FOREWORD

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

Applicable models: NHW11 series

This manual is divided into 4 sections.

1. **Introduction –** Exterior appearance and model code.
2. **New Model Outline –** Explanation of the product to give a general understanding of its features.
3. **Technical Description –** Technical explanation of the construction and operation of each new system and component.
4. **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 to people may occur if instructions on what to do or not do are ignored.
NOTICE	Damage to the vehicle or components may occur if instructions on what to do or not do 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.
• 2001 PRIUS Repair Manual	RM778U
• 2001 PRIUS Electrical Wiring Diagram	EWD414U

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

First Printing: Apr. 5, 2000 01-000405-00

EXTERIOR APPEARANCE

182IN01

182IN02

MODEL CODE AND MODEL LINE-UP

MODEL CODE

NHW11	L	–	A	E	E	E	B	A
1	2		3	4	5	6	7	8

1	**BASIC MODEL CODE**
	NHW11: With 1NZ-FXE Engine

2	**STEERING WHEEL POSITION**
	L: Left-Hand Drive

3	**MODEL NAME**
	A: Prius

4	**BODY TYPE**
	E: 4-Door Sedan

5	**GEAR SHIFT TYPE**
	E: Automatic, Column

6	**GRADE**
	E: Standard

7	**ENGINE SPECIFICATION**
	B: Atkinson

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

MODEL LINE-UP

DESTINATION	ENGINE	BODY TYPE	GRADE	TRANSAXLE
				Automatic
				P111
U.S.A.	1NZ-FXE	Sedan	Standard	NHW11L-AEEEBA
Canada				NHW11L-AEEEBK

– MEMO –

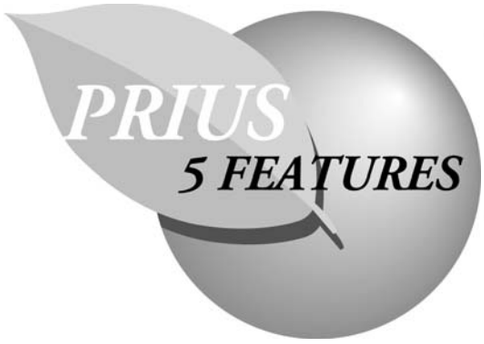
CONCEPT

Introducing the Prius – the car that is friendly to both the earth and to people! ... and announcing of a new feel of future worth.

When we consider the future of the earth, this car was deemed to become a necessary part of it.
A car that is unbelievably friendly and comfortable while still maintaining a high degree of practicality...
The answer to this is the car we would like to present to you here – the Prius.
A streamlined and artistic exterior design combined with a safety features that would make anyone feel at ease.
What's more, through selecting the TOYOTA hybrid system which effectively utilizes 2 power sources – electricity and gasoline – we have been able to achieve world top-class level fuel economy and low emissions.
TOYOTA is proud to present the "Hybrid Car Prius" as a car that is ideal for now and well into the future as well.
The Prius leads the way in the showing direction that cars must go in the 21st century.

182IN01

Prius – a 4-door compact sedan
5 Features to lead the way into the next generation



POINT1 Exterior

Futuristic image and symmetry are reflected in the artistic design of the new Prius.

POINT2 Interior

An interior which reflects the type of comfort that will be regarded as a must in cars hereinafter.

POINT3 Main Mechanism

Low-emission & high-fuel efficiency.
TOYOTA hybrid system leading the way into the next generation.

POINT4 Main Equipment

A range of features for comfort - the more you use them, the better it gets.

POINT5 Safety

Prius - one step ahead of the rest even in the area of safety.
Drive with the utmost peace of mind.

EXTERIOR

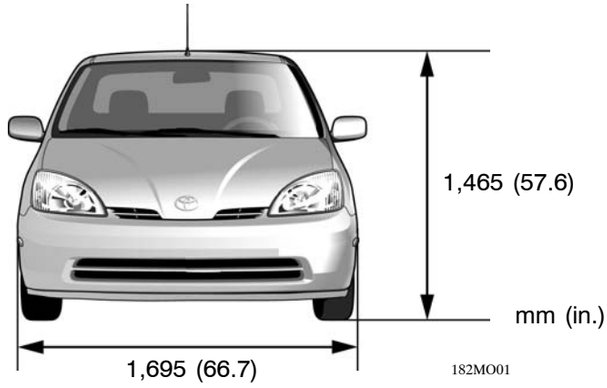
Futuristic image and symmetry are reflected in the artistic design of the new Prius.

Front Design

A short slanted hood highlights the singular front design.

- The defined character lines from the front fender curving around to the rear give off a fresh appeal.
- Crystal-look front combination lamps and compact grille finish off the masked look.

182IN01



182MO01

Rear Design

The simple rear design gives out an impression of stability.

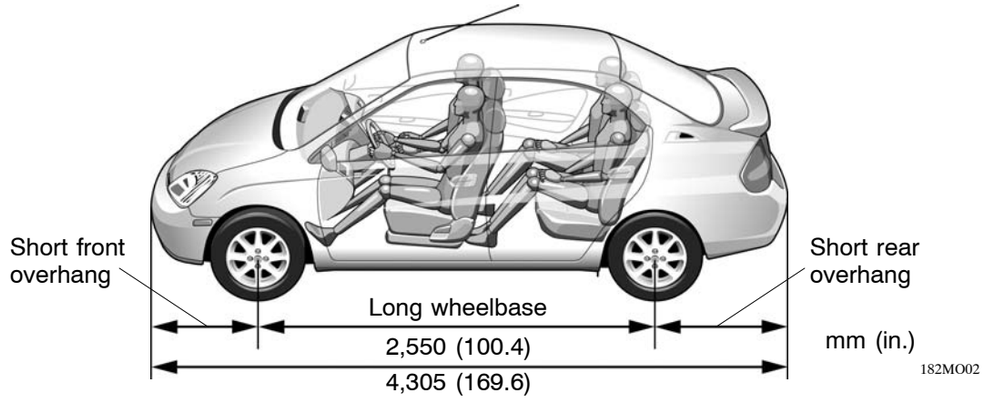
- Three-dimensional panel make-up produces a perfect balance in its feeling of presence and stability for the rear view.
- The rear combination lamps extend around to the sides, giving emphasis to the wide image.

182IN02

Side Design

A mono-form silhouette is the basis of the ultra modern side view.

- The short overhang adopted reflects the consideration given to minimize the turning radius. And the long wheelbase brings better riding comfort and spacious cabin.



Aerodynamics

The upper body profile provides smooth airflow through the free use of computer simulation. Furthermore, the front tire fairing, rear tire fairing, rear spoiler and flat under-body, among others achieve an excellent drag coefficient of CD = 0.29.

Disc Wheel

Aluminum wheels are fitted standard on all models.

Size	Design
P175/65 R14 5 1/2JJ	 182MO04

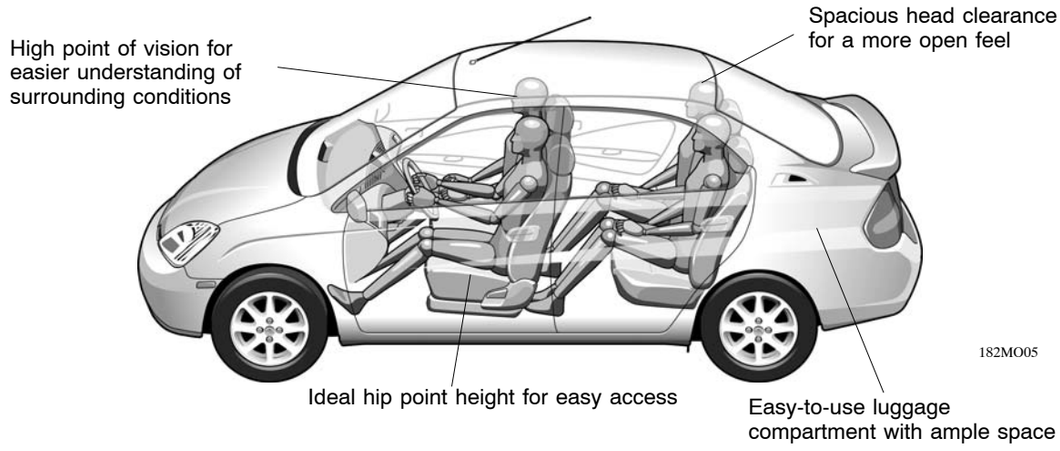
INTERIOR

An interior which reflects the type of comfort that will be regarded as a must in cars hereinafter.

Package

The Prius package gives highest priority to driver and passenger comfort.

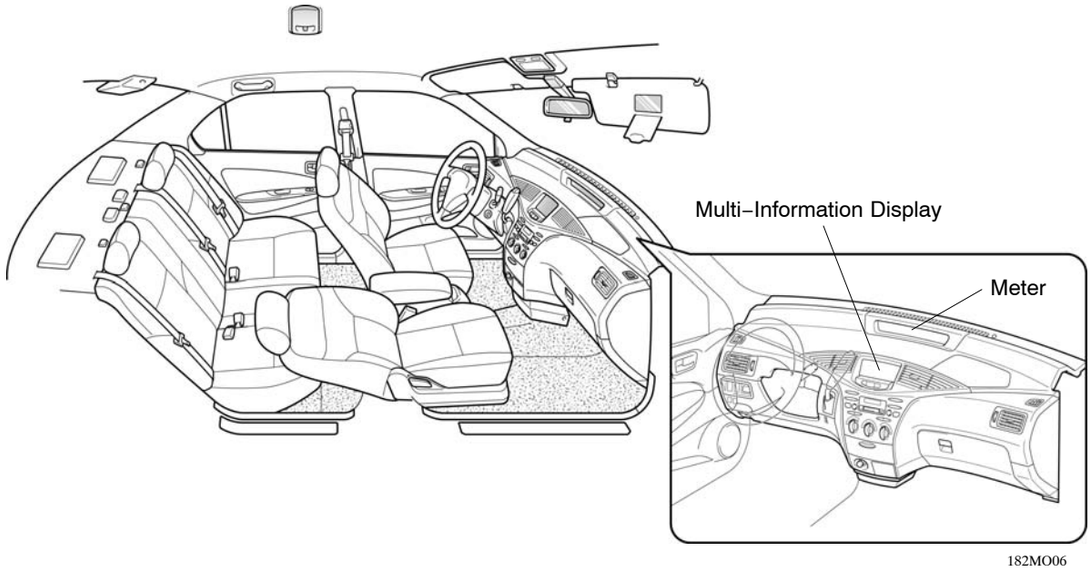
- A spacious cab that is hard to imagine in a car of this size.
- Spacious head clearance for a more open feel.
- Ideal seat height for easy access.
- An easy-to-use luggage compartment with ample space.



Instrument Panel

The instrument panel is a balanced combination of functionality and symmetry.

- Human-engineered layout perfectly suited to the new age, with centrally positioned operational functions.



Meter

A digital-display combination meter is located in the uppermost, center position of the instrument panel. This ensures ease of visual confirmation, including that of all indicators.

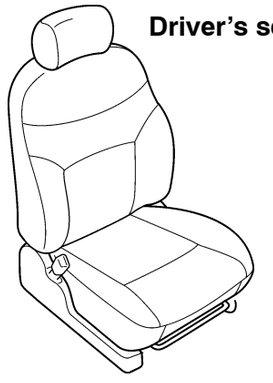
(For U.S.A.)

182MO07

Seat

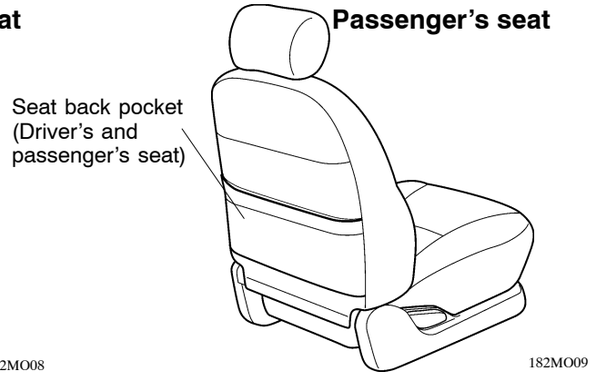
[Front Seat]

- The pads fitted on the side of the seatback are of a different degrees of hardness, ensuring a superior hold.
- A seatback pocket has been included on the front seat providing additional and convenient storage space.



Driver's seat

182MO08

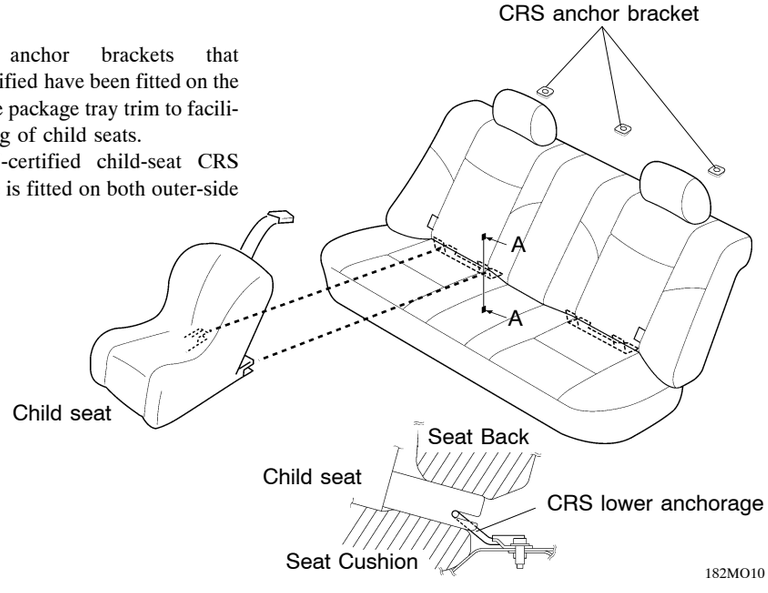


Passenger's seat

182MO09

[Rear Seat]

- Three CRS anchor brackets that FMVSS225-certified have been fitted on the top section of the package tray trim to facilitate the mounting of child seats.
- An FMVSS225-certified child-seat CRS lower anchorage is fitted on both outer-side seats.



182MO10

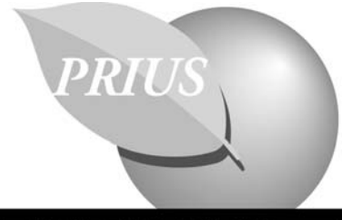
A – A Cross Section

MAIN MECHANISM

Low-emission & high-fuel efficiency. TOYOTA hybrid system leading the way into the next generation.

Tackling the challenge for high fuel efficiency and low emissions

Prius - the mass-production gasoline hybrid vehicle - already meets all of the various strict emission levels being proposed throughout the world, well ahead of the competition. What's more, through the use of the hybrid system, surpassing fuel efficiency and a massive reduction in CO_2 has become a reality. The Prius can truly be acclaimed as "the clean and environmentally friendly vehicle."



PRIUS achieved SULEV (California) for exhaust emissions.

Emission Reduction Features

1. Precision Emission Control

Through full utilization of the two Oxygen sensors, precision emission control is made possible even when the engine is frequently stopped and re–started. Furthermore, excellent purification of exhaust gas is ensured through the catalytic converter, resulting in reduced emissions.

2. Vapor Reducing Fuel Tank System

We have developed a new fuel tank system that can dramatically reduce the amount of fuel vapor generated in the tank both when the vehicle is moving as well as when it is at a standstill. This system is the first one in the world to be used.

3. TOYOTA HC Adsorber and Catalyst System

A new system has been adopted which adsorbs the HC that is emmitted between the time the engine is cold-started and the catalytic converter is still cool and not yet activated, until the time the catalytic converter becomes active.
After the catalytic converter has been activated, the HC disassociates little by little and is then purified.

4. Adoption of a Thin-walled High-density Cell Catalytic Converter

In order to reduce the amount of time taken until the catalytic converter is activated, we developed a catalytic chamber with a super thin ceramic wall. Also, high-density cells have been utilized as a measure to improve strength and increase contact area with exhaust gas. Through these measures we have been able to achieve a balance of reliability and purification efficiency.

TOYOTA Hybrid System (THS)

The TOYOTA hybrid system has two drive sources, one is the gasoline engine and the other, the AC motor. The power train system selects the best combination of the different characteristics of both depending on driving conditions. Also, through the adoption of a regenerative braking system, which recovers energy during deceleration and "idling stop" whereby the engine is stopped during idling, we have been able to provide for maximum energy conservation. This has resulted in a vastly superior fuel economy compared with that of gasoline A/T vehicles of the same displacement.

Gasoline engine + AC motor = TOYOTA Hybrid System (THS)

Tremendous improvement in fuel efficiency & clean achieved!

Features of the System

1. Optimum distribution of drive sources

The most efficient engine operating zone is automatically selected by controlling the optimum distribution of the engine and motor drive energy sources.

2. Reduced energy loss

The engine is automatically stopped when starting and travelling at low load to reduce fuel consumption.*1
The kinetic energy that used to be lost through engine or foot braking is recovered by the regenerative braking system and used for recharging, thereby contributing to improved fuel efficiency. When the driver applies the brakes, the hydraulic and regenerative braking systems are coordinated. In order to recover more energy, a higher proportion of regenerative braking is used.

3. Not required for recharging from an external source

The system uses MG1 (Motor Generator No.1) and MG2 (Motor Generator No.2) to maintain a constant battery charge, so unlike an electric vehicle, recharging from an external source is not required.

*1 : In some cases, the engine does not stop, depending on the air conditioner and HV battery (Hybrid Vehicle Battery) status.

System configuration

◆P111 HYBRID TRANSAXLE

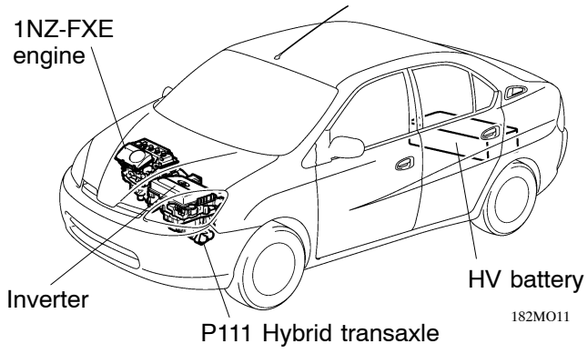
Fitted with built-in THS transaxle MG1 (Motor Generator No.1), MG2 (Motor Generator No.2), power spliting device and reduction gears for the hybrid system. These function to switch engine operation to MG2 assistance, HV battery charging and power generation for driving MG2.

◆Inverter

This controls the current between MG1, MG2 and HV battery and converts DC/AC power.

◆HV Battery (Hybrid Vehicle Battery)

This supplies power to the motor at full load or on engine stopping and stores power recovered by regenerative braking or power generation by MG1. 228 nickel-metal hydride batteries are connected in series to obtain a voltage of 273.6 V DC.



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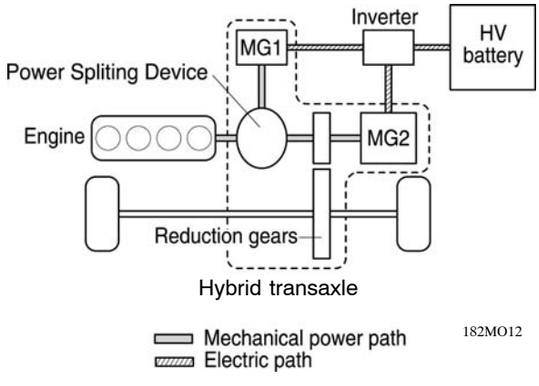


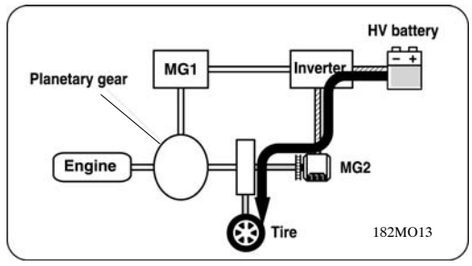
182MO12

MAIN MECHANISM

THS operation

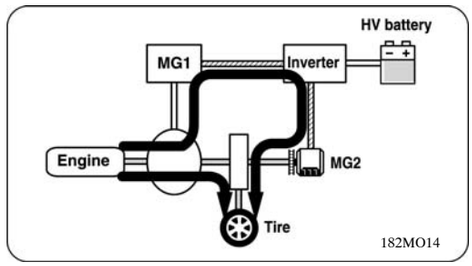
Starting and traveling at low load

When the engine efficiency is low such as when starting, traveling at low load or the engine is stopped, permitting travel by MG2; (however the engine may start under SOC (State Of Charge) of the HV battery.)



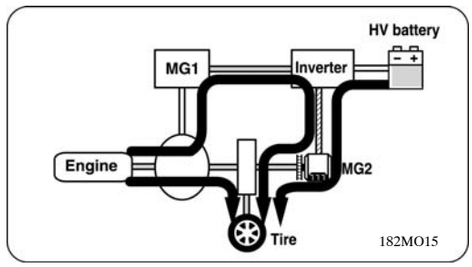
Normal traveling

The engine energy is divided into two. One portion directly drives the wheels. The other portion drives MG1 to drive MG2 by generated power, which also drives the wheels.



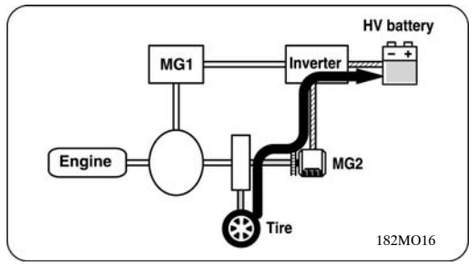
Full acceleration

In addition to the 2-way system for normal travelling, the drive power of MG2 is further supplemented by the power stored in the HV battery, resulting in powerful and smooth acceleration.



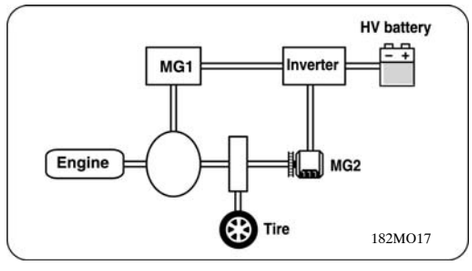
Deceleration or braking

The wheels drive MG2 which acts as the generator for regenerative power generation. The power recovered by generation is stored in the HV battery.



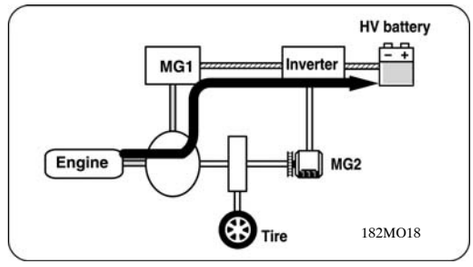
Stopped

When the vehicle is stopped, the engine stops automatically. However, when it is necessary to charge the HV battery or to run the air conditioner compressor, the engine will not stop.

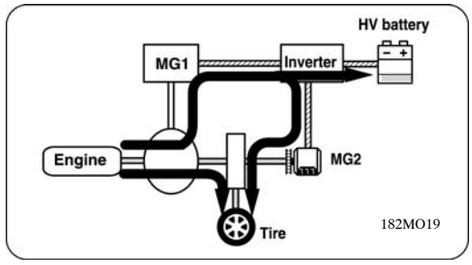


HV Battery Charging

When high load operation is continued, the engine does not stop to charge the HV battery even if the vehicle is stopped, in order to keep the HV battery charged to a given level. (when "READY" light is ON.);however, the engine does not charge the HV battery when the lever is shifted into the "N" position.



The engine speed may also be increased during normal traveling in order to charge the HV battery.



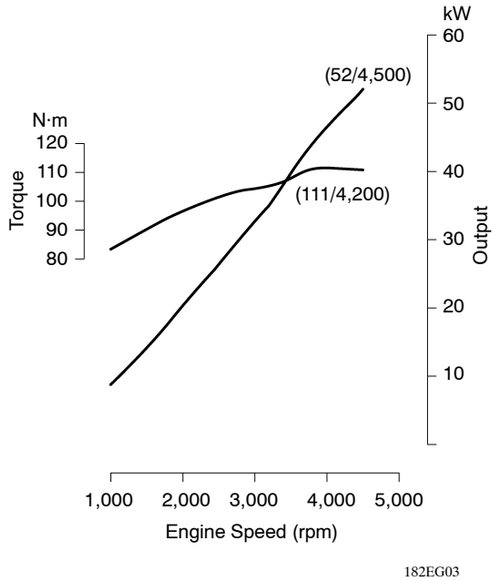
1NZ-FXE Engine

The new Prius is fitted with a 1.5 ℓ gasoline engine which has been developed for the use with the TOYOTA hybrid system. A mass of leading-edge technology has been implemented to achieve excellent fuel economy, low emissions, light weight, compactness, and low vibration and noise.

Outline of the 1NZ-FXE Engine

	1NZ-FXE
Displacement (mℓ)	1,497
Type	DOHC 4 valves
Bore × Stroke (mm)	75.0 × 84.7
Compression ratio	13.0
Maximum output [kW (HP)/rpm]	52 (70)/4,500
Maximum torque [N·m (lb·ft)/rpm]	111 (82)/4,200
Fuel	Gasoline

Engine performance curve



MAIN MECHANISM

4 Features of the 1NZ-FXE engine

1. Highly efficient and high expansion ratio gasoline engine

Adoption of a super fuel-efficient engine developed for use with THS. Its high expansion ratio cycle is achieved by applying the Atkinson cycle*1 which obtains high thermal efficiency.

2. Reduction in frictional loss

The maximum engine speed is set at 4,500 rpm to reduce frictional resistance, thereby producing a highly efficient low-speed engine.

- An offset crankshaft with 12 mm deviation from the center axis of the cylinder bore is utilized to reduce frictional resistance of the piston.
- Frictional resistance is reduced through the use of low tension valve springs and piston rings.
- Lightweight design has been adopted for reciprocating engine parts.

The above measures for reducing frictional loss contribute to improved fuel economy.

3. VVT-i (Variable Valve Timing -intelligent)

The timing of the opening and closing of the intake valves is controlled by the computer according to driving conditions, such as engine speed and level of acceleration. Thus, smooth intake and exhaust are achieved to greatly improve torque in the low and medium speed zones. This also contributes to better fuel economy and purification of exhaust gas. Then the VVT-i function is used to reduce vibration when the engine starts.

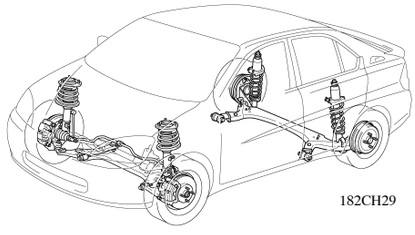
4. Compact, lightweight, and low emission

Adoption of an aluminum cylinder block and compact design of parts. And, by positioning the catalytic converter near the engine for a backwards exhaust layout, we have been able to reduce emissions when the engine is cold started.

*1 : Atkinson Cycle: Proposed by an English engineer named James Atkinson, this thermal cycle enables the compression stroke and the expansion stroke of the mechanism to be set independently of each other.

Suspension

MacPherson strut type suspension with L-shape lower arms has been adopted in the front and torsion beam with toe control link suspension in the rear. Also, each component part is optimally located and tuned for both excellent controllability and enhanced riding comfort.



182CH29

EMPS (Electric Motor-assisted Power Steering) System

Vehicle speed sensing type electric motor-assisted power steering is fitted as standard. Unlike conventional hydraulic power steering, EMPS does not depend on an engine for its power source, providing a steering feel in no way inferior to conventional steering when the engine has stopped. Thus it is suitable for the HV system. Other merits include improved fuel economy through energy conservation, lighter weight, and no need to fill the power steering fluid.

MAIN EQUIPMENT

A range of features for comfort - the more you use them, the better they get.

Multi-Information Display

- The 5.8” wide touch panel type multi-information color LCD is standard.
- Energy monitor, fuel consumption and other vehicle information screens, audio operation status and audio operation screen can be indicated on the multi-information display. The outside temperature are also indicated on the screen.

[Audio system]

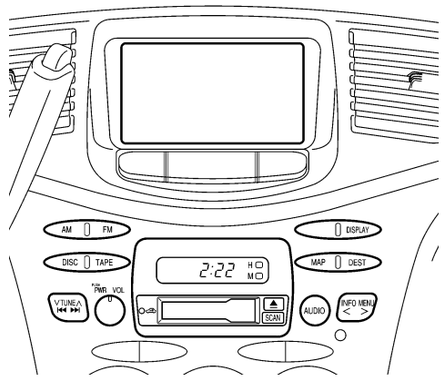
- An AM/FM cassette and 4-speaker system compatible with the multi-information display has been adopted.
- As the touch panel type display is used to operate the audio system, the multi-information display simultaneously indicates the operating status of the audio system.
- The antenna provided is a collapsible style pole antenna positioned at the center of the roof.

[GPS Voice Navigation]

- A GPS (Global Positioning System) voice navigation system is optional.
- The multi-information display can show the map on favorite type among turn list, arrow display and enlarged intersection.
- Using DVD (Digital Versatile Disk) as a memory source for map data, a large quantity of information can be processed.

• Main Function of the Multi-information Display

Screen	Function
Map screen display (option)	Enlargement / reduction, rotation and movement of map
	Indication of current position and direction of travel
	Correction of current position
	Setting, change and indication of route
	Voice guidance
	Indication of enlarged intersections
	Memory and indication of map position
Audio screen	Status of audio equipment and audio operation screen indication
Information screen	Energy monitor screen indication
	Fuel consumption screen indication
Adjustment screen	Sound quality adjustment screen indication
	Image quality adjustment screen indication
	No indication
On-screen indication	Audio status indication
	Warning indication
Interrupt screen	Warning indication
Diagnosis screen display	Displays system diagnosis
	Displays various types of coefficient settings

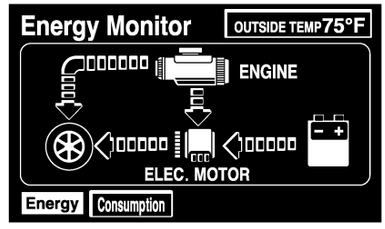


182MO20

[Information Screen]

<Energy monitoring screen>

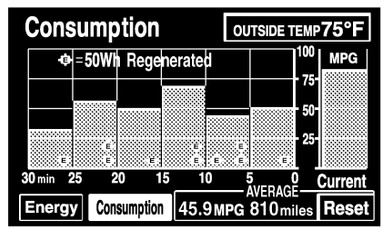
This screen indicates the direction of energy transmission. It is also possible to check the current drive method (engine, motor or both) and status of power generation by the engine and that of charging regenerative energy.



182BE36

<Fuel consumption screen>

This screen indicates the average fuel consumption, amount of recovered energy and fuel consumption for that moment. Average fuel consumption is displayed at 5-minutes intervals. The recovered energy display indicates the amount of energy recovered over the past 5 minutes, with each mark representing 50Wh.



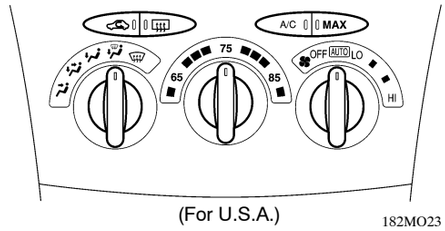
182BE37

MAIN EQUIPMENT

Air Conditioning

An automatic air conditioning has been adopted in consideration to ease of use.

- A clean air filter which removes pollen and dust is included as a standard fitting for purifying the air inside the cab.
- Two air conditioning modes, A/C for economical air conditioning and MAX for especially strong air conditioning, are provided.



(For U.S.A.) 182MO23

Wireless Door Lock Remote Control System

With the wireless door lock remote control system, all the doors can be locked and unlocked by signals emitted by the transmitter.

Power Window System

A power window system which enables all windows to be raised or lowered with switches has been adopted. An auto up/down function and jam protection function have been added to the driver's power window.

HV Immobiliser System

HV immobiliser system will not allow the HV system to be started by duplicate key is used. This system will permit the HV system to be started only when the ID code of the transponder chip impregnated in the key matches the ID code registered beforehand in the transponder key amplifier.

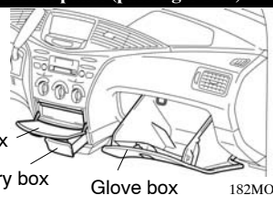
Theft Deterrent System

When an attempt is made to forcibly enter the vehicle or open the hood or trunk lid without a key, or when the battery terminals are removed and reconnected, this system sounds the horn and flashes the headlights, taillights and emergency flashers for about 1 minute to alert the owner. At the same time, it locks all the doors.

Storage Space

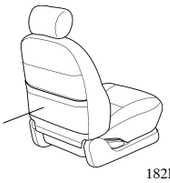
Ample storage space with an emphasis on practicality provided throughout the Prius.

Instrument panel (passenger seat)



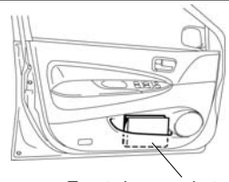
182MO24

Seat back pocket



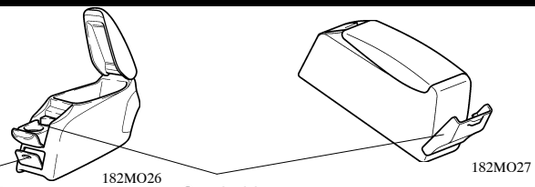
182MO09

Front door pocket



182MO25

Center console box



182MO26 182MO27

Luggage space

182MO28

11.839ft^3 (by SAE suitcase method) luggage space is secured.

SAFETY

Prius – one step ahead of the rest even in the area of safety.
Drive with the utmost peace of mind.

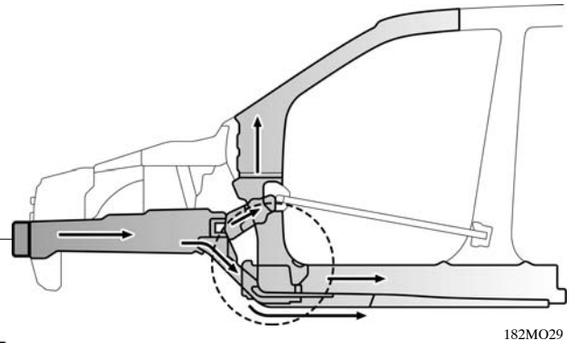
Passive Safety Body

The impact absorbing body adopted for the new Prius effectively absorbs and distributes the impact from front and side collisions to ease the effects of the impact on the driver and passengers, and the high-strength body structure minimizes deformation of the cabin itself.

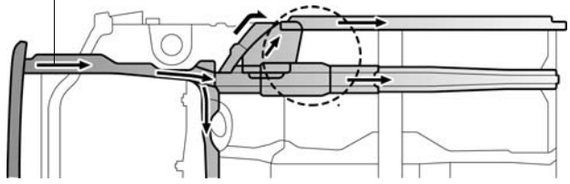
[Frontal collision]

The front section of the body frame and under body absorb and distribute the load generated by a frontal collision, while the strong cabin frame eases the effect of the impact on the driver and passengers and minimizes deformation of the cabin, thus realizing an ideal body structure.

The front side member is of a straight design to be deformed effectively from the front end. Also, in the event of a front collision, the force of the impact is effectively distributed to each of the braces and members through the sections where they join the cabin.



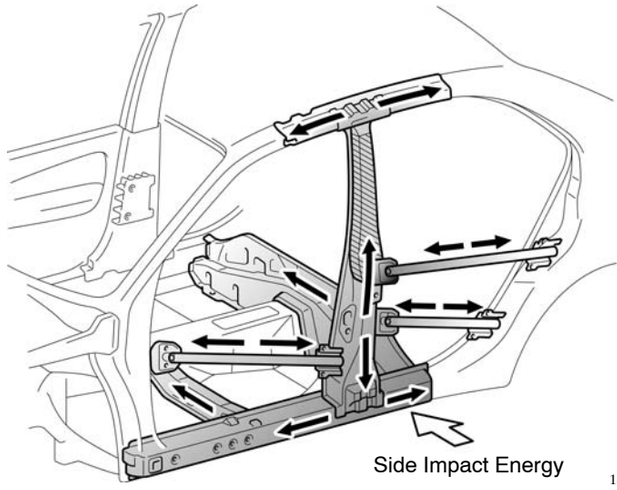
182MO29



182MO30

[Side collision]

Along with the ideal body structure which effectively absorbs and distributes the load on the frame in side collisions, we have maintained the strength of each pillar, rocker panel and door to minimize deformation of the cabin.

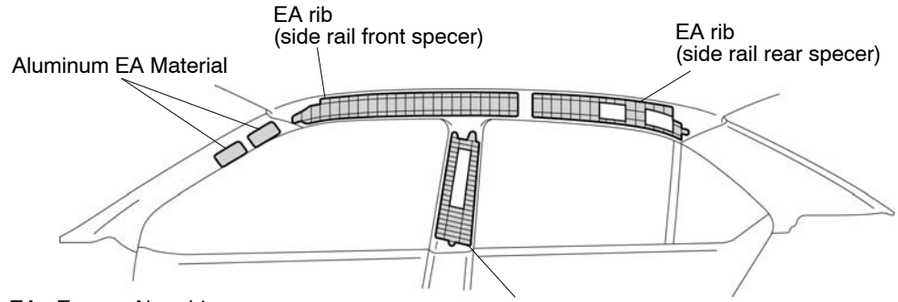


182MO31

SAFETY

Head Impact Protection Structure

The construction of the pillar trims and roof side adopted gives full consideration to protecting the heads of the driver and passengers from injury in the event of a collision. In addition, impact absorbing material has been built into the interior of each pillar trim and roof side which are most likely to be the cause of head injuries in a collision.



SRS Airbag

SRS airbags are standard for the driver and front passenger seats on all models. In the event of a frontal collision, the airbags function to support the seatbelts in reducing the impact to the driver and front passenger. Also, SRS side airbags are available as a option. The SRS side airbags have been designed to help reducing the impact energy that is transmitted to the driver and front passenger in the event of a side collision.

Seatbelt with Pre-tensioner and Force-limiting Mechanism

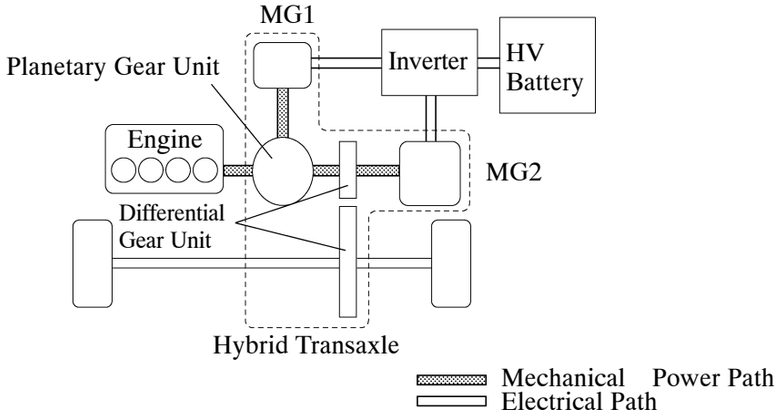
Three-point type seatbelts with pre-tensioner and force limiter are standard on the front seats of all models. An ELR-equipped seatbelt is provided on the driver's side and an ALR/ELR selectable one on the passenger side.

Three sets of 3-point type ALR/ELR selectable seatbelts are fitted on the rear seats.

THS (TOYOTA HYBRID SYSTEM)

■DESCRIPTION

The hybrid system is a type of powertrain that uses a combination of two types of motive forces, such as an engine and a motor (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 can be broadly divided into two systems: the series hybrid system, and the parallel hybrid system.

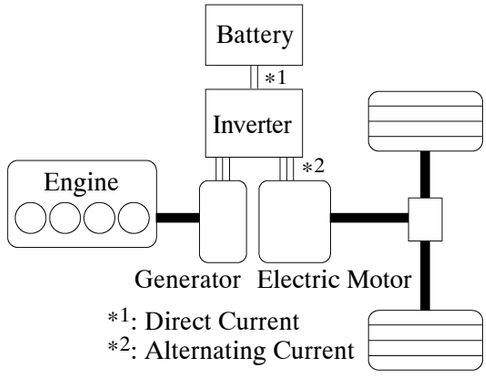


182TH03

– REFERENCE –

Series Hybrid System

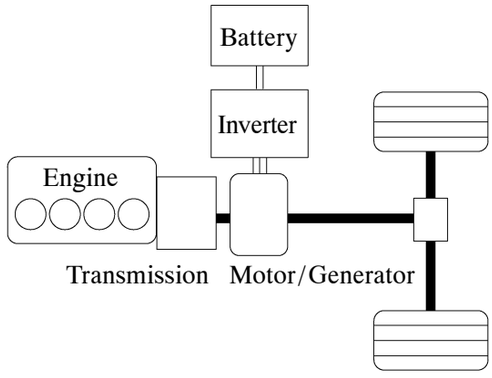
In the series hybrid system, the engine runs a generator, and the generated electricity enables the electric motor to drive the wheels. This type of vehicle can be described as an electric car that is equipped with an engine-driven generator.
Equipped with a low-output engine, the engine is operated 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

■ FEATURES OF THS

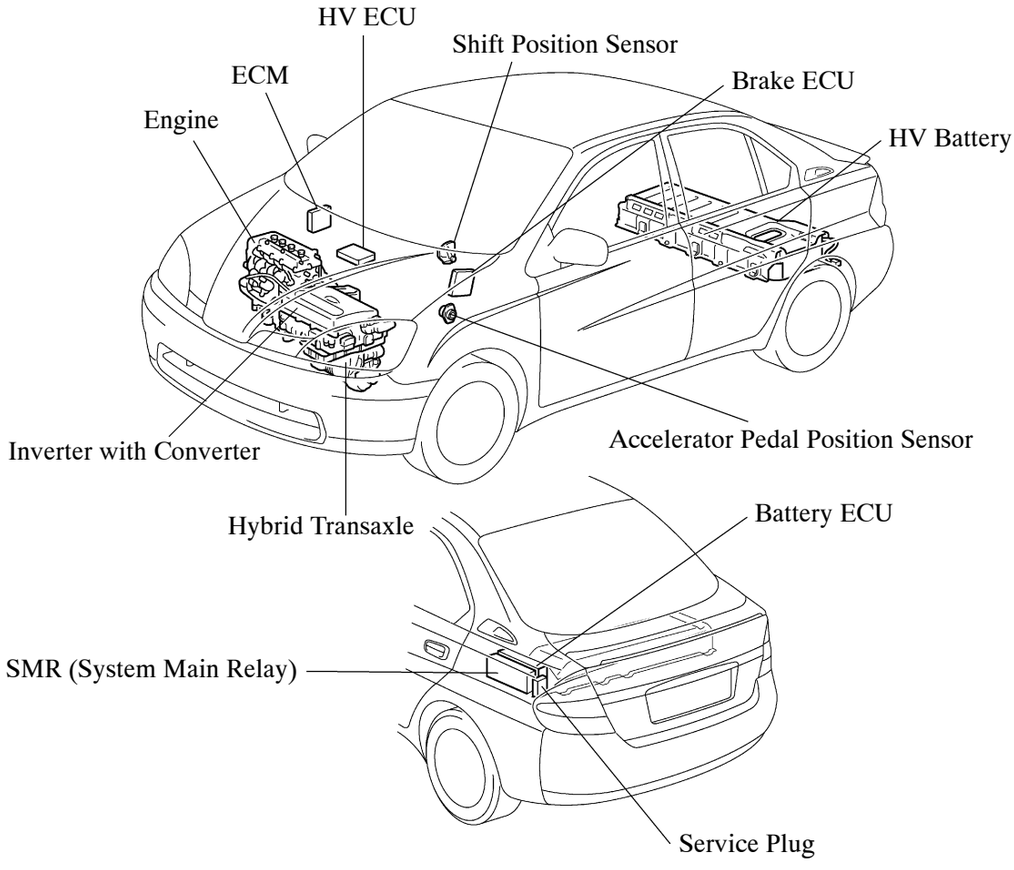
This system controls the following modes in order to achieve the most efficient operations to match the driving conditions:

1. Supply of electrical power from the HV battery to MG2 provides force to drive the wheels
2. While the tires are driven by the engine via the planetary gears, MG1 is driven via the planetary gears to supply electricity to MG2 to drive the wheels
3. 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, 1 + 2, or 3) according to the driving conditions. However, when the SOC of the HV battery is low, the HV battery is charged by the engine by turning MG1.

As a result, it achieves far greater the fuel economy compared to conventional gasoline engine vehicles, at a reduced level of exhaust gas emissions. Furthermore, this revolutionary powertrain has eliminated the constraints that are associated with electric vehicles (such as their short cruising range or their reliance on external recharging units).

■ LAYOUT OF MAIN COMPONENTS

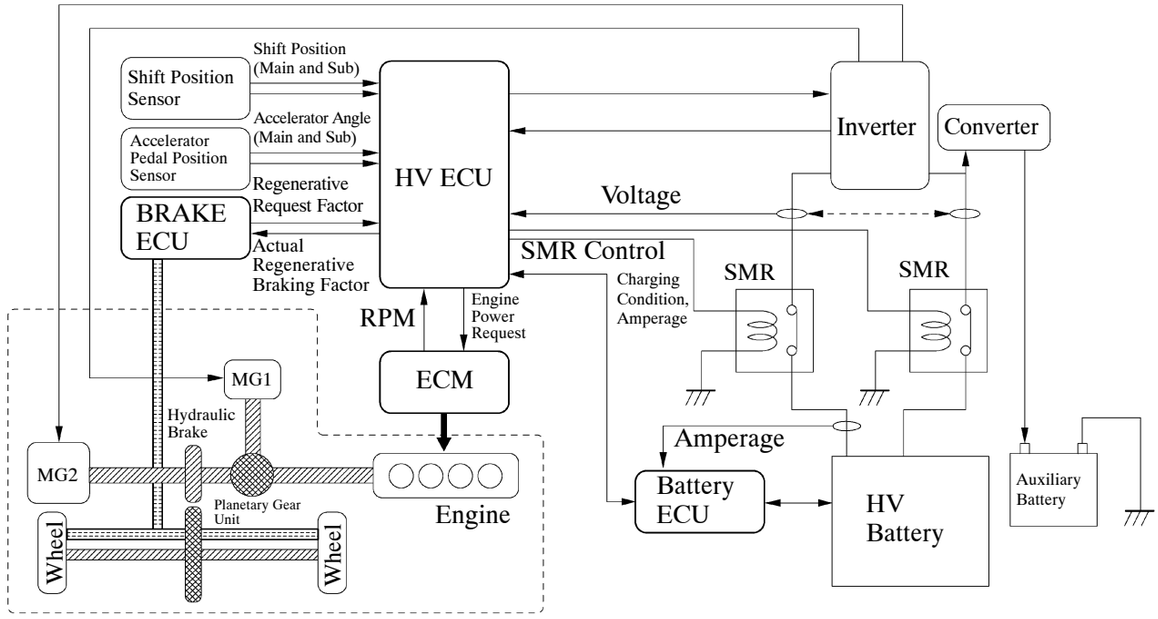


182TH19

■MAIN FUNCTIONS OF COMPONENTS

Hybrid Trans-axle	MG1	Generates high-voltage electricity by being powered primarily by the engine. Also functions as a starter to start the engine.
	MG2	Primarily provide additional power to the engine in order to increase the overall drive force. During braking, or when the accelerator pedal is not depressed, it generates electricity to recharge the HV battery (Regenerative brake system).
	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		A device that converts the high-voltage DC (HV battery) into AC (MG1 and MG2) and vice versa (Converts AC into DC).
Converter		Drops the high-voltage direct current (DC 273.6 V) into DC12 V in order to supply electricity to body electrical components, as well as to recharge the auxiliary battery (12 V).
HV (Hybrid Vehicle Control) ECU		Information from each sensor as well as from the ECU (ECM, Battery ECU, ABS ECU) is received, and based on this the required torque and output power is calculated. The HV ECU sends the calculated result to the actuators and controllers.
ECM		Sends a throttle open command to the electronically-controlled throttle in accordance with the engine output request factor received from the HV ECU.
Battery ECU		Monitors the charging condition of the HV battery.
Brake 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 brake ECU performs the ABS control 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 lever position into an electrical signal and outputs it to the HV ECU.
SMR (System Main Relay)		Connects and disconnects the high-voltage power circuit through the use of a signal from the HV ECU.
Service plug		Shuts off the high-voltage circuit of the HV battery when this plug is removed for vehicle inspection or maintenance.

■SYSTEM DIAGRAM



182TH05

Mechanical Power Path
Hydraulic
Electrical Signal

■DRIVING CHARACTERISTICS

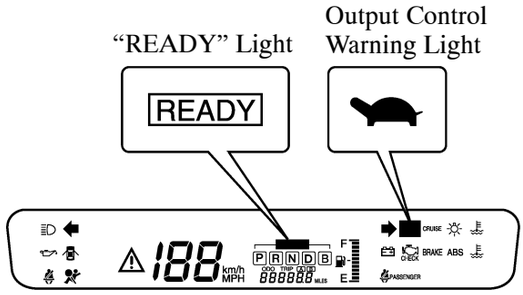
Because the Prius uses a parallel series hybrid system, some aspects of its operation may differ from those of existing automobiles, and may require precautions that are unique to this system.

1. Starting the THS

Make sure that the parking brake is engaged and that the shift lever is in the P position.
While depressing the brake pedal, turn the ignition switch to the START position. After this, the “READY” light flashes.
The engine does not start when the shift lever is in the N position; it can only start in the P position. When the external air temperature is low, the “READY” light may flash longer than usual.
As soon as the engine has started, the “READY” light illuminates steadily and a beeping sound is heard.
Several seconds after the engine warms up, the engine stops automatically, provided that the air conditioning compressor does not need to operate and that the HV battery maintains a proper SOC (state of charge).

2. Start-Off

While keeping the brake pedal depressed, release the parking brake, and move the shift lever to the D position.
The vehicle has the same creeping movement as the conventional automatic transmission vehicles.
Gradually release the brake pedal and slowly depress the accelerator pedal to start off.
At this time, the vehicle starts off powered only by the MG2 (Motor Generator No.2)



182TH24

NOTICE: The vehicle can be started off, provided that the “READY” light remains illuminated, even if the engine remains stopped.

3. Acceleration

Depress the accelerator pedal to accelerate the vehicle.
If the engine remained stopped during start-off, the engine will start automatically during acceleration.

4. Downhill Driving

Move the shift lever to the B position as necessary in order to simultaneously apply the regenerative brake and the engine friction brake.

5. Deceleration and Stopping

Depress the brake pedal to decelerate and to stop the vehicle.
Depressing the brake pedal causes the regenerative brake to activate automatically in the D or B position. (In the regenerative brake system, kinetic energy is converted to electrical energy.) If the engine has warmed up, the air conditioning compressor does not need to operate, and if the HV battery maintains a proper SOC (state of charge), the engine stops automatically when the vehicle speed drops-even if the vehicle comes to a stop.

6. Parking

Push down the parking brake pedal, move the shift lever to the P position, and pull out the ignition key.

NOTICE: Make sure to pull out the ignition key after parking the vehicle because the vehicle can be driven as long as the “READY” light remains illuminated even if the engine is stopped.

7. Other Characteristics and Precautions

- If a drive wheel slips on slippery terrain, causing the front wheels to spin faster than the rear wheels, the THS effects control to limit the slippage by restraining the drive force. (This also protects the planetary gear from damage.)
- When the HV battery temperature is too high or low, the output control warning light illuminates, alerting the driver that output power may be limited.
  This is not a malfunction. This condition may be corrected by avoiding sudden acceleration/decelaration, after which the light will go out.
- When the vehicle is stopped and the shift lever is in the N position, electricity is not generated even if the engine is running. If the vehicle remains stopped for a long time, make sure to move the shift lever to the P position. In heavy traffic, keep the shift lever in the D position.

■THS CONTROL SYSTEM

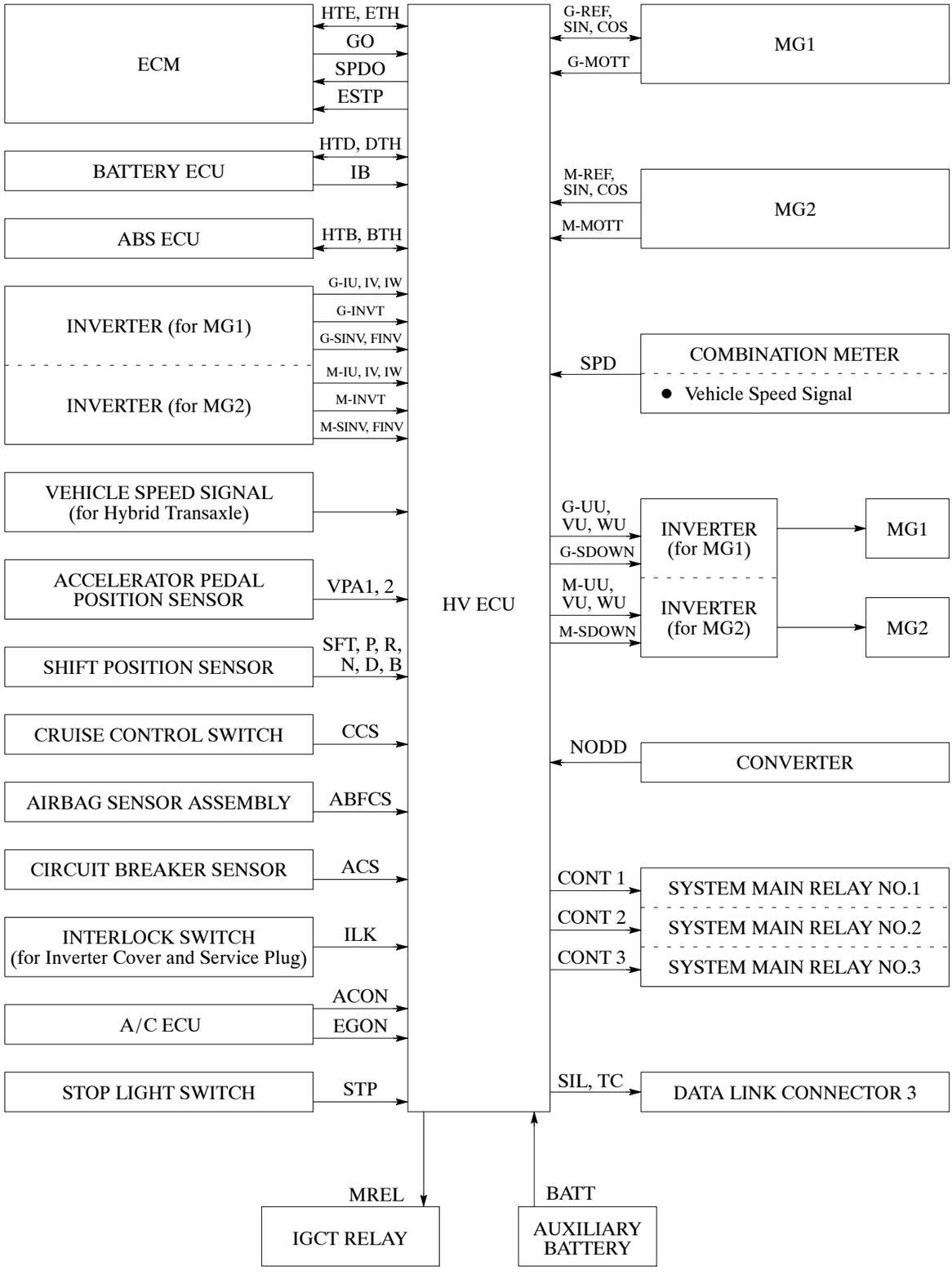
1. General

The THS control system contains the following components:

HV (Hybrid Vehicle Control) ECU		Controls the MG1, 2 and the engine according to the demand torque, regenerative brake control and the SOC (state of charge) of HV battery. These factors are determined by the shift position, the degree which the accelerator is depressed, and vehicle speed.
	ECM Control	The HV ECU receives engine status data (rpm, torque) from the ECM and determines the engine demand torque. Moreover, engine stop and fuel cut signals are sent according to the driving conditions. In addition, the vehicle speed signal received from the combination meter is also sent.
	BRAKE ECU Control	The HV ECU receives data corresponding to the total braking force needed. The HV ECU transmits the regeneration brake demand torque valve, as well as the regeneration brake execution torque valve.
	Inverter (for MG1, MG2) Control	The HV ECU sends the signal to the power transistor in the inverter for switching the U, V, W, phase of the MG1, 2 in order to drive the MG1 and 2. Moreover, if an overheating, overcurrent or fault voltage signal is received from the inverter, it is shut down.
Converter		When a malfunction is in the Hybrid vehicle control system, the HV ECU sends a signal to the converter, and the converter is stopped.
MG1, MG2		Detects the position of the rotor of the MG1, 2 and controls the current flowing to the MG1, 2. In addition, the temperature is detected and the maximum load is controlled.
Battery ECU		Receives the SOC of the HV battery and the current value.
Airbag Sensor Assembly		Receives the airbag deployment signal.
A/C ECU		Receives the engine power rise demand (when air-conditioning is turned ON) and the engine running demand for water-temperature maintenance.
Accelerator Pedal Position Sensor		Receives the value corresponding to degree at which the accelerator pedal is depressed.
Shift Position Sensor		Receives the shift position signal (P, R, N, D, B).
Cruise Control Switch		Receives the cruise control switch signal.
Stop Light Switch		Receives the brake signal.
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.
Diagnosis		When the HV ECU detects a malfunction, the HV ECU diagnosis and memorizes the values corresponding to the failure.
Fail-Safe		When the HV ECU detects a malfunction, the HV ECU stops or controls the actuators and ECUs according to the data already stored in memory.

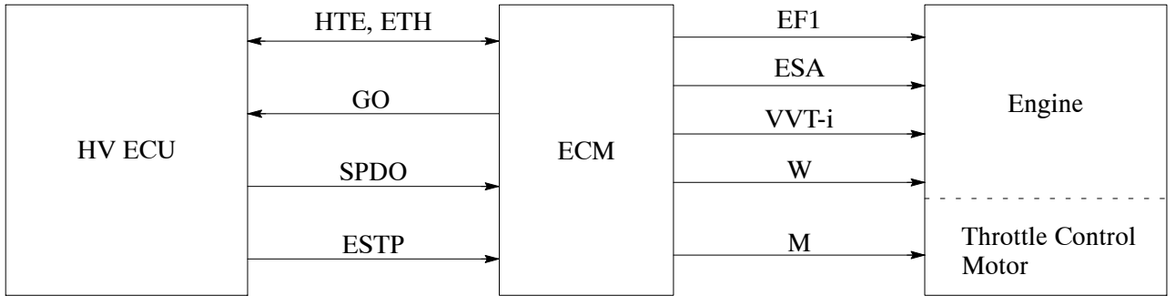
2. Construction

The configuration of the THS control system in the Prius is shown in the following chart.



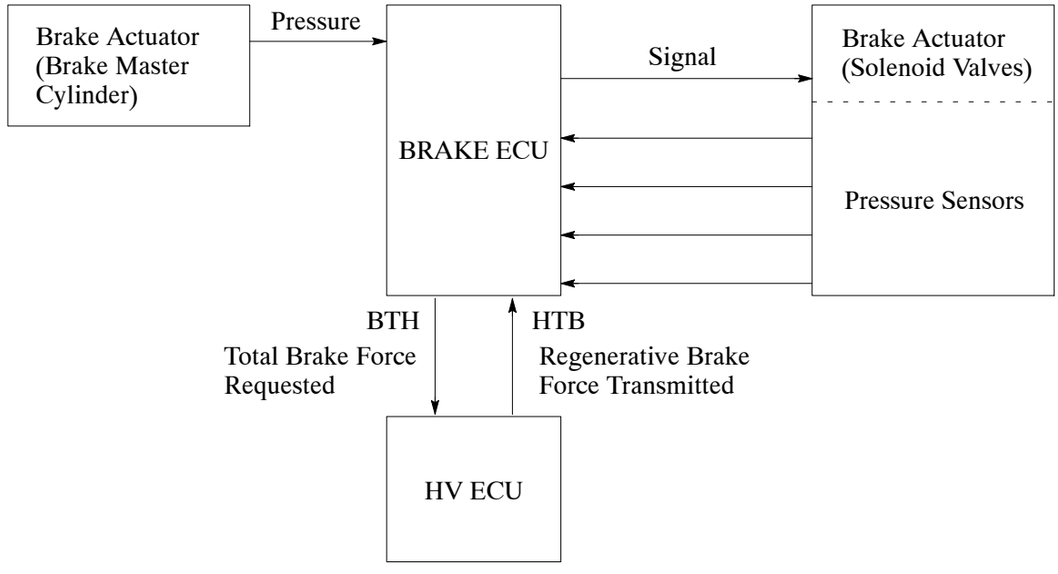
3. ECM Control

The ECM receives the demand torque and the target rpm which were sent from HV ECU (THE, ETH), and controls the degree of throttle valve opening, fuel injection timing, ignition time and VVT-i.
In addition, the actual rpm is sent to the HV ECU with GO, and the speed signal from the hybrid transaxle is received through HV ECU with SPDO.
When the vehicle is stopped, the HV ECU may send an engine stop (ESTP) command to the ECM to reduce fuel used.
When a malfunction occurs in the system, the ECM activates MIL via the directions from the HV ECU.



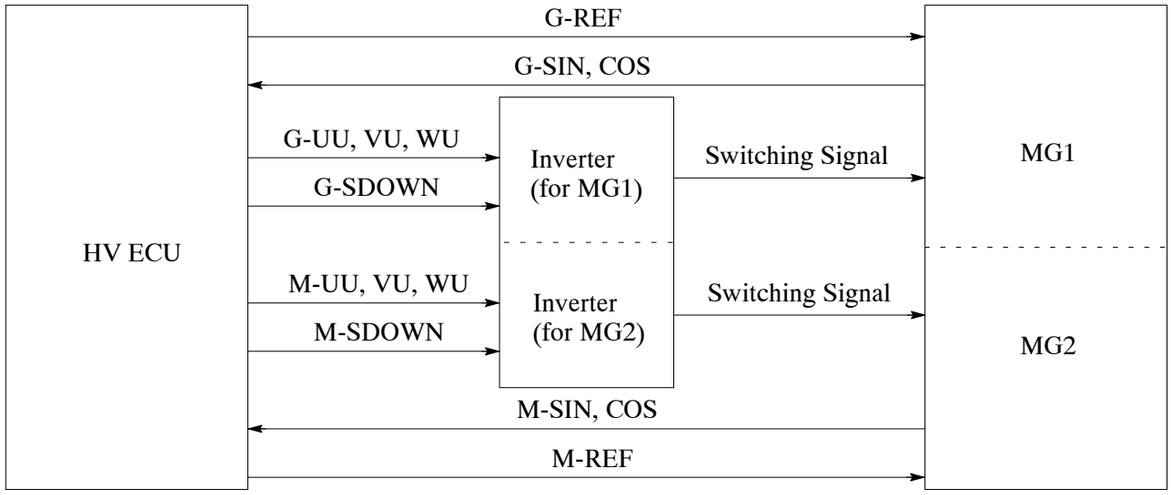
4. BRAKE ECU Control

The brake ECU calculates the total braking force needed, based on the master cylinder pressure in the brake actuator generated when the driver depresses the brake pedal, and sends this valve to the HV ECU.
The HV ECU computes a part for the regeneration brake force from the total braking force, and sends the result to the brake ECU.
The HV ECU executes to the minus torque to MG2, and carries out the regenerative brake functions.
The brake ECU controls the brake actuator solenoid valves and generates the wheel cylinder pressure, which is the regenerative brake force subtracted from the total braking force.



5. Inverter Control (for MG1, MG2)

The HV ECU transmits a signal to the power transistor in the inverter (G-UU, VU, WU, M-UU, VU, WU) for switching the U, V, W phase of the stator coil of MG1 and MG2, based on the rotor position information sent from MG1, 2 (G-SIN, COS, M-SIN, COS) and the SOC of the HV battery sent from the battery ECU. When shutting down the current to MG1, 2, a signal is sent to the inverter from the HV ECU (G-SDOWN, M-SDOWN).



Clutchless System

A clutchless system has been adopted to keep the front wheels and MG2 linked mechanically via gears and a chain. To disengage the drive force in the neutral position, the N position signal from the shift position sensor turns OFF all the power transistors in the inverter (which connects the MG1 and the MG2) in order to shut down the operation of the MG1 and the MG2, thus rendering the drive force at the wheels to zero. In this state, even if the engine is running, the MG1 merely freewheels in the no-load state.
Therefore, if the vehicle is allowed to operate continuously in the N position in a stationary state such as in heavy traffic, the SOC (state of charge) of the HV battery will continue to drop lower and lower.

6. Battery ECU

The SOC, temperature and the voltage of HV battery are detected by the battery ECU, and this information is sent to HV ECU.

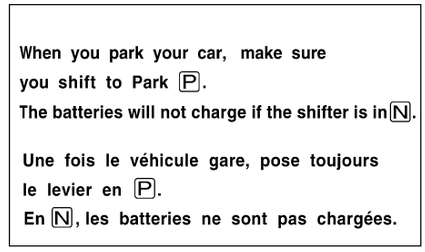
– REFERENCE –

The MG1 and the MG2 are generally shut down when the shift lever is in the N position.
However, the shut-down function is canceled under the following exceptions:

- *During driving, if the brake pedal is depressed and a wheel locks up, the ABS 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 lever 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 lever 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 its shut-down function.*

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

- *The "READY" light is illuminated, the shift lever is in the N position, and the HV battery is discharged.*
- *The "READY" light is illuminated, the shift lever is in the N position, and the driver's door is open.*



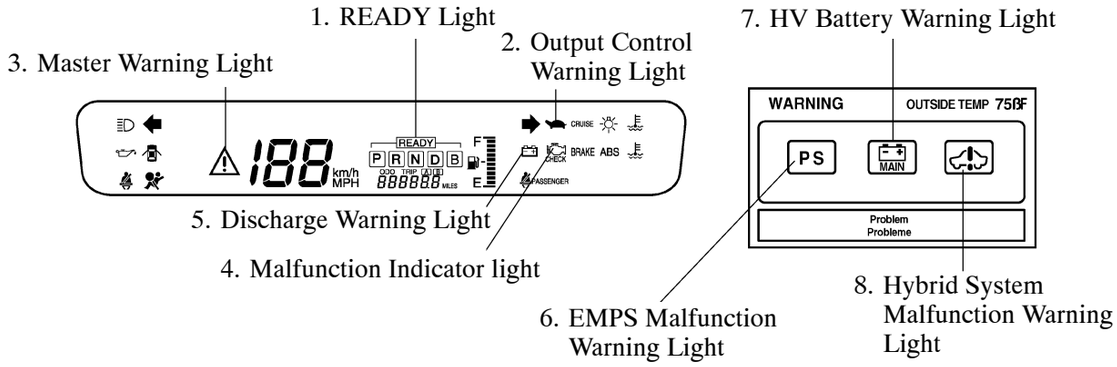
182TH33

- *The "READY" light is illuminated, the parking brake is engaged, the shift lever is in the B or D position, and the driver's door is open.*

■INDICATOR AND WARNING LIGHT

The warning lights of the Prius are different from those on conventional vehicles. Inspection and repair should be performed while referring to the troubleshooting section in the 2001 Prius repair manual (RM778U).

▶ Center Meter ◀ **▶ Multi Information Display ◀**



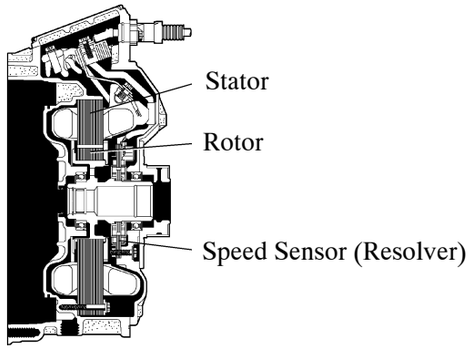
182TH22

1. READY light	Turns on when the ignition switch is turned to START to indicate that the vehicle is ready to drive.
2. Output control warning light	Turns on when the remaining HV battery charge becomes insufficient at R range or when there is an abnormal temperature rise in the HV battery due to continuous driving under heavy loads. It may also light when the HV battery temperature is low (after starting at low temperatures). The hybrid system output is limited while this light is on. ● Travel at reduced speeds (avoid sudden acceleration) while the light is lit.
3. Master warning light	Turns on with buzzer sounding by linked operation with warning lights “6” to “8” on the multi center display.
4. Malfunction indicator light	Turns on when there is a malfunction in the engine control system.
5. Discharge warning light	Turns on when there is a malfunction in the 12 V charging system (converter assembly). ● If it turns on together with the master warning light and hybrid system warning light, check the diagnostic code.
6. EMPS malfunction warning light	Turns on when there is a malfunction in the EMPS control system.
7. HV battery warning light	Turns on when the HV battery is discharged to the lower limit.
8. Hybrid system warning light	Turns on when a malfunction in MG1, 2, inverter, HV battery or HV ECU is detected.

MG1 AND MG2 (MOTOR GENERATOR NO.1 AND NO.2)

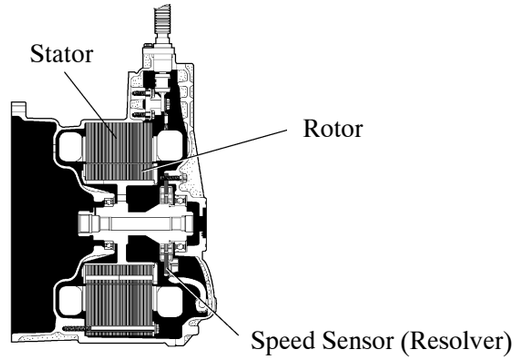
■DESCRIPTION

- Both the MG1 and the MG2 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.



MG1

182CH05



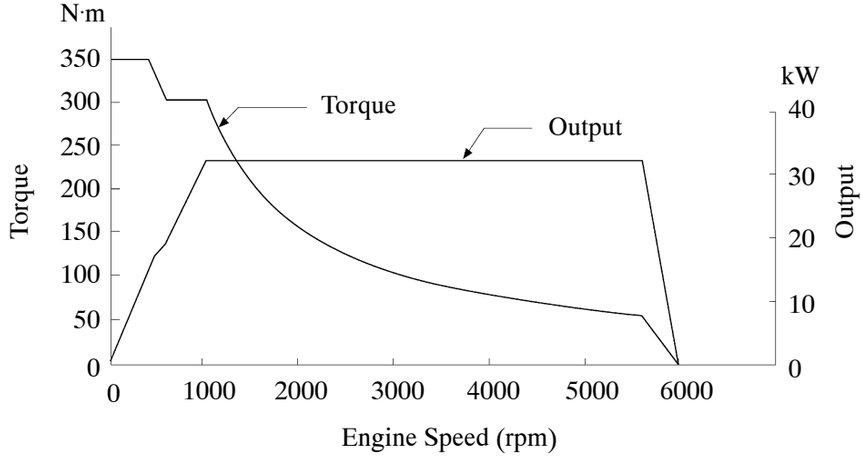
MG2

182CH04

▶ MG2 Specifications ◀

Type	Permanent Magnet Motor (1CM)
Rated voltage [V]	273.6
Maximum output [kW] (rpm)	33/(1040 ~ 5600)
Maximum torque [N·m (kgf·m) (rpm)	350/(0 ~ 400)
Amperage at maximum torque [A]	351
Cooling system	Water-cooled

▶ Performance Curve ◀



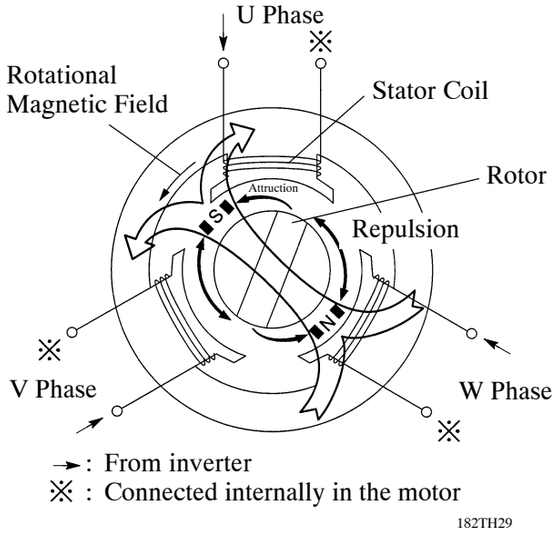
182TH07

1. 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.



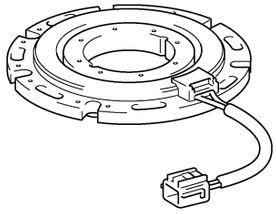
182TH29

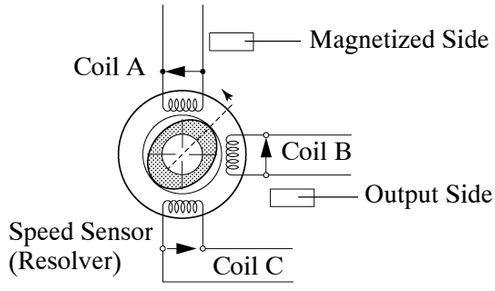
2. Speed Sensor (Resolver)

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 coils 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.





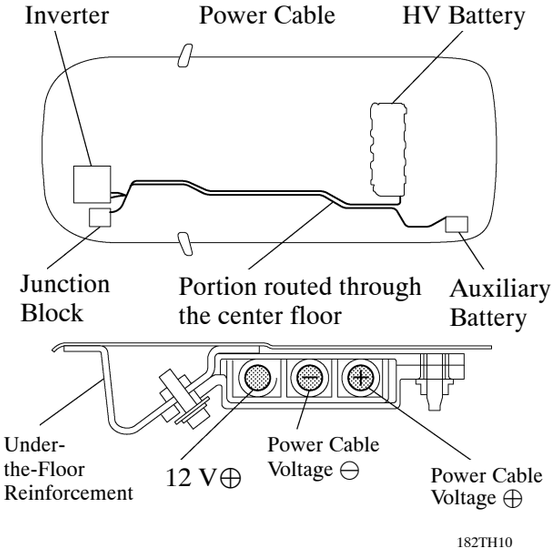
182TH09

3. Power Cable

The power cable is a high-voltage, high-amperage cable that connects the HV battery with the inverter, and the inverter with MG1 and MG2. 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 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.

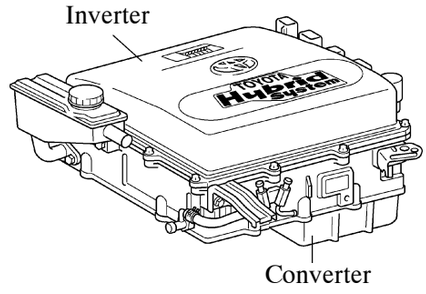


182TH10

INVERTER

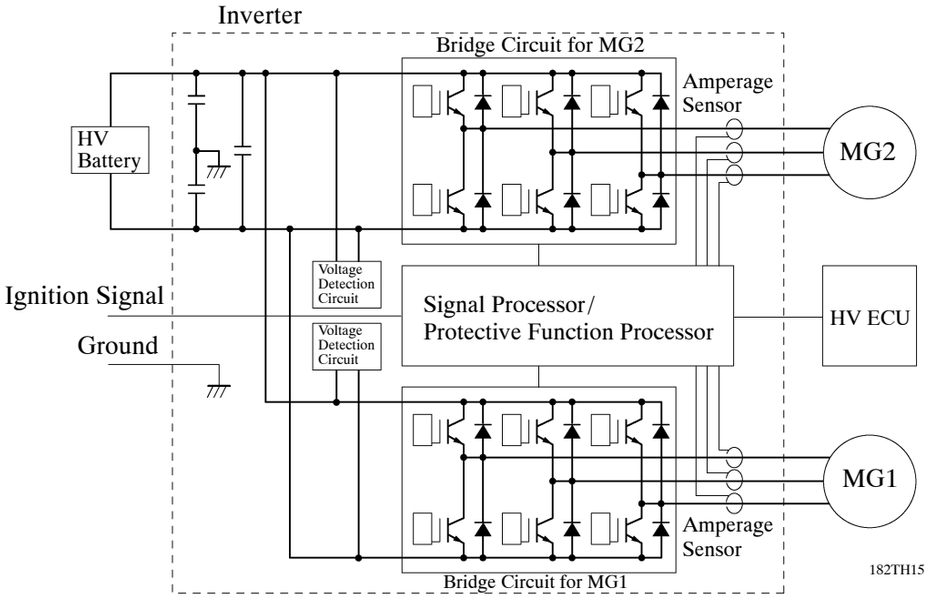
1. General

The inverter is an electric power converter that converts the direct current of the Hybrid vehicle's high-voltage battery (DC 273.6 V) and the alternating current of the MG1 and MG2.
Consisting of 2 three-phase bridge circuits for MG1 and MG2, respectively, and each containing 6 power transistors, the inverter converts direct current and three-phase alternating current. 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.



182TH26

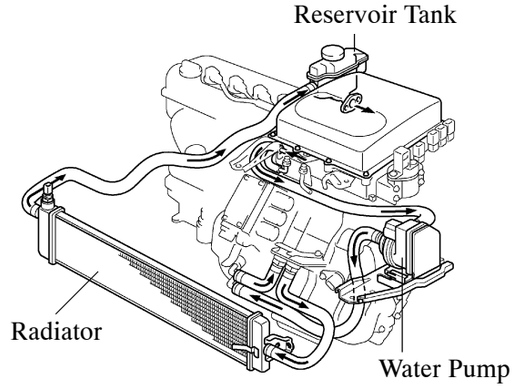
2. System Diagram



182TH15

3. Cooling System

A cooling system via water pump for the inverter and MG1, 2 has been added.
The HV ECU controls the water pump with coolant temperature.
It is separated with the engine cooling system.

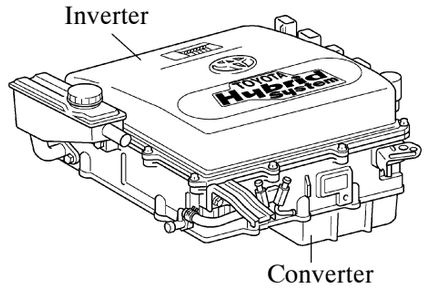


182TH27

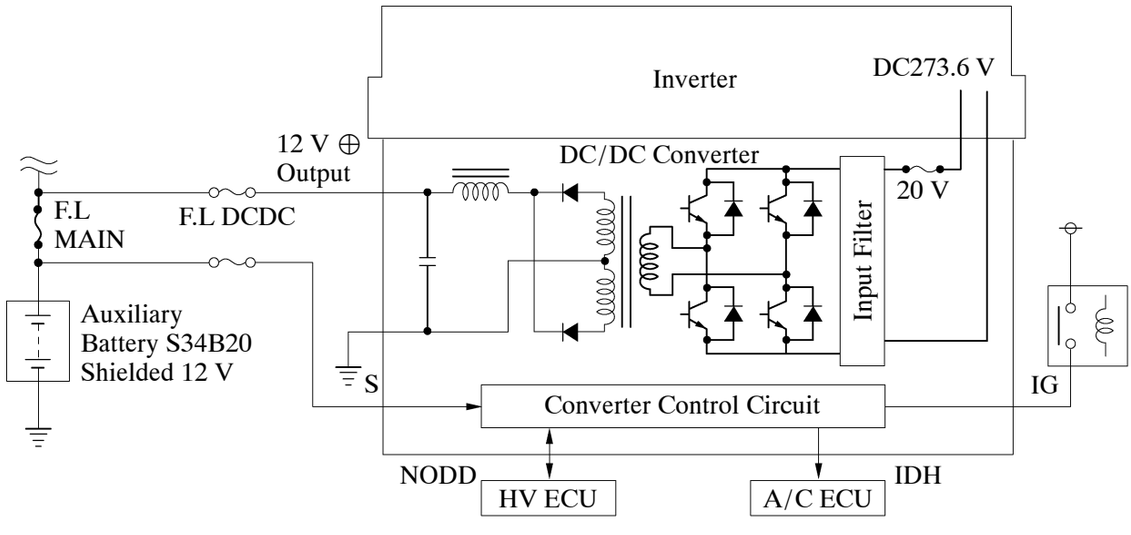
CONVERTER

1. General

The power source for auxiliary equipment of the vehicle such as the lights, audio system, and the air conditioner cooling fan, as well as the ECUs, is based on a 12 V system. Because the THS generator outputs at 273.6 V, the converter is used to transform the voltage from DC273.6 V to DC 12 V in order to recharge the auxiliary battery. The converter is installed on the underside of the inverter.



182TH26



182TH17

2. Operation

- The DC273.6 V input is initially converted into alternating current by the transistor bridge circuit and transformed into a low voltage by the transformer. After this, the current is rectified, smoothed (into direct current) and converted into DC12 V.
- The voltage at the positive terminal of the auxiliary battery is monitored by the converter and is maintained at a constant level. Consequently, the voltage of the auxiliary battery is unrelated to the engine rpm (even if the engine is stopped) and to the auxiliary equipment (output current of converter).

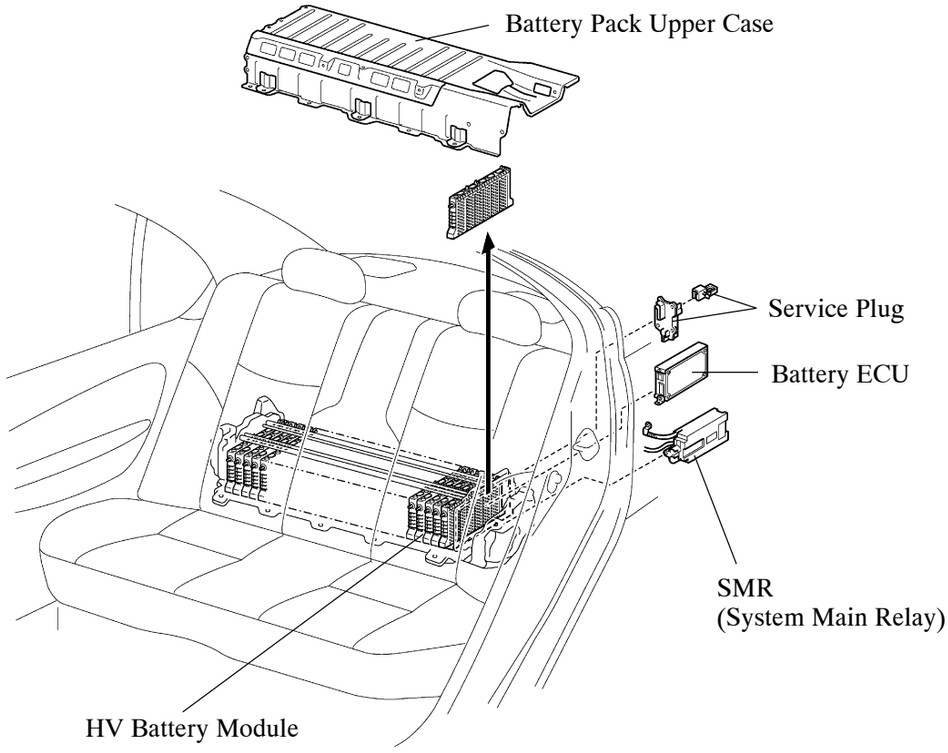
HV BATTERY

■DESCRIPTION

The sealed nickel metal hydride (Ni-MH) battery technology has been further evolved in the newly developed HV battery that offers features such as high power density, lightweight, and longevity, that are specifically designed to match the characteristics of the THS. Because the THS effects charge/discharge control to maintain a constant level of SOC (state of charge) while the vehicle is operating normally, it does not rely on the use of external rechargers.

In the battery area, six 1.2-volt cells are connected in series to form one module. A total of 38 modules are divided into two holders and connected in series. Thus, the HV battery containing a total of 228 cells has a rated voltage of 273.6 V.

The electrode plates in the HV battery are made of materials such as porous nickel and metal hydride alloy.



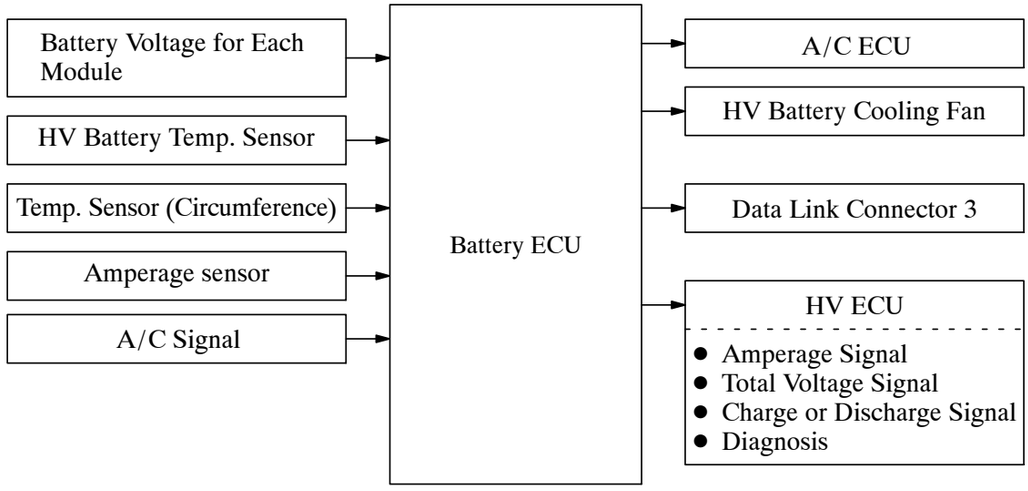
182TH34

HV BATTERY CONTROL SYSTEM

■DESCRIPTION

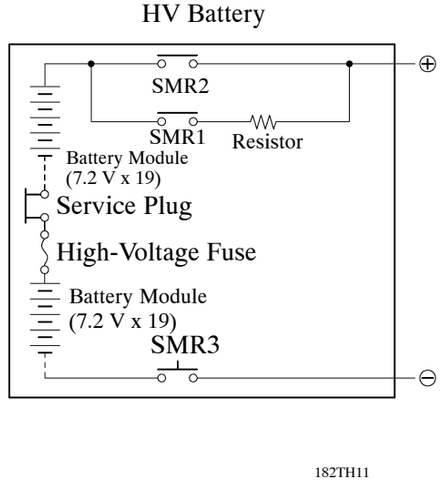
To maintain the battery at a proper SOC (state of charge), and to ensure safety in the event that the HV battery malfunctions, the battery ECU features the following control functions:

▶ System Diagram ◀



■CONSTRUCTION

- The HV battery, battery ECU, and SMR (system main relay), are enclosed in a single case and placed in the luggage compartment behind the rear seat to make more effective use of vehicle space.
- In the battery area, six 1.2-volt cells are connected in series to form one module. A total of 38 modules are connected in series.
  Thus, the HV battery containing a total of 228 cells has a rated voltage of 273.6 V.
- A service plug that shuts off the circuit is provided in the middle of the 38 modules. Before servicing any portion of the high-voltage circuit, make sure to remove the service plug. For further details, refer to the 2001 Prius Repair Manual (Pub No. RM778U).



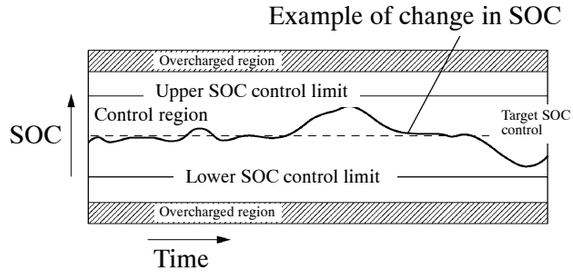
182TH11

1. Battery ECU

The battery ECU provides the following functions.

SOC (state of charge) 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 outputs charge/discharge requests to the HV ECU so that the SOC can be constantly maintained at a center level, by estimating the charging/discharging amperage.



182TH12

Cooling Fan Control

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.

HV Battery Malfunction Monitoring

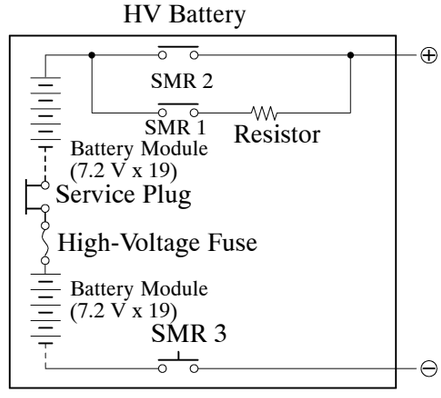
This function includes the monitoring of the temperature and the voltage of the battery via the battery ECU. If a malfunction is detected, the battery ECU protects the HV battery by restricting or stopping the charging and discharging of the HV battery. In addition, this function illuminates the warning light, outputs DTCs (Diagnostic Trouble Codes), and stores them in memory. For further details on the DTCs, refer to the 2001 Prius Repair Manual (Pub No. RM778U).

2. SMR (System Main Relay)

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.

At the time of connection, SMR1 and SMR3 are turned ON; after this, SMR2 is turned ON and SMR1 is turned OFF. By allowing the controlled current via the resistor to pass through initially in this manner, the circuit is protected against rush current.

At the time of disconnection, SMR2 and SMR3 are turned OFF in that order, and the HV ECU verifies that the respective relays have been properly turned OFF.

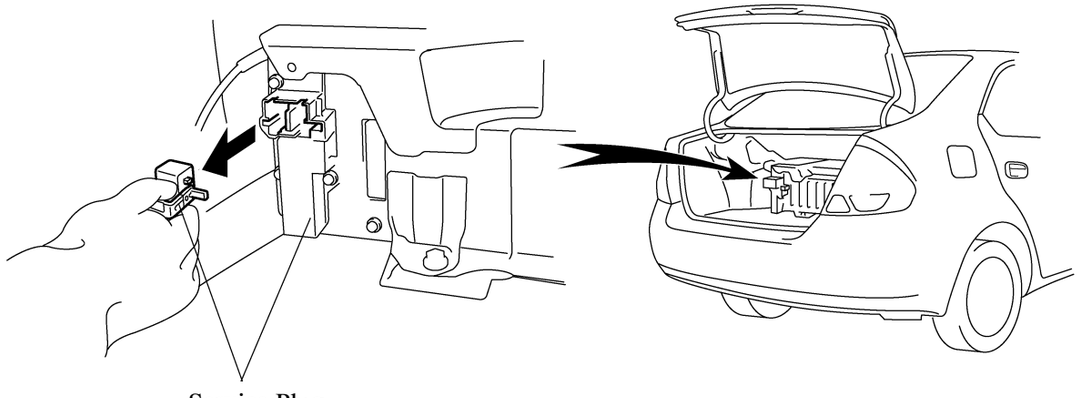


182TH11

3. 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 reed switch for interlock. Lifting the clip lock up turns OFF the reed switch, which shuts off the SMR. However, to ensure safety, make sure to turn OFF the ignition switch before removing the service plug. For further details on how to handle the service plug, refer to the 2001 Prius Repair Manual (Pub No. RM778U). The main fuse for the high-voltage circuit is provided inside of the service plug assembly.

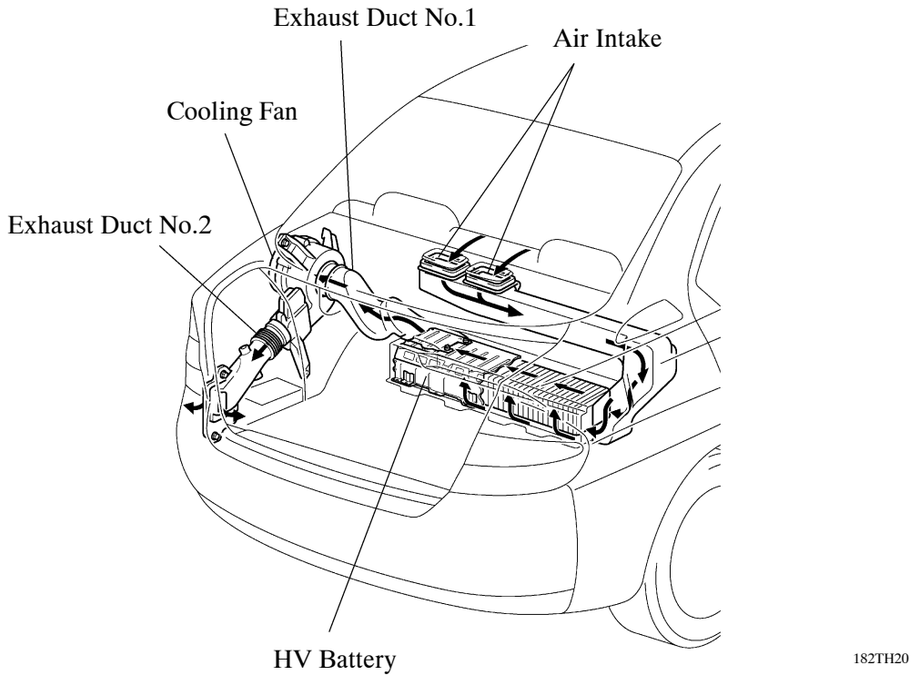


182TH30

HV BATTERY COOLING SYSTEM

■DESCRIPTION

When the temperature of the HV battery rises, the battery ECU executes a command to cause the cooling fan to operate from OFF to LO, MID and HI speeds. However, if the air conditioning is being used at that time to cool the vehicle's interior, and if there is still some margin left in the temperature of the HV battery, the battery ECU keeps the fan OFF or running at LO speed, thus giving priority to the air conditioning.
The air intake for the cooling fan is located above the package tray trim. If an object (such as clothing) is placed over this area, the HV battery might not be able to cool sufficiently, which could cause the output control warning light to illuminate.



■CONSTRUCTION

This system feature a cooling fan which is driven by DC motor.

▶ Specifications ◀

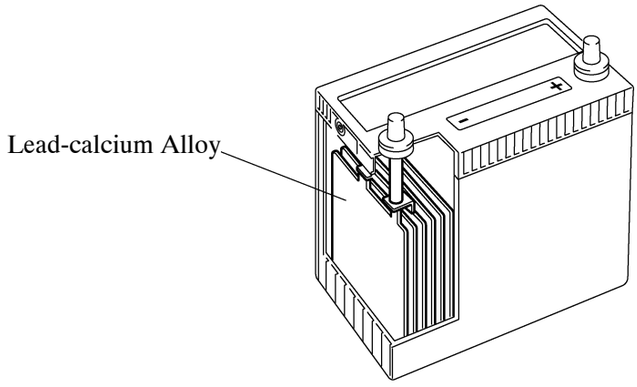
Type		Sirocco Fan
Fan Size Dia x H mm (in.)		100 x 40 (4.0 x 1.6)
Motor Type		DC Motor
Air Flow Volume m^3/h	Lo	50
	Mid	100
	Hi	150
Power Consumption W		60

- The operation of the cooling fans is controlled by the signals that are output by the battery ECU, which monitors the temperature of the HV battery.

AUXILIARY BATTERY

■DESCRIPTION

The shielded, maintenance-free 12V battery (S34B20L) for the Prius is used.
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.



182TH21

HV IMMOBILISER SYSTEM

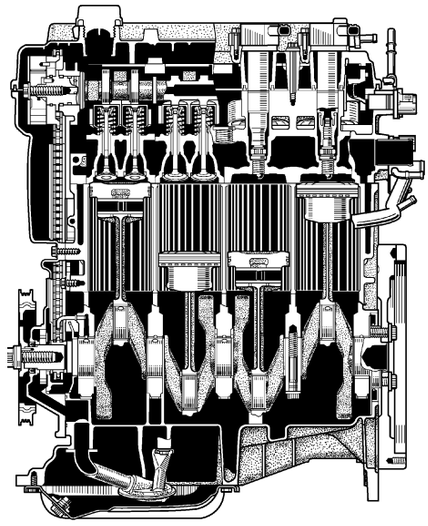
The HV immobiliser system has been designed to prevent the vehicle from being stolen. This system uses a ECM that stores the ID code of the authorized ignition key. If an attempt is made to start the HV system using an unauthorized key, the ECM prohibit fuel delivery and ignition, effectively disabling the engine.

ENGINE

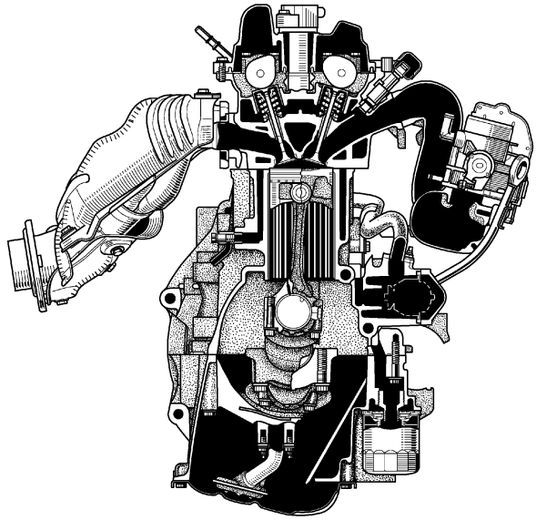
1NZ-FXE ENGINE

■ DESCRIPTION

The Prius uses the 1NZ-FXE engine that has been newly developed for hybrid system application. Based on the 1NZ-FE engine, the high-expansion ratio Atkinson cycle has been adopted. It is an in-line 4-cylinder, 1.5-liter, 16-valve DOHC engine.
This engine has adopted the VVT-i (Variable Valve Timing-intelligent) system has been developed to realize high performance, quietness, fuel economy and clean emissions.



182EG01



182EG02

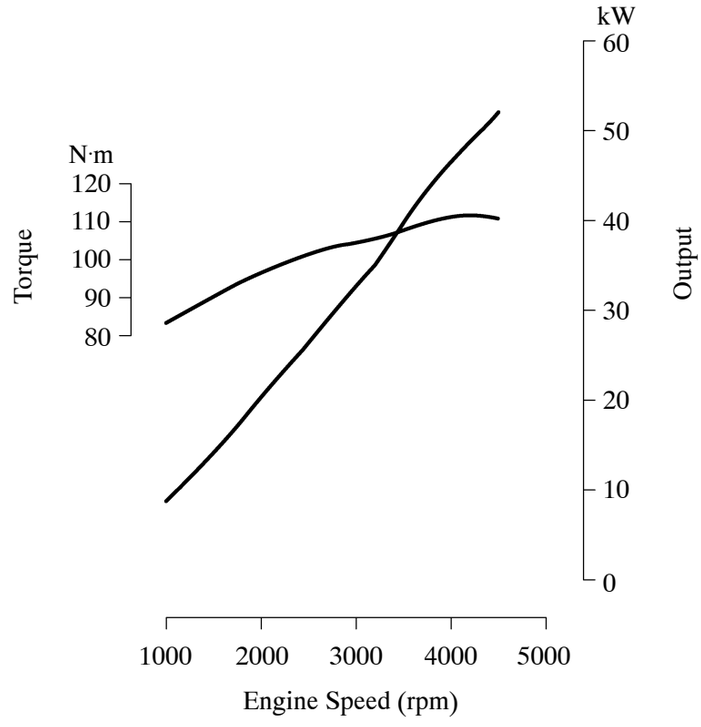
– REFERENCE –

Atkinson Cycle: Proposed by an English engineer named James Atkinson, this thermal cycle enables the compression stroke and the expansion stroke of the mechanism to be set independently of each other. Later, this concept was realized by the American R. H. Miller, who developed a system called the Miller Cycle in which the opening and closing timing of the intake valves was made adjustable. Because this system does not generate high output, there is no practical application for this system unless it is combined with a supercharger; however, this system offers a high level of thermal efficiency.
On Prius, this weak point can be covered by combining the Atkinson cycle engine with THS.

▶ Engine Specifications ◀

Engine Type			1NZ-FXE	1NZ-FE (ECHO)
No. of Cyls. & Arrangement			4-Cylinder, In-line	←
Valve Mechanism			16 Valve DOHC, Chain Drive	←
Combustion Chamber			Pentroof Type	←
Manifolds			Cross-Flow	←
Fuel System			SFI	←
Displacement cm^3 (cu. in.)			1497 (91.3)	←
Bore x Stroke mm (in.)			75.0 x 84.7 (2.95 x 3.33)	←
Compression Ratio			13.0 : 1	10.5 : 1
Max. Output [SAE-NET]			52 kW @ 4500 rpm 70 HP @ 4500 rpm	81 kW @ 6000 rpm 108 HP @ 6000 rpm
Max. Torque [SAE-NET]			111 N·m @ 4200 rpm 82 lb-ft @ 4200 rpm	142 N·m @ 4200 rpm 105 lb-ft @ 4200 rpm
Valve Timing	Intake	Open	18° ~ −25° BTDC	−7° ~ 53° BTDC
		Close	72° ~ 115° ABDC	52° ~ −8° ABDC
	Exhaust	Open	34° BBDC	42° BBDC
		Close	2° ATDC	←
Fuel Octane Number RON			91 or more	←
Oil Grade			API SJ EC or ILSAC	←

▶ Performance Curve ◀



182EG03

■ FEATURES OF 1NZ-FXE ENGINE

The 1NZ-FXE engine has been able to achieve the following performance through the adoption of the items listed below.

(1) High performance and fuel economy

(2) Low noise and vibration

(3) Lightweight and compact design

(4) Good serviceability

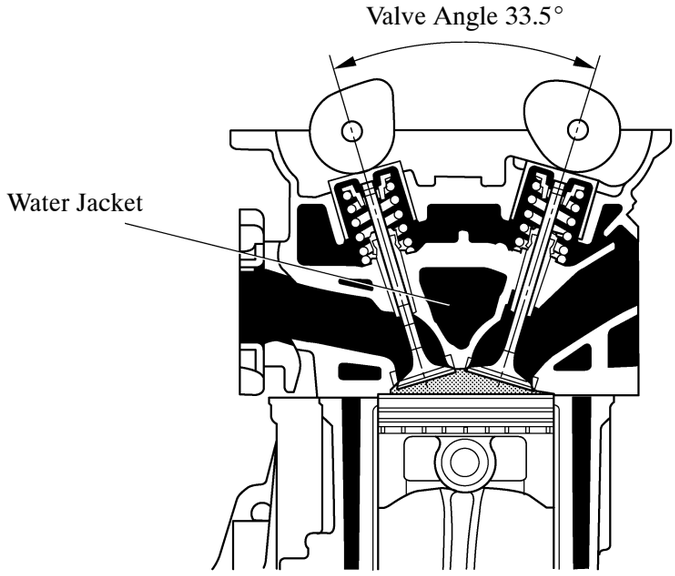
(5) Clean emission

Item	(1)	(2)	(3)	(4)	(5)	1NZ-FE
The VVT-i system is used.	○				○	○
High-expansion Atkinson cycle has been adopted.	○					
An offset crankshaft has been adopted.	○					○
A cylinder block made of aluminum has been adopted.		○	○			○
A stainless steel exhaust manifold is used for weight reduction.			○		○	○
A rearward exhaust layout has been adopted to realize the early activation of the catalyst.					○	○
HC Adsorber and catalyst system has been adopted.					○	
Fuel returnless system has been adopted.					○	○
12-hole type fuel injectors have been adopted.	○				○	○
The DIS (Direct Ignition System) makes ignition timing adjustment unnecessary.				○		○
Quick connectors are used to connect the fuel hose with the fuel pipes.				○		○
The oil filter is installed diagonally downward.				○		○
A timing chain has been adopted.				○		○
A vacuum system that detects leaks in the evaporative emission control system has been adopted.				○	○	○
The vapor reducing fuel tank system has been adopted. This system reduces the amount of fuel vapor that is generated.					○	

■ENGINE PROPER

1. Cylinder Head

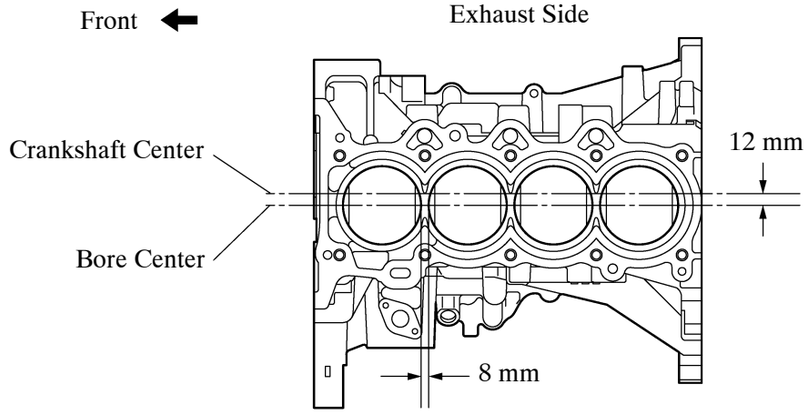
- The angle of the intake and exhaust valves is narrowed and set at 33.5° to permit a compact cylinder head.
- As a result of installing the injector in the intake port of the cylinder head, the contact of the fuel against the intake port wall has been minimized and fuel economy has been improved.
- A water jacket has been provided between the exhaust port and the spark plug boss in order to maintain the combustion chamber wall temperature uniform, thus improving the cooling performance of the combustion chamber and the area around the spark plug.



182EG04

2. Cylinder Block

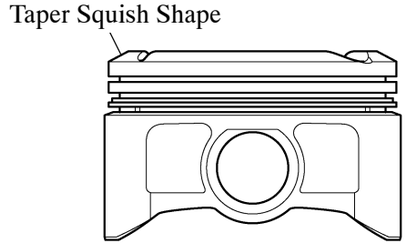
- A cylinder block made of aluminum alloy has been adopted to realize a significant amount of weight reduction.
- A water pump swirl chamber and an inlet passage to the pump are provided in the cylinder block.
- The rear portion of the cylinder block has been shaped conically to improve the coupling rigidity with the transaxle.
- Through the adoption of the offset crankshaft, the bore center has been shifted 12 mm towards the intake, in relation to the crankshaft center. Thus, the side force when the maximum pressure is applied has been reduced and the heat efficiency has been improved. And as a result, fuel economy has been improved.
- Through the use of a thin-walled cast iron liner in the cylinder bore, a distance of 8 mm between the bores has been realized, resulting in a compact package. This liner is thin, so that boring is not possible.
- By discontinuing the use of the rear oil seal retainer and by pressing the rear oil seal into the cylinder block, a compact package has been realized.



182EG05

3. Piston

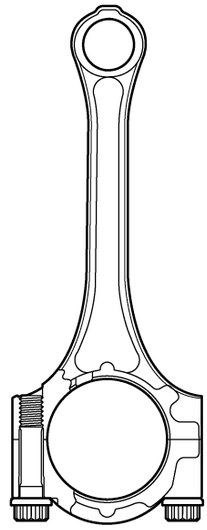
- The taper squish shaped piston has been adopted to improve combustion chamber.
- Low-tension piston rings have been adopted to reduce friction and improve fuel economy and oil consumption performance.
- By increasing the mechining precision of the cylinder bore diameter, the outer diameter of the piston has been made into the one type.



182EG06

4. Connecting Rod

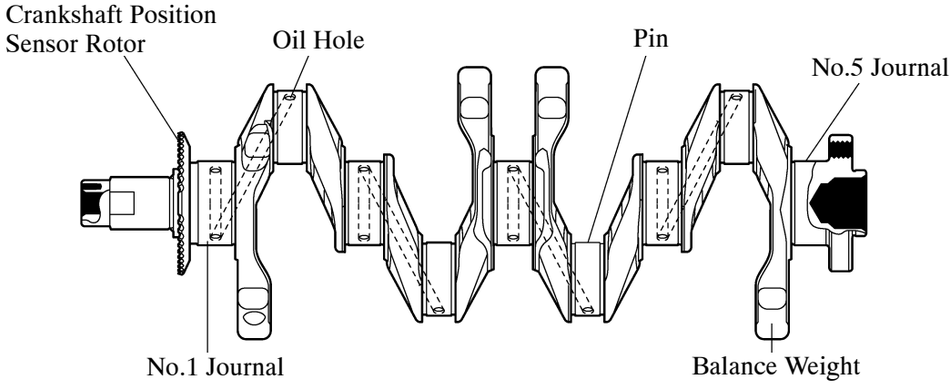
- The connecting rods are made of high-strength material for weight reduction.
- The connecting rod cap is held by bolts tightened to plastic region.



171EG07

5. Crankshaft

- The crankshaft has 5 journals and 4 balance weights.
- A crankshaft position sensor rotor has been pressed into the crankshaft to realize an integrated configuration.
- The surface roughness of the pins and journals have been improved for low-friction operation.
- The bearing width has been reduced for low-friction operation.

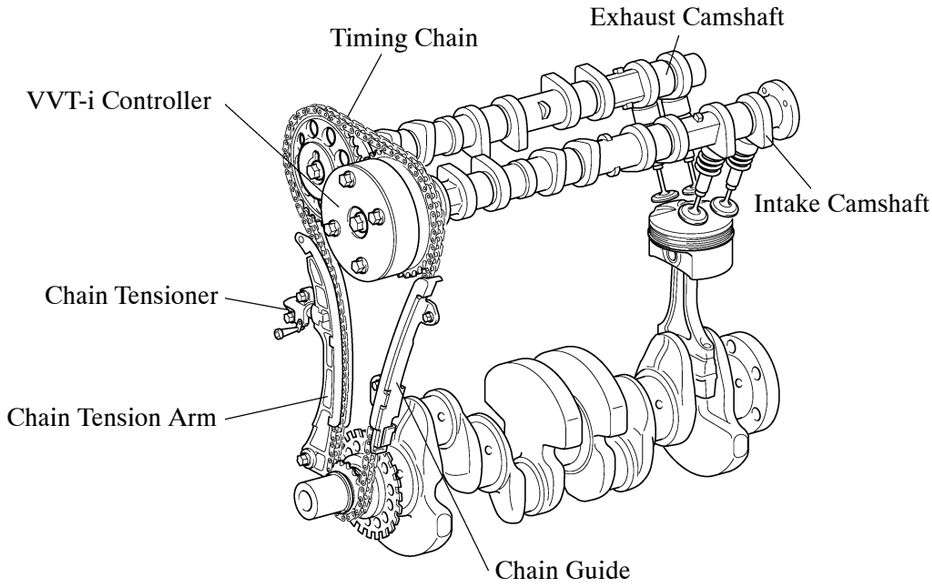


182EG07

■ VALVE MECHANISM

1. General

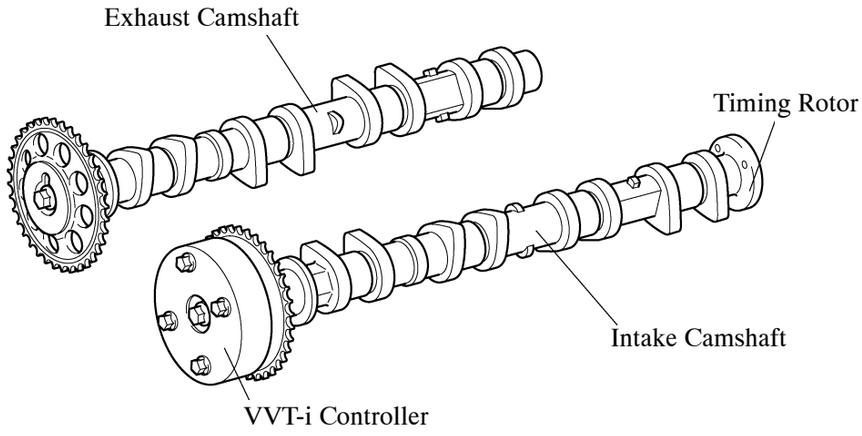
- Each cylinder has 2 intake valves and 2 exhaust valves.
- The valves are directly opened and closed by 2 camshafts.
- The intake and exhaust camshafts are driven by a roller timing chain.
- The VVT-i system is used to improve fuel economy, engine performance and reduce exhaust emission.



171EG09

2. Camshafts

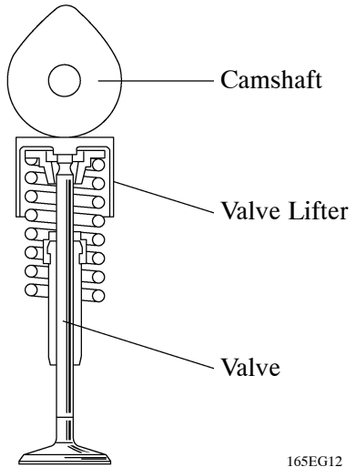
- In conjunction with the adoption of the VVT-i system, an oil passage is provided in the intake camshaft in order to supply engine oil to the VVT-i system.
- A VVT-i controller has been installed on the front of the intake camshaft to vary the timing of the intake valves.
- The timing rotor is provided behind the intake camshaft to trigger the camshaft position sensor.



171EG10

3. Intake and Exhaust Valve and Valve Lifter

- Valve lifters with shimless valve adjustment have been adopted for weight reduction.
  The adjustment of the valve clearance is accomplished by selecting and replacing the appropriate valve lifters.
- Narrower valve stems have been adopted to reduce the intake and exhaust resistance and for weight reduction.

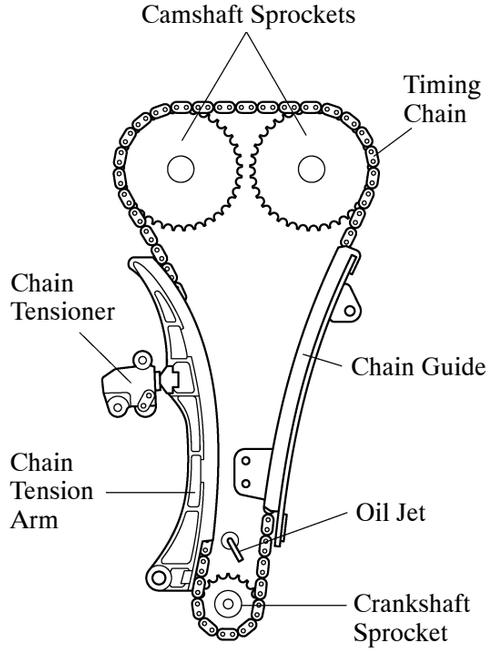


▶ Specifications ◀ mm (in.)

Item	Intake Valve	Exhaust Valve
Face Diameter	30.5 (1.2)	25.5 (1.0)
Stem Diameter	5.0 (0.20)	5.0 (0.20)

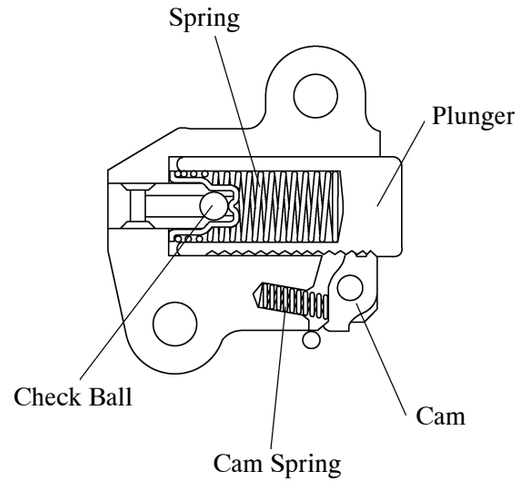
4. Timing Chain

- A roller timing chain with an 8.0 mm pitch has been adopted to make the engine more compact and reduce chain noise.
- A material which has excellent wear resistance has been selected for the timing chain to improve reliability.
- The timing chain is lubricated by engine oil from an oil jet.
- Chain tensioner, chain tension arm and chain guide are established to reduce the engine noise and friction loss.



5. Chain Tensioner

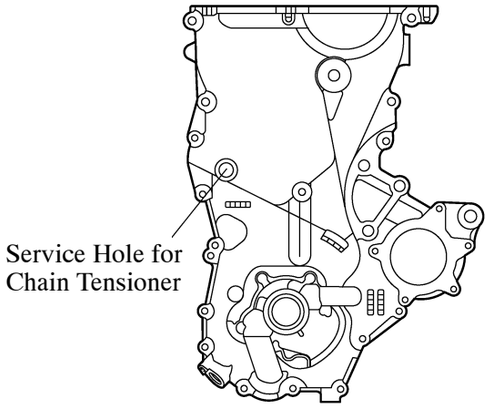
- The chain tensioner uses a spring and oil pressure to maintain proper chain tension at all times.
  The chain tensioner suppresses noise generated by the chain.
- A ratchet type half-back mechanism is used.



171EG13

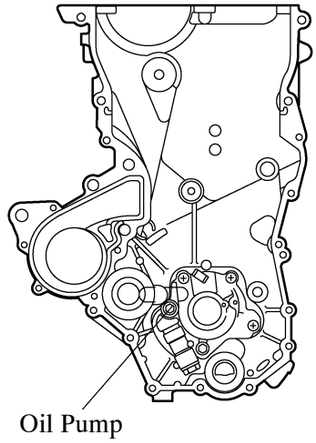
6. Timing Chain Cover

- A single-piece, aluminum die-cast timing chain cover that entirely seals the front portion of the cylinder block and the cylinder head has been adopted.
- A service hole for the chain tensioner has been provided in the timing chain cover to improve serviceability.



Front View

171EG31

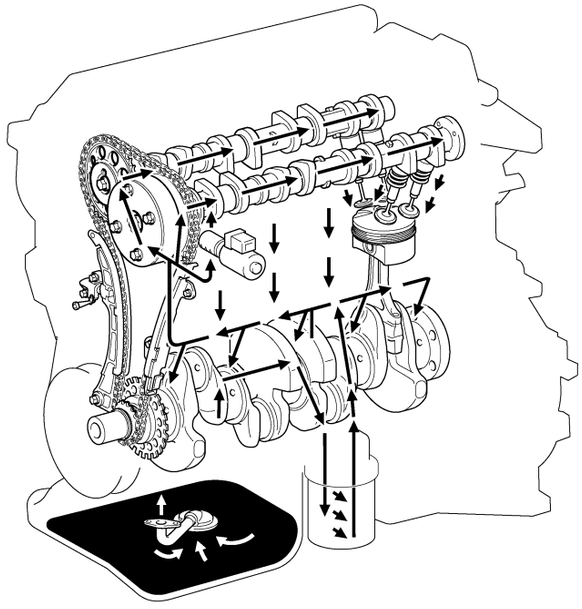


Back View

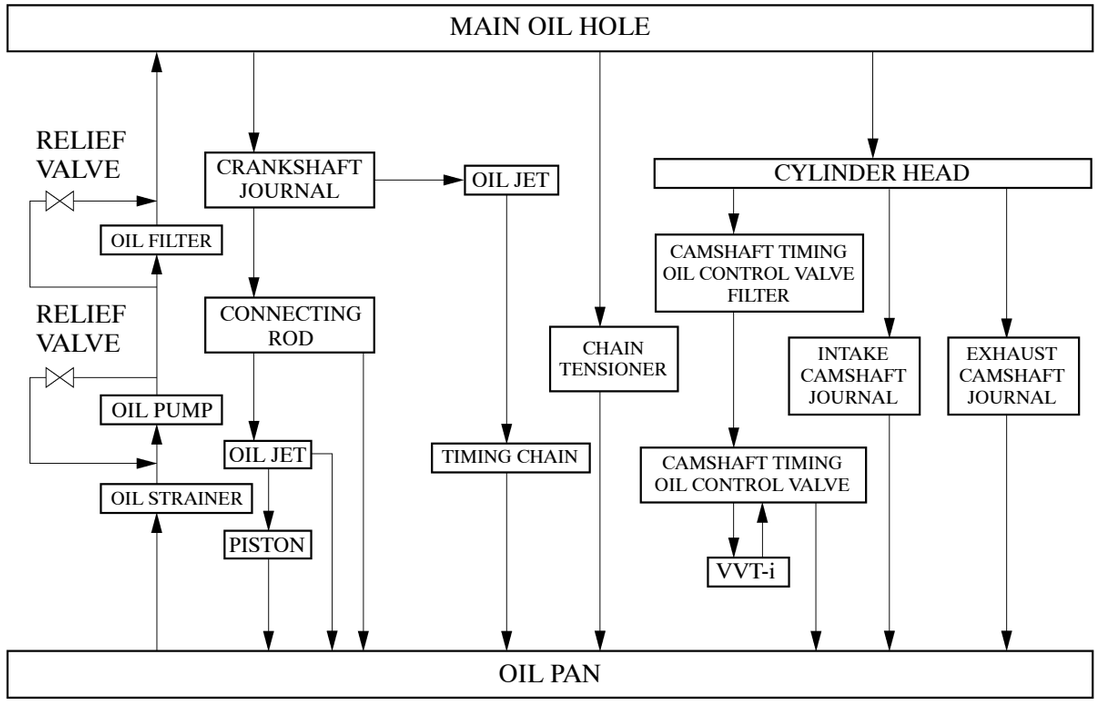
171EG32

■LUBRICATION SYSTEM

- The lubrication circuit is fully pressurized and all oil passes through an oil filter.
- A trochoid gear type oil pump, which is driven directly by the crankshaft, has been provided in the front of the cylinder block.
- The oil filter has been installed diagonally downward from the side of the cylinder block to improve serviceability.



182EG08

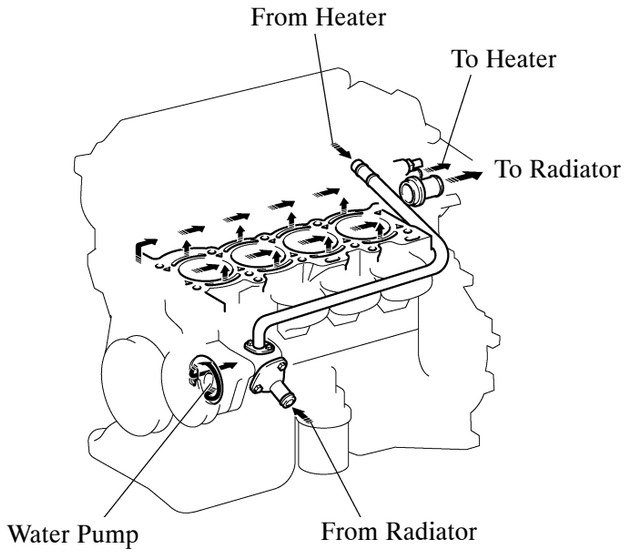


182EG09

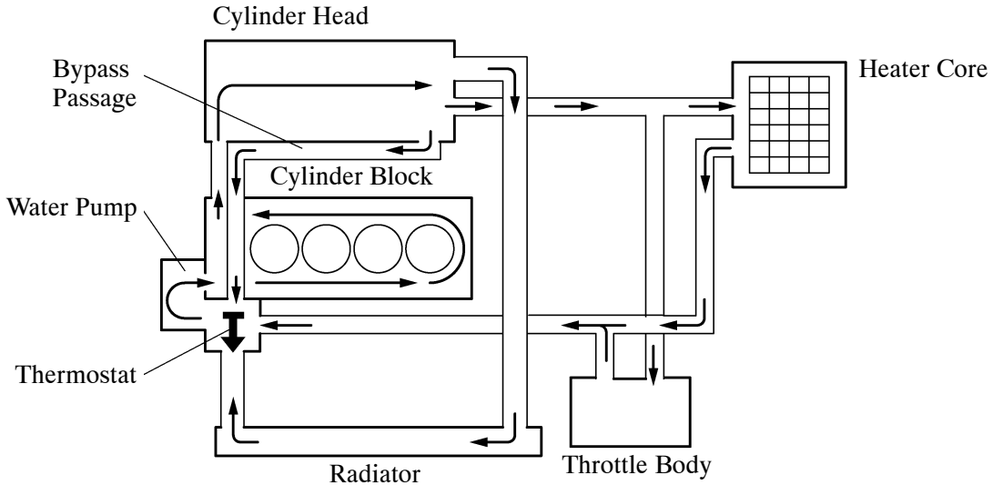
■COOLING SYSTEM

1. General

- The cooling system is a pressurized, forced-circulation type.
- A thermostat with a bypass valve is located on the water inlet housing to maintain suitable temperature distribution in the cooling system.
- The flow of the engine coolant makes a U-turn in the cylinder block to ensure a smooth flow of the engine coolant.
- The radiator for the engine and the A/C condenser have been integrated to minimize the space they occupy in the engine compartment.



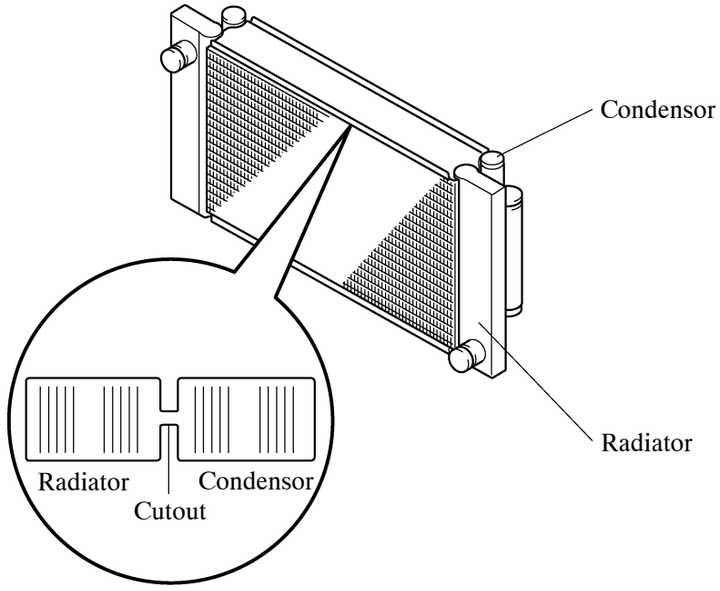
182EG10



171EG17

2. Radiator

The radiator for the engine and the A/C condenser have been integrated to minimize the space they occupy in the engine compartment. Cutouts have been provided between the radiator and condenser sections to prevent the transfer of heat between the two sections.

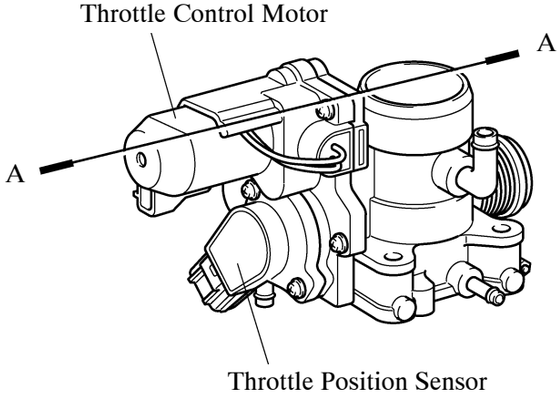


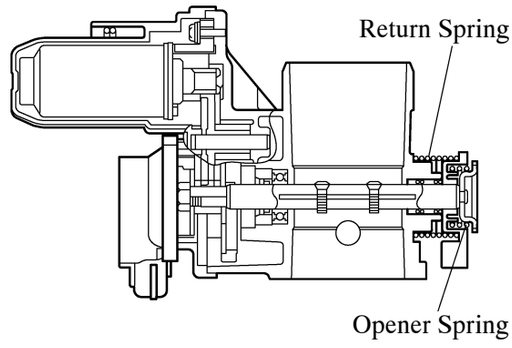
182EG11

■INTAKE AND EXHAUST SYSTEM

1. Throttle Body

- The adoption of the ETCS-i has realized excellent throttle control.
- The ISC system and cruise control system are controlled comprehensively by the ETCS-i.
- The ETCS-i, which drives the throttle valve through a DC motor that is controlled by the ECM, thus doing away with a throttle link to connect the accelerator pedal to the throttle valve, has been adopted.
- The throttle control motor is provided with a return spring that closes the throttle valve.
- An opener spring is provided on the throttle position sensor side. This spring opens the throttle valve slightly when the engine is stopped to prevent the throttle valve from sticking and to improve the engine's restartability.
- A warm coolant passage is provided below the throttle body to prevent the throttle valve from freezing during cold temperatures.



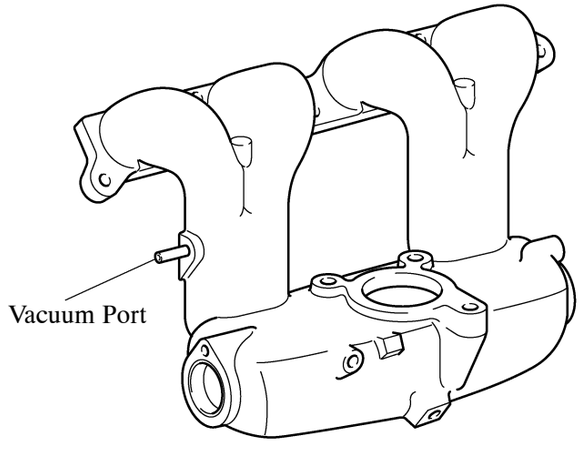


A – A Cross Section

182EG12

2. Intake Manifold

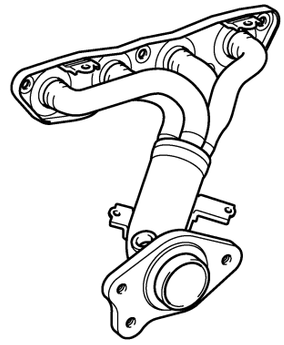
- Because it is not necessary to improve the intake air efficiency through inertial intake due to the adoption of the Atkinson cycle, the length of the intake pipe of the intake manifold has been shortened, and furthermore, the intake pipes for cylinders #1 and #2, as well as for #3 and #4, have been integrated midstream to achieve a large-scale weight reduction.
  In addition, the throttle body has been oriented downflow in the center of the surge tank to achieve a uniform intake air distribution.
- A vacuum port has been provided for the Toyota HC adsorber and catalyst system.



182EG13

3. Exhaust Manifold

- A ball joint has been adopted for coupling the exhaust manifold to the front pipe in order to improve reliability.
- A stainless steel exhaust manifold is used for weight reduction.

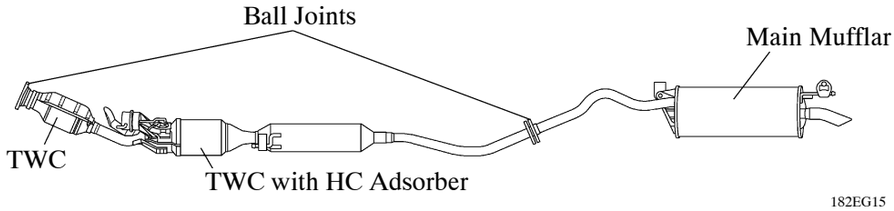


182EG14

4. Muffler

General

- A ball joint has been adopted for coupling the exhaust manifold to the exhaust pipe and the exhaust pipe to the main muffler to achieve a simple configuration and improved reliability.
- The ceramic walls in the front TWC (Three-Way Catalytic Converter) have been decreased in thickness and increased in density from the conventional models.
  By decreasing the thermal capacity in this manner, it becomes easier to heat the catalyst and the catalyst's exhaust cleansing performance is improved.
- A Toyota HCAC (HC Adsorber and Catalyst) system has been adopted to improve the clean emission performance of the exhaust gases when the temperature of the TWC is low.



182EG15

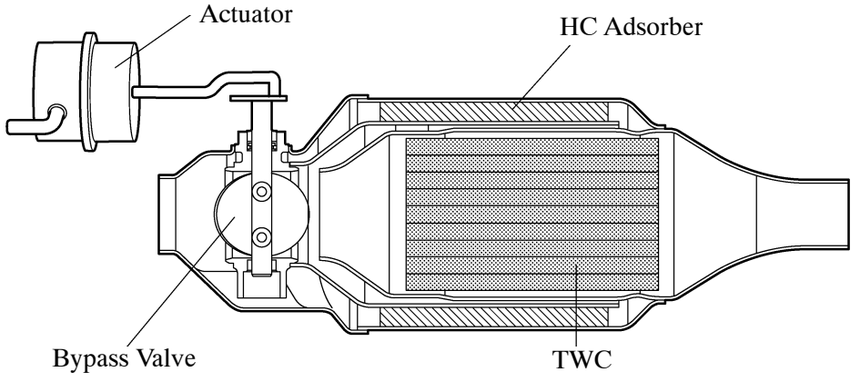
Toyota HCAC System

a) General

This system provides HC adsorber coaxially to the TWC to improve the clean emission performance of the exhaust gases when the temperature of the TWC is low.

b) Construction

This system consists of HC adsorber, TWC, actuator, bypass valve.



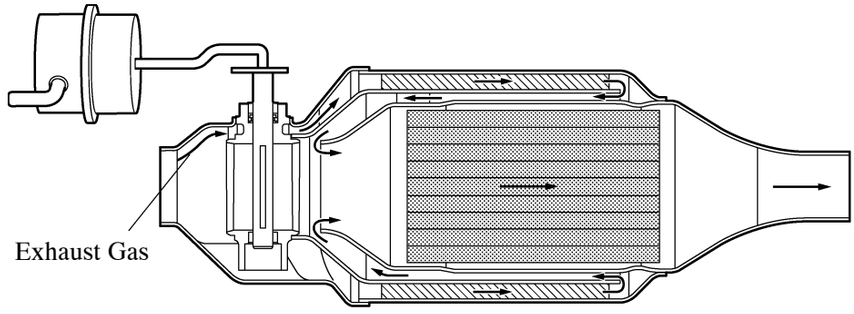
182EG16

c) Operation

Before the engine is started, the bypass valve remains open. When the engine is started, the ECM outputs a signal to the VSV (for HC adsorber and catalyst system), which is applying a vacuum to the actuator. As a result, the bypass valve closes.

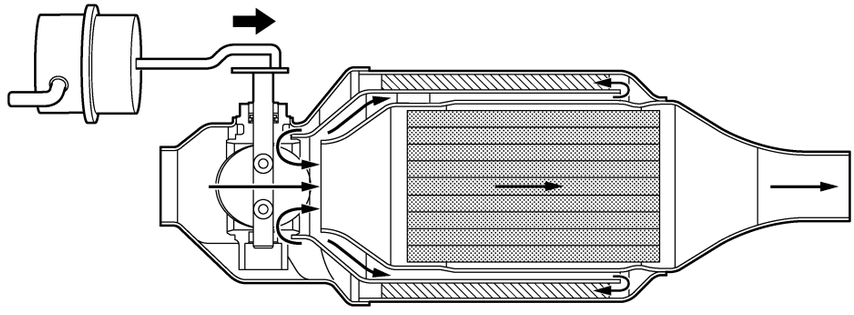
Immediately after the engine has started, the exhaust gases pass through the HC adsorber in which HC adsorbed and stored for a certain time (until the temperature of the HC adsorber rises). And prevent the HC emitted from the tail pipe when the temperature of the TWCs are low.

After the TWC has warmed up, the VSV closes to the bypass valve to open. Then, as the temperature of the rear TWC rises, the temperature of the HC absorber that surrounds it also rises, and the HC starts to be desorbed, and cleaned by the TWC.
Furthermore, this system activates the VSV after the HC adsorber is warmed up and triggerd by deceleration condition, the bypass valve is closed in order to scavenge the HC that remains in the HC adsorber.



Cold Engine or Scavenging Mode

182EG17



Warm Engine

182EG18

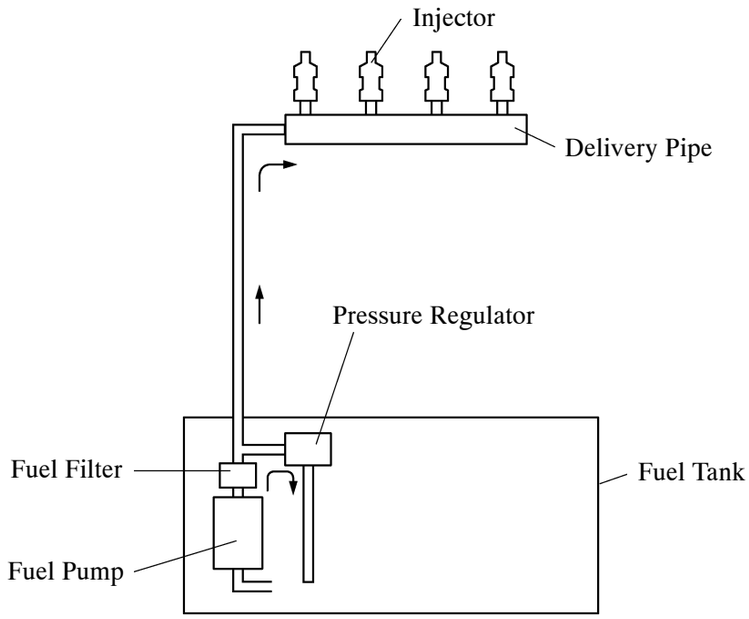
■FUEL SYSTEM

1. Injector

A compact 12-hole type injector has been adopted to improve the atomization of fuel.

2. Fuel Returnless System

This system is to reduce the evaporative emission. As shown below, integrating the pressure regulator and fuel filter with the fuel pump assembly made it possible to discontinue the return of fuel from the engine area and prevent temperature rise inside the fuel tank.



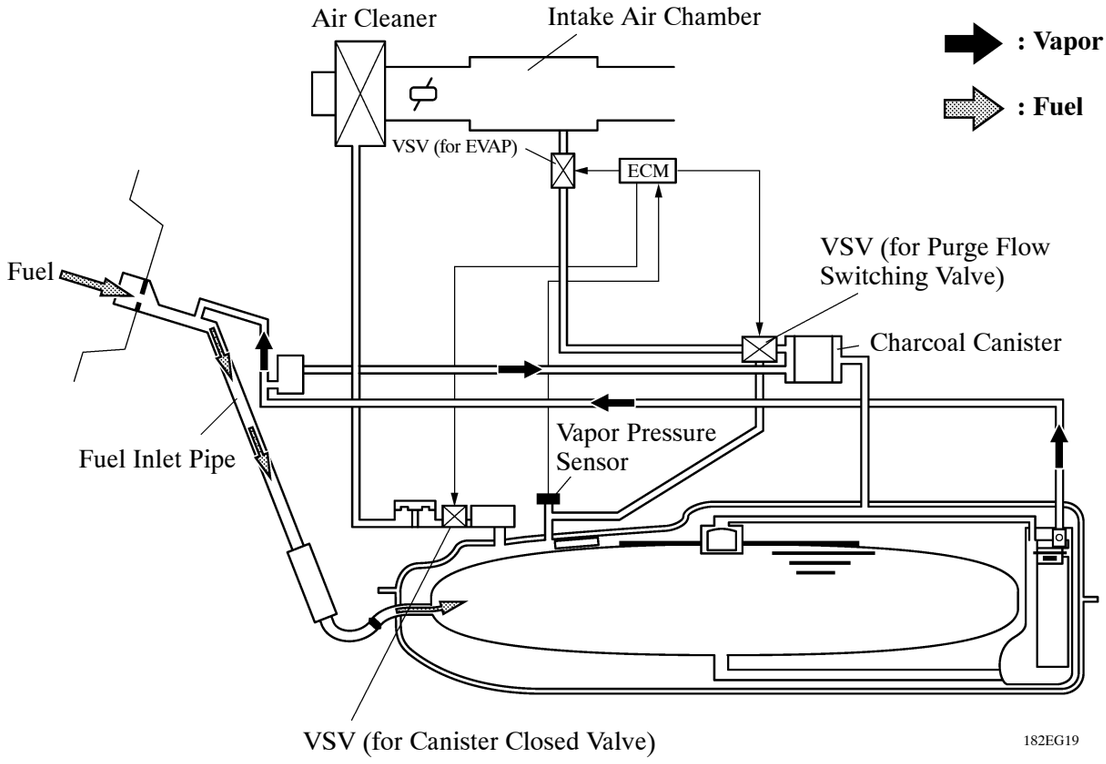
182EG38

3. Quick Connector

Quick connector has been adopted to connect the fuel pipe with the fuel hose to improve serviceability.

4. 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.



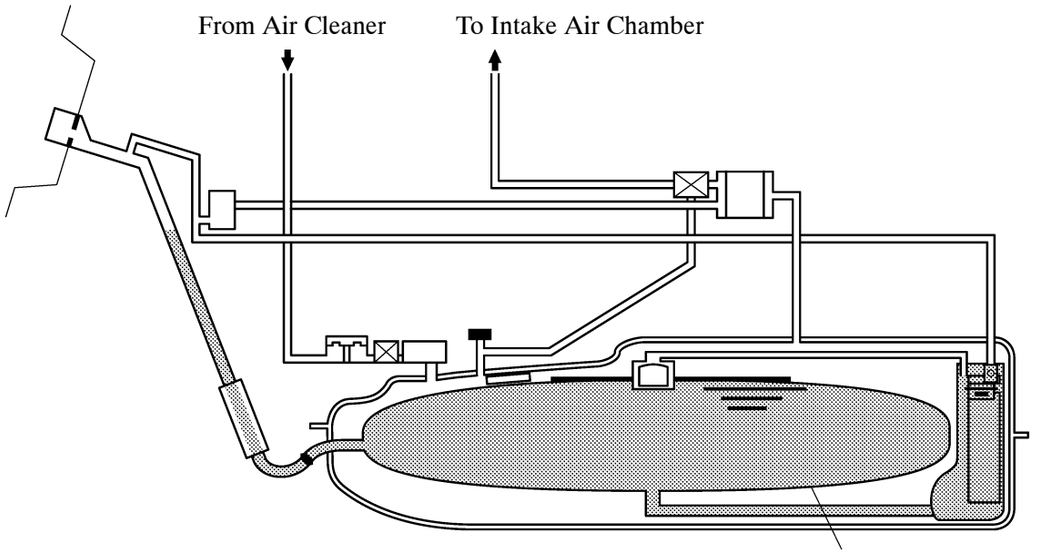
5. Fuel Tank

General

- To reduce the amount of fuel vapor generated when the vehicle is parked, during refueling, or while driving, a vapor reducing fuel tank system has been adopted.
  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.
- Along with the provision of the vapor reducing fuel tank whose size fluctuates in the fuel tank, the fuel gauge and the fuel pump have been provided in the sub tank. For this reason, a direct-acting fuel gauge has been adopted.

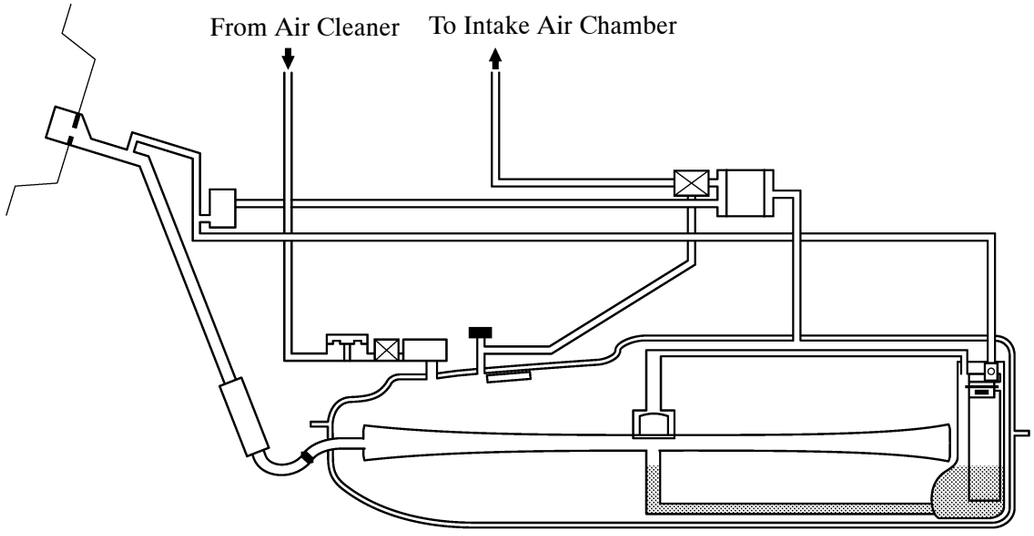
  NOTE: At low ambient temperatures, the capacity of the vapor reducing fuel tank is reduced as it is made of resin (When the outside temperature is at −10°C (14°F) the size of the tank will be reduced by approximate 5 liters).

▶ System Diagram ◀



When the Tank is Full

182EG20



When the Tank is Empty

182EG21

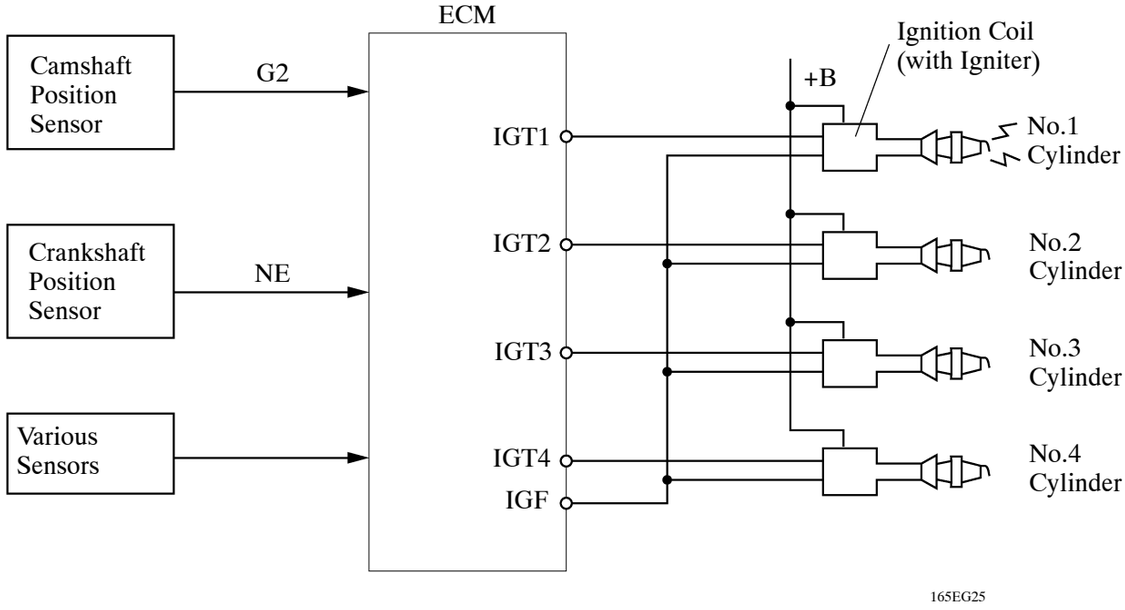
Fuel Gauge

- A direct-acting fuel gauge has been provided in the sub tank.
- This gauge consists of a pipe that is surrounded by a coil, and a float in the pipe moves up and down with the fluctuation of the fuel level.
  A magnet is attached to the back side of the float. The up or down movement of the float causes a change in the magnetic field. The flow of current through the coil creates a potential difference, and the resultant voltage is transmitted to the meter ECU. For details, see page 146 (Meter Section).

■IGNITION SYSTEM

1. General

A DIS (Direct Ignition System) has been adopted. The DIS improves the ignition timing accuracy, reduces high-voltage loss, and enhances the overall reliability of the ignition system by eliminating the distributor. The DIS in 1NZ-FXE engine is an independent ignition system which has one ignition coil (with igniter) for each cylinder.



2. Ignition Coil

The DIS provides 4 ignition coils, one for each cylinder. The spark plug caps, which provide contact to the spark plugs, are integrated with an ignition coil. Also, an igniter is enclosed to simplify the system.

3. Spark Plug

Iridium-tipped spark plugs have been adopted to realize a 60,000-mile (100,000 km) maintenance-free operation. Their center electrode is made of iridium, which excels in wear resistance. As a result, the center electrode is made with a smaller diameter and improved the ignition performance.

■CHARGING AND STARTING SYSTEM

MG1 and MG2 (Motor Generator No.1 and 2) have been adopted in the charging system, and the conventional generator has been discontinued.
Furthermore, due to the adoption of MG1 for the starting system, the conventional starter has been discontinued.

■ENGINE CONTROL SYSTEM

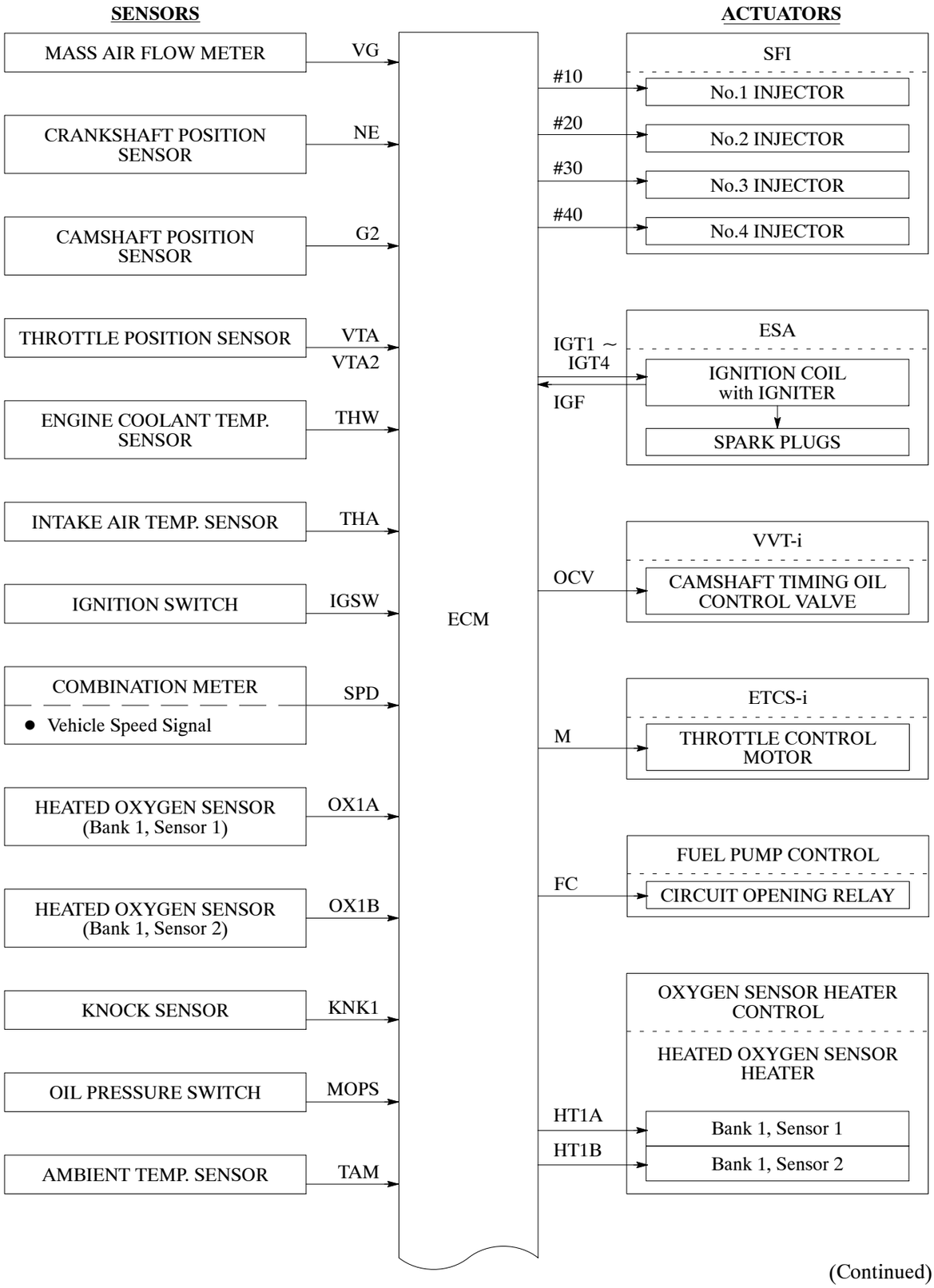
1. General

The engine control system for the 1NZ-FXE engine has following system.

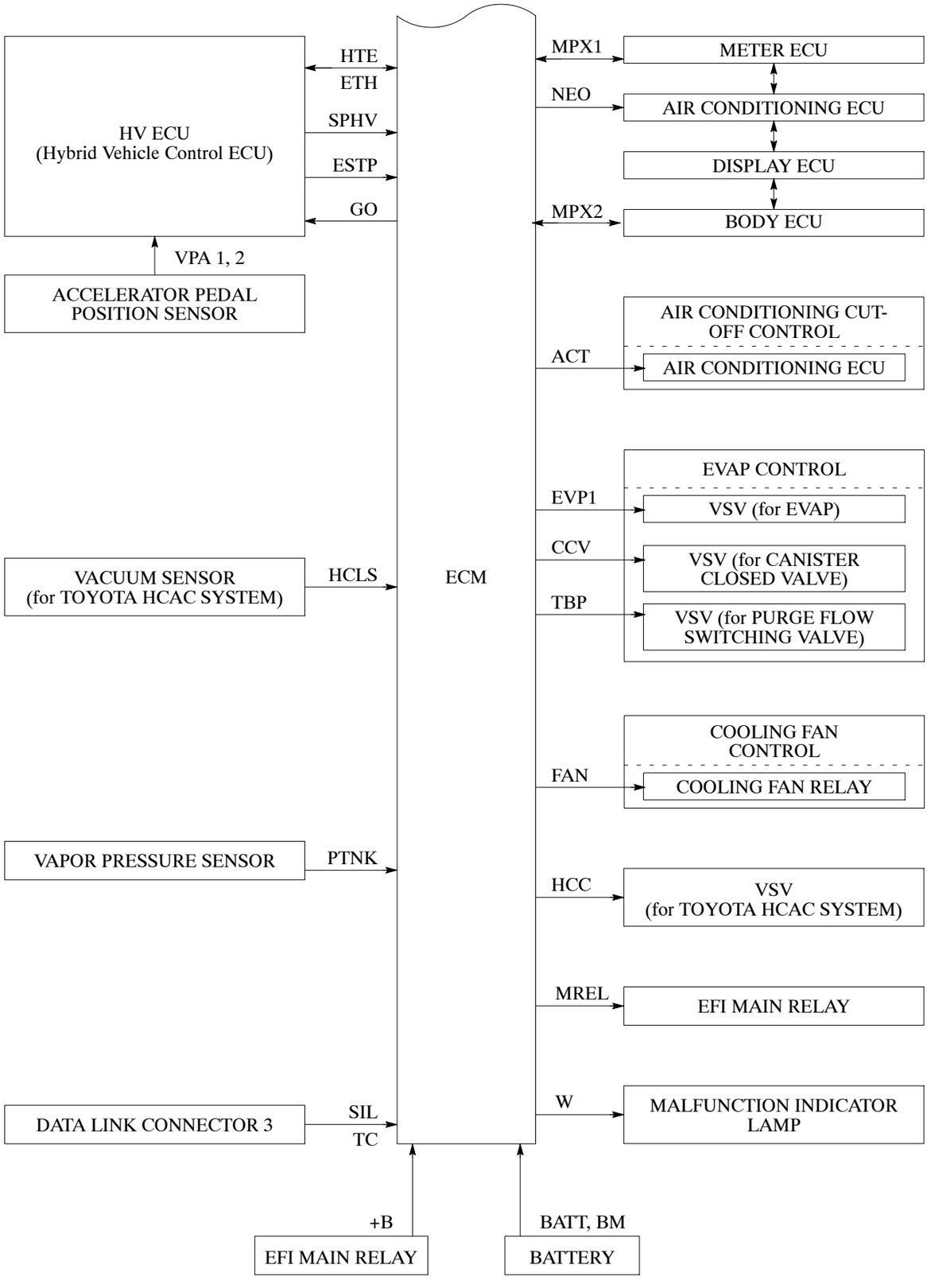
System	Outline
SFI (Sequential Multiport Fuel Injection)	An L-type SFI system directly detects the intake air volume with a hot-wire type mass air flow meter.
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM based on signals from various sensors. The ECM corrects ignition timing in response to engine knocking.
VVT-i (Variable Valve Timing-intelligent)	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.
ETCS-i (Electronic Throttle Control System-intelligent)	Optimally controls the throttle valve opening in accordance with the ECM, and the conditions of the engine and the vehicle, and comprehensively controls the ISC and cruise control system.
Fuel Pump Control	● Fuel pump operation is controlled by signal from the ECM. ● To stop the fuel pump during operation of the SRS airbag.
Oxygen Sensor Heater Control	Maintains the temperature of the oxygen sensors at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.
Evaporative Emission Control	● The ECM controls the purge flow of evaporative emissions (HC) in the charcoal canister in accordance with engine conditions. ● Using 3 VSVs and a vapor pressure sensor, the ECM detects any evaporative emission leakage occurring between the fuel tank and the charcoal canister, and vapor reducing fuel tank through the changes in the tank pressure. For details, see page 79.
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. For details, see page 58.
Air Conditioning Cut-Off Control	By turning the air conditioning compressor OFF in accordance with the engine condition, drivability is maintained.
Cooling Fan Control	Radiator cooling fan operation is controlled by signals from ECM based on the engine coolant temperature sensor signal (THW).
HV Immobiliser	Prohibits fuel delivery, ignition, and starting the HV system if an attempt is made to start the HV system with an invalid ignition key. For details, see page 80.
Diagnosis	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.
Fail-Safe	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in memory.

2. Construction

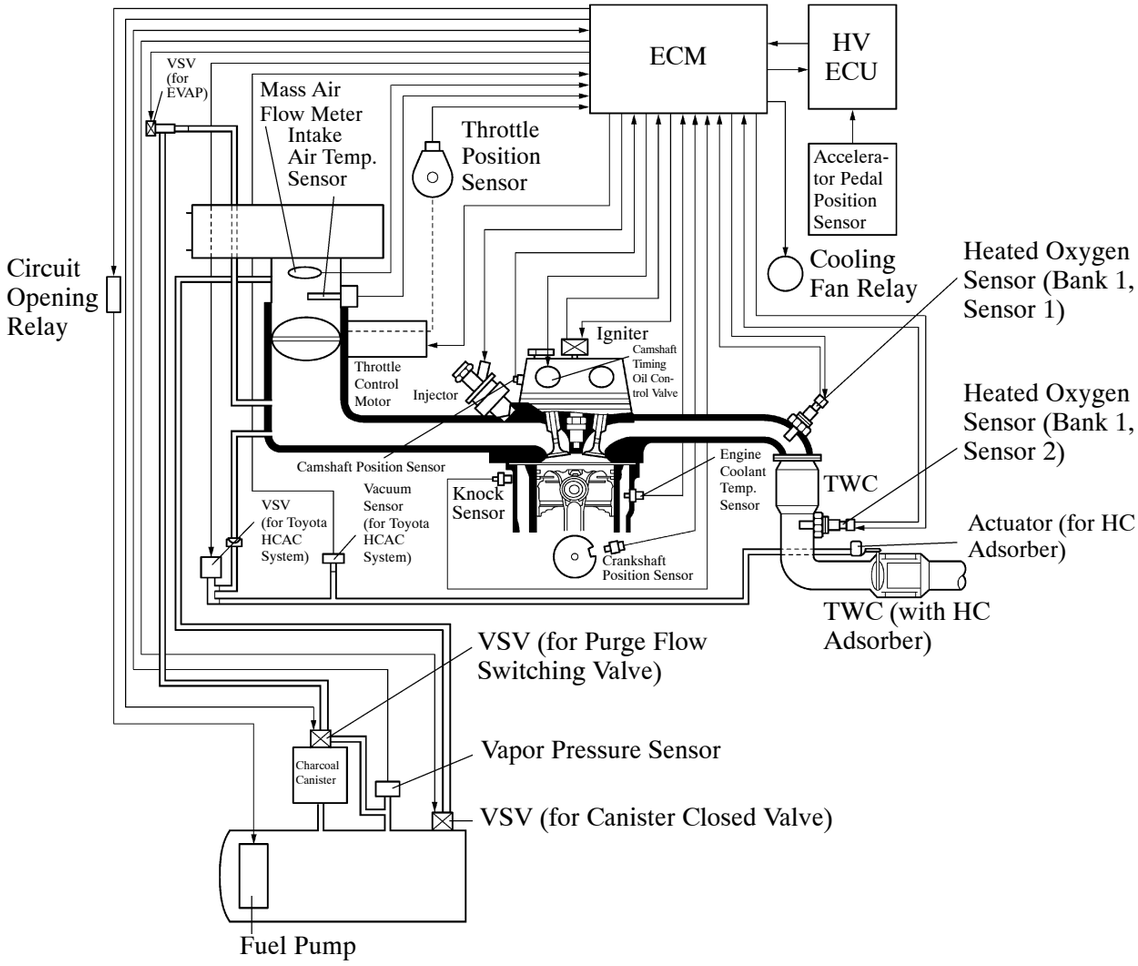
The configuration of the engine control system in the INZ-FXE engine is shown in the following chart.



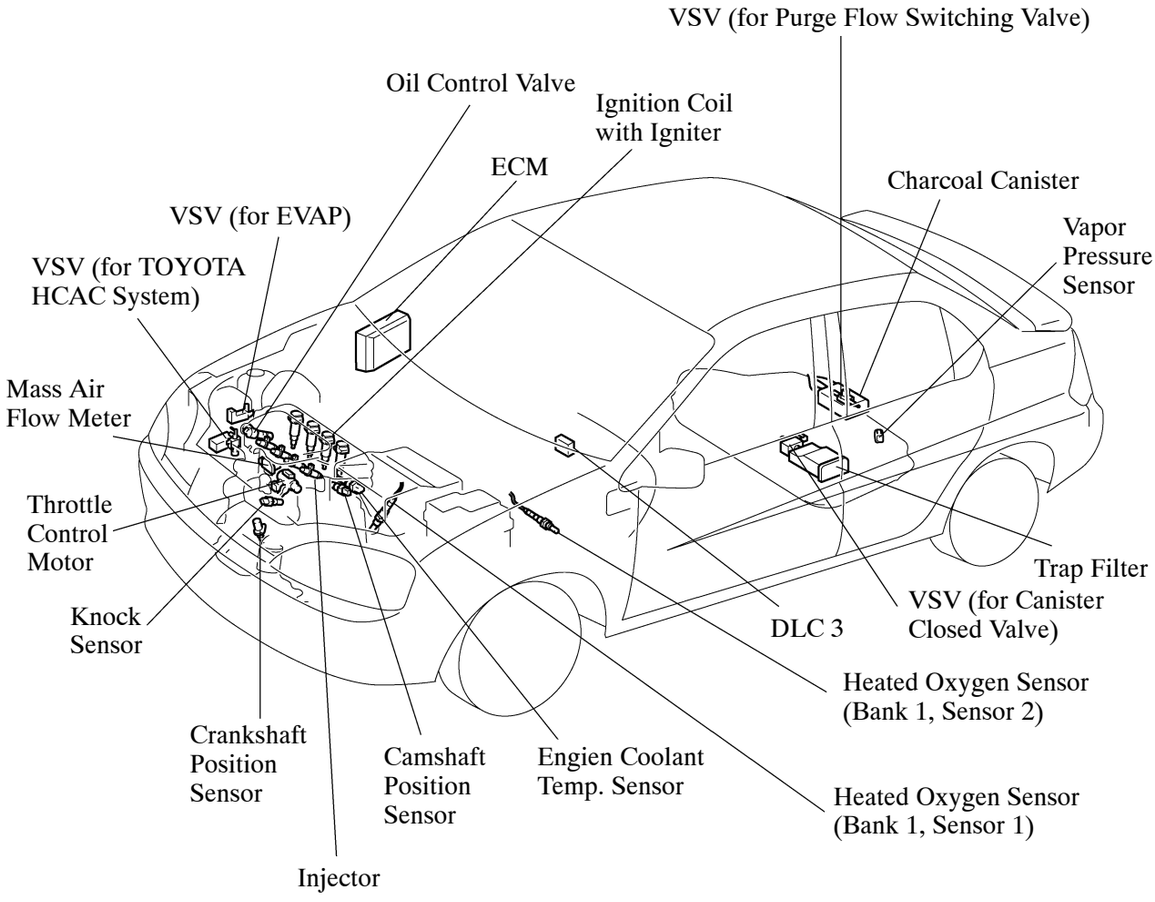
(Continued)


HV ECU
(Hybrid Vehicle Control ECU)
HTE
ETH
SPHV
ESTP
GO
VPA 1, 2
ACCELERATOR PEDAL POSITION SENSOR
VACUUM SENSOR
(for TOYOTA HCAC SYSTEM)
HCLS
VAPOR PRESSURE SENSOR
PTNK
DATA LINK CONNECTOR 3
SIL
TC
+B
EFI MAIN RELAY
BATT, BM
BATTERY
ECM
MPX1
METER ECU
NEO
AIR CONDITIONING ECU
DISPLAY ECU
MPX2
BODY ECU
AIR CONDITIONING CUT-OFF CONTROL
ACT
AIR CONDITIONING ECU
EVAP CONTROL
EVP1
VSV (for EVAP)
CCV
VSV (for CANISTER CLOSED VALVE)
TBP
VSV (for PURGE FLOW SWITCHING VALVE)
COOLING FAN CONTROL
FAN
COOLING FAN RELAY
HCC
VSV
(for TOYOTA HCAC SYSTEM)
MREL
EFI MAIN RELAY
W
MALFUNCTION INDICATOR LAMP

3. Engine Control System Diagram



4. Layout of Components



182EG23

5. Main Components of Engine Control System

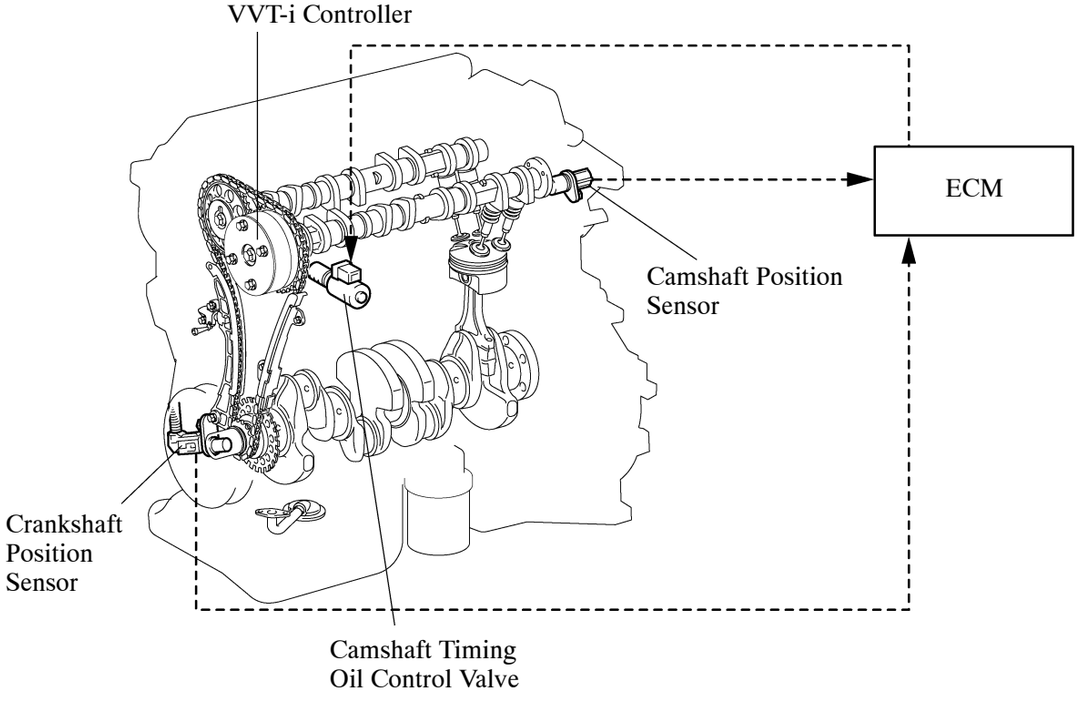
The main components of the 1NZ-FXE engine control system are as follows:

Components	Outline	Quantity
Mass Air Flow Meter	Hot-Wire Type	1
Crankshaft Position Sensor (Rotor's Teeth)	Pick-Up Coil Type (36-2)	1
Camshaft Position Sensor (Rotor's Teeth)	Pick-Up Coil Type (3)	1
Throttle Position Sensor	Linear Type (Double)	1
Knock Sensor	Built-In Piezoelectric Element Type	1
Oxygen Sensor	Heated Oxygen Sensor (Bank 1, Sensor 1) (Bank 1, Sensor 2)	2
Injector	12-Hole Type	4

6. VVT-i (Variable Valve Timing-intelligent) System

General

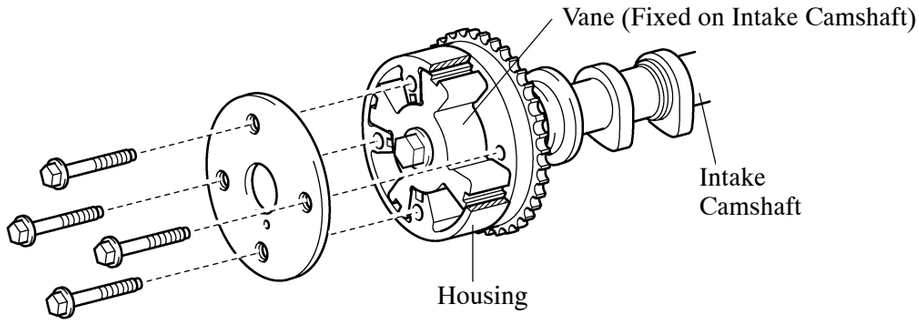
The VVT-i system is designed to control the intake camshaft within a wide range of 43° (of crankshaft angle) to provide a valve timing that is optimally suited to the engine condition, thus realizing improved torque in all the speed ranges and fuel economy, and reduce exhaust emissions.



Construction

1) VVT-i Controller

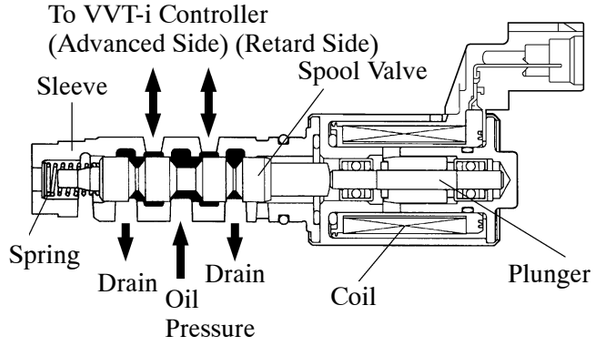
This controller consists of the housing driven from the timing chain and the vane coupled with the intake camshaft.
The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.



182EG40

2) Camshaft Timing Oil Control Valve

The camshaft timing oil control valve controls the spool valve position in accordance with the duty control from the ECM thus allocating the hydraulic pressure that is applied to the VVT-i controller to the advance and the retard side. When the engine is stopped, the camshaft timing oil control valve is in the most retarded state.



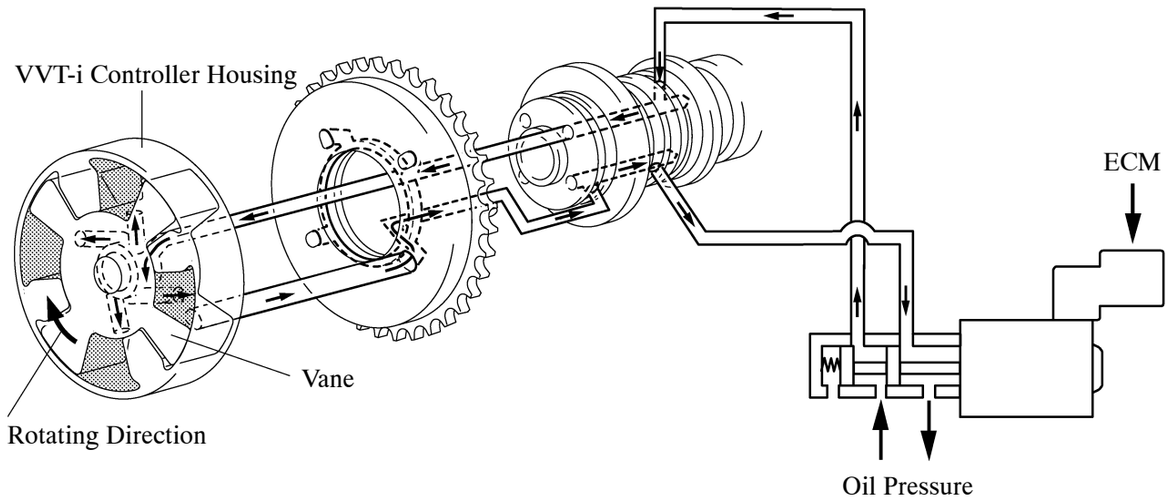
165EG34

Operation

The camshaft timing oil control valve selects the path to the VVT-i controller according to the advance, retard or hold signal from the ECM. The VVT-i controller rotates the intake camshaft in the timing advance or retard position or holds it according to the position where the oil pressure is applied.

1) Advance

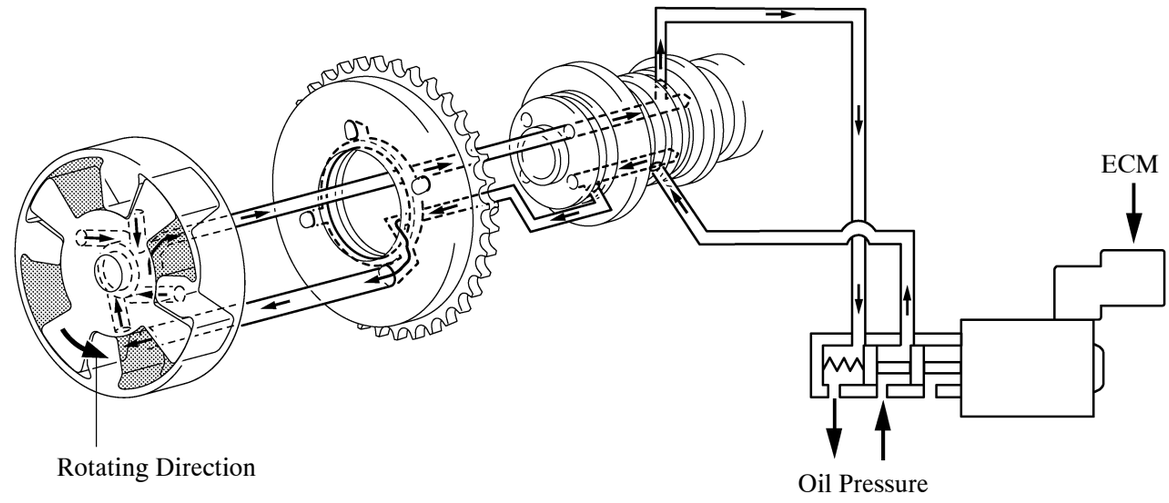
When the camshaft timing oil control valve is positioned as illustrated below by the advance signal from the ECM, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



185EG18

2) Retard

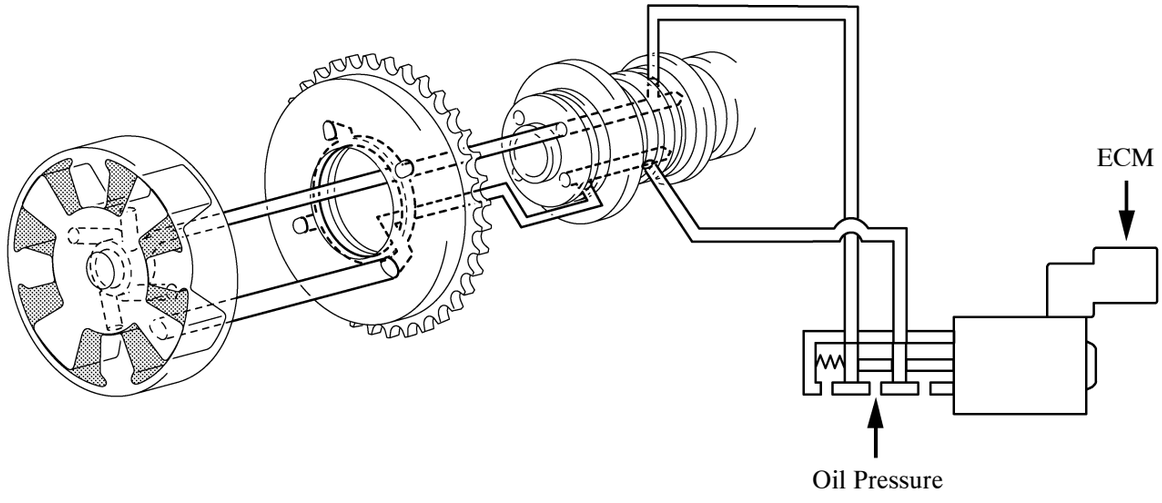
When the camshaft timing oil control valve is positioned as illustrated below by the retard signal from the ECM, the resultant oil pressure is applied to the timing retard side vane chamber to rotate the camshaft in the timing retard direction.



185EG19

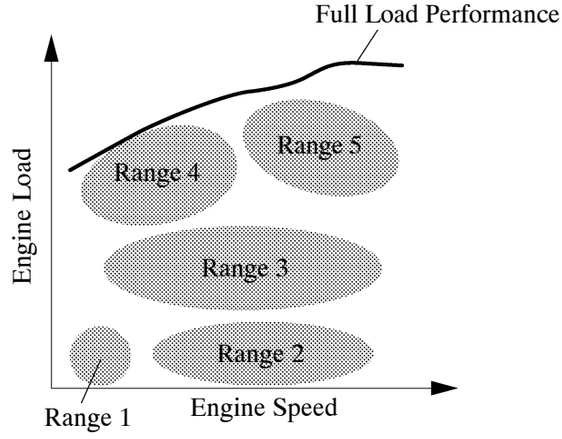
3) Hold

The ECM calculates the target timing angle according to the traveling state to perform control as described in the previous page. After setting at the target timing, the valve timing is held by keeping the camshaft timing oil control valve in the neutral position unless the traveling state changes.
This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.

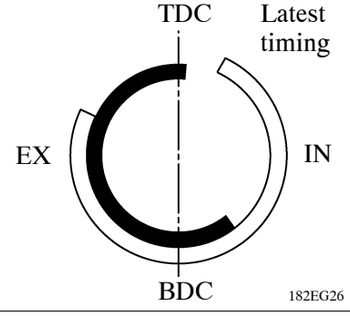
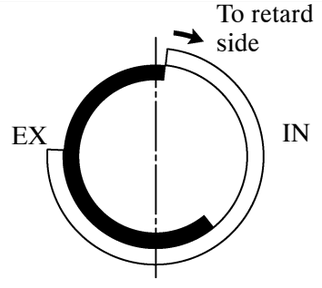
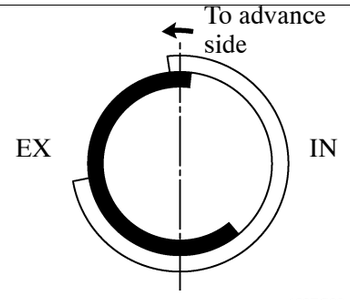


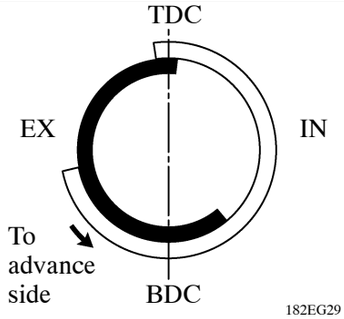
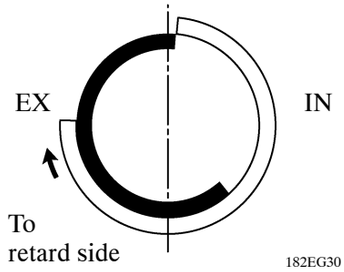
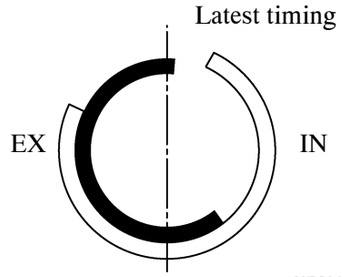
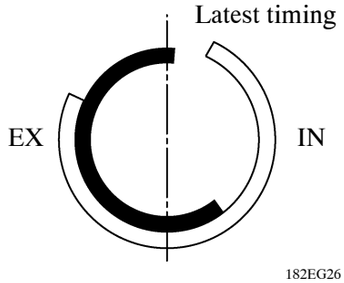
In proportion to the engine speed, intake air volume, throttle position and water temperature, the ECM calculates an optimal valve timing under each driving condition and control the camshaft timing oil control valve. In addition, ECM uses signal from the camshaft position sensor and the crankshaft position sensor to detect the actual valve timing, thus performing feedback control to achieve the target valve timing.

▶ Operation During Various Driving Condition (Conceptual Diagram) ◀



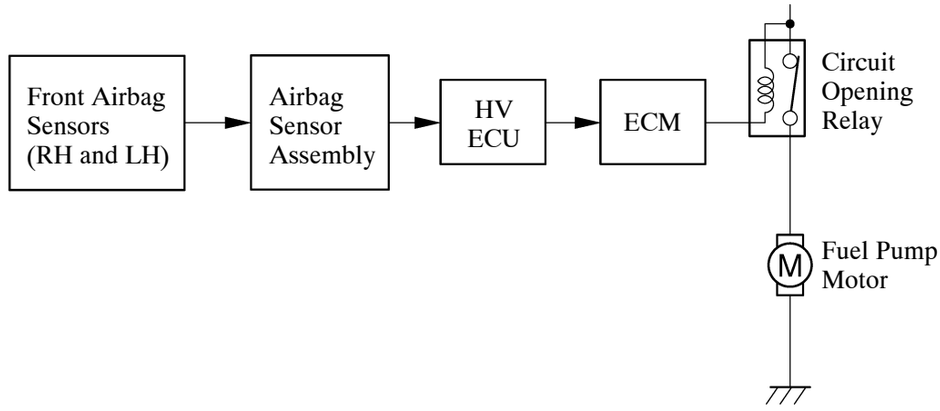
182EG25

Operation State	Range	Valve Timing	Objective	Effect
During Idling	1	 182EG26	Eliminating overlap to reduce blow back to the intake side	Stabilized idling rpm Better fuel economy
At Light Load	2	 182EG27	Decreasing overlap to eliminate blow back to the intake side	Ensured engine stability
At Medium load	3	 182EG28	Increasing overlap to increase internal EGR for pumping loss elimination	Better fuel economy Improved emission control

Operation State	Range	Valve Timing	Objective	Effect
In Low to Medium Speed Range with Heavy Load	4		Advancing the intake valve close timing for volumetric efficiency improvement	Improved torque in low to medium speed range
In High Speed Range with Heavy Load	5		Retarding the intake valve close timing for volumetric efficiency improvement	Improved output
At Low Temperatures	—		Eliminating overlap to prevent blow back to the intake side for reduction of fuel increase at low temperatures, and stabilizing the idling rpm for decreasing fast idle rotation	Stabilized fast idle rpm Better fuel economy
Upon Starting/ Stopping the Engine	—		Eliminating overlap to eliminate blow back to the intake side	Improved startability

7. Fuel Pump Control

A fuel cut control is adopted to stop the fuel pump when the SRS airbag is deployed, thus helping reduce fuel leakage.
In this system, the airbag deployment signal from the airbag sensor assembly is detected by the HV ECU, send the signal to ECM, which turns OFF the circuit opening relay.
After the fuel cut control has been activated, turning the ignition switch from OFF to ON cancels the fuel cut control, thus engine can be restarted.



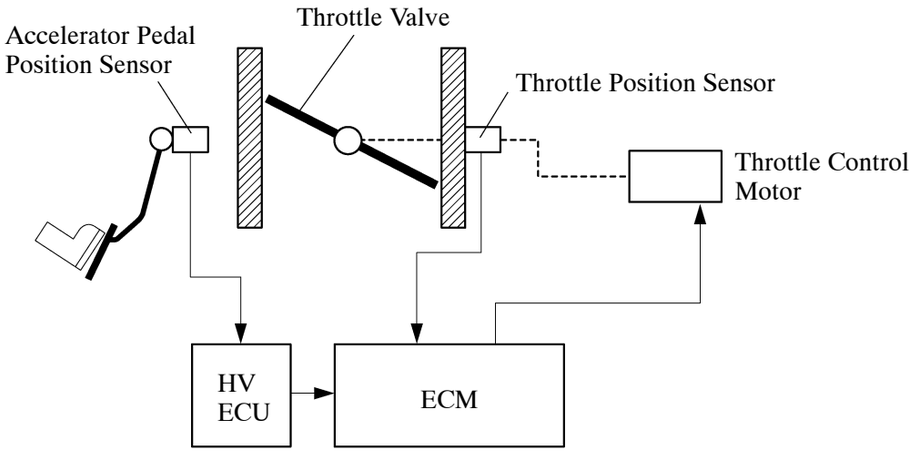
182EG39

8. ETCS-i (Electronic Throttle Control System-intelligent)

General

- The ETCS-i, which realizes excellent throttle control in all the operating ranges, has been adopted.
- In the conventional throttle body, the throttle valve opening is determined invariably by the amount of the accelerator pedal effort. In contrast, the ETCS-i used the ECM to calculate the optimal throttle valve opening that is appropriate for the respective driving condition and uses a throttle control motor to control the opening.
- The ETCS-i controls the ISC (Idle Speed Control) system and the cruise control system.

▶ System Diagram ◀

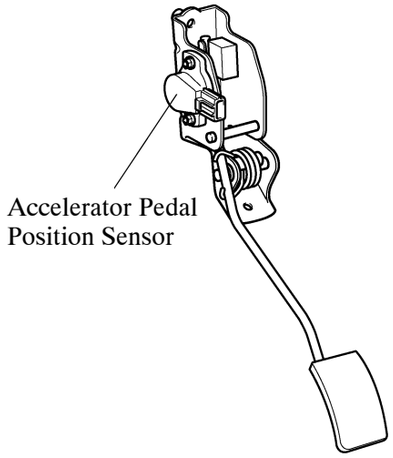


182EG31

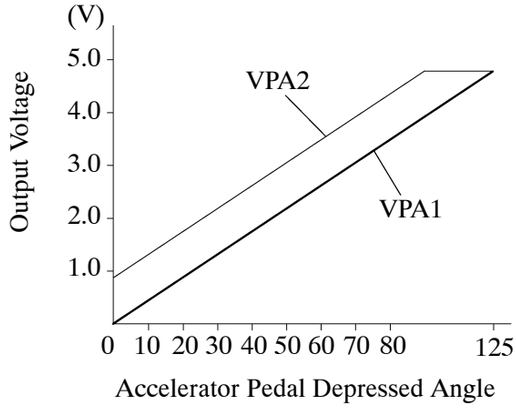
Construction

1) Accelerator Pedal Position Sensor

The accelerator pedal position sensor is mounted on the accelerator pedal. To detect the pedal opening angle, 2 separate systems consisting of main and sub sensors are used, and 2 separate return springs are used to improve reliability. In the detecting portions, Hall elements have been adopted. Due to the characteristics of the Hall elements, different signals are output depending on whether the pedal is pressed all the way or is released. To correct these signals, a mechanical device has been provided to detect the correct pedal opening angle. The sensors of the 2 systems output the same signals.



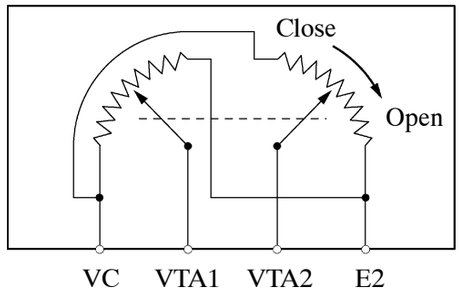
182EG32



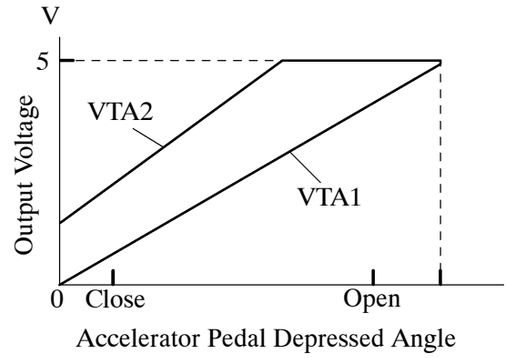
182EG33

2) Throttle Position Sensor

The throttle position sensor is mounted on the throttle body.
The throttle position sensor converts the amount of accelerator pedal effort into two types of electrical signals with distinct output characteristics. The signals are then input into the ECM.



150EG40



150EG39

3) Throttle Control Motor

A DC motor with excellent response and minimal power consumption is used for the throttle control motor. The ECM performs the duty ratio control of the direction and the amperage of the current that flows to the throttle control motor in order to regulate the opening angle of the throttle valve.

Operation

The ECM drives the throttle control motor by determining the target throttle valve opening in accordance with the respective operating condition.

1) Idle Speed Control

The idle speed control is effected entirely by the ETCS-i. The following are the contents of the control: idle-up control during cold engine operation, intake air volume control to improve the startability of the engine, and control for when the electrical load changes such as when the air conditioning switch is turned ON or OFF.

2) Cruise Control

Through the adoption of the ETCS-i, the vehicle speed is now controlled by the throttle control motor, which controls the throttle valve.

Fail Safe

If an abnormal condition occurs with the ETCS-i, the check engine warning light in the combination meter illuminates to alert the driver. The current to the throttle control motor is cut off to prevent the ETCS-i from operating. This enables the return spring to close the throttle valve.

Diagnosis

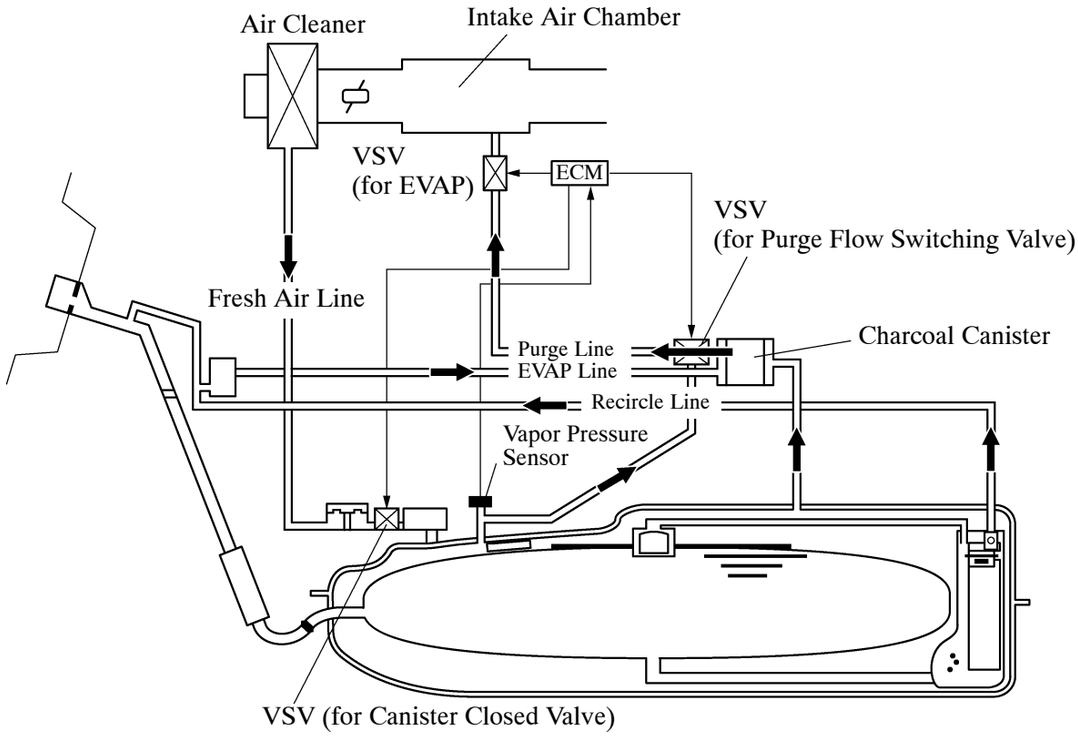
If the diagnostic trouble code 89 is being output to the combination meter check engine warning light, it means that the ECM has detected a malfunction in the ETCS-i, and outputs the diagnostic trouble code of the ETCS-i.
Also, the diagnostic trouble code can be output to a hand-held tester via the data link connector 3.
For details, refer to the 2001 Prius Repair Manual (Pub. No.RM778U).

9. Evaporative Emission Control

General

A vacuum system has been newly adopted to detect leaks in the evaporative emission control system. This vacuum system detects leaks by forcefully introducing the purge vacuum into the entire system and monitoring the changes in the pressure.
In order to detect evaporative emission leaks from the vapor reducing fuel tank, a density method has been adopted. This system uses an oxygen sensor to measure the HC density in the exhaust gases in order to detect leaks.
It consists of the following main conponents:

- A VSV (for canister closed valve) has been provided between the fresh air line and the fuel tank.
- The VSV (for purge flow switching valve) switches the passages from the charcoal canister to the purge line and from the fuel tank to the purge line.
- A vapor pressure sensor has been provided in the fuel tank in order to further ensure the precision of the vapor pressure sensor.
- DTCs (Diagnostic Trouble Codes) have been added. For details on the DTCs (Diagnostic Trouble Codes), refer to the 2001 Prius Repair Manual (Pub. No.RM778U).



182EG34

Operation

Initially, the VSV (for canister closed valve) is closed, and the VSV (for EVAP) is open, enabling the VSV (for purge flow switching valve) to keep the passage between the charcoal canister and the purge line open. This causes a vacuum to be applied to the purge line, evaporator line, recirculation line, and the line from the charcoal canister to the fuel tank.
Next, the VSV (for EVAP) is closed in order to maintain a vacuum from the VSV (for EVAP) to the inside of the fuel tank. Then, any subsequent changes in the pressure are monitored by the vapor pressure sensor in order to check for evaporative emission leaks.
Next, the VSV (for canister closed valve) and the VSV (for EVAP) open, enabling the VSV (for purge flow switching valve) to keep the passage between the fuel tank and the purge line open. Then, the air in the fuel tank is drawn in by the vacuum of the intake chamber, and the density of HC in the exhaust gases is measured by the oxygen sensor to detect any leaks.
If a leak is detected, the malfunction indicator lamp (MIL) illuminates to inform the driver. Also, the diagnostic trouble code (DTC) can be accessed through the use of a hand-held tester.
For details on the DTCs, refer to the 2001 Prius Repair Manual (Pub. No.RM778U).

10. HV Immobiliser System

The HV immobiliser system has been designed to prevent the vehicle from being stolen. This system uses a HV ECU that stores the ID code of the authorized ignition key. If an attempt is made to start the HV system using an unauthorized key, the HV ECU prohibit fuel delivery, ignition, and starting the HD system effectively disabling the engine.
For details see page 184 in the HV Immobiliser System section.

11. Diagnosis System

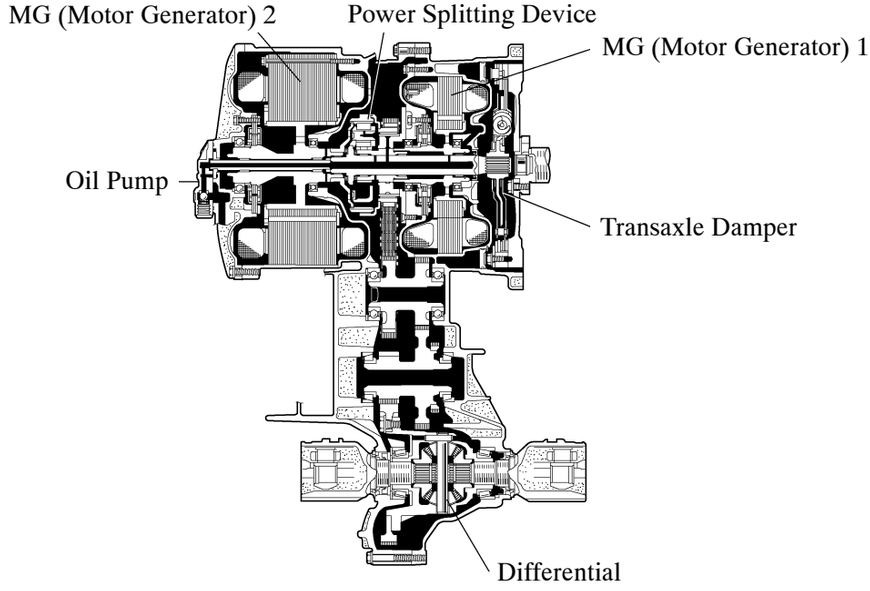
The diagnostic trouble codes can be output via DLC3 to an OBD-II scan tool or a hand-held tester. For details, refer to the 2001 Prius Repair Manual (Pub. No.RM778U).

CHASSIS

P111 HYBRID TRANSAXLE

■ DESCRIPTION

The P111 hybrid transaxle has been newly developed for the hybrid system application.
Containing a MG (Motor Generator) 2 for driving the vehicle and a MG (Motor Generator) 1 for generating electrical power, the P111 hybrid transaxle uses a continuously variable transmission mechanism with power splitting device that achieve smooth and quiet operation.



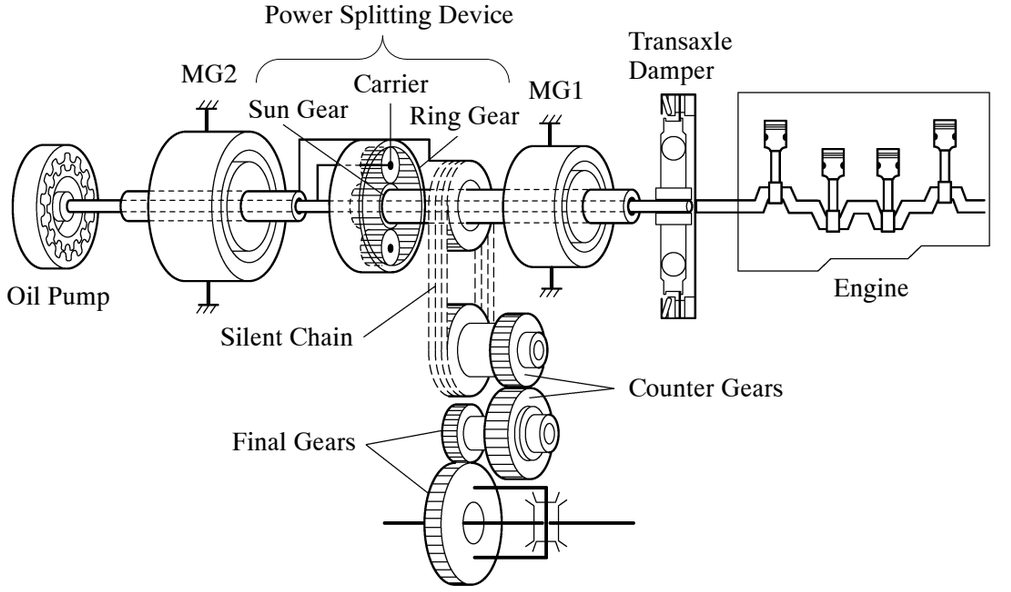
▶ Specifications ◀

Planetary Gear	The No. of Ring Gear Teeth	78
	The No. of Pinion Gear Teeth	23
	The No. of Sun Gear Teeth	30
Gear Ratio		3.905
Chain	Number of Links	74
	Drive Sprocket	39
	Driven Sprocket	36
Counter Gear	Drive Gear	30
	Driven Gear	44
Final Gear	Drive Gear	26
	Driven Gear	75
Fluid Capacity	Liters (US qts, Imp.qts)	4.6 (4.9, 4.0)
Fluid Type		ATF Type T-IV or equivalent

■TRANSAXLE UNIT

1. General

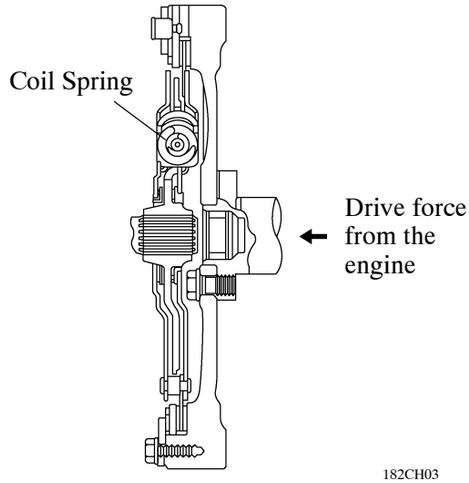
The transaxle unit consists primarily of a transaxle damper, MG (Motor Generator) 1, MG2, power splitting device and a reduction unit (containing a silent chain, counter gears, and final gears).



182CH02

2. Transaxle Damper

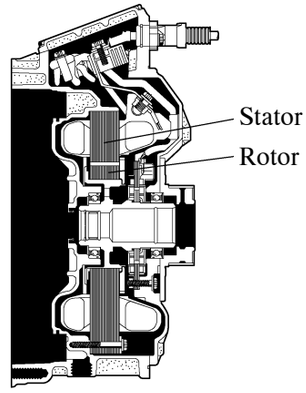
- A coil-spring type damper with low-twist characteristics has been adopted as the mechanism to transmit the drive force from the engine.
- A torque fluctuation absorbing mechanism that uses a dry-type single-plate friction material has been adopted.



182CH03

3. MG (Motor Generator) 1

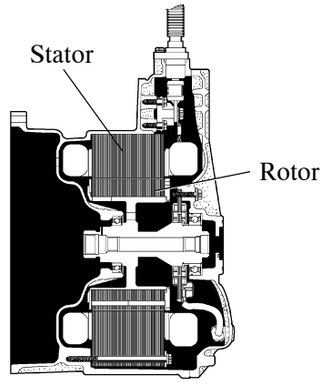
The MG1 recharges the HV (Hybrid Vehicle) battery and supplies electrical power to drive the MG2. In addition, by regulating the amount of electrical power generated, thus varying the MG2's speed, the MG1 effectively controls the continuously variable transmission function of the transaxle. Connected to the sun gear of the planetary gear unit, MG1 also functions as a starter for starting the engine.



182CH05

4. MG (Motor Generator) 2

Serving as the source of supplemental motive force that provides power assist to the output of the engine as needed, the electric motor helps the vehicle achieve an excellent dynamic performance that includes smooth start-offs and acceleration. Connected to the ring gear in the planetary gear unit, MG2 is an electric motor that converts the vehicle's kinetic energy that is generated through the activation of the regenerative brake into electrical energy, which is then stored in the HV batteries.

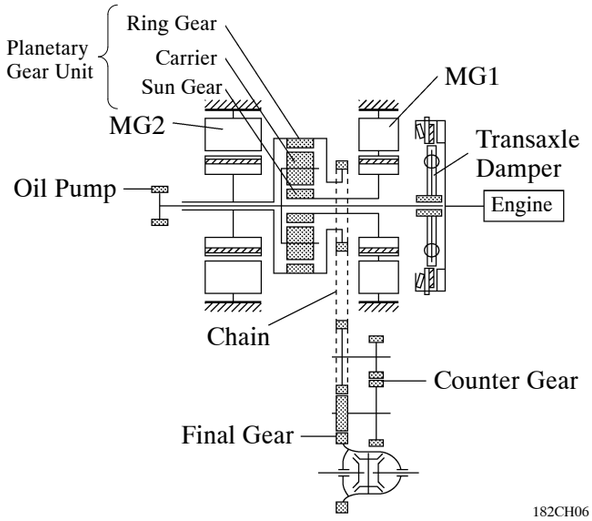


182CH04

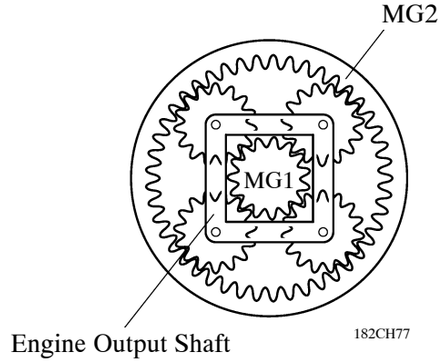
5. Power Splitting Device

General

Planetary gear unit is used for a power splitting device.
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.



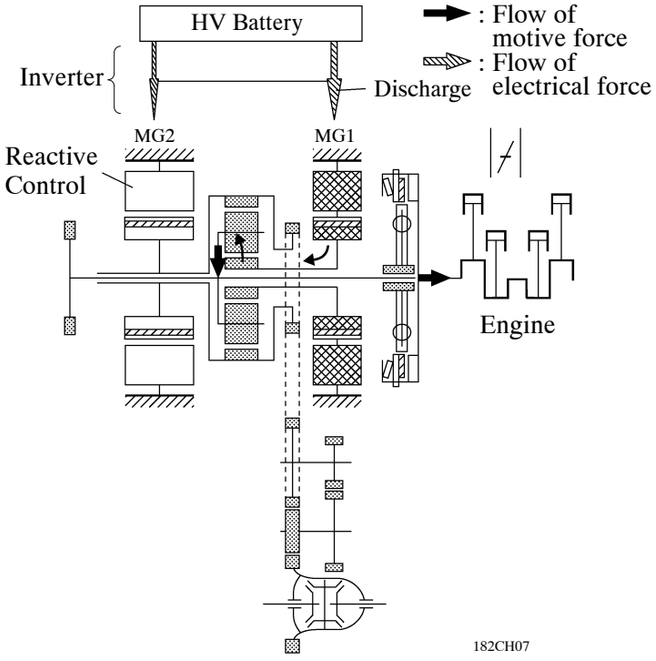
Item	Connection
Sun Gear	MG1
Ring Gear	MG2
Carrier	Engine Output Shaft

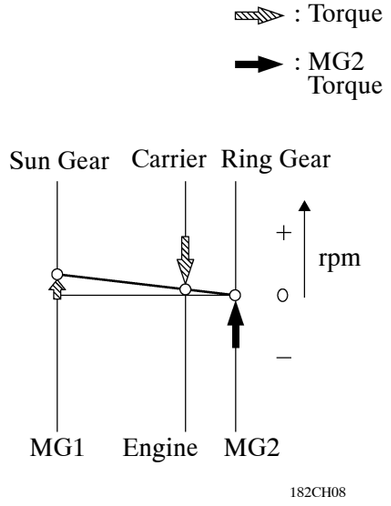


Operation

1) Starting the Engine

Both while the vehicle is stopped and is in motion, the starting of the engine is performed by MG1. Because the motive force is transmitted at this time to the ring gear in the planetary gear unit, an electrical current is applied to MG2 to cancel out the motive force (reactive control).
The nomographic chart below gives a visual representation of the planetary gear's rotational direction, rotational speed, and power balance. In the nomographic chart, the rpm of the 3 gears maintain a relationship in which they are invariably joined by a direct line.

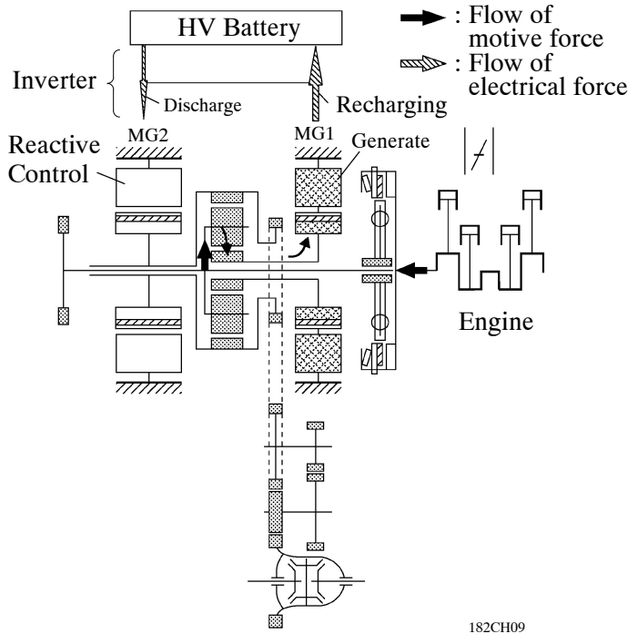


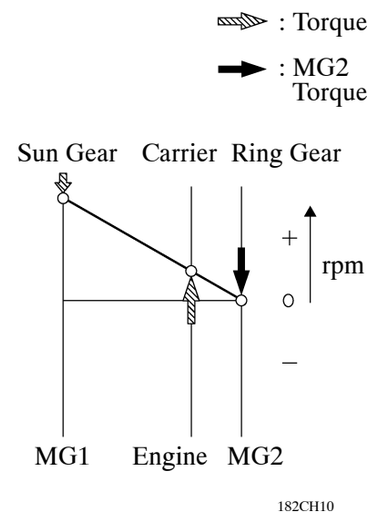


Nomographic Chart of Planetary Gear Unit

2) Generation During Shift Position P

When the shift lever is in the P position, if the SOC (State Of Charge) of the HV batteries exceeds the specified value, the engine remains stopped. However, if the SOC is below the specified value, the engine operates to generate electricity through MG1 in order to recharge the HV batteries. At this time, reactive control is effected to allow the electric current to flow from the HV batteries to MG2, thus receiving the reactive force of MG2.

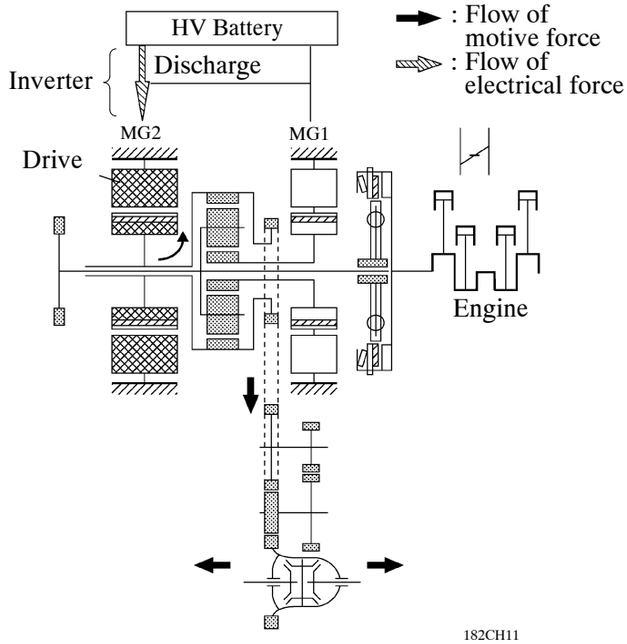


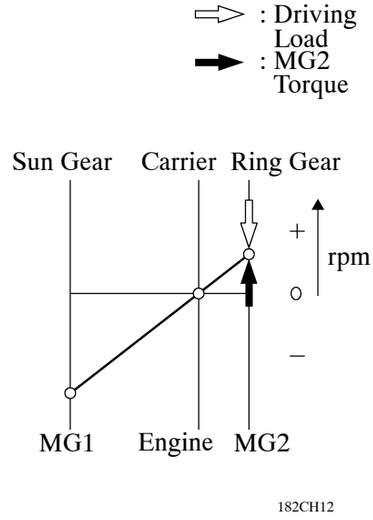


Nomographic Chart of Planetary Gear Unit

3) Starting and Light-Load Driving

When the vehicle is started off or is being driven under light-load conditions, and the SOC of the HV batteries exceeds the specified value, 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. If the SOC is below the specified value, the engine operates to generate electricity through MG1 in order to recharge the HV batteries.

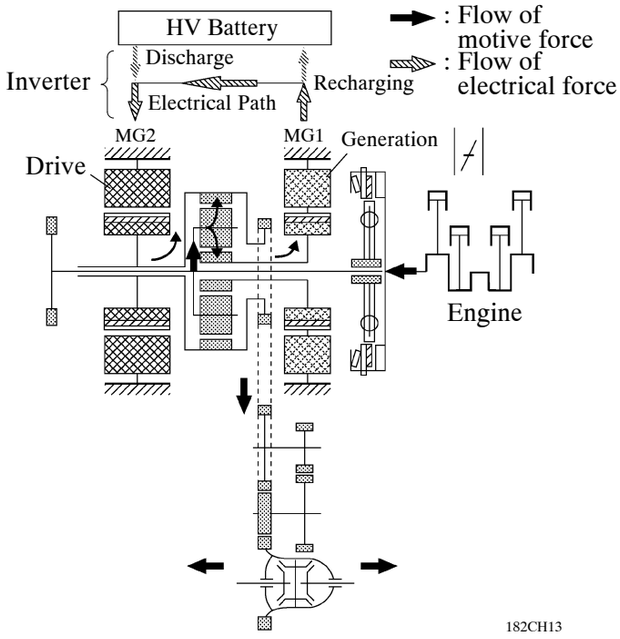


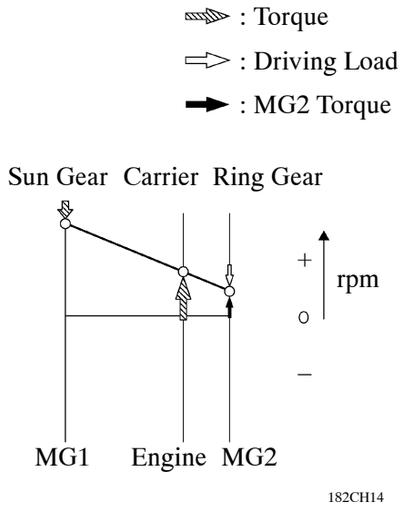


Nomographic Chart of Planetary Gear Unit

4) Normal Traveling

When the vehicle is being driven under normal traveling condition, 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. Under further high-load conditions, the electrical force from the HV batteries is also used as a motive force of MG2.

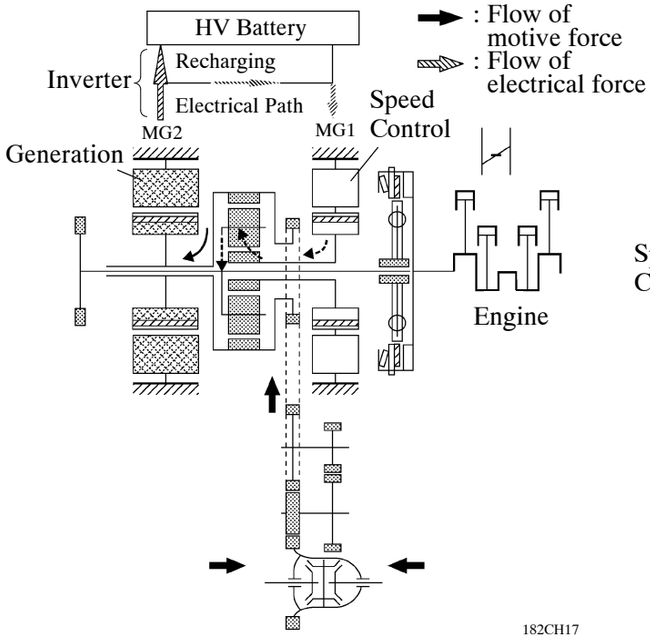


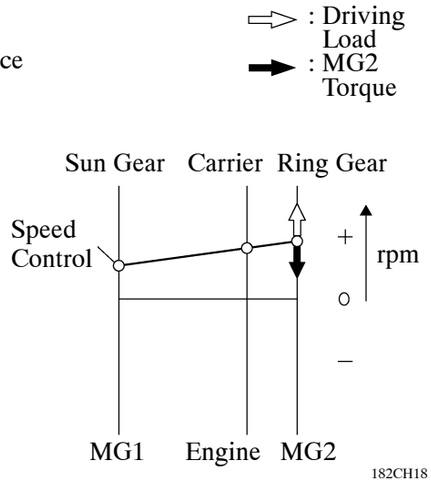


Nomographic Chart of Planetary Gear Unit

5) Deceleration Driving

If the SOC of the HV batteries is within the specified value during deceleration, electricity is generated by MG2 to recharge the HV batteries. If the SOC is excessive, the apportionment of energy to the hydraulic brakes is increased. However, if the shift lever is in position B, the engine is started by MG1 in order to apply the engine brake.

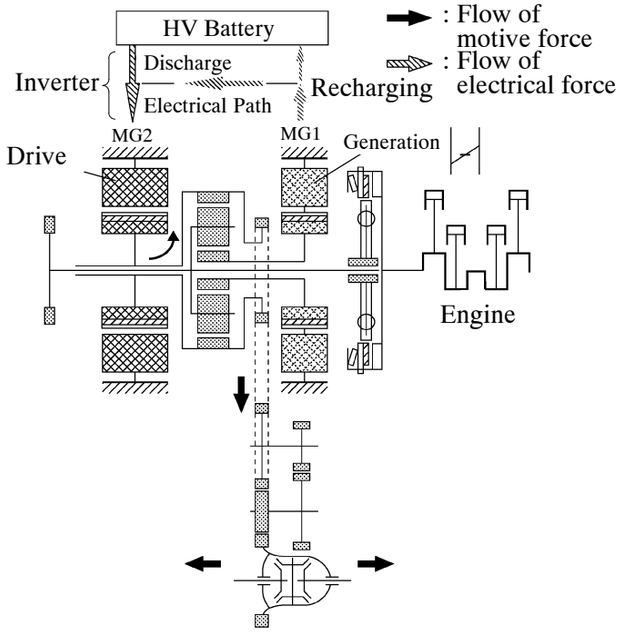




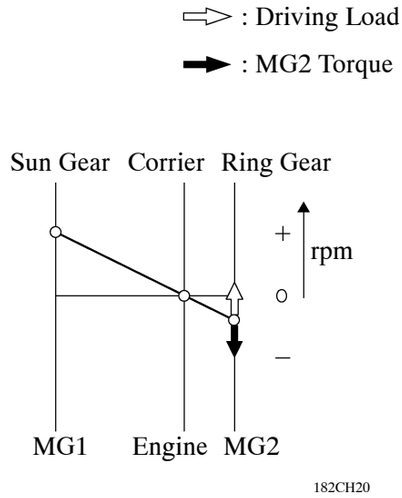
Nomographic Chart of Planetary Gear Unit

6) Reverse Driving

The vehicle drives in reverse powered only by MG2. If the SOC of the HV batteries exceeds the specified value, the vehicle drives powered only by MG2. If the SOC is below the specified value, the engine starts, and the electrical force generated by MG1 passes through the electrical path function of the inverter in order to be used as the motive force of MG2.



182CH19



182CH20

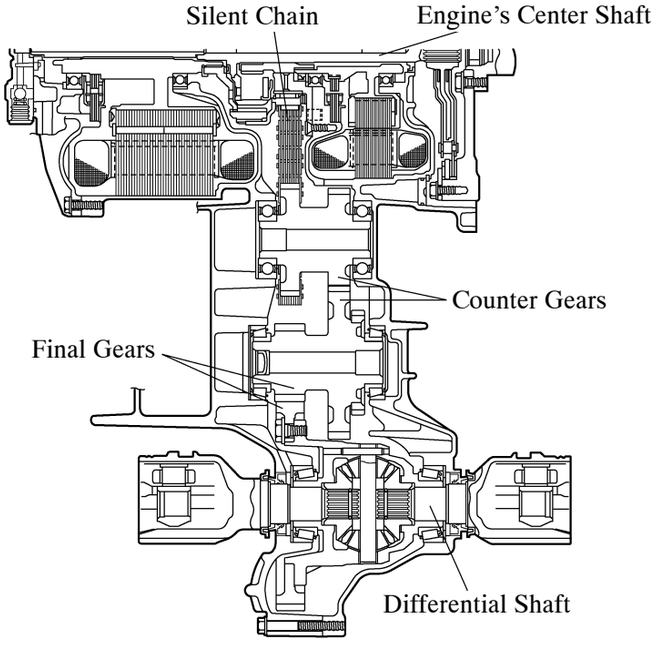
Nomographic Chart of Planetary Gear Unit

NOTICE

Because it is not possible for this transaxle to separate the MG2 output force from the drive wheels when the shift lever is in position N, the generation of electricity is disabled. In this condition, the generation of electricity could cause the motive force to be transmitted, which creates a hazardous situation. Therefore, beware that the HV batteries could become discharged in this state.

6. Reduction Unit

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 housing 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.



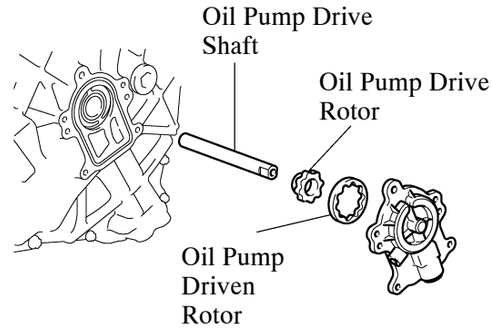
182CH21

■ DIFFERENTIAL UNIT

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

■ LUBRICATION SYSTEM

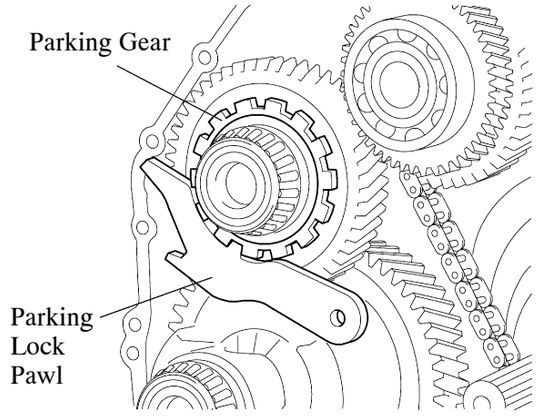
A force-feed lubrication system using a trocoid pump has been adopted for lubrication of the planetary gear unit and the bearings on the main shaft. The oil pump is directly driven by the engine. The same type of oil is used for both the reduction unit portion and the differential portion.



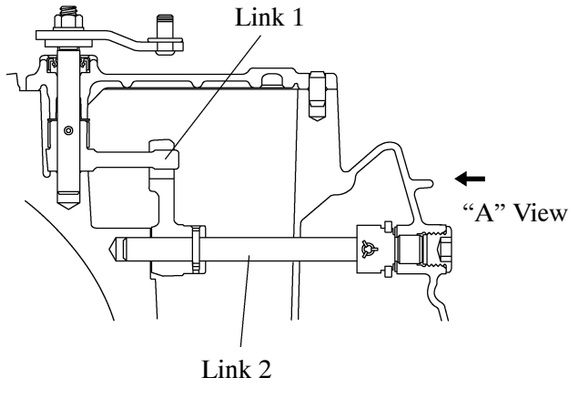
182CH22

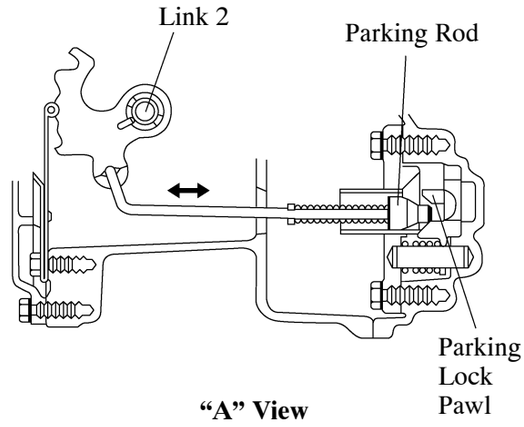
■ PARKING LOCK MECHANISM

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.
The direction of the parking lock pawl changes via the two link mechanisms that are connected to the outer lever through the shift cable. The longitudinal movement of the parking rod causes a vertical movement of the parking lock pawl that meshes with the parking gear.



182CH23





182CH24

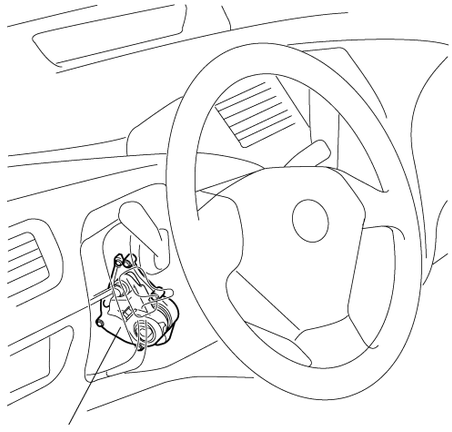
■SHIFT CONTROL

1. Shift Lever

A column-type shift lever with 5 positions has been adopted. The shift lever is operated by moving it in the vehicle's longitudinal direction to ensure excellent ease of use. The shift lever is integrated with the shift position sensor.

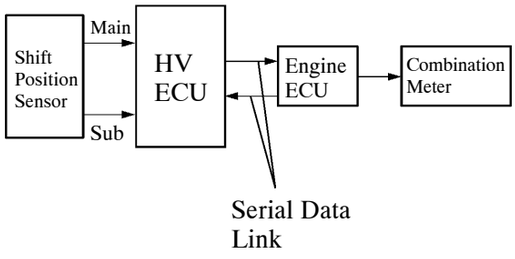
2. Shift Control

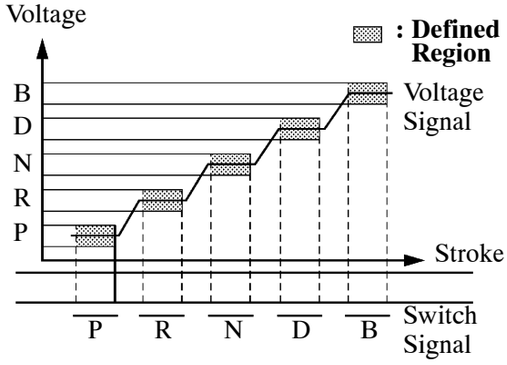
For shift control, a shift-by-wire system has been adopted. This system uses electrical signals that are output by the shift position sensor to determine the shift position. For operating the parking lock pawl in the transaxle, however, a shift cable is used for attaining P position.
The shift position sensor outputs two systems of signals: the main switch signals, and the sub switch signals containing high and low voltages. When these signals match, the HV ECU determines the respective shift position.



Shift Position Sensor

182CH25





182CH26

Service Tip

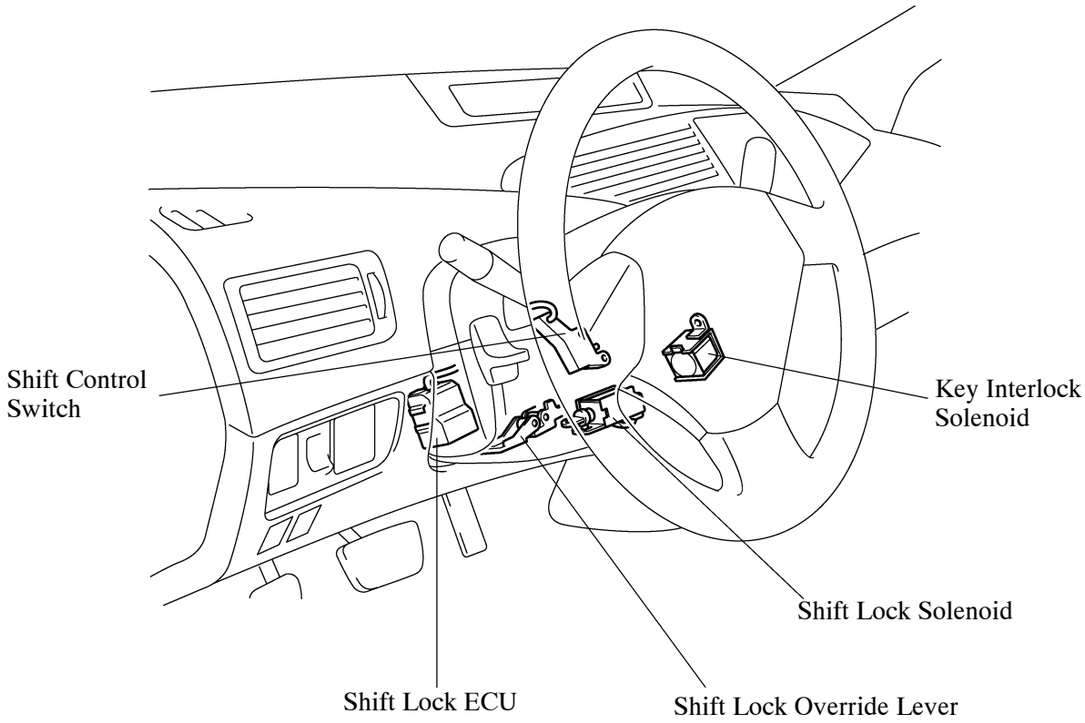
Because it is extremely difficult to precisely assemble the shift position sensors, do not disassemble the shift lever.

■SHIFT LOCK SYSTEM

1. General

A shift lock system that help prevent the unintended operation of the shift lever has been provided. The shift lock system consists of a key interlock device and shift lock mechanism.

2. Layout of Components



182CH78

3. Function of Components

Components	Function
P Position Detection Switch	Detects whether or not the shift lever is in P position and sends signals to the shift lock ECU.
Key Interlock Solenoid	Regulates the movement of the ignition key cylinder.
Shift Lock Solenoid	Regulates the operation of the shift lever at P position.
Stop Light Switch	Sends the brake signal to the shift lock ECU.
Shift Lock ECU	Receives inputs of various types of signals and regulates the operation of the two solenoids.

4. Key Interlock Device

The activation of the key interlock solenoid that is mounted on the upper column bracket moves the lock pin to restrict the movement of the key cylinder.
Therefore, if the shift lever is shifted to any position other than “P”, the ignition key cannot be moved from “ACC” to the “LOCK” position.

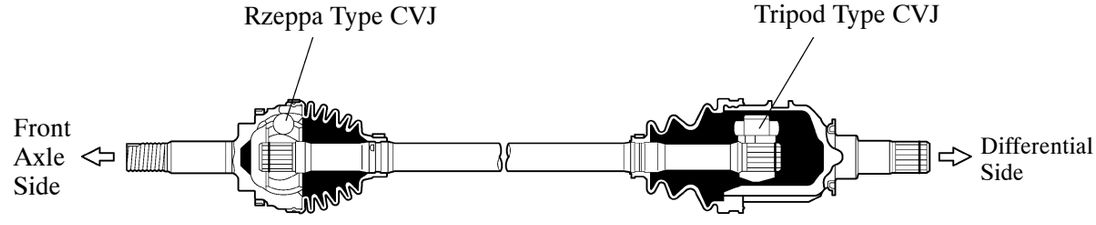
5. Shift Lock Mechanism

The shift lock mechanism prevents the shift lever from being shifted out of the “P” position to any other position unless the ignition switch is turned ON and the brake pedal is pressed.
A shift lock override lever, which manually overrides the shift lock mechanism, is provided.

DRIVE SHAFT

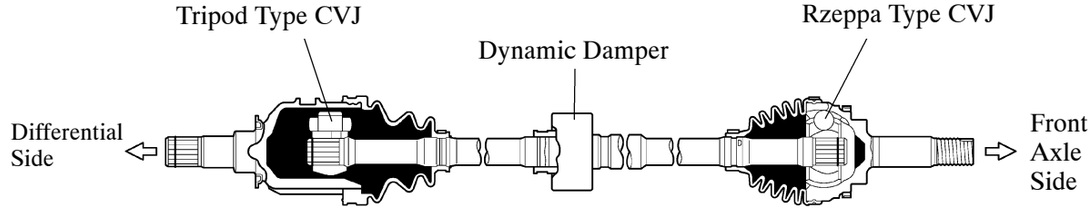
■ DESCRIPTION

- A tripod type CVJ (Constant Velocity Joint) is used on the differential side, and Rzeppa type CVJ is used on the front axle side.
- A dynamic damper has been provided on the right driveshaft to reduce vibration and noise.



Left Side

182CH27



Right Side

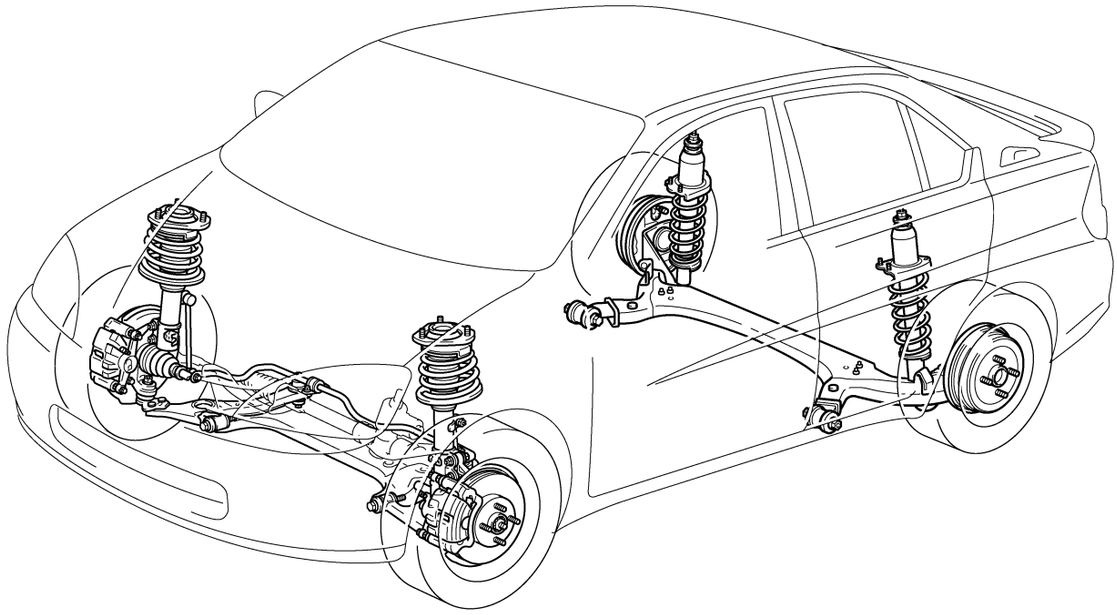
182CH28

SUSPENSION AND AXLES

■SUSPENSION

1. General

- MacPherson strut type suspension that uses L-shaped lower arms has been adopted for the front.
- Torsion-beam type suspension with toe control links has been adopted for the rear.
- The characteristics and the allocation of the components have been optimized to ensure excellent drivability, stability, and riding comfort.



182CH29

▶ Specifications ◀

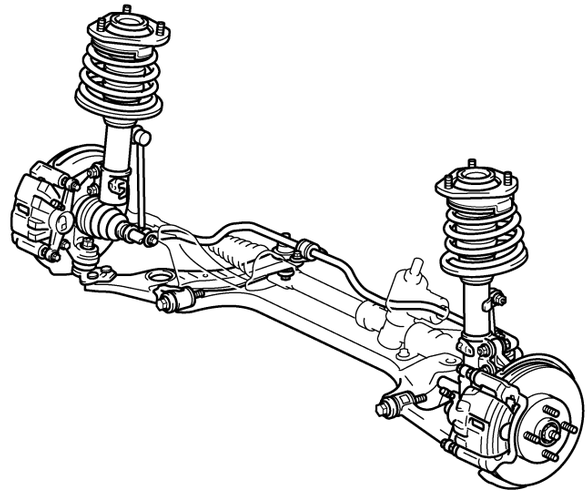
Item		Front	Rear
Tread	mm (in.)	1480 (58.3)	1478 (58.2)
Caster*	degrees	1°02’	—
Camber*	degrees	−0°26’	−1°30’
Toe-In*	mm (in.)	1 (0.04)	1 (0.04)
King Pin Inclination*	degrees	9°52’	—

*: Unloaded Vehicle Condition

2. Front Suspension

General

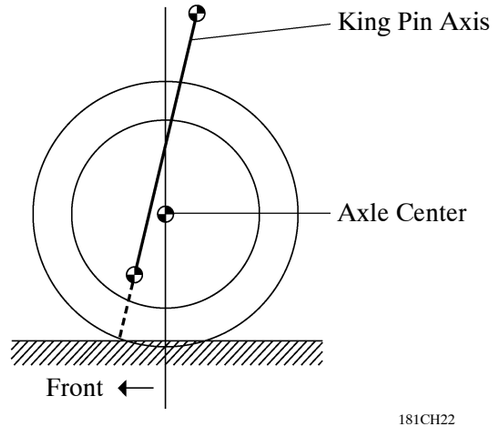
A MacPherson strut type independent suspension with an L-shaped lower arm has been adopted. Through the optimal allocation of components, and the adoption of the nachlauf geometry, negative camber, and anti-dive geometry, the front suspension realizes excellent riding comfort, stability, and controllability.



182CH30

Nachlauf Geometry

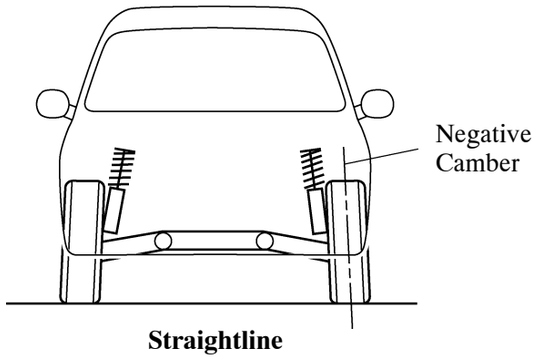
The front suspension adopts the nachlauf geometry in which the king pin axis is located ahead of the axle center.
As a result, excellent straightline stability has been realized and the steering feeling has been improved.



181CH22

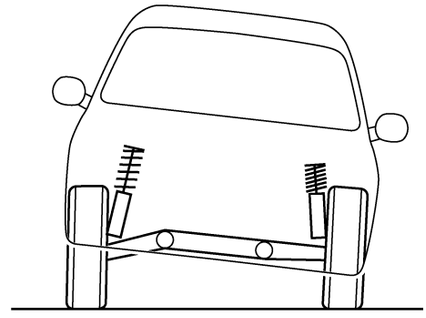
Negative Camber

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.



Straightline

181CH23

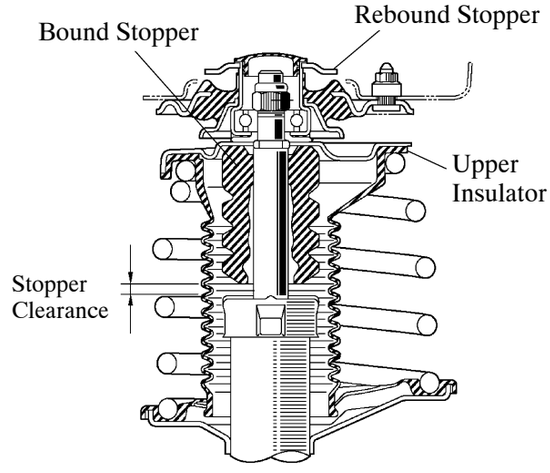


Cornering

181CH24

Suspension Upper Support and Dust Cover

- The upper support optimizes the characteristics of the rubber mount. Also, a rebound stopper has been provided to ensure riding comfort, drivability, and stability.
- A bound stopper made of urethane has been adopted. By optimizing the stopper characteristics and the clearance, excellent riding comfort and a high level of roll rigidity have been achieved.
- An upper insulator that is integrated with the dust boot has been adopted.



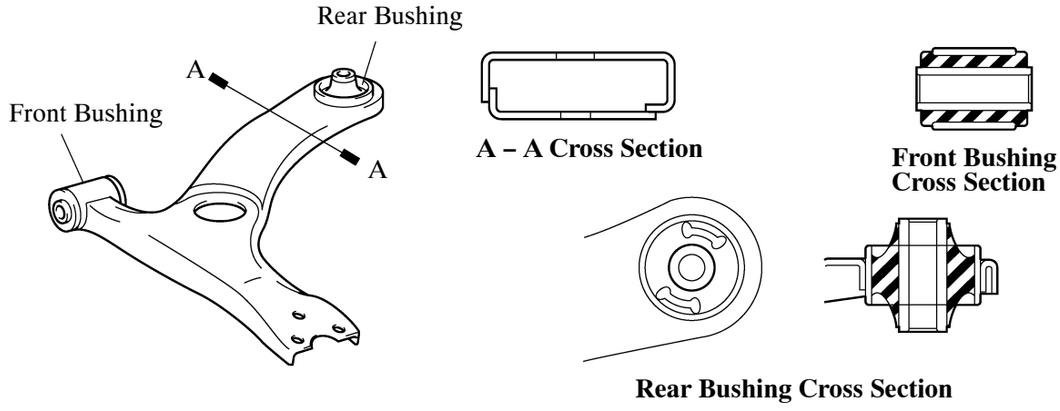
182CH31

Shock Absorber

- Low-pressure (N_2) gas sealed shock absorbers that offer stable dampening force characteristics without causing cavitation have been adopted.
- The dampening force characteristics of the shock absorbers have been optimized to achieve excellent riding comfort, drivability, and stability.

Lower Arm

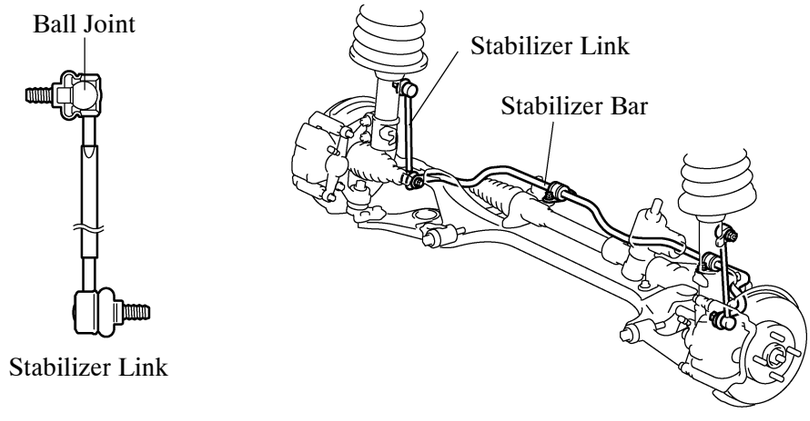
- An L-shaped stamped lower arm has been adopted.
- Rubber bushings have been adopted, and the mounting position and the construction of the lower arm have been optimized to improve the steering feel.



182CH32

Stabilizer Bar

A ball-joint type stabilizer link has been adopted. Also, by mounting the stabilizer link to the shock absorber, the excellent stabilizing efficiency has been provided while realizing both steering stability and riding comfort.



182CH33

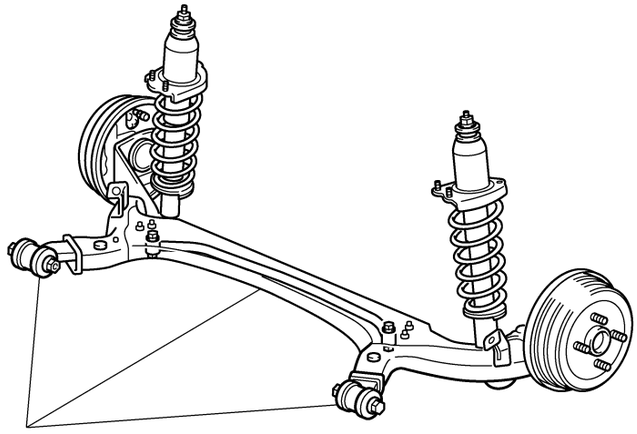
3. Rear Suspension

General

- A torsion beam type suspension with toe control links has been adopted, in which an axle beam is located in the middle of the trailing arm.
- The torsion beam type rear suspension minimizing change in the tire-to-road camber during cornering, thus delivering good cornering stability and driving stability.
- The stabilizer bar has been adopted to realize excellent drivability and stability.
- A toe control link mechanism has been adopted in the construction of the trailing arm bushings. The toe-correct function that is effected by the movement of the links results in optimal compliance steering, thus achieving excellent drivability, stability, and riding comfort at high levels.

NOTICE

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

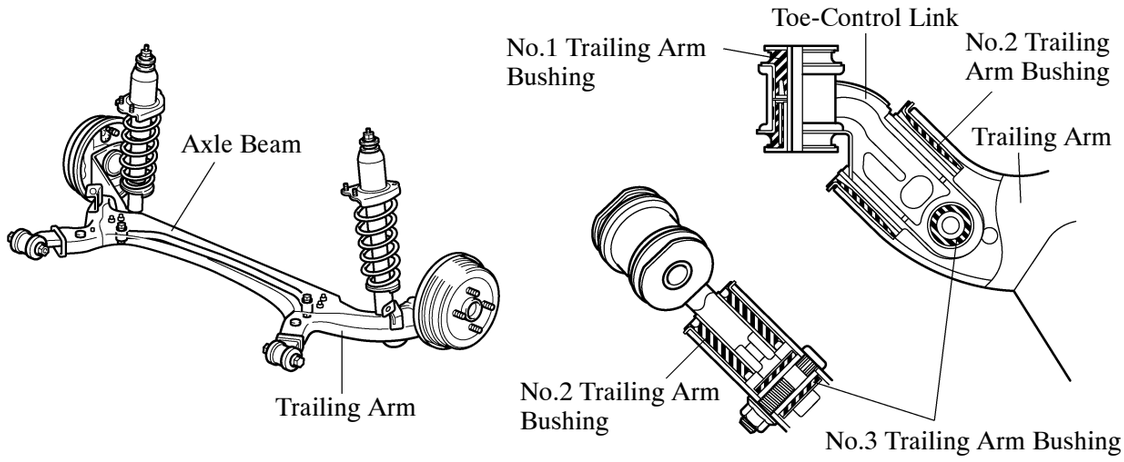


Never use these areas
as jack-up points.

182CH34

Trailing Arm and Axle Beam

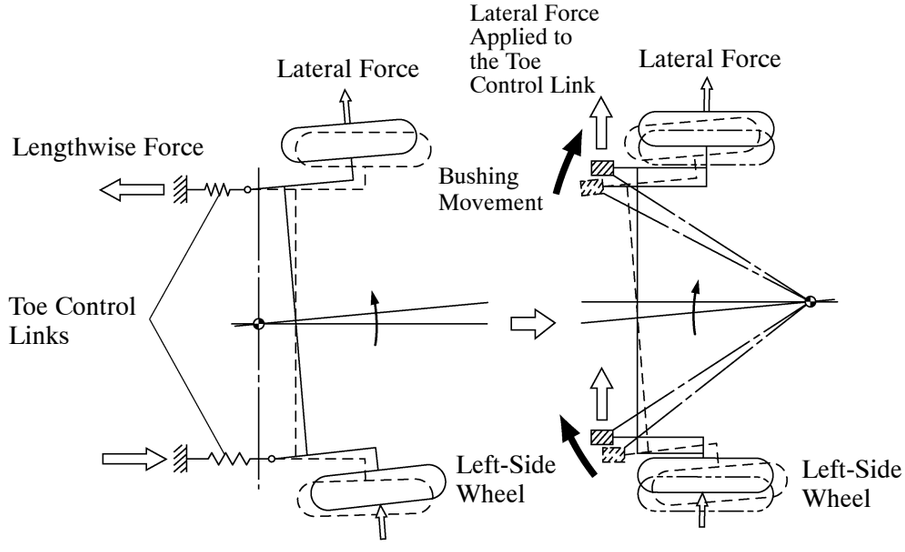
- Trailing arms that are lightweight, highly rigid, hollow inside, and a gently curved axle beam with a rear-open U-shaped cross section have been adopted.
- A toe control links integrated axle beam has been adopted. The toe control link consists of the No.1, No.2, and No.3 trailing arm bushings, and it rotates within the horizontal plane of the vehicle, around the No.3 bushing that serves as the axial center.
- The rolling regidity has been optimized through the adoption of the stabilizer bar.



182CH35

Toe-Correct Function

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



181CH35

Toe and Camber Change

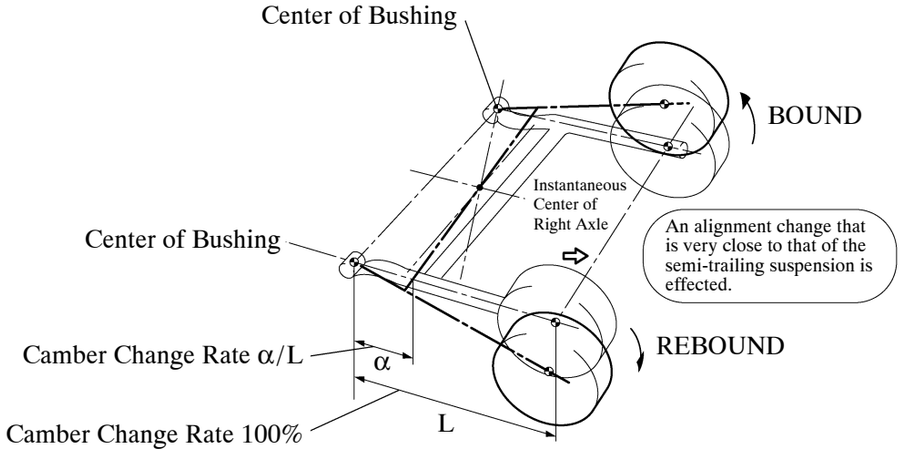
In the torsion beam type suspension, the camber angle and the toe change differ between the same direction stroke case and the opposite direction stroke case, offering both straightline stability and excellent cornering stability.

1) Same Direction Stroke 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) Opposite Direction Stroke Case

During opposite direction stroke 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 (‘α’ 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.



165CH48

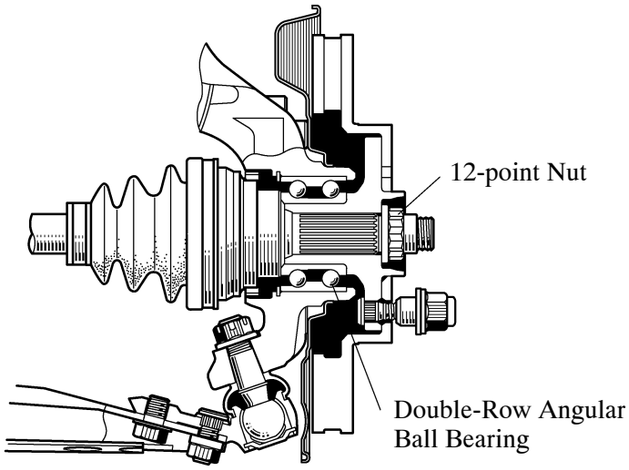
Shock Absorber

- Low-pressure (N_2) gas sealed shock absorbers that offer stable dampening force characteristics without causing cavitation have been adopted.
- The dampening force characteristics of the shock absorbers have been optimized to achieve excellent riding comfort, drivability, and stability.

■AXLES

1. Front Axle

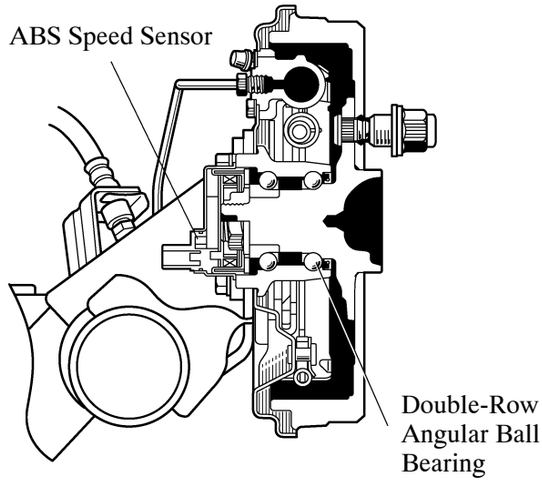
- The front axle use a double-row angular ball bearing which offers low rolling resistance.
- A lock nut (12-point) has been adopted and staked for tightening the axle hub in order to ensure the tightening performance. This nut cannot be reused.



182CH36

2. Rear Axle

- The rear axle use a double-row angular ball bearing which offers low rolling resistance.
- ABS speed sensor and rotor are built in the axle bearing.

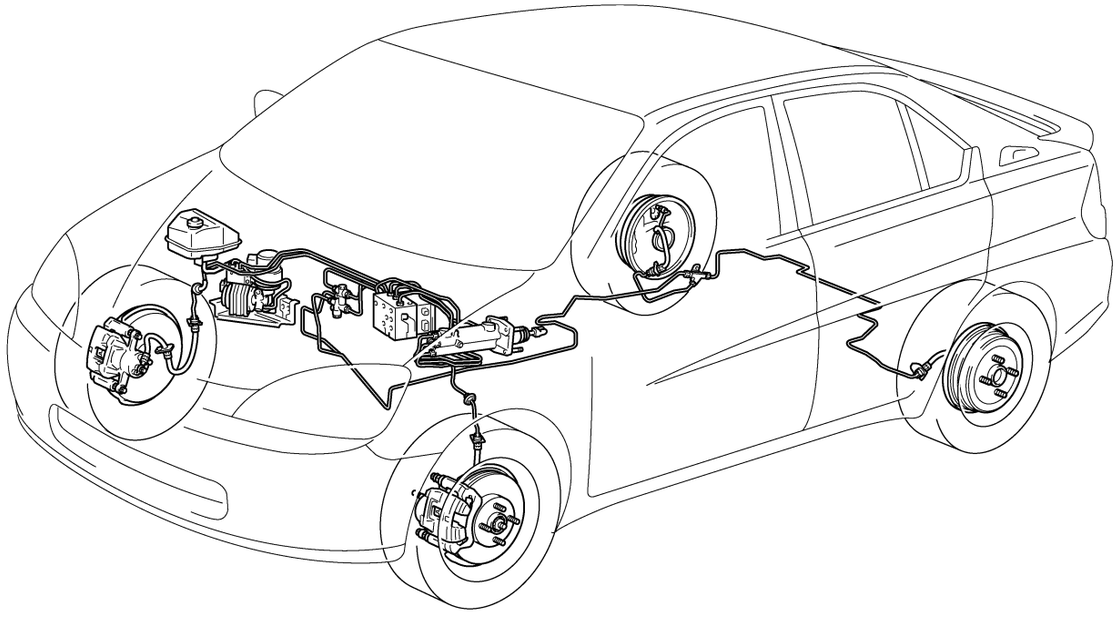


182CH37

BRAKES

■DESCRIPTION

- The front brakes use ventilated disc brakes and the rear brakes use leading-trailing drum brakes.
- To adjust the clearance between the shoes and drum, the rear drum brakes uses the incremental type hydraulic auto adjuster.
- On the Prius uses a pedal type parking brake that is released by pressing the pedal further.
- A hydraulic brake booster in which the master cylinder and booster are integrated has been adopted.
- The Prius has adopted the ABS with EBD (Electronic Brake force Distribution) as a standard equipment.
- A regenerative brake system, which uses the MG2 that is used for driving the vehicle as a generator to efficiently convert the energy that is created during braking has been adopted. This system enables to collect more driving energy by having the control to cooperate the hydraulic brake and the regenerative brake.



182CH38

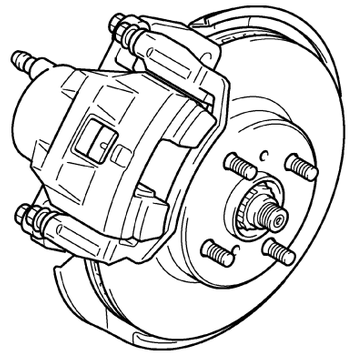
▶ Specifications ◀

Master Cylinder	Type		Single
	Diameter	mm (in.)	22.22 (0.87)
Brake Booster Type			Hydraulic
Front Brake	Type		Ventilated Disc
	Caliper Type		PE54
	Wheel Cylinder Dia.	mm (in.)	54.0 (2.13)
	Rotor Size (D x T)*	mm (in.)	255 x 22 (10.04 x 0.87)
Rear Brake	Type		Leading-Trailing Drum
	Wheel Cylinder Dia.	mm (in.)	20.64 (0.81)
	Drum Inner Dia.	mm (in.)	200 (7.87)
Brake Control Valve Type			P & B Valve
Parking Brake	Type		Drum
	Size	mm (in.)	200 (7.87)
	Lever Type		Pedal
ABS with EBD			STD

*: D: Outer Diameter, T: Thickness

■ FRONT BRAKE

The PE54 type brake calipers and ventilated disc rotor have been adopted. These brake calipers are lightweight and compact to realize excellent brake performance.

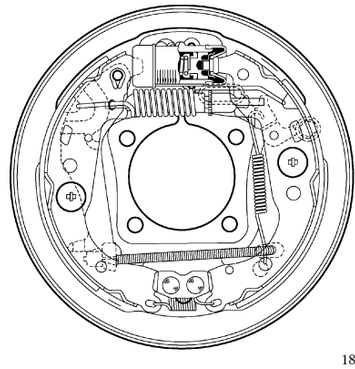


182CH39

■ REAR BRAKE

General

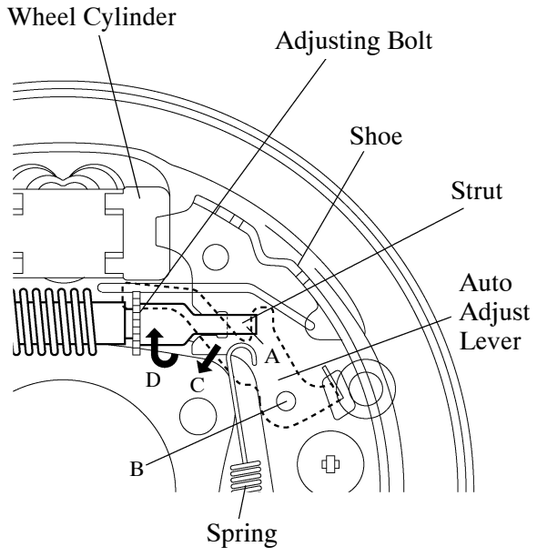
- The leading-trailing type drum brakes using drums with a 200 mm (7.87 in.) inner diameter have been adopted.
- A hydraulic system that adjusts the clearance between the shoes and the drum has been adopted.



182CH40

Incremental Type Hydraulic Auto Adjuster

Ordinarily, when the rear brakes are applied, the shoes expand until they come in contact with the inner surface of the drum.
While the auto adjust lever remains in contact with point A of the strut, the spring force causes the auto adjust lever to rotate in direction C, with adjust lever point B as the fulcrum. At this time, if the shoe clearance exceeds a predetermined amount, the tip of the auto adjust lever rotates the adjusting bolt in direction D by 1 tooth, causing the strut to move for a predetermined amount towards the direction that expands the shoes. As a result, by pushing and expanding the initial position of the shoes, an appropriate amount of clearance is maintained between the shoes and the drum.



165CH33

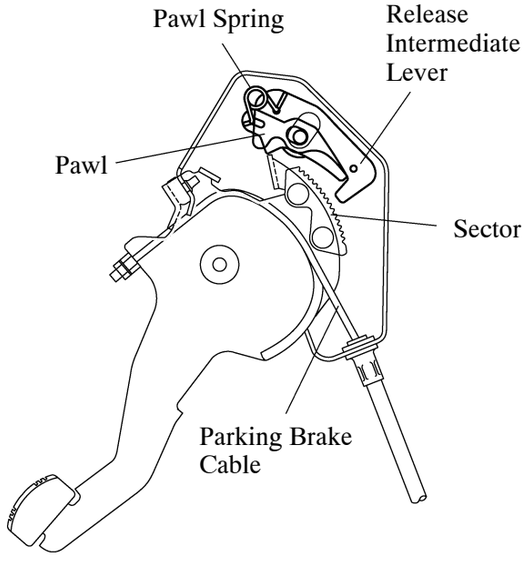
■PARKING BRAKE

1. General

On the Prius uses a pedal type parking brake that is released by pressing the pedal further.

2. Construction

A pedal type parking brake pedal consists mainly of a parking brake pedal, sector, pawl, release intermediate lever, pawl spring and pedal return spring.
The parking brake pedal and sector are integrated, and parking brake cable is attached to the parking brake pedal.
The pawl and the release intermediate lever are linked by the pawl spring and operate together along with the movement of the pedal.

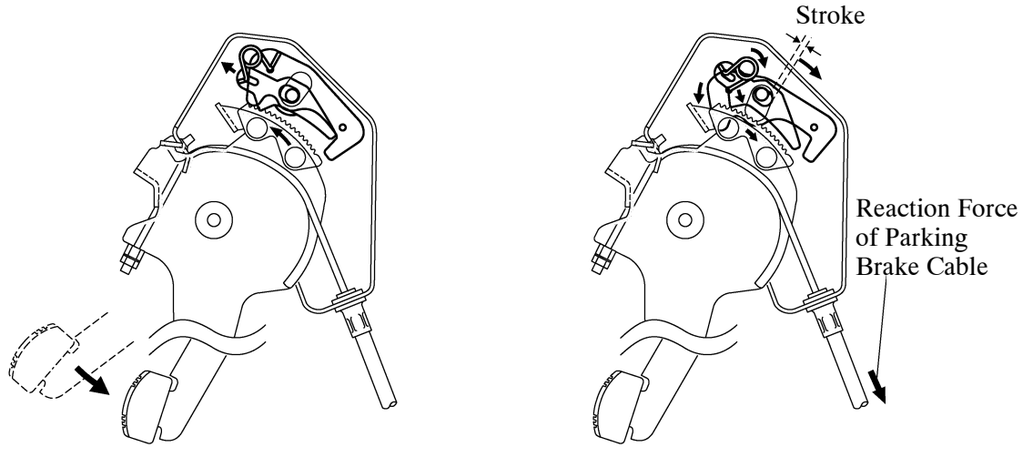


182CH41

3. Operation

During Applying

Pressing the parking brake pedal causes the sector's rachet to engage with the pawl. Then, when the pressure on the brake pedal is released, the reaction force of the parking brake cable and the force of the pedal return spring cause the pawl and sector, which remain engaged, to return (only for the stroke). As the result, the parking brake becomes locked.
At this time, because the relative installed position of the pawl spring changes, the force of the pawl spring that was applied to the intermediate release lever switches its direction and now pushes the intermediate release lever down.

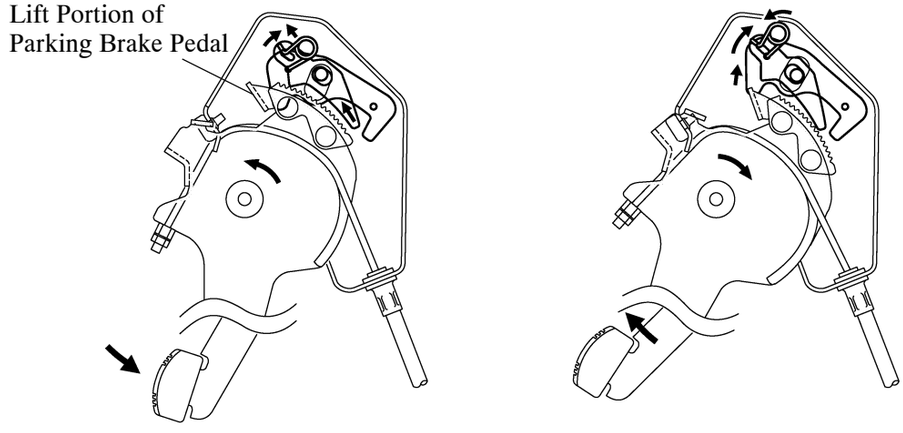


While Pressing **Locked State**

182CH42

During Releasing

When the parking brake pedal is pressed again, as the reaction force of the parking brake cable and the force of the pedal return spring will not be applied to the pawl, the action of the pawl spring causes the pawl to lift. As a result, the pawl is released from the sector's ratchet.
Next, when the parking brake pedal returns to its initial point, the lift portion of the parking brake pedal causes the intermediate release lever to lift. The pawl is then pushed down by the force of the pawl spring and returns to its initial state.



Press Again **During Pedal Return**

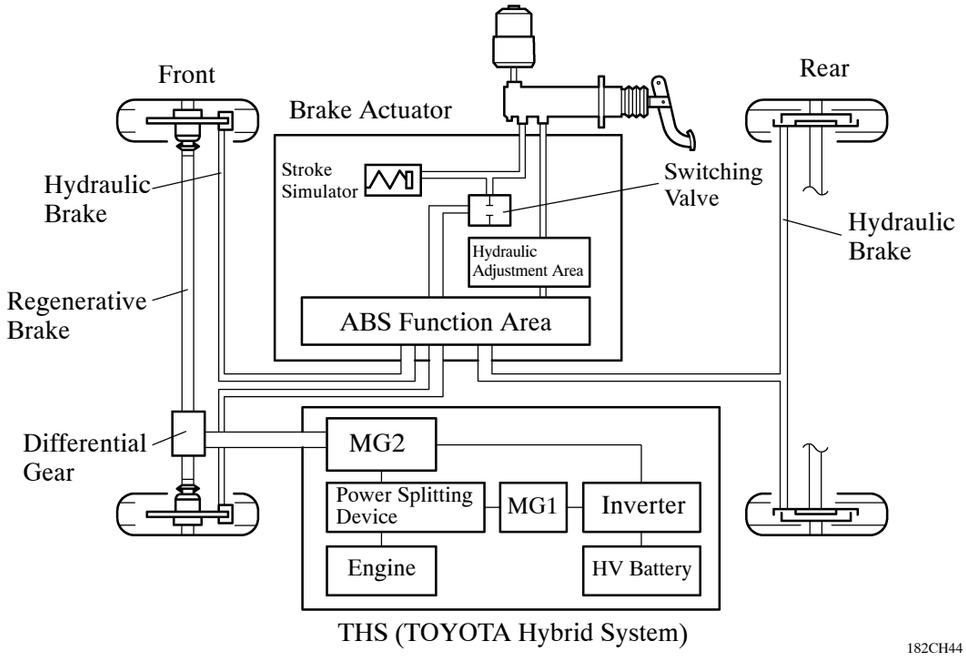
182CH43

■BRAKE SYSTEM

1. General

- A brake system, which uses brake fluid that is stored under high pressure to assist the brake pedal effort and to operate the ABS with EBD control and the regenerative brake cooperative control, has been adopted.
- A regenerative brake system, which uses the MG2 that is used for driving the vehicle as a generator to efficiently convert the energy that is created during braking, has been adopted. This system enables to collect more driving energy by having the control to cooperate the hydraulic brake and the regenerative brake.

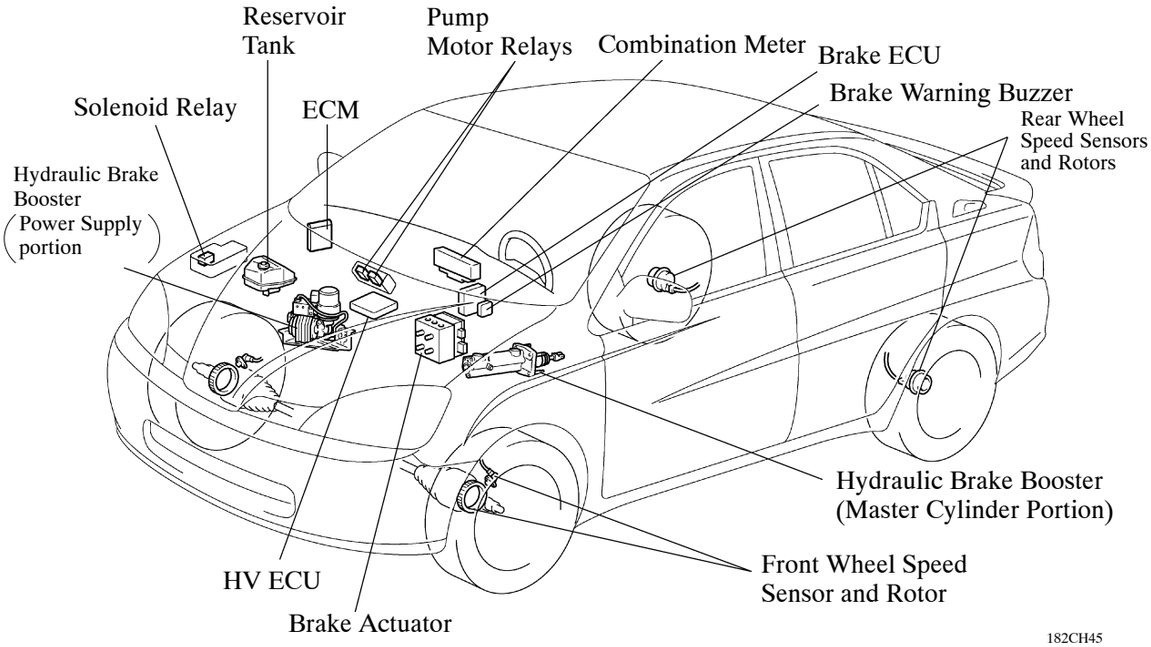
2. System Diagram



THS (TOYOTA Hybrid System)

182CH44

3. Layout of Main Components

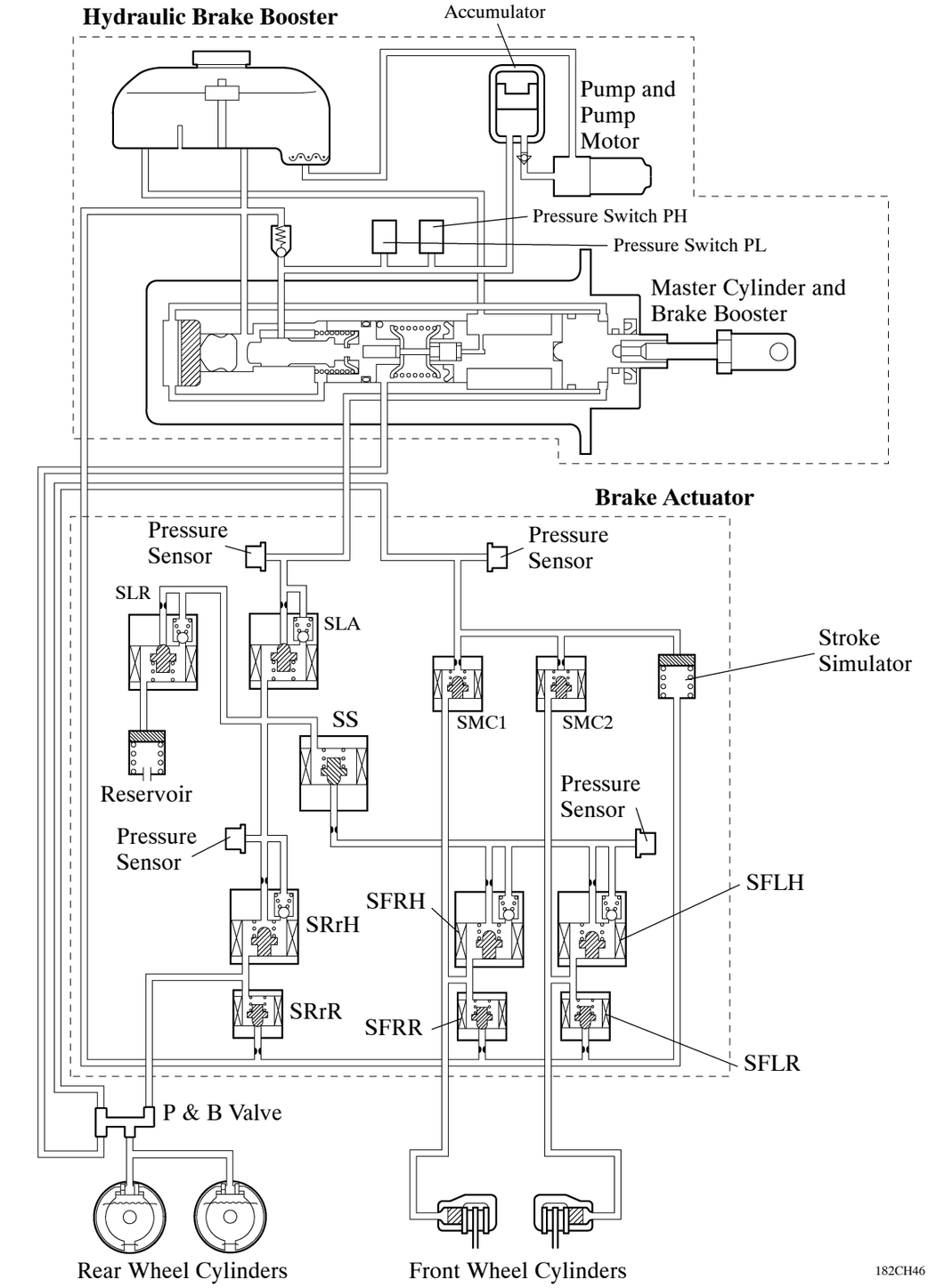


182CH45

4. Function of Main Components

Components		Function
Combination Meter	ABS Warning Light	Lights up to alert the driver when the brake ECU detects the malfunction in the ABS.
	Brake System Warning Light	● Lights up together with the ABS warning light to alert the driver when the brake ECU detects the malfunction not only in the ABS but also in the EBD control. ● Lights up to alert the driver when the malfunction occurs in the brake system.
Stop Light Switch		Detects the brake depressing signal.
Brake Warning Buzzer		Emits a continuous sound to inform the driver that the ABS ECU detects the malfunction in the hydraulic brake booster.
Speed Sensors		Detect the wheel speed of each of the four wheels.
Brake ECU		● Processes various sensor signals, regenerative brake signals, to execute control of the ABS control, EBD control, regenerative coordination control and hydraulic brake booster. ● Communicates control data with the HV ECU.
HV ECU		Maintains serial communication with the brake ECU to exchange regenerative coordination control signals.
Hydraulic Brake Booster		● Assists with the pedal effort applied to the brake pedal. ● Supplies hydraulic pressure.
Brake Actuator		Controls the brake fluid pressure to each brake wheel cylinder by signals from the brake ECU.
Solenoid Relay		Supplies power to the ABS's solenoid valve's in the brake actuator.
Pump Motor Relays		Control the pump motor operation in the hydraulic brake booster.

5. Hydraulic Circuit



SMC1, SMC2, SS — Switching Solenoid Valves

SLA, SLR — Linear Solenoid Valves

SFRH, SFRR, SFLH, SFLR, SRrH, SRrR — ABS Solenoid Valves

6. Construction and Operation

The brake system of Prius consists of the following components:

Components			Function
Hydraulic Brake Booster	Power Supply Portion	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 highpressure nitrogen gas.
		Pressure Switches	Monitors the hydraulic pressure of the accumulator and outputs control signals for the pump motor. There are two types: the pressure switch PH for controlling the pump, and the pressure switch PL for giving a warning when the pressure is low.
		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 pressure switch.
		Reservoir Tank	Stores the brake fluid.
		Brake Fluid Level Warning Switch	Detects the low brake fluid level.
	Master Cylinder Portion	Master Cylinder	Generates the hydraulic pressure in accordance with the pedal effort that is applied to the brake pedal.
		Brake Booster	Regulates the accumulator pressure in accordance with the pedal effort that is applied to the brake pedal and introduces this pressure to the booster chamber in order to provide a power assist to the brakes.
Brake Actuator		Pressure Sensors	Detects the pressure of the master cylinder, regulator, and front and rear wheel cylinders.
		Switching Solenoid Valves	Switches the hydraulic path between normal braking and braking under control.
		ABS Control Solenoid Valves (Pressure Holding Valves, Pressure Reduction Valves)	Controls the hydraulic pressure that is applied to the wheel cylinders during ABS control or EBD control.
		Linear Solenoid Valve	Regulates the hydraulic pressure to the wheel cylinders during braking in accordance with the fluctuations in the regenerative brake force.
		Reservoir	Temporarily stores the brake fluid when regulating the hydraulic pressure to the wheel cylinders in accordance with the fluctuations in the regenerative brake force.
		Stroke Simulator	Generates a pedal stroke during braking in accordance with the driver's pedal effort.

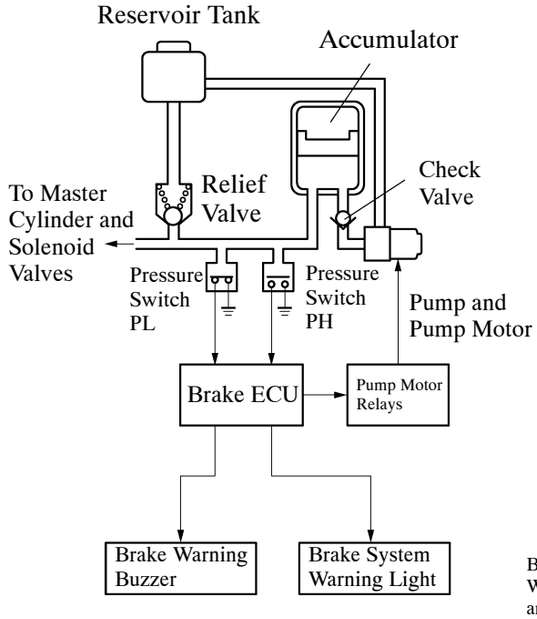
Hydraulic Brake Booster

1) General

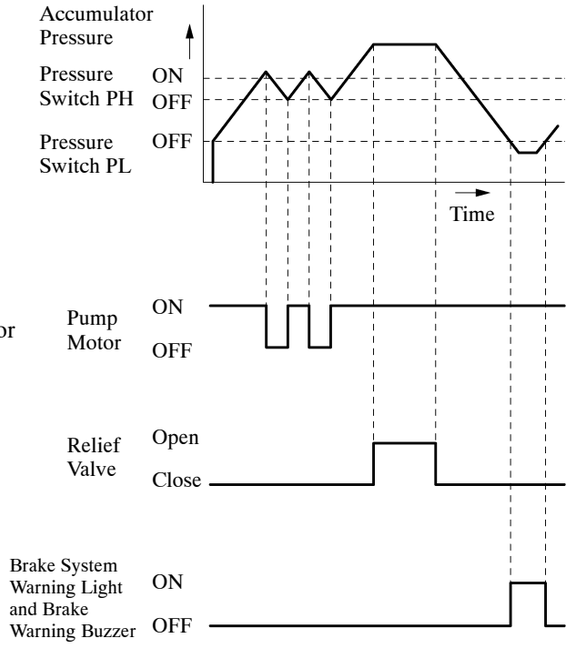
Due to installation space constraints, a type of hydraulic brake booster that comprises two separate portions has been adopted: the power supply portion (pump, pump motor, accumulator, pressure switches, and relief valve) and the master cylinder portion.
Consisting of an pump and pump motor, accumulator, and hydraulic pressure switches, the hydraulic brake booster performs the functions of both the booster and the master cylinder.
By optimizing the hydraulic circuits, the hydraulic pressure that is generated by the booster is applied directly to the rear brakes. Thus, the hydraulic pressure from the master cylinder is used exclusively by the front brakes.

2) Pump and Pump Motor, Accumulator, Pressure Switches and Relief Valve

If the accumulator pressure becomes lower than the pressure that is specified in the pressure switch PH, which is used for detecting high pressure, the pressure switch PH turns OFF. Then, the brake ECU turns ON the pump motor relays to operate the pump motor and the pump.
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, for operating the ABS, and for operating the EBD control, and for regenerative brake cooperative controlling.
If the accumulator pressure becomes higher than the pressure that is specified in the pressure switch PH, the pressure switch PH turns ON. Then, after several seconds, the brake ECU turns OFF the pump.
At this time, if the pressure switch PH malfunctions and causes the pump to operate continuously, the relief valve opens to prevent excessive pressure from being generated.
Moreover, if the accumulator pressure becomes lower than the pressure that is specified in the pressure switch PL, which is used for detecting low pressure, the pressure switch PL turns OFF. As a result, the brake system warning light turns ON and the brake warning buzzer activates.
At this time, the ABS or EBD is prohibited from operating.



182CH47



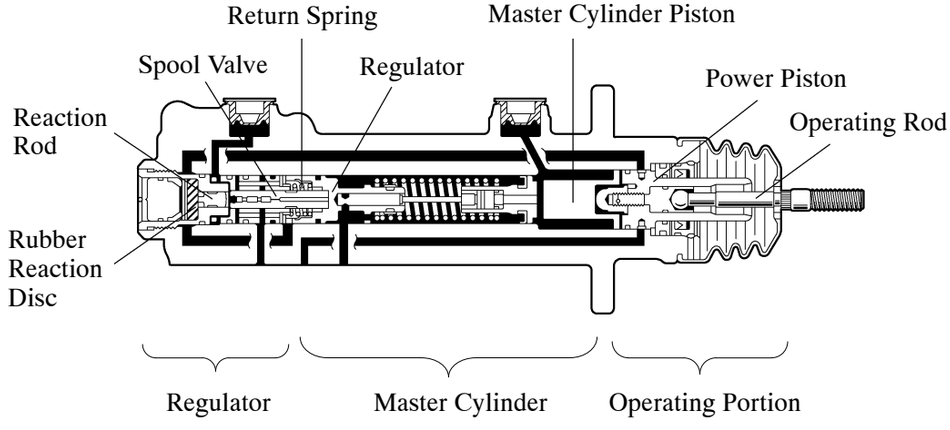
152CH17

2) Master Cylinder and Brake Booster

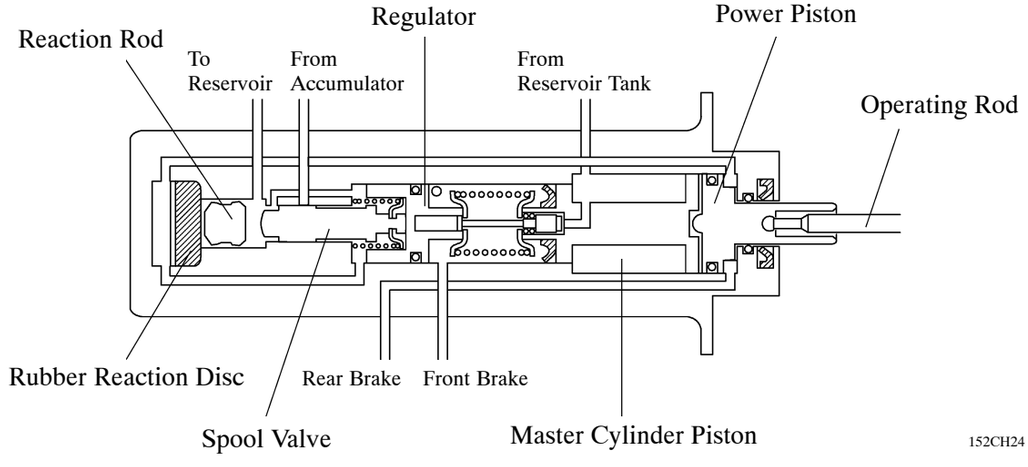
a. Construction

- This construction enables the hydraulic pressure that is generated by the brake booster to be applied directly to the rear brakes.
- The master cylinder is the center port type single master cylinder, which is used for the front brakes only.
- The brake booster is integrated with the master cylinder. The operating portion, master cylinder, and regulator are positioned coaxially to achieve a simple and compact construction.
- The operating rod and the power piston are linked directly to transmit the pedal effort that is applied to the brake pedal.
- The regulator and the spool valve are linked directly. A forward (leftward) force generated by the master cylinder pressure and a rearward (rightward) force generated by the power assist of the booster are applied to the regulator. Both forces maintain a balance.
- A return spring is provided for the regulator to ensure the return of the spool valve.

▶ Cross-Sectional Drawing ◀



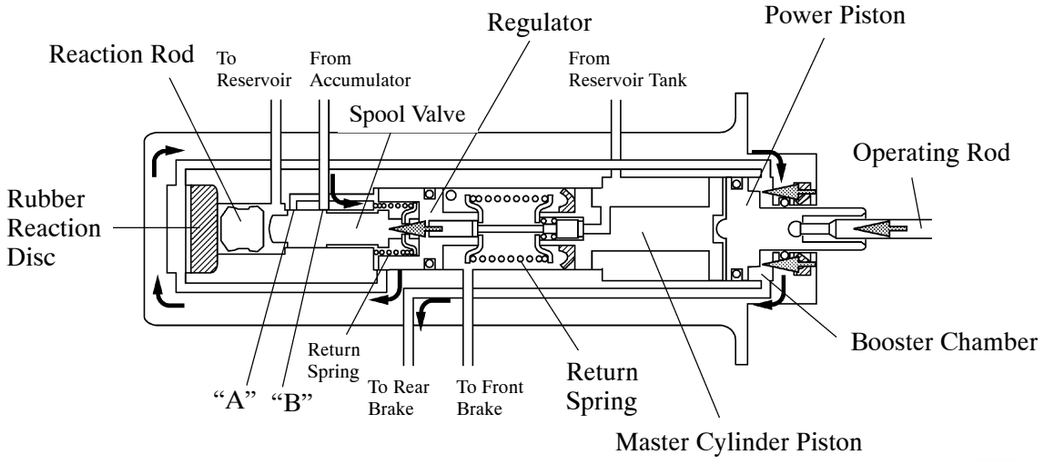
▶ Simplified Drawing ◀



b. Operation

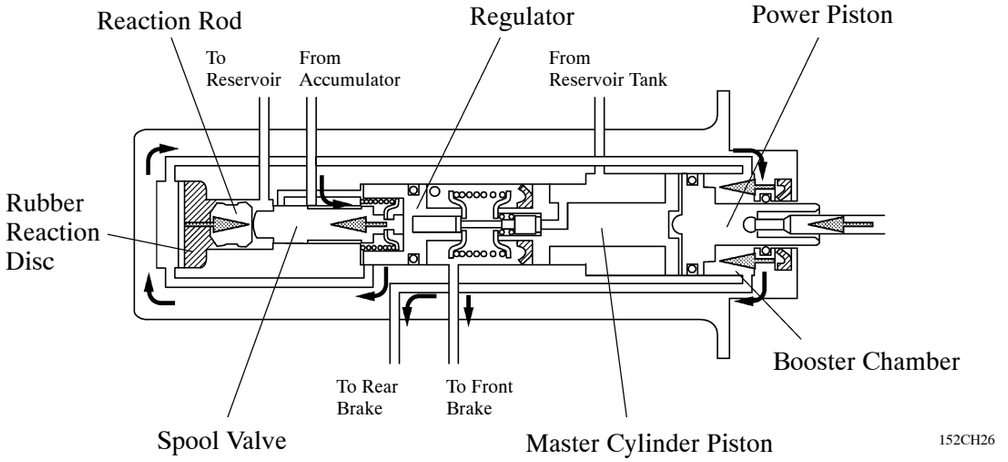
i) Pressure Increase (Low Pressure)

The pedal effort that is applied to the brake pedal is transmitted via the operating rod, power piston, and master cylinder piston. However, because the load setting of the master cylinder's return spring is higher than that of the regulator piston's return spring, the regulator piston gets pushed before the volume in the master cylinder becomes compressed. As a result, the spool valve moves forward.
The spool valve closes the port "A" between the reservoir and the booster chamber (behind the power piston) and opens the port "B" between the accumulator and the booster chamber. Then, the pressurized brake fluid is introduced into the booster chamber to provide a power assist to the pedal effort.
When the pressure is introduced into the booster chamber, the power assist overcomes the force of the master cylinder's return spring. This causes the volume in the master cylinder to become compressed and increases the pressure that is applied to the front brakes. At the same time, the pressure in the booster chamber increases the pressure that is applied to the rear brakes.
During the initial stage of the brake operation, the booster pressure that is applied to the rubber reaction disc is small. Therefore, a return force in the rightward direction does not apply to the spool valve via the reaction rod.



ii) Pressure Increase (High Pressure)

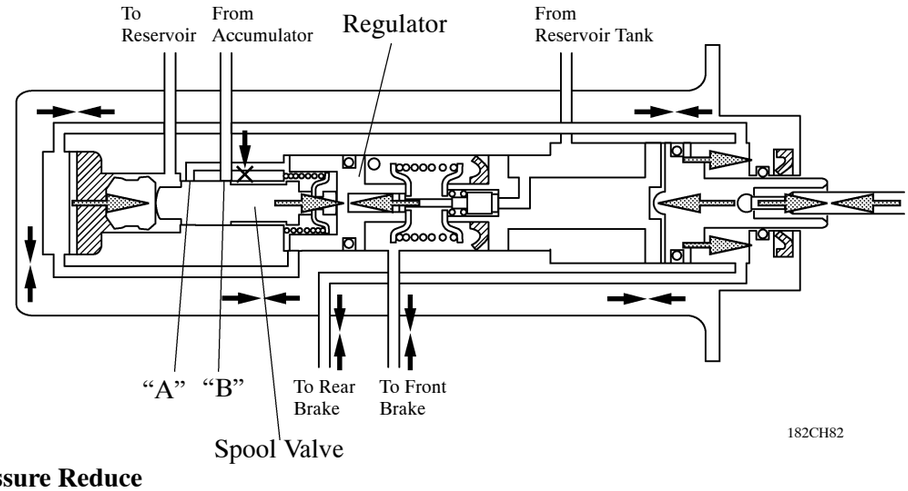
In contrast to the time when the pressure is low, when the pressure is high, the booster pressure that is applied to the rubber reaction disc increases. Accordingly, the rubber reaction disc deforms and causes a return force in the rightward direction to be applied to the spool valve via the reaction rod. Therefore, in contrast to the time when the pressure is low, a greater reaction force is transmitted to the brake pedal.
As a result, a variable servo mechanism is realized, in which the servo ratio is lower during high pressure than during low pressure.



iii) Holding

This is a state in which the force that is applied via the brake pedal and the master cylinder pressure are in balance.

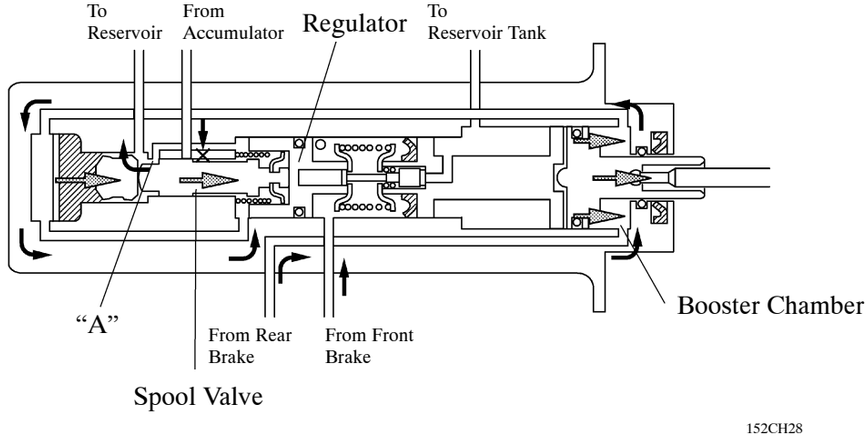
The forces that are applied to the front and the rear of the regulator piston, in other words, forces that are generated by the master cylinder pressure and the regulator pressure become balanced. This causes the spool valve to close both port "B" from the booster chamber to the accumulator and port "A" to the reservoir. As a result, the brake system is in the holding state.



iv) Pressure Reduce

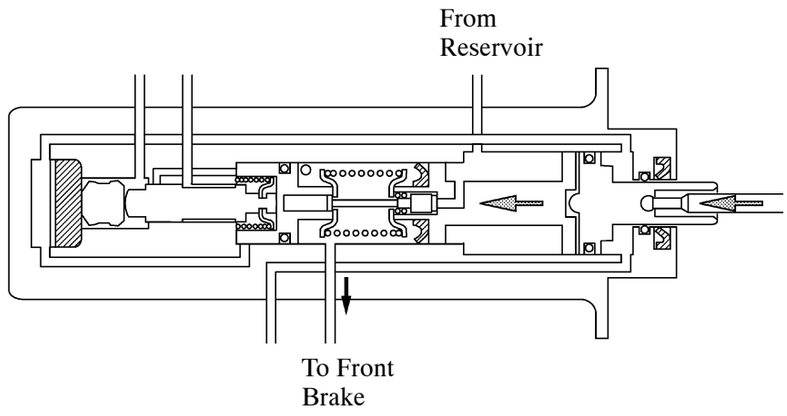
When the force that is applied to the brake pedal is relaxed, the master cylinder pressure decreases. Then, the regulator's return (rightward) force becomes relatively greater, causing the regulator to retract and the spool valve to also retract. As a result, the port "A" between the reservoir and the booster chamber opens.

The booster pressure becomes reduced in this state, creating a balance that corresponds to the force that is newly applied via the brake pedal. This process is performed repetitively to reduce the booster pressure and the master cylinder pressure in accordance with the force that is applied via the brake pedal.



v) During Power Supply Malfunction

If the accumulator pressure is affected due to some type of malfunction, no pressure will be supplied by the regulator. Then, a power assist cannot be provided to the force that is applied via the brake pedal and the pressure to the rear brakes cannot be increased.
The pressure to the front brakes will be increased by the master cylinder in accordance with the pedal effort applied to the brake pedal.

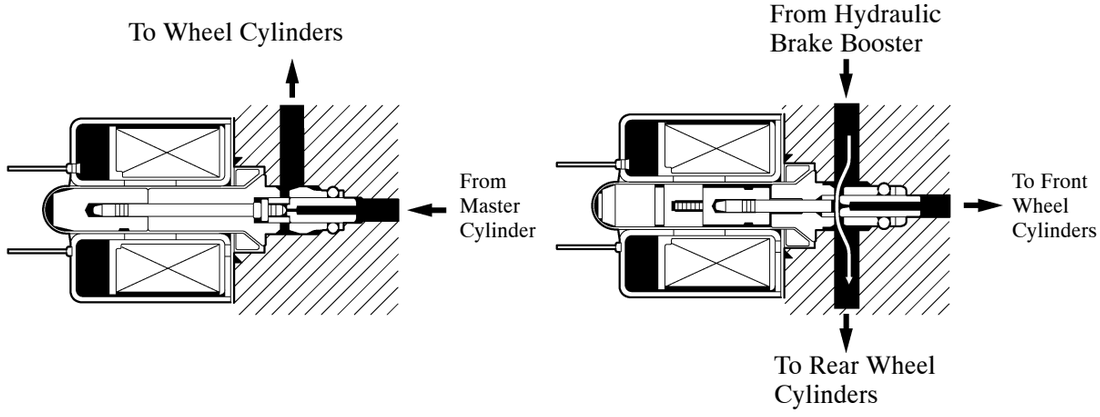


152CH29

Brake Actuator

1) Switching Solenoid Valves

The control signals from the brake ECU cause the valves to open and close to switch the passages of the brake fluid. There are 3 switching solenoid valves (SMC1, SMC2, and SS) and they switch the passages to effect conventional brake control and ABS control.



SMC1 and SMC2 **SS**

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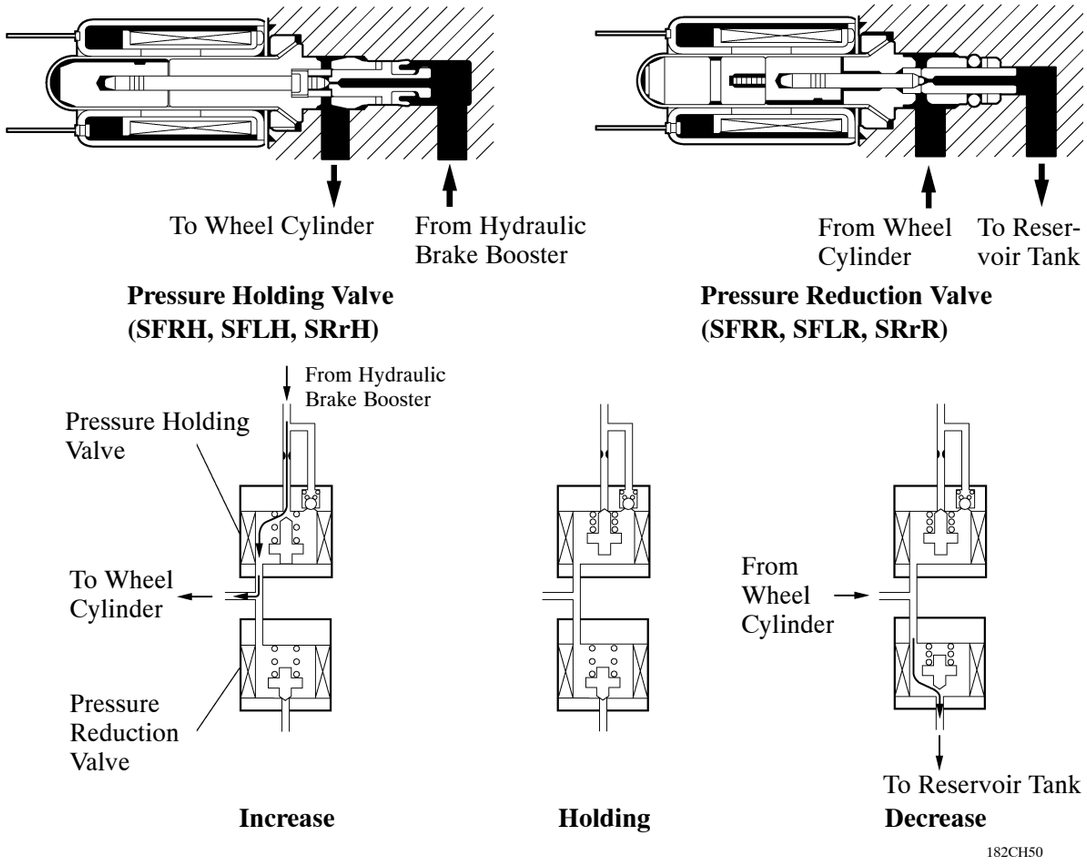
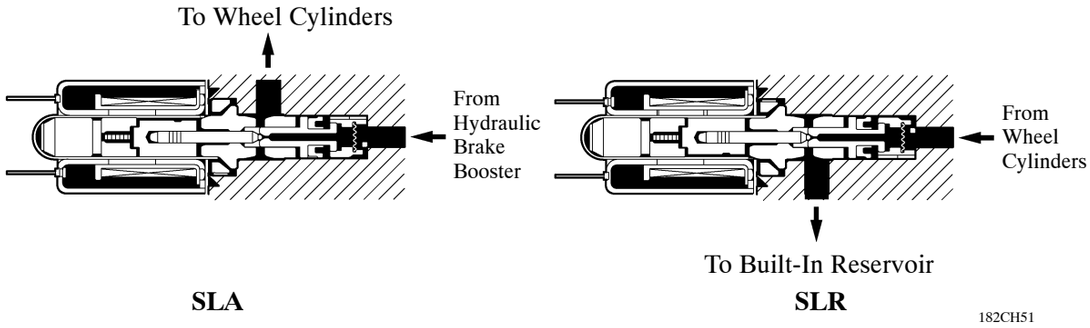
2) ABS Solenoid Valves

The control signals from the brake ECU cause the valves to open and close to switch the passages of the brake fluid. There are 2 (pressure holding valve, pressure reduction valve) ABS solenoid valves provided. The pressure increases if no current is applied to either valve. The pressure is held if current is applied only to the pressure holding valve. The pressure decreases if current is applied to both the pressure holding valve and pressure reduction valve. To effect control independently to the front wheels, simultaneously to both rear wheels, 6 solenoid valves are provided.



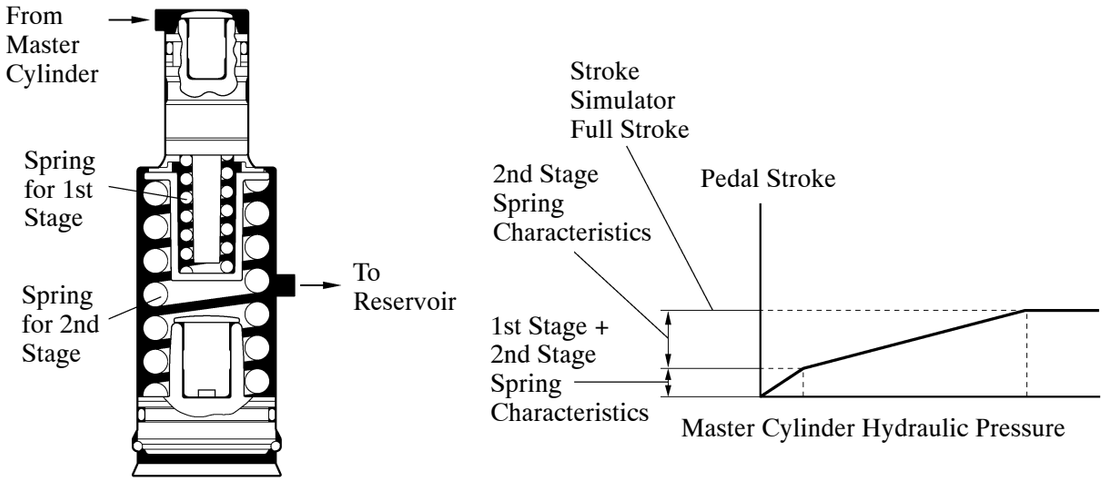
3) Linear Solenoid Valves

The control signals from the brake ECU cause the valves to open and close to regulate the volume of the brake fluid that flows into the wheel cylinders. There are 2 types of linear solenoids, the SLA for pressure increase and the SLR for pressure decrease, and they regulate the wheel cylinder pressure in accordance with the fluctuations in the regenerative brake force. In addition, the SLA contains a relief function to provide hydraulic pressure to the wheel cylinders in the event of a brake ECU failure.



4) Stroke Simulator

The stroke simulator 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.



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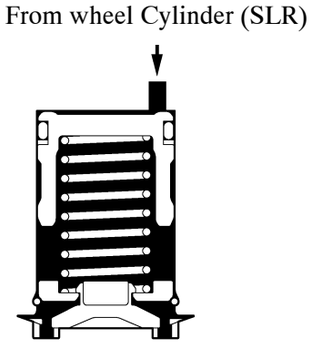
5) Reservoir

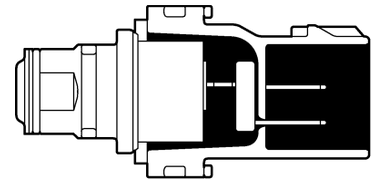
Temporarily stores the brake fluid to absorb the pressure when regulating the wheel cylinder pressure.



182CH53

6) Pressure Sensors

Mounted on the brake actuator, the pressure sensor linearly detects the pressure that is generated in the master cylinder, regulator, and the front and rear wheel cylinders and outputs them to brake ECU.



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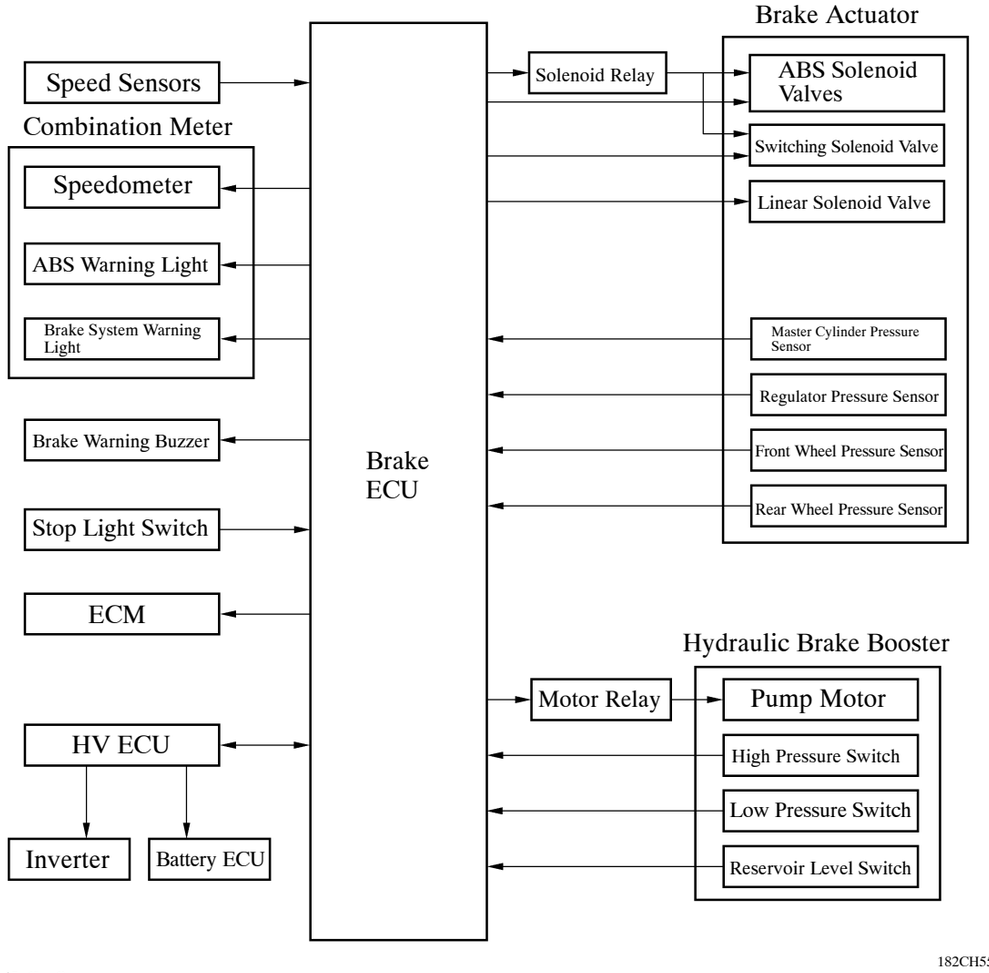
Brake ECU

1) General

Based on the signals received from the sensors the communication it maintains with the HV ECU, the brake ECU effects conventional brake control, ABS with EBD control, and regenerative brake cooperative control.



2) Fail Safe

If a malfunction occurs in the brake ECU, in the input signals from the sensors, or in actuator system, this function prohibits the current from flowing to the brake actuator.
As a result, the solenoids in the brake actuator turn off, enabling the braking force of the hydraulic brake to take effect. Furthermore, by illuminating the ABS warning light or the brake system warning light, this function alerts the driver that a malfunction exists in the system.
Only if the regenerative brake system cannot be used, such as in the case of a malfunction in the communication with the HV ECU, this function switches controls to enable the hydraulic brake to generate the entire brake force.

3) Warning Light Check Function

The ABS warning light and brake system warning light turns on for about 3 seconds after the ignition switch is turned on to check the circuit.

4) Self-Diagnosis

If the brake ECU detects a malfunction in the brake system, the ABS warning light and brake system warning light will light up and alert the driver that a malfunction has occurred. The ECU will also store the codes of malfunctions. See the 2001 Prius Repair Manual (Pub. No. RM778U) for the DTC (Diagnostic Trouble Code) check method, DTC and DTC clearance.

Brake System Control

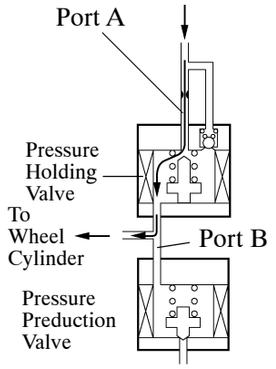
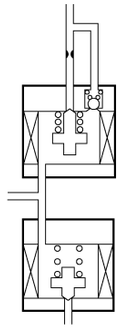
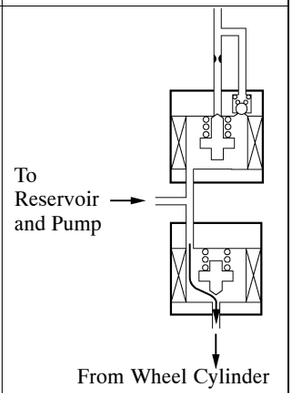
1) ABS with EBD control

a. General

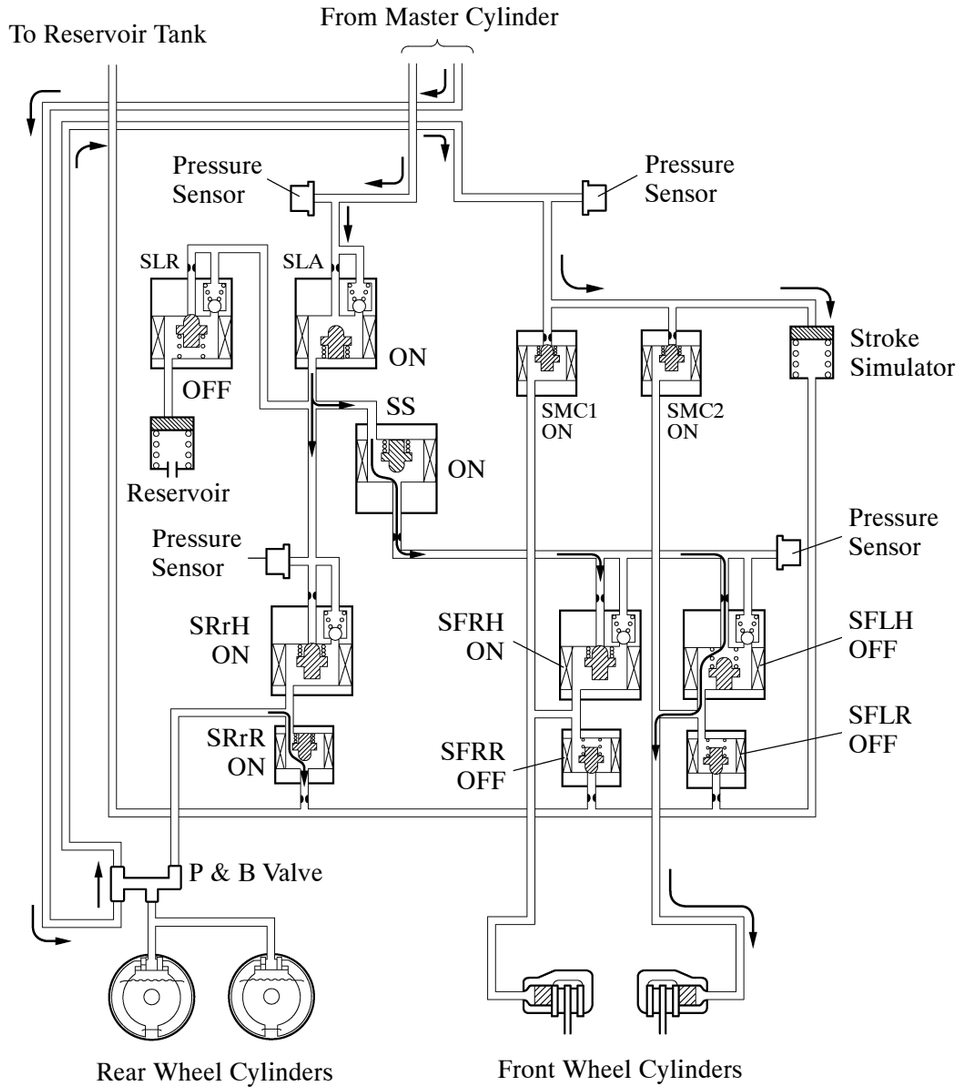
The EBD control utilizes ABS, realizing the proper brake force distribution between front and rear wheels in accordance with the driving conditions. In addition, during cornering braking, it also controls the brake forces of right and left front wheels, helping to maintain the vehicle stability.
The distribution of the brake force is performed under electrical control of the brake ECU, which precisely controls the brake force in accordance with the vehicle's driving conditions.

b. Operation

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

Not Activated	Normal Braking	–	–
Activated	Pressure Increase Mode	Pressure Holding Mode	Pressure Reduction Mode
Hydraulic Circuit			
Pressure Holding Valve (Port A)	OFF (Open)	ON (Close)	ON (Close)
Pressure Reduction Valve (Port B)	OFF (Close)	OFF (Close)	ON (Open)
Wheel Cylinder Pressure	Increase	Hold	Reduction

▶ Sample of ABS control ◀



182CH57

2) Regenerative Brake Cooperative Control

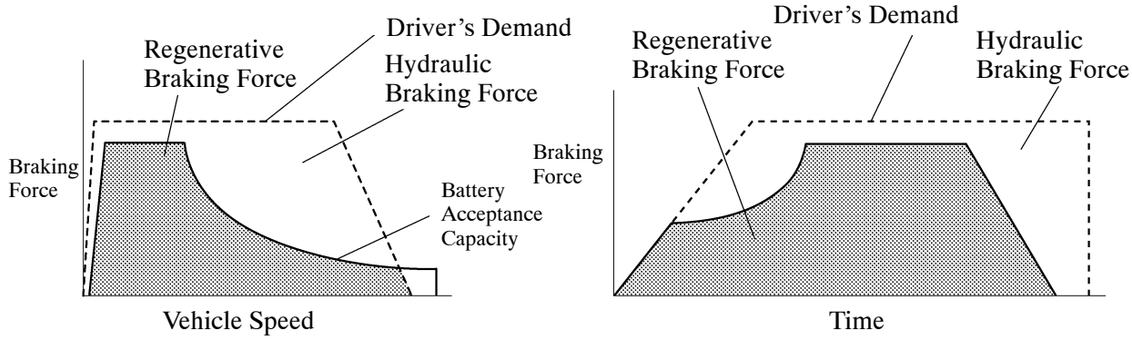
a. General

The regenerative brake cooperative control uses the switching valves and linear solenoid valves to regulate the hydraulic pressure that is supplied to the wheel cylinders. It also operates cooperatively with the regenerative braking force that is generated in the MG2 in accordance with the master cylinder pressure.

b. 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 controlled so that the total brake force of the hydraulic brake and the regenerative brake matches the brake force that the driver requires.

▶ Imagery Drawing ◀



Changes in Regenerative Braking Force **Changes in Braking Force Apportionment**

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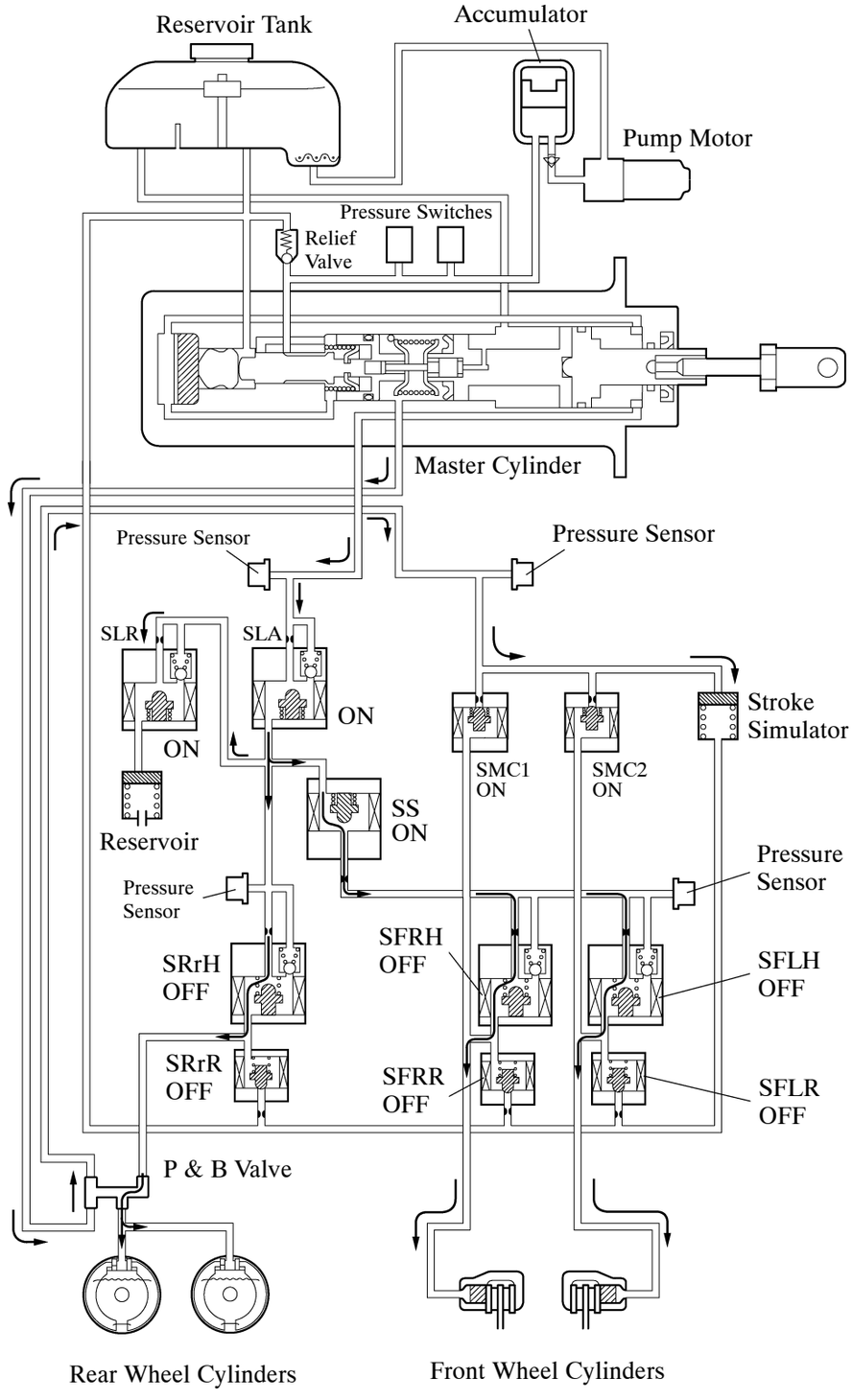
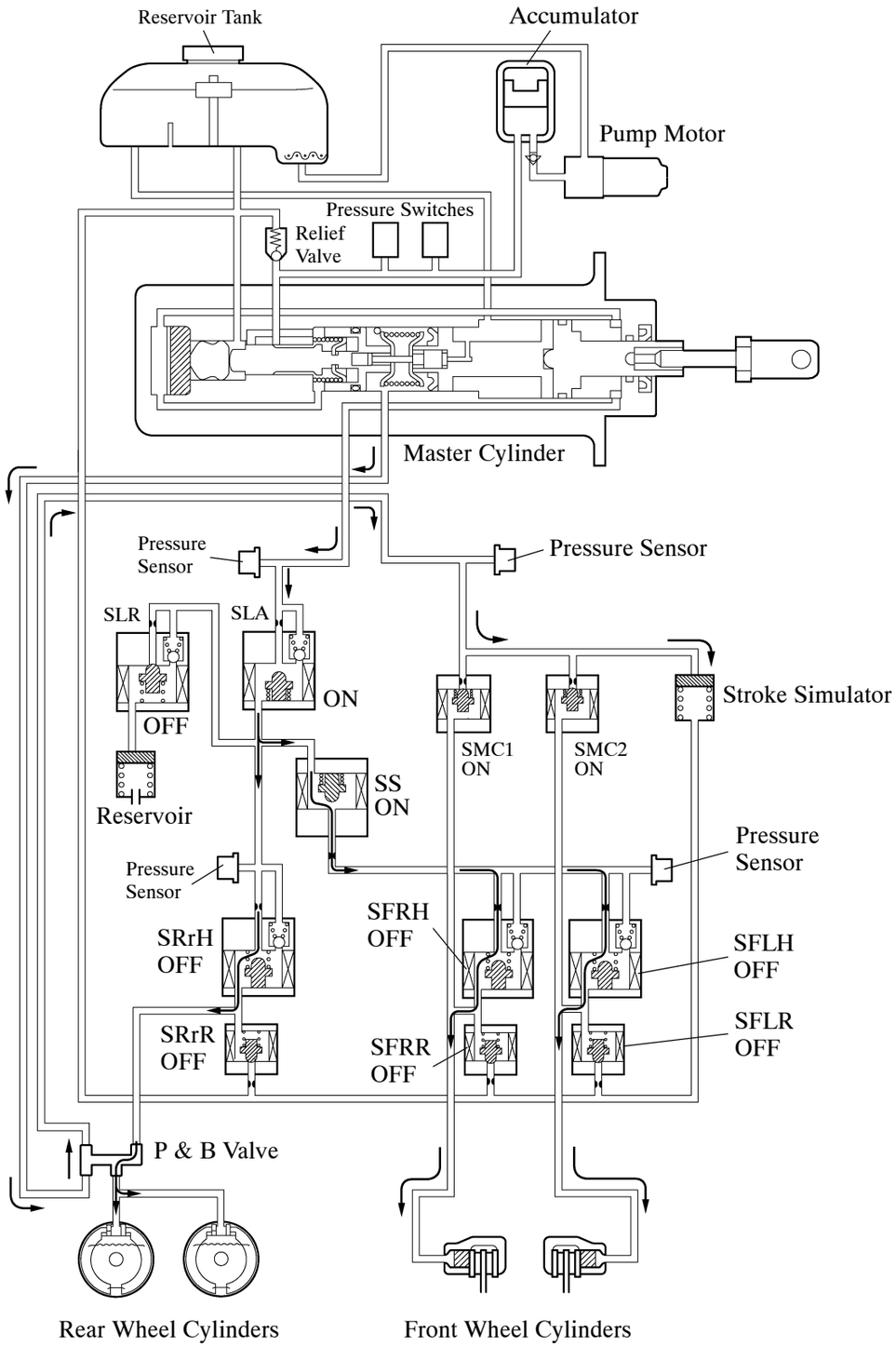
c. Operation

Regenerative brake cooperative control is executed when the vehicle is driven in the shift position "D" or "B".
The master cylinder pressure that is generated when the driver presses on the brake pedal is detected by the pressure sensor, and the brake ECU calculates the brake force request factor. A portion of the brake force request factor is transmitted to the HV ECU in the form of a regenerative brake activation request factor. The HV ECU executes generative braking by commanding the electric motor to generate negative torque.
The brake ECU controls the opening of the linear solenoid valves, which are used for increasing/decreasing the hydraulic pressure, to regulate the wheel cylinder hydraulic pressure in relation to the master cylinder hydraulic pressure, thus compensating for the brake force that is not provided sufficiently by the regenerative brake.
While the regenerative brake cooperative control is being prohibited due to an abnormality in the system, or when the shift lever is in a position other than D or B, the regenerative braking force is not generated. At this time, only the hydraulic braking force is applied by turning ON (opening) the linear solenoid valve SLA and turning OFF (closing) the SLR.

i) Regenerative Brake Cooperative Control

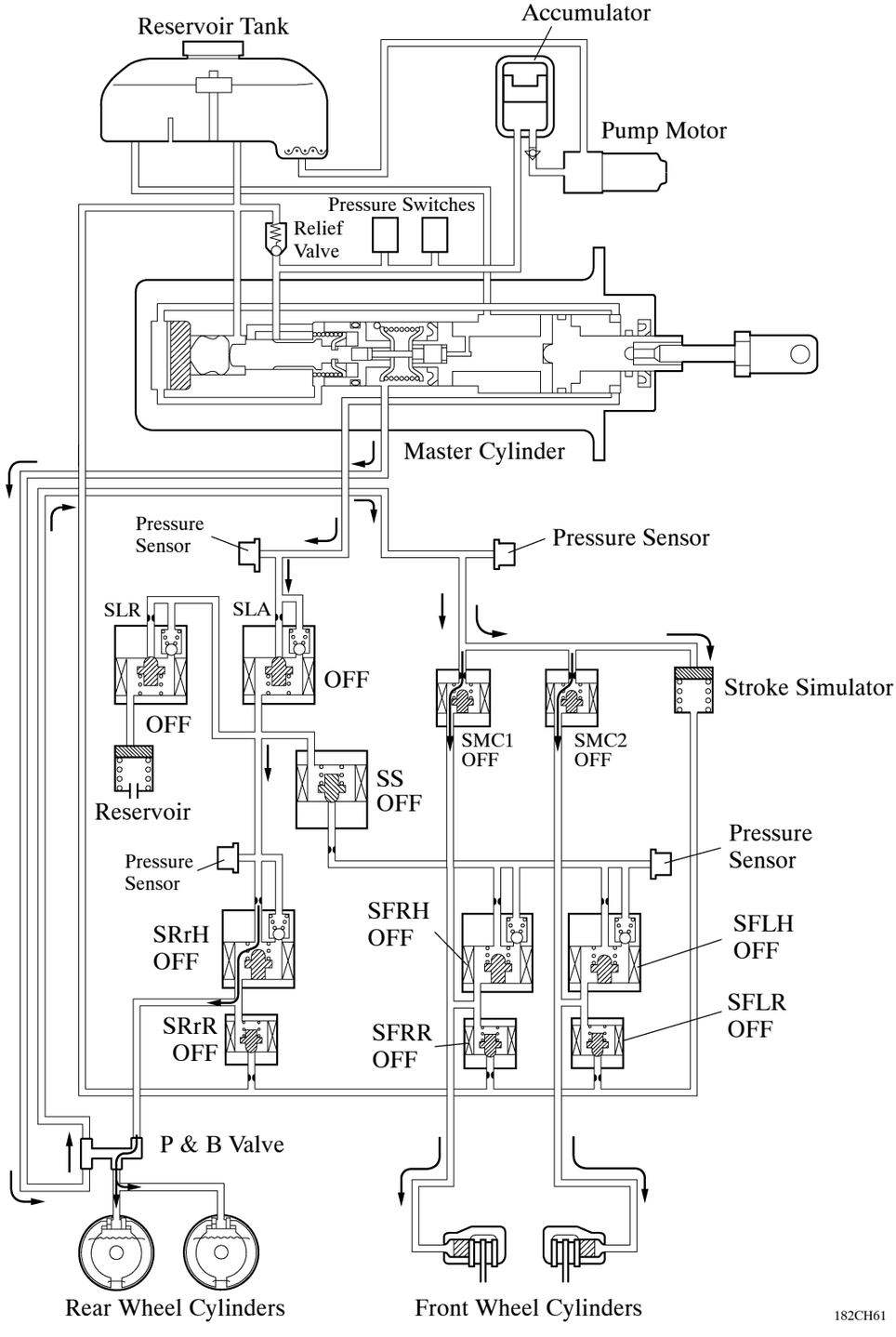


ii) Without Regenerative Brake Cooperative Control (Hydraulic Brake Only)



3) Fail-Safe Control

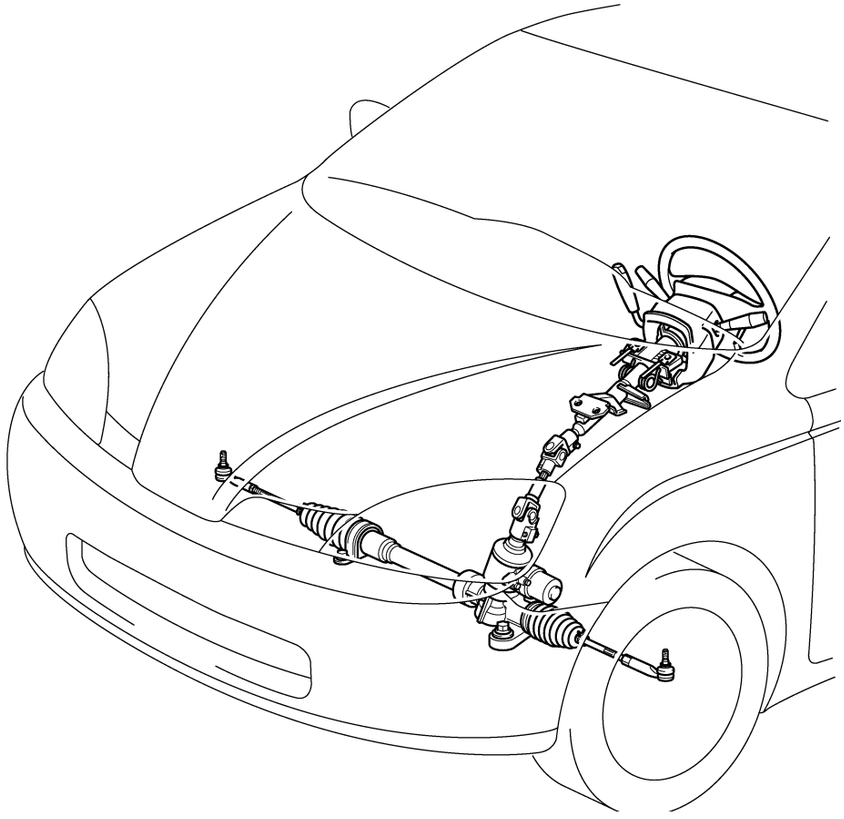
If a malfunction occurs in the brake ECU, in the input signals from the sensors, or in the actuator system, this function prohibits the current from flowing to the brake actuator.
As a result, the solenoids in the brake actuator turn off, enabling the braking force of the hydraulic brake to take effect. The relief function is provided in order to ensure the proper wheel cylinder hydraulic pressure even if the linear solenoid valve SLA is OFF (closed). Only if the regenerative brake system cannot be used, such as in the case of a malfunction in the communication with the HV ECU, this function switches controls to enable the hydraulic brake to generate the entire brake force.



STEERING

■ DESCRIPTION

- A vehicle-speed sensing type EMPS (Electric Motor-assisted Power Steering) has been adopted. The EMPS uses the EMPS ECU to control a DC motor that is mounted on the steering gear in accordance with the signals received from various sensors to provide power assist to the steering effort.
- A rack and pinion type steering gear and a stepless tilt steering have been adopted.
- The steering column has adopted an energy absorbing mechanism that uses energy absorbing plate.



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▶ Specifications ◀

Gear Ratio (Overall)		16.4 ~ 18.3
No. of Turns Lock to Lock		3.99
Rack Stroke	mm (in.)	149.6 (5.89)

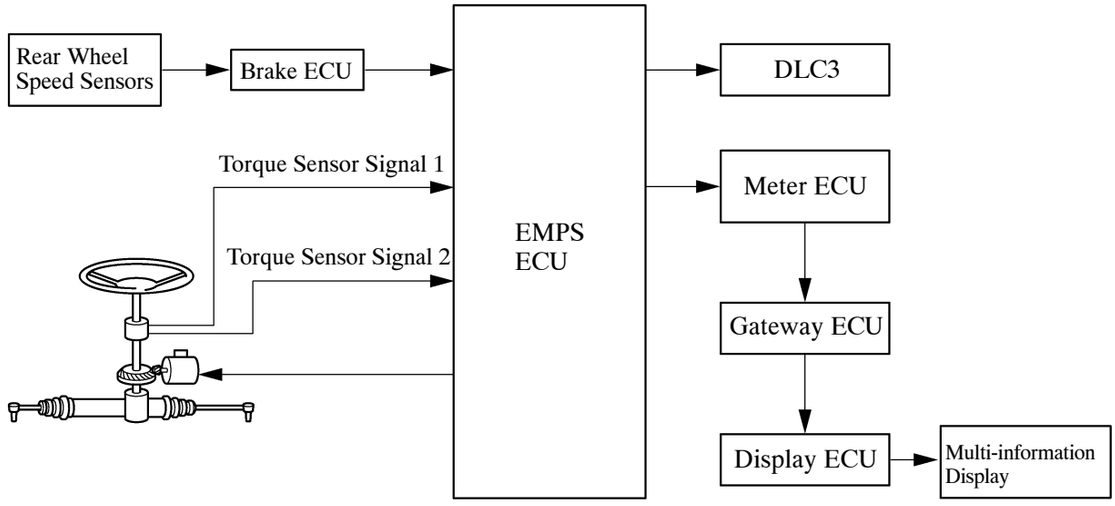
■ EMPS (Electric Motor-assisted Power Steering)

1. General

In accordance with sensor information such as that provided by the rear wheel speed sensors, the torque sensor that is mounted on the steering gear, and the EMPS ECU determines the direction and the force of the power assist and actuates the DC motor that is mounted on the steering gear to provide power assist to the steering effort.
The EMPS in the Prius the following features:

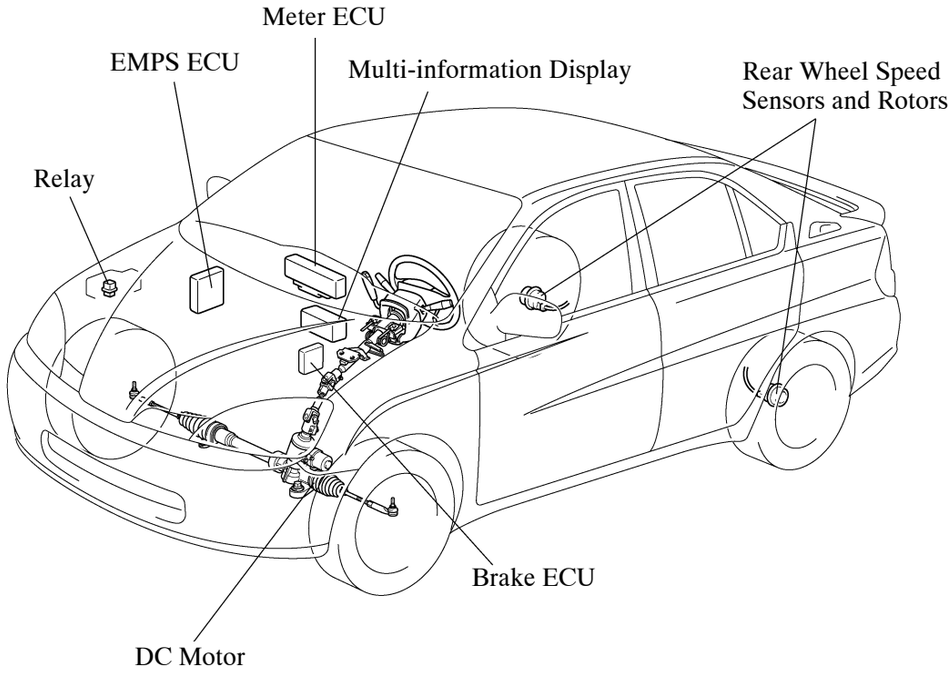
- This system can provide power assist even when the engine is stopped.
- This system offers excellent fuel economy characteristics because power assist is provided by the DC motor that is mounted on the steering gear, and this motor consumes energy only when power assist is required.
- Unlike the conventional hydraulic power steering system, this system excels in serviceability because it does not require pipes or the power steering fluid.

▶ System Diagram ◀



182CH68

2. Layout of Main Components



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3. Function of Main Components

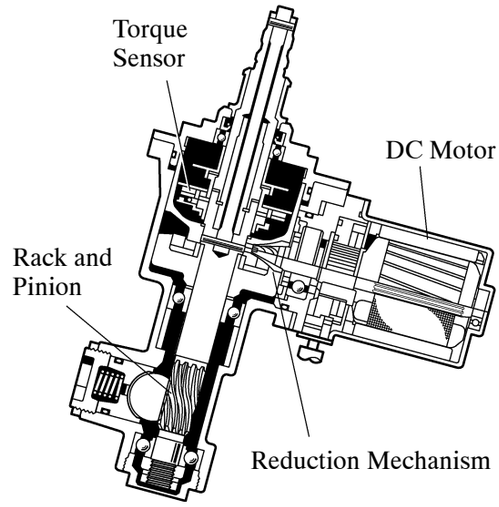
Components		Function
Steering Gear	Torque Sensor	Detects the twist of the torsion bar, converts the torque that is applied to the torsion bar into an electrical signal, and outputs this signal to the ECU.
	DC Motor	Generates power assist in accordance with a signal received from the EMPS ECU.
	Reduction Mechanism	Reduces the rotation of the DC motor and transmits it to the pinion shaft.
EMPS ECU		Actuates the DC motor mounted on the steering gear for providing power assist, based on the signals received from various sensors and the rear wheel speed signal.
Meter ECU		Outputs a signal for displaying the PS warning on the center display in case of a malfunction in the system.
Brake ECU		Rear wheel speed signals are outputted to EMPS ECU.
Relay		Supplies power to the DC motor for power assist.
Multi-information Display		Displays the PS warning in case of a malfunction in the system.

4. Construction and Operation of Main Components

Steering Gear

1) General

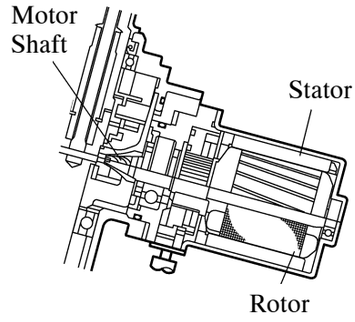
The steering gear consists of the rack and pinion, DC motor, reduction mechanism, and torque sensor. The front suspension components have been optimized to reduce the load on the DC motor. Also, the components have been optimally allocated to ensure ample rack travel and wheel turning angle, resulting in excellent cornering performance.



182CH70

2) DC Motor

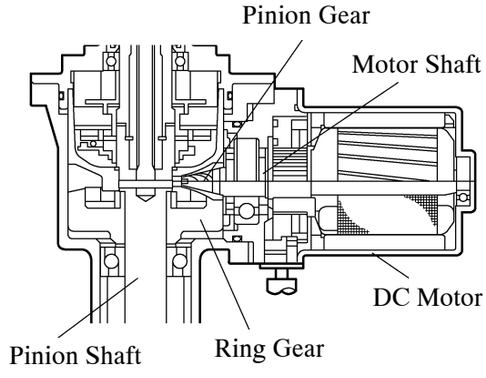
The DC motor is mounted on the gear housing. The DC motor consists of the motor shaft that is integrated with the hypoid pinion to transmit the torque that has been generated by the drive force of DC motor to the pinion shaft, the rotor and stator.



182CH71

3) Reduction Mechanism

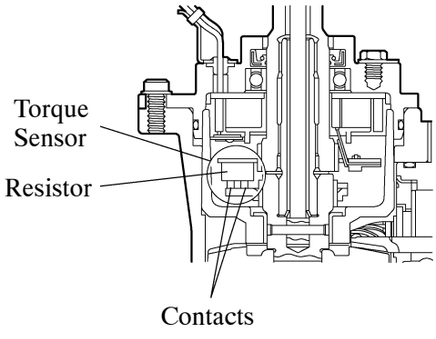
A reduction mechanism that transmits the rotation of the motor to the pinion shaft has been mounted on the steering gear. The reduction mechanism consists of the ring gear that is secured to the pinion shaft and the pinion gear that is integrated with the motor shaft. The power assist of the motor is transmitted by the reduction mechanism to the pinion shaft, which provides power assist to the steering effort.

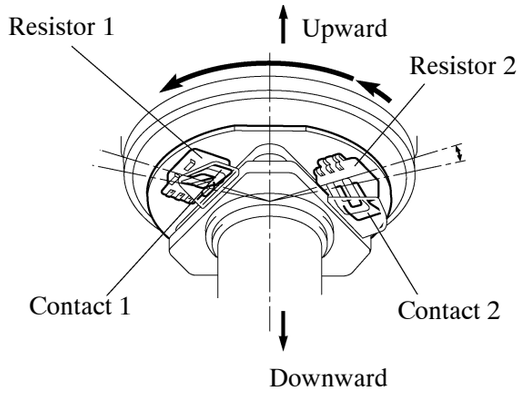


182CH72

4) Torque Sensor

A torque sensor that detects the torque that is input by the steering wheel has been mounted on the pinion shaft. The torque sensor has been integrated with the pinion shaft, and the pinion shaft's input and output shafts are linked via the torsion bar. Resistors for the torque sensor are mounted on the input shaft of the pinion shaft, and contacts for the torque sensor are mounted on the output shaft of the pinion shaft. Operating the steering wheel causes the torsion bar to twist, creating a displacement between the pinnion shaft's input and output. Two systems of torque sensors detect this displacement in the form of voltage changes, which are then output to the EMPS ECU.

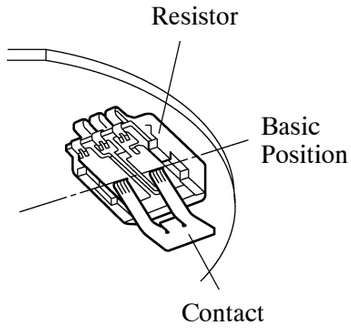




182CH73

i) Straightline Driving

If the vehicle is driven straight and the driver does not turn the steering, torque is not generated in the pinion shaft's input shaft. Thus, the torsion bar does not twist, and no changes in resistance occur in the torque sensor.

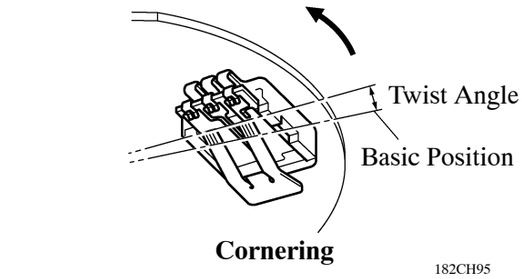


Straightline

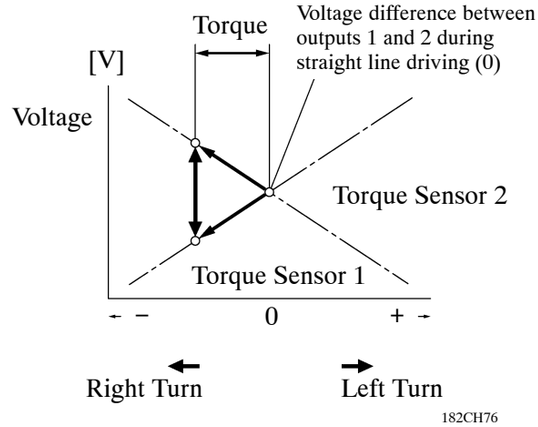
182CH74

ii) Steering to the right

When the driver turns the steering to the right, the steering torque is transmitted to the pinion shaft's input shaft, causing the input shaft to rotate. Because the reaction force of the ground surface acts on the rack bar, the torsion bar that links the input shaft and the pinion twists until a torque that equalizes with the reaction force is generated. Thus, a relative displacement is created between the resistor that is secured onto the input shaft and the contact that is secured onto the pinion shaft's output shaft. As a result, the resistance changes, causing the torque sensor's outputs 1 and 2 to change as shown in the right diagram. The EMPS ECU uses this voltage difference to calculate the power assist torque to drive the DC motor, thus generating a power assist force in the pinion shaft via the reduction mechanism.



182CH95



182CH76

iii) Steering Hold Condition

The torsion bar shift to a position in which the sum of the driver's steering torque and the motor's assist torque equalizes with the reaction force of the ground surface in order to maintain the steering holding condition.

EMPS ECU

1) EMPS Control

The EMPS ECU receives signals from various sensors, judges the current vehicle condition, and determines the assist ampere to be applied to the DC motor accordingly.

2) Self-Diagnosis

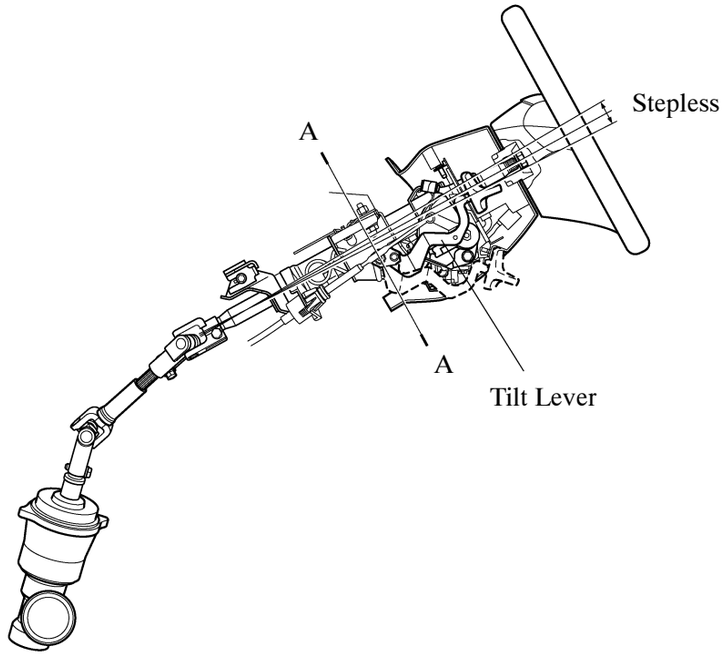
If the EMPS ECU detects a malfunction in the EMPS system, the warning light that corresponds to the function in which the malfunction has been detected lights up to alert the driver of the malfunction. The EMPS ECU will also store the codes of the malfunctions. The DTCs (Diagnostic Trouble Codes) can be accessed through the use of a hand-held tester. For details, see the 2001 Prius Repair Manual (Pub. No. RM778U).

3) Fail-Safe

If the EMPS ECU detects a malfunction in the EMPS system, the system basically turns OFF the power to prohibit power assist. As a result, the EMPS system operates the same way as manual steering. However, depending on the location in which the malfunction occurred, power assist may be provided by reducing the power assist amperage or by fixing the amount of power assist without relying on the vehicle speed.

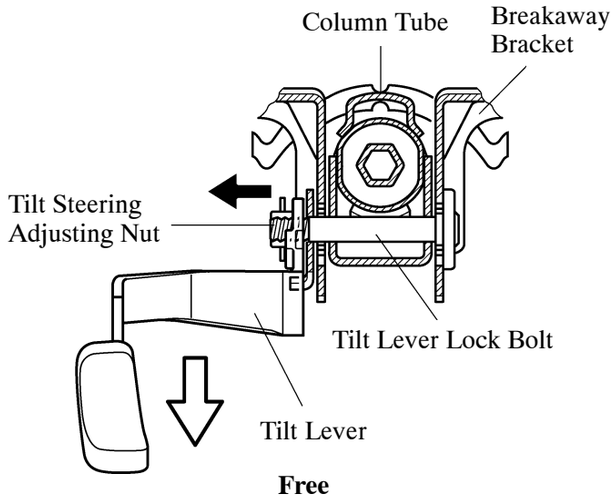
■TILT STEERING

The tilt mechanism consists of a tilt lever, column tube, breakaway bracket, tilt lever lock bolt, tilt steering adjusting nut.
When the tilt mechanism is in its locked state, operating the tilt lever downward causes the tilt steering adjusting nut to loosen (because the tilt lever lock bolt has left-handed screw threads).
When the tilt mechanism is in its free state, operating the tilt lever upward causes the tilt steering adjusting nut to tighten.



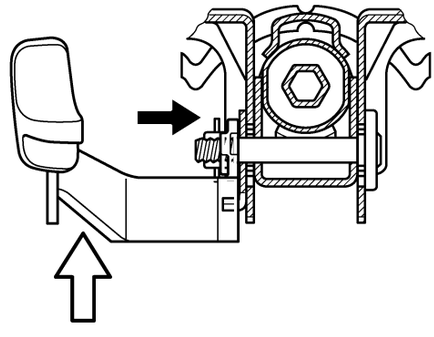
182CH63

▶ A – A Cross Section ◀



Free

182CH64



Lock

182CH65

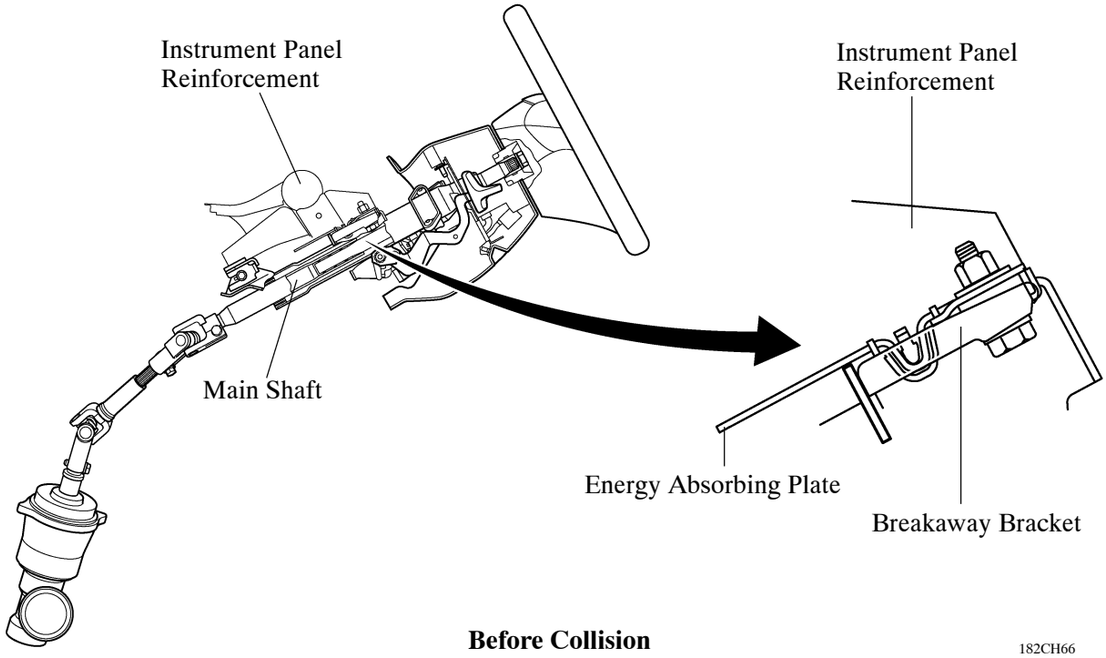
■ ENERGY ABSORBING MECHANISM

The energy absorbing mechanism in the steering column consists of a lower bracket, breakaway bracket, energy absorbing plate and a contractile main shaft. The steering column is mounted onto the instrument panel reinforcement via a lower bracket and breakaway bracket which is supported via a capsule and energy absorbing plate. The steering column and the steering gear box are connected with a contractile intermediate shaft. Operational examples of this mechanism are follows.

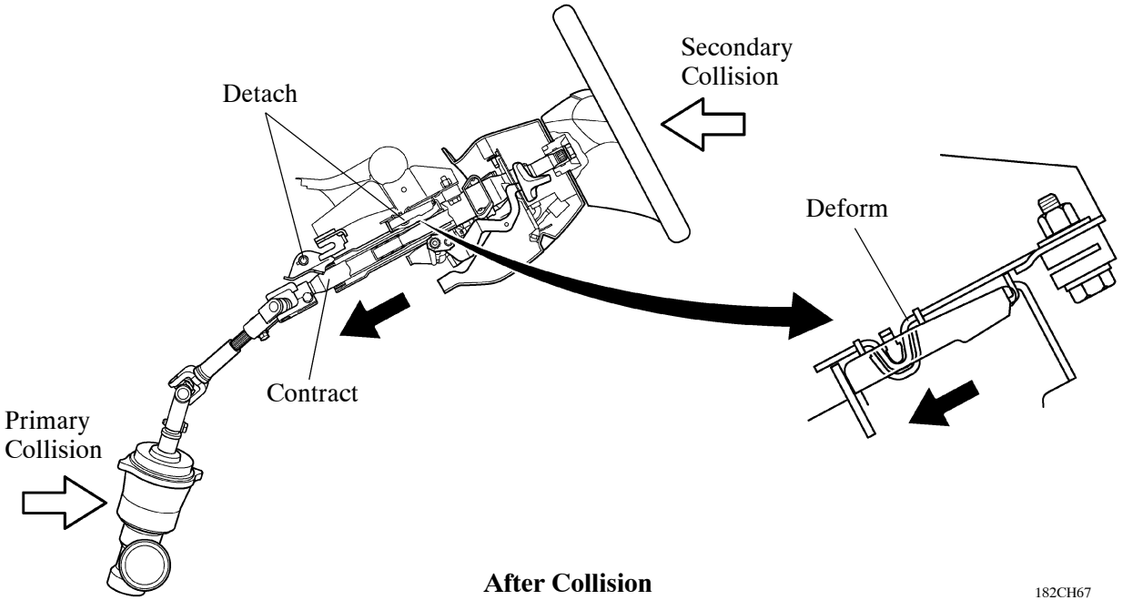
When the steering gear box moves during a collision (primary collision), the main shaft and the intermediate shaft contract, thus reduce the chance that the steering column and the steering wheel protrude into the cabin.

When an impact is transmitted to the steering wheel in a collision (secondary collision), the steering wheel and the driver airbag help absorb the impact. In addition, the breakaway bracket and the lower bracket separate, causing the entire steering column to move forward.

At this time, the energy absorbing plate becomes deformed to help absorb the impact of the secondary collision.



Before Collision 182CH66



After Collision 182CH67

BODY

BODY STRUCTURE

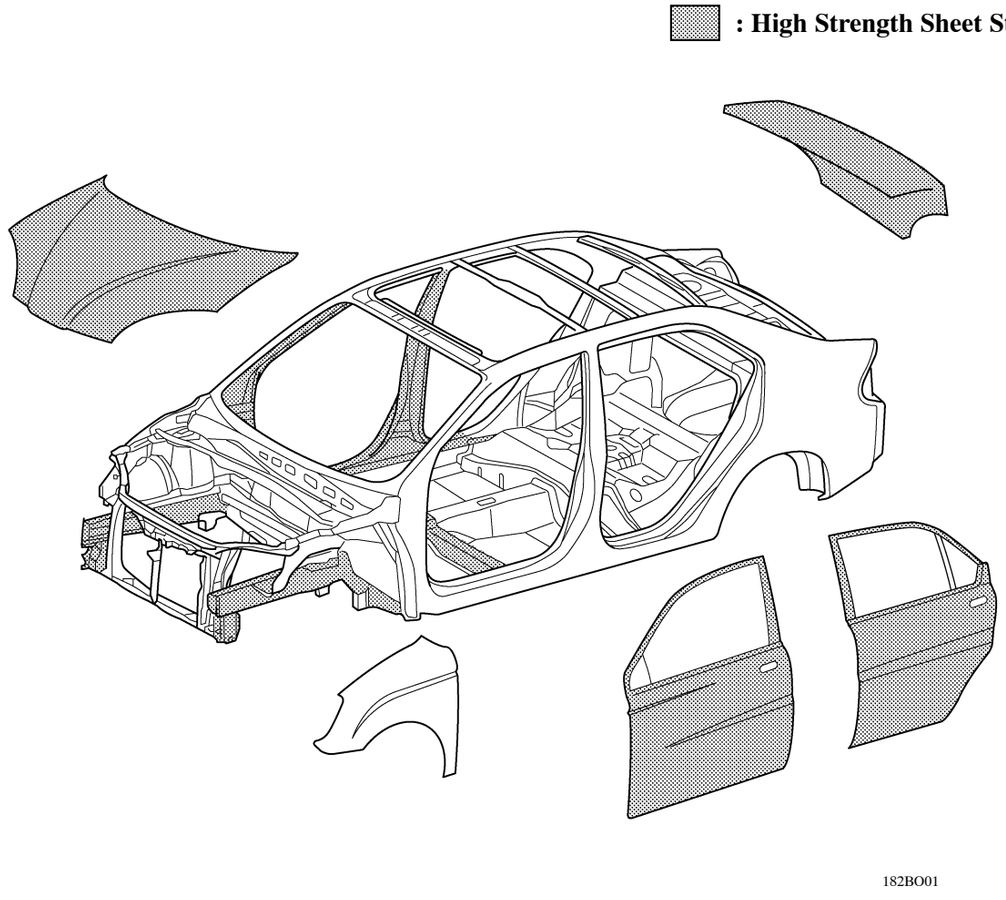
■DESCRIPTION

The Prius has adopted a body construction that achieves both high rigidity and safety.

■LIGHTWEIGHT AND HIGHLY RIGID BODY

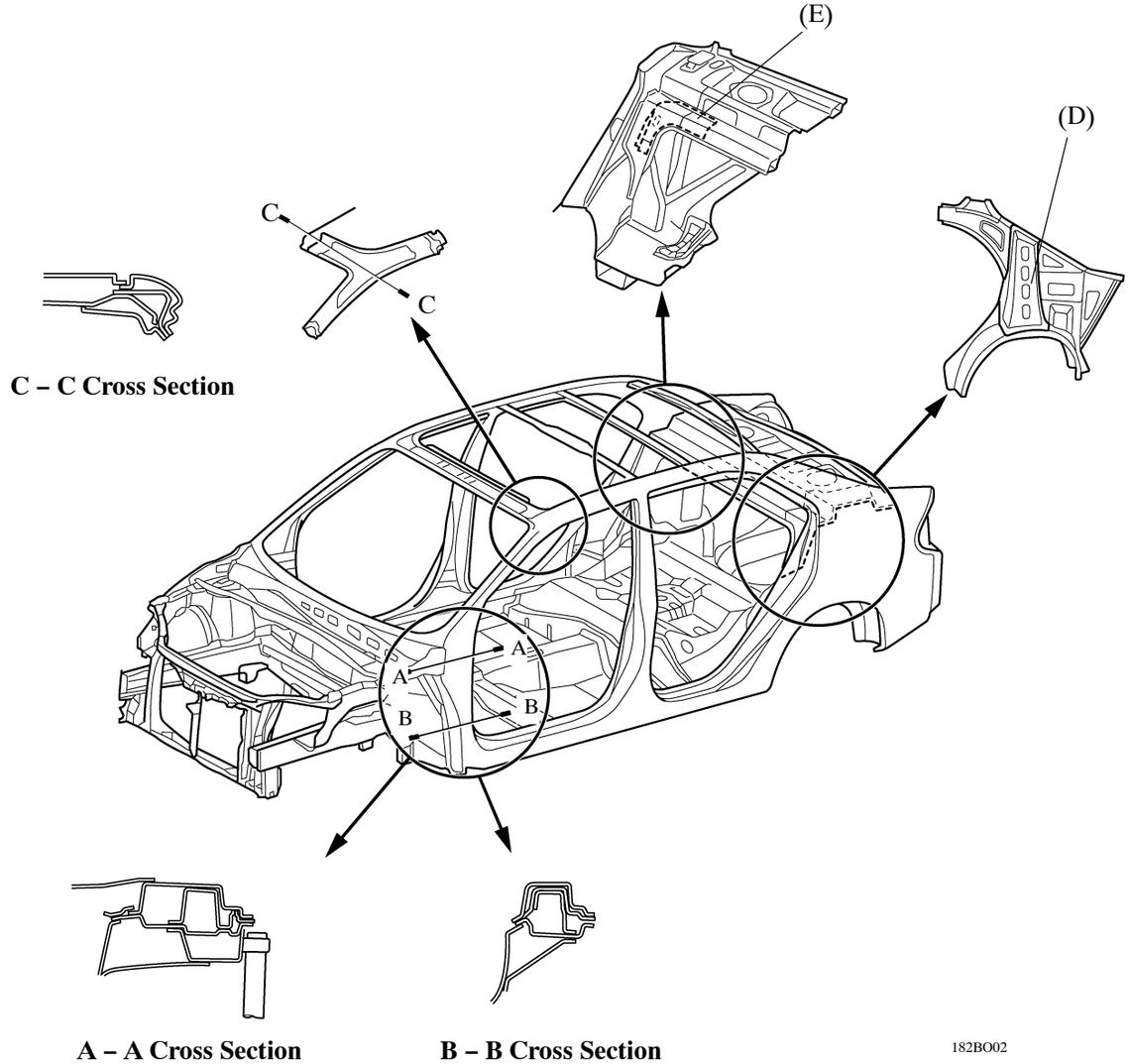
1. High Strength Sheet Steel

High strength sheet steel has been used in order to ensure body rigidity and realize a lightweight body.



2. Body Shell

- The joining construction (A-A cross section) of the cowl side panel, front pillar, and the instrument panel reinforcement has been optimized to restrain the generation of vibrations.
- By joining the under body and the front pillar with a pillar brace (B-B cross section), as well as the upper end of the front pillar with the roof header (C-C cross section), the generation of vibrations has been restrained.
- By providing a gusset (D) in the quarter wheel house and a reinforcement (E) in the upper back panel, the generation of vibrations in the rear body area has been restrained.



■SAFETY FEATURES

1. Impact Absorbing Structure

General

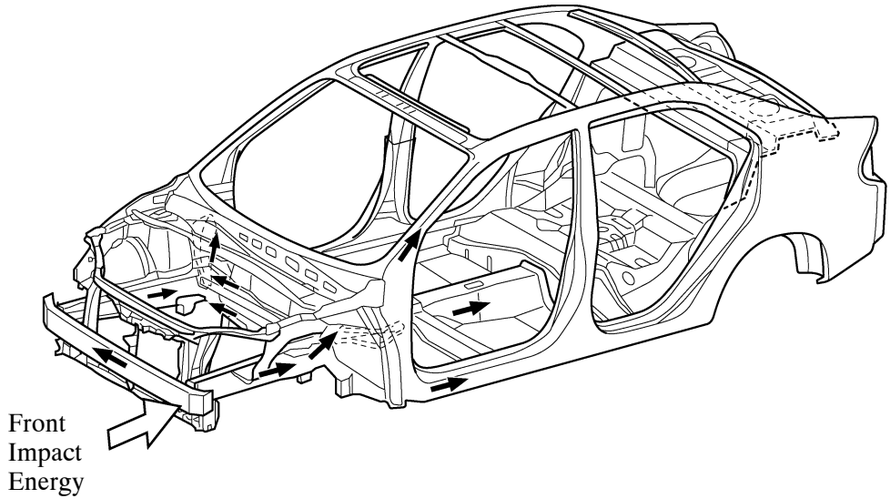
The impact absorbing structure of the Prius provides a body construction that can effectively helps absorb the energy of impact in the event of a front, or side collision. Also, it realizes a high level of occupant protection performance through the use of reinforcements and members that help to minimize cabin deformation.

Construction

1) Impact Absorbing Structure for Front Collision

In conjunction with the high level of impact absorbing structure for a front collision, the front bumper reinforcement, the side members, the reinforcements and members that surround the cabin have been optimally allocated.
Accordingly, the frameworks of the underbody and cabin help to absorb and dissipate the impact energy efficiently, and to realize the minimized cabin deformation, in case of a front collision.

▶ Impact Absorbing Structure for Front Collision ◀

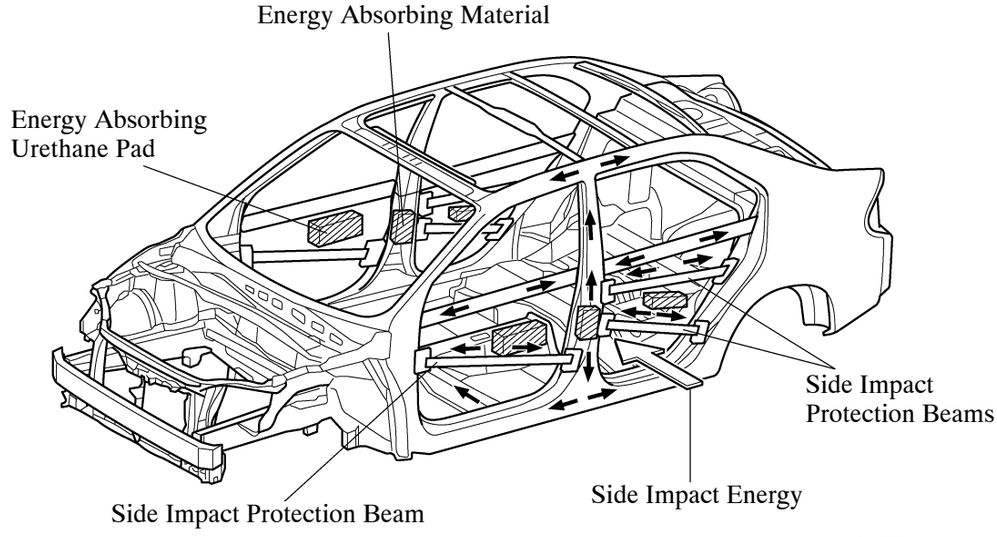


182BO03

2) Impact Absorbing Structure for Side Collision

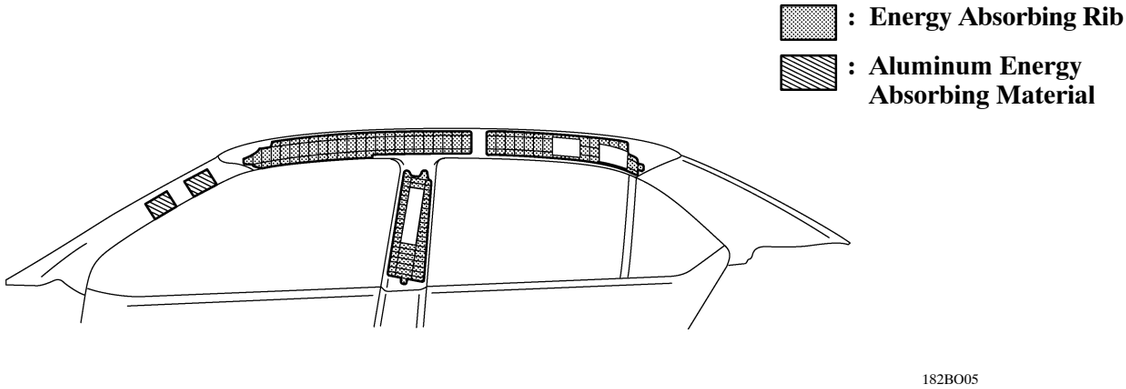
- Impact energy of a side collision directed to the cabin area is dispersed throughout the body via pillar reinforcements, side impact protection beams, floor cross members, thus helping minimize the impact energy finally directed to the cabin. In addition, the body is made reinforced joints and high strength sheet steel, in order to help maintain the maximum preservation of the cabin space. And, in order to make the door energy absorbent, a closed cross section configuration is provided at the belt line area of the front and rear doors.
- By providing an energy absorbing urethane pad in the front door panel and an energy absorbing material in the door panel and the center pillar garnish, the impact of a collision can be dampened.
- A head impact protection structure has been adopted. 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 panel of the roof side rail and pillar collapses to help reduce the impact.

▶ Impact Absorbing Structure for Side Collision ◀



182BO04

▶ Head Impact Protection Structure ◀



182BO05

■RUST-RESISTANT BODY

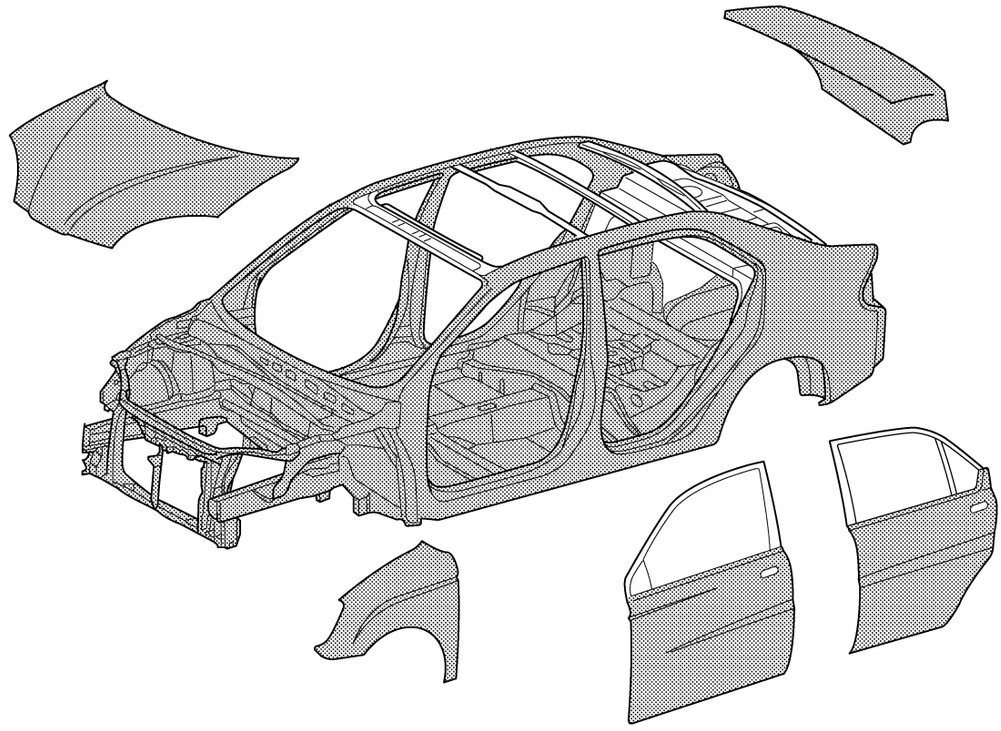
1. General

Rust-resistant performance is enhanced by extensive use of anti-corrosion sheet steel and an anti-corrosion treatment by applying wax, sealer and anti-chipping paint to easily corroded parts such as the hoods, doors and rocker panels.

2. Anti-Corrosion Sheet Steel

Anti-corrosion sheet steel is used in all areas other than the roof and interior parts.

: Anti-Corrosion Sheet Steel



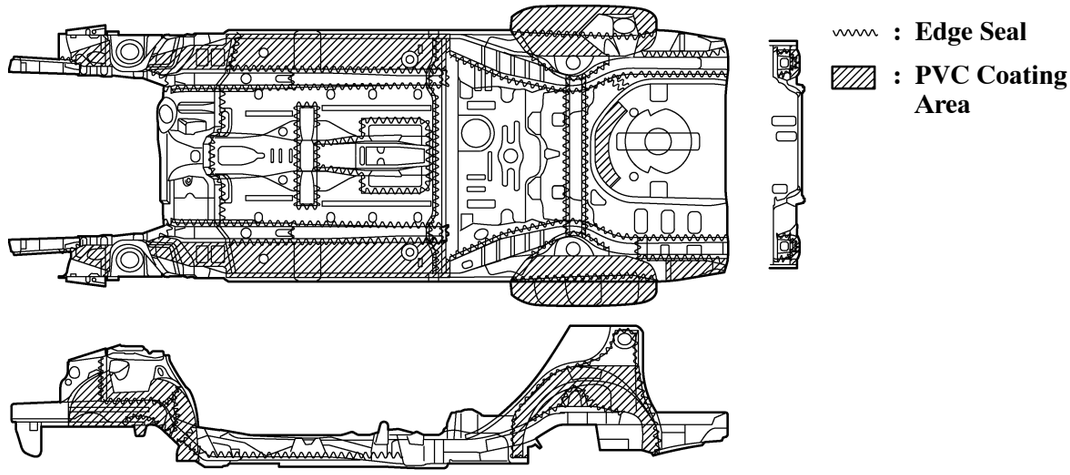
182BO06

3. Wax and Sealer

Wax and sealer are applied to the hemmed portions of the hoods, door panels, rocker panel and luggage compartment door to improve rust-resistant performance.

4. Under Coat

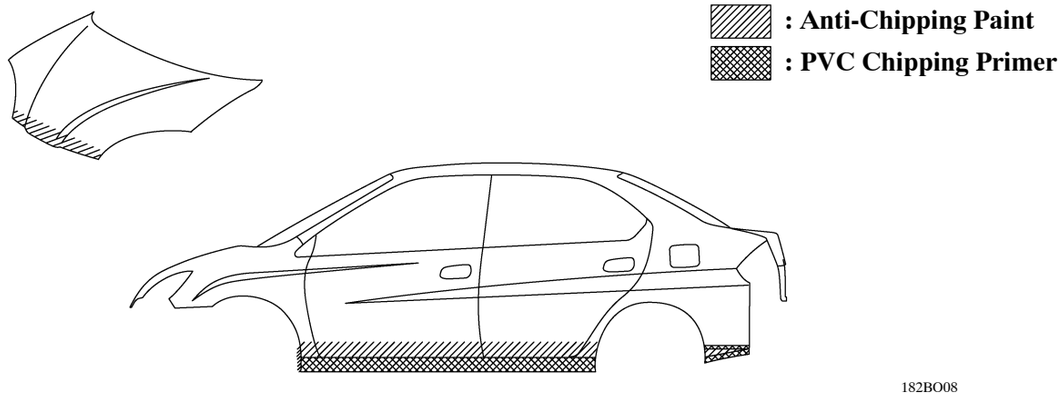
PVC (Polyvinyl Chloride) coating is applied to the under side of the body.
The bottom side of the cowl panel, the fender apron and other parts which are subject to damage by stone chipping.



182BO07

5. Anti-Chipping Application

Anti-chipping paint and PVC chipping primer are applied to the lower quarter panel area, lower door panel area, front hood area and the rocker panel area to protect them from stone chipping.



182BO08

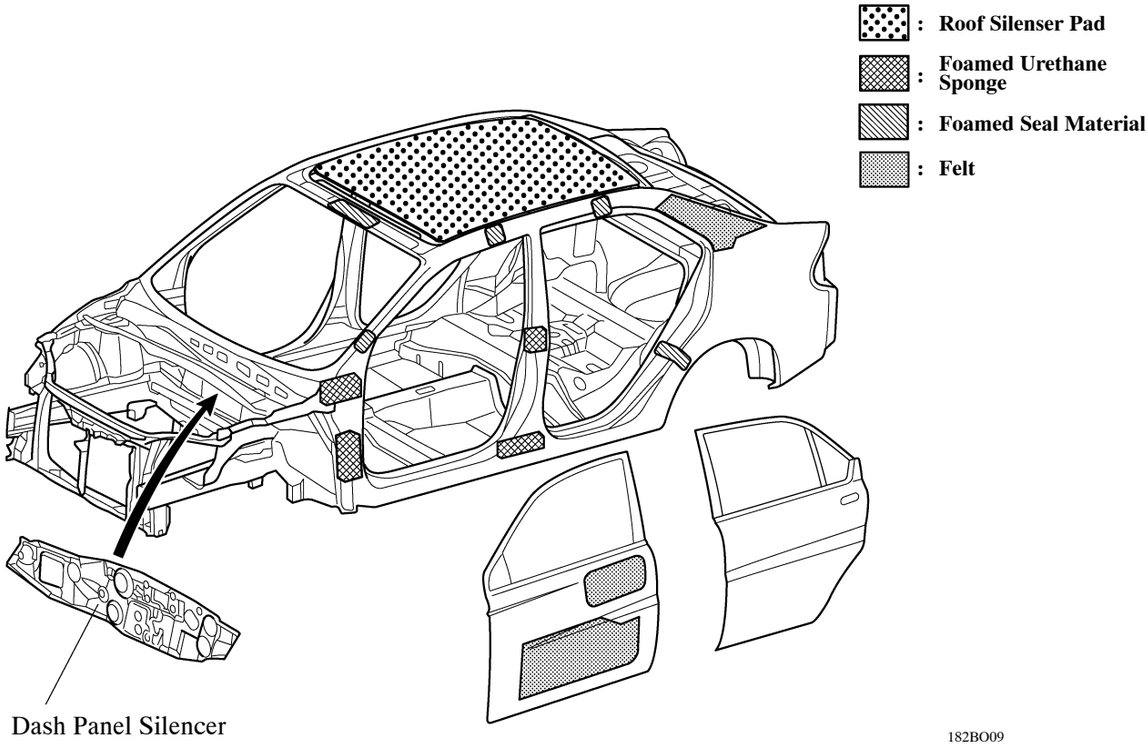
■LOW VIBRATION AND LOW NOISE BODY

1. General

Effective application of vibration damping and noise suppresant materials reduces engine and road noise.

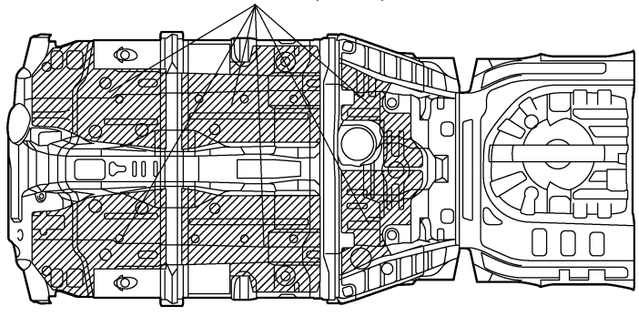
2. Sound Absorbing and Vibration Damping Materials

- Adoption of the dash panel silencer made the reduction of the engine and road noise and improved the quietness in the compartment.
- Foamed urethane sponge, foamed seal material, felt and roof silencer pad are applied onto the roof panel and pillars to reduce wind and road noise.
- The adoption of the floor silencer realized the reduction of the engine and road noise. Also, the adoption of RSPP (Recycled Sound Proof Products) for raw material realized the improvement of recylability.



182BO09

Floor Silencer (RSPP)



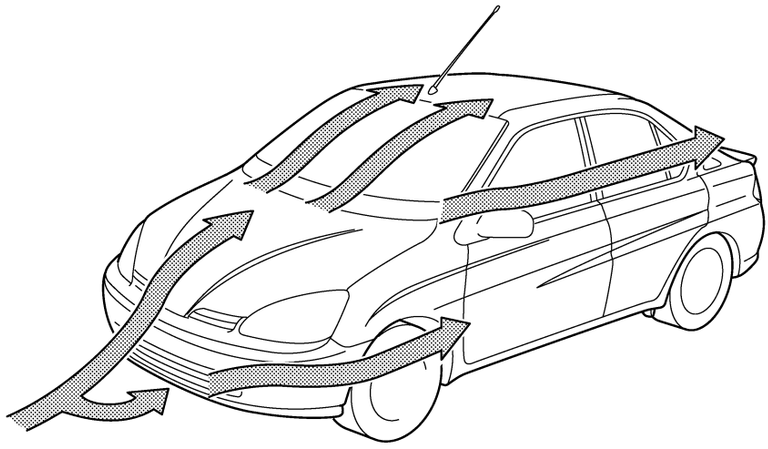
182BO10

AERODYNAMICS

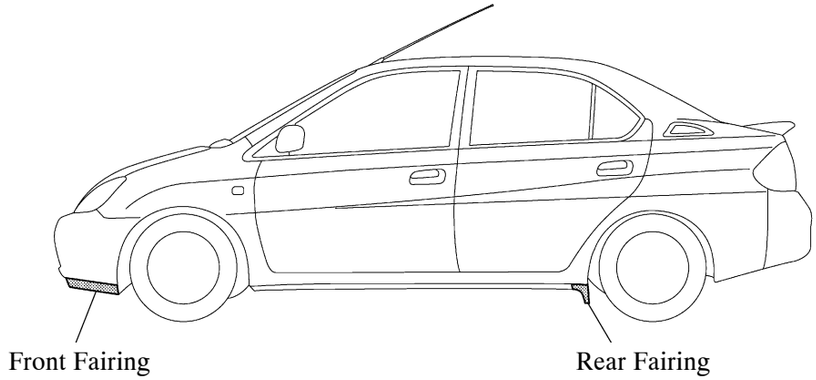
■ DESCRIPTION

To improve aerodynamic performance, the following measures have been taken.

- The shapes of the front pillar, outside rear view mirror, and the front windshield glass have been optimized to achieve a smooth air flow.
- The height and the shape of the front bumper have been optimized in order to rectify the airflow under the floor and along the body sides.
- The shapes of the engine undercover, fuel tank bottom surface, and the rear floor bottom surface have been optimized to achieve a smooth underbody air flow.
- A front and rear fairings are provided to smooth out the airflow around the tires and reduce the air resistance while the vehicle is in motion.



182BO12

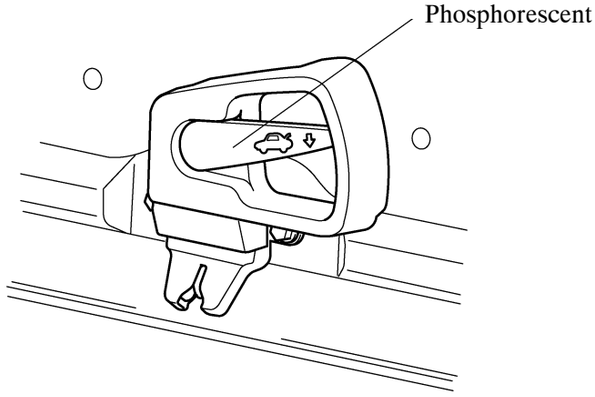


182BO13

ENHANCEMENT OF PRODUCT APPEAL

■INTERNAL TRUNK RELEASE HANDLE

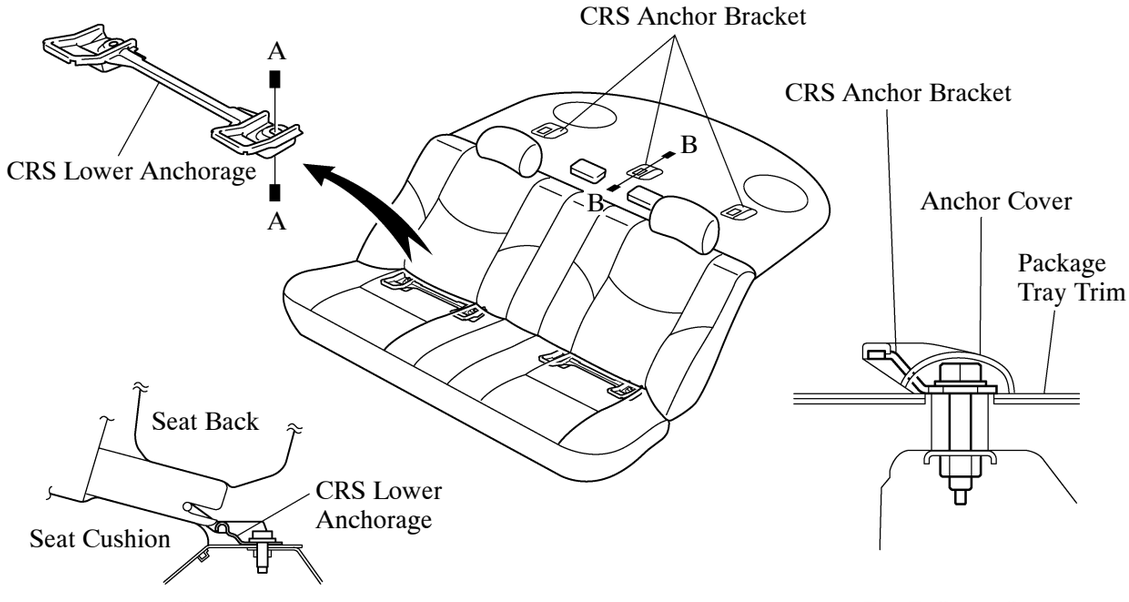
An internal trunk release handle is included inside the trunk in case a person inadvertently locks himself within the trunk and needs to free himself. The handle is made of phosphorescent so that it is visible in the trunk for a while even after the trunk has been closed.



182BO14

■SEAT

- CRS (Child Restraint System) lower anchorage for securing child seats, which complies with FMVSS225, has been provided behind the seat cushion of both outer rear seats.
- Three CRS anchor brackets for securing a child seat have been provided above the package tray trim.



A – A Cross Section

B – B Cross Section

182BO15

■SEAT BELT

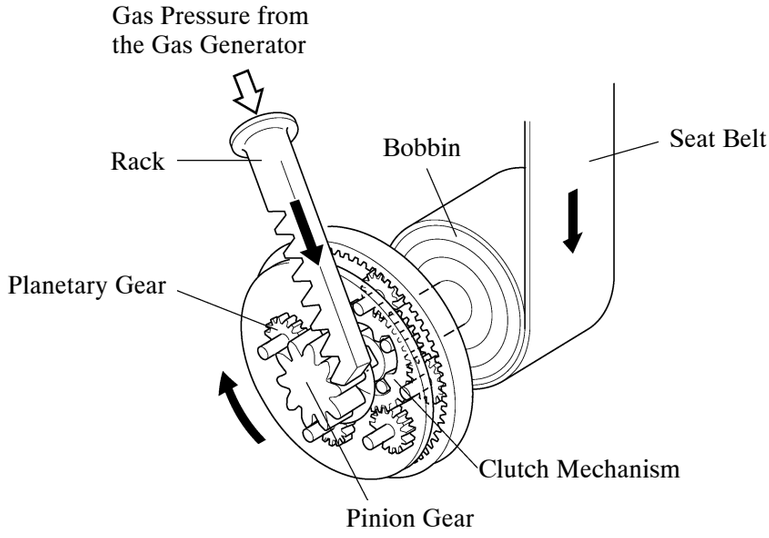
1. General

- The front seats are provided with an electrical sensing type seat belt pretensioner and a seat belt force limiter. In the beginning of a collision, the seat belt pretensioner instantly pulls up the seat belt thus providing the excellent belt's effectiveness in restraining the occupant.
  When the impact of a collision causes the tension of the seat belt applied to the occupant to reach a predetermined level, the force limiter restrains the tension, thus controlling the force applied to the occupant's chest area.
- In accordance with the ignition signal from the airbag sensor assembly, the seat belt pretensioner activates simultaneously with the deployment of the SRS airbags for the driver and front passenger.
- The passenger seats are provided with ALR (Automatic Locking Retractor)/ELR (Emergency Locking Retractor) seat belts.

2. Seat Belt Pretensioner

General

The pretensioner mechanism mainly consists of a rack, pinion gear, planetary gear, clutch mechanism, and a bobbin.
During the deployment of this pretensioner mechanism, the gas pressure from the gas generator pushes the rack down and retracts the seat belt via the pinion gear, planetary gear, clutch mechanism, and bobbin.

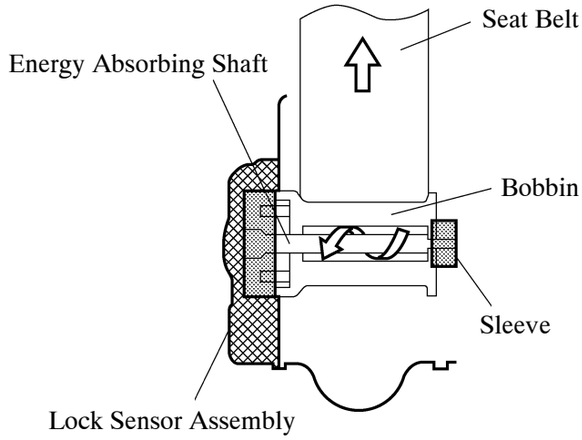


182BO16

3. Seat Belt Force Limiter

The seat belt force limiter mainly consists of an energy absorbing shaft, lock sensor assembly, bobbin, and sleeve.

When the seat belt is pulled out at a rate that exceeds the specified acceleration rate, the ELR (Emergency Locking Retractor) becomes activated, causing the lock sensor assembly to lock the energy absorbing shaft. Because the bobbin on which the seat belt is attached is secured to the energy absorbing shaft via the sleeve, the energy absorbing shaft becomes twisted. The twisting of the energy absorbing shaft causes the bobbin to rotate and the seat belt to be pulled out, thus maintaining the tension that is applied to the seat belt.



174BO02

BODY ELECTRICAL

AUXILIARY BATTERY

■ DESCRIPTION

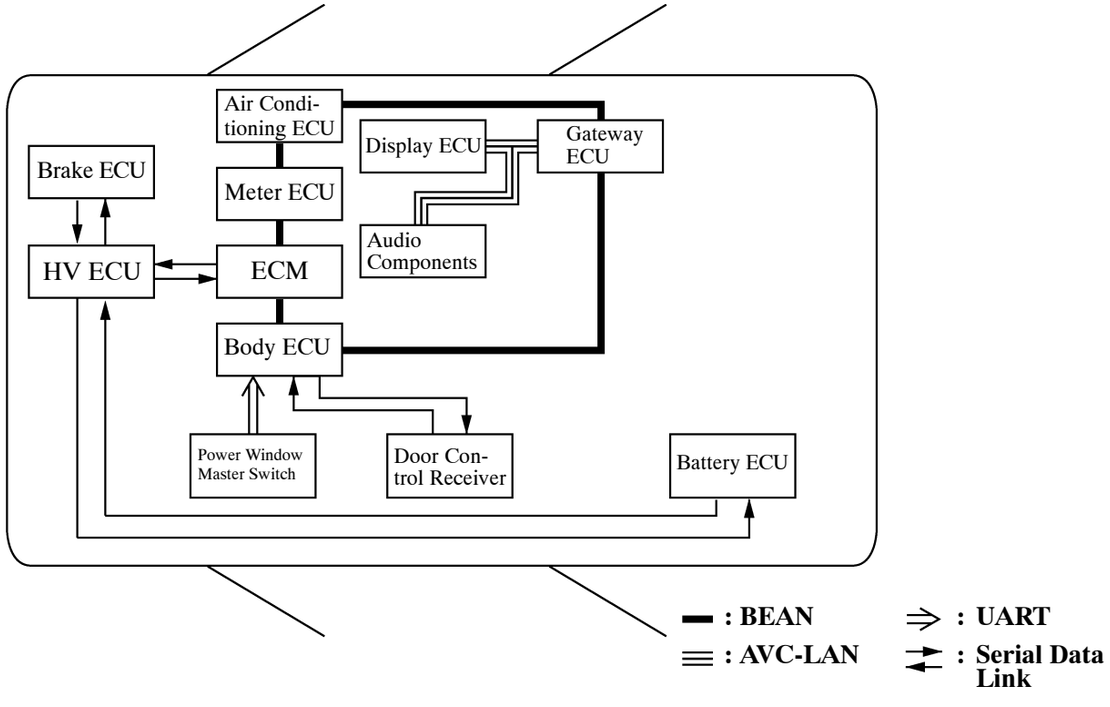
All the body electrical systems and auxiliary equipment operate using the same 12 V battery used on ordinary gasoline engine vehicles.
However, as the battery structure is different, Prius uses an exclusive battery. See page 42 in the THS (TOYOTA Hybrid System) section for details of the auxiliary battery structure.

MULTIPLEX COMMUNICATION SYSTEM

■ DESCRIPTION

- A multiplex communication system has been adopted for body electrical system control and to achieve a slimmer wiring harnesses configuration.
- BEAN (Body Electronics Area Network) has been adopted between the body ECU, ECM, meter ECU, air conditioning ECU, and the gateway ECU. Furthermore, AVC-LAN (Audio Visual Communication-Local Area Network) has been adopted between the display ECU and the audio components.
  The conversion of communication signals between BEAN and AVC-LAN is performed by the gateway ECU.
- UART (Universal Asynchronous Receiver Transmitter), which performs unidirectional communication, has been adopted between the body ECU and the power window master switch.
- A serial data link has been adopted between the body ECU and the door control receiver. In addition, a serial data link has been adopted between the ECM, HV ECU, brake ECU, and the battery ECU, which pertain to the control of the hybrid system.

▶ System Diagram ◀



182BE01

■SYSTEM OPERATION

1. General

The ECUs that pertain to the body electrical system perform the functions and system controls described below.

Gateway ECU

- Conversion of data between AVC-LAN and BEAN
- Transmission of vehicle information to the display ECU, in order for it to be displayed on multi-information display

Body ECU

- Power window system control (Front, Rear passenger only)
- Door lock control system control
- Wireless door lock remote control system control
- Theft deferrent system control
- Daytime running light system control
- Illuminated entry system control
- Light auto turn-off system control
- Seat belt warning system control
- Key reminder system control
- Diagnosis

Meter ECU

- Meter control
- Illumination and flashing control of indicator and warning lights
- Sounding control of warning buzzer

Air Conditioning ECU

Air Conditioning control

ECM

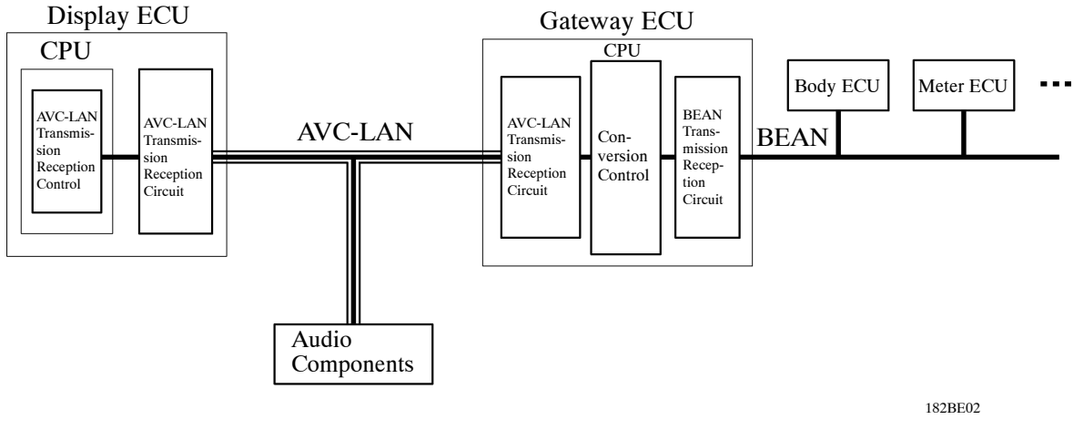
- Engine control
- Diagnosis

Display ECU

- Transmission and reception associated with audio and visual functions

2. Gateway Function (Gateway ECU)

This multiplex communication system has adopted BEAN (Body Electronics Area Network) between the body ECU, ECM, meter ECU, air conditioning ECU, and the gateway ECU, as well as AVC-LAN between the display ECU and the audio components. Because the data configuration differs between BEAN and AVC-LAN, their data must be converted in order for them to exchange each other's data. The conversion of communication data is performed by the gateway ECU. As a result, it has become possible for a single communication line to transmit various types of information.

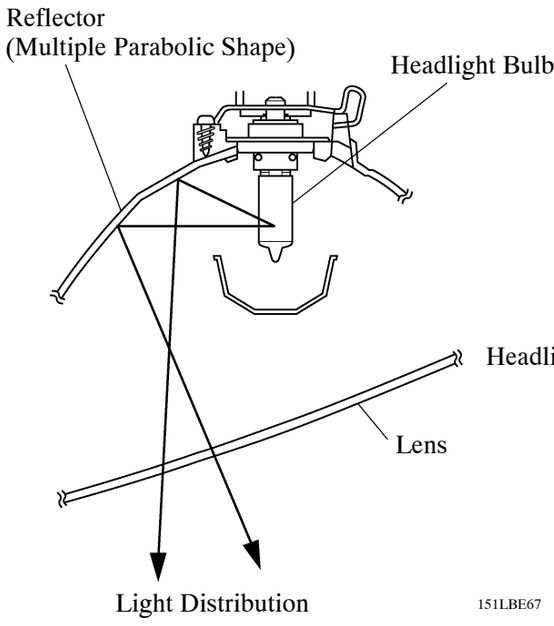


LIGHTING

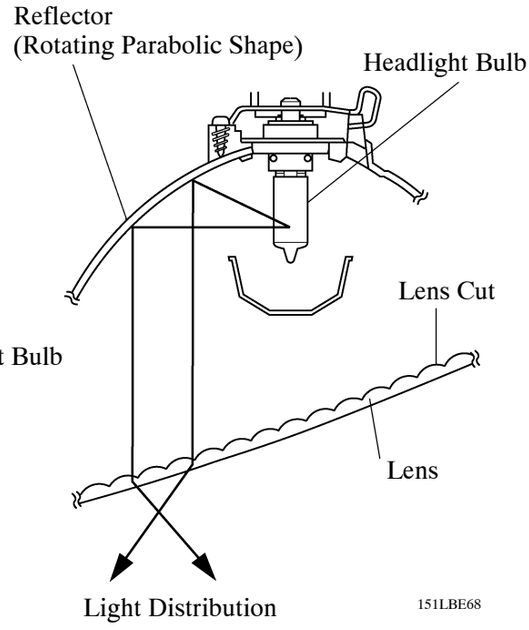
■HEADLIGHTS

The prius has newly adopted the multi-reflector headlights. Conventional headlights accomplish the dispersion and distribution of the light that is emitted by the bulbs through the lens cut pattern. However, 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 Diagram ◀



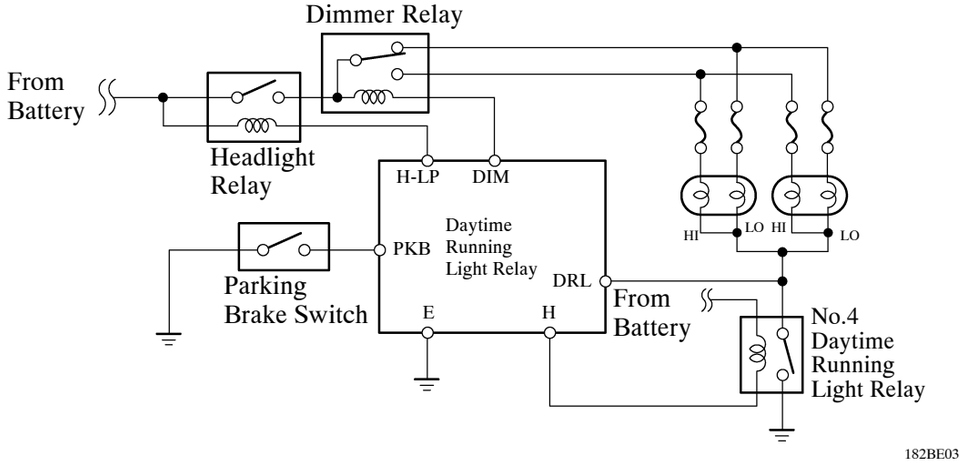
Multi-Reflector Type Headlight



Conventional Headlight

■DAYTIME RUNNING LIGHT SYSTEM

The daytime running light system is adopted for Canada model as standard and U.S.A. model as optional equipment. This system is designed to automatically activate the headlights (dimmed low beams) during the daytime to keep the car highly visible to other vehicles.
This system is controlled by a semi-conductor relay circuit (daytime running light relay).



■ ILLUMINATED ENTRY SYSTEM

- When a door is unlocked through a key operation or transmitter operation, or if a door is opened or closed, the illuminated entry system turns ON the dome light. If the ignition switch is turned to the ACC or ON position or if all doors are locked during the 15 seconds in which this light are ON, they will immediately turn OFF.
- This system is controlled by the body ECU.

■ LIGHT AUTO TURN-OFF SYSTEM

- When the ignition key is turned from ON or ACC to LOCK position and the 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.

METER

■COMBINATION METER

1. General

- The combination meter is available as a digital display type. It is located at the upper center of the instrument panel to improve its visibility.
- For this combination meter, a meter ECU that effects multiplex communication through the use of BEAN (Body Electronics Area Network) has been adopted.
- The display of the speedometer can be switched between km/h and MPH readings by operating the km/h-MPH selector switch located in the middle of the center cluster. Furthermore, the odo/trip meter can be switched between odometer and tripmeter readings by operating the odo/trip selector/reset switch located in the middle of the center cluster.
- A “READY” light that informs the driver that the vehicle is ready to be driven has been adopted.
- A master warning light that informs the driver if an abnormality occurs in either the EMPS (Electric Motor-assisted Power Steering), HV batteries, or the THS (TOYOTA Hybrid System) has been adopted.
- An output control warning light has been adopted to show the drop of power function due to the output drop of HV batteries.
- For the purpose of making corrections in 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. In addition, an outer ambient temperature sensor has been provided in the fuel tank to detect the temperature in the fuel tank.

U.S.A. Model

182BE04

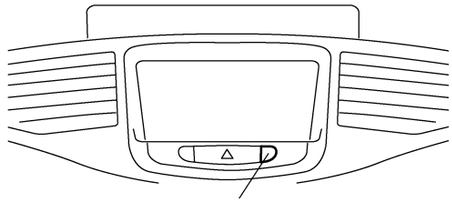
Canada Model

182BE16

2. Construction and Operation

Speedometer

- The speedometer is displayed digitally through the VFD (Vacuum Fluorescent Display). It can be switched between the km/h and MPH readings by operating the km/h-MPH selector switch located in the middle of the center cluster.
- The vehicle speed signal, which originates at the speed sensor that is installed in the hybrid transaxle, travels via the HV ECU and ECM (BEAN) and is received by the meter ECU.



Km/h-MPH Selector Switch

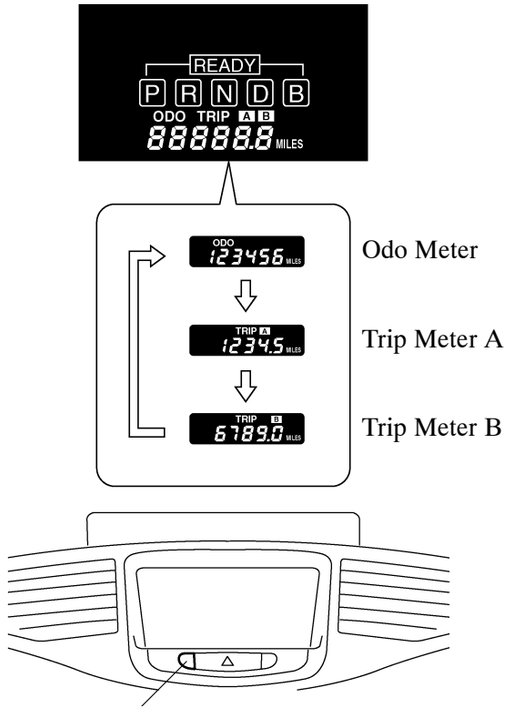
182BE05

Odo/Trip Meter

Similar to the speedometer, the odo/trip meter is displayed digitally through the VFD (Vacuum Fluorescent Display). By operating the odo/trip selector/reset switch located in the middle of the center cluster, its display can be switched in the following sequence: odometer → trip meter A → trip meter B.

While trip meter A or B is displayed, pressing the odo/trip selector/reset switch 0.8 seconds or longer causes the driven distance displayed by the current trip mode to revert to 0.0 mile or 0.0 km.

The trip meter will resume measuring the distance at the moment the odo/trip selector/reset switch is released.

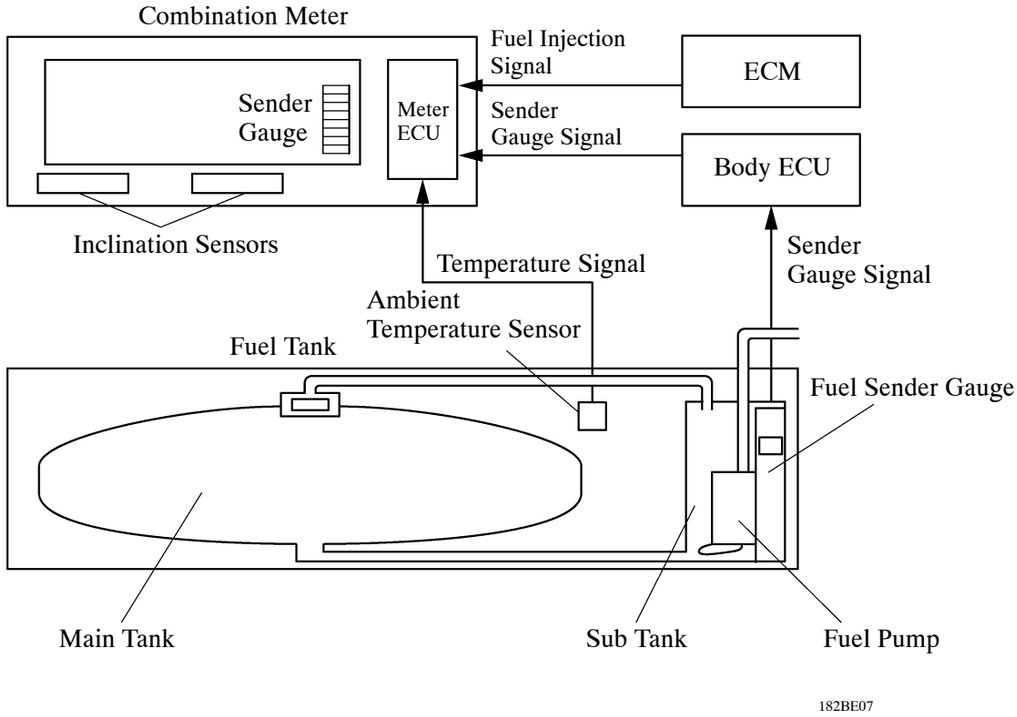


Odo/Trip Selector/Reset Switch

182BE06

Fuel Gauge

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 that have been received via the body ECU, and the fuel injection signals received from the ECM. 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.



"READY" Light

When the shift position is P, turning the ignition switch to START 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 ignition switch is turned to START

Illuminates when the vehicle is ready to be driven

182BE08

Service Tip

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

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

Master Warning Light

A master warning light that informs the driver if an abnormality occurs in either the EMPS, HV batteries, or the THS has been adopted.
If an abnormality occurs in the system, the master warning light illuminates and the multi-information display shows the warning items. For details, see page 178.

Output Control Warning Light

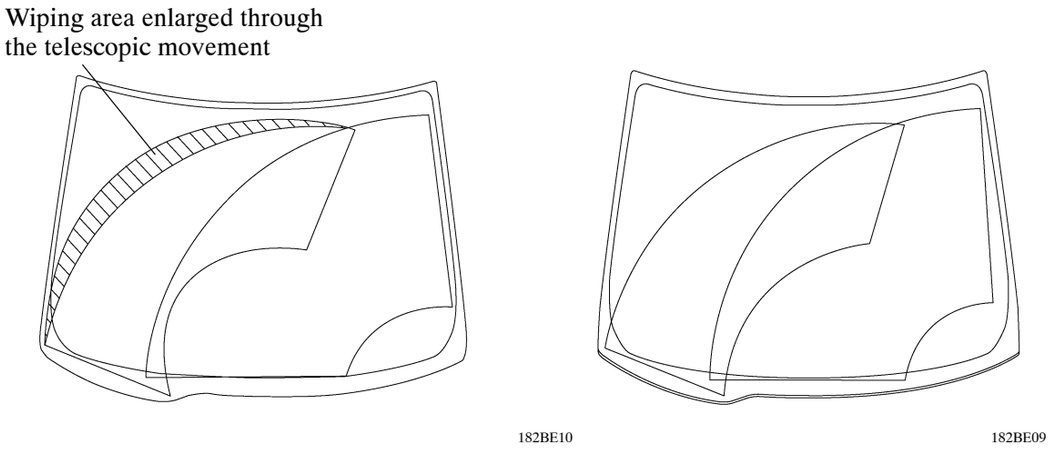
An output control warning light has been adopted to show the drop of power function due to the output drop of HV batteries.
This warning light comes on when the temperature of HV batteries is higher or lower than that of specified range, or when SOC (State of Charge) is lower than the specified value with the shift position in R range. When this warning light comes on, avoid sudden acceleration and drive carefully.

WIPER

■TELESCOPIC WIPER

1. General

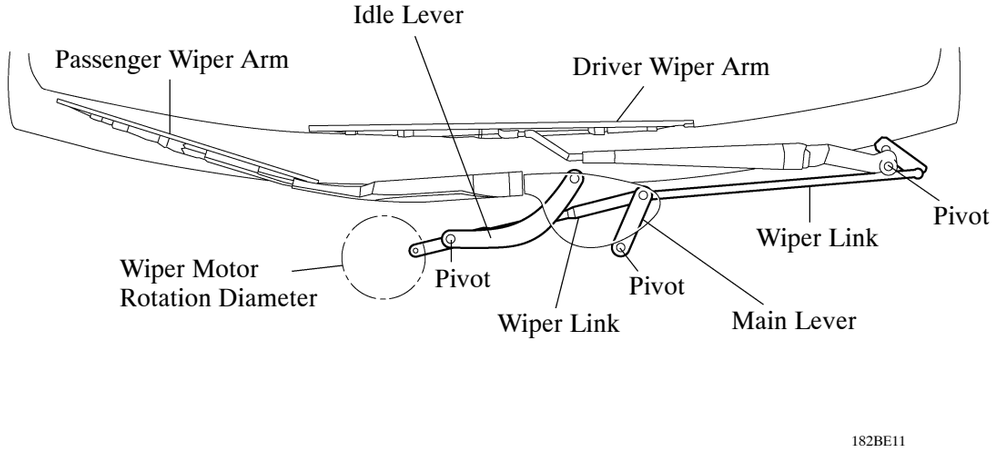
- The telescopic wiper has been adopted.
- The telescopic wiper consists of a wiper arm for the front passenger side that wipes telescopically from the stopped position to the upper return position in order to enlarge the wiping area.



Telescopic Type **Conventional Type**

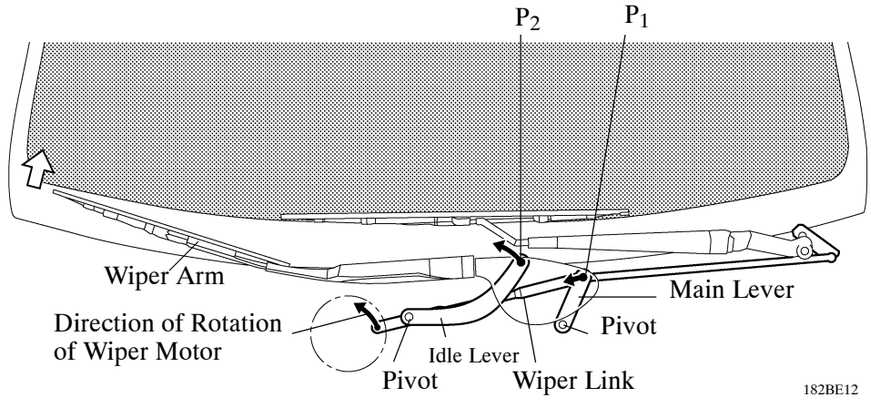
2. Construction

The telescopic wiper mainly consists of a driver wiper arm, passenger wiper arm, main lever, idle lever, wiper link and wiper motor.

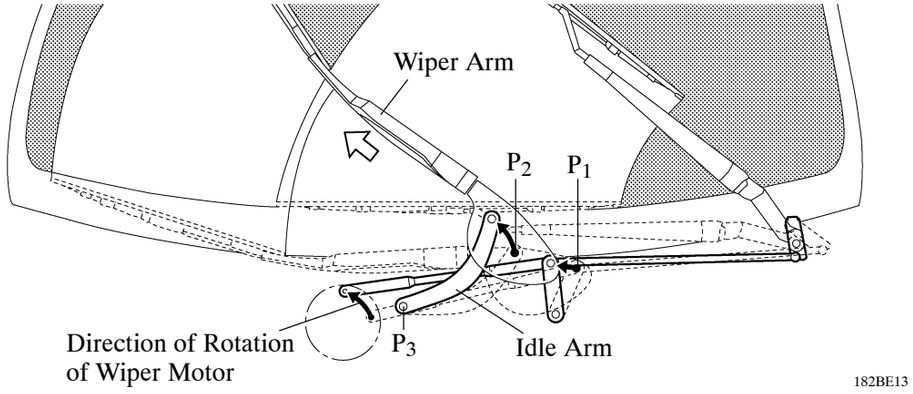


3. Operation

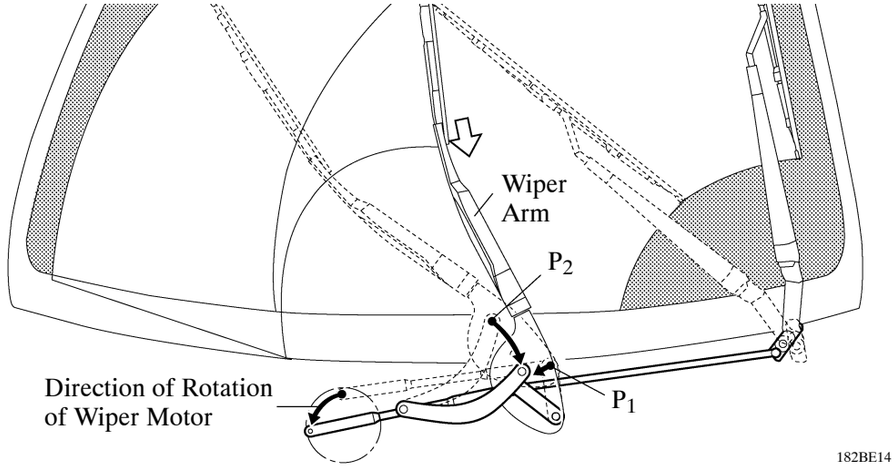
- With the rotation of the wiper motor, the wiper link for driving wiper will operate and connection point P_1 with the main lever will move toward the arrow mark by the influence of the wiper link with a pivot as a supporting point. With this, the connection point P_2 between the wiper arm and the idle lever becomes the supporting point of the pry and starts wiping by holding the arm upward.



- In addition, when the wiper motor rotates, P_1 and P_2 will move toward the arrow mark. Then, the wiper arm with P_3 as a supporting point will rise by the influence of the idle arm as if expanding upward to the left. With this, it enables to wipe wider range.



- When the wiper motor rotates more, P_1 and P_2 will move toward the arrow mark. The wiper arm with P_2 as a supporting point will move toward contracting direction and wipe further to the upper reversal position.



AIR CONDITIONING

■DESCRIPTION

The air conditioning system in the Prius has the following features:

- Both heating and demisting performances are realized by adopting performances are realized by adopting the 2-way flow heater type air conditioning unit.
- A multi-tank, super-slim structure evaporator has been adopted.
- An automatic air conditioning system which provides enhanced air conditioning comfort according to the occupant's senses has been adopted.
- 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 compact, high-performance scroll compressor with oil separator has been adopted.
- The heat exchange efficiency has been improved through the adoption of the sub-cool condenser. This condenser is integrated with the radiator to minimize the space they occupy in the engine compartment.
- A compact, lightweight, and highly efficient straight flow (full-path flow) aluminium heater core has been adopted.
  This heater core is integrated with a PTC (Positive Temperature Coefficient) heater, which excels in heating performance.
- PTC heaters have been provided in the air duct at the footwell outlet in front of the air conditioning unit. However, air conditioning without the PTC heaters is offered as an option on the U.S.A. models.
- An electrical water pump with a bypass valve that provides a stable heater performance even if the engine is stopped due to a function of the THS (TOYOTA Hybrid System) has been adopted.
- A clean air filter that excels in removing pollen and dust is standard equipment.

▶ Performance ◀

Item			Performance
Heater	Heat Output	W	5300
	Air Flow Volume	m^3/h	330
	Power Consumption	W	170
Heater Core Integrated PTC Heater	Heat Output	W	330 (165 x 2)
PIC Heater*1	Heat Output	W	165 x 2
Air Conditioning	Heat Output	W	4200*2
	Air Flow Volume	m^3/h	450
	Power Consumption	W	200

*1: U.S.A. Cold Area Specification Model and Canada Model
*2: When the compressor is at 1,800 rpm

▶ Specifications ◀

Item				Specifications	
Ventilation and Heater	Heater Core	Type		Straight Flow (Full-path Flow)	
		Size W x H x L	mm (in.)	216.9 x 140 x 27 (8.5 x 5.5 x 1.1)	
		Fin Pitch	mm (in.)	1.8 (0.07)	
	Blower	Motor Type		S70F-13T	
		Fan Size Dia. x H	mm (in.)	External Air	132 x 41 (5.2 x 1.6)
				Internal Air	150 x 36 (5.9 x 1.4)
Air Conditioning	Condenser	Type		Multi-Flow Type (Sub-Cool Type)	
		Size W x H x L	mm (in.)	600 x 349.8 x 37.5* (23.6 x 13.8 x 1.5)	
		Fin Pitch	mm (in.)	2.8 (0.11)	
	Evaporator	Type		Drawn Cup (Multi-tank, Super Slim Structure)	
		Size W x H x L	mm (in.)	253.2 x 215 x 58 (10.0 x 8.5 x 2.3)	
		Fin Pitch	mm (in.)	3.5 (0.14)	
	Compressor	Type		SCS06	

*: With the radiator

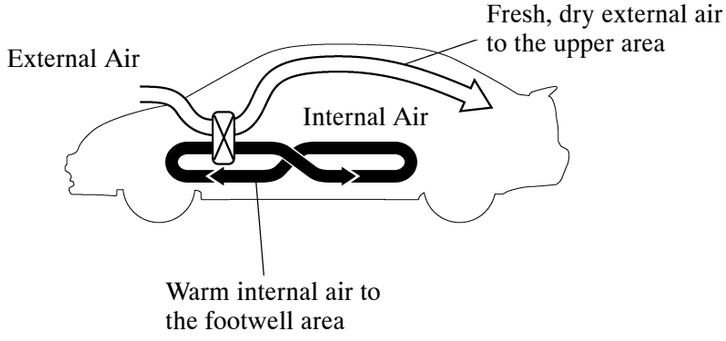
■CONSTRUCTION AND OPERATION

1. Air Conditioning Unit

Air Conditioning Assembly

1) General

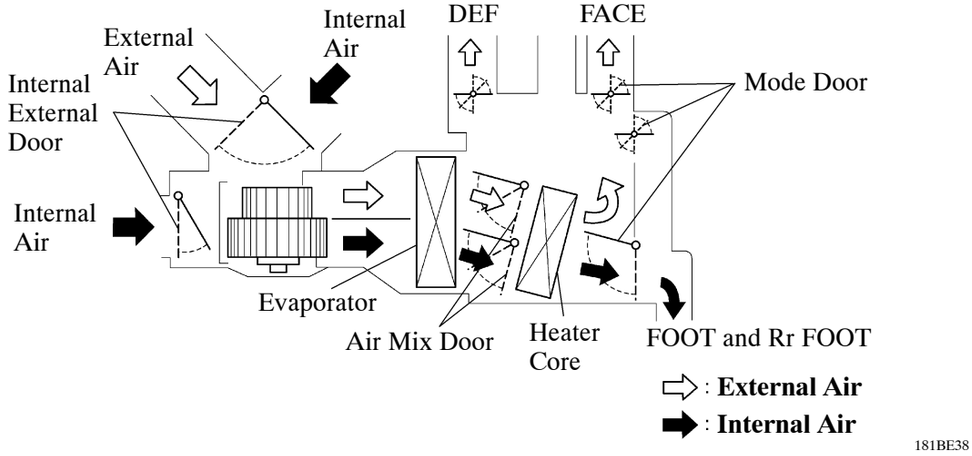
- A semi-center location air conditioning unit, in which the multi tank type evaporator and straight flow heater core are placed in the vehicle's longitudinal direction, has been adopted.
- Both heating and demisting performances are realized by adopting the 2-way flow heater type air conditioning unit.
  This unit, which introduces external air and internal air simultaneously, discharges warm internal air to the footwell area, and the fresh, dry external air to the upper area. Thus, it realizes both excellent heating performance and demisting performance.



182BE15

2) Construction

A partition plate divides the inside of the air conditioning unit into two parts, the external air passage, and the internal air passage. Thus, by controlling the external air door and the internal air door separately, the external air and internal air are introduced into the cabin in the following three modes: fresh-air mode, recirculation mode, and fresh-air/recirculation (2-way flow) mode.



181BE38

Airflow During 2-way Flow Control

3) 2-Way Flow (Fresh-air/Recirculation) Mode

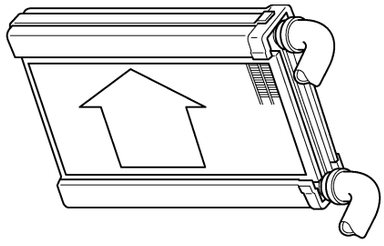
When all the conditions listed below are met, the external air door, internal air door, which are controlled by the air conditioning ECU, are switched to the 2-way flow mode.

- External air mode in the selected state
- Blower switch in the ON state (except OFF)
- Tentative air mix damper opening angle is above the specified value. (MAX HOT)
- Mode select switch in either FOOT or FOOT/DEF state

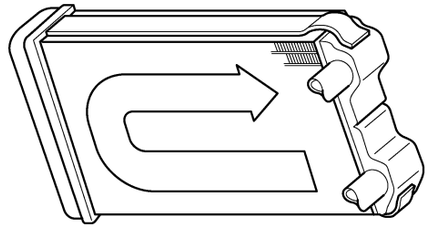
Heater Core and PTC Heater

1) General

- A compact, lightweight, and highly efficient straight flow (full-path flow) aluminum heater core has been adopted.

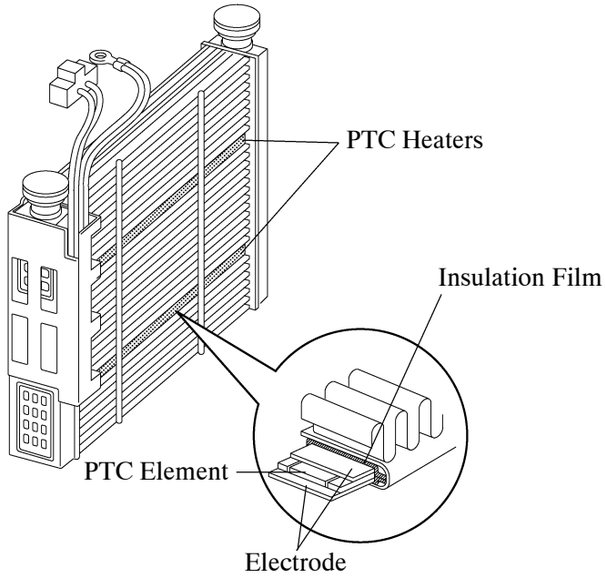


New (Straight Flow) 152BE21



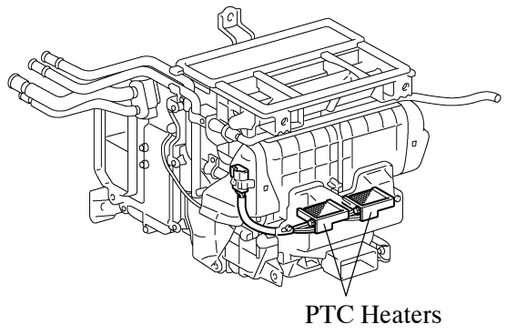
Previous (U-turn Flow) 152BE22

- The 2 PTC (Positive Temperature Coefficient) heaters have been built into the heater core.



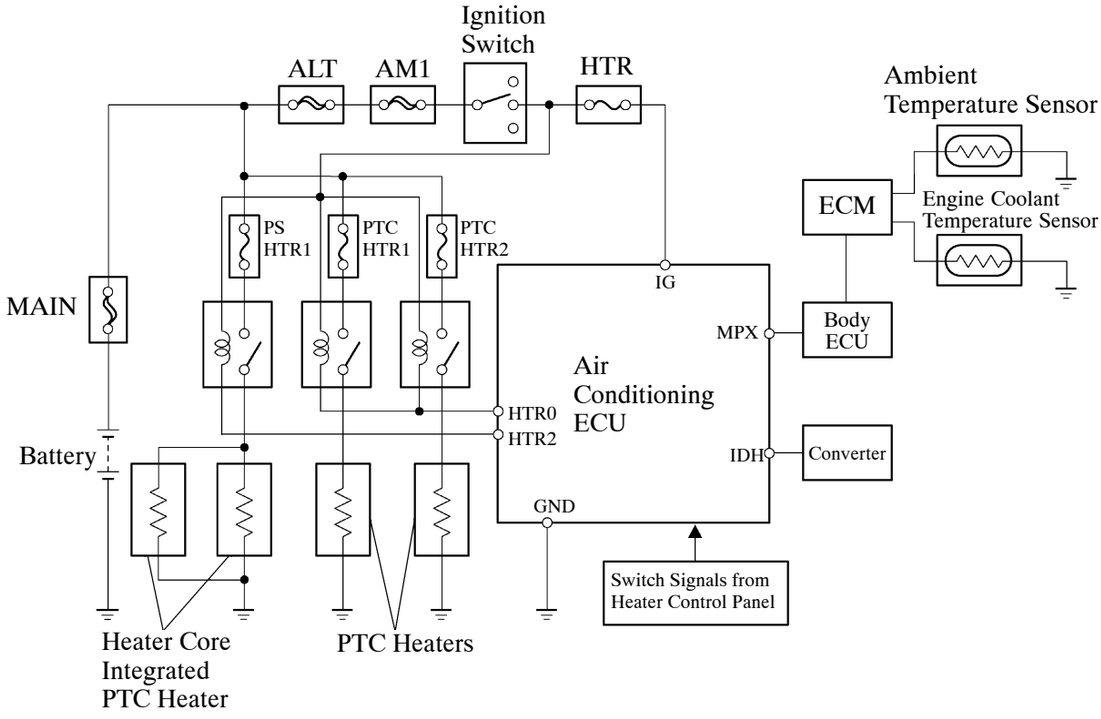
165BE18

- PTC heaters have been provided in the air duct at the footwell outlet in front of the air conditioning unit. However, air conditioning without the PTC heaters is offered as an option on the U.S.A. models.
  This PTC heater, which is a honeycomb-shaped PTC thermistor, directly warms the air that flows in the duct.



182BE17

▶ Wiring Diagram ◀



182BE18

2) Operation

a. Heater Core Integrated PTC Heater Model

The heater turns ON when all the conditions listed below have been met.

i) Outlet is in the DEF mode:

- Coolant temperature is below the specified value.
- Ambient temperature is below the specified value.
- Converter's PTC heater prohibition signal is OFF.

ii) Outlet is in the FOOT or FOOT/DEF mode:

- Coolant temperature is below the specified value.
- Tentative air mix damper opening angle is above the specified value. (MAX HOT)
- Converter's PTC heater prohibition signal is OFF.

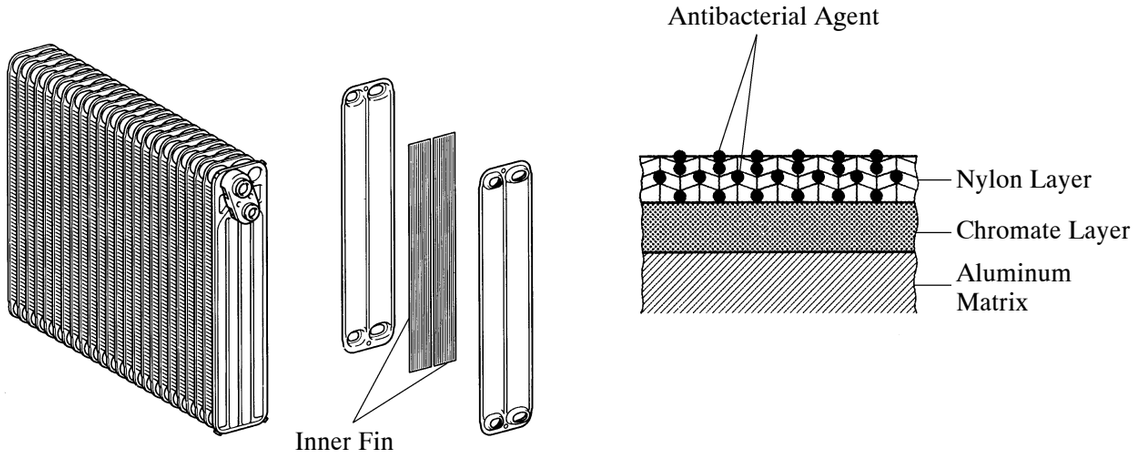
b. Heater Core Integrated PTC Heater and PTC Heater Model

In the case of the heater core integrated PTC heater and PTC heater model, the conditions under which the heater core integrated PTC heater operates are the same as those for the heater core integrated PTC heater model described above. Furthermore, in the heater core integrated PTC heater and PTC heater model, the PTC heater turns ON when all the conditions listed below have been met.

- Outlet is in the FOOT or FOOT/DEF mode.
- Blower switch in the ON state.
- Coolant temperature is below the specified value.
- Tentative air mix damper opening angle is above the specified value. (MAX HOT)
- Converter's PTC heater prohibition signal is OFF.

Evaporator

By placing the tanks at the top and the bottom of the evaporator unit and by adopting an inner fin construction, the heat exchanging efficiency has been improved and the evaporator unit's temperature distribution has been made more uniform. As a result, it has become possible to realize a thinner evaporator construction. Furthermore, 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.

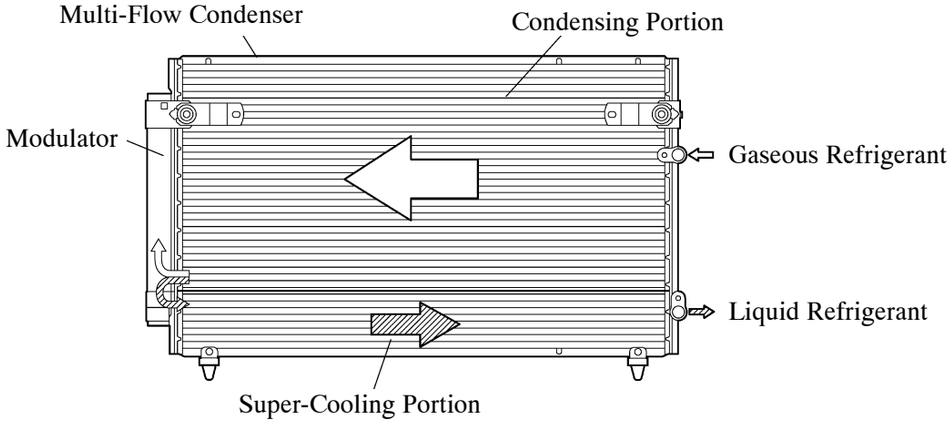


2. Condenser

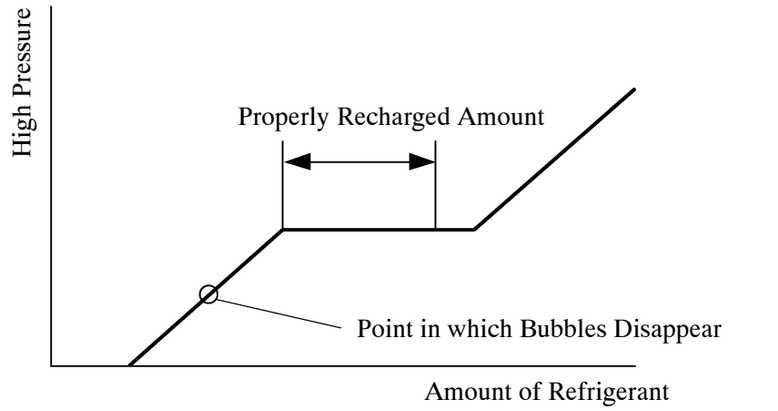
The Prius has adopted sub-cool condenser in which a multi-flow condenser (consisting of two cooling portions: a condensing portion and a super-cooling portion) and a gas-liquid separator (modulator) have been integrated. This condenser has adopted the sub-cool cycle for its cooling cycle system to improve the heat exchanging efficiency.
This condenser is integrated with the radiator to minimize the space they occupy in the engine compartment. For details, see page 54 in the Engine Cooling System Section.

Sub-Cool Cycle

In the sub-cool cycle of the sub-cool condenser that has been adopted, after the refrigerant passes through the condensing portion of the condenser, both the liquid refrigerant and the gaseous refrigerant that could not be liquefied are cooled again in the super-cooling portion. Thus, the refrigerant is sent to the evaporator in an almost completely liquefied state.



NOTE: 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 is 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.
For the proper method of verifying the amount of the refrigerant and to recharge the system with refrigerant, see the 2001 Prius Repair Manual (Pub. No.RM778U).



152BE40

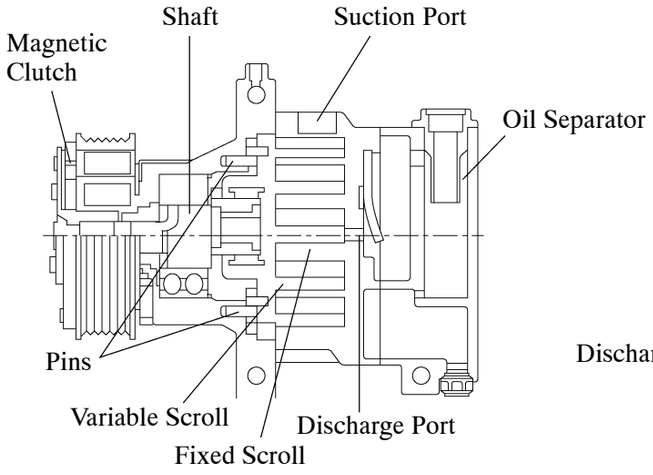
3. Compressor

General

A compact and high performance scroll compressor with oil separator has been adopted.

Construction

The scroll compressor with oil separator consists of a spirally wound fixed scroll and variable scroll that form a pair, and oil separator, and a magnetic clutch.
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.
A pin is attached behind the variable scroll to prevent the autorotation of the variable scroll, allowing it only to revolve.
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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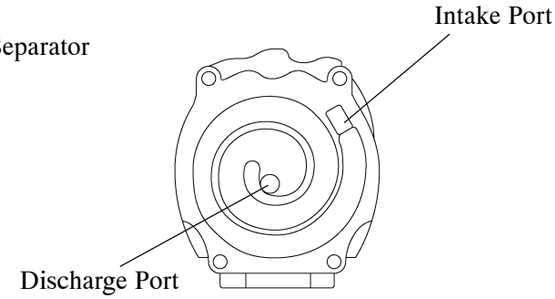


Fixed Scroll

165BE22

Operation

1) Suction

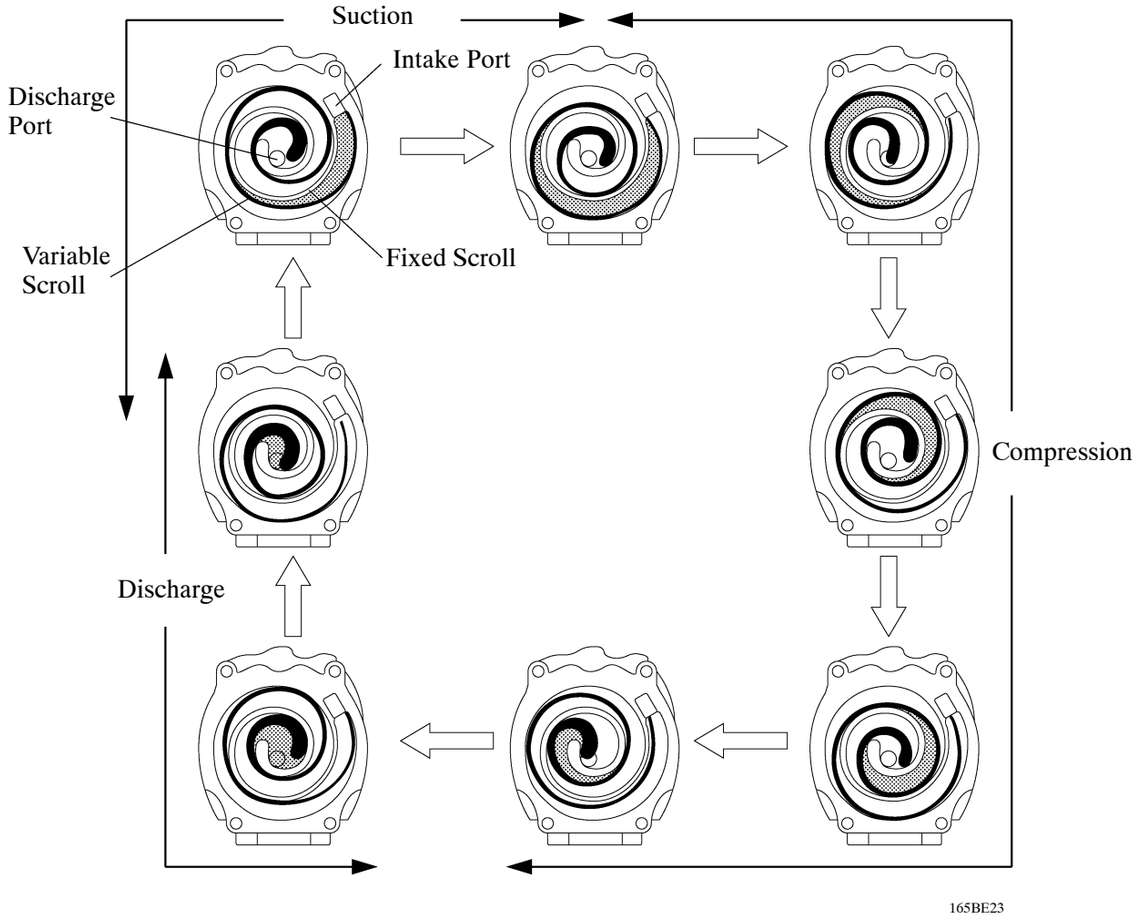
As the capacity of the compression chamber, which is created between the variable scroll and the fixed scroll, increases in accordance with the revolution of the variable scroll, refrigerant gas is drawn in from the intake port.

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

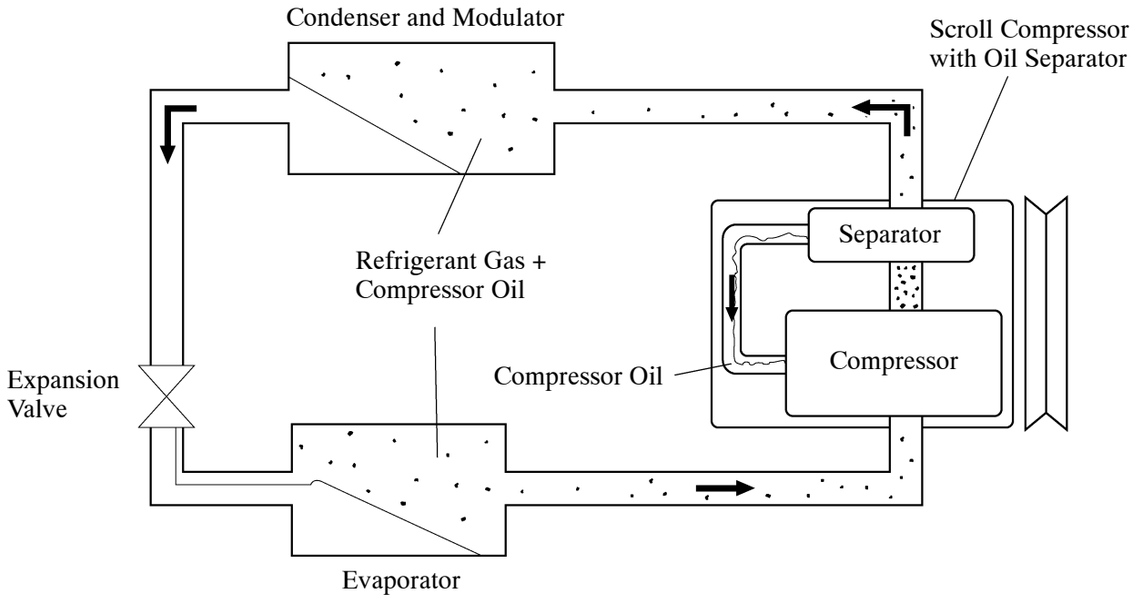
When the compression of the refrigerant gas is completed and the refrigerant pressure becomes high, the refrigerant gas discharges through the discharge port located in the center of the fixed scroll by pushing the discharge valve.



Oil Separator

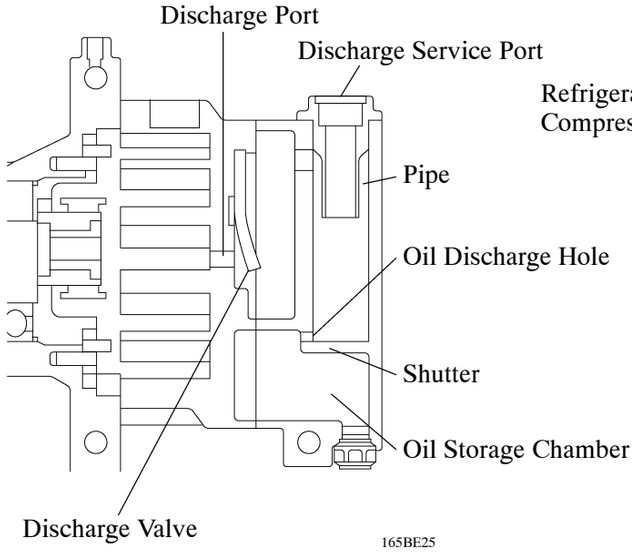
1) General

A CS (Centrifugal with Shutter) type oil separator has been adopted to reduce the circulation rate of the compressor oil that is intermixed with the refrigerant and circulates in the refrigeration cycle.
This oil separator is provided with a cylindrical pipe in the separator case, enabling the refrigerant gas that has been discharged through the discharge gas inlet to be separated into refrigerant gas and oil through centrifugal force, and minimizing the outflow of the oil to the discharge service port. As a result, the oil circulation rate has been reduced and makes energy savings possible.

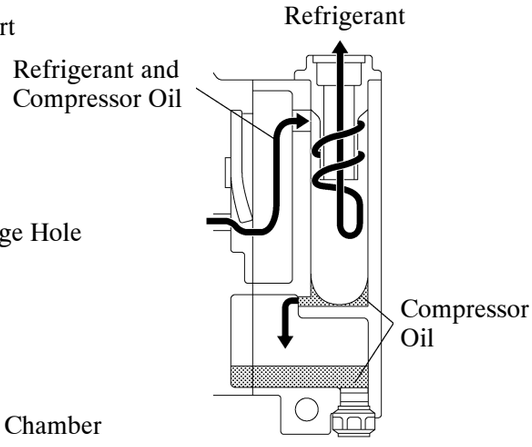


2) Construction and Operation

The refrigerant gas that is discharged from the discharge port flows by rotating around the cylindrical pipe in the oil separator. At this time, the centrifugal force that is created during the rotation separates the refrigerant gas and the compressor oil due to the difference in their specific gravity. The refrigerant gas with the lighter specific gravity passes through the inside of the pipe and travels from the discharge service port to the outside of the compressor. The compressor oil with the heavier specific gravity is discharged through the oil discharge hole in the shutter and is stored in the oil storage chamber. Then, the compressor oil is fed again into the compressor and circulates inside the compressor.



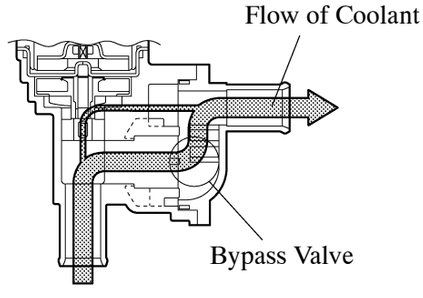
165BE25



165BE26

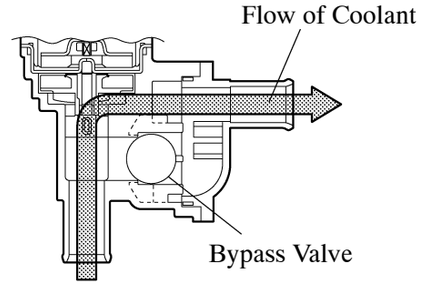
4. Water Pump (For Air Conditioning)

An electrical water pump with a bypass valve that provides a stable heater performance even if the engine is stopped due to a function of the THS has been adopted.
When the engine is running, this water pump ceases its operation and opens the bypass valve to minimize the flow resistance of the coolant that is pumped by the engine water pump.



Water Pump OFF
(Engine ON)

182BE19

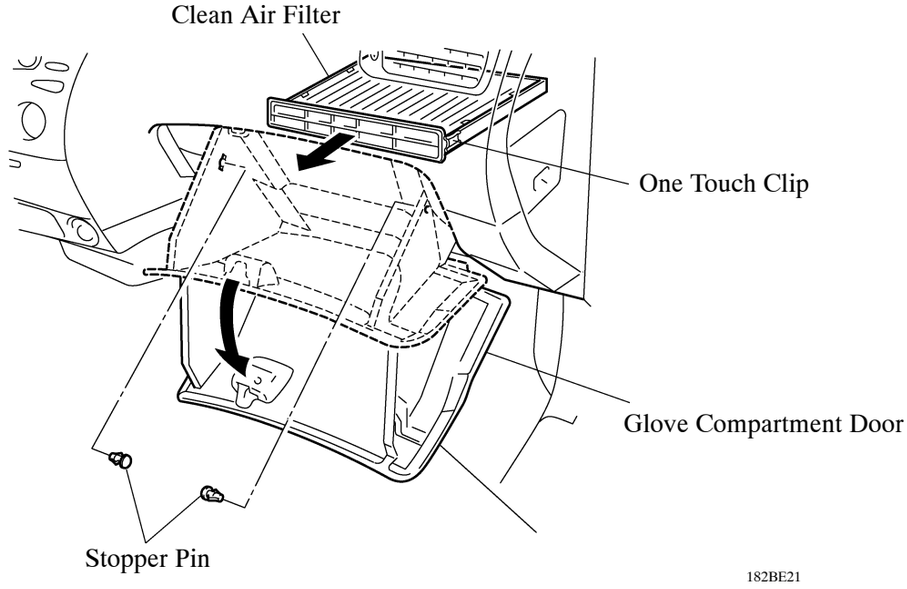


Water Pump ON
(Engine OFF)

182BE20

5. Clean Air Filter

A clean air filter that excels in removing pollen and dust is standard equipment.
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 provided in consideration of the environment.
To facilitate the replacement of the filter, a one-touch clip is used in the filter cover which is unified with filter case. Thus, a construction that excels in serviceability has been realized.



Service Tip

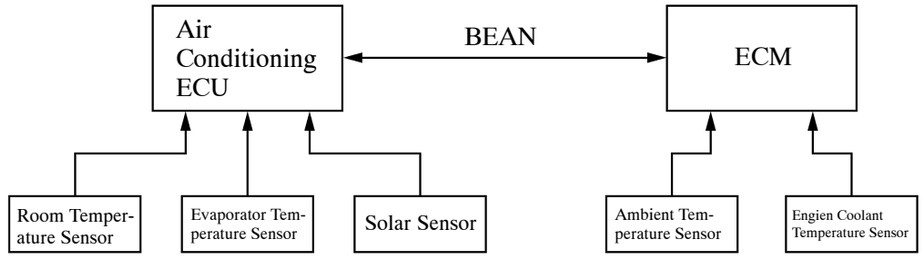
The replacement interval for the clean air filter is 30,000 km or 2 years.
However, it varies with the use conditions (or environment).

6. Air Conditioning ECU

General

- An automatic control type air conditioning has been adopted. This system uses an air conditioning ECU to perform the calculation of the required outlet air temperature control, temperature control, blower control, air inlet control, air outlet control, and compressor control.
  The information that is necessary for effecting the controls are the signals from the room temperature sensor, evaporator temperature sensor, and solar sensor that are directly transmitted to the air conditioning ECU, and the signals from the ambient temperature sensor and the engine coolant temperature sensor that are transmitted via the ECM. These signals are calculated by the air conditioning ECU to effect the proper control.

▶ System Diagram ◀

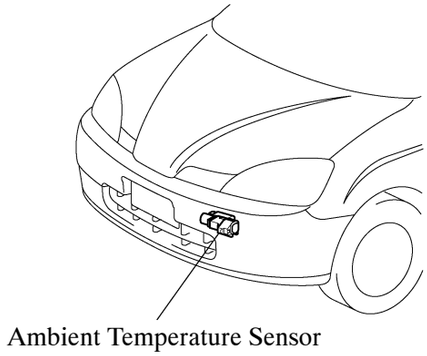


182BE22

Sensors

1) Ambient Temperature Sensor

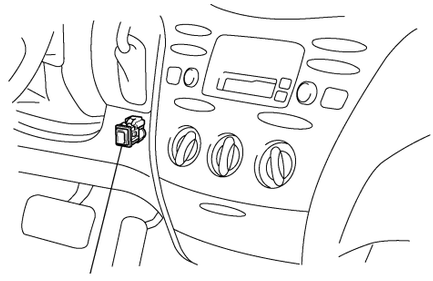
The ambient temperature sensor has been provided on the left, in front of the condenser. The signals from this sensor are transmitted to the air conditioning ECU via the ECM.



182BE23

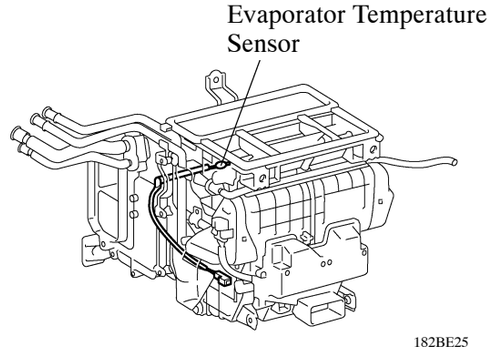
2) Room Temperature Sensor

The room temperature sensor has been provided inside the instrument finish lower panel.
The signals from this sensor are directly transmitted to the air conditioning ECU.



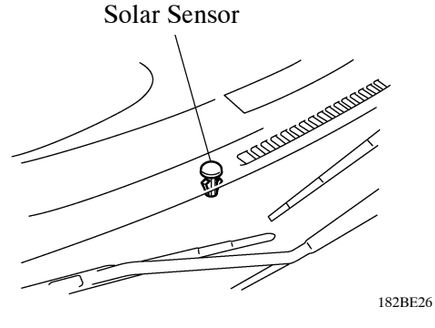
3) Evaporator Temperature Sensor

The evaporator temperature sensor has been provided behind the evaporator in the air conditioning unit.
The signals from this sensor are directly transmitted to the air conditioning ECU.



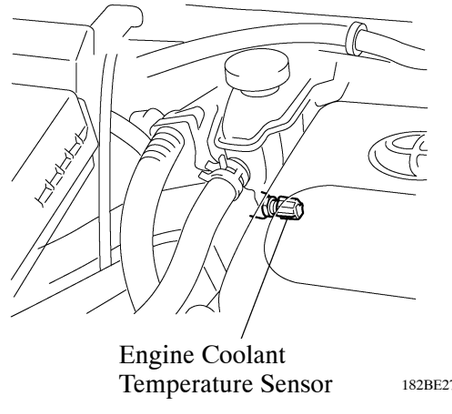
4) Solar Sensor

The solar sensor has been provided on top of the instrument panel.
The signals from this sensor are directly transmitted to the air conditioning ECU.



5) Engine Coolant Temperature Sensor

The water temperature sensor has been provided on the water outlet area on the left side of the engine.
The signals from this sensor are transmitted to the air conditioning ECU via the ECM.



Calculation of Required Outlet Air Temperature (TAO: Temperature Air Outlet)

After receiving the signals from the sensors and the temperature control switch setting, the air conditioning ECU uses the formula shown below to calculate the required outlet air temperature, to regulate the servomotors and blower motor. This is an outlet air temperature that is required in maintaining the set temperature in a stable manner.

$$TAO = K_{SET} \times TSET - Kr \times TR - K_{AM} \times TAMdisp - Ks \times TS + C - TC$$

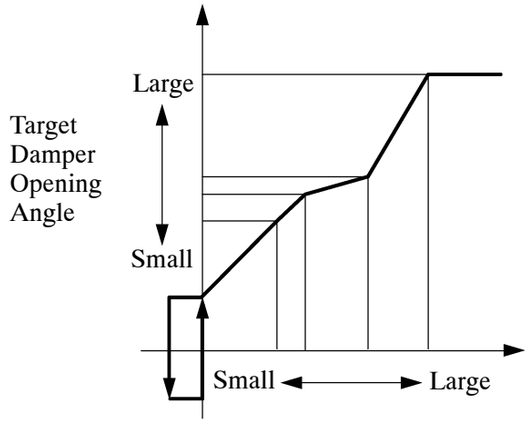
K_{SET}	= Setting Temperature Coefficient	TSET	= Setting Temperature
Kr	= Room Air Temperature Coefficient	TR	= Room Air Temperature
K_{AM}	= Ambient Air Temperature Coefficient	TAMdisp	= Ambient Air Temperature
Ks	= Solar Radiation Coefficient	TS	= Solar Radiation
C	= Correct Constant	TC	= Compressor ON/OFF Correct Constant

Temperature Control System

1) Air Mix Damper Control

In response to the temperature control switch setting, the required ambient temperature, evaporator temperature sensor, and engine coolant temperature sensor compensations are used by the air mix 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.

▶ Calculating the Target Damper Opening ◀



182BE50

Blower Control System

1) Blower Motor Startup Control

When the blower motor is started up, the blower voltage in the auto mode (low speed) is output to the blower controller for 3 seconds. This is designed to protect the blower controller from a sudden startup current surge.

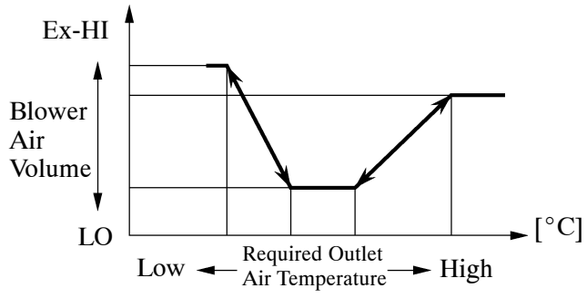
2) Manual Control

Sets the blower speed according to operation of the blower switch.

3) Automatic Control

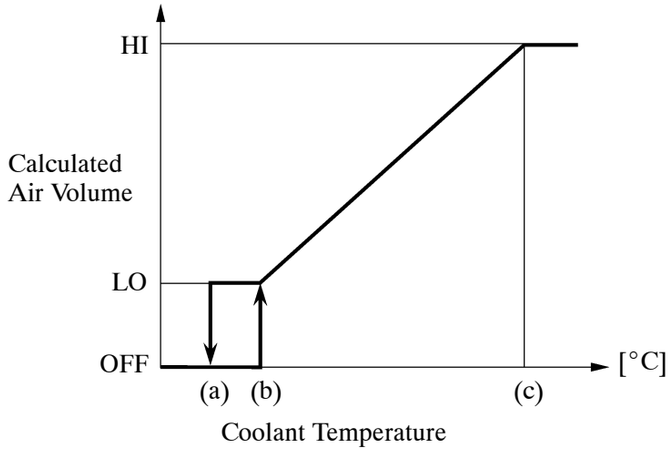
a. Stepless Air Volume Control

As shown on the right, when the AUTO switch on the heater control panel is pushed, the air conditioning ECU automatically regulates the voltage to the blower controller, in accordance with the required outlet air temperature, to deliver stepless air volume.



b. Warm-Up Control

When the coolant temperature detected by the engine coolant temperature sensor is below a predetermined level and the air outlet is in the FOOT or BI-LEVEL mode, the blower does not operate. When the coolant temperature reaches specified temperature (b), the blower motor operates at low speed. When the coolant temperature is between specified temperature (b) to (c), the air flow calculation using the engine coolant temperature sensor signal, and, the air flow calculation using the required outlet air temperature are compared, and the lesser of the two is automatically selected as the air flow to be used. When the coolant temperature reaches specified temperature (c) or more, the blower motor runs at high speed. Moreover, when the coolant temperature is under specified temperature (a), and the warm-up control is effected (blower motor off), the air outlet is switched to the DEF mode. Later, when the blower motor turns on, the air outlet changes from the DEF mode to the FOOT or BI-LEVEL mode.

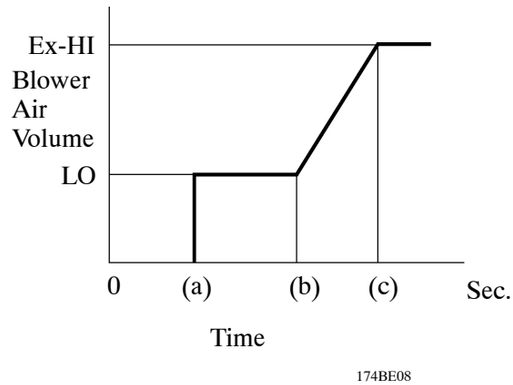


c. Time-Lagged Air Flow Control

2 types of time-lagged air flow control (in accordance with the temperature detected by the evaporator temperature sensor) help prevent hot air from being emitted from FACE or BI-LEVEL vent.

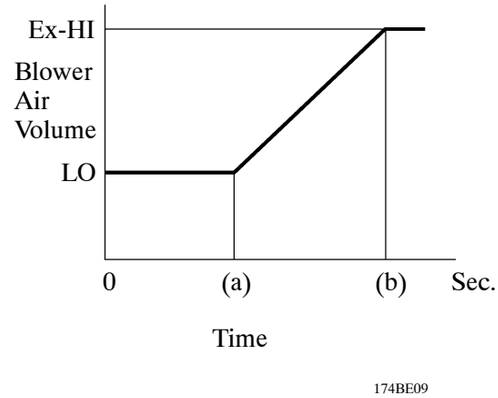
i) Evaporator temperature sensor at specified temperature or more

As shown in the diagram on the right, this control turns OFF the blower motor for approximately specified time (a) and turns ON the compressor to cool the air conditioning unit.
After approximately specified time (a) have elapsed, the blower motor rotates in the manual LO mode, allowing the cooled air to be discharged from the vents. Thus, the discomfort that is associated with the discharge of warm air is prevented.
Between approximately specified time (b) to (c), the airflow volume according to the timelagged airflow control and the airflow volume of the blower control according to the calculation of the required outlet air temperature are compared. The airflow volume is then regulated at the smaller volume of the two.
After specified time (c) have elapsed, control is effected by the blower control according to the calculation of the required outlet air temperature.



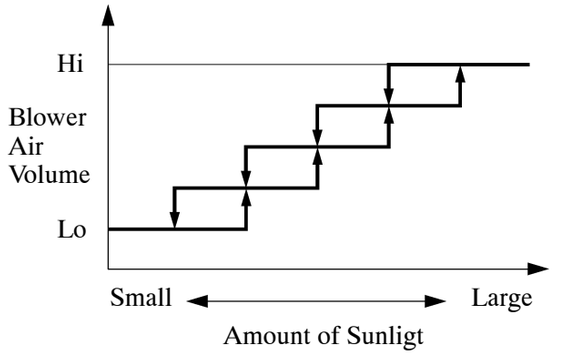
ii) Evaporator temperature sensor at specified temperature or less

As shown in the diagram on the right, for approximately specified time (a), the blower motor rotates in the manual LO mode.
Thereafter, up to approximately specified time (b), the airflow volume according to the time-lagged airflow control and the airflow volume according to the blower control of the calculation of the required outlet air temperature are compared. The airflow volume is then regulated at the smaller volume of the two.
After specified time (b) have elapsed, control is effected based on the blower control according to the calculation of the required outlet air temperature.



d. Sunlight Air Flow Control

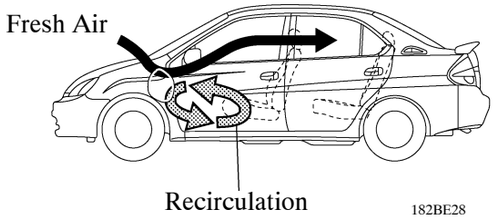
Controls the blower speed in accordance with the intensity of the sunlight when the air outlet mode is at FACE or BI-LEVEL. The blower low speed can be adjusted up to 4 steps, in response to the sunlight signal received from the solar sensor.



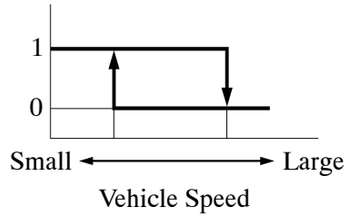
182BE51

2-Way Flow Mode Control

At the time of selecting FRESH mode, air conditioning 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 valve (MAX HOT), and either the blower volume is more than the specified volume or the vehicle speed is less than the specified speed.



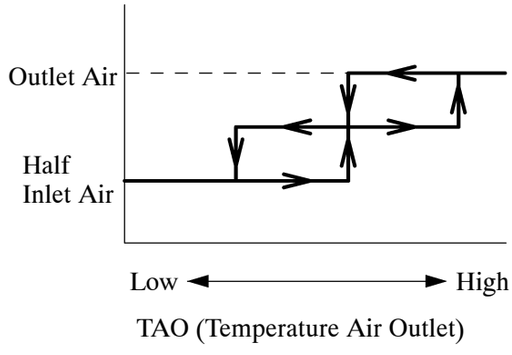
182BE28



182BE29

Half Inlet Air Mode Control

At the time of selecting FRESH mode, air conditioning ECU will judge it as half inlet air mode when the blower outlet mode is selected to FACE or BI-LEVEL and TAO (Temperature Air Outlet) is more than the specified temperature, and operates both outlet air introduction and inlet air circulation at the same time.

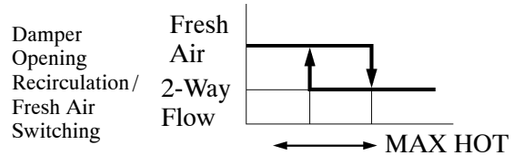


182BE52

Air Inlet Control System

1) 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.
The 2-way flow mode control switches the recirculation/fresh-air function in accordance with the opening of the air mix damper, calculates the target opening of the damper, and rotates the servomotor.



Tentative Damper Opening Angle
(During 2-Way Flow Mode)

182BE31

2) Battery ECU Forced Fresh Air Mode

When the air conditioning ECU receives the forced fresh air mode signal from the battery ECU via the HV ECU and the ECM, the damper forcefully switches to the FRESH mode.

3) DEF, FOOT/DEF Mode Control

When the mode switching switch is switched to FOOT/DEF mode from DEF mode or other than FOOT/DEF mode, air conditioning ECU switches to FRESH mode forcibly.
Also, when the mode switching switch is switched to DEF mode from other than DEF mode, air conditioning ECU turns MAX mode ON and switched to FRESH mode forcibly.

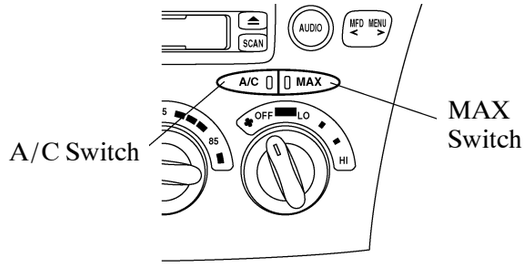
Compressor Control System

1) OFF Control

Turns OFF the magnetic clutch of the compressor when the conditions for turning the blower motor OFF during warm-up control have been met.

2) Compressor Lock Judgment

When the magnetic clutch is ON, if the air conditioning ECU judges that the compressor has been locked, it turns OFF the magnetic clutch relay and flashes the indicator lamp in the A/C or MAX switch. The conditions in which the ECU judges the compressor to have locked are when a slippage rate of 80% or more has been continued for 3 seconds or more.



182BE33

3) Refrigerant Pressure Malfunction Detection

By monitoring the pressure switch signal, this system can judge the refrigerant pressure to be abnormal, and turns off the compressor magnetic clutch relay, if the pressure switch remains off.

4) MAX Switch ON Control

a. General

In case of usual air conditioning operation, the air conditioning system shows superior control on cooling performance and fuel efficiency by combining the engine ON/OFF control by the hybrid control and the air conditioning ON/OFF control.
In this MAX switch ON control, it controls by attaching greater importance to cooling performance of the air conditioning.

ACCESSORIES

■MULTI-INFORMATION DISPLAY

1. General

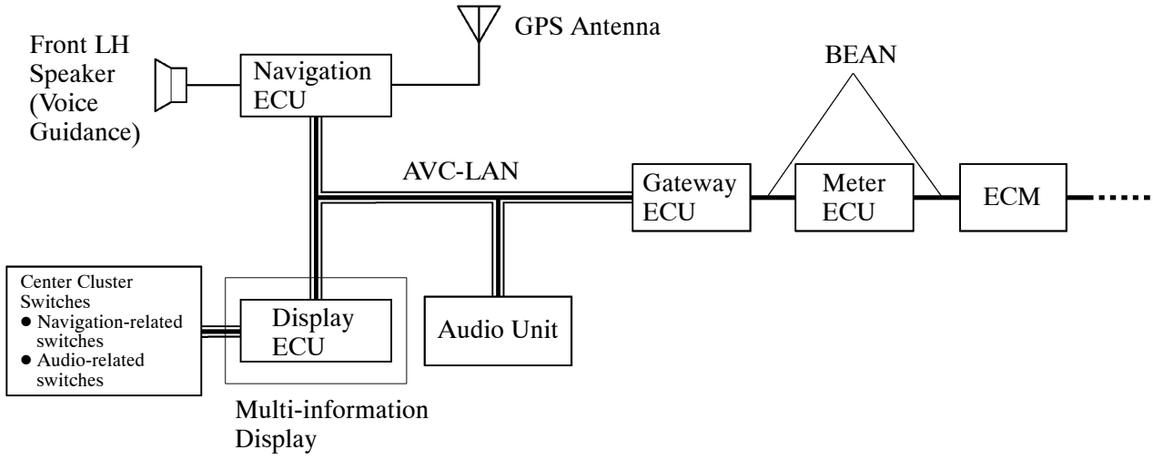
- A multi-information display has been provided on top of the center console as standard equipment. Consisting of a 5.8-inch wide LCD (Liquid Crystal Display) screen, this multi-information display provides a vehicle information screen, warning screen, and an audio operation screen. The outside temperature is also shown on the screen.
- A GPS (Global Positioning System) voice navigation is offered as an option. Through the use of the GPS 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.

Listed below are the main functions of the multi-information display.

Function	Outline
Map Screen Display*	● Enlargement/reduction, rotation and movement of map. ● Indication of current position and direction of travel. ● Correction of current position. ● Setting, change and indication of route. ● Voice guidance. ● Indication of enlarged intersections. ● Memory and indication of map position.
Audio Screen Display	Status of audio equipment and audio operation screen indication.
Information Screen Display	● Energy monitor screen indication. ● Fuel consumption screen indication.
Adjustment Screen Display	● Sound quality adjustment screen indication. ● Image quality adjustment screen indication. ● No indication.
On-screen Display	● Audio status indication. ● Warning indication.
Interrupt Screen Display	Warning indication.
Diagnosis Screen Display	● Display system diagnosis. ● Displays various type of coefficient settings.

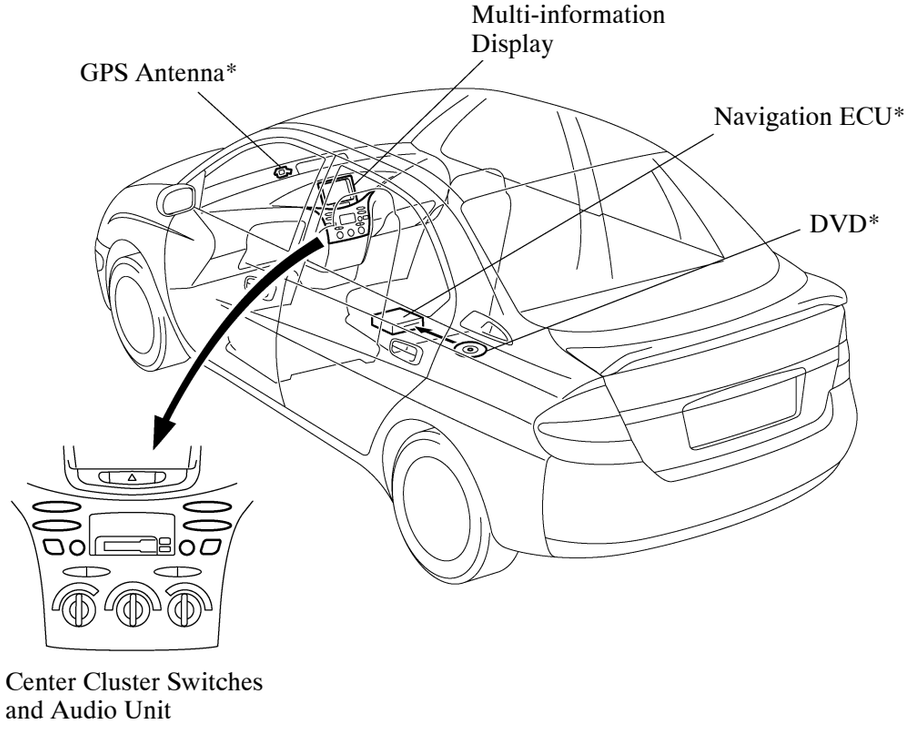
*: with GPS Voice Navigation System

2. System Diagram



182BE34

3. Layout of Components



182BE35

*: with GPS Voice Navigation System

4. Construction and Operation

General

This system mainly consists of a multi-information display, navigation ECU, display ECU, gateway ECU, GPS antenna and audio unit.
The navigation ECU, display ECU, gateway ECU, and the audio unit all maintain communication through the AVC-LAN.

Navigation ECU

The navigation ECU is provided on the models with the GPS voice navigation. Based on the map data on the DVD, signals from the GPS satellites, signals from the built-in gyro sensor, and signals from the vehicle's speed sensor, this ECU calculates the vehicle's present position, direction of travel, and driven distance, and transmits the data to the display ECU. In addition, it outputs navigation voice instructions.

Display ECU

Upon receiving the vehicle information that is transmitted by the gateway ECU, the navigation information that is transmitted by the navigation ECU, and the operation information from the audio unit, the display ECU displays these data on the multi-information display.

Gateway ECU

The gateway ECU transmits the vehicle information to the display ECU in order for it to be displayed on multi-information display. Because vehicle information is transmitted by the ECUs that maintain communication on the BEAN (Body Electronics Area Network), the gateway ECU converts this information into signals for AVC-LAN use and sends it to the display ECU.

GPS Antenna

The GPS antenna is provided on the models with the GPS voice navigation.
The GPS antenna receives signals from the GPS satellites that are located on the orbits that circle the earth at an approximate altitude of 20,000 km. The GPS satellites continuously transmit orbit signals and the signal transmission time.

Multi-information Display

- The multi-information display has the functions for displaying the map screen, audio screen, information screen, adjustment screen, interrupt screen, and on-screen.
- This system's self-diagnosis function can be displayed and operated on the multi-information display. For details, refer to the 2001 Prius Repair Manual (Pub. No. RM778U).

1) Map Screen

The map screen is a function that is provided in the GPS voice navigation system.
Based on the map data on the DVD, signals 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 this screen. This screen has the display functions listed below.

Item		Outline
Map Display	Heading Up/North Up	Changes the orientation of the map.
	Front Wide	Displays a map in the direction of travel of the vehicle in an enlarged form.
	Stepless Scale Display	Changes the scale of the map from the basic 11 steps to an even finer display.
	Direct Scale Change	Directly select and display the map scale.
	Multi-step Scale Display	Change and display the map scale in 11 stages.
	Scroll Display	Scrolls the screen to display the desired point on the map.
	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 numbers on the map.
Destination Search	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 Points-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 intersect 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.
Search	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.

(Continued)

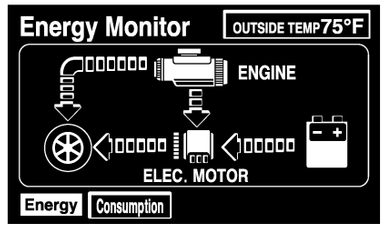
Item		Outline
Guidance	Right or Left Turn Guidance	Voice guidance to instruct the direction of travel to be taken.
	Freeway Direction of Travel Guidance	Voice guidance to instruct the direction of travel to take on the freeway.
	Distance Display to Destination	Displays the distance from the present location 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.

2) Information Screen

The information screen provides two types of indications: the energy monitor screen indication that displays the present energy flow of the hybrid system, and the fuel consumption screen indication that displays the average fuel consumption rate, the amount of regenerative energy, and the instantaneous fuel consumption rate.

a. Energy Monitor Screen Indication

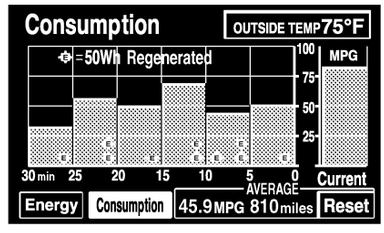
This screen indicates the energy transmission direction for checking the current drive method (engine, motor or both), the power generation status by the engine and status of regenerative energy use.



182BE36

b. Fuel Consumption Screen Indication

This screen indicates the average fuel consumption, recovered energy and the current fuel consumption, all at once.
The average fuel consumption is calculated using 5-minute units. The recovered energy over the past 5 minutes is indicated by symbols, with one mark representing 50 Wh.
In addition, the total fuel consumption before resetting and the total travel distance are displayed at the right bottom of the screen.

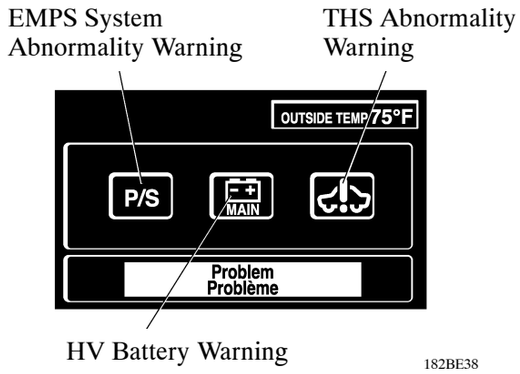


182BE37

3) Interrupt Screen

a. General

If an abnormal condition occurs in the vehicle system, even if another screen is being displayed, the interrupt screen automatically indicates a warning to inform the driver of an abnormality in the system. The warning indication 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.



182BE38

▶ List of Warning Display Items ◀

Warning Display Item	Description of Warning
EMPS System Abnormality Warning	When an abnormality occurs in the EMPS (Electric Motor-assisted Power Steering) system.
HV Battery Warning*	When the HV battery voltage drops.
THS Abnormality Warning	When an abnormality occurs in the THS (TOYOTA Hybrid System).

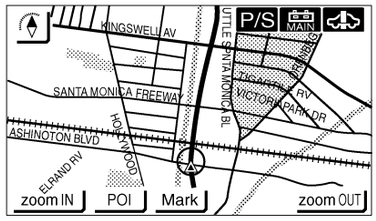
*: While “READY” light is lighting.

b. HV Battery Warning

When starting THS (when turning the IG key to START position) and if HV battery is displayed in this interrupt screen, it means that HV battery has abnormality.

4) On-screen

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 right area of the screen. The displayed mark disappears when the system is reinstated to normal.



182BE39

5. GPS (Global Positioning System) Voice Navigation

General

- The GPS (Global Positioning System) function receives, via an GPS antenna, the signals that are transmitted from the GPS satellites located in space at an approximate altitude of 20,000 km, in order to determine the vehicle's present position.
- The GPS voice navigation function combines the radiowave navigation system that determines the present position through the GPS signals, and the self-contained navigation system that detects the driven distance and the direction of travel through the speed sensors and the gyro sensor that is contained in the navigation ECU. The GPS voice navigation function is a high-precision navigation system that indicates the vehicle position on the map display on the DVD and guides the route from the present position to the destination on a map and pictogram and through voice instructions.
  The multi-information display shows the data that has been calculated by the radiowave navigation system and the self-contained navigation system.

Construction and Operation

The GPS voice navigation function consists of the following components:

- GPS Antenna
- Speed Sensor
- GPS Receiver (contained in the navigation ECU)
- Gyro Sensor (contained in the navigation ECU)
- Navigation ECU
- Speaker

For details on the basic operation of the GPS antenna and the navigation ECU, see page 175.

1) Speed Sensor

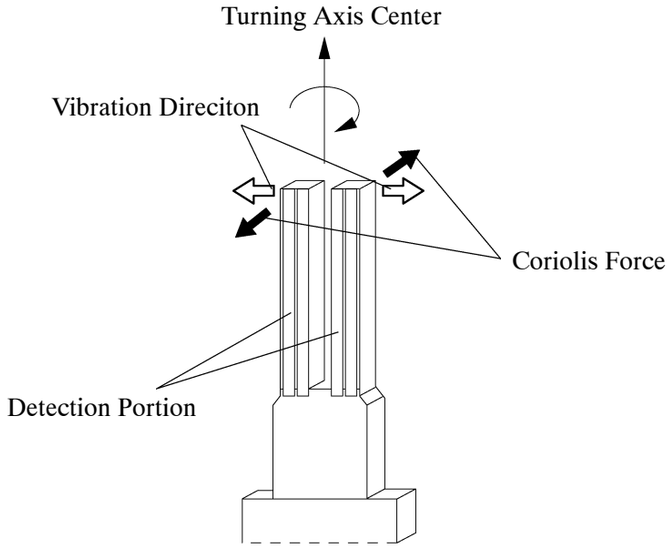
The navigation ECU will receive the vehicle speed signal directly from the meter ECU.

2) GPS Receiver

The GPS receiver demodulates the signals that are received by the GPS antenna from the satellites and outputs them to the navigation ECU.

3) Gyro Sensor

The gyro sensor is designed to detect the yaw rate of vertical axis turn of the vehicle and installed in the Navigation ECU.
The gyro sensor has a turning-fork shape type piezoelectric ceramic piece inside. This piezoelectric ceramic piece deforms by charging voltage and generates voltage by deforming with force.
The piezoelectric ceramic piece inside the gyro sensor is vibrated by the driving circuit and when the vehicle turns (when the detection portion turns to the axis direction), coriolis force is added to the detection portion. With this force, the detection portion is twisted. The voltage generated by this twisting is signal-processed inside the gyro sensor and outputted.
Navigation ECU receives this signal and judges the yaw rate of the vehicle.



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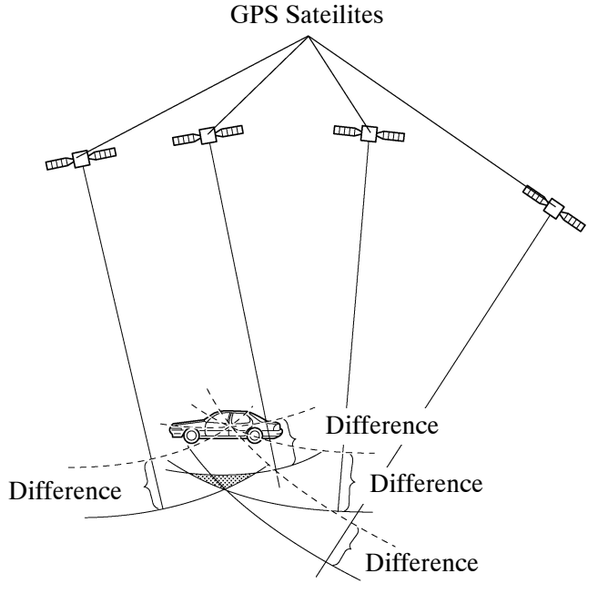
4) Speaker

Outputs the sound signals that are transmitted from the power amplifier. Also outputs the navigation voice instructions via the front left speaker.

5) Detecting the Vehicle Position

The navigation ECU calculates the position based on the principle of a 3-point measurement.
The GPS satellites are equipped with high-precision clocks. Thus, the satellites are able to transmit continuous orbit signals and radiowave transmission time signals.
The navigation ECU also contains a clock, which can understand the radiowave time signals that are received from the satellites.
As a result, the length of time that is taken by the radiowaves to arrive from the satellites to the antenna can be determined. Thus, the lengths of time that elapse for the radiowaves of the 4 satellites to reach the antenna are measured. Each of these lengths of time are multiplied by the luminous flux (the rate of transmission of luminous energy: approximately 300,000 km per second), the results of which are the distances from the satellites to the antenna. Because the positions of the GPS satellites are known by their signals, the receiving point (vehicle position) can be rendered as the point in which the 4 spheres (of which the centers are the respective satellites) converge.
However, due to the differences that exist between the clocks of the satellite and the ECU, the 4 spheres do not converge at a single point. Therefore, the ECU uses another satellite to calculate the point at which the 4 spheres converge at a single point and corrects its internal clock. As a result, the ECU determines the vehicle position and adjusts its internal clock to the clocks of the satellites.



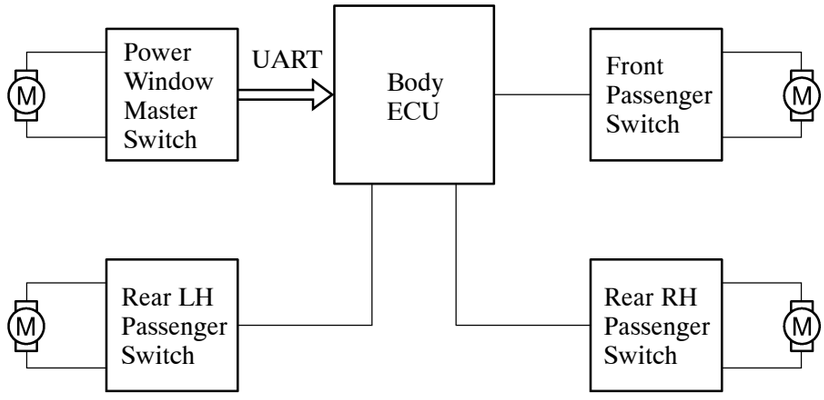
151LBE24

■POWER WINDOW SYSTEM

The power window system has the following features:

- This system includes one-touch auto-up and down and key-off operation function. The one-touch auto up and down function automatically fully closes and opens the driver's side window. The key-off operation function makes it possible to operate the power windows for approximately 45 seconds after the ignition key is turned to the ACC or LOCK position, if the front doors are not opened.
  Also, a jam protection function has been adopted to the closing operation of the driver's window. If a foreign object becomes jammed in the window during one-touch auto-up or key-off operation of the driver's window, this function automatically stops the power window and moves it downward.
- This system controls the driver's door through the power window master switch, and the front passenger and rear passenger doors through the body ECU. The power window master switch and the body ECU maintain communication through the UART (Universal Asynchronous Receiver Transmitter).

▶ System Diagram ◀



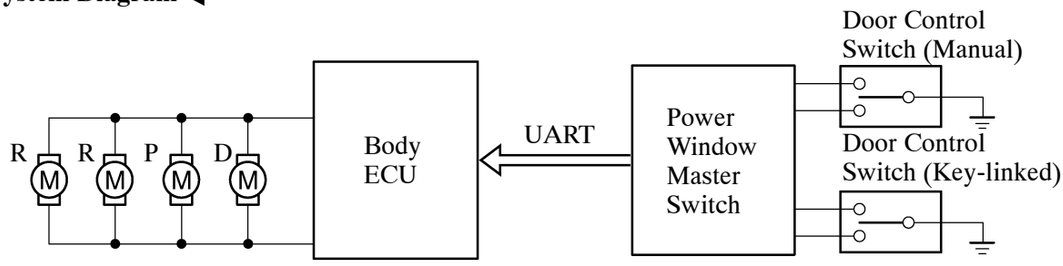
182BE40

■ DOOR LOCK CONTROL SYSTEM

The door lock control system has the following features:

- This system has a “key-linked lock and unlock”, “key-confine prevention” and “manual unlock prohibition” functions.
- A 2-step unlock function is provided to unlock the driver’s door by turning the key cylinder first and to unlock passenger’s door by turning it the second time.
- The control of this system is effected by the body ECU. The door lock control signal from the driver’s door is transmitted from the power window master switch to the body ECU through the UART (Universal Asynchronous Receiver Transmitter).
- If you unlock using the ignition key from the conditions in which all the doors are locked, the dome light will be lighted.

▶ System Diagram ◀

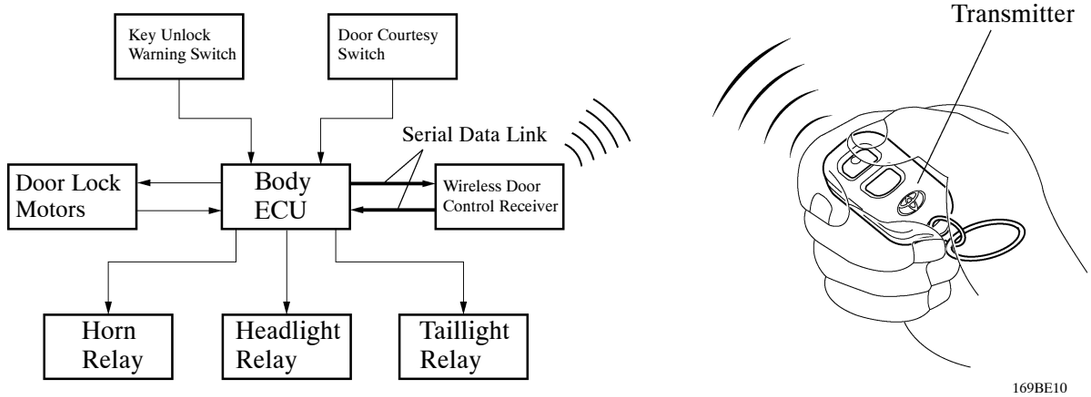


182BE41

■ WIRELESS DOOR LOCK REMOTE CONTROL SYSTEM

The wireless door lock remote control system has the following features:

- In this system, the wireless door control 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 and the body ECU.
- A key-holder type transmitter has been adopted, and it contains the following three switches: the door lock switch, door unlock switch, and panic switch.
- A rolling code system, in which the signal configuration changes each time when a signal is transmitted by the transmitter, has been adopted.
- Panic alarm operation has been adopted.
- The verification light function has been adopted. When the transmitter is used to lock or unlock the doors, this function flashes the taillights to inform that the operation has been completed. However, at the time of unlocking, the dome light will be lighted.

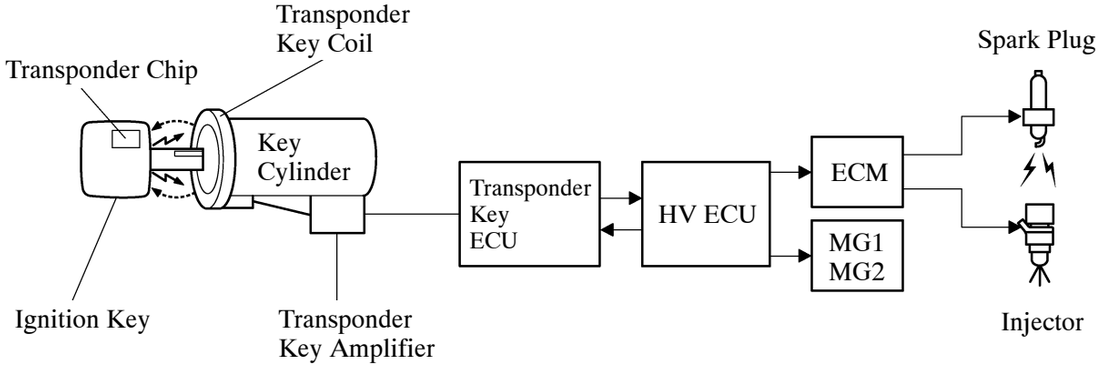


169BE10

■HV IMMOBILISER SYSTEM

The HV immobiliser system has a theft-deterrent system to disable the THS (TOYOTA Hybrid System) from starting using the ignition key without the ID code pre-registered.
This system adopts a transponder system which uses a transponder chip embedded in the grip of the ignition key. When the coil located around the ignition key cylinder receives the ID code signal transmitted by the transponder chip, the ECU determines whether or not the ID code matches the code registered.

▶ System Diagram ◀



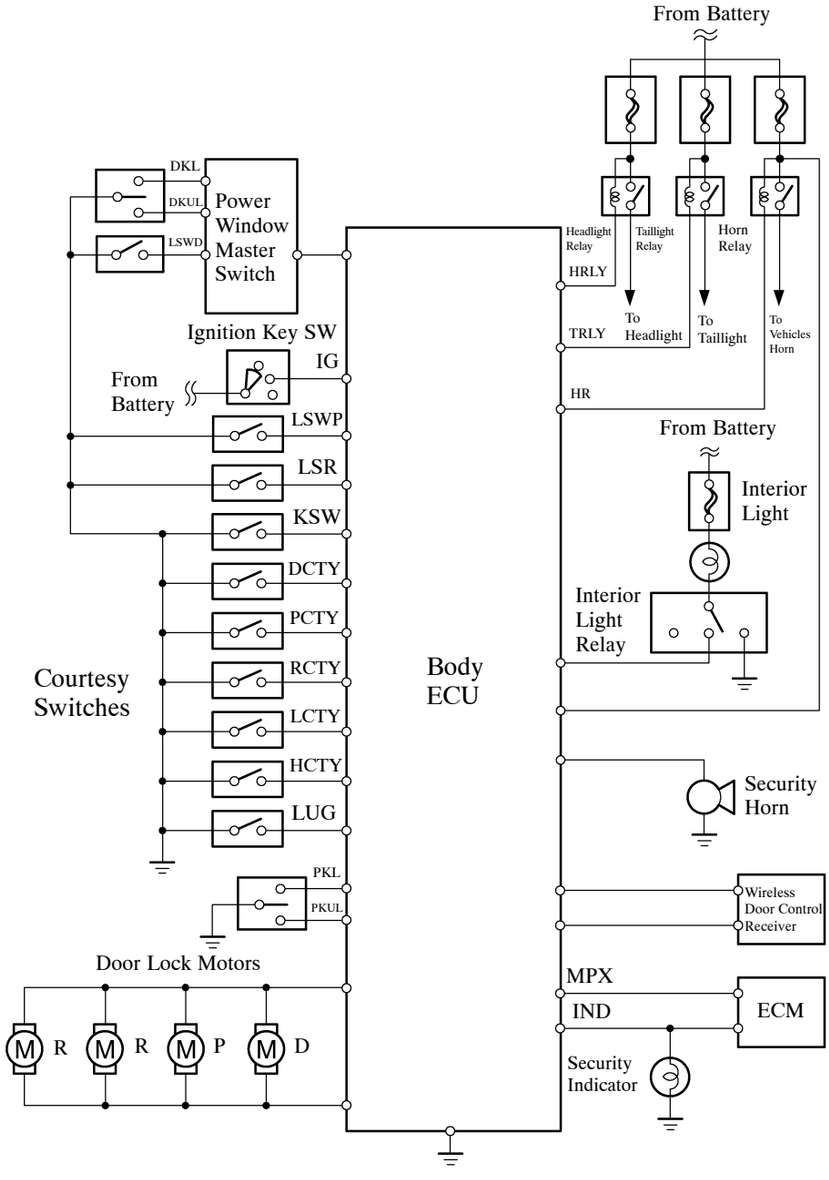
182BE42

■ THEFT DETERRENT SYSTEM

1. General

- The theft deterrent system uses the door lock control system components and some other parts. When somebody attempts to forcibly enter the vehicle or open the engine hood or luggage compartment door without a key, or when the battery terminals are removed and reconnected, the theft deterrent system sounds the vehicle's horn, security horn and flashes the headlights, taillights, hazard lights and interior light for about one minute to alert. At the same time, it locks all the doors.
- The control of this system is effected by the body ECU.

▶ Wiring Diagram ◀



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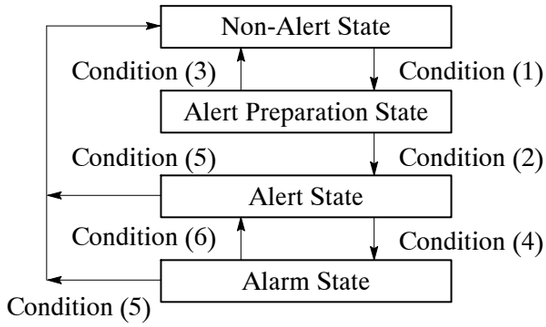
▶ List of Input/Output Signals ◀

Terminal Name	Outline	Terminal Name	Outline
DKL	Driver's door key lock signal	LCTY	Rear left door courtesy switch status signal
DKUL	Driver's door key unlock signal	HCTY	Hood courtesy switch status signal
LSWD	Driver's door lock position switch signal	LUG	Luggage compartment door courtesy switch status signal
IG	Ignition key switch status signal	PKL	Front passenger door key lock signal
LSWP	Front passenger door lock position switch signal	PKUL	Front passenger door key unlock signal
LSR	Rear left door lock position switch signal	HRLY	Output signal to headlight relay
KSW	Ignition key cylinder's key presence/absence signal	TRLY	Output signal to taillight relay
DCTY	Driver's door courtesy switch status signal	HR	Output signal to vehicle horn relay
PCTY	Front passenger door courtesy switch status signal	MPX	Multiplex Communication (BEAN)
RCTY	Rear right door courtesy switch status signal	IND	Output signal to security indicator

2. Operation



Non-Alert State: When the security function is inactive

Without having the ignition key in the ignition key cylinder, if any one of the conditions listed below exists, the system transfers to the alert preparation state.

Condition (1)

- When the doors, engine hood, and luggage compartment door are all closed, the ignition key is used to lock all doors.
- When the doors, engine hood, and luggage compartment door are all closed, the wireless door lock remote control system is used to lock all doors.
- When all doors are locked, if any door, engine hood, or luggage compartment door is changed from "close" to "open", and "close" again, all doors, engine hood, and luggage compartment door will be locked.

Alert Preparation State: a delay time until the alert state

The system transfers to the alert state if the condition (2) listed below is met, and to the non-alert state if one of the conditions (3) is met.

Condition (2)

- When the doors, engine hood, and luggage compartment door are all closed and locked, and 30 seconds have elapsed.

Condition (3)

- When one of the doors, engine hood, or luggage compartment door is changed from “close” to “open”.
- When one of the doors, engine hood, or luggage compartment door is changed from “lock” to “unlock”.
- When the ignition key is inserted in the ignition key cylinder.
- When a terminal is disconnected from the battery and re-connected.

Alert State: a state in which attempted theft can be detected

The system transfers to the alarm state if any one of the conditions (4) listed below is met, or to the non-alert state if any one of the conditions (5) is met.

Condition (4)

- Any door, engine hood, or luggage compartment door is opened.
- The ignition key or the wireless door lock remote control system other than the transmitter is used for unlocking.
- The luggage compartment door is opened with something other than the ignition key.
- The engine hood is opened.
- A terminal is disconnected from the battery and re-connected.
- The wiring harness is directly connected as if to turn the ignition switch ON.

Condition (5)

- The ignition key is used to unlock the doors or the luggage compartment door.
- The transmitter of the wireless door lock remote control system is used to unlock the doors.
- The ignition key is inserted in the ignition key cylinder and turned until the ignition switch is ON.

Alarm State: a state in which attempted theft can be detected

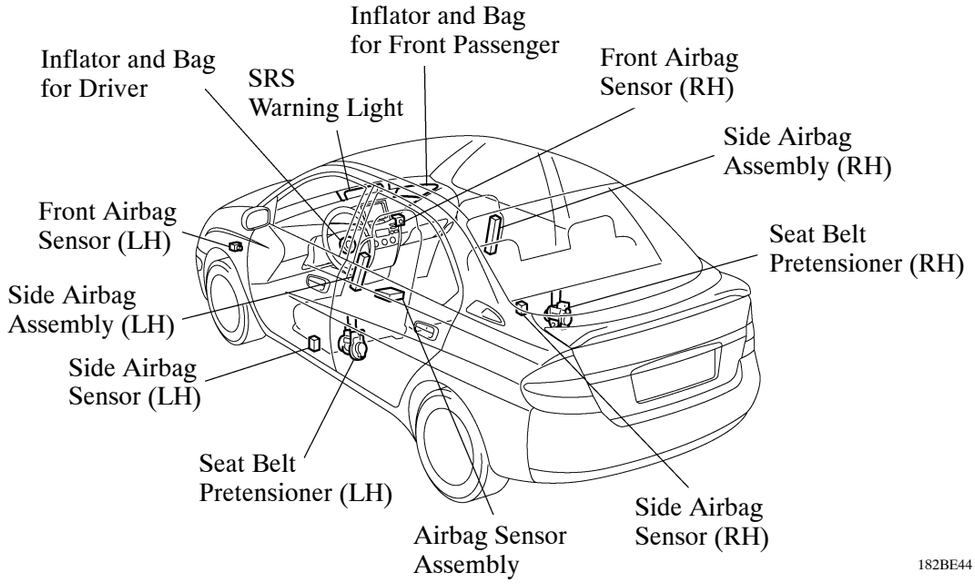
- When an attempted theft is detected, the system sounds the vehicle’s horn and the security horn, flashes the headlights, taillights, and hazard lights, and illuminates the interior light to alert the people in the area. If any one of the doors is unlocked, and the ignition key is not inserted in the ignition key cylinder, the system forcefully locks the doors once.
- The system transfers to the alert state if the condition (6) described below is met, or, when the system is in the alarm state, it transfers to the non-alert state if any one of the conditions (5) described above is met. At this time, the taillights are illuminated for 2 seconds to inform the driver that an attempted theft has been detected.

Condition (6)

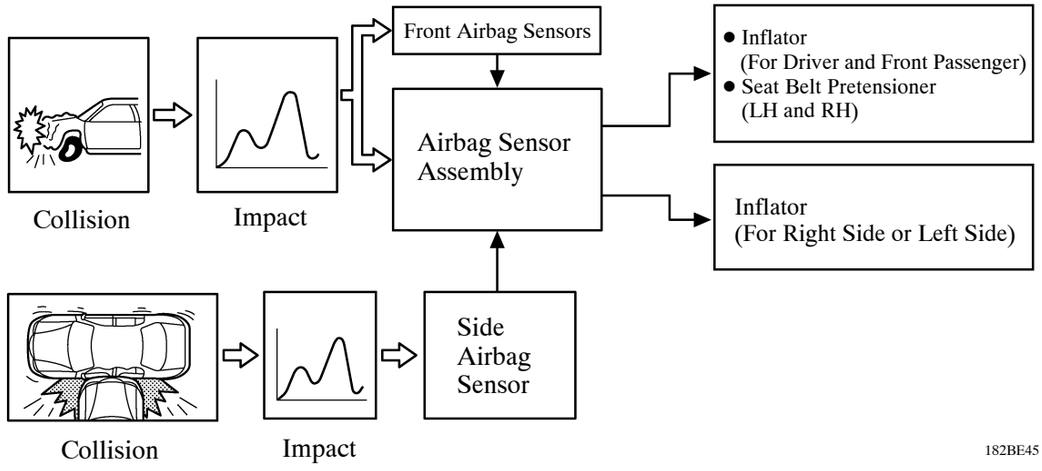
- After approximately 60 seconds of the alarm time have elapsed.

■SRS AIRBAG AND SRS SIDE AIRBAG

- The SRS (Supplemental Restraint System) airbags are provided for the driver and front passenger. The SRS airbags have been designed to help reducing the shocks to the heads and chests of the driver and front passenger in the event of a frontal impact collision as supplements to the seat belts.
  This system is a 3-sensor type airbag system to detect the impact during a front collision using the airbag sensor assemblies and front airbag sensor, and to make the airbag system and seat belt pretensioner operate as well.
  Also, the function of the ECU to memorize the seat belt wearing condition while inflating the airbag is added.
- The SRS side airbags are provided for the driver and front passenger as an option. The SRS side airbags have been designed to help reducing the impact energy that is transmitted to the driver and front passenger in the event of a side collision.
  The driver side and the front passenger side are each provided with one sensor.
- A fuel cut control has been adopted to stop the fuel pump when the SRS airbag is deployed, thus helping reduce fuel leakage.



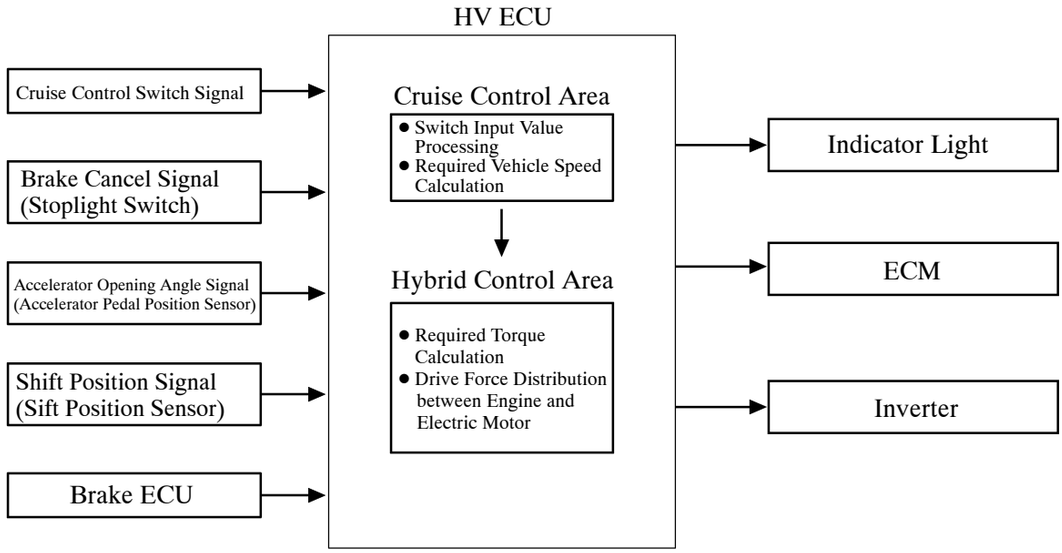
▶ System Diagram ◀



■CRUISE CONTROL SYSTEM

1. General

The Prius has adopted a cruise control system that uses the hybrid system, and it is offered as an option. 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.



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2. Construction

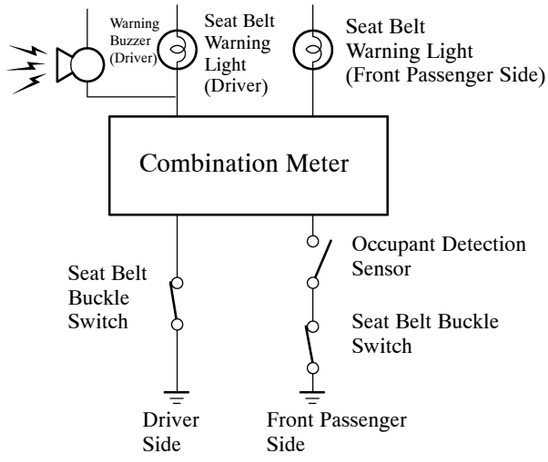
The cruise control system mainly consists of an HV ECU, cruise control switches, indicator, stoplight switch, accelerator pedal position sensor, and the shift position sensor.
The table below shows each of the functions.

Item	Function
HV ECU	Controls all the functions of the cruise control system in accordance with the signals from the sensors.
Cruise Control Main Switch	Cruise control system's ON/OFF signal requirement.
Cruise Control Switch	A three-directional switch that provides the SET/COAST, RESUME/ACCEL, and CANCEL functions. It requires the functions and settings in accordance with its operations.
Indicator Light	It is provided in the combination meter to display whether the system is ON or OFF.
Stop Light Switch	Detects that the driver has stepped on the brake pedal.
Accelerator Pedal Position Sensor	Detects the accelerator pedal opening angle.
Shift Position Sensor	Detects the shift position.

■SEAT BELT WARNING SYSTEM

1. General

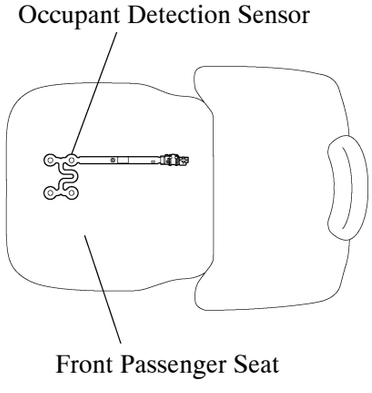
A seat belt warning system has been adopted. If the driver's seat belt is not buckled, the warning light flashes and the buzzer sounds. If the front passenger seat belt is not buckled, it flashes the warning light. When the ignition switch is turned ON, this system determines whether or not the seat belt is buckled by the ON or OFF condition of the switch that is provided in the seat belt buckle. 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.



182BE47

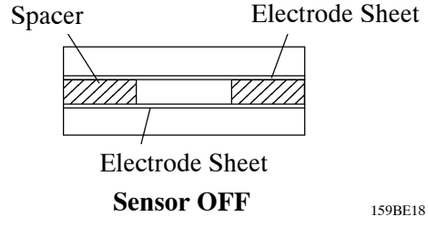
2. Occupant Detection Sensor

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.



Upside View

182BE53



Sensor OFF

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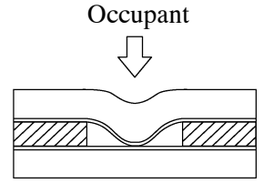

Sensor ON

159BE19

MAJOR TECHNICAL SPECIFICATIONS

Item \ Area			U.S.A. and Canada	
Body Type			4-Door Sedan	
Vehicle Grade			—	
Model Code			NHW11L-AEEEBA	NHW11L-AEEEBK
Major Dimensions & Vehicle Weights	Overall	Length mm (in.)	4305 (169.5)	←
		Width mm (in.)	1695 (66.7)	←
		Height mm (in.)	1465 (57.6)	←
	Wheel Base	mm (in.)	2550 (100.4)	←
	Tread	Front mm (in.)	1475 (58.1)	←
		Rear mm (in.)	1480 (58.3)	←
	Effective Head Room	Front mm (in.)	985 (38.8)	←
		Rear mm (in.)	942 (37.1)	←
	Effective Leg Room	Front mm (in.)	1047 (41.2)	←
		Rear mm (in.)	899 (35.4)	←
	Shoulder Room	Front mm (in.)	1342 (52.8)	←
		Rear mm (in.)	1325 (52.2)	←
	Overhang	Front mm (in.)	815 (32.1)	←
		Rear mm (in.)	940 (37.0)	←
	Min. Running Ground Clearance	mm (in.)	125 (4.9)	←
	Angle of Approach	degrees	14°	←
	Angle of Departure	degrees	22°	←
	Curb Weight	Front kg (lb)	770 (1700)	←
		Rear kg (lb)	485 (1065)	←
		Total kg (lb)	1255 (1765)	←
	Gross Vehicle Weight	Front kg (lb)	890 (1965)	←
		Rear kg (lb)	750 (1650)	←
		Total kg (lb)	1640 (3615)	←
	Fuel Tank Capacity	ℓ (US. gal., lmp.gal.)	45* (11.9, 9.9)	←
	Luggage Compartment Capacity	m^3 (cu.ft.)	0.39 (137.7)	←
Performance	Max. Speed	km/h (mph)	160 (99.4)	←
	Max. Cruising Speed	km/h (mph)	160 (99.4)	←
	Acceleration	0 to 100 km/h sec.	12.7	←
		0 to 400 m sec.	19.0	←
	Max. Permissible Speed	1st Gear km/h (mph)	—	—
		2nd Gear km/h (mph)	—	—
		3rd Gear km/h (mph)	—	—
		4th Gear km/h (mph)	—	—
	Min. Turning Radius (Outside Front)	Wall to Wall m (ft.)	10.2 (33.5)	←
		Curb to Curb m (ft.)	9.4 (30.8)	←
Engine	Engine Type		1NZ-FXE	←
	Valve Mechanism		16-Valve, DOHC	←
	Bore × Stroke	mm (in.)	75.0 × 84.7 (2.95 × 3.33)	←
	Displacement	cm^3 (cu.in.)	1497 (91.4)	←
	Compression Ratio		13.0	←
	Carburetor Type		SFI	←
	Research Octane No.	RON	95	←
	Max. Output (EEC)	kW/rpm (HP@rpm)	52/4500 (70@4500)	←
	Max. Torque (EEC)	N·m/rpm (lb-ft@rpm)	111/4200 (82@4200)	←
Engine Electrical	Battery Capacity (5HR)	Voltage & Amp. Hr.	12 – 28	←
	Alternator Output	Watts	—	—
	Starter Output	kW	—	—
Chassis	Clutch Type		—	—
	Transaxle Type		P111	←
	Transmission Gear Ratio	In First	—	—
		In Second	—	—
		In Third	—	—
		In Fourth	—	—
		In Fifth	—	—
		In Reverse	—	—
	Counter Gear Ratio		—	—
	Differential Gear Ratio (Final)		3.905	←
	Brake Type	Front	Ventilated Disc	←
		Rear	L.T. Drum	←
	Parking Brake Type		L.T. Drum	←
	Brake Booster Type and Size	in.	Hydraulic	←
	Proportioning Valve Type		P-Valve	←
	Suspension Type	Front	MacPherson Strut	←
		Rear	Torsion Bean	←
	Stabilizer Bar	Front	STD	←
		Rear	STD	←
	Steering Gear Type		Rack and Pinion	←
	Steering Gear Ratio (Overall)		16.4~18.3	←
	Power Steering Type		Electric Motor	←

*: EPA / CARB ORVR Test conditions