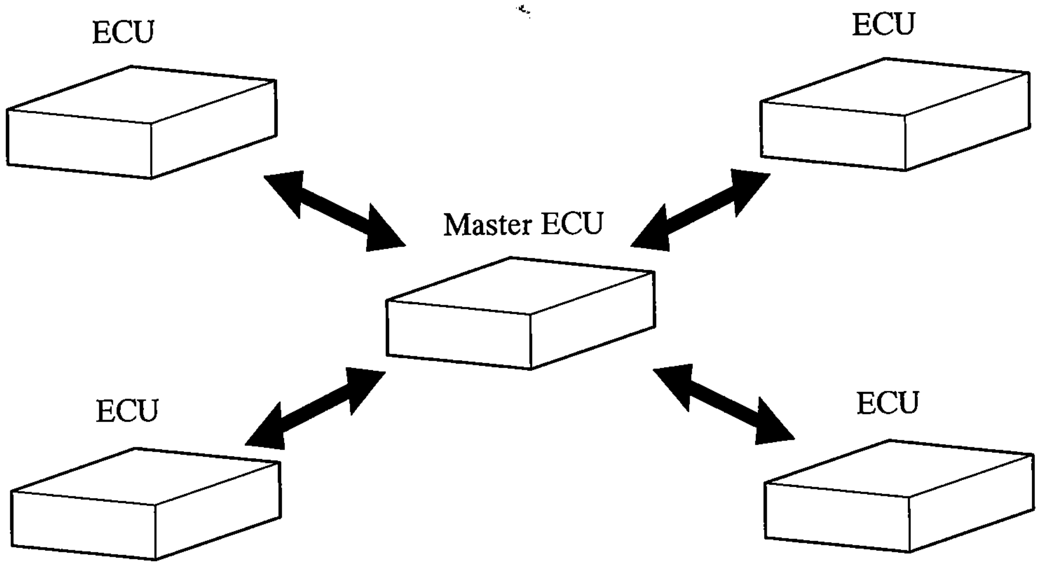
Star Style

This style is centered on a master ECU, which holds a central control function. The ECUs are connected in a star shape. The ECUs cannot establish communication with other ECUs without passing through the master ECU.



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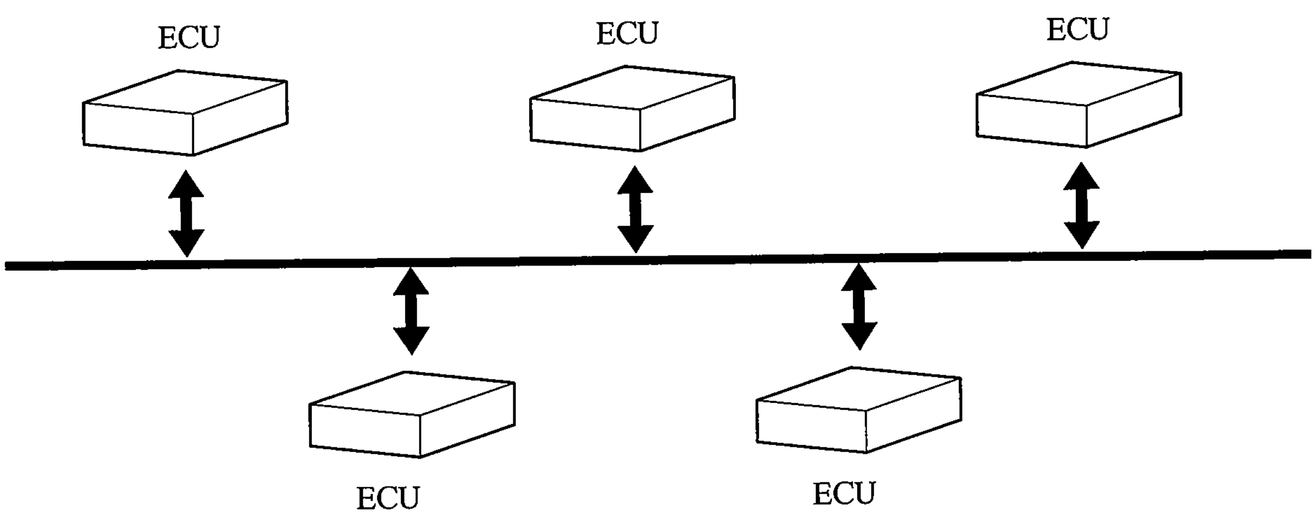
Bus Style

In this style of network, all ECUs are connected to a single common communication wire. The transmitting ECUs output signals through a common communication wire and the receiving ECUs input data through a common communication wire.



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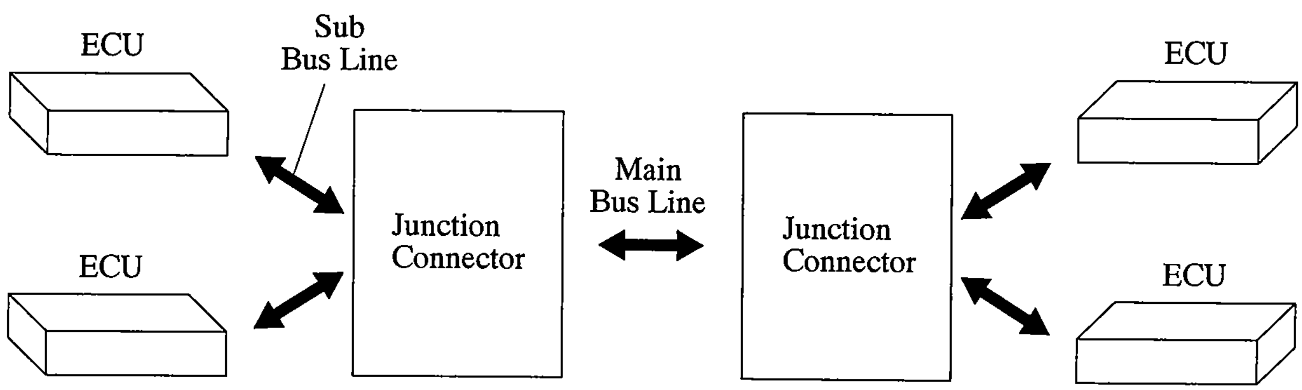
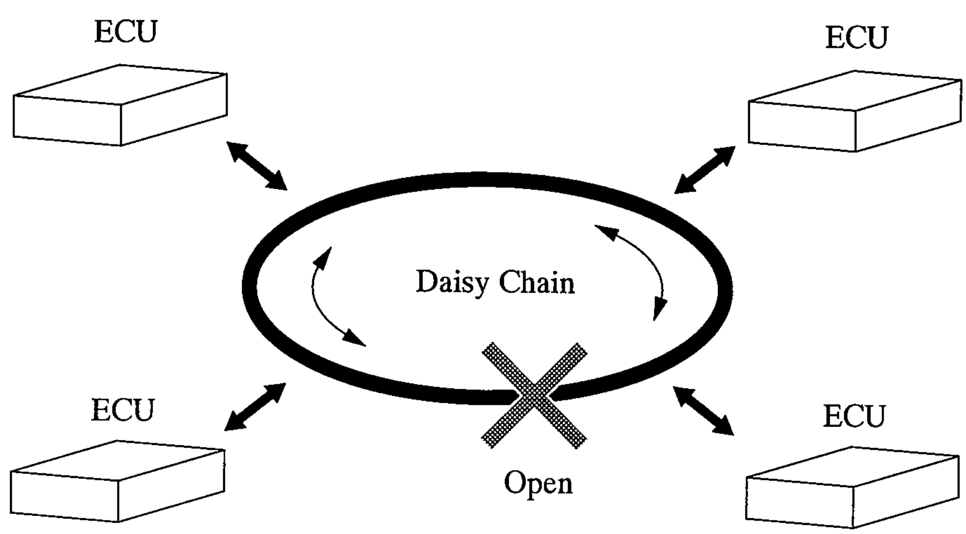
— REFERENCE —

- CAN communication on the '04 Prius uses the multi star style bus connection. The two junction connectors are connected with a main bus line. The junction connector extend sub bus line, and enables communication between all the connected ECUs.



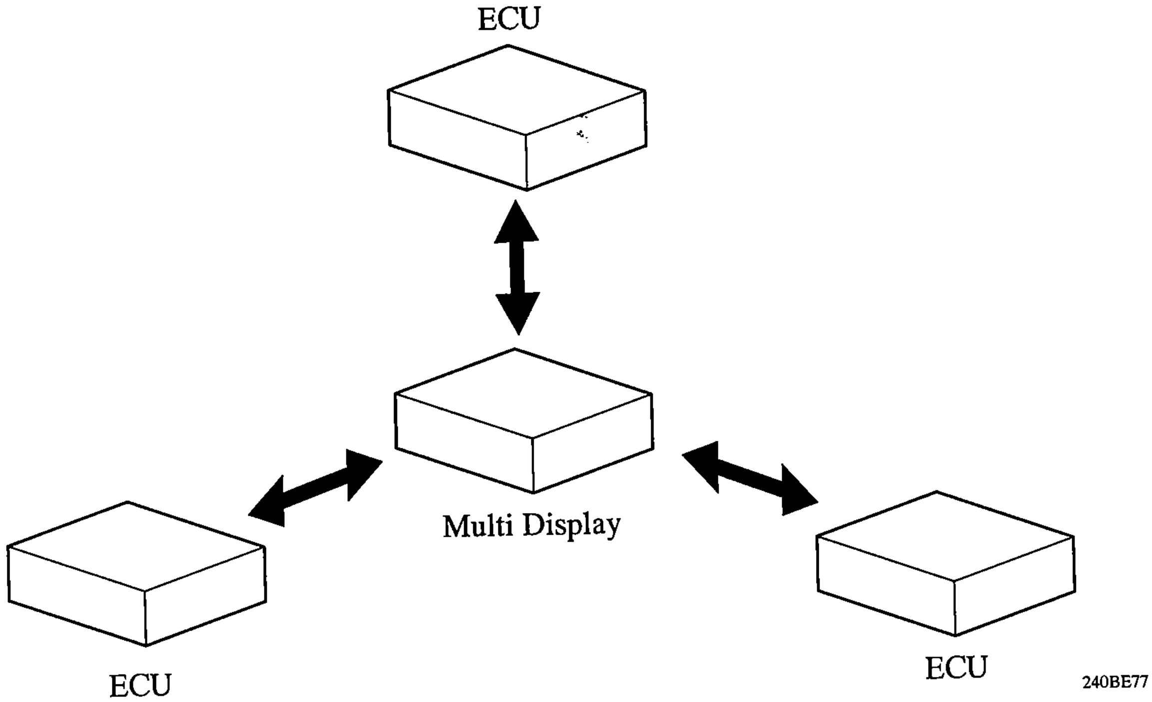
241BE02

- The BEAN on the '04 Prius uses the ring and bus styles of networks to connect ECUs. This style of connection method is called a "Daisy Chain". In a daisy chain, communication can be maintained even if there is an area that has an open circuit.



241BE06

- The AVC-LAN in the '04 Prius uses a star style, which is centered on the multi display.



3. Difference of CAN, BEAN and AVC-LAN

- The protocols, which are the rules for establishing data communication, differ between the CAN, BEAN and the AVC-LAN. If ECUs use different types of data such as communication speed, communication wire, and signals, they will be unable to understand each other. Therefore, protocols (rules) must be established among them.

Control	Chassis Electrical System Control	Body Electrical System Control	
Protocol	CAN (ISO Standard)	BEAN (TOYOTA Original)	AVC-LAN (TOYOTA Original)
Communication Speed	500 k bps* (Max. 1 M bps)	Max. 10 k bps*	Max. 17.8 k bps*
Communication Wire	Twisted-pair Wire	AV Single Wire	Twisted-pair Wire
Drive Type	Differential Voltage Drive	Single Wire Voltage Drive	Differential Voltage Drive
Data Length	1-8 Byte (Variable)	1-11 Byte (Variable)	0-32 Byte (Variable)

*: bps: abbreviation for "Bits Per Second", indicating the number of bits that can be transmitted per second.

- Although BEAN and AVC-LAN communicate at almost the same speed, the CAN communication speed is much faster than BEAN or AVC-LAN. When the vehicle control system uses BEAN or AVC-LAN, which have a slower communication speed than CAN, it means that the system control could be delayed by the slow speed. For this reason, the vehicle control system uses CAN, which can send and receive a large volume of data at one time, in addition to being able to transmit at a faster speed.
- The gateway ECU connects the CAN, BEAN, AVC-LAN and the DLC3, and manages the communication among them.

— REFERENCE —

There are two types of BEAN communication methods: the one-way type and the two-way type. The '04 Prius uses the two-way type, which is currently in the main stream.

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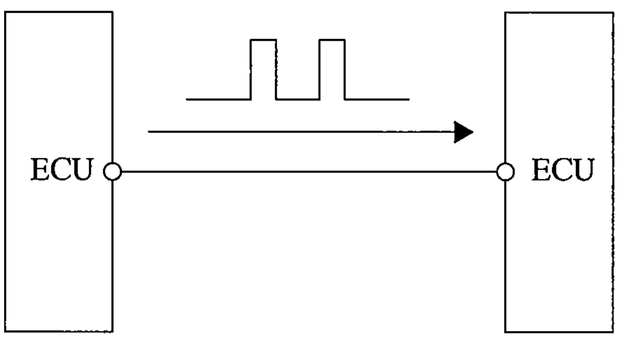

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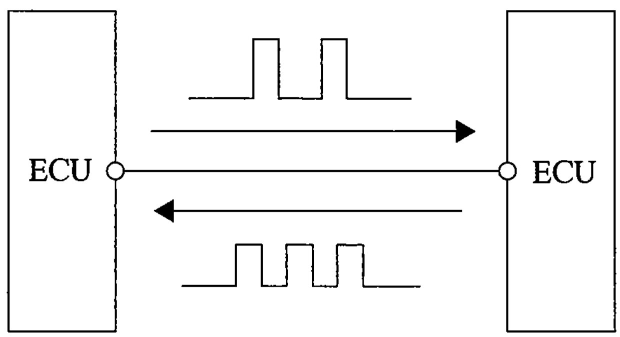
One-way Type



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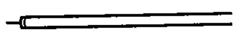
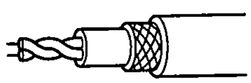
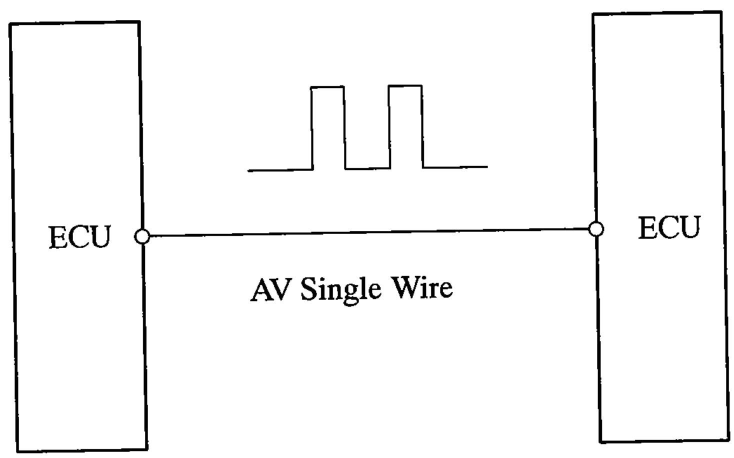
Two-way Type

4. Communication Wire

A single, AV (Automobile Vinyl) wire is used for BEAN communication. A twisted-pair wire is used for CAN and AVC-LAN communication.

Communication Wire	Outline
AV Single Wire  240BE09	This is a lightweight single communication wire that consists of a single core line surrounded by insulation. Voltage is applied to this line in order to drive communication, and this system is called a "Single Wire Voltage Drive".
Twisted-pair Wire for AVC-LAN  240BE10	In this communication wire, a pair of lines is twisted together and covered with insulation. Communication is driven by applying positive (+) and negative (-) voltage to the two lines in order to send a single signal. This system, which is called a "Differential Voltage Drive", can reduce noise.
Twisted-pair Wire for CAN  241BE168	In this communication wire, a pair of lines is twisted. Communication is driven by applying 1.5 to 2.5 V and 2.5 to 3.5 V of voltage to the two lines in order to send a single signal. This system, which is called a "Differential Voltage Drive", can reduce noise.

▶ Single Wire Voltage Drive ◀



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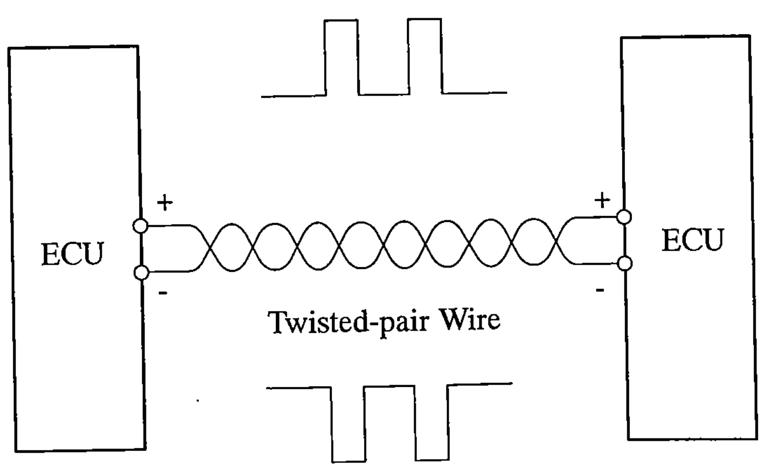
▶ Differential Voltage Drive ◀

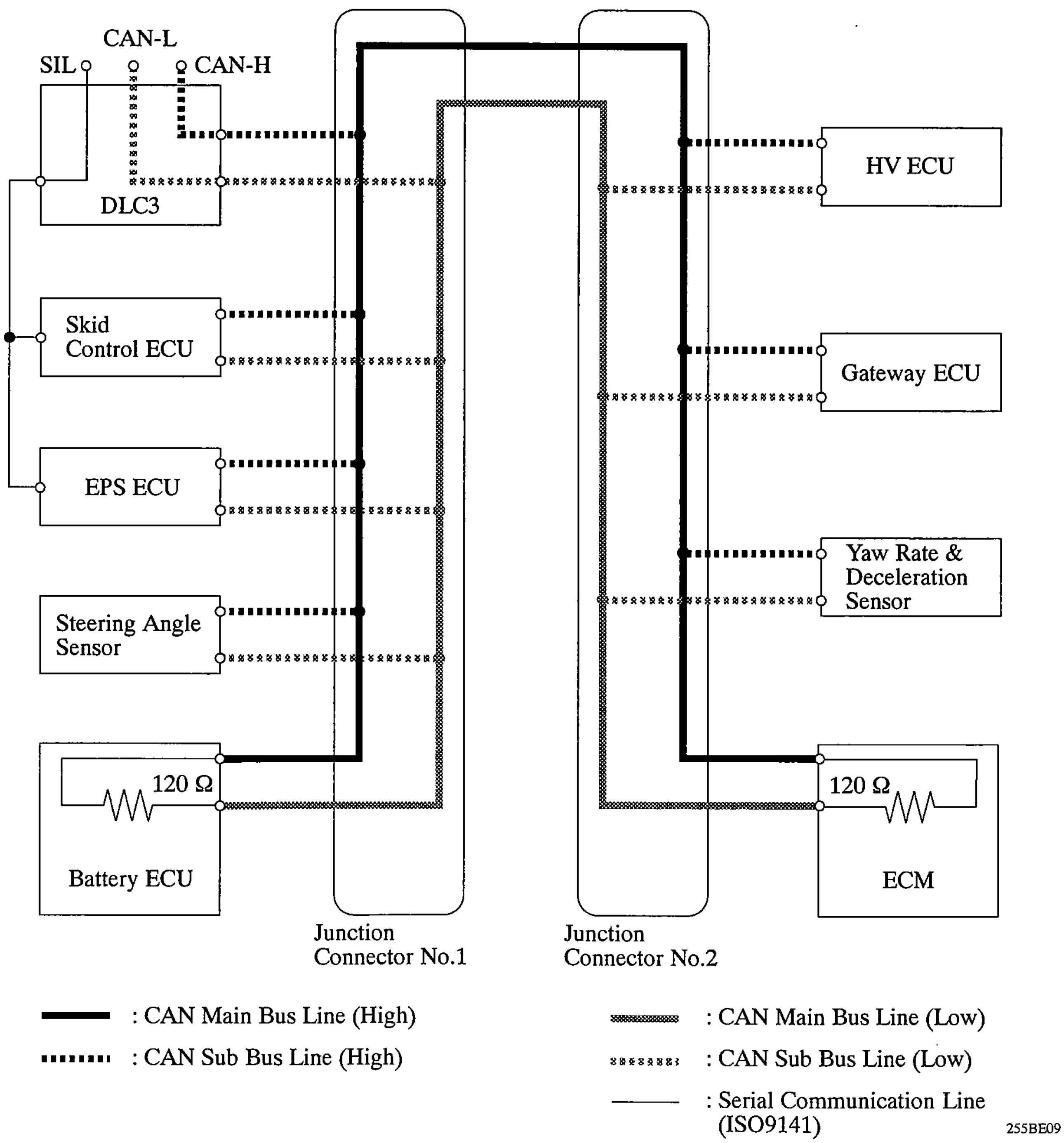


240BE12

■CAN (CONTROLLER AREA NETWORK)

1. General

- CAN is a serial data communication system for real time application. It is a multiplex communication system to be equipped for a vehicle and has a high communication speed (500 kbps) and the function to detect malfunction.
- The CAN in the '04 Prius is connected to the battery ECU, skid control ECU, EPS ECU, ECM, HV ECU, gateway ECU, steering angle sensor, yaw rate & deceleration sensor and DLC3.
- CAN uses a twisted-pair wire as the communication line, so the bus line has a high line (2.5 to 3.5 V of voltage is applied) and a low line (1.5 to 2.5 V of voltage is applied).
- The DTCs (Diagnostic Trouble Codes) associated with the engine control system and the hybrid system control are output by the respective ECUs (ECM, HV, and battery ECUs) via CAN communication to the DLC3 connector (CAN-L and CAN-H terminals), then to a hand-held tester.
- As in the past, the DTCs associated with the chassis control system (EPS and brake control system) are output by the respective ECUs (EPS and brake ECUs) via a serial communication line (ISO9141) to the DLC3 connector (SIL terminal), then to a hand-held tester.
- DLC3 is equipped with CAN-H and CAN-L terminals for CAN diagnosis. It is possible to determine if there is an open or short on the main bus line by measuring the resistance value between these terminals. For details on CAN diagnosis, see page BE-62.



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■ DIAGNOSIS

1. Diagnosis of CAN

- If a malfunction occurs on the CAN communication line, the ECU that is connected to the CAN communication line stores the DTCs (Diagnostic Trouble Codes) in its memory.
- The DTCs for CAN communication concerning the engine control and THS control can be read by connecting a hand-held tester (5-digit code).
- The DTCs for CAN communication concerning the brake control system can be read by connecting the SST 09843-18040 to the Tc and CG terminals of the DLC3 connector, and observing the blinking of the ECB, ABS and VSC warning light (2-digit code) or by connecting a hand-held tester (5-digit code).
- The details of a communication malfunction (such as the location of the malfunction) on the CAN communication line can be checked by connecting a hand-held tester to the DLC3 connector. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).
- If a communication malfunction occurs, the ECUs will perform the failsafe processes. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

▶ DTC Chart ◀

ECU	DTC	Detection Item
Battery ECU	U0100	Lost Communication with ECM/PCM "A"
	U0293	Lost Communication with Hybrid Vehicle Control System
ECM	U0293	Lost Communication with Hybrid Vehicle Control System
EPS ECU	U0073	Control Module Communication Bus Off
	U0121	Lost Communication with Anti-Lock Brake System (ABS) Control Module
HV ECU	U0100	Lost Communication with ECM/PCM "A"
	U0111	Lost Communication with Battery Energy Control Module "A"
	U0129	Lost Communication with Brake System Control Module
	U0131	Lost Communication with Power Steering Control Module
	U0146	Lost Communication with Gateway "A"
Skid Control ECU	U0073	Control Module Communication Bus Off
	U0123	Lost Communication with Yaw Rate Sensor Module
	U0124	Lost Communication with Lateral Acceleration Sensor Module
	U0126	Lost Communication with Steering Angle Sensor Module
	U0293	Lost Communication with Hybrid Vehicle Control System

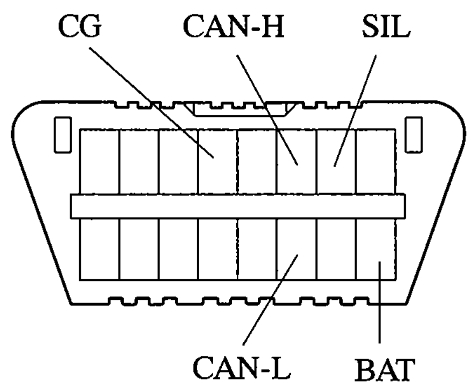
Service Tip

The diagnosis communication for engine control and hybrid system control has been changed from serial communication (ISO 9141) to CAN communication. Accordingly, a dedicated adapter (CAN VIM) must be attached to the conventional hand-held tester in order to read the DTCs and check the details of a communication malfunction. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

- DLC3 is equipped with CAN-H and CAN-L terminals for CAN diagnosis. It is possible to determine if there is an open or short on the main bus line by measuring the resistance value between these terminals. It is possible to determine if there is a short between the bus line-power supply/ground by measuring the resistance value between terminal CAN-H or CAN-L, and the BAT or CG terminal.
- For details of the CAN diagnosis system, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

▶ CAN-H - CAN-L Inspection ◀

Resistance Value	Bus line condition
54 Ω ~ 69 Ω	• Normal • Sub bus line open (except DLC3 bus line, DTC output) • Short between bus line ~ power supply/ground (Short in one area, DTC output)
more than 69 Ω	• Sub bus line open (only DLC3 bus line, No DTC output) • Main bus line open
less than 54 Ω	• Short between bus line



DLC3
241BE110

▶ Inspection for short between bus line - power supply/ground ◀

Inspection Item	Resistance Value	Bus line condition
• CAN-H~BAT • CAN-L~BAT	more than 1MΩ	No bus line malfunction if no DTC output
	less than 1MΩ	Short between bus line ~ power supply/ground
• CAN-H~CG • CAN-L~CG	more than 1kΩ	No bus line malfunction if no DTC output
	less than 1kΩ	Short between bus line ~ power supply/ground

2. Diagnosis of BEAN

If a malfunction occurs in BEAN communication line, gateway ECU stored DTCs in its memory. The DTCs can be read by connecting a hand-held tester to DLC3. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

3. Diagnosis of AVC-LAN

If a malfunction occurs in the AVC-LAN communication line, DTCs (Diagnostic Trouble Codes) are stored in the multi display memory.
DTCs for AVC-LAN can be read on the diagnosis menu display on the multi. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

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■ CUSTOMIZED BODY ELECTRONICS SYSTEM

1. General

The customized body electronics system enables the control function settings of the ECUs to be changed through the use of a hand-held tester.
However, this system can change the settings of only the ECUs that belong to the bus in which communication is centered on the body ECU.

2. Operation

The specifications of the systems and functions that can be changed by operating a hand-held tester.

System	Hand-Held Tester Display Content	Contents	Default	Selection
Wireless Door Lock Remote Control System	OPEN DOOR WARN (Open door warning)	Function to make the buzzer sound for 10 seconds if the door is open when locking with the wireless door lock function.	ON	ON/OFF
	WIRELESS OPER (Wireless door lock control function)	ON / OFF of the wireless door lock function.	ON	ON/OFF
	ALARM FUNCTION (Panic function)	Function to operate the theft deterrent system by keeping pressing the panic button of the transmitter for 0.8 seconds.	ON	ON/OFF
	UNLOCK/2 OPER (2 times operation wireless unlock)	Function to unlock the driver's door by pressing the unlock button of the transmitter once and to unlock all the doors by pressing it twice. In the OFF setting, pressing one time makes all the doors unlocked.	ON	ON/OFF
	AUTO LOCK DELAY (Auto lock time)	To change the time until re-locking after unlocking with the wireless door lock function.	30 sec.	30 sec. / 60 sec.
	HAZARD ANS BACK (Hazard answer back of the wireless)	Function to light up the all turn signal light once when pressing the transmitter lock button and twice when pressing the unlock button.	ON	ON/OFF
	WIRLS BUZZ RESP (Wireless buzzer response)	ON/OFF of the wireless buzzer response function.	ON	ON/OFF
Door Lock Control System	UNLK/KEY TWICE (Unlock w/2 times D key operation)	Function to unlock only the driver's door by doing the key operation once and to unlock all the doors by doing it twice. In the OFF setting, operating the key "UNLOCK" once makes all the doors unlocked.	ON	ON/OFF
Security*	PASSIVE MODE (Passive mode (Security system))	PASSIVE MODE is the function to set the theft deterrent system 30 seconds later after having the driver's door closed from opening condition by removing the key from the ignition key cylinder.	OFF	ON/OFF
	WARN BY GLS SEN (Warning by glass broken sensor)	Function to turn ON/OFF of the glass break sensor. This function is only effective for the vehicle with glass break sensor.	OFF	ON/OFF
	ENTRY DELAY (Entry Delay)	To change the entry delay time(period before starting the warning) by the passive mode.	14s	0s/14s/ 30s
	WARN BY HORN (Warning by horn)	Function to make the warning by the horn and theft deterrent horn available.	ON	ON/OFF

(Continued)

System	Hand-Held Tester Display Content	Contents	Default	Selection
Illuminated Entry System	LIGHTING TIME (Lighting time)	To change the lighting time after closing the door. (It will quickly fade out in case of turning the ignition ON.)	15s	7.5s/15s/30s
	I/L AUTO OFF (Battery Saver)	Function to turn off the interior light automatically after specified time for prevent the battery loss when the interior light switch is "DOOR" position and the door is open.	ON	ON/OFF
	I/L ON/UNLOCK (Light dome lamp when unlocking with door key)	Function to light the interior light, etc. when the door is unlocked with a transmitter, door key or door lock control switch.	ON	ON/OFF
	I/L ON/ACC OFF (Light the I/L when ACC OFF)	Function to light the interior light when the ignition switch is operated from "ACC" to "LOCK".	ON	ON/OFF
Light Control	SENSITIVITY (Turn ON luminous intensity)	To adjust the sensitivity of the lighting illumination.	NORMAL	LIGHT 2/LIGHT 1/NORMAL /DARK 1/DARK 2
	DISP EX ON SEN (Display extinction luminous intensity)	To change the brightness of lowering the lights such as the indicator light of the combination meter, A/C indicator light, clock.	NORMAL	LIGHT 2/LIGHT 1/NORMAL /DARK 1/DARK 2
	DISP EX OFF SEN (Display extinction release luminous intensity)	To change the brightness of canceling the lowering the lights such as the indicator light of the combination meter, A/C indicator light, clock.	NORMAL	LIGHT 2/LIGHT 1/NORMAL /DARK 1/DARK 2
	DRL FUNCTION* (DRL function)	ON/OFF of the DRL function.	ON	ON/OFF
Air Conditioning	SET TEMP SHIFT (Set Temperature Shift)	To control with the shifted temperature against the display temperature.	NORMAL	+2C/+1C/ NORMAL /-1C/-2C
	AIR INLET MODE (Air Inlet Mode)	In case of turning the A/C ON when you desire to make the compartment cool down quickly, this is the function to change the mode automatically to RECIRCULATED mode.	AUTO	MANUAL /AUTO
	COMPRESSOR MODE (Compressor Mode)	Function to turn the A/C ON automatically by pressing the AUTO button when the blower is ON and the A/C is OFF.	AUTO	MANUAL /AUTO
	COMPRS/DEF OPER (Compressor/Air Inlet DEF operation)	Function to turn the A/C ON automatically linking with the FRONT DEF button when A/C OFF.	LINK	NORMAL /LINK
	FOOT/DEF MODE (Foot/DEF auto mode)	Function to turn the air flow from FOOT/DEF ON automatically when AUTO MODE is ON.	ON	OFF/ON
	AUTO BLOW UP (Foot/DEF automatic blow up function)	Function to switch the blower level automatically when the defroster is ON.	ON	OFF/ON
	AMBIENT TMP SFT (Ambient Temperature Shift)	To control with the shifted ambient temperature against the display ambient temperature.	NORMAL	+3C/+2C /+1C/ NORMAL /-1C/-2C/ -3C
	FOOT AIR LEAK (Foot air leak)	Function to cut off the airstream felt underfoot while the vehicle is moving.	ON	OFF/ON

(Continued)

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System	Hand-Held Tester Display Content	Contents	Default	Selection
Smart Entry & Start System*	SMART WARN1 (Warn a key is taken from D-door with P range)	Function to warn that a key is taken out from the driver's door when shift position is in P range and ignition is not OFF.	ON	ON/OFF
	SMART WARN2 (Warn a key is taken from D-door without P range)	Function to warn that a key is taken out from the driver's door when shift position is in other than P range and ignition is not OFF.	ON	ON/OFF
	SMART WARN3 (Warn a key is taken out by fellow passengers)	Function to warn that a key is taken out by fellow passengers(it means the key is taken out from except the driver's door) when ignition is not OFF.	ON	ON/OFF
	SMART BUZ NUM (Setting a number of warning buzzer sounds)	Setting a number of warning buzzer sounds in case if a key is taken out.	3 TIMES	OFF/ 3TIMES/ 5TIMES/ 7TIMES
	SMART WARN4 (Warn locking door when Engine is idling)	Setting a warning time for locking doors while the engine is idling.	2s	OFF/1s/2s
	SMART WARN5 (Warn when the key is left in the vehicle)	Setting a warning time for locking doors while the key is left in the vehicle.	2s	OFF/1s/2s
	SMART WARN6 (Warn starting E/G when the key is out of range)	Setting a warning function for trying to start the engine with SMART before SMART is still out of its range.	OFF	ON/OFF
	KEY LOW-BATT WRN (Warn when the key battery becomes weak)	Setting a warning function for the first time when a key battery becomes weak.	OFF	ON/OFF
	KEY BATTERY BUZ (Key battery buzzer)	Function to make the warning available when the smart key battery is low.	ON	ON/OFF
	SMART UNLOCK (SMART door unlock mode)	Setting an operation to unlock a door with SMART function.	DRIVER'S	ALL/ EACH/ DRIVER'S
	TRANSMIT INTVAL (Transmition interval)	Function to set the smart key signal interval transmitted from the outside of the vehicle when the vehicle is parked.	300 ms	150 ms/ 300 ms/ 450 ms/ 600 ms
	PARK WAIT TIME (Wait time to permit opening door after locking)	Setting a wait time to permit opening a door after it being locked with SMART entry.	2.5 s	0.5s/1.5s/ 2.5s/5s
	SMART TRUNK (Trunk open mode with SMART when vehicle is locked)	Function to permit opening a trunk with SMART entry.	ON	ON/OFF
	KEY_IN_TRUNK (Trunk open mode when the key is left in a trunk)	Function to open a trunk when the key is detected inside the trunk.	OFF	ON/OFF
	SMART BACK DOOR (Backdoor opening operation when vehicle is locked)	Function to open a back door when the key is detected inside the back door.	LONG	LONG/ TWICE/ OFF/LONG

*: Optional Equipment

LIGHTING

■ DESCRIPTION

The ’04 Prius has a lighting system with the following equipment.

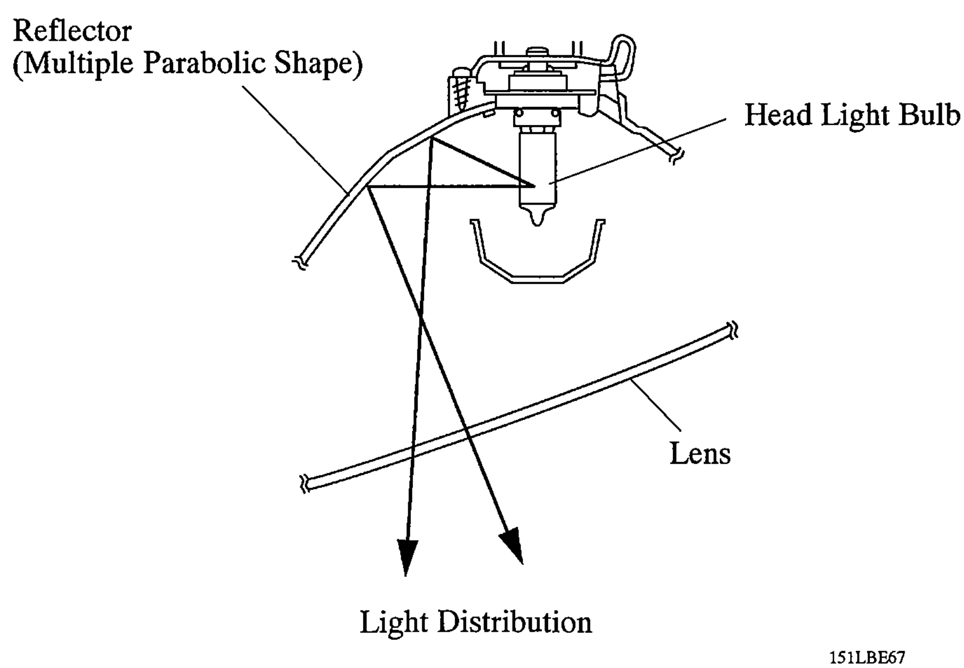
System		Destination	
		U.S.A.	Canada
Headlight	Multi-reflector Type	Standard	←
	HID Headlight System	Set Option*	—
Automatic Headlight Beam Level Control System			—
Daytime Running Light System		Set Option*	Standard
Automatic Light Control System			Standard
Light Auto Turn-Off System		Standard	←
Illuminated Entry System		Standard	←
Front Fog Light		Option	←
Rear Combination Light	LED type Stop Light	Standard	←

*: It is not possible to provide the vehicle with both the HID headlight system and the daytime running light system.

■ MULTI-REFLECTOR TYPE HEADLIGHT

With the multi-reflector type headlights, the light from the bulbs is dispersed and distributed through multiple parabolic shaped reflectors. As a result, the lens cut pattern is no longer provided in the center of the lens, thus realizing a clear look.

▶ Light Distribution Imaginary Diagram ◀



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■ HID HEADLIGHT SYSTEM

1. General

The HID headlight system applies high voltage to the electrodes on the light bulb to discharge arcs, the metal atoms that are enclosed in the bulb to emit light.

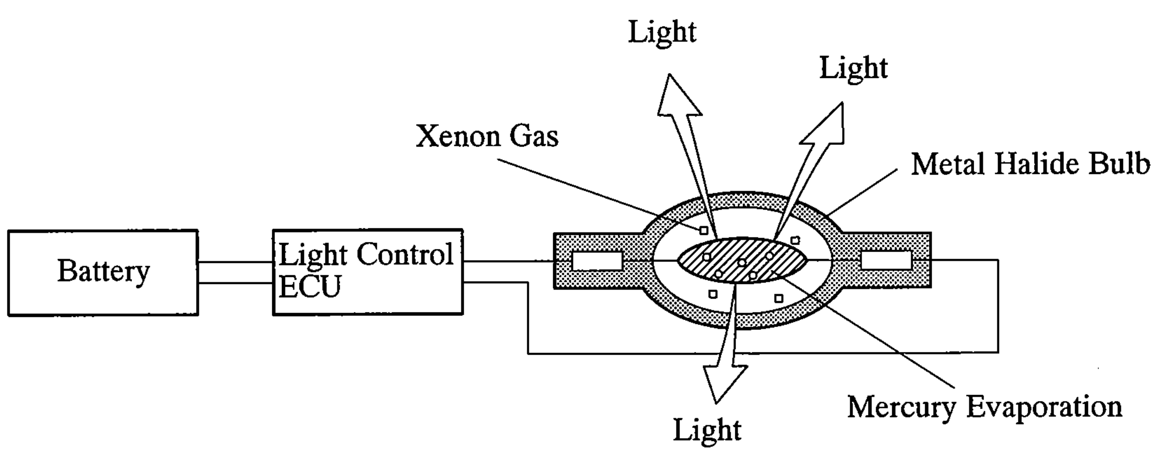
2. Construction and Operation

General

The HID headlight system consists of metal halide bulbs and a light control ECU. The basic construction and operation are the same as in the '03 Celica.

Metal Halide Bulb

- The metal halide bulb contains xenon gas, mercury, and metal halide.
- When high voltage (approximately 20,000 volts) is applied to the electrodes of the metal halide bulb, the xenon gas in the bulb emits light.
- As the temperature in the bulb rises, the mercury evaporates and causes arcs to be discharged.
- As the temperature in the bulb rises even further, the metal halide in the mercury arc separates into metal atoms and iodine atoms.
- The separated metal atoms discharge light, which causes the bulb to emit light.



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CAUTION

The replacement of an HID (High Intensity Discharge) must be performed only by a TOYOTA dealer. Never touch the glass portion or the electrode portion of the bulb because high voltage that is generated at those areas is very dangerous.

Light Control ECU

1) General

The light control ECU is an electronic control unit which is necessary for illuminating the metal halide bulb. A light control ECU is located under each headlight unit. This ECU provides the functions Listed below.

- Generates the high voltage (approximately 20,000 volts) which is applied to the electrodes of the bulbs to enable the HID headlights to start to illuminate.
- Optimally controls the amperage and voltage in order to quickly provide an optimal amount of light immediately after the bulbs have been turned ON and to enable the bulbs to continue to illuminate in a stable manner.
- A fail-safe function is provided as a countermeasure against the high voltage that is generated in case that a problem occurs in the headlight system.

2) Fail-Safe Function

The light control ECU executes the fail-safe actions listed below in accordance with the item that has been detected.

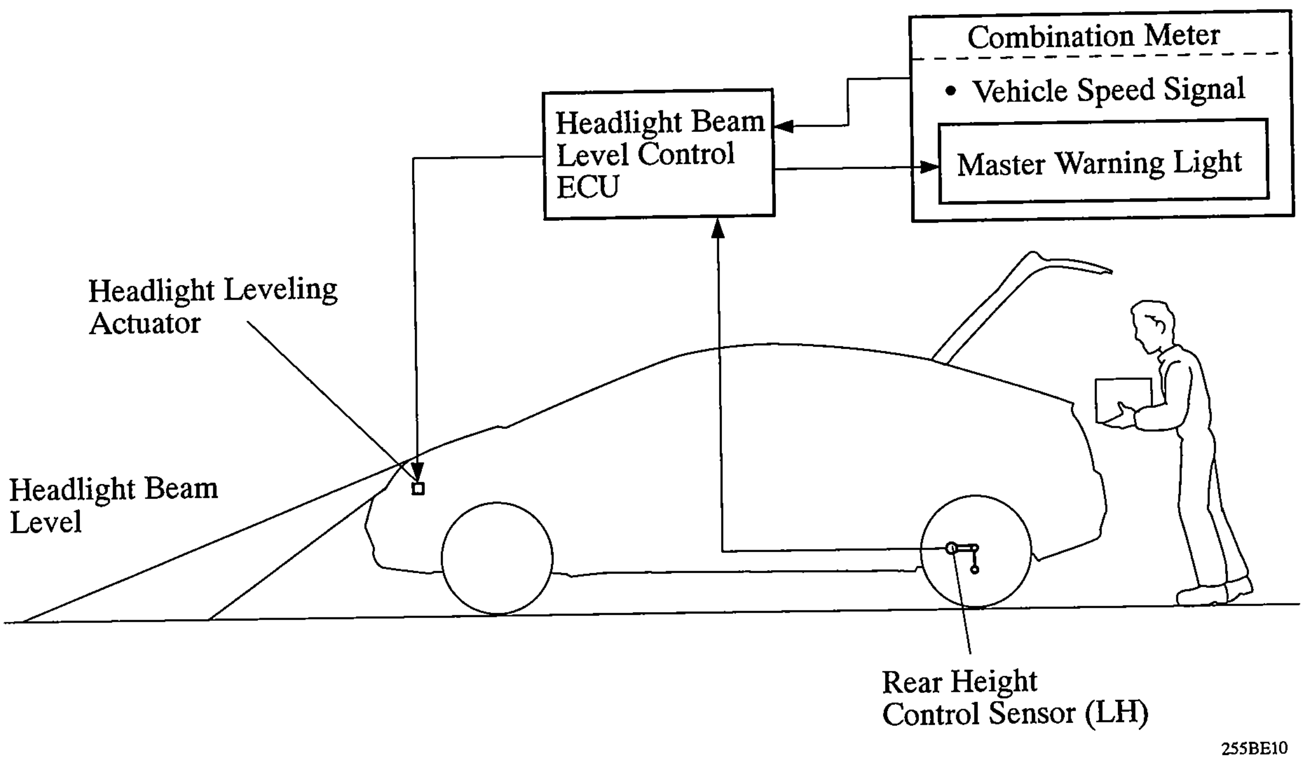
Item	Outline
Detection of Abnormal Input Voltage	If the voltage that is input to the light control ECU deviates from the operating voltage (9-16 volts), the ECU stops illuminating the headlights, and resumes illuminating the headlights once the voltage reverts to the operating voltage range. However, if the input voltage decreases after the headlights have illuminated, the headlights will remain illuminated until the bulbs are extinguished.
Detection of Abnormal Output (Open Circuit or Short Circuit) or Flashing Bulb	If an abnormal condition (open or short circuit) occurs in the voltage that is output by the light control ECU, or if the bulb flashes, the ECU stops illuminating the headlights and will maintain this state until the power is reinstated (by tuning the headlight control switch from OFF to ON or turning the ignition switch from OFF to ON).
Detection of Bulb Open	If a bulb is not inserted in its socket, the ECU stops generating high voltage until the bulb is inserted correctly and the power is reinstated (by turning the headlight control switch from OFF to ON or turning the ignition switch from OFF to ON).

■ AUTOMATIC HEADLIGHT BEAM LEVEL CONTROL SYSTEM

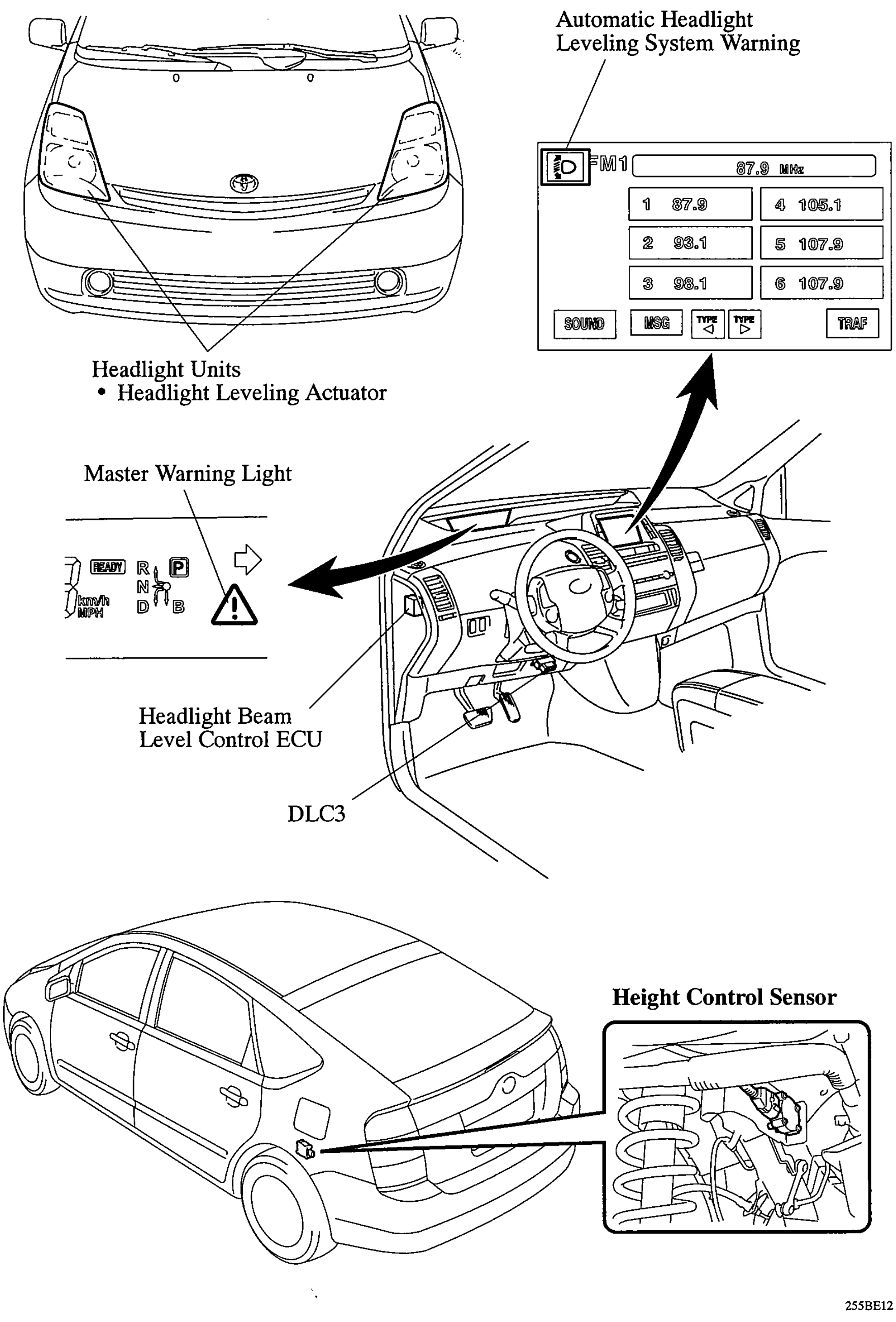
1. General

- The automatic headlight beam level control system maintains the headlight beams at a constant level.
- This system is controlled by the headlight level control ECU. This ECU detects the vehicle posture via the rear height control sensor, and detects the vehicle speed via the combination meter. The ECU then controls the headlight leveling actuator based on these pieces of information, in order to change the headlight reflector angle.

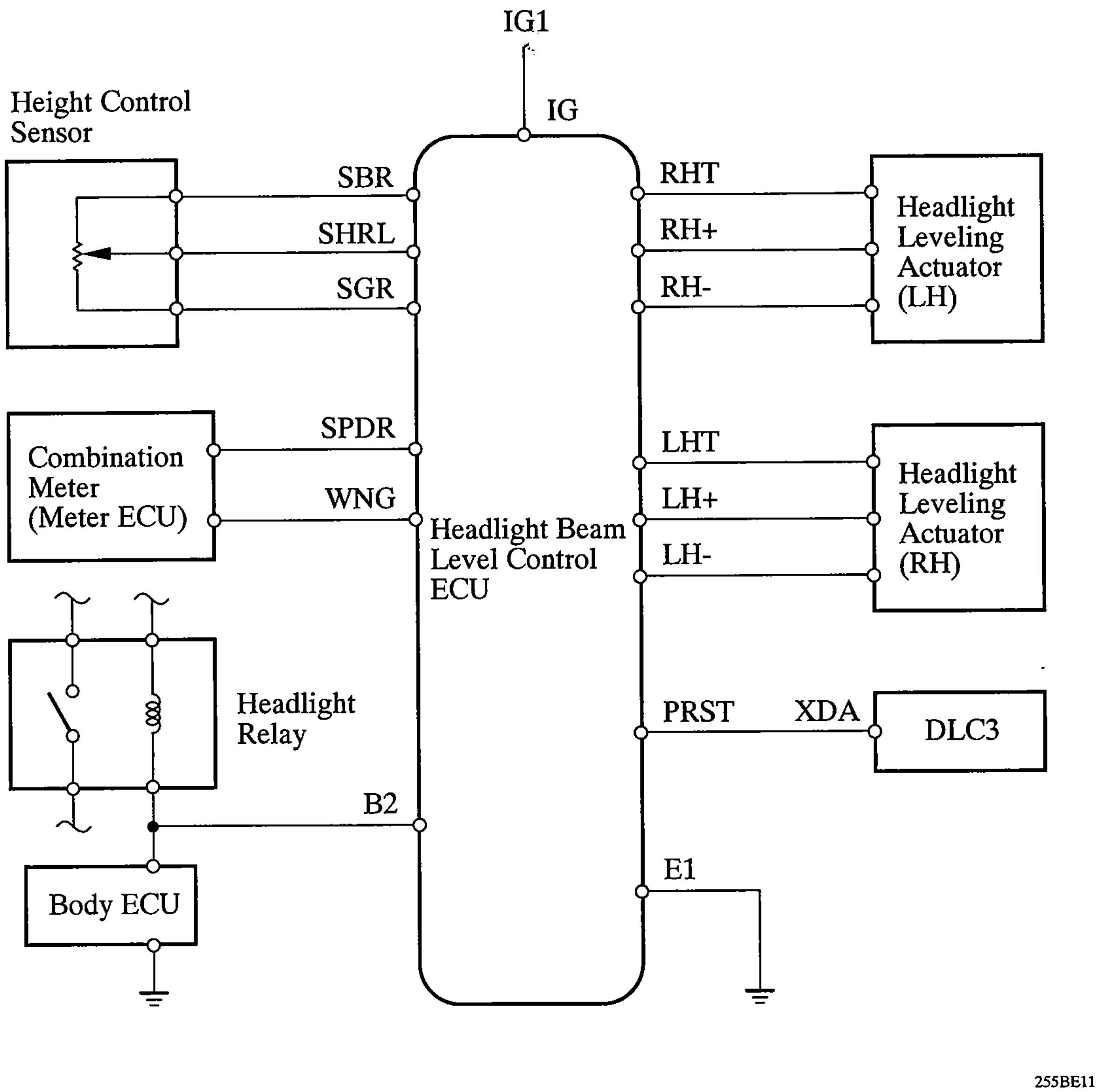
▶ System Diagram ◀



2. Layout of Main Components



3. Wiring Diagram



4. Function and Construction of Main Components

Components	Function and Construction
Headlight Beam Level Control ECU	• Based on the signals that are transmitted by height control sensor and the combination meter, this ECU detects the amount of variance of the vehicle posture. • Based on the detected value, this ECU outputs control signal to the height leveling actuator. • When the ECU detects a malfunction, it outputs a request signal to illuminate the automatic headlight leveling system warning light to the combination meter. • This ECU provides initial set control and fail-safe function.
Headlight Leveling Actuator	• Based on the signals received from the headlight beam level control ECU, each headlight leveling actuator moves the reflector in the headlight to vary its beam. • This actuator uses a step motor to precisely regulate the angle of the reflector.
Height Control Sensor	The height control sensor detects the amount of variance of the vehicle height and outputs this amount in the form of signal to the headlight beam level control ECU.
Combination Meter	• Outputs the vehicle speed signal to the headlight beam level control ECU. • When the headlight beam level control ECU detects malfunction in the automatic headlight beam level control system, the headlight beam level control ECU illuminates the master warning light on the combination meter. • Once the master warning light is illuminated, the meter ECU sends a signal to the multi display to indicate the automatic headlight leveling system warning.
DLC3	• Sets the headlight beam level control ECU in the initial mode. • If an operation involving the removal and reinstallation of the height control sensor or the headlight beam level control ECU has been performed, the headlight beam level control ECU must be initialized. This is accomplished by connecting the SST (09843-18040) between the XDA and CG terminals of the DLC3 connector and operating the light control switch. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).

5. Fail-Safe Function

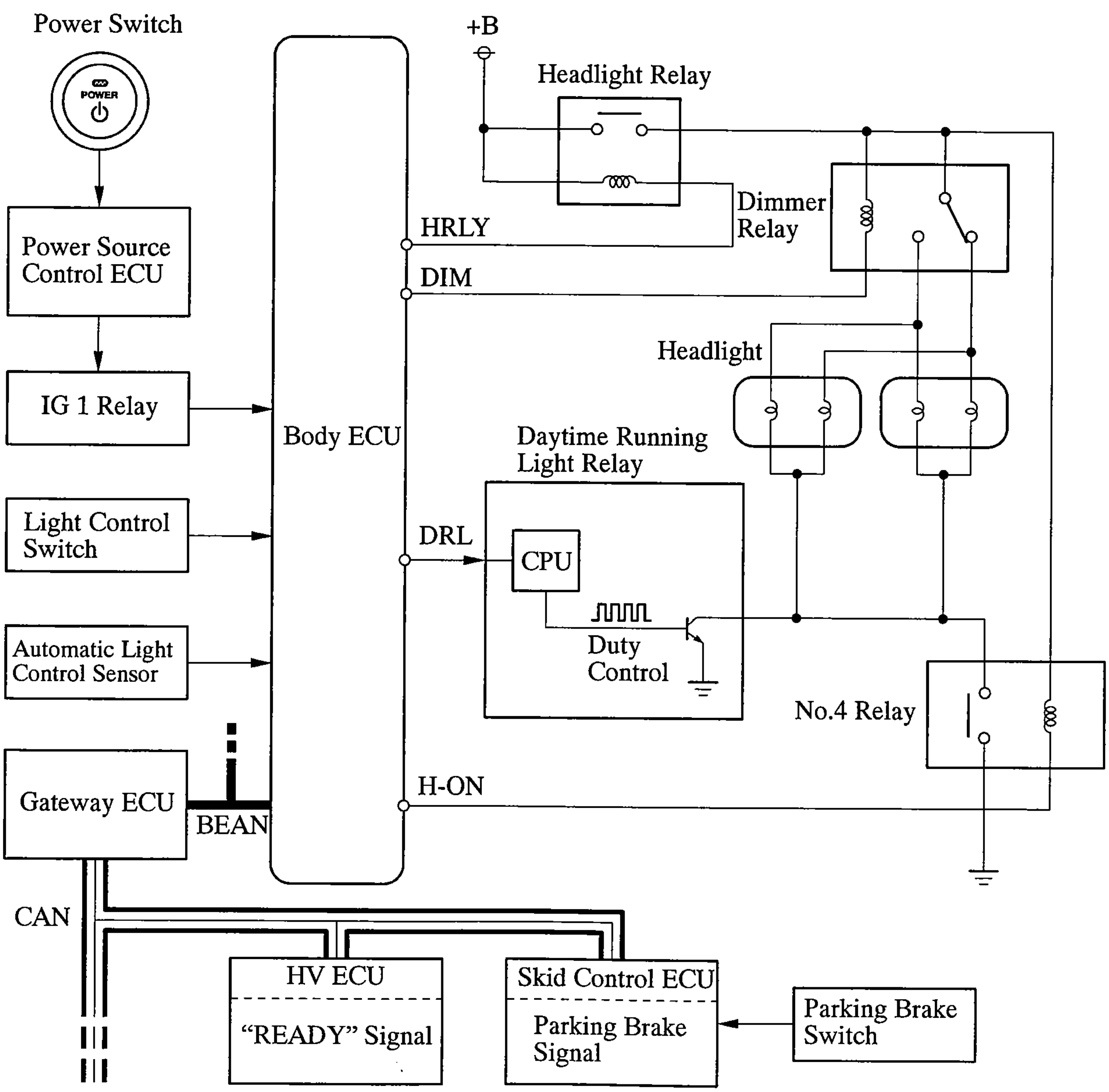
The headlight beam level control ECU operates in the fail-safe mode if an abnormal condition such as those listed below has been detected, and illuminates the automatic headlight leveling system warning light in the combination meter.

Item	Abnormality Detection Condition	Description of Control
Headlight Leveling Actuator	Open or Short	Holds the beam at the position of the headlight leveling actuator when the abnormality has been detected.
Height Control Sensor	Signal Level Abnormality	Holds the beam at the position of the headlight leveling actuator when an abnormality has been detected.
Headlight Beam Level Control ECU	When an abnormal processing of the CPU has been detected.	Holds the beam at position of the headlight leveling actuator when the abnormality has been detected.

■ DAYTIME RUNNING LIGHT SYSTEM

- This system is designed to automatically activate the headlight Lo beams during the daytime to keep the car highly visible to other vehicles. This system is controlled by the body ECU.
- The daytime running light system operates the low-beam headlights during the daytime by dimming them approximately 80%.
- Upon receiving a daytime running light system actuation signal from the body ECU, the daytime running light relay dims the low-beam headlights to approximately 80% of their normal intensity through duty cycle control.
- This system is enabled when the conditions given below are met.
  - Power switch ON condition
  - Parking brake switch OFF condition
  - Light control switch OFF, TAIL or AUTO condition (only when headlights-on control is not performed by the automatic light control system).
  - Hybrid system "READY" signal input (Hybrid system stand by condition)

▶ System Diagram ◀



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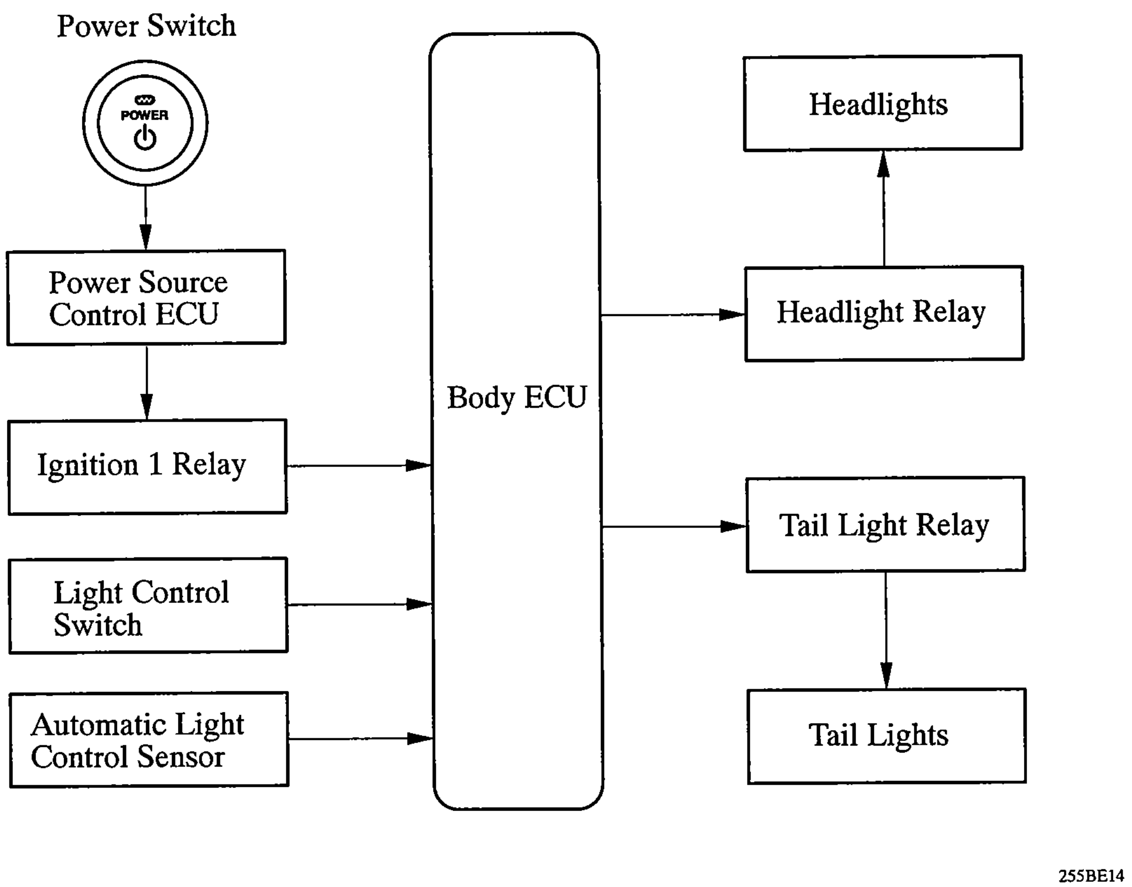
■AUTOMATIC LIGHT CONTROL SYSTEM

- When the light control switch is in the AUTO position, the automatic light control sensor detects the ambient light and automatically turns the headlights and taillights ON or OFF accordingly.
- This system is controlled by the Body ECU.

▶ System Diagram ◀



■LIGHT AUTO TURN-OFF SYSTEM

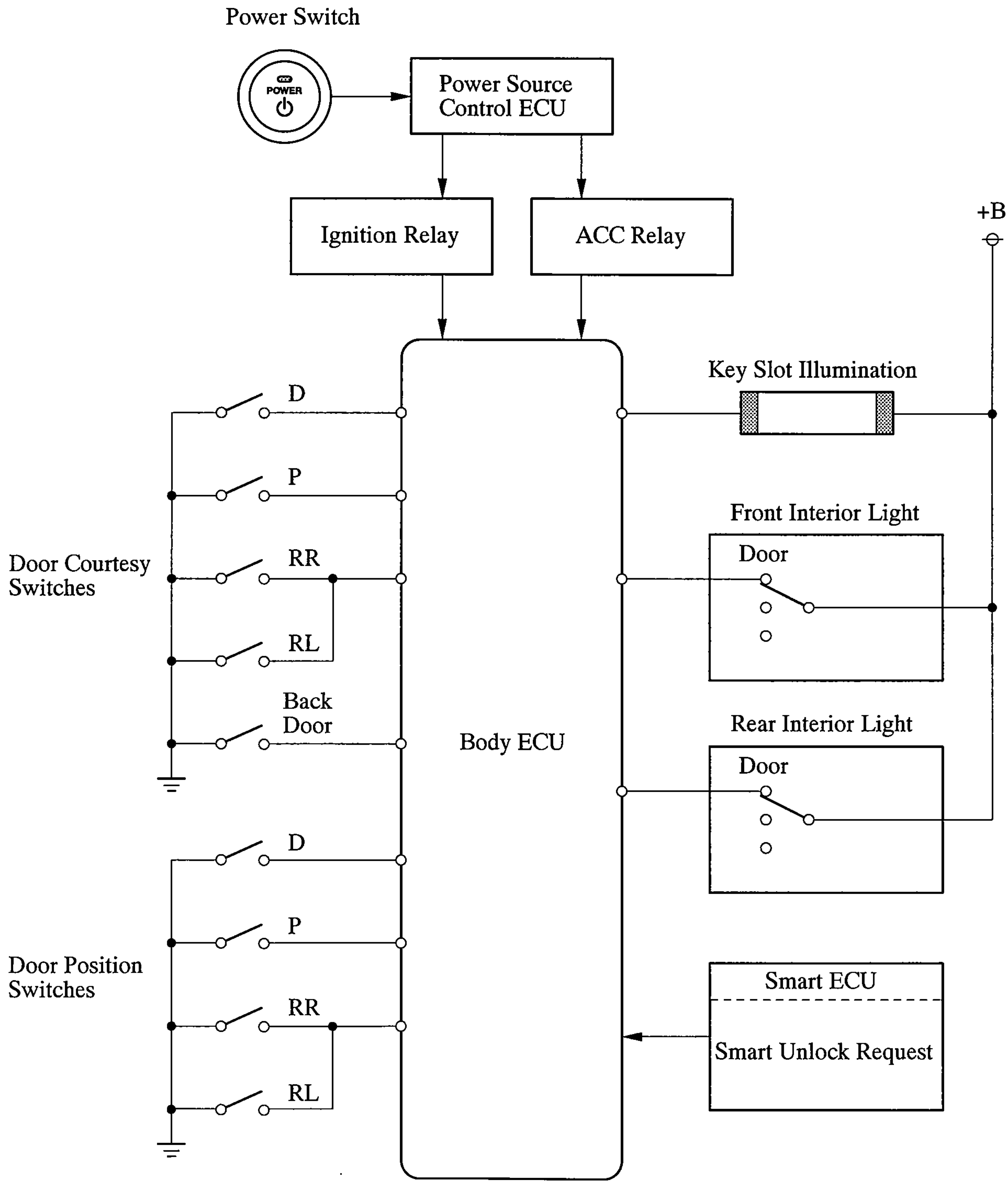
- When the power switch is turned from READY, IG-ON or ACC to OFF position and driver's door is opened with the taillights and headlights on, this system automatically turns them off.
- This system is controlled by the Body ECU.

■ ILLUMINATED ENTRY SYSTEM

1. General

- The illuminated entry system of the '04 Prius controls 3 kinds of light: front interior light, rear interior light and key slot illumination.
- This system is controlled by the body ECU.

▶ System Diagram ◀



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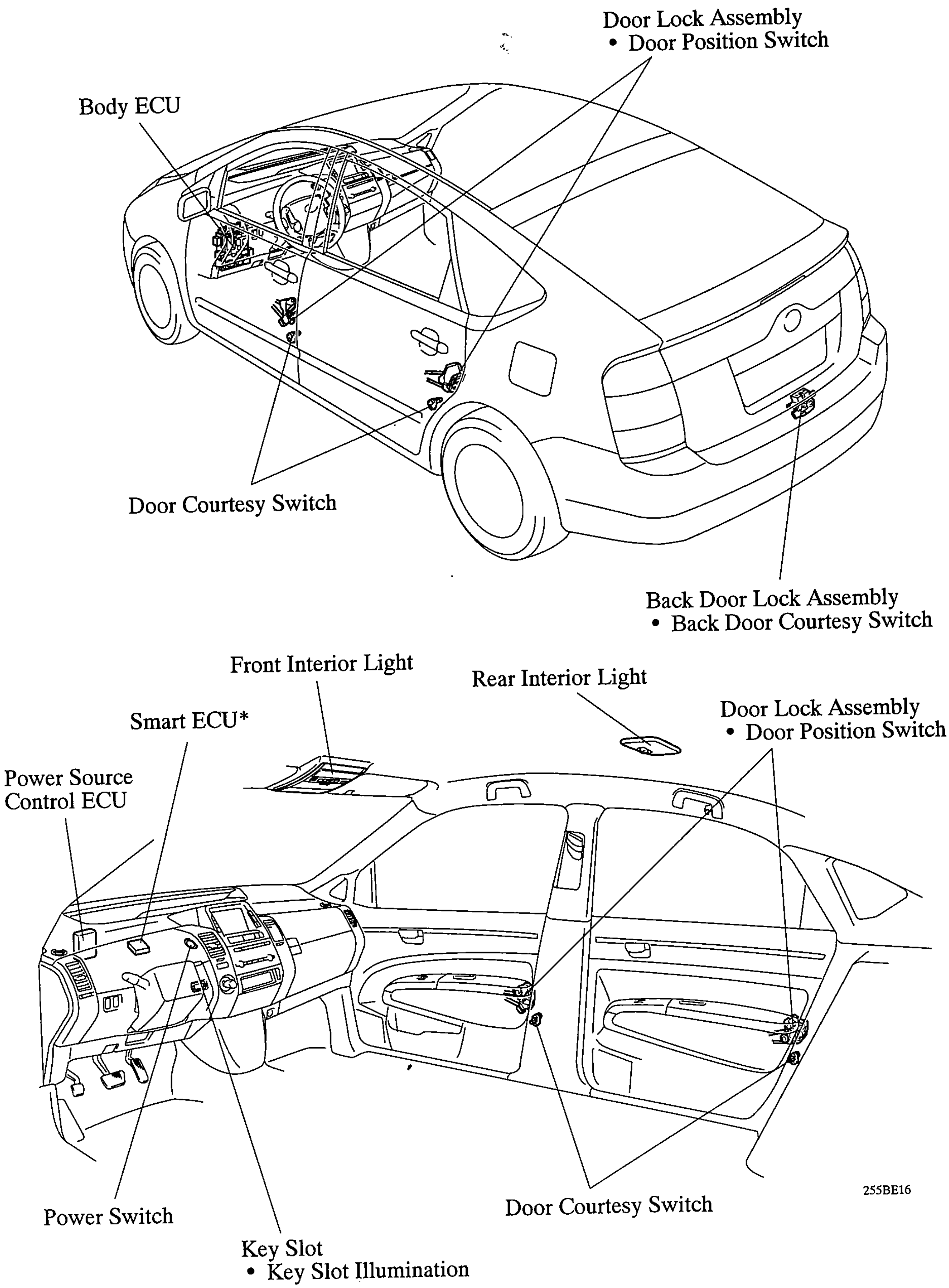
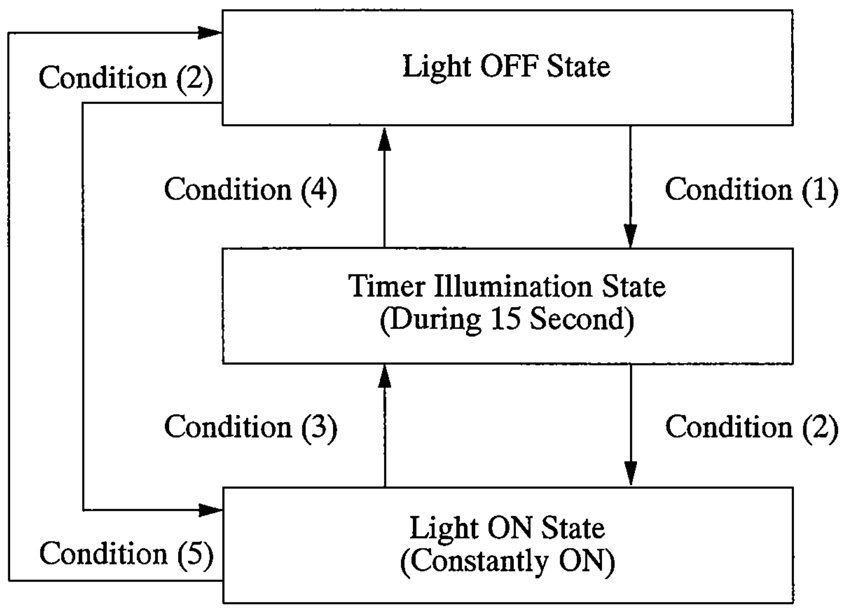
2. Layout of Main Components



*: Optional Equipment

3. Interior Light and Key Slot Light Control

- The interior light and key slot light control consists primarily of the fade-in/fade-out function and timer illumination function.
- The fade-in function gradually fades the lighting in approximately 1.5 seconds when the illumination is turned ON.
- The fade-out function gradually fades the lighting out in approximately 0.9 seconds when the illumination is turned OFF.
- The interior light and key slot light control activates as described in the diagram below when the items are in the respective state.



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Condition	Item
Condition (1)	• With the power switch OFF, all doors closed, and all doors locked, any door unlocks. • With all doors closed, the power switch is turned from READY, IG-ON, or ACC to the OFF position. • With the power switch OFF and all doors closed, smart unlock*1 is performed.
Condition (2)	• Any door is open.
Condition (3)	• When the power switch is OFF and any door is unlocked, all doors are closed.
Condition (4)	• Power switch is at READY, ACC or IG-ON position. • More than 15 seconds have elapsed since the Timer Illumination State (15 second duration)*2. • With power switch OFF and all doors closed, all doors are locked.
Condition (5)	• With power switch at READY, ACC or IG-ON, all doors are closed. • All doors are closed, and all doors are locked.

*1: Models with Smart Entry & Start System

*2: The setting of function can be changed using the customized body electronics system. For details, refer to Customized Body Electronics System section on page BE-64.

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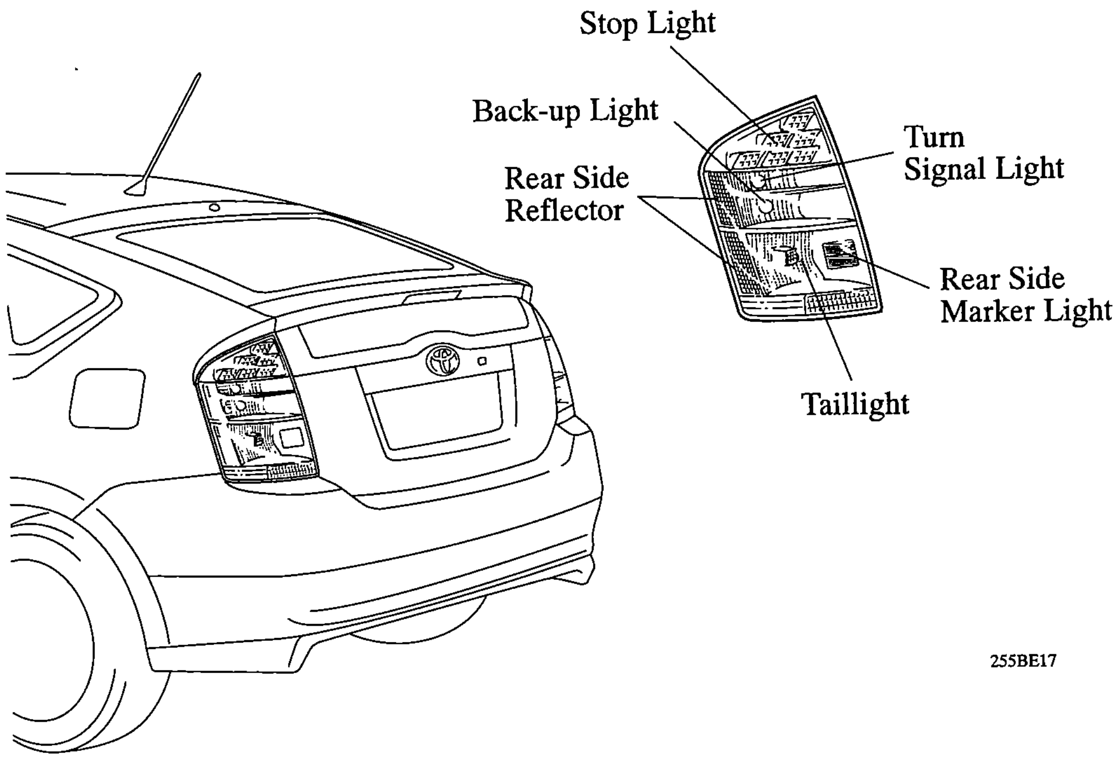
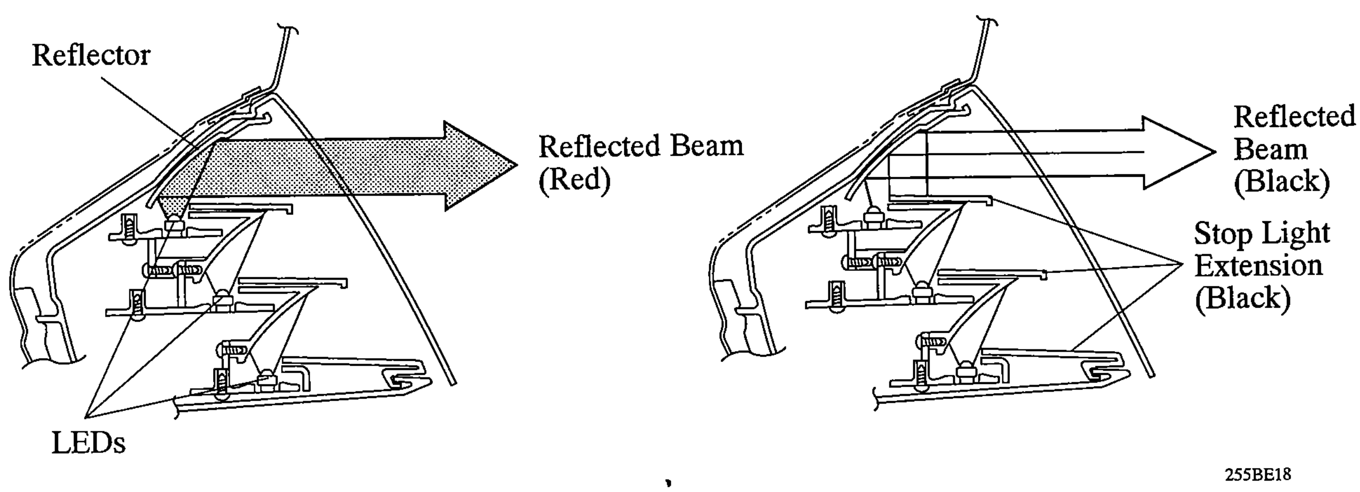
■ REAR COMBINATION LIGHT

- The stop light bulbs have been changed to LEDs. Accordingly, the power consumption of the stop lights has been reduced.
- These LEDs are located in a position that is invisible from the outside. Thus, the beams that are reflected by the reflector are the only sources for the stop light beams. Therefore, the appearance of the stop lights is different from when the stop lights are ON and OFF.



▶ Stop Light Cross Section ◀



Stop Light ON **Stop Light OFF**

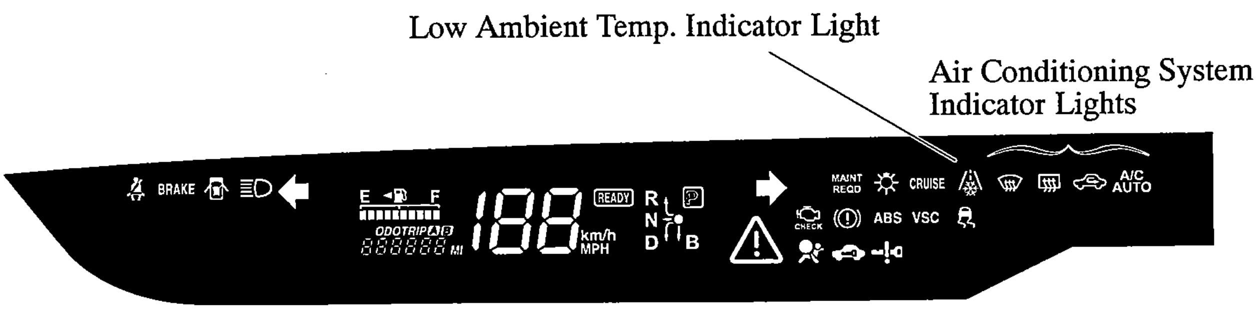
METER

■ COMBINATION METER

1. General

The combination meter of '04 Prius has the following features.

- The combination meter is available as a digital display type. It is located at the upper of the instrument panel to improve its visibility.
- A reflective virtual image display meter, which uses a VFD (Vacuum Fluorescent Display), a mirror, and a smoke acrylic plate to reflect the images of the speedometer, ODO/TRIP meter, fuel gauge, shift position indicator light, and READY indicator light, has been adopted to improve visibility.
- A meter ECU and buzzer are enclosed in the combination meter. This ECU maintains communication with other ECUs through the BEAN. In addition, this ECU maintains communication with other ECUs or devices comprising the CAN and AVC-LAN networks, via the gateway ECU.
- A "READY" light that informs the driver that the vehicle is ready to be driven is used.
- The contents of the warning issued with the illumination of the master warning light have been changed.
- The output control warning light has been discontinued.
- A low ambient temperature indicator light, which illuminates when the ambient temperature is low (ambient temperature of 3°C [37.4°F] or less) to alert the driver, has been adopted.
- The following indicator lights have been provided for the air conditioning system: A/C AUTO, RECIRCULATION, Front DEF, and Rear DEF.
- Two inclination sensors are used in the combination meter to detect the inclination (longitudinal and latitudinal) of the vehicle.
- Oil replacement reminder light has been established in the combination meter, which will light or flash to remind the driver to change the engine oil depending on the vehicle driving distance.
- A fuel lid mark uses to point the side of the vehicle where the fuel lid is located.



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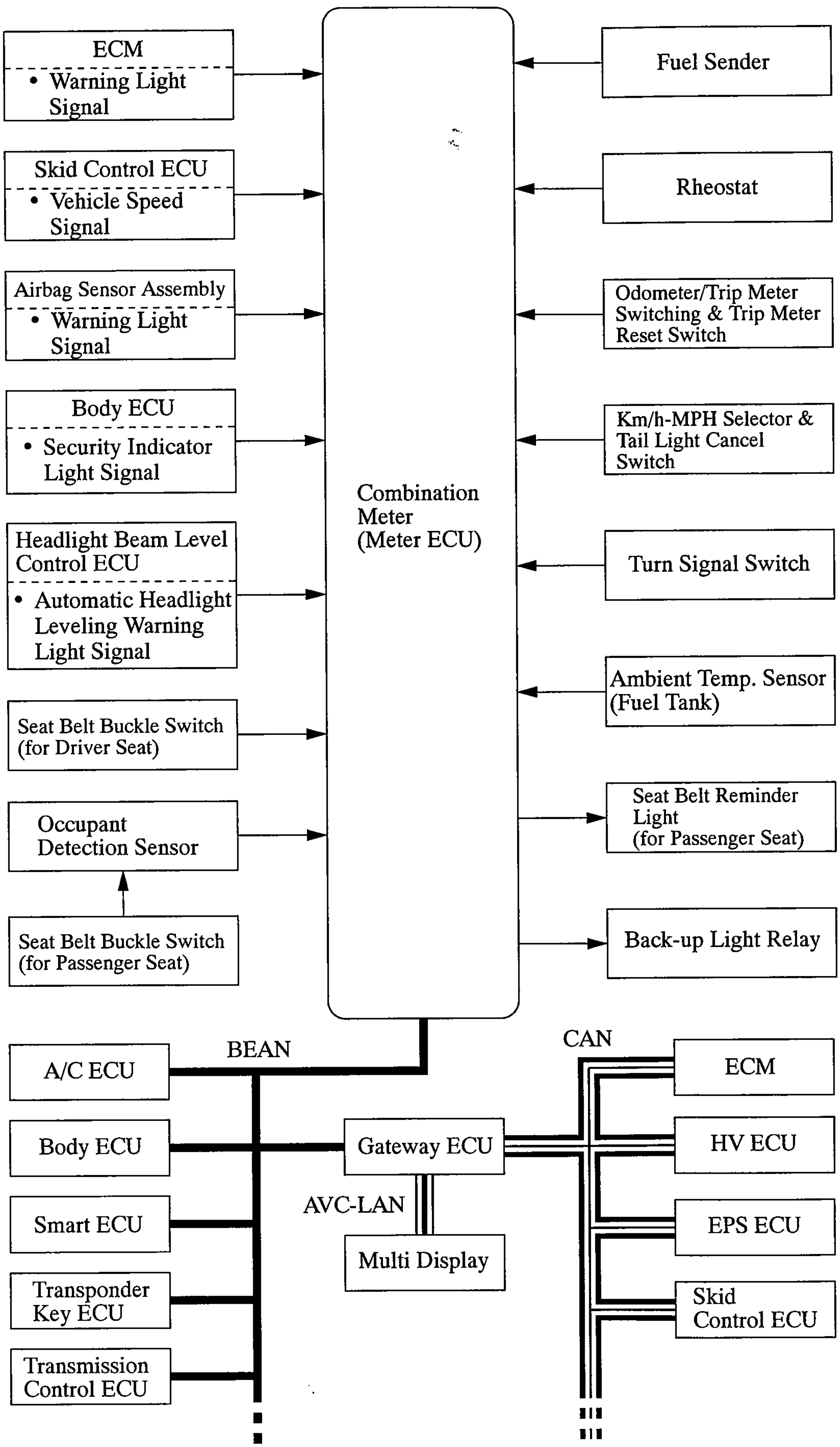
2. System Diagram



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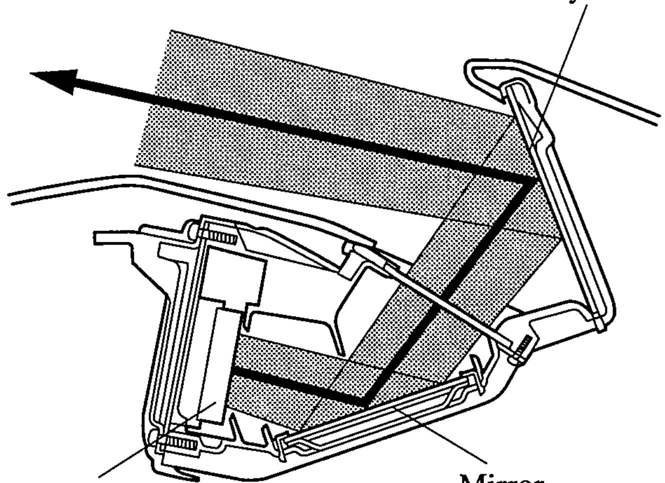
▶ MPX Communication ◀

Protocol	ECU	Signals Exchanged with Combination Meter (Meter ECU)
BEAN	A/C ECU	• Transmits ambient Temp. signal • Transmits an indicator light (A/C AUTO, RECIRCULATION, Front DEF, and Rear DEF) illumination request signal. • Receives vehicle speed signal
	Body ECU	• Transmits a meter illumination light dim request signal. • Transmits driver's door courtesy switch signal • Transmits all door courtesy switch signal • Transmits a headlight illumination signal • Transmits a tail light illumination signal. • Transmits front fog light illumination signal • Receives vehicle speed signal
	Smart ECU	• Transmits smart entry system warning light illumination request signal • Transmits a buzzer sounding request signal. • Receives vehicle speed signal
	Transmission Control ECU	• Transmits a master warning light (Transmission control ECU malfunction) illumination request signal. • Transmits shift position (N, P) signal
	Transponder Key ECU	• Transmits a master warning light (shift warning) illumination signal. • Transmits a buzzer sounding request signal. • Receives vehicle speed signal
CAN	HV ECU	• Transmits a shift position signal (P,R,N,D,B). (for shift position indicator light) • Transmits a READY indicator light illumination or blinking signal. • Transmits a master warning light (HV system, main battery, NDB warning, high water Temp., CHARGE) illumination request signal • Transmits a cruise indicator light illumination request signal
	ECM	• Transmits an engine speed signal (for calculating trip information). • Transmits an engine coolant Temp. signal (for master warning light [engine coolant Temp. warning]) • Transmits a fuel injection volume signal (for calculating trip information) • Transmits a master warning light (oil pressure) illumination signal • Receives fuel tank volume signal
	Skid Control ECU	• Transmits a warning light (ABS, VSC, BRAKE, ECB) illumination or blinking signal. • Transmits a slip indicator light illumination or blinking signal.
	EPS ECU	• Transmits a master warning light (EPS) illumination request signal
AVC-LAN	Multi Display	• Transmits a trip information operation signal • Receives warning (fuel volume, headlight leveling, EPS) display signal • Receives trip information display signal

3. Reflective Virtual Image Display Meter

- A reflective virtual image display meter, which uses a VFD, a mirror, and a smoke acrylic plate to reflect the images of the speedometer, ODO/TRIP meter, fuel gauge, shift position indicator light, and READY indicator light, has been adopted to improve visibility.
- In this meter, the image on the VFD is reflected by the mirror and the smoke acrylic plate, and appears as a virtual image to the driver. This type realizes excellent visibility because it is less susceptible to external light.

VFD Display



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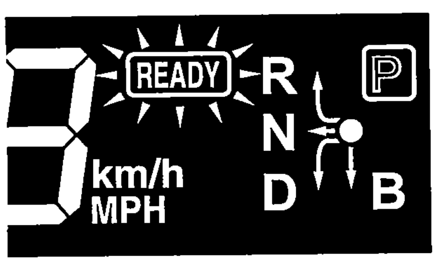
Cross Section

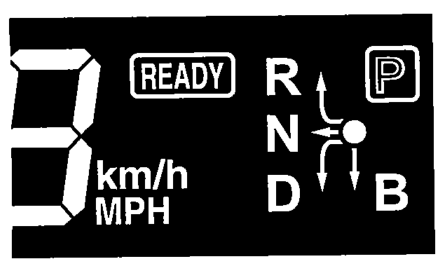
4. Indicator and Warning Light

Ready Light

When the shift position is P and the brake pedal is depressed, turning the power switch to READY causes the "READY" light to flash and enables the vehicle to be driven. Then, this indicator illuminates and the buzzer sounds simultaneously.



Flashes when the power switch is turned to READY.



Illuminates when the vehicle is ready to driven.

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Service Tip

If the indicator dose not illuminate, the vehicle cannot be driven because one of the driving prohibition conditions listed below applies.

- Service plug discontinued.
- Inverter unit cover is left open.
- Hybrid system abnormality.
- HV ECU has detected a collision.
- Driving prohibition condition due to overload on MG1, MG2 or inverter.

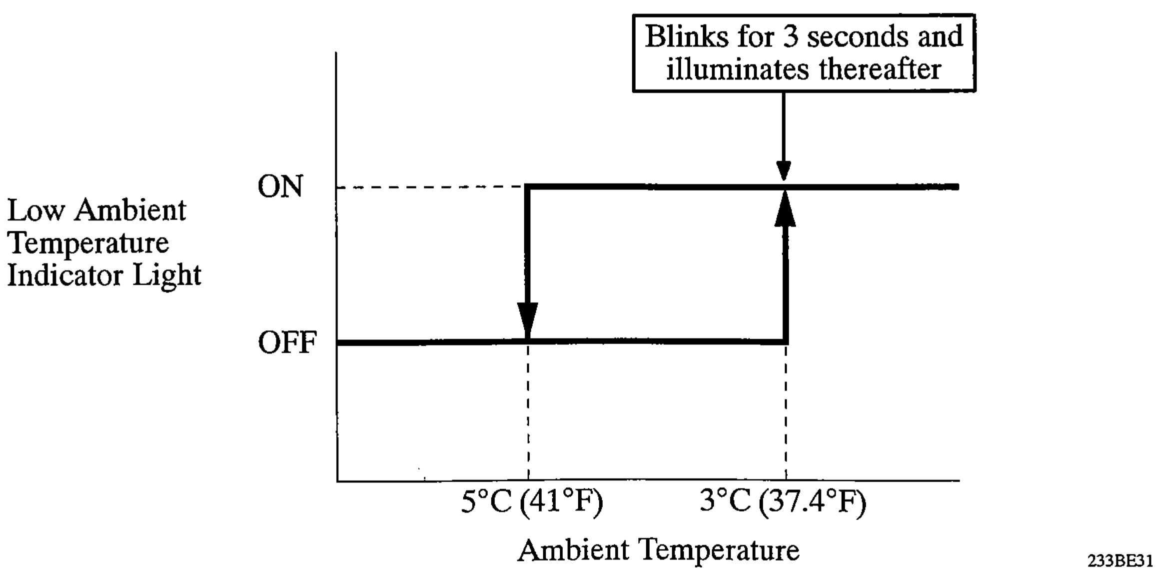
Master Warning Light

If any of the situations indicated below occur, the meter ECU will illuminate the master warning light and sound the buzzer. At the same time, a warning will appear on the multi display.

Master Warning Light	Outline
Hybrid System Abnormal	When the abnormality occurs in the hybrid system.
HV Battery Warning	When the HV battery voltage drops.
N, D and B Range Warning	• The READY light is illuminated, the shift position is in the N position, and the HV battery is discharged. • The READY light is illuminated, the shift position is in the N, B or D position, and the driver's door is open.
High Engine Coolant Temperature Warning	• When the engine coolant temperature is above specified value. • When the inverter coolant temperature is above specified value.
Discharge Warning	When there is a malfunction in the 12 V charging system (converter assembly).
Oil Pressure Warning	When the engine oil pressure is low.
EPS Warning	When there is a malfunction in the EPS system.
Shift Position Warning	When the hybrid system is OFF, the shift position is in a position other than P, and the driver's door is opened.
Transmission Control ECU Warning	When there is a malfunction in the transmission control ECU.
Automatic Headlight Leveling System Warning	When there is a malfunction in the automatic headlight leveling system.

Low Ambient Temperature Indicator Light

- If the ambient temperature drops, and may create a situation such as a frozen road surface that requires the driver to pay attention, the meter ECU illuminates the low ambient temperature indicator light to alert the driver.
- When the power switch is turned ON, the meter ECU will turn ON the low ambient temperature indicator light for 3 seconds in order to check the bulb.
- The meter ECU uses the ambient temperature sensor signal provided by the air conditioning system in order to determine the ambient temperature. If the meter ECU has determined that the ambient temperature is approximately 3°C (37.4°F) or less, it causes the indicator light to blink for 3 seconds and illuminate thereafter. If the ambient temperature rises to 5°C (41°F) or above, the meter ECU will turn OFF the indicator light.



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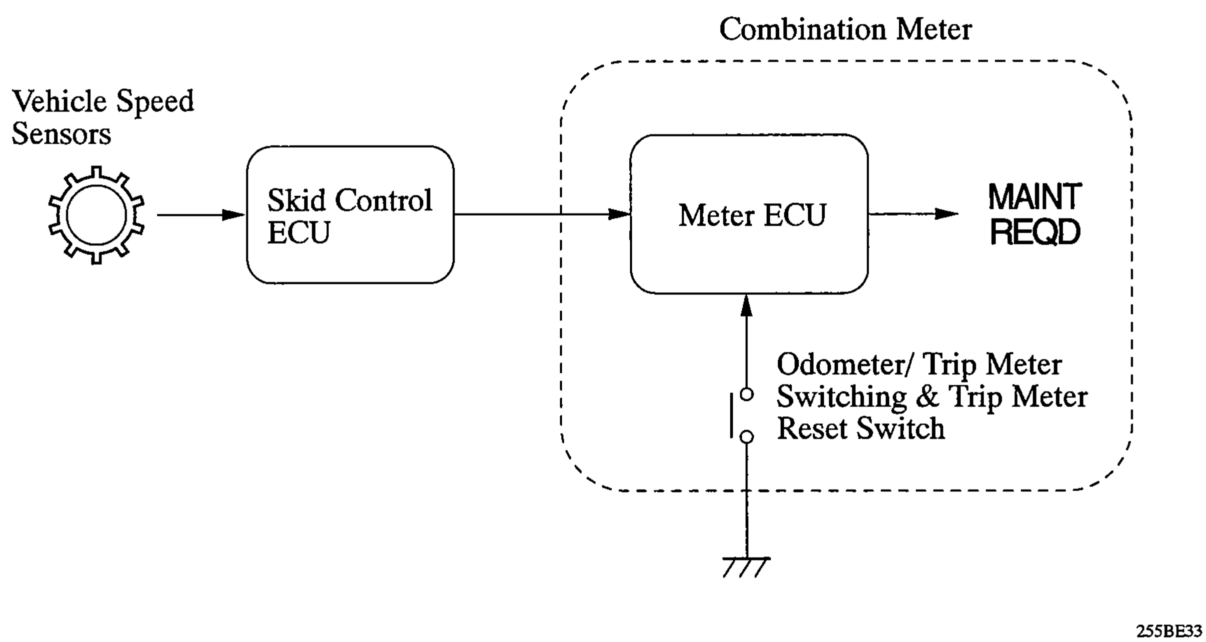
Oil Replacement Reminder Light

An oil replacement reminder light will light or flash to remind the driver to change the engine oil depending on the vehicle driving distance. Oil replacement reminder light is standard equipment only for U.S.A. model.

- Lighting and flashing of the oil replacement reminder light is operated based on the accumulated vehicle driving distance memorized in the combination meter (meter ECU).
- The meter ECU calculates the vehicle driving distance based on the signals from the brake ECU.
- This light has a bulb check function and an oil replacement reminder function.
- When turning the power switch ON, the meter ECU will turn ON the oil replacement reminder light for 3 seconds for the bulb check.
- When the accumulated vehicle driving distance memorized in the meter ECU exceeds 4500 miles after being reset, the meter ECU will flash the oil replacement reminder light for 12 seconds after the bulb check and remind the driver that the engine oil changing time is near at hand.
- When the accumulated vehicle driving distance memorized in the meter ECU exceeds 5000 miles after being reset, the meter ECU will keep the oil replacement reminder light on after the bulb check and remind the driver to change the engine oil.

▶ System Diagram ◀

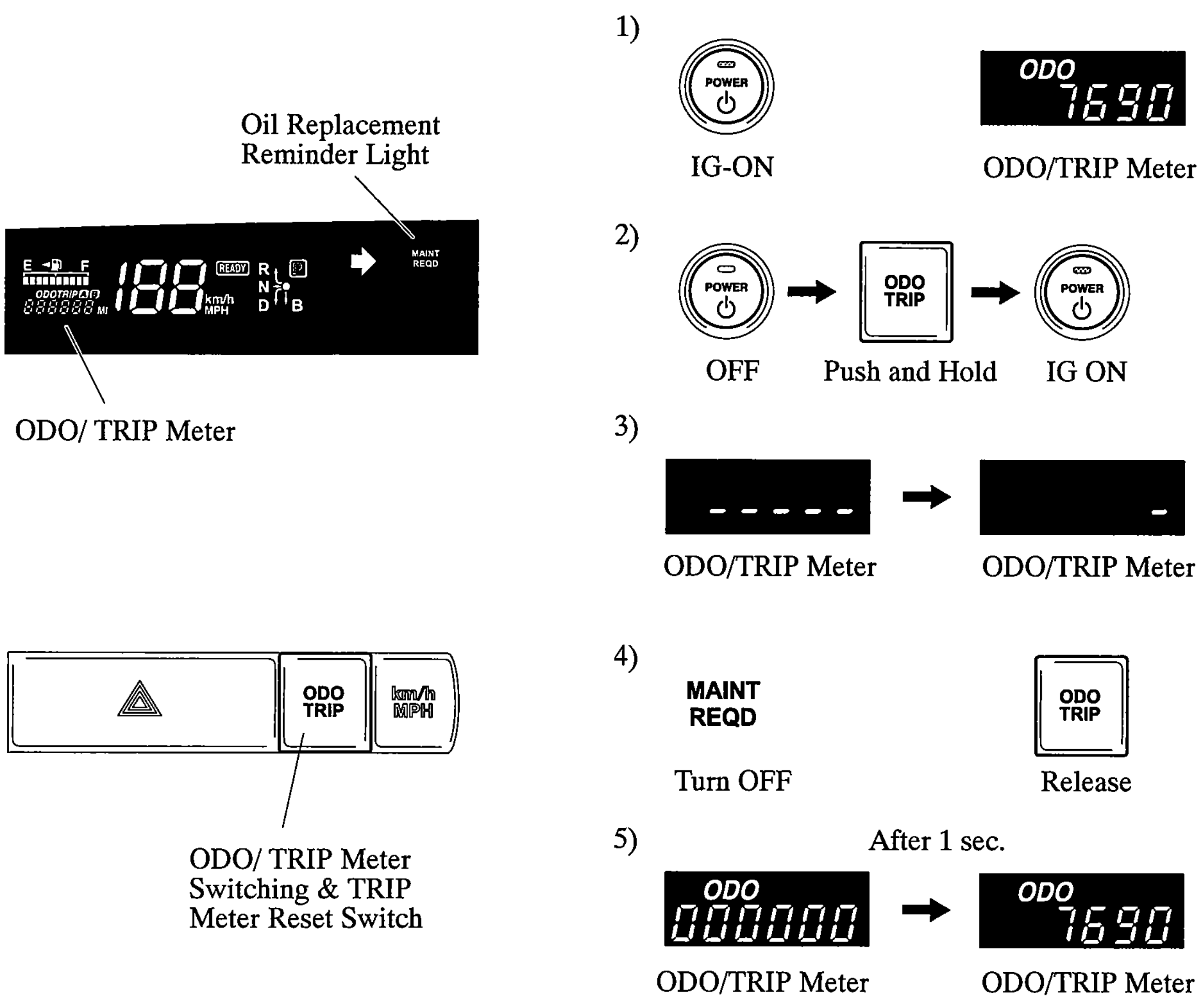


- After the engine oil has been changed, accumulated vehicle driving distance memorized in the meter ECU should be reset by the odometer/ trip meter switching & trip meter reset switch. At this point, the accumulated vehicle driving distance is reset to zero and the cycle begins again.

Service Tip

The accumulated vehicle distance memorized in the meter ECU can be reset by the following procedures.

1) Turn the power switch IG-ON and make sure that the ODO/TRIP meter is the odometer display.
2) Turn the power switch OFF. While pushing the "ODO/ TRIP meter switching & TRIP meter reset" switch, turn the power switch IG-ON.
3) Until the resetting is completed, the reminder light flashes and the ODO/TRIP meter displays as shown below.
4) The resetting is completed when the reminder light turns OFF. Release the "ODO/TRIP meter switching & TRIP meter reset" switch.
5) After the resetting is completed, the ODO/TRIP meter displays as follows for 1 second. Then, the ODO/TRIP meter displays the odometer.



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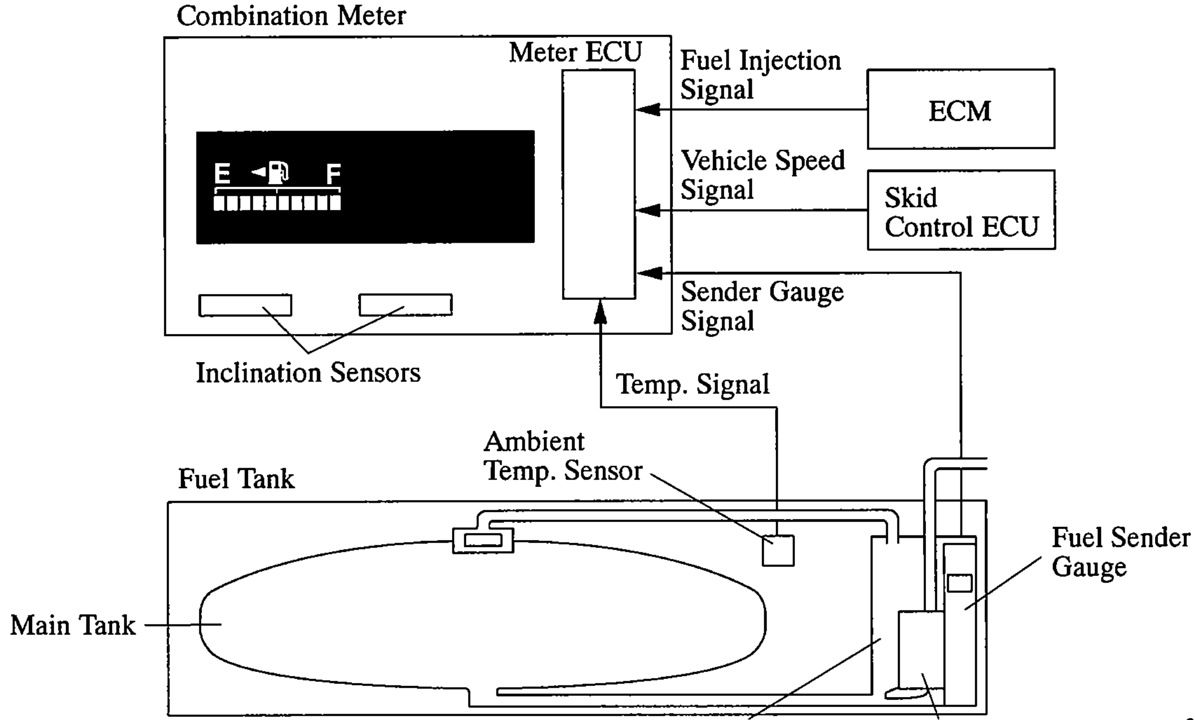
5. Fuel Gauge

General

- For the purpose of correcting the calculation of the fuel level by the meter ECU, two inclination sensors that detect the vehicle's longitudinal and latitudinal inclinations have been provided in the meter ECU, and an ambient temperature sensor has been provided in the fuel tank to detect the temperature in the fuel tank.
- The fuel level is calculated by the meter ECU in accordance with the signals of the sender gauge located in the sub tank, and the vehicle speed signal received from the skid control ECU. At this time, corrections are made by the signals from the inclination sensors that detect the vehicle's longitudinal and latitudinal inclinations and the ambient temperature sensor that detects the temperature in the fuel tank.



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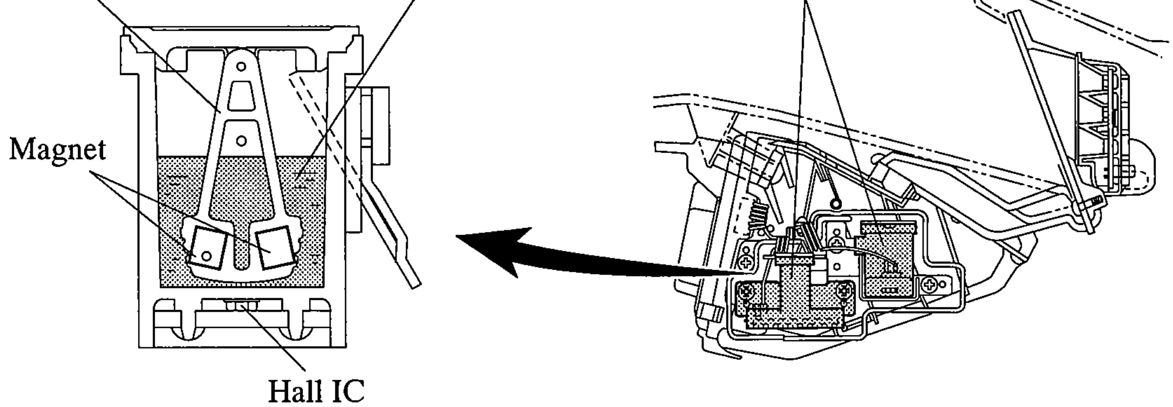
Inclination Sensor

This sensor consists of a pendulum, 2 magnets provided for the pendulum and hall IC. Hall IC converts the magnetic flux density change caused by a pendulum inclination into the voltage value and output it to the meter ECU. The meter ECU judges the inclination condition of the vehicle based on this signal and corrects the fuel gauge.



Inclination Sensor Cross Section **Combination Meter Cross Section**

255BE36

AIR CONDITIONING

■ DESCRIPTION

1. General

The following changes have been made to the air conditioning system on the '04 Prius:

- An ES18 type Electric Inverter Compressor has been newly adopted. This compressor is driven by an alternating current provided by the A/C inverter, which is built into the inverter of the hybrid system. As a result, the air conditioning system is actuated without depending on the operation of the engine, thus realizing a comfortable air conditioning system and low fuel consumption.
- The automatic air conditioning system, which automatically switches the air outlet in addition to the outlet air temperature and volume, has been adopted on all the models as standard equipment.
- A blower pulse controller, which regulates the speed of the blower motor by controlling the output voltage in accordance with the duty cycle signal provided by the A/C ECU, has been newly adopted. As a result, the power loss associated with the heat generation of the conventional blower linear controller has been reduced, thus realizing low fuel consumption.
- A humidity sensor function has been added to the room temperature sensor in order to optimize the amount of dehumidification effort during the operation of the air conditioning system.
- A compact, lightweight and highly efficient RS (Revolutionary Slim) evaporator has been adopted.
- A compact, lightweight and highly efficient MF-IV (Multi Flow-IV) condenser has been adopted.
- A compact, lightweight, and highly efficient electrical water pump has been adopted in order to ensure the proper heater performance while the engine is stopped.
- Fuzzy control has been adopted for calculating the required outlet air temperature (TAO: Temperature Air Outlet) and the blower volume in the automatic air conditioning control system. Accordingly, the air conditioning ECU is able to calculate the outlet air temperature, blower volume, air outlet, and compressor speed that is suited to the operating environment. As a result, the comfort level of the occupants has been improved.
- On the previous model, the air conditioning was controlled at the heater control panel. This control operation has been changed to the air conditioning screen display on the multi display and the steering pad switch, in order to improve the ease of use.

— REFERENCE —

Fuzzy Control: *This control method is implemented on a computer to simulate the fuzzy decision-making process of humans. It uses mathematical functions consisting of "IF-THEN" control rules for determining the circumstances (such as "slightly large" or "considerably large") that cannot be handled through ordinary calculations. Thus, this control simulates on a computer numerous information processing techniques of humans, using a language that is similar to the language used by humans.*

▶ Performance ◀

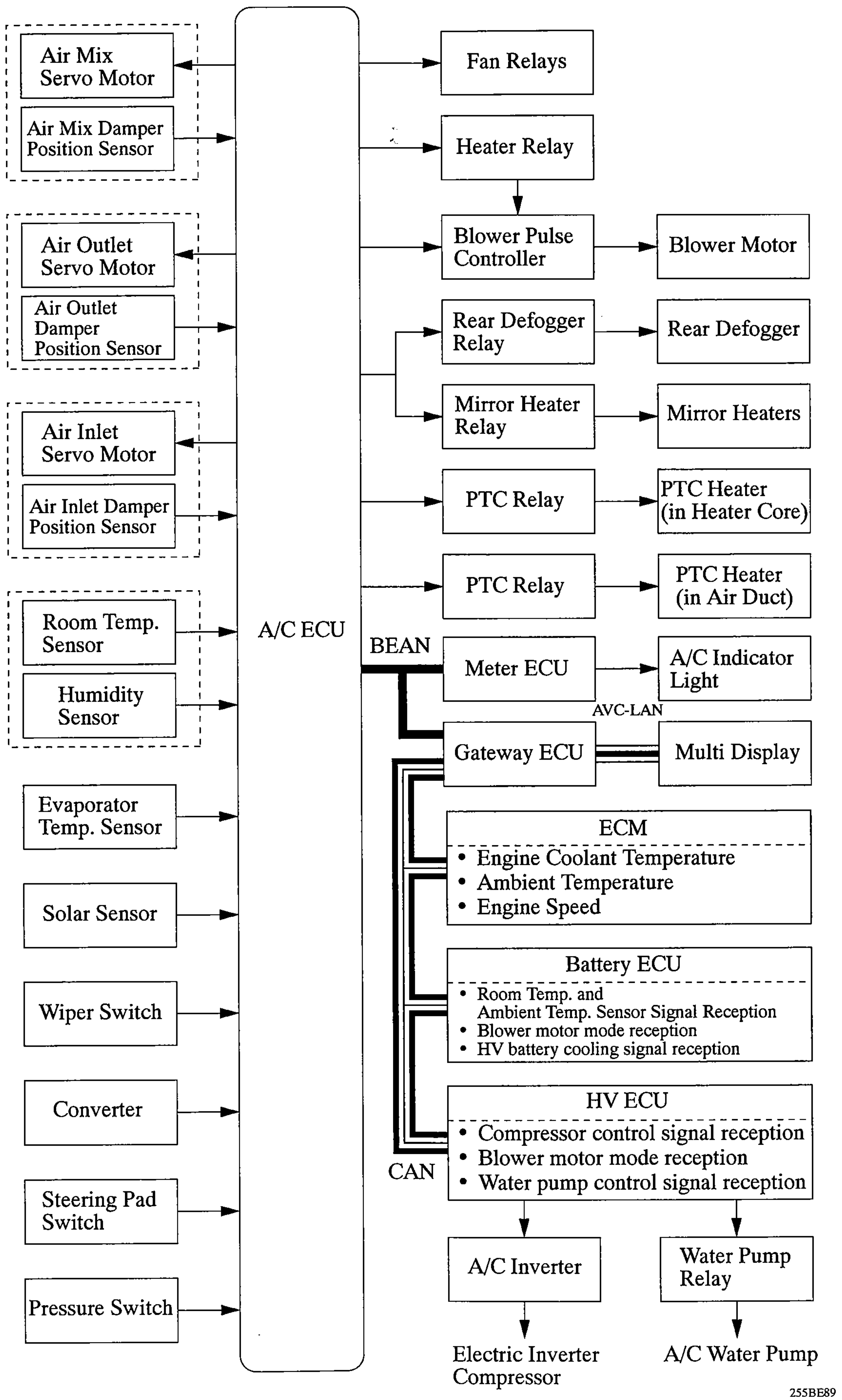
Model			'04 Prius	'03 Prius
Heater	Heat Output	W	5300	←
	Air Flow Volume	m^3/h	330	←
	Power Consumption	W	170	←
PTC Heater (Heater Core Integrated)	Heat Output	W	330 (165 × 2)	←
PTC Heater (in the air duct at the footwell outlet)	Heat Output	W	165 × 2	←
Air Conditioning	Cooling Capacity	W	4500*	4200
	Air Flow Volume	m^3/h	450	←
	Power Consumption	W	200	←

*: When the Electric Inverter Compressor revolves at its maximum speed.

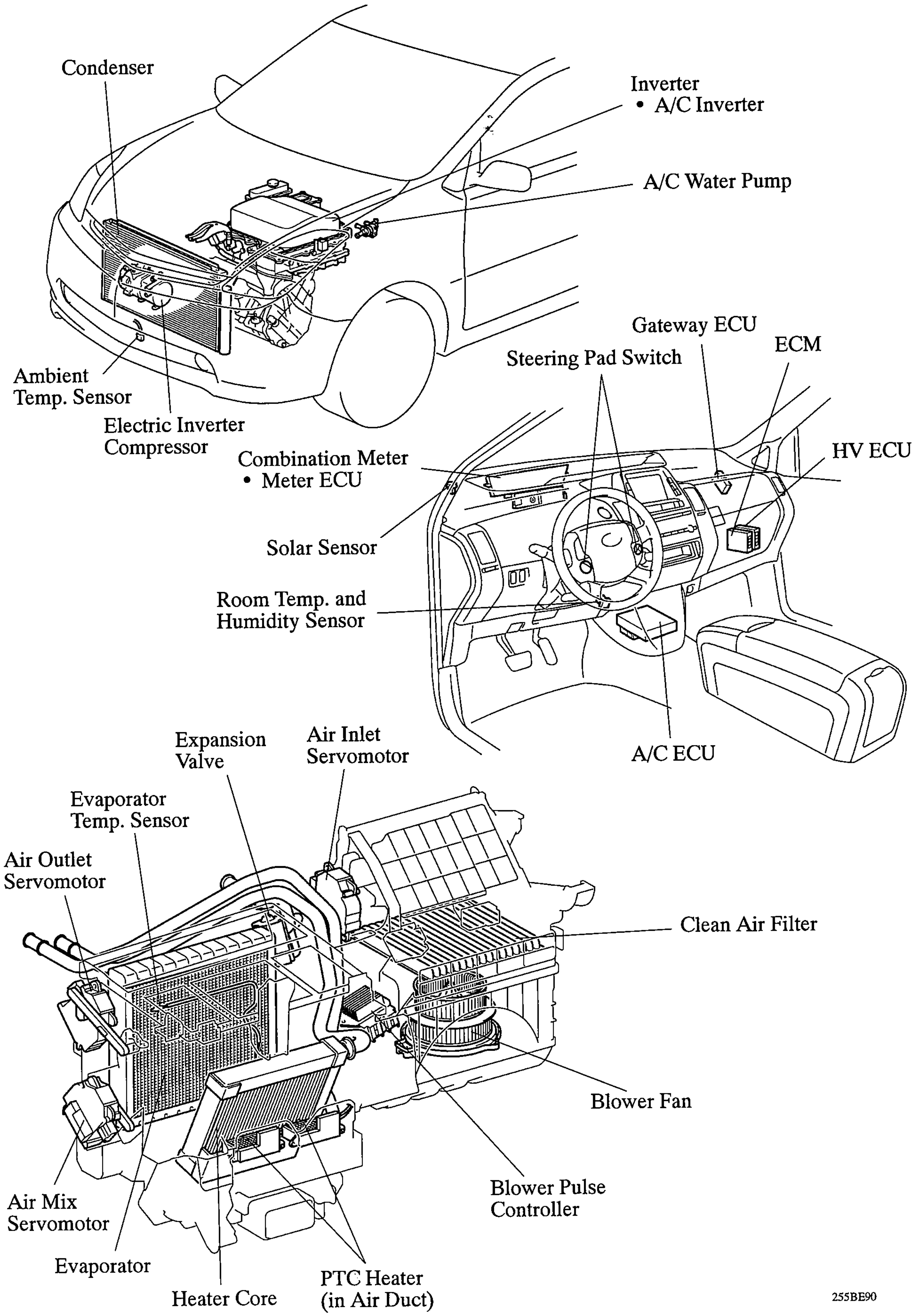
▶ Specifications ◀

Model				'04 Prius	'03 Prius
Ventilation and Heater Core	Heater Core	Type		Straight Flow (Full-path Flow)	←
		Size W × H × L	mm (in.)	216.9 × 140 × 27 (8.5 × 5.5 × 1.1)	←
		Fin Pitch	mm (in.)	1.8 (0.07)	←
	Blower	Motor Type		S70F-13T	←
		Fan Type		Shroud Fan	←
		Fan Size Dia. × H	mm (in.)	132 × 41 (5.2 × 1.6) 150 × 36 (5.9 × 1.4)	←
Air Conditioning	Condenser	Type		Multi Flow-IV (Sub-cool)	Multi Flow-III (Sub-cool)
		Size W × H × L	mm (in.)	600 × 351 × 16 (23.6 × 13.8 × 0.6)	600 × 349.8 × 37.5 (23.6 × 13.8 × 1.5)
		Fin Pitch	mm (in.)	2.75 (0.11)	2.8 (0.11)
	Evaporator	Type		Revolutionary Slim Structure	Multi-tank, Super-slim Structure
		Size W × H × L	mm (in.)	252.9 × 215 × 38 (10 × 8.5 × 1.5)	253.2 × 215 × 58 (10 × 8.5 × 2.3)
		Fin Pitch	mm (in.)	3.0 (0.12)	3.5 (0.14)
	Compressor	Type		ES18	SCS06
		Compressor Oil Type		ND11	ND8
	Refrigerant	Type		HFC134a (R134a)	←
		Volume	g	450	500

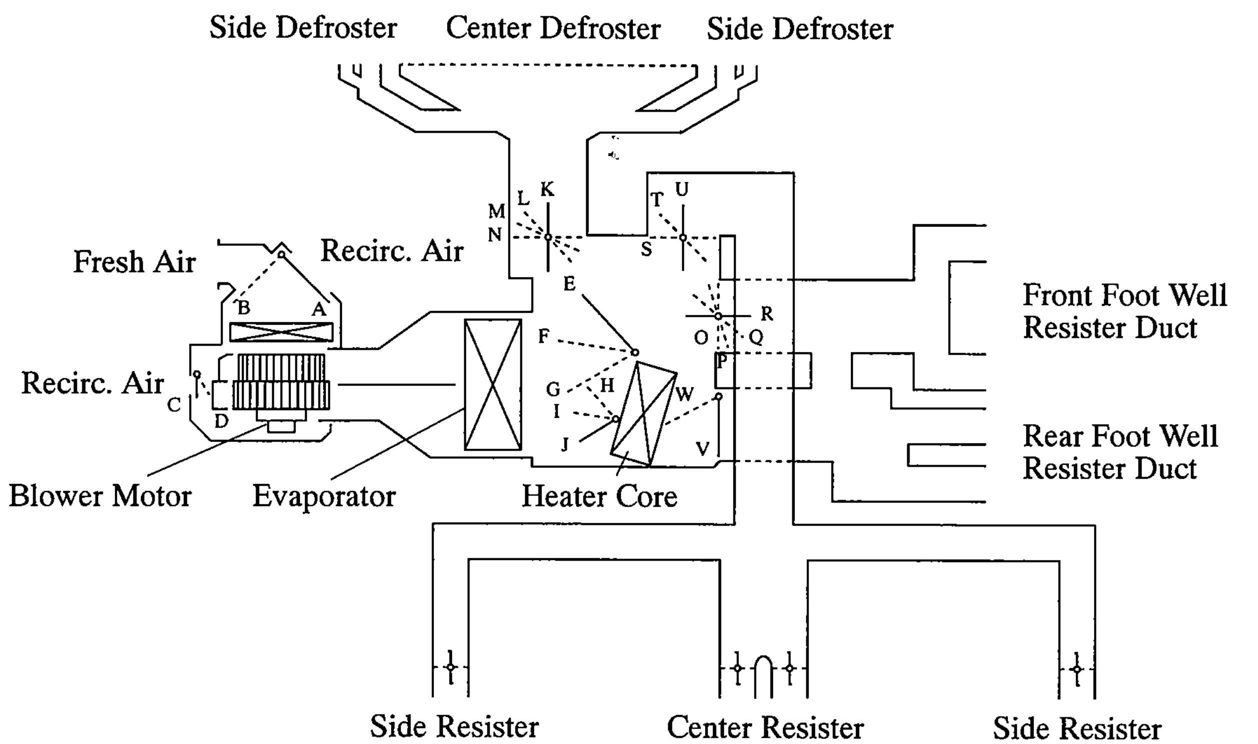
2. System Diagram



3. Layout of Main Component



4. Model Position and Damper Operation



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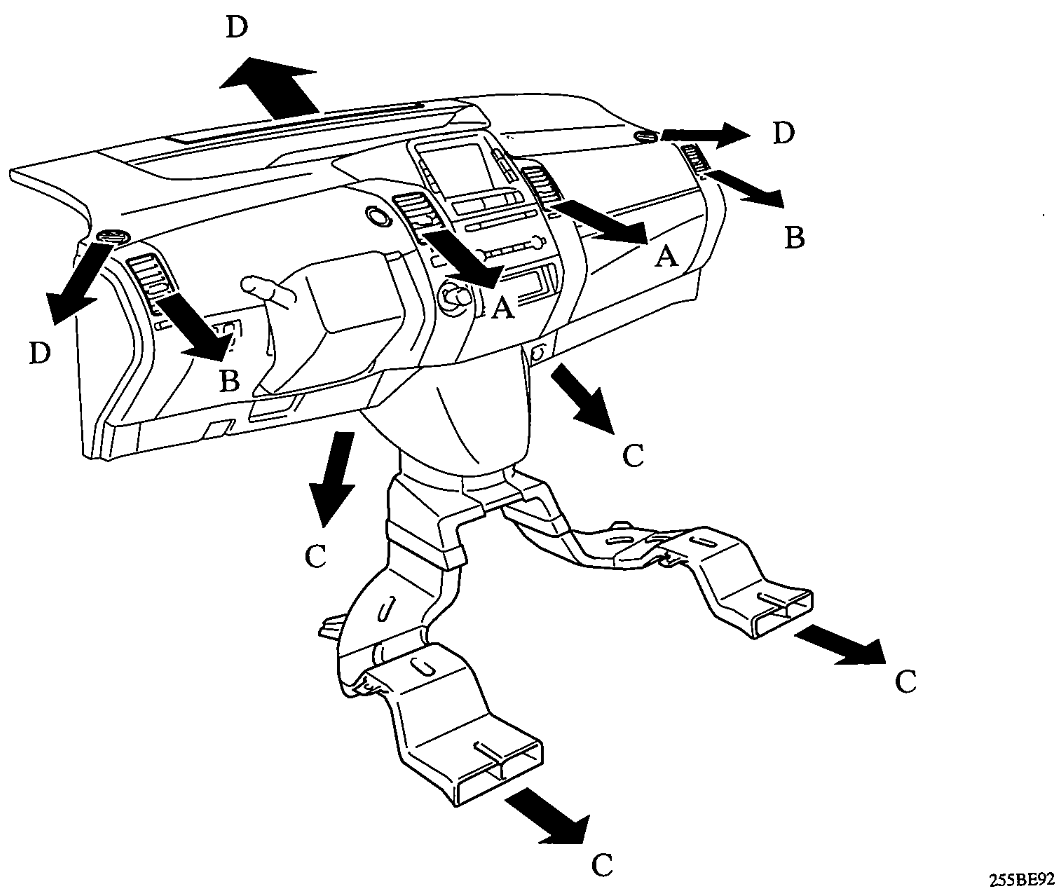
▶ Function of Main Damper ◀

Control Damper	Control Position	Damper Position	Operation
Air Inlet Control Damper	FRESH	A, C	Brings in fresh air.
	FRESH (During 2-way flow control)	A, D	Brings in fresh air and recirculates internal air.
	RECIRC	B, D	Recirculates internal air.
Air Mix Control Damper	WARM - COOL	E ~ F ~ G H ~ I ~ J	Varies the mixture ratio of the cool air and the warm air in order to regulate the temperature continuously from WARM to COOL.
Mode Control Damper	DEF 187BE28	K, O, S, V	Defrosts the windshield through the center defroster, side defroster and side register.
	FOOT/DEF 187BE27	L, Q, S, V (K, O, S, W)*1	Defrosts the windshield through the center defroster, side defroster and side register, while air is also blown out from the front and rear foot well register ducts.
	FOOT 187BE26	M, R, S, V (L, Q, S, W)*1	Air blows out of the front and rear foot well register ducts and side register. In addition, air blows out slightly from the center defroster.
	BI-LEVEL 187BE25	N, Q, T, V	Air blows out of the center register, side registers, and front and rear foot well register ducts.
	FACE 187BE24	N, O, U, V (N, P, U, V)*2	Air blows out of the center register, and side register.

*1: During 2-way Flow Control
*2: Early Stages of COOL During AUTO

5. Air Outlets and Air Volume Rations



Air Outlet Position Symbol		A	B	C	D
Air Outlet Mode	Air Mix Position	Center Face	Side Face	Foot	Defroster
FACE 187BE24	Max Cool	○	○	— (○)*	—
BI-LEVEL 187BE25	Center	○	○	○	—
FOOT 187BE26	Max Hot	—	○	○	○
FOOT/DEF 187BE27	Max Hot	—	○	○	○
DEF 187BE28	Max Hot	—	○	—	○

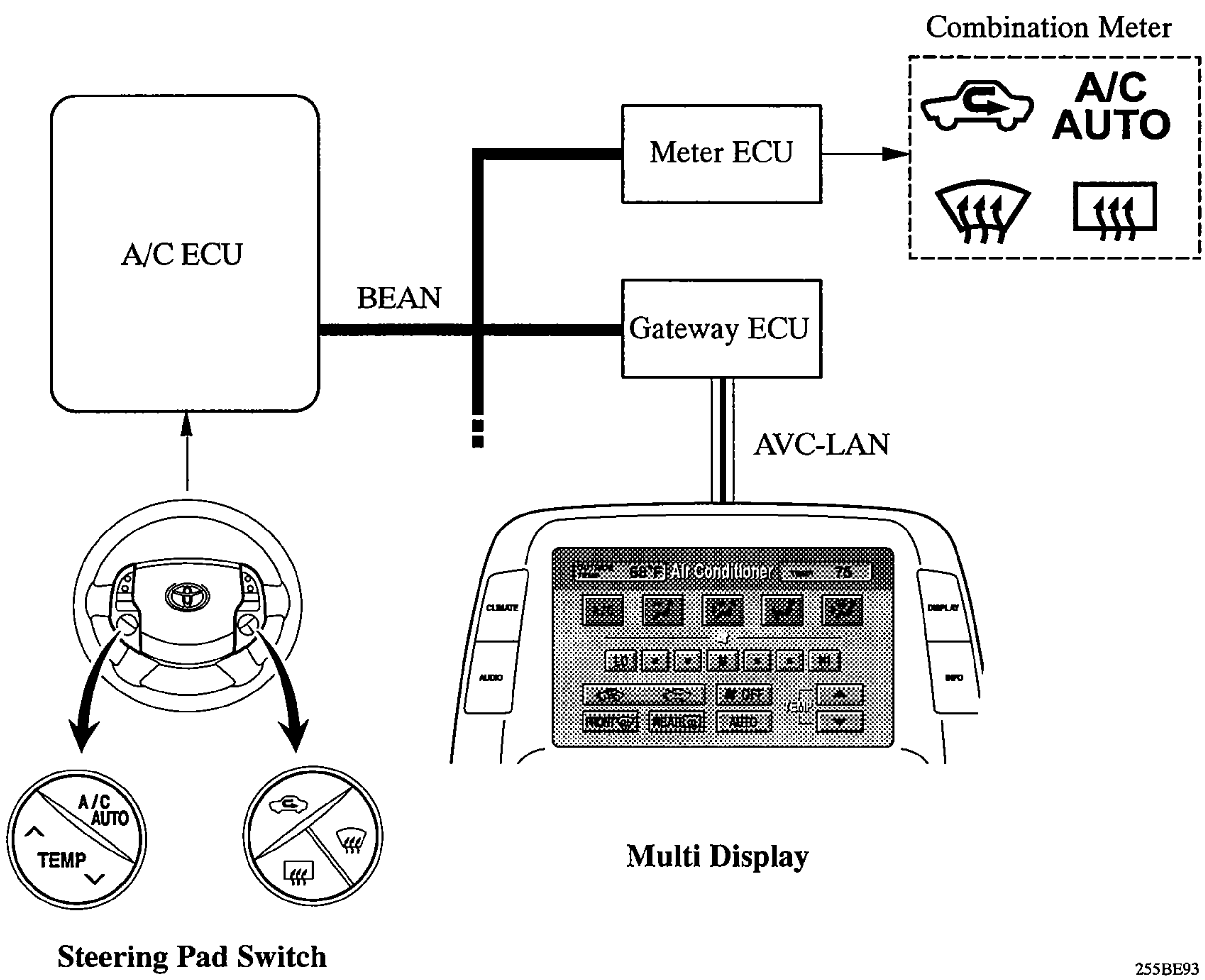
The size of the circle ○ indicates the proportion of airflow volume.

*: Early Stage of COOL During AUTO

■ CONSTRUCTION AND OPERATION

1. Air Conditioning Operation

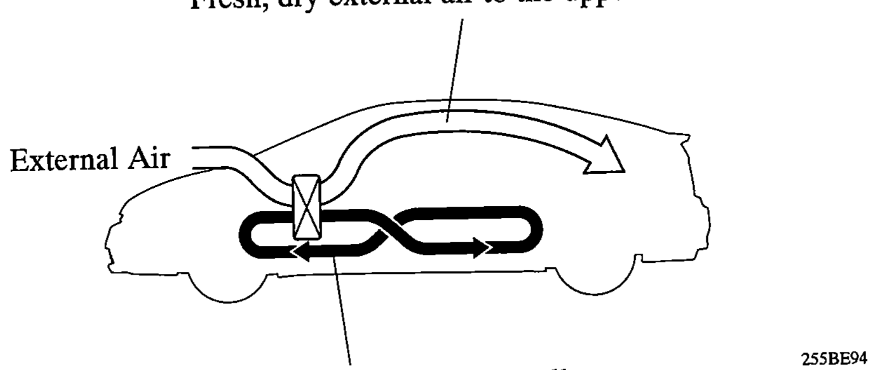
- On the '03 Prius, the air conditioning was controlled at the air conditioning control panel. On the '04 Prius, this control operation has been changed to the switches that appear on the air conditioning screen display of the multi display and the switches provided on the steering pad.
- In addition to the air conditioning screen display, the operating conditions of the AUTO, RECIRCULATION, front DEF, and rear DEF switches are indicated by the indicator lights in the combination meter.



2. Air Conditioning Unit

General

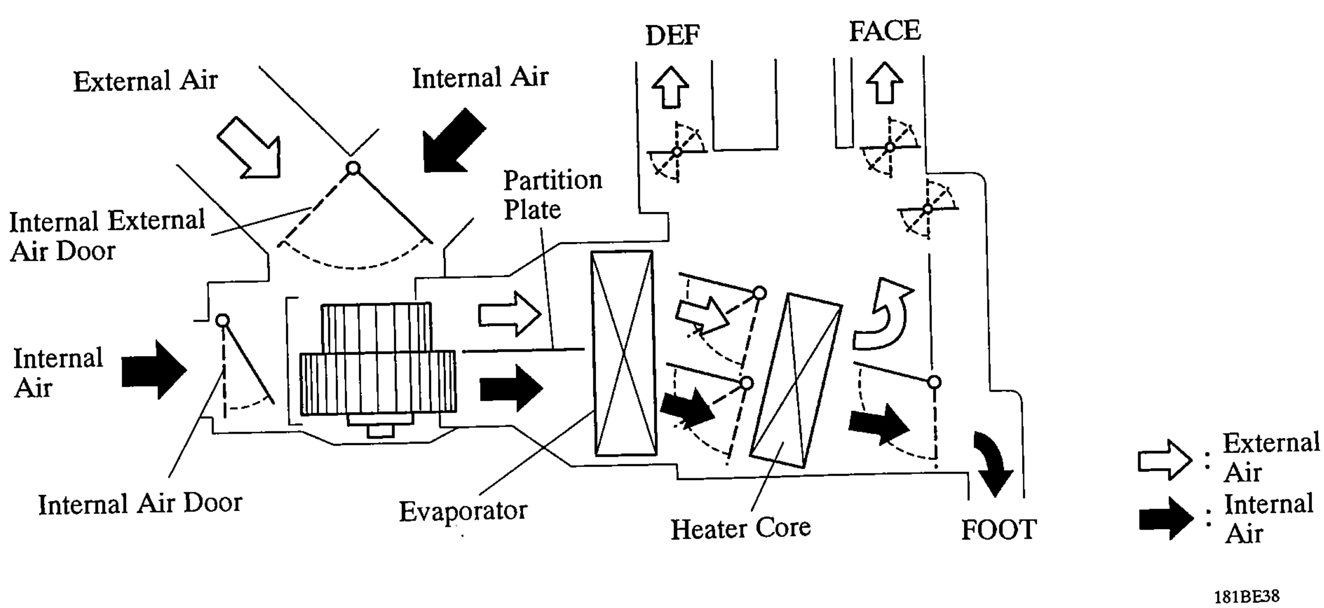
- A semi-center location air conditioning unit, in which the evaporator and heater core are placed in the vehicle's longitudinal direction, has been adopted.
- A 2-way flow type air conditioning unit that changes the 2-way flow operation if specified conditions are met, is adopted. Under 2-way flow operation, the system introduces external air and internal air simultaneously, discharges warm internal air to the foot area, and the fresh, dry external air to the upper area. Thus, it realizes both excellent heating performance and demisting performance. For details, 2-way flow control on see page BE-107.



Construction

A partition plate divides the inside of the air conditioning unit into two (External and internal air passages) parts. Thus, by controlling the external air door and the internal air door separately, the external and internal airs are introduced into the cabin in the following three modes.

- FRESH AIR
- RECIRC AIR
- BI-LEVEL, FRESH AIR/ RECIRC AIR (2-way flow)

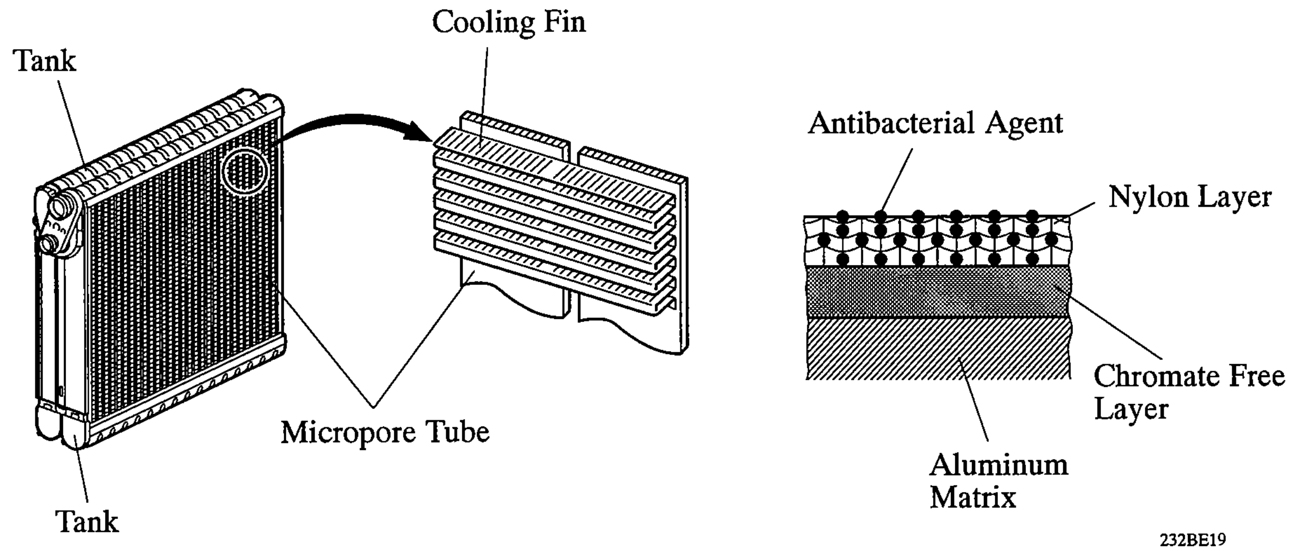


Evaporator

- An RS (Revolutionary Slim) evaporator has been adopted.
- By placing the tanks at the top and the bottom of the evaporator unit and adopting a micropore tube construction, the following effects have been realized:

  a) The heat exchanging efficiency has been improved.
  b) The temperature distribution has been made more uniform.
  c) The evaporator has been made thinner. 58 mm (2.3 in.) → 38 mm (1.5 in.)

- The evaporator body has been coated with a type of resin that contains an antibacterial agent in order to minimize the source of foul odor and the propagation of bacteria. The substrate below this coating consists of a chromate-free layer to help protect the environment.



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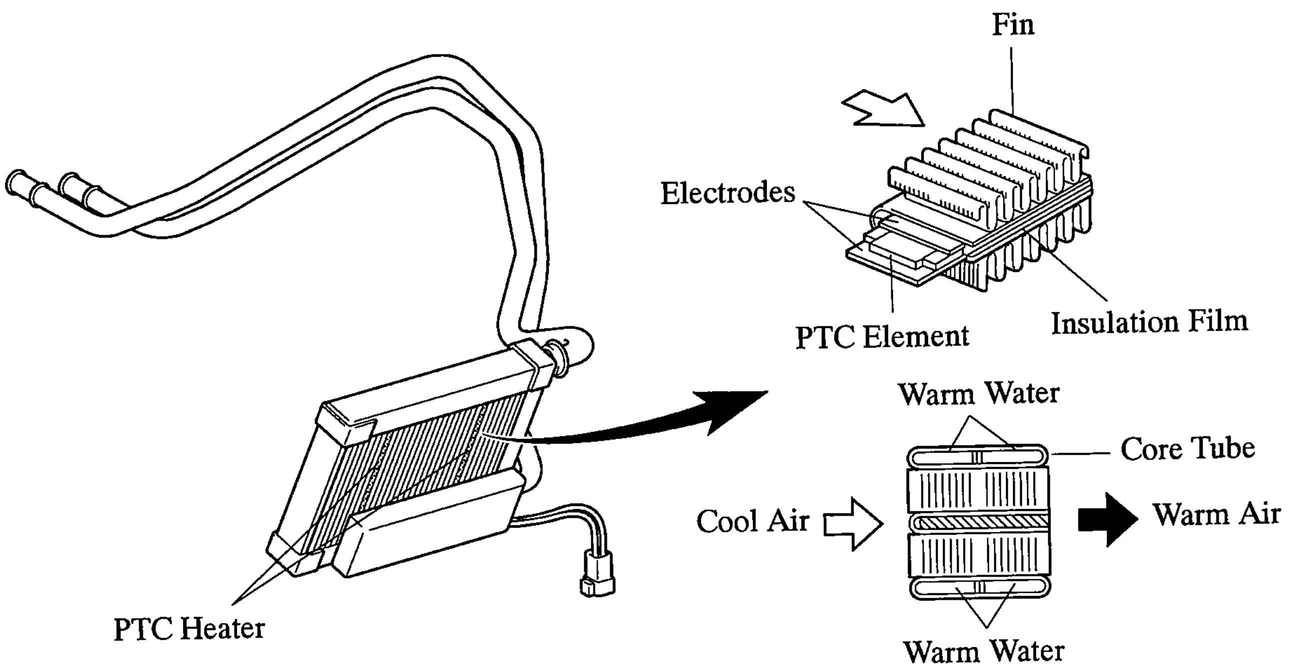
Heater Core and PTC Heater

- A compact, lightweight, and highly efficient straight flow (full-path flow) aluminum heater core is used. A PTC (Positive Temperature Coefficient) heater has been built into the heater core tube.
- The PTC heater contains electrodes that are interposed with a PTC element, to which current is applied in order to warm the air that passes through the fin. For details, PTC heater control on see page BE-108.



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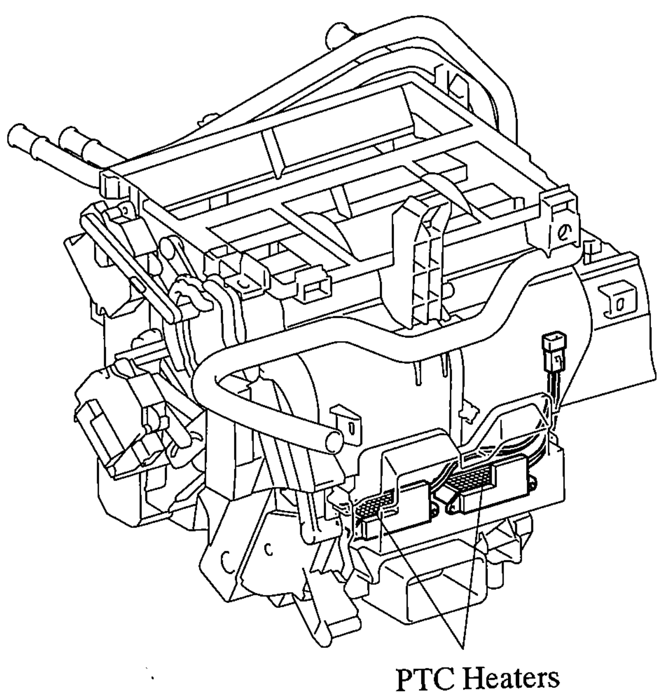
- PTC heater has been provided in the air duct at the footwell outlet in front of the air conditioning unit. This PTC heater, which is a honeycombshaped PTC thermistor, directly warms the air that flows in the duct.



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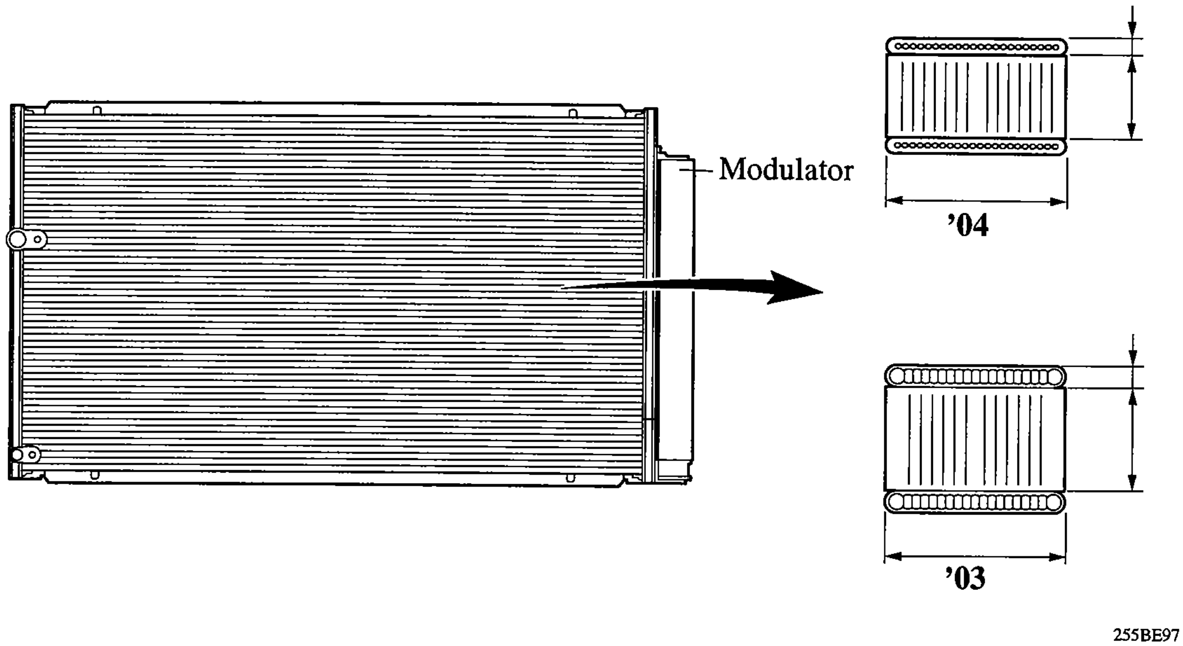
3. Condenser

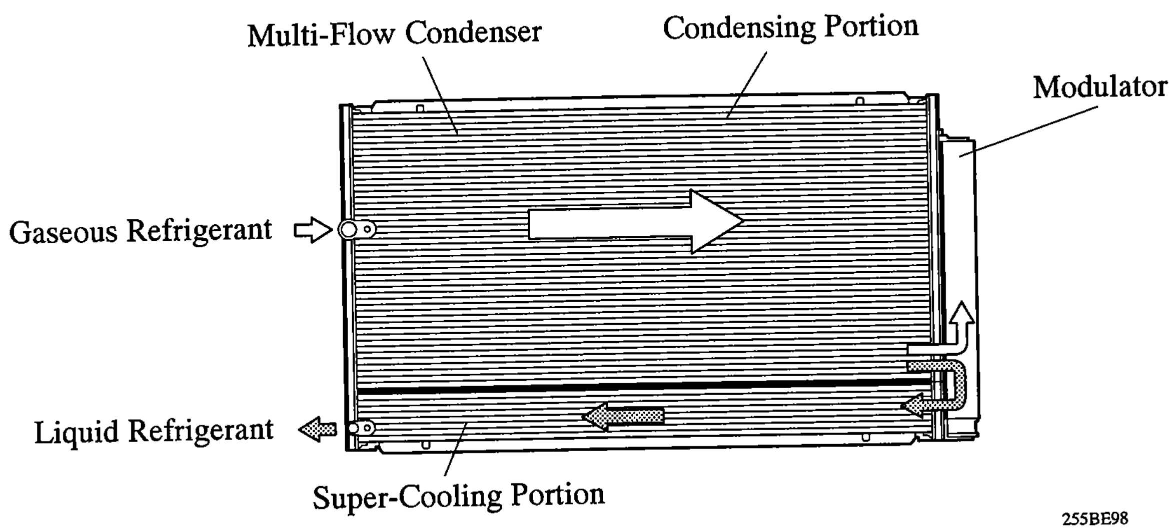
General

- The '04 Prius retains the sub-cool condenser from the '03 Prius. However, in the '04 Prius the condenser core has been made more minute and the refrigerant volume reduced.
- This condenser has adopted a sub-cool cycle for its cooling cycle system to improve heat-exchanging efficiency.



Sub-Cool Cycle

The sub-cool cycle consists of the condensing portion and the super-cooling portion, and has the gas-liquid separator (modulator) located between the two portions. A liquid refrigerant passed though the modulator is cooled again in the super-cooling portion to increase energy of the refrigerant itself, thus high-efficiency of the cooling performance is provided.



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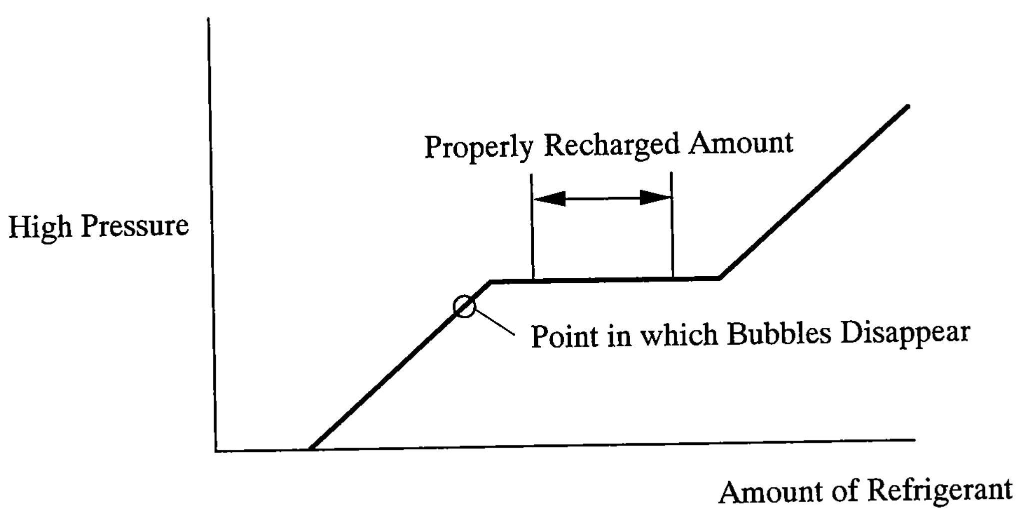
Service Tip

The point at which the air bubbles disappear in the refrigerant of the sub-cool cycle is lower than the proper amount of refrigerant with which the system must be filled. Therefore, if the system recharged with refrigerant based on the point at which the air bubbles disappear, the amount of refrigerant would be insufficient. As a result, the cooling performance of the system will be affected. If the system is overcharged with refrigerant, this will also lead to a reduced performance.

For the proper method of verifying the amount of the refrigerant and to recharge the system with refrigerant, see the 2004 Prius Repair Manual (Pub. No. RM1075U).



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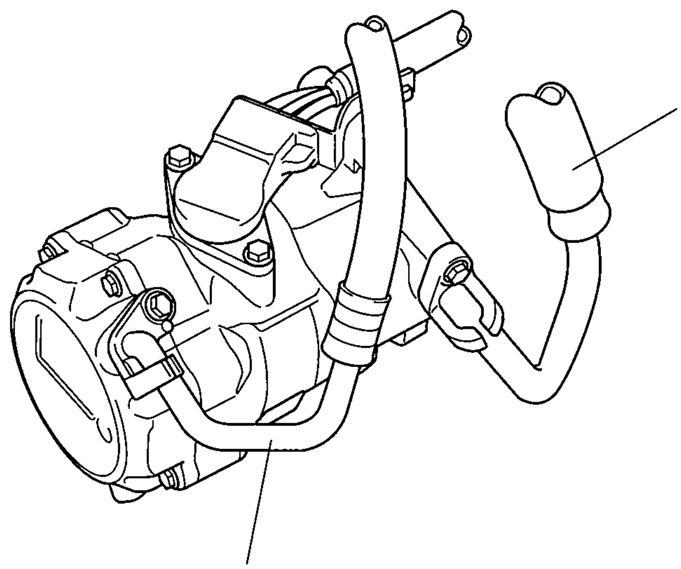
4. Compressor

General

- Instead of the SCS06 scroll compressor that is actuated by the engine on the '03 Prius, the '04 Prius has newly adopted an ES18 Electric Inverter Compressor that is actuated by a built-in electric motor. Except for the portion that is actuated by the electric motor, the basic construction and operation of this compressor are the same as in the scroll compressor used on the '03 Prius.
- The electric motor is actuated by the alternating current power (201.6 V) supplied by the A/C inverter, which is integrated in the hybrid system inverter. As a result, the air conditioning control system on the '04 Prius is actuated without depending on the operation of the engine, thus realizing a comfortable air conditioning system and low fuel consumption.
- Due to the adoption of an electric inverter compressor, the compressor speed can be controlled at the required speed calculated by the A/C ECU. Thus, the cooling and dehumidification performance and power consumption have been optimized.
- Low-moisture permeation hoses have been adopted for the suction and discharge hoses at the compressor in order to minimize the entry of moisture into the refrigeration cycle.
- The compressor uses high-voltage alternating current. If a short or open circuit occurs in the compressor wiring harness, the HV ECU will cut off the A/C inverter circuit in order to stop the power supply to the compressor.
- For details on the Electric Inverter Compressor control effected by the A/C ECU, see page BE-110.



Service Tip

In order ensure the proper insulation of the internal high-voltage portion of the compressor and the compressor housing, the '04 Prius has adopted a compressor oil (ND11) with a high level of insulation performance. Therefore, never use a compressor oil other than the ND11 type compressor oil or its equivalent.

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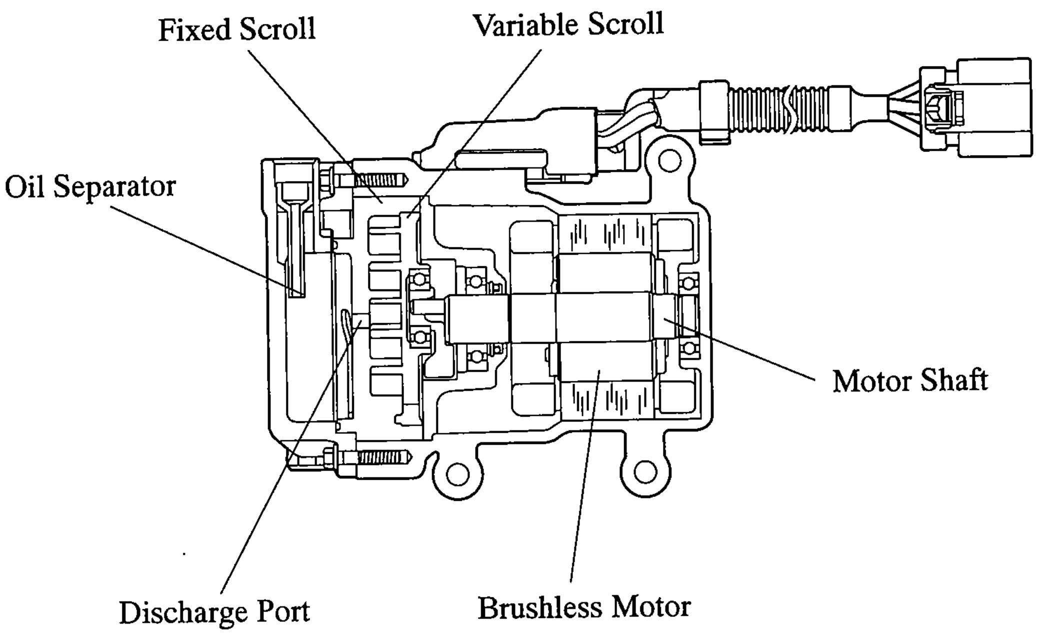
Construction

- The Electric Inverter Compressor consists of a spirally wound fixed scroll and variable scroll that form a pair, a brushless motor, an oil separator, and a motor shaft.
- The fixed scroll is integrated with the housing. Because the rotation of the shaft causes the variable scroll to revolve while maintaining the same posture, the volume of the space that is partitioned by both scrolls varies to perform the suction, compression, and the discharge of the refrigerant gas.
- Locating the suction port directly above the scrolls enables direct suction, thus realizing improved suction efficiency.
- Containing a built-in oil separator, this compressor is able to separate the compressor oil that is intermixed with the refrigerant and circulates in the refrigeration cycle, thus realizing a reduction in the oil circulation rate.



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Operation

1) Suction

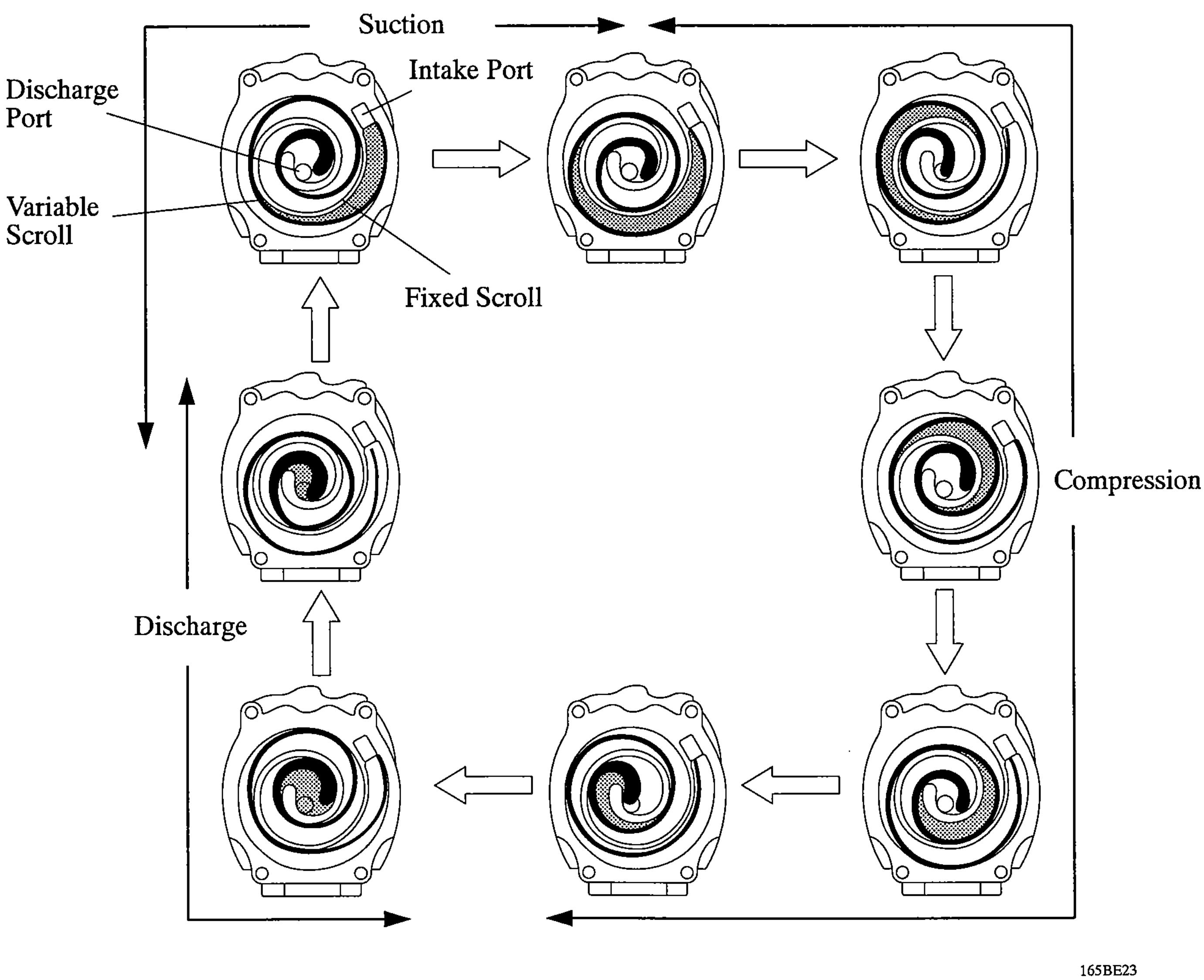
As the capacity of the compression chamber, which is created between the variable scroll and the fixed scroll, increases in accordance with the revolution of the variable scroll, refrigerant gas is drawn in from the intake port.

2) Compression

From the state at which the suction process has been completed, as the revolution of the variable scroll advances further, the capacity of the compression chamber decreases gradually. Consequently, the refrigerant gas that has been drawn in becomes compressed gradually and is sent to the center of the fixed scroll. The compression of the refrigerant gas is completed when the variable scroll completes approximately 2 revolutions.

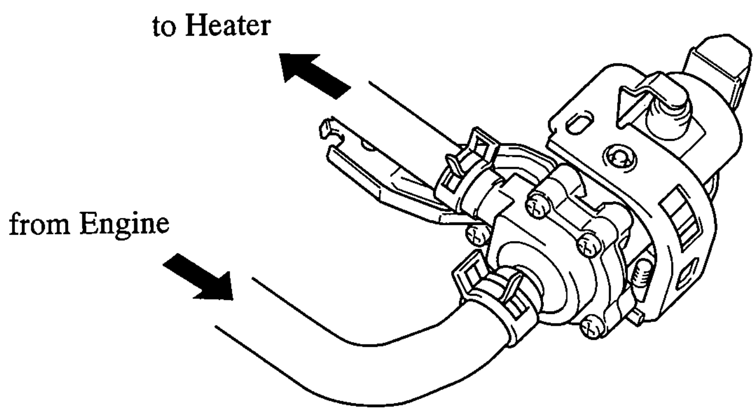
3) Discharge

When the compression of the refrigerant gas is completed and the refrigerant pressure becomes high, the refrigerant gas discharges through the discharge port located in the center of the fixed scroll by pushing the discharge valve.



5. Water Pump

- Same as the '03 Prius, an electrical water pump has been adopted. This provides a stable heater performance even if the engine is stopped because of a function of the THS-II.
- The '04 Prius has adopted a new type of electrical water pump in which the water flow resistance has been reduced. As a result, the bypass valve that was used on the '03 Prius has been discontinued.



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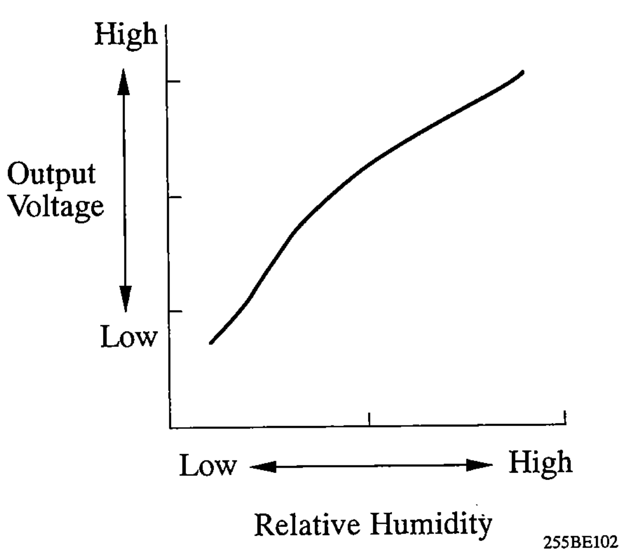
6. Room Temp. and Humidity Sensor

- A humidity sensor function has been added to the room temperature sensor. By enabling the detection of humidity in the vehicle interior, this function optimizes the amount of dehumidification effort during the operation of the air conditioning system. As a result, the power consumption of the compressor has been reduced and a comfortable level of humidity has been realized in the vehicle interior.
- The humidity-sensing resistance film that is built into the humidity sensor absorbs and releases the humidity in the vehicle interior. During the absorption and releasing processes, the humidity-sensing resistance film expands (during the absorption of humidity) and contracts (during drying). The clearance between the carbon particles in the humidity-sensing resistance film expands and contracts during absorption and drying, thus changing the resistance between the electrodes. The A/C ECU determines the humidity in the vehicle interior through the changes in the output voltage of the humidity sensor that are caused by the resistance between the electrodes.



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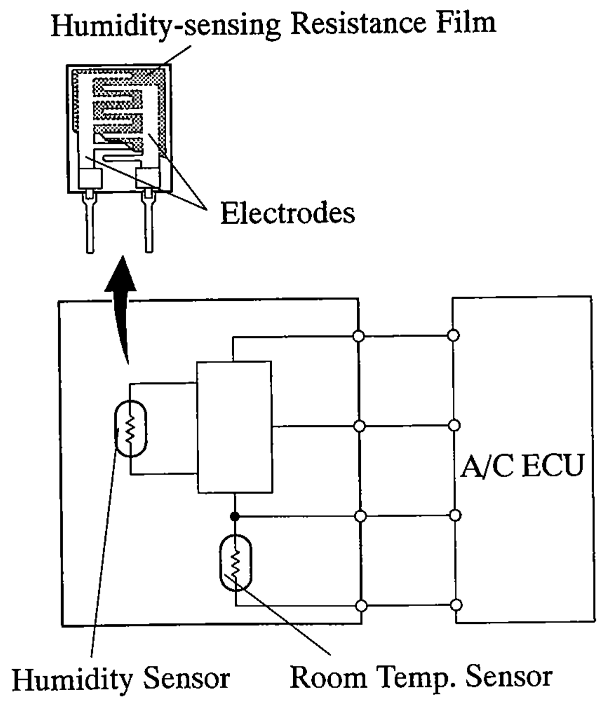

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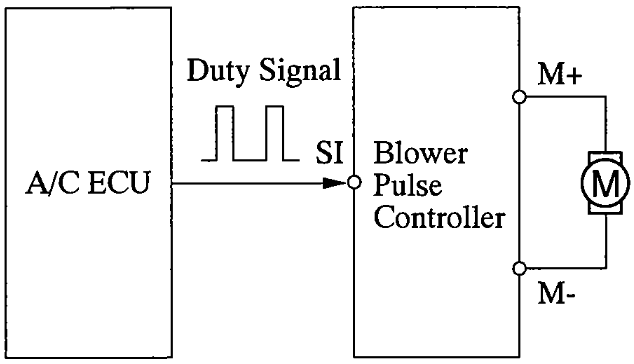
7. Blower Pulse Controller

The blower pulse controller controls the voltage that is output to the blower motor in accordance with the duty cycle signals that are input by the A/C ECU. It is characterized by a smaller amount of heat generation than the blower controller used on the previous model. As a result, the power loss associated with the heat generation of the conventional blower linear controller has been reduced, thus realizing low fuel consumption.



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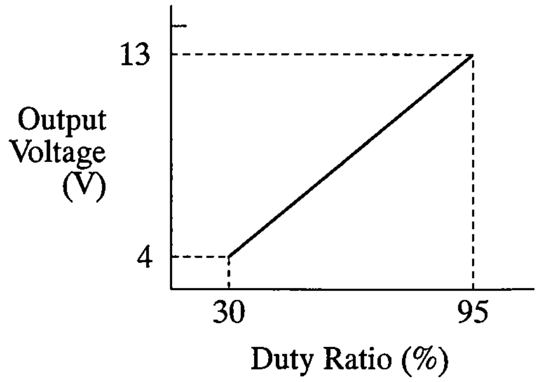

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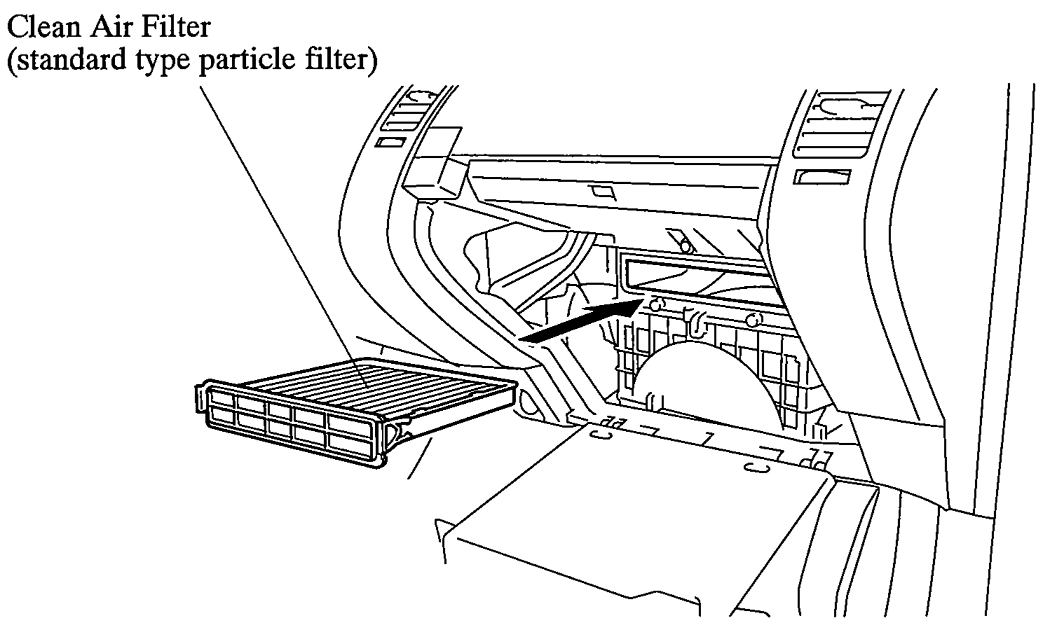
8. Clean Air Filter

- A clean air filter (Standard type Particle Filter) that excels in the removal of dust and pollen, located in the blower unit is provided.
- This filter, which cleans the air in the cabin, is made of polyester. Thus, it can be disposed of easily as a combustible material, a feature that is friendly the environment.



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Service Tip

The clean air filter (standard type particle filter) on U.S.A. model should be changed at 30,000 miles. On Canada model, it should be changed at 16,000 km. However, it varies with the use conditions (or environment).

9. Air Conditioning ECU

General

The air conditioning ECU has following control.

Control		Outline
Fuzzy Control (see page BE-109)		The fuzzy control determines the conformity levels of the temperature deviation, ambient temperature, and solar radiation by defining their respective mathematical functions. In addition, a fuzzy calculation method is used to calculate the required outlet air temperature (TAO) and the blower volume. Based on these calculations, the A/C ECU effects the respective controls for the outlet air temperature, blower volume, compressor, and air outlet.
Outlet Air Temp. Control	Air Mix Damper Control	In response to the temperature control switch setting, the required outlet air temperature, evaporator temperature sensor, and engine coolant temperature sensor compensations are used by the air mix control damper control to calculate a tentative damper opening angle, through an arithmetic circuit in the air mix damper, to arrive at a target damper opening angle.
Blower Control	Blower Motor Start Up Control	When the blower motor is started up, the A/C ECU transmits a blower motor actuation signal with a low duty cycle ratio to the blower pulse controller, which applies a low voltage to the blower motor, in order to operate the blower motor for 3 seconds at a low speed. This is designed to protect the blower pulse controller from a sudden start-up voltage surge.
	Manual Control	Sets the blower speed according to operation of the blower switch.
	Automatic Control	**Step Less Air Volume Control:** • When the AUTO switch located on the steering pad switch is pushed, or the air conditioning screen display of the multi display is touched, the A/C ECU automatically regulates the duty ratio to the blower pulse controller in accordance with a calculation result by the fuzzy control in order to deliver step less air volume. **Warm-up Control:** • When the air outlet is in the FOOT, BI-LEVEL, or FOOT/DEF mode, the blower will not operate until the engine coolant temperature increases above a prescribed value. When the temperature increases above a prescribed value, the blower motor operates at the LO speed. **Time-Lagged Air Flow Control:** • 2 types of time-lagged air flow control (in accordance with the detected by the evaporator temperature sensor) help prevent hot air from being emitted from FACE or BI-LEVEL vent. **Sunlight Air Flow Control:** • Controls the blower speed in accordance with the intensity of the sunlight when the air outlet mode is at FACE or BI-LEVEL. The blower speed can be adjusted in response to the signal received from the solar sensor.

(Continued)

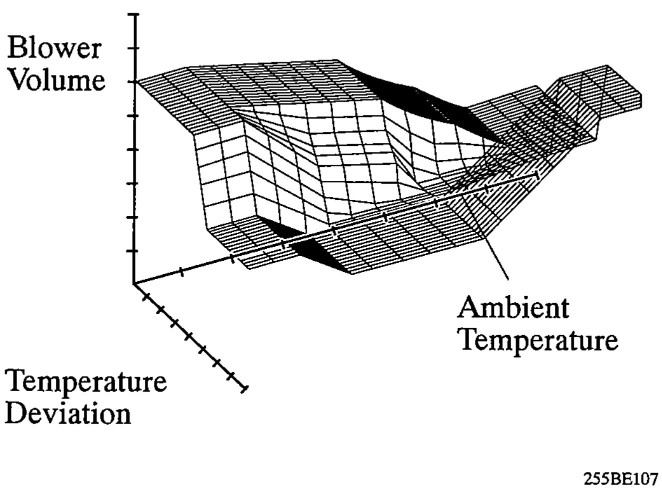
Control		Outline
Air Outlet Control	Manual Control	Changes the air outlet in accordance with the selected position of the mode select switch.
	Automatic Control	**Mode Damper Switching Servomotor Control:** • When the AUTO switch is pushed, automatic control causes the mode servomotor to rotate to a desired position in accordance with the target damper opening, which is based on the calculation of the TAO. **Low-Temperature FOOT/DEF Control:** • In accordance with the engine coolant temperature, ambient temperature, amount of sunlight, required outlet temperature (TAO), and vehicle speed conditions, this control automatically switches the blower outlet between the FOOT/ DEF modes to prevent the window from becoming fogged when the outside air temperature is low.
Air Inlet Control	Manual Control	Drives the air inlet servomotor according to the operation of the air inlet control switch and fixes the dampers in the FRESH or RECIRC position.
	Automatic Control	**Automatic RECIRC/ FRESH Control:** • When the AUTO switch is pressed, the system controls the servo motor in order to achieve the air inlet that has been calculated in accordance with the TAO. **DEF Mode Control:** • When switching the mode switching switch to DEF mode, A/C ECU turns MAX mode ON forcibly and switches to FRESH mode. • When switching the mode switching switch to FOOT/DEF mode, A/C ECU switches to FRESH mode.
2-Way Flow Mode Control		At the time of selecting FRESH mode, A/C ECU will judge it as 2-way flow mode when the blower outlet is selected to FOOT or FOOT/DEF, the tentative air mix damper opening angle is above the specified value (MAX HOT), and either the blower volume is more than the specified volume or the vehicle speed is less than the specified speed.
Half Inlet Air Mode Control		At the time of selecting FRESH mode, A/C ECU will judge it as half inlet air mode when the blower outlet mode is selected to FACE or BI-LEVEL and TAO is more than the specified temperature, and operates both outlet air introduction and inlet air circulation at the same time.
Electric Inverter Compressor Control (see page BE-110)	Compressor Speed Control	• The A/C ECU calculates the target speed of the compressor based on the target evaporator temperature (which is calculated by the room temperature sensor, humidity sensor, ambient temperature sensor, and the solar sensor) and the actual evaporator temperature that is detected by the evaporator temperature sensor in order to control the compressor speed. • The A/C ECU calculates the target evaporator temperature, which includes corrections based on the vehicle interior humidity (which is obtained from the humidity sensor) and the windshield glass inner surface humidity (which is calculated from the humidity sensor, solar sensor, room temperature sensor, mode damper position, and wiper operation condition). Accordingly, the A/C ECU controls the compressor speed to an extent that would not inhibit the proper cooling performance or defogging performance.
Electric Water Pump Control		When the blower motor is ON and the engine has been stopped by the hybrid control, the A/C ECU turns ON the electric water pump in accordance with the judgment of the air mix damper opening.

(Continued)

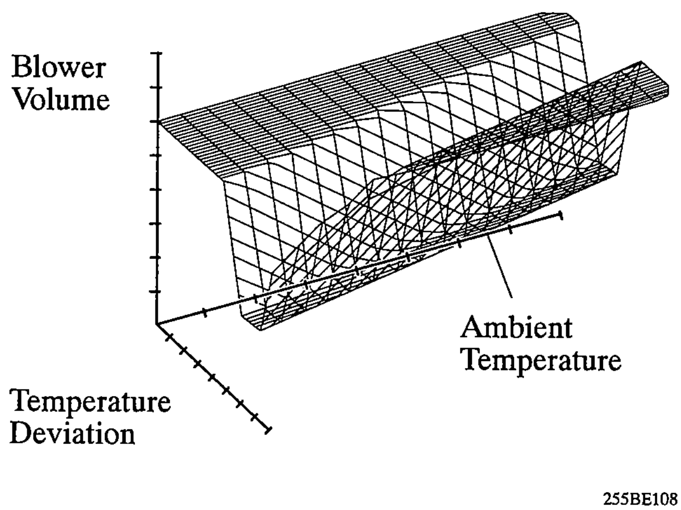
Control	Outline
Engine Start Request Control	To ensure the proper heater performance when the hybrid system is started at low temperatures, the A/C ECU transmits an engine start request to the HV ECU in accordance with the TAO, engine coolant temperature sensor signal, and ambient temperature sensor signal.
PTC Heater Control	When the hybrid system is operating (READY), and the blower motor is turned ON, the A/C ECU turns ON the PTC heater if the conditions listed below are met. **Heater core integrated PTC Heater** • Air outlet is in the FOOT, FOOT/DEF or DEF mode. • Engine coolant temperature is below specified temperature. • Ambient temperature is below specified temperature (DEF mode). • Tentative air mix damper opening angle is above the specified value. (MAX HOT) **Footwell air duct integrated PTC heater** • Air outlet is in the FOOT or FOOT/DEF mode. • Engine coolant temperature is below specified temperature. • Tentative air mix damper opening angle is above the specified value. (MAX HOT)
Electric Cooling Fan Control	The A/C ECU control the cooling fan in accordance with the vehicle speed signal and compressor speed signal.
Rear Window Defogger Control	Switches the rear defogger and outside rear view mirror heaters, on for 15 minutes when the rear defogger switch is switched on. Switches them off if the switch is pressed while they are operating.
Outer Temperature Indication Control	Based on the signals from the ambient temperature sensor, this control calculates the outside temperature, which is then corrected in the air conditioning ECU, and shown in the multi display.
Self-Diagnosis	Checks the sensor and A/C inverter in accordance with operation of the air conditioning switches, then heater control panel display portion a DTC (Diagnosis Trouble Code) to indicate if there is a malfunction or not (sensor check function).
	Drives the actuators through a predetermined sequence in accordance with the operation of the air conditioning switches (actuator check function).

Fuzzy Control

- In the conventional automatic air conditioning control system, the A/C ECU calculates the required outlet air temperature (TAO: Temperature Air Outlet) for the set temperature in accordance with a prescribed calculation formula based on the temperature information obtained from the sensors. By automatically controlling the servo motors and the blower motors in order to achieve the TAO that has thus been calculated, this system maintains a stable temperature in the vehicle interior and ensures the comfort of the occupants. However, the conventional automatic air conditioning control system that univocally determines all controls based on the TAO offers a low level of freedom of control (as it was an aggregation of linear systems). Therefore, the '04 Prius has adopted fuzzy control (for non linear control) in order to achieve fine-tuned control. The fuzzy control determines the conformity levels of the temperature deviation, ambient temperature, and solar radiation by defining their respective mathematical functions. In addition, it uses a fuzzy calculation method (algebraic product addition center of gravity method) to calculate the required outlet air temperature (TAO) and the blower volume. Based on these calculations, the A/C ECU effects the respective controls for the outlet air temperature, blower volume, compressor, and air outlet.
- The conformity levels for the temperature deviations are defined in 9 levels in accordance with the actual room temperature and the set temperature, for the solar radiation in 4 levels (low, medium low, medium, and high) in accordance with the solar sensor, and for the ambient temperatures in 6 levels (midwinter, winter, spring-autumn, spring-summer, and midsummer) in accordance with the ambient temperature sensor.



Non-Linear Control (Fuzzy Control)

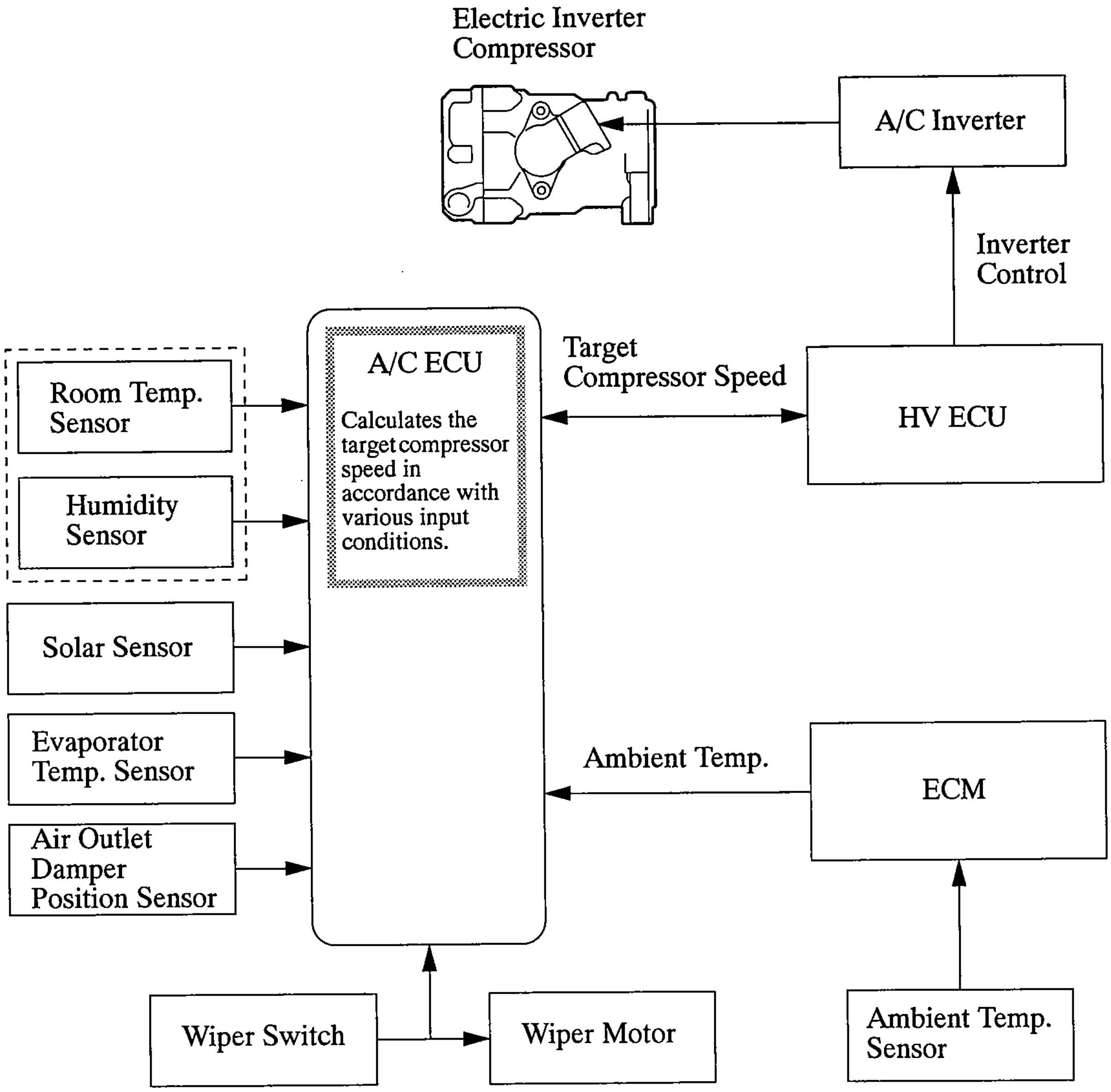


Conventional

Electric Inverter Compressor Control

1) Compressor Speed Control

- The A/C ECU calculates the target compressor speed based on the target evaporator temperature (calculated from the room temperature sensor, humidity sensor, ambient temperature sensor, and solar sensor) and the actual evaporator temperature detected by the evaporator temperature sensor. Then, the A/C ECU transmits the target speed to the HV ECU. The HV ECU controls the A/C inverter based on the target speed data in order to control the compressor to a speed that suits the operating condition of the air conditioning system.
- The A/C ECU calculates the target evaporator temperature, which includes corrections based on the vehicle interior humidity (which is obtained from the humidity sensor) and the windshield glass inner surface humidity (which is calculated from the humidity sensor, solar sensor, room temperature sensor, mode damper position, and wiper operation condition). Accordingly, the A/C ECU controls the compressor speed to an extent that does not inhibit the proper cooling performance or defogging performance. As a result, comfort and low fuel consumption can be realized.



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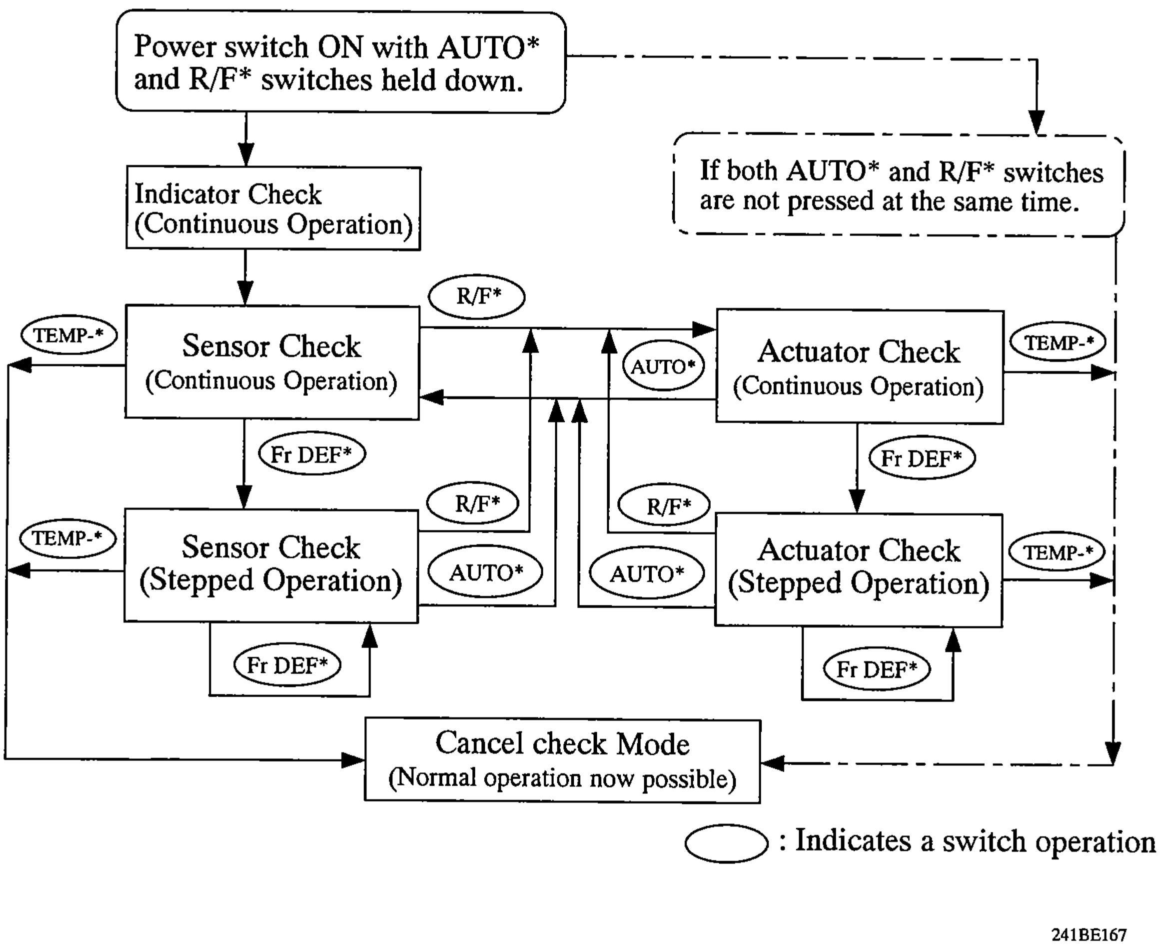
Self-Diagnosis

- The air conditioning ECU has a self-diagnosis function. It stores any operation failures in the air conditioning system memory in the form of a malfunction code. By operating the air conditioning control switches, the stored malfunction codes are displayed on the multi display. Since diagnostic results are stored directly by electric power from the battery, they are not cleared even when the ignition switch is turned off.

▶ Functions ◀

Function	Outline
Indicator Check	Checks mode and temperature setting display.
Sensor Check	Checks the past and present malfunctions of the sensors and A/C inverter, and clearing the past malfunction data.
Actuator Check	Checks against actuator check pattern if blower motor, servomotors and magnetic clutch are operating correctly according to signals from ECU.

- The check function can be started by the following procedure shown below.



*: Use the switches that are provided on the steering pad switch.

- For details on the indicator check, sensor check, actuator check function, and clearing DTC of this system, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

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MULTI DISPLAY

■ DESCRIPTION

- A multi display has been provided on the center cluster panel as standard equipment. The display, which consists of a wide 7.0-inch LCD (Liquid Crystal Display) screen with a pressure sensitive touch panel, offers improved ease of use.
- A GPS (Global Positioning System) voice navigation is offered as an option for U.S.A. model.
- Upon receiving the operation information from the A/C ECU that is transmitted by the gateway ECU, trip information from the meter ECU that is transmitted by the gateway ECU, operation information from the audio head unit, and the navigation information from the navigation ECU, multi display displays theses data on the display.
- The following functional additions and changes have been made to the multi display of the '04 Prius in order to improve its ease of use.

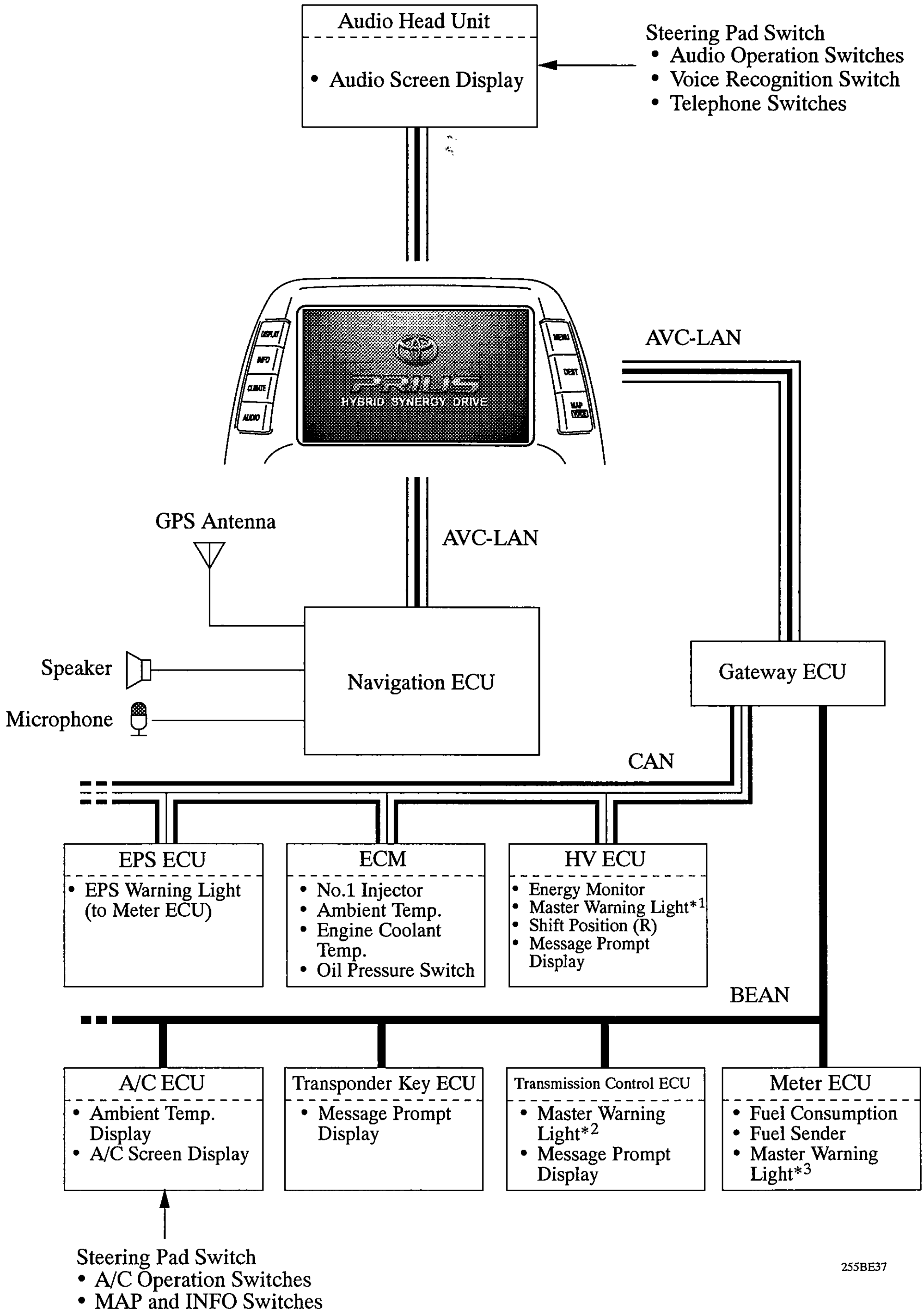
  - Screen design has been changed.
  - Screen color change function has been added.
  - Some functions have been added to the GPS voice navigation system.
  - A voice recognition function has been newly adopted in the GPS voice navigation system.
  - The energy monitor screen display has been changed.
  - A hands-free function for a Bluetooth-compatible* cellular telephone has been newly adopted.
  - The method for displaying on-vehicle warnings by illuminating the master warning light has been changed and a warning display has been added.
  - A shift position warning message display has been added.
  - An A/C system operation screen has been newly adopted.
  - A language selector screen has been newly adopted.

*: Bluetooth is a high-speed wireless data communication system that uses the 2.4 GHz frequency band prescribed by the Bluetooth SIG (Special Interest Group), with communication at a speed of 1 Mbps.

▶ Specifications ◀

Model			'04 Prius	'03 Prius
Display	Wide 7.0-inch LCD		○	—
	Wide 5.8-inch LCD		—	○
	Pressure Sensitive Touch Panel		○	○
Navigation System	GPS		○	○
Languages Supported	Voice Guidance	English French	○	○
	Voice Recognition	English	○	—
Map Data Media	DVD		○	○
Gyro Sensor (Including in Navigation ECU)	Piezoelectric Ceramic Piece		○	○

▶ System Diagram ◀



*1: HV System, Main Battery, N/D/B range warning, Inverter Coolant Temp. and Charge Warning Light
*2: Transmission Control ECU Malfunction
*3: EPS and Automatic Headlight Leveling System Warning Light

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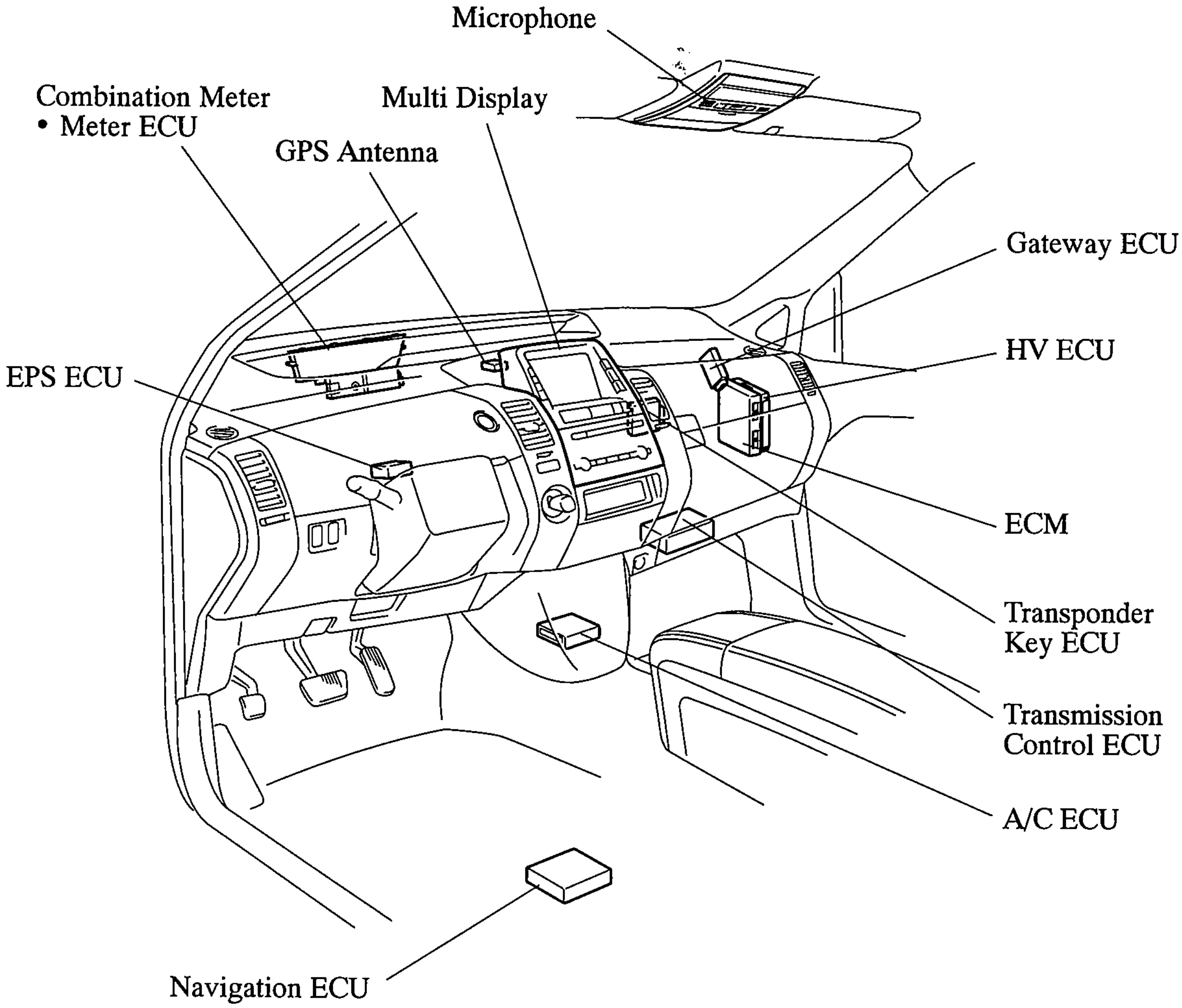
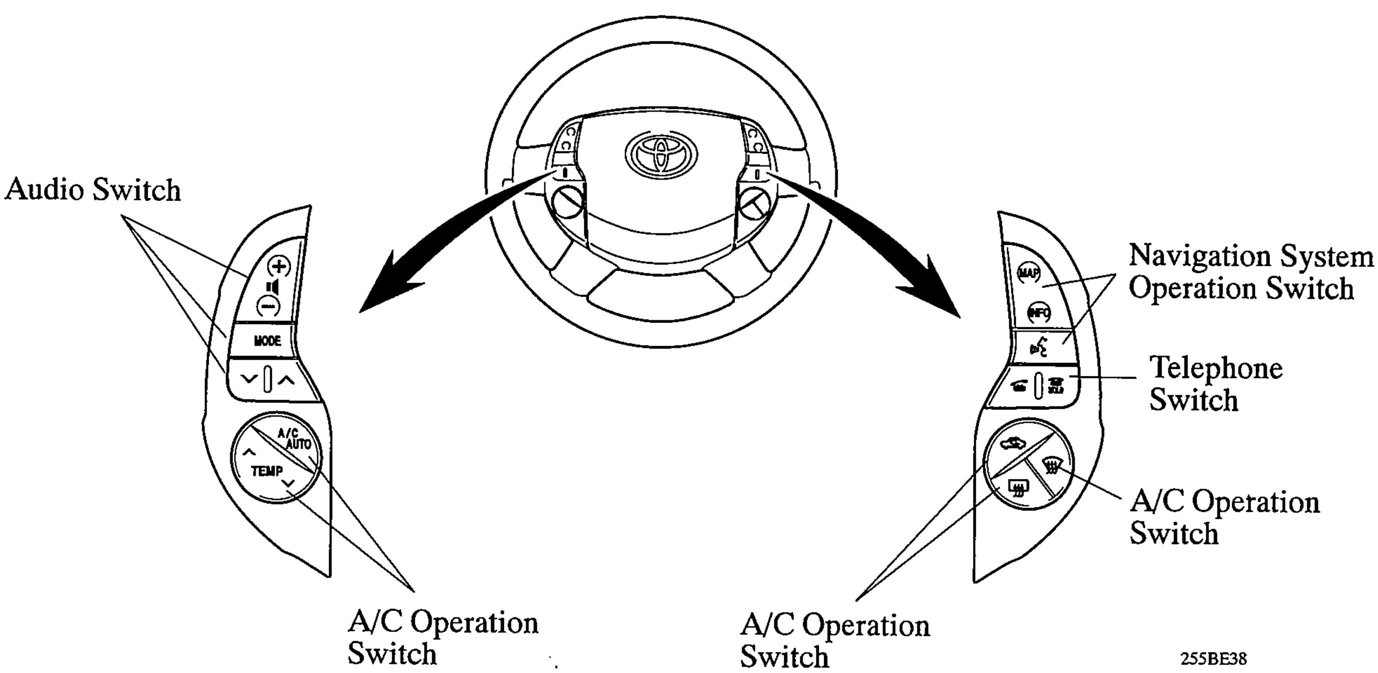
■ LAYOUT OF MAIN COMPONENTS





■ CONSTRUCTION AND OPERATION

1. General

Items listed below are the main functions of the multi display.

▭ : New

Function		Outline
On-screen Display		• Displays the audio status at the upper area of the screen when it is showing a display other than the audio screen display. • Constantly shows a warning indicator on the screen when a warning is issued.
Navigation Screen Display		Through the use of the GPS and map data in a DVD, the navigation system analyzes the position of the vehicle and indicates that position on the map that is displayed on this screen.
Information Display	Energy Monitor Screen Display	The following pieces of information are displayed in accordance with the signals from the HV ECU (and meter ECU). • Energy Transmission Direction • HV Battery State of Charge Display • Outside Temp. Display • Instant Fuel Consumption
	Fuel Consumption Screen Display	The following pieces of information are displayed in accordance with the signals from the meter ECU (and HV ECU). • Instant Fuel Consumption • Average Fuel Consumption After Refueling • Driven Distance After Refueling • Regenerated Energy Display • Outside Temp. Display
Warning Screen Display		Forces a warning screen to appear when the master warning light of the combination meter illuminates.
Audio Screen Display		Status of audio equipment and audio operation screen indication.
Air Conditioning Screen Display		• Display the outside temperature. • The operation and control of the air conditioning system can be effected through the use of the automatic air conditioning display of the multi display and the touch switch that appears on the display.
Telephone Operation Screen Display		When a Bluetooth-compatible cellular telephone is registered on the multi display, the user can make and receive calls or talk hands-free on the cellular telephone by operating the switches on the screen or the steering pad.
Language Selector Screen Display		The text displayed on the multi display and the voice guidance in the GPS voice navigation system can be selected from two languages: English and French.
Adjustment Screen Display		Changes screen color (green, blue, gray, and beige).
		Image quality adjustment screen indication.
Diagnosis Screen Display		This contains the following 3 items: • Service Check Menu. • Display Check. • Navigation Check.

2. Navigation Screen Display

Based on the map data on the DVD, signal from the GPS satellites, signals from the built-in gyro sensor, and signals from the vehicle's speed sensor, the vehicle's present position, direction of travel, and driven distance are calculated and displayed on the navigation display. This screen has the display functions listed below.

▭ : New

Item		Function
Map Display	Linear Touch Scroll	Enables smooth scrolling by connecting the touch points on the screen
	On-route Scroll	Scrolls the center of the cursor forward and reverse constantly along the route.
	Heading Up	Displays the map so that the direction of the route progression head up during route guidance.
	Map Color Change	Automatically changes the map display color by season.
	Front Wide	Displays a map in the direction of travel of the vehicle in an enlarged form. (Heading up only)
	Step-less Scale Display	Changes the scale of the map from the basic 13 steps to an even finer display.
	Direct Scale Change	Directly selects and displays the map scale.
	Multi-step Scale Display	Changes and displays the map scale in 13 stages.
	Split-view Display	Displays different modes on a screen that is split into two views.
	Points-of-Interest Display	Displays selected types of marks on the map.
	Taillight-interlocked Map Color Change	Changes the displayed color on the map screen when the taillights are turned ON.
	Road Number Sign Board Display	Displays the road number on the map.
	Compass Mode Screen	Displays the direction of travel and detailed data of the present location.
	Map Coverage Information Display	Displays the map area that is recorded on DVD.
	Street Name Indication on Scrolled Map	Displays the street name and the city name even when the map screen is being scrolled.
	Footprint Map	Displays a map on scale of 75 feet (25 m). (for specific areas in the following cities: Detroit, Chicago, New York, and Los Angels.)
Destination Search	Last Destination Memory	Stores 20 locations of coordinates, names and times that have been set as destinations in the past.
	Hybrid Points-of-interest Search	Narrows the search by names of the points-of-interest, category, and areas.
	Points-of-interest Pinpoint Display	Pinpoints and displays the position of the point-of-interest.
	House Number Search	Searches for a house number.
	Special Memory Point	Sets a pre-registered point as a destination point while driving.
	Nearest Point-of-interest Search List Display	Searches nearest points-of-interest and displays a list.
	Intersection Search	By specifying two streets, the point at which they intersection is set as the destination point.
	Emergency Search	Performs a specific search for hospitals, police stations and dealers.
	Freeway Entrance / Exit Search	Searches for the destination by the name of the street that connects to a freeway entrance / exit.
	Coordinate Search	Searches a destination by latitude and longtitude.
	Telephone Number Search	Searches a facility by its telephone number.

(Continued)

Item		Function
Route Search	Multiple Destination Setting	Sets multiple destinations. It can also rearrange the sequence of the destinations.
	Route Search	Searches for multiple routes.
	Search Condition Designation	Searches for the recommended, shortest, and other routes.
	Regulated Road Consideration	Performs search while considering regulated roads.
	Avoidance Area	Avoids a designated area and searches a route.
Guidance	Destination Direction Arrow Display	Function to display the direction from the current position to the destination in case of being off the route during the guidance.
	Off-Route Arrow Display	Function to display the route ahead on the route guidance line in case of being off the route during the guidance.
	Rotary Guidance	To guide with a special voice phrase in the rotary.
	Right or Left Turn Guidance	Voice guidance to instruct the direction of travel to be taken.
	Freeway Direction of Travel Guidance	Voice guidance to instruct the direction of travel to take on the freeway.
	Distance Display Destination	Displays the distance from the present location to the destination.
	Freeway Branch Type Specimen Guidance	Type specimen for guidance to a freeway branch.
	Intersection Zoom-in Display	Zoom-in display when approaching an intersection.
	Turn List Display	Displays a turn list on the right side of the two-screen display when approaching an intersection.
	Freeway mode screen	Displays the distance to the next junction and exit, or POIs in the vicinity of the freeway exit.
Others	Voice Recognition	Recognizes the voice of the driver, follows the driver's instructions, and operates the navigation system.
	Calendar	Enables calendar display until 2020 and memo registration.

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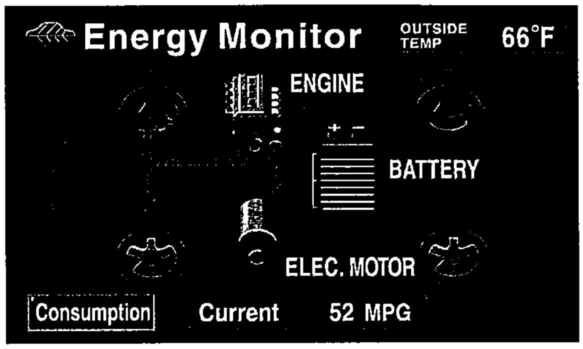
3. Information Display

Energy Monitor Screen Display

The energy monitor screen is displayed as illustrated below. This screen has the display functions listed below.

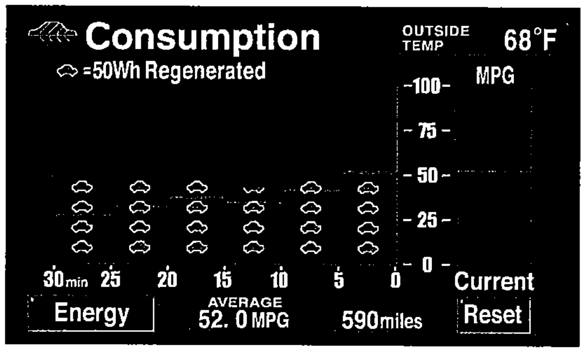


255BE39

Item	Outline
Outside Temp. Display	Displays the outside temperature that is output by the air conditioning ECU.
Energy Monitor Display	• Energy monitor display indicates the energy transmission direction for checking the current drive method (engine, motor or both), the power generation status by the engine and status of regenerative energy use. • The SOC (State of Charge) of the battery can be checked on the meter with an 8-stage display, which is provided in the battery illustration. • Displays the energy monitor status that has been calculated by the HV ECU. • The energy monitor status is calculated by the HV ECU.
Instant Fuel Consumption	• Displays the value that has been calculated by the meter ECU, which is based on the driven distance and the fuel consumption volume (fuel injection signal from No. 1 injector), provided that the power switch is turned ON. • The display updates every 0.5 seconds.

Fuel Consumption Screen Display

The fuel consumption screen is displayed as illustrated below. This screen has the display functions listed below.



255BE40

Item	Outline
Outside Temp. Display	Displays the outside temperature that is output by the air conditioning ECU.
Instant Fuel Consumption	• Displays the value that has been calculated by the meter ECU, which is based on the driven distance and the fuel consumption volume (fuel injection signal from No. 1 injector), provided that the power switch is turned ON. • The meter ECU displays the instant fuel consumption value on a bar graph. • The display updates every 0.5 seconds.
Average Fuel Consumption After Refueling	• Displays the value that has been calculated by the meter ECU, which is based on the driven distance after refueling and the fuel consumption volume (fuel injection signal from No. 1 injector). • The meter ECU determines that the vehicle has been refueled in accordance with the signal from the fuel sender gauge, or the Reset button has been pressed. • The display updates every 10 seconds.
Driven Distance After Refueling	• Displays the driven distance that is output by the meter ECU after the refueling or the Reset button has been pressed. • The meter ECU determines that the vehicle has been refueled in accordance with the signal from the fuel sender gauge. • The display updates every mile.
Recovered Energy	• The recovered energy over the past 5 minutes is indicated by symbols. • The recovered energy status is calculated by the HV ECU.

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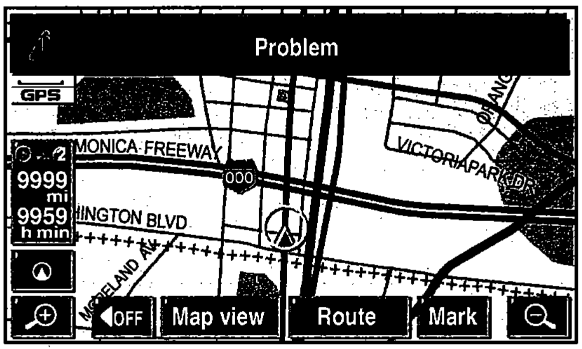
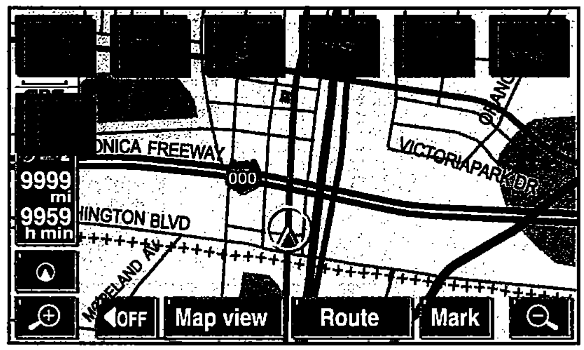
4. Warning Screen Display

- If an abnormal condition occurs in the vehicle system or the fuel level drops, a warning screen appears, even if another screen is currently being displayed. The warning screen automatically indicates a warning to alert the driver of an abnormality in the system. At this time, in the combination meter, the meter ECU illuminates the master warning light or blinks the fuel gauge.
- The warning screen flashes for 5 seconds the mark of the system in which the abnormality occurred. Then, it illuminates and remains displayed until the screen is switched or the system is reinstated to normal.
- If the screen switches to another screen while displaying a warning indication, the mark of the system in which the abnormality occurred is displayed at the top area of the screen. The displayed mark disappears when the system is reinstated to normal.

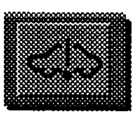
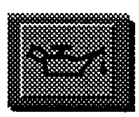
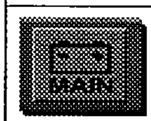
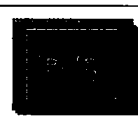
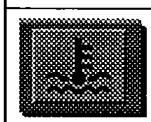
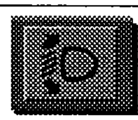
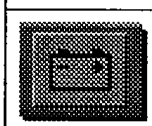


Warning Screen Display 255BE42

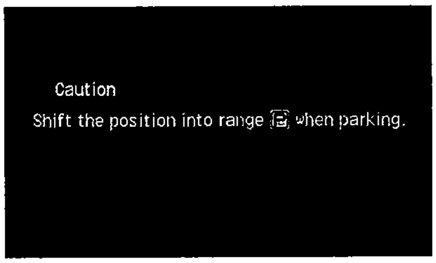
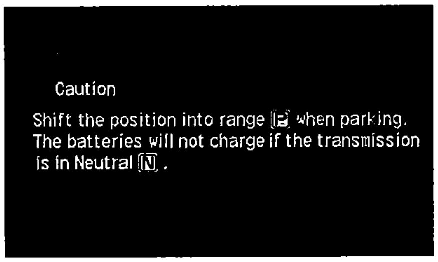
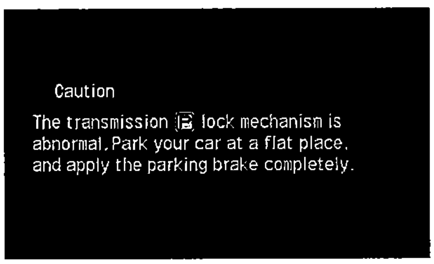


On-screen Display 255BE41

▶ List of Warning Screen Items ◀

Mark	Warning Display Item	Combination Meter	Mark	Warning Display Item	Combination Meter
 255BE81	Hybrid System Abnormal	Master Warning Light	 255BE78	Oil Pressure Warning	Master Warning Light
 255BE80	HV Battery Warning	Master Warning Light	 255BE82	EPS Warning	Master Warning Light
 255BE79	High Engine Coolant Temperature Warning	Master Warning Light	 255BE84	Automatic Headlight Leveling System Warning	Master Warning Light
 255BE83	Discharge Warning	Master Warning Light	—		

- When any of the conditions described below is present, the message prompt as shown appears in the multi display, accompanied by the illumination of the master warning light and the continuous sounding of the buzzer.

Message Prompt	Condition
 255BE120	**Shift Position Warning** While the hybrid system is OFF and the shift position is in a position other than P, the driver's door is opened.
 255BE121	**N, D and B Range Warning** • The READY light is illuminated, the shift position is in the N position, and the HV battery is discharged. • The READY light is illuminated, the shift position is in the N, B or D position, and the driver's door is open.
 255BE122	**Transmission Control ECU Warning** When there is a malfunction in the transmission control ECU.

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5. Telephone Operation Screen Display

- A hands-free Bluetooth system has been provided on the multi display as an option. This system enables the user to make and receive calls or talk hands-free on the cellular telephone by operating the switches on the screen display or on the steering pad.
- The hands-free Bluetooth system consists of the multi display, a microphone located in the overhead console, and steering pad switches.
- Bluetooth is a high-speed wireless data communication system that uses the 2.4 GHz frequency band prescribed by the Bluetooth SIG (Special Interest Group), with communication at a speed of 1 Mbps. Accordingly, if the user merely brings a Bluetooth-compatible telephone that is registered in the multi display into the vehicle, wireless data communication will be established between the telephone and the multi display. As a result, the user will be able to utilize the hands-free function, without needing to connect the telephone to a hands-free connecting device as in the past.
- This screen has the display functions listed below.

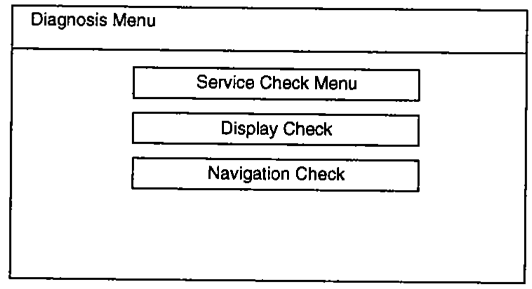
Item	Outline
Incoming Call Screen	If a call comes in to the telephone that is registered on the multi display, this screen appears. The user can receive the call by operating the incoming call button that appears on the screen or the incoming switch on the steering pad.
Call Dialing Screen	• The user can press the numeric key pad that appears on this screen to enter the telephone number and press the call button that appears on this screen or the call switch on the steering pad to make a call. • This function is disabled when the vehicle is in motion.
Telephone Directory Screen	• This screen shows telephone directory data stored in the multi display memory, which has a maximum capacity of 500 × 2 numbers. The user can make a call by selecting a telephone number from this directory and pressing the call switch on this screen or the call switch on the steering pad. • This function is disabled when the vehicle is in motion.
Redial Screen	• This screen shows redial data stored in the multi display memory, which has a maximum capacity of 5 numbers. The user can make a call by selecting a telephone number from the redial list and pressing the call switch on this screen or the call switch on the steering pad. • This function is disabled when the vehicle is in motion.
Call History Screen	• This screen shows incoming call history data stored in the multi display memory, which has a maximum capacity of 5 numbers. The user can make a call by selecting a telephone number from this list and pressing the call switch on this screen or the call switch on the steering pad. • This function is disabled when the vehicle is in motion.
One-Touch Call Screen	• The user can select telephone numbers from the telephone directory or the incoming call history data and record them on this screen as one-touch call data, which has a maximum capacity of 17 numbers. The most recent redial data (one number) is always recorded as part of the one-touch call data. • The user can make a call by selecting a telephone number from the list of one-touch call numbers and pressing the call switch on this screen or the call switch on the steering pad.
Point-of-Interest Info Screen	The user can make a call by selecting a telephone number that appears on the point-of-interest screen of the navigation system and pressing the call switch on this screen or the call switch on the steering pad.
Hands-Free Setup Screen	• The data from the telephone directory in the user's cellular telephone can be transferred to the telephone directory in the multi display. A maximum of 500 × 2 numbers can be transferred. • By registering the pass-key of the user's Bluetooth-compatible cellular telephone on this screen, the user can make and receive calls to the registered telephone numbers or talk hands-free by operating the switches on the multi display or the switches on the steering pad. • A maximum of 4 Bluetooth-compatible cellular telephones can be registered. However, only one cellular telephone can be used at a time.

6. Diagnosis Screen Display

The navigation display is equipped with a self-diagnosis system and can display the diagnosis menus shown on the right.
The diagnosis menu contains the following three items

a) Service Check Menu
b) Display Check
c) Navigation Check

See the 2004 Prius Repair Manual (Pub. No. RM1075U) for detail of Diagnosis Screen Start-up procedure.



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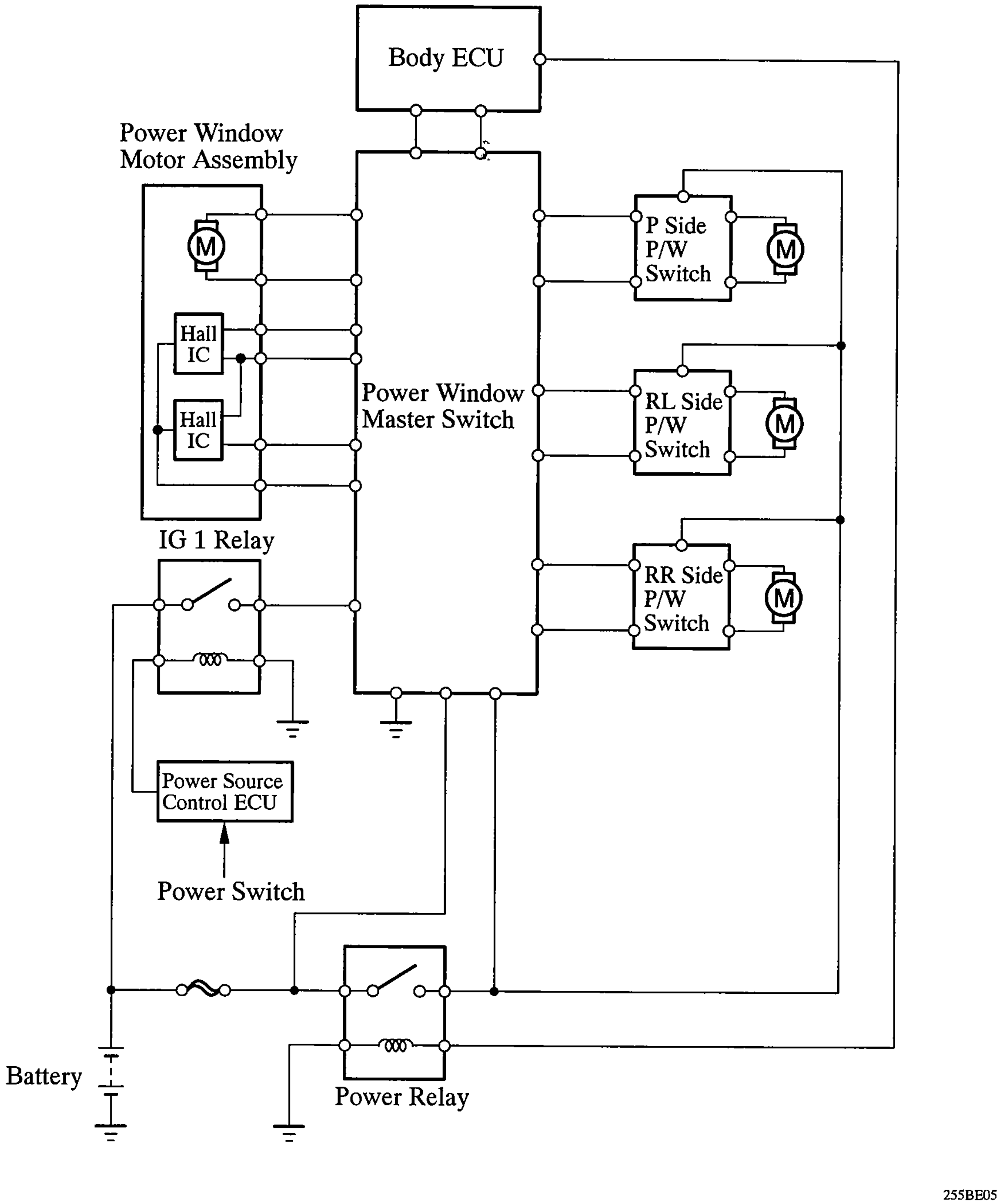
POWER WINDOW SYSTEM

■ DESCRIPTION

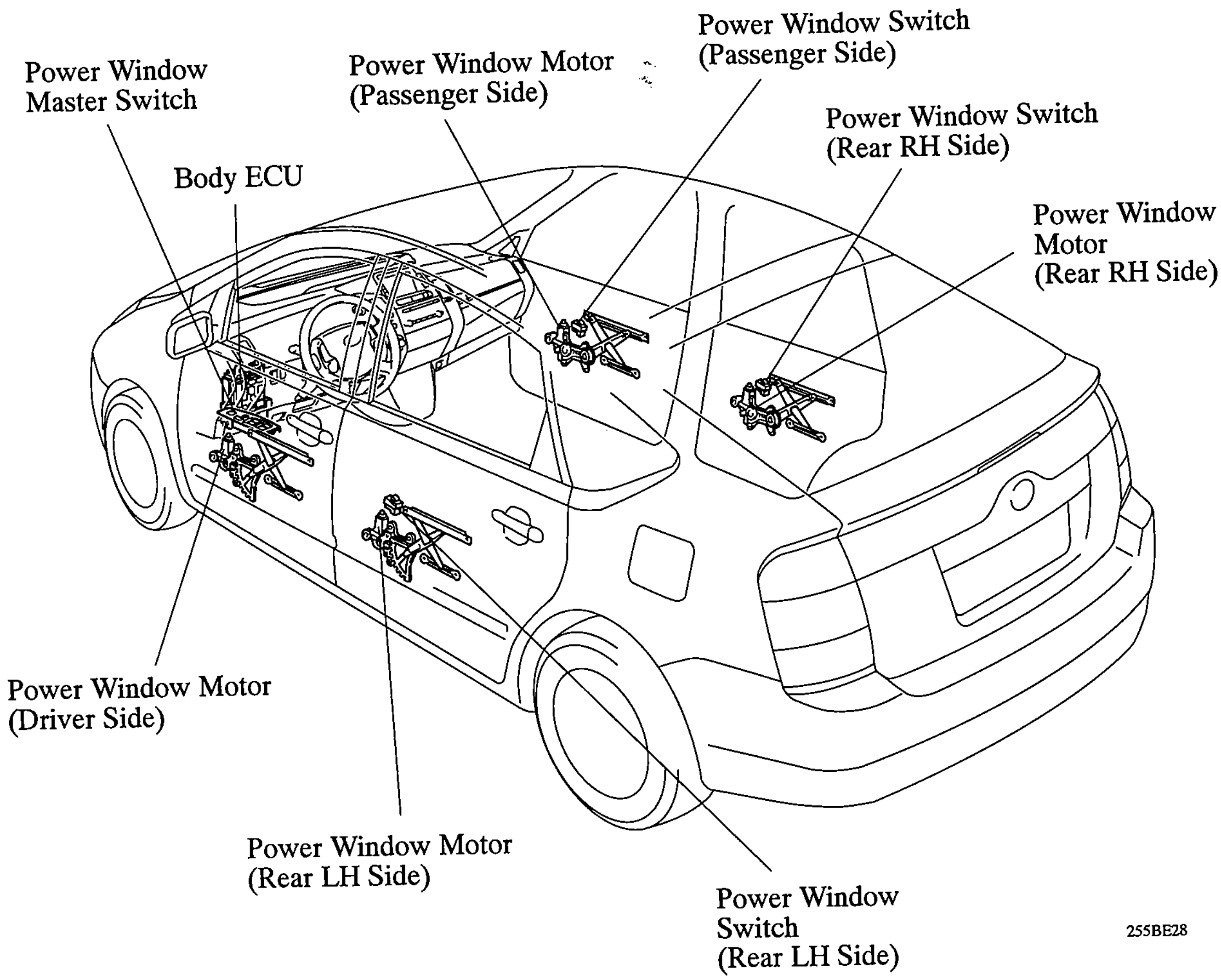
The power window system has the following functions:

Function	Outline
Manual up-and-down function	This function causes the window to open or close while the power window switch is being pulled halfway up or pushed halfway down. The window stops as soon as the switch is released.
Driver's door one-touch auto up-and-down function	The driver's door one-touch auto up-and-down function enables the window of driver's door to be fully opened or closed at a touch of the power window switch.
Jam protection function	A jam protection function automatically stops the power window and moves it downward if a foreign object gets jammed in the driver's door window during one-touch auto-up operation.
Remote control function	The up-and-down operations of the front passenger door window and the rear door windows can be controlled by operating the power window master switch.
Key-off operation function	This function makes it possible to operate the power window for approximately 43 seconds after the power switch is turned to the OFF position, if the driver's door is not opened.
Diagnosis	When the power window master switch detects a malfunction in the power window system, the power window master switch makes a diagnosis the failed section. Furthermore, the power window master switch illumination illuminates or blinks to inform the driver. For details, refer to 2004 Prius Repair Manual (Pub. No. RM1075U).
Fail-Safe	If the hall ICs in the power window motor malfunctions, the power window functions will be prohibited for the fail-safe: • The driver's door one-touch auto up-and-down function and the remote control function are prohibited. • The manual operation is possible by each power window switch.

▶ **System Diagram** ◀



■ LAYOUT OF MAIN COMPONENTS



■ JAM PROTECTION FUNCTION

1. General

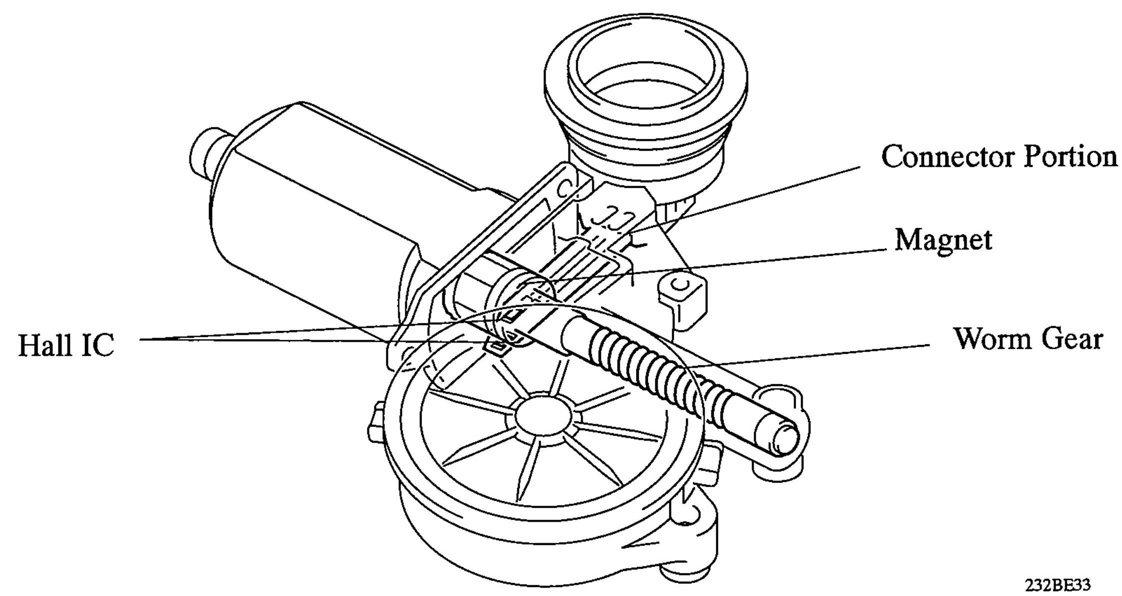
- A jam protection function automatically stops the power window and moves it downward if a foreign object gets jammed in the driver's door window during one-touch auto-up operation.
- On the '03 model, the jamming of the driver's door power window was detected by the limit switch and pulse sensor (pulse plate). On the '04 model, this has been changed to the two hall ICs that are integrated in the driver's power window motor.
- The activation of the jam protection function is described below.

Door Window Position from Full Close	Operation of Jam Protection Function
200 mm (7.87 in.) or more	Down operation of 50 mm (1.97 in.) or 1 sec.
200 mm (7.87 in.) or less*	Down operation until door window opening of 200 mm (7.87 in.) is reached or 5 sec.

*: However, the jam protection function will not operate in the area between the full-close and 4 mm opening of the door window.

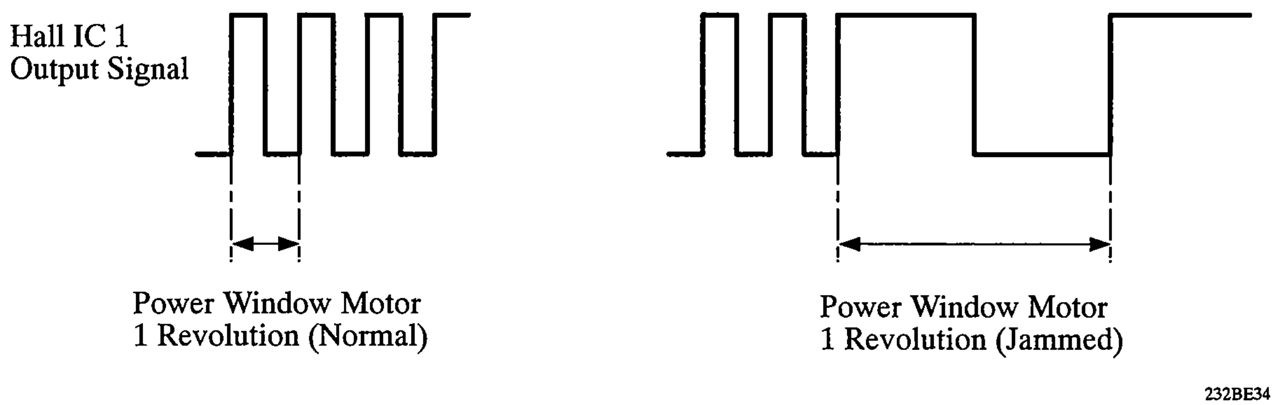
2. Jammed Window Detection Mechanism

- The jammed window detection mechanism consists of a magnet that is provided on the worm gear of the power window motor assembly and the two Hall IC that are provided on the connector.

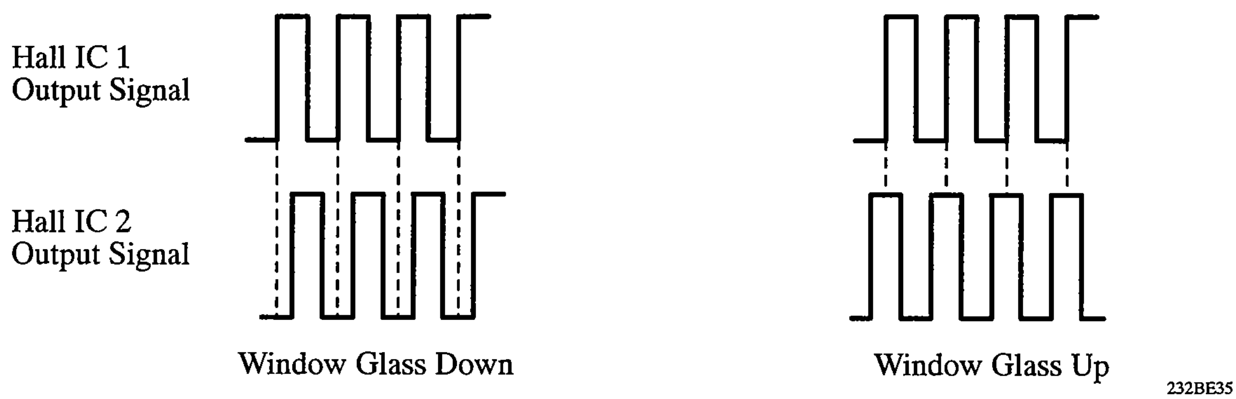


- The Hall IC converts the changes in the magnetic flux that occur through the rotation of the worm gear into pulse signals and outputs them to the power window master switch.
- To control the jam protection function, the power window master switch determines the amount of movement and the jamming of the window glass from the pulse signals from the Hall IC1; and the moving direction of the window glass from the phase difference between the pulses from the Hall IC1 and Hall IC2.

▶ Judgment of Amount of Movement and Jamming of Window Glass ◀



▶ Judgment of Window Glass Moving Direction ◀



Service Tip

The power window master switch memorizes the initial position of the driver's door window. This data will be lost if a battery terminal, fuse, or power window master switch is disconnected, allowing only a manual operation. Therefore, after reconnecting the battery terminal, fuse, or power master switch, initialize the system by performing the steps described below.

(1) Open the driver's door window a minimum of 1/4.

(2) Press and hold the power window master switch UP. By keeping the switch pressed UP for approximately 1 second after the driver's door window is fully closed, the power window master switch memorizes the initial position of the driver's door window.

For details, refer to 2004 Prius Repair Manual (Pub. No. RM1075U).

DOOR LOCK CONTROL SYSTEM

■ DESCRIPTION

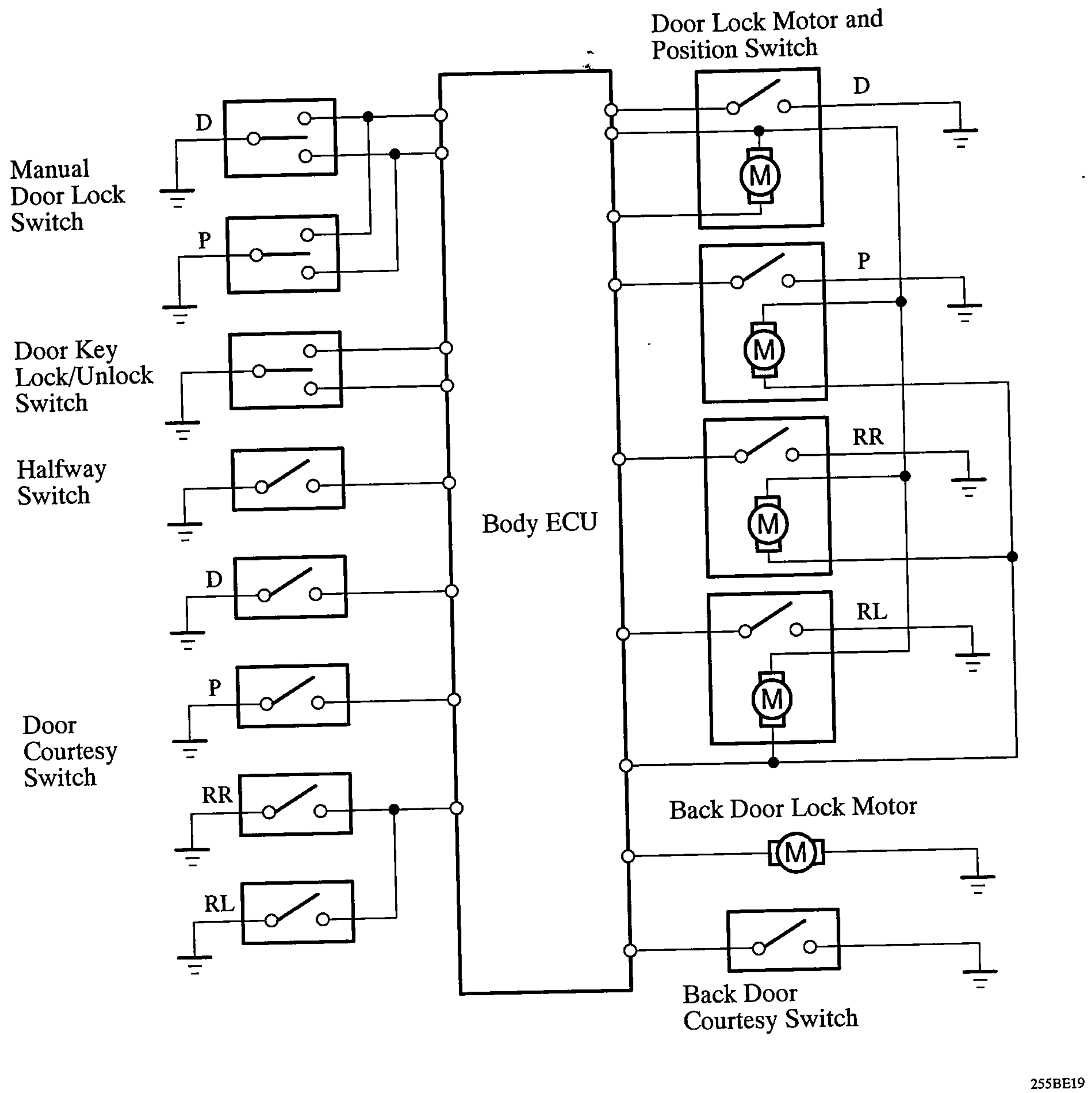
- This system is controlled by the body ECU. The body ECU outputs signals to the respective door lock motors.
- The door lock control system in the '04 Prius has the following functions:

Function	Outline
Manual lock and unlock function	This function can lock or unlock all doors by the manual door lock switch operation.
Key-linked lock and unlock function	This function, which is linked with the door key cylinder, can lock or unlock all the doors when a lock or unlock operation is effected.
Key confine prevention function	When the card key is inserted in the card slot with the driver's door open and if you perform the door lock operation, all the doors will be unlocked.
Manual unlock prohibition function	Performing the door lock operation with a transmitter, mechanical key or smart lock function*1 will prohibit the unlock operation by the door lock control switch.
2-step unlock function*1	This function is provided to unlock the driver's door by turning the door key cylinder first and to unlock remaining doors by turning it the second time.
All doors lock with transmitter*1 (see page BE-134)	Pressing the door lock switch of the transmitter locks all doors.
All doors unlock with transmitter*1 (see page BE-134)	Pressing the door unlock switch twice within 3 seconds opens all doors after opening the driver's door.
Smart unlock function*2 (see page BE-32)	With this function, the user can unlock the driver or passenger door by keeping a smart key in his/her possession and touching the outside door handle.
Smart lock function*2 (see page BE-35)	With this function, the user can lock all doors by keeping a smart key in his/her possession and pressing the lock switch that is provided on the outside door handle.

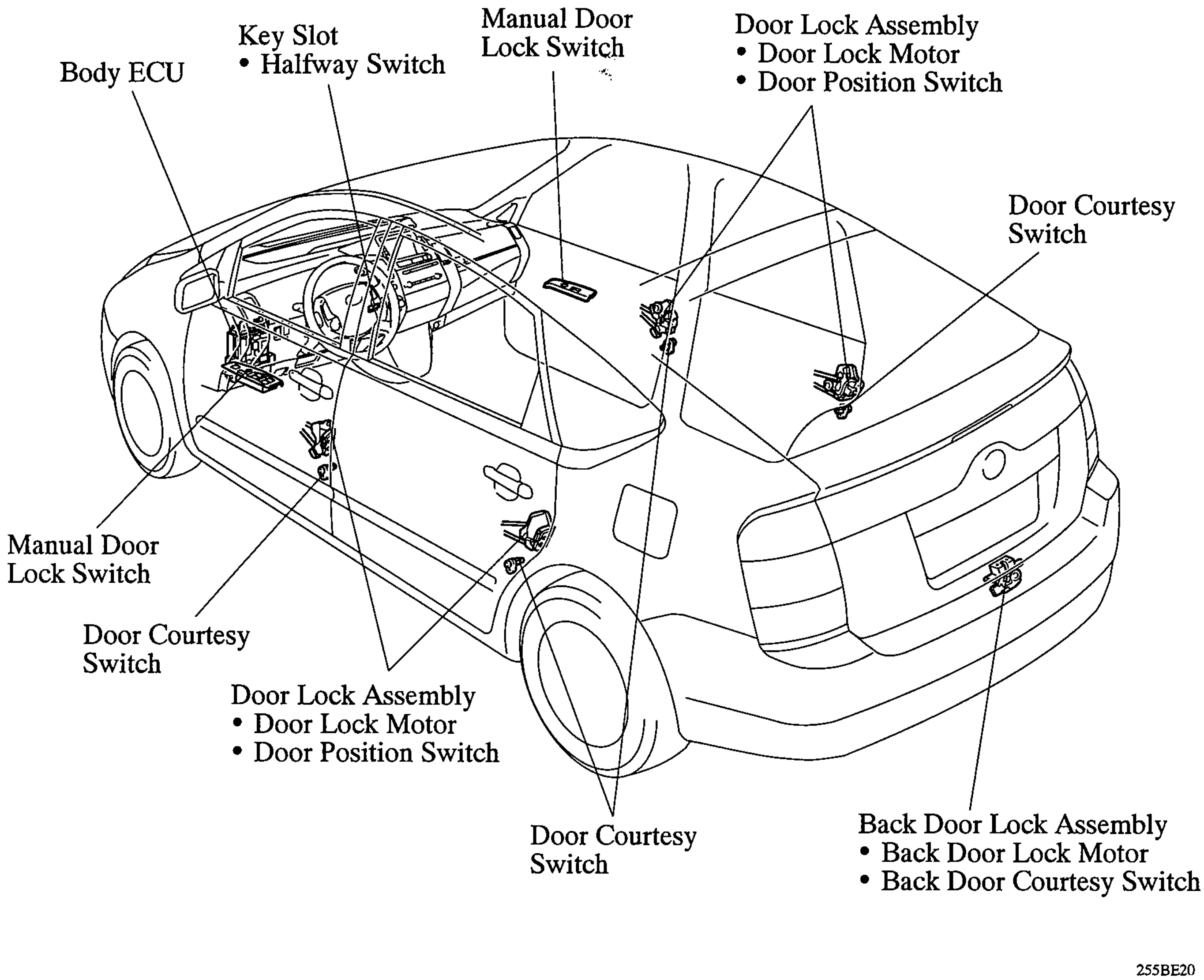
*1: It is possible to set by the customized body electronics system. For details, see page BE-64.

*2: Models with Smart Entry & Start System

▶ System Diagram ◀



■ LAYOUT OF MAIN COMPONENTS



WIRELESS DOOR LOCK REMOTE CONTROL SYSTEM

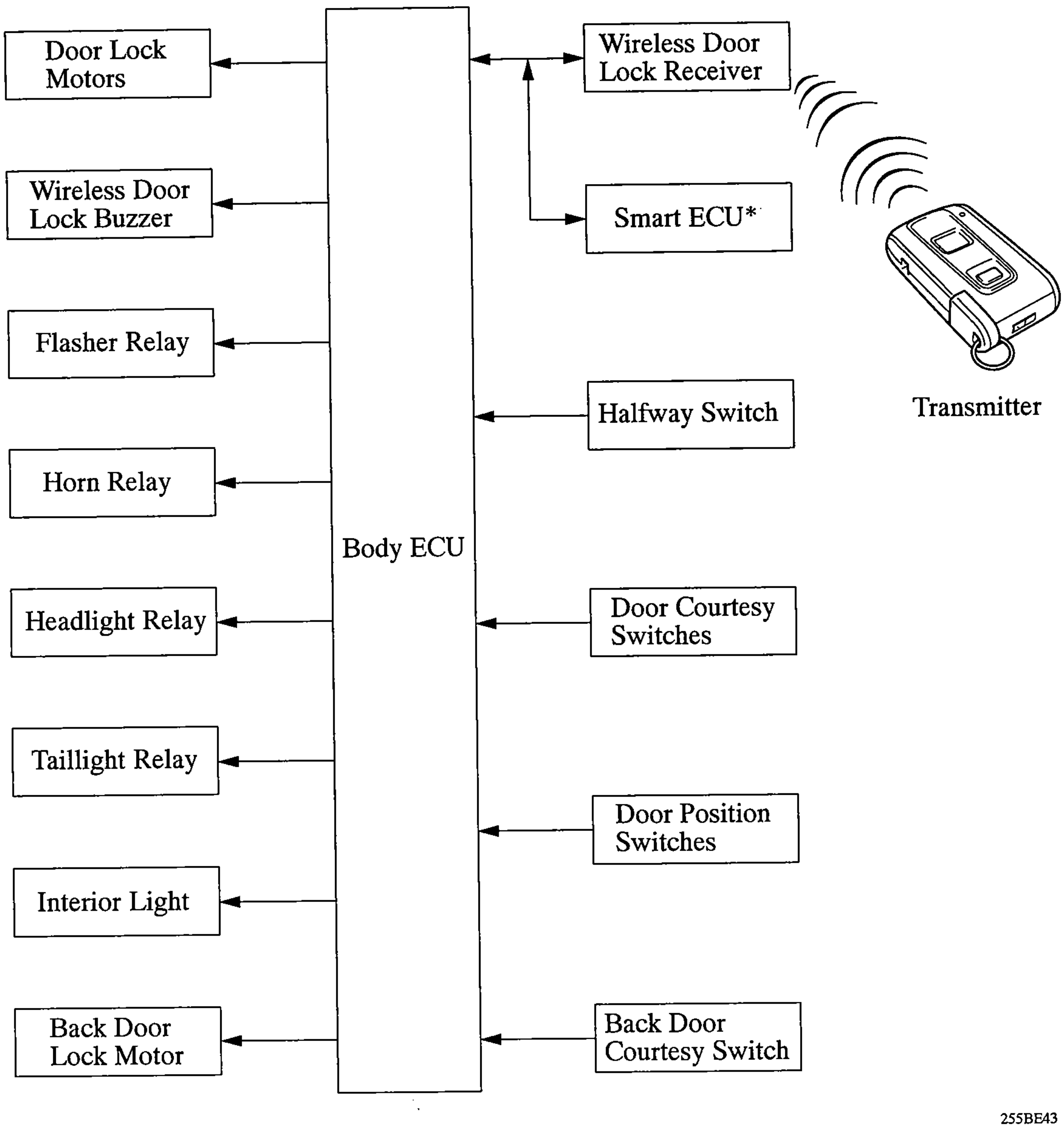
DESCRIPTION

The wireless door lock remote control system has been adopted as standard equipment.
This system is a convenient system for locking and unlocking all the doors, at a distance. This system in the '04 Prius has the following features:

- In this system, the wireless door lock receiver performs the code identification process and the body ECU effects the door lock control. Serial data link is provided for communication between the wireless door control receiver, the body ECU and Smart ECU*.
- A key integrated type transmitter is used, and it contains the following three switches: the door lock switch, door unlock switch, panic switch.
- A rolling code system, in which the signal configuration changes each time when a signal is transmitted by the transmitter, is used.

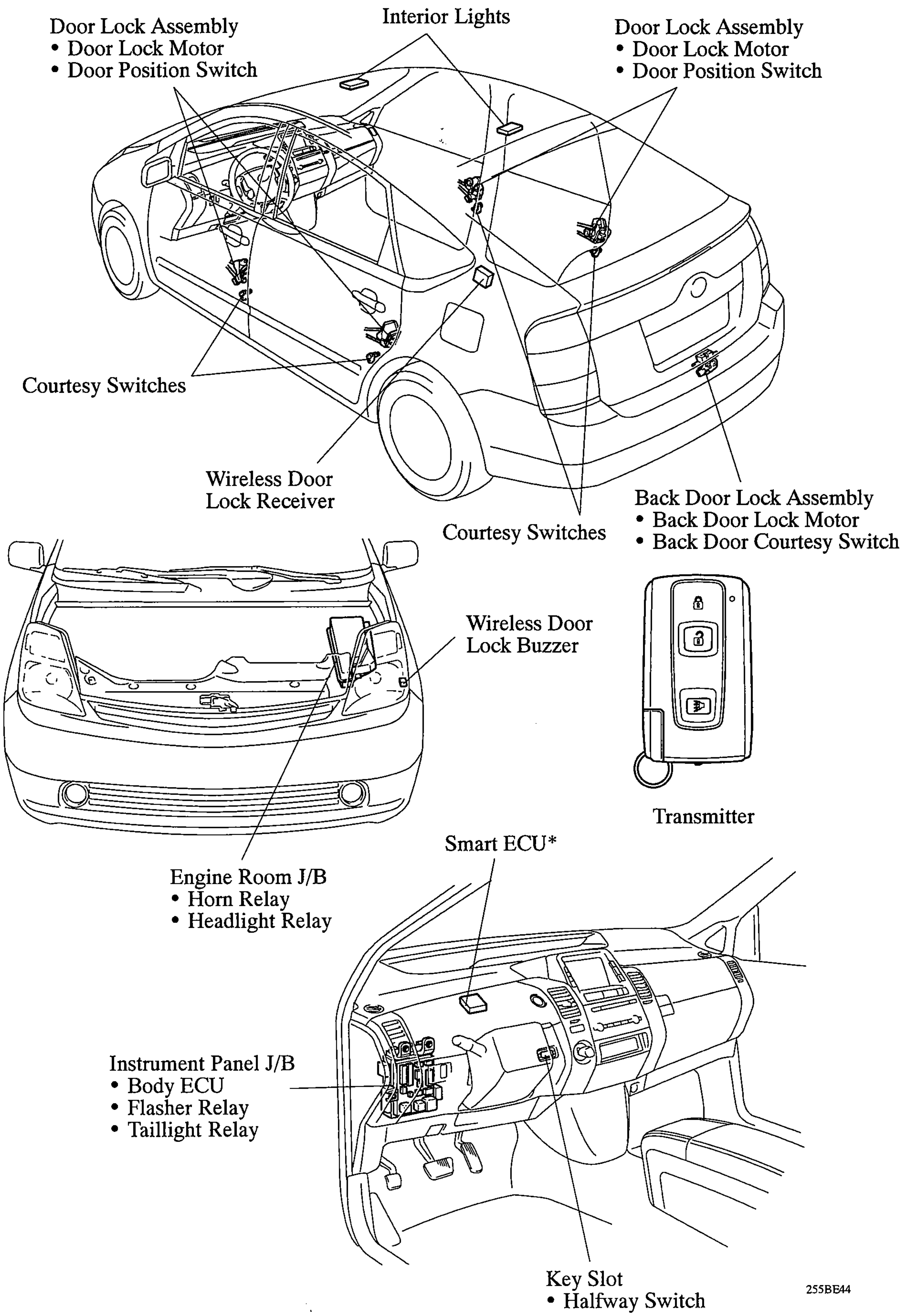
*: Models with Smart Entry & Start System

▶ System Diagram ◀



*: Models with Smart Entry & Start System

■ LAYOUT OF MAIN COMPONENTS



*: Models with Smart Entry & Start System

■ FUNCTION

1. General

The wireless door lock remote control system in the '04 Prius has the following functions.

Function	Outline
All Doors Lock Operation*	Pressing the door lock switch of the transmitter locks all doors.
All Doors Unlock (2-step Unlock) Operation*	Pressing the door unlock switch twice within 3 seconds opens all doors after opening the driver's door.
Answer Back Operation*	The hazard light is flashed once when locking, and the hazard light is flashed twice when unlocking, to inform that the operation has been completed.
	The wireless door lock buzzer is sound once when locking, and the wireless door lock buzzer is sound twice when unlocking, to inform that the operation has been completed. (Only for Models with Smart Entry & Start System)
Panic Alarm Operation*	Keeping the PANIC switch of the transmitter pressed longer than about 0.8 second activates the alarm of the theft deterrent system (to sound the horn, flash the headlights, taillights, and hazard lights).
Automatic Lock Function*	If none of the doors are opened within 30 seconds after they are unlocked by the wireless door lock remote control, all the doors are locked again automatically.
Repeat Function	If a door is not locked in response to the locking operation of the transmitter, the body ECU will output a lock signal after the 1 second.
Illuminated Entry Function*	When all the doors are locked, pressing the door unlock switch causes the interior lights to illuminate simultaneously with the unlock operation.
Security Function	Sends an operation signal as a rolling code.
Door Ajar warning Function*	If any door is open or ajar, pressing the "door lock" switch of the transmitter will cause the wireless door lock buzzer to sound for about 10 seconds. (Only for Models with Smart Entry & Start System)
Transmitter Recognition Code Registration Function	Enables the registering (writing and storing) of 4 types of transmitter recognition codes in the EEPROM that is contained in the body ECU.
Self-Diagnosis	If there is a malfunction in the system, the body ECU stores the DTCs (Diagnostic Trouble Codes) in its memory.

*: The setting of function can be changed using the customized body electronics system. For details, refer to Customized Body Electronics System section on page BE-64

2. Transmitter Recognition Code Registration Function

The table below shows the 4 special coded ID registration function modes through which up to 4 different codes can be registered. The codes are electronically registered (written to and stored) in the EEPROM. For details of the recognition code registration procedure, refer to the Prius Repair Manual (Pub. No. RM1075U) to register the codes correctly.

Mode	Function
Rewrite Mode	Erases all previously registered codes and registers only the newly received codes. This mode is used whenever a transmitter or the Body ECU is replaced.
Add Mode	Adds a newly received code while preserving any previously registered codes. This mode is used when adding a new transmitter. If the number of codes exceeds 4, the oldest registered code is erased first.
Confirm Mode	Confirms how many codes are currently registered. When adding a new code, this mode is used to check how many codes already exist.
Prohibit Mode	To delete all the registered codes and to prohibit the wireless door lock function. This mode is used when the transmitter is lost.

Service Tip

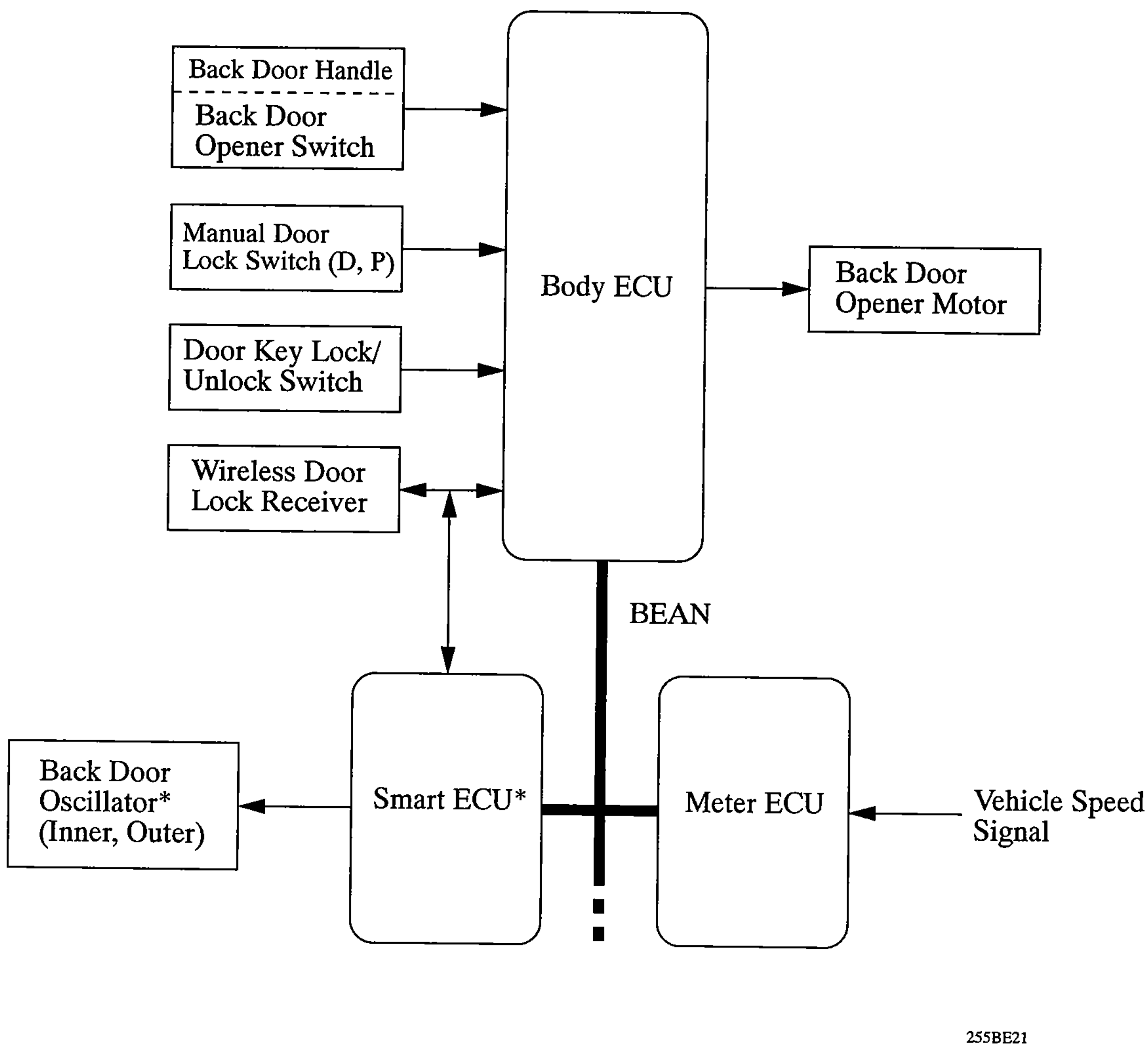
In case of making new ignition key due to the loss of it, it is necessary to register recognition code. Refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

ELECTRICAL BACK DOOR OUTSIDE HANDLE SYSTEM

■ DESCRIPTION

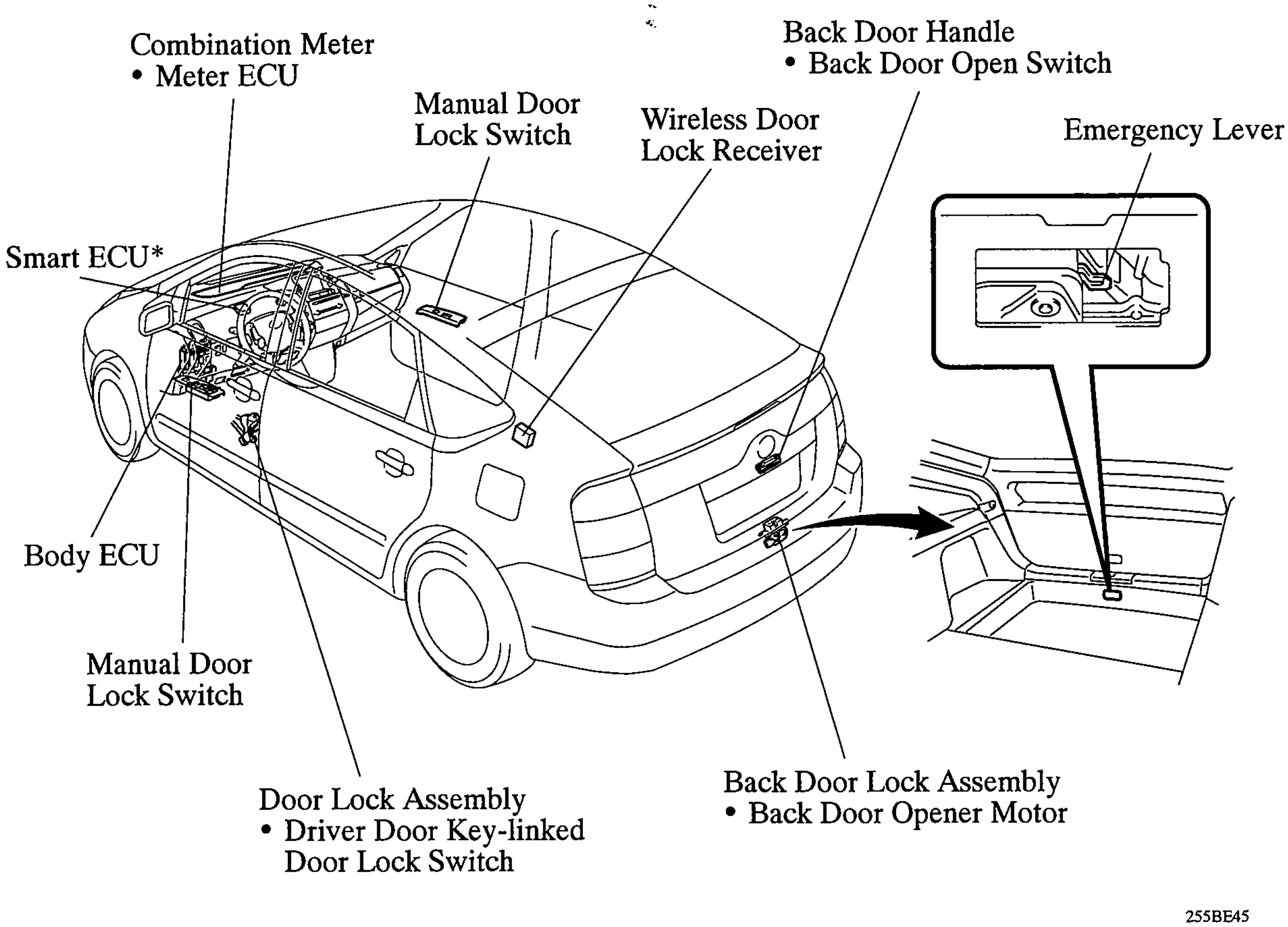
- This system is provided on '04 Prius with a switch on the back door outside handle to open the back door electrically.
  Along with the adoption of this system, the key cylinder and the opener for the back door have been discontinued.
- When this system dose not operate due to a discharged battery or other malfunctions, the back door can be opened by directly operating the emergency lever in the back door lock assembly.
- This system is controlled by the body ECU.
- This system activates when the following two conditions are met:
  1) Vehicle speed is less than 5 km/h (3 mph).
  2) An unlock signal is input into the body ECU from the respective doors in accordance with the wireless door lock remote control, key, door lock control or smart entry & start system.
  3) The body ECU receives a back door unlock request signal from the smart ECU. (Only on models with the smart entry & start system.) For details, see page BE-34.

▶ System Diagram ◀



*: Models with Smart Entry & Start System

■ LAYOUT OF MAIN COMPONENTS



*: Models with Smart Entry & Start System

THEFT DETERRENT SYSTEM

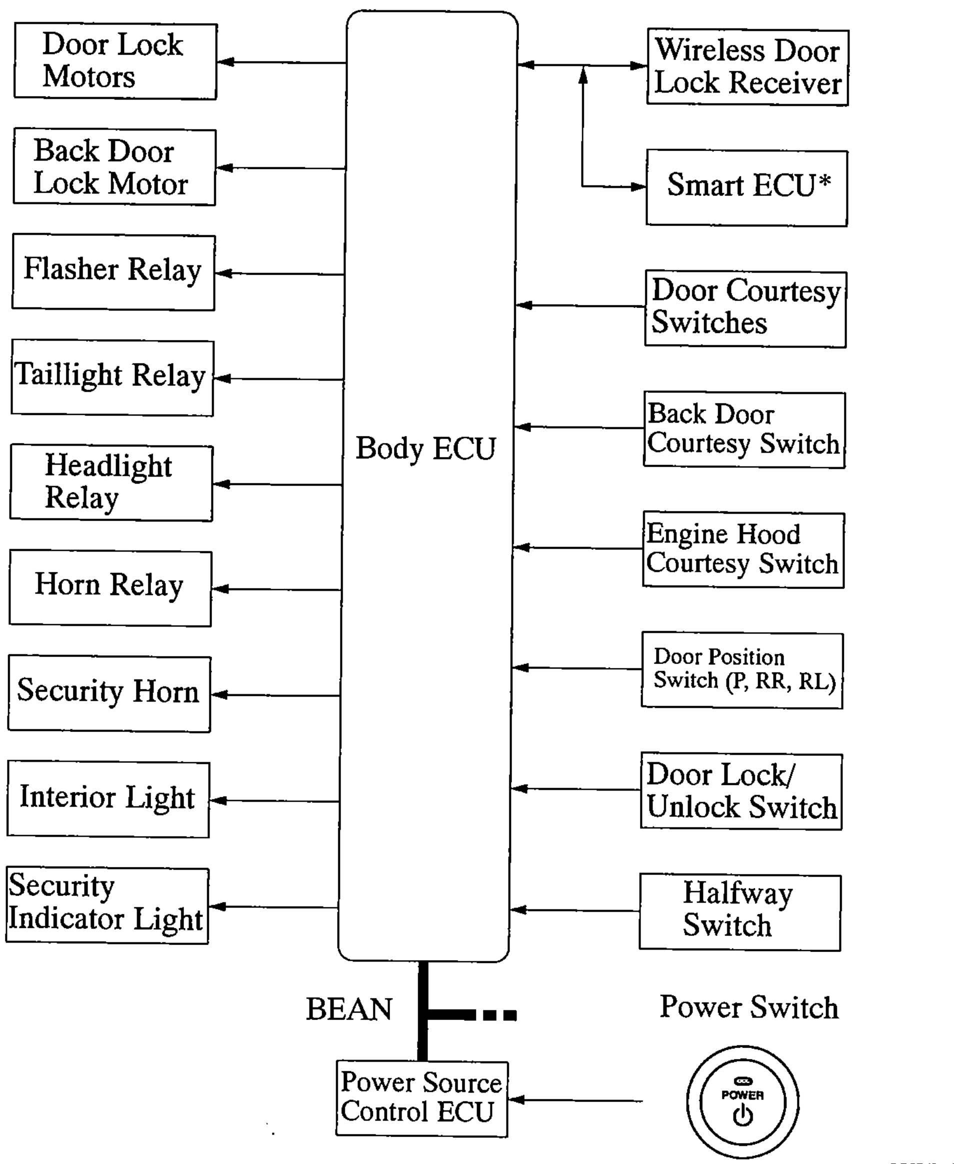
■DESCRIPTION

- This system has been provided as optional equipment on all models.
- The theft deterrent system uses the door lock control system, wireless door lock remote control system and smart entry and start system parts. The theft deterrent system will operate when somebody attempts to forcibly enter the vehicle, open the engine hood, or when the battery terminals are removed and reconnected.
- The control of this system is effected by the body ECU.

▶ Warning Specifications ◀

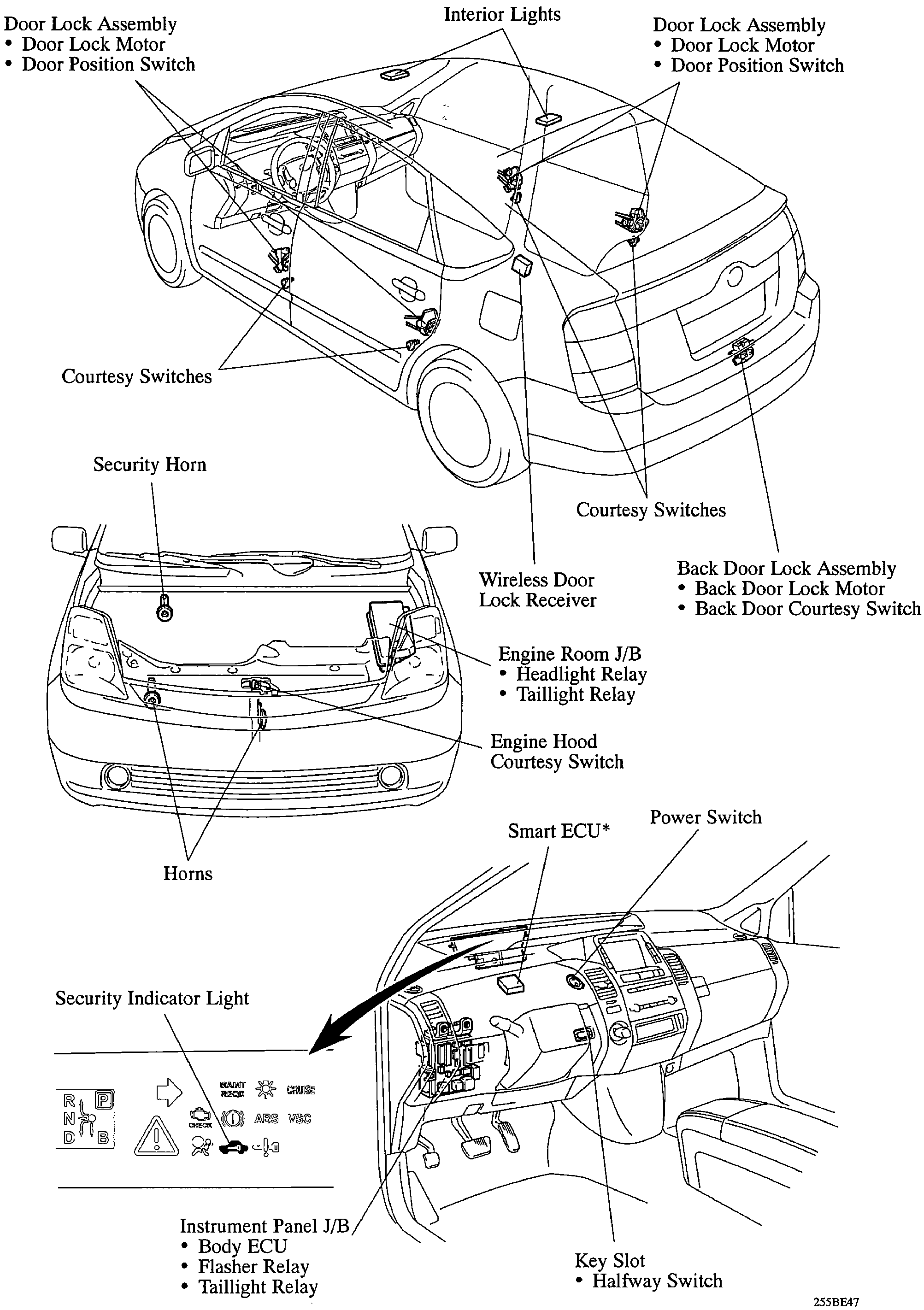
Warning Method	Interior Light	Illuminates
	Hazard Light	Flashing
	Headlights and Taillights	Flashing
	Vehicle Horn	Sounds a warning at approx. 0.4 second cycles
	Security Horn	Sounds a warning at approx. 0.4 second cycles
	Door Lock Motor	Locking
Warning Time		57 sec.

▶ System Diagram ◀



*: Models with Smart Entry & Start System

■ LAYOUT OF MAIN COMPONENTS

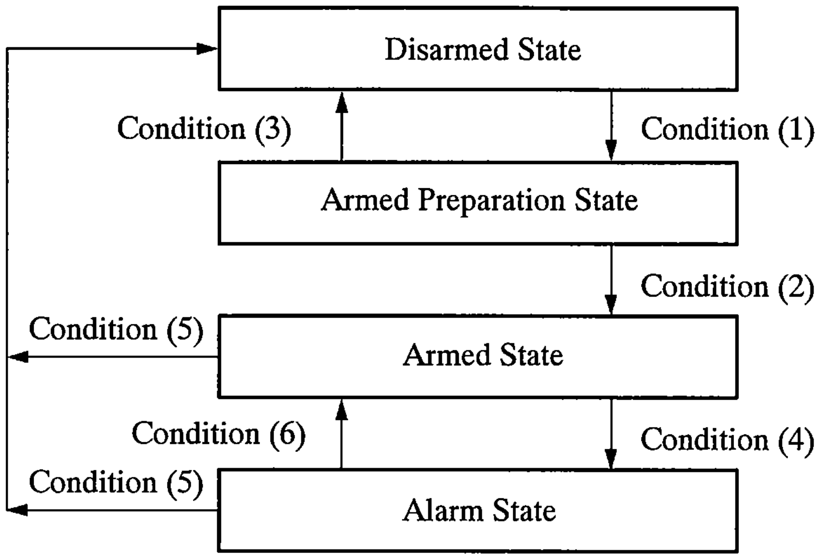


*: Models with Smart Entry & Start System

■ SYSTEM OPERATION

1. Basic Operation

This system activates as described in the diagram below when one of items place in the respective state.



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Condition	Item
Condition (1)	• There is no key in the key slot. • When the doors, engine food, and back door are all closed, all doors are closed by the wireless door lock remote control system or smart entry & start system*. • When the doors, engine food, and back door are all closed, the mechanical key is use to lock all doors. • When all the doors are locked, one of the doors, engine food, or back door is changed from "open" to "close", and all the doors are locked and closed.
Condition (2)	When the doors, engine hood, and back door are all closed and locked, and 30 seconds have elapsed.
Condition (3)	• When one of the doors, engine hood, or back door is changed from "close" to "open". • When one of the doors, engine hood, or back door is changed from "lock" to "unlock". • When the key is inserted in the key slot. • When a terminal is disconnected from the battery and reconnected. • When the power switch is pressed.
Condition (4)	• Any door, engine hood, or back door is opened. • Any door is unlocked with something other than the mechanical key, transmitter or smart entry & start system*. • The engine hood is opened. • A terminal is disconnected from the battery and reconnected. • The wiring harness is directly connected as if the turn the power switch ON.
Condition (5)	• The transmitter or smart entry & start system* is used to unlock the doors. • The mechanical key is used to unlock the doors. • The key is inserted in the key slot and the power switch is turned ON.
Condition (6)	After approximately 60 seconds of the alarm time have elapsed.

*: Optional Equipment

2. Forced Door Lock Operation

When the system starts the alarm state, and one of the doors is subsequently unlocked, the forced door lock operation forcefully outputs a door lock signal to prevent intrusion into the vehicle. This operation becomes activated when all the starting conditions listed below have been met, and stops when one of the stopping conditions occurs.

Condition	Item
Starting Condition	The theft deterrent system is in the alarm state.
	There is no key inserted in the key slot.
	If one of the front doors is unlocked.
Stopping Condition	All doors are locked.
	The warning ends after approximately 60 seconds.
	The key is inserted in the key slot.

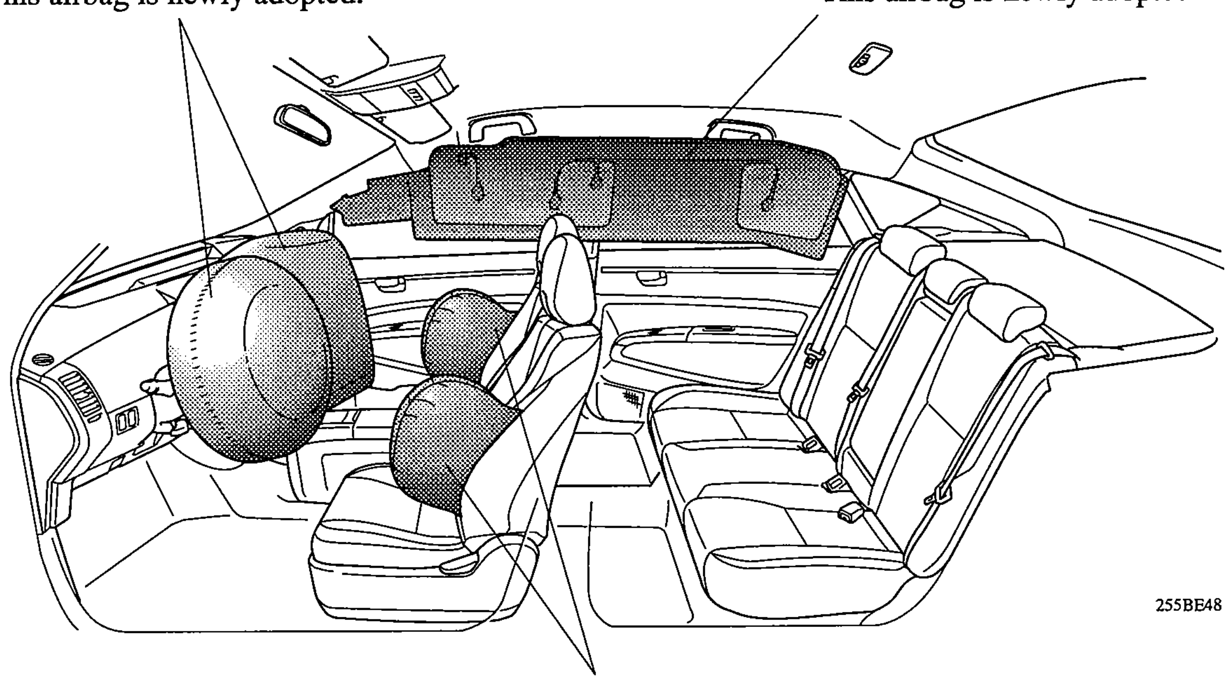
SRS AIRBAG SYSTEM

■DESCRIPTION

- The driver and front passenger dual stage SRS (Supplemental Restraint System) airbags help to reduce the shocks to the head and chest of the driver and front passenger in the event of a frontal collision to supplement the seat belts.
- The SRS side and curtain shield airbags help to reduce the shocks to the head and chest of the driver, the front passenger, and rear outer passenger in the event of a side impact collision.
  Also, SRS curtain shield airbag is designed to help reduce the shocks to the head of the rear outer passenger in the event of a side collision.
- For the '04 Prius, the previous mechanical type front airbag sensor has been changed to an electrical type front airbag sensor.
- The electrical connection check mechanism has been discontinued.
- The front passenger airbag door is made invisible. This means that without the airbag door, the airbag will be inflated by splitting the instrument panel along the cleavage line.
- The function of the airbag sensor assembly to memorize the driver and passenger seat belt wearing condition while inflating the airbag is added.
- A no-contact type seat belt buckle switch that uses a Hall IC has been adopted in the driver's seat belt buckle.
- If any of the airbags have been deployed, the airbag sensor assembly transmits an airbag deployment signal to the HV ECU. For details, see page TH-56.

Driver and Front Passenger Dual Stage SRS Airbags
• This airbag is newly adopted.

SRS Curtain Shield Airbag
• This airbag is newly adopted

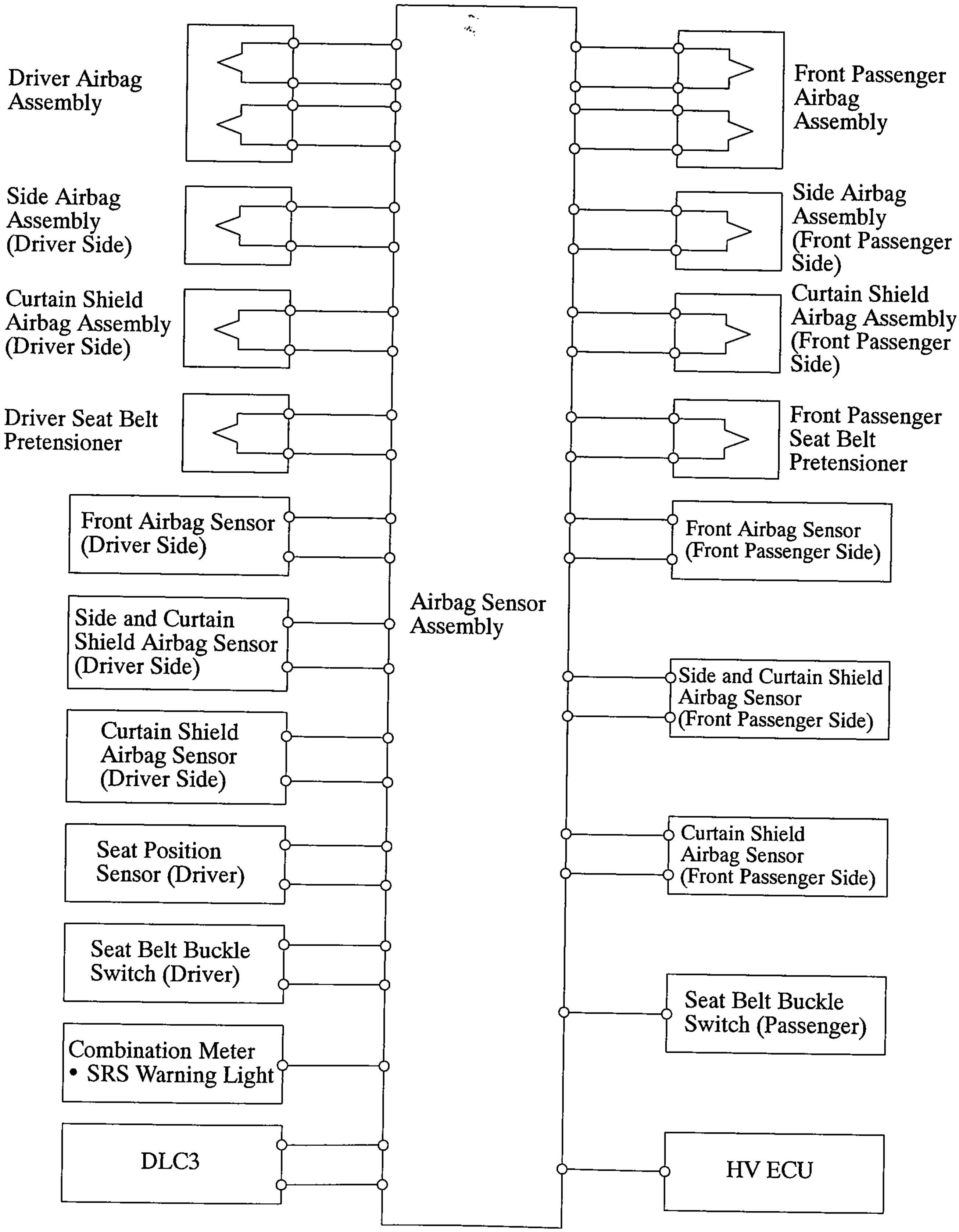


SRS Side Airbags

- The '04 Prius has a SRS airbag system with the following equipment:

Model		'04	'03
Airbag	Driver and Front Passenger Dual Stage	Standard	—
	Drive and Front Passenger	—	Standard
	Side	Option	←
	Curtain Shield	Option	—

▶ Wiring Diagram ◀



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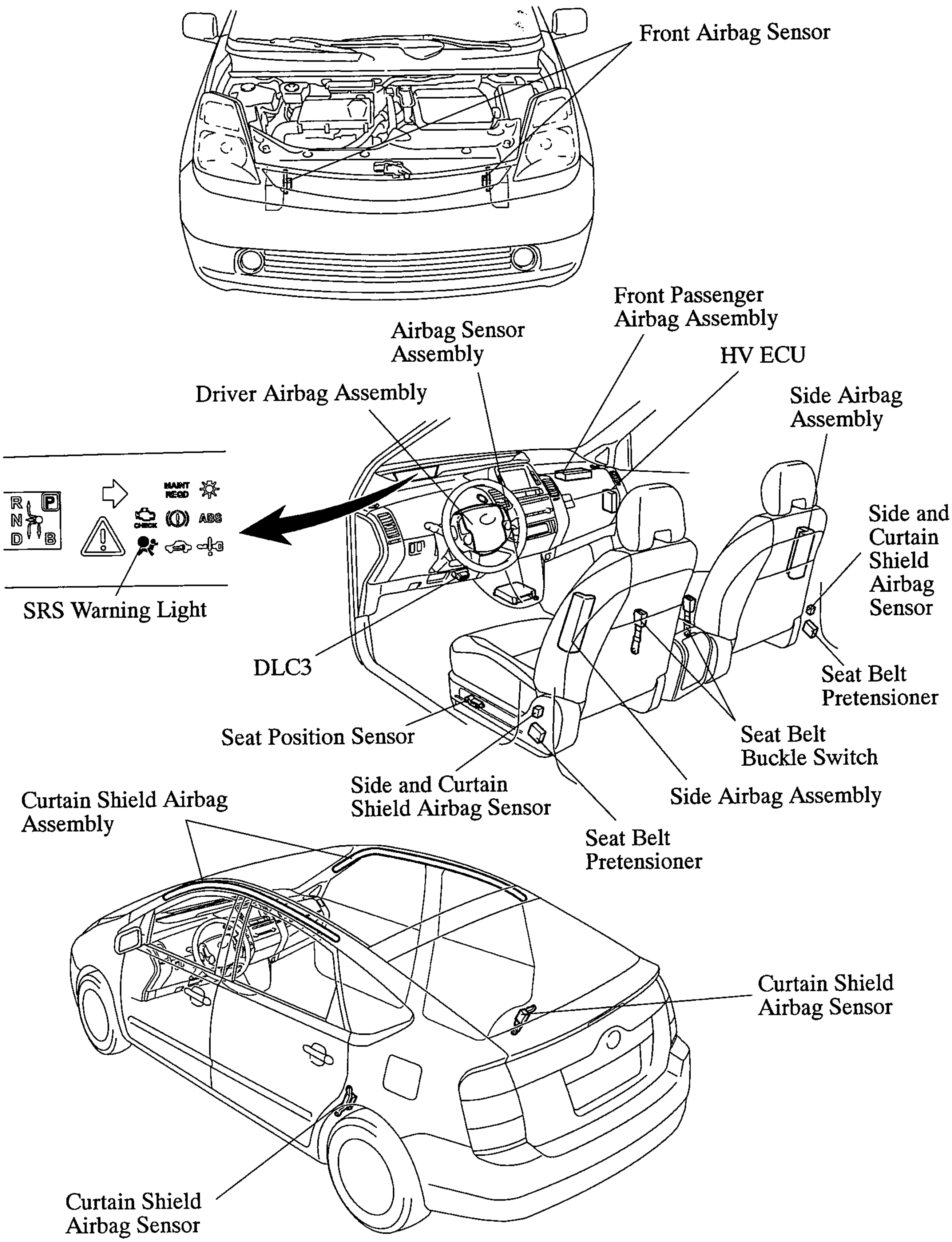
■ LAYOUT OF MAIN COMPONENTS



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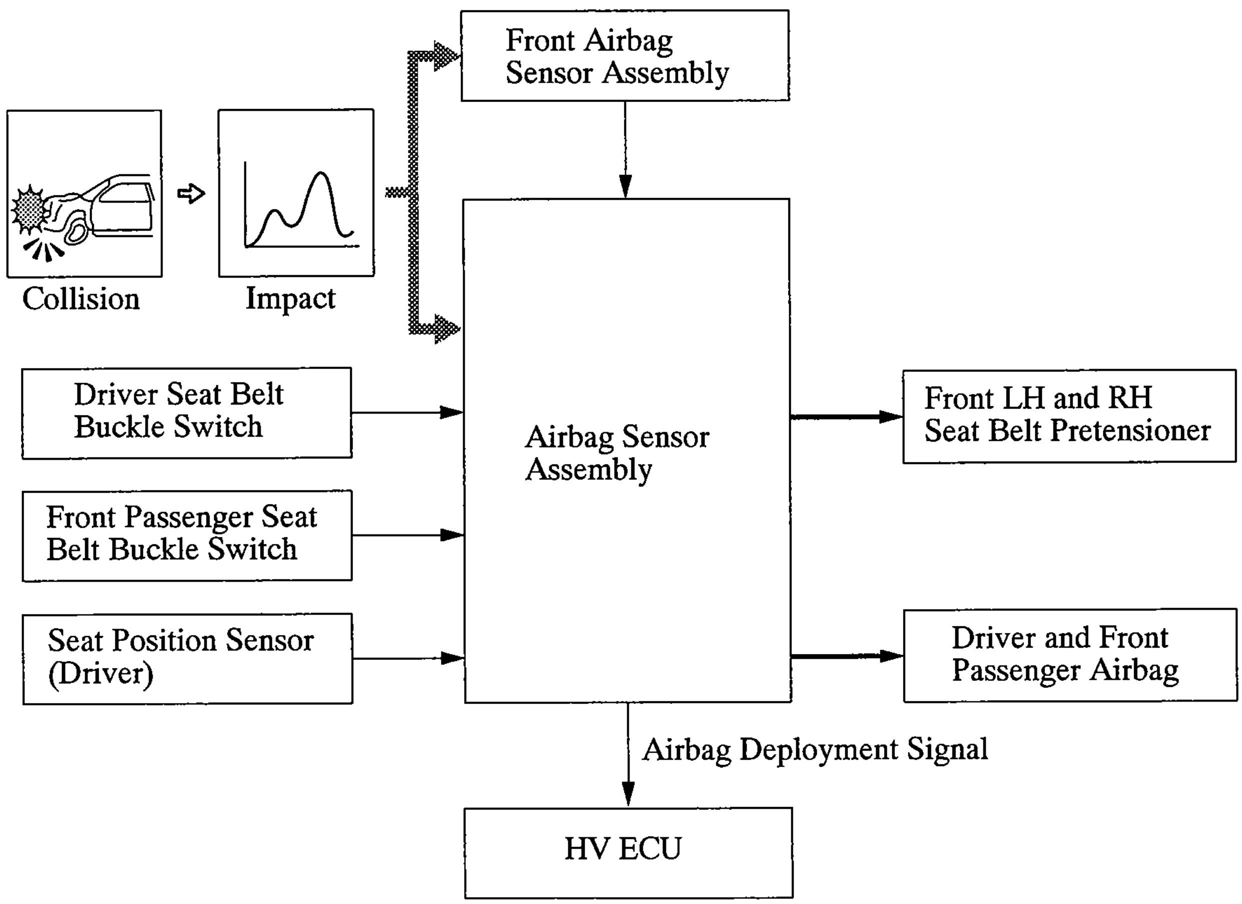
■AIRBAGS FOR FRONT COLLISION

1. General

- In conjunction with impact absorbing structure for front collision, the driver and front passenger dual-stage SRS airbags have been designed to help reduce the impact to the head and chest in the event of a front collision. These airbags all deploy with the same timing, and are supplements to the seat belts.
- The previous mechanical type front airbag sensor (consisting of movable and stationary contact points) has been changed to an electrical (deceleration sensor) type front airbag sensor.
- The deceleration sensor is enclosed in the front airbag sensor. Based on the deceleration of the vehicle during a front collision, a distortion is created in the sensor and converted into an electrical signal. Accordingly, the extent of the initial collision can be detected in detail.

▶ System Operation ◀



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2. Dual-stage SRS Airbags

General

In this system, when the front airbag sensors and airbag sensor assembly detect the front collision, the airbag sensor assembly judges the extent of impact, driver seat position and whether or not the driver and front passenger seat belts are fastened, thus making the airbag inflating output optimum by delaying the inflating timing of the 2nd initiator and the 1st initiator.

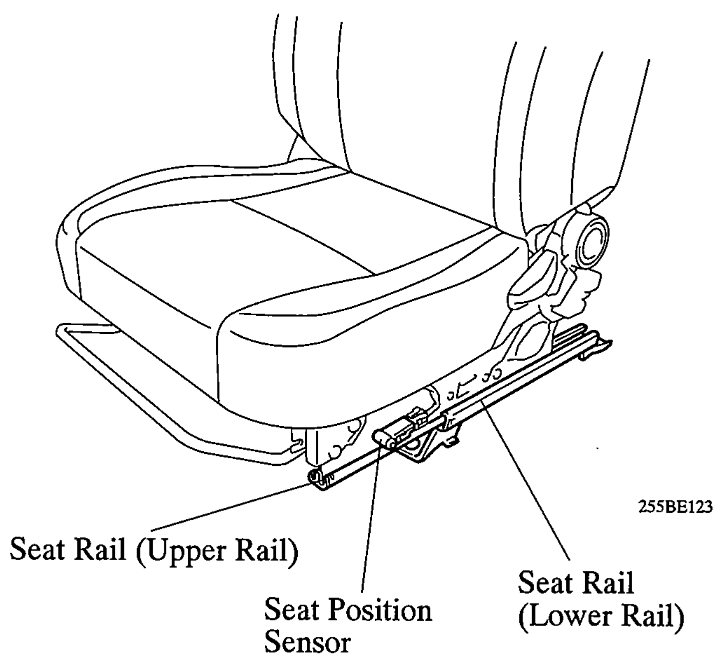
Service Tip

In accordance with the structure change of the driver and front passenger inflators on '04 Prius, a SST (09082-00802) used for scrapping driver and front passenger airbag assemblies of the vehicle has been newly established.

Seat Position Sensor

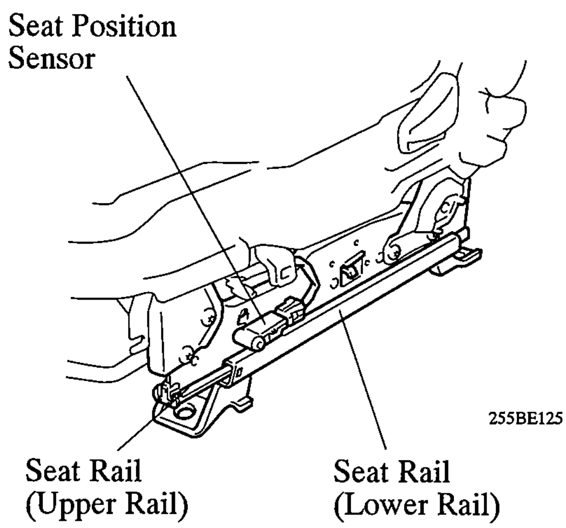
1) General

The seat position sensor is mounted on the upper rail portion of the driver seat rail, and includes a Hall IC and a magnet. This sensor is used to detect a sliding position of the driver seat.

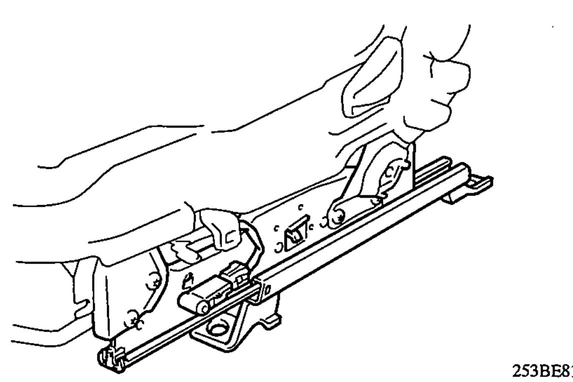


2) Operation

When a seat is in rearward position, the lower rail portion of the seat rail is close to the seat position sensor. When it is in the forward position, distance between the lower rail portion and the sensor becomes longer. Thus, magnetic flux of the magnet inside the seat position sensor will vary depending on the seat position. The Hall IC detects this variation of the magnetic flux and outputs signals to the airbag sensor assembly.



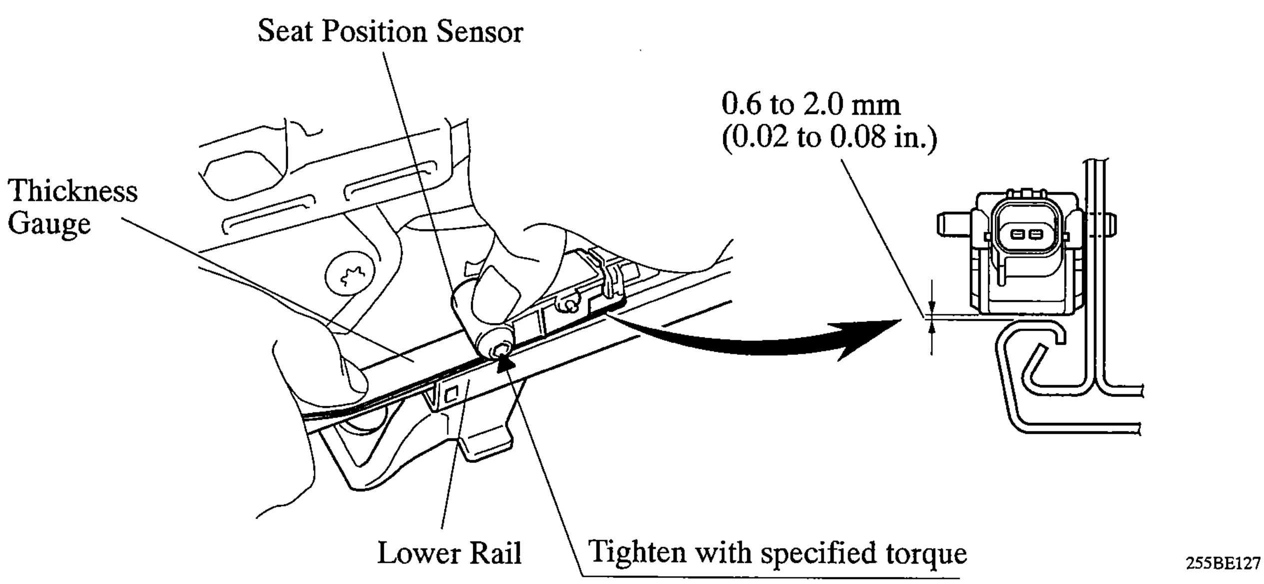
Seat position is rearward



Seat position is forward

Service Tip

When installing the seat position sensor, first insert a 1 mm (0.04 in.) thickness gauge between the seat position sensor and the lower rail portion. And then, tighten the mounting bolt to the specified torque with the seat position sensor pushed down as shown.
For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).



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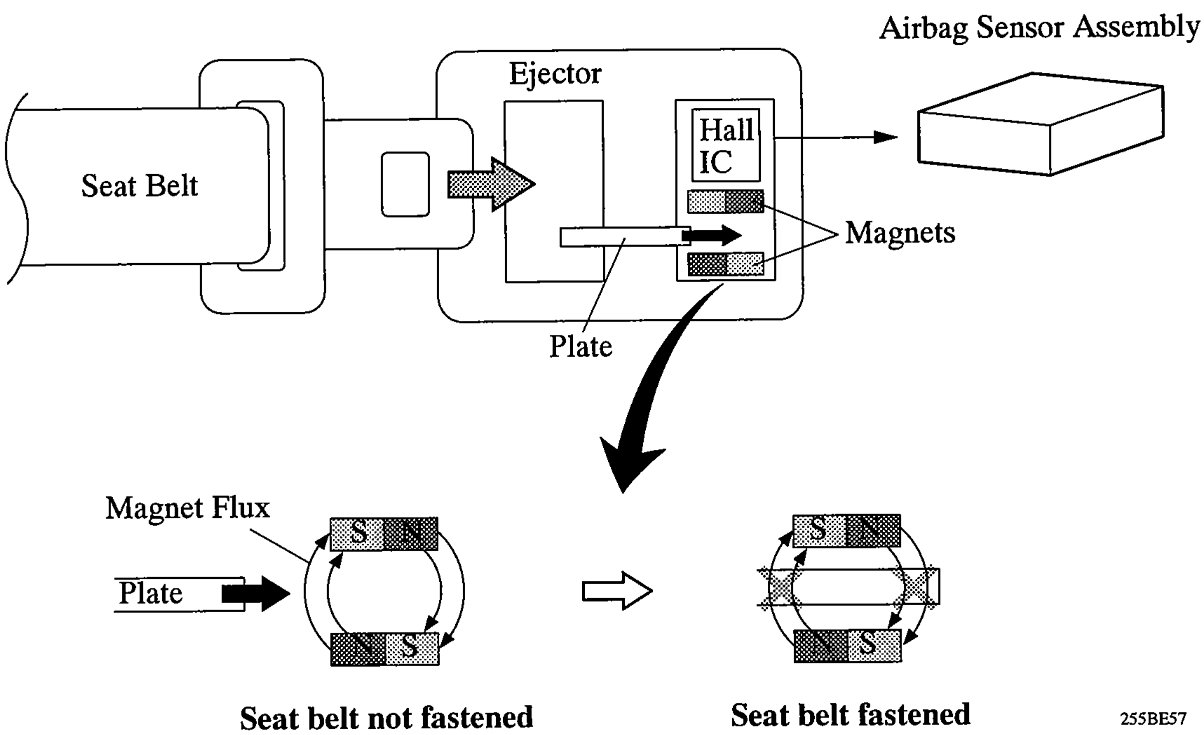
Seat Belt Buckle Switch

- The following two types of seat belt buckle switches have been adopted on the driver's seat of the '04 Prius:
  - A no-contact type buckle switch, which uses a Hall IC, has been newly adopted for controlling the driver's dual stage SRS airbag.
  - As on the '03 Prius, a contact type seat belt buckle switch is used for controlling the driver's seat belt reminder light.
- The no-contact type seat belt buckle switch is provided only for the driver's seat. The front passenger seat is provided with the contact type as on the '03 Prius.
- The no-contact type seat belt buckle switch comprises a Hall IC and 2 magnets, installed into the front seat inner belt assembly.
  The ejector inside the front seat inner belt assembly and the plate installed to the ejector move when the seat belt is removed or applied. The movement of the plate cuts off the magnetic flux density of the seat belt buckle switch magnet. The Hall IC detects the changes in the magnetic flux density as seat belt removal or application, and outputs the signal to the airbag sensor assembly.



■ AIRBAGS FOR SIDE/REAR SIDE COLLISION

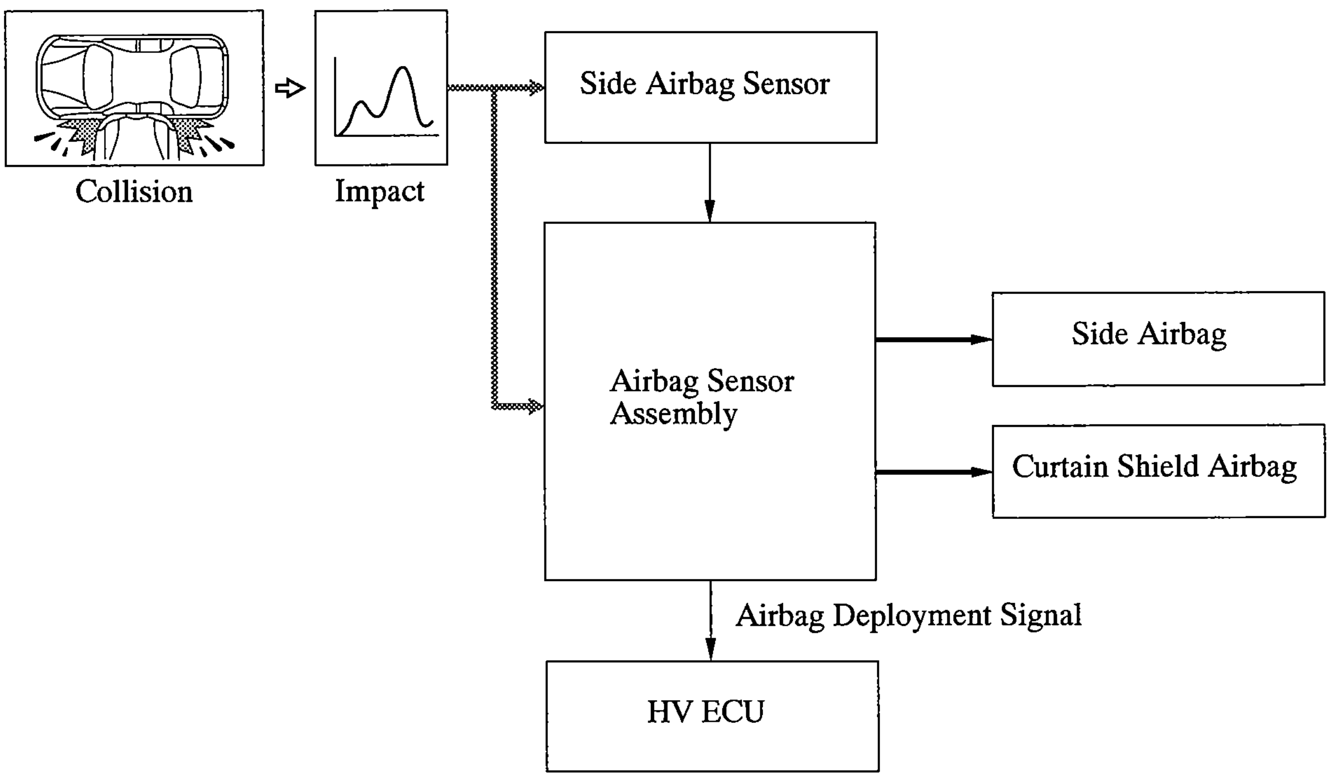
1. General

In conjunction with impact absorbing structure for side/rear side collision, the SRS side and curtain shield airbags have been designed to help reduce the impact energy that is transmitted to the driver, front passenger and rear outer passenger in the event of a side collision

2. Side Collision

A side collision is detected by the side airbag sensor in order to simultaneously deploy the side and curtain shield airbags.

▶ System Operation ◀



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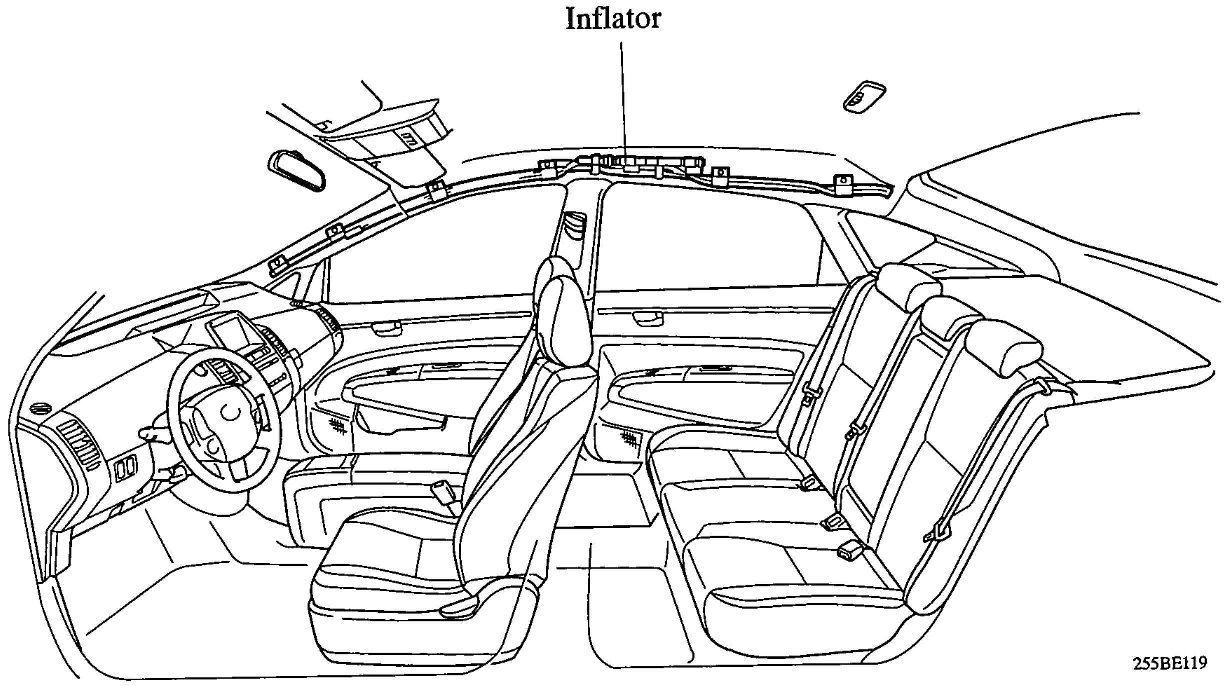
3. Rear Side Collision

- A side collision is detected by the curtain shield airbag sensor in order to deploy only the curtain shield airbag.
- In the '04 Prius, the deployment time for the curtain shield airbag has been reduced by locating the inflator above the center pillar.



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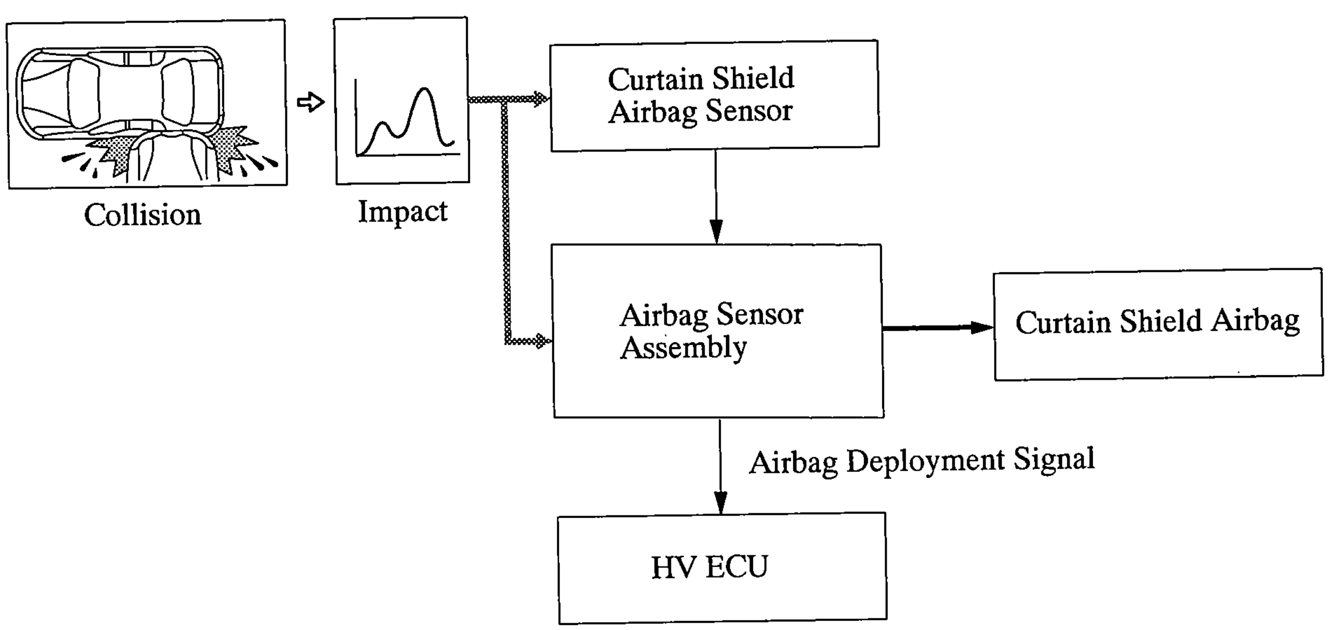
▶ System Operation ◀



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■ DIAGNOSIS

- If the airbag sensor assembly detects a malfunction in the SRS airbag system, the airbag sensor assembly stores the malfunction data in memory, in addition to illuminating the SRS warning light. Then, the DTCs (Diagnostic Trouble Codes) can be accessed by connecting a hand-held tester to the DLC3 terminal or the SST (09843-18040) to the Tc and CG terminals of the DLC3 and reading the blinking of the SRS warning light. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).
- To comply with the OBD-II regulations, all the DTCs (Diagnostic Trouble Codes) have been made to correspond to the SAE controlled codes. Some of the DTCs have been further divided into smaller detection areas than in the past, and new DTCs have been assigned to them.
- The method for clearing (using not hand-held tester) past DTCs of the SRS airbag system has been changed.
- If the SRS Airbag deploys, the airbag sensor assembly will turn on the SRS airbag warning light. However, different from the ordinary diagnosis function, a DTC will not be memorized. The airbag warning light can be turned off only by changing the airbag sensor assembly to a new one.
- The DTCs listed below is used.

▶ DTC Chart ◀

DTC No.	Detection Item	DTC No.	Detection Item
B1100/31	Airbag sensor assembly malfunction	B1811/53	Open in D squib (Dual stage - 2nd step) circuit
B1610/13	Front airbag sensor (RH) malfunction	B1812/53	Short in D squib (Dual stage - 2nd step) circuit (to ground)
B1615/14	Front airbag sensor (LH) malfunction	B1813/53	Short in D squib (Dual stage - 2nd step) circuit (to +B)
B1620/21	Side airbag sensor assembly (D seat side) malfunction	B1815/54	Short in P squib (Dual stage - 2nd step) circuit
B1625/22	Side airbag sensor assembly (P seat side) malfunction	B1816/54	Open in P squib (Dual stage - 2nd step) circuit
B1630/23	Curtain Shield airbag sensor (D seat side) malfunction	B1817/54	Short in P squib (Dual stage - 2nd step) circuit (to ground)
B1635/24	Curtain Shield airbag sensor (P seat side) malfunction	B1818/54	Short in P squib (Dual stage - 2nd step) circuit (to +B)
B1653/35	Seat position sensor assembly malfunction	B1820/55	Short in side squib (D seat side) circuit
B1655/37	Seat belt buckle switch (D seat side) malfunction	B1821/55	Open in side squib (D seat side) circuit
B1800/51	Short in D squib circuit	B1822/55	Short in side squib (D seat side) circuit (to ground)
B1801/51	Open in D squib circuit	B1823/55	Short in side squib (D seat side) circuit (to +B)
B1802/51	Short in D squib circuit (to ground)	B1825/56	Short in side squib (P seat side) circuit
B1803/51	Short in D squib circuit (to +B)	B1826/56	Open in side squib (P seat side) circuit
B1805/52	Short in P squib circuit	B1827/56	Short in side squib (P seat side) circuit (to ground)
B1806/52	Open in P squib circuit	B1828/56	Short in side squib (P seat side) circuit (to +B)
B1807/52	Short in P squib circuit (to ground)	B1830/57	Short in curtain shield airbag (D seat side) squib circuit
B1808/52	Short in P squib circuit (to +B)	B1831/57	Open in curtain shield airbag (D seat side) squib circuit
B1810/53	Short in D squib (Dual stage - 2nd step) circuit	B1832/57	Short in curtain shield airbag (D seat side) squib circuit (to ground)

(Continued)

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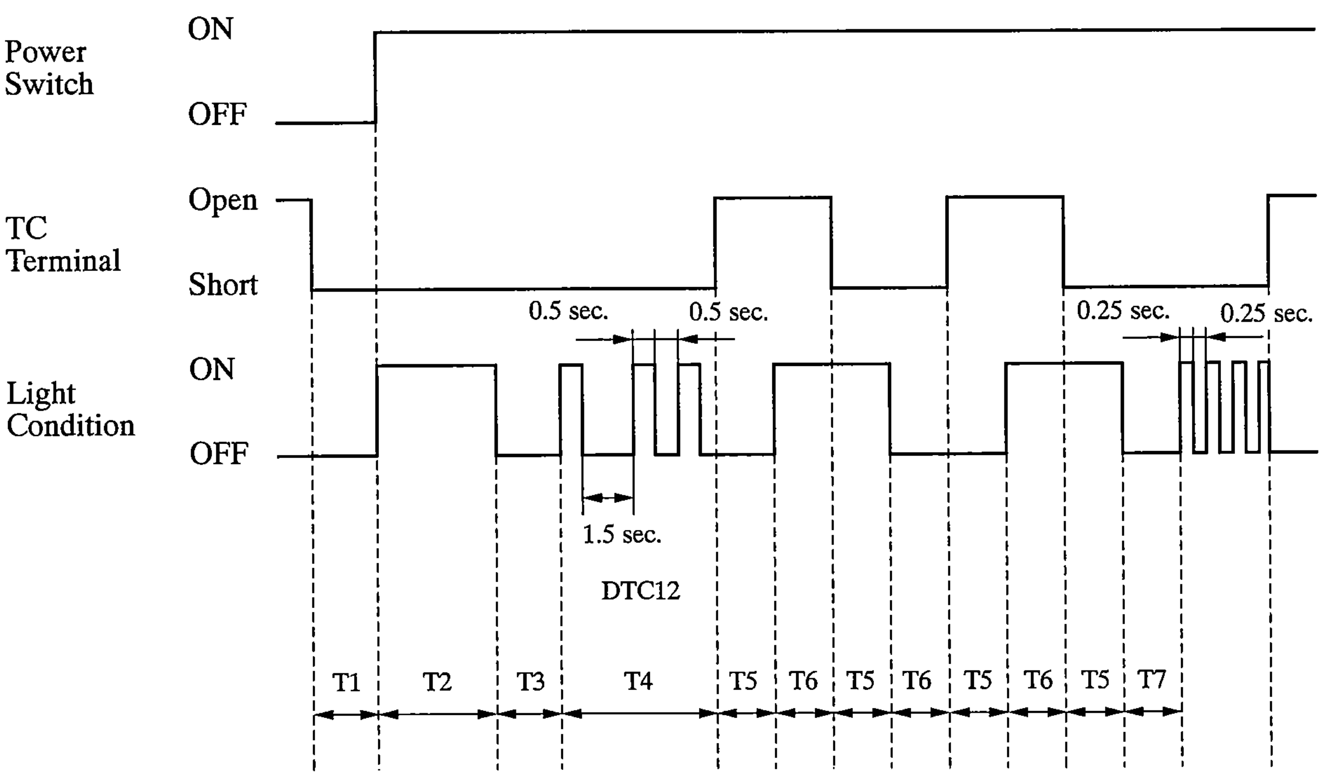
DTC No.	Detection Item	DTC No.	Detection Item
B1833/57	Short in curtain shield airbag (D seat side) squib circuit (to +B)	B1902/73	Short in P/T squib (D seat side) circuit (to ground)
B1835/58	Short in curtain shield airbag (P seat side) squib circuit	B1903/73	Short in P/T squib (D seat side) circuit (to +B)
B1836/58	Open in curtain shield airbag (P seat side) squib circuit	B1905/74	Short in P/T squib (P seat side) circuit
B1837/58	Short in curtain shield airbag (P seat side) squib circuit (to ground)	B1906/74	Open in P/T squib (P seat side) circuit
B1838/58	Short in curtain shield airbag (P seat side) squib circuit (to +B)	B1907/74	Short in P/T squib (P seat side) circuit (to ground)
B1900/73	Short in P/T squib (D seat side) circuit	B1908/74	Short in P/T squib (P seat side) circuit (to +B)
B1901/73	Open in P/T squib (D seat side) circuit	—	

Service Tip

DTC Clearance (Using not hand-held tester)

The DTCs are cleared by opening and shorting the Tc and CG (or ground) terminals of the DLC3 in accordance with the timing chart shown below.

1) Using SST (09843-18040), connect terminal TC and CG terminals of the DLC3.
2) Disconnect terminal TC of DLC3 within 10 seconds after the DTCs appear, and check if the SRS warning light come on within 3 seconds.
3) Within 2 seconds to 4 seconds after the SRS warning light come on, reconnect the Tc and CG terminals of the DLC3.
4) SRS warning light goes off 3 seconds after reconnecting the Tc and CG terminals of the DLC3. Then disconnect the terminal TC of the DLC3 within 2 to 4 seconds after the SRS warning light goes off.
5) Warning light comes on within 3 seconds after re-disconnecting the Tc and CG terminals of the DLC3.
6) Within 2 seconds to 4 seconds after the SRS warning light comes on, reconnect the Tc and CG terminals of the DLC3.
7) SRS warning light goes off 3 seconds after reconnecting the Tc and CG terminals of the DLC3.
8) Normal codes appears 1 seconds after the SRS warning light goes off.



T1: 0~∞ second
T2: Approx. 6 seconds
T3: 3~5 seconds
T4: 3~10 seconds
T5: 2~4 seconds
T6: 1~5 seconds
T7: within 1 second

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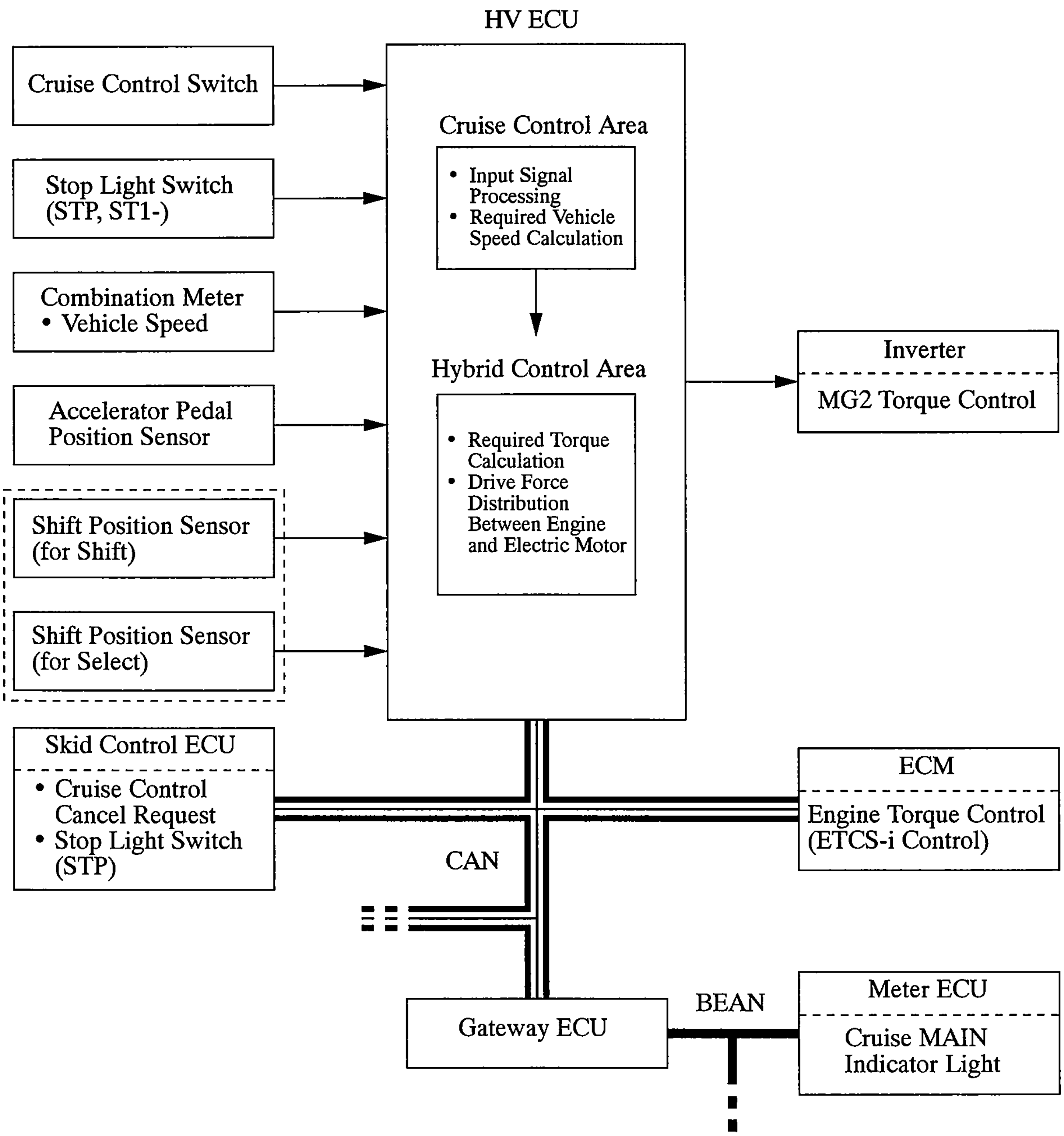
CRUISE CONTROL SYSTEM

■ DESCRIPTION

- '04 Prius has adopted a cruise control system that uses the hybrid system, and it is offered as standard equipment.
- This system, which is controlled by the HV ECU that is integrated with the cruise control ECU, operates the vehicle through an optimal combination of the drive forces of the electric motor and the engine in accordance with the setting on the cruise control switch.

▶ System Diagram ◀



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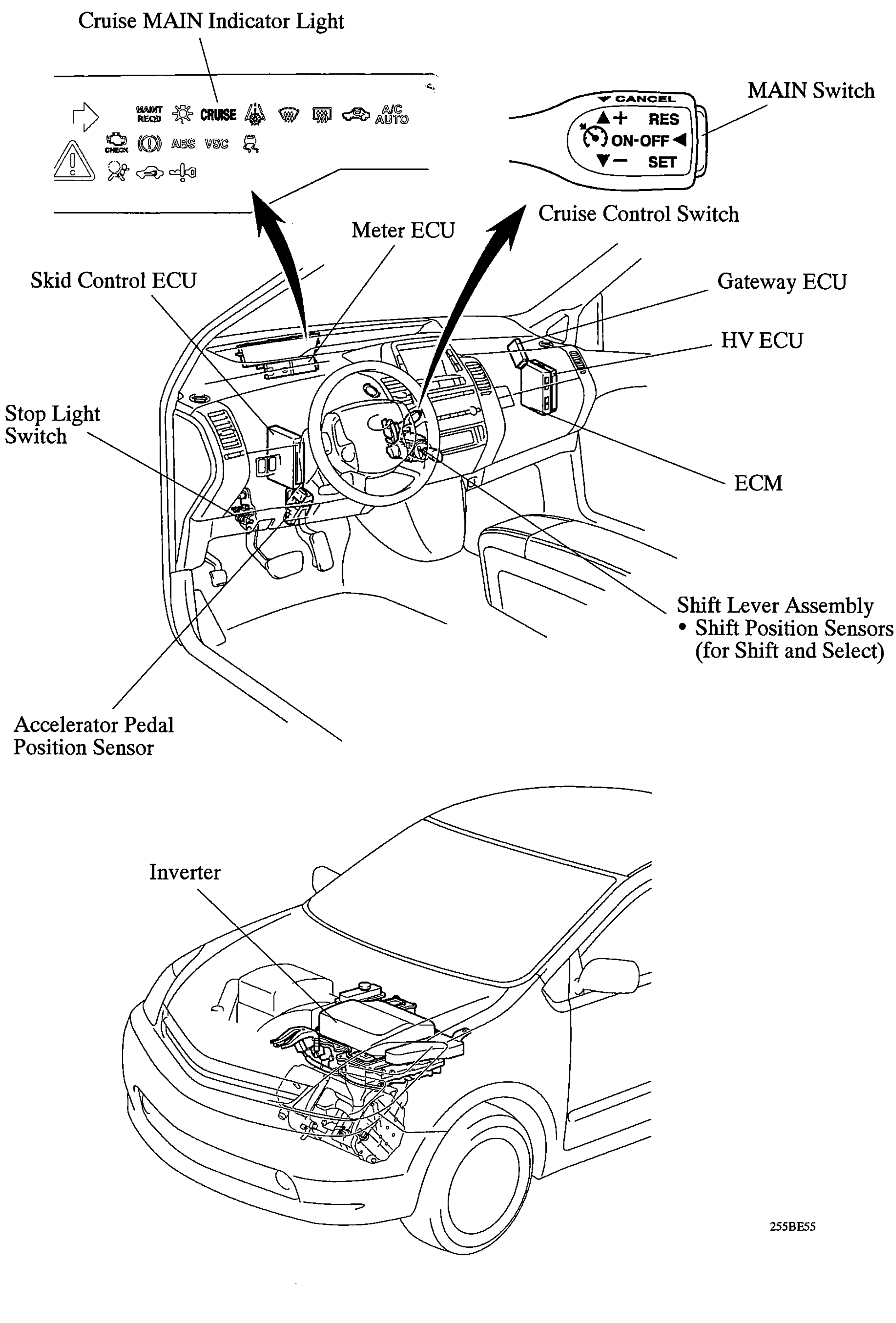
■ LAYOUT OF MAIN COMPONENTS



■ FUNCTION

The cruise control has the following functions.

Function	Outline
Constant Speed Control	The HV ECU compares the actual vehicle speed with the set speed, and regulates the drive force of the electric motor and the engine so that the actual vehicle speed and the set speed will become equal.
Set Control	When this system fulfils the following conditions, and the cruise control switch is pressed to the SET/- side and released with the MAIN switch turned on, the HV ECU stores the vehicle speed and controls it constantly at that speed. • The vehicle is running within a cruising speed control range [approx. 40 km/h (25 mph) or more]. • While the shift position is in position D.
Low Speed Limit Control	The low speed limit is the lowest speed that cruise control can be set and is designed at approx. 40 km/h (25 mph). The cruise control cannot be set below that speed. If the vehicle speed drops below that speed while running in the cruise control mode, the cruise control is cancelled automatically and the set speed in the memory is cleared.
Accelerator Control	When the driver keeps the cruise control switch pushed to the RES/+ side while the vehicle operates in the cruise control mode, the HV ECU regulates the drive force of the electric motor and the engine in the direction that increases the vehicle speed. As the vehicle keeps accelerating, the HV ECU stores the vehicle speed at the time the driver's hand is released from the cruise control switch. From then on, the HV ECU keeps the vehicle operating at that speed.
Tap-Up Control	When the difference between the actual vehicle speed and the set speed is less than 5 km/h (3 mph), the set speed can be increased approx 1.6 km/h (1 mph) each time by operating the RES/+ switch quickly within approx 0.5 seconds.
Coast Control	When the driver keeps the cruise control switch pushed to the SET/- side while the vehicle operates in the cruise control mode, the HV ECU regulates the drive force of the electric motor and the engine in the direction that decreases the vehicle speed. As the vehicle keeps decelerating, the HV ECU stores the vehicle speed at the time the driver's hand is released from the cruise control switch. From then on, the HV ECU keeps the vehicle operating at that speed.
Tap-Down	When the difference between the actual vehicle speed and the set speed is less than 5 km/h (3 mph), the set speed can be lowered approx. 1.6 km/h (1 mph) each time by operating the SET/- switch quickly within approx. 0.5 seconds
Resume Control	After the cruise control mode is cancelled by any of the cancel switches, the mode can be resumed and controlled at the set speed by operating the cruise control switch in the RES/+ direction providing that the vehicle speed has not dropped below the low speed limit [approx. 40 km/h (25 mph)]. The mode cannot be resumed if the vehicle speed once drops below the low speed limit, because the speed in the memory is cleared.
Manual Cancel Control	If any of the following signals is sent to the HV ECU while the vehicle is running in the cruise control, the cruise control is cancelled accordingly. • Stop light switch ON signal (Depress the brake pedal) • Shift the shift lever from D to B or N • CANCEL switch ON signal • MAIN switch OFF signal • During Enhanced VSC operation

(Continued)

Automatic Cancel Control	When any of the following conditions occur during cruise control driving, the speed that is set in the memory is cleared to cancel the cruise control mode. Furthermore, the cruise main indicator light blinks until the MAIN switch is turned OFF, and the operation of the cruise control is disabled until the MAIN switch is turned ON again. • Stop light switch open or short circuit • ETCS-i malfunction • When there is a considerable change in the vehicle speed signal values that are input in the HV ECU, this condition can be verified in the CRUISE CONTROL DATA LIST of the hand-held tester. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).
	When any of the following conditions occur during the cruise control driving, the speed that is set in the memory is cleared to cancel the cruise control mode. Furthermore, the cruise main indicator light blinks until the MAIN switch is turned OFF, and the operation of the cruise control is disabled until the ignition switch is turned OFF again. • Stop light switch input signal abnormal • HV ECU malfunction
	When any of the following conditions occurs during the cruise control driving, the set speed in the memory is cleared to cancel the cruise control mode. Cruise control can be resumed at the set speed by operating the SET or RESUME switch providing that the vehicle speed is above the lower speed limit [approx. 40 km/h (25 mph)]. • The vehicle speed falls below the low speed limit [approx. 40 km/h (25 mph)]. • The vehicle speed drops more than 16 km/h (10 mph) below the set speed as in uphill driving.
Diagnosis	If a malfunction occurs in the cruise control system, during cruise control driving, the HV ECU actuates Auto Cancel of the cruise control and turns on and off the cruise main indicator light to inform the driver of a malfunction. At the same time, the malfunction is stored in memory as a DTC (Diagnostic Trouble Code).

■ DIAGNOSIS

- If a malfunction occurs in the cruise control system, during cruise control driving, the HV ECU actuates Auto Cancel of the cruise control and turns on and off the cruise main indicator light to inform the driver of a malfunction. At the same time, the malfunction is stored in memory as a DTC (Diagnostic Trouble Code).
- The DTC can be accessed by connecting a hand-held tester to DLC3 terminal. For details, see the 2004 Prius Repair Manual (Pub. No. RM1075U).
- The DTC listed below is used.

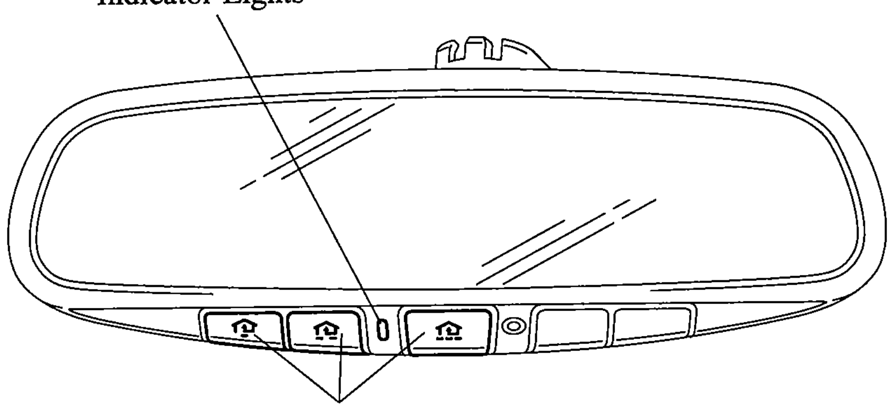
DTC No.	Detection Item
P0500	Vehicle Speed Sensor "A"
P0571	Brake Switch "A" Circuit
P0607	Control Module Performance

GARAGE DOOR OPENER

■ DESCRIPTION

The garage door opener system has been adopted as optional equipment on all models.
This system enables the garage door to be opened or closed from inside the vehicle by operating the switch.
This system provides the features listed below.

- Up to three types of transmitter codes can be registered in the garage door opener.
- The garage door opener switch is provided in the inside rear view mirror where it is easily accessible.
- An indicator light is provided to enable the operator to verify the operation mode of the garage door opener.
- A rolling code function has been adopted, which changes the transmitter code each time the garage door opener switch is pressed.



■ FUNCTION

The following table shows the garage door opener function and the indicator light operation in each of the modes.

Function	Outline	Indicator Light
Transmission Mode	While the switch is being pressed, the garage door opener transmits the code that was previously registered. Even if the button is pressed continuously, the transmission stops after 20 seconds.	Flash → On (Rolling Code) ON (Except Rolling Code)
Learning Mode	When the button is pressed continuously for 20 seconds, the mode transfers to the learning mode in which a transmitter code can be registered. In this mode, a new transmitter code can be registered or an existing code can be overwritten. If no codes are registered within 90 seconds after transferring to the learning mode, the mode transfers to the low power mode.	Slow flashing (during learning mode) Quick flashing (registration completed)
All Delete Mode	When the 2 outside buttons are pressed simultaneously for 20 seconds, all the transmitter codes that are registered in the button are cleared. By releasing the buttons within 10 seconds after clearing the codes, the mode transfers to the learning mode. By keeping the buttons pressed longer than 10 seconds after clearing the codes, all the buttons will be registered with a code for operation verification.	Quick flashing (code clearing completed)
Low Power Mode	If the button remains pressed longer than 100 seconds, such as in the case in which the pressed button does not release it self, the mode transfers to the low power mode to reduce power consumption.	OFF

■TRANSMITTER CODE REGISTRATION PROCEDURE

The garage door opener contains an EEPROM in which the maximum of 3 types of transmitter recognition codes can be registered. A transmitter code is registered into the EEPROM of the garage door opener according to the following steps.

A: Press the button for registering transmitter codes continuously until the indicator light flashes slowly.
B: While keeping the garage door opener's button pressed, place the transmitter for while you wish to register the code within about 25 mm (1 in.) of the garage door opener and press the transmitter's button.
C: After the flashing of the indicator light changes from slow to quick flashing, the registration of the transmitter code has been completed. Then, release your fingers from the buttons of the garage door opener and the transmitter.
D: To register the code of another transmitter, repeat the operation starting with step "A". To register a new code to the button that already has a code registered to it, select the button to which you wish to register the new code and start the operation starting with step "A".

CAUTION
The garage door or the gate could operate unintentionally while registering a transmitter code. Therefore, make sure that there are no people near the garage door or the gate before carrying out this operation.

NOTE:
- Before performing a transmitter code registration, stop the hybrid system and pull the key from the key slot.
- The transmitter code of a garage door opener manufactured before 1982 cannot be registered in this system.

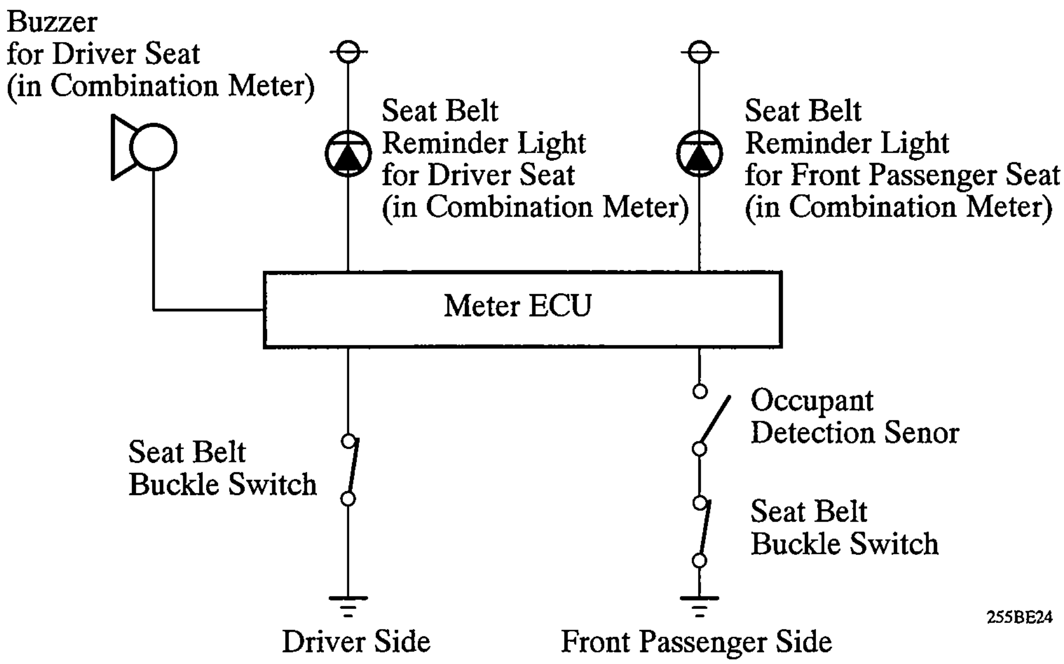
For details of procedures of transmitter code registration, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U) to register the codes correctly.

SEAT BELT REMINDER SYSTEM

■ DESCRIPTION

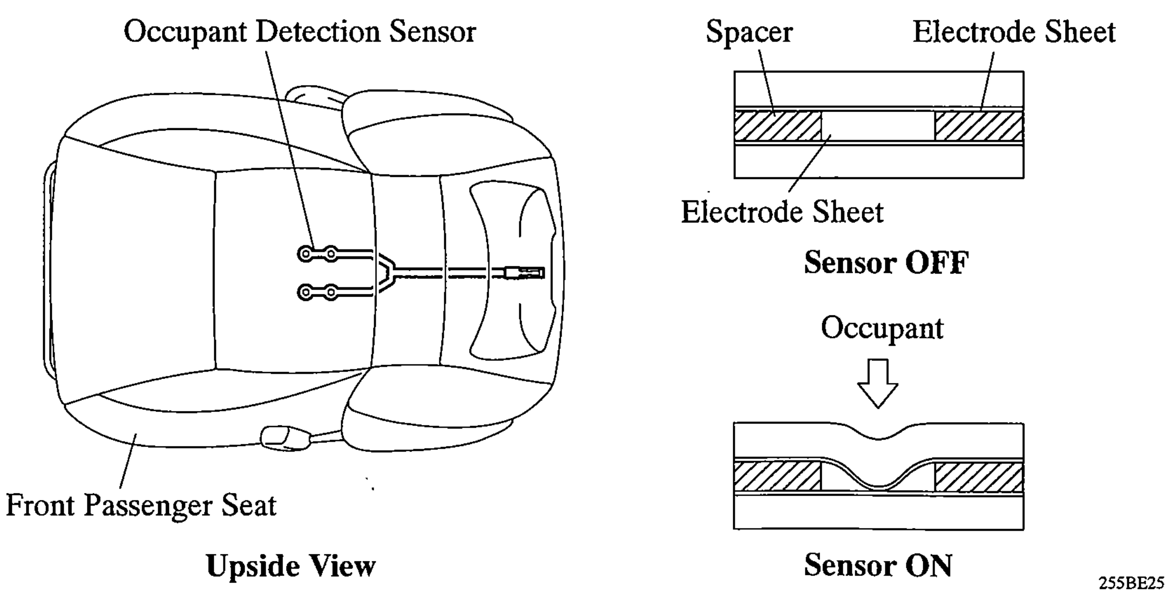
- A seat belt reminder system is used. If the seat belt is not buckled, the reminder light flashes and the buzzer sounds (Driver's side only).
- When the power switch is turned ON, this system determines whether or not the seat belt is buckled depending on whether the signal from the switch in the seat belt buckle is ON or OFF.
- The occupant detection sensor provided in the seat cushion of the front passenger seat determines whether or not an occupant is seated in the front passenger seat.

▶ System Diagram ◀



■ OCCUPANT DETECTION SENSOR

The occupant detection sensor, which is enclosed in the seat cushion of the front passenger seat, is used to detect whether or not the front passenger seat is occupied.
This sensor, which is shaped as illustrated below, consists of a construction in which two sheets of electrodes sandwich a spacer. When the occupant is seated, the electrode sheets come in contact with each other through the hole that is provided in the spacer portion, thus enabling the current to flow.
Thus, the sensor detects whether or not an occupant is seated in the front passenger seat.



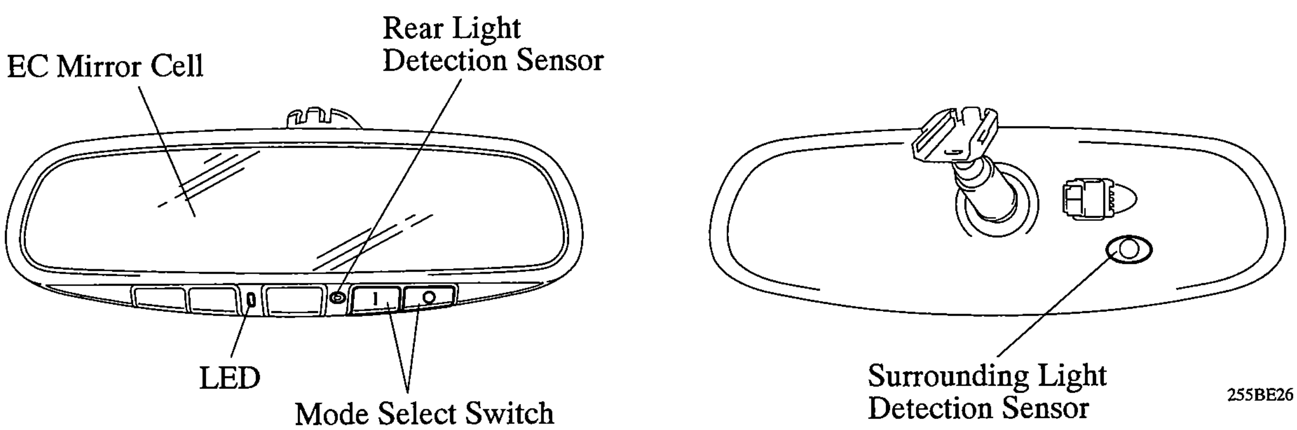
AUTOMATIC GLARE-RESISTANT EC MIRROR

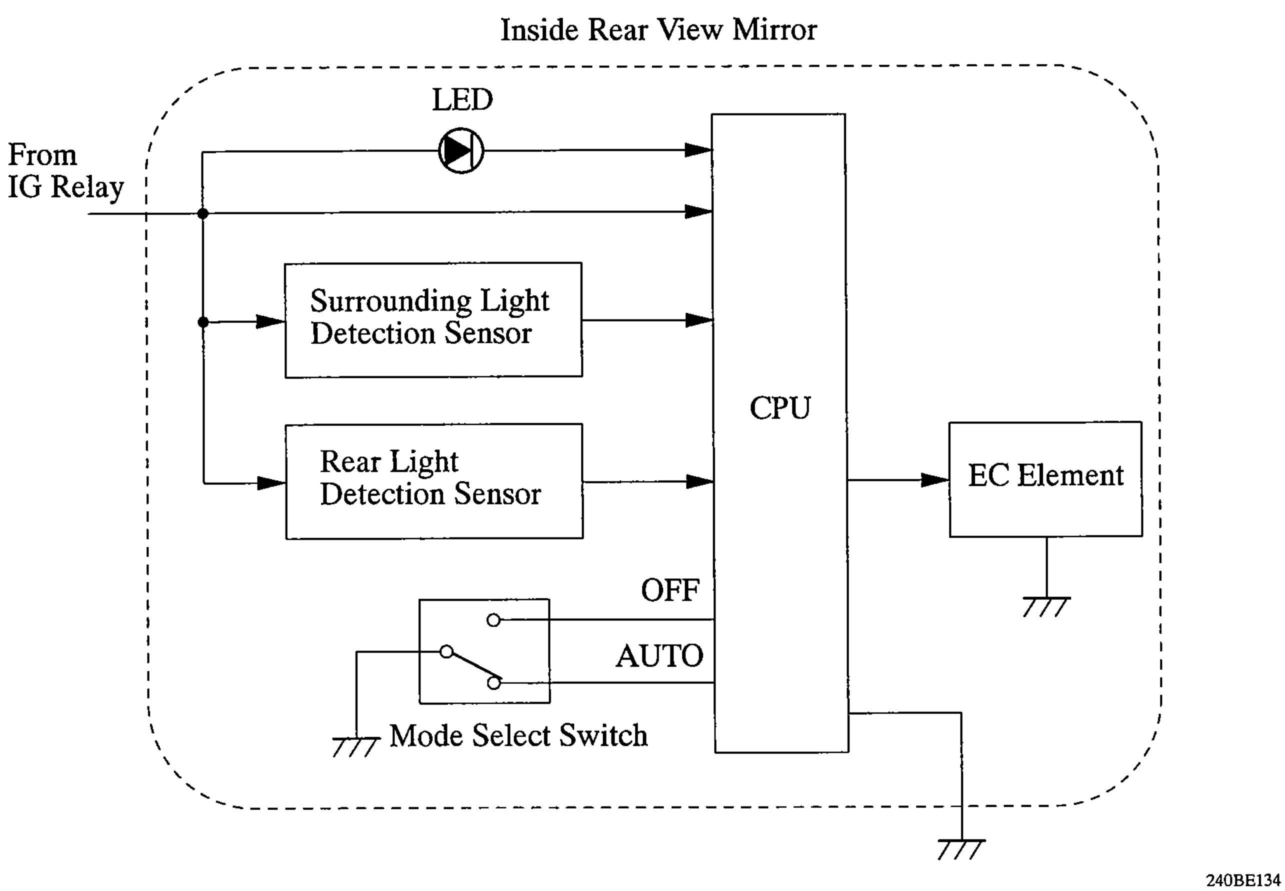
■ DESCRIPTION

During nighttime driving, if a large difference in intensity exists between the surrounding light and the light entering the inside rear view mirror from the headlights behind, automatic glare-resistant EC (Electrochromic) mirror automatically reduce the reflection rate of the inside rear view mirror and thus dampens the glare on the mirror.

- This system is optional equipment on all models.
- This system uses 2 sensors that are attached onto the inside rear view mirror to detect the difference between the intensity of light entering the inside rear view mirror from the rearward.
- When the power switch is turned from OFF to ON, this system always turns on in the AUTO mode.

▶ System Diagram ◀





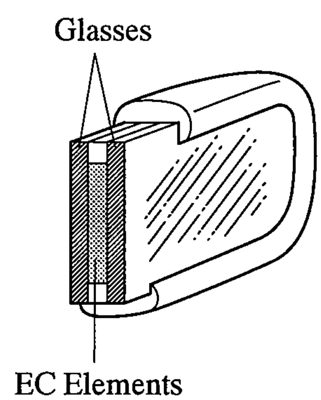
■ FUNCITON OF COMPONENT

1. General

Component	Function
Surrounding Light Detection Sensor	Detect the intensity of the light surrounding the vehicle.
Rear Light Detection Sensor	Detects the intensity of the light entering the inside rear view mirror from behind the vehicle.
LED	Turns on of inform the driver during the AUTO mode is operating.
Mode Select Switch (AUTO, OFF)	Selects the inside rear view mirror control to AUTO mode AUTO OFF mode.
EC Mirror Cell	Varies the refection rate of the mirror through the function of EC element.
CPU	Controls the reflection rate in accordance with the signals from the 2 sensors.

2. EC Mirror Cell

An EC mirror cell consists of 2 layers of glass, which sandwich the EC (Electrchromic) elements in the middle. The EC elements control coloring and discoloring characteristics through their electro-chemical oxidation reduce reaction. These characteristics are utilized to electronically vary the mirror's reflection rate.



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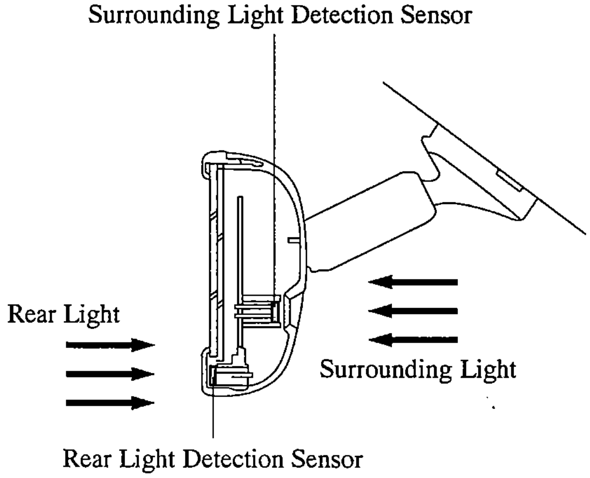
■ REFLECTION RATE CONTROL

This CPU detects the surrounding light through its surrounding light detection sensor, the rear light through its rear light detection sensor, and determines whether it is day or night through the intensity of the surrounding light. At the same time, the intensity of the glare from the rear determined through the difference in intensity between the surrounding and rear light. In accordance with the intensity of the rear light, the reflection rate varies steplessly.



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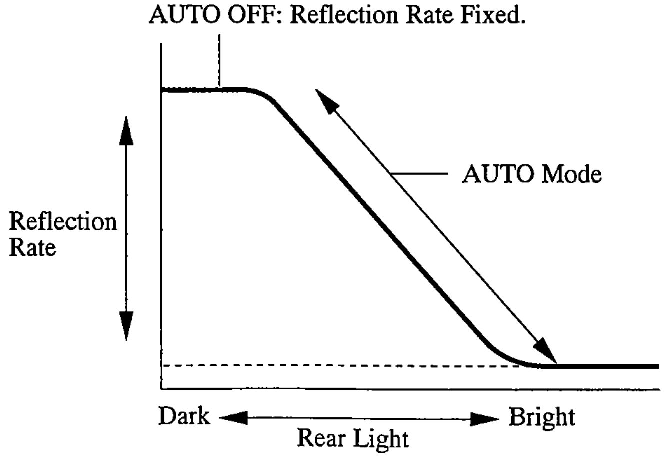

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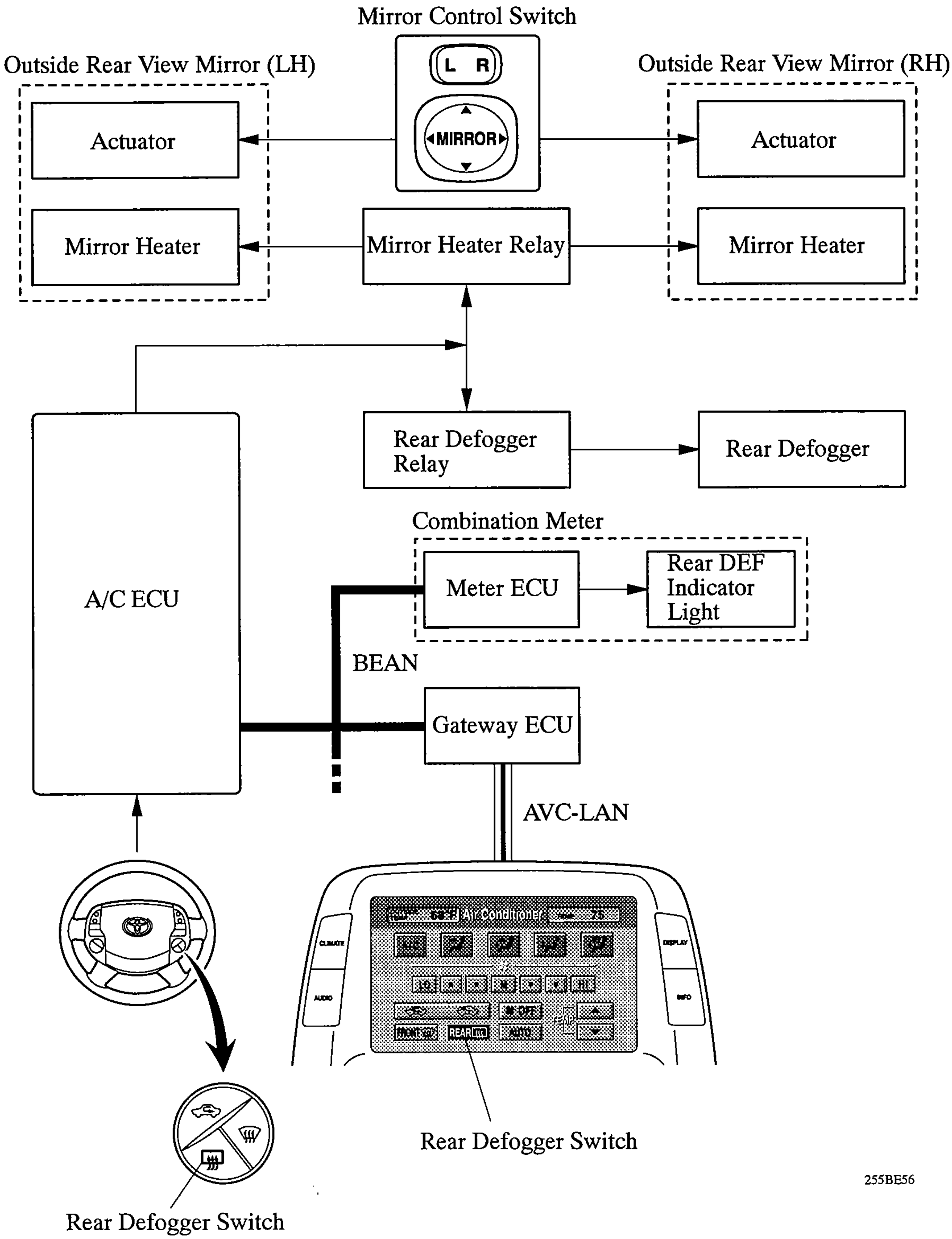
OUTSIDE REAR VIEW MIRROR

■ DESCRIPTION

- Electrical remote control mirrors with internal heater, which operate in conjunction with the rear window defogger have been adopted.
- The positions of the outside rear view mirrors are controlled by the mirror control switch.
- The mirror heaters are controlled by the air conditioning ECU.

▶ System Diagram ◀



■ FUNCTION

The outside rear view mirror has following functions:

Function	Outline
Electrical Remote Control type Mirror	When the mirror control switch is operated, this function moves the mirror surface vertically or laterally to enable the driver to attain an optimal mirror angle. Setting the mirror master switch to the "R" position operates the right mirror, and to the "L" position operates the left mirror.
Rear Window Defogger-linked Mirror Heater	This function also automatically turns ON the mirror heater when the rear window defogger switch is turned ON. After 15 minutes have elapsed from the time this function has been activated, the rear window defogger turns OFF automatically, and the mirror heater also turns OFF.

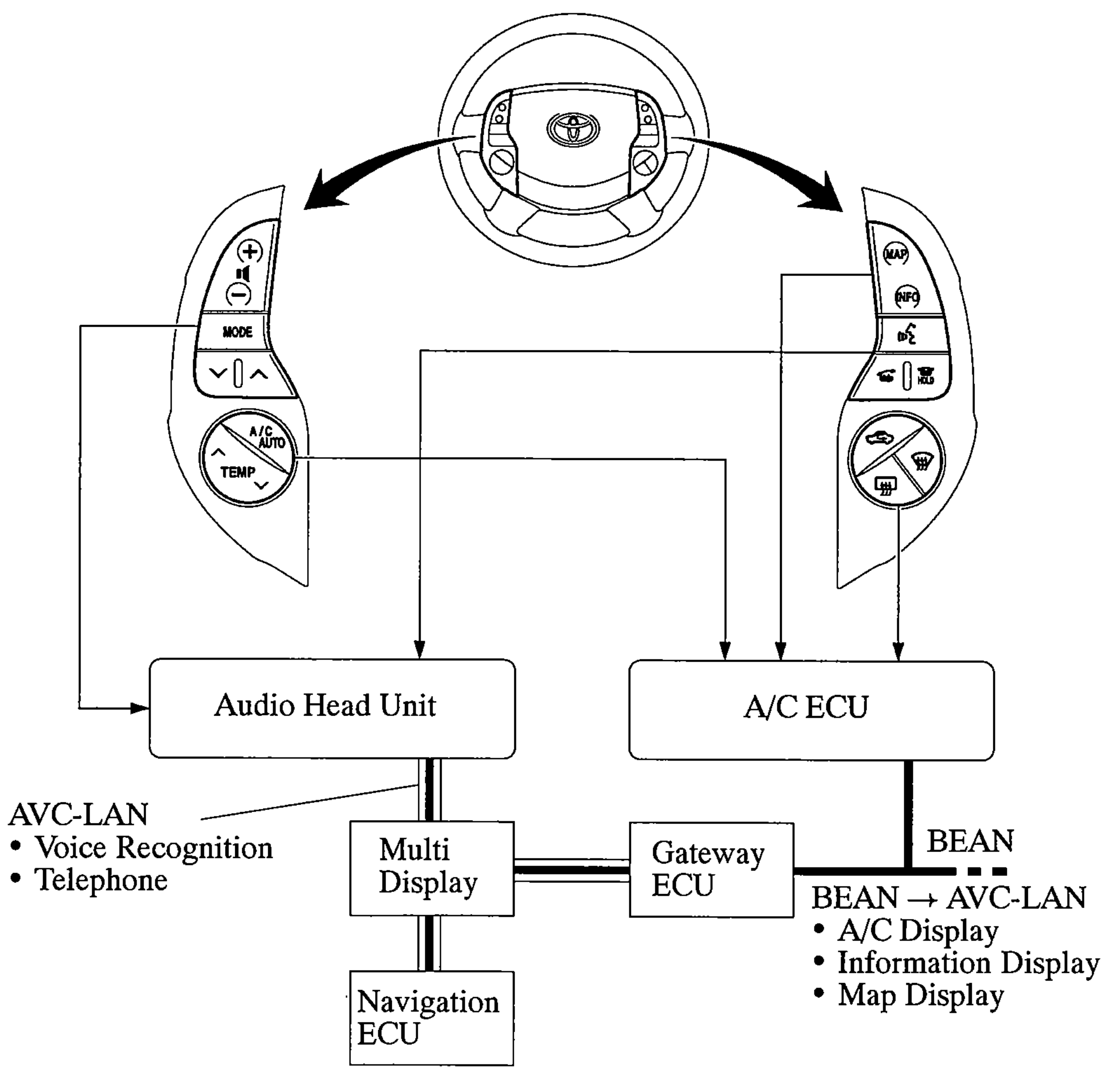
STEERING PAD SWITCH

■ DESCRIPTION

- A steering wheel with steering pad switches is standard equipment on all models. The frequently used switches are located on the steering pad for easy use.
- The switches that are provided on the steering pad vary by destination country and optional equipment, as indicated in the table below.

System		Switch	U.S.A. With Navigation	U.S.A. Without Navigation	CANADA
Audio		• VOLUME (+/-) • MODE • SEEK (+/-)	○	○	○
Air Conditioning		• AUTO • Front DEF • TEMP (+/-) • Rear DEF • RECIRCULATION	○	○	○
Multi Display	Information	• INFO	○	—	—
	Navigation	• MAP • VOICE			
	Telephone	• ON HOOK • OFF HOOK			

▶ **System Diagram** ◀



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MAJOR TECHNICAL SPECIFICATIONS

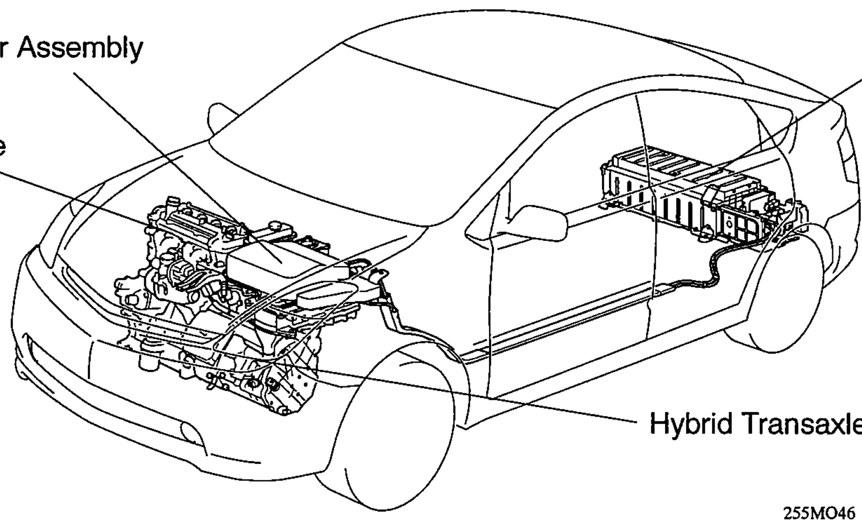
Item			Area	U.S.A	Canada
Body Type				4-Door Hatchback	
Vehicle Grade				-	
Model Code				NHW20L-AHEEBA	NHW20L-AHEEBK
Major Dimensions & Vehicle Weights	Overall	Length	mm (in.)	4445 (175.0)	4445 (175.0)
		Width	mm (in.)	1725 (67.9)	1725 (67.9)
		Height	mm (in.)	1475 (58.1)	1475 (58.1)
	Wheel Base		mm (in.)	2700 (106.3)	2700 (106.3)
	Tread	Front	mm (in.)	1505 (59.3)	1505 (59.3)
		Rear	mm (in.)	1480 (58.3)	1480 (58.3)
	Effective Head Room	Front	mm (in.)	950 (37.4)	950 (37.4)
		Rear	mm (in.)	900 (35.4)	900 (35.4)
	Effective Leg Room	Front	mm (in.)	811 (31.9)	811 (31.9)
		Rear	mm (in.)	727 (28.6)	727 (28.6)
	Shoulder Room	Front	mm (in.)	1405 (55.3)	1405 (55.3)
		Rear	mm (in.)	1345 (53.0)	1345 (53.0)
	Overhang	Front	mm (in.)	885 (34.8)	885 (34.8)
		Rear	mm (in.)	860 (33.9)	860 (33.9)
	Min. Running Ground Clearance		mm (in.)	142 (5.6)	142 (5.6)
	Angle of Approach		degrees	14.0°	14.0°
	Angle of Departure		degrees	19.0°	19.0°
	Curb Weight	Front	kg (lb)	780 (1725)	780 (1725)
		Rear	kg (lb)	530 (1165)	530 (1165)
		Total	kg (lb)	1310 (2890)	1310 (2890)
	Gross Vehicle Weight	Front	kg (lb)	920 (2030)	920 (2030)
		Rear	kg (lb)	800 (1765)	800 (1765)
		Total	kg (lb)	1720 (3795)	1720 (3795)
	Fuel Tank Capacity		L (US. Gal., Imp. gal.)	45 (11.9, 9.9)	45 (11.9, 9.9)
	Luggage Capacity		m3 (cu.ft.)	0.41 (14.4)	0.41 (14.4)
Performance	Max. Speed		km/h (mph)	165 (103)	165 (103)
	Max. Cruising Speed		km/h (mph)	165 (103)	165 (103)
	Acceleration	0 to 60 mph	sec.	10.1	10.1
		0 to 400 m	sec.	17.6	17.6
	Max. Permissible Speed	1st Gear	km/h (mph)	-	-
		2nd Gear	km/h (mph)	-	-
		3rd Gear	km/h (mph)	-	-
		4th Gear	km/h (mph)	-	-
		5th Gear	km/h (mph)	-	-
	Turning Diameter (Outside Front)	Wall to Wall	m (ft.)	11.0 (36.1)	11.0 (36.1)
		Curb to Curb	m (ft.)	10.6 (34.9)	10.6 (34.9)
Engine	Engine Type			1NZ-FXE	1NZ-FXE
	Valve Mechanism			16-Valve, DOHC	16-Valve, DOHC
	Bore × Stroke		mm (in.)	75.0 × 84.7 (2.95 × 3.33)	75.0 × 84.7 (2.95 × 3.33)
	Displacement		cm^3 (cu.in.)	1497 (91.4)	1497 (91.4)
	Compression Ratio			13.0 : 1	13.0 : 1
	Fuel System			SFI	SFI
	Octane Rating			87 or higher	87 or higher
	Max. Output (SAE-NET)		kW/rpm (HP@rpm)	57/5000 (76@5000)	57/5000 (76@5000)
	Max. Torque (SAE-NET)		N·m/rpm (lb-ft@rpm)	111/4200 (82@4200)	111/4200 (82@4200)
Engine Electrical	Battery Capacity (5HR)		Voltage & Amp. hr.	12 - 28, 12 - 36*1	12 - 28, 12 - 36*2
	Alternator Output		Watts	-	-
	Starter Output		kW	-	-
Chassis	Clutch Type			-	-
	Transaxle Type			P112	P112
	Transmission Gear Ratio	In First		-	-
		In Second		-	-
		In Third		-	-
		In Fourth		-	-
		In Fifth		-	-
		In Reverse		-	-
	Counter Gear Ratio			-	-
	Differential Gear Ratio (Final)			4.113	4.113
	Differential Gear Size (Final)		in.	-	-
	Brake Type	Front		Ventilated Disc	Ventilated Disc
		Rear		Leading-Trailing Drum	Leading-Trailing Drum
	Parking Brake Type			Leading-Trailing Drum	Leading-Trailing Drum
	Brake Booster Type			-	-
	Proportioning Valve Type			-	-
	Suspension Type	Front		MacPherson Strut	MacPherson Strut
		Rear		Torsion Beam	Torsion Beam
	Stabilizer Bar	Front		Standard	Standard
		Rear		Standard	Standard
	Steering Gear Type			Rack & Pinion	Rack & Pinion
	Power Steering Type			Electric Motor	Electric Motor

*1: With Smart Entry System and/or Navigation System
*2: With Smart Entry System

PERFORMANCE

THS-II (TOYOTA HYBRID SYSTEM-II)

- The hybrid system is a type of power-train that uses a combination of two types of motive forces, such as an engine and a motor [MG2 (Motor Generator No.2)]. This system is characterized by its skillful use of two types of motive forces according to the driving conditions. It complements weakness of motive forces each other to maximize the motive force of the vehicle.
- The '04 Prius is powered by a new-generation Toyota Hybrid System called "THS-II", which has been developed under a "Hybrid Synergy Drive" concept to pursue better environmental performance and to realize "fun to drive" feeling. Under this concept, the THS-II has achieved significant advances in control systems, which aim for synergy between the power of the electric motor and the power of the engine. By greatly boosting the power supply voltage, this system has achieved a high level of balance between environmental performance and power.



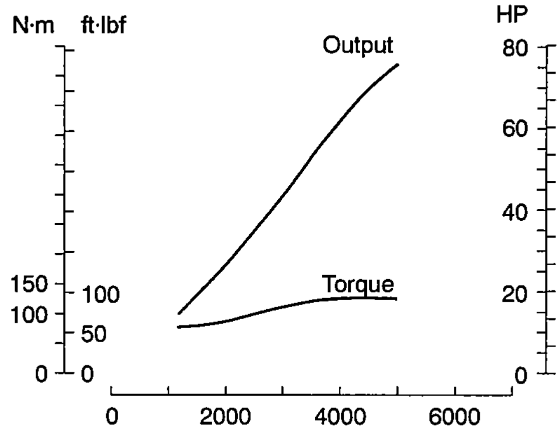
Engine

Model	'04 Prius	'03 Prius
Type	1NZ-FXE High Expansion Ratio Cycle Engine, Certified ATPZEV*1	1NZ-FXE High Expansion Ratio Cycle Engine, Certified SULEV*2
Displacement	1497 cm^3	1497 cm^3
Max. Output	57 Kw/5000 rpm (76 HP/5000 rpm)	52 Kw/4500 rpm (70 HP/4500 rpm)
Max. Torque	111 N·m/4200 rpm (82 ft·lbf/4200 rpm)	111 N·m/4200 rpm (82 ft·lbf/4200 rpm)

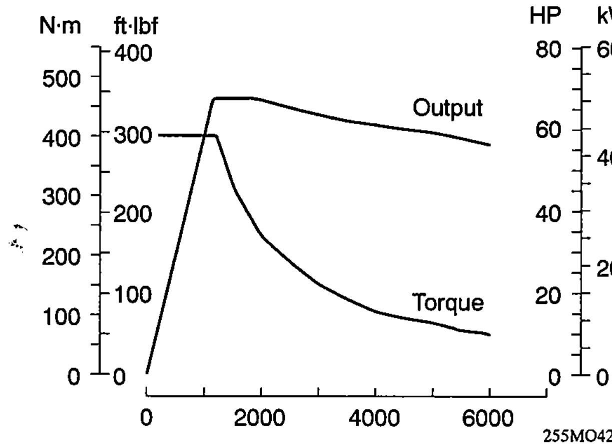
*1: Advanced Technology Partial Zero Emission Vehicle
*2: Super Ultra Low Emission Vehicle

Motor and Generator

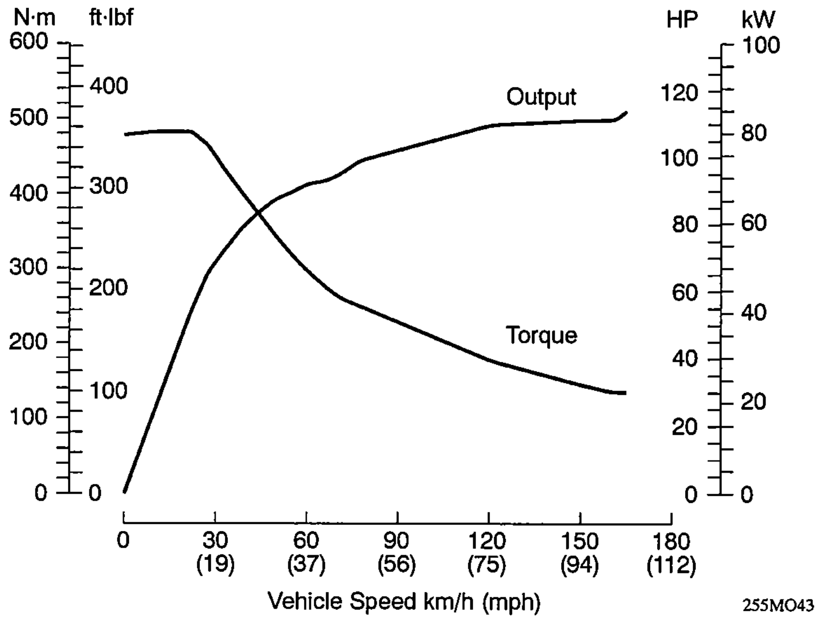
Item	MG1	MG2	
		'04 Prius	'03 Prius
Type	Permanent Magnet Motor	Permanent Magnet Motor	Permanent Magnet Motor
Function	Generate, Engine Starter	Generate, Drive Wheels	Generate, Drive Wheels
Max. Voltage [V]	AC 500	AC 500	AC 273.6
Max. Output kW (HP)/(rpm)	—	50 (68)/(1200 ~ 1540)	33 (45)/(1040 ~ 5600)
Max. Torque N·m (ft·lbf)/(rpm)	—	400 (295)/(0 ~ 1200)	350 (259)/(0 ~ 400)



Engine Performance Curve



Motor Performance Curve

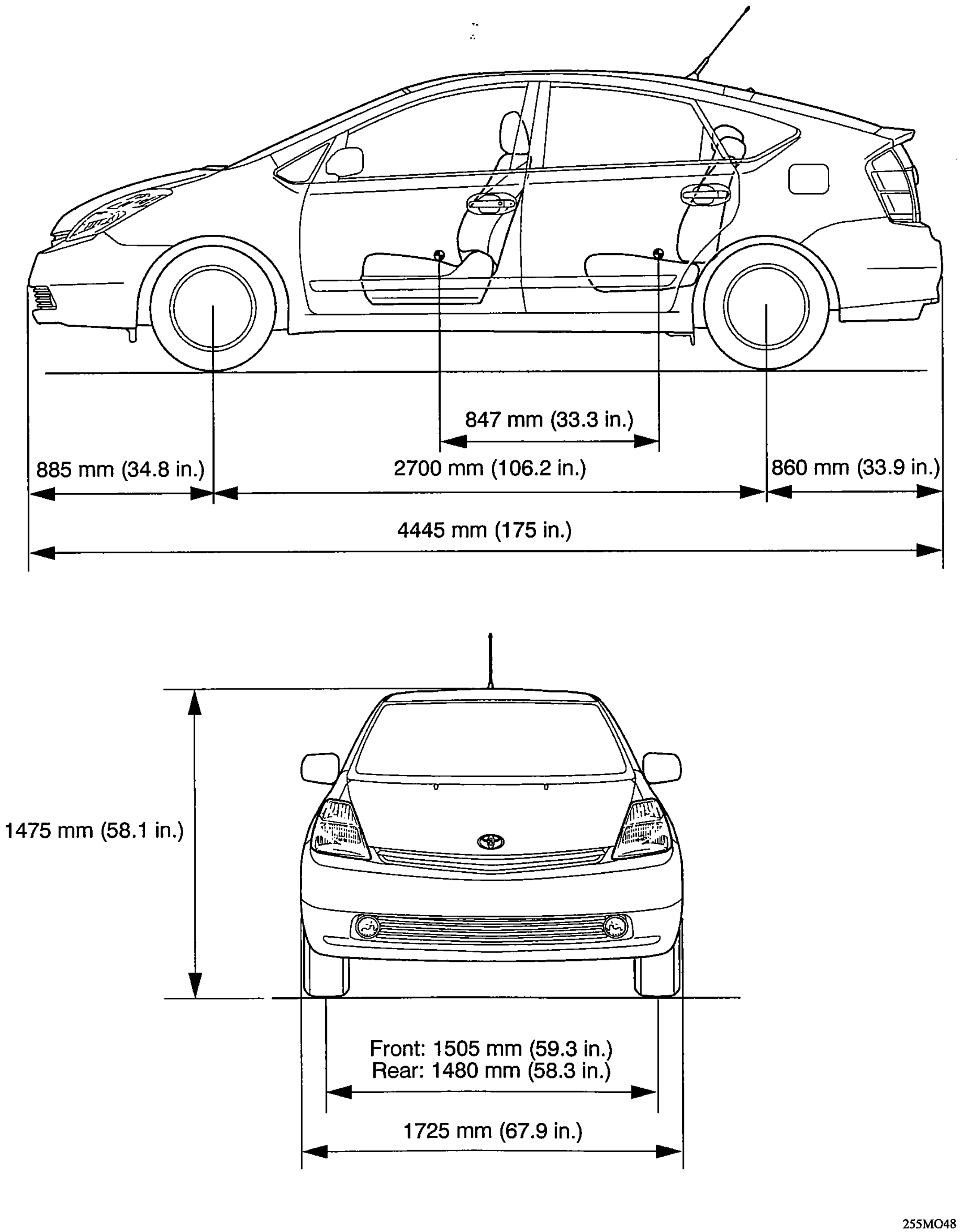


System Performance Curve

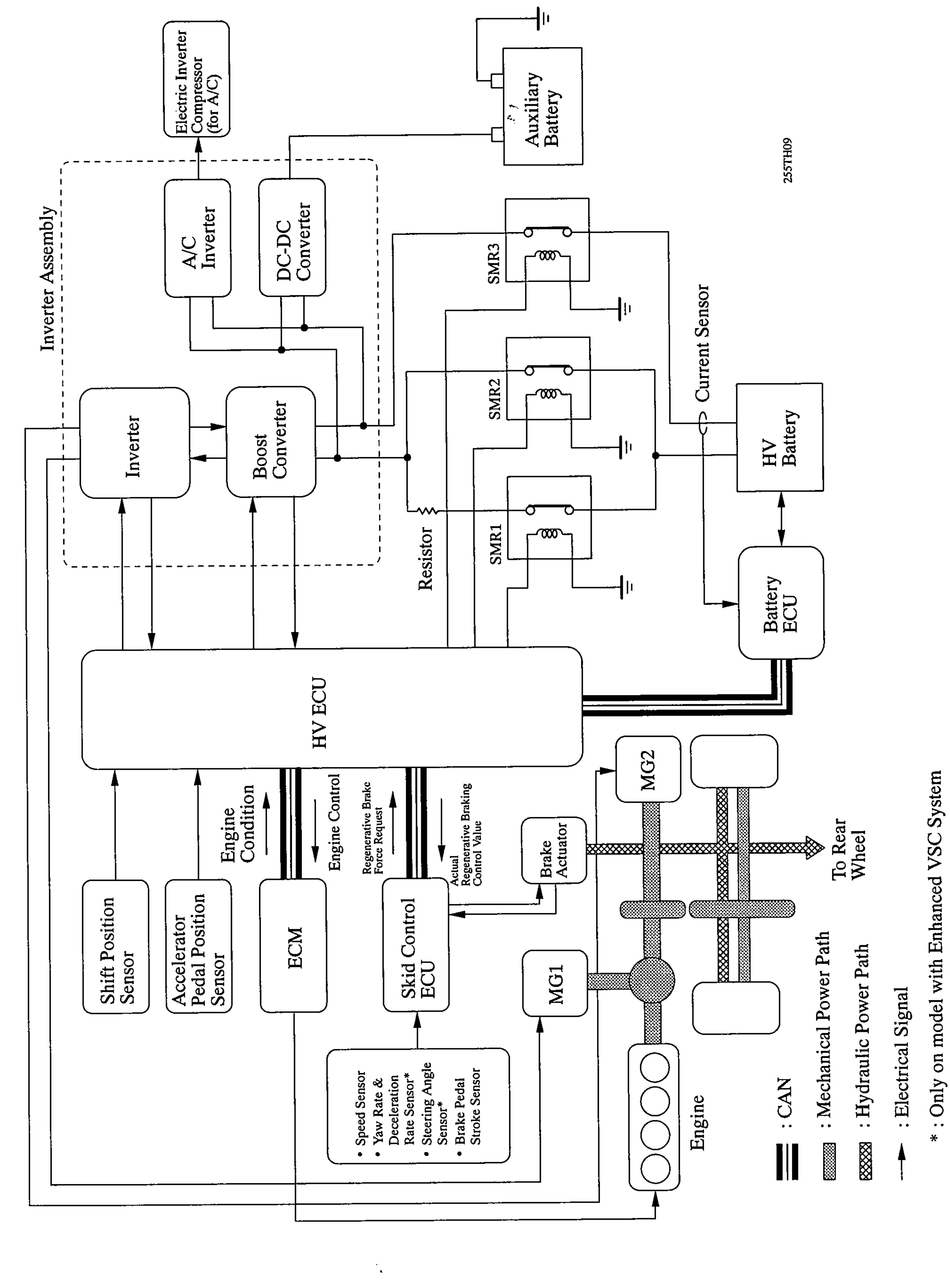
Fuel Economy

- The '04 Prius has achieved 15% reduction in fuel consumption, comparing with the '03 Prius, to be in top level of the world. It is due to the adoption of THS-II and load reduction on the vehicle.
- Improvement Items in THS-II:
  (1) A high-voltage power circuit has been adopted between the motor and the generator, in order to greatly reduce the energy loss during power transmission and deliver optimal energy in an efficient manner.
  (2) As a result of increasing the power output of the motor 1.5 times, the THS-II significantly increases the use of the electrical motor. Under conditions in which the efficiency level of the engine is low, this system stops the engine, allowing the vehicle to run using only the power provided by the electric motor.
  (3) The amount of energy regenerated during deceleration and braking has been significantly increased in order to increase energy efficiency.
- Load Reduction Items on Vehicle:
  (1) Reduction of air resistance
  (2) Reduction of friction at various components: Examples: Engine, transaxle oil, etc.
  (3) Reduction of electrical loads: Example: Adoption of LED stoplight
  (4) Adoption of electric inverter air conditioning system

DIMENSIONS


847 mm (33.3 in.)
885 mm (34.8 in.)
2700 mm (106.2 in.)
860 mm (33.9 in.)
4445 mm (175 in.)
1475 mm (58.1 in.)
Front: 1505 mm (59.3 in.)
Rear: 1480 mm (58.3 in.)
1725 mm (67.9 in.)
255MO48

■SYSTEM DIAGRAM



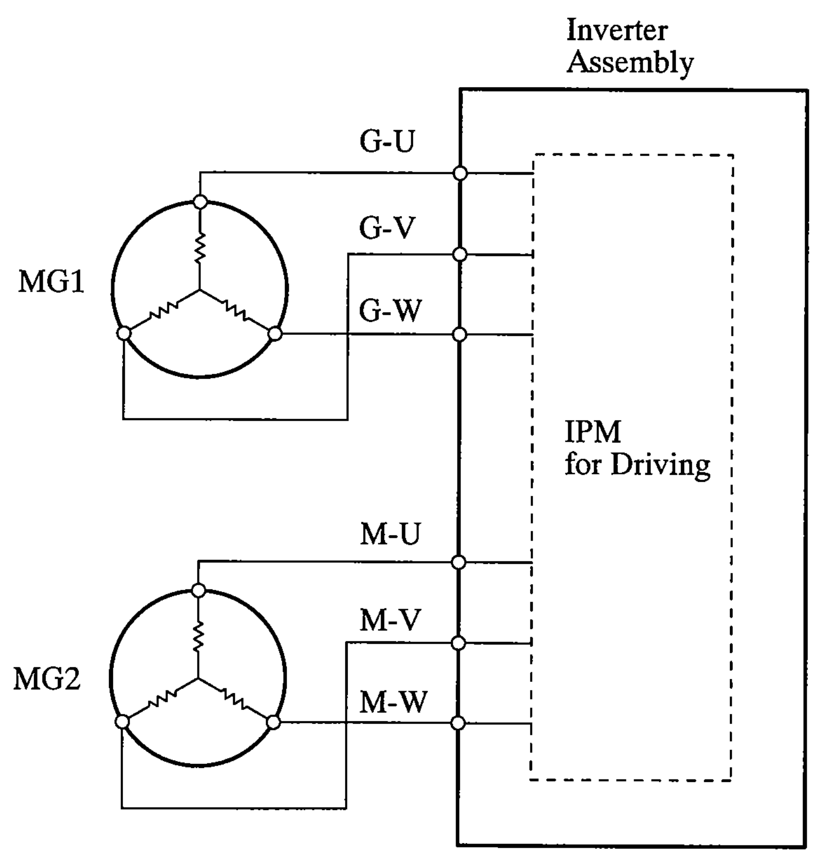
▶ MG1 Specifications ◀

Item		'04 Model	'03 Model
Type		Permanent Magnet Motor	←
Function		Generate, Engine Starter	←
Maximum Voltage	[V]	AC 500	AC 273.6
Cooling system		Water-cooled	←

▶ MG2 Specifications ◀

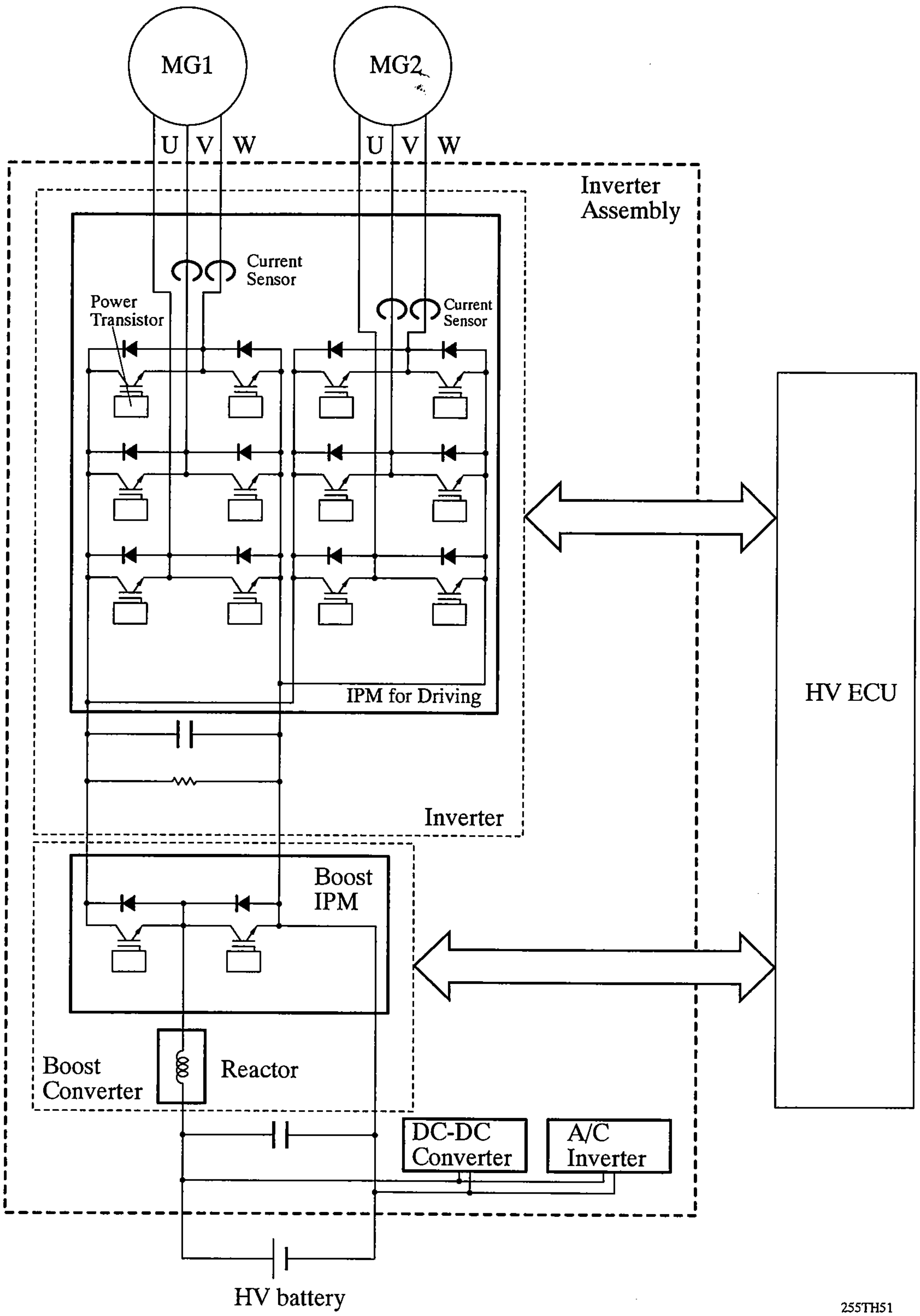
Item		'04 Model	'03 Model
Type		Permanent Magnet Motor	←
Function		Generate, Drive Wheels	←
Maximum Voltage	[V]	AC 500	AC 273.6
Maximum Output	kW (PS) / rpm	50 (68) / 1,200 ~ 1,540	33 (45) / 1,040 ~ 5,600
Maximum Torque	N·m (kgf·m) / rpm	400 (40.8) / 0 ~ 1,200	350 (35.7) / 0 ~ 400
Cooling system		Water-cooled	←

▶ System Diagram ◀



TH

▶ System Diagram ◀



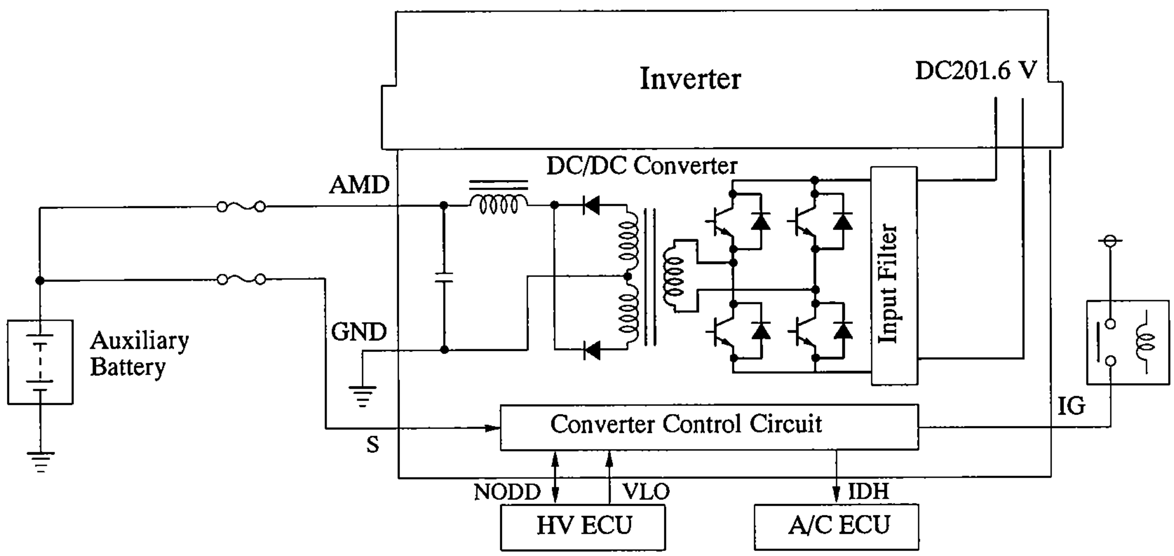
255TH51

TH

DC/DC Converter

The power source for auxiliary equipment of the vehicle such as the lights, audio system, and the air conditioning system (except A/C compressor), as well as the ECUs, is based on a DC 12 V system. Because the THS-II generator outputs at nominal voltage of DC 201.6 V, the converter is used to transform the voltage from DC 201.6 V to DC 12 V in order to recharge the auxiliary battery. The converter is installed on the underside of the inverter.

▶ System Diagram ◀

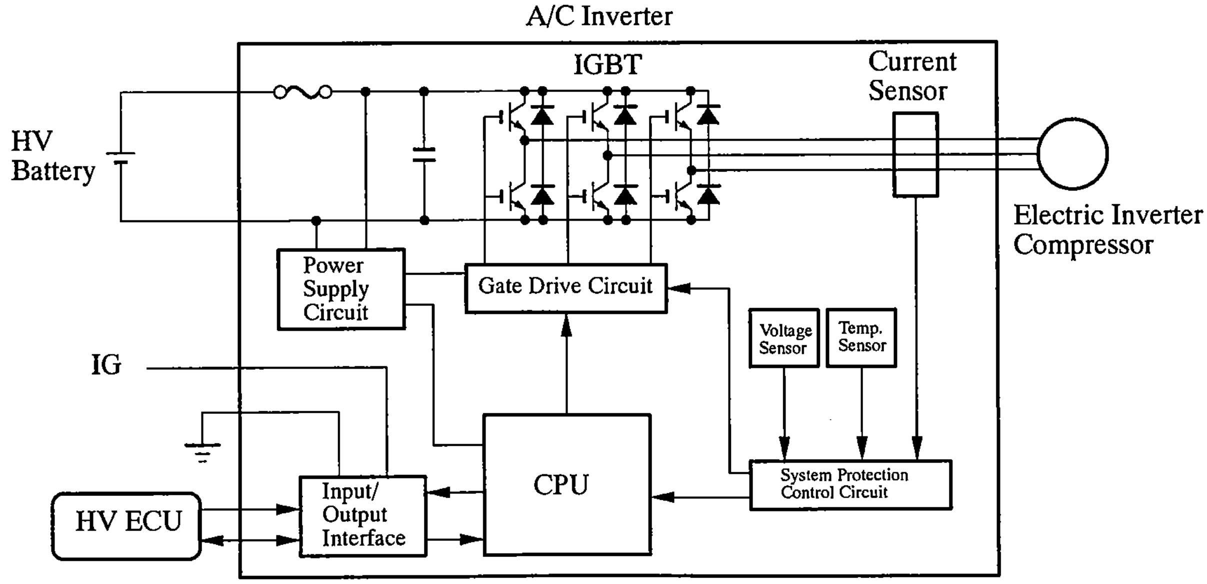


255TH92

A/C Inverter

An A/C inverter, which supplies power for driving the electric inverter compressor of the A/C system, has been included in the inverter assembly.
This inverter converts the HV battery's nominal voltage of DC 201.6 V into AC 201.6 V and supplies power to operate the compressor of the A/C system.

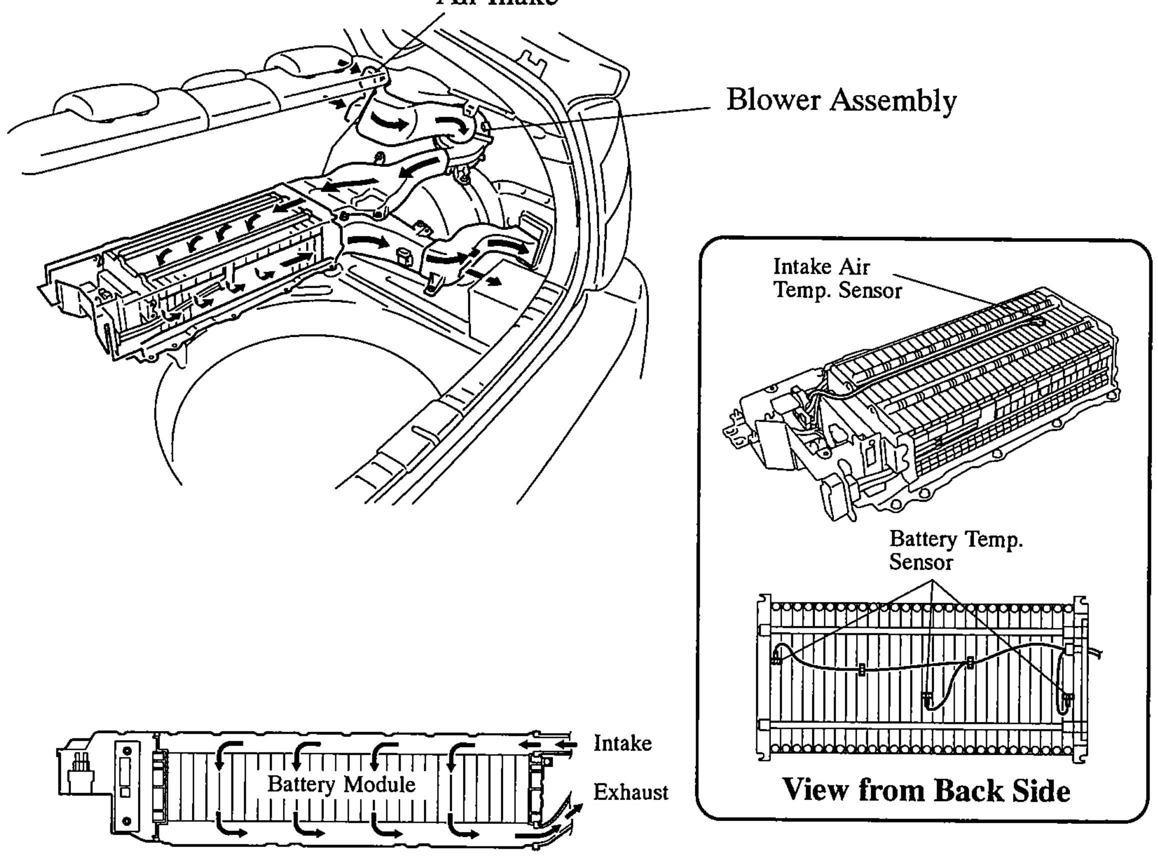
▶ System Diagram ◀



255TH93

HV Battery Cooling System

- To ensure the proper performance of the HV battery while it generates heat during the repetitive charge and discharge cycles, a dedicated cooling system for the HV battery has been adopted.
- A cooling fan is provided on the right side of the luggage compartment, in order to draw the cabin air by way of the air intake located at the right side of the rear seat. Thereafter, the intake air that has entered from the top right area of the battery flows between the battery modules from the top to the bottom to cool the battery modules. Then, the air flows through the exhaust duct and the cabin, in order to be discharged outside of the vehicle.
- The battery ECU controls the operation of the cooling fan. The battery ECU controls the temperature of the HV battery to an appropriate level in accordance with the signals provided by the three battery temperature sensors that are built into the HV battery, and one intake air temperature sensor. For details, refer to the Battery ECU Control on page TH-53.



View from Back Side

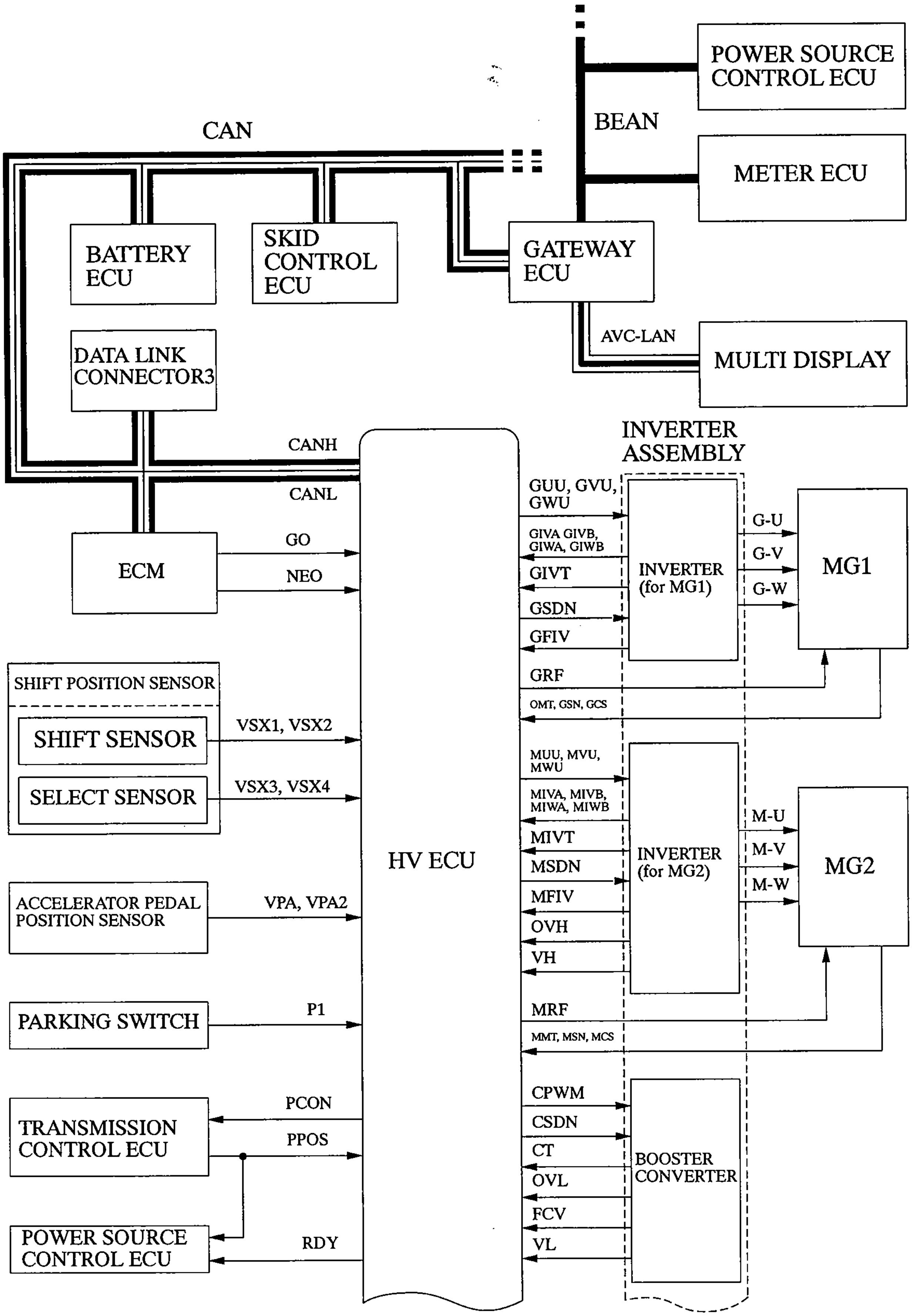
Cross Section of HV Battery

▶ Specifications ◀

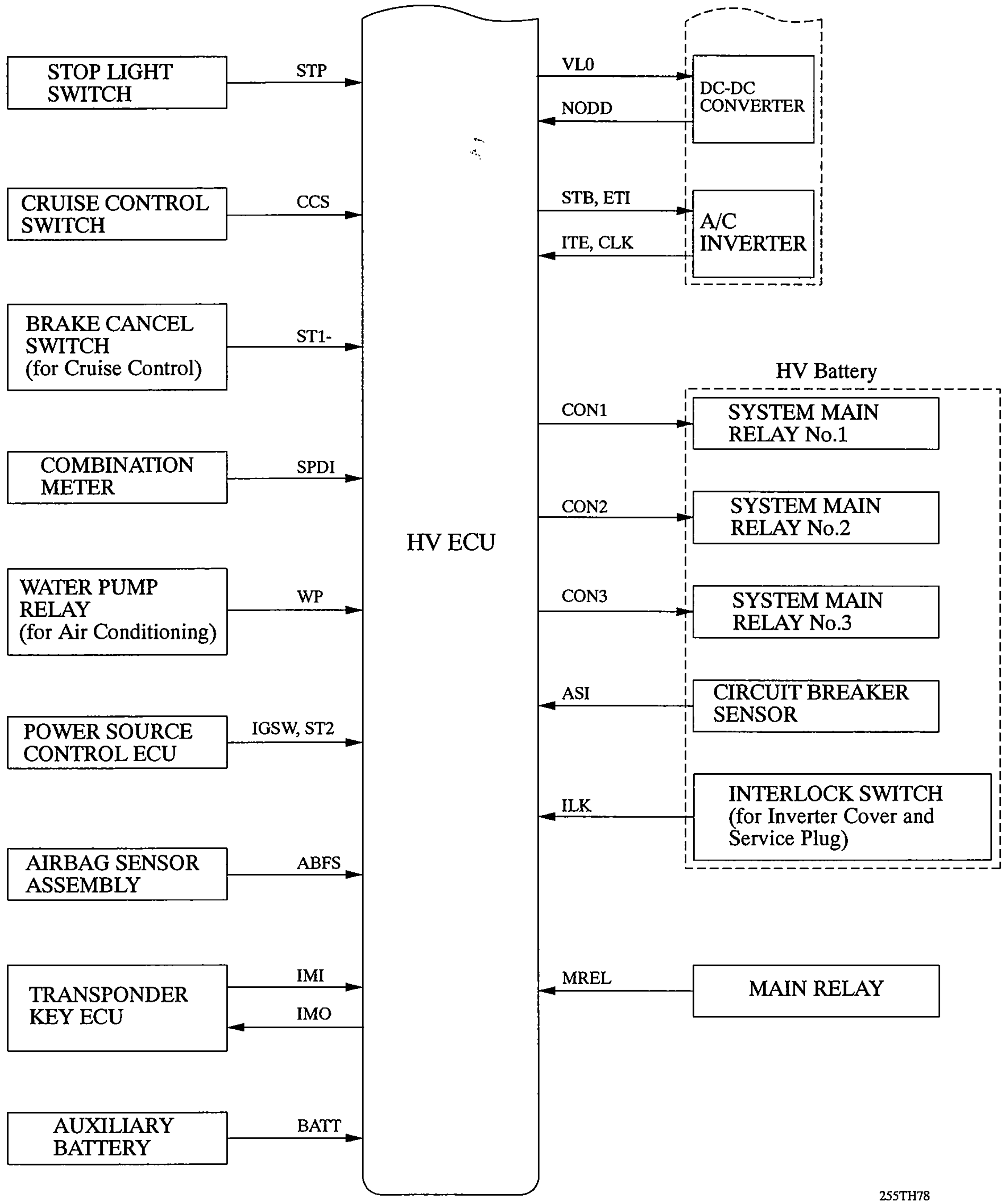
Model		'04 Prius		'03 Prius	
Type		Sirocco Fan		←	
Fan Size Dia. × H	mm (in.)	100 × 50 (4.0 × 2.0)		100 × 40 (4.0 × 1.6)	
Motor Type		DC Motor		←	
Air Flow Volume	m^3/h	Step-less Control		3-step Control	
		Min.	40	Lo	50
		Max.	150	Mid	100
				Hi	150
Power Consumption	W	50 or less		60	

2. Construction

The configuration of the THS-II control system in the '04 Prius is shown in the following chart.



255TH77


STOP LIGHT SWITCH
STP
CRUISE CONTROL SWITCH
CCS
BRAKE CANCEL SWITCH (for Cruise Control)
ST1-
COMBINATION METER
SPDI
WATER PUMP RELAY (for Air Conditioning)
WP
POWER SOURCE CONTROL ECU
IGSW, ST2
AIRBAG SENSOR ASSEMBLY
ABFS
TRANSPONDER KEY ECU
IMI
IMO
AUXILIARY BATTERY
BATT
HV ECU
VL0
NODD
DC-DC CONVERTER
STB, ETI
ITE, CLK
A/C INVERTER
HV Battery
CON1
SYSTEM MAIN RELAY No.1
CON2
SYSTEM MAIN RELAY No.2
CON3
SYSTEM MAIN RELAY No.3
ASI
CIRCUIT BREAKER SENSOR
ILK
INTERLOCK SWITCH (for Inverter Cover and Service Plug)
MREL
MAIN RELAY

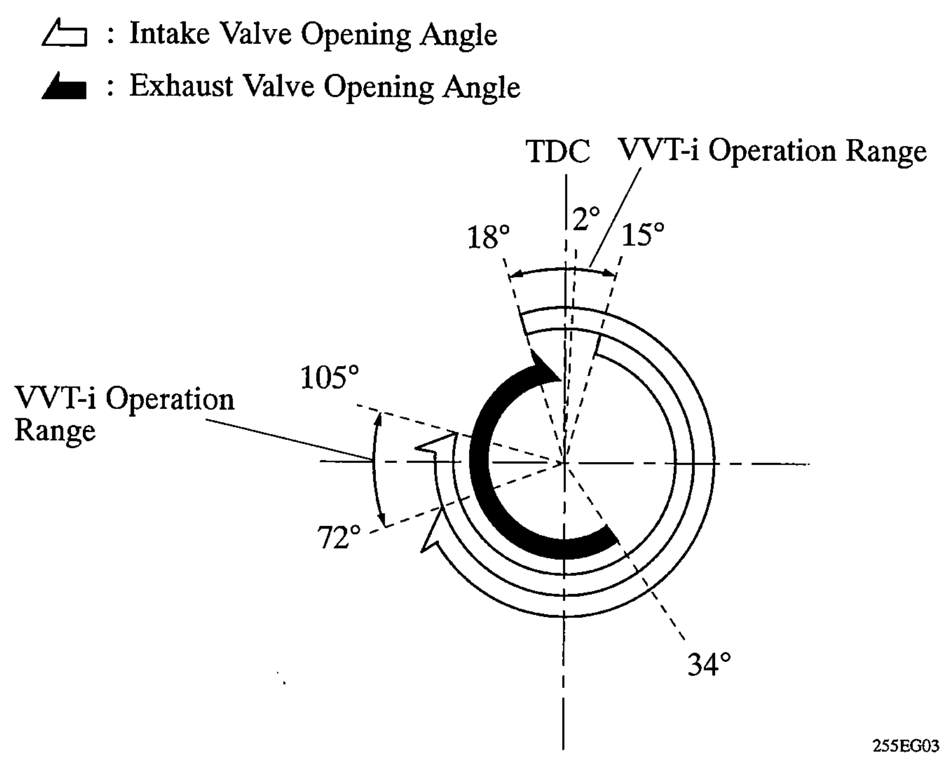
255TH78

▶ Engine Specifications ◀

Model			'04 Prius	'03 Prius
Engine Type			1NZ-FXE	←
No. of Cyls. & Arrangement			4-Cylinder, In-line	←
Valve Mechanism			16-Valve DOHC, Chain Drive (with VVT-i)	←
Combustion Chamber			Pentroof Type	←
Manifolds			Cross-Flow	←
Fuel System			SFI	←
Displacement cm³ (cu. in.)			1497 (91.3)	←
Bore × Stroke mm (in.)			75.0 × 84.7 (2.95 × 3.33)	←
Compression Ratio			13.0 : 1	←
Max. Output (SAE-NET)			57 kw @ 5000 rpm (76 HP @ 5000 rpm)	52 kw @ 4500 rpm (70 HP @ 4500 rpm)
Max. Torque (SAE-NET)			111 N·m @ 4200 rpm (82 ft·lbf @ 4200 rpm)	←
Valve Timing	Intake	Open	18° ~ –15° BTDC	18° ~ –25° BTDC
		Close	72° ~ 105° ABDC	72° ~ 115° ABDC
	Exhaust	Open	34° BBDC	←
		Close	2° ATDC	←
Firing Order			1-3-4-2	←
Research Octane Number			91 or higher	←
Octane Rating			87 or higher	←
Engine Service Mass* (Reference) kg (lb)			86.1 (189.8)	86.6 (190.9)
Oil Grade			API SJ, SL, EC or ILSAC	API SH, SJ, EC or ILSAC
Tailpipe Emission Regulation			SULEV	←
Evaporative Emission Regulation			AT-PZEV, ORVR	LEV-II, ORVR

*: Weight shows the figure with the oil and engine coolant fully filled.

▶ Valve Timing ◀



- SLLC is pre-mixed (50% coolant and 50% distilled water), so no dilution is needed when adding or replacing SLLC in the vehicle.
- If LLC is mixed with SLLC, the interval for LLC (every 25,000 miles / 40,000 km or 24 months) should be used.
- You can also apply the new maintenance interval (every 50,000 miles/ 80,000 km) to vehicles initially filled with LLC (red-colored), if you use SLLC (pink-colored) for the engine coolant change.

▶ Specifications ◀

Model			'04 Prius	'03 Prius
Engine Coolant	Capacity liters (US qts, Imp. qts)		8.6 (9.1, 7.6)	4.9 (5.2, 4.3)
	Type		TOYOTA Genuine Super Long Life Coolant (SLLC) or Equivalent	TOYOTA Genuine Long Life Coolant (LLC) or Equivalent
	Color		Pink	Red
	Maintenance Intervals	First Time	100,000 mile (160,000 km)	**U.S.A. Model:** Every 30,000 miles or 24 months whichever come first **Canada Model:** Every 32,000 km or 24 months whichever come first
		Subsequent	Every 50,000 mile (80,000 km)	
Thermostat	Opening Temperature °C (°F)		80 - 84 (176 - 183)	←

Service Tip

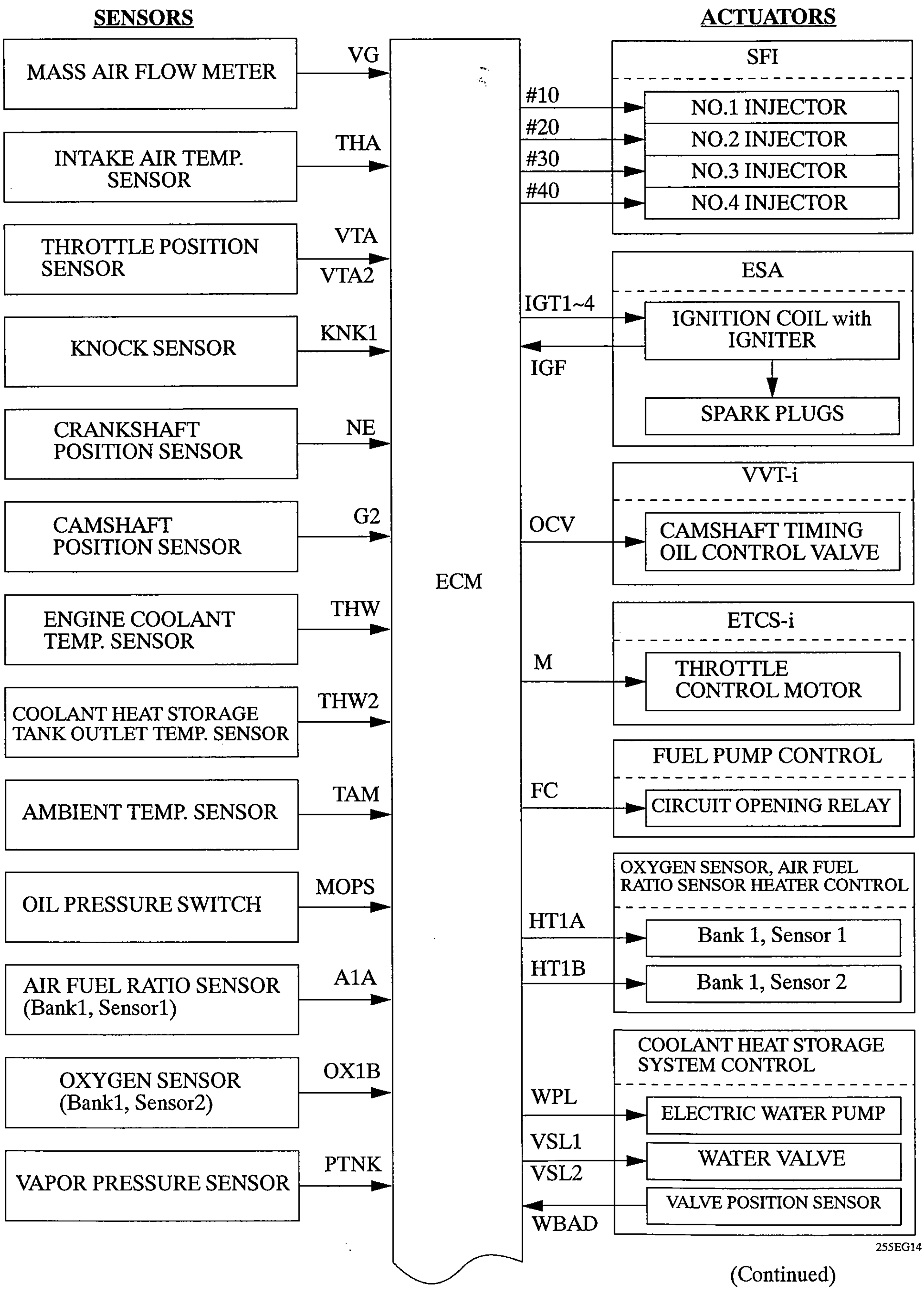
The engine coolant in the coolant heat storage tank is kept hot even if the engine and the radiator are cold. To verify the thermal insulation of the coolant heat storage tank and abnormality in the coolant heat storage water pump, the ECM may cause the coolant heat storage water pump to actuate even when the power switch is OFF (IG-OFF). Therefore, the user should never attempt to change the engine coolant. Because of the reason above, the engine coolant change method has been changed on the '04 Prius. An outline of the change as follow:

- Remove the coolant heat storage water pump connector prior to replacement, in order to prevent the pump from activating when draining the engine coolant.
- Drain the engine coolant from the coolant heat storage tank.
- When refilling engine coolant, operate the coolant heat storage water pump to help the inflow of the coolant into the coolant heat storage tank.
- Due to the aforementioned function of the ECM, the ECM may operate the coolant heat storage water pump while the engine coolant is being changed. If this occurs, the ECM will determine that a failure has occurred in the coolant heat storage system, it will record DTC P1151 or P2601 in its memory, and illuminate the MIL (Malfunction Indicator Lamp). However, this condition is not actual system fail. If the MIL has illuminated, make sure to delete the DTC after changing the engine coolant.

For detailed information of changing the engine coolant, refer to the 2004 Prius Repair Manual (Pub. No. RM1075U).

2. Construction

The configuration of the engine control system in the 1NZ-FXE engine is shown in the following chart.



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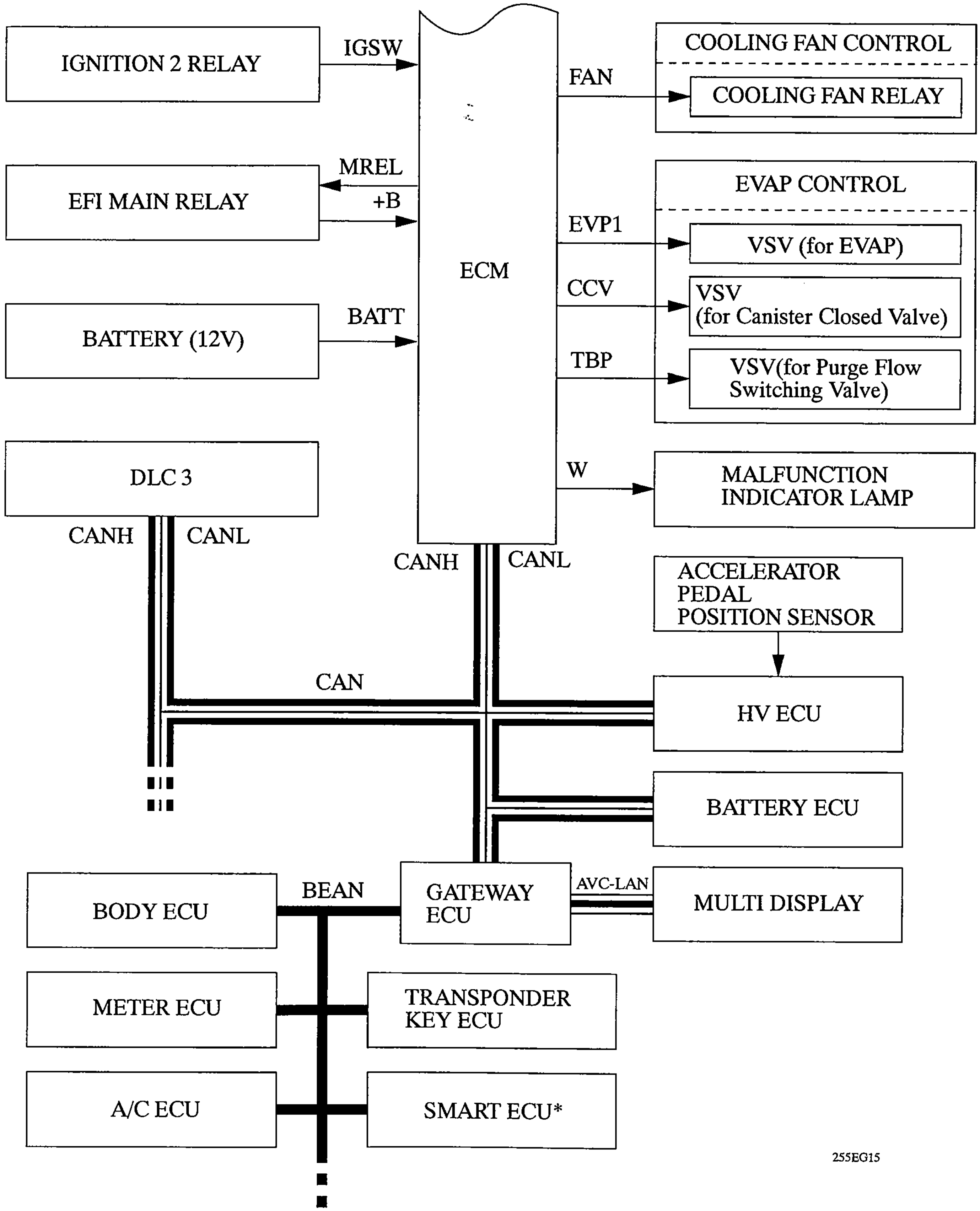


*: Models with Smart Entry & Start System

EG

5. Main Components of Engine Control System

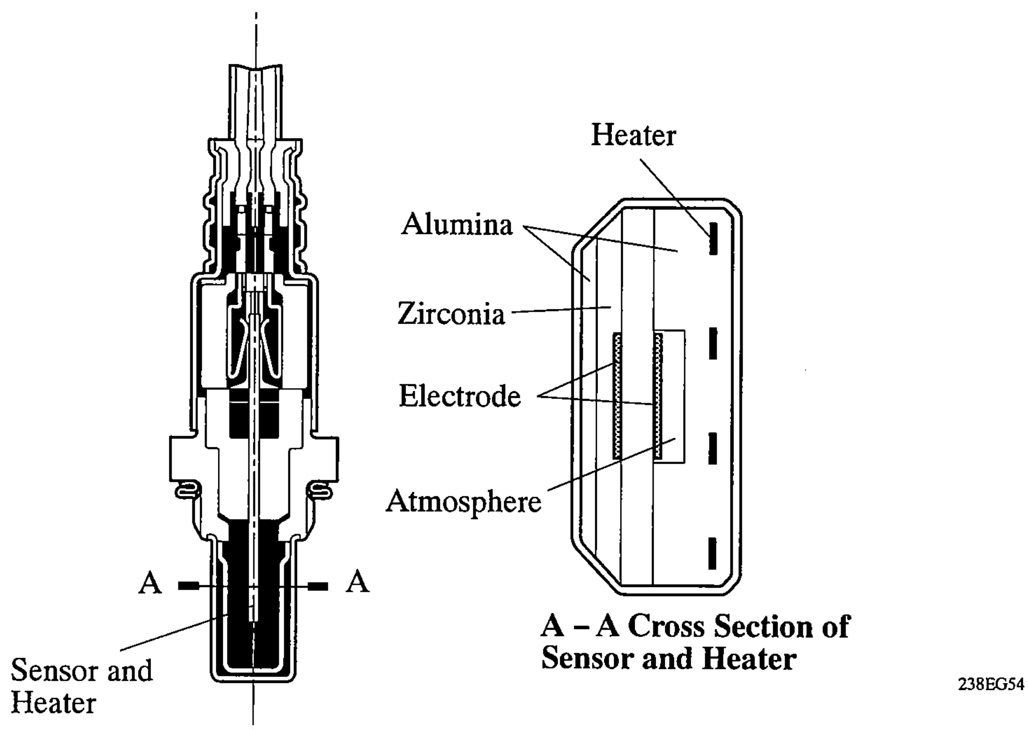
General

The following table compares the main components.

Components	'04 Prius		'03 Prius	
	Outline	Quantity	Outline	Quantity
ECM	32-bit CPU	1	16-bit CPU	1
Air Fuel Ratio Sensor	with Heater Type (Planar Type)	1	—	
Oxygen Sensor	with Heater Type (Cup Type)	1	with Heater Type (Cup Type)	2
Mass Air Flow Meter	Hot-wire Type	1	←	
Crankshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (36-2)	1	←	
Camshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (3)	2	←	
Knock Sensor	Built-in Piezoelectric Type (Flat Type)	1	Built-in Piezoelectric Type (Conventional Type)	1
Throttle Position Sensor	Linear Type	1	←	
Injector	12-Hole Type	4	←	

Air Fuel Ratio Sensor

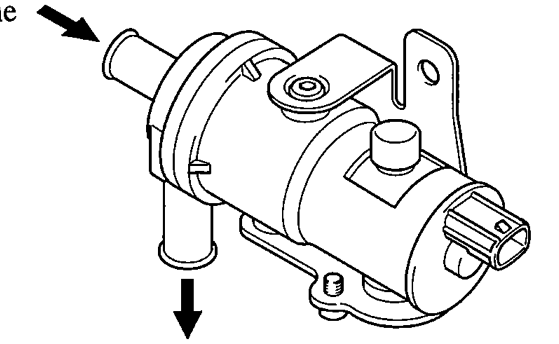
The air-fuel ratio sensor is the planar type. Compared to the conventional type (cup type), the sensor and heater portions of the planar type are narrower overall. Because the heat of the heater acts directly on the alumina and zirconia (of the sensor portion) it accelerates the activation of the sensor.



Air Fuel Ratio Sensor

2) Coolant Heat Storage Water Pump

- This water pump contains a DC brush motor that is driven with a 12V~14V power supply.
- The ECM actuates a relay to operate the water pump in order to supply the hot coolant from the coolant heat storage tank to the engine (pre-heat operation), and recover the hot coolant to be stored in the coolant heat storage tank while the vehicle is stopped (IG-OFF).



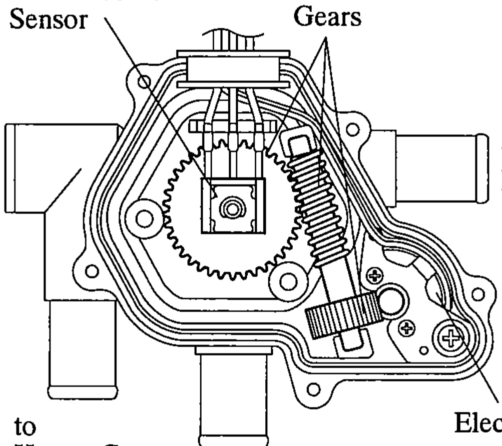
▶ **Specifications** ◀

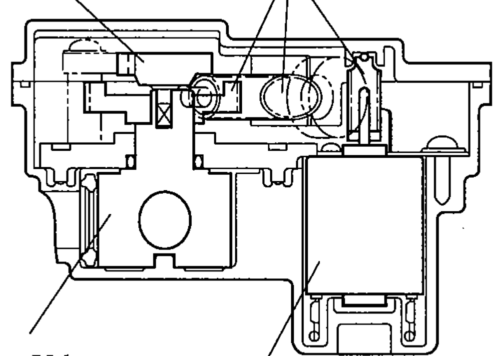
Pump Type		Centrifugal Pump
Motor Type		DC Brush Motor
Flow Volume	14 V	23.5L/min
	12 V	21.0L/min
Discharge Pressure	14 V	32 kPa (4.6 psi)
	12 V	25.5 kPa (3.7 psi)

3) Water Valve

a. General

- The water valve is located in the engine coolant passage between the engine, heater core, and the coolant heat storage tank. It switches the engine coolant passages when the position of the rotary valve, which is built into the water valve, is switched.
- The water valve consists of a rotary valve, valve position sensor, reduction gear, and an electric motor.
- This sensor, which is located above the rotary valve, outputs a voltage that corresponds to the rotation of the rotary valve to the ECM.



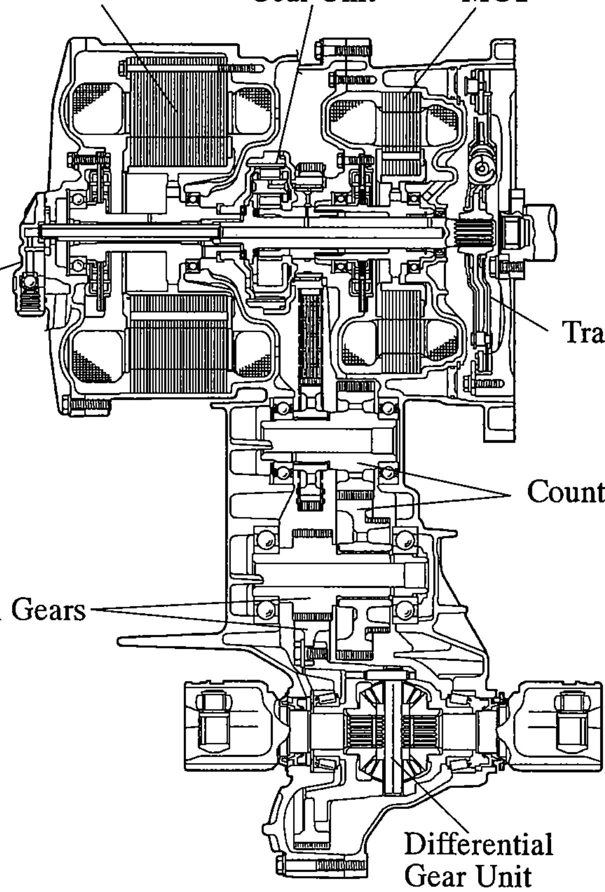


Cross Section

▶ Specifications ◀

Model		'04 Model	'03 Model
Transaxle Type		P112	P111
Planetary Gear	The No. of Ring Gear Teeth	78	←
	The No. of Pinion Gear Teeth	23	←
	The No. of Sun Gear Teeth	30	←
Differential Gear Ratio		4.113	3.905
Chain	The NO. of Links	72	74
	The NO. of Drive Sprocket Teeth	36	39
	The NO. of Driven Sprocket Teeth	35	36
Counter Gear	The NO. of Drive Gear Teeth	30	←
	The NO. of Driven Gear Teeth	44	←
Final Gear	The NO. of Drive Gear Teeth	26	←
	The NO. of Driven Gear Teeth	75	←
Fluid Capacity	Liters (US qts, Imp.qts)	3.8 (4.0, 3.3)	4.6 (4.9, 4.0)
Fluid Type		ATF WS or equivalent	ATF Type T-IV or equivalent
Weight (Reference)*	kg (lb)	107 (236)	—

* : Weight shows the figure with the fluid fully filled.



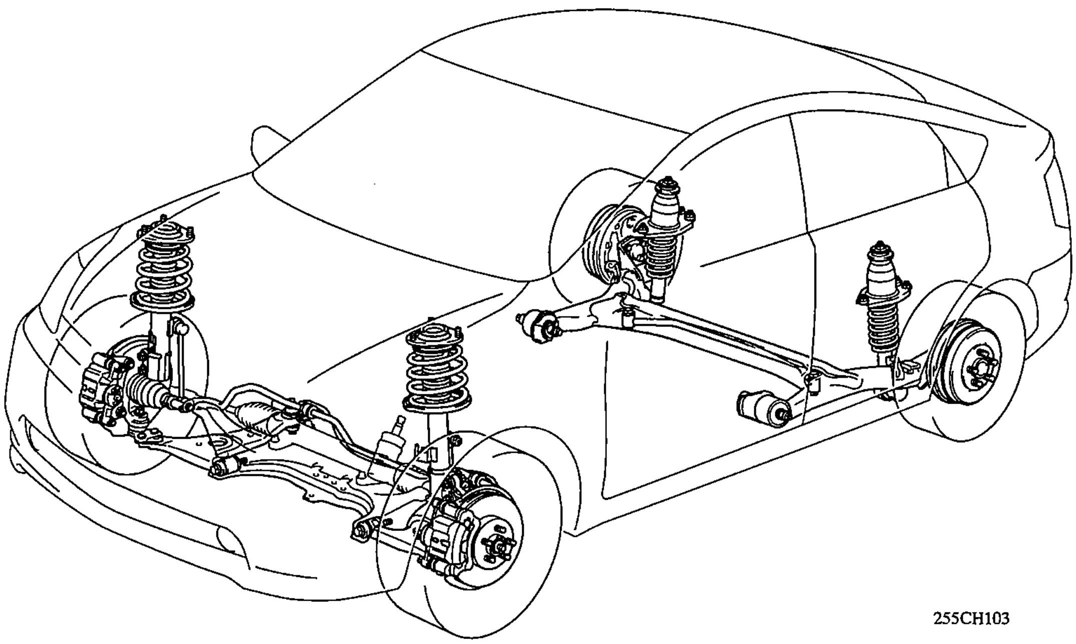
CH

SUSPENSION AND AXLE

■ SUSPENSION

1. General

- A MacPherson strut type independent suspension with L-shaped lower arms is used for the front.
- A torsion beam type suspension is used for the rear. In contrast to the toe-control link type used on the '03 Prius, the rear suspension of the '04 Prius has been changed to a toe-correction bushing type.



255CH103

▶ **Specifications** ◀

Model			'04 Prius	'03 Prius
Front Wheel Alignment	Type		MacPherson Strut	←
	Tread*	mm (in.)	1505 (59.3)	1480 (58.3)
	Caster*	degrees	3° 10'	1° 02'
	Camber*	degrees	– 0° 35'	– 1° 26'
	Toe-in*	mm (in.)	0 (0.00)	1 (0.04)
	King Pin Inclination*	degrees	12° 35'	9° 52'
Rear Wheel Alignment	Type		Torsion Beam	←
	Tread*	mm (in.)	1480 (58.3)	1478 (58.2)
	Camber*	degrees	– 1° 30'	←
	Toe-in*	mm (in.)	3 (0.12)	1 (0.04)

*: Unloaded Vehicle Condition

BRAKE

■ DESCRIPTION

1. General

The ’04 Prius has a brake system with the following specifications:

Model		’04 Prius	’03 Prius
Front Brake	Type	Ventilated Disk	←
	Rotor Size	For 14 in. wheel	←
Rear Brake	Type	Leading Trailing Drum	←
	Drum Inner Diameter mm (in.)	200 (7.87)	←
Regenerative Brake Cooperative Control & ABS with EBD & Brake Assist		Standard	—
Regenerative Brake Cooperative Control & ABS with EBD & Brake Assist & Enhanced VSC		Option	—
Regenerative Brake Cooperative Control & ABS with EBD		—	Standard
Parking Brake Lever Type		Pedal	←

▶ Specifications ◀

Model		’04 Prius	’03 Prius
Master Cylinder	Type	Single	←
	Diameter mm (in.)	19.05 (0.75)	22.22 (0.78)
Brake Booster	Type	—	Hydraulic
Front Disk Brake	Caliper Type	PE54C	PE54C
	Wheel Cylinder Diameter mm (in.)	54.0 (2.13)	←
	Rotor Size (D × T) mm (in.)	255 × 22 (10.04 × 0.87)	←
	Pad Material	PS558H-FF	PN540H-FG
Rear Drum Brake	Wheel Cylinder Diameter mm (in.)	19.05 (0.75)	20.64 (0.81)
	Drum Inner Diameter mm (in.)	200 (7.87)	←
	Lining Material	LN521-FF	LA509-EE
Parking Brake	Type	Leading Trailing Drum	←
	Drum Inner Diameter mm (in.)	200 (7.87)	←
	Lever Type	Pedal	←

▶ **Performance** ◀

Model			'04 Prius	'03 Prius
Heater	Heat Output	W	5300	←
	Air Flow Volume	m^3/h	330	←
	Power Consumption	W	170	←
PTC Heater (Heater Core Integrated)	Heat Output	W	330 (165 × 2)	←
PTC Heater (in the air duct at the footwell outlet)	Heat Output	W	165 × 2	←
Air Conditioning	Cooling Capacity	W	4500*	4200
	Air Flow Volume	m^3/h	450	←
	Power Consumption	W	200	←

*: When the Electric Inverter Compressor revolves at its maximum speed.

▶ **Specifications** ◀

Model				'04 Prius	'03 Prius
Ventilation and Heater Core	Heater Core	Type		Straight Flow (Full-path Flow)	←
		Size W × H × L	mm (in.)	216.9 × 140 × 27 (8.5 × 5.5 × 1.1)	←
		Fin Pitch	mm (in.)	1.8 (0.07)	←
	Blower	Motor Type		S70F-13T	←
		Fan Type		Shroud Fan	←
		Fan Size Dia. × H	mm (in.)	132 × 41 (5.2 × 1.6) 150 × 36 (5.9 × 1.4)	←
Air Conditioning	Condenser	Type		Multi Flow-IV (Sub-cool)	Multi Flow-III (Sub-cool)
		Size W × H × L	mm (in.)	600 × 351 × 16 (23.6 × 13.8 × 0.6)	600 × 349.8 × 37.5 (23.6 × 13.8 × 1.5)
		Fin Pitch	mm (in.)	2.75 (0.11)	2.8 (0.11)
	Evaporator	Type		Revolutionary Slim Structure	Multi-tank, Super-slim Structure
		Size W × H × L	mm (in.)	252.9 × 215 × 38 (10 × 8.5 × 1.5)	253.2 × 215 × 58 (10 × 8.5 × 2.3)
		Fin Pitch	mm (in.)	3.0 (0.12)	3.5 (0.14)
	Compressor	Type		ES18	SCS06
		Compressor Oil Type		ND11	ND8
	Refrigerant	Type		HFC134a (R134a)	←
		Volume	g	450	500