FOREWORD

This manual has been prepared to provide information for the construction, operation and other technical details of SUBARU vehicles.
Read this manual thoroughly and make the most of it to give better service to your customers and improve your knowledge of vehicle maintenance.

All information, illustration and specifications contained in this manual are based on the latest product information available at the time of publication approval.

SUBARU CORPORATION

1 GENERAL DESCRIPTION

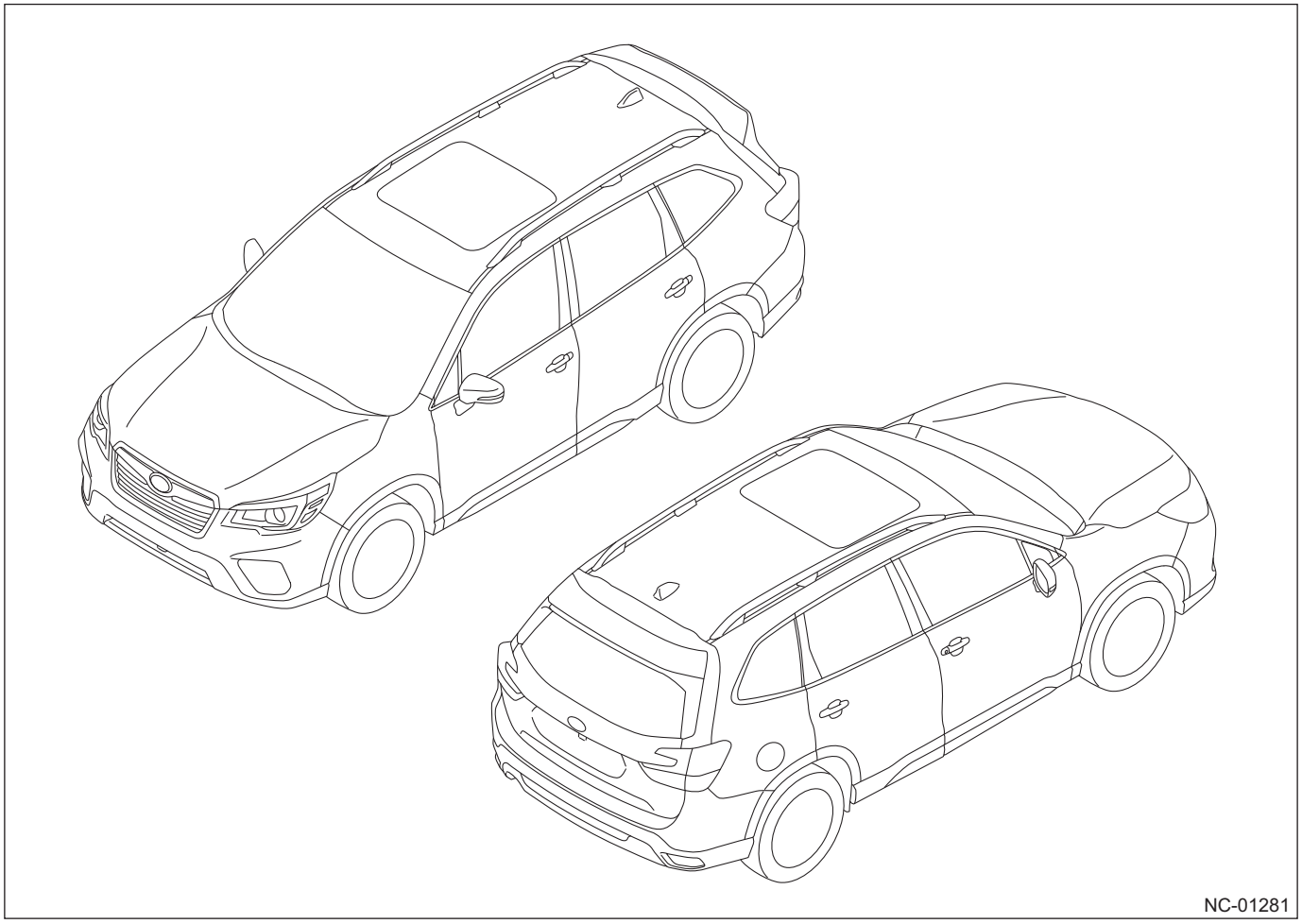
CONTENTS

1.1 General Overview

1.1.1 Vehicle Composition List Table

Vehicle shape	Type	Destination code	Engine	Driving method	Grade	Transmission
Forester	SK	U5	2.5 L DOHC NA	AWD	2.5i EyeSight	CVT
		C5			2.5i Plus	
		U5, C5			2.5i Plus EyeSight	
		C5, C4			2.5i-Premium	
		U5			2.5i-Premium EyeSight base	
		U5, C5, C4			2.5i-Premium EyeSight	
		U5			2.5i-Sport EyeSight base	
		U5, C5, C4			2.5i-Sport EyeSight	
		U5			2.5i Limited EyeSight base	
		U5, C5, C4			2.5i Limited EyeSight	
		U5, C5, C4			2.5i-Touring EyeSight	

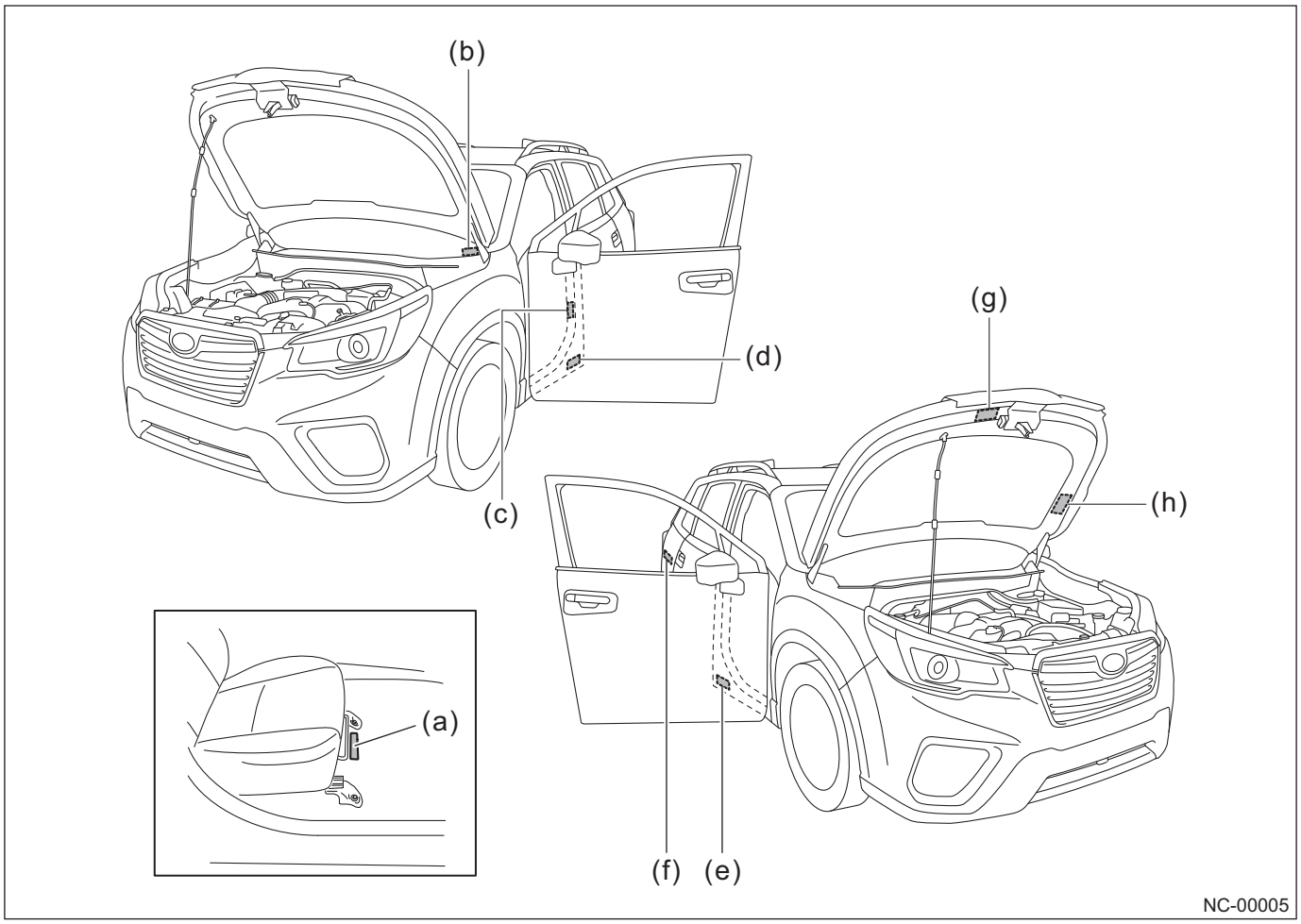
1.1.2 Vehicle Appearance and Dimension



Overall length		in (mm)	182.1 (4,625)
Overall width		in (mm)	71.5 (1,815)
Overall height (for C.W.*)		in (mm)	With roof rail 68.1 (1,730) Without roof rail 67.5 (1,715)
Wheel base		in (mm)	105.1 (2,670)
Tread	Front	in (mm)	61.6 (1,565)
	Rear	in (mm)	61.8 (1,570)
Minimum road clearance		in (mm)	8.7 (220)

*: Curb weight

1.1.3 Identification Number and Label Locations



(a) Chassis number (VIN) (under right front floor carpet)
(b) VIN label
(c) Tire inflation pressure label
(d) FMVSS and CMVSS label
(e) Model number label
(f) Fuel label
(g) Air conditioner label
(h) Emission control label

1.1.4 Vehicle Type Classification Symbol

VIN

Display example:]JF2SK##C#KH######[

The starting and ending brackets ( ] [ ) are stop marks.

#: Depends on the vehicle model.

Digits	Meaning	Details
1 to 3	Vehicle classification	JF2: MPV manufactured by SUBARU CORPORATION
4	Car line	S: FORESTER
5	Body classification	K: Wagon
6	Displacement class	A: 2.5 L NA U5 4 CYLINDERS GASOLINE 182 HP D: 2.5 L NA C4 4 CYLINDERS GASOLINE 182 HP E: 2.5 L NA C5 4 CYLINDERS GASOLINE 182 HP
7	Grade	A: Base + EyeSight B: Base Plus C: Base Plus + EyeSight D: Premium E: Premium Base + EyeSight F: Premium Base + EyeSight + Navi G: Premium + EyeSight + Smart key & Push start H: Premium + EyeSight J: Sport Base + EyeSight + Smart key & Push start K: Sport + EyeSight + Smart key & Push start L: Sport + EyeSight + Navi + Smart key & Push start M: Sport + EyeSight + Navi (Harman Kardon audio) + Smart key & Push start P: Sport + EyeSight + Harman Kardon audio + Smart key & Push start S: Limited Base + EyeSight + Smart key & Push start T: Limited Base + EyeSight + Navi (Harman Kardon audio) U: Limited + EyeSight + Navi (Harman Kardon audio) + Smart key & Push start V: Limited + EyeSight + Harman Kardon audio + Smart key & Push start W: Touring + EyeSight + Navi (Harman Kardon audio) + Smart key & Push start X: Touring + EyeSight + Harman Kardon audio + Smart key & Push start
8	Restraints and GVWR class	C: Manual belts + dual airbag + side airbag for seat back + curtain airbag for roof + driver + knee airbag, Class C (GVWR 4,001 to 5,000 lb)
9	Check digit	X or 0 to 9
10	Model year	K: 2019MY
11	Transmission type	H: Full-time AWD CVT Yajima plant, Gunma
12 to 17	Serial number	400001 to 599999

Vehicle type classification

Display example: SK9AY*L

#: Depends on the vehicle model.

Digits	Meaning	Details
1	Series	S: Forester
2	Body type	K: Wagon
3	Total engine displacement/Drive system	9: 2.5 L AWD NA
4	Model year	A: 2019MY
5	Destination	Y: U.S., Canada, and Mexico
6	Grade	1: 2.5i EyeSight 3: 2.5i Plus 4: 2.5i Plus EyeSight 5: 2.5i Premium 6: 2.5i Premium EyeSight 7: 2.5i Premium Esb 9: 2.5i Sport EyeSight 7: 2.5i Premium EyeSight base 9: 2.5i Sport EyeSight A: 2.5i Sport EyeSight base D: 2.5i Limited EyeSight E: 2.5i Limited EyeSight base H: 2.5i Touring EyeSight
7	Fuel feed system/Transmission	L: DI DOHC NA CVT

Engine

Display example: FB25DAZHTA

Digits	Meaning	Details
1 to 2	Engine type symbol	FB: 4-cylinder gasoline
3 to 4	Displacement	25: 2.5 L
5	Valve train/fuel supply system/ steering	D: DOHC NA (LHD)
6	Exhaust regulations	X: North America (Tier 3/LEV III)
7	Intake/exhaust system	Z: Intake AVCS, exhaust AVCS, TGV, EGR
8	Mounted transmission	H: CVT
9 to 10	Detailed specifications	Used when ordering parts. For details, refer to the parts catalog.

Transmission

TR580DHTAA

Digits	Meaning	Details
1	Transmission symbol	T: Transmission
2	Basic transmission system	R: Full-time AWD CVT
3 to 4	Distance between pulley centers	58: Between pulley centers 6.22 in (158 mm)
5	Model series	0: CVT
6	Transmission basic specifications	D: With Auto Start-Stop, with CVTF cooler (with warmer function), without CVTF cooler (with air cooler)
7	Mounted engine	H: 2.5 L DOHC NA
8 to 10	Detailed specifications	Used when ordering parts. For details, refer to the parts catalog.

Rear differential

Identification	Reduction speed ratio	LSD
42	3.7000	None

1.2 List of Abbreviations

2ndr	Secondary
AAI	Air Assist Injection
AAR	Angular Adjusted Roller
A/B	Airbag
ABS	Anti-lock Brake System
A/C	Air Conditioner
AC	Angular Contact
ACC	Accessory
A/F	Air-Fuel Ratio
ALT	Alternator
APS	Accessory Power Supply Socket
ASSY	Assembly
AT	Automatic Transmission
ATF	Automatic Transmission Fluid
AUX	Auxiliary Storage Unit (External storage)
AVCS	Active Valve Control System
AWD	All Wheel Drive
BATT	Battery
BCM	Brake Control Module
BJ	Ball Fixed Joint
BRKT	Bracket
BSD/RCTA	Blind Spot Detection / Rear Cross Traffic Alert
CAN	Controller Area Network
CCA	Cold Cranking Ampere
CD	Compact Disc
CD-R/RW	CD Recordable/Rewritable
CM	Control Module
COMPL	Complete
CPC	Canister Purge Control Solenoid Valve
CPU	Central Processing Unit
CTR	Center
CU	Control Unit

CVT	Continuously Variable Transmission
CVTF	Continuously Variable Transmission Fluid
DCCD	Driver's Control Center Differential
DOHC	Double Overhead Camshaft
DOJ	Double Offset Joint
D/R	Dual-range
DTC	Diagnosis Trouble Code
DU	Drive Unit
DVD	Digital Versatile Disc or Digital Video Disc
EBD	Electronic Brake Distribution
EBJ	High-Efficiency Compact Ball Fixed Joint
ECM	Engine Control Module
ECV	Exhaust Control Valve
EDJ	High-Efficiency Compact Double Offset Joint
E/G	Engine
EGI	Electronic Gasoline Injection
EGR	Exhaust Gas Recirculation
ELR	Emergency Locking Retractor
EPB	Electronic Parking Brake
ETC	Electronic Throttle Control
EX	Exhaust
F/B	Fuse & Joint Box
FL	Fusible Link
Ft	Front
FWD	Front Wheel Drive
GPS	Global Positioning System
HBA	High Beam Assist
HI	High
HID	High-Intensity Discharge
H/L	Headlight
H/M	Hydraulic Control Module
HVAC	Heater, Ventilator and Air Conditioner
ICR	Inrush Current Reduction
I/F	Interface

IG	Ignition
IN	Intake
INT	Intermittent
I/O	Input/Output
IR	Infrared Ray
ISC	Idle Speed Control
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left Hand
LHD	Left Hand Drive
Lo	Low
LSD	Limited Slip Differential
LWR	Lower
M/B	Main Fuse & Relay Box
MD	Mini Disc
MID	Multi-Information Display
MPI	Multi-Point Injection
MP-T	Multi-Plate Transfer
MT	Manual Transmission
NA	Natural Aspiration
NC	Normal Close (Relay)
NO	Normal Open (Relay)
OBD	On-Board Diagnosis
OP	Option Parts
PC	Personal Computer
PCD	Pitch Circle Diameter
PCV	Positive Crankcase Ventilation
PID	Parameter Identification
Pr	Primary
PRG	Power Rear Gate
P/S	Power Steering
PTJ	Pillow Tripod Joint
P/W	Power Window

RAM	Random Access Memory
RH	Right Hand
RHD	Right Hand Vehicle
ROM	Read Only Memory
Rr	Rear
SDI	Subaru Diagnostic Interface
SI	Subaru Intelligent
SOHC	Single Overhead Camshaft
SRS	Supplemental Restraint System
SSM	Subaru Select Monitor
ST	Special Tool
STD	Standard
SW	Switch
T/B	Turbocharger
TCM	Transmission Control Module
TCS	Traction Control System
TGV	Tumble Generator Valve
T/M	Transmission
UJ	Universal Joint
UPR	Upper
UV	Ultraviolet
VDC	Vehicle Dynamics Control
VIN	Vehicle Identification Number
ViS-C	Viscous Coupling
VSV	Vacuum Switching Valve
VTD	Variable Torque Distribution
W/H	Wiring Harness

2 ENGINE (FB25)

CONTENTS

2.1 General Overview

2.1.1 Overview

Newly developed FB-type 2.5 L direct-injection engine is mounted. The cylinder direct fuel injection function is adopted for the fuel system and weight is reduced by reviewing approximately 90% of parts. High fuel efficiency and steering stability is improved through achieving class-leading maximum net thermal efficiency.

In addition, thermo-control valve assembly system is adopted for the first time by SUBARU. Improvement of fuel efficiency by enhancing the engine warm-up characteristics during cold start, cabin heating performance, and management of amount of heat generated in the engine which contributes to overcool prevention are realized.

The engine is in accordance with the following environmental performances.

- TIER3 BIN50/LEV3 SULEV30

Performance and fuel consumption

The exhaust AVCS is adopted to enable optimal valve timing according to traveling and driving conditions to ensure power performance and enable lower emissions.

The EGR cooler with high EGR gas cooling performance is adopted to design the engine with superior knocking resistance performance.

Vibration and noise

A fix point is added to the rocker cover to reduce noise.

The journal piece is changed to casting structure and the intake and exhaust system components are optimized to reduce vibration and noise.

Weight

Material substitution and function elimination and consolidation are implemented thoroughly to reduce weight.

The plastic oil strainer, thin cylinder liner, TGV-integrated plastic intake manifold, and exhaust system components are optimized to reduce weight.

2.1.2 Specification

Power unit

Engine	Transmission type	Maximum output kW (HP)/(rpm)	Maximum torque N・m (kgf-m, ft-lb)/(r/min)
2.5 L DOHC	CVT	136 (182)/5,800	239 (24.4, 176)/4,400

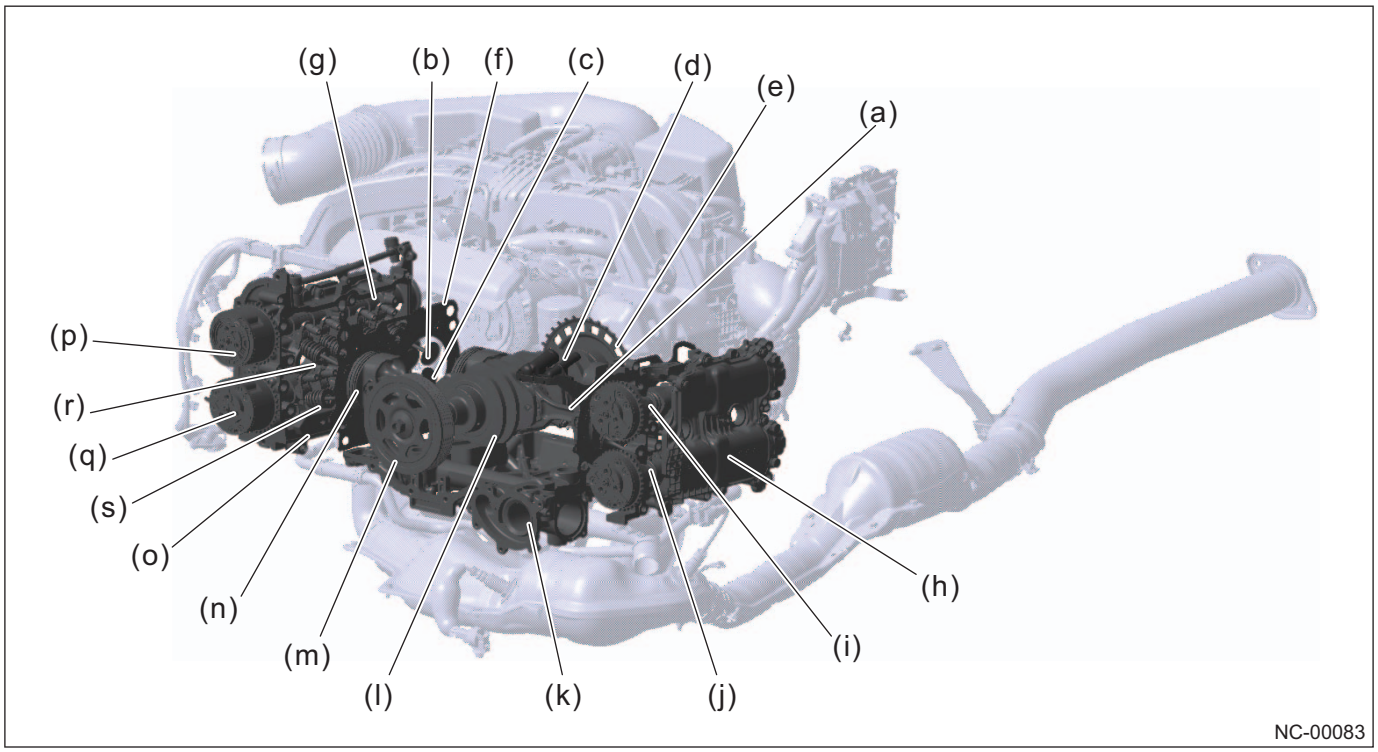
Major specification

Engine classification	2.5 L DOHC
Engine type	FB25
Cylinder arrangement	Horizontally opposed, 4-cylinder, 4-stroke gasoline engine
Valve train	Timing chain drive
	Double overhead camshaft
	Roller rocker system
	Shim-adjusted valve clearance system
Cylinders	4
Bore × Stroke in (mm)	3.70 × 3.54 (94.0 × 90.0)
Displacement cu in (cm^3)	152 (2,498)
Compression ratio	12.0
Compression pressure (at 200 to 300 r/min)	1,050 to 1,400 kPa (11 to 14 kgf/cm^2, 152 to 203 psi)
Fuel supply system	Cylinder direct fuel injection
Ignition timing (BTDC) (r/min)	8° ± 10°/675
Idle speed	675 ± 100 (A/C switch OFF), 800 to 900 ± 50 (A/C switch ON)
Intake system	Natural aspiration

* When idling

2.2 General Component

2.2.1 Engine Component Layout Drawing

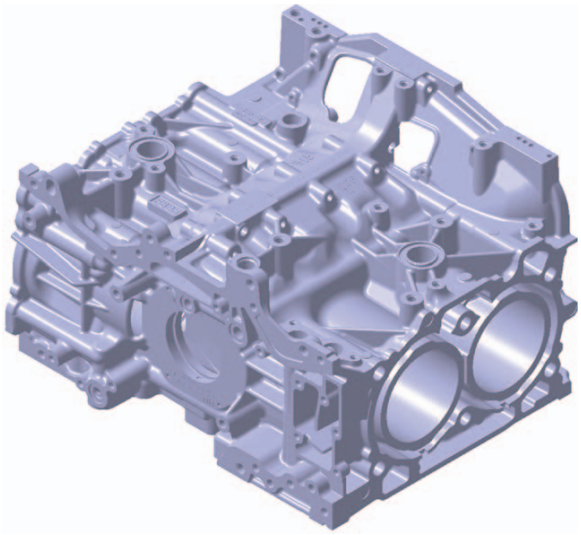


(a) Connecting rod
(b) Intake valve
(c) Exhaust valve
(d) PCV connector
(e) Crankshaft position sensor plate
(f) Cylinder head gasket
(g) Cam carrier
(h) Rocker cover
(i) Camshaft (intake side)
(j) Camshaft (exhaust side)
(k) Oil pan upper
(l) Crankshaft
(m) Crank pulley
(n) Piston
(o) Oil spacer
(p) Cam sprocket (intake side)
(q) Cam sprocket (exhaust side)
(r) Valve spring (intake side)
(s) Valve spring (exhaust side)

2.2.2 Engine Component Details

Cylinder block

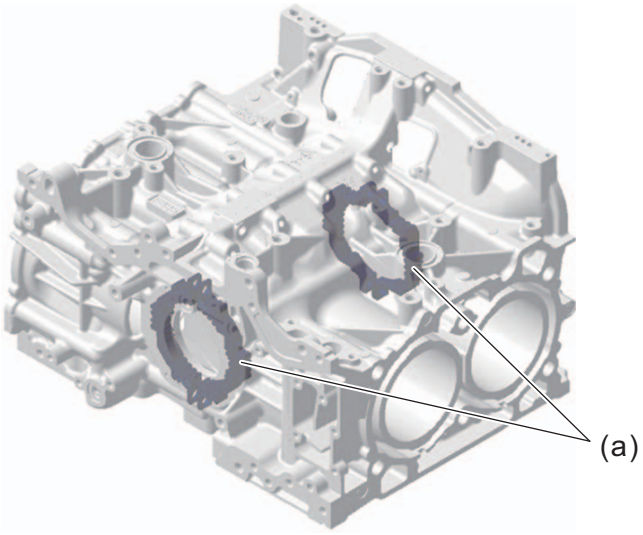
The cylinder block is highly improved in strength to support high compression ratio. The weight reduction is made to every part by using various analyses, resulting in approximately 10% reduction in weight.



NC-00639

Journal piece

Casting structure is adopted for the first and fifth journal pieces to reduce annoying vibration and noise and realize comfortable vibration noise performance and sound quality.

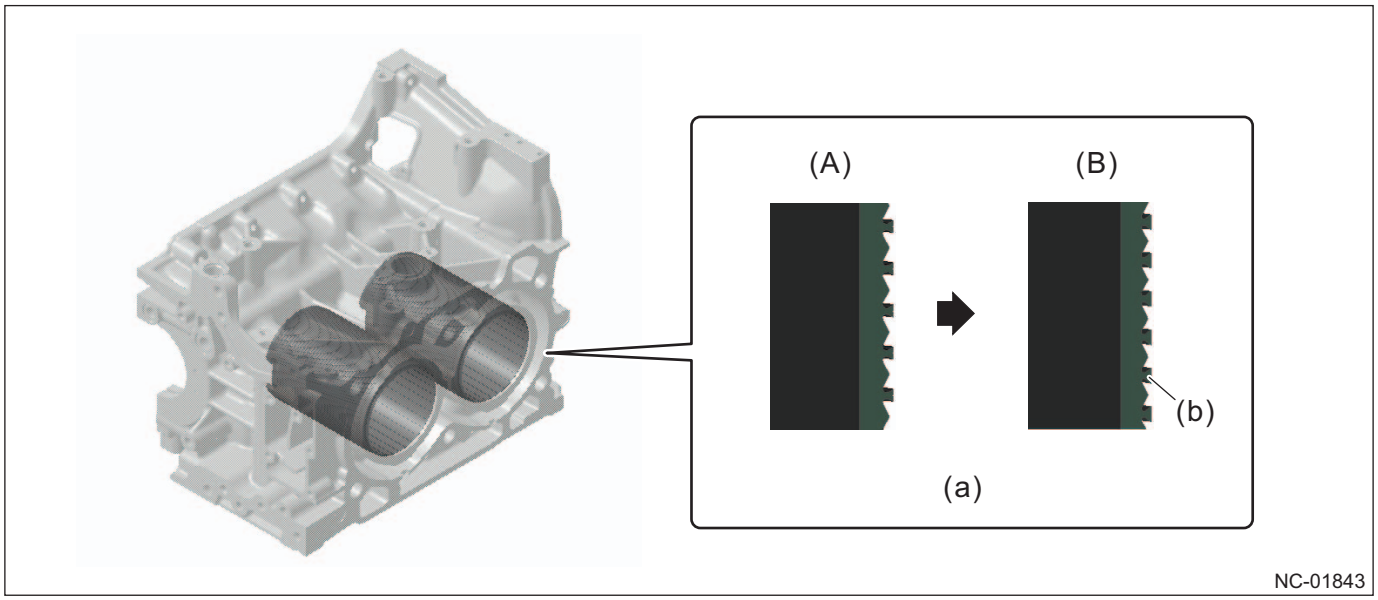


NC-00034

(a) Journal piece

Cylinder liner

The gray cast iron liner with superior vibrational absorption and heat resistance is adopted. Weight is reduced by thinning the thickness from 0.09 in (2.2 mm) to 0.06 in (1.5 mm) Shape with high contact for interface with the aluminum cylinder block is adopted to reduce bore deformation and oil consumption.



(A) Existing model vehicle

(B) New model vehicle

(a) Cylinder liner cross section

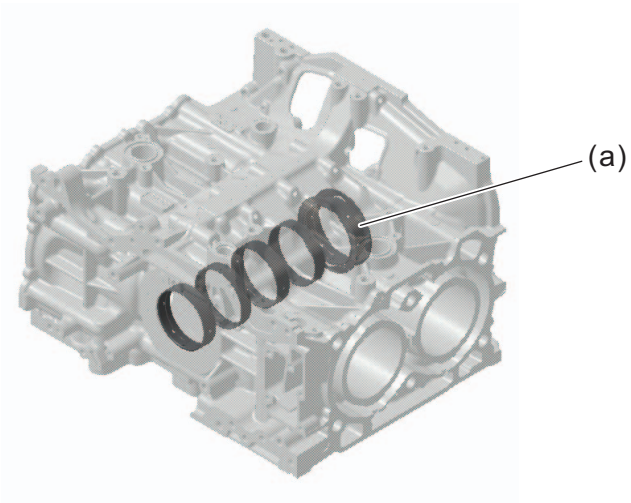
(b) Shape change of the closely-contact surface with aluminum

Water jacket spacer

Since the temperature of the cylinder liner wall can be controlled properly by introducing the thermo-control valve assembly, use of water jacket spacer is discontinued, and weight reduction is realized.

Crankshaft bearing

Molybdenum coat is provided on all crankshaft bearings to form lubricative layer on the bearing surface to reduce friction and improve fuel efficiency.



NC-00036

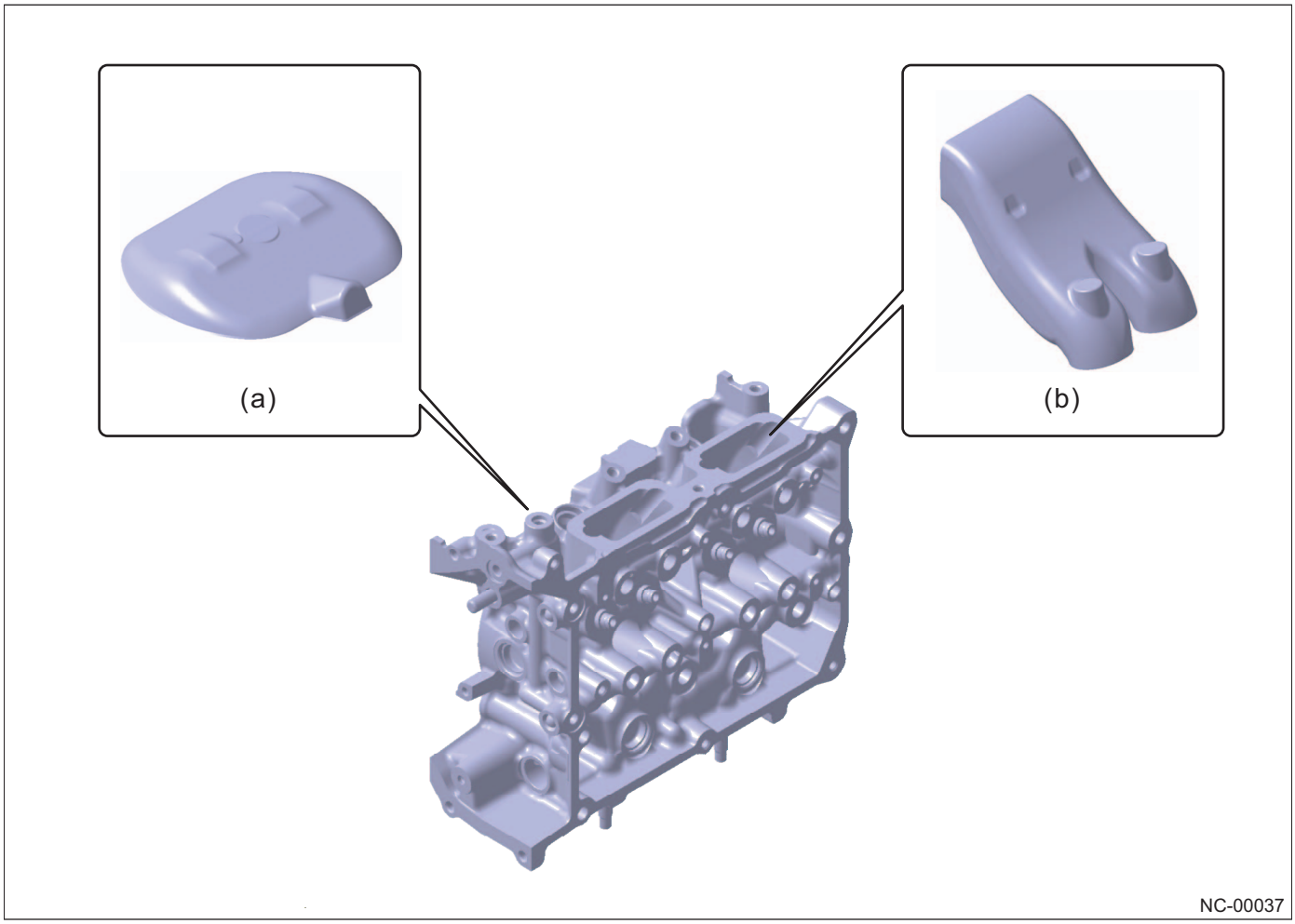
(a) Crankshaft bearing

Cylinder head

Combustion efficiency and knock resistance is improved by adopting the pent roof shaped combustion chamber and placing the spark plug close to the center.

The combustion chamber is downsized by setting the valve holding angle to the narrow-angle 27°. The shape of the combustion chamber is formed most suitable for the cylinder direct fuel injection function.

The shape of the intake port is changed to improve flow rate, output by the strengthened tumble and fuel efficiency.

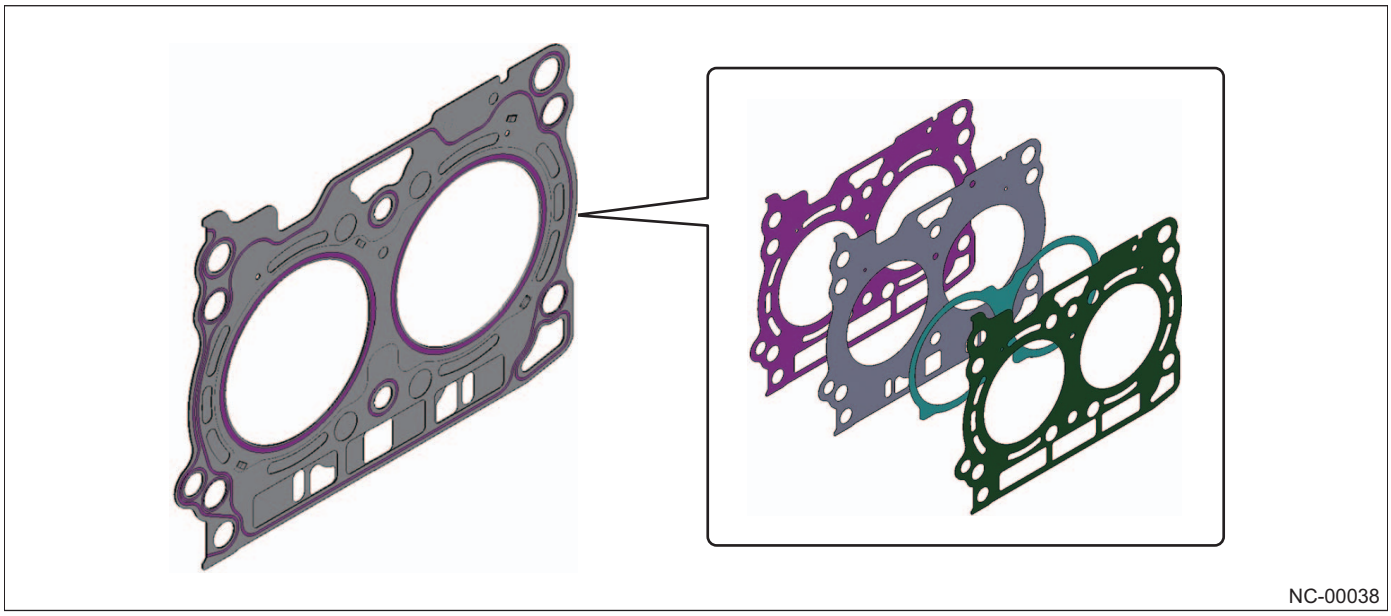


(a) Combustion chamber

(b) Intake port

Cylinder head gasket

The stainless cylinder head gasket is adopted. To improve opening yield strength due to the difference between the inside and outside temperature of the engine generated by the introduction of the engine coolant control valve, a 3.5-layer structure cylinder head gasket which improves seal yield strength is adopted.



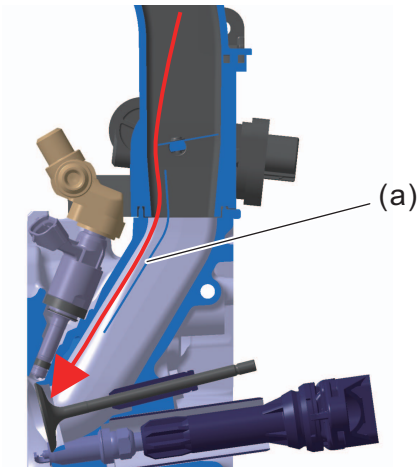
NC-00038

Port partition wall

To realize a class-leading fuel efficiency and environmental performance, the intake air flow is reviewed as a means of improving the flow in the cylinder. The port partition wall is newly mounted with the tumble generation valve.

The port partition wall is installed inside the intake port, separating the intake port into two portions. This further reinforces the tumble flow optimized by TGV and realizes superior fuel efficiency and environmental performance.

In addition, the plate length is extended to the tumble generation valve side to optimize the gas flow and the plate is changed to aluminum to reduce weight.

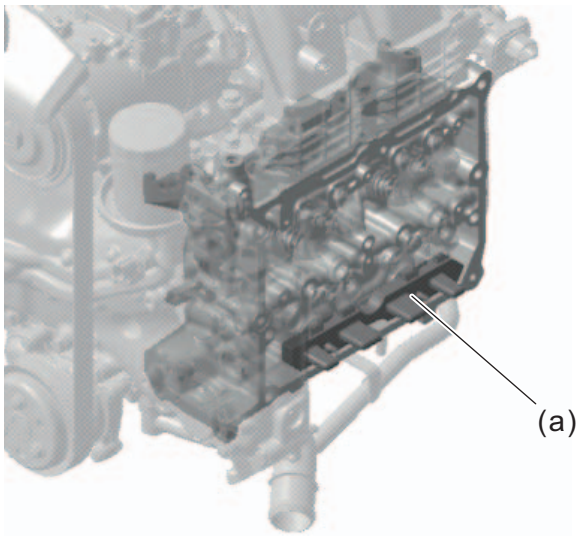


NC-00039

(a) Port partition wall

Oil spacer

The oil spacer for reducing dead space in the cylinder head LH and the cylinder head RH is added. This improves warm up performance by reduction of the engine oil amount and decrease in the warm up capacity, realizing improvement of fuel efficiency performance. Also, the amount of oil exchanged in the market is reduced and product quality is improved.

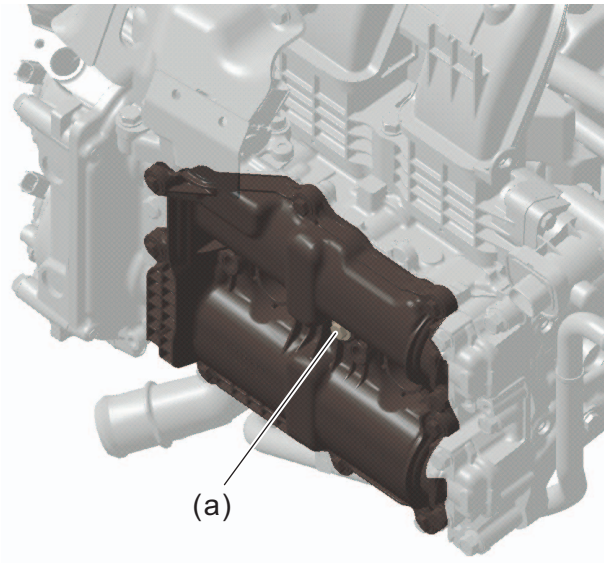


NC-00040

(a) Oil spacer

Rocker cover

The shape of the rocker cover is changed to reduce vibration and noise. The fixed point is added in the center of the cover.

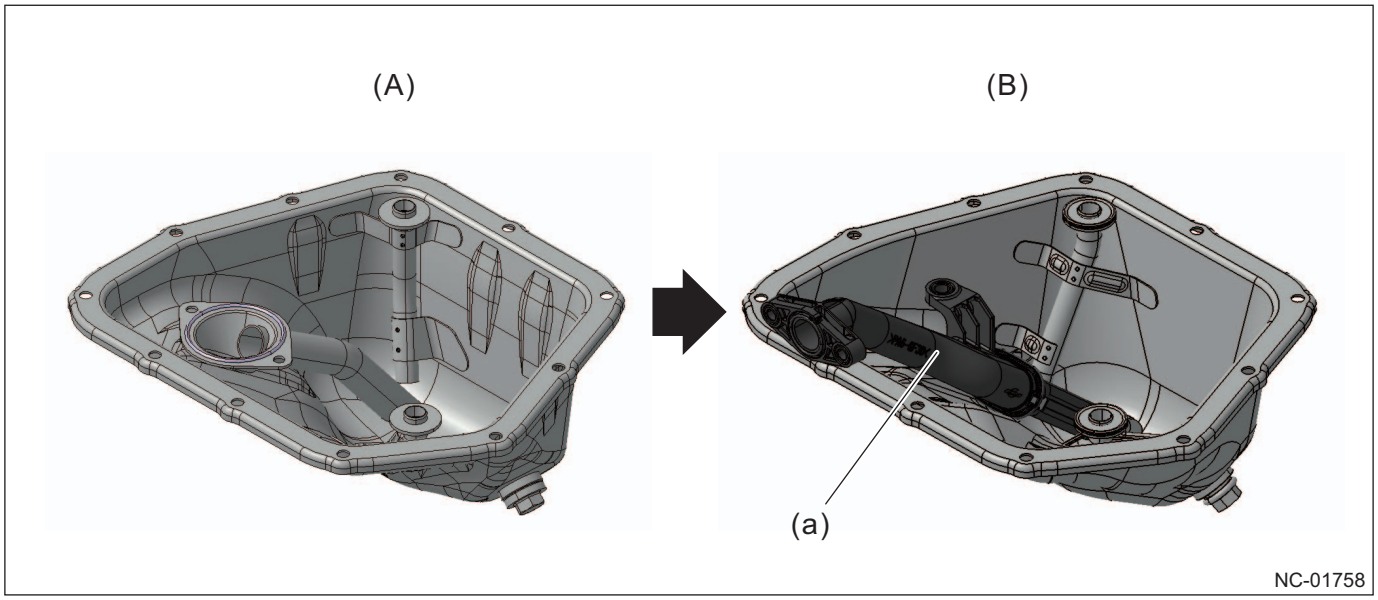


NC-00041

(a) Center fixed point

Oil pan

The lightweight plastic oil strainer is adopted. Also, product quality is improved by adopting a shape that reduces the oil exchange amount for the oil pan.



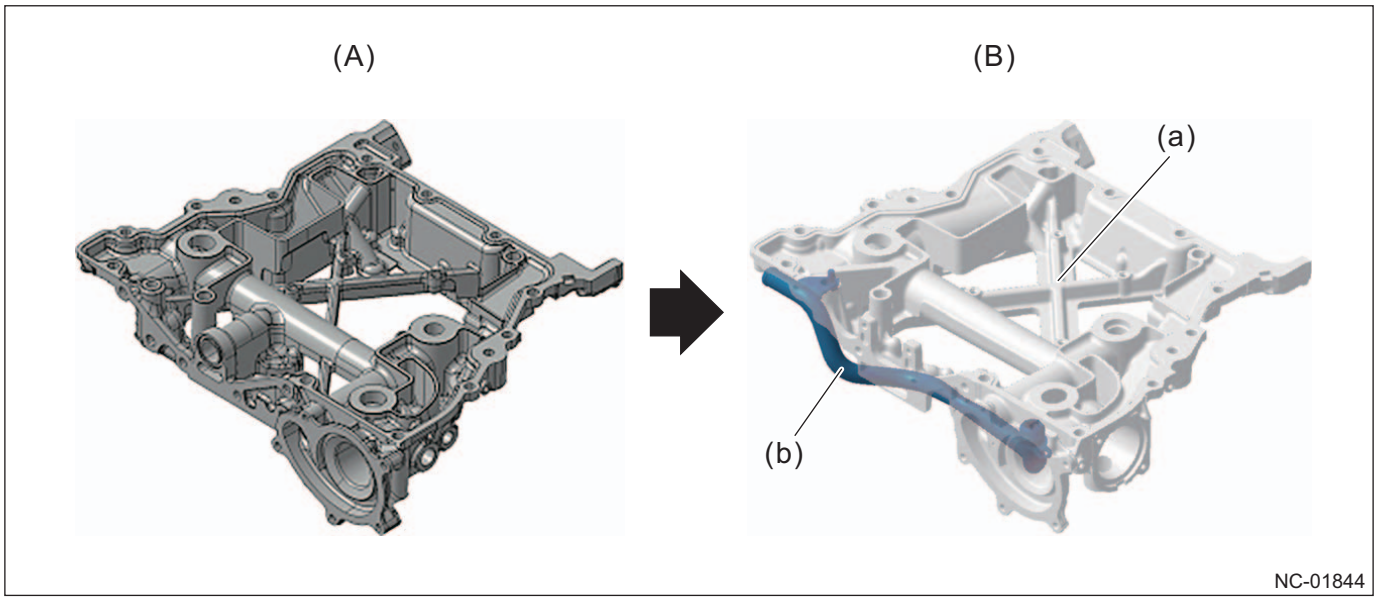
(A) Existing model vehicle

(B) New model vehicle

(a) Plastic oil strainer

Oil pan upper

The shape of the X-type rib is changed to reduce vibration and noise. The shape of each part is reviewed in response to weight reduction and left-hand exhaust system. The cooling water circuit in the oil pan upper is changed for water circulation in the main mechanism due to the introduction of the thermo-control valve assembly.



(A) Existing model vehicle

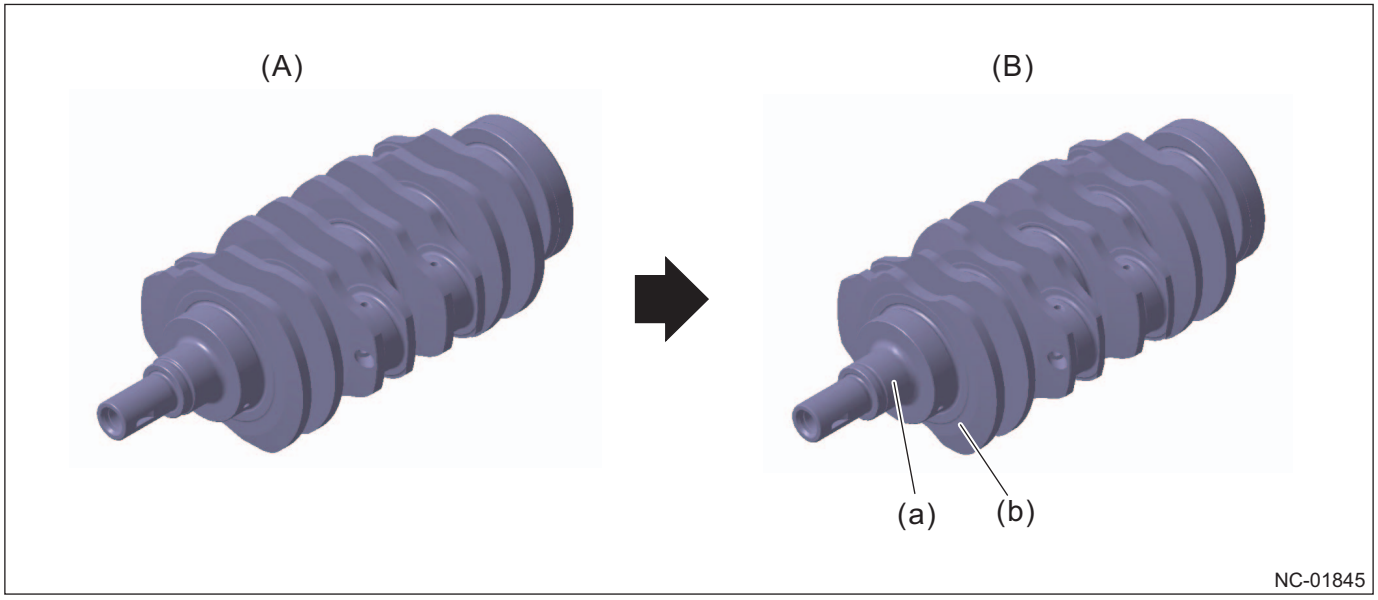
(B) New model vehicle

(a) X-type rib

(b) Cooling water circuit

Crankshaft

The forge crankshaft with 4 pins and 5 journals is adopted. Moreover, the high-frequency quenching is implemented for the crankshaft to harden the surface to ensure abrasion resistance while maintaining toughness. Moreover, the web is thinned and the front boss diameter is reduced to lower weight.



(A) Existing model vehicle

(B) New model vehicle

(a) Front boss

(b) Web

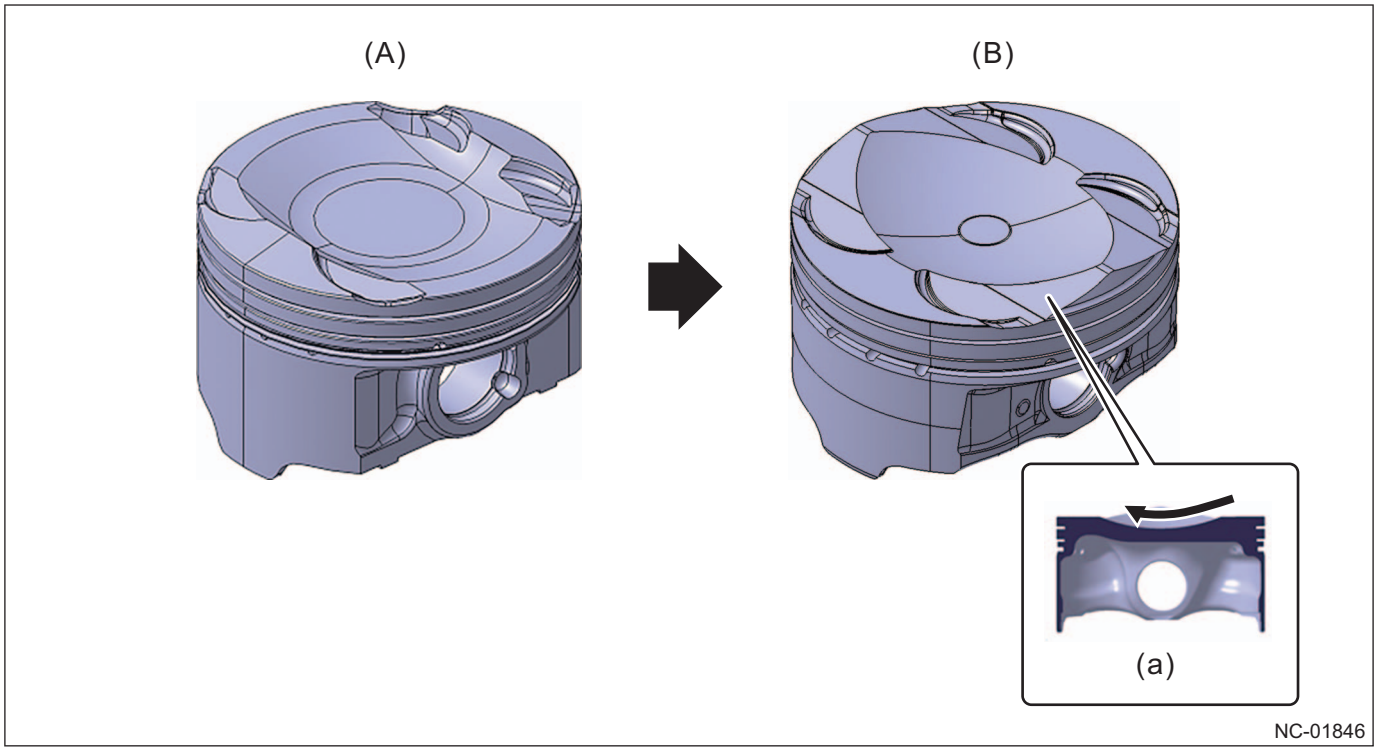
Piston

The piston made of the aluminum alloy with lightweight and high stiffness is adopted.

The convex crown top shape of the piston is changed responding to the increase in the compression ratio and adoption of the cylinder direct fuel injection function.

In addition, the air guide improves flow in the cylinder, and contributes to the weight reduction and lower friction (changes of pin diameter and coating material) as well as improvement of fuel efficiency.

Alumite treatment in the top ring groove is adopted to ensure abrasion resistance.



(A) Existing model vehicle

(B) New model vehicle

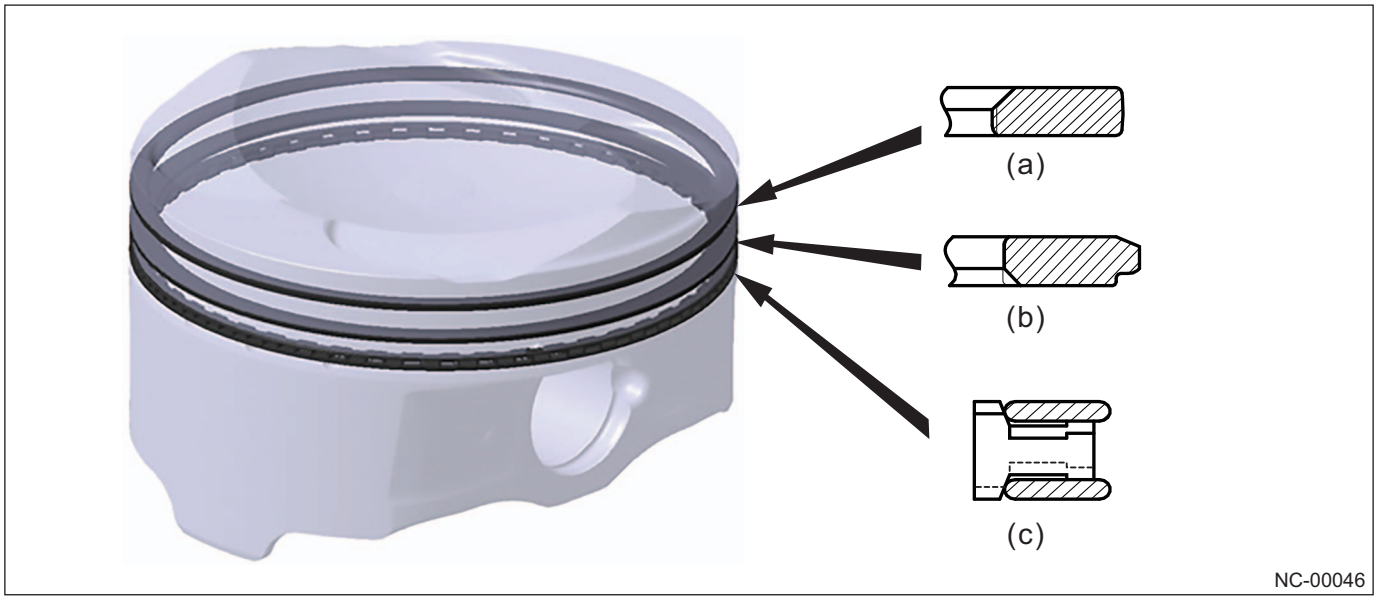
(a) Air guide

Piston ring

Top ring
A high thermal conducting material is adopted to reduce knocking occurrence and contribute to improving fuel efficiency. Also, tension is optimally designed to reduce friction and support higher output.

Second ring
Tension is optimally designed to reduce friction and support higher output.

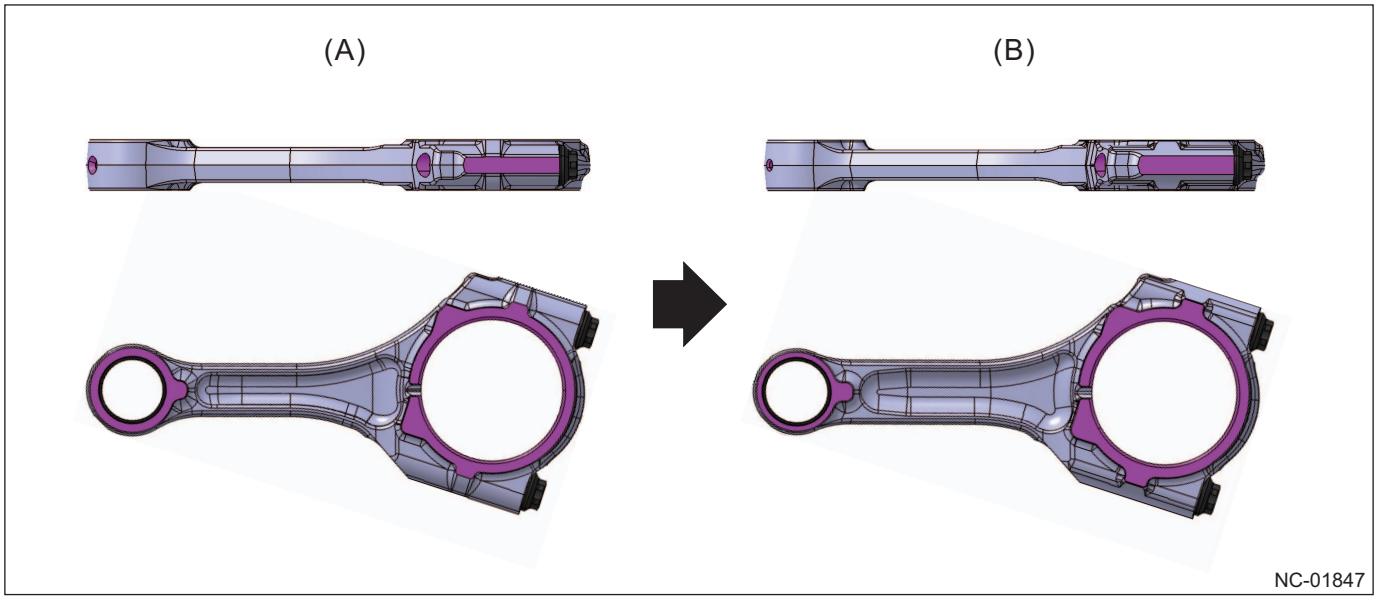
Oil ring
Tension is optimally designed to reduce friction and support higher output.



(a) Top ring
(b) Second ring
(c) Oil ring

Connecting rod

The shape is changed to reduce deformation of the large end during high-speed rotation and reduce the weight. Also, the skew split method is adopted to the large end in consideration of maintenance.

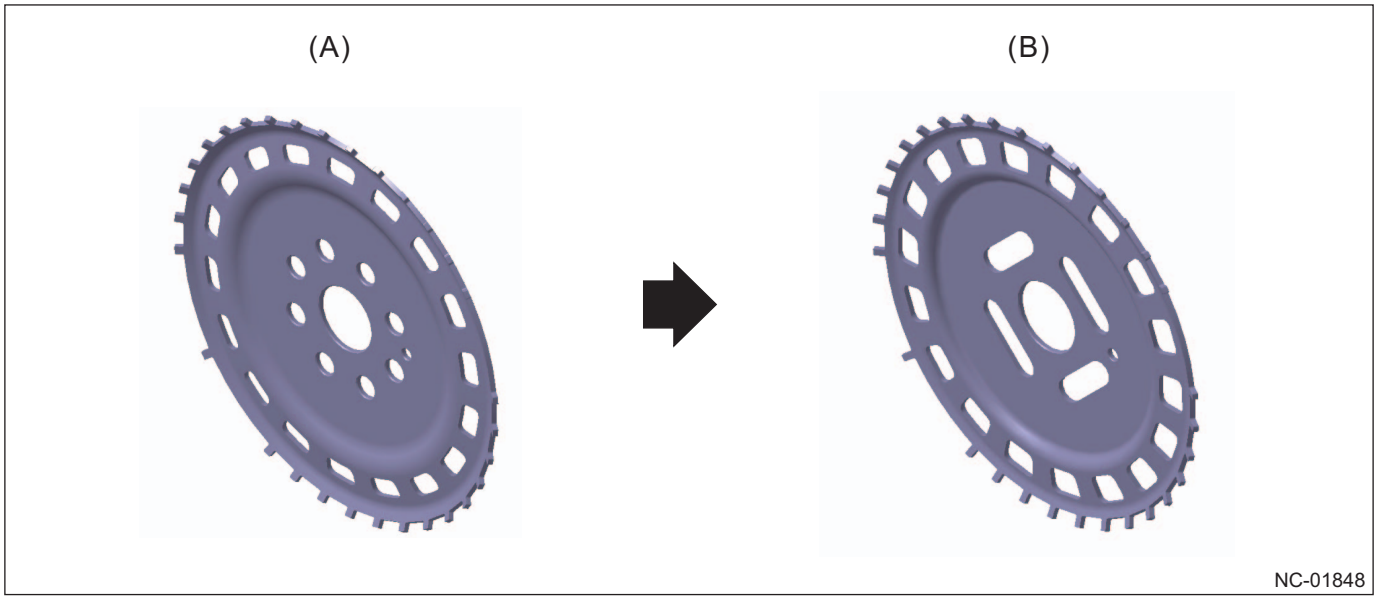


(A) Existing model vehicle

(B) New model vehicle

Crankshaft position sensor plate

Some portions are removed from the crankshaft position sensor plate, and the outer diameter is reduced to realize weight reduction and improve the detection performance of the crankshaft position sensor plate.

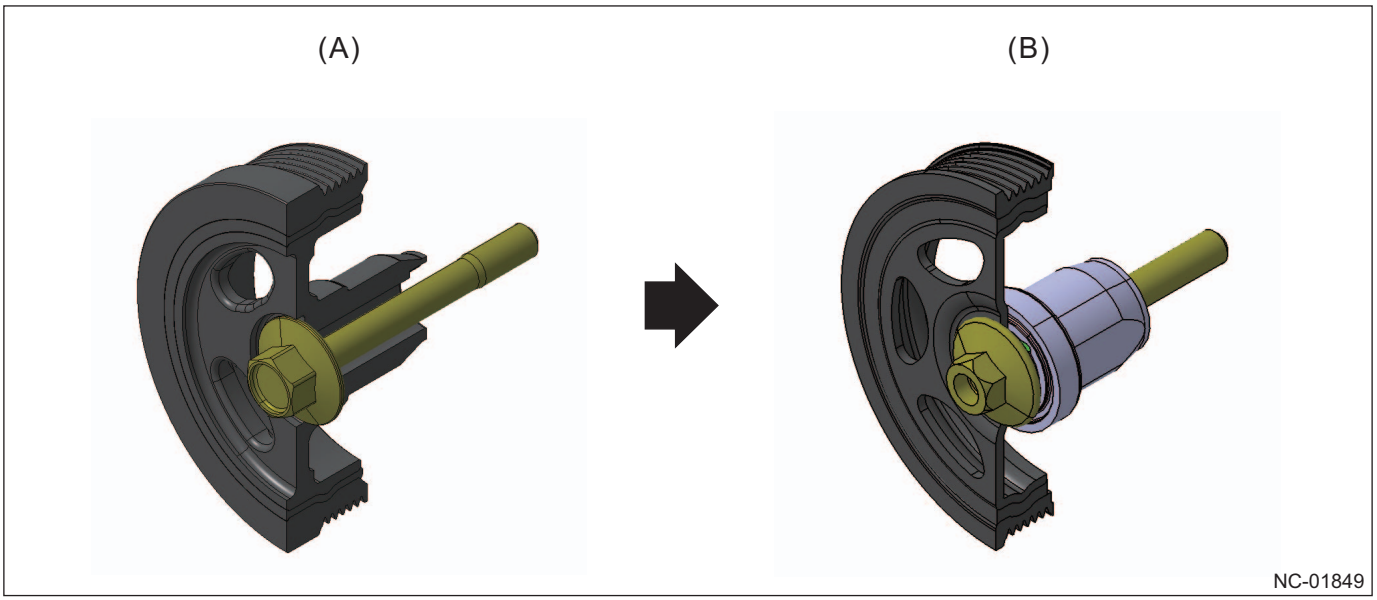


(A) Existing model vehicle

(B) New model vehicle

Crank pulley

The manufacturing method is changed from casting to sheet-metal processing to reduce the weight.



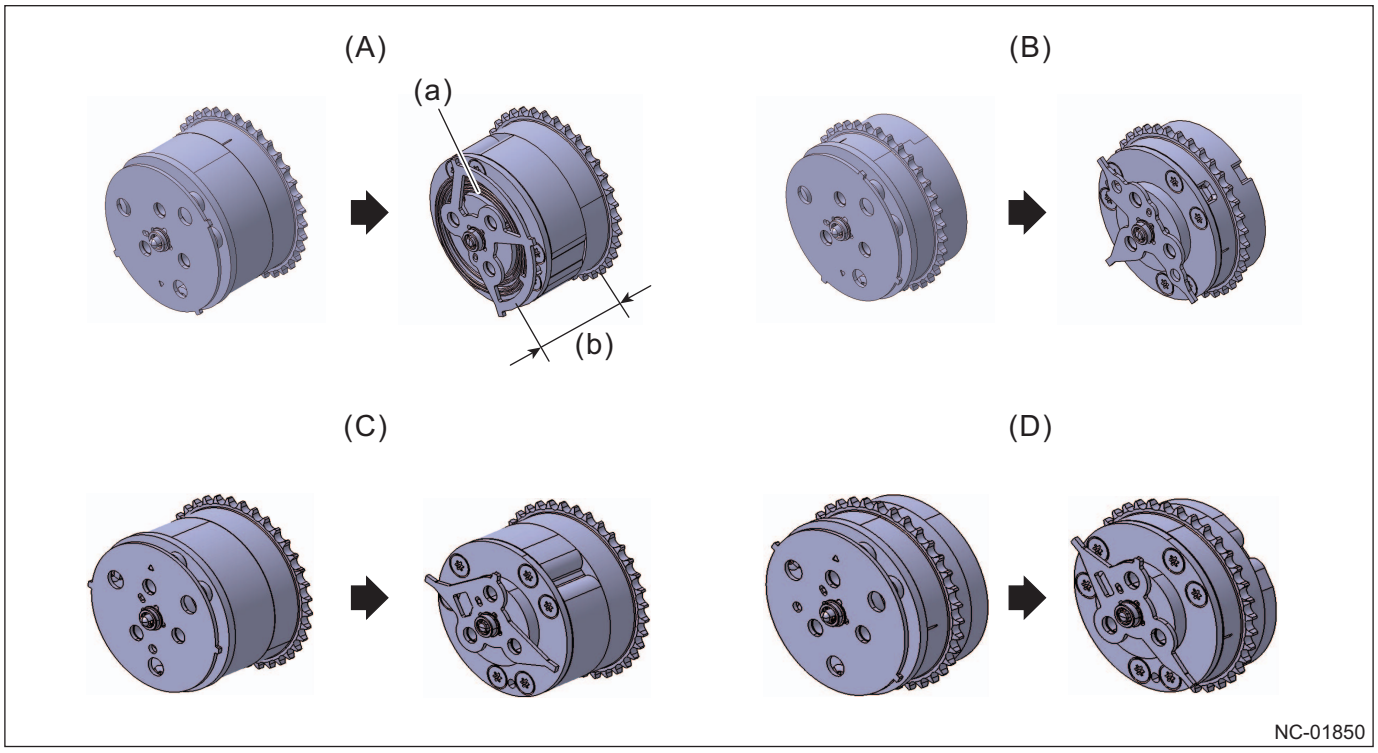
(A) Existing model vehicle

(B) New model vehicle

Cam sprocket

The thickness of the cam sprocket is thinned to secure the clearance in the engine compartment and ensure security at collision while reducing weight.

The return spring is installed on the intake right side to prevent reduction in the cam driving speed during AVCS operation.



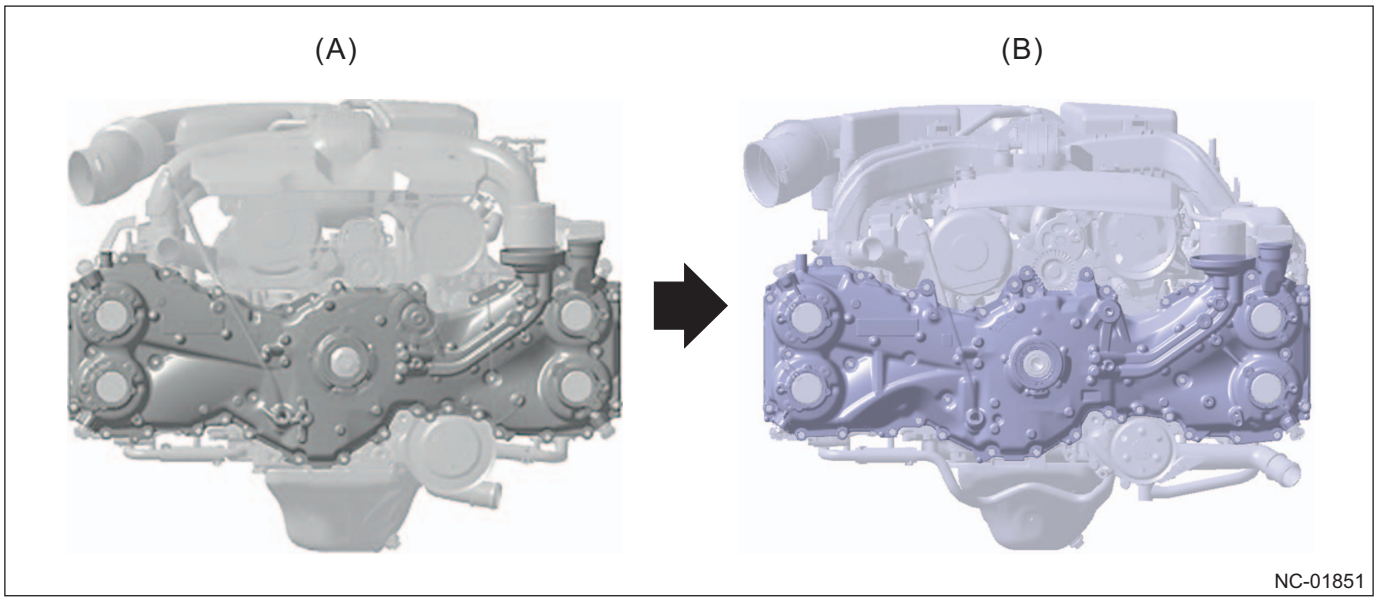
(A) Intake cam sprocket RH
(B) Intake cam sprocket LH
(C) Exhaust cam sprocket RH
(D) Exhaust cam sprocket LH

(a) Return spring (intake right side only)
(b) Thickness reduction

Chain cover

The fuel efficiency is improved by reducing the oil pump diameter and the friction during oil pump rotation. (No change in the discharge volume due to enlargement of the pump width)

The mounting position of the oil control solenoid is changed responding to the thinner cam sprocket.



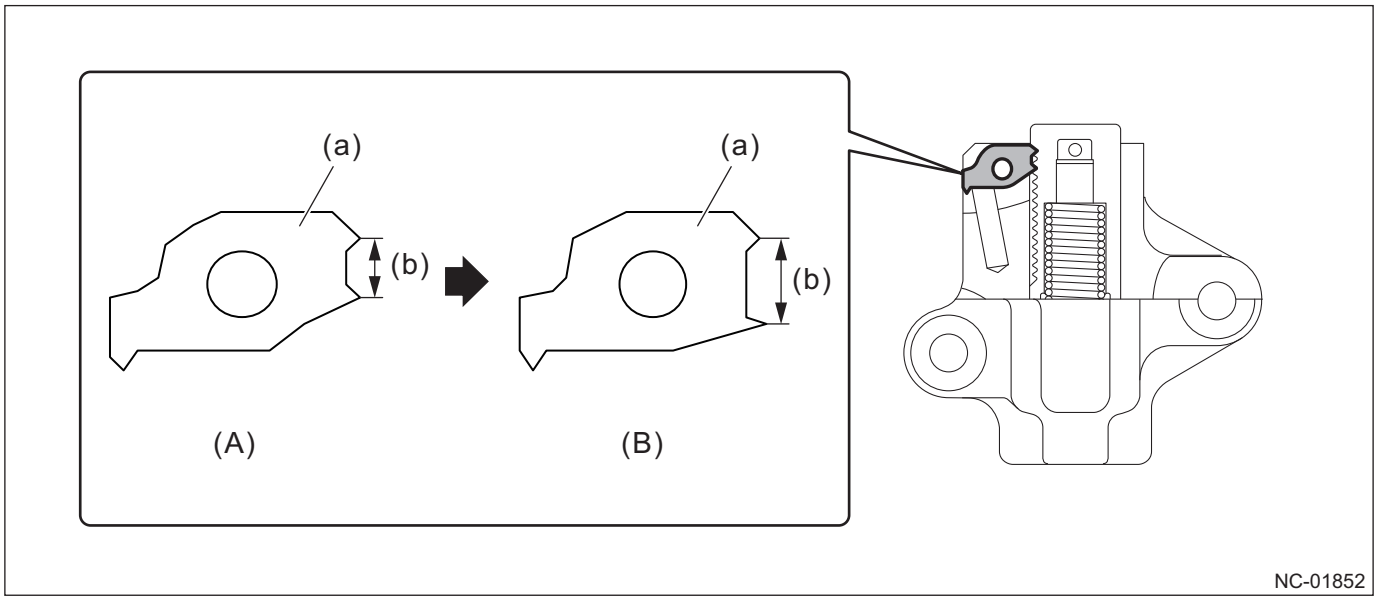
(A) Existing model vehicle

(B) New model vehicle

Chain tensioner

Widening the pitch of the ratchet cam enlarges the backlash, contributing to the chain sound reduction as well as vibration and noise reduction.

The aluminum body also contributes to the weight reduction.



(A) Existing model vehicle

(B) New model vehicle

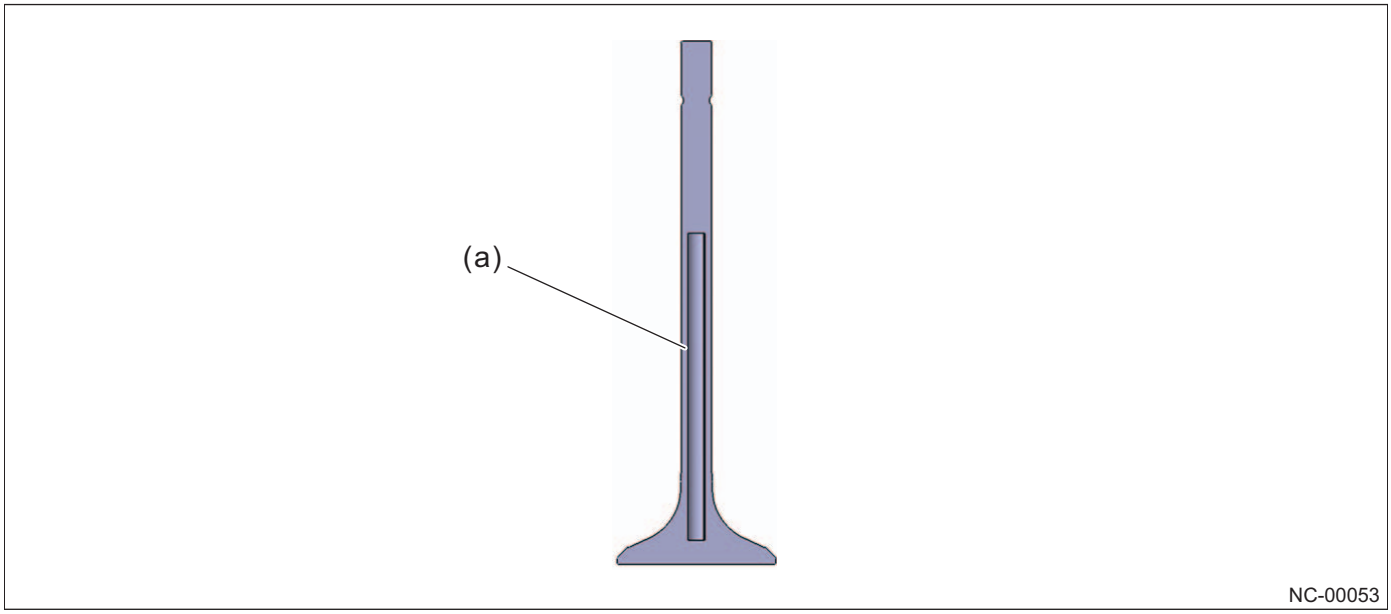
(a) Ratchet cam

(b) Pitch

Intake and exhaust valves

Friction is reduced by improving roughness on the stem surface of the intake and exhaust valves to improve fuel efficiency.

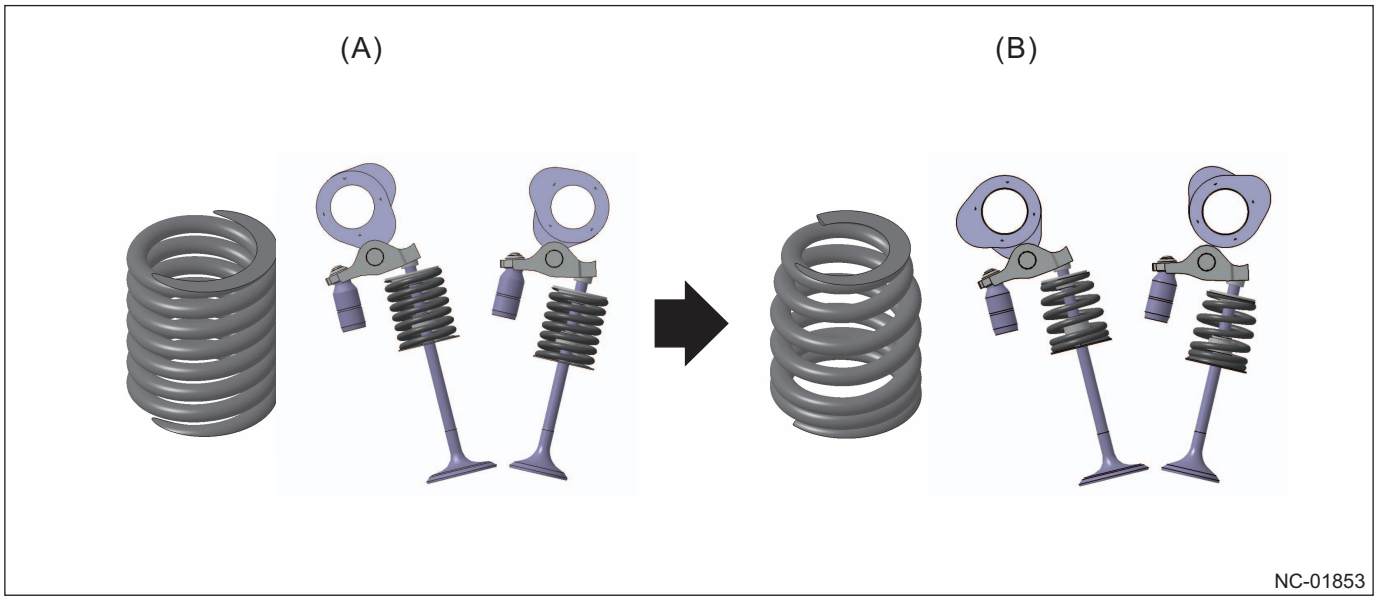
Exhaust valve with encapsulated sodium is adopted for its good cooling performance. The knocking resistance performance is improved by the improvement of cooling effect, which contributes to both the fuel efficiency improvement and output improvement.



(a) Exhaust valve (hollow, with sodium filled)

Valve spring

Cone-shaped valve spring is adopted to inhibit surging and reduce weight.

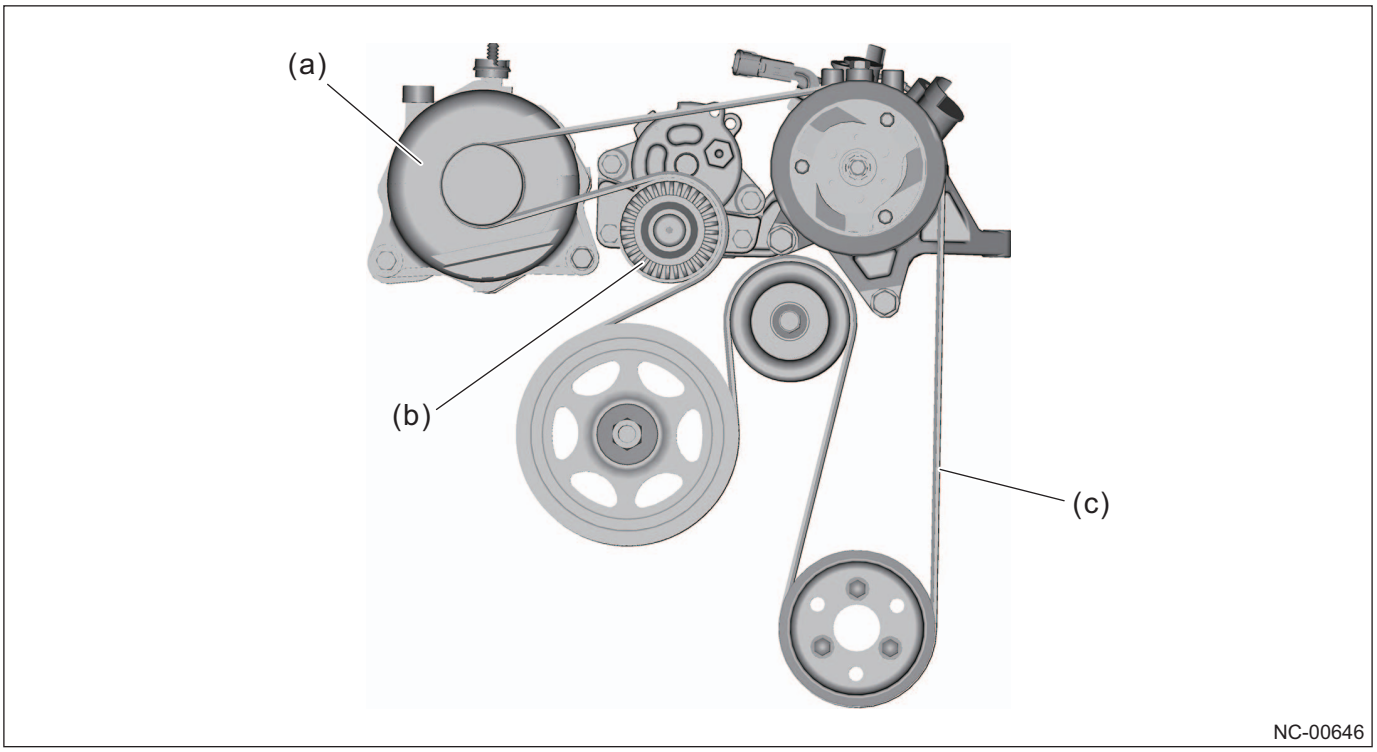


(A) Existing model vehicle

(B) New model vehicle

Belt system

The generator is directly attached to the cylinder block to make overall belt system compact, lowering the overall engine center of gravity and significantly reducing weight.



(a) Generator
(b) V belt tensioner
(c) V belt

2.3 Fuel System

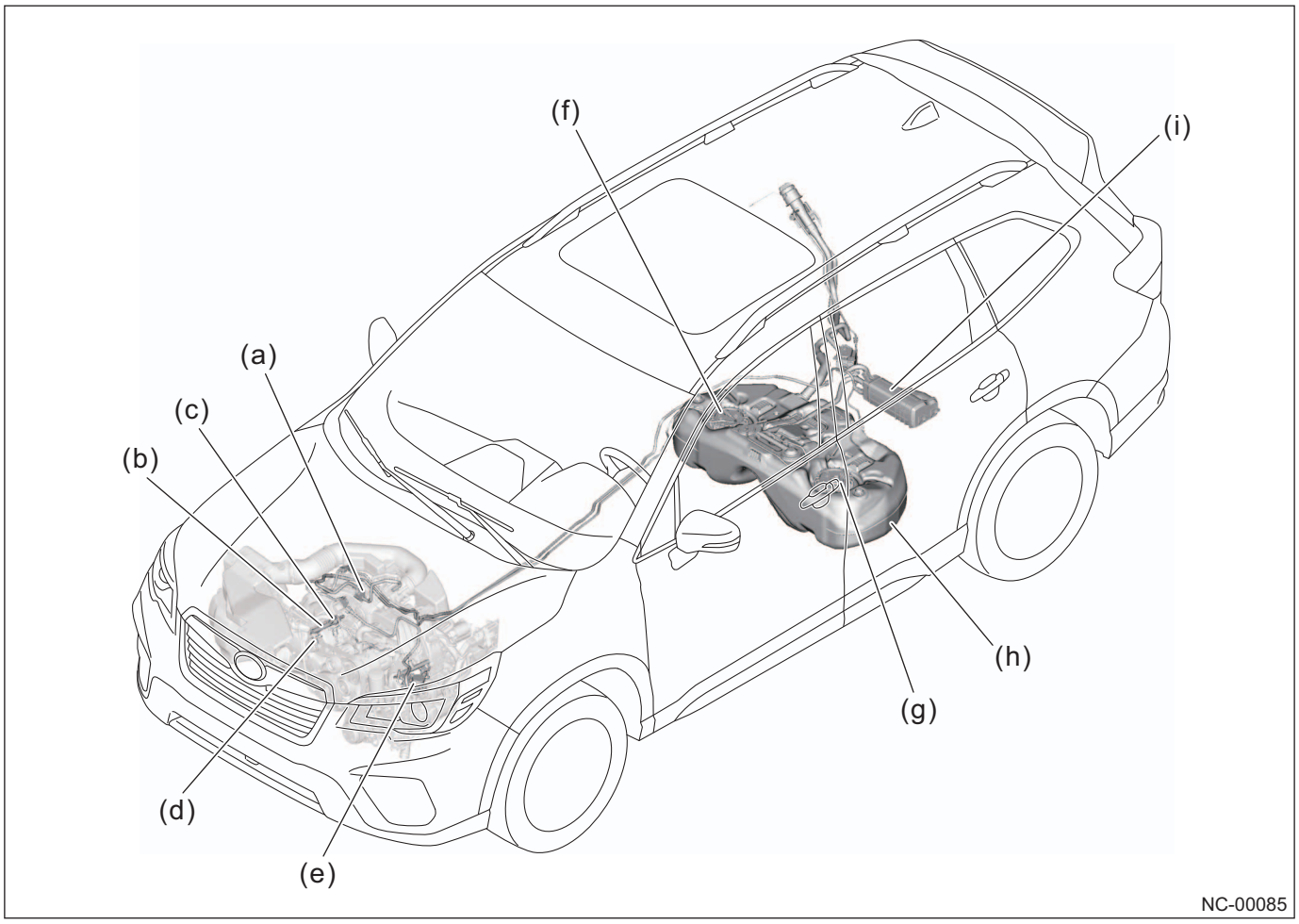
2.3.1 Overview

The following systems are adopted for the fuel system.

- Cylinder direct fuel injection system
- TGV (Tumble Generator Valve)
- Plastic straddle type fuel tank
- Fuel return-less system

2.3.2 Component

Component layout drawing



(a) Purge control solenoid valve
(b) Fuel injector pipe
(c) Fuel pressure sensor
(d) Fuel injector assembly
(e) High-pressure fuel pump
(f) Fuel pump assembly
(g) Fuel sub level sensor
(h) Fuel tank assembly
(i) Canister assembly

Component details

Fuel tank

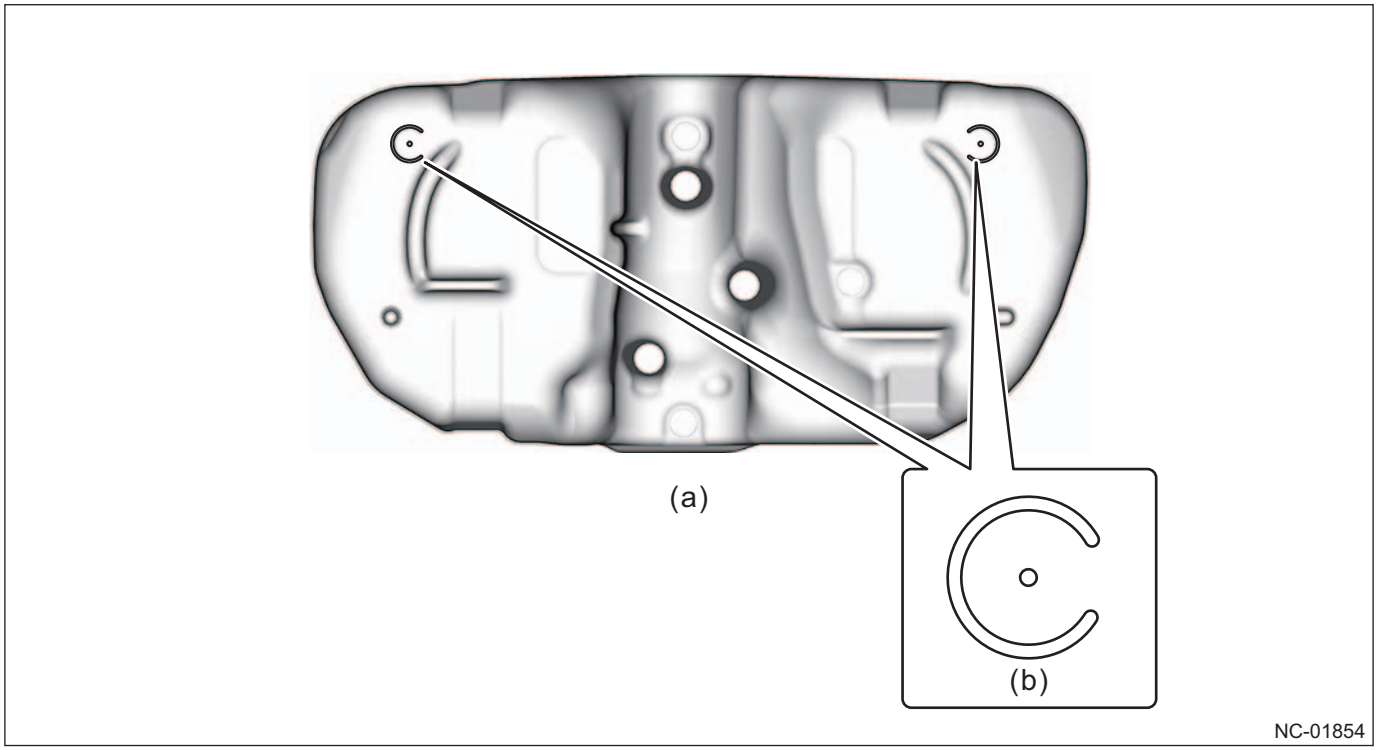
The fuel tank material is changed from sheet metal to plastic to reduce the weight.

The capacity at the filled-up fuel tank is designed to be 63 L (16.6 US gal, 13.9 Imp gal).

Since the propeller shaft passes through the center portion of the fuel tank assembly, the tank shape is designed as a straddle type. This ensures the foot space of the rear seat passengers. Due to the above, jet pump for fuel transport is adopted for the fuel chamber on the low-pressure fuel pump side.

The fuel level sensor is installed in both the right and left chambers for correctly notifying the remaining capacity of the straddle type tank to the driver.

The fuel draining marks are set on the bottom surface of the fuel tank assembly to clarify and simplify the position adjustment of the fuel draining device and to securely drain fuel when disassembling.



(a) Fuel tank assembly bottom surface view

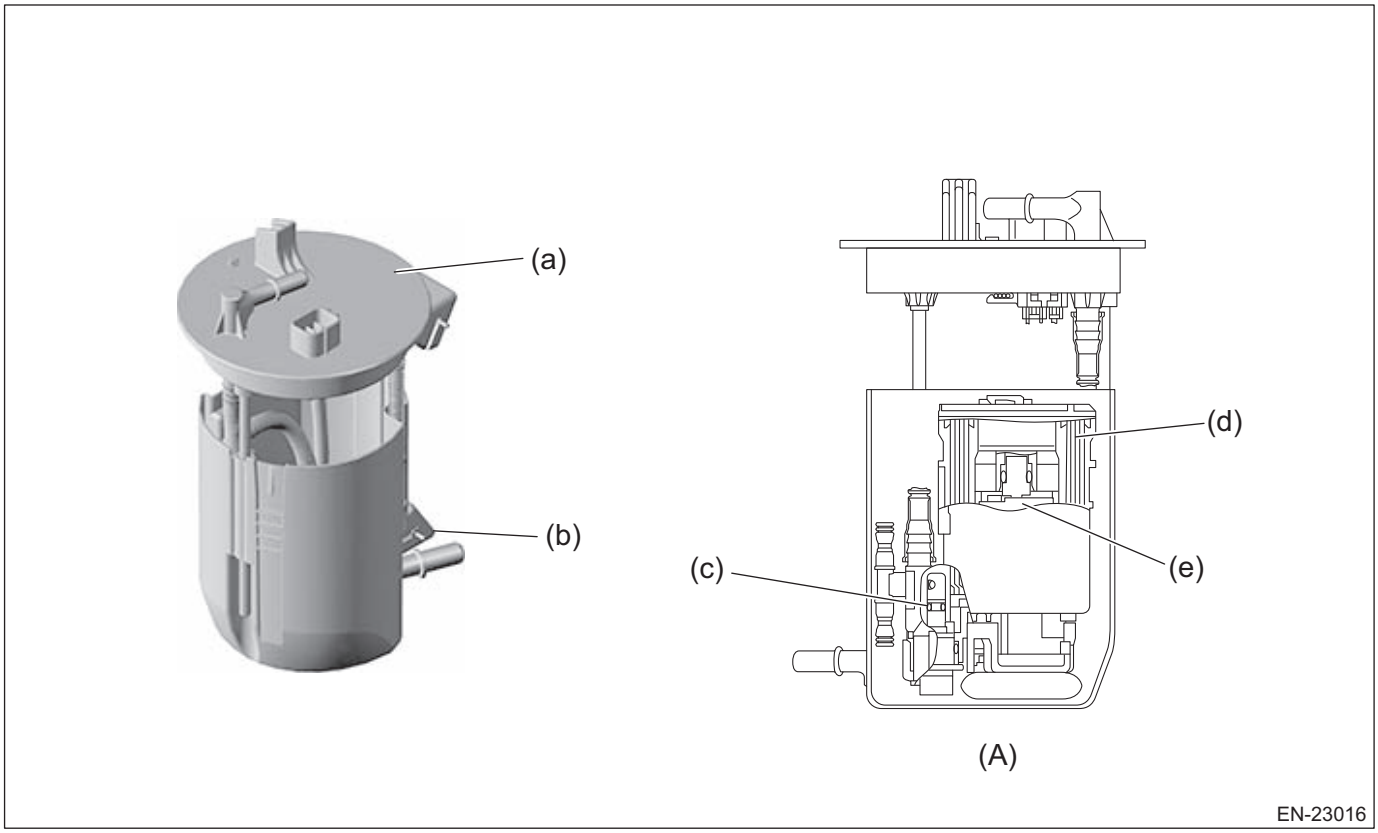
(b) Fuel draining marks

Fuel pump

Fuel pump integrating fuel pump, fuel filter, and fuel level sensor is adopted.

The fuel pump is the circumferential flow type in-tank fuel pump. This fuel pump force feeds the fuel to a high-pressure fuel.

A system is adopted that turns off the circuit opening relay in response to the signal transmitted from the airbag CM to prevent fuel leaks, in synchronization with the front collision and the side collision deployment at collision (when airbag is deployed).

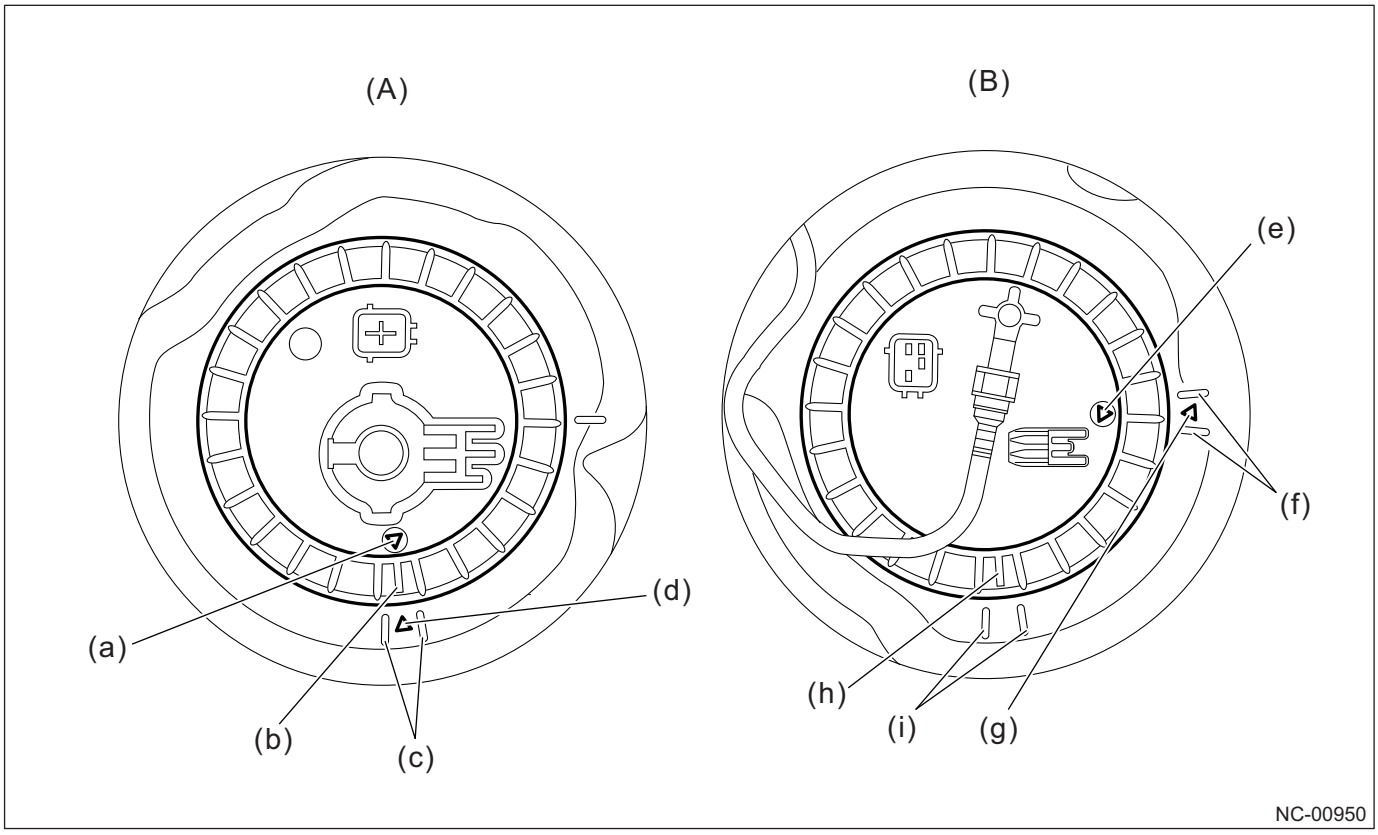


(A) Cross section

(a) Fuel pump assembly
(b) Fuel level sensor
(c) Pressure regulator
(d) Fuel filter
(e) Fuel pump

The fuel pump and the fuel sub level sensor are installed in the fastening angle types.

For more efficient work activity, a visual confirmation of working is possible by matching the position marks of the fuel pump and fuel sub level sensor with the attachment start position mark and the attachment position termination area marks of the fuel tank.



(A) Fuel sub level sensor

(a) Fuel sub level sensor position mark
(b) Ring nut position mark
(c) Attachment position area end marks (fuel tank side)
(d) Position mark (fuel tank side)
(e) Fuel pump position mark

(B) Fuel pump

(f) Fuel pump attachment position area end marks (fuel tank side)
(g) Fuel pump position mark (fuel tank side)
(h) Ring nut position mark
(i) Ring nut attachment position area end marks (fuel tank side)

High-pressure fuel pump

Drive torque is reduced by adopting a highly efficient single plunger and a roller lifter.

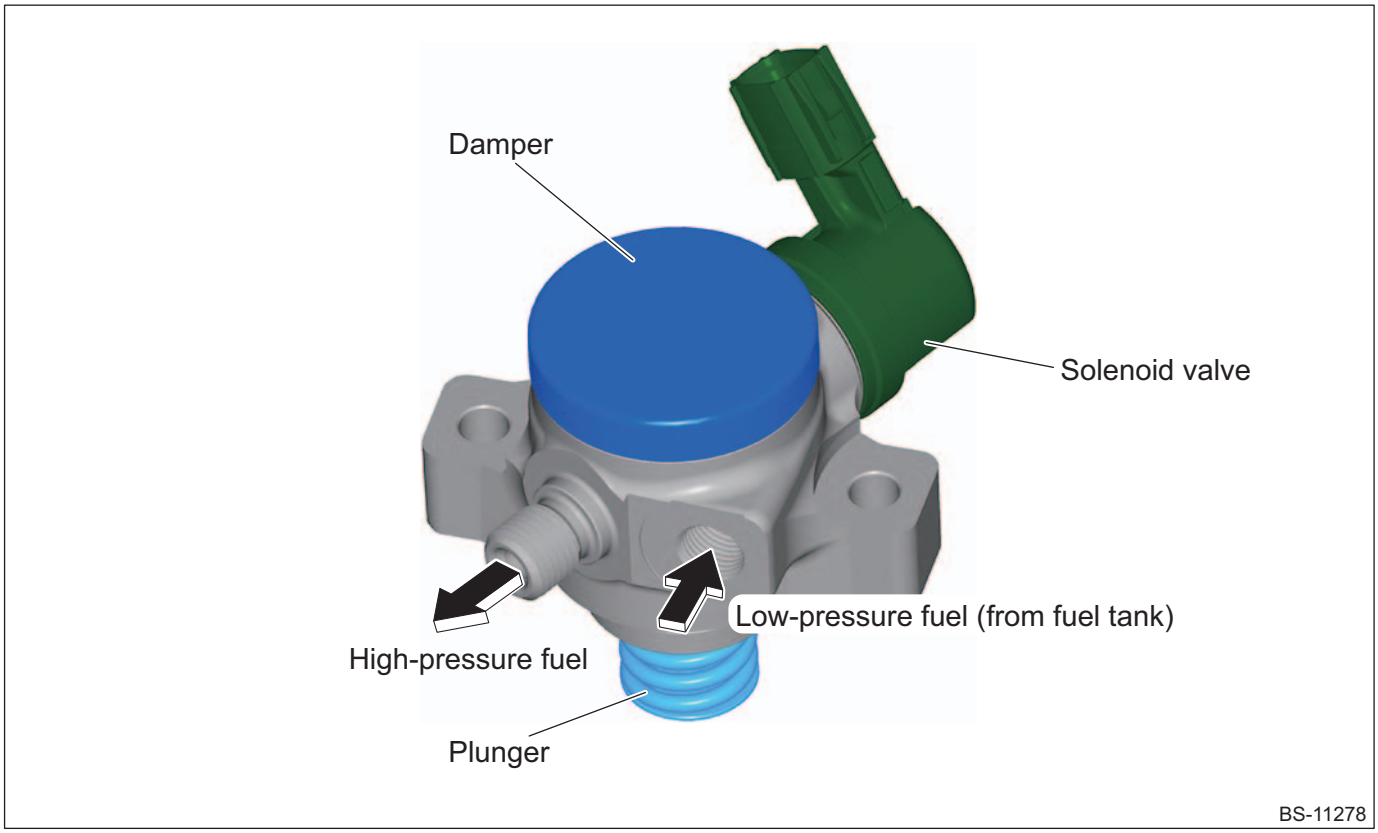
The fuel pump is composed of a solenoid valve to regulate the volume of high-pressure fuel discharged, a plunger driven by the intake camshaft LH to pressurize the fuel, a check valve to mechanically open and close passage to the high-pressure fuel delivery pipe, and a relief valve used when fuel pressure becomes abnormal. The solenoid valve, check valve, and relief valve are integrated to reduce weight and make the system more compact.

The fuel pump is installed on the cam carrier LH and is driven by the cam on the front end of the intake camshaft LH.

Fuel pulsation is reduced by installing a pulsation damper on the low-pressure fuel gate from the fuel tank.

Friction loss is reduced by varying high-pressure fuel pressure depending on driving conditions.

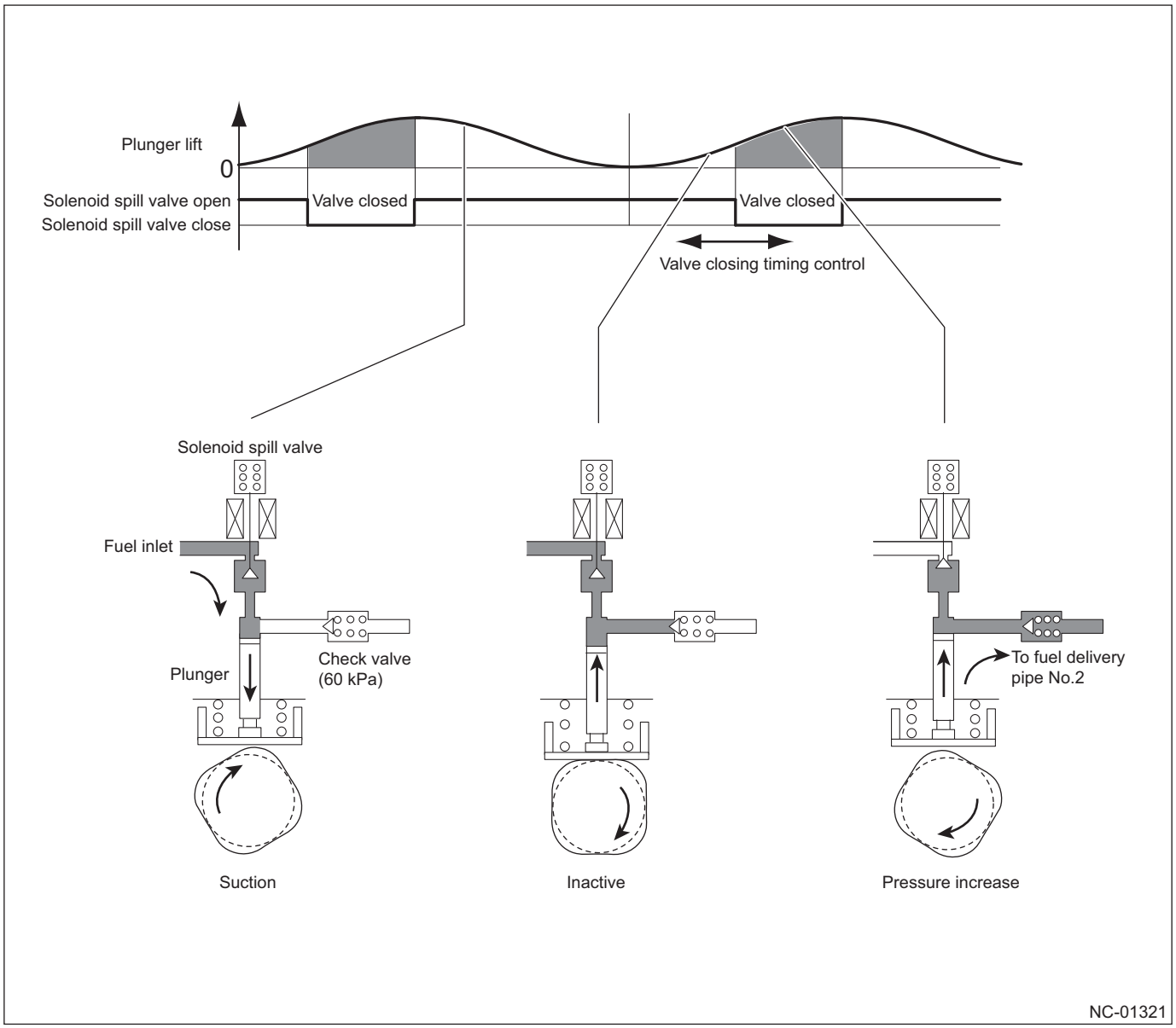
Tapered seal metal fasteners are adopted to fasten the high-pressure fuel pipe.



Operation of high-pressure fuel pump

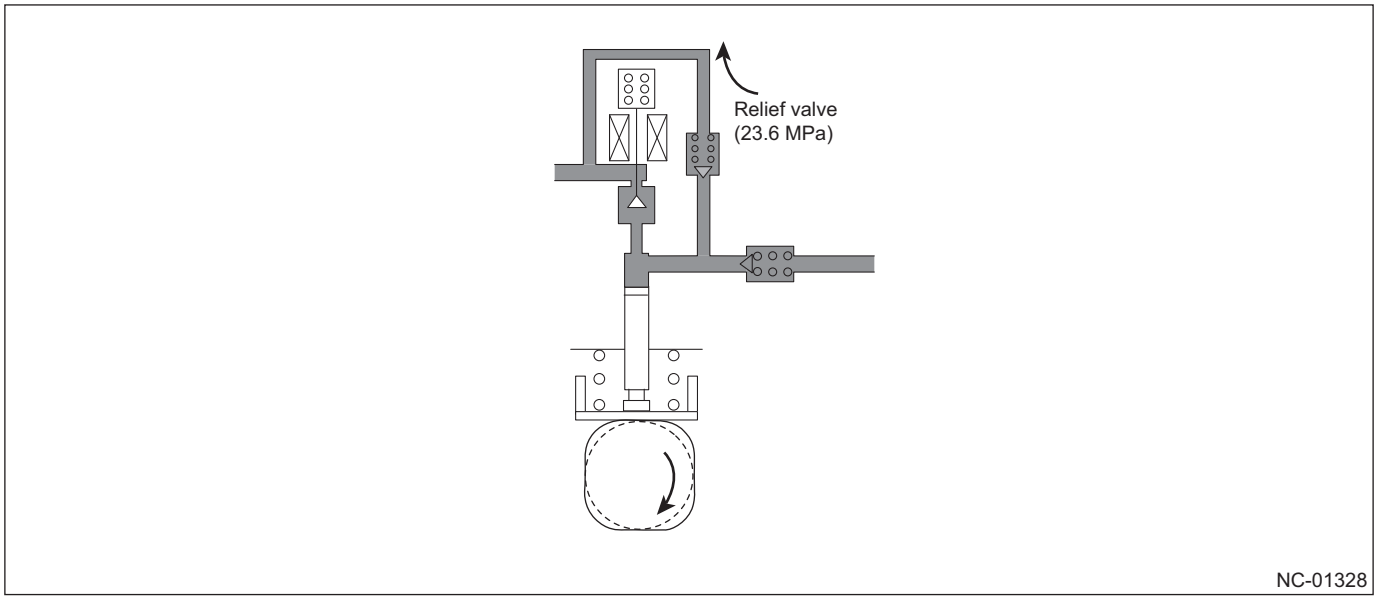
The fuel is pressurized when the pump plunger moves up and down. When the solenoid spill valve on the pump intake side is closed at the optimal timing during pressurized process, it is controlled that the fuel becomes the necessary fuel pressure and the amount of fuel. When the solenoid spill valve is closed at early timing, the valid stroke of the plunger becomes long, and then the fuel is more pressurized.

The fuel pressurized by the plunger is force fed to the high-pressure fuel delivery pipe, when the check valve is pushed and opened.



Relief valve

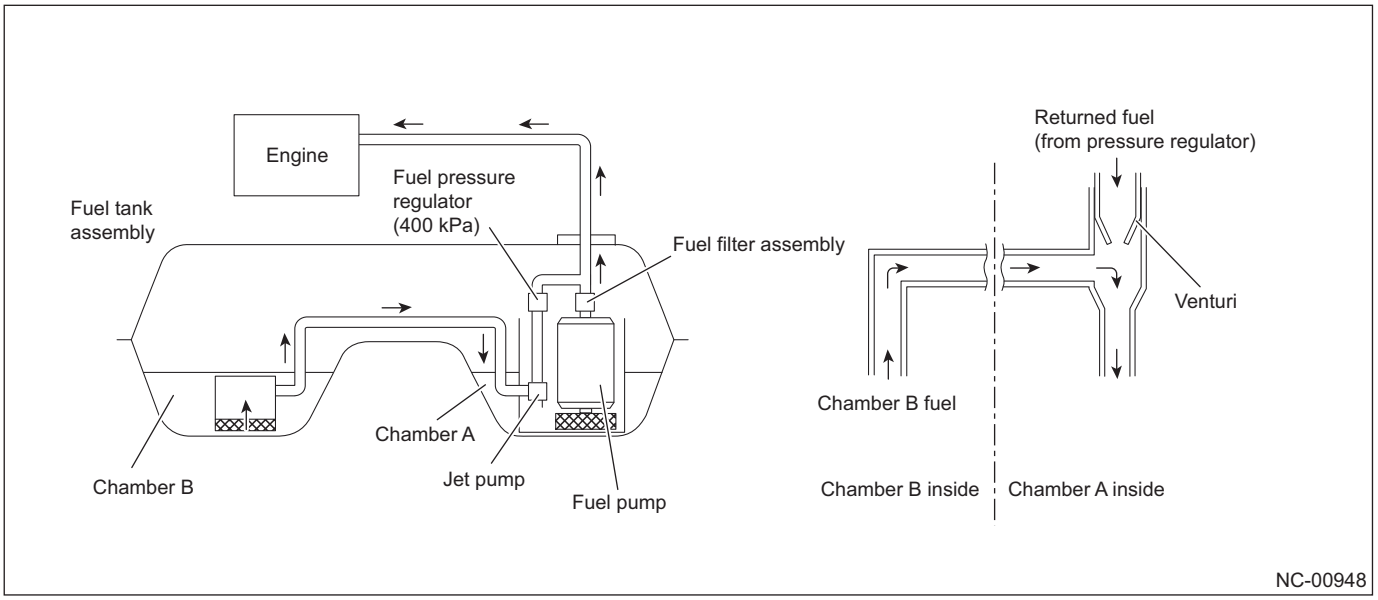
The fuel is returned to high-pressure fuel pump when the fuel pressure in the fuel delivery pipe rises to a specific value.



Jet pump

The straddle type tank is divided into two rooms (A and B) when a fuel decreases and the fuel in room B remains.

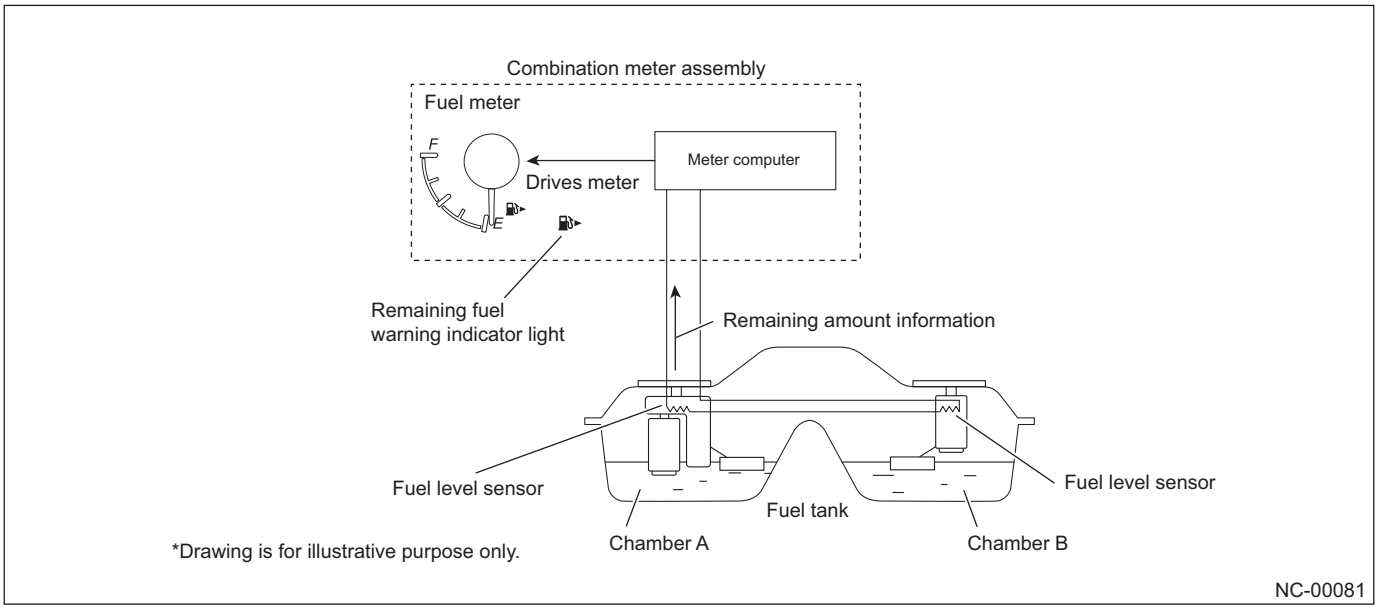
When the return fuel passes through the venturi of the jet pump, the remaining fuel is transported to room A by using the negative pressure.



Fuel level sensor

To correctly notify the driver of the remaining capacity of the straddle type tank, the fuel level sensor is serially set with room A and B, and the sensor notifies the meter computer of the remaining capacity in both rooms.

The ECM transmits the EFI control information to the meter computer via CAN communication. The meter computer calculates the remaining capacity of the gasoline based on the signals from the two fuel level sensors and ECM, and drives the fuel gauge.



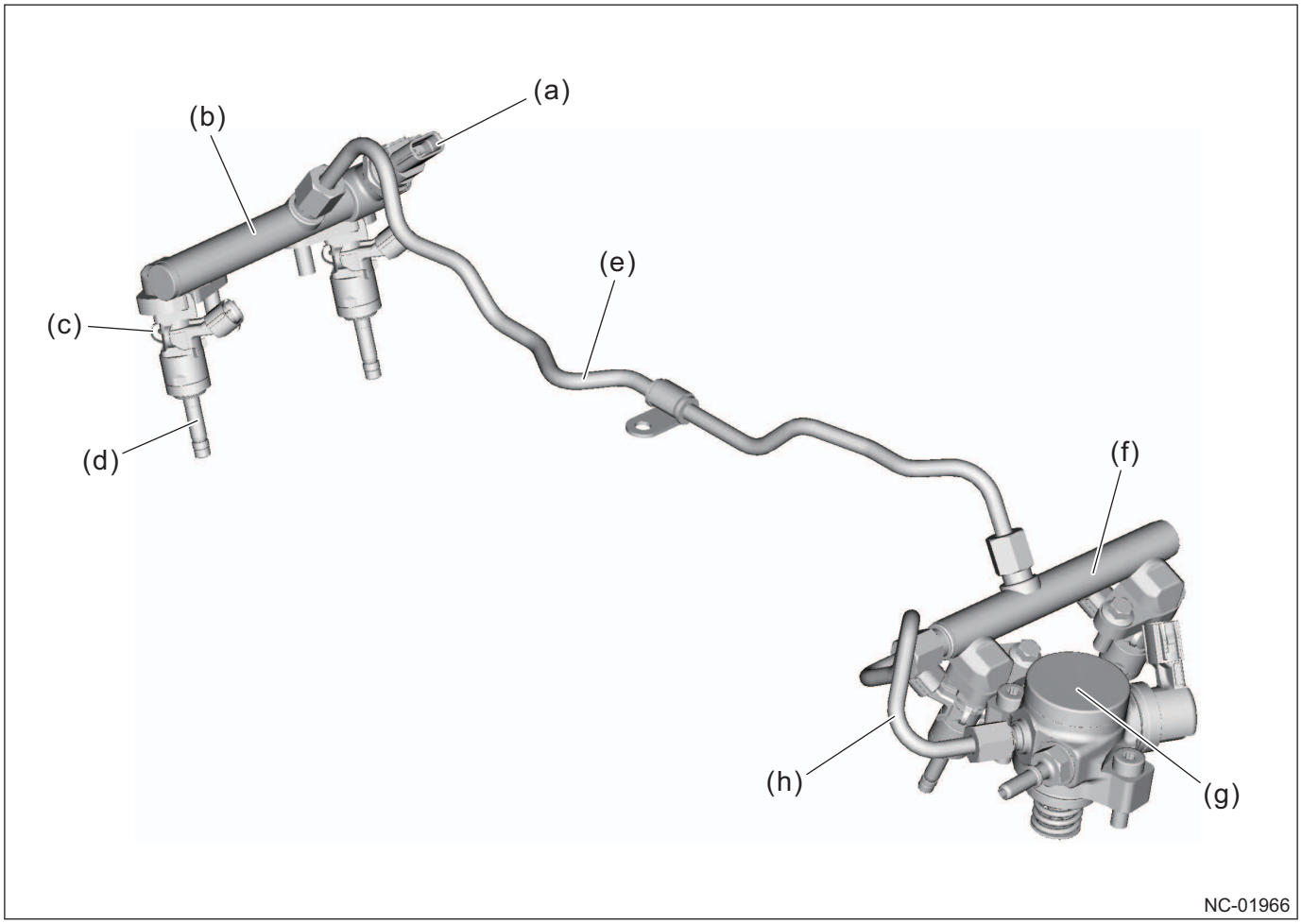
Fuel delivery pipe

The fuel contact position is changed from the left center of the engine to the rear right side of the engine to support Subaru Global Platform.

Fuel injector pipe RH is selected for fuel pressure sensor (for high pressure).

The fuel injector holder is introduced on the installing portion of the fuel injector assembly for cylinder injection. Structure whose fuel injector assembly is always pushed with spring force is adopted to prevent the fuel injector assembly from moving when combustion pressure is applied to the fuel injector assembly at engine start when fuel pressure is low. This increases air tightness and reduces vibration and noise.

The construction method for the fuel injector pipes RH and LH is changed to sheet metal assembly from forging production to reduce the weight.

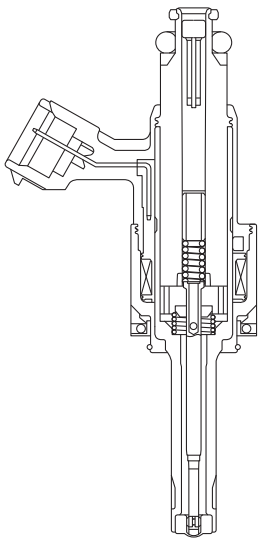


(a) Fuel pressure sensor
(b) Fuel injector pipe RH
(c) Fuel injector holder
(d) Fuel injector assembly
(e) High-pressure fuel delivery pipe assembly
(f) Fuel injector pipe LH
(g) High-pressure fuel pump
(h) High-pressure fuel delivery pipe

Injector

The multi hole injector is adopted for creating ideal combustion depending on each driving condition and the spray guide method is adopted for generating air-fuel mixture around the direct plug.

The high-performance spring and the improved sliding portion are adopted to enable high-precision fuel injection control. The spraying precision is improved by reviewing the injection hole processing method to prevent variations while spraying. Thus, the fuel efficiency and exhaust gas performance are improved.



NC-00056

2.3.3 Construction and Operation

Cylinder direct fuel injection system

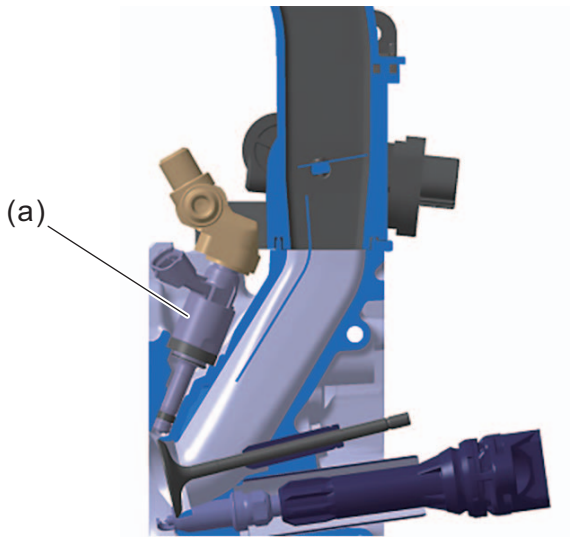
The system injects high-pressure gasoline directly into the cylinder from the injector and from intake stroke to compression stroke of the engine.

Output improvement

When the system injects fuel directly into the cylinder at high temperature, the cylinder is cooled by vaporization heat of the fuel and the cylinder temperature decreases, increasing torque in the whole speed range. This realizes both low fuel consumption and output improvement.

Exhaust gas reduction

The system facilitates fuel atomization and air mixture by using multistage injection during fast idle to reduce exhaust gas.



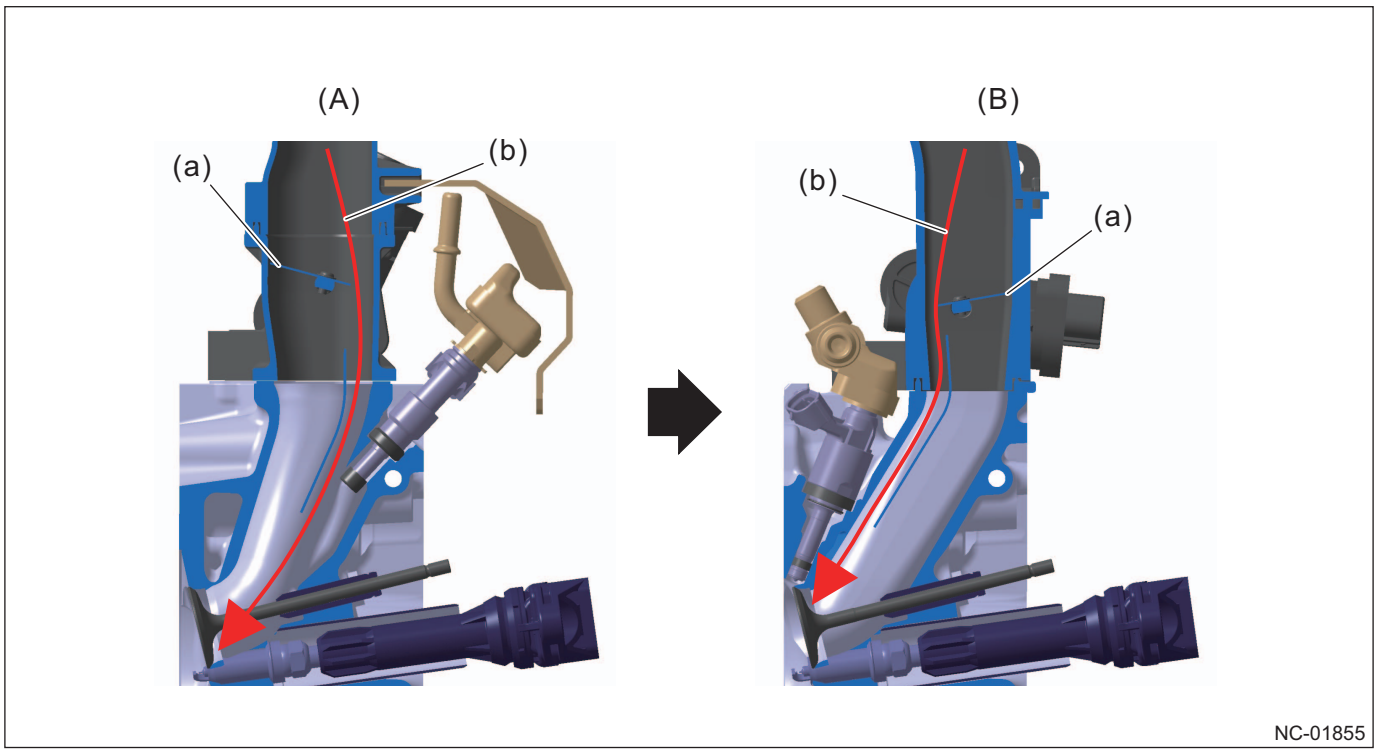
NC-00057

(a) Injector

TGV (Tumble Generator Valve)

The valve is installed in the intake manifold and generates the necessary tumble depending on the driving region at cooling start and idling. The valve is closed when tumble is required, closing one passage increases the flow rate of air to form tumble. This generates a vortex in the combustion chamber and improves fuel efficiency.

The intake passage position when the valve is closed is changed to the inside the engine, which improves the fuel efficiency. Tumble leakage amount is reduced, opening space is optimized, and specifically designed intake port and combustion chamber are combined to improve fuel efficiency and exhaust gas performance.



(A) Existing model vehicle

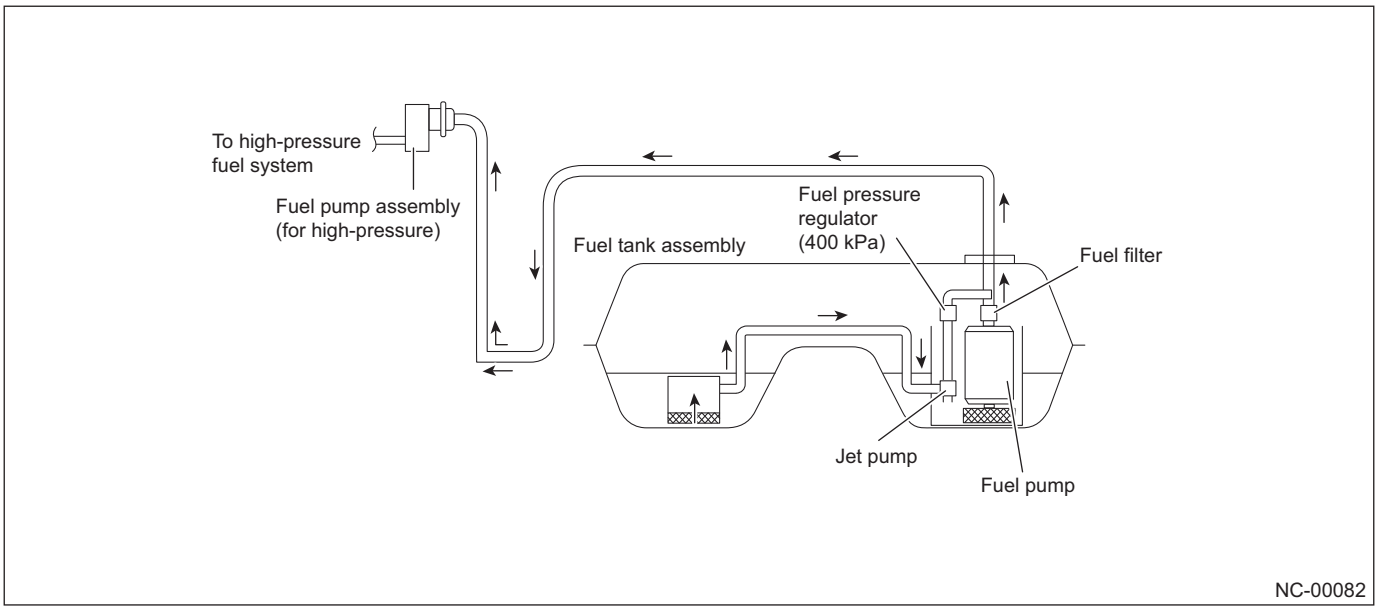
(B) New model vehicle

(a) TGV

(b) Intake passage when TGV closes

Fuel return system

Fuel return-less system is adopted to prevent fuel being heated while passing through the engine compartment from returning to the fuel tank. This reduces generation of evaporation gas in the fuel tank.



2.4 Emission Control System

2.4.1 Overview

The following systems are adopted for the emission control system.

- Crankcase emission control system
- Fuel evaporation gas emission inhibition system
- Exhaust gas recirculation system

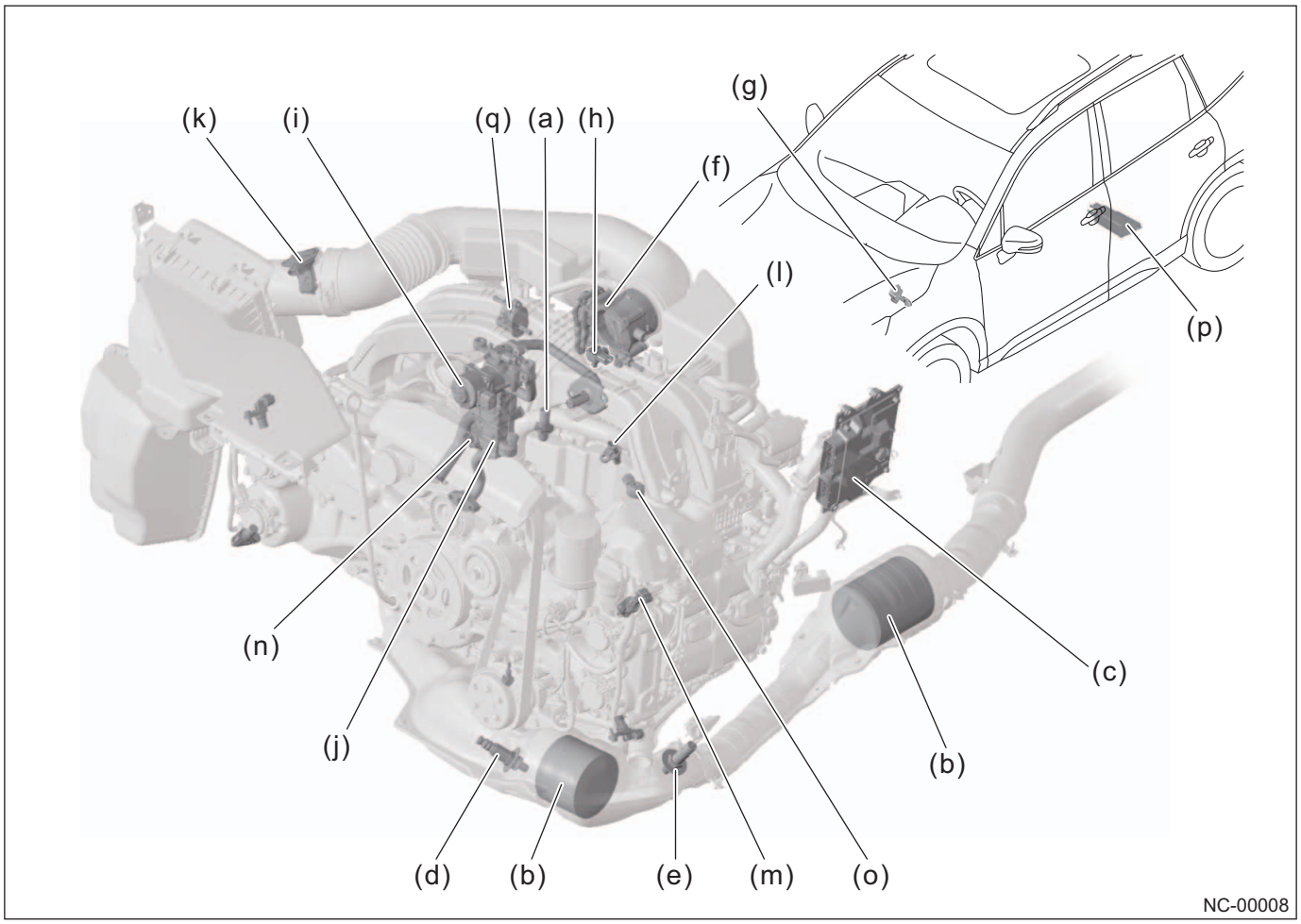
Function in each system

System			Main component	Function
Crankcase emission control system			PCV valve	Blowby gas is inhaled into the intake manifold from the crankcase, and the blowby gas and air-fuel mixture are combusted.
Exhaust emission control system	Catalyst	Front	Catalyst	NOx is deoxidized when HC and CO in the exhaust gas are oxidized.
		Rear		
	Air-fuel ratio control system		ECM	This receives input signals from various sensors, compares the signals with stored data, and transmits a signal to optimally control the air-fuel ratio.
			Front oxygen (A/F) sensor	This detects the concentration of oxygen in exhaust gas.
			Rear oxygen sensor	This detects the concentration of oxygen in exhaust gas.
			Throttle position sensor	This detects the throttle position.
			Accelerator pedal position sensor	This detects the accelerator pedal position.
			Intake manifold absolute pressure sensor	This detects the absolute pressure of the intake manifold.
			Air flow and intake air temperature sensor	This detects the amount of intake air and temperature.
	Ignition control system		ECM	This receives various signals, compares the signal with base data stored in the memory, and transmits the signal to optimally control ignition timing.
			Crankshaft position sensor	This detects engine speed (rotation number).
			Camshaft position sensor	This detects the reference signal for determining the cylinder in which combustion occurs.
			Engine coolant temperature sensor	This detects the coolant temperature.
			Knock sensor	This detects knocking of the engine.

Fuel evaporation gas emission inhibition system	Canister	This absorbs the fuel evaporation gas occurring in the fuel tank at engine stop and discharges the gas into the combustion chamber at engine start to completely combust the gas. This prevents HC discharge into the atmosphere.
	Purge control solenoid valve	This receives the signal from ECM and controls discharge of the fuel evaporation gas absorbed in the canister.
Exhaust gas recirculation system	EGR valve	This recirculates exhaust gas into the combustion chamber, and then the oxygen concentration of the intake air decreases, and the combustion temperature lowers. Thereby, this can reduce NOx.
	EGR cooler	

2.4.2 Component

Component layout drawing



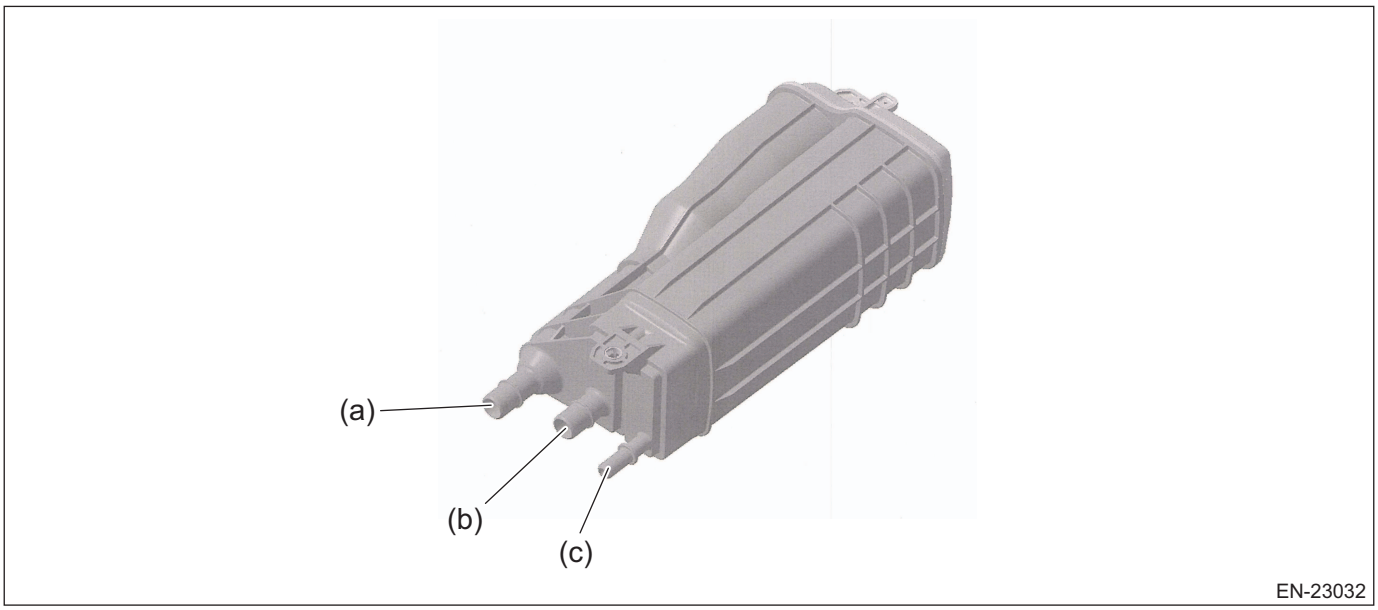
(a) PCV valve
(b) Catalyst
(c) ECM
(d) Front oxygen (A/F) sensor
(e) Rear oxygen sensor
(f) Throttle position sensor
(g) Accelerator pedal position sensor
(h) Manifold absolute pressure sensor
(i) EGR control valve
(j) EGR cooler
(k) Air flow and intake air temperature sensor
(l) Crankshaft position sensor
(m) Camshaft position sensor
(n) Engine coolant temperature sensor
(o) Knock sensor
(p) Canister
(q) Purge control solenoid valve

Component details

Canister

The canister purge control that transports the fuel evaporation gas from the fuel tank assembly to the intake port to combust the gas is adopted.

The canister is installed at the rear of the fuel tank assembly.

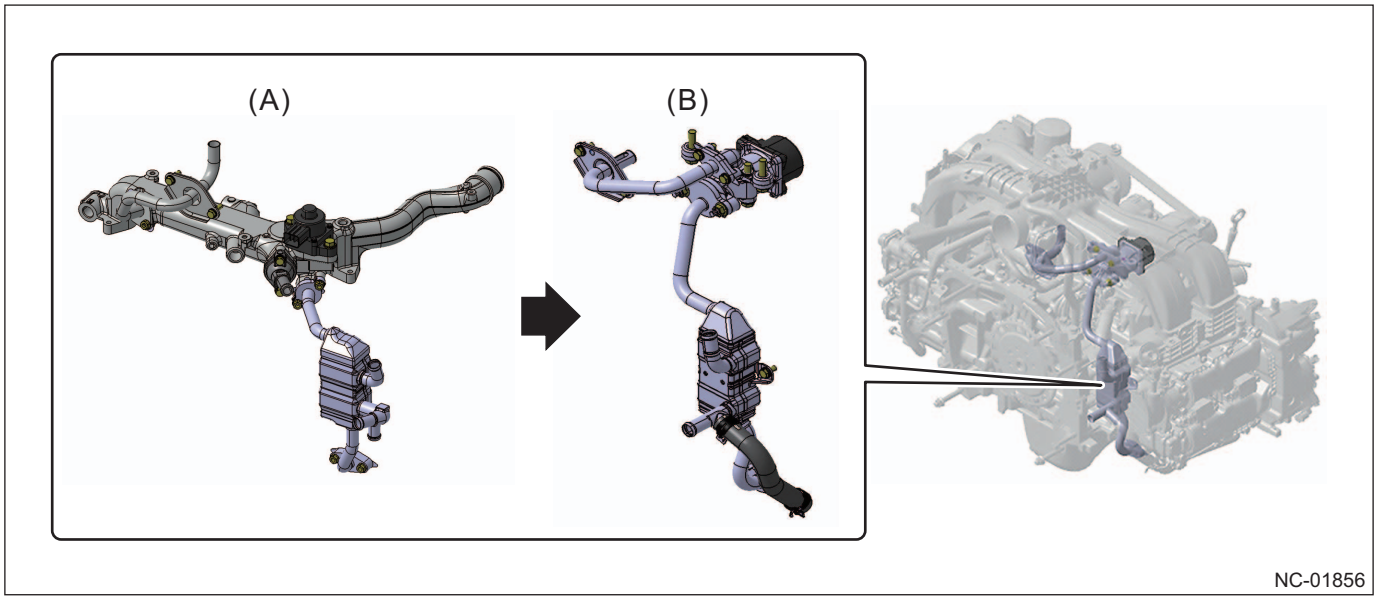


(a) To ELCM
(b) From fuel tank
(c) To purge control solenoid valve

EGR cooler

Fuel efficiency is improved by adopting a high efficiency core, shortening pipe length, and reducing pressure loss through increasing EGR gas volume.

The protruding edge of the pipe to intake manifold is optimized to distribute EGR gas more evenly to each cylinder and reduce combustion fluctuation, increasing EGR gas to improve fuel efficiency.

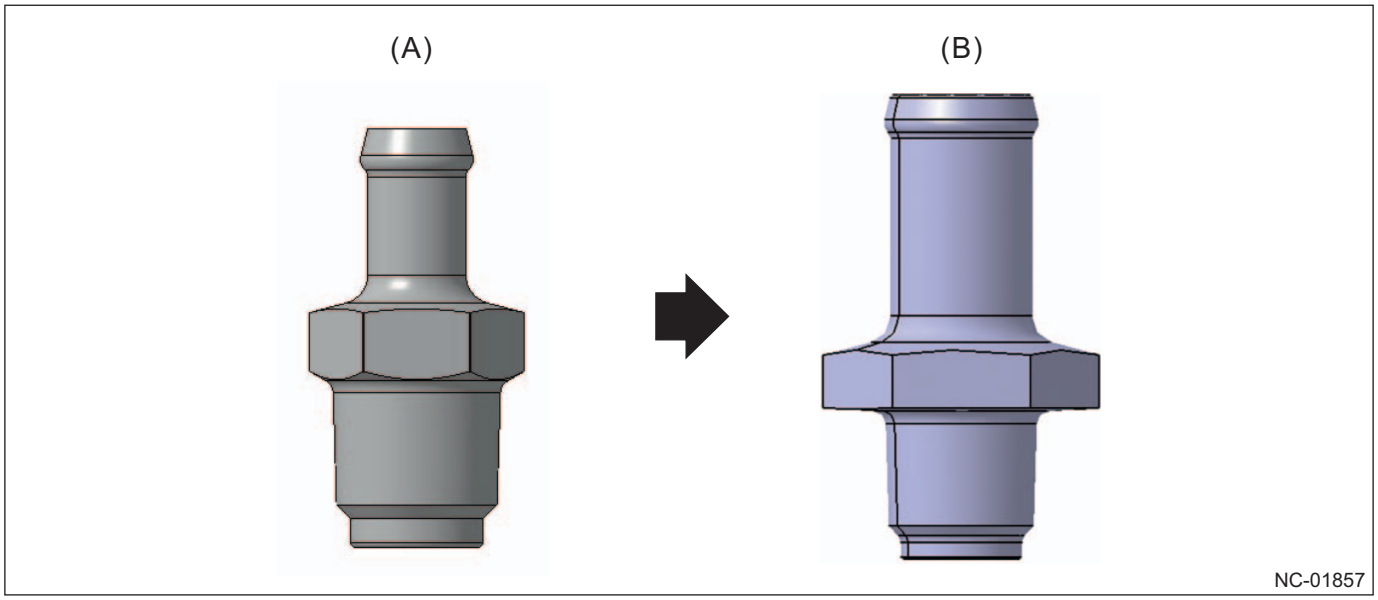


(A) Existing model vehicle

(B) New model vehicle

PCV valve

The nipple length is extended to prevent the hose from slipping out easily.



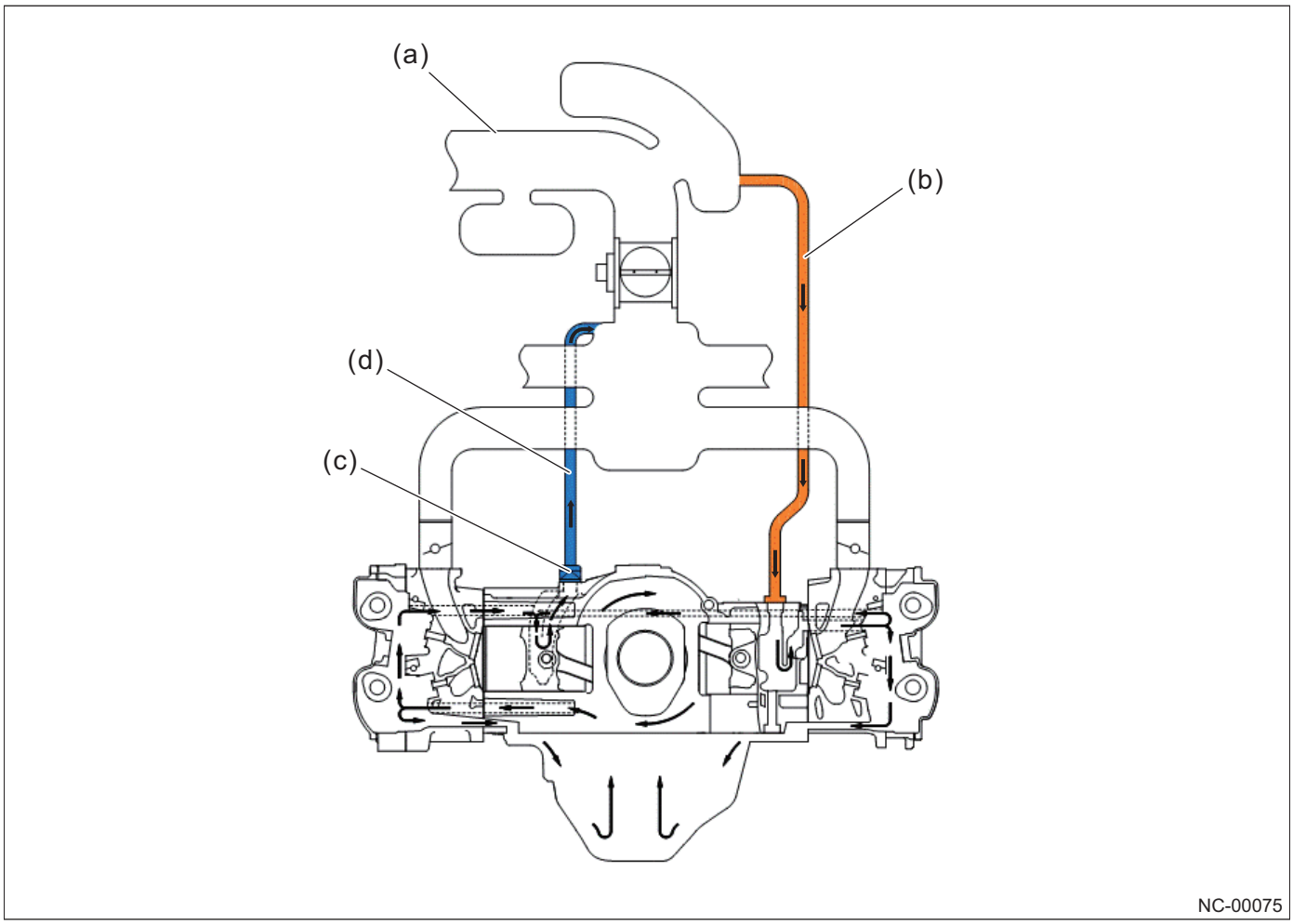
(A) Existing model vehicle

(B) New model vehicle

2.4.3 Construction and Operation

Crankcase emission control system

The PCV system prevents the air pollution caused by the blowby gas discharged from the crankcase.



(a) Air intake boot
(b) Fresh air introduction hose
(c) PCV valve
(d) PCV hose

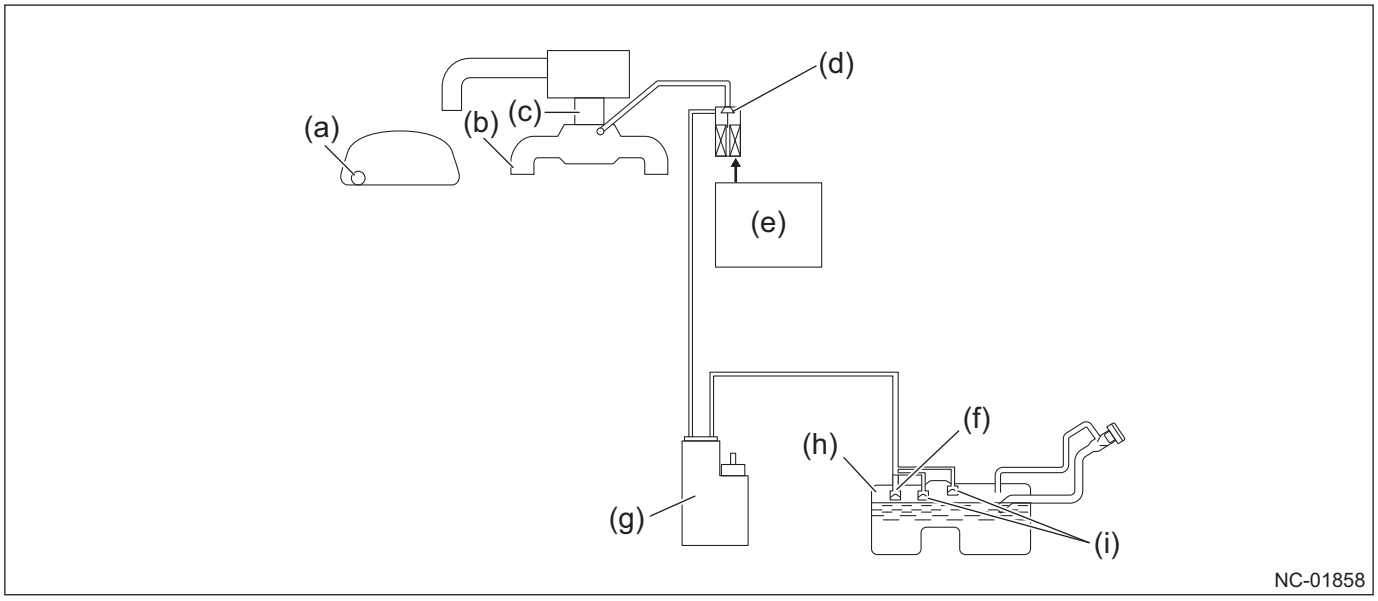
Fuel evaporation gas emission inhibition system

The fuel evaporation gas emission inhibition system prevents the fuel evaporation gas from discharging into the atmosphere. This system is composed of a canister, purge control solenoid valve, fuel cut valve, and pipes connecting those components.

The evaporation fuel in the fuel tank is led to the canister through the evaporation fuel line and is absorbed with active carbon in the canister. The fuel tank line includes the fuel cut valve.

The purge control solenoid valve is optimally controlled by the ECM according to the engine condition.

The fuel cut valve is included in the fuel tank. The float moves up and blocks the pipe as the oil level of the fuel in the fuel tank rises, stopping the fuel from flowing into the evaporation fuel line.

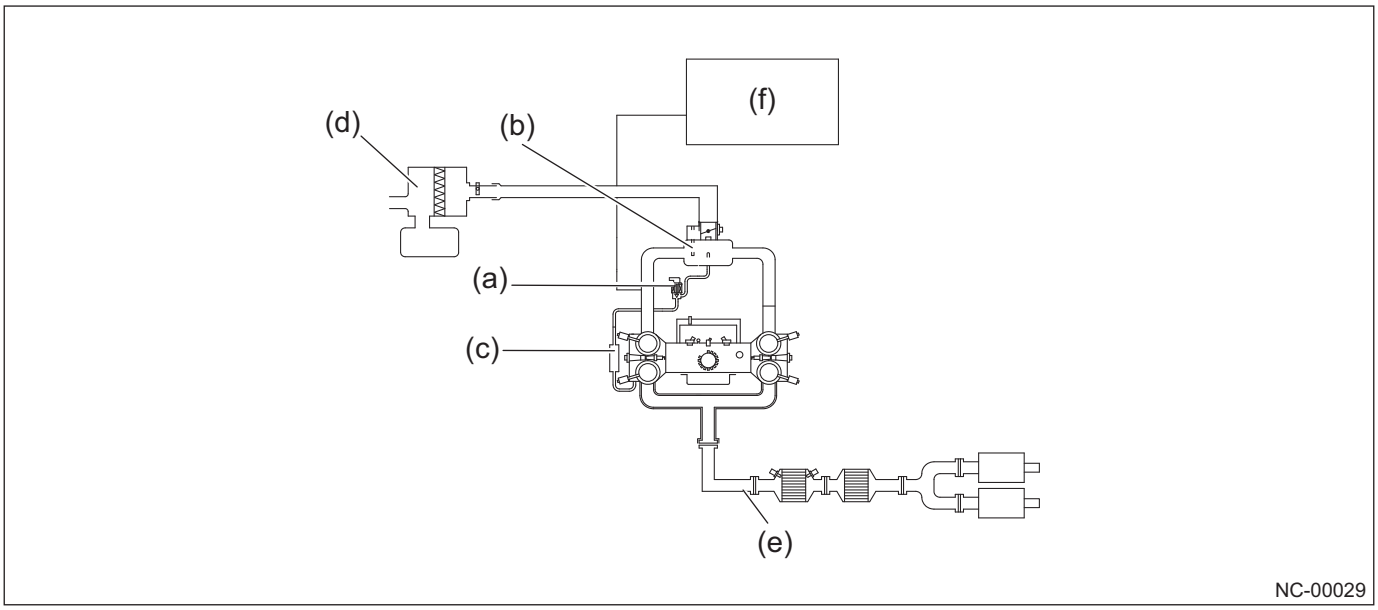


(a) Fuel gauge
(b) Intake manifold
(c) Throttle body
(d) Purge control solenoid valve
(e) ECM
(f) Vent valve
(g) Canister
(h) Fuel tank
(i) Fuel cut valve

Exhaust gas recirculation system

This system recirculates exhaust gas controlled optimally into the combustion chamber depending on engine status and decreases oxygen concentration of the intake air and the combustion temperature, reducing NOx.

The recirculated exhaust gas is controlled by the EGR valve. Exhaust gas is cooled by the high-efficiency EGR cooler to increase EGR amount, and NOx and fuel consumption are reduced.



(a) EGR valve
(b) Intake manifold
(c) EGR cooler
(d) Air cleaner
(e) Exhaust pipe
(f) ECM

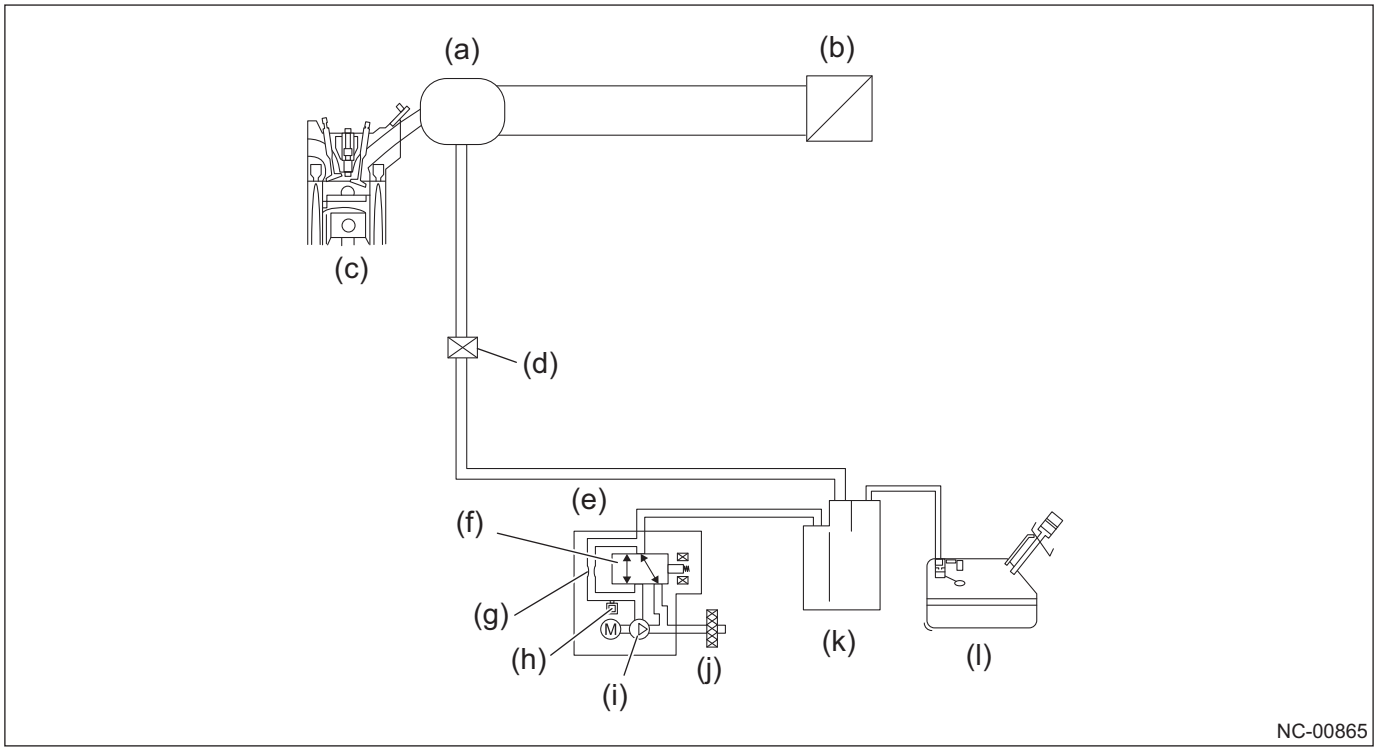
Evaporative leak check module system

The evaporative leak check module system is composed of a reference orifice (0.02 in (0.5 mm) diameter), vacuum pump (for introducing negative pressure into the evaporation line), switching valve (for switching negative pressure introduction passages), and pressure sensor.

In order to accurately conduct evaporation leak check diagnosis, operation and evaporation leak check diagnosis starts by a signal from the ECM when a fixed time has elapsed after the engine has been stopped and the evaporation pressure has stabilized.

The evaporative leak check module system conducts evaporation leak check diagnosis by introducing negative pressure into the evaporation line by an internal pump while the engine is stopped.

Evaporation leak check diagnosis frequency is increased and forced evaporation leak check diagnosis is enabled while the engine is stopped, enabling to reliably verify completion of the repair after evaporation system maintenance work is complete.

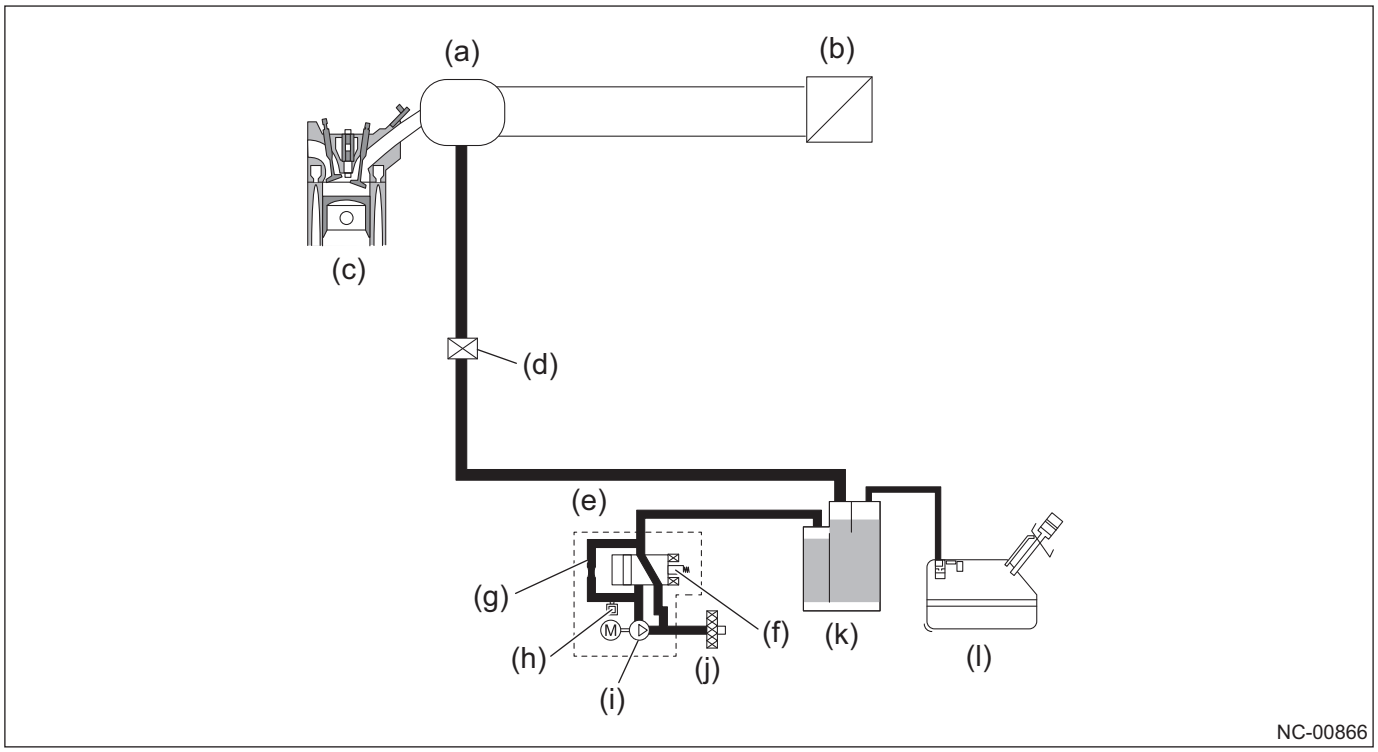


(a) Intake manifold
(b) Air cleaner
(c) Engine
(d) Purge control solenoid valve
(e) Evaporative Leak Check Module
(f) Switching valve
(g) Pressure sensor
(h) Reference orifice
(i) Vacuum pump
(j) Drain filter
(k) Canister
(l) Fuel tank

Operation during normal driving

Vacuum pump: not operating

Switching valve: not operating (atmosphere release)

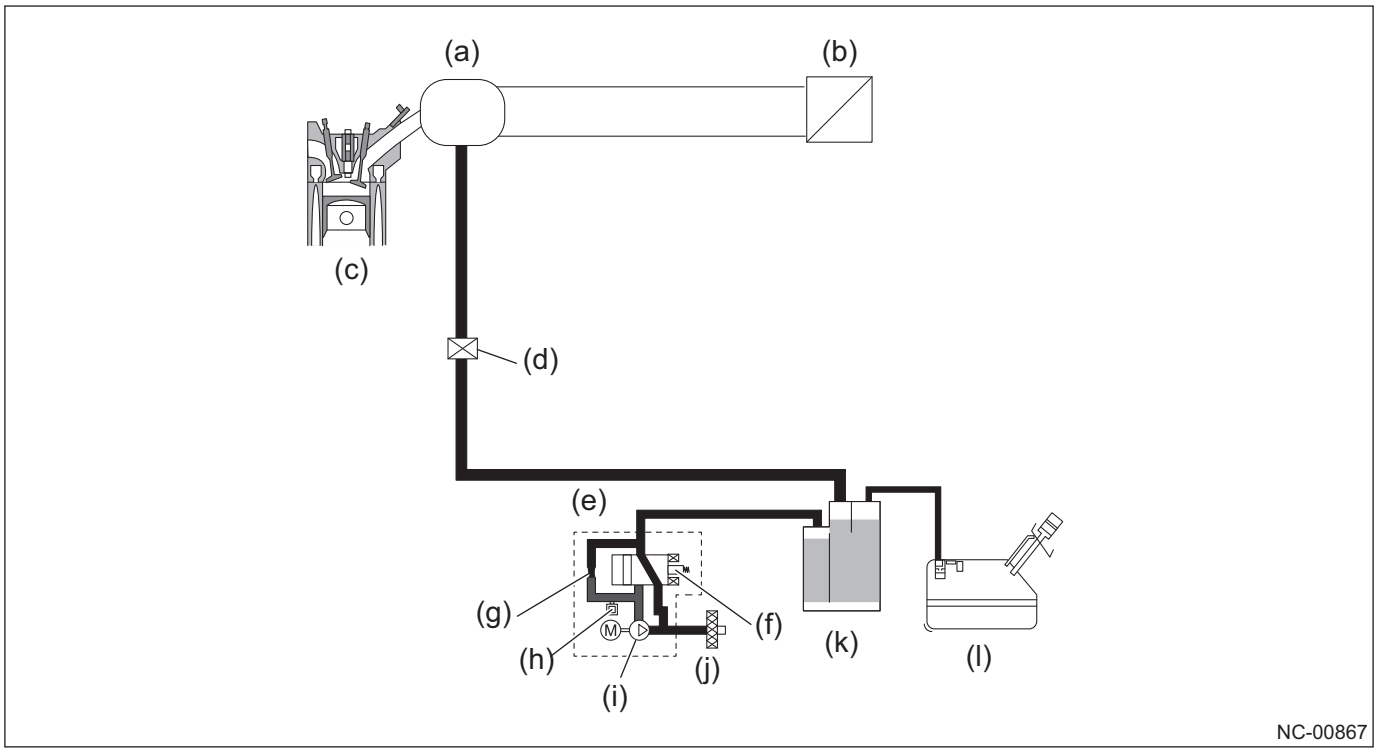


(a) Intake manifold
(b) Air cleaner
(c) Engine
(d) Purge control solenoid valve
(e) Evaporative Leak Check Module
(f) Switching valve
(g) Pressure sensor
(h) Reference orifice
(i) Vacuum pump
(j) Drain filter
(k) Canister
(l) Fuel tank

Operation during diagnosis (during reference orifice pressure detection)

Vacuum pump: operating

Switching valve: not operating (atmosphere release)

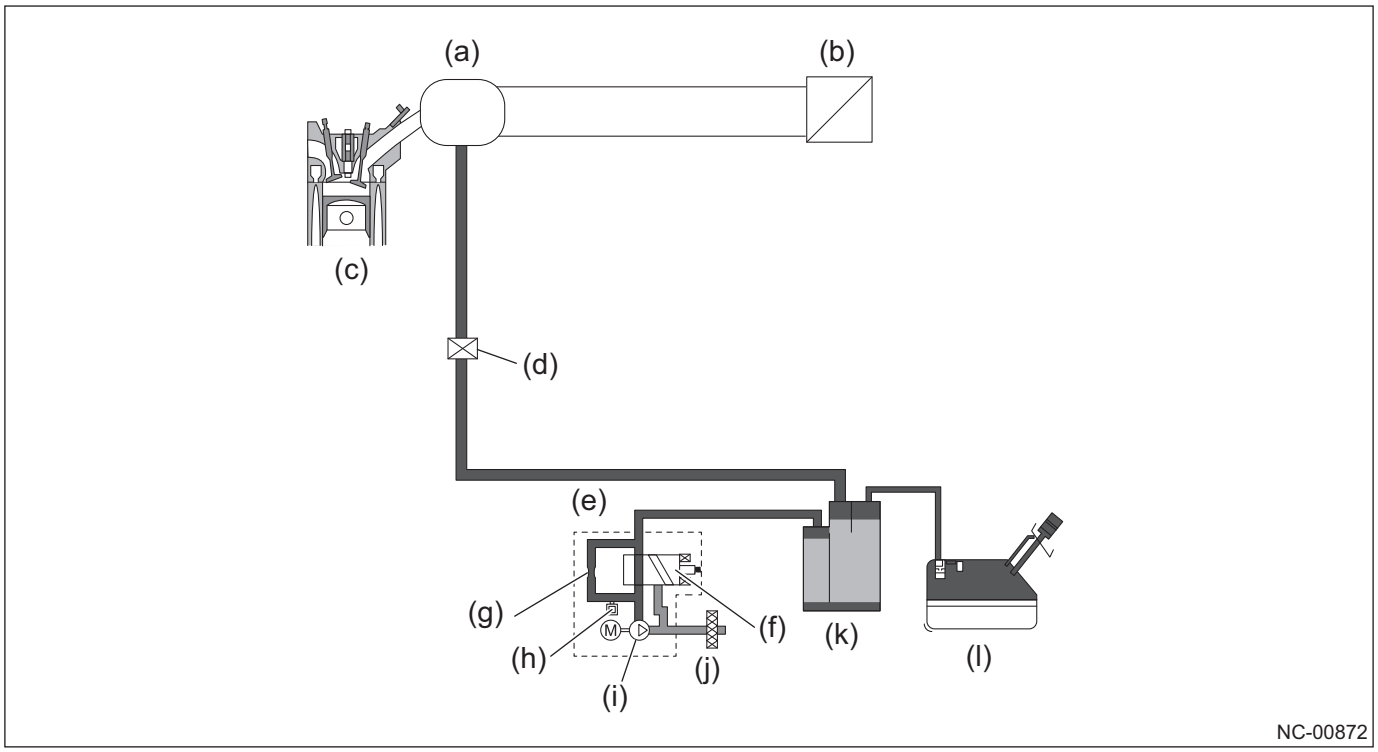


(a) Intake manifold
(b) Air cleaner
(c) Engine
(d) Purge control solenoid valve
(e) Evaporative Leak Check Module
(f) Switching valve
(g) Pressure sensor
(h) Reference orifice
(i) Vacuum pump
(j) Drain filter
(k) Canister
(l) Fuel tank

Operation during diagnosis (during negative pressure introduction)

Vacuum pump: operating

Switching valve: operating (closed)



(a) Intake manifold
(b) Air cleaner
(c) Engine
(d) Purge control solenoid valve
(e) Evaporative Leak Check Module
(f) Switching valve
(g) Pressure sensor
(h) Reference orifice
(i) Vacuum pump
(j) Drain filter
(k) Canister
(l) Fuel tank

2.5 Intake and Exhaust System

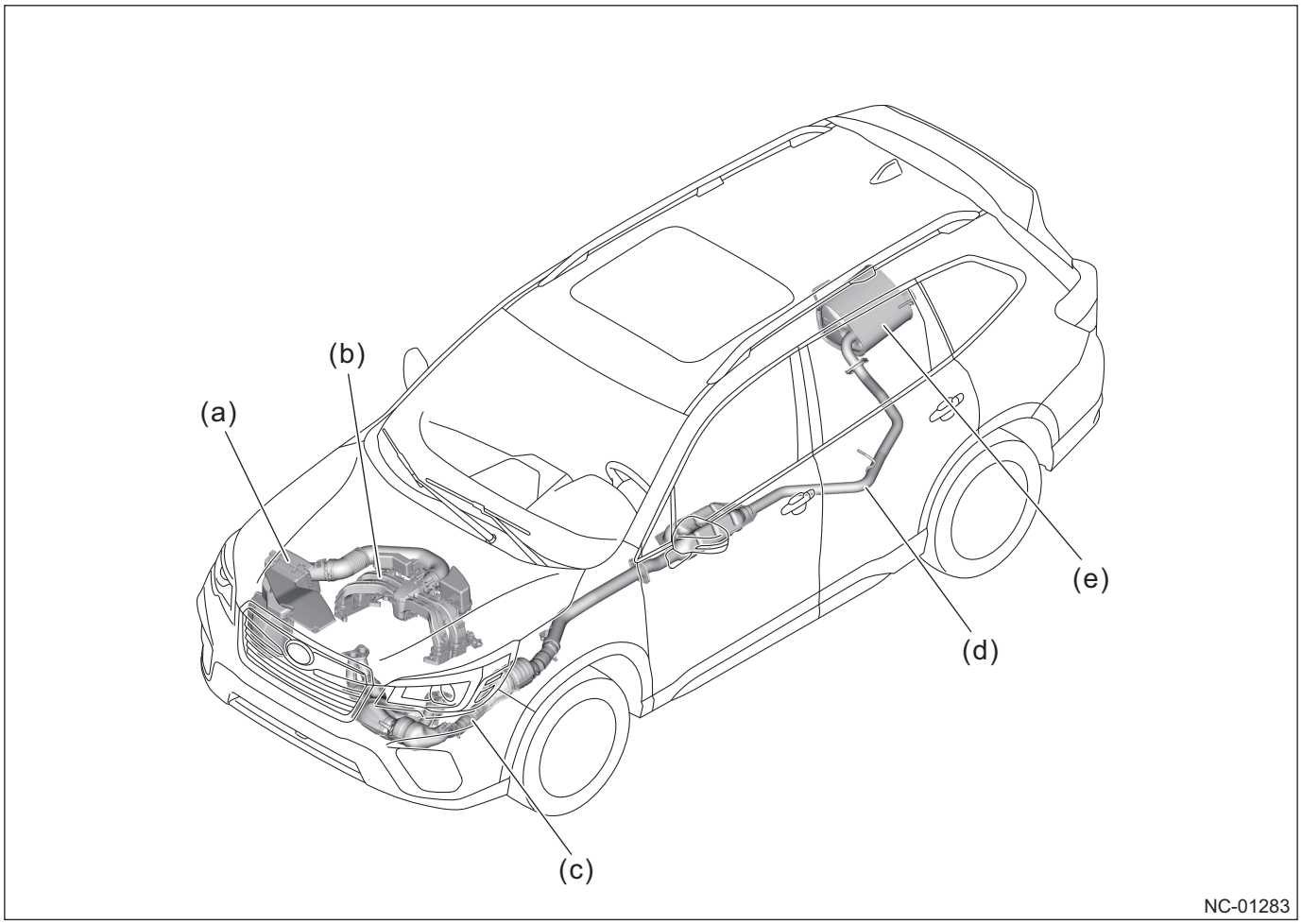
2.5.1 Overview

The following systems are adopted for intake and exhaust system.

- Dry filter paper type air cleaner element
- Electronic throttle system
- Stainless 4-2-1 exhaust manifold and exhaust pipe

2.5.2 Component

Component layout drawing



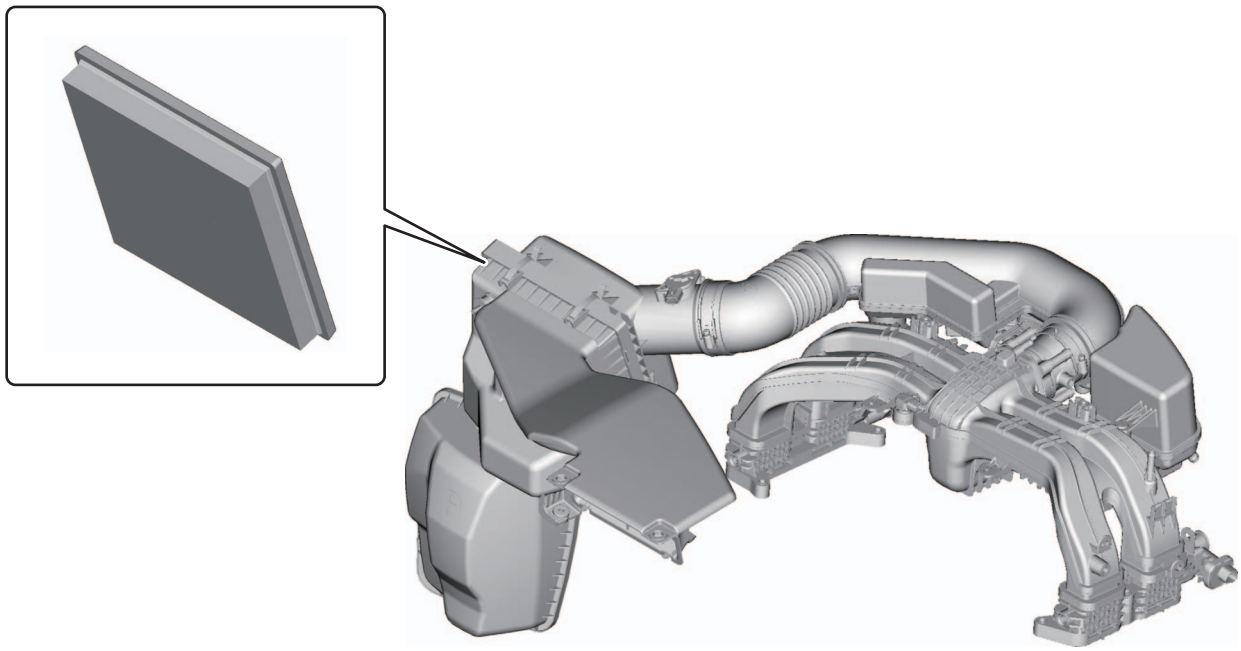
(a) Air cleaner
(b) Intake manifold
(c) Front exhaust pipe
(d) Rear exhaust pipe
(e) Muffler

Component details

Air cleaner element

The air cleaner case whose element can be removed is adopted to improve serviceability. Also, the intake air flow meter is installed in the air cleaner case.

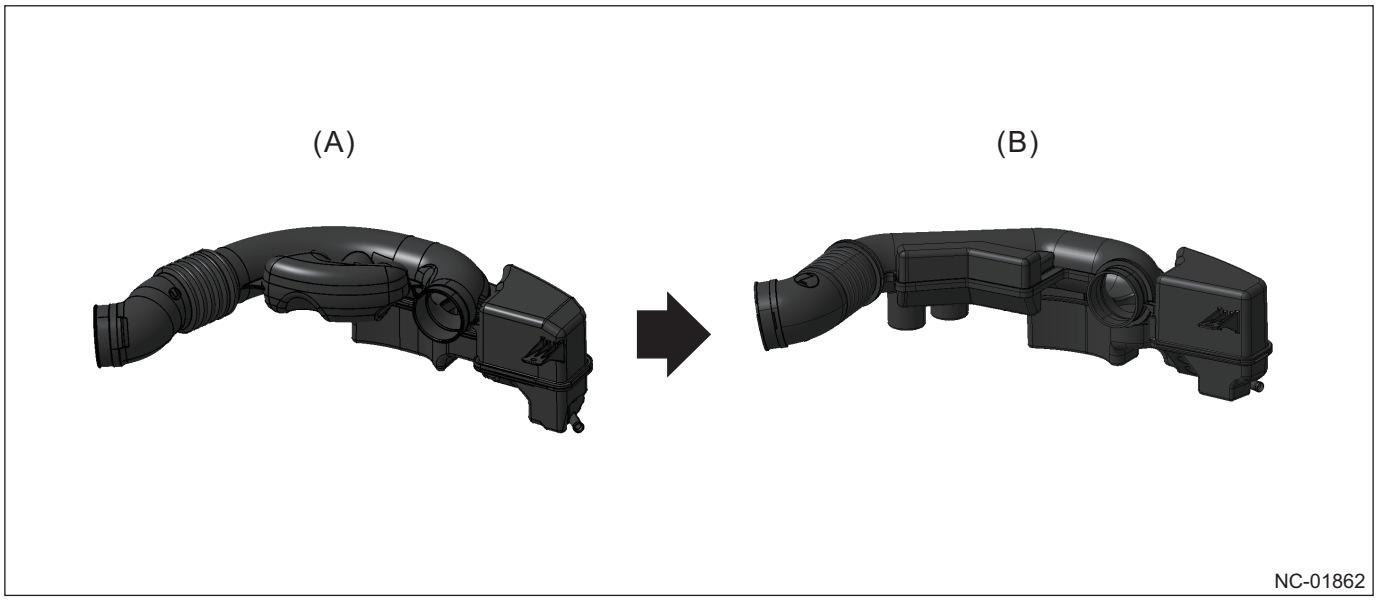
The filter is changed from the dry non-woven type to the dry filter paper type with low ventilation resistance, which realizes the reduction of the pressure loss by 20% or more while the same level of dust holding ability is kept.



NC-00011

Intake boot

The pressure loss is reduced by 20% to improve output. The capacity of the resonator is changed to reduce vibration and noise. The manufacturing method is changed (from blow to injection) and thinning process is applied to reduce the weight.

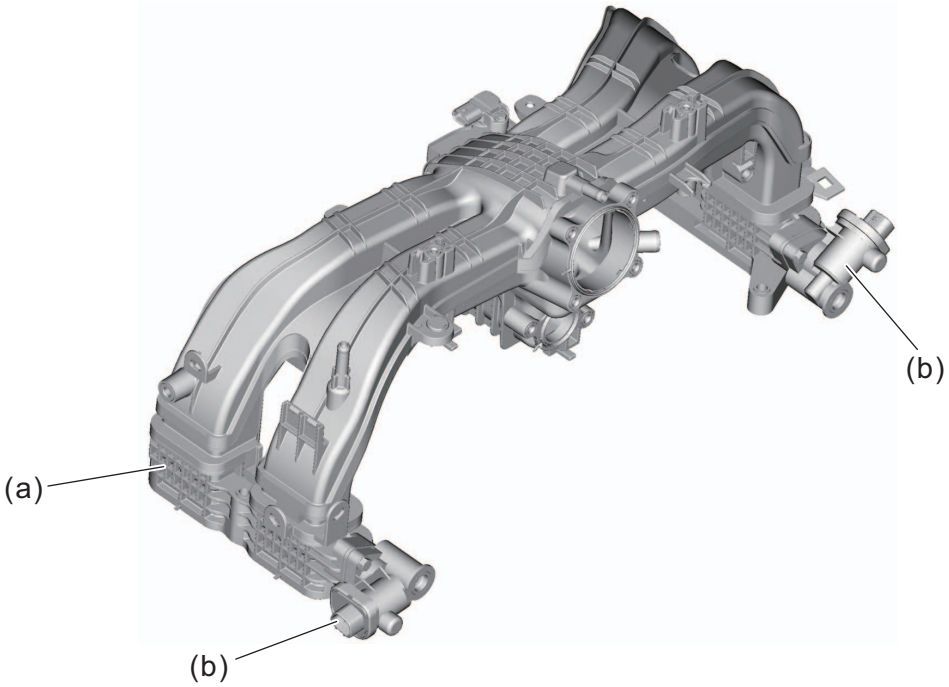


(A) Existing model vehicle

(B) New model vehicle

Intake manifold

The intake manifold is made of plastic. The TGV is also made of plastic and is integrated into the intake manifold to reduce weight.



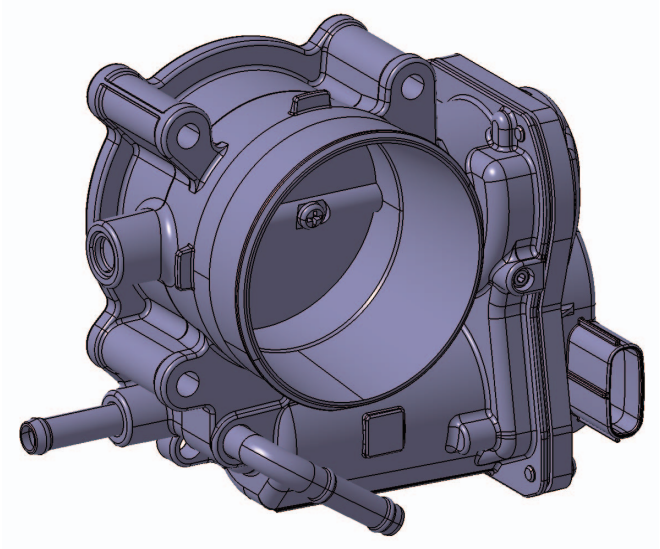
(a) Intake manifold

(b) TGV

Throttle body

DC motor with quick response and low power consumption is adopted for the motor for driving the throttle valve.

Each component of the throttle body made of aluminum is reviewed to reduce the weight.



NC-00062

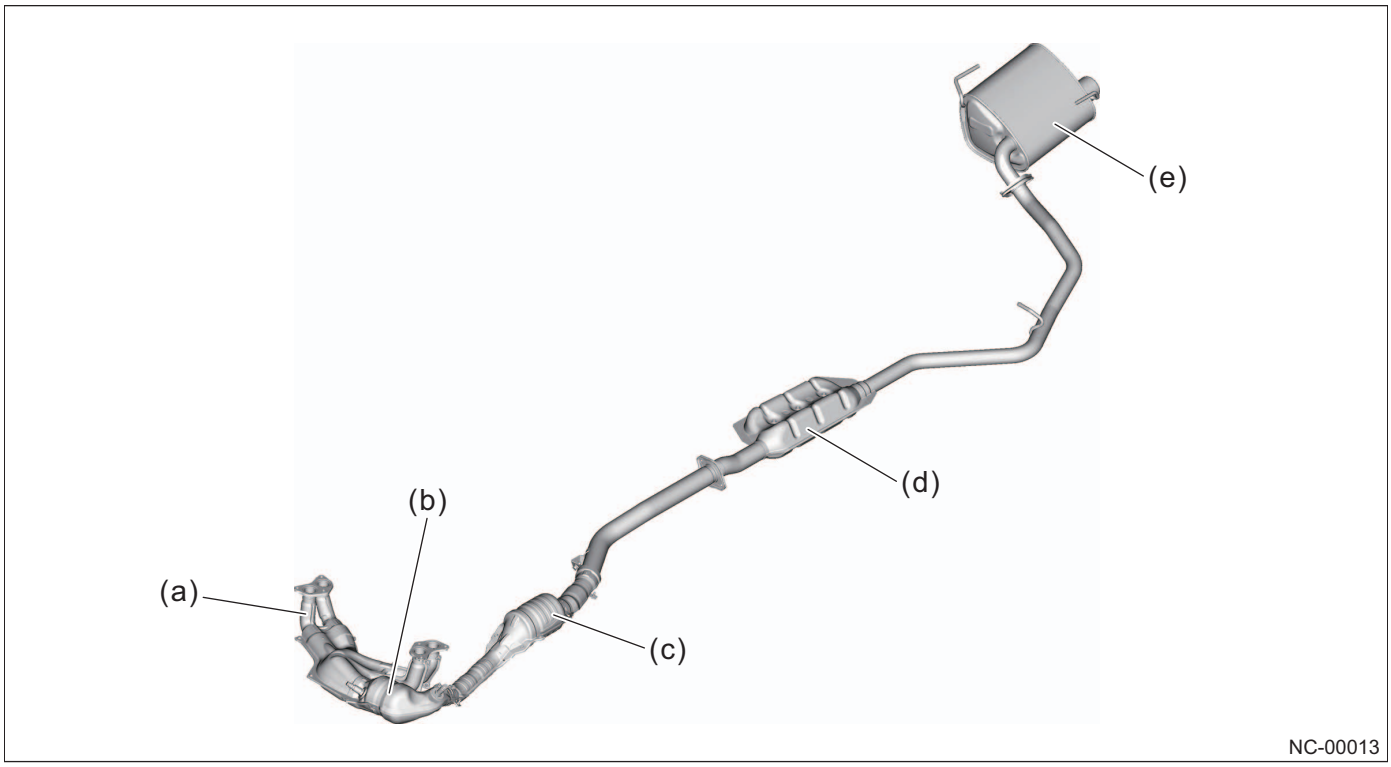
Exhaust pipe

Stainless front exhaust pipe is adopted to ensure weight reduction and corrosion resistance.

The handling direction of the exhaust pipe is changed to counterclockwise rotation in accordance with Subaru Global Platform. Use of 4-2-1 collector, reduction in pipe thickness, and optimization of heat insulating cover shape are implemented to improve comfortable feeling at startup, ensure the maximum output, improve the exhaust gas performance, and enable the weight reduction.

Ternary catalysts are arranged at the exhaust manifold-collecting part and at the side of the transmission to ensure sufficient emission performance. Emission immediately after engine start (at cold time) is lowered by the ternary catalyst mounted at the exhaust manifold-collecting part. In addition, a catalyst highly effective in reducing NOx is developed based on the fact that NOx increasing in high temperatures can be reduced by cooling fuel. This reduces the flow of fuel injected to cool the fuel, and improves the fuel efficiency.

The front oxygen (A/F) sensor is installed on the upstream side of the ternary catalyst of the exhaust manifold and the rear oxygen sensor is installed on the downstream side of the ternary catalyst of the exhaust manifold to enable precise air-fuel ratio control.



(a) Front exhaust pipe
(b) Front catalyst (ternary catalyst)
(c) Rear catalyst (ternary catalyst)
(d) Rear exhaust pipe
(e) Muffler

2.5.3 Construction and Operation

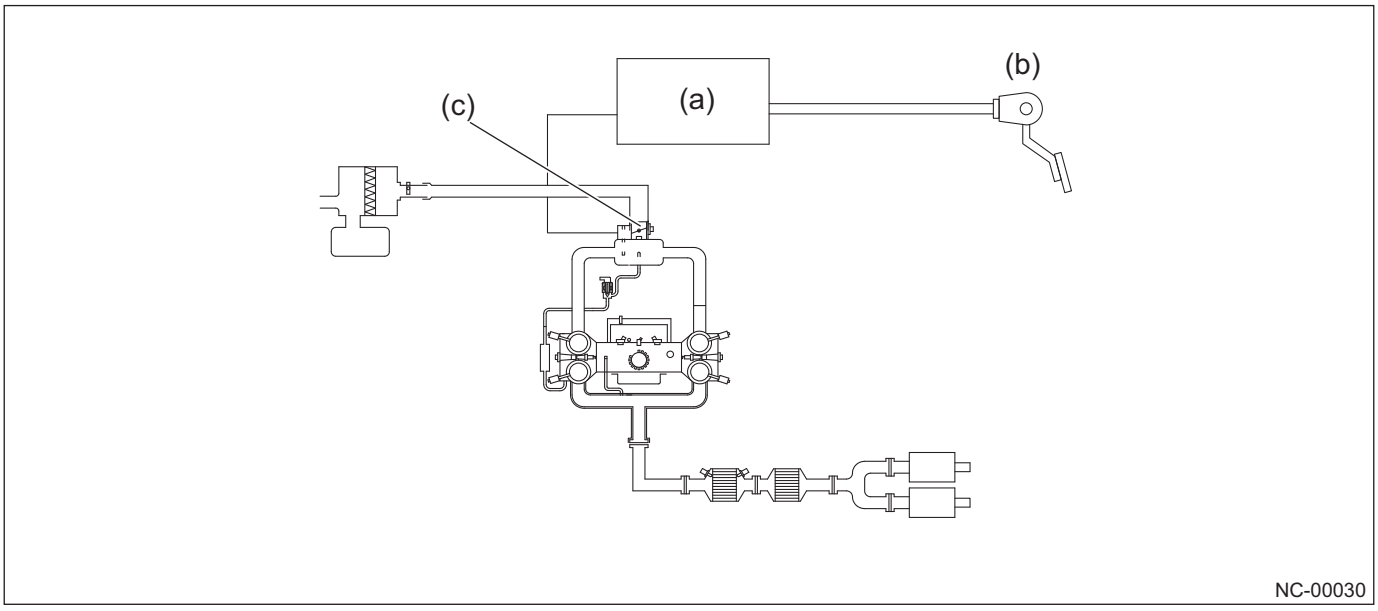
Electronic throttle system

The electronic throttle system detects how much the accelerator pedal is depressed by the accelerator position sensor and the throttle motor precisely drives the throttle valve through ECM.

The operation of the driver (amount of the accelerator pedal depressing) is transmitted to ECM through the accelerator pedal position sensor placed on the accelerator pedal. ECM determines the throttle opening angle depending on the driving conditions and drives the throttle motor. The throttle valve opening angle is fed back to ECM by the throttle position sensor.

Accelerator pedal position sensor and throttle position sensor have dual system installed internally and continuously monitor system errors.

When an anomaly is detected in the system, the system notifies the driver of the anomaly with the warning light in the meter and then stops the motor.



(a) ECM
(b) Accelerator pedal position sensor
(c) Throttle motor

2.6 Cooling System

2.6.1 Overview

Unlike existing model vehicles, the engine cooling system is composed of a large down flow radiator, electric motor drive fan, water pump, and engine coolant temperature sensor.

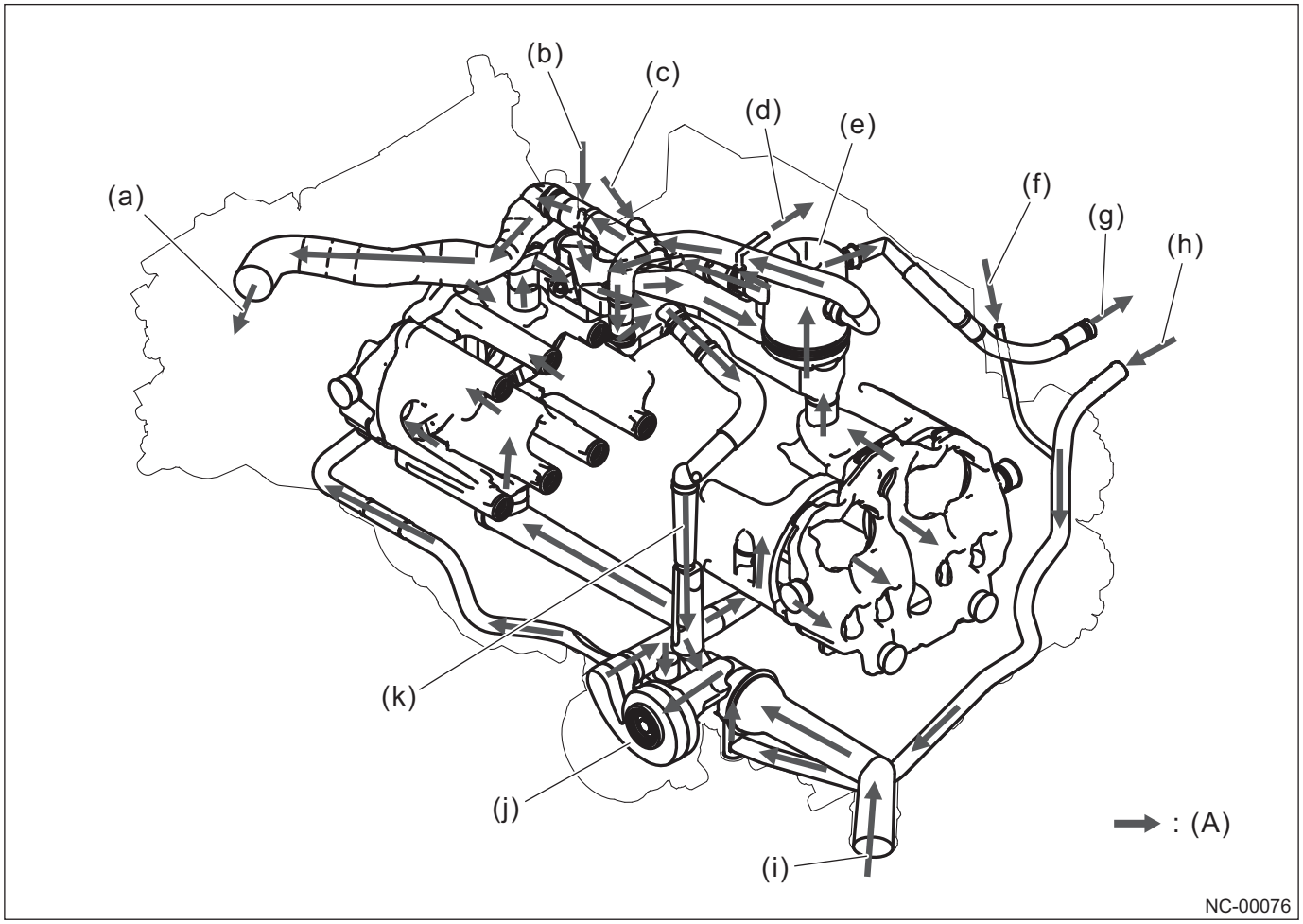
In addition, thermo-control valve system assembly is adopted for the first time by SUBARU. Positioning the thermo-control valve in the circuit-collecting part enables the intentional water temperature control (heat management control).

The reservoir tank is made of a transparent plastic and the coolant amount can be easily checked. Also, coolant can be refilled through the reservoir tank.

The CVT fluid warmer is adopted and heating and cooling are controlled by the CVT fluid warmer.

2.6.2 Component

Component layout drawing

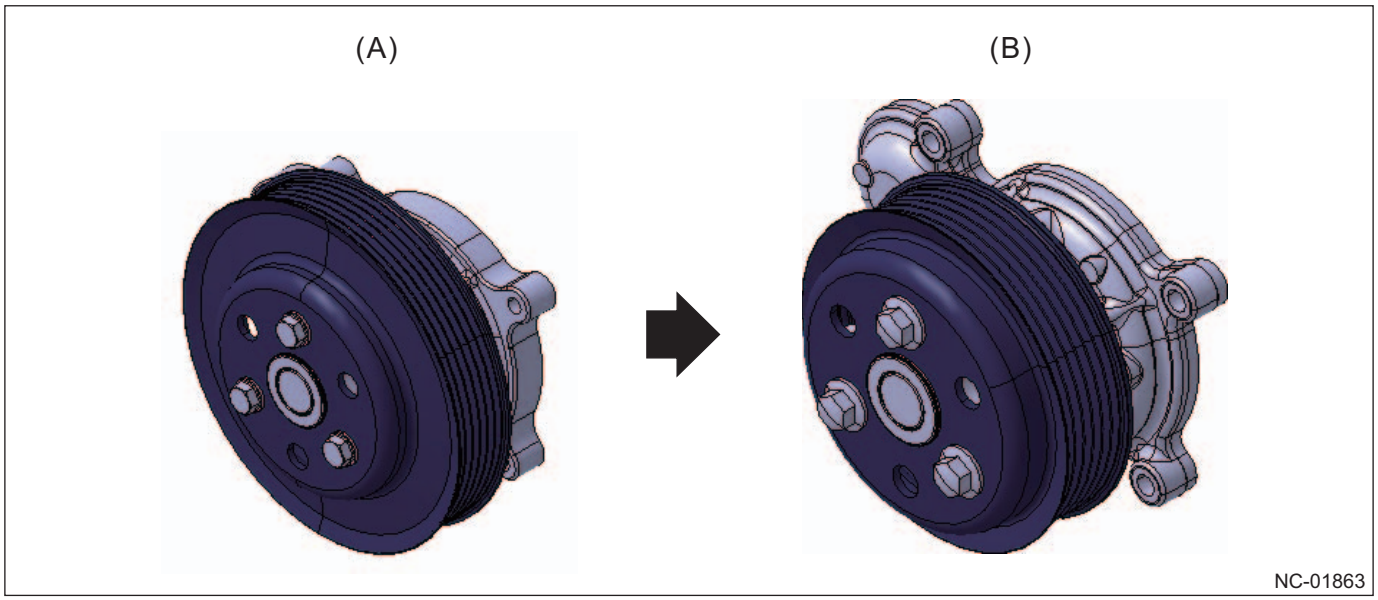


(a) To radiator
(b) From CVTF cooler
(c) From EGR cooler
(d) To electronic throttle
(e) Thermo-control valve assembly
(f) From electronic throttle
(g) To heater core
(h) From heater core
(i) From radiator
(j) Water pump
(k) Bottom bypass passage

Component details

Water pump pulley

The routing direction of the exhaust pipe is changed to counterclockwise rotation in accordance with Subaru Global Platform. Accordingly, the diameter of the water pump pulley is changed (from 5.12 in (130 mm) to 3.94 in (100 mm)). Also, the housing is thinned to reduce the weight.

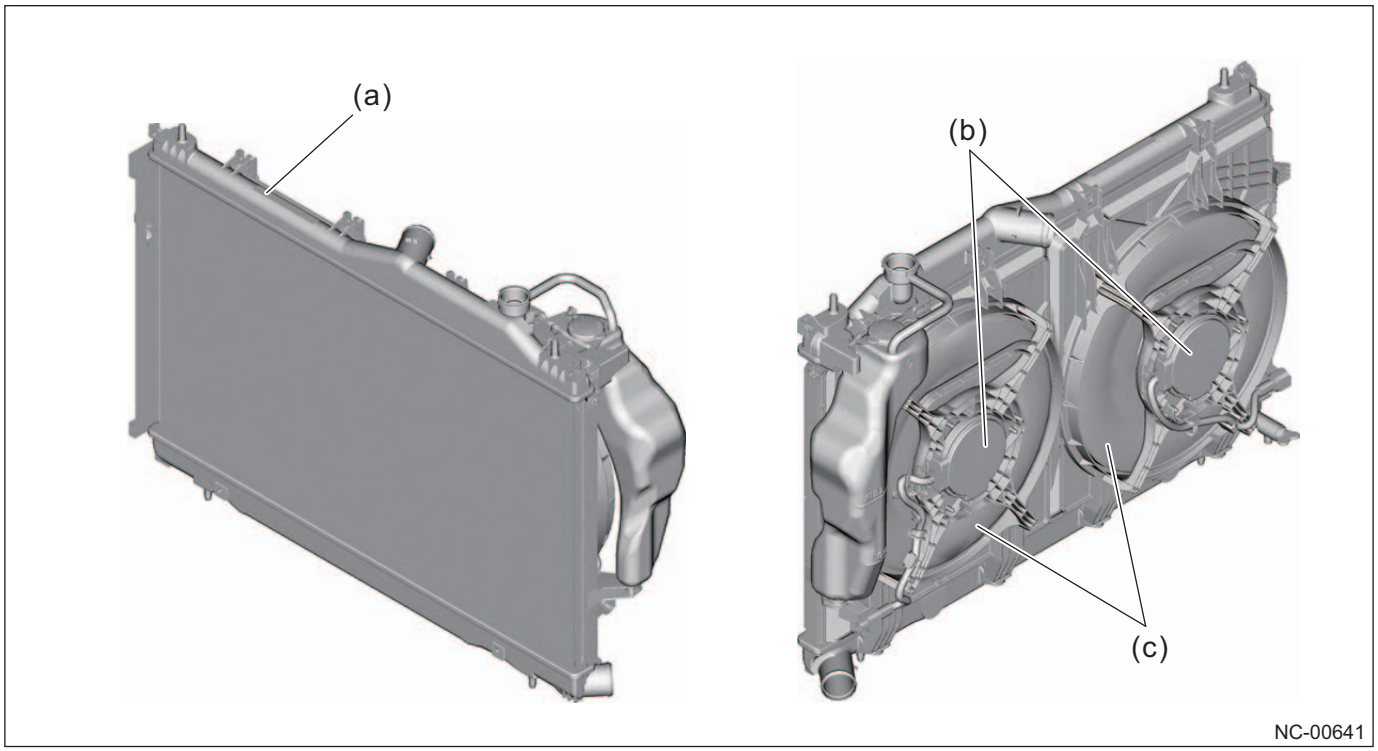


(A) Existing model vehicle

(B) New model vehicle

Radiator fan

This switches the rotation speed of the two cooling fan motors according to the acceleration and deceleration of vehicle, cooling water temperature, load condition of the air conditioner, etc.



(a) Radiator
(b) Fan motor
(c) Cooling fan

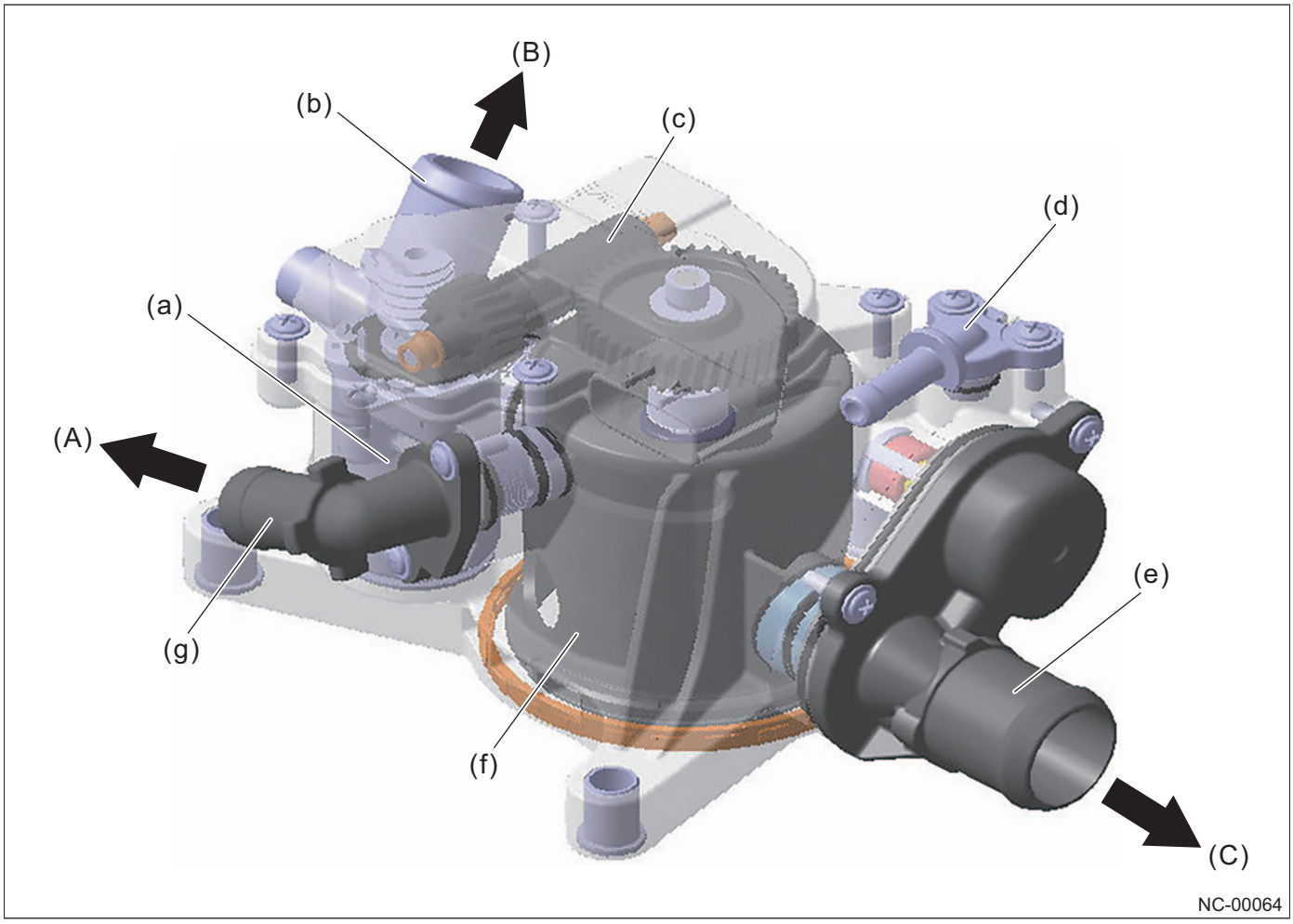
Thermo-control valve

Depending on the situation, based on the signal from ECM, the thermo-control valve switches between three-directional switching port for bottom bypass passage, radiator passage, and heater passage and normal water passage circuit for preventing the throttle valve from freezing.

Switching the flow passage performs the optimal water temperature control to contribute to the improvements of fuel efficiency and heating performance.

The DC motor with excellent responsiveness and less power consumption is adopted. The plastic body to reduce the weight and worm gear to save the space are also adopted.

The thermo-control valve cannot be disassembled.



(A) To heater core
(B) To bottom bypass passage
(C) To radiator

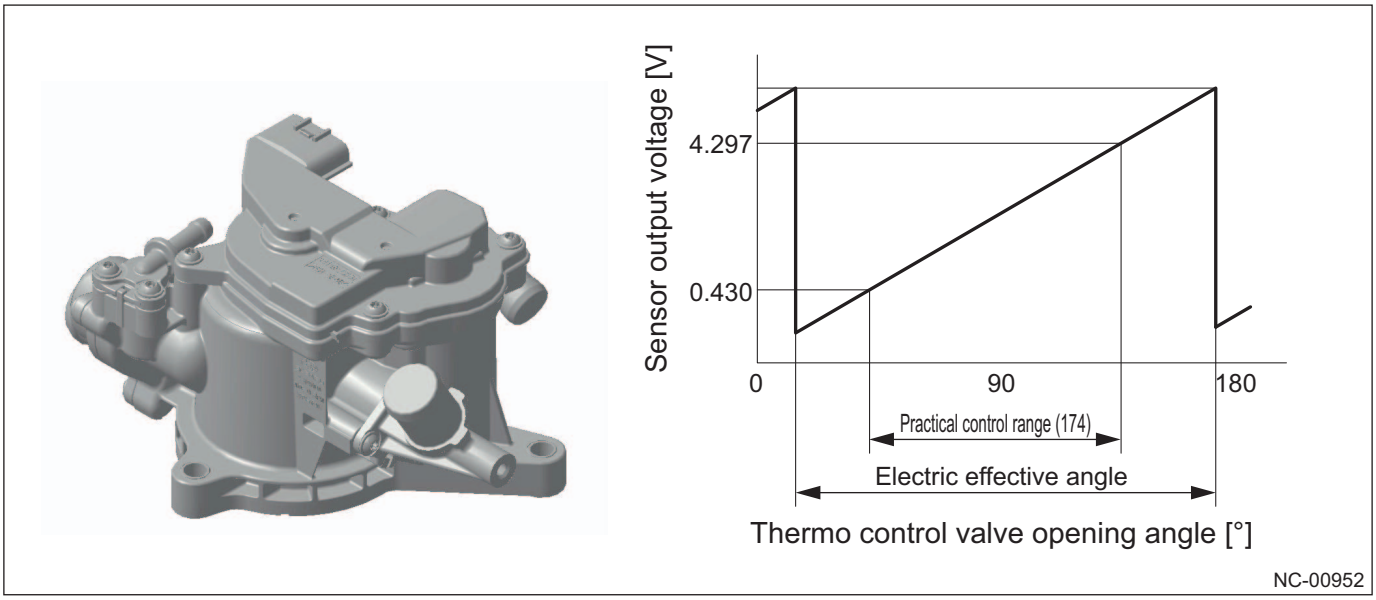
(a) Motor
(b) Bottom bypass port
(c) Worm gear
(d) Normal water passage port
(e) Radiator port
(f) Rotor

Thermo-control valve position sensor

The thermo-control valve position sensor is installed inside the sensor cover of the thermo-control valve.

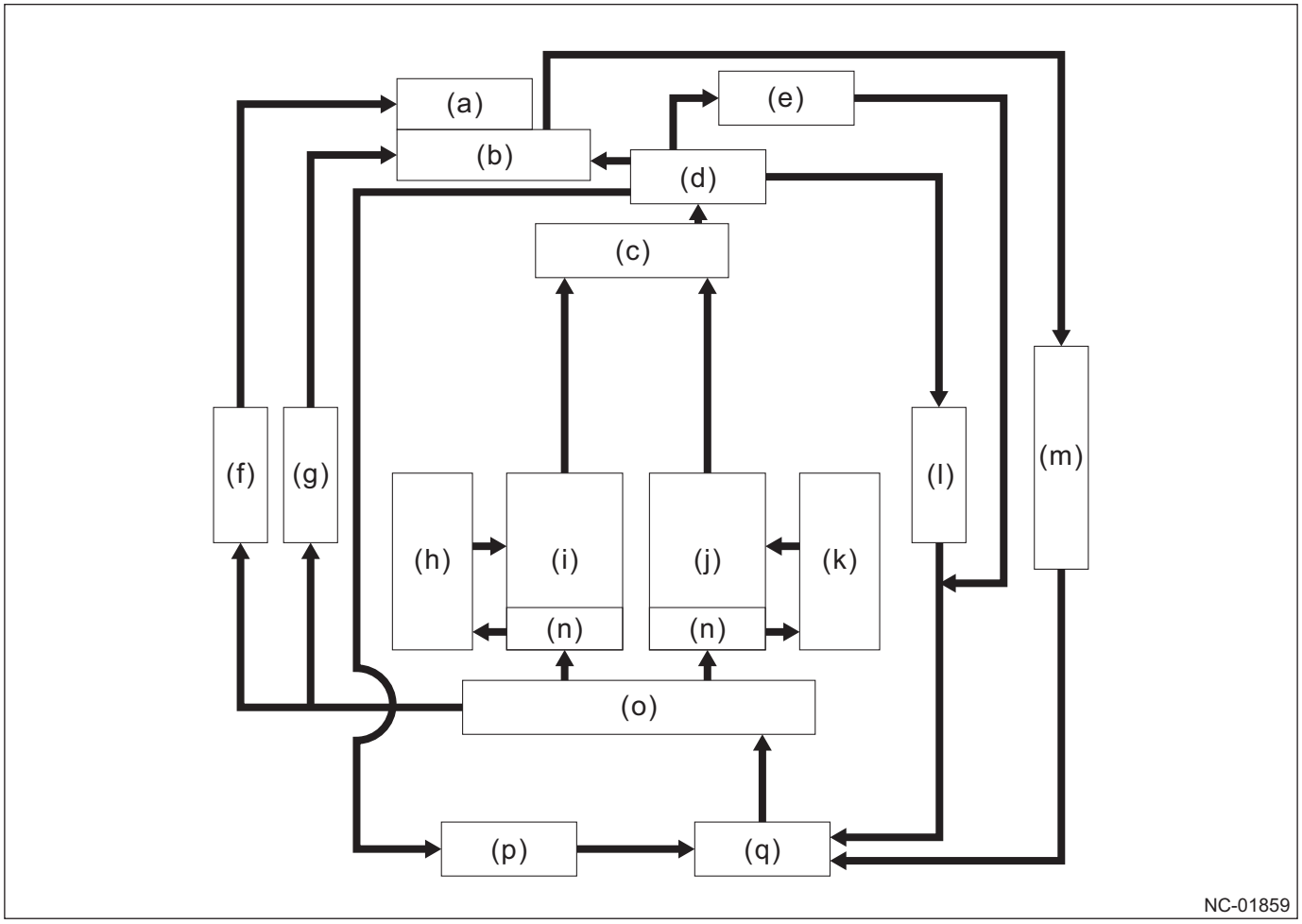
The magnet inside the sensor rotates in synchronism with the valve, and sends the voltage changing according to the magnetic changes as the rotation position information of the valve to the ECM.

The ECM recognizes the opening of the valve from the received sensor voltage, and performs the optimal control of the opening of the valve.



2.6.3 Construction and Operation

System diagram



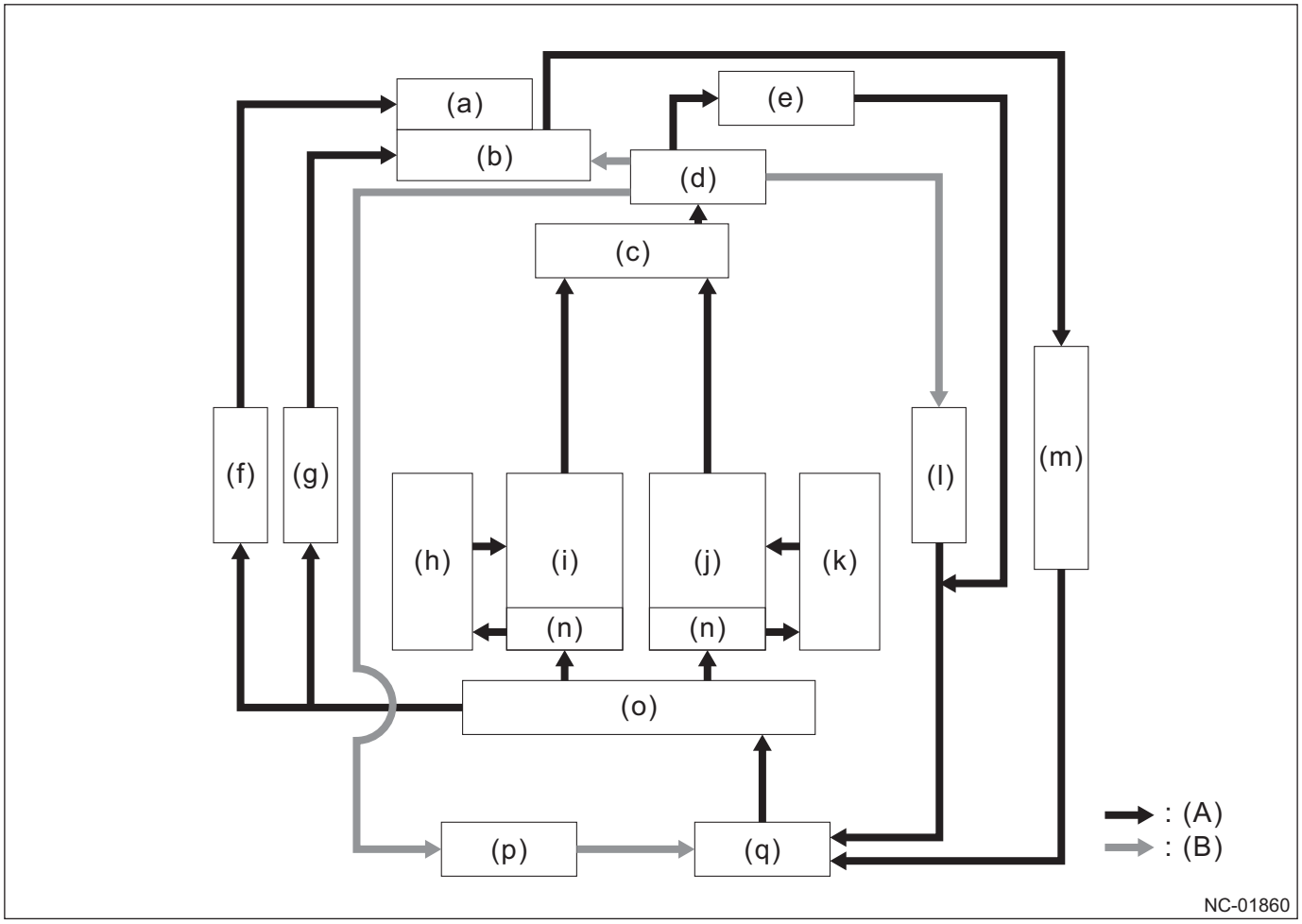
(a) Sub thermostat
(b) Water delivery pipe 2
(c) Water delivery pipe
(d) Thermo-control valve
(e) Throttle
(f) CVTF warmer
(g) EGR cooler
(h) Cylinder head RH
(i) Cylinder block RH
(j) Cylinder block LH
(k) Cylinder head LH
(l) Heater
(m) Bottom bypass
(n) Separation chamber
(o) Oil pan upper
(p) Radiator
(q) Water pump

Thermo-control valve system

The thermo-control valve system controls the flow rate and water temperature in the cooling system. During low load, the engine is controlled to keep high temperature to reduce the mechanical loss caused by reduction of oil viscosity. During high and medium load, the engine temperature is lowered to reduce the knocking, which enlarges the ignition timing area where the maximum torque is achieved. The cooling water is controlled by the thermo-control valve.

When the engine is not well warmed up, water passing to the bottom bypass passage radiator and heater core is stopped, and the cooling water is circulated only within the engine main body to facilitate warming up.

Water is always passed to the heater core by turning on the air conditioner.

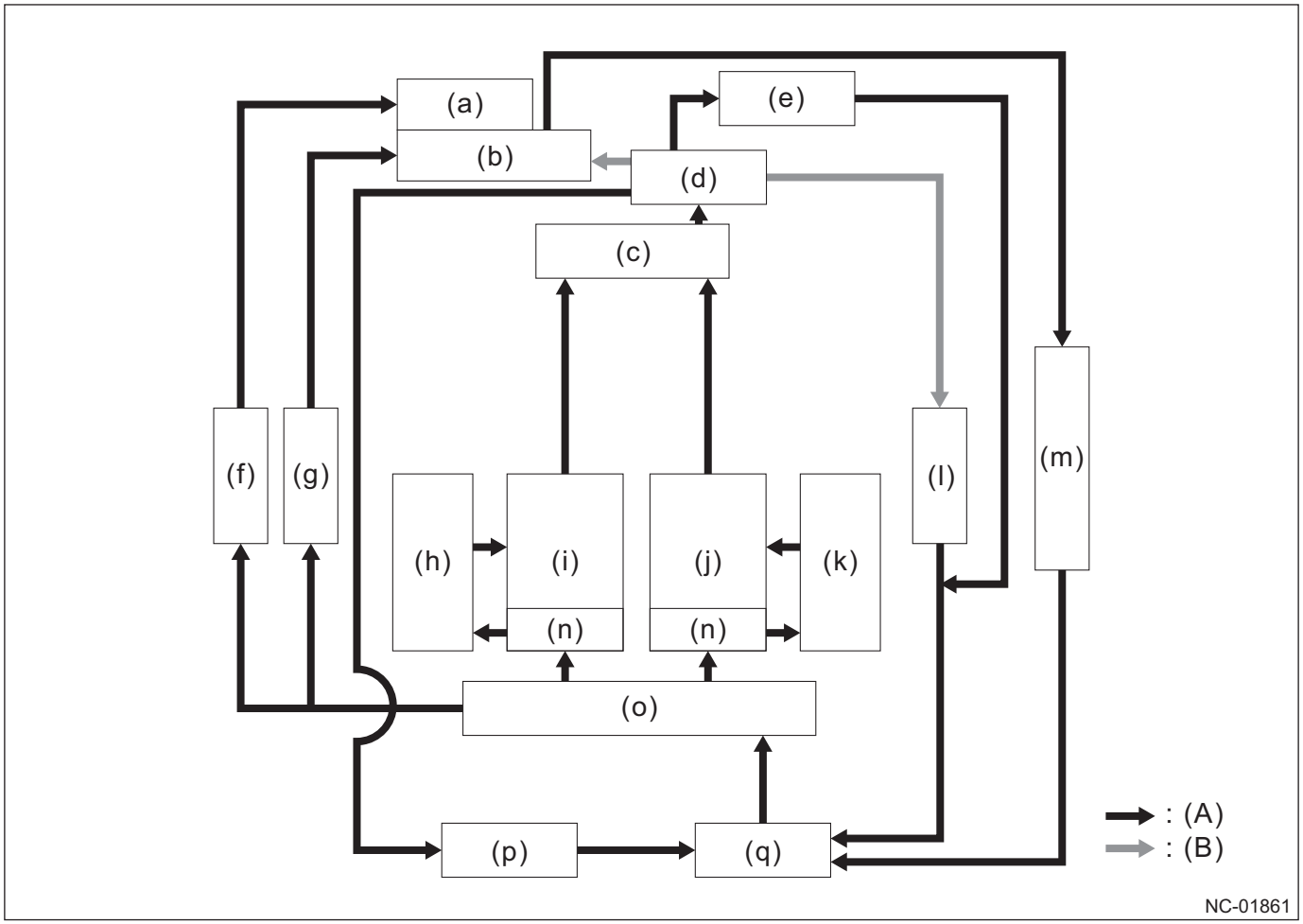


(A) Water passing

(B) No water passing

(a) Sub thermostat
(b) Water delivery pipe 2
(c) Water delivery pipe
(d) Thermo-control valve
(e) Throttle
(f) CVTF warmer
(g) EGR cooler
(h) Cylinder head RH
(i) Cylinder block RH
(j) Cylinder block LH
(k) Cylinder head LH
(l) Heater
(m) Bottom bypass
(n) Separation chamber
(o) Oil pan upper
(p) Radiator
(q) Water pump

In the water temperature condition where overheat is likely to occur, water is passed to the radiator with full-open to ensure the cooling performance and lower the temperature.



(A) Water pass

(B) No water pass

(a) Sub thermostat
(b) Water delivery pipe 2
(c) Water delivery pipe
(d) Thermo-control valve
(e) Throttle
(f) CVTF warmer
(g) EGR cooler
(h) Cylinder head RH
(i) Cylinder block RH
(j) Cylinder block LH
(k) Cylinder head LH
(l) Heater
(m) Bottom bypass
(n) Separation chamber
(o) Oil pan upper
(p) Radiator
(q) Water pump

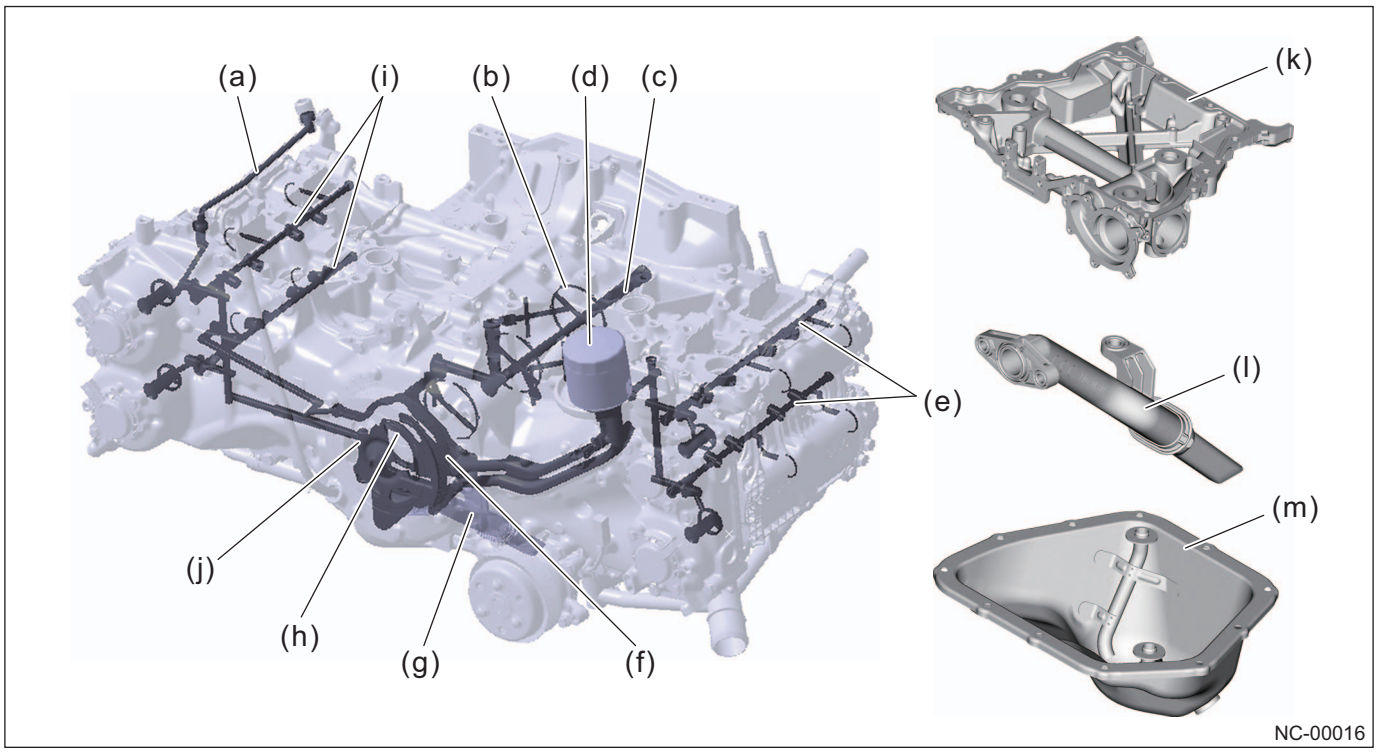
2.7 Lubrication System

2.7.1 Overview

Full-pressure feed and full filter methods are adopted for the lubrication method, and oil pump and the oil passage are built into the timing chain cover to front-modulize the system to improve serviceability. Also, oil pump that drives in front of the crankshaft is adopted.

2.7.2 Component

Component layout drawing

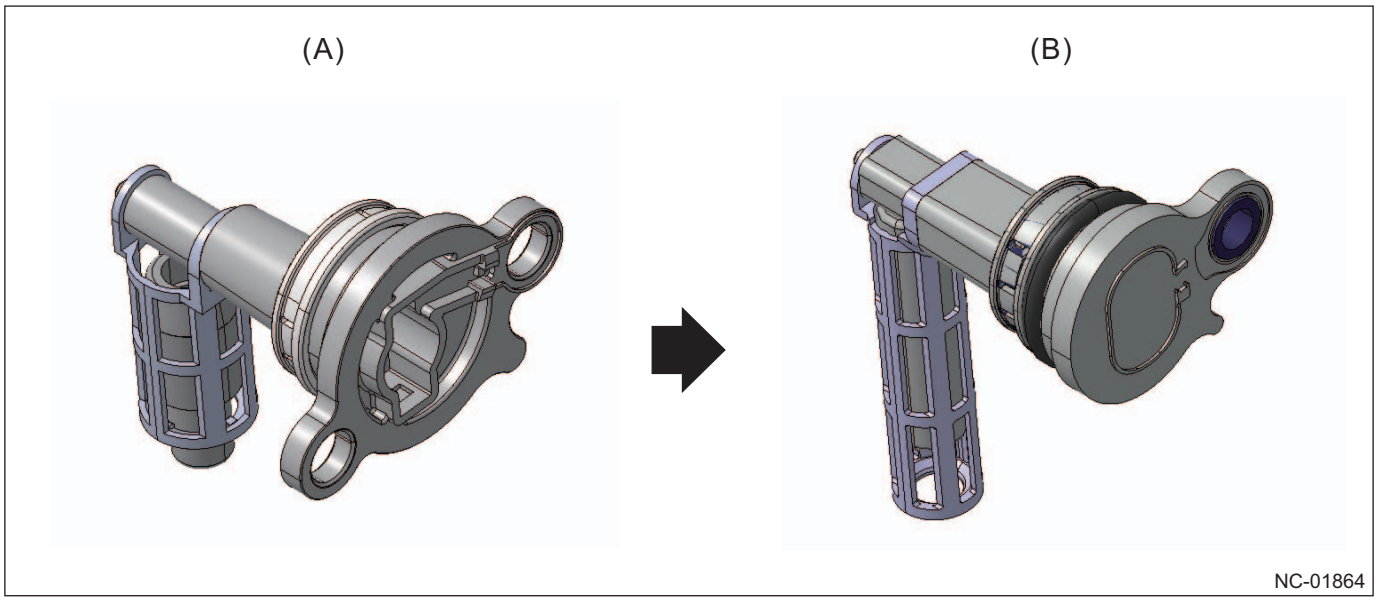


(a) Vacuum pump pipe
(b) Crankshaft oil passage
(c) Main oil passage
(d) Oil filter
(e) Camshaft journal LH oil passage (IN/EX)
(f) Chain tensioner LH oil passage
(g) Oil strainer
(h) Oil pump
(i) Camshaft journal RH oil passage (IN/EX)
(j) Chain tensioner RH oil passage
(k) Oil pan upper
(l) Oil strainer
(m) Oil pan

Component details

Oil level switch

The oil level switch is downsized to reduce weight. Also, the detection system is changed from detection while the engine is idling to detection while the engine is stopped to improve the detection accuracy.

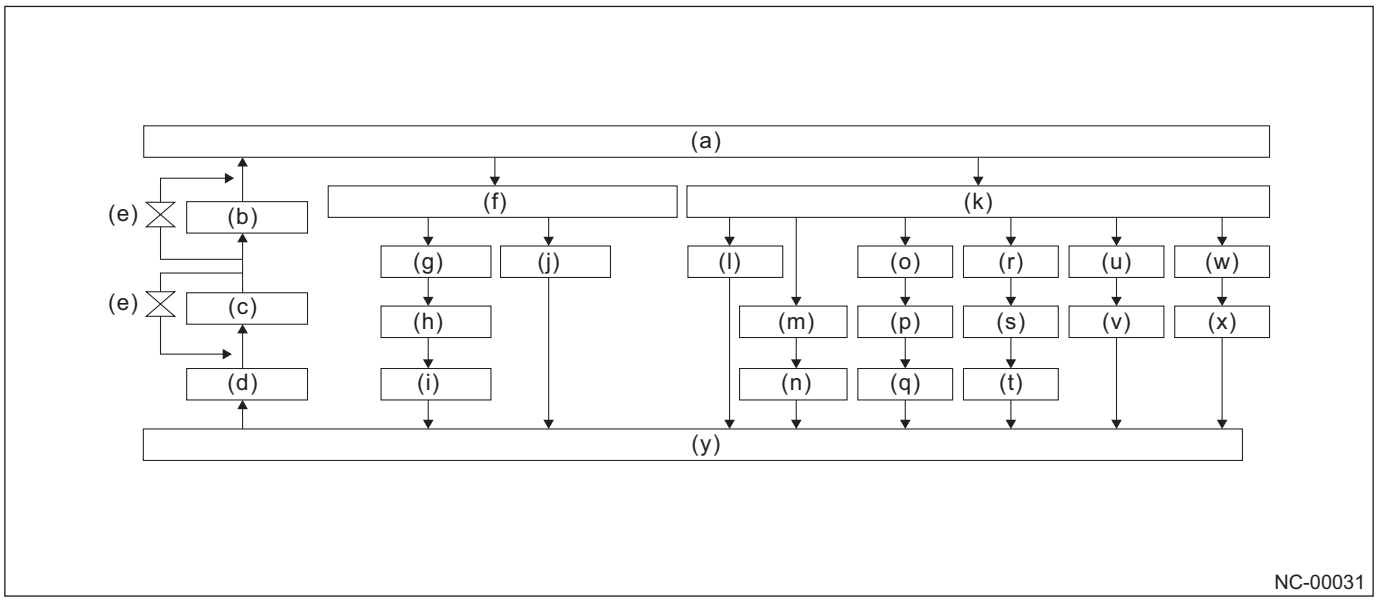


(A) Existing model vehicle

(A) New model vehicle

2.7.3 Construction and Operation

System diagram



(a) Oil passage in chain cover
(b) Oil filter
(c) Oil pump
(d) Oil strainer
(e) Relief valve
(f) Cylinder block
(g) Crankshaft journal
(h) Crankshaft pin
(i) Connecting rod
(j) Chain tensioner LH
(k) Cylinder head
(l) Rocker arm pivot
(m) Oil jet in cylinder head
(n) Locker arm
(o) Cam carrier
(p) Camshaft journal
(q) AVCS
(r) Cam carrier RH
(s) Vacuum pump pipe
(t) Vacuum pump
(u) Cam carrier LH
(v) Fuel pump lifter
(w) Cylinder block
(x) Chain tensioner RH
(y) Oil pan

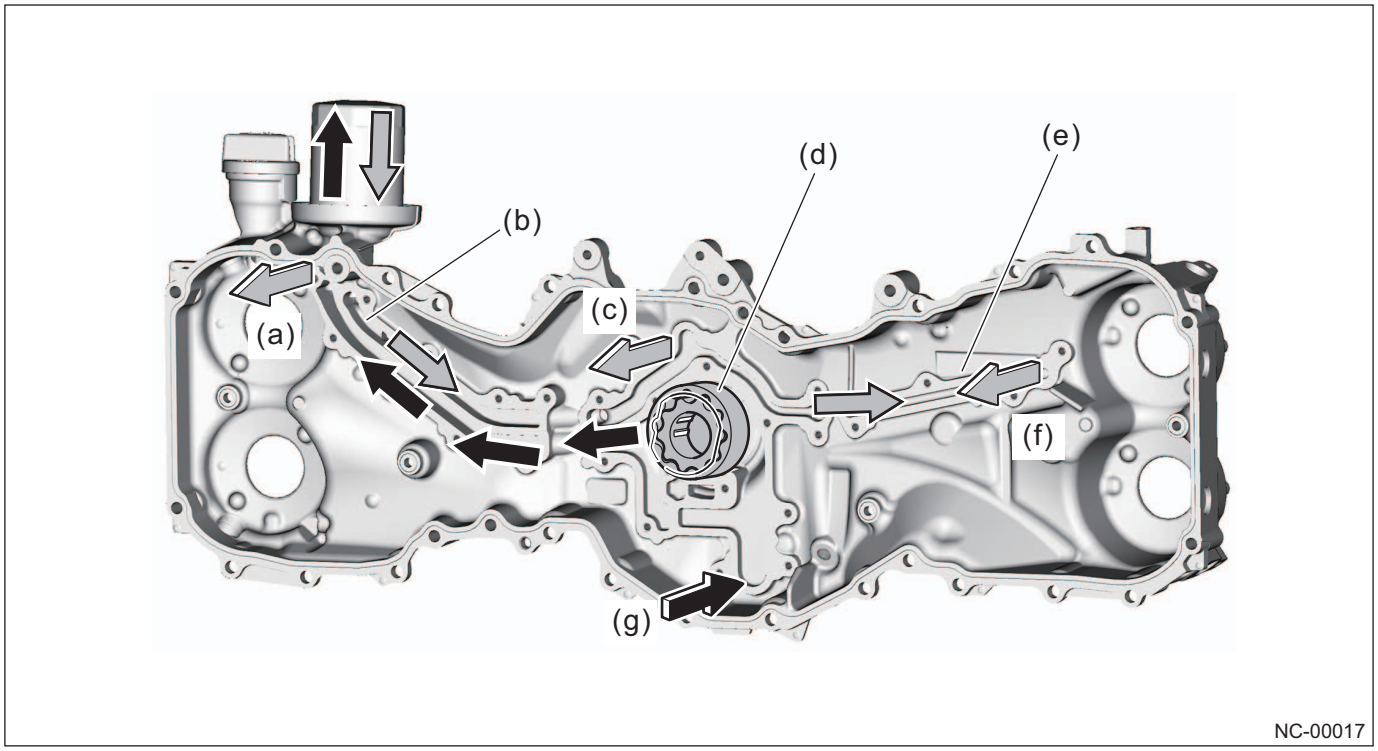
Chain cover with built-in oil pump

The oil pump with optimized discharge volume and the compact and highly efficient multi teeth trochoid rotor driven by the crankshaft is installed in the chain cover

The relief valve is built-in and bypass passage is installed to prevent relieved oil from returning directly to the oil pan, reducing oil level fluctuation and friction.

To ensure reliability, the FIPG (liquid gasket) with good sealing is adopted on the installation surfaces of the cylinder block, cylinder head, and oil pan upper.

Chain cover with built-in oil pump cannot be disassembled.



(a) To cylinder head LH
(b) Oil passage
(c) To cylinder block LH
(d) Oil pump
(e) Oil passage
(f) To cylinder head RH
(g) From oil pan

2.8 Engine Control System

2.8.1 Overview

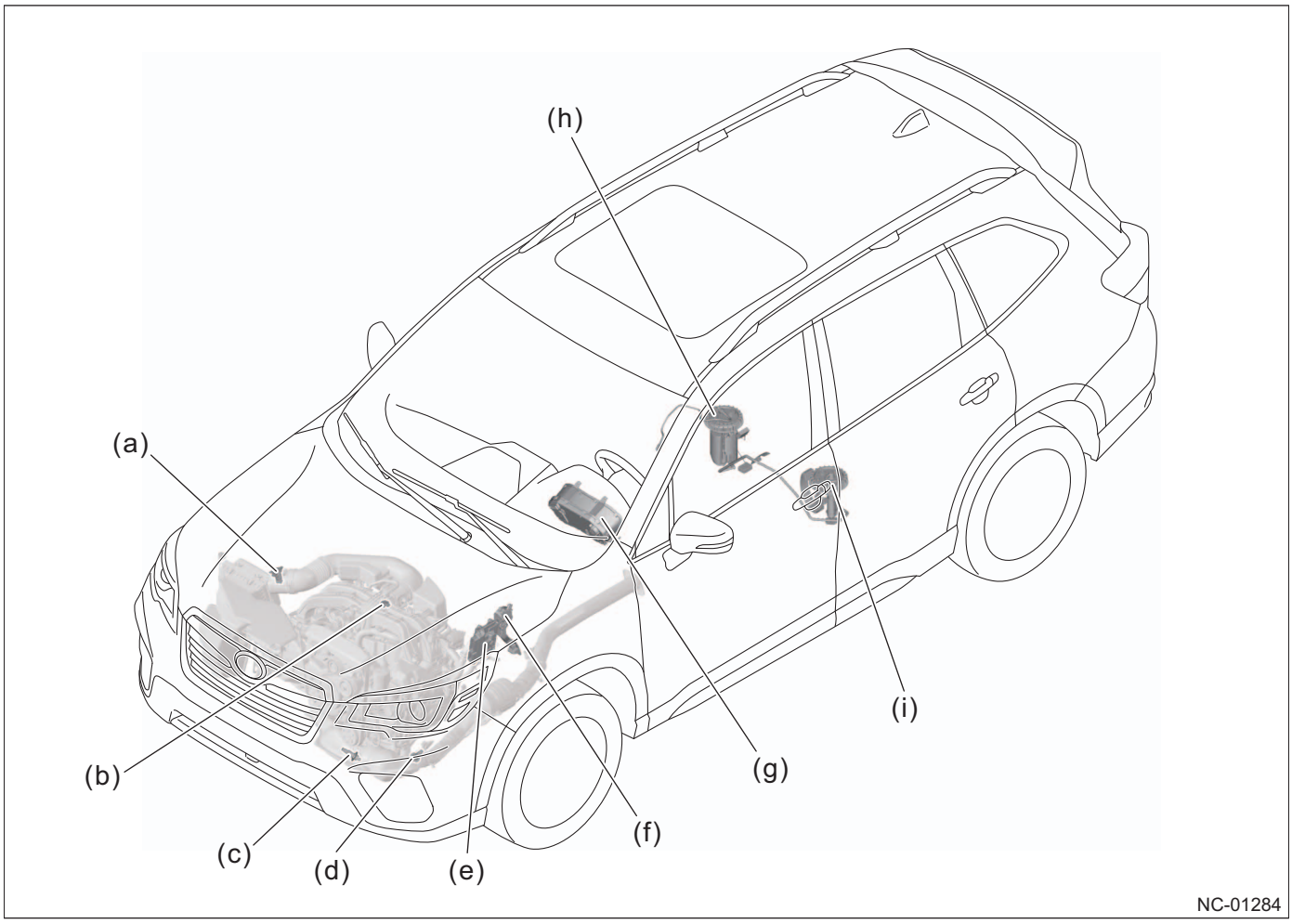
ECM comprehensively controls EGI, ignition timing control, AVCS, and electronic throttle control, etc. in the engine control system.

The diagnosis (self-diagnosis) function and the fail-safe function are installed for when problems occur.

2.8.2 Component

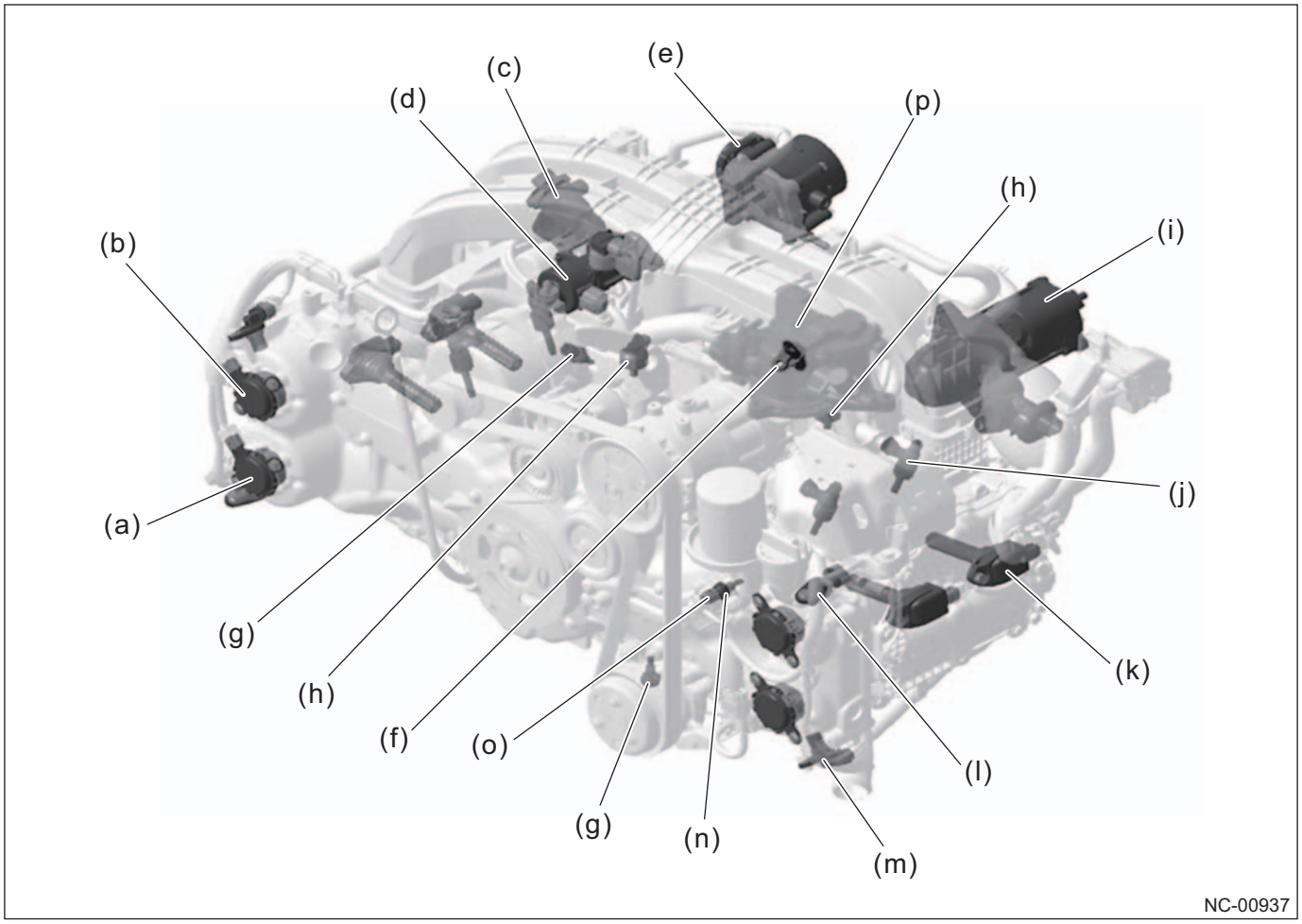
Component layout drawing

Main component 1



(a) Air flow and intake air temperature sensor
(b) Manifold absolute pressure sensor
(c) Front oxygen (A/F) sensor
(d) Rear oxygen sensor
(e) ECM
(f) Accelerator pedal position sensor
(g) Combination meter
(h) Fuel pump
(i) Fuel sub level sensor

Main component 2



(a) Exhaust oil control solenoid
(b) Intake oil control solenoid
(c) TGV
(d) EGR control valve
(e) Electronic throttle control sensor
(f) Crankshaft position sensor
(g) Engine coolant temperature sensor
(h) Knock sensor
(i) Starter
(j) Injector
(k) Ignition coil
(l) Intake camshaft position sensor
(m) Exhaust camshaft position sensor
(n) Engine oil temperature sensor
(o) Engine oil pressure sensor
(p) Thermo-control valve assembly

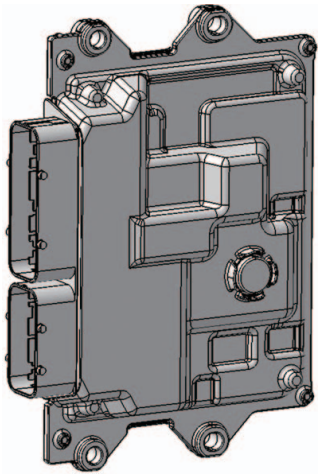
Component details

ECM

ECM is installed in the engine compartment and performs fuel injection control, electronic advance angle control, AVCS valve timing control, electronic throttle system control, EGR control, and evaporative purge control, etc.

Since the ECM layout is changed (from the foot of the front passenger's seat to the inside of the chamber), aluminum die-cast and steel plate are adopted for the chassis with waterproof construction. Also, the bracket is divided to upper part and lower part to reduce the weight.

The specification is also changed to improve the connectivity of connectors.

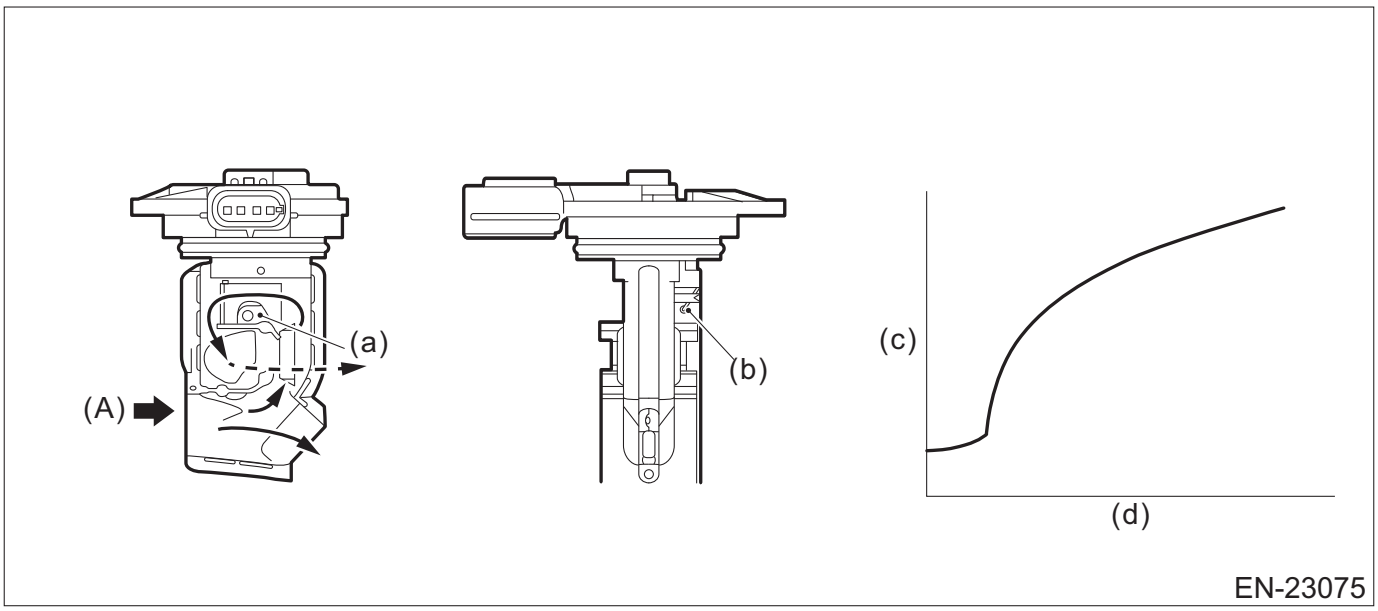


NC-01777

Air flow and intake air temperature sensor

Air flow and intake air temperature sensor are integrated with each other. This unit is installed in the air cleaner case and measures intake air amount and temperature.

The measured intake air amount and temperature are converted into electric signals, and the signals are transmitted to ECM. ECM uses these signals to control injection and ignition timings and fuel injection amount.



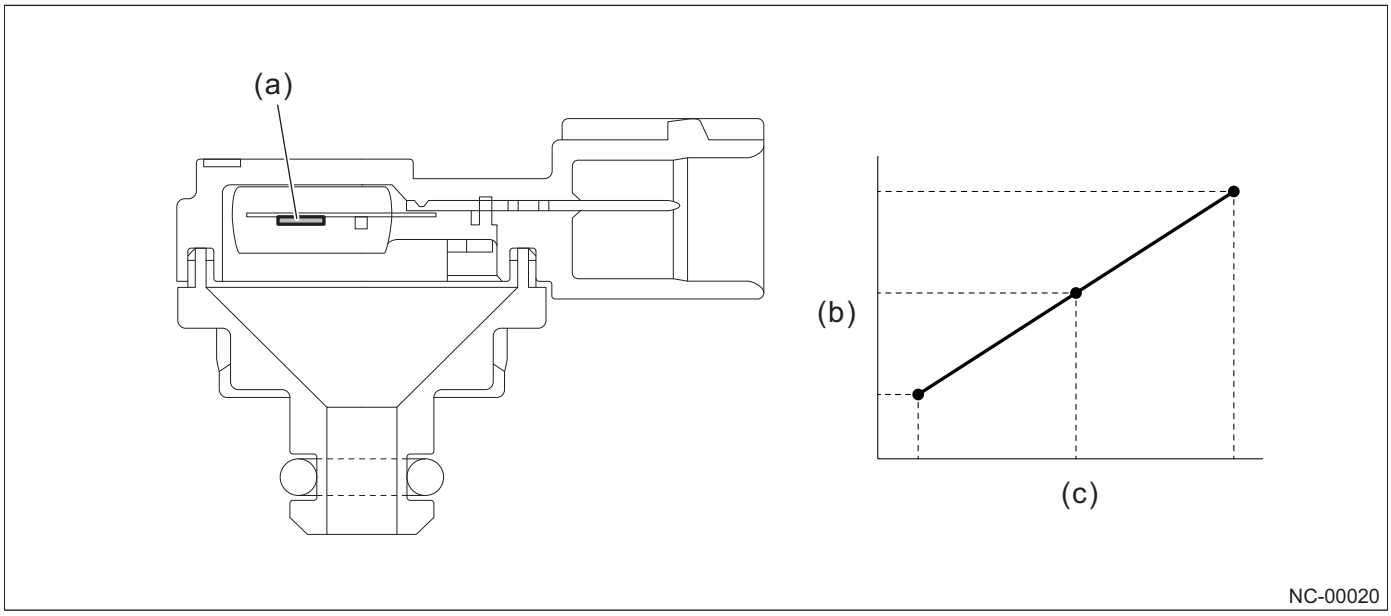
(A) Air

(a) Air flow sensor
(b) Intake air temperature sensor
(c) Frequency (kHz)
(d) Amount of intake air (kg (lb)/s)

Manifold absolute pressure sensor

The manifold absolute pressure sensor is installed in the intake manifold, and measures intake pressure.

The measured intake pressure is converted into electric signals, and the signals are transmitted to ECM. ECM uses these signals to control injection and ignition timings and fuel injection amount.

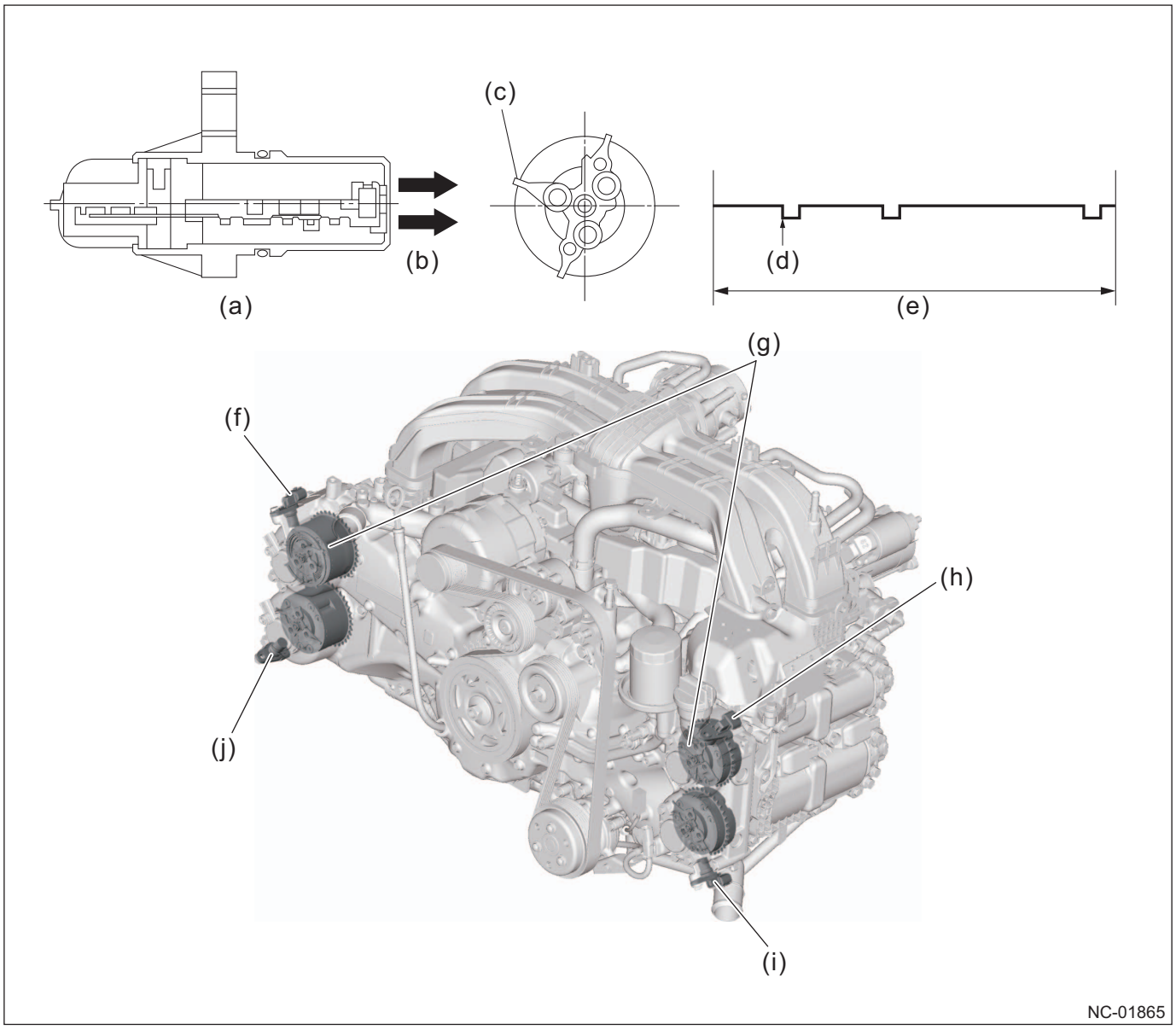


(a) IC chip
(b) Output voltage (V)
(c) Absolute pressure (kPa)

Camshaft position sensor

Since the camshaft position sensor detects phases of the camshaft and the crankshaft, the sensor detects the rotation position of the camshaft with the camshaft position sensor that is installed in the intake and exhaust AVCS. The GMR (Giant Magneto Resistance) element type is adopted for the camshaft position sensor.

The system detects phases of the camshaft and the crankshaft with signals transmitted from the cam position sensor and the crank position sensor, and performs the AVCS valve timing control based on these phases.

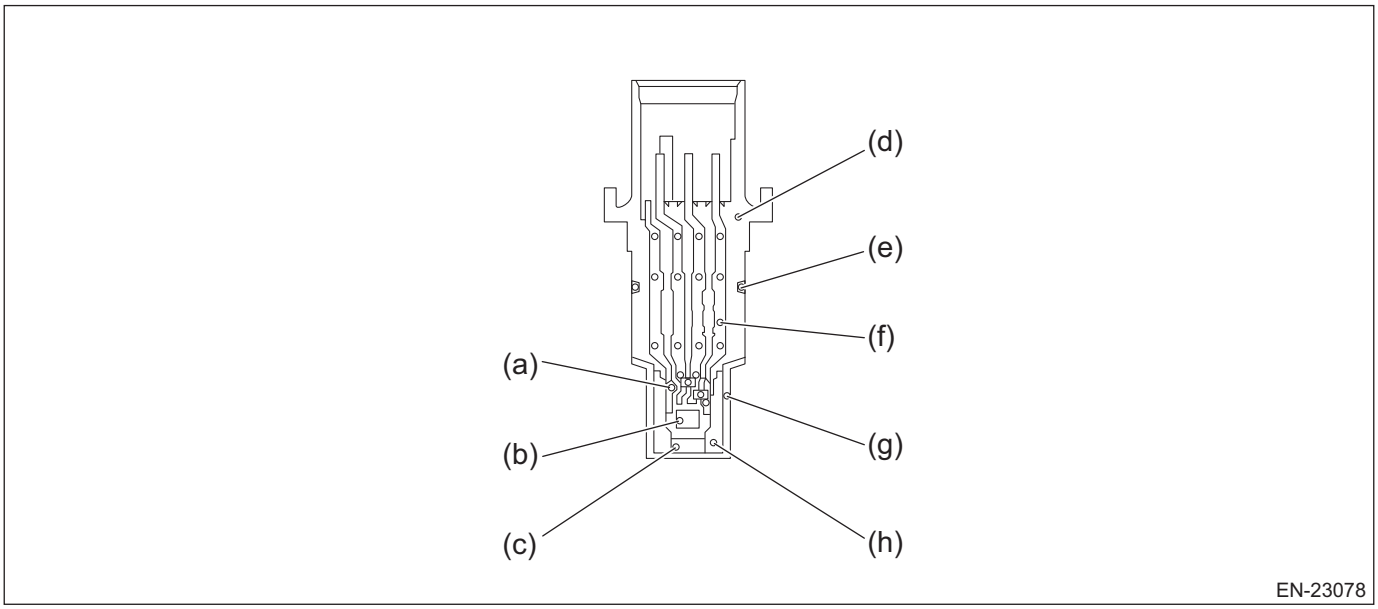


(a) Camshaft position sensor (hall element)
(b) Magnetic field
(c) Slot (camshaft position sensor plate)
(d) Detecting point
(e) Camshaft one revolution (crankshaft two revolutions)
(f) Camshaft position sensor (intake air RH side)
(g) Camshaft position sensor plate
(h) Camshaft position sensor (intake air LH side)
(i) Camshaft position sensor (exhaust air LH side)
(j) Camshaft position sensor (exhaust air RH side)

Crankshaft position sensor

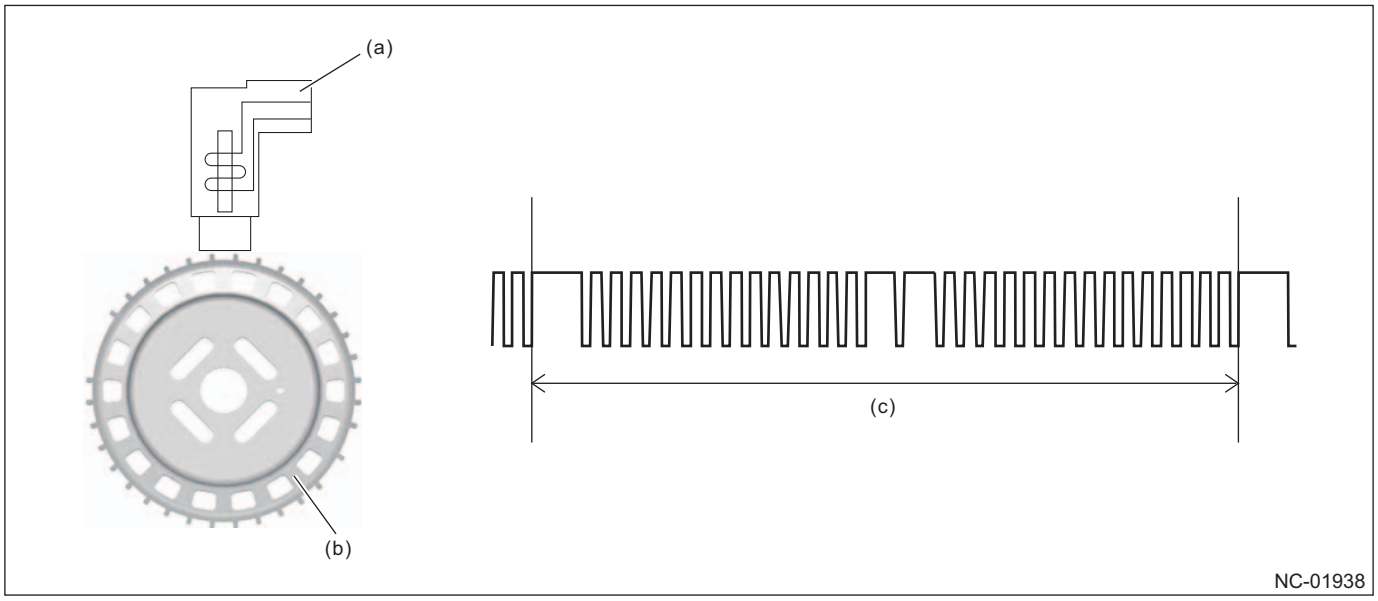
The crankshaft position sensor generates one pulse when one of the outer teeth of the crankshaft sprocket (that rotates together with the crankshaft) passes in front of the sensor. ECM counts the pulse number to determine the angular position of the crankshaft.

The crankshaft position sensor is a magnet pick up type. It consists of magnet, core, coil, terminal etc. as shown below and molded.



(a) Chip condenser
(b) Circuit chip
(c) Sensor chip
(d) Molded material
(e) O-ring
(f) Terminal
(g) Case
(h) Magnet

When the crankshaft rotates, there is a moment at which each tooth matches the position of the crankshaft position sensor. At the time, the air gap changes between the pickup of the sensor and the sprocket, and the magnetic flux of the coil in the sensor changes. A voltage pulse is induced in the sensor with the change in the magnetic flux and the pulse is transmitted to ECM.

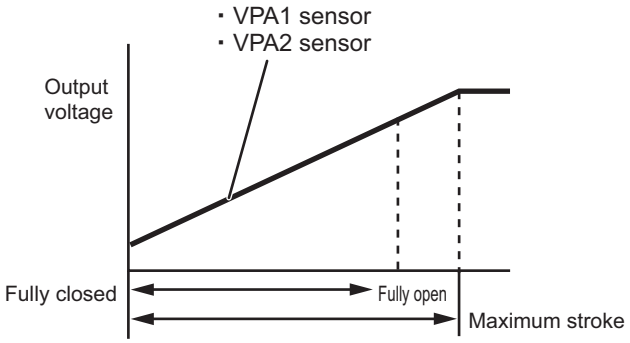


(a) Crankshaft position sensor
(b) Plate (crankshaft sensor)
(c) One crankshaft rotation

Accelerator pedal position sensor

The accelerator pedal position sensor is installed in the accelerator pedal and detects the changes in magnetic field which corresponds to the depression amount of the accelerator pedal as an electric signal. Non-contact method that uses a hall element is adopted for the sensor.

The system compares outputs of the VP1 sensor and the VP2 sensor which have the same output characteristic to determine problems.



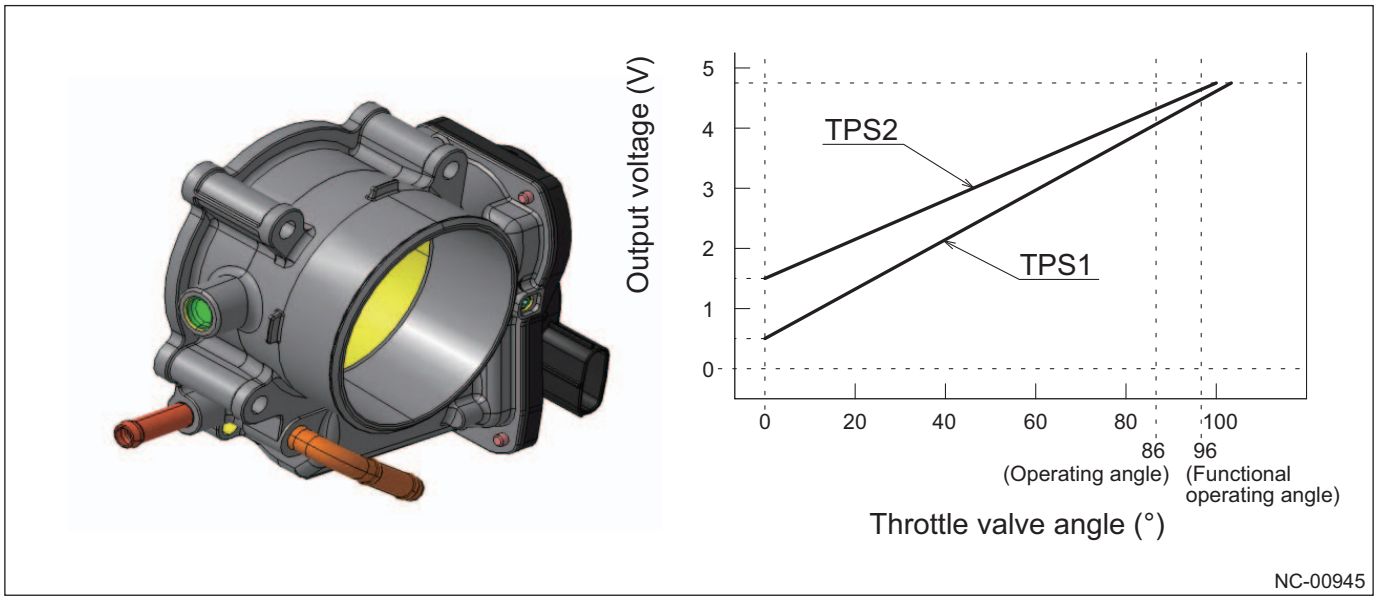
Accelerator pedal position sensor
Output voltage characteristics

EN-23080

Throttle position sensor

The throttle position sensor is installed in the throttle body and detects the throttle valve opening angle.

Non-contact method that uses a hall element is adopted for the sensor. Two sensors that have different sensor output characteristics are adopted to ensure reliability.

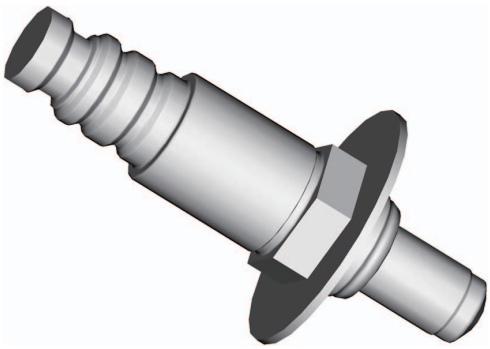


Front oxygen (A/F) sensor

Front oxygen (A/F) sensor is installed on the upstream side of the front catalyst of the front exhaust pipe to surely detect the air-fuel ratio condition of exhaust gas.

Oxidized zirconium (ZrO_2) is adopted for the front oxygen (A/F) sensor. Oxidized zirconium has a characteristic of generating electromotive force when both surfaces contact oxygen ion that has different concentration. The electromotive force changes depending on the difference in oxidized concentration. With this characteristic, this sensor can linearly detect the status of exhaust gas and precisely control the air-fuel ratio compared to the rear oxygen sensor which detects lean or rich from theoretical air-fuel ratio.

On the sensor section, the outer surface of the oxidized zirconium contacts exhaust gas and the inner surface contacts atmosphere to obtain the current output from the sensor. Also, since the output characteristic of the front oxygen (A/F) sensor stabilizes at about 700°C (1,292°F), the sensor is designed as a layer type to shorten the heating time.



NC-01780

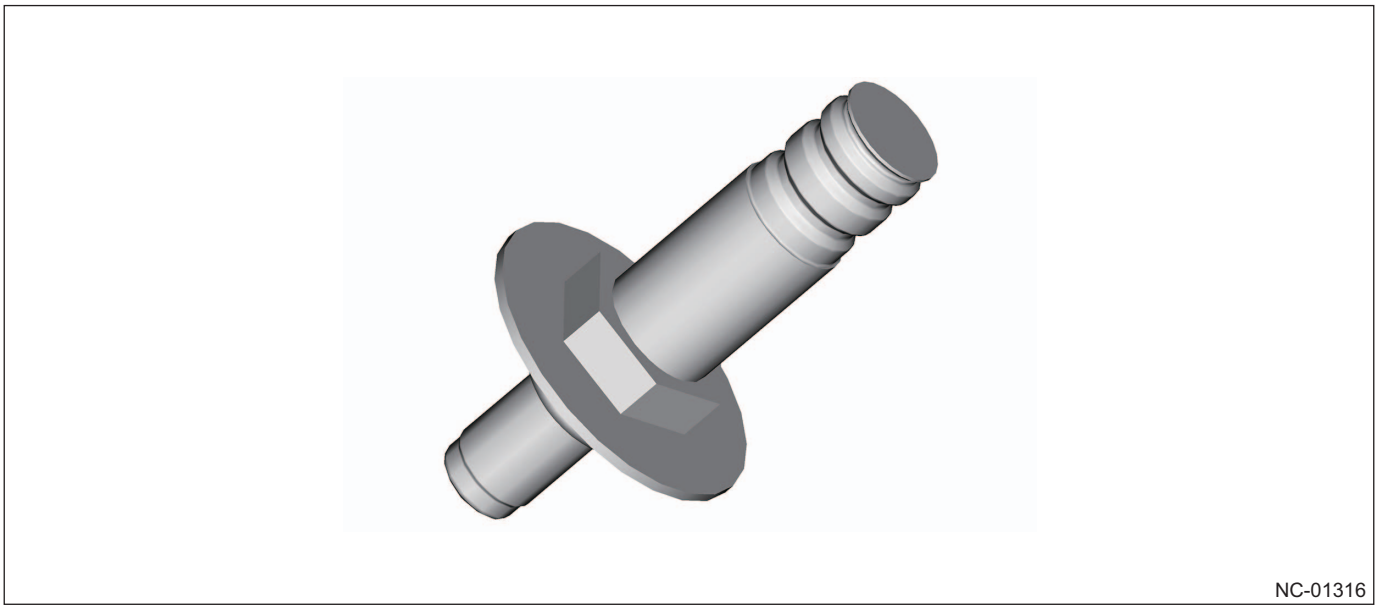
The illustration is for illustrative purposes only.

Rear oxygen sensor

The rear oxygen sensor is installed on the downstream side of the front catalyst of the exhaust manifold and detects whether oxygen concentration in the exhaust gas is higher or lower than the theoretical air-fuel ratio.

Zirconium tube (ceramic) is used for the rear oxygen sensor and generates voltage if there is a difference in oxygen ion concentration inside and outside the tube.

Since the output characteristic of the rear oxygen sensor stabilizes at about 300 to 400°C (572 to 752°F), the ceramic heater is installed.



The illustration is for illustrative purposes only.

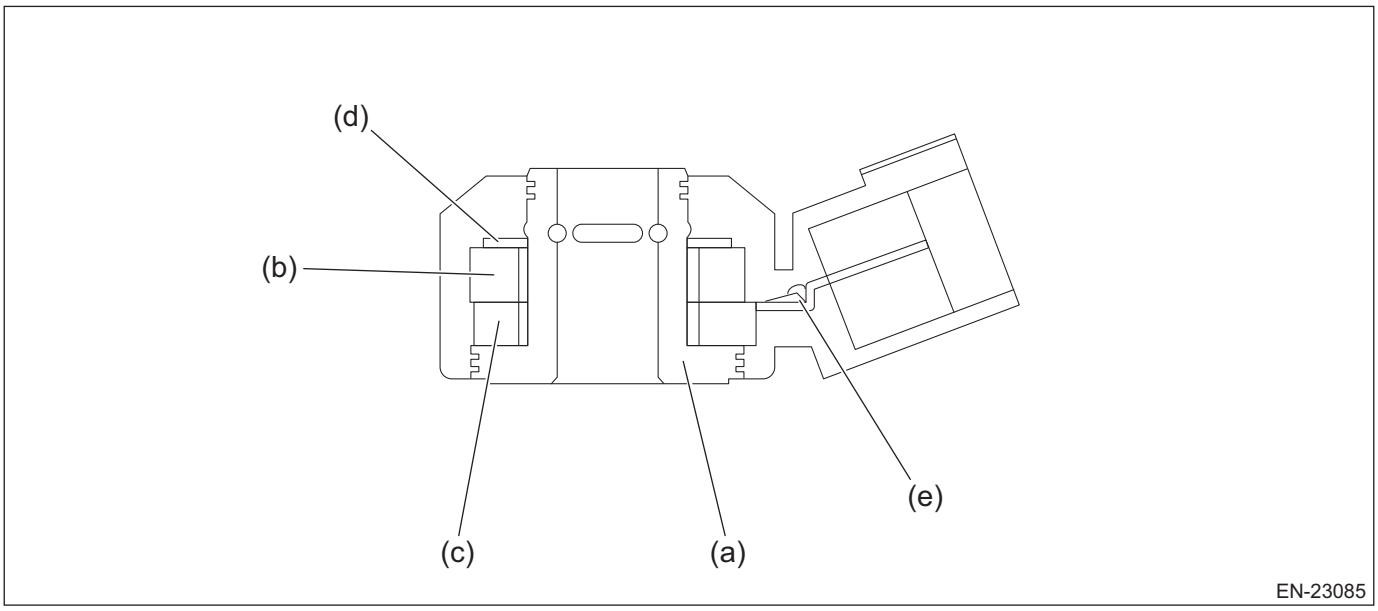
Knock sensor

The knock sensor is installed on the cylinder block and detects the knocking occurring in the engine.

The knock sensor has a built-in piezoelectric element to convert the vibration caused by knocking into an electric signal.

A knock sensor is installed for both the right and left cylinder blocks to ensure reliability.

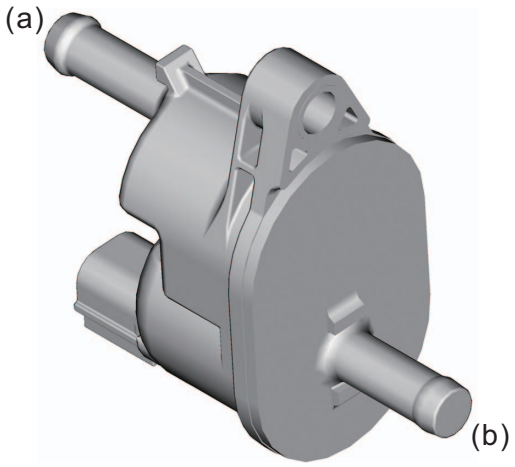
In addition to the piezoelectric element, the sensor is composed of weight and case. When knocking occurs in the engine, the weight moves in the case and then a voltage occurs in the piezoelectric element.



(a) Case
(b) Weight
(c) Piezoelectric element
(d) Washer
(e) Resistance

Purge control solenoid valve

The purge control solenoid valve is installed in the evaporation fuel line between the canister and the intake manifold. The valve is installed on the lower side of the intake manifold to intake the fuel evaporation gas stored in the canister into the intake manifold.



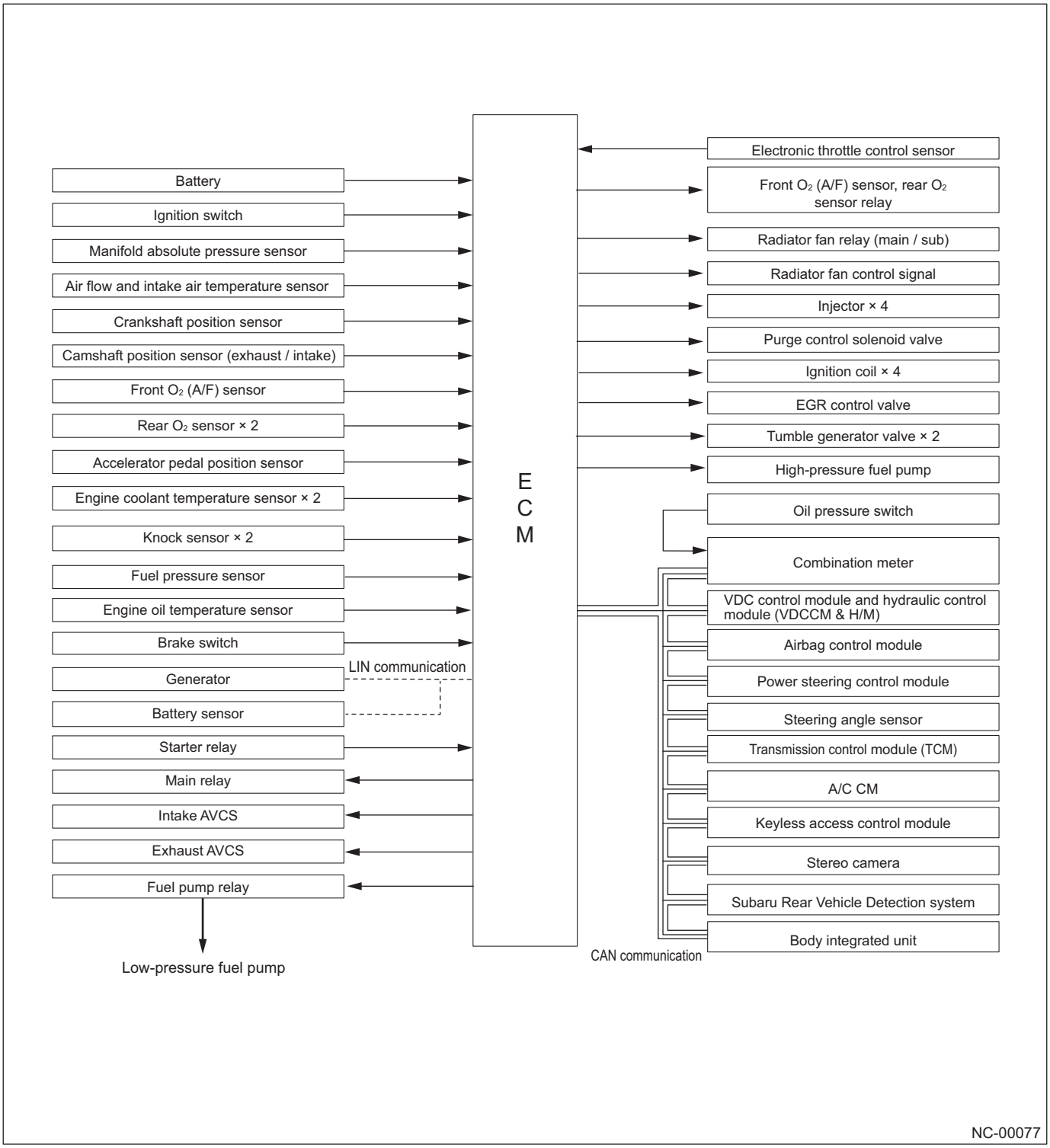
NC-00022

(a) From canister

(b) To intake manifold

2.8.3 Construction and Operation

System diagram



Fuel injection control

The fuel injection control senses driving conditions with the signal transmitted from each sensor and controls fuel injection amount (energization time to the injector) to maintain the air-fuel ratio suitable for driving conditions.

AVCS

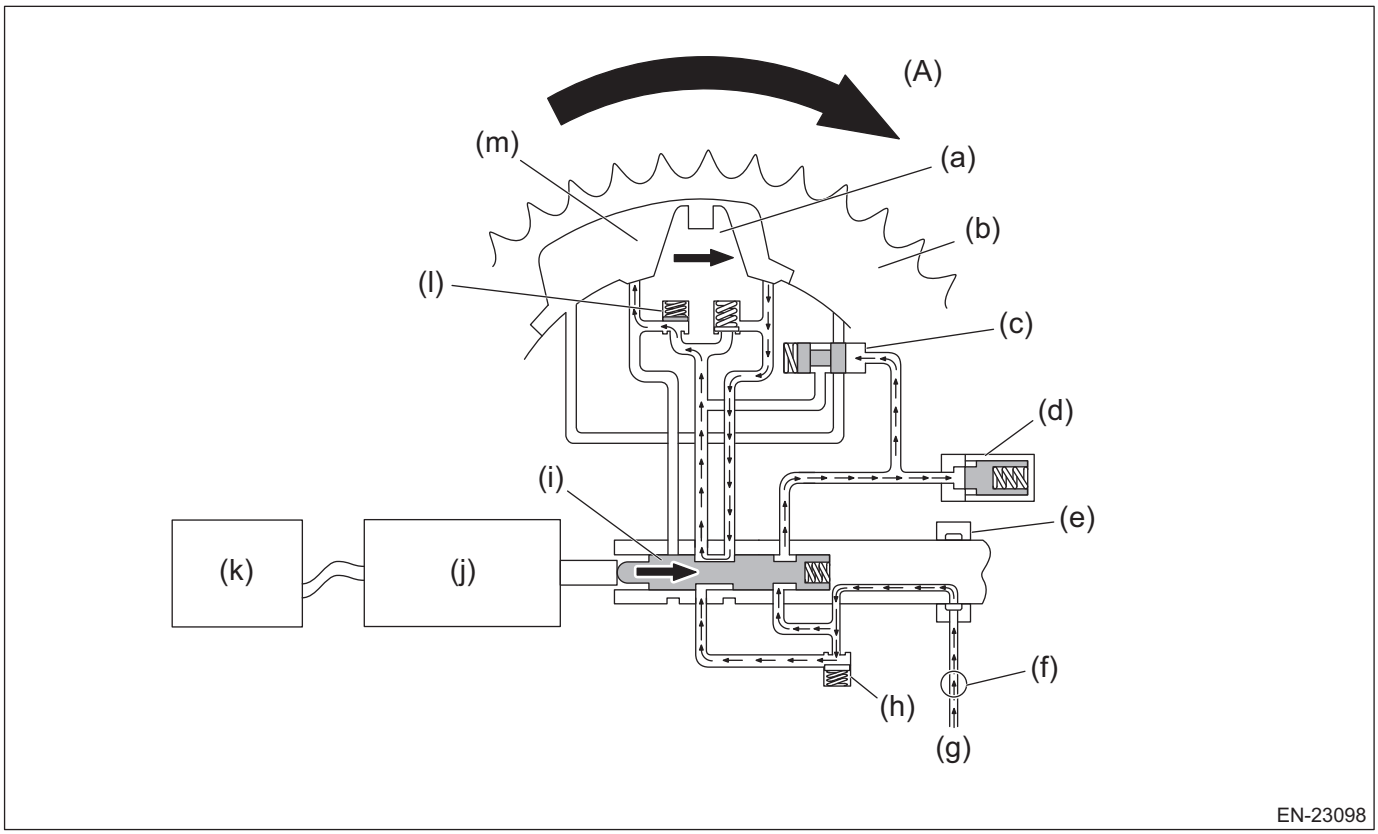
AVCS constantly changes the phase angle of the camshaft sprocket to the camshaft to optimize the timing when the valve opens and closes.

ECM determines the optimal camshaft angle against the crank angle referencing the engine rotation speed, vehicle speed, throttle opening angle, and other relevant parameters. Oil control valve assembly moves the spool and switches the oil passage between the advance angle and delay angle chambers installed in the camshaft sprocket under the control of ECM. This continuously changes the phase angle between the camshaft sprocket and the camshaft.

Advance angle

When the oil control valve assembly operates in response to the signal transmitted from the ECM, the spool valve moves to the right side. Due to the negative cam torque, the oil pressure of the delay angle chamber is applied in the advance angle oil pressure chamber through the advance angle check valve. The rotor vane integrated in the camshaft rotates in the advanced angle direction against the rotations of the housing and the sprocket (engine is rotated by the timing chain drive), and advances the angle of valve timing.

Since the detent oil passage is closed due to being pushed by the oil pressure of the oil pump, the detent valve does not operate.



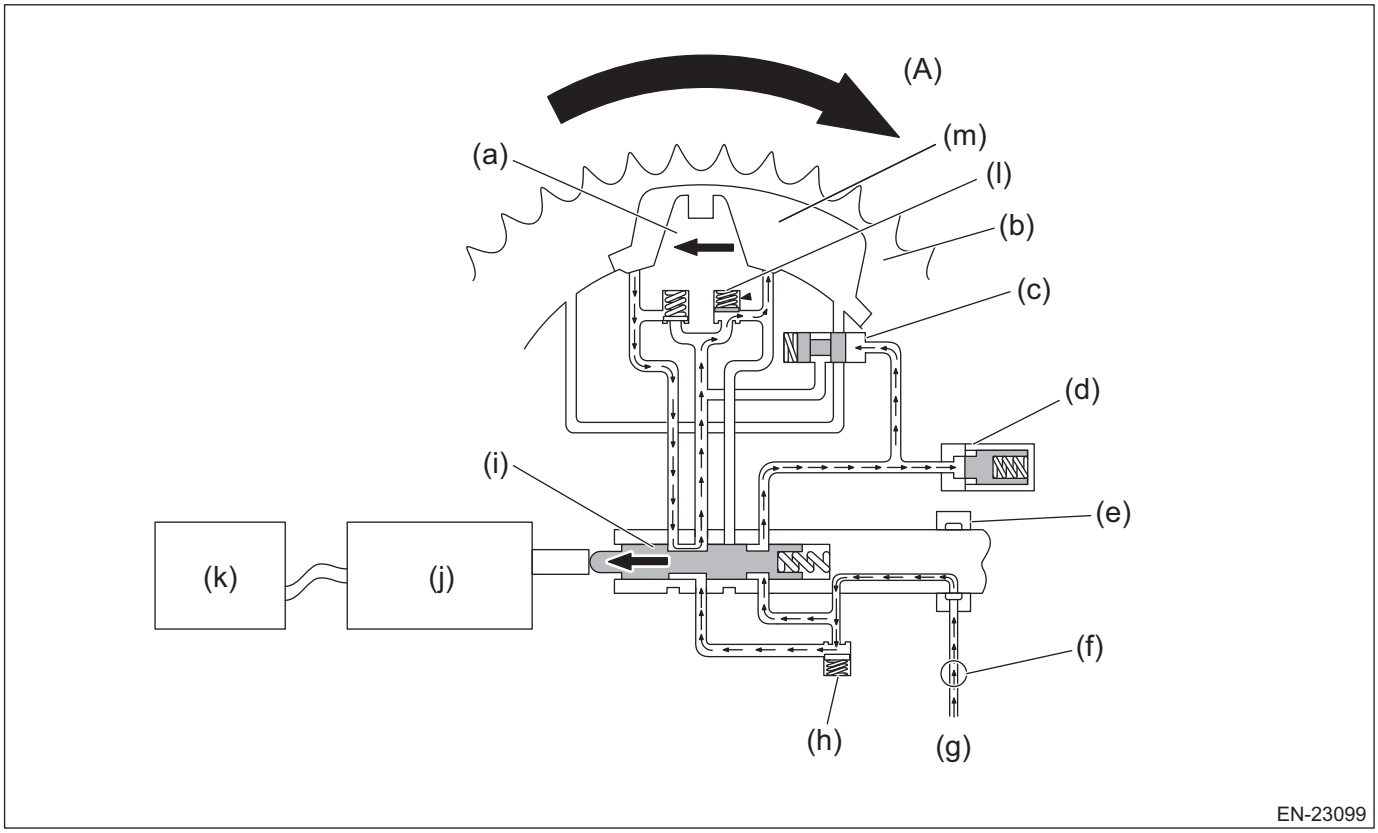
(A) Cam sprocket rotation direction

(a) Rotor vane
(b) Housing and sprocket
(c) Detent valve
(d) Lock pin
(e) Front camshaft cap
(f) Oil pump
(g) From oil strainer
(h) Inlet check valve
(i) Spool valve
(j) Oil control valve assembly
(k) ECM
(l) Advance angle check valve
(m) Advance angle oil pressure chamber

Delay angle

When the oil control valve assembly operates in response to the signal transmitted from the ECM, the spool valve moves to the left side. Due to the positive cam torque, the oil pressure of the advance angle chamber is applied in the delay angle oil pressure chamber through the delay angle check valve. The rotor vane integrated in the camshaft rotates in the delay angle direction against the rotations of the housing and the sprocket (engine is rotated by the timing chain drive), and delays the angle of valve timing.

Since the detent oil passage is closed due to being pushed by the oil pressure of the oil pump, the detent valve does not operate.



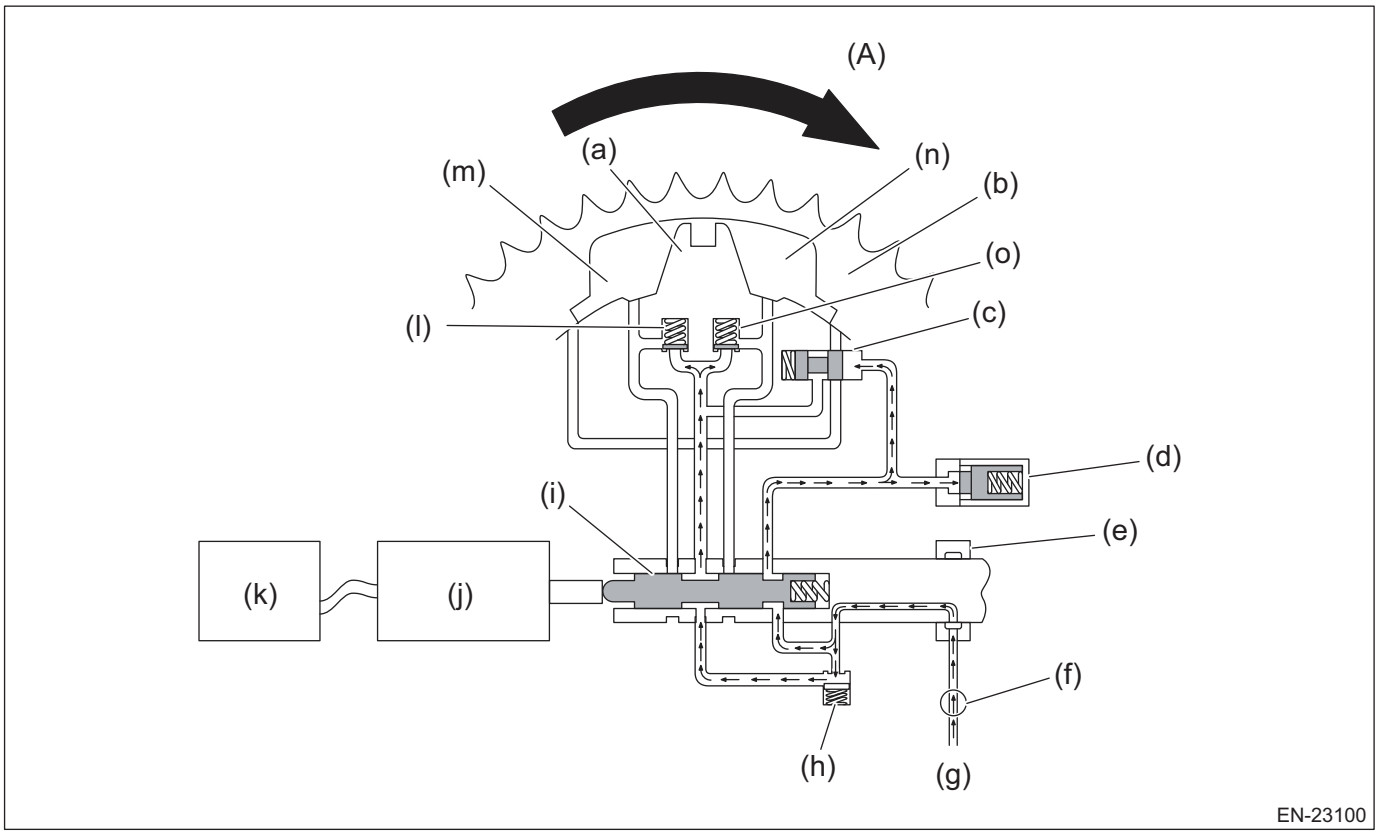
(A) Cam sprocket rotation direction

(a) Rotor vane
(b) Housing and sprocket
(c) Detent valve
(d) Lock pin
(e) Front camshaft cap
(f) Oil pump
(g) From oil strainer
(h) Inlet check valve
(i) Spool valve
(j) Oil control valve assembly
(k) ECM
(l) Delay angle check valve
(m) Delay angle oil pressure chamber

Holding

When the oil control valve assembly operates in response to the signal transmitted from the ECM, the spool valve holds at the middle position. When the spool valve and the check valve are closed in each interior oil passage, these valves hold at any position. The rotor vane integrated in the camshaft holds at any position against the rotations of the housing and the sprocket (engine is rotated by the timing chain drive), and holds the valve timing.

Since the detent oil passage is closed due to being pushed by the oil pump, the detent valve does not operate.



(A) Cam sprocket rotation direction

(a) Rotor vane
(b) Housing and sprocket
(c) Detent valve
(d) Lock pin
(e) Front camshaft cap
(f) Oil pump
(g) From oil strainer
(h) Inlet check valve
(i) Spool valve
(j) Oil control valve assembly
(k) ECM
(l) Advance angle check valve
(m) Advance angle oil pressure chamber
(n) Delay angle oil pressure chamber
(o) Delay angle check valve

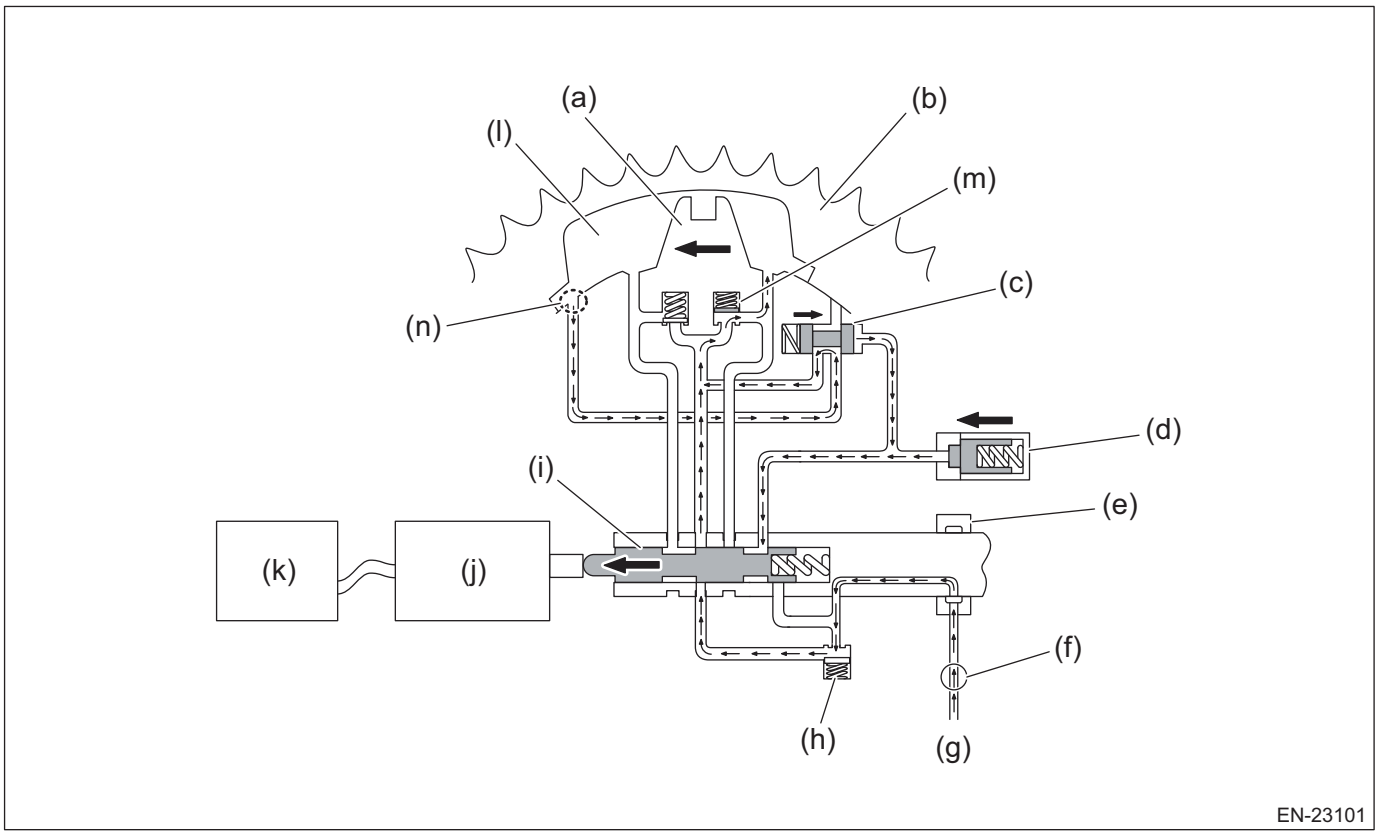
Intermediate lock

When the oil control valve assembly is turned off (IG OFF), the spool valve moves and operates the detent valve, and oil flows through the detent oil passage. This moves the rotor to the locking position and is fitted by the lock pin.

The overlap when engine starts is optimized to prevent blow back amount of the exhaust gas to the intake port and improve fuel efficiency and start performance.

Reference

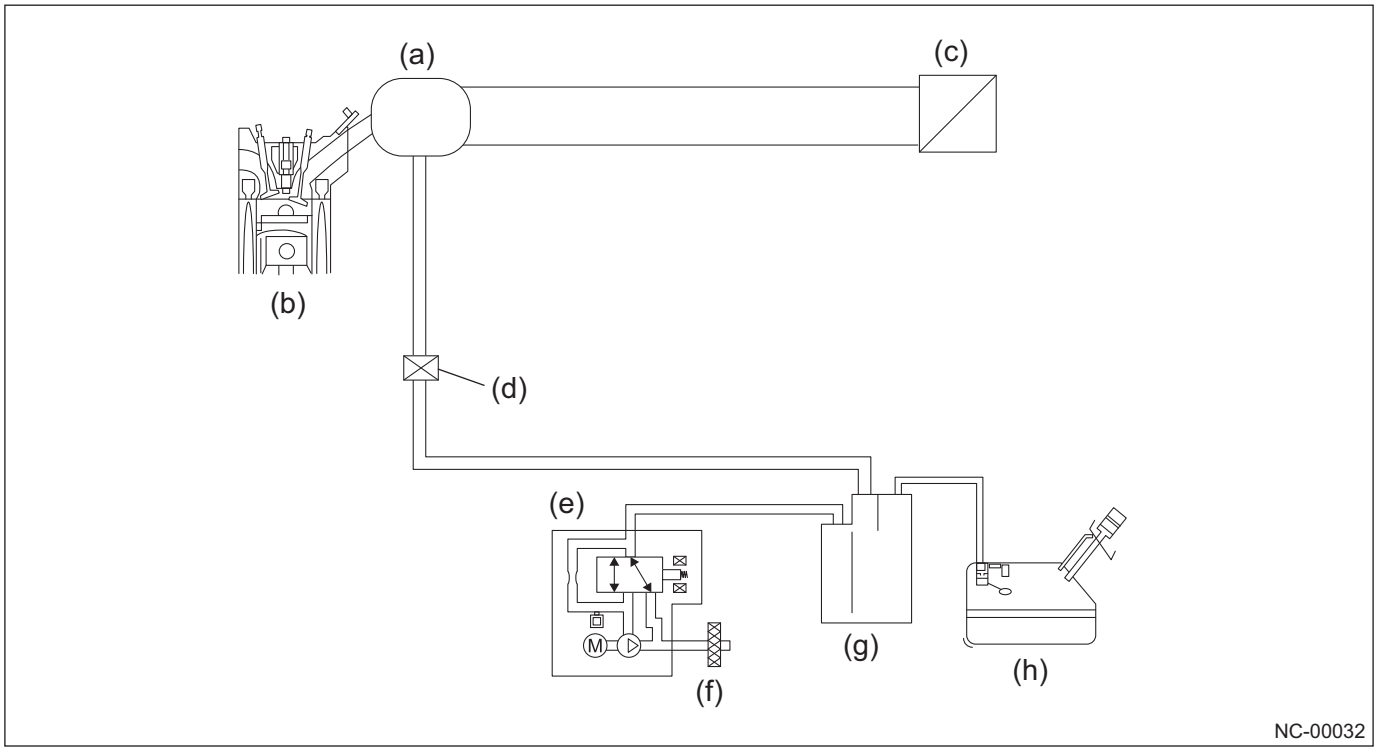
In the following diagram, the detent port in the advance angle oil pressure chamber is opened and oil is passing through the detent valve and flowing into the delay angle oil passage side and the delay angle oil passage chamber.



(a) Rotor vane
(b) Housing and sprocket
(c) Detent valve
(d) Lock pin
(e) Front camshaft cap
(f) Oil pump
(g) From oil strainer
(h) Inlet check valve
(i) Spool valve
(j) Oil control valve assembly
(k) ECM
(l) Advance angle oil pressure chamber
(m) Delay angle check valve
(n) Detent port

Canister purge control

ECM makes the purge control solenoid valve take in the fuel evaporation gas from the canister into the engine depending on engine conditions. The purge control solenoid valve is located in front of the intake manifold.



(a) Intake manifold
(b) Engine
(c) Air cleaner
(d) Purge control valve
(e) Evaporative Leak Check Module
(f) Drain filter
(g) Canister
(h) Fuel tank

2.9 Ignition

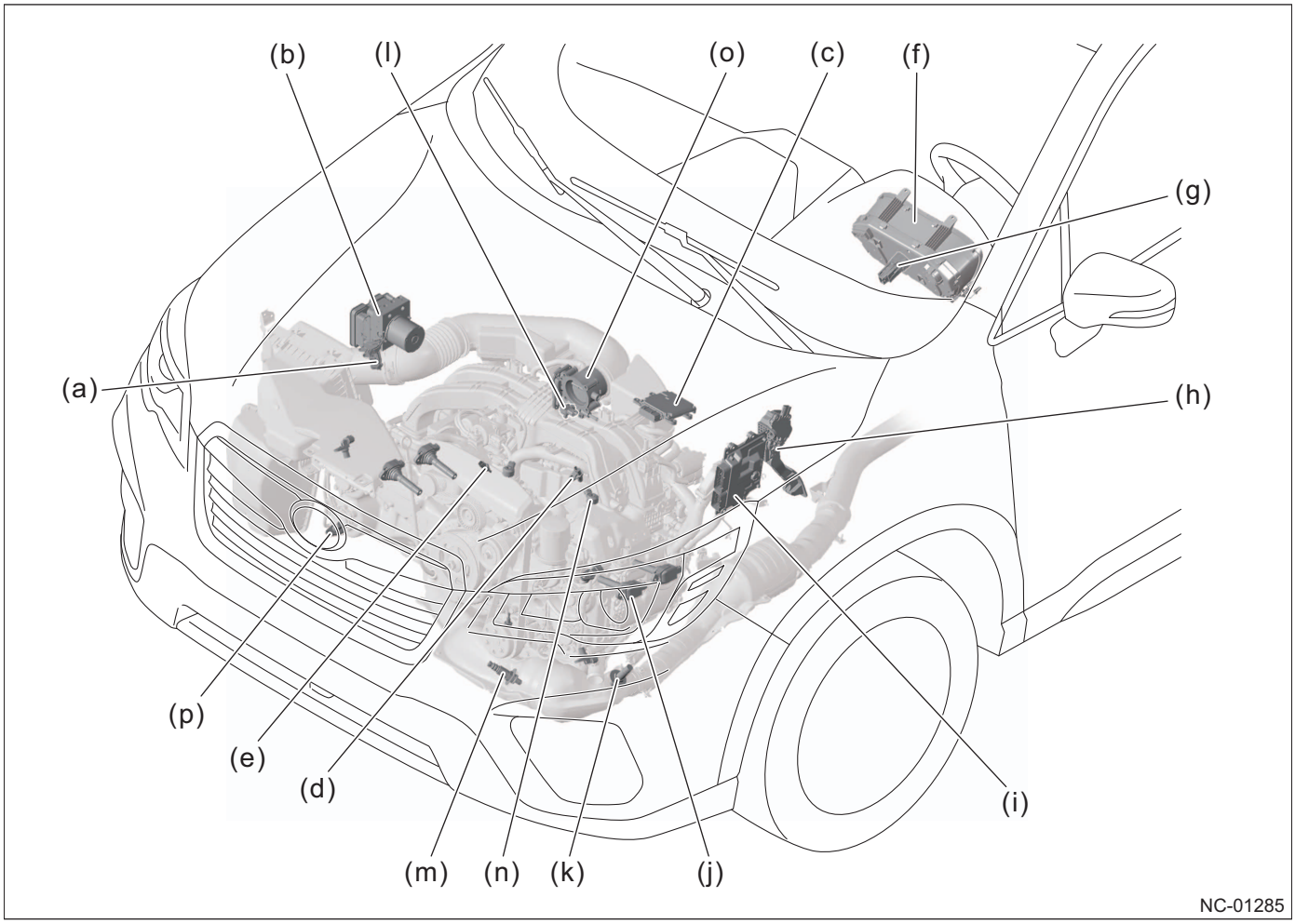
2.9.1 Overview

The following systems are adopted for ignition.

- Small ignition coil
- Optimized spark plug

2.9.2 Component

Component layout drawing

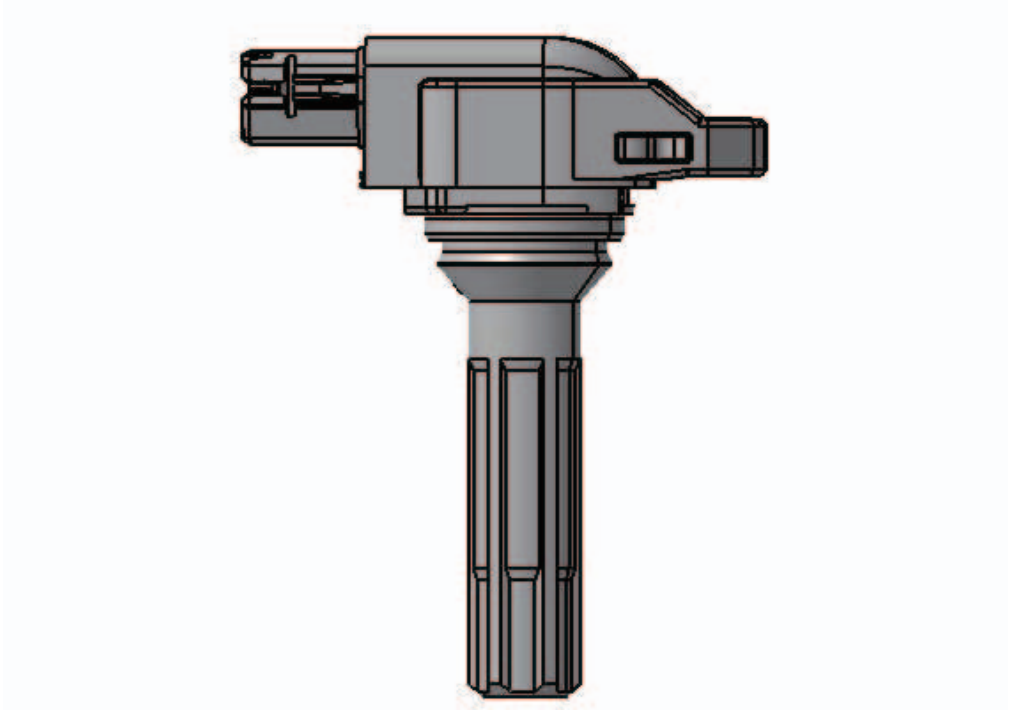


(a) Air flow and intake air temperature sensor
(b) VDCCM & H/M
(c) TCM
(d) Crankshaft position sensor
(e) Engine coolant temperature sensor
(f) Combination meter
(g) Ignition switch and push button ignition switch
(h) Accelerator pedal position sensor
(i) ECM
(j) Ignition coil assembly
(k) Rear oxygen sensor
(l) Manifold absolute pressure sensor
(m) Front oxygen (A/F) sensor
(n) Knock sensor
(o) Throttle position sensor
(p) Camshaft position sensor

Component details

Ignition coil

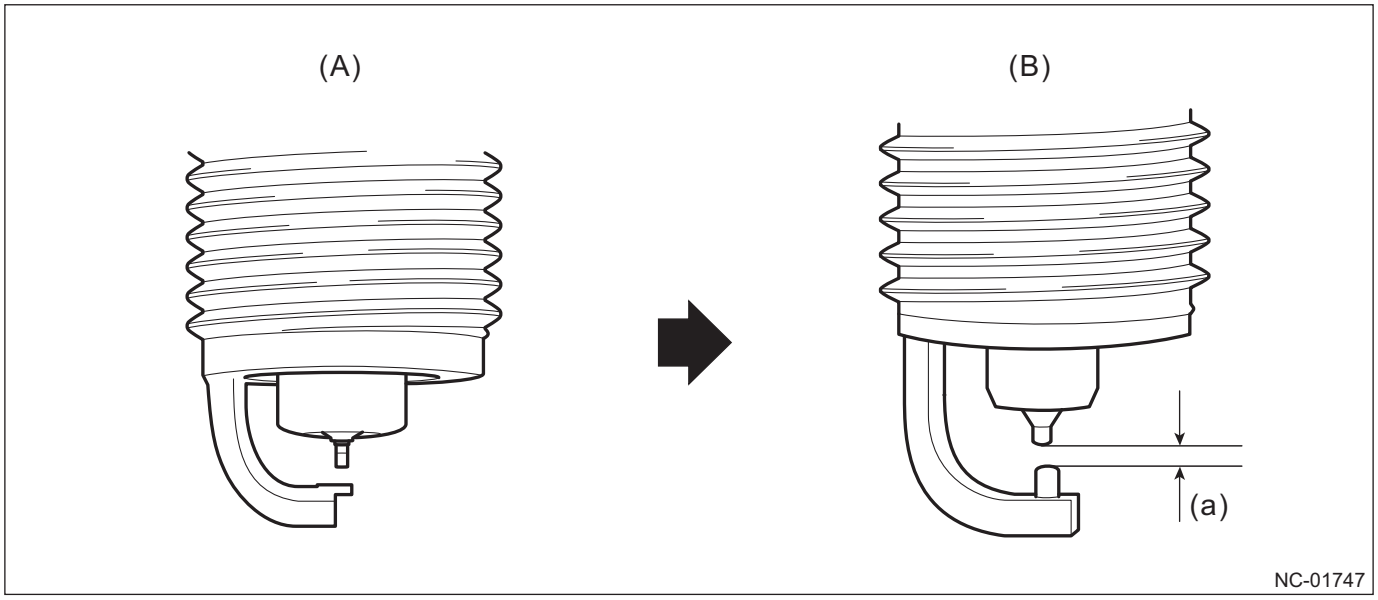
The coil has a small and lightweight built-in ignitor to induce high voltage on the secondary coil side in response to the signal transmitted from ECM.



EN-23056

Spark plug

The center electrode is made of iridium alloy, and the electrode position is optimized based on the combustion concept. The shape of the outer electrode is changed to improve the fuel efficiency.



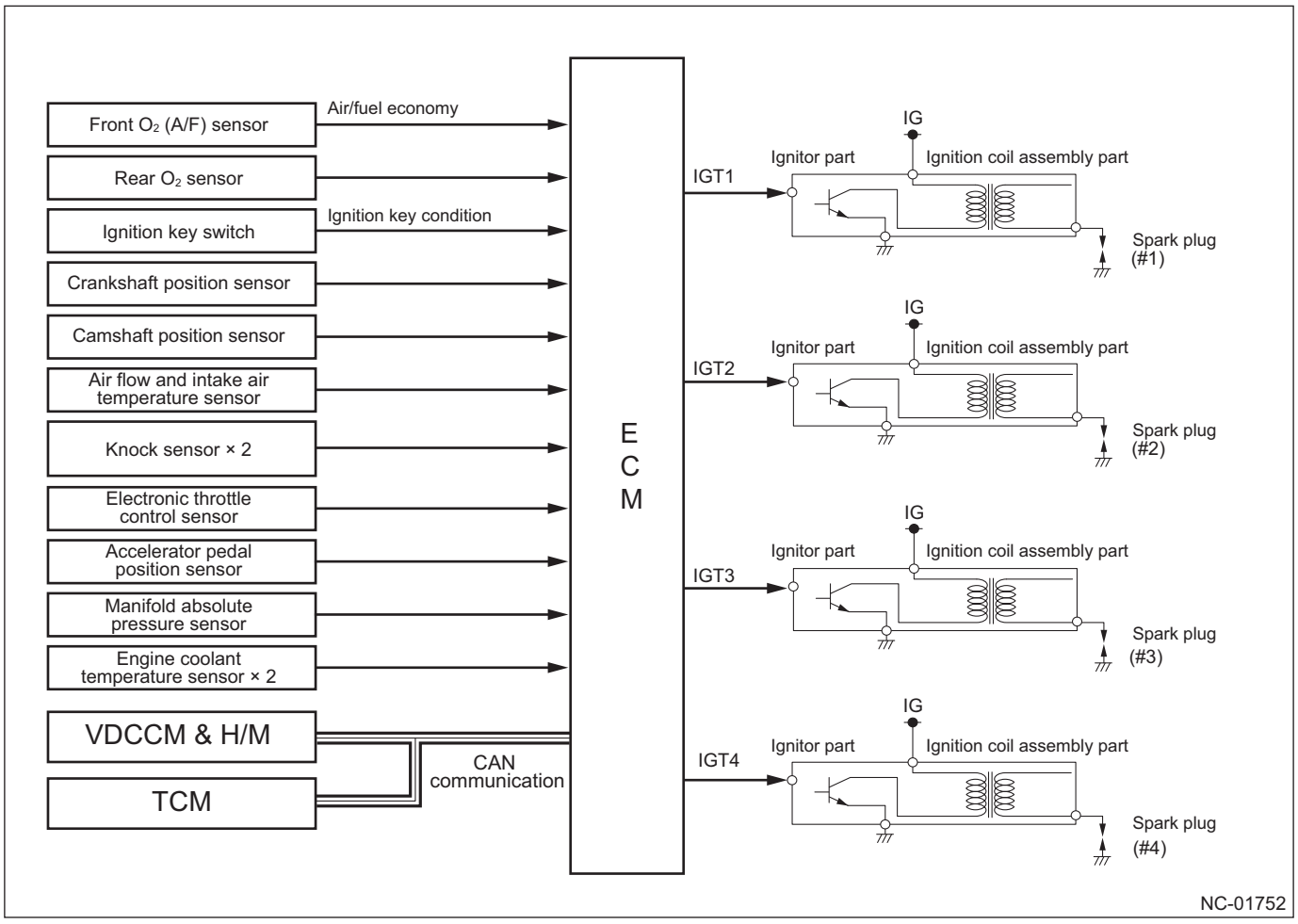
(A) Existing model vehicle

(B) New model vehicle

(a) Gap: 0.028 to 0.031 in (0.7 to 0.8 mm)

2.9.3 Construction and Operation

System diagram



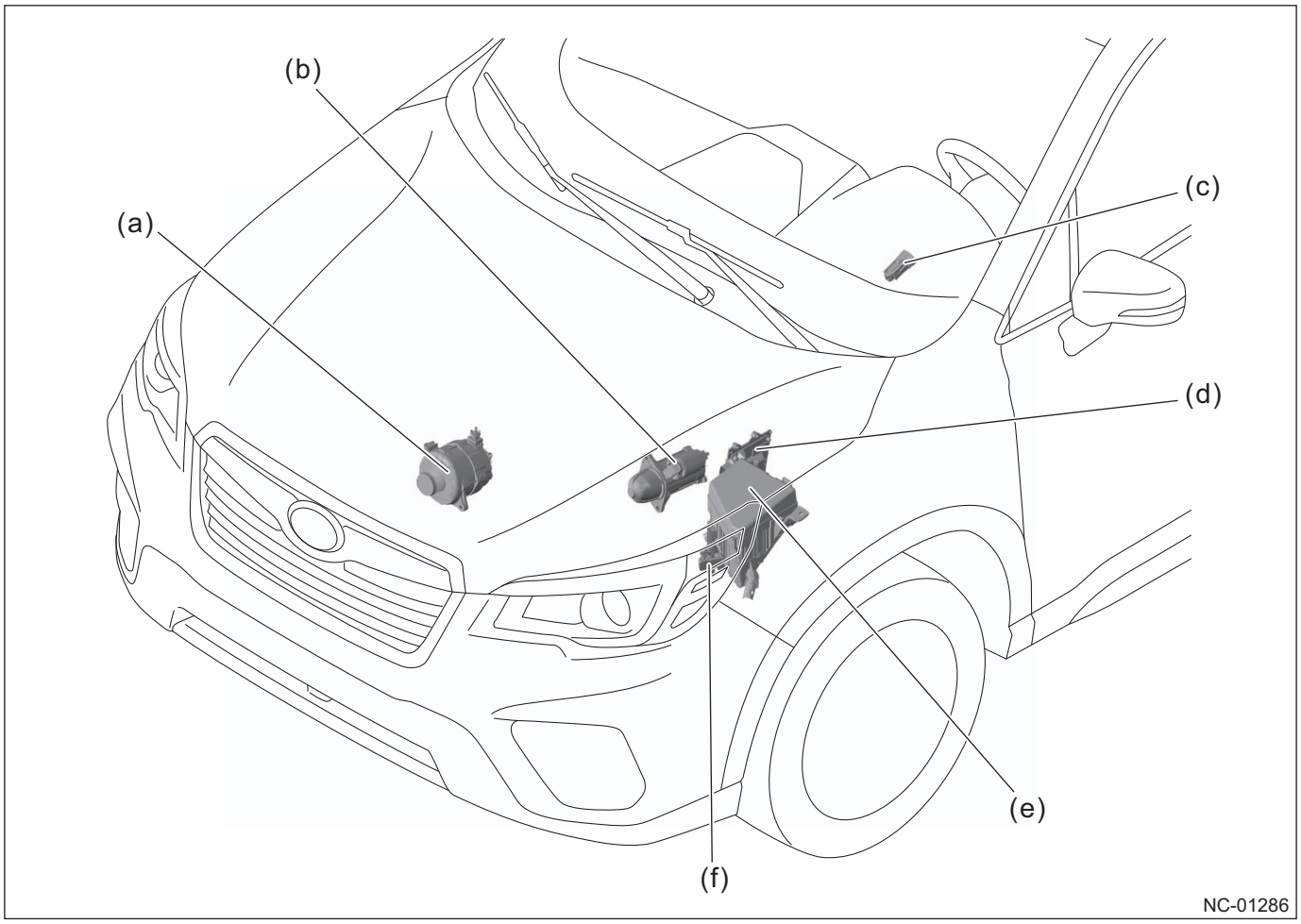
2.10 Starting/Charging System

2.10.1 Overview

Starting/charging system optimally controls the starter driving time and the generator electricity generation through ECM.

2.10.2 Component

Component layout drawing

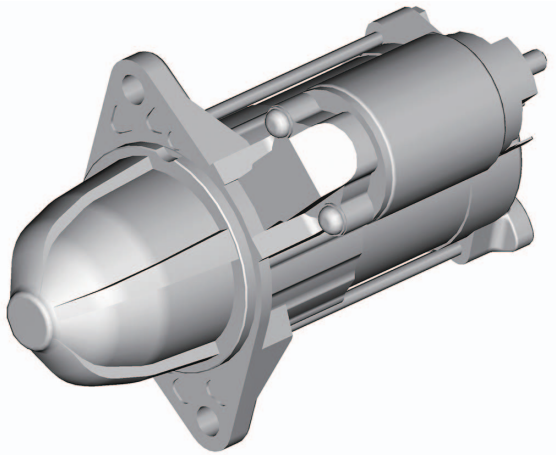


(a) Generator
(b) Starter
(c) Ignition switch and push button ignition switch
(d) ECM
(e) Relay BOX
(f) Battery sensor

Component details

Starter

The small and lightweight reduction-type starter assembly is adopted.



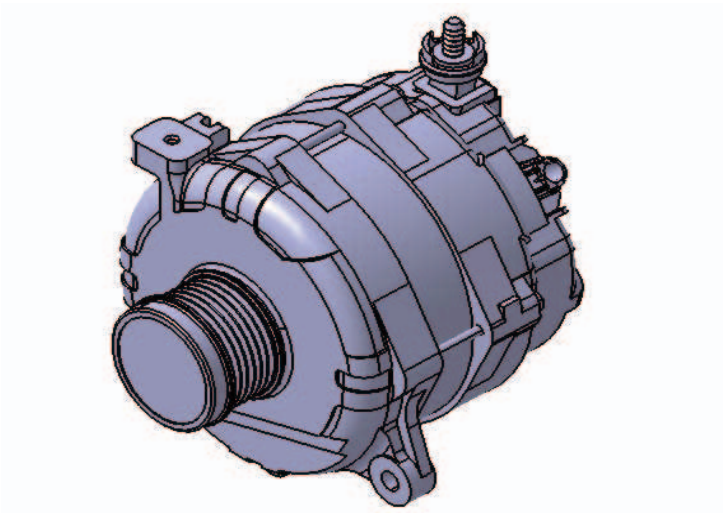
NC-00025

Starter specifications

Type	Reduction type
Rated voltage (V)	12
Rated output (kW)	1.4

Generator

Small and lightweight generator assembly with the high output and efficiency is adopted.



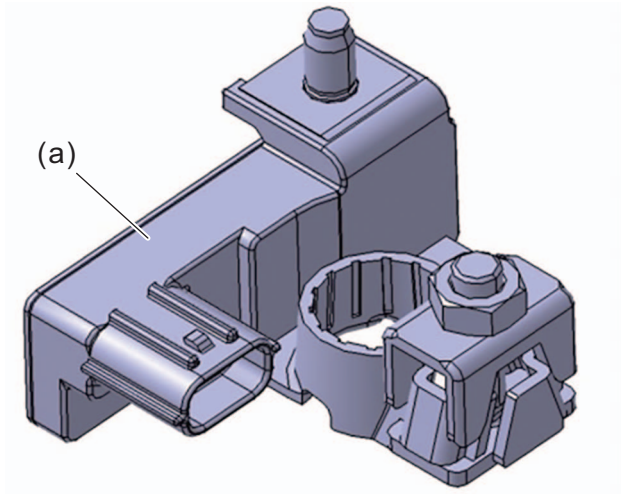
EN-23062

Generator specifications

Rated voltage (V)	12
Rated output (A)	150

Battery sensor

Battery sensor that measures charge and discharge currents of a battery, voltage, and temperature is adopted to accurately maintain charge conditions of a battery. Various types of measurement data are transmitted through the communication circuit with ECM. ECM controls the generation amount of the generator based on the data and maintains charge conditions of a battery.



NC-00078

(a) Battery sensor

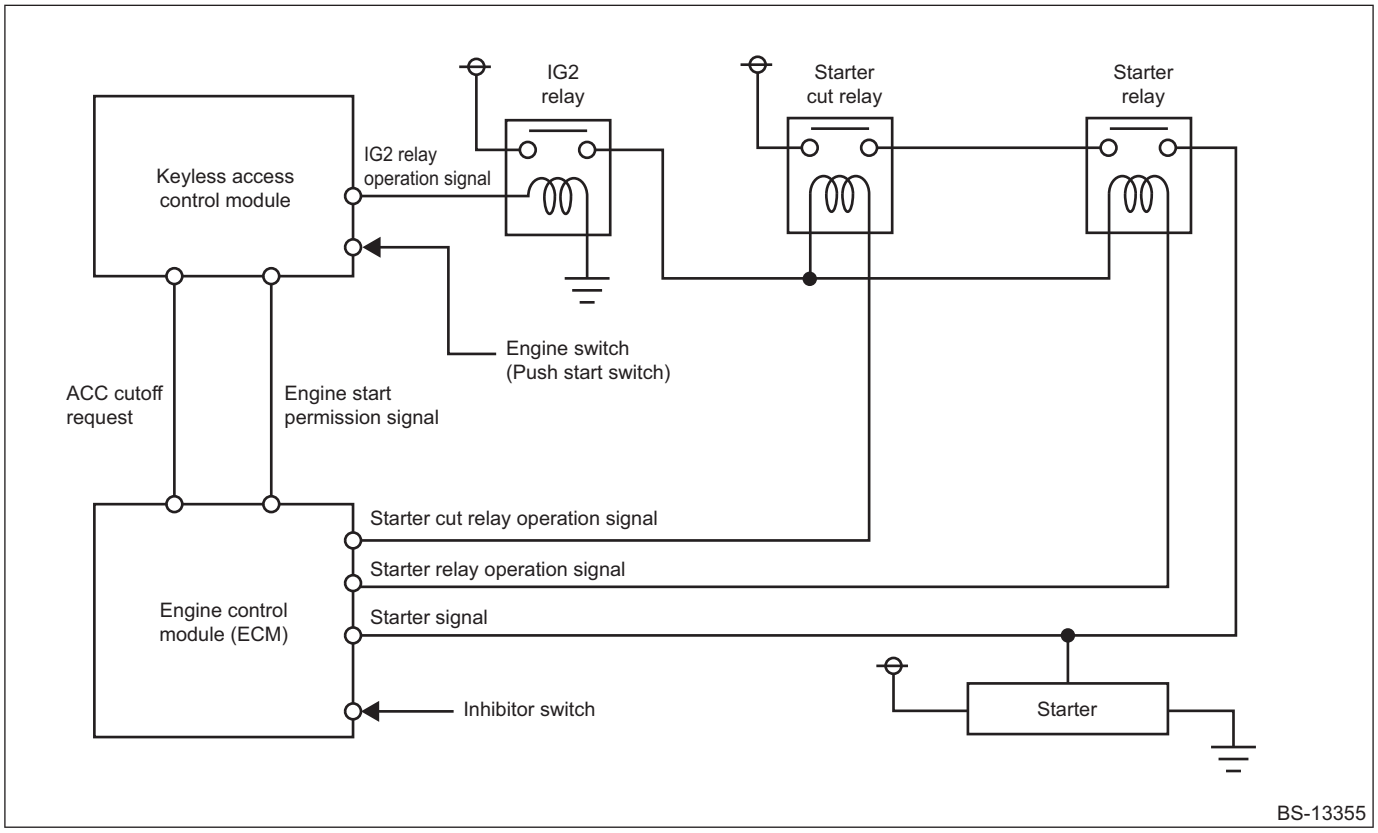
2.10.3 Construction and Operation

Starting system

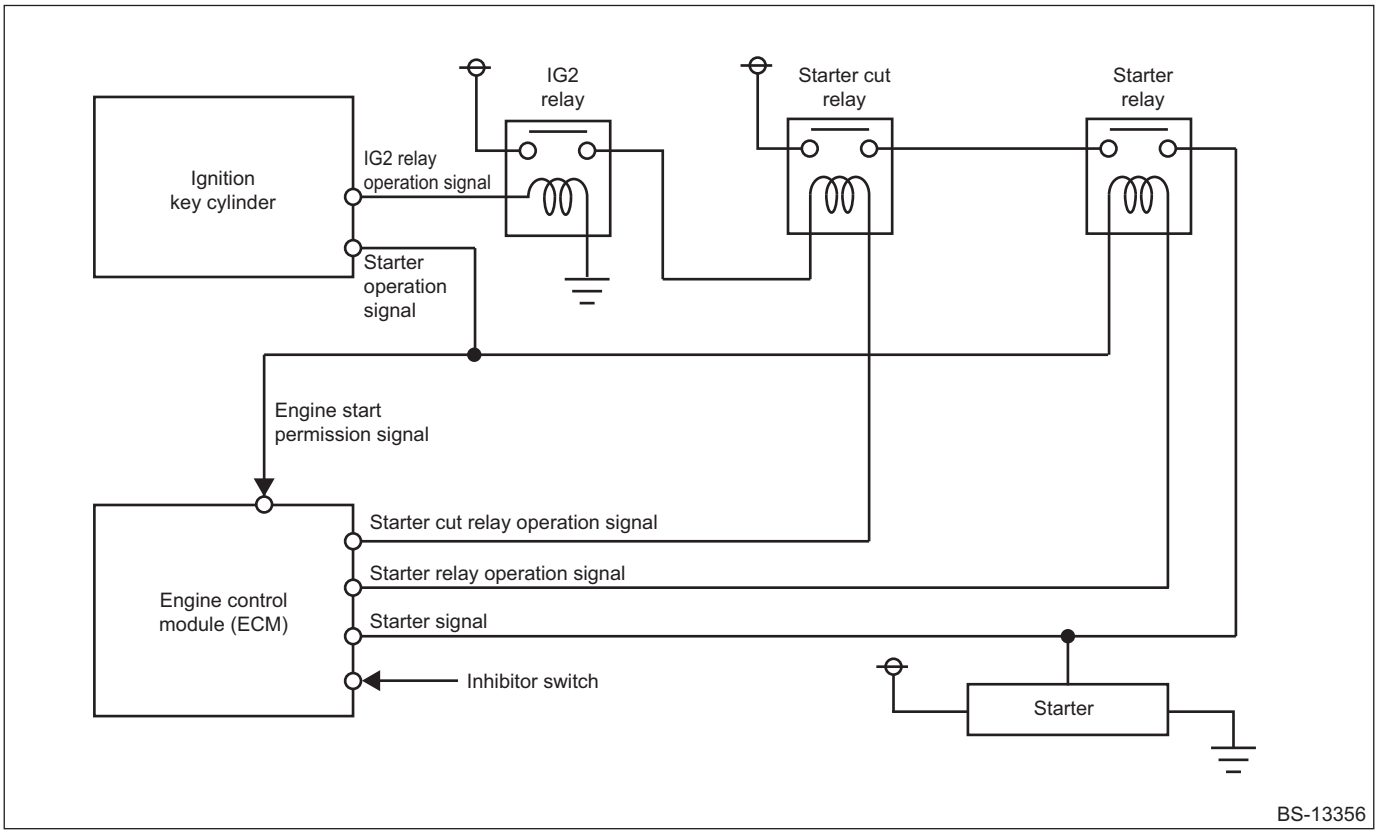
When the keyless access CM receives the start signal from the engine switch, the keyless access CM transmits the engine start permission signal to the ECM. When ECM receives the engine start permission signal, ECM determines each condition and operates the starter relay to start the starter. (Models with keyless access and push button start)

When ECM receives the start signal from the ignition switch, ECM determines each condition and operates the starter relay to start the starter.

Models with keyless access and push button start

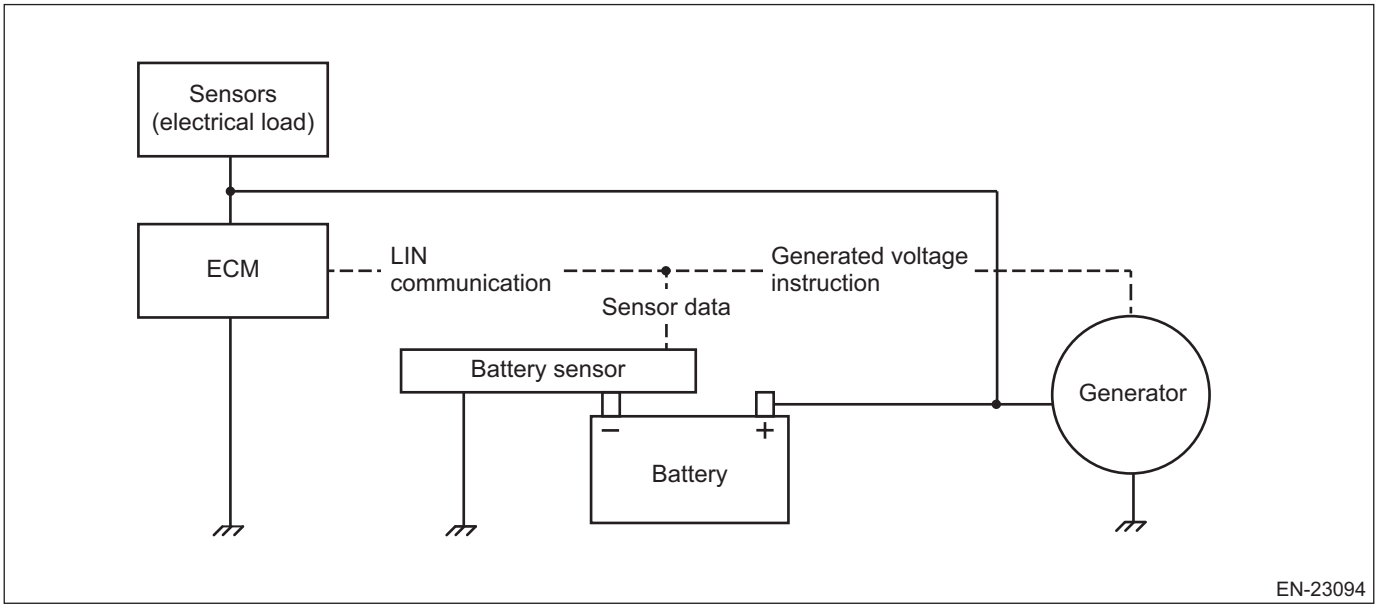


Models without keyless access and push button start



Charging system

ECM controls the power generation load of the generator depending on the vehicle driving conditions and optimally controls the generation voltage.



2.11 Auto Start-Stop System

2.11.1 Overview

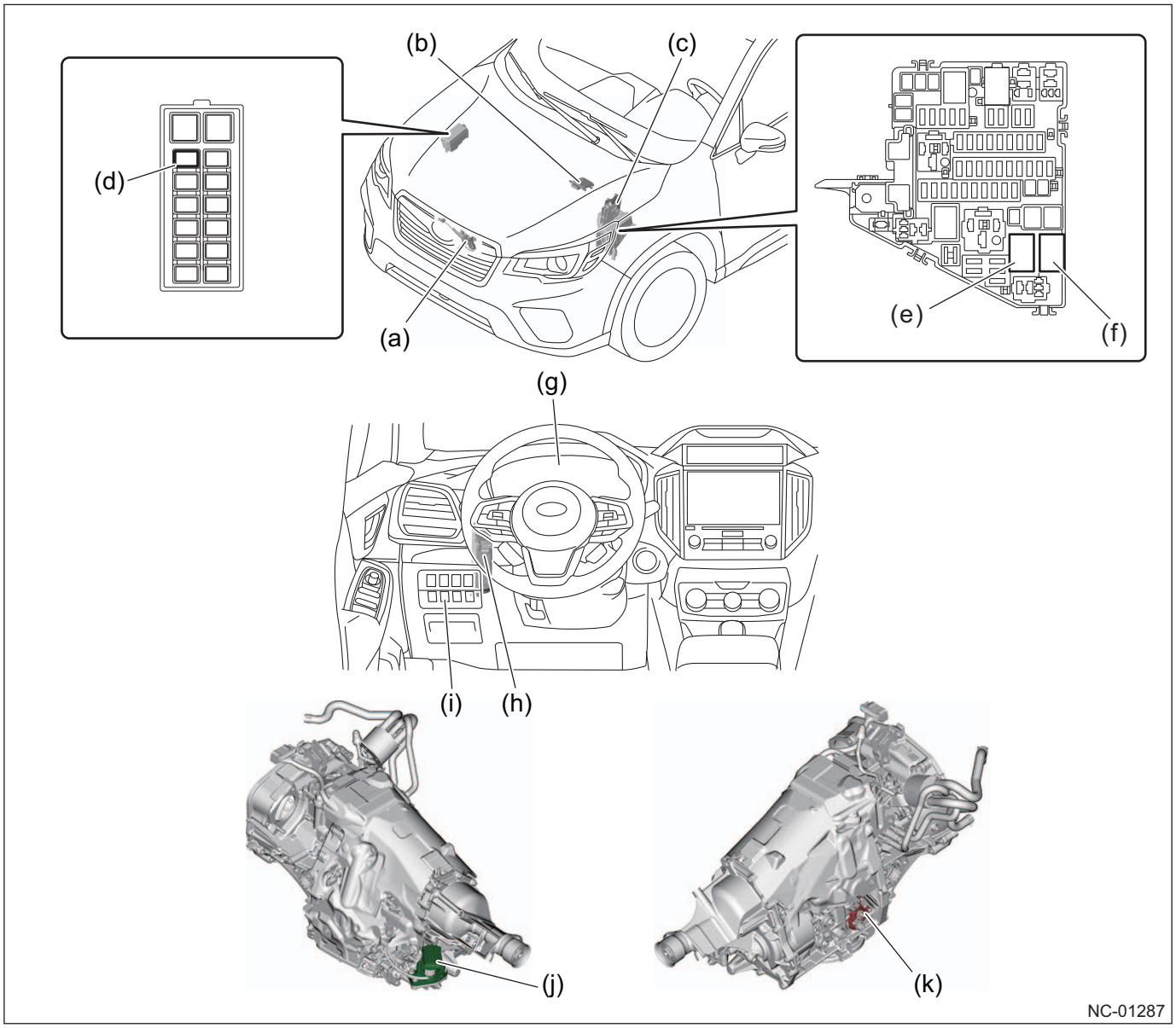
The Auto Start-Stop control module is integrated into the TCM.

The newly designed crankshaft position sensor and the crankshaft position sensor plate enable the detection of reverse rotation of the engine.

With adoption of the auto vehicle hold (AVH) function, convenience is improved by reviewing the control so that the Auto Start-Stop continues while this function is operating even if the foot is released from the brake pedal.

2.11.2 Component

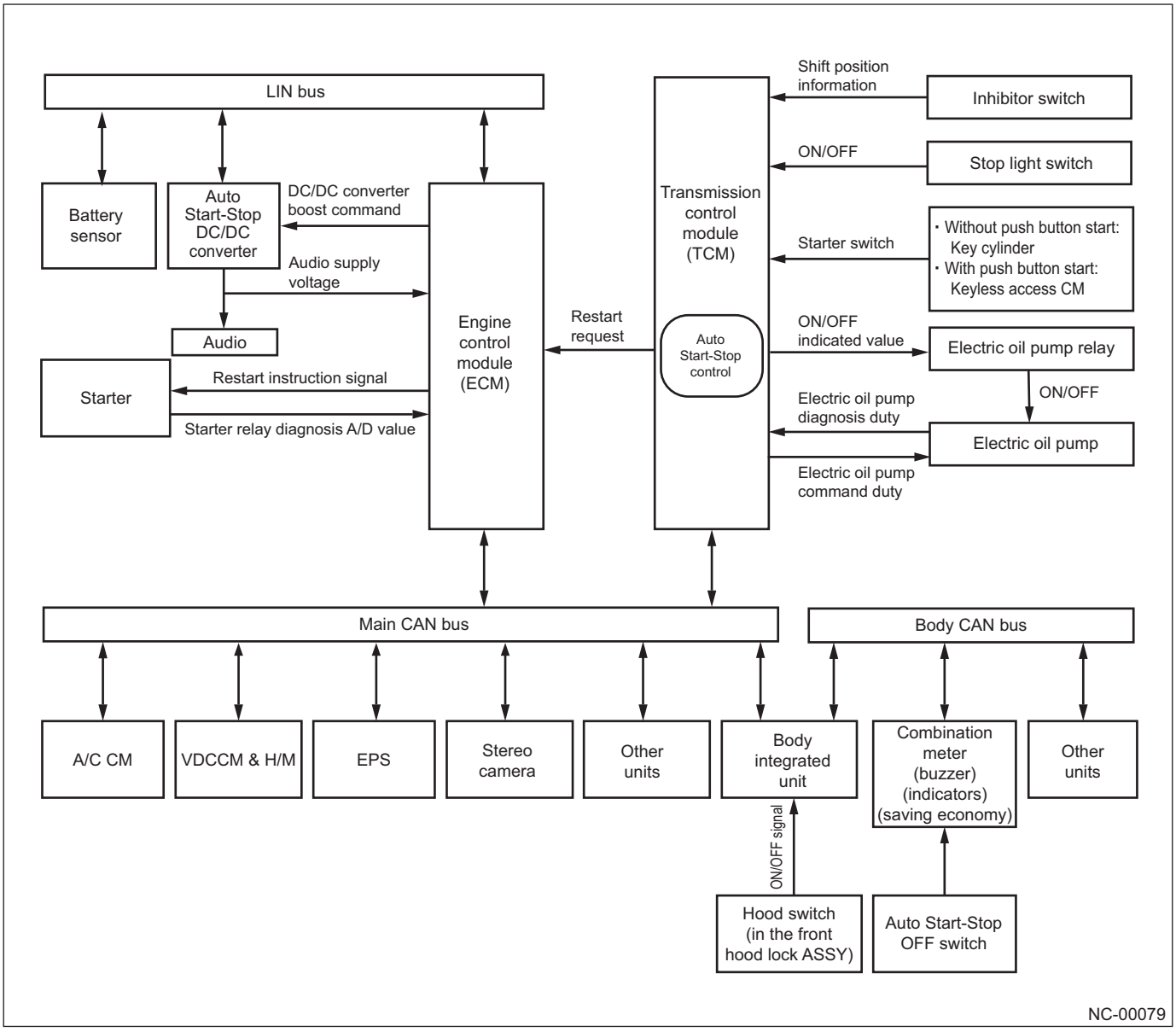
Component layout drawing



(a) Hood switch (in the front hood lock assembly)
(b) TCM
(c) ECM
(d) Electric oil pump relay (in the relay holder)
(e) Starter relay (in M/B)
(f) Starter cut relay (in M/B)
(g) Combination meter
(h) Auto Start-Stop DC/DC converter
(i) Auto Start-Stop OFF switch (driver's seat side)
(j) Electric oil pump
(k) Inhibitor switch

2.11.3 Construction and Operation

System diagram



Auto Start-Stop system operation

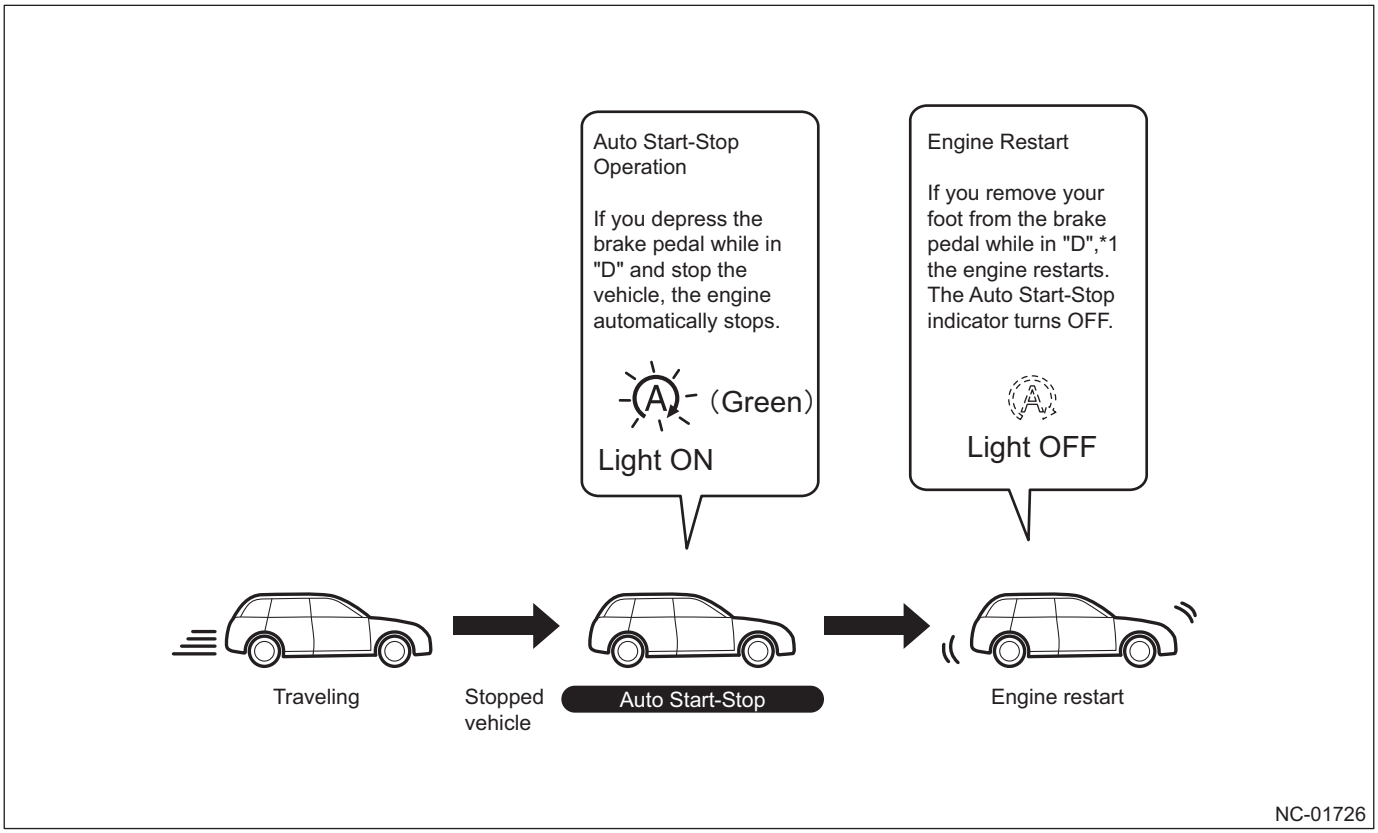
The Auto Start-Stop is a function that automatically stops the engine by brake operation when the vehicle is stopped while waiting for a traffic light or during traffic jam after the engine is warmed up. This function improves the fuel efficiency and reduces the exhaust gas and idling noise. Releasing the brake pedal restarts the engine automatically. When all the following conditions are met and continue for 0.5 seconds or more, the engine is automatically stopped.

Existing model vehicles perform the Auto Start-Stop control keeping the brake fluid pressure constant in consideration of burst-out or slide-down of vehicles on a slope; however, the pressure is too large on a level land in some cases. New model vehicles increase the frequency of the Auto Start-Stop of engine by changing the brake conditions based on the inclination of a slope. The brake fluid pressure is set according to the inclination of a slope. The pressure is set to 1.04 MPa (10.6 kg/cm^2, 151 psi) on a level land, and set to 1.95 MPa (19.88 kg/cm^2, 283 psi) on a downhill. The operating condition of the Auto Start-Stop on a downhill is increased from 3% to 8 %.

In addition, the controllable altitude is increased from 1,500 m (4,922 ft) to 3,000 m (9,843 ft) to enable the control at high altitudes.

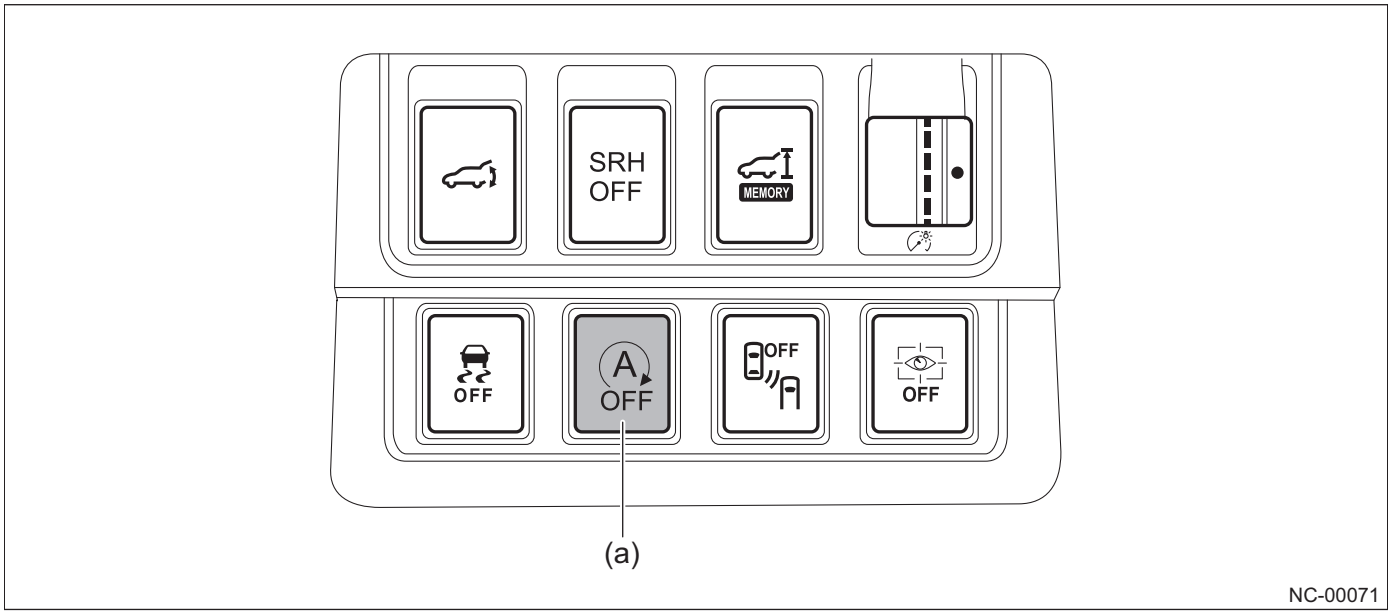
The Auto Start-Stop function can be canceled by operating the Auto Start-Stop OFF switch. If the vehicle is not driven with the engine idling after the start-up of the engine, the Auto Start-Stop is not activated.

Operation



*1: When the vehicle is in the half-stop state by the adaptive cruise control or AVH, the engine is not restarted even if the foot is released from the brake pedal.

Auto Start-Stop OFF switch



(a) Auto Start-Stop OFF switch

Auto Start-Stop operating conditions

The Auto Start-Stop operating conditions and non-operating conditions are shown below.

Condition	Item
Operating conditions	The engine is well warmed up.
	The door of the driver's seat is closed.
	The driver is wearing the seat belt.
	The air conditioner "Defroster switch" is OFF. (full automatic air conditioner: push type)
	The air conditioner mode switching dial is at a position other than "DEF". (full automatic air conditioner: dial type)
	The rear window defogger switch is OFF.
	The turn signal light is not operated.*
	After the vehicle is stopped, the steering wheel is in the straight running position.
	After the vehicle is stopped, the steering wheel is not operated.
	The X-MODE is not operated.
Non-operating conditions	The engine warning light is turned on.
	The Auto Start-Stop warning light or Auto Start-Stop OFF indicator light is turned on or blinking.
	The hood is open.
	The power rear gate is operating.
	The vehicle is at an altitude of 3,000 m (9,843 ft) or more.
	The electronic parking brake is operating.
	The vehicle is on a slope (slope angle ± 8%).
	The CVTF oil temperature is low or high.
	Battery voltage is not proper.
	The difference between the set temperature of the air conditioner and the temperature in the vehicle is large while the air conditioner is used.
	The air volume is large while the air conditioner is used.
	The X-MODE is operated
	The ABS is activated.

*: The operating condition differs depending on the customized setting.

Automatic cancellation of the Auto Start-Stop

In the following cases, the Auto Start-Stop is automatically canceled. The engine is restarted even if the foot is not released from the brake pedal.

If the hood is opened, it is not canceled automatically.

Condition	Item
Automatic cancellation conditions	When the brake pedal is released on a slope and the vehicle starts to move
	When the brake pedal is further depressed quickly
	When the accelerator pedal is depressed
	When the select lever is set to "R"
	When the select lever is set to "D" from "N" or "P"
	When the steering wheel is operated
	When the air conditioner "Defroster switch" is set to ON (full automatic air conditioner: push type)
	When the air conditioner mode switching dial is set to the "DEF" position (full automatic air conditioner: dial type)
	When the rear window defogger switch is set to ON
	When the set temperature of the air conditioner cannot be maintained
	When the turn signal light is operated *1
	When the electronic parking brake switch is operated
	When the driver's seat belt is released
	When the driver's seat door is opened
	When the negative pressure of the brake booster is reduced
	When the battery is being discharged
	When the AVH control is ended *2

*1: The operating condition differs depending on the customized setting.

*2: For details of AVH cancellation, refer to the descriptions on the auto vehicle hold (AVH) cancellation operation in Chapter 6 BRAKE SYSTEM. (page 6-26)

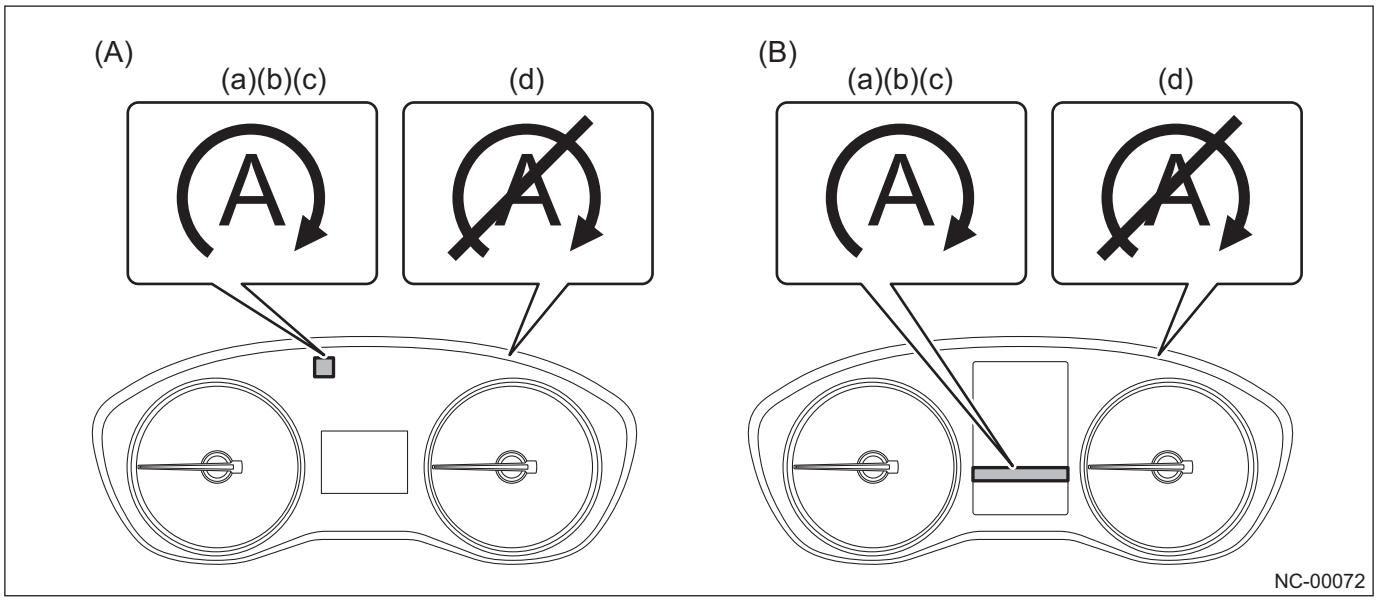
Indicator light and warning light

When the engine is automatically stopped, the Auto Start-Stop indicator light (green) lights up. It turns off when the engine is restarted.

When the Auto Start-Stop OFF switch is pressed to release the system, the OFF indicator light lights up (yellow).

If there is abnormality in the Auto Start-Stop system, the Auto Start-Stop warning light (yellow) blinks.

The Auto Start-Stop non-operation light is added to inform the Auto Start-Stop does not operate. The Auto Start-Stop non-operation light lights up if the Auto Start-Stop operation conditions are not satisfied when the vehicle is stopped. When the vehicle runs, it turns off.



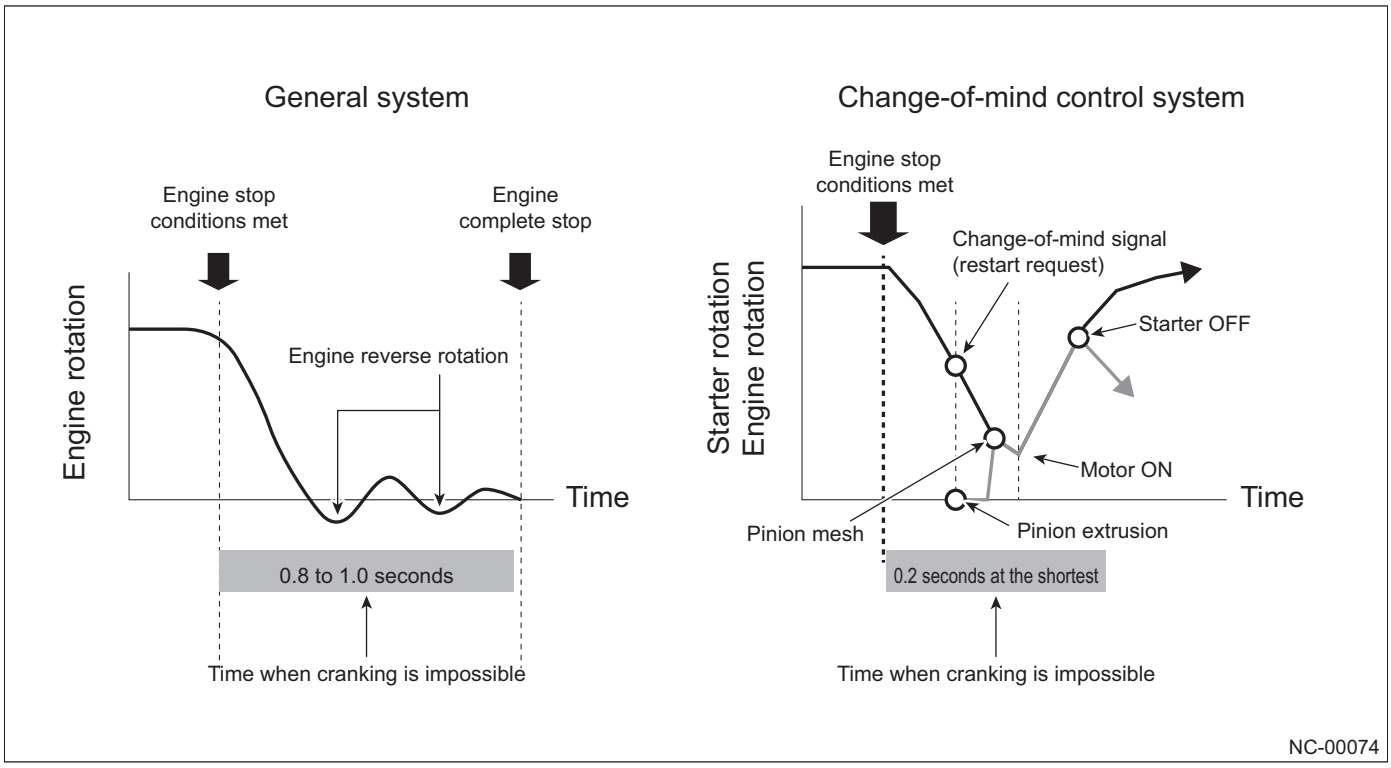
(A) Normal meter

(B) High grade meter

(a) Auto Start-Stop indicator light (green: lighting)
(b) Auto Start-Stop OFF indicator light (yellow: lighting)
(c) Auto Start-Stop warning light (yellow: blinking)
(d) Auto Start-Stop non-operation light (gray: lighting)

Change-of-mind control

Traditional systems required 0.8 to 1 second before restarting right after stopping such as when a traffic light changes or traffic jam clears. To respond to such cases, the change-of-mind control is adopted to drastically shorten the time to restart the engine to within 0.2 seconds.



3 DRIVE TRAIN

CONTENTS

3.1 General Overview

3.1.1 Overview

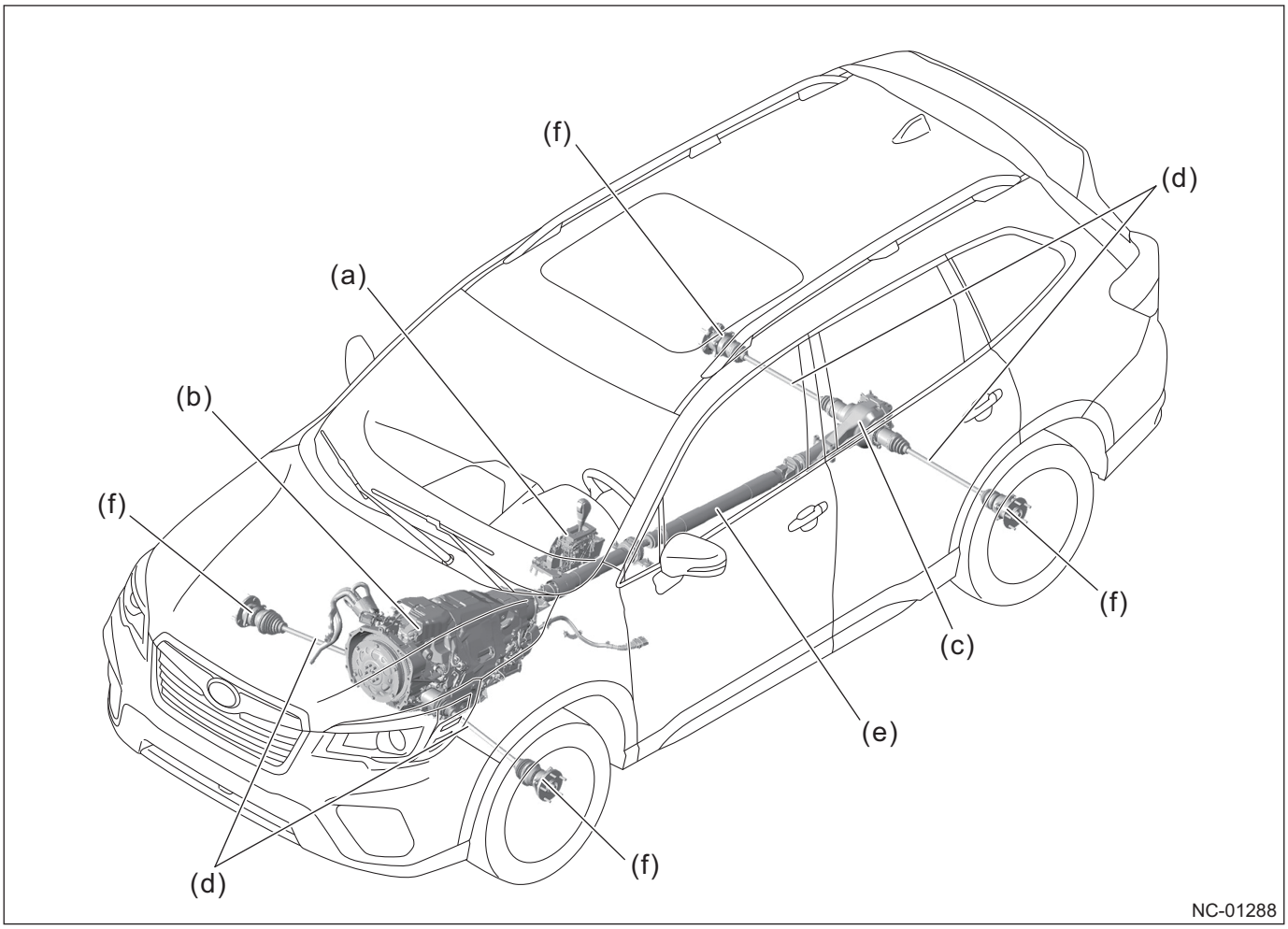
This chapter describes a set of mechanisms that transmits power to tires.

The drive train is mainly composed of the following parts.

- Transmission: Device that reduces and increases the engine speed and transmits force to the drive wheels.
- Differential: Device that absorbs the rotation differences between right and left and front and rear drive wheels that occur when turning, etc.
- Propeller shaft: Shaft that transmits drive force from the transmission to the rear differential.
- Drive shaft: Shaft that transmits drive force from the differential to the drive wheels.

Also, the select lever mechanism which selects the shift position of the transmission is described in Control System.

Component layout drawing



(a) Control system
(b) Continuously variable transmission (CVT)
(c) Rear differential
(d) Drive shaft
(e) Propeller shaft
(f) Axle

3.1.2 Specification

Continuously variable transmission

Driving method		AWD
Transmission type		TR580
Torque converter type		With 3-element, single stage, 2-phase lock-up mechanism
Clutch		Sprag one-way clutch
Gear ratio	Low	3.600
	OD	0.512
	REV	3.687
Pulley specification	Pulley ratio (Low)	2.683
	Pulley ratio (OD)	0.382
	Ratio coverage	7.031
Gear ratio	Reduction gear	1.342
	TRF gear	1.000
	Front final gear	3.700
	REV gear	1.024
Forward and reverse switching elements	Forward	Wet type multi-plate clutch: 1 set
	Reverse	Wet type multi-plate brake: 1 set
AWD mechanism		Active torque split AWD
Torque converter	Nominal diameter (in (mm))	9.29 (ϕ 236)
	Stall torque ratio	2.18
	Stall speed (r/min)	2,550 to 1,950 (D range), 2,450 to 1,850 (R range)
CVTF	Name	Subaru CVT fluid lineartronic II
	Oil amount (US qt (L, Imp qt))	12.41 to 12.94 (11.74 to 12.24, 10.33 to 10.77)
Front differential gear oil	Name	SUBARU GEAR OIL EXTRA MT
	Oil amount (US qt (L, Imp qt))	1.28 to 1.38 (1.21 to 1.31, 1.06 to 1.15)

Rear differential

Rear differential type			VA type
LSD type			-
Gear type			Hypoid gear
Gear ratio			3.700
Drive pinion bearing preload (for new bearing)	Measured with spring scale (measured at the companion flange bolt hole)	N (kgf, lbf)	12.7 to 32.2 (1.3 to 3.3, 2.9 to 7.2)
	Measured with torque wrench	N・m (kgf-m, ft-lb)	0.48 to 1.22 (0.05 to 0.12, 0.35 to 0.90)
Side gear backlash		in (mm)	0.002 to 0.006 (0.05 to 0.15)
Hypoid driven gear backlash		in (mm)	0.004 to 0.006 (0.10 to 0.15)
Hypoid driven gear back surface runout limit		in (mm)	0.002 (0.05)
Total preload (measured at the companion flange bolt hole)		N (kgf, lbf)	12.7 to 32.2 (1.3 to 3.3, 2.9 to 7.2)
Companion flange mating surface runout limit		in (mm)	0.003 (0.08)
Companion flange runout on its inner side		in (mm)	0.003 (0.08)
Differential gear oil capacity		Name	SUBARU GEAR OIL EXTRA MT
		Oil amount US qt (L, Imp qt)	0.8 (0.8, 0.7)

Front drive shaft

Drive shaft type	Shaft diameter in (mm)	Shaft length in (mm)
High-efficiency compact ball fixed joint (EBJ) + pillow tripod joint (PTJ)	0.87 (22)	14.39 (365.4)

Rear drive shaft

Drive shaft type	Shaft diameter in (mm)	Shaft length in (mm)
Ball fixed joint (BJ) + double offset joint (DOJ)	0.87 (22)	16.2 in (410.8)

Propeller shaft

Propeller shaft type	High-efficiency compact double offset joint (EDJ)
Propeller shaft joint-to-joint length (front side)	26.6 in (675.5 mm)
Propeller shaft joint-to-joint length (rear side)	29.41 in (747 mm)
Outer diameter of tube:	2.50 in (63.5 mm)
	2.3 in (57.5 mm)

3.2 Control System

3.2.1 Overview

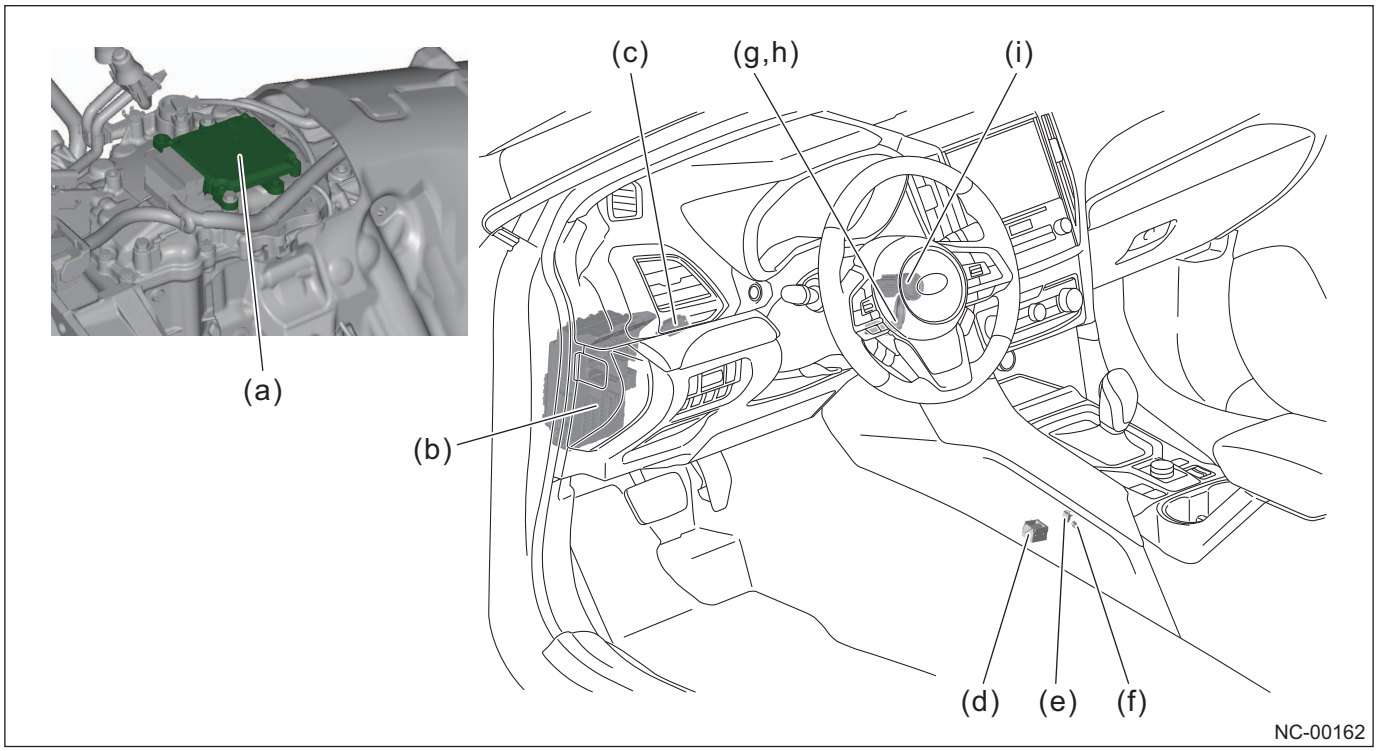
The following components, systems, etc. are adopted for the control system.

- Select lever with the shift boot or without boot (depending on grades)
- Plastic or leather select lever grip (depending on grades)
- Grip arrangement tailored to the seating position
- Select lever boot with silver or orange stitch applied (depending on grades)
- Red nighttime indicator illumination
- Silver paint or high-gloss black shift indicator cover (depending on grades)
- M mode or L mode (depending on grades)

3.2.2 Component

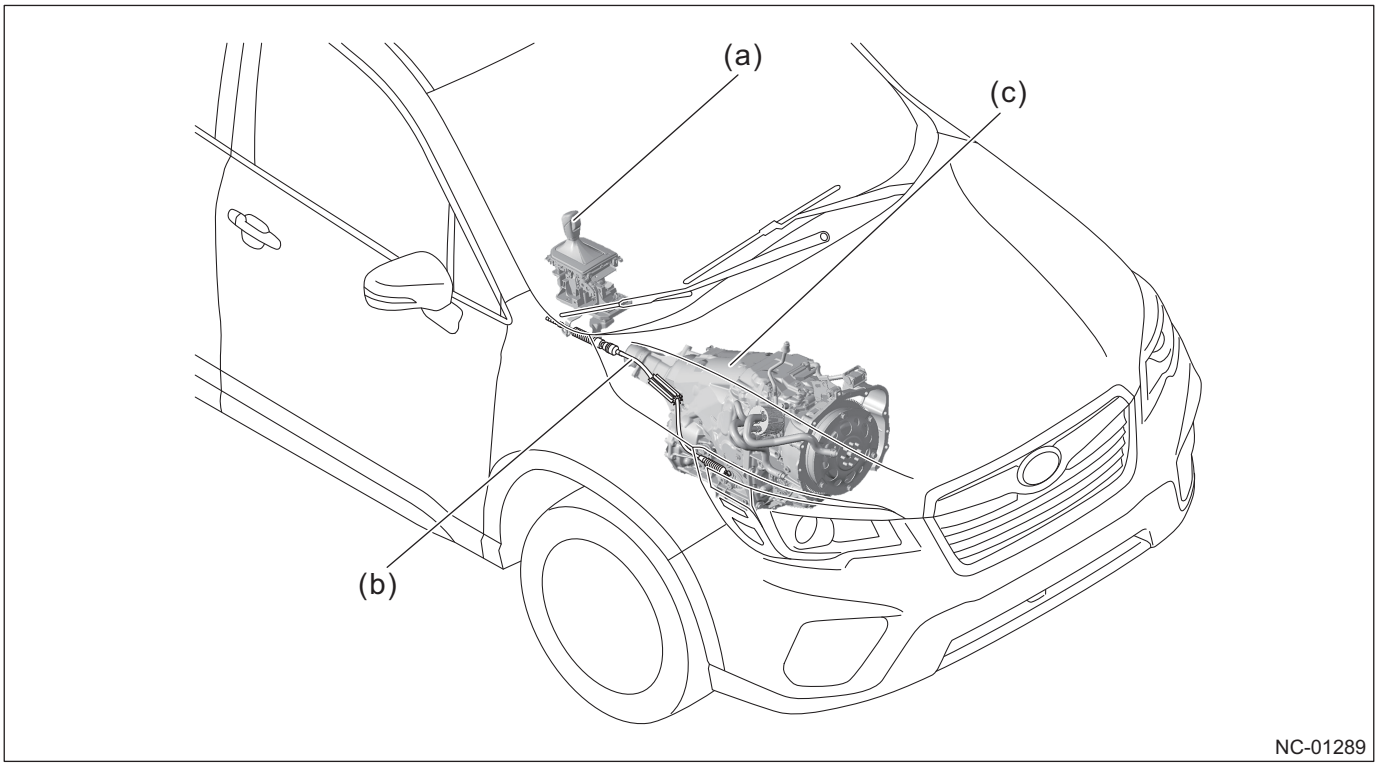
Component layout drawing

AT shift lock control system



(a) TCM
(b) Body integrated unit
(c) Stop light switch
(d) Solenoid unit
(e) "P" range switch
(f) M/Lo mode switch
(g) Key lock solenoid (Models without keyless access and push button start)
(h) Key warning switch (Models without keyless access and push button start)
(i) Ignition switch and push button ignition switch

Shift control system



(a) Select lever
(b) Control cable
(c) Continuously Variable Transmission (CVT)

Component details

Select lever

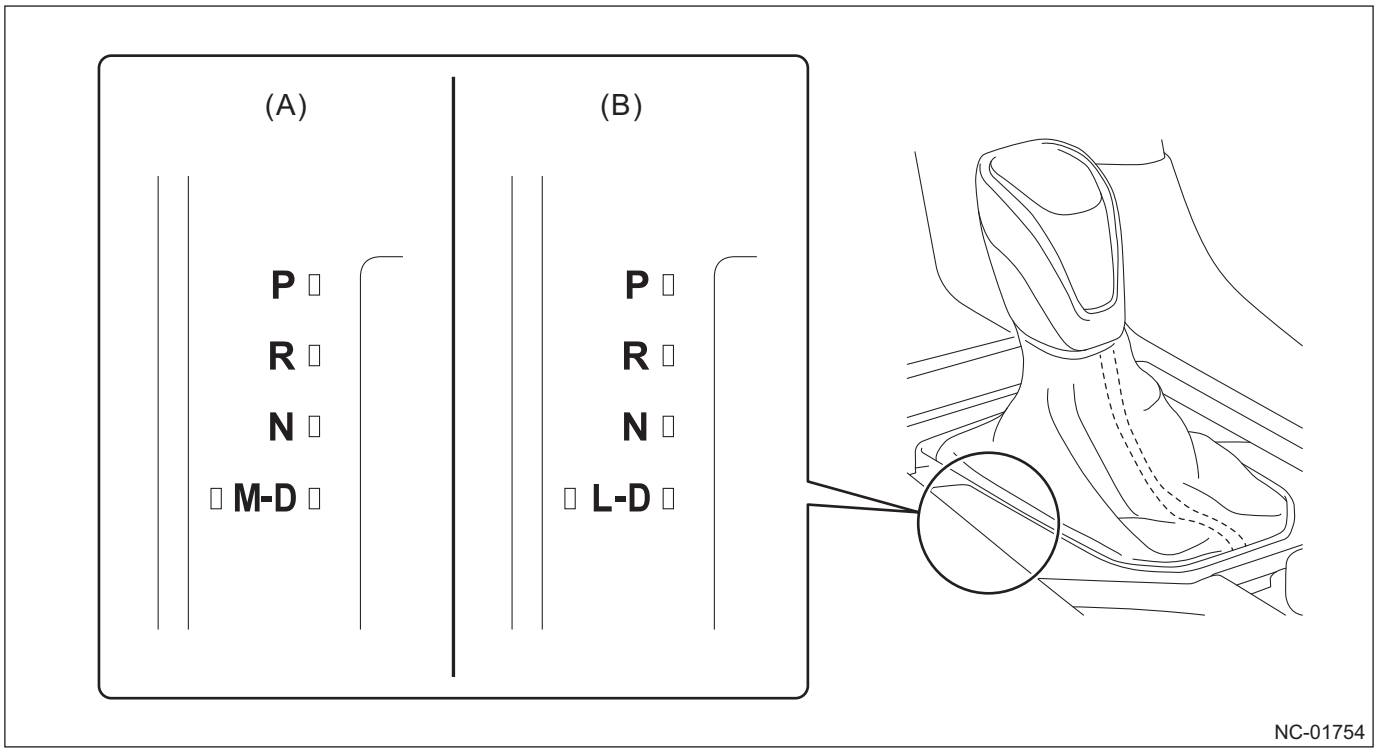
The shift boot design is adopted to improve the texture.

The following two types of shift patterns are adopted depending on grades.

- Vehicle with paddle shift switch: straight (PRND) + M mode
- Vehicle without paddle shift switch: straight (PRND) + L mode

The mode can be switched between M mode (vehicle with paddle shift switch) and L mode (vehicle without paddle shift switch) by moving the select lever sideways from the D range.

The select lever mechanism is equipped with a detent spring and a detent plate, providing more accurate shifting of the select lever.



(A) Vehicle with paddle shift switch

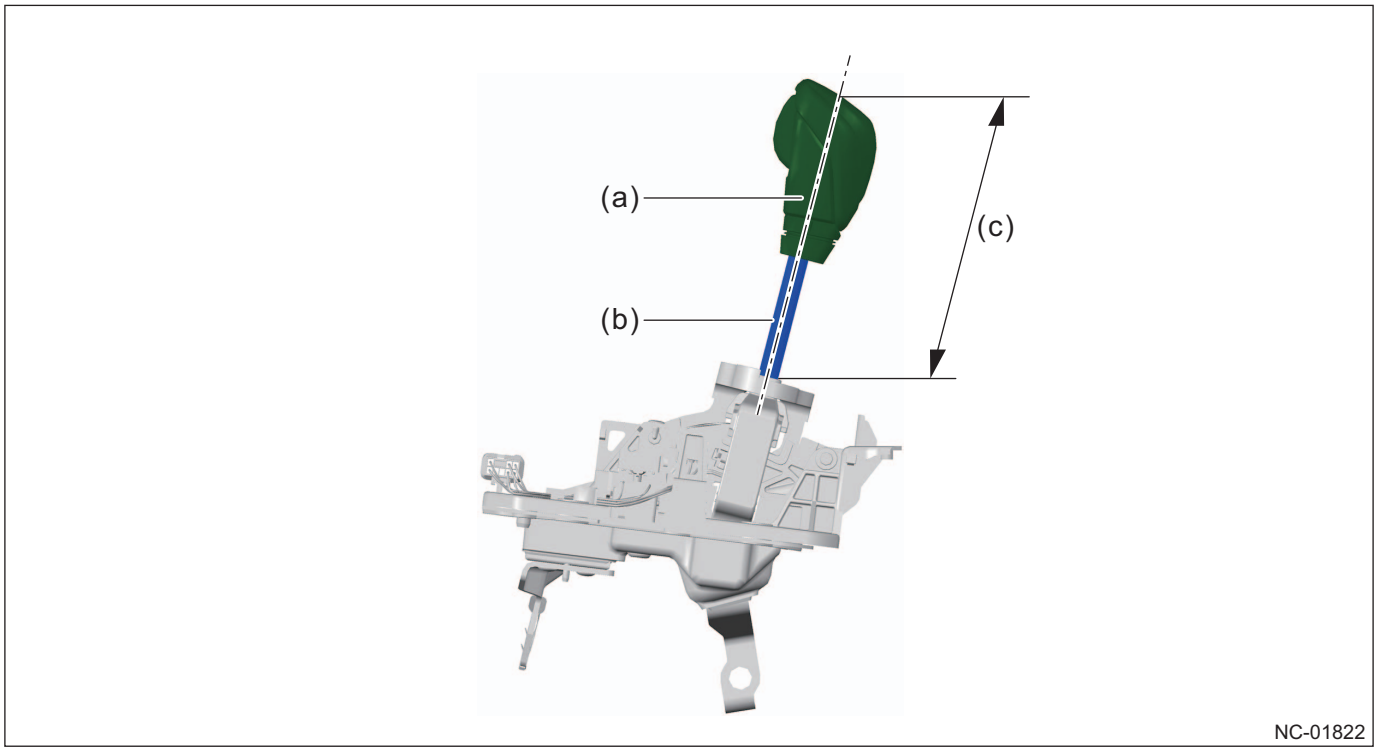
(B) Vehicle without paddle shift switch

■ Select lever grip

Plastic type and leather type of select lever grips are adopted. (depending on grades)

The select lever grip position is optimized according to the seating position. The operability of the select lever is improved by making the grip position closer to the shoulder point.

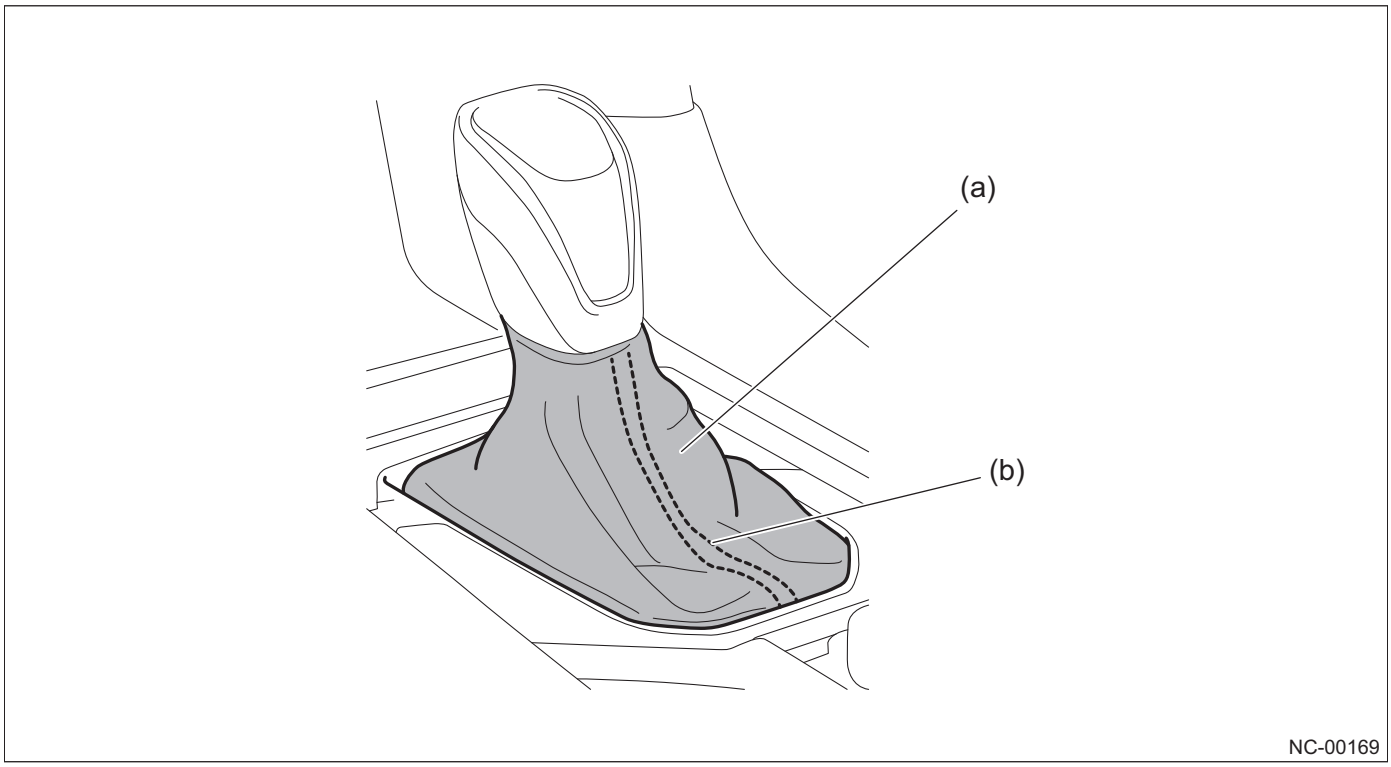
Shift position	New model vehicle	Existing model vehicle
P	25.1 (637.9)	26.4 (671.1)
R	23.4 (594.0)	24.8 (629.3)
N	22.5 (571.8)	23.9 (607.5)
D	21.8 (554.6)	23.2 (589.9)



(a) Grip
(b) Lever
(c) Lever extension (existing mass-production model + 0.7 in (17.6 mm))

■ Select lever boot

The silver stitch is applied for the boot to improve the texture.



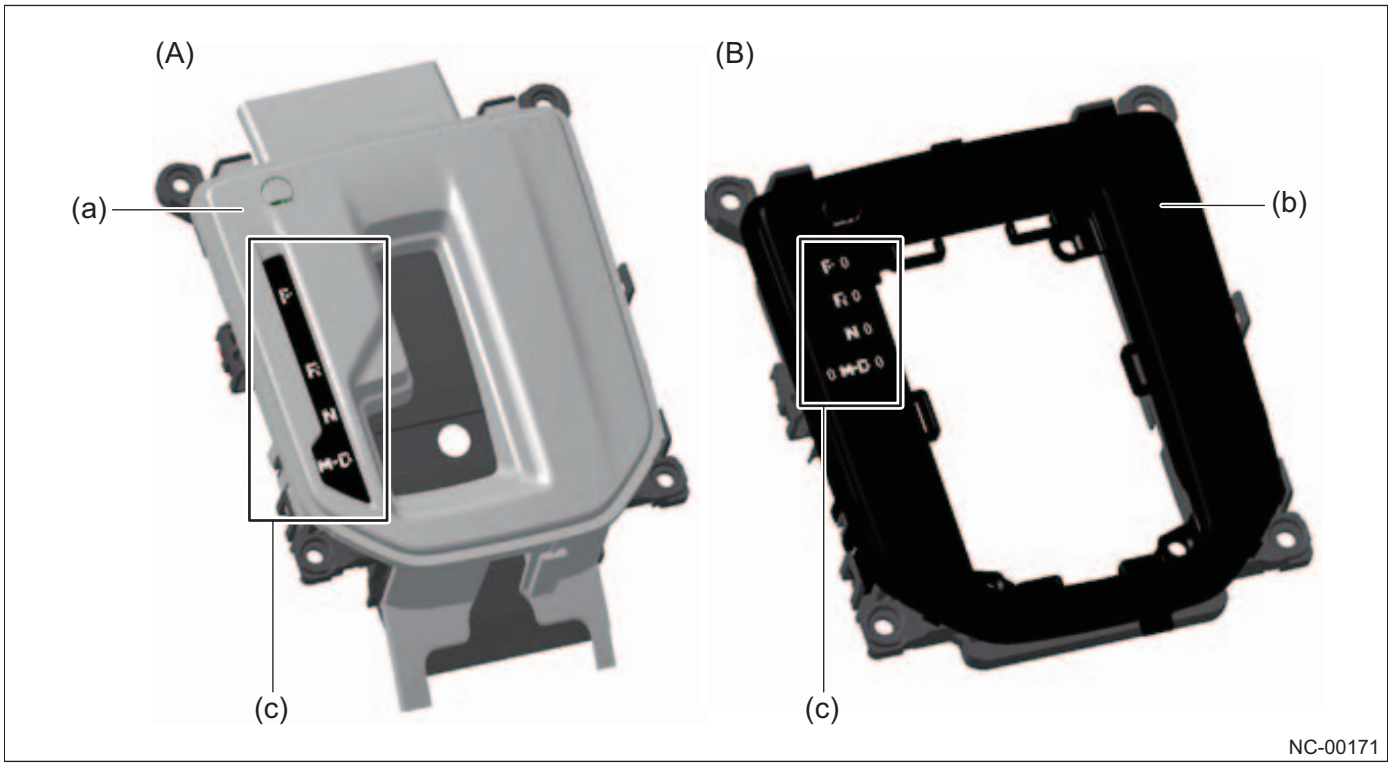
(a) Boot

(b) Stitch

■ Shift indicator cover

Red is adopted for the nighttime illumination color of the shift indicator, and high-gloss black is adopted for the dial face color to improve the texture.

Silver paint (without the shift boot) and high-gloss black (with the shift boot) are adopted for the shift indicator cover to improve feeling of quality.



(A) Without the boot (blind)

(B) With the shift boot

(a) Silver paint
(b) High-gloss black

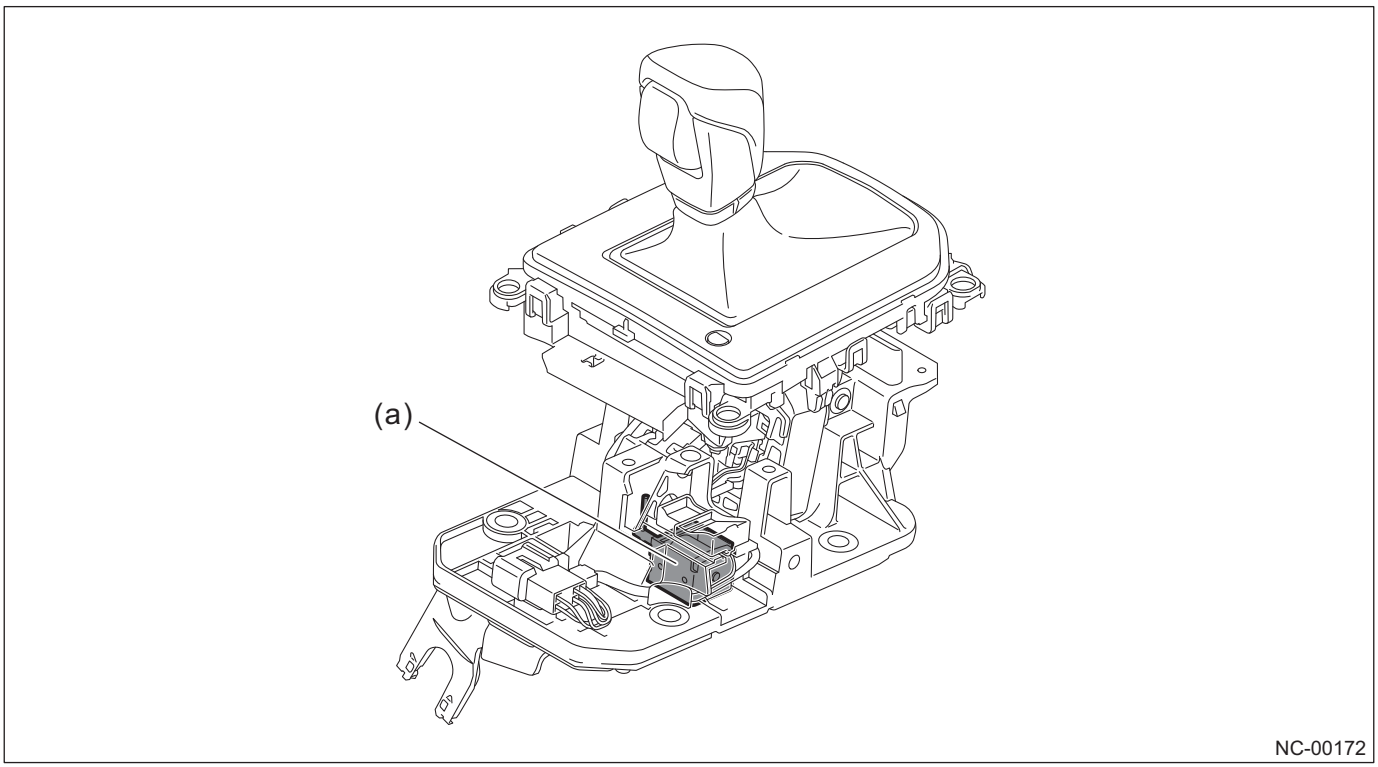
(c) Indicator (nighttime illumination color: red, dial face color: high-gloss black)

■ Shift lock solenoid

The shift lock solenoid is installed in the select lever. When the following conditions are all satisfied, the shift lock solenoid is energized to release the shift lock.

- IG "ON"
- P range detection switch "ON"
- Stop light switch "ON"

The solenoid return spring of the shift lock solenoid is changed to reduce the suction power of the solenoid. Thus, the operating noise of the solenoid during shift lock is reduced.

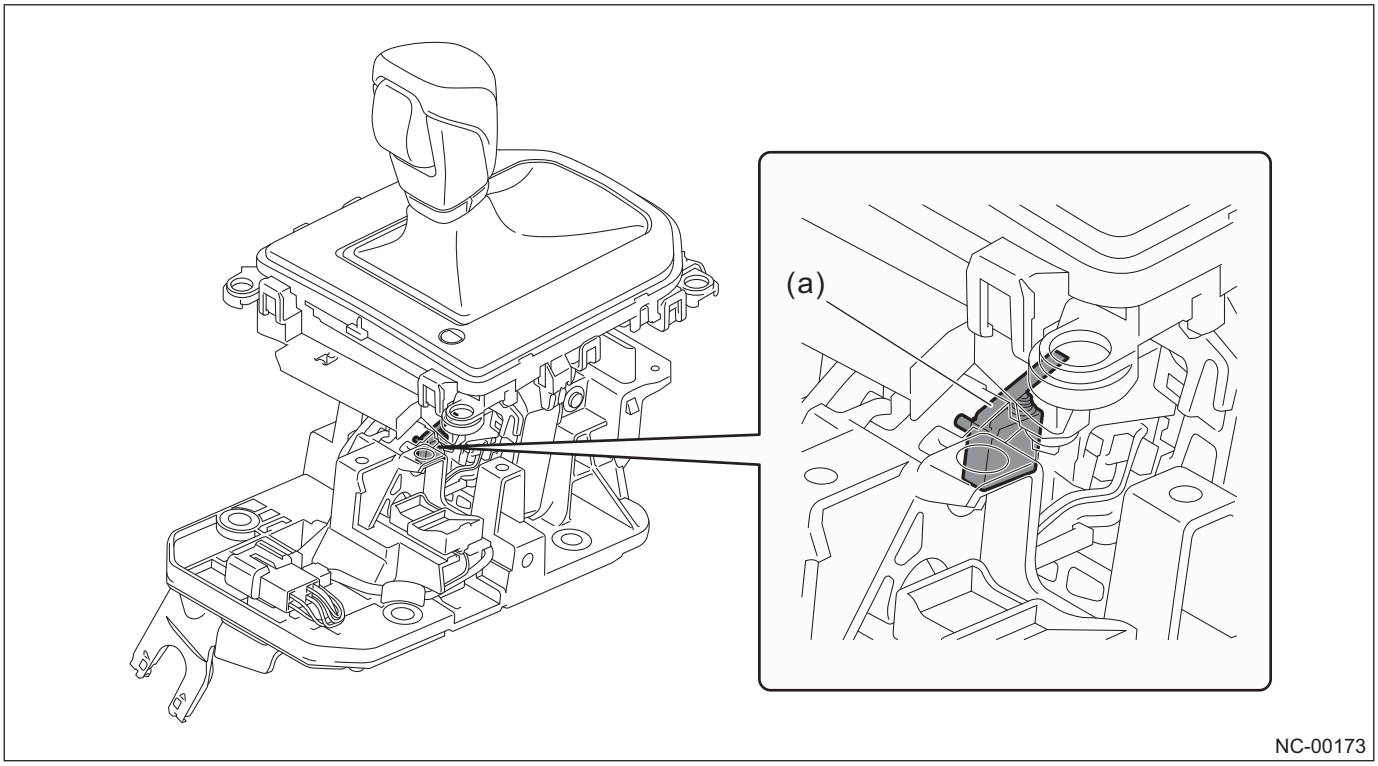


(a) Shift lock solenoid

■ "P" range switch

The "P" range switch is installed in the select lever. The switch detects that the select lever is located at the "P" position.

When the select lever is located at the "P" position, the system is "ON". When the select lever is located at a position other than the "P" position, the system is "OFF".

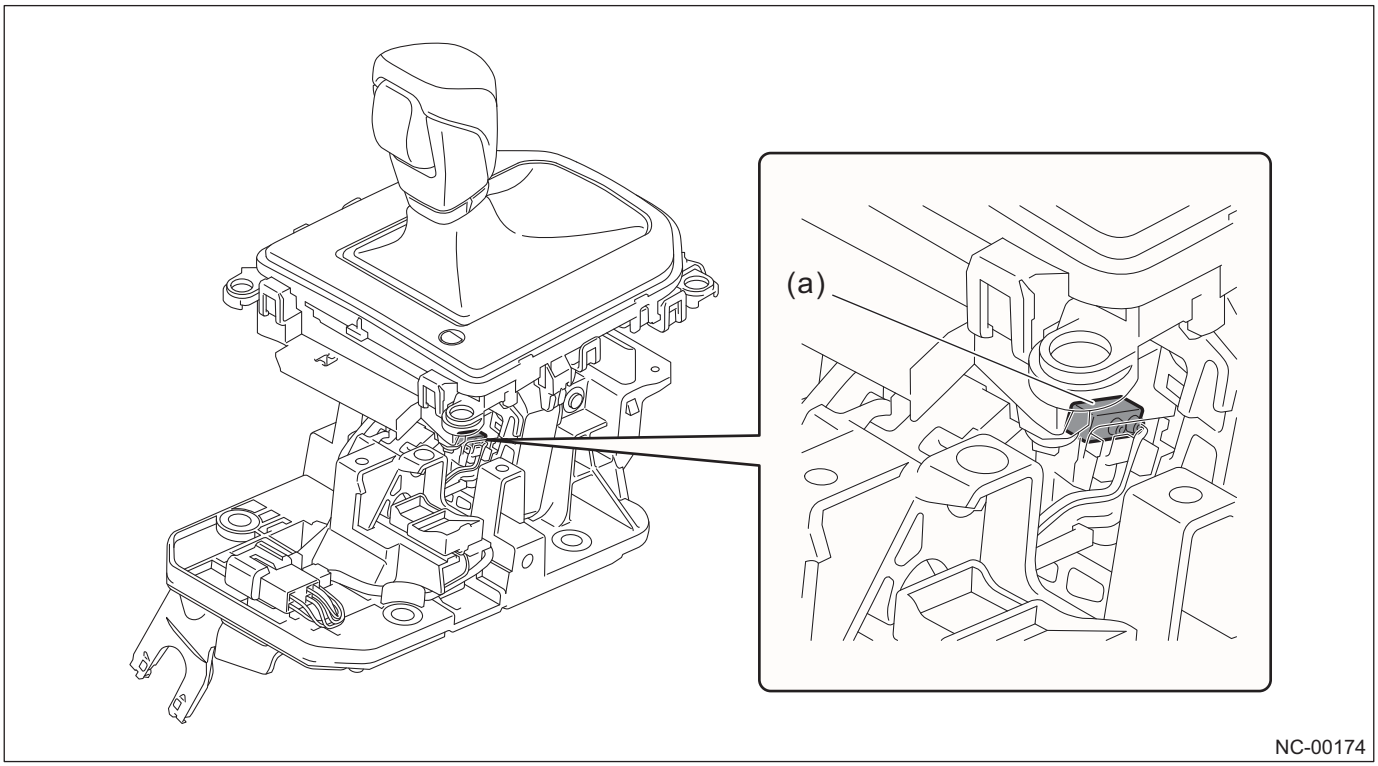


(a) "P" range switch

■ M mode switch (vehicle with paddle shift switch)

The M mode switch is installed in the select lever. The switch detects that the select lever is located at the "M" position.

When the select lever is located at the "M" position, the system is "ON". When the select lever is located at a position other than the "M" position, the system is "OFF".

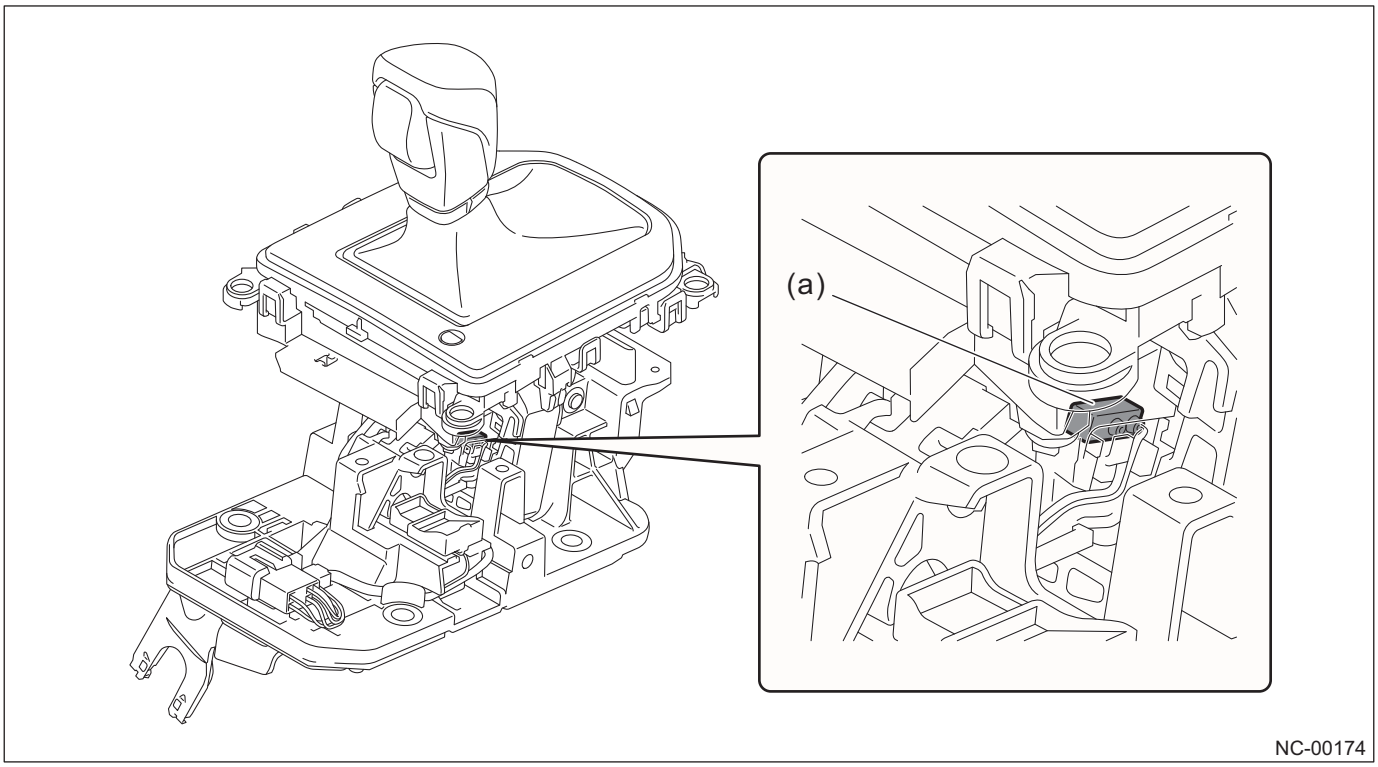


(a) M mode switch

■ L mode switch (vehicle without paddle shift switch)

The L mode switch is installed in the select lever. The switch detects that the select lever is located at the "L" position.

When the select lever is located at the "L" position, the system is "ON". When the select lever is located at a position other than the "L" position, the system is "OFF".

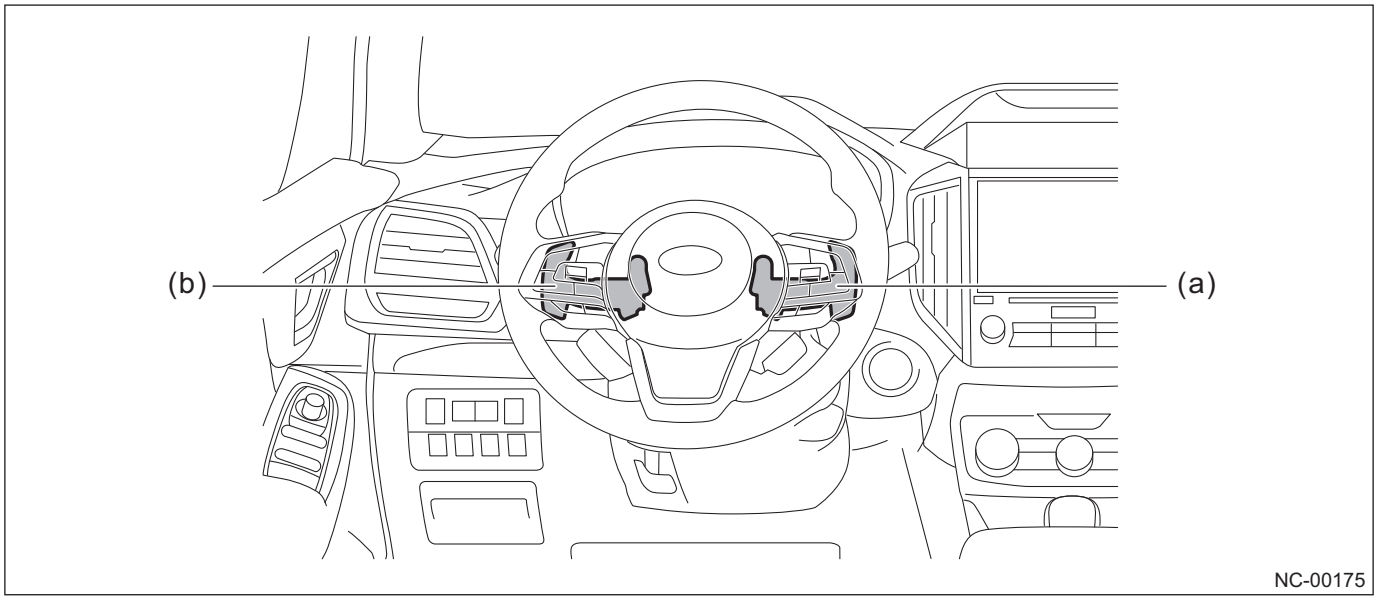


(a) L mode switch

Paddle shift switch

When the select lever is shifted to the manual side in the D range, the transmission enters manual mode. By operating the paddle shift switch located on the steering wheel, the driver can quickly select the appropriate gear even during sudden braking or acceleration without releasing driver's hands from the steering wheel.

When the driver wants to shift gears while driving in manual mode, the driver can shift up or down by operating the paddle shift switch (+) or the paddle shift switch (-). The gear to shift is indicated on the shift indicator in the multi-information display at that time.

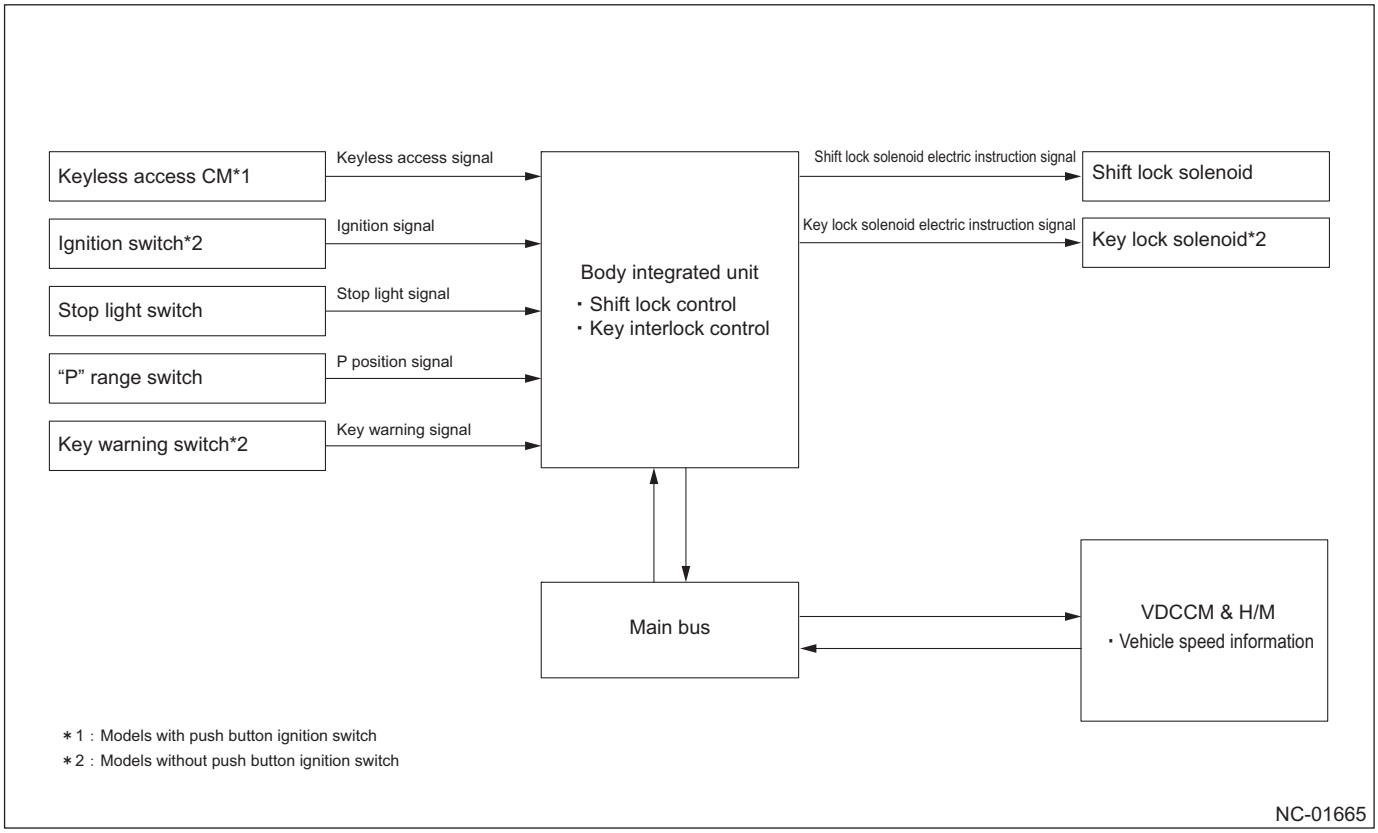


(a) Paddle shift switch (+)

(b) Paddle shift switch (-)

3.2.3 Construction and Operation

System diagram



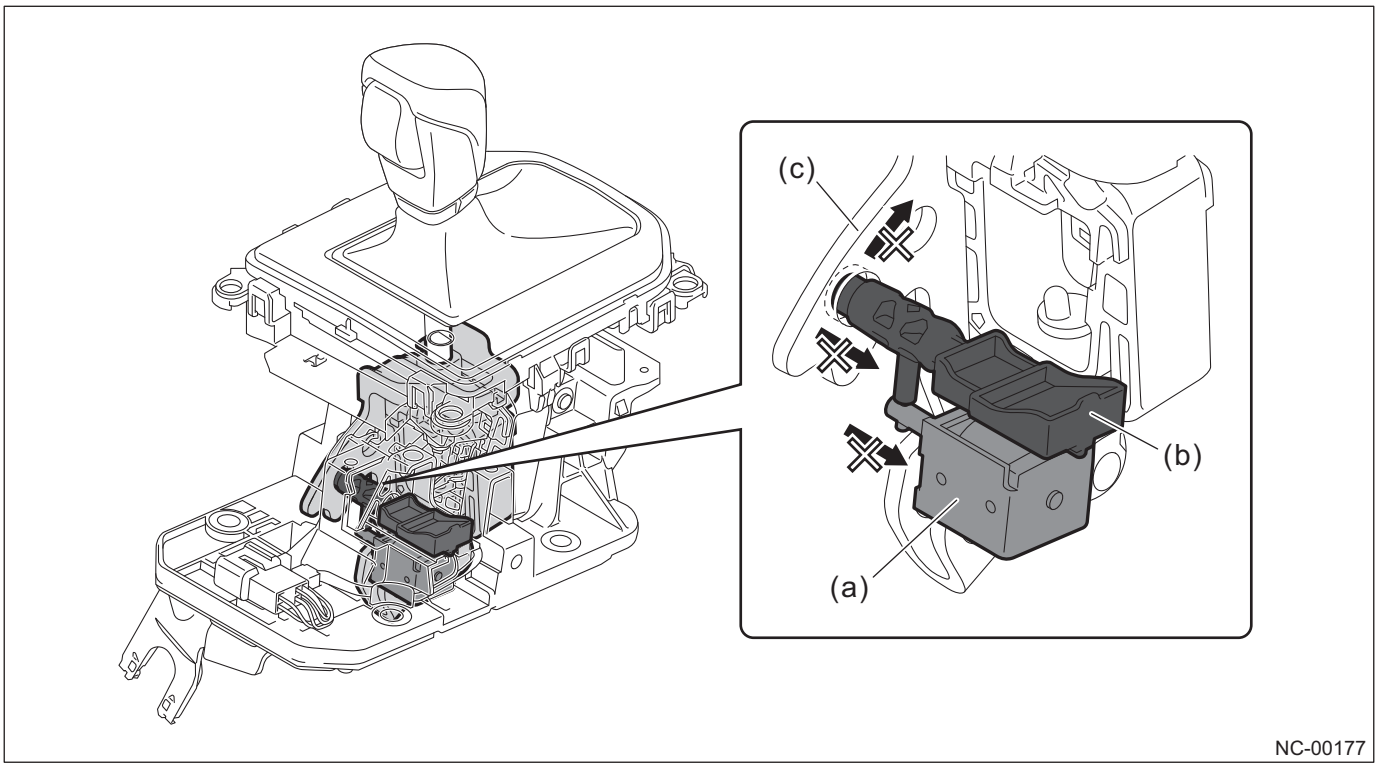
Shift lock system

For improved safety during initial acceleration, the shift lock system prevents the select lever from being moved to any position other than the "P" position unless the brake pedal is depressed. The shift lock system is composed of the rod shift lock in the select lever, solenoid unit, and arm lever.

Shift lock

When the select lever is at the "P" position, the shift lock rod remains at the lock position.

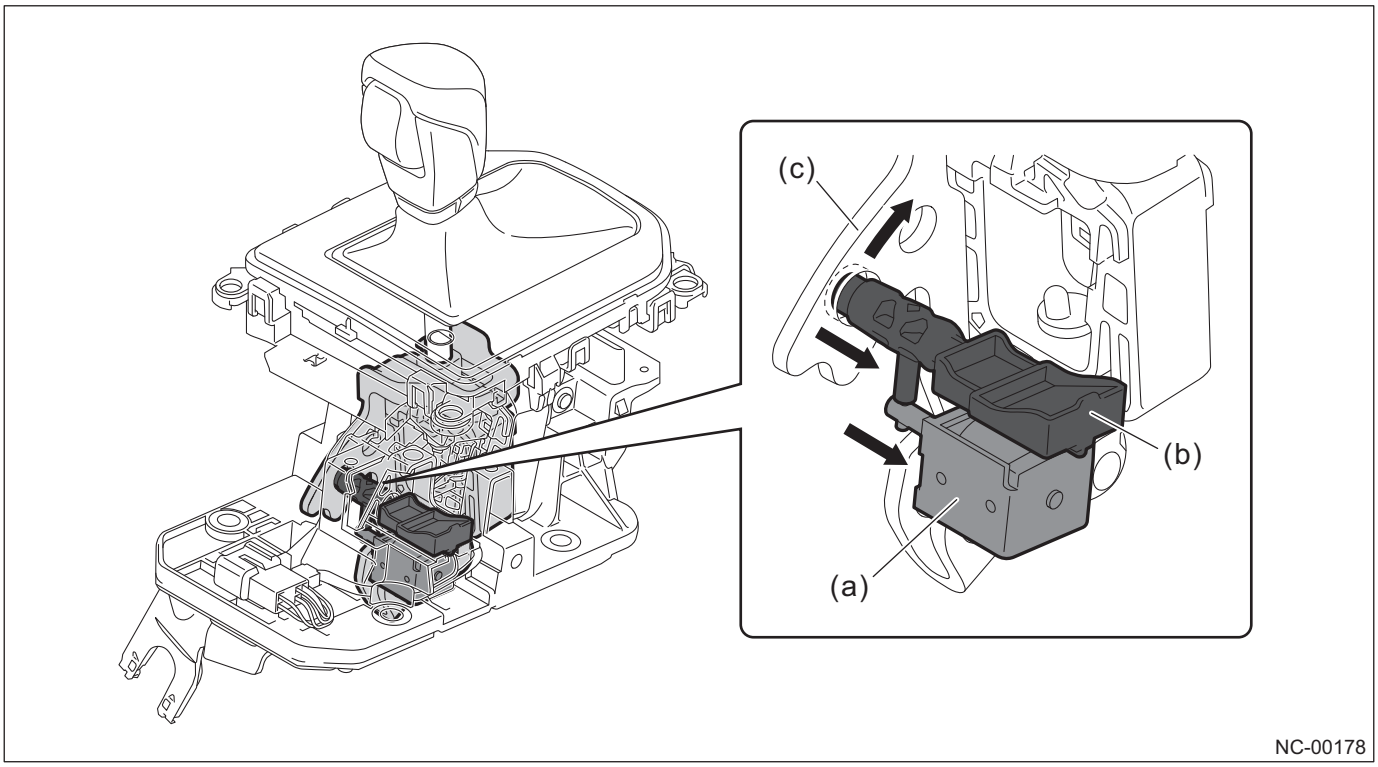
When the engine starts at "P" position and the brake pedal is not depressed, the shift lock solenoid is OFF and the shift lock rod locks the arm at the P position. Therefore, the shift position cannot move from the P position.



(a) Shift lock solenoid
(b) Shift lock rod
(c) Arm

Shift lock release

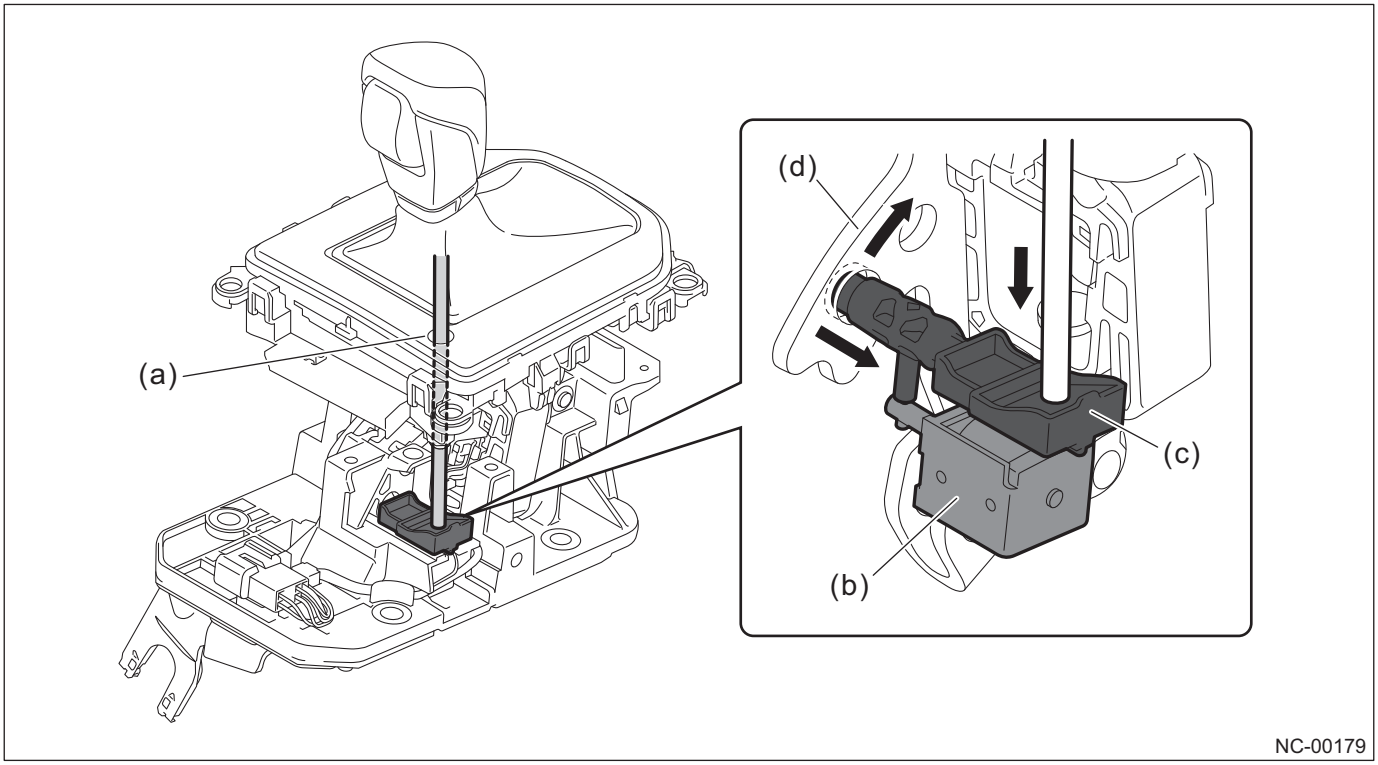
When the brake pedal is depressed with the ignition ON, the shift lock solenoid turns on and pulls the shift lock solenoid plunger to unlock the arm of the shift lock rod. This allows the select lever to move from the P position.



(a) Shift lock solenoid
(b) Shift lock rod
(c) Arm

Shift lock force release

When the shift lock is not released due to shift lock solenoid failure or electrical system problems, insert a thin flat tip screwdriver or the like into the shift lock release hole of the shift indicator panel and push the shift lock solenoid to release the shift lock. Pushing the shift lock solenoid will move the shift lock rod and release the shift lock.



(a) Shift lock release hole
(b) Shift lock solenoid
(c) Shift lock rod
(d) Arm

N-R lock controller

This control prevents the select lever from accidentally entering the R position while driving. This is to prevent damaging parts such as the reverse brake. Once the vehicle exceeds a specified speed, the body integrated unit turns off the shift lock solenoid (in the solenoid unit) of the select lever. This activates the N-R lock mechanism, preventing the select lever from being operated from the N range to the R range and prevents the transmission from entering reverse.

Key interlock function (model without push button ignition switch)

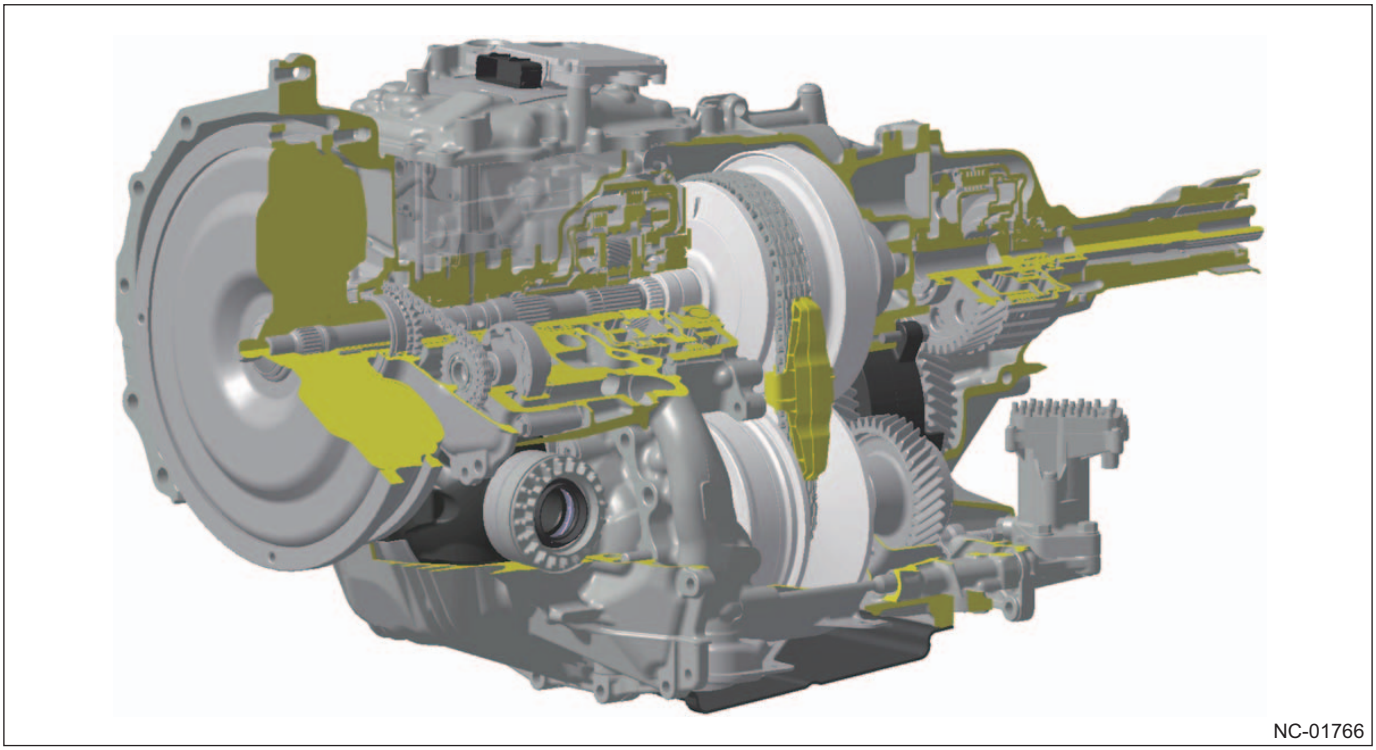
When the select lever is located at any position other than "P", the key lock solenoid built into the key cylinder pushes out the lock pin and prevents the ignition key from turning to the LOCK position. When the select lever moves to "P", the P range switch of the select lever assembly operates. Since the key lock solenoid will not be able to push out the lock pin, the key can be removed from the ignition switch by turning the key to the LOCK position.

3.3 TR580 Continuously Variable Transmission (CVT)

3.3.1 Overview

The vehicle is equipped with the lightweight compact CVT with the advanced environmental performance and vibration and noise restraining performance.

- This CVT has the following major characteristics.
- Using the torque converter with the lock-up, the CVT ensures the starting performance of the vehicle by adding a creep phenomenon, and expands the lock-up area to improve the fuel efficiency.
- The torque converter with the lock-up is combined with the automatic continuously variable transmission mechanism by pulley and chain to improve the traveling performance and fuel efficiency.
- The expanded ratio coverage of the automatic continuously variable transmission mechanism improves the drive quality as well as the environmental performance. The variator chain with shorter pitch realizes the superior silent property.
- A double-pinion planetary gear and a hydraulic actuation wet multi-plate clutch are combined on the forward and reverse switching to improve the drive force when reversing.
- The oil pump uses an axis different from the engine axis, and increases the speed using the sprocket and chain to ensure the required flow rate.
- The characteristic of the detent inside the transmission is changed to enhance the operability of the select lever.
- The electric oil pump is mounted at the rear of the transmission.
- The CVT auto-step shift control is adopted to realize the smoothness specific to CVT as well as the traveling performance which is faithful to the driver's intention and enables a smooth drive.
- 7th-speed manual mode is adopted to enable selection of the optimal gear ratio. (vehicle equipped with the paddle shift switch)
- The active torque split AWD is adopted for the AWD system.
- X-MODE is adopted. (for some grades)
- SI-DRIVE is adopted.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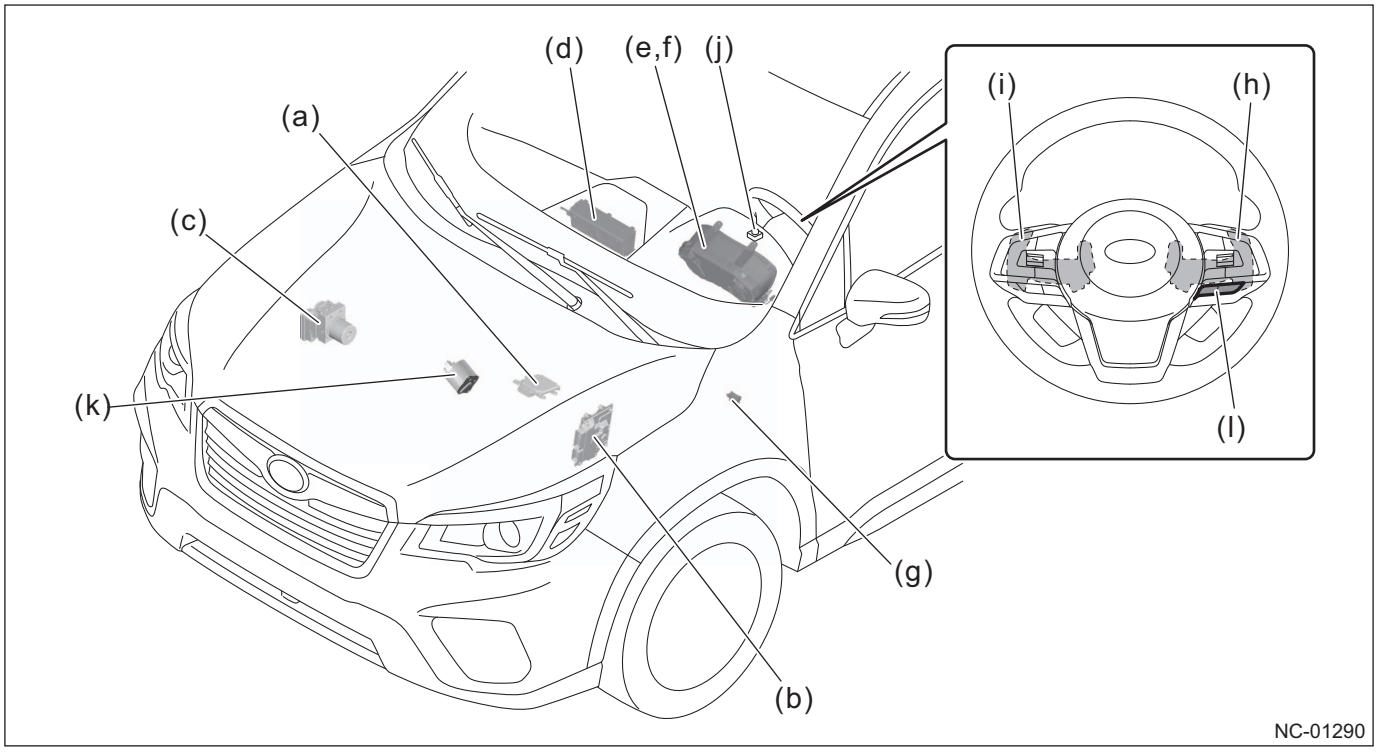
3.3.2 Component

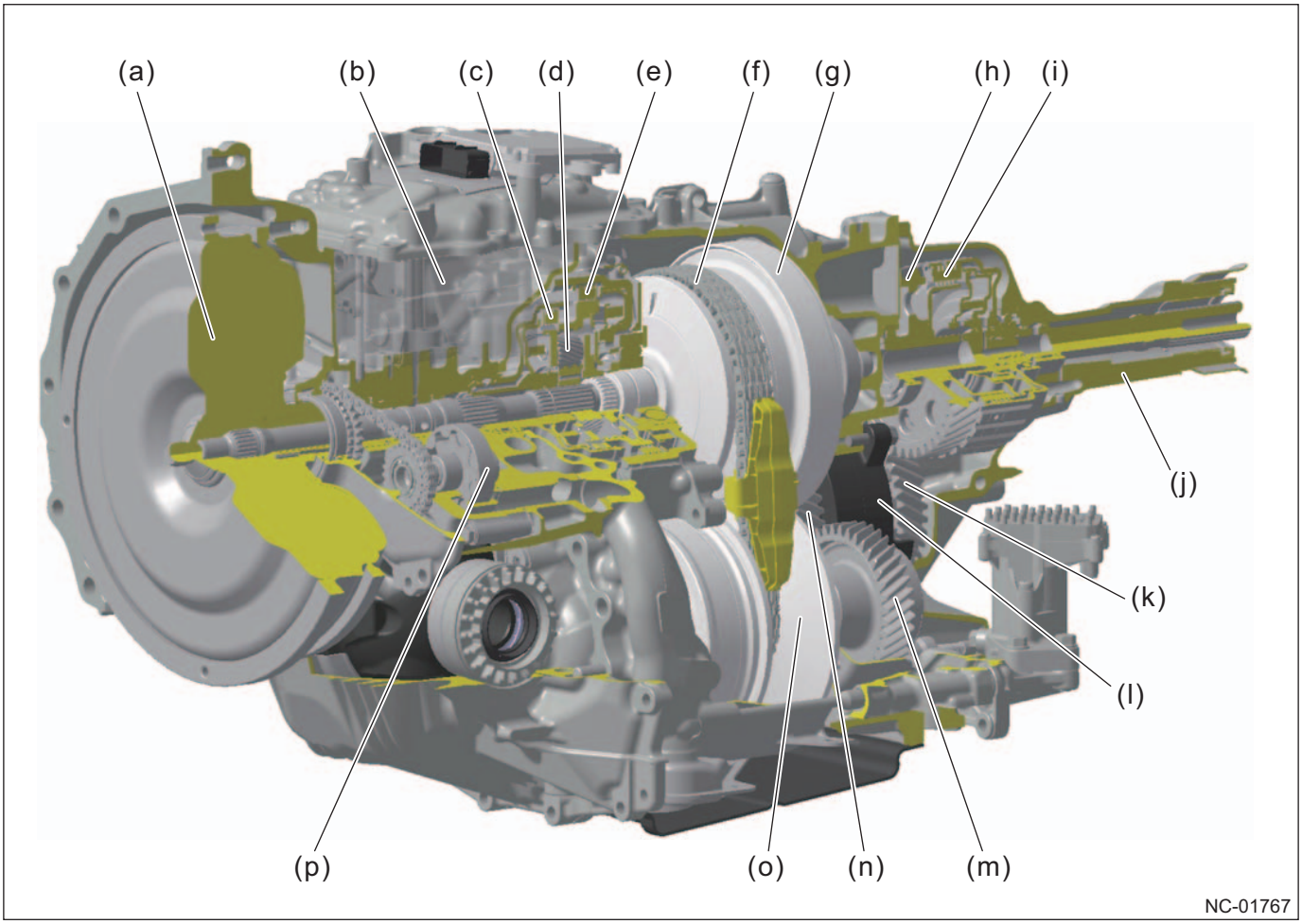
Component layout drawing

CVT control related device



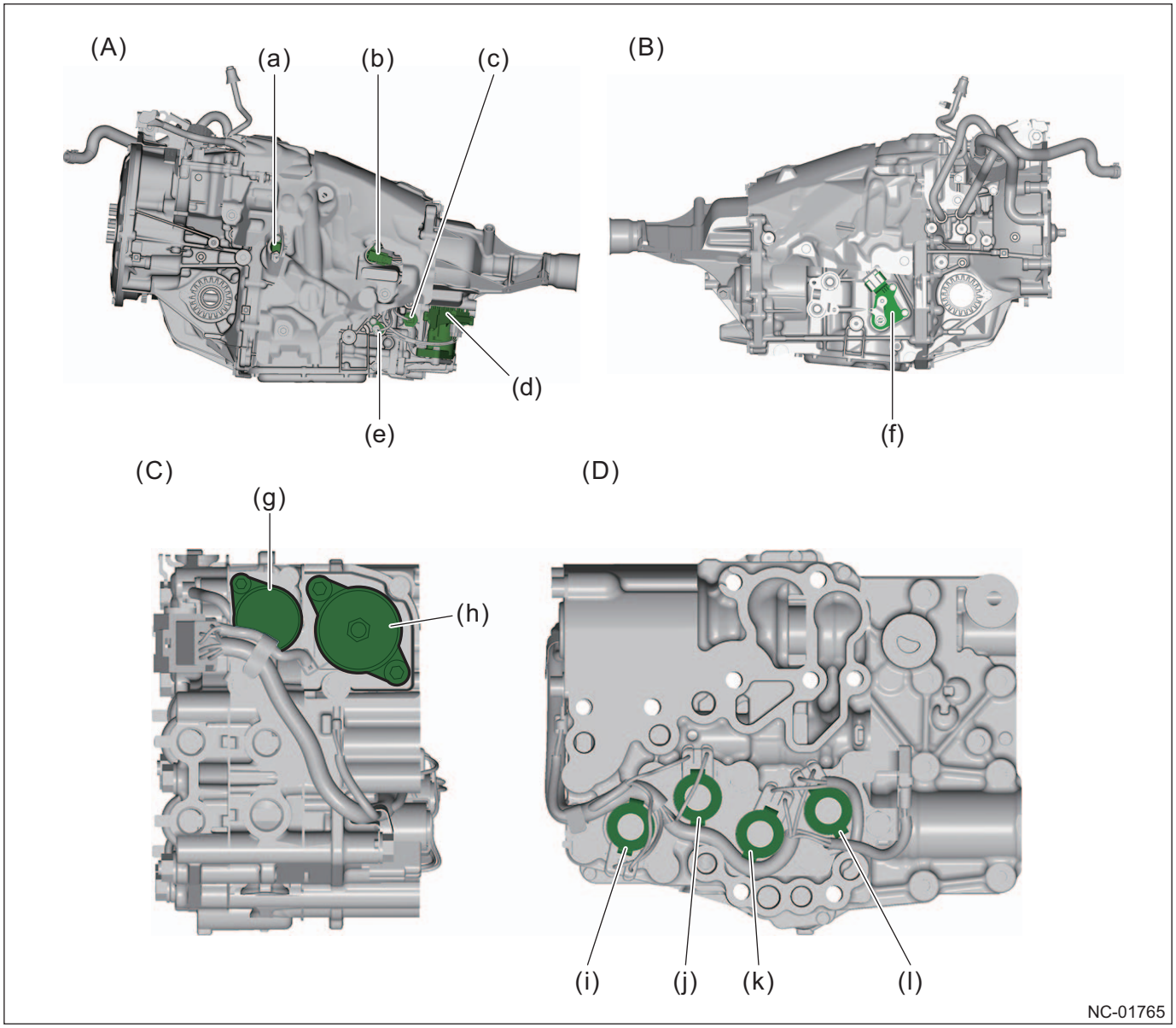
(a) TCM
(b) ECM
(c) VDCCM & H/M
(d) MFD
(e) Combination meter
(f) Multi-information display
(g) DLC
(h) Paddle shift switch (+)
(i) Paddle shift switch (-)
(j) X-MODE switch
(k) CVTF cooler (with warmer function)
(l) SI-DRIVE selector

CVT gear train



(a) Torque converter
(b) Control valve
(c) Forward clutch
(d) Planetary gear
(e) Reverse brake
(f) Variator chain
(g) Primary pulley
(h) Transfer driven gear
(i) Transfer clutch
(j) Rear drive shaft
(k) Transfer drive gear
(l) Parking gear
(m) Reduction drive gear
(n) Reduction driven gear
(o) Secondary pulley
(p) Oil pump

CVT electronic control device



(A) Transmission left side
(B) Transmission right side
(C) Control valve front side
(D) Control valve under side

(a) Turbine speed sensor
(b) Primary speed sensor
(c) Secondary pressure sensor
(d) Electric oil pump
(e) Secondary speed sensor
(f) Inhibitor switch
(g) F&R clutch solenoid
(h) Secondary solenoid
(i) AWD solenoid
(j) Primary DOWN solenoid
(k) Primary UP solenoid
(l) Lock-up duty solenoid

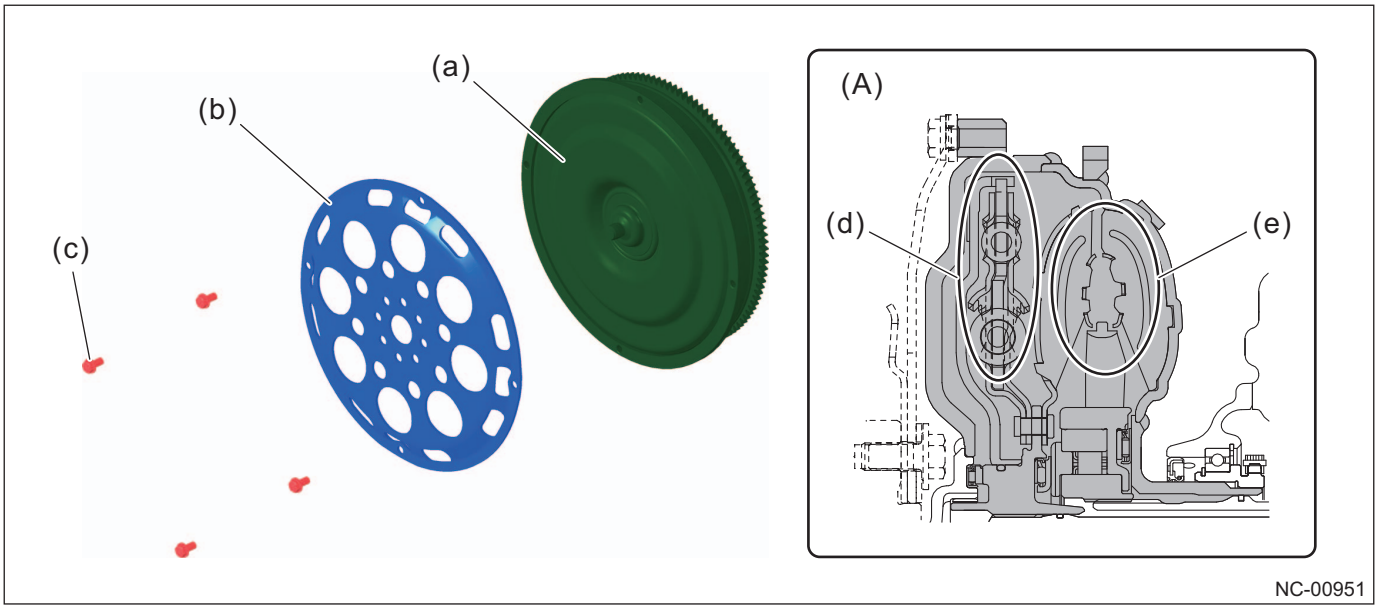
Component details

Torque converter

In response to the adoption of 2.5 L direct-injection engine, the torque converter with both high fluid performance and high damper performance is newly developed.

The torus that enables reduction of space (flow passage shape formed by an impeller and a turbine) is made ultra-flat, and the fluid performance is optimized to support the high-power engine.

The damper structure is adopted to absorb engine torque fluctuations and realize high ride quality. Also, the lock-up clutch damper with low rigidity is adopted to reduce vibration.

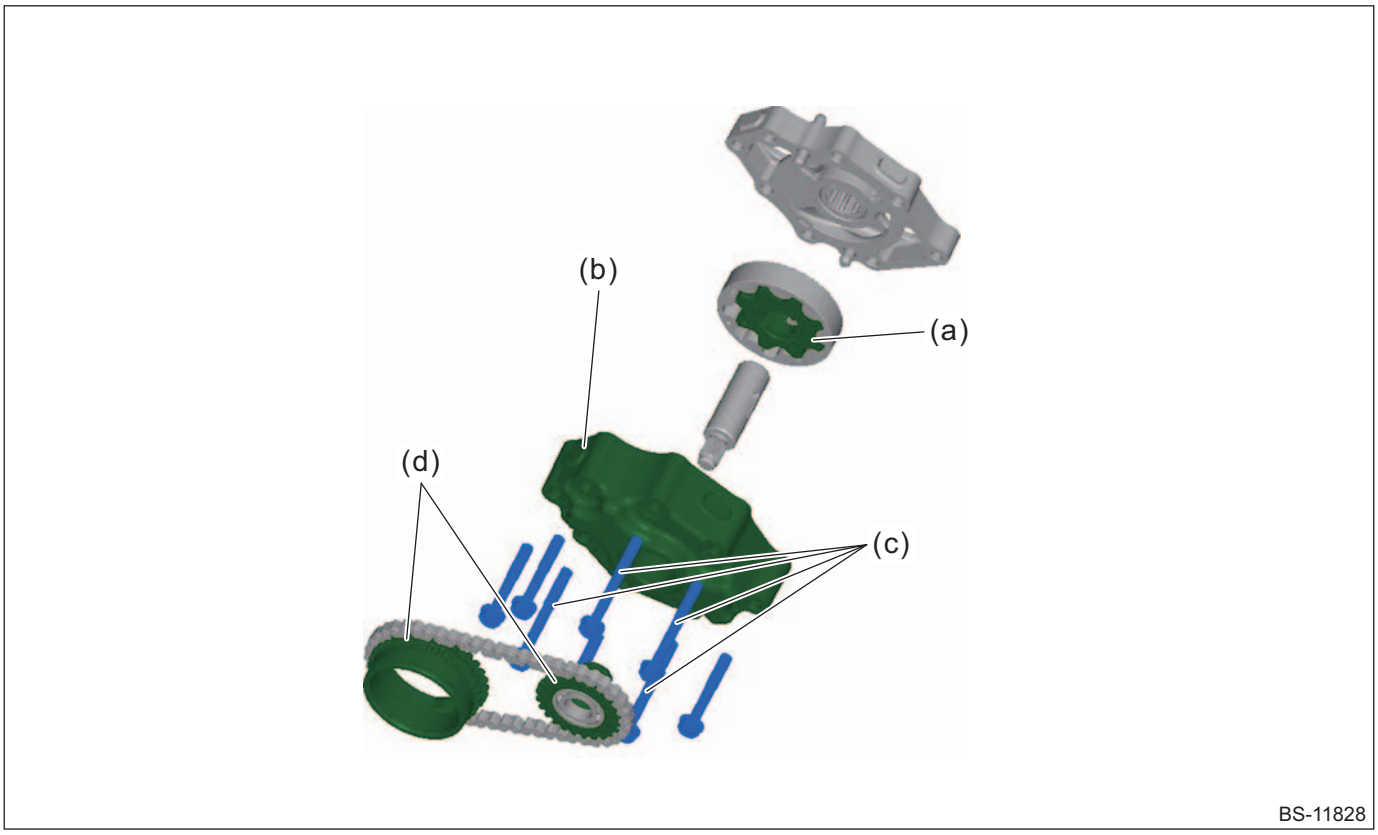


(A) Torque converter cross section

(a) Torque converter
(b) Drive plate
(c) Tightening bolt (4 pieces)
(d) Damper
(e) Torus

Oil pump

The following changes and items implemented improve vibration and noise restraining performance, and enable weight reduction.



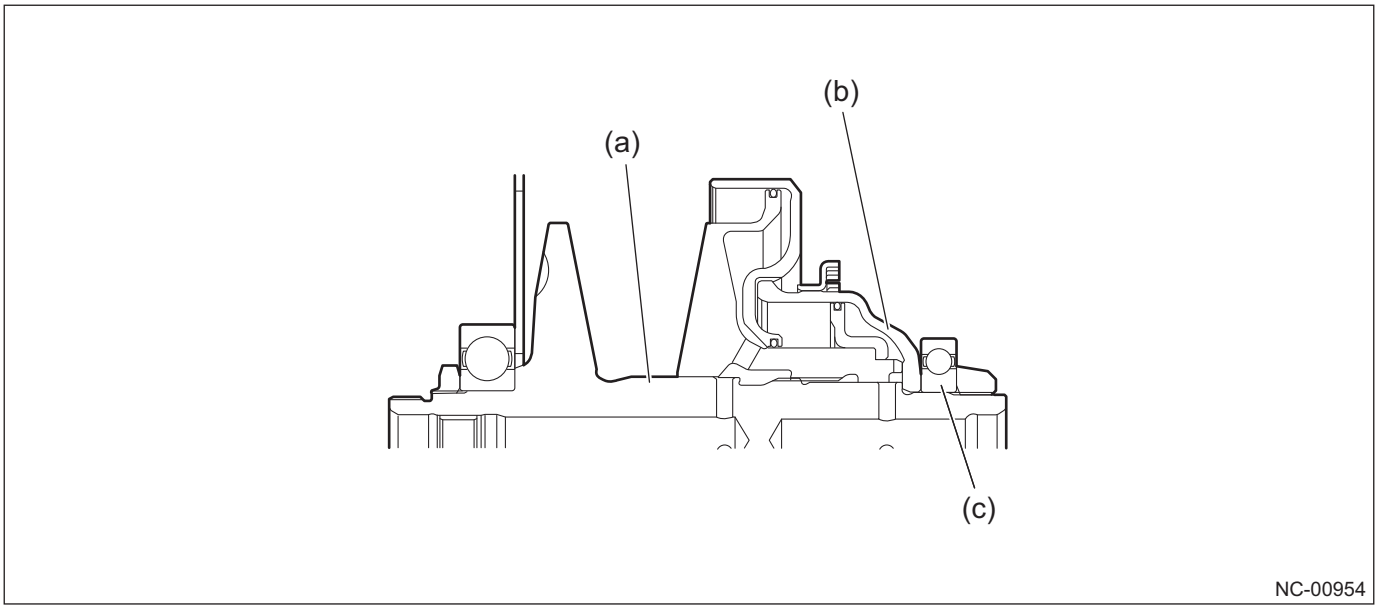
(a) Changes of the eccentricity amount, thickness and tooth shape of the oil pump rotor
(b) Optimized housing rigidity
(c) Shared bolt
(d) Change of speed up ratio (1.33 to 1.24)

Pulley and chain

While the distance between axes is constant, the diameter of the pulley shaft is reduced and the short pitch variator chain is adopted to make the minimum winding diameter of the variator chain smaller compared to existing model vehicles. Thus, the ratio coverage is expanded while the fuel efficiency and the vibration and noise restraining performance are improved.

■ Primary pulley and secondary pulley

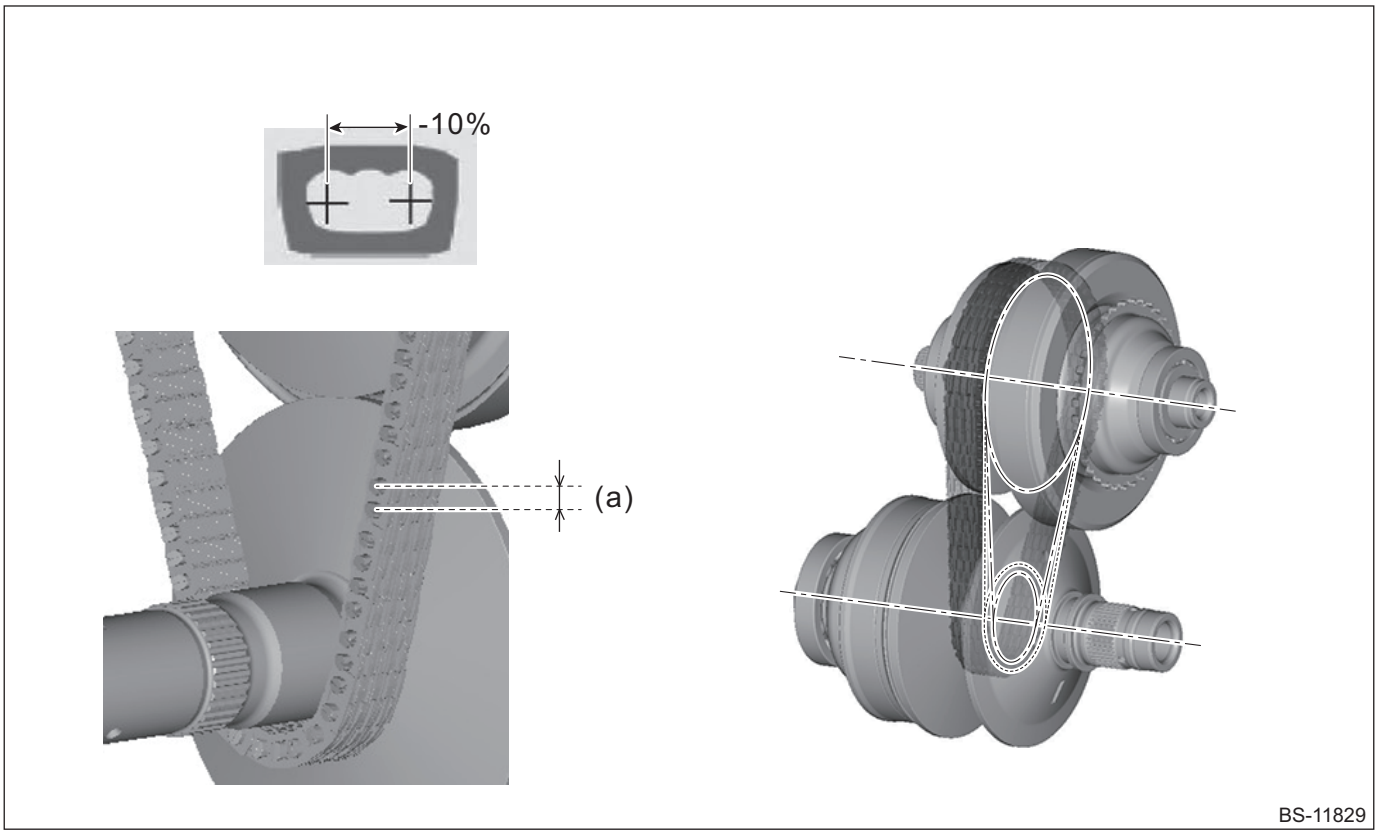
While the shaft diameter is reduced ϕ 1.8 in (45 mm), the cylinder diameter (pressurized area) is enlarged and the bearing-inner diameter is reduced ϕ 1.3 in (34 mm).



(a) Shaft
(b) Cylinder
(c) Bearing

■ Variator chain

The variator chain distance is reduced by 10% from existing products to achieve shorter pitch.



(a) Shorter pitch

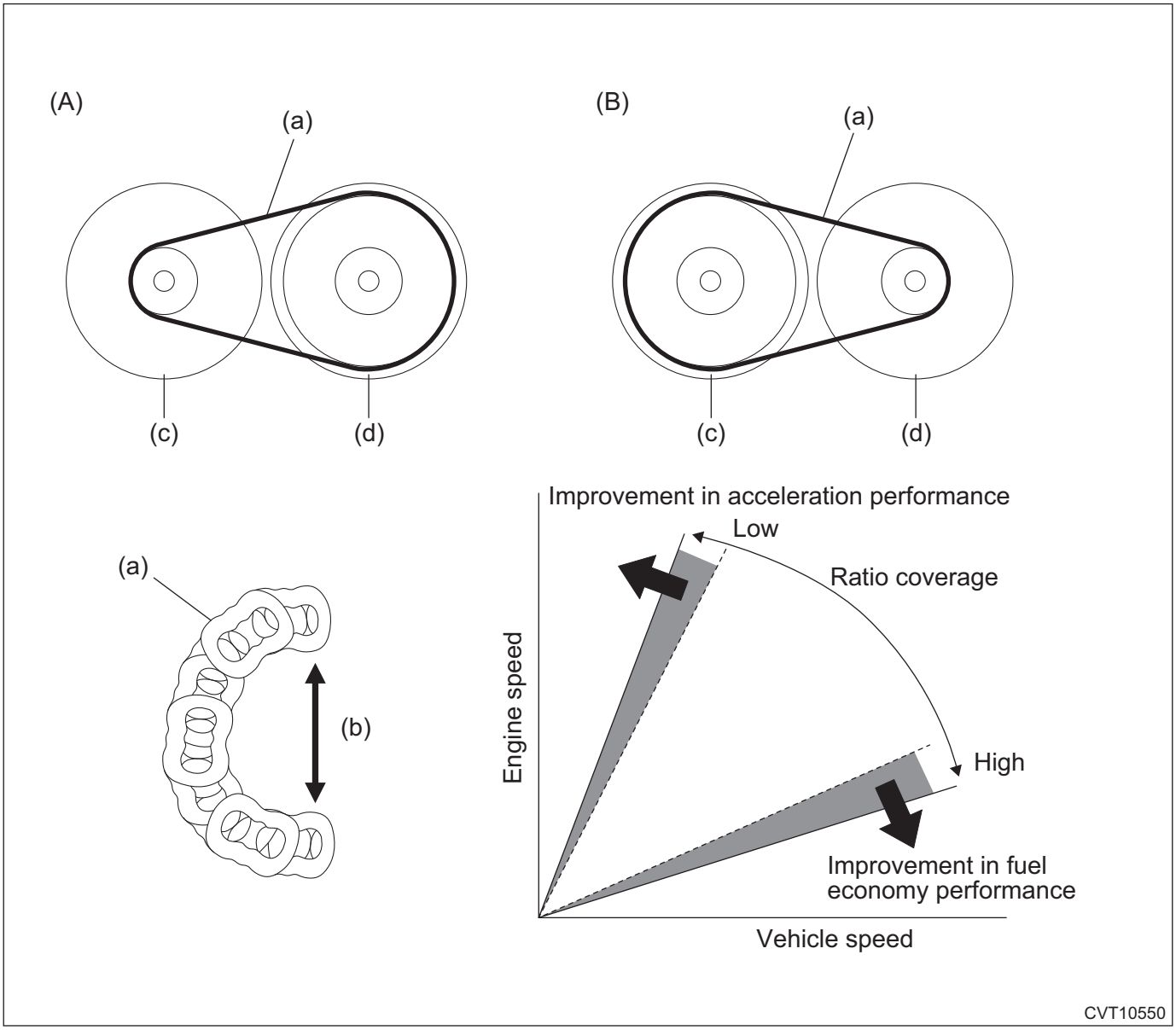
■ Ratio coverage

CVT changes speeds by changing the "winding diameter" of the variator chain from the primary pulley to the secondary pulley.

Ratio coverage is expanded to 7.03, top class for CVT, by adopting the variator chain which enables smaller winding diameter and broader shifting range as a transmission.

The ratio coverage is expanded to improve starting performance and fuel efficiency.

- Since the reduction speed ratio increases at low gear, acceleration performance at startup improves.
- Since the reduction speed ratio decreases at high gear, the engine speed decreases at high speed cruise driving and fuel efficiency improves.

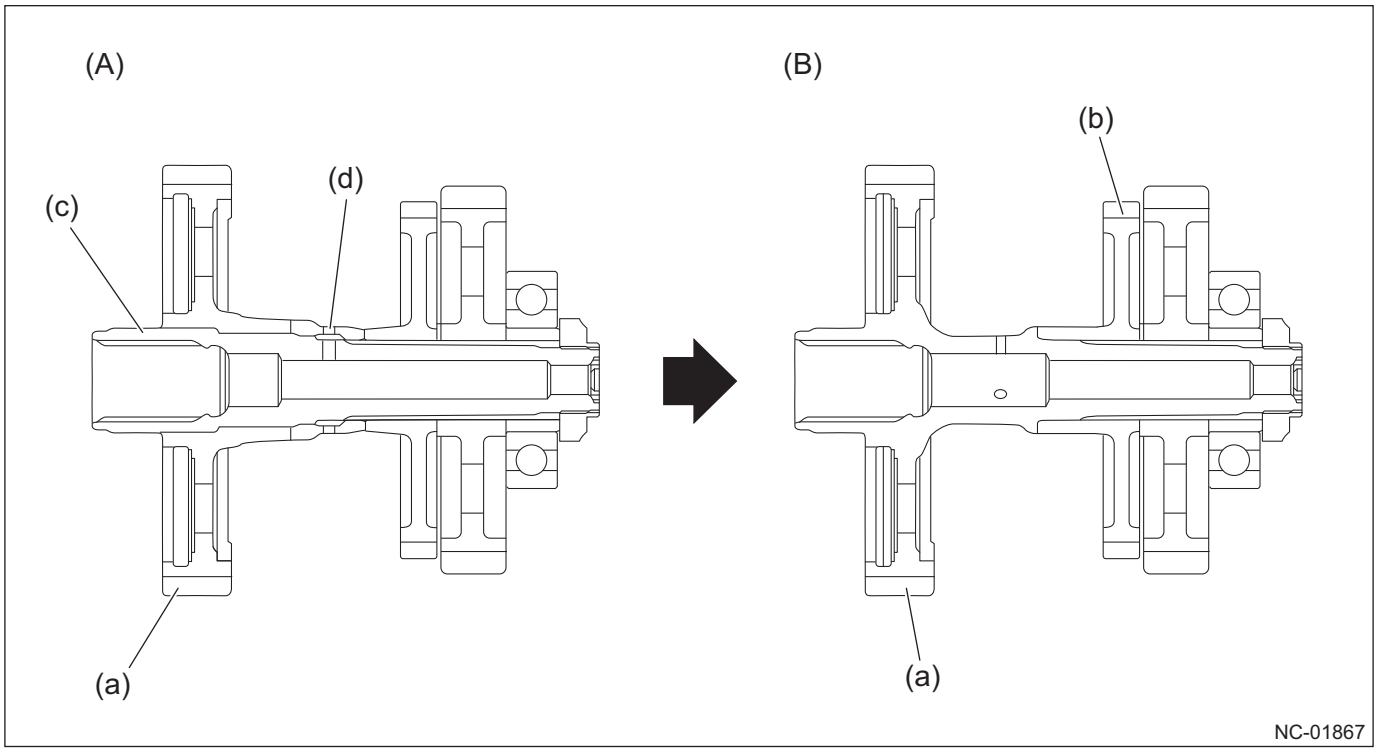


(A) At low gear
(B) At high gear

(a) Variator chain
(b) Winding diameter
(c) Primary pulley
(d) Secondary pulley

Reduction driven gear

The reduction driven gear, driven shaft and collar are integrated to reduce the weight. Accordingly, the parking gear is newly installed.

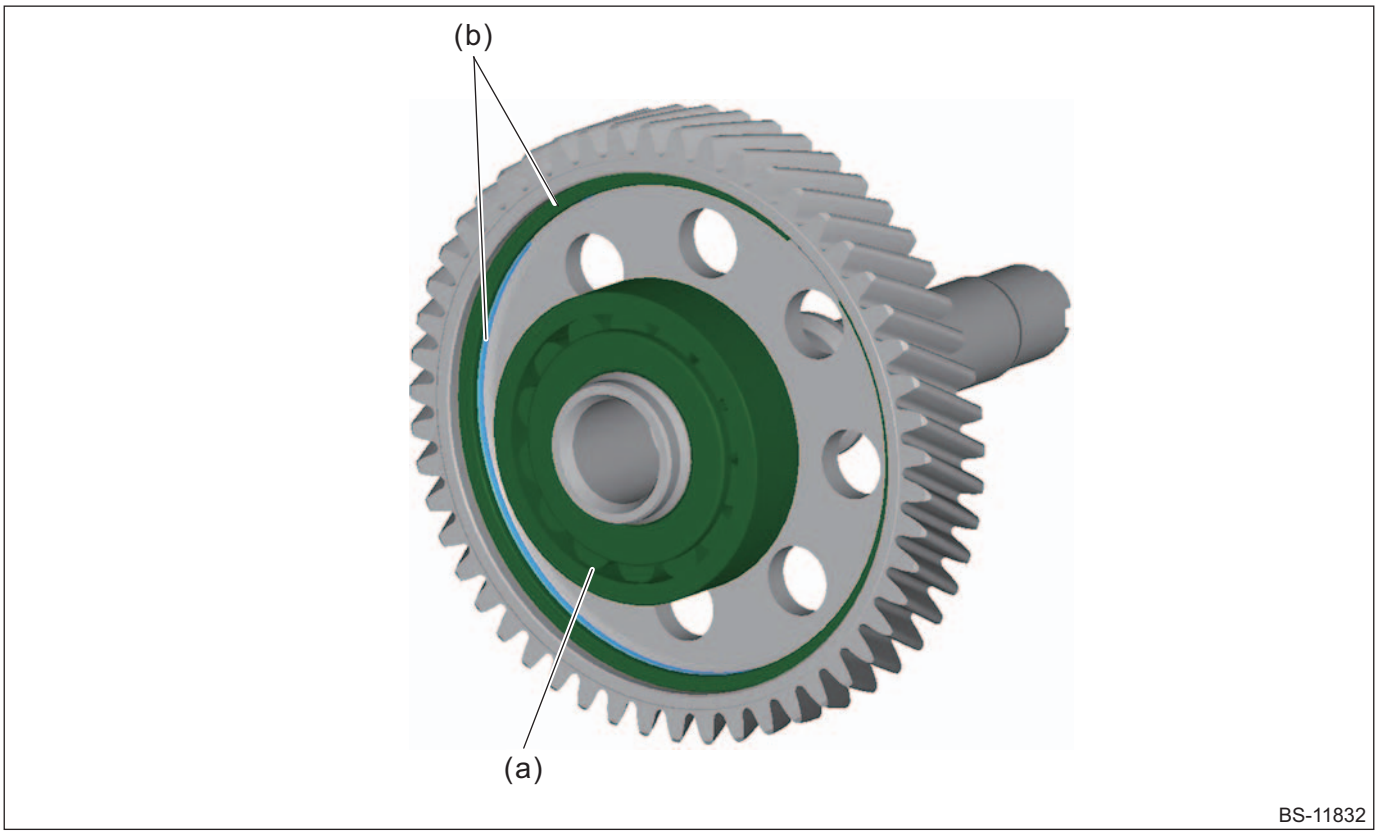


(A) Existing model vehicle
(B) New model vehicle

(a) Reduction driven gear
(b) Parking gear
(c) Driven shaft
(d) Collar

Snap rings (2 pieces) are added to the reduction driven gear to reduce vibration. This improves the quietness.

The front side bearing of the reduction driven gear is made into the roller + thrust bearing structure to increase the shaft supporting rigidity and reduce vibration and noise.

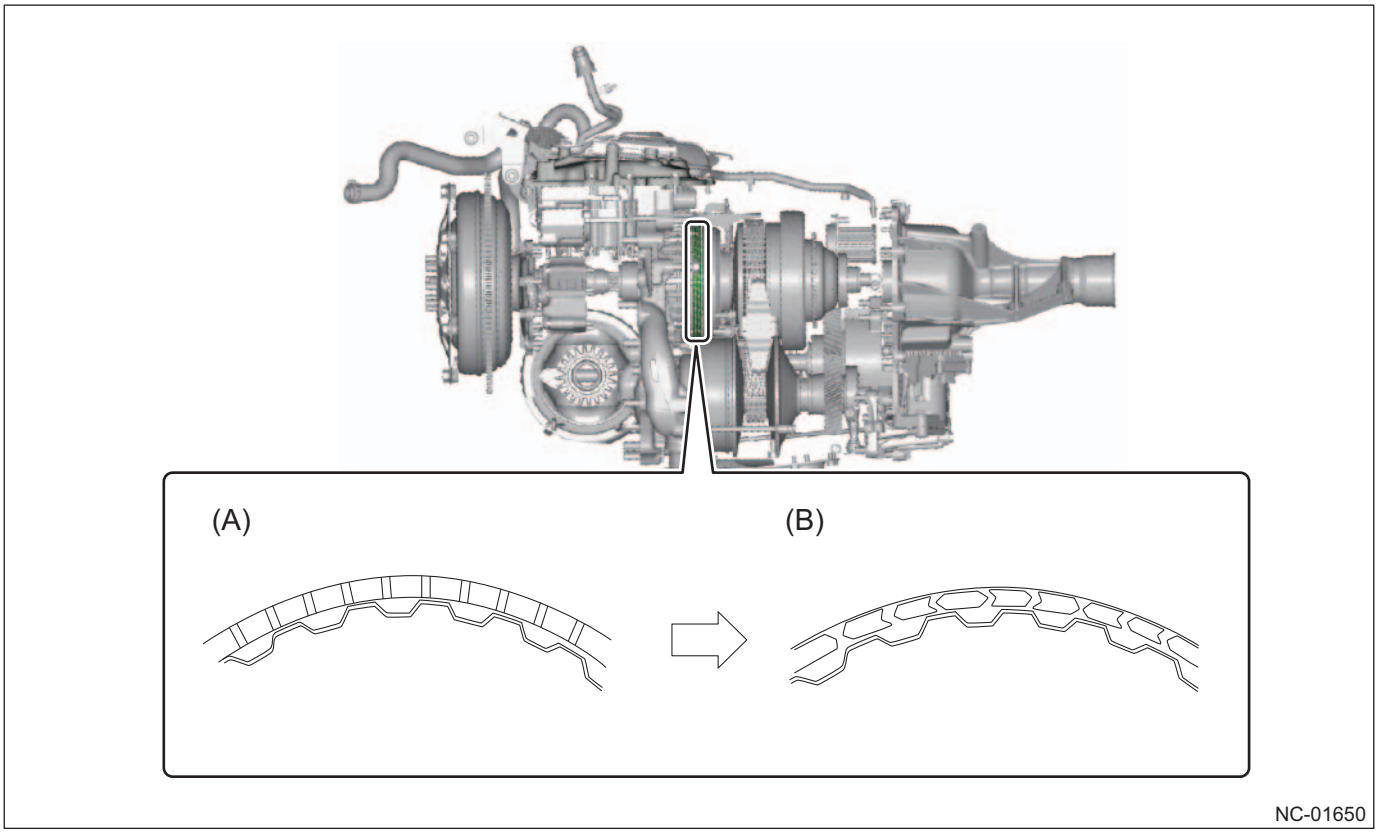


(a) Front side bearing

(b) Snap ring

Reverse brake drive plate

The shape of groove of the facing material is changed to reduce friction during driving.

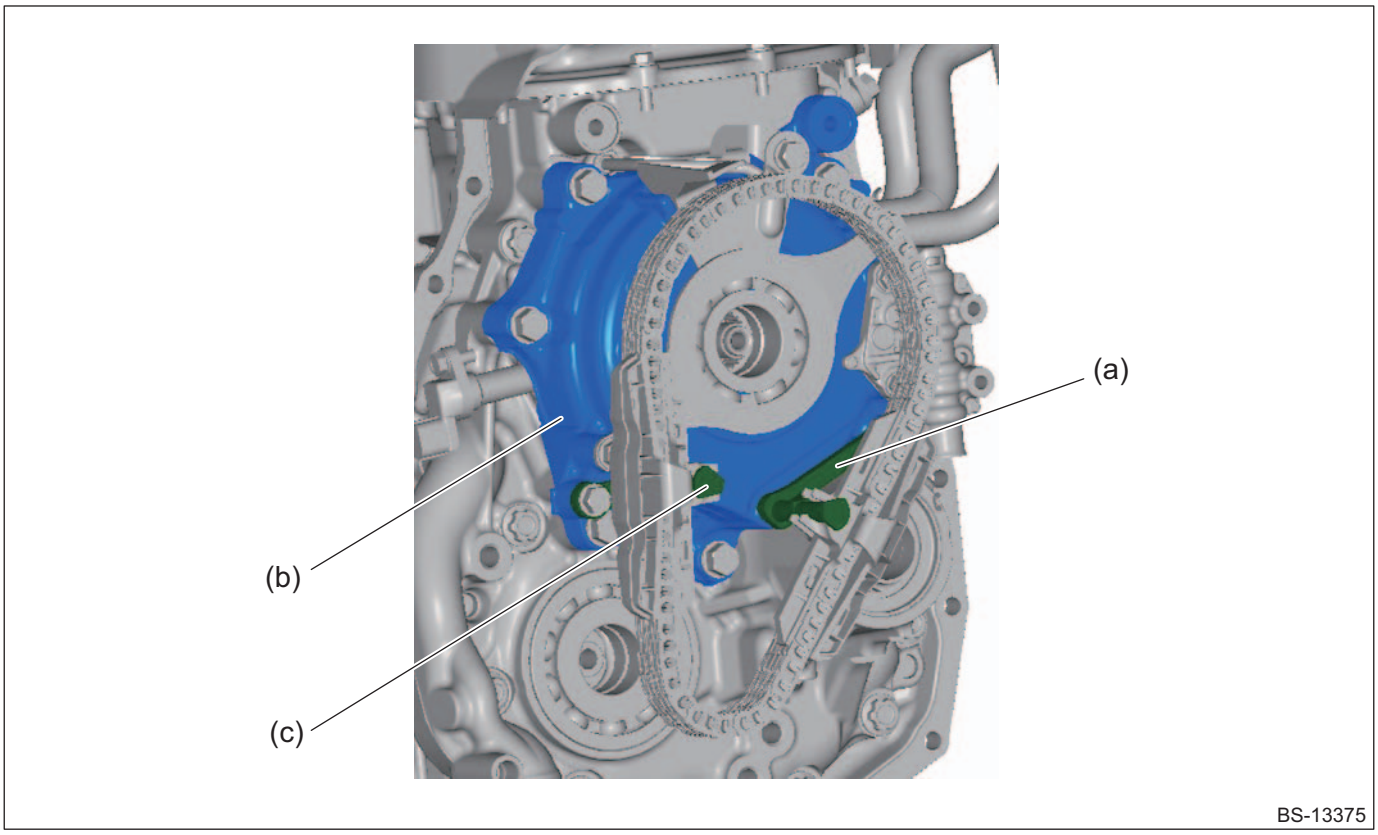


(A) Existing model vehicle

(B) New model vehicle

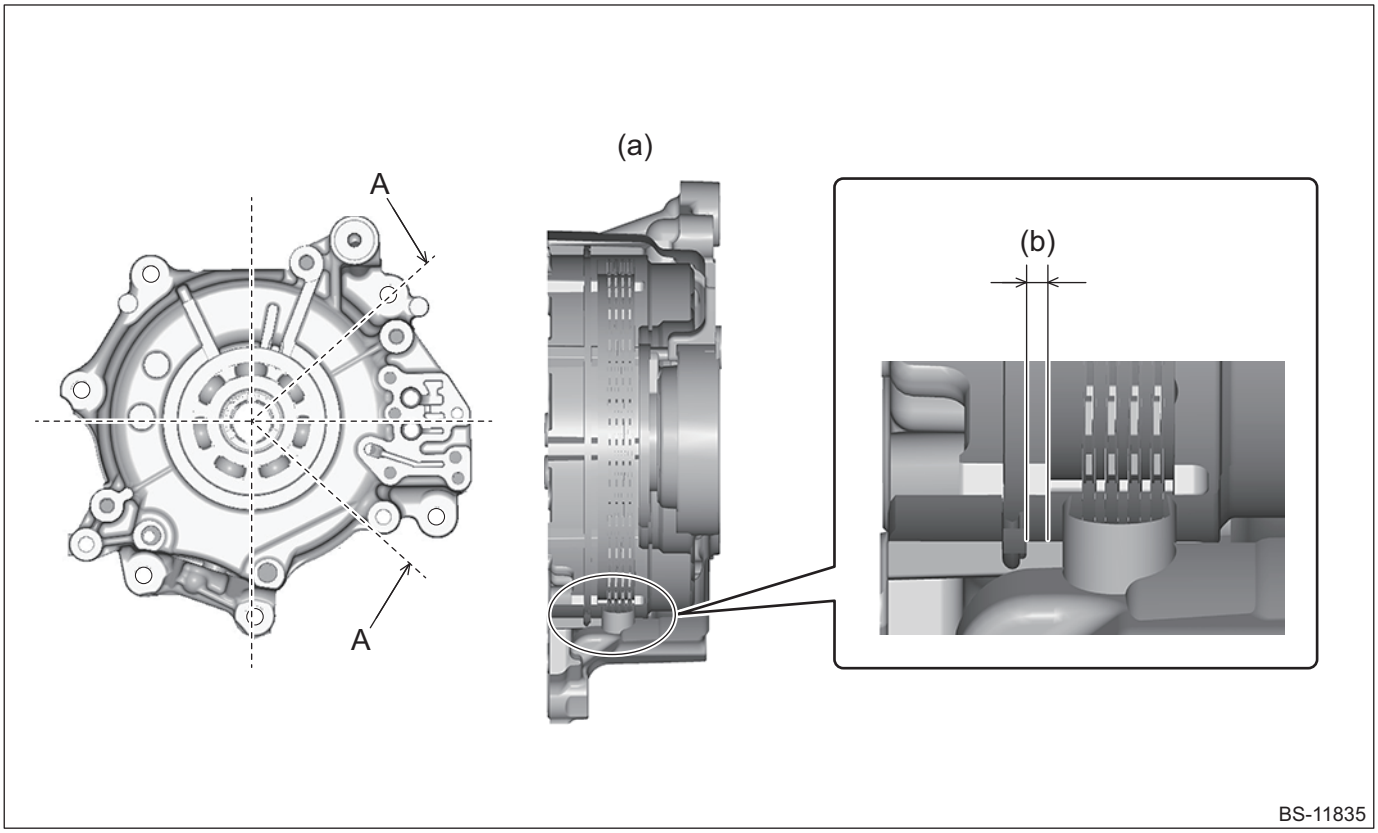
Reverse brake housing

With the expansion of the ratio coverage, the supporting positions of the support rod and lubrication pipe are changed.



(a) Support rod
(b) Reverse brake housing
(c) Lubrication pipe

The clearance of the reverse brake is set to approx. 80% to improve the responsiveness during reverse select.



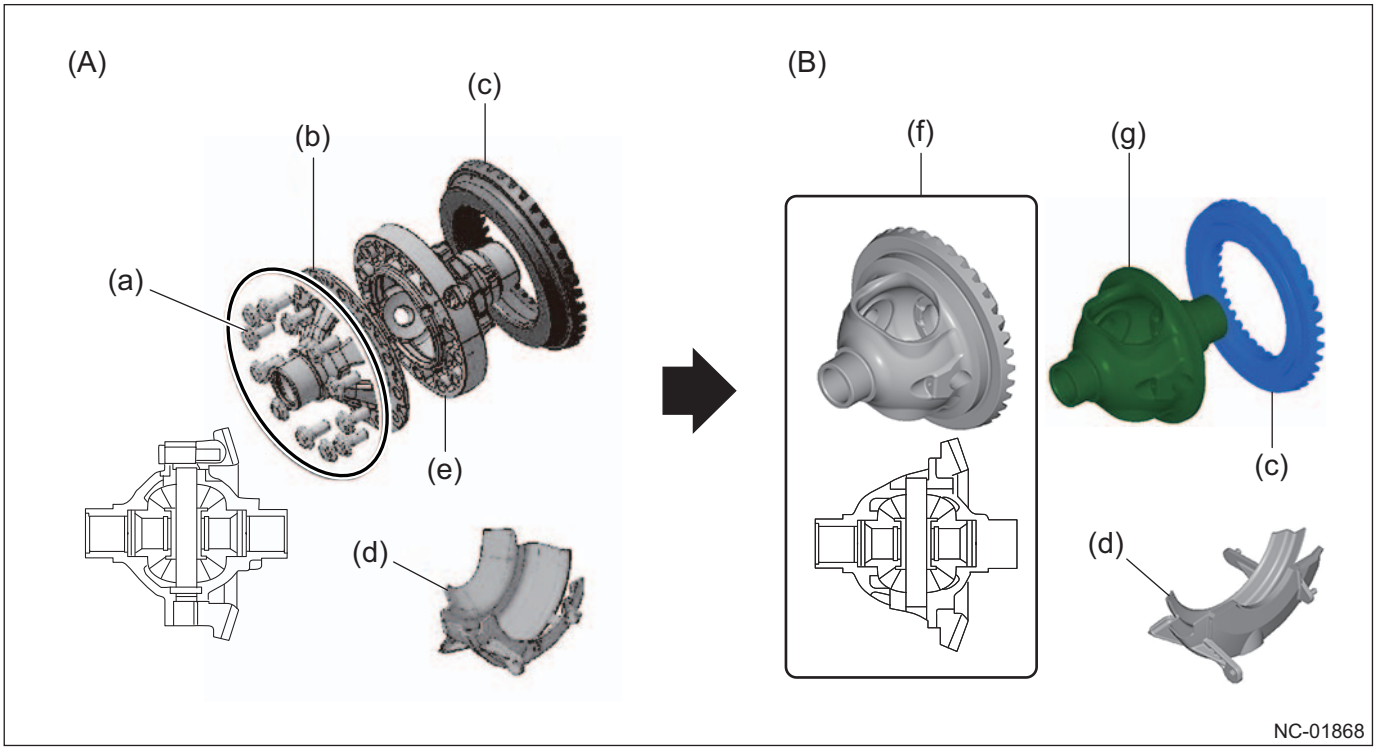
(a) A-A cross section

(b) Reverse brake clearance

Front differential

The structure of the differential case is changed from the bolt tightening type to the welding integrated type to reduce the weight.

With the change of the differential case, the baffle shape is optimized.



(A) Existing model vehicle

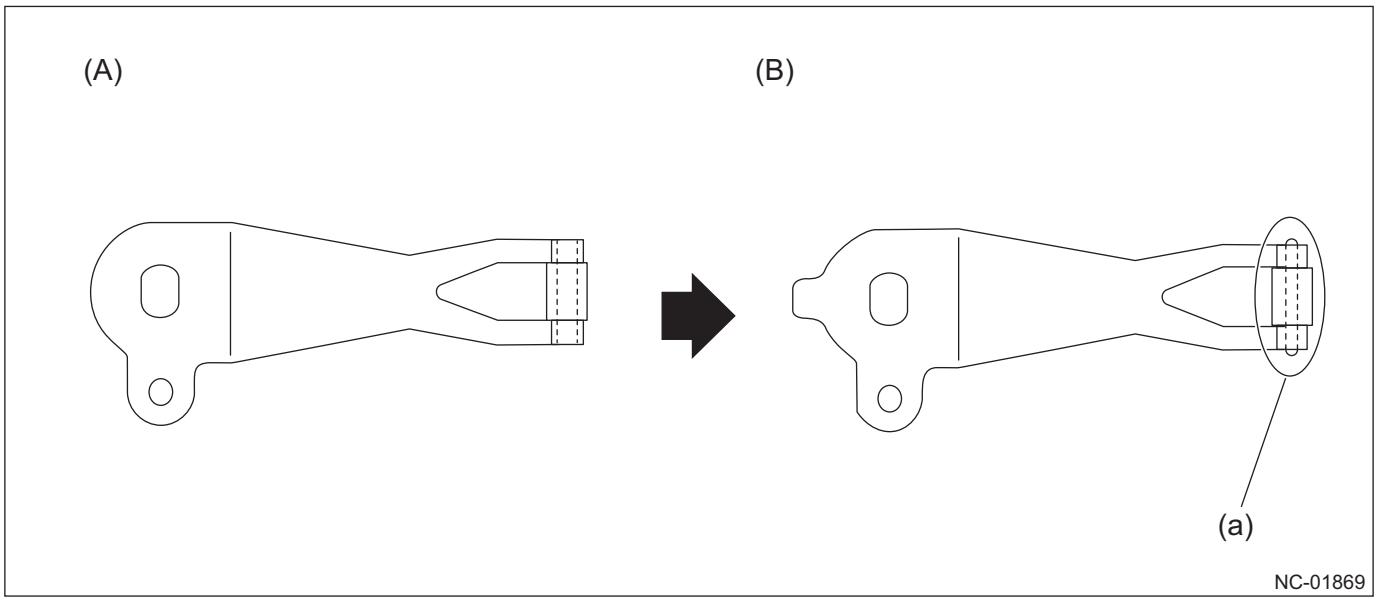
(a) Bolt × 12
(b) Differential case LH
(c) Crown gear
(d) Baffle

(B) New model vehicle

(e) Differential case RH
(f) Welding portion (whole circumference welded)
(g) Differential case assembly

Detent spring

The bearing is added inside the roller of the detent spring tip which is the contact point with the manual plate, to improve the motion smoothness when the select lever is operated.



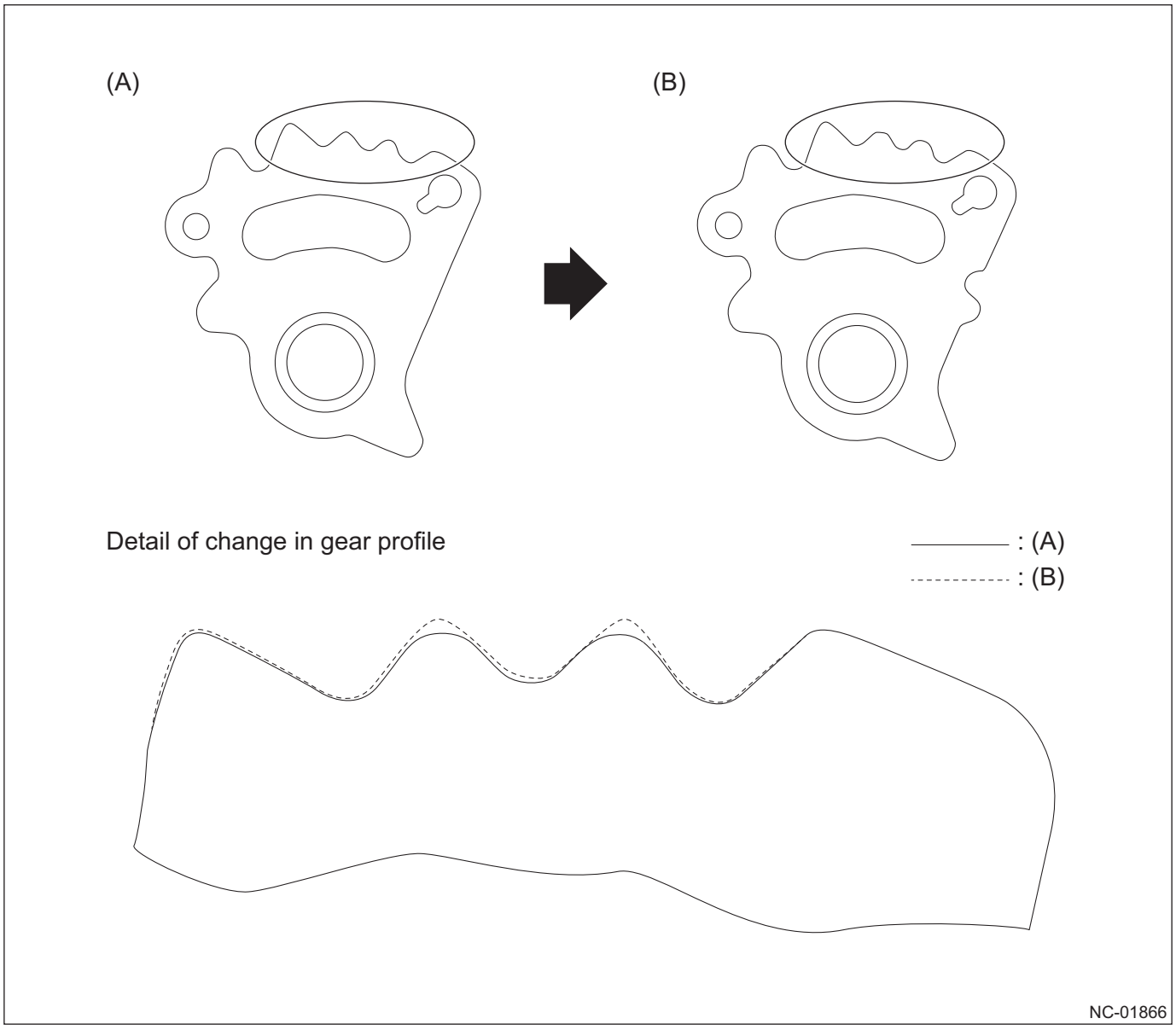
(A) Existing model vehicle

(B) New model vehicle

(a) Bearing added inside the roller

Manual plate

The tooth shape profile of the manual plate is changed to improve the motion smoothness when the select lever is operated.



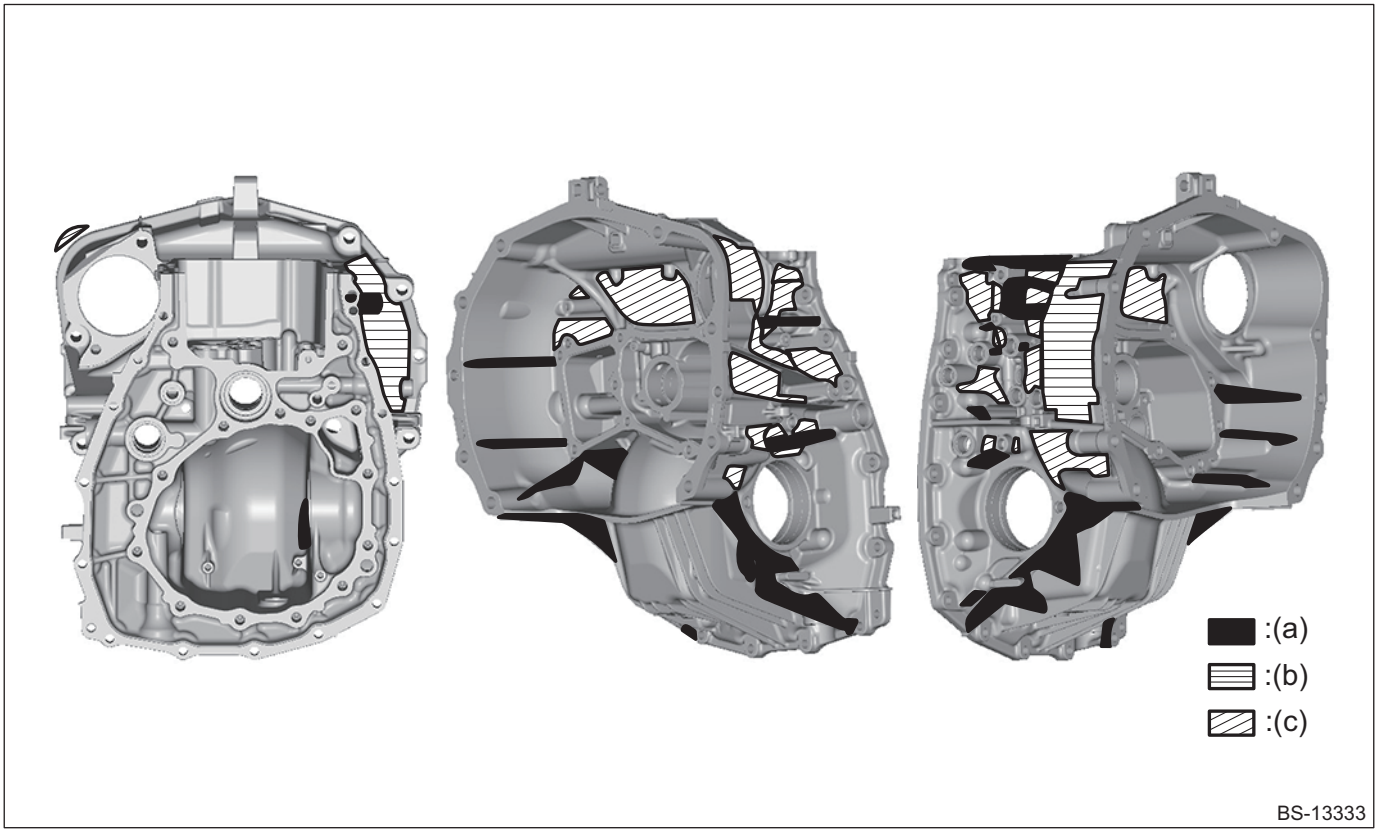
(A) Existing model vehicle

(B) New model vehicle

Cases

■ Converter case

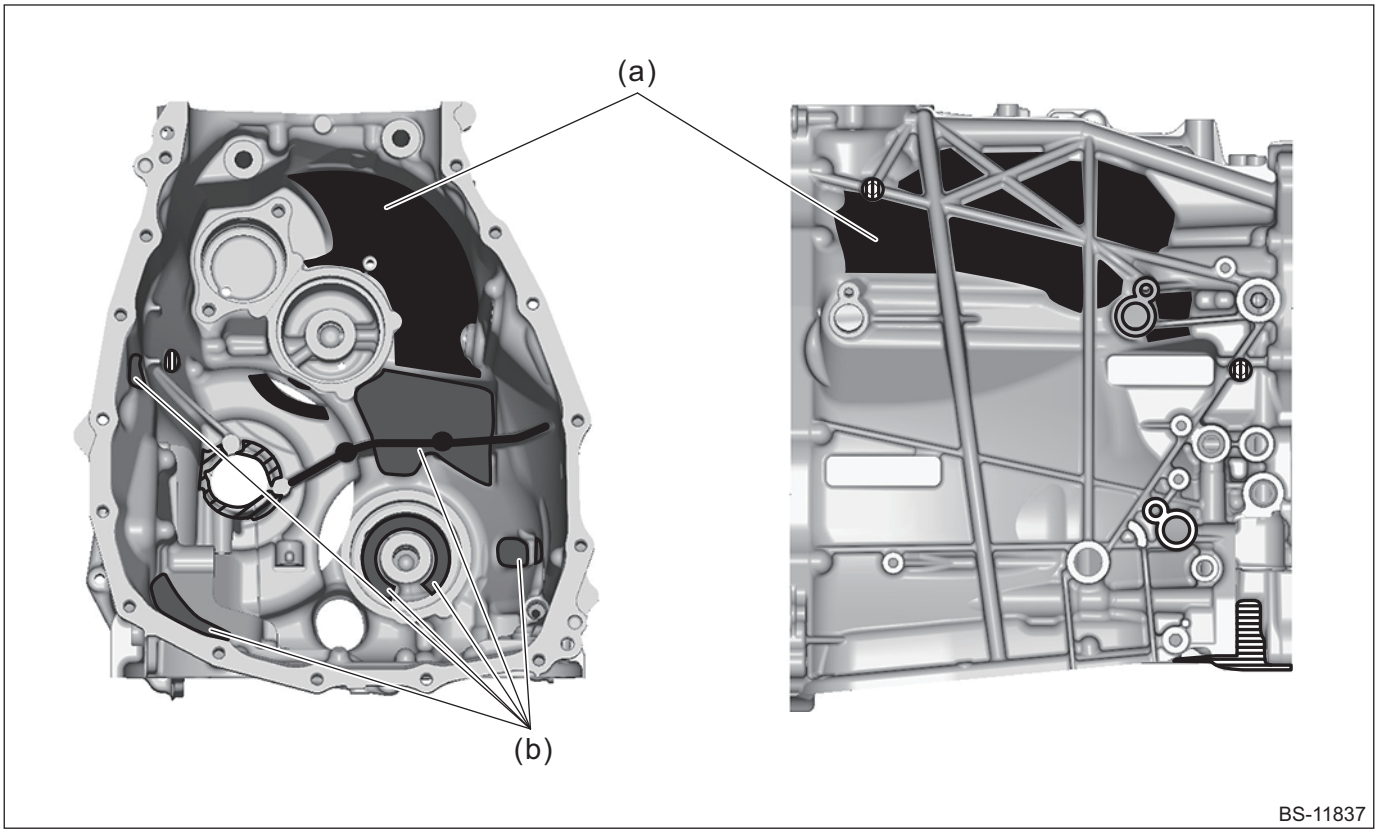
The optimization analysis for strength, noise, and vibration is performed to reduce the weight.



(a) Rib-reinforced portion
(b) Thickness increased
(c) Thickness reduced

■ Transmission case

While the exterior wall of the case is expanded to expand the ratio coverage, unnecessary portions are removed to optimize the shape, and weight reduction is also realized.

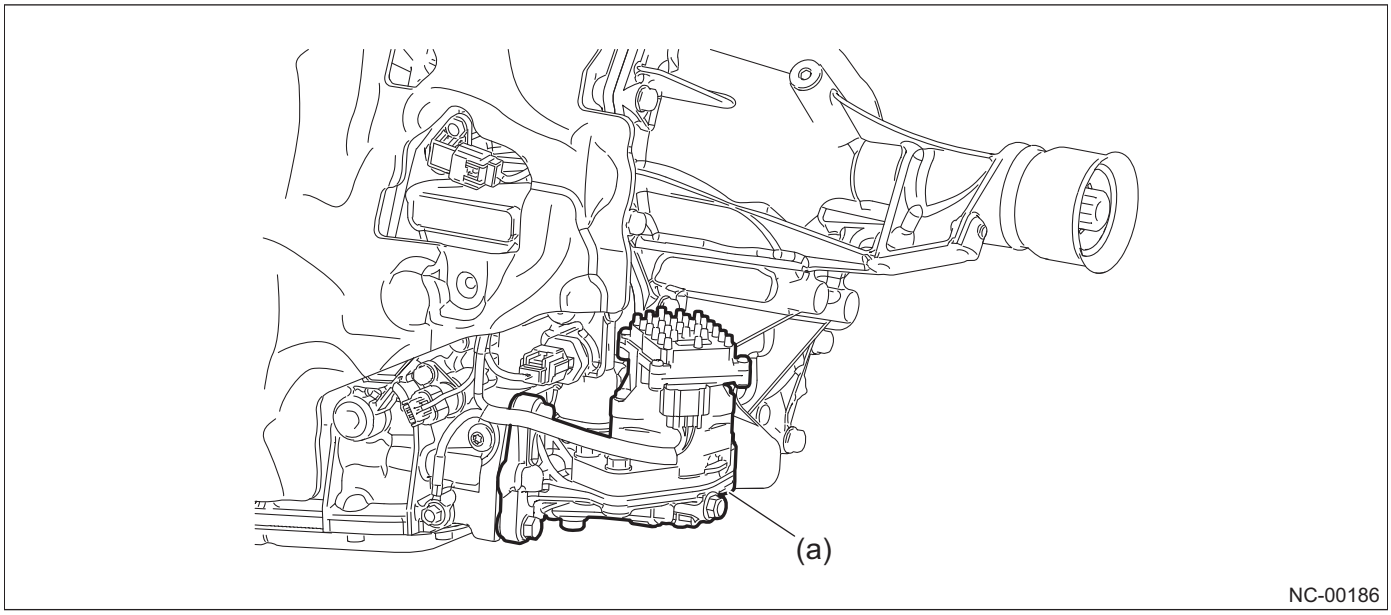


(a) Expanded portions of the exterior wall of the case around the primary axis

(b) Weight-reduced portions by shape optimization (unnecessary portions removed)

Electric oil pump

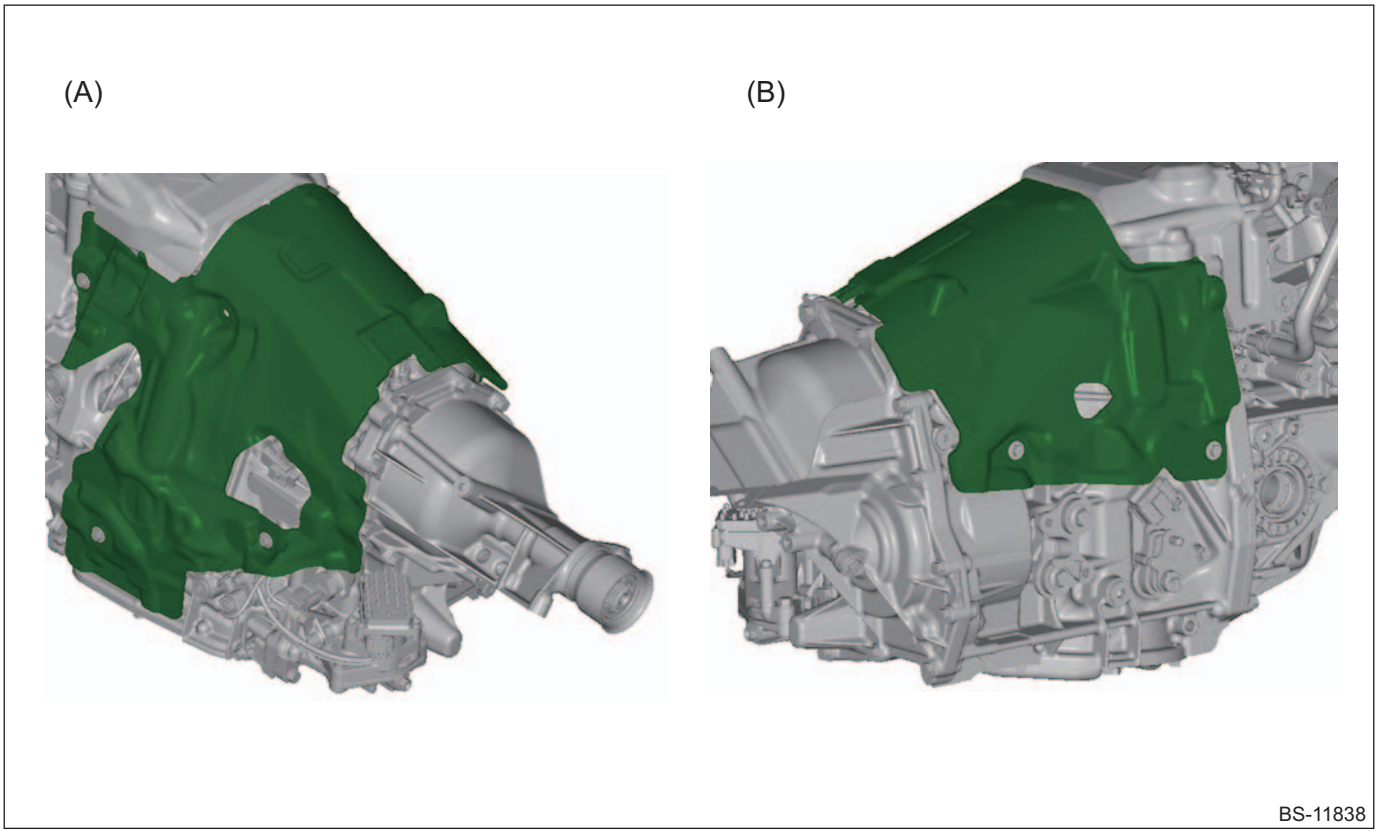
Since the Auto Start-Stop system is adopted, the electric oil pump is mounted at the back of the transmission. Accordingly, the line pressure detection position is changed, and the check valve and inlet pipe are added.



(a) Electric oil pump

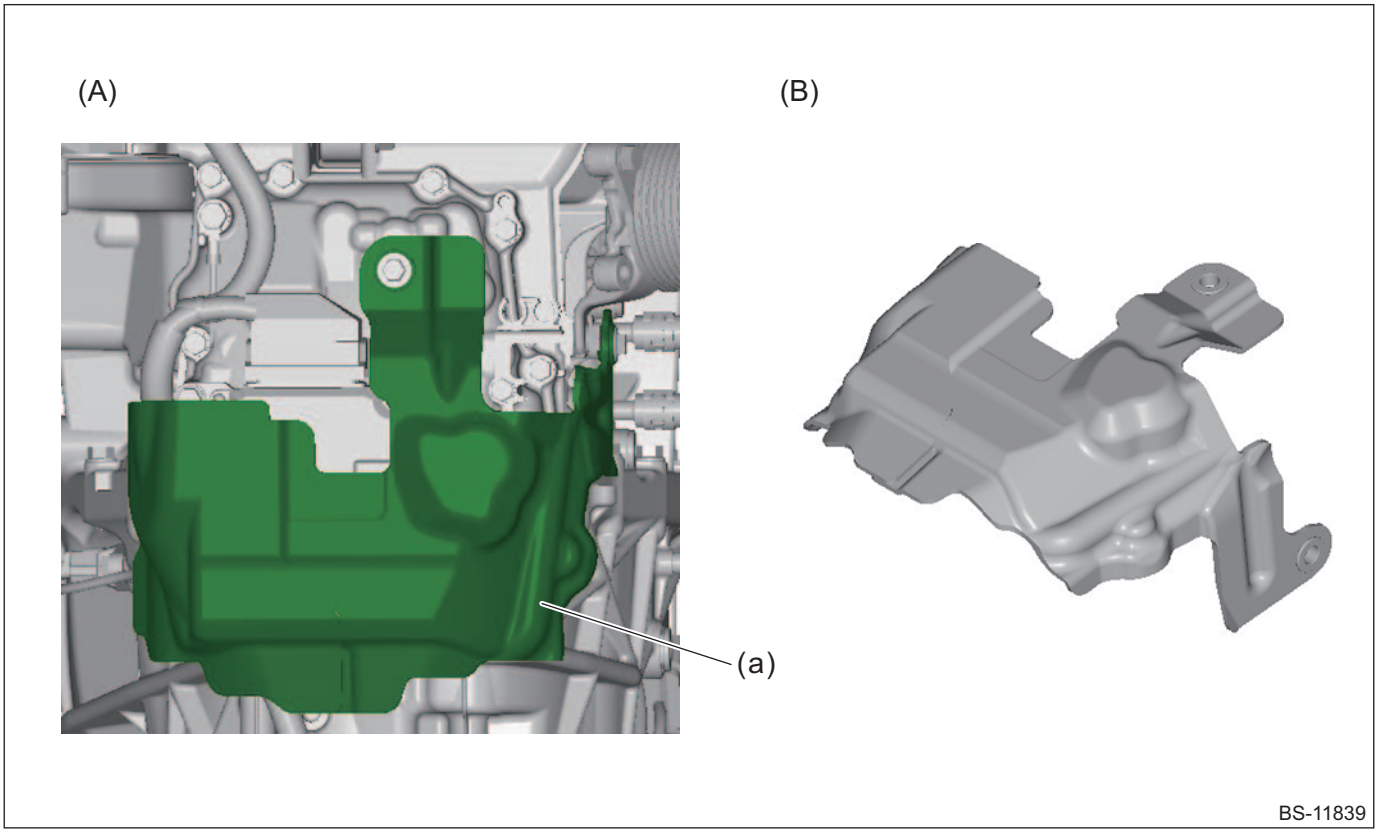
Transmission case cover

The shape of the transmission case cover (rear) is optimized to improve vibration and noise restraining performance.



(A) Left side (B) Right side

The transmission case cover of the valve is changed since the transmission control module (TCM) is mounted on the upper part of the transmission unit and the layout of the wire harness is changed.



(A) Cover arrangement

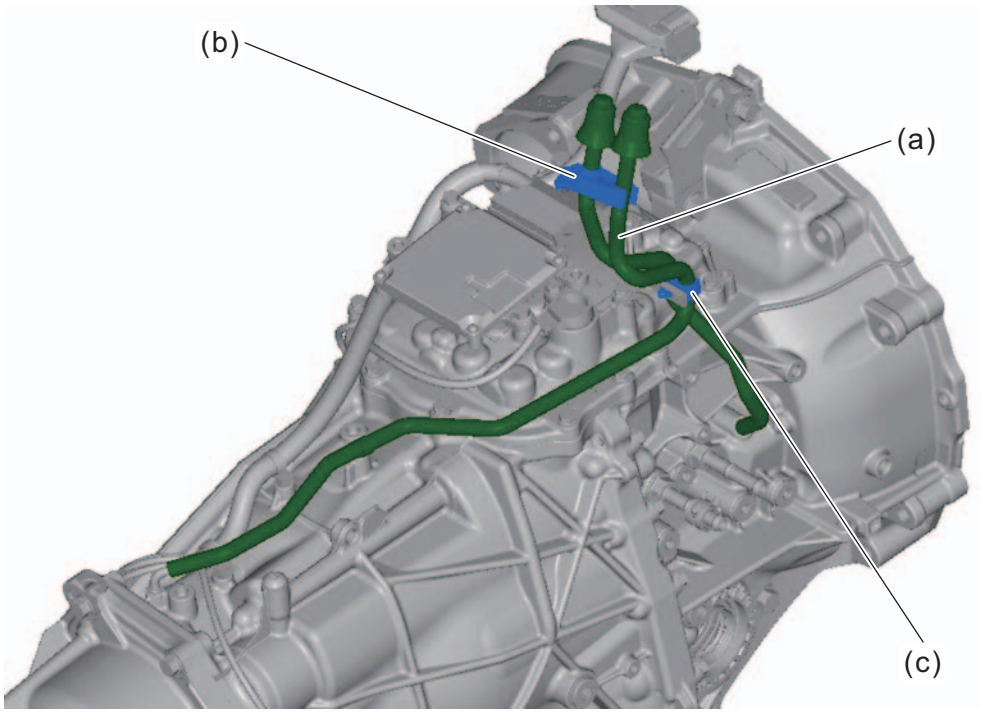
(B) Cover design

(a) Transmission case cover (front)

Air breather hose

The air breather hose is extended and the end of the air breather hose is fixed to the vehicle body floor above the transmission, and a large breather cap is adopted to improve bearing force against the entry of moisture and foreign matters into the transmission.

In response to the extended air breather hose, the mounting/fixing clip on the vehicle side for the air breather hose, and the mounting medium clip on the transmission side are set.



BS-11840

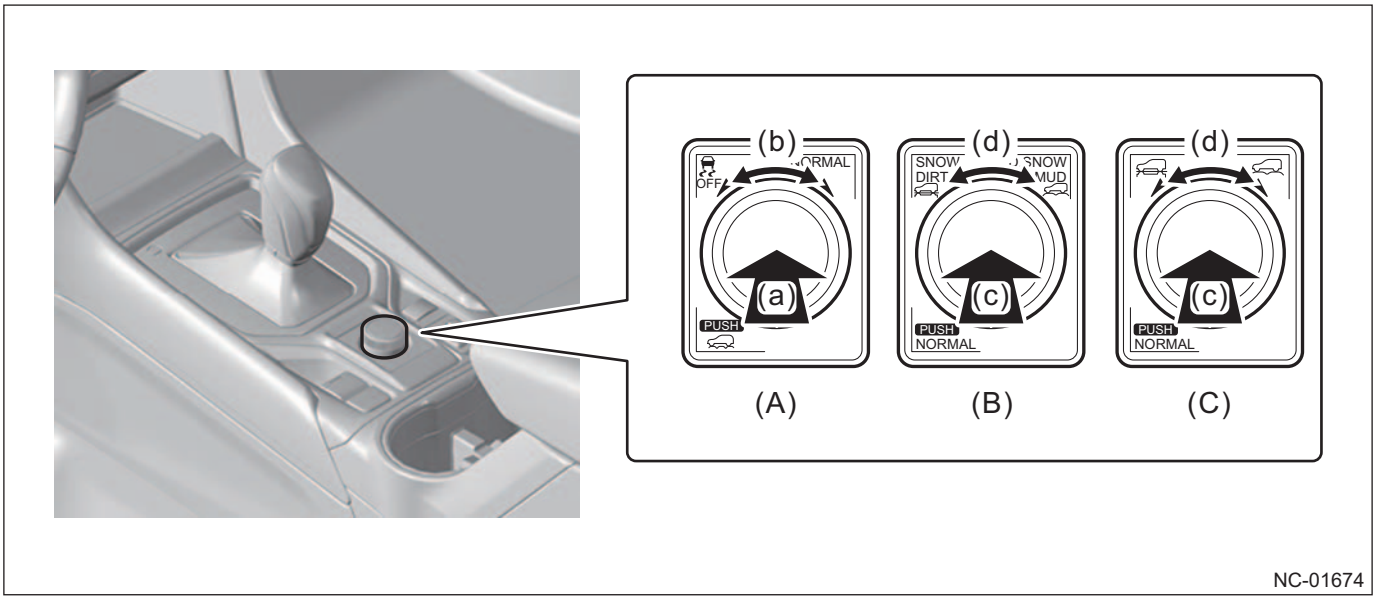
(a) Air breather hose
(b) Mounting/fixing clip on the vehicle side
(c) Mounting medium clip on the transmission side

X-MODE switch

The X-MODE switch is arranged at the back of the select lever. The adopted X-MODE switch excels in operability.

In addition, the X-MODE switch that can be easily switched between the two modes according to the road condition is set for some grades.

- Standard: The switch that integrates the X-MODE switch and VDC OFF switch is adopted. Since the X-MODE switch and VDC OFF switch are collected at one place, the operability is improved and easier switching control according to the road condition is realized.
- 2 modes: The switch that integrates the X-MODE switch and mode selection switch is adopted. The mode can be selected more intuitively between "SNOW/DIRT" and "D.SNOW/MUD" according to the road condition.



(A) Standard grade
(B) Upper grade
(C) Upper grade (for C5)

(a) Push: Switching X-MODE on/off
(b) Dial: Switching VDC on/off
(c) Push: Turning X-MODE off
(d) Dial: Switching modes (X-MODE automatically turns on by dial operation.)

■ X-MODE display

When X-MODE is selected, the X-MODE indicator light lights up on MFD and MID.

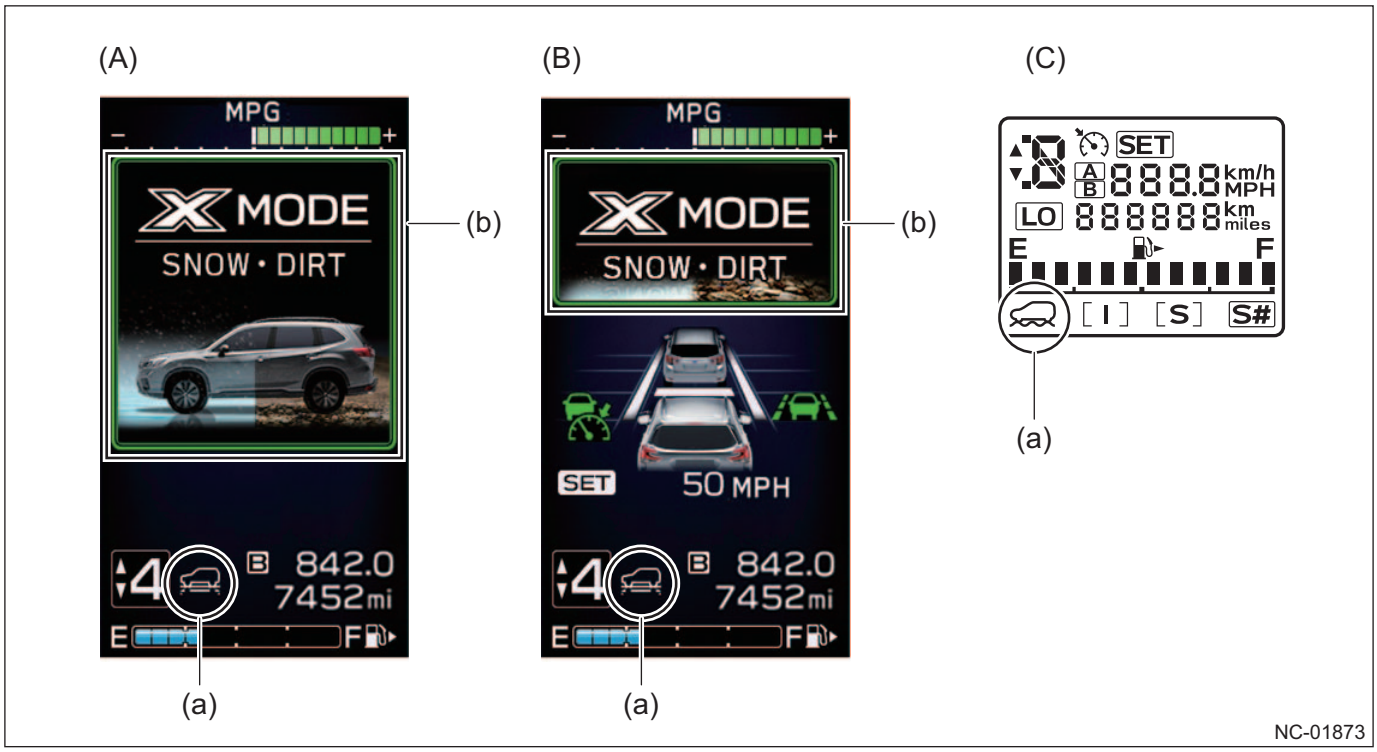
As for vehicles with 2 modes, when either of the two modes is selected, the MFD and MID displays (road condition) change according to the selected mode. Also, the roll angle is displayed on MFD at the same time to enable visual confirmation of vehicle posture.

X-MODE display: MFD

(A) High grade MFD
(B) High grade MFD (2 modes)
(C) Standard MFD

(a) X-MODE indicator light
(b) Roll display (model with auto headlight beam leveler)
(c) Mode display

X-MODE display: MID

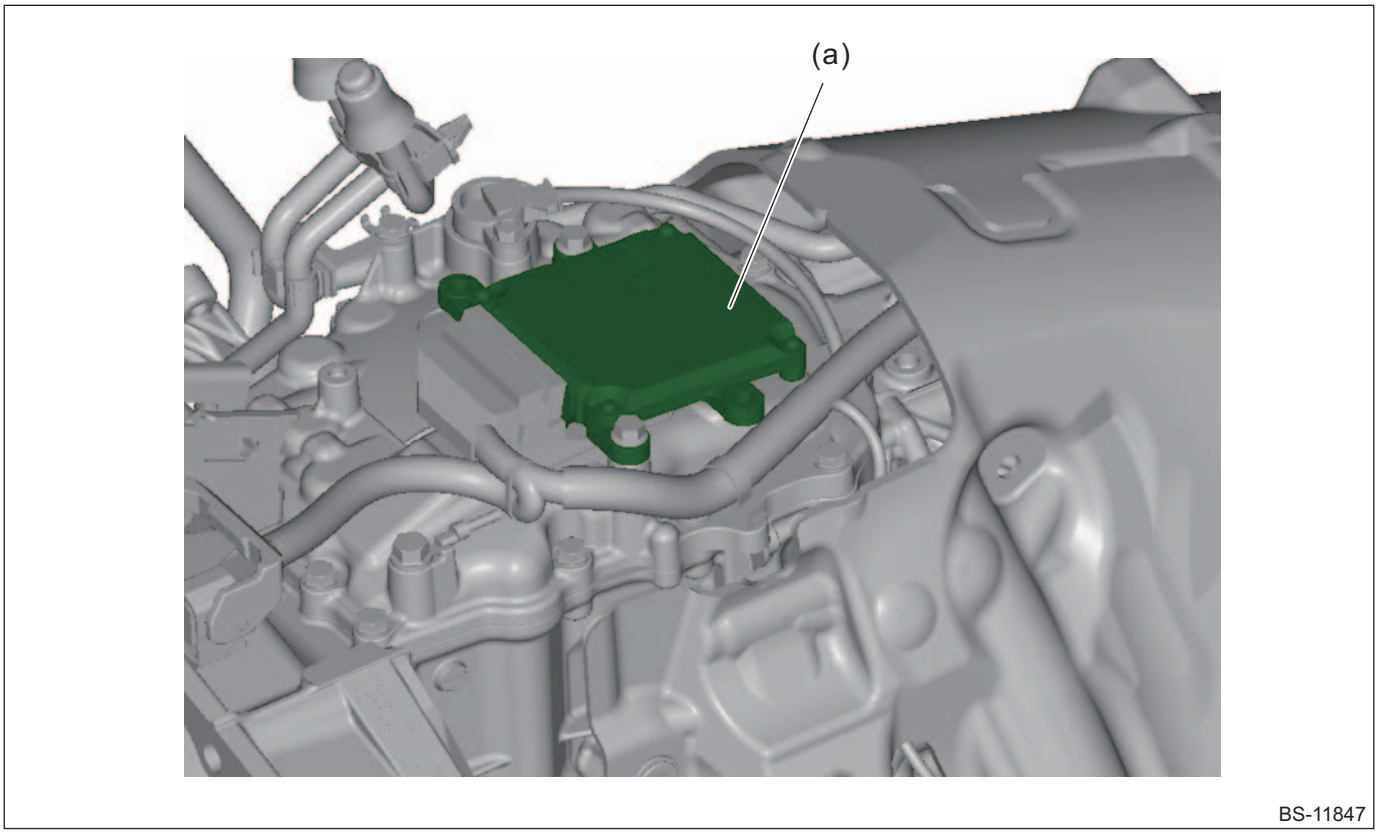


(A) High grade MID (EyeSight is off.)
(B) High grade MID (EyeSight is on.)
(C) Standard MID

(a) X-MODE indicator light
(b) Mode display

Transmission control module (TCM)

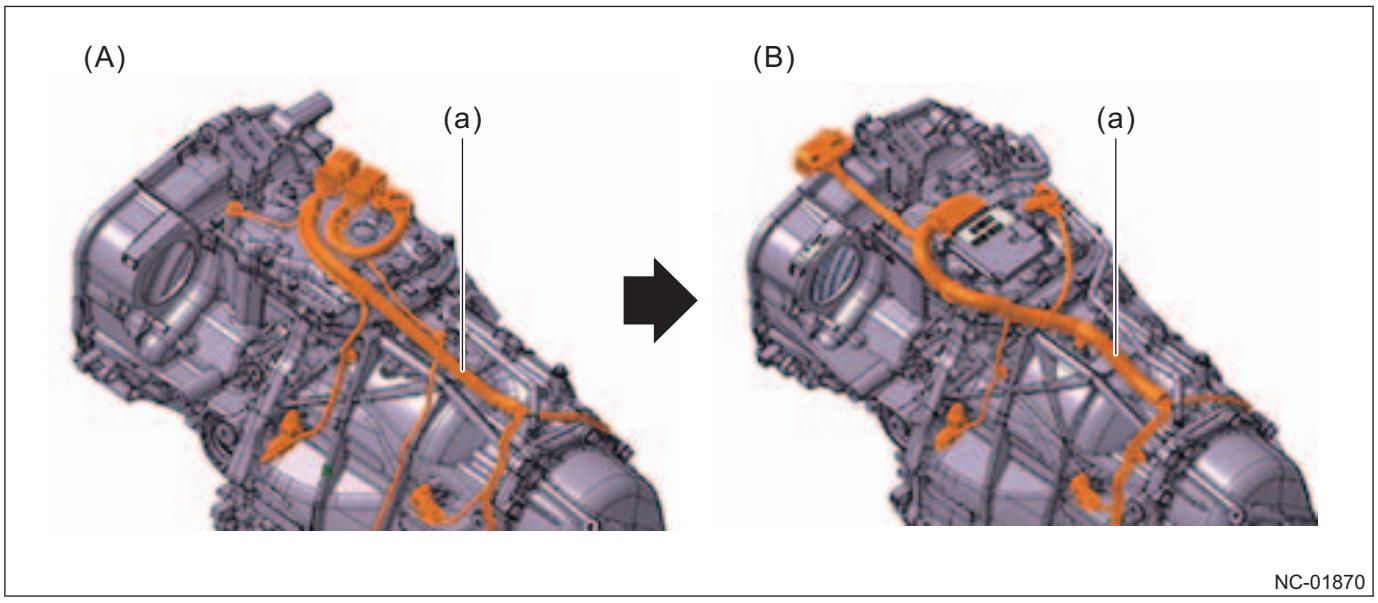
It is directly mounted on the upper part of the transmission unit unlike the conventional arrangement in the cabin.



(a) Transmission control module (TCM)

Transmission harness

Since the TCM installation position is changed and the Auto Start-Stop system is adopted, the transmission harness is changed.



(A) Existing model vehicle

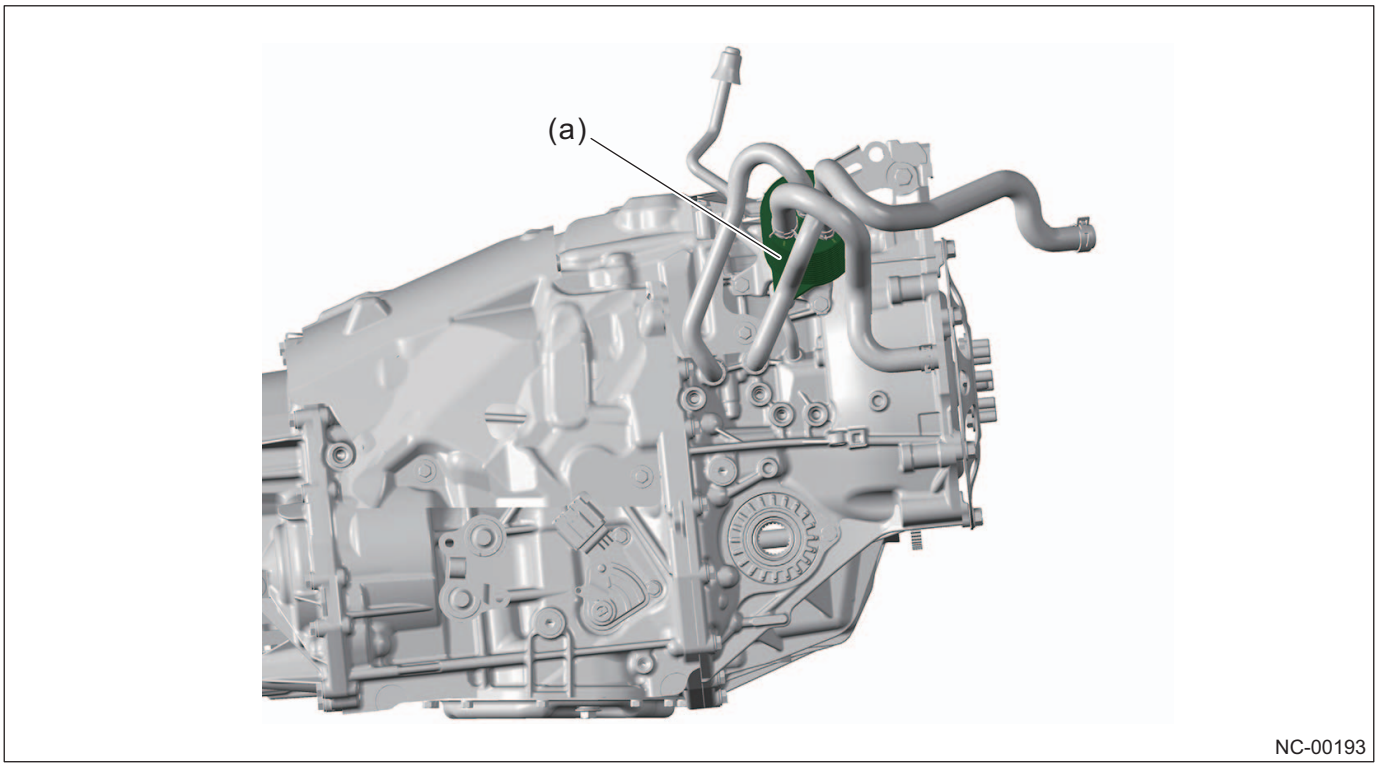
(B) New model vehicle

(a) Transmission harness

CVTF cooler (with warmer function)

The CVTF cooler with warmer function is adopted.

The friction is reduced and the fuel efficiency is improved by using engine coolant to quickly increase CVT fluid temperature and reducing CVT fluid viscosity. Also acts as a cooler when CVT fluid temperature is high.

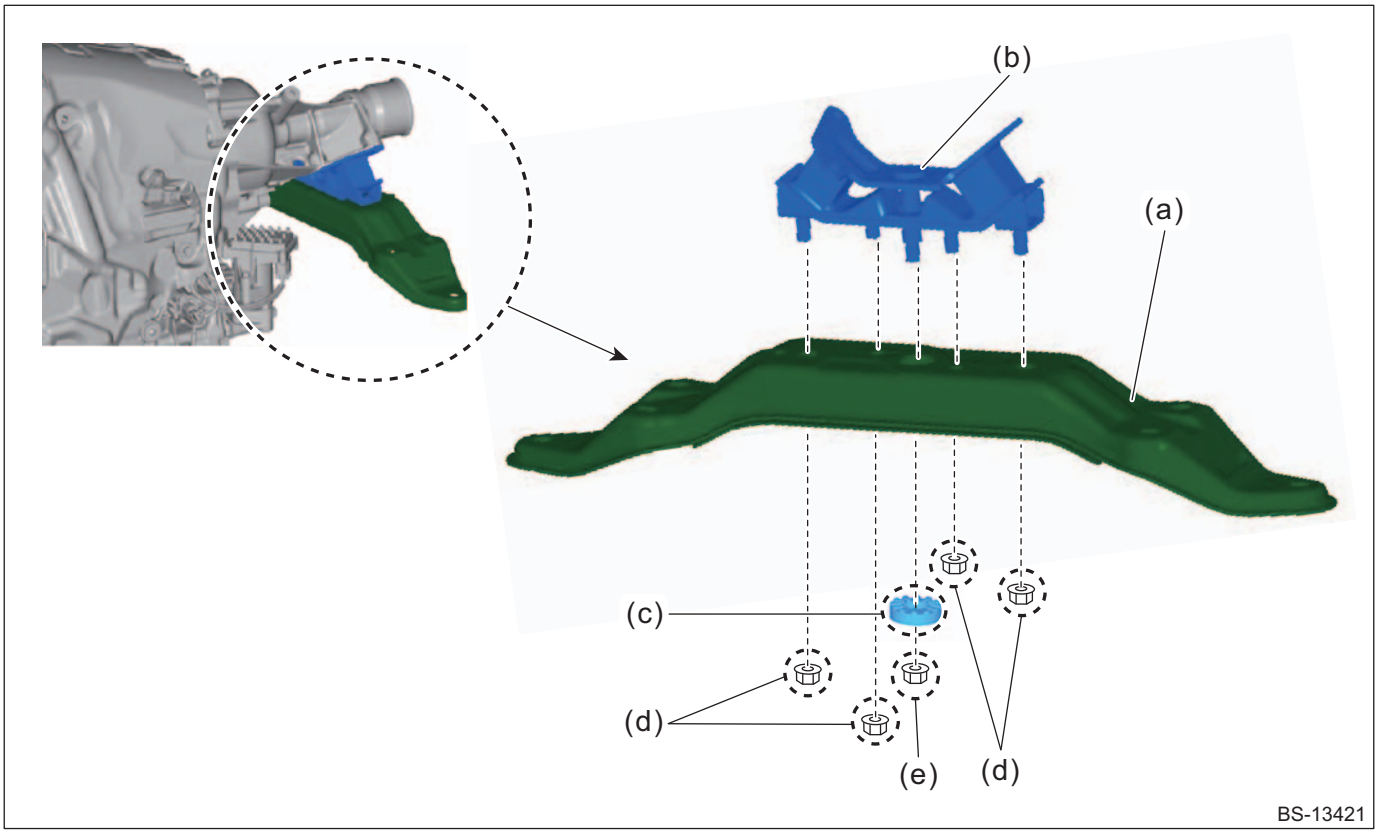


(a) CVTF cooler (with warmer function)

Transmission mount

The shapes of the transmission rear crossmember and rear cushion rubber are optimized for the new vehicle frame.

The engaging locations between the transmission rear crossmember and rear cushion rubber are changed from two points to four points to reduce the operating noise of the CVT chain at low speed.



(a) Transmission rear crossmember
(b) Rear cushion rubber
(c) Stopper
(d) Tightening nut between the transmission rear crossmember and transmission cushion rubber
(e) Stopper tightening nut

3.3.3 CVT Control System

Overview

The transmission electronic hydraulic control system is composed of TCM, various sensors and switches, and oil pressure controllers including the solenoid valve. This system controls forward/reverse motion, lock-up clutch operation, line pressure, and transmission operation that includes shifting properties.

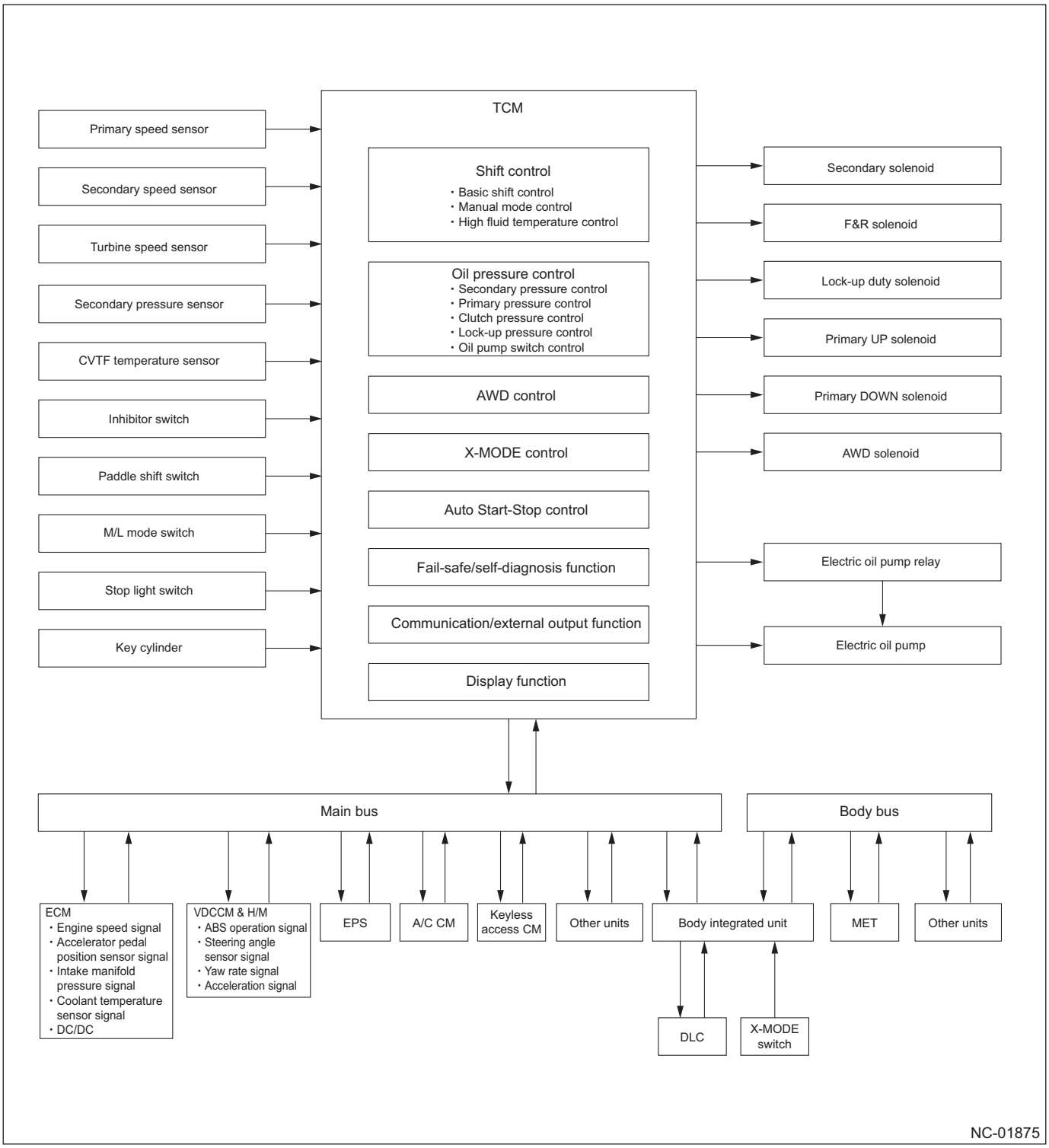
TCM controls the transmission by determining vehicle driving conditions based on the various input signals from the other systems and sending proper signals to each solenoid (primary UP/DOWN solenoid, secondary solenoid, lock-up duty solenoid, F&R clutch solenoid, and AWD solenoid).

The TCM has the following major functions.

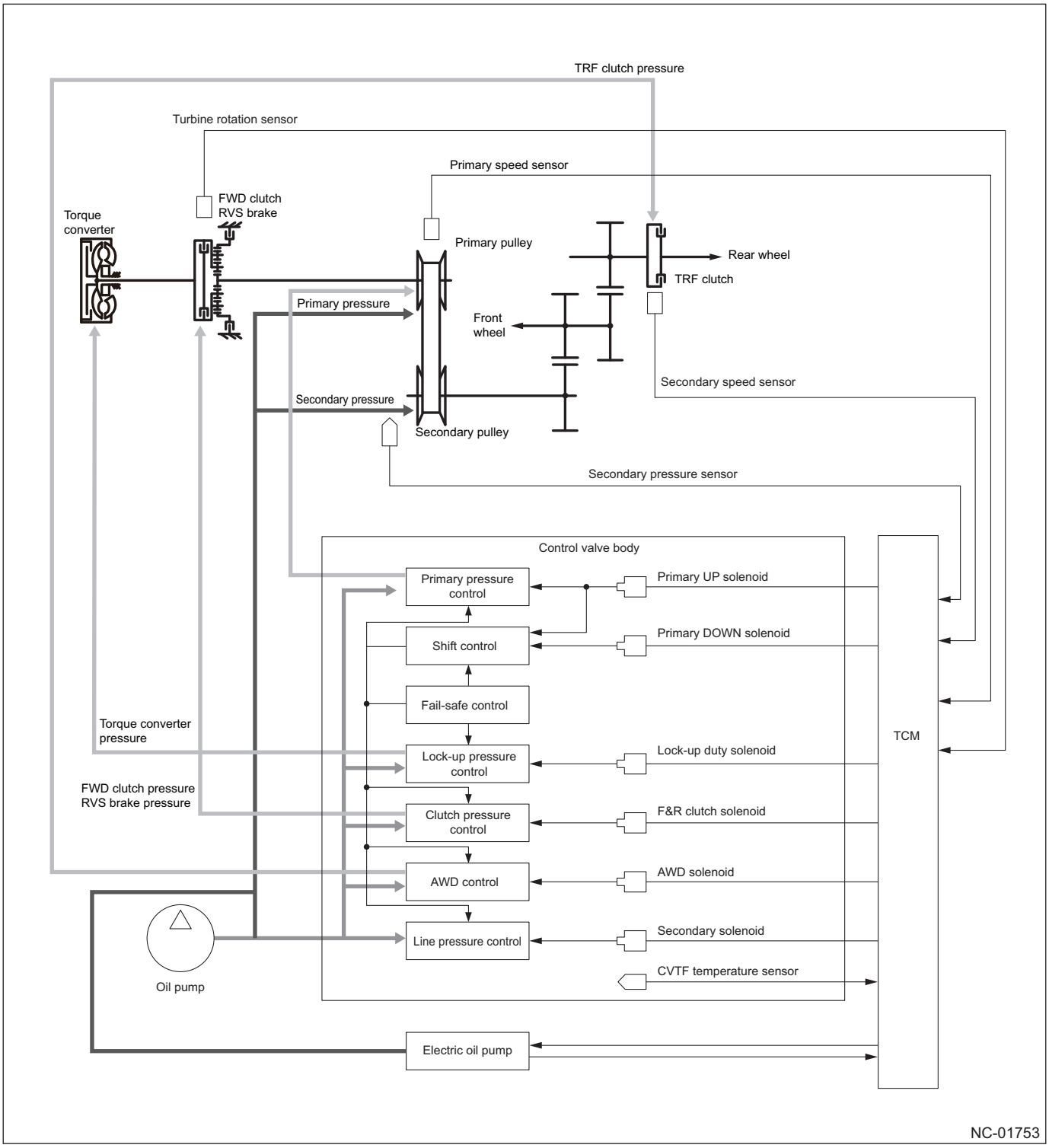
- Selects shift transmission/lock-up pattern and determines gear ratio/lock-up conditions.
- Drives mechatronic devices such as the solenoid valve based on a shift command and a control signal for operating pressure.
- AWD transfer clutch control function
- Self-diagnosis function for identifying faulty parts of the transmission and fail-safe function when problem is detected
- Communication function with the Subaru Select Monitor for diagnosis and maintenance
- Hard variation correction function for a transmission by learned control
- Communication function (CAN communication) with other control modules

System diagram

CVT control system diagram



CVT control hydraulic circuit diagram



Component function list

Component	Function
Secondary solenoid	Controls the oil pressure applied to the secondary pulley.
F&R clutch solenoid	Controls the oil pressure applied to the forward clutch and the reverse brake.
Lock-up duty solenoid	Controls the oil pressure applied to the lock-up clutch piston in the torque converter.
Primary UP solenoid	Controls the oil pressure applied to the primary pulley at up-shifting.
Primary DOWN solenoid	Controls the oil pressure applied to the primary pulley at down-shift.
AWD solenoid	Controls the oil pressure applied to the transfer clutch.
Primary speed sensor	Detects rotation number of the input shaft.
Secondary speed sensor	Detects rotation number of the output shaft.
Turbine speed sensor	Detects rotation number of the turbine.
Secondary pressure sensor	Detects the oil pressure in the secondary pulley.
CVTF temperature sensor	Detects the oil temperature.
Inhibitor switch	Detects the shift position.
Paddle shift switch (+)	Detects the up-shifting.
Paddle shift switch (-)	Detects the down-shift.
TCM	Controls the transmission operation by determining vehicle driving conditions based on various input signals and sending proper signals to each solenoid.
	Includes the diagnosis mode and the fail-safe function for serviceability at system failure.
ECM	Sends the engine control signal to TCM.
VDCCM & H/M	Sends the brake control signal to TCM.
MDF	Displays "X-MODE".
Combination meter	Flashes the AT oil temperature warning light at system failure.
Multi-information display	Displays the current shift position on shift position indicator.
	Displays the warning screen at system failure.
DLC	Reads DTC by connecting it to the Subaru Select Monitor 4.

Controls

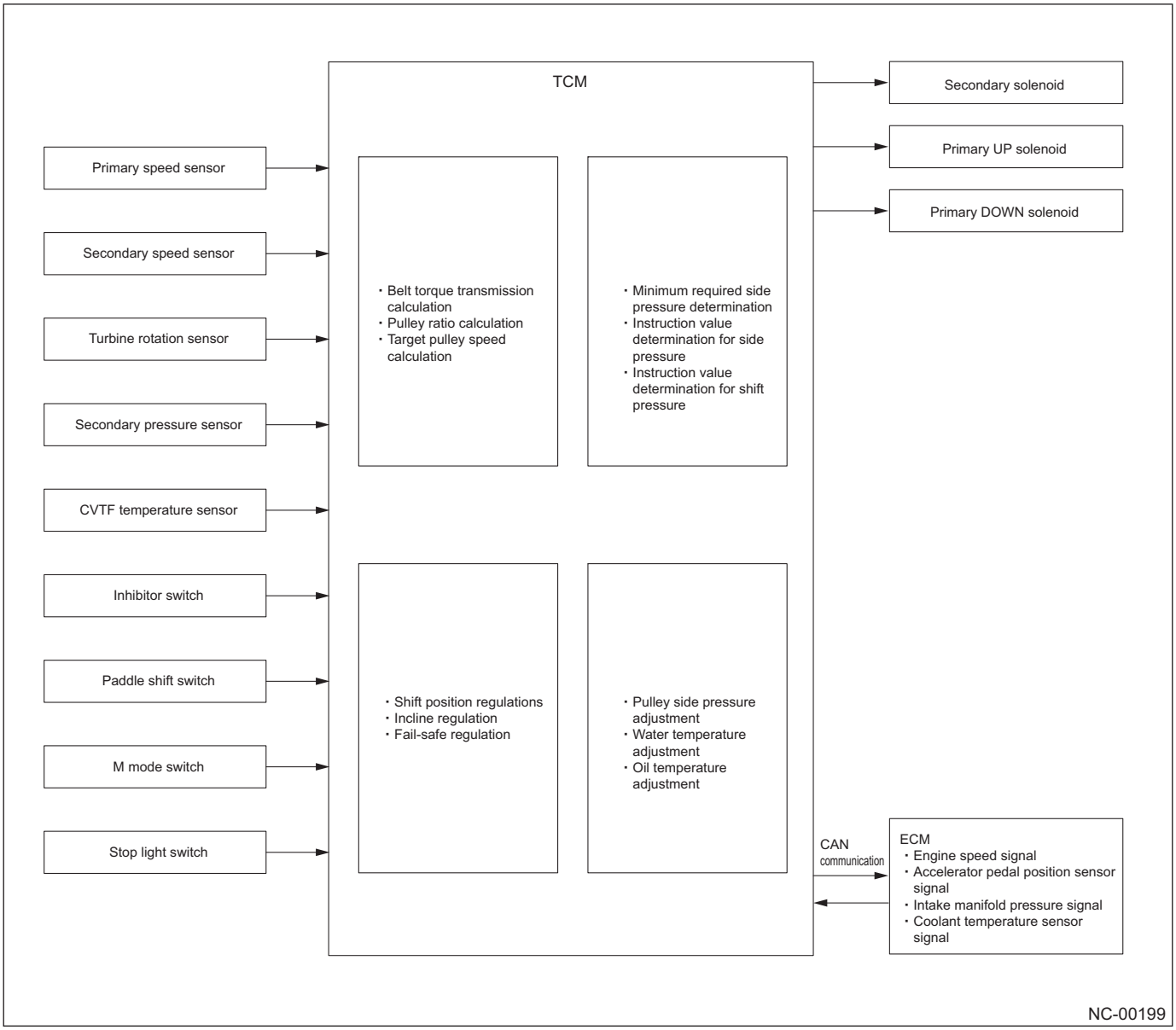
Control item		Control description	Control signal
Shift control	Basic shift control	Shifting properties are set for each range depending on the acceleration opening angle and vehicle speed.	• Accelerator position signal • Engine speed • Secondary speed sensor signal • Primary speed sensor signal • Oil pressure sensor signal • Range signal • Intake manifold pressure signal
	Manual mode control	When the M-range is selected, manual mode control is selected.	• Accelerator position signal • Range signal • Engine speed • Secondary speed sensor signal • Primary speed sensor signal • Oil pressure sensor signal • Brake switch signal
	Lo mode control	When the L range is selected, Lo mode control is selected.	(Same as the signals in manual mode control)
	SI-DRIVE control	Controls the shifting properties according to the SI-DRIVE mode.	(Same as the signals in manual mode control)
	High fluid temperature control	Regulates the upper limit for transmission speed when CVTF or coolant is hot.	• Engine speed • Primary speed sensor signal • Range signal • Coolant temperature sensor signal • CVTF temperature signal • Secondary speed sensor signal

Oil pressure control	Secondary pressure control	Secondary pressures are controlled depending on the necessary oil pressures selected by each range and switch inputs. Feedback control on the necessary oil pressures is performed by oil pressure sensors.	• Engine speed • Secondary speed sensor signal • Primary speed sensor signal • Oil pressure sensor signal • Range signal • Intake manifold pressure signal • CVTF temperature signal • Brake switch signal
	Primary pressure control	Primary pressure is determined from secondary pressure, ranges, and gear ratio for feedback control.	(Same as the secondary pressure control)
	Forward clutch pressure and reverse brake pressure control	Controls oil pressure for the forward clutch and reverse brake according to secondary speed and acceleration opening angle.	• Acceleration opening angle signal • Engine speed turbine speed sensor signal • Secondary speed sensor signal • Primary speed sensor signal • Oil pressure sensor signal • Range signal • CVTF temperature signal • Brake switch signal
	ISS control	Controls the forward clutch pressure during the Auto Start-Stop.	• Voltage signal • Starter switch signal • Coolant temperature sensor signal • Oil pressure sensor signal • Brake switch signal • Range signal • Oil pressure sensor signal • Acceleration opening angle signal
	Lock-up pressure control	In accordance with the shift pattern selected by ranges and switch input, the lock-up engagement/release vehicle speeds are determined based on the CVTF temperature and vehicle speed. Accordingly, the lock-up duty solenoid is controlled so that the lock-up clutch in the torque converter is engaged and released smoothly.	• Acceleration opening angle signal • Engine speed • Range signal • Primary speed sensor signal • Secondary speed sensor signal • CVTF temperature signal

AWD control	Active torque split AWD control	Controls the transfer clutch pressure in cooperation with VDC.	• Engine speed • Secondary speed sensor signal • Primary speed sensor signal • ABS operation signal • Steering angle sensor signal • Yaw rate signal • Lateral acceleration signal • Brake switch signal • Range signal • Oil pressure sensor signal • Acceleration opening angle signal
X-MODE control	Cooperation control of engine, transmission, AWD, and brake	Controls drive force and the brake in cooperation with VDC.	• Engine speed • Secondary speed sensor signal • Primary speed sensor signal • ABS operation signal • Steering angle sensor signal • Yaw rate signal • Lateral acceleration signal • Brake switch signal • Range signal • Oil pressure sensor signal • Acceleration opening angle signal

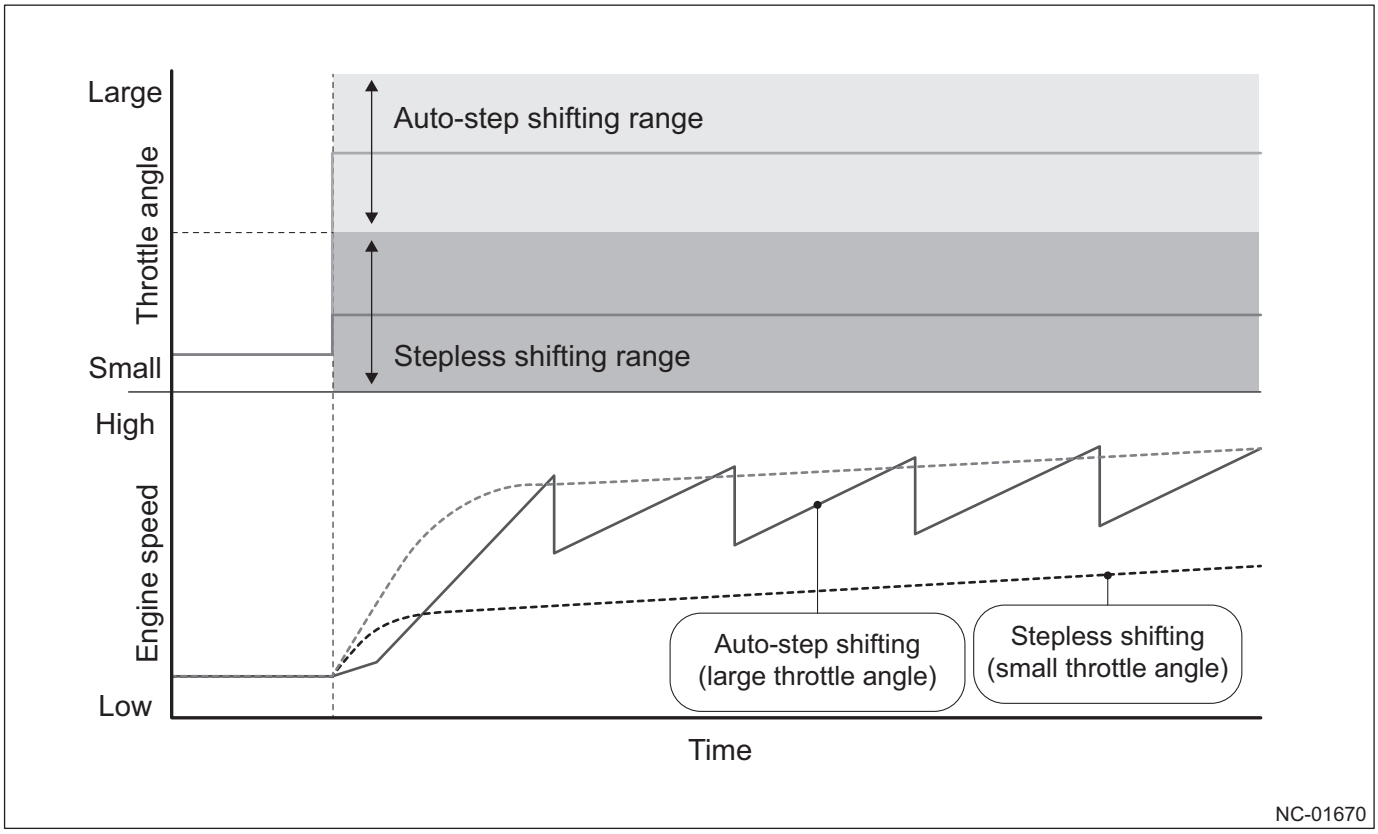
Shift control

The shift control is performed with the primary UP solenoid and the primary DOWN solenoid. The control module calculates based on input signals such as the engine speed, throttle opening angle, inhibitor switch, and input-output rotation numbers to control gear change by changing the primary pressure applied to the primary pulley.



Auto-step shift control

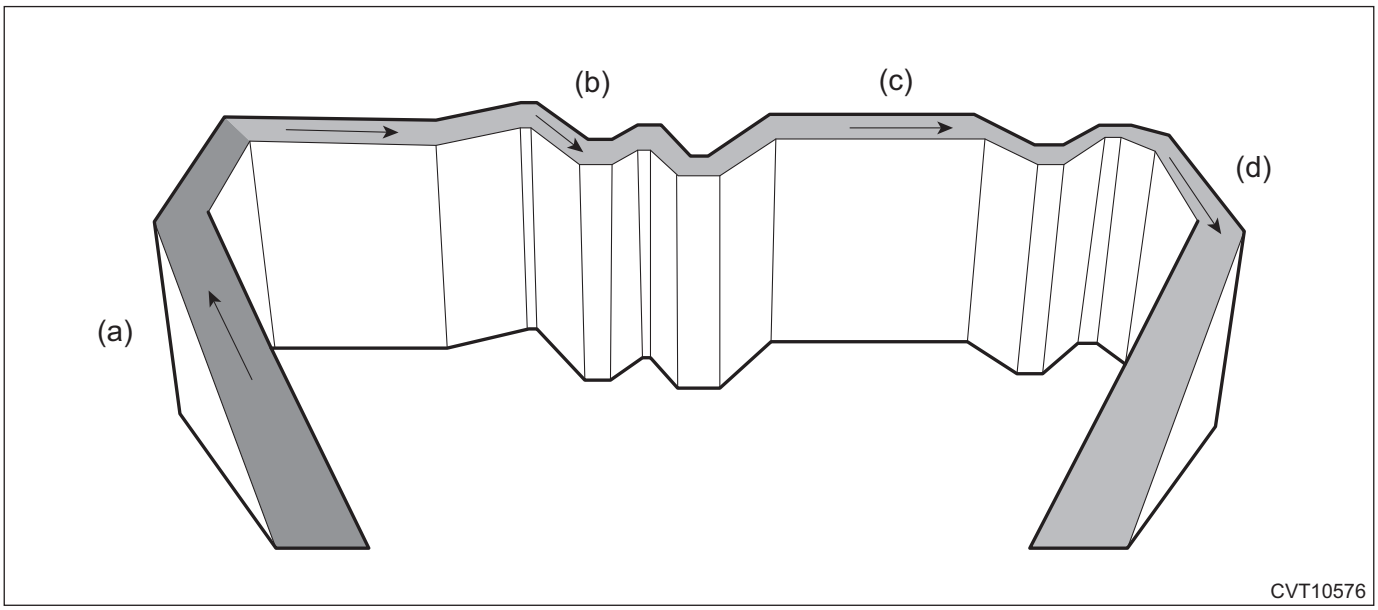
The auto-step shift control switches between the smooth shifting property with fuel efficiency and the sporty shifting property according to the acceleration opening angle. When the acceleration opening angle is small, the non-step shift control is selected to enable driving with an appropriate gear ratio according the traveling condition. When the angle is large, the plural-step shift control is selected to enhance the sense of unity between the engine sound and the vehicle speed increase.



■ Active shift control

The active shift control performs the following controls.

- Hill climb/down control: Automatically adjusts the gear ratio according to the road surface gradient (angle of a sloping road).
- Cornering control: The lateral acceleration sensor detects cornering conditions and reduces unnecessary gear changes while cornering.
- Accelerator pedal quick return control: Secures engine brake, prevents unnecessary gear change, and creates a state that waits for re-acceleration when the accelerator pedal suddenly returns from depressed (acceleration) state.
- Braking control: Engine brake is generated and gear is shifted down to create a state that waits for re-acceleration when the brake pedal is firmly depressed.



(a) Hill climb/down control
(b) Cornering control
(c) Accelerator pedal quick return control
(d) Braking control

High fluid temperature control

Protects the transmission and engine by reducing the maximum shift allowable speed from normal operation when the engine coolant temperature or CVTF temperature is high.

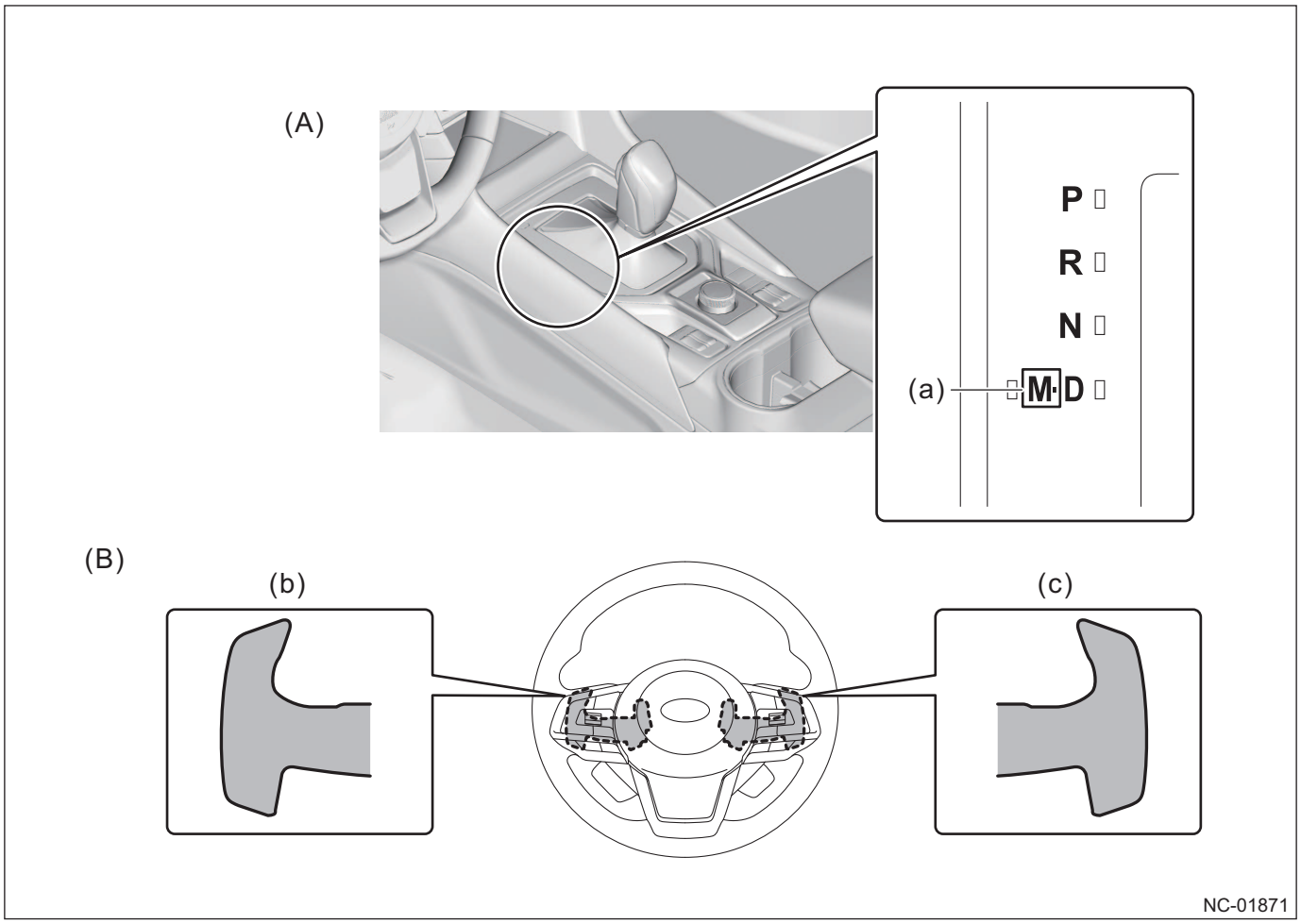
Clutch control

The clutch control is optimized and initial acceleration is made smoother to improve responsiveness when the select lever is operated from N to D or N to R.

Manual mode control

■ Normal manual shift mode (vehicle with paddle shift switch)

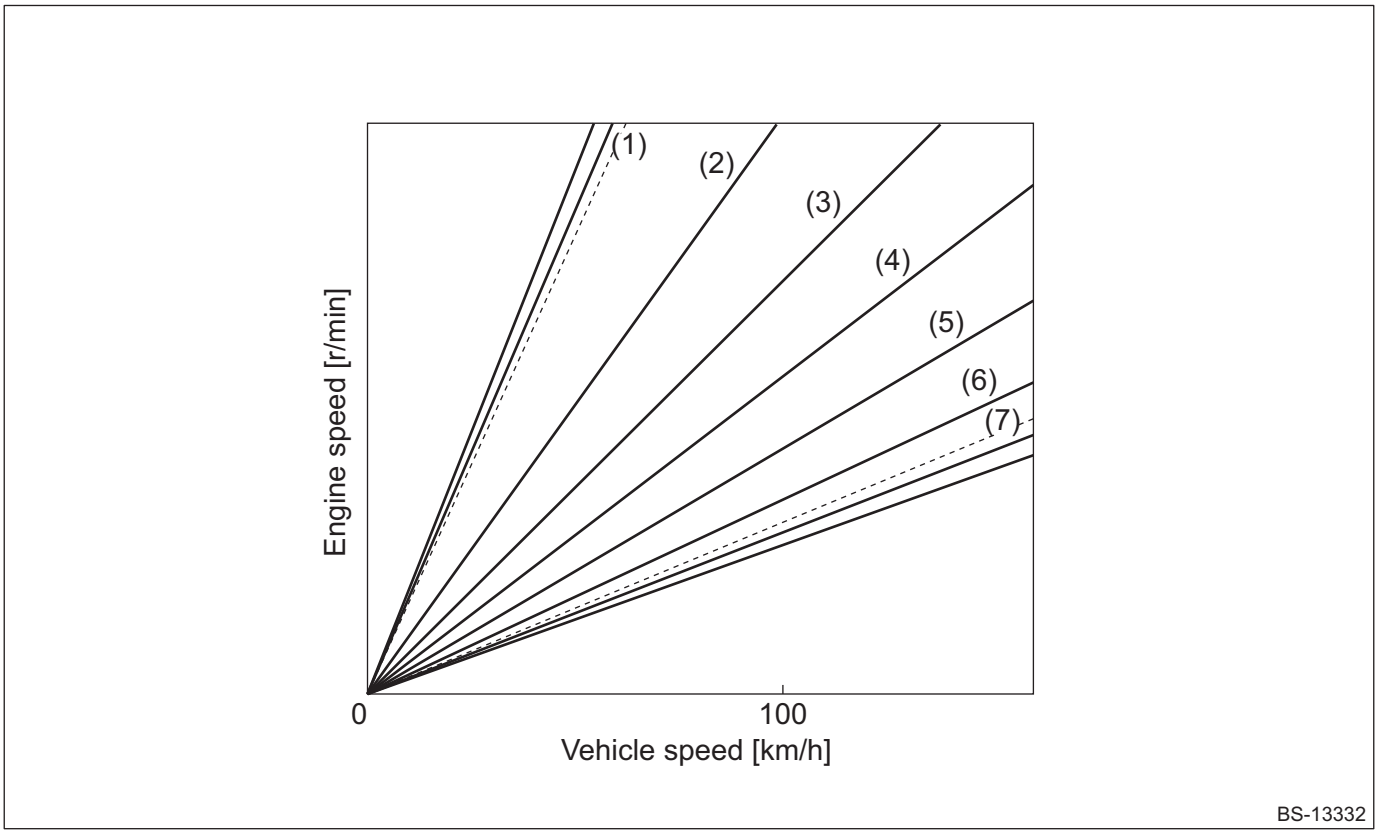
When the select lever is shifted to the manual side in the D range, the transmission enters manual mode. The desired gear can be selected by operating the paddle shift switches located on the steering wheel.



(A) Select lever
(B) Paddle shift switch

(a) Manual mode
(b) Paddle shift switch (-)
(c) Paddle shift switch (+)

The manual mode gear (seven) is adopted to increase gears selectable by the driver for driver-friendly manual shifting.



■ Temporary manual shift mode

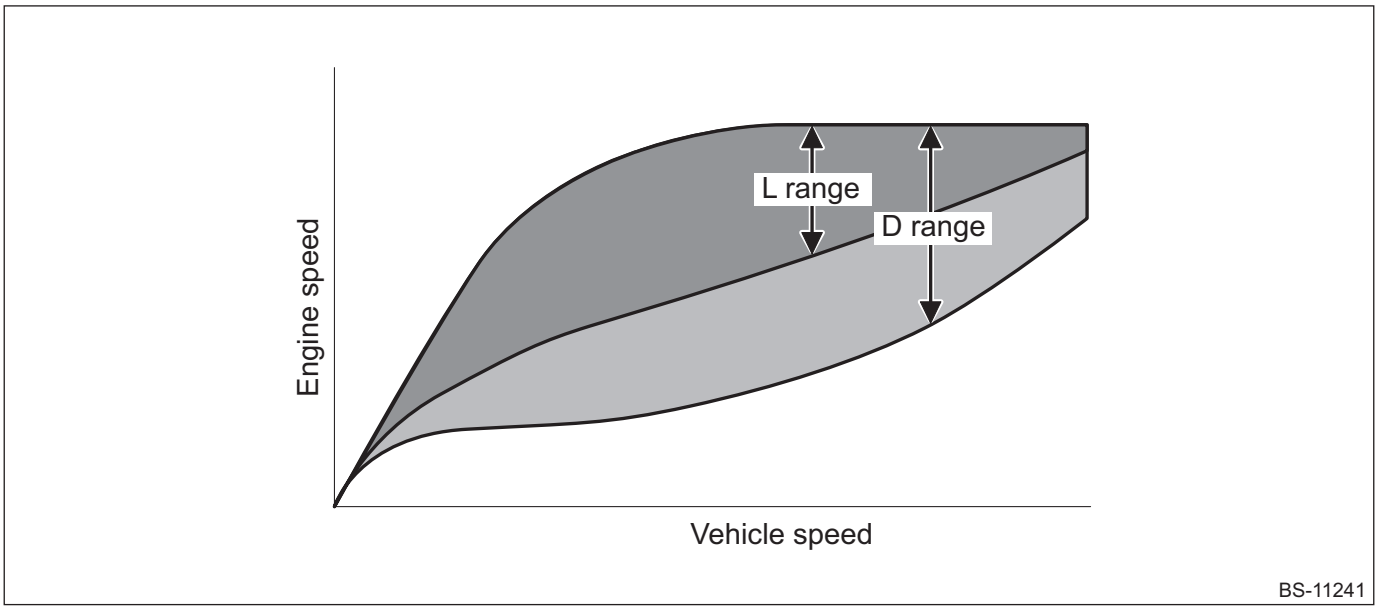
Temporary manual mode which can be switched temporarily to manual mode just by operating the paddle shifts while in the D range. A constant speed driving or accelerator full open is determined, the shift automatically returns to the D range.

■ Start from manual 2nd gear mode

Starting from stop in the second gear is enabled. This reduces wheel spin in winter or otherwise slippery road surfaces.

L range mode control (vehicle without paddle shift switch)

When the select lever is shifted to the L range side while in the D range, the mode changes to the L range mode. In the L range mode, driving is possible during travel on an uphill/downhill road with the engine brake applied.

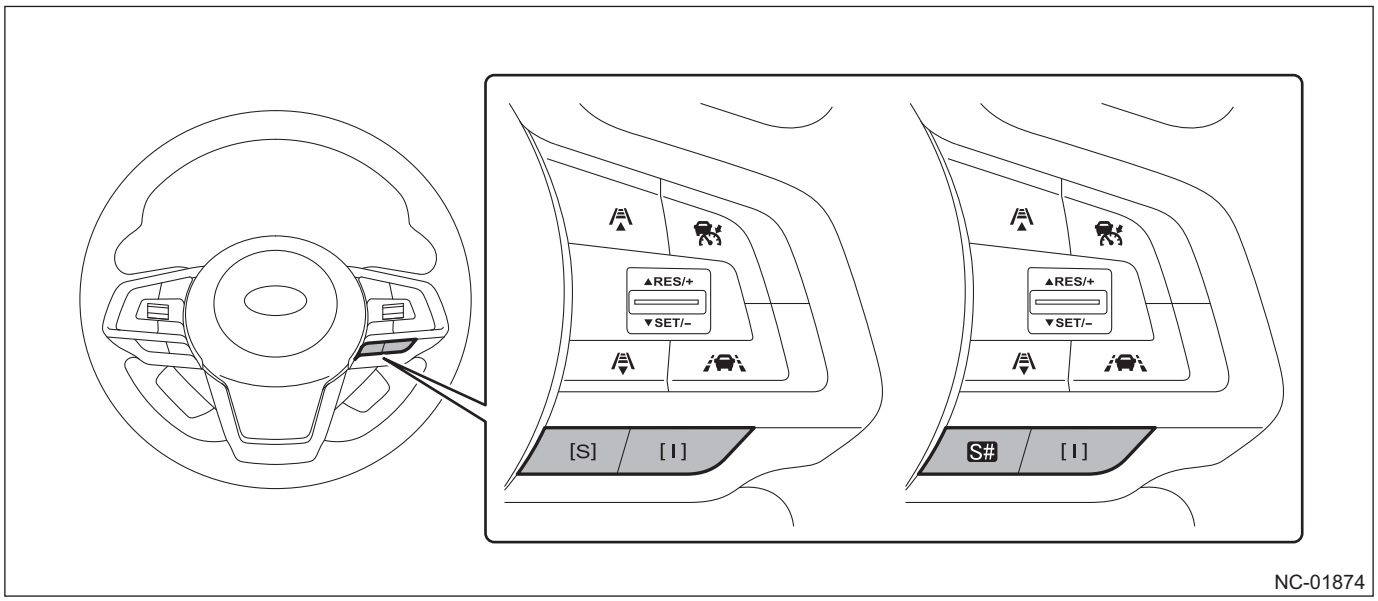


SI-DRIVE control

The SI-DRIVE allows the engine property and transmission property to be selected according to the driving style, driving sense and driving situation.

The three control modes with dedicated output properties are set in the ECM. Accordingly, the electronic throttle and TCM are accurately and multiply controlled in cooperation to realize traveling performance with distinctive features in each control mode.

- I (Intelligent mode)
- S (Sport mode)
- S# (Sport sharp mode) (for some grades)



■ Each mode characteristics

▮ I (Intelligent mode)

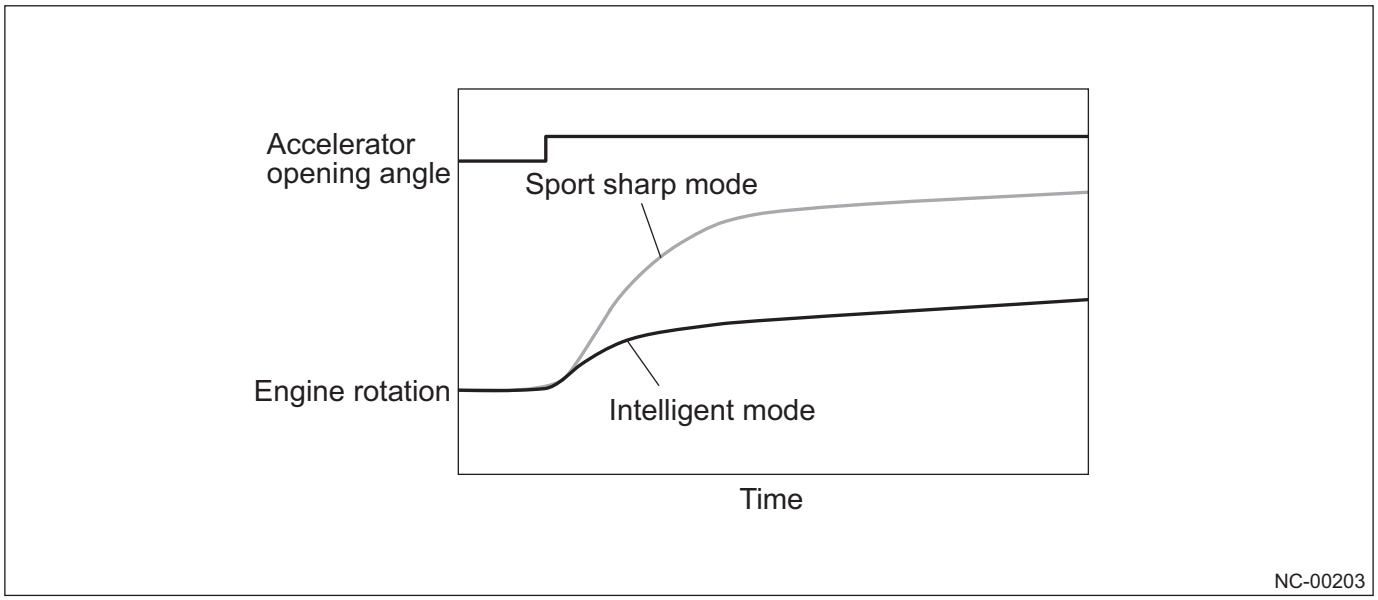
This realizes smooth traveling performance and ecological driving by setting mild power output for the accelerator operation. It also has a characteristic that enables smooth operation even on a snowy road and other slippery roads.

▮ S (Sport mode)

This mode enables acceleration with linearity from any vehicle speed range. This all-around mode exhibits the comfortable grand touring performance.

▮ S# (Sport sharp mode) (For some grades)

This very responsive mode maximizes the engine performance and realizes direct response and acceleration feeling corresponding to the accelerator operation. In addition, the S# mode uses the cross ratio (compared to the S mode) to give a sporty feeling when auto-step shift is used.



■ Low fuel consumption traveling in the intelligent mode

The throttle property suitable to low fuel consumption traveling is applied to the intelligent mode.

In addition, the ECO gauge supports fuel-efficient traveling by providing the driver with information of low fuel consumption traveling.

The vehicle is always in the intelligent mode at engine start. The improvement in the basic performance of the engine ensures sufficient traveling performance even in the intelligent mode while the environmental performance is maintained.

Oil pressure control

Secondary pressure control

This controls the optimal secondary pressure according to the driving conditions and generates the chain clamping power needed for power transmission, based on signals that include acceleration opening angle, vehicle speed, engine speed, secondary pressure sensor, brake switch, and fluid temperatures.

Primary pressure control

This controls the optimal primary flow rate and gear ratio according to the driving conditions based on the acceleration opening angle, vehicle speed, primary speed, secondary pressure, brake switch and fluid temperatures.

Forward clutch pressure and reverse brake pressure control

This determines the properties for engaging and releasing the forward clutch and reverse brake based on the engine speed and acceleration opening angle, and electronically controls the F&R clutch solenoid with the control module to engage and release the clutch and brake.

■ When engaged

When in the D, M (vehicle with paddle shift switch), L (vehicle without paddle shift switch) or R range, and if the slip control valve controlled by the F&R clutch solenoid is in the "clutch engaged" position, the clutch pressure connects to the clutch or brake actuation circuit. When in the D, M (vehicle with paddle shift switch) or L (vehicle without paddle shift switch) range, the forward clutch engaged. When in the R range, the reverse brake is engaged.

■ When released

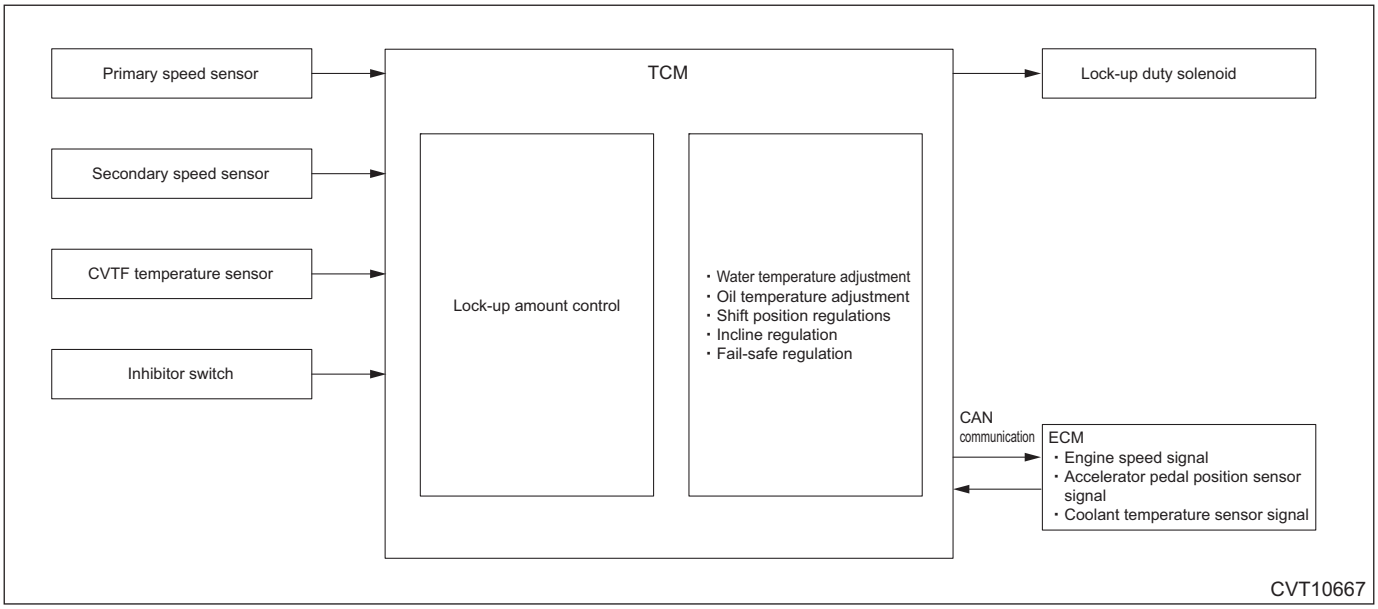
When in the N range or P range, the manual valve directly connected with the select lever releases the clutch and brake actuation circuit. At that time, both the forward clutch and reverse brake are released.

■ Reverse prohibition control

This control prohibits the gear shift to reverse by inhibiting the generation of the reverse brake control pressure when the select lever accidentally enters the R position at the set speed or higher. This prevents parts such as the reverse brake from being damaged.

Lock-up pressure control

TCM controls lock-up operation based on acceleration opening angle and vehicle speed.

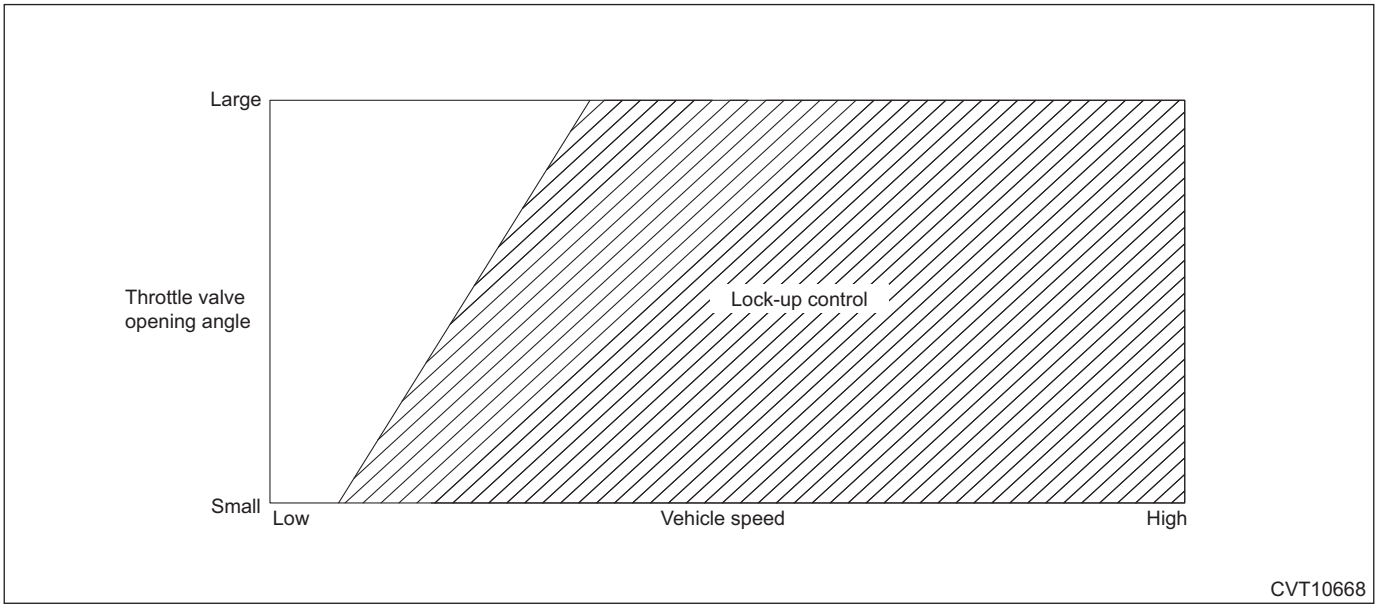


The slip in the torque converter is eliminated and the transmission efficiency is improved by engaging the lock-up clutch within the torque converter.

The lock-up duty solenoid is controlled with signals from the control module to smoothly engage or release the lock-up clutch within the torque converter.

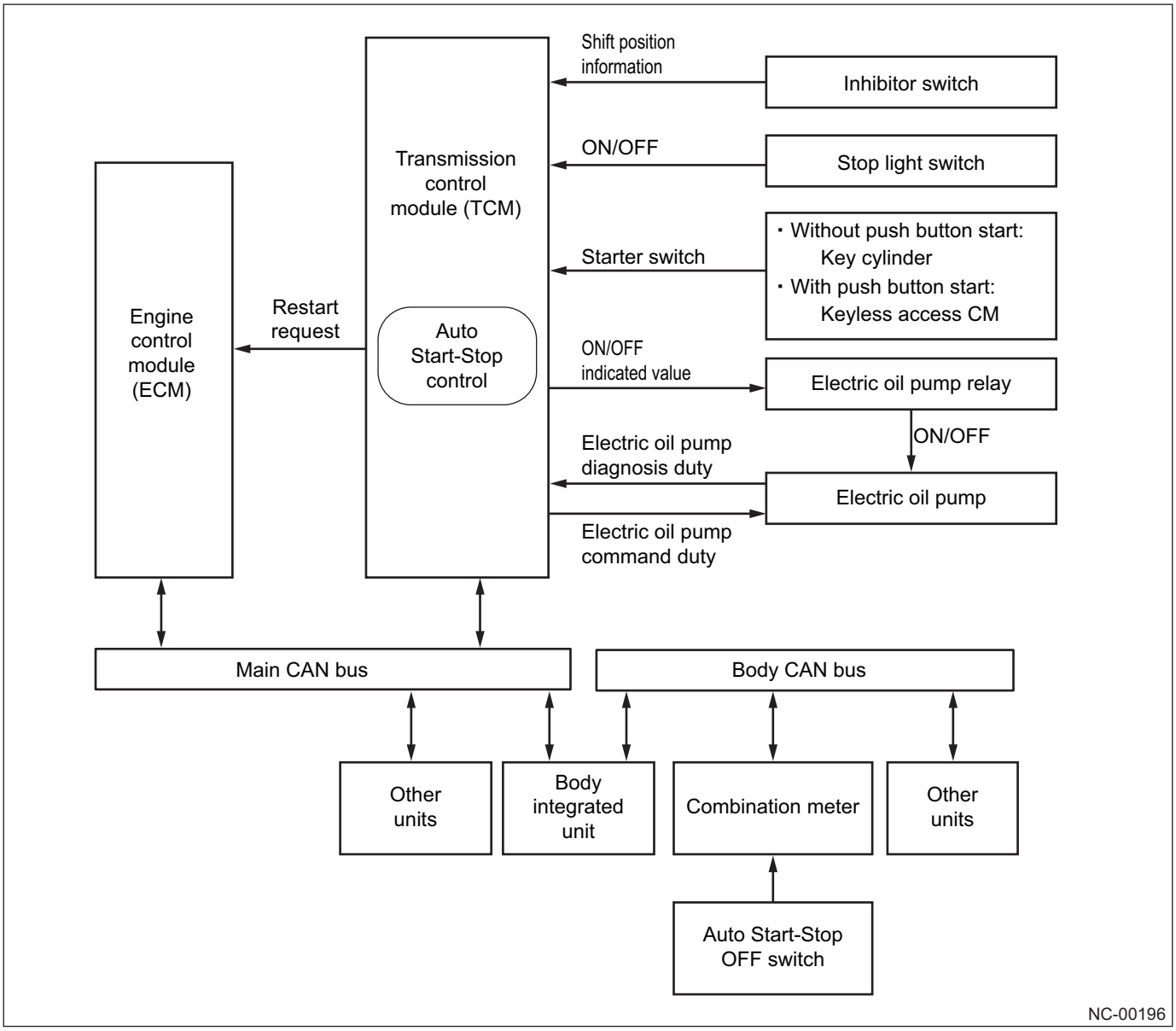
- Lock-up clutch "ON": The lock-up oil pressure is controlled optimally to reduce shock in operation.
- Lock-up clutch "OFF": The control module is controlled to release the clutch smoothly.

The lock-up operation range is expanded to operate lock-up in the low speed range. Also, the lock-up operation range is expanded when decelerating to expand the fuel cut area and realizes superior low fuel consumption performance.



Electric oil pump control

When oil is fed to the oil pressure circuit of the forward clutch while the engine is stopped, the start time lag and clutch-engaging shock at restart are reduced.



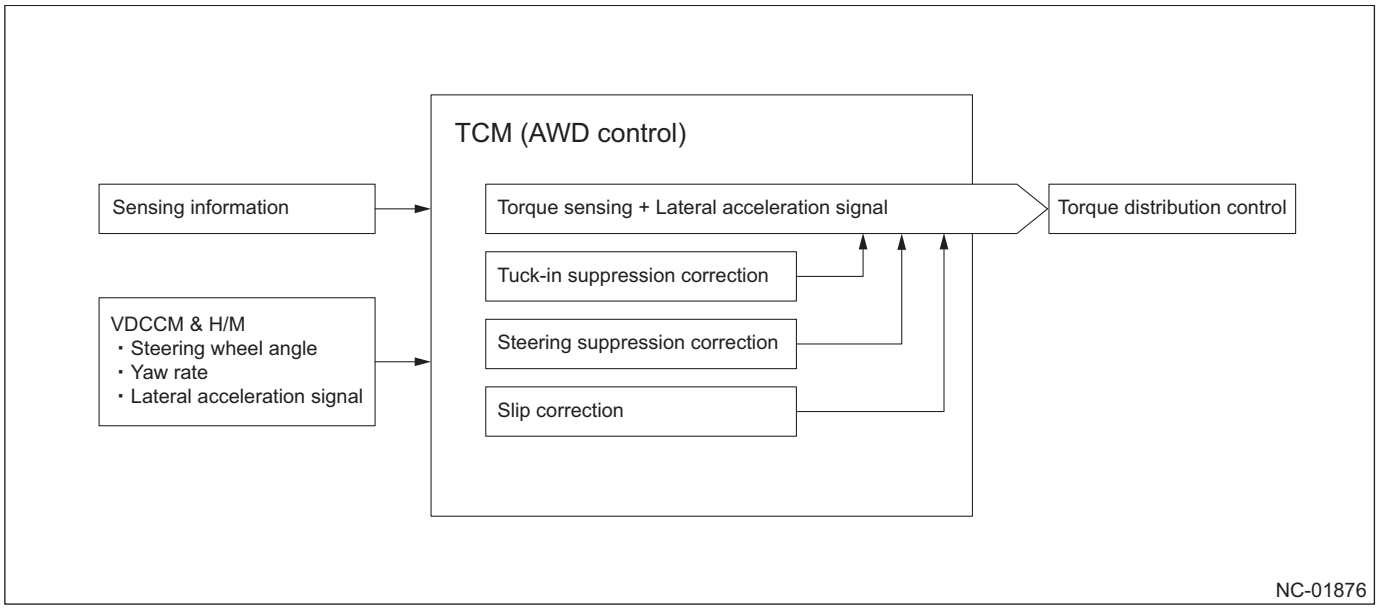
AWD control

Active torque split AWD control

The active torque split AWD system with a high regard for stability can maximize the merit of AWD in any driving conditions, regardless of skills of the driver.

The electronically controlled AWD system is adopted with MP-T (multi-plate [multi-plate clutch] transfer) in the transfer mechanism that distributes torque to the rear wheel. In the system, TCM controls transfer pressure based on the ABS operation signal sent from VDC.

The vehicle information such as steering angle, yaw rate, and lateral acceleration signals from VDC is monitored to distribute torque precisely.

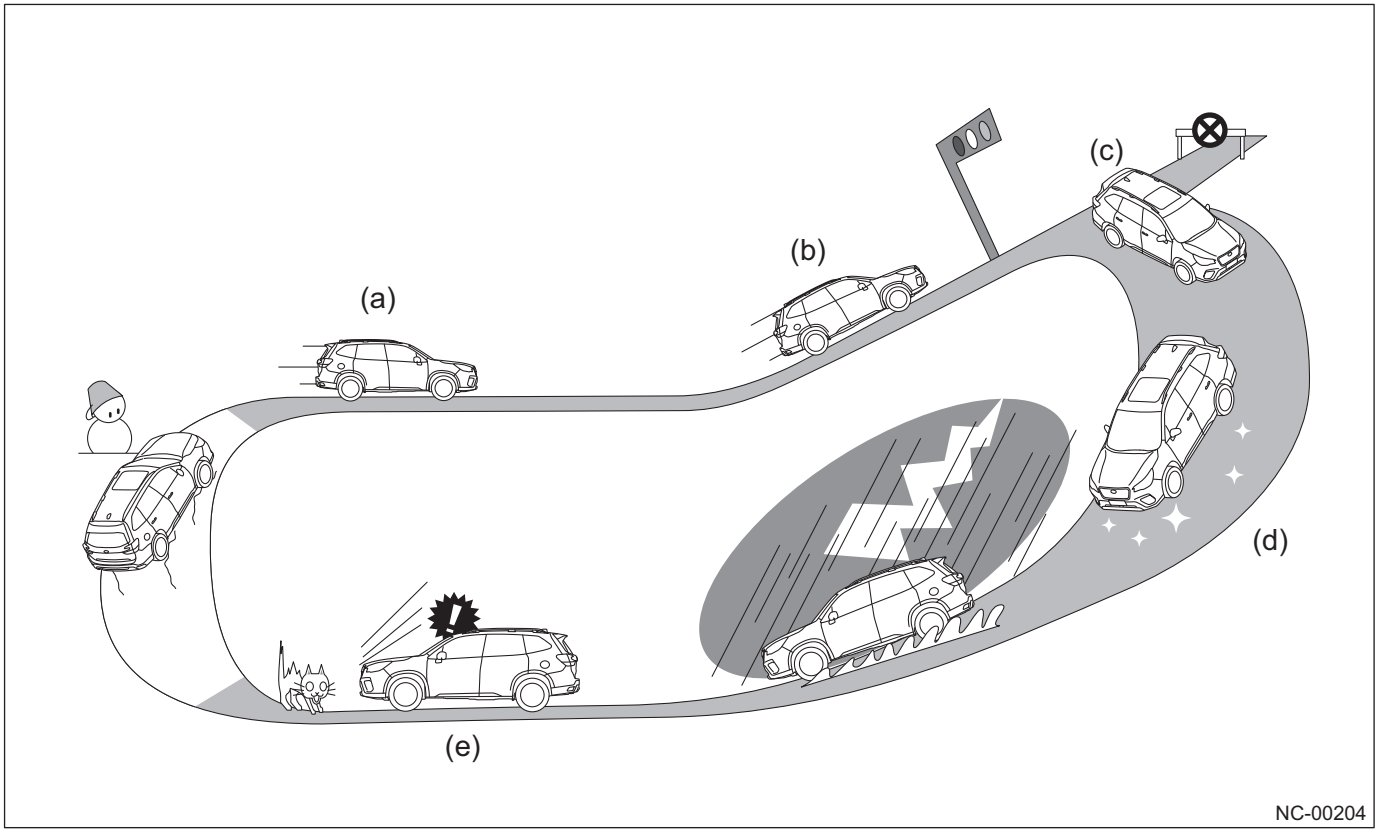


■ Control description

TCM controls the torque distribution in real time depending on driving conditions such as accelerating, hill climbing, and turning based on the torque distribution (front 60: rear 40).

The active torque split AWD control is performed in five basic control modes except the vehicle attitude control.

- Normal control: Distributes more torque to the front wheel at normal driving.
- Departure control: Ensures traction similar to directly connected AWD on an uphill or at full acceleration.
- Steering control: Slips clutch more when steering at low speed to avoid tight corner braking.
- Slip control: When the front wheel slips with exceeding the setting value, this increases the torque distribution to the rear wheel.
- ABS operation control: Reduces clutch engaging power to perform the brake control independently for four wheels.



(a) Normal control
(b) Departure control
(c) Steering control
(d) Slip control
(e) ABS operation control

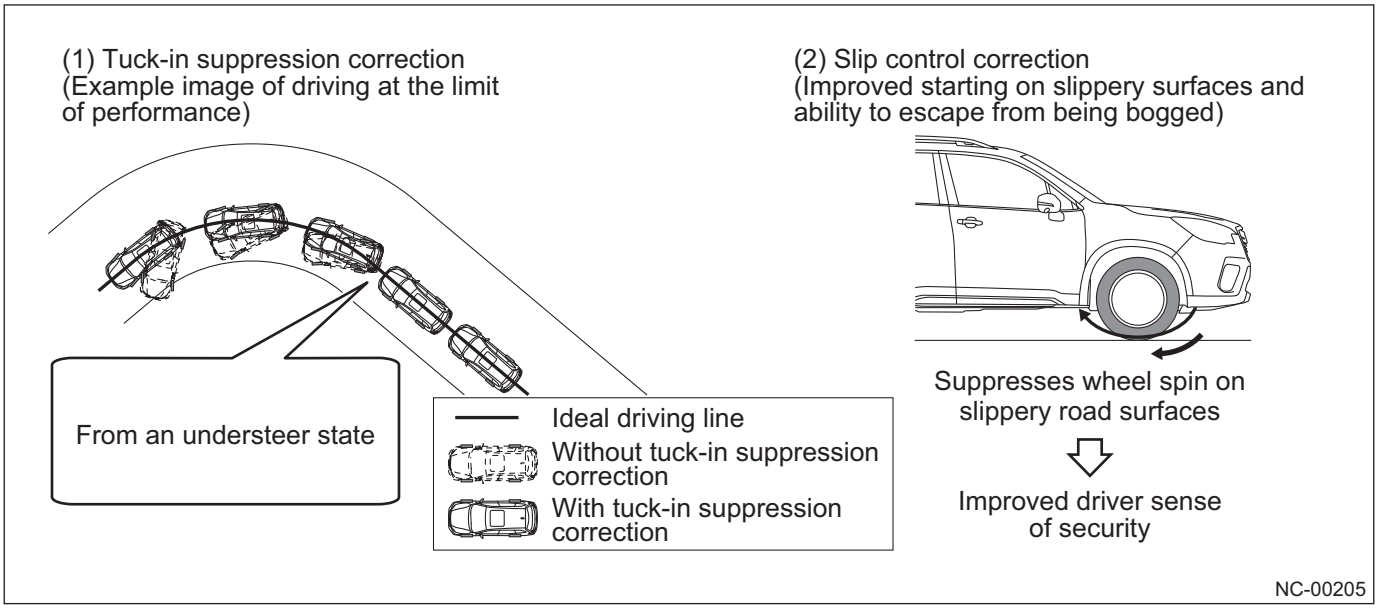
■ Control merits

Improves the torque distribution accuracy to front and rear wheels using steering angle, yaw rate, and lateral acceleration signals from the VDC system, in addition to the improvement for differential rotation correction in wheel speed of input torque or four wheels.

Improves the response at initial steering when entering a corner and can perform the precise control over the inhibition for the booming noise or the tight corner braking phenomenon when steering.

Also, this inhibits wheel spin at startup on the slippery road surface such as a snowy road and improves inherent practical performance in AWD to improve more than ever sense of security at startup.

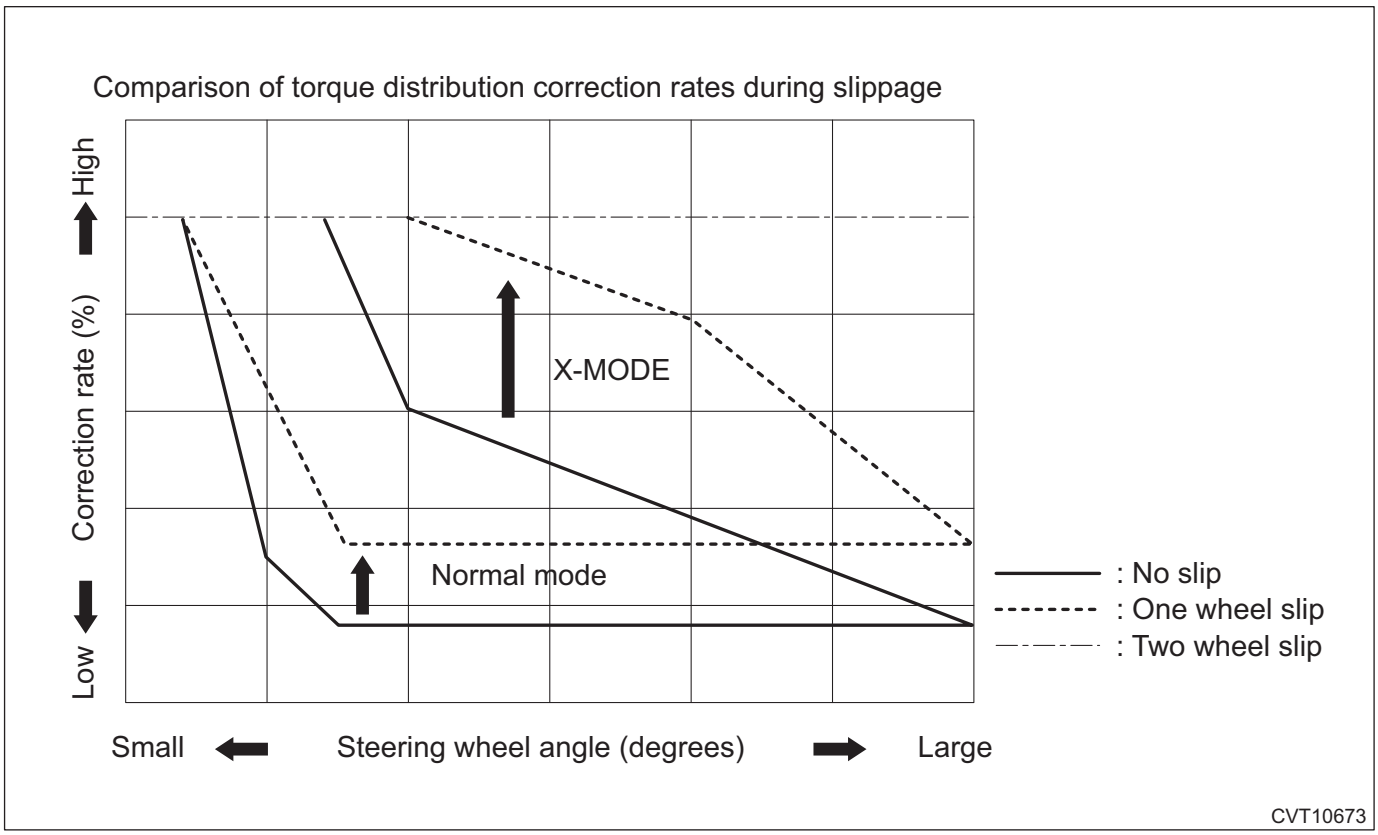
No.	Control item	Merit	Typical graphic explanation
1	Tuck-in inhibition correction	Behavior stabilization (tuck-in inhibition)	A: Tuck-in
2	Slip control correction	• Improvement in starting performance on the low μ road • Improvement in escape performance	B: Start on the low μ road
3	Steering correction	• Inhibition of booming noise when steering • Inhibition of tight corner braking phenomenon	-



X-MODE control

The X-MODE enhances traveling performance on a bad road by the optimally integrated control of the engine, transmission, AWD, brakes, etc. even in a scene where the tires spin or slip on slippery road surfaces or the vehicle may become bogged while maintaining a state where the vehicle can be driven safely. It also sets the hill descent control that enables travel while maintaining the same speed on downward slopes, improving the driver's feeling of safety on downward slopes.

When the vehicle slips while the X-MODE operates, the departure control is performed to optimize the correction factor of the torque distribution in accordance with the steering angle. Thus, the torque distribution can be properly performed even when the steering angle becomes larger.



Control description

The controls in X-MODE are described in the following table.

Item	Description			Details	Operation range
	Standard	Upper grade (2 modes)			
	X-MODE	SNOW/ DIRT	DEEP SNOW/ MUD		
ECM	Dedicated torque MAP setting	Dedicated torque MAP for SNOW/ DIRT	Dedicated torque MAP for DEEP SNOW/ MUD	[Standard]/[SNOW/DIRT] Low load area: A delayed throttle opening characteristic is set to improve low μ road drivability by avoiding sudden torque changes. High load area: An advance throttle opening characteristic is set to improve bad road drivability by rapidly producing maximum torque. [DEEP SNOW/MUD] From the low load area through high load area, an advance throttle opening characteristic is set to improve the performance to escape from the stuck condition by rapidly producing maximum torque.	40 km/h (24.9 MPH) or less
TCM	Dedicated AWD control			The AWD clutch engaging power is increased by approximately 25% to suppress differential rotation between the front and rear wheels in all situations and improve traction performance.	
	Dedicated shift control			Compared to normal control, dedicated shift control is adopted that places the gear ratio in the low range and turns lock-up off to make the most of the driving force, improving controllability.	
VDC	Reinforced LSD control			This improves traction performance on slippery roads by increasing the brake pressurization speed when differential rotation occurs and by providing dedicated control that delays brake decompression timing when differential rotation convergence occurs with respect to differential rotation between the left and right side wheels.	24.9 MPH (40 km/h) or less
	Traction control ON/OFF switchable by the VDC OFF switch operation	Traction control ON (fixed to ON)	Traction control OFF (fixed to OFF)	[Standard: with VDC ON operation]/[SNOW/DIRT] Starting performance is improved by the traction control when the tires are likely to spin or slip on a slippery road surface. [Standard: with VDC OFF operation]/[DEEP SNOW/MUD] The performance to escape from the stuck state is improved by slipping drive wheels when the tires are bogged in mud, deep snow or sandy soil.	
	Hill descent control			This improves the feeling of safety and security by rendering driver operation of the brakes unnecessary and allowing the driver to concentrate on steering by controlling the brakes so as to maintain the vehicle speed when the accelerator and brakes are off while traveling on a steep downward incline.	12.4 MPH (20 km/h) or less

TCS	Traction control	Traction control ON	Traction control OFF	[Standard]/[SNOW/DIRT] Starting performance is improved by the traction control when the tires are likely to spin or slip on a slippery road surface. [DEEP SNOW/MUD] The performance to escape from the stuck state is improved by moderately slipping drive wheels when the tires are bogged in mud, deep snow or sandy soil.	40 km/h (24.9 MPH) or less

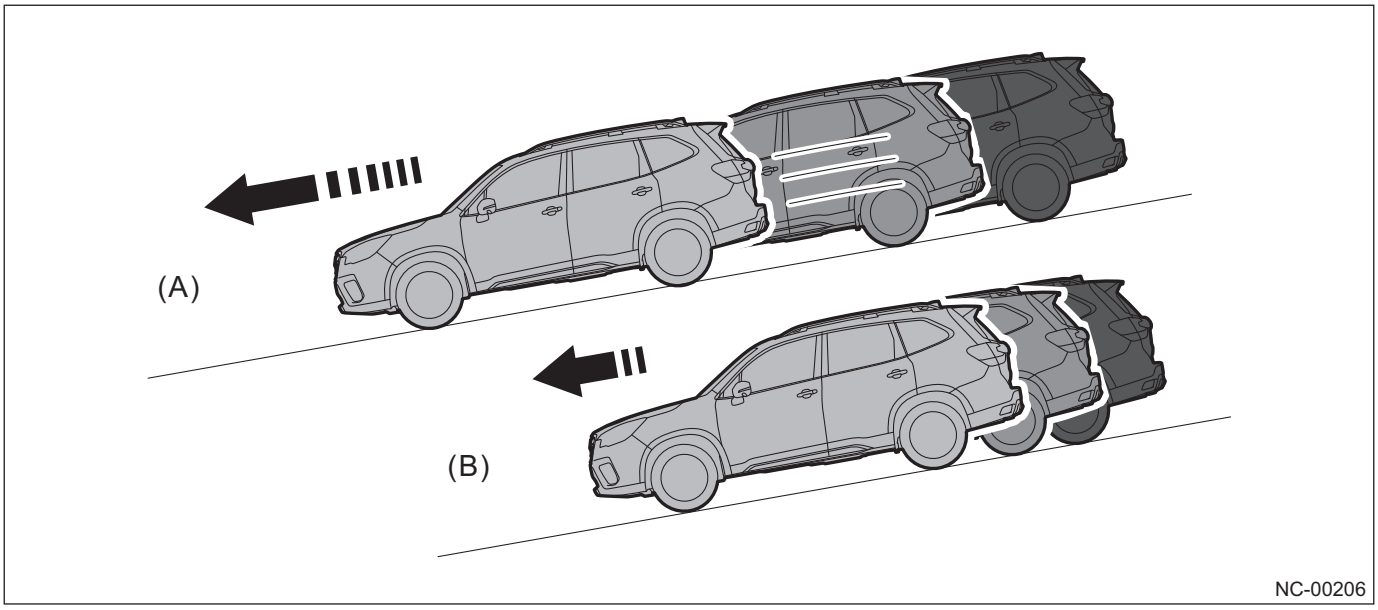
■ Hill descent control

When the X-MODE is turned on, the hill descent control operates automatically if the speed is likely to increase quickly on a downhill slope etc., enabling travel while maintaining a fixed speed. Even when a driver specially takes care of the brake operation on a downhill slope of a snowy road and gravel road, etc., the vehicle can travel while maintaining a fixed speed. Speed adjustment is controlled by the brakes.

For example, while traveling at 15 km/h (9 mph), the accelerator pedal is depressed and speed increases to 20 km/h (12 mph). Thereafter, when the accelerator pedal is released, the vehicle travels while maintaining a speed of 20 km/h (12 mph). Also, while traveling at 20 km/h (12 mph), the brake pedal is depressed and speed decreases to 15 km/h (9 mph). Thereafter, when the brake pedal is released, the vehicle travels while maintaining a speed of 15 km/h (9 mph)*.

*: When the brake or accelerator is operated, hill descent control does not operate so that the driver's operation is prioritized.

Speed adjustment of the hill descent control is controlled by the brakes. Since control is not conducted by estimating an incline but by means of vehicle speed information, the speed of the vehicle can be maintained even when entering a downward slope from a level road. Also, due to the brakes being controlled by hill descent control, the driver can entrust brake operation to the vehicle and concentrate on operating the steering wheel when traveling downhill and in curves.



(A) Without hill descent control

(B) With hill descent control

■ Traveling performance improvement control

As well as increasing the multi-plate transfer engaging power, this increases hill climbing and travel performances in situations where one wheel lifts (or diagonally opposing wheels lift) by utilizing the limited slip differential function of the vehicle dynamics control to apply the proper torque to all four wheels.

It also applies the dedicated X-MODE characteristic of torque output with respect to the acceleration opening angle to improve escape performance and driver controllability.

On-board diagnosis system

The system detects malfunctions related to TCM and transmission, and flashes the AT oil temperature warning light on the combination meter to display malfunction or defect.

When the AT oil temperature warning light flashes, a corresponding diagnostic trouble code (DTC) is stored in the transmission control module (TCM).

DTC stored in TCM can be read out by connecting the Subaru Select Monitor 4 to the data link connector (DLC).

The on-board diagnosis system detects the following electrical malfunctions and system malfunctions.

- Secondary solenoid
- F&R clutch solenoid
- Lock-up duty solenoid
- Primary UP solenoid
- Primary DOWN solenoid
- AWD solenoid
- Primary speed sensor
- Secondary speed sensor
- Turbine speed sensor
- Secondary pressure sensor
- CVTF temperature sensor
- Inhibitor switch
- CAN communication circuit
- M/Lo mode switch
- Stop light switch
- Electric oil pump

Fail-safe function

The fail-safe control function ensures a minimum level of drivability in the event of a malfunction in a speed sensor, switch, or solenoid.

Turbine speed sensor

If the turbine speed sensor malfunctions, the AT oil temperature warning light flashes. The vehicle travels on the LOW side until the lock-up is carried out. After lock-up, the turbine speed is regarded as the engine speed for control.

Primary speed sensor

If the primary speed sensor malfunctions, the AT oil temperature warning light flashes. When in the P range or N range, the control is performed at the secondary speed until the D range is selected and the F&R clutch engages. After the F&R clutch engages, the control is performed at the turbine speed.

Secondary speed sensor

If the secondary speed sensor malfunctions, the AT oil temperature warning light flashes, and the control is performed at the secondary speed calculated based on the vehicle speed received from the brake control module.

Lock-up duty solenoid

If the lock-up duty solenoid malfunctions, the AT oil temperature warning light flashes and power to the duty solenoid is forcibly stopped so that the lock-up clutch is always released.

Primary UP/DOWN solenoid

If the primary UP/DOWN solenoid malfunctions, the AT oil temperature warning light flashes and power to the malfunctioning duty solenoid is forcibly stopped. According to the malfunction status, output to the other duty solenoid makes it difficult to enter full low or overdrive, and the secondary pressure is increased above normal levels to prevent pulley damage.

AWD solenoid

If the AWD solenoid malfunctions, the AT oil temperature warning light flashes, power to the linear solenoid is forcibly stopped, and the control is performed to always become FWD model.

F&R clutch solenoid

If the F&R clutch solenoid malfunctions, the AT oil temperature warning light flashes, power to the linear solenoid is forcibly stopped, and the clutch is always engaged when in the D-range or R-range. The secondary pressure is increased above normal levels to prevent pulley damage.

Secondary solenoid

If the secondary solenoid malfunctions, the AT oil temperature warning light flashes, power to the linear solenoid is forcibly stopped, and the secondary pressure is always controlled to be the maximum pressure to prevent pulley damage.

Inhibitor switch

If there is an input to the control module other than the inputs of specified patterns, the AT oil temperature warning light flashes and the range in the meter is hidden. The AT control mode selects a range in the following order of priority:

D > R > N > P.

CVTF temperature sensor

If the temperature sensor malfunctions, the AT oil temperature warning light flashes, and the secondary pressure is controlled to be higher than the normal level to prevent pulley damage.

Secondary pressure sensor

If the secondary pressure sensor malfunctions, the AT oil temperature warning light flashes, and the secondary pressure is controlled to be higher than the normal level to prevent pulley damage.

M mode (L mode) switch

If the M mode switch malfunctions, the AT oil temperature warning light flashes, and the speed change in manual mode is prohibited.

AT learning

The CVT shift and the forward and reverse switching are performed by applying oil pressure through the oil passage from the control valve to the pulley, the hydraulic multi-plate clutch, and the hydraulic multi-plate brake. At that time, when applying oil pressure suddenly, the shift shock increases. Also, when oil pressure is slowly applied, slippage occurs.

The frictional force between the pulley slope and the variator chain, and the engaging power of the clutch or the brake change due to oil pressure, piston stroke, and frictional force between drive plate and driven plate as well as worn drive plate and deteriorated ATF.

TCM checks gear change status, performs gear changes while learning, and stores learning value. When a transmission or TCM is replaced, it is necessary to store the learning value that is newly learned. The "AT learning" is the learning promotion.

3.3.4 Construction and Operation

Power transmission mechanism

■ Overview

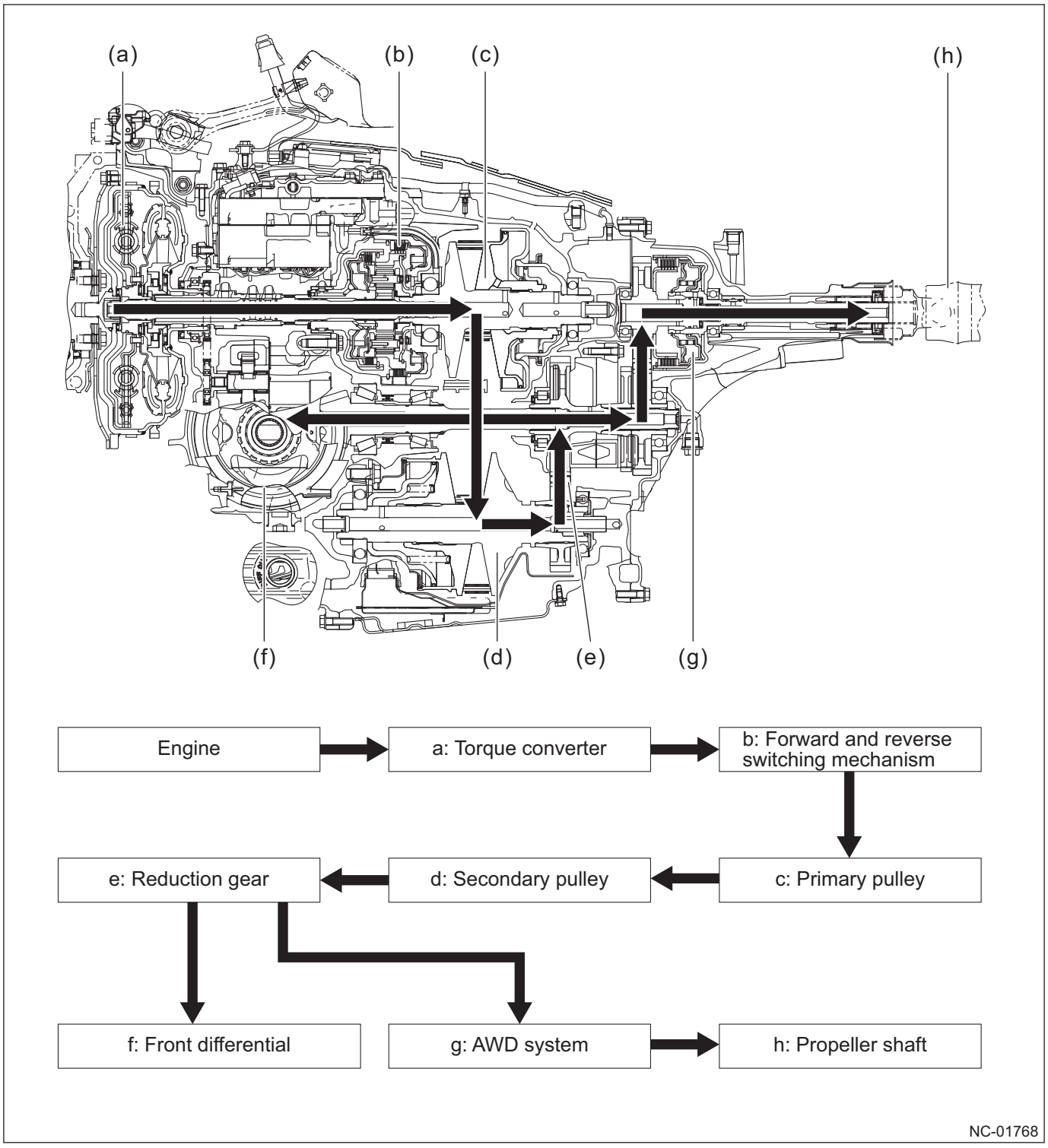
The power transmission mechanism is composed of the torque converter, continuously variable transmission mechanism, forward and reverse switching mechanism, reduction gear mechanism, and AWD mechanism, etc.

The gear change is continuously performed by changing the winding diameter of the variator chain using a pulley that changes the groove width depending on the oil pressure control.

A double-pinion planetary gear and a hydraulic multi-plate clutch are combined on the forward and reverse switching mechanism.

The power transmission is transmitted in the following order.

- The drive force from the engine is transmitted from the torque converter to the forward and reverse switching mechanism.
- When the drive force is switched to forward or reverse by the forward and reverse switching mechanism, it is transmitted to the continuously variable transmission mechanism (pulley), and then transmitted to the front differential and AWD mechanism through the reduction gear.
- The front drive force is output to the front wheel shaft through the front differential.
- The rear drive force torque-adjusted by the AWD mechanism is output to the propeller shaft.

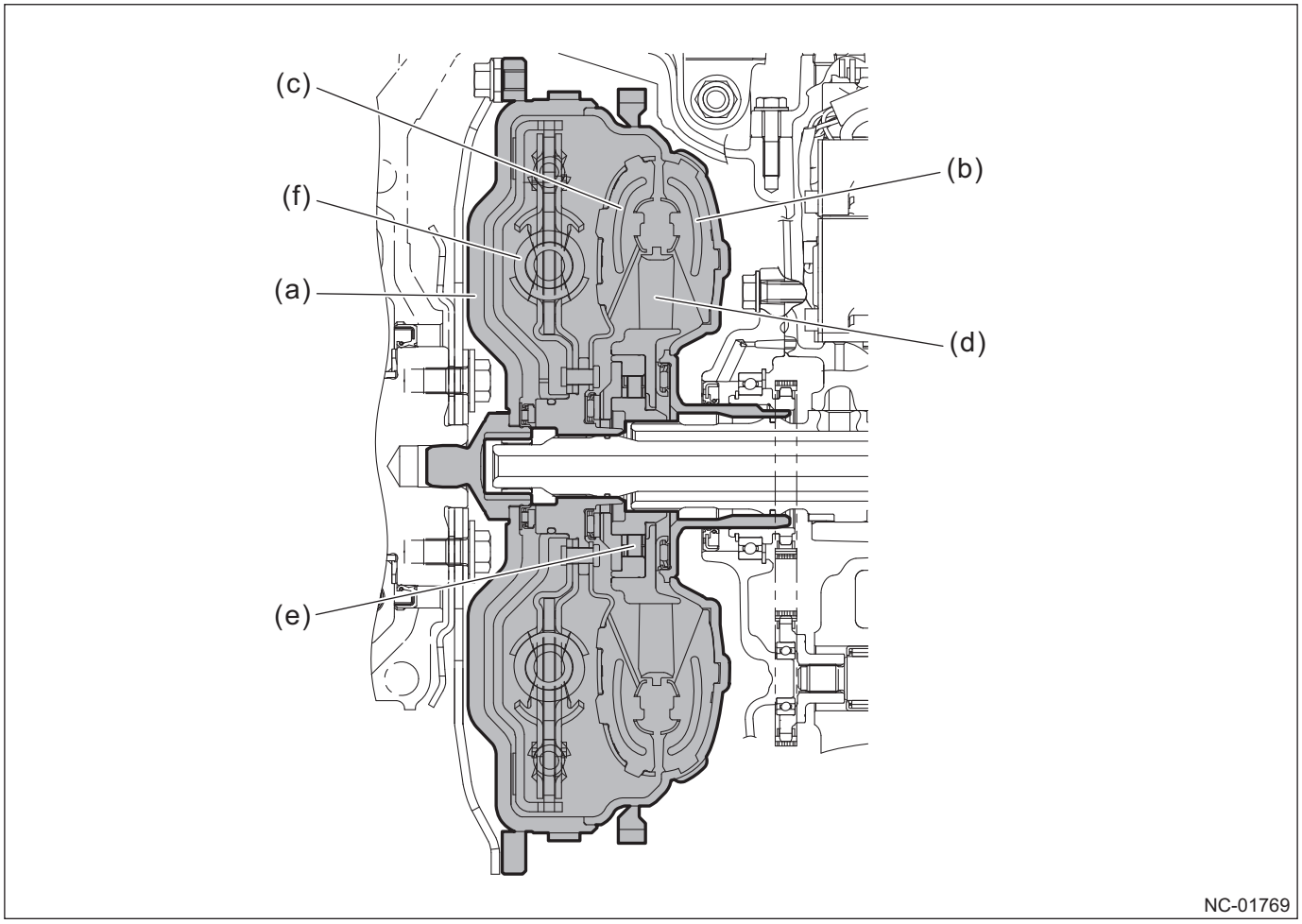

(a)
(b)
(c)
(h)
(f)
(d)
(e)
(g)
Engine
a: Torque converter
b: Forward and reverse switching mechanism
c: Primary pulley
d: Secondary pulley
e: Reduction gear
f: Front differential
g: AWD system
h: Propeller shaft
NC-01768

Torque converter

■ Construction

The torque converter is composed of the pump impeller integrated with the torque converter cover with the drive plate mounted, turbine splined to the input shaft, stator, one-way clutch that supports the stator, and lock-up clutch, etc.

In the lock-up mechanism, the mechanical clutch is installed between the torque converter cover and the turbine, and the pump impeller is directly connected with the turbine. This mechanism reduces rotation difference and improves transmission efficiency.



(a) Torque converter cover
(b) Pump impeller
(c) Turbine
(d) Stator
(e) One-way clutch
(f) Damper structure

■ Operation

The torque converter transmits engine power to the transmission by oil.

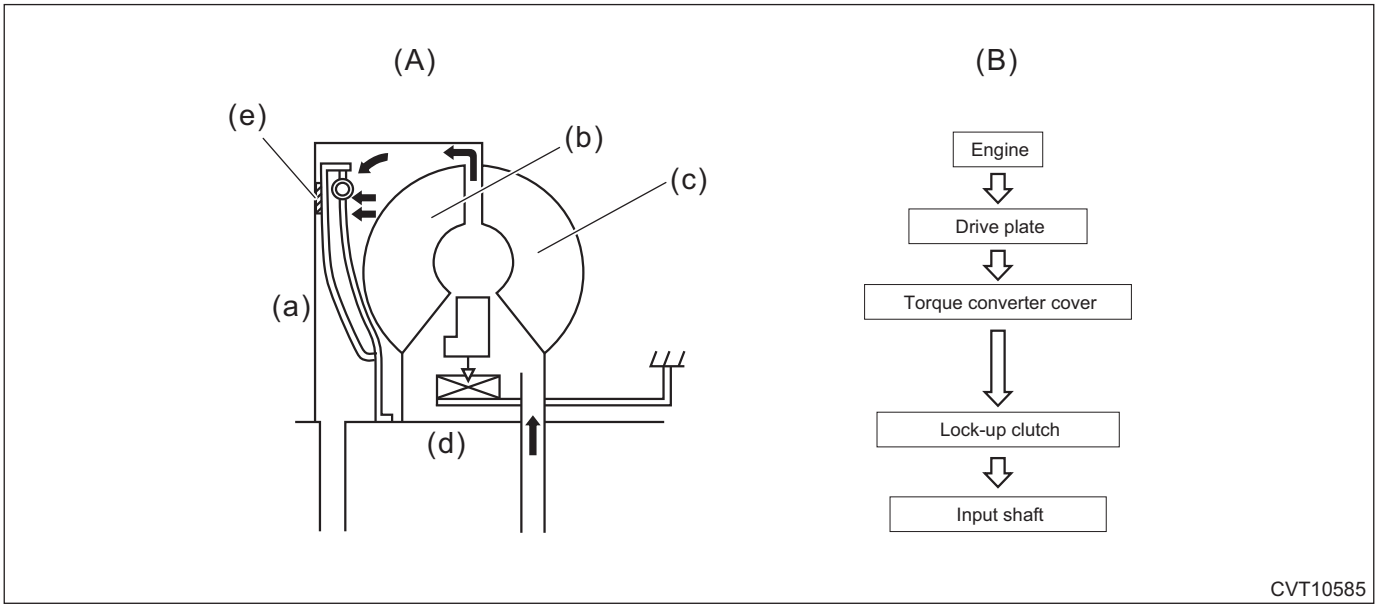
When the pump impeller rotates as engine rotates, oil flows into the torque converter. When the turbine receives the flowing oil and then it rotates, the input shaft rotates.

When the engine rotates, the pump impeller which the power is directly applied to rotates. Even when the engine rotates at low speed (idling state), the oil in the torque converter is rotating at low speed. Thus, the turbine that receives the rotation of the oil also rotates and transfers some of the power to the transmission. The state is said to be creep phenomenon.

▮ When lock-up clutch is operating

When the lock-up clutch is operating, TCM controls the oil pressure control mechanism to switch the fluid flow into the lock-up clutch within the torque converter as shown below.

Next, when the lock-up clutch is pushed to the torque converter cover due to the difference between the right and left oil pressures, the lock-up clutch rotates with the cover.



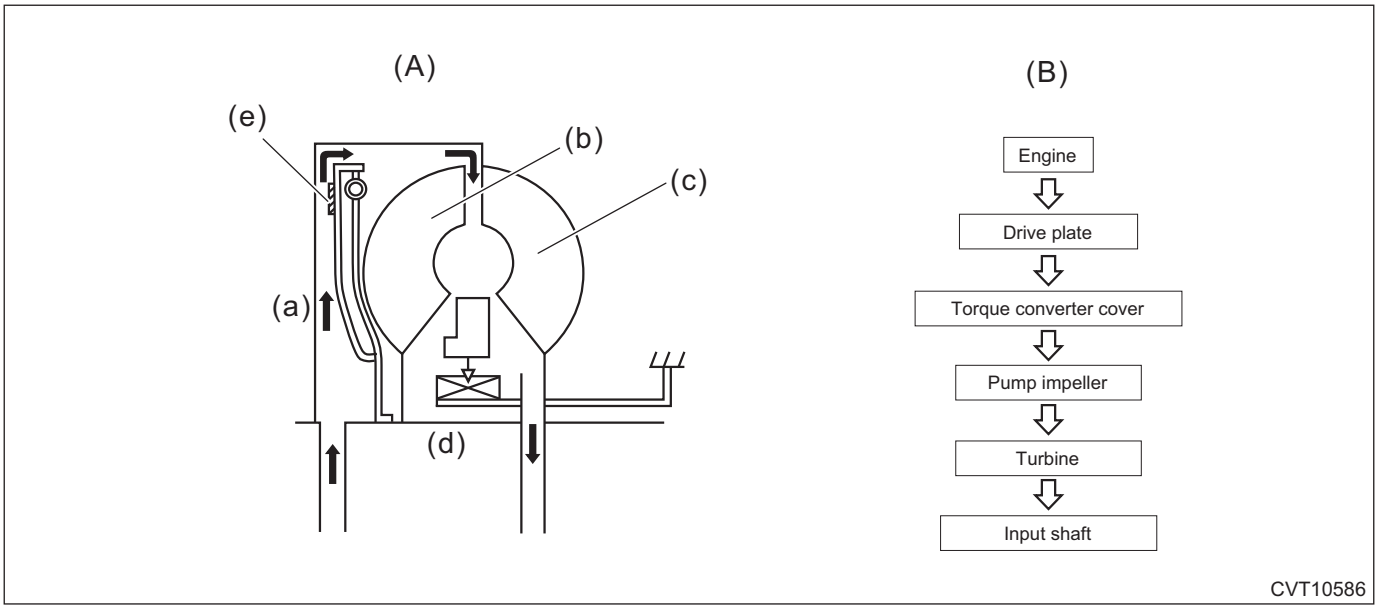
(A) Fluid flow
(B) Power transmission

(a) Torque converter cover
(b) Turbine
(c) Pump impeller
(d) Input shaft
(e) Lock-up clutch

When lock-up clutch is not operating

When the lock-up clutch is not operating, TCM controls the oil pressure control mechanism to switch the fluid flow into the lock-up clutch within the torque converter as shown below.

Then, when the lock-up clutch is away from the torque converter cover due to the difference between the right and left oil pressures, the power is transmitted as the normal torque converter.



(A) Fluid flow
(B) Power transmission

(a) Torque converter cover
(b) Turbine
(c) Pump impeller
(d) Input shaft
(e) Lock-up clutch

Continuously variable transmission mechanism

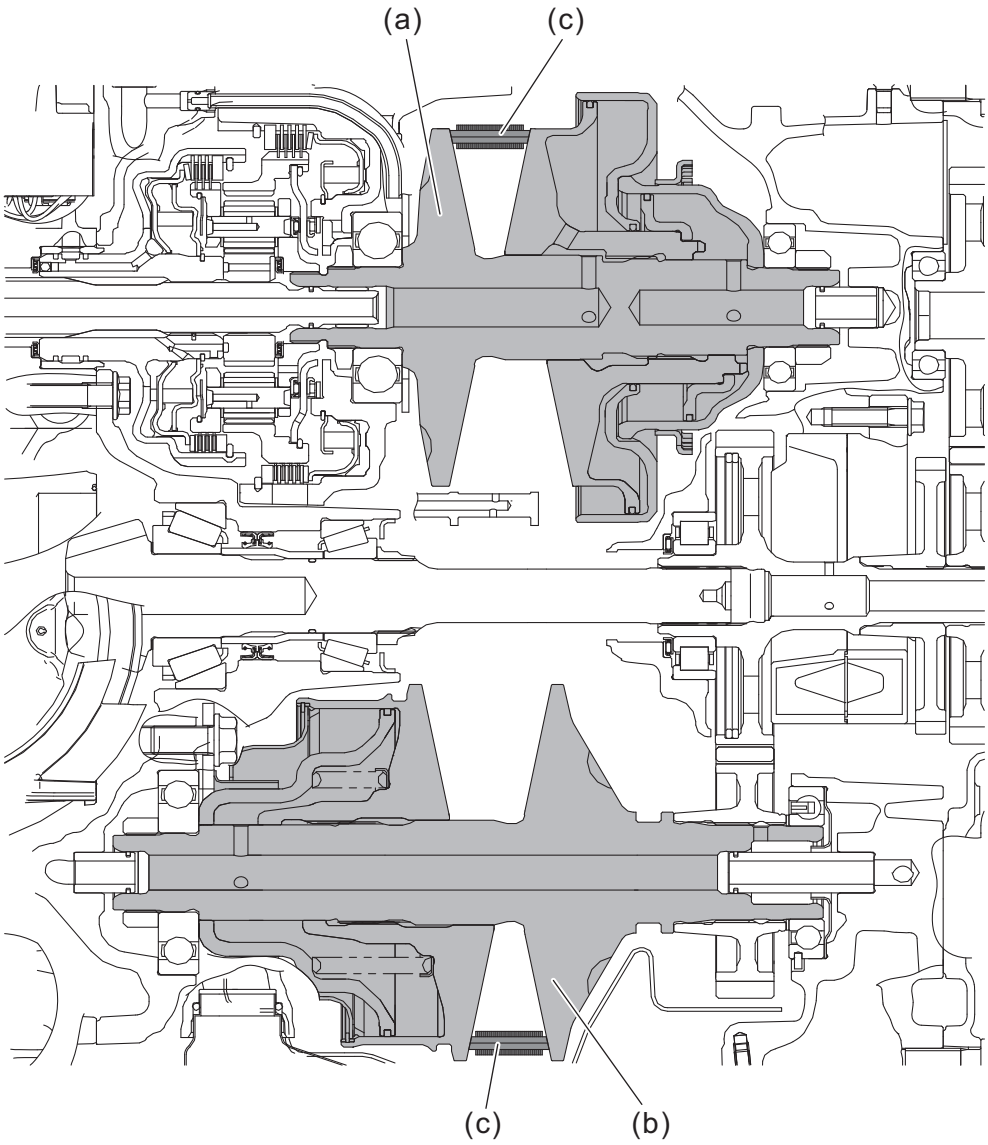
■ Construction

The continuously variable transmission mechanism is composed of a primary pulley, secondary pulley, and variator chain.

Each of the primary pulley and the secondary pulley is composed of a shaft with an inclined surface (fixed conical surface), a movable sheave (a conical surface movable in an axial direction), and an oil pressure chamber (chamber) on the back side of the movable sheave.

The variator chain is held on by pressure generated in the oil pressure chamber of the pulley and power is transmitted by frictional force generated between the pulley slope and variator chain.

Infinitely variable speed adjustment is made possible by controlling the primary pulley oil amount and secondary pulley oil pressure, and changing the pulley width. Gear ratios have also been widened for both drivability and fuel efficiency.

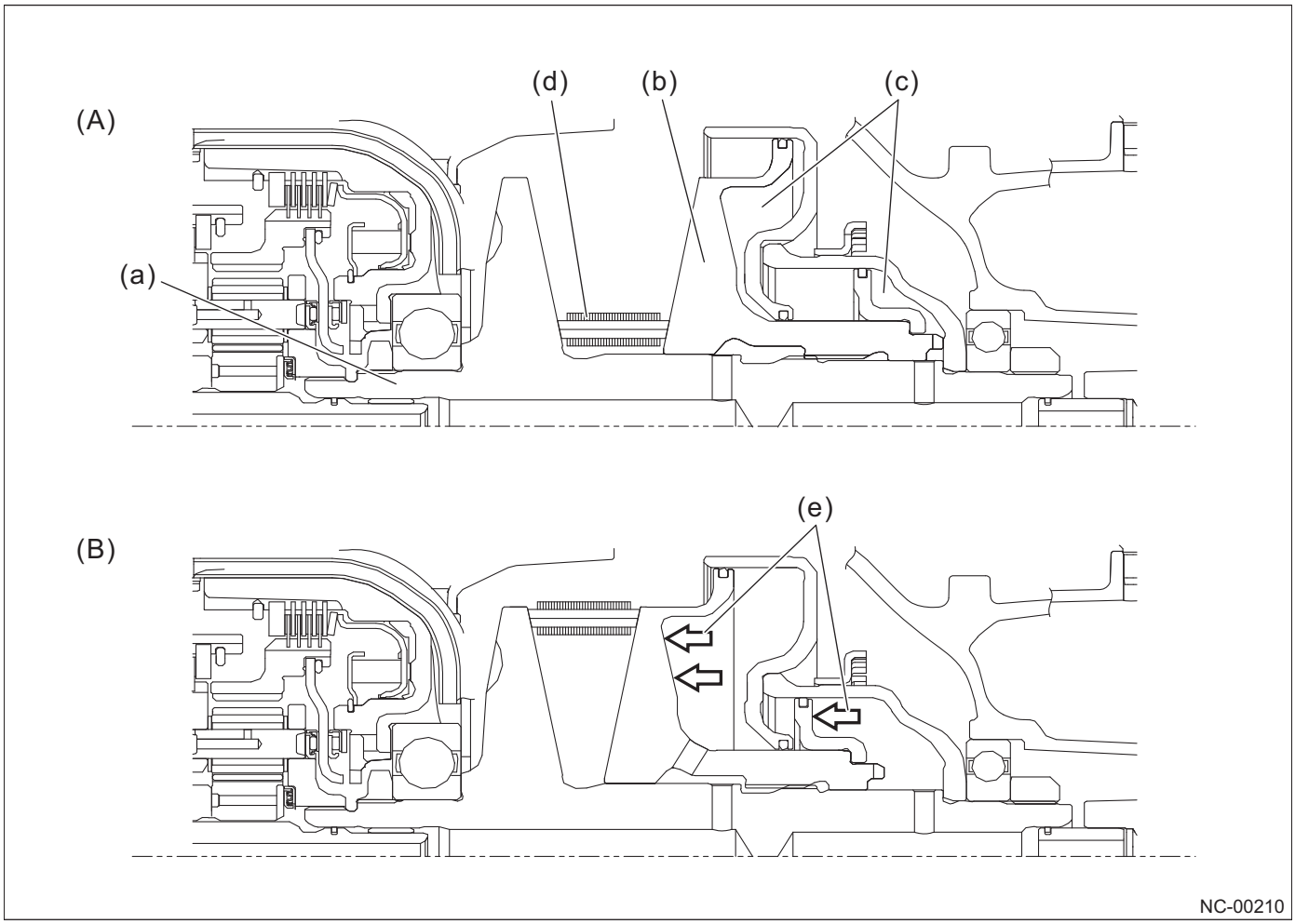


(a) Primary pulley
(b) Secondary pulley
(c) Variator chain

■ Primary pulley

The double piston structure is adopted on the primary pulley.

The variator chain is held on by the pressure generated in the two oil pressure chambers serially-arranged.



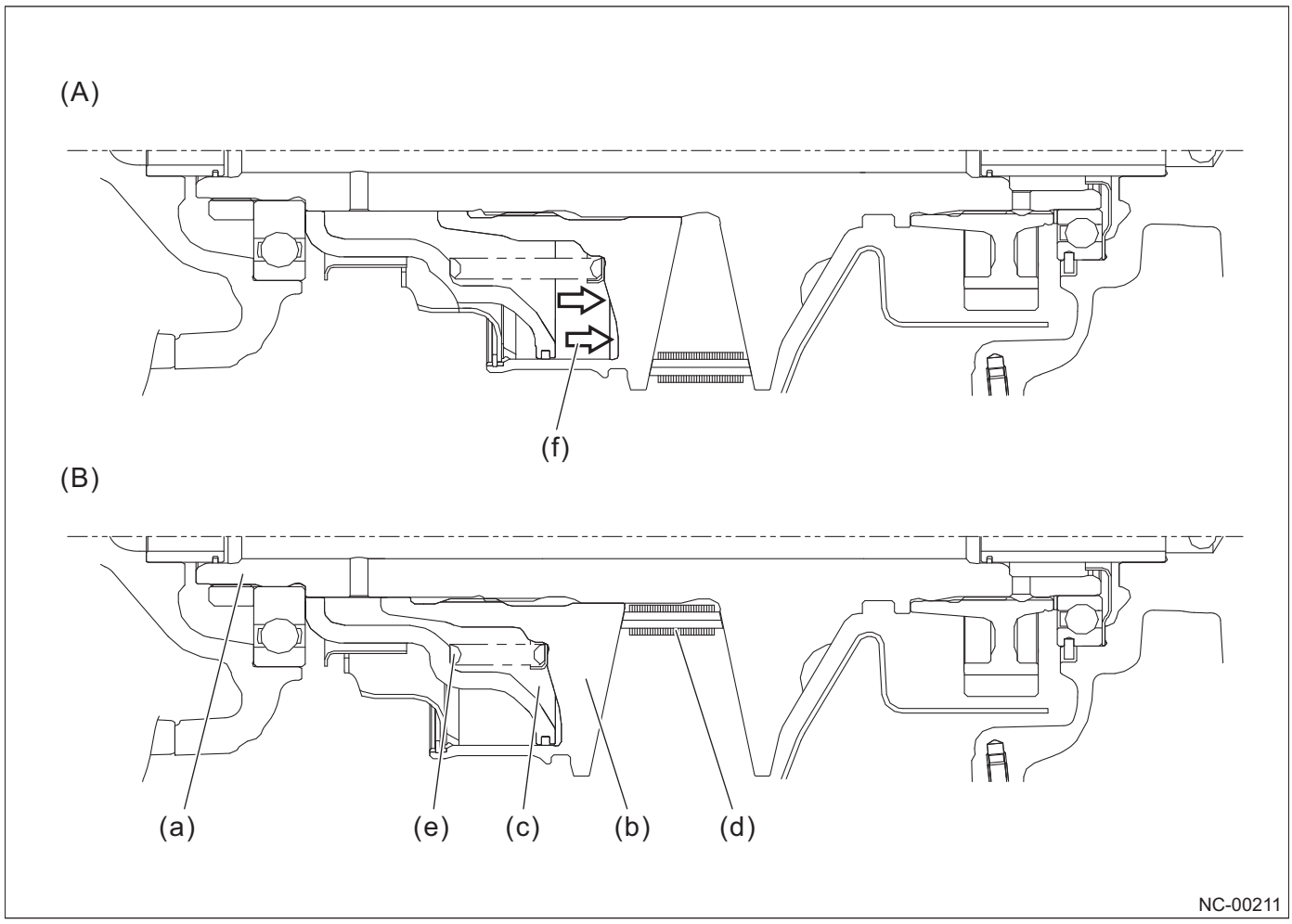
(A) At low gear
(B) At high gear

(a) Shaft
(b) Movable sheave
(c) Oil pressure chamber
(d) Variator chain
(e) Primary pressure

■ Secondary pulley

The single piston structure is adopted on the secondary pulley.

The variator chain is held on by pressure generated in the secondary pulley oil pressure chambers and spring force.



(A) At low gear
(B) At high gear

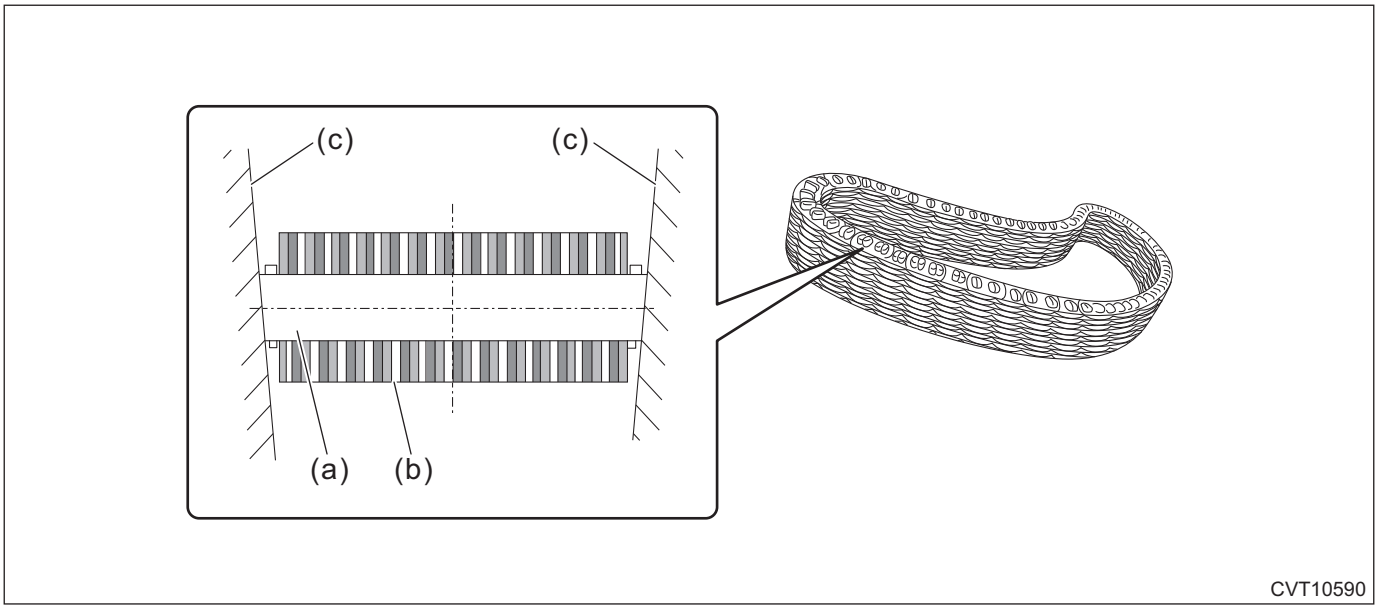
(a) Shaft
(b) Movable sheave
(c) Oil pressure chamber
(d) Variator chain
(e) Spring
(f) Secondary pressure

■ Variator chain

The variator chain is composed of a pin that contacts with a pulley to transmit torque and a link plate that connects several pins to form a chain.

Since both ends of the pin contacts with the pulley to transmit torque, the pin has the same angle as the pulley.

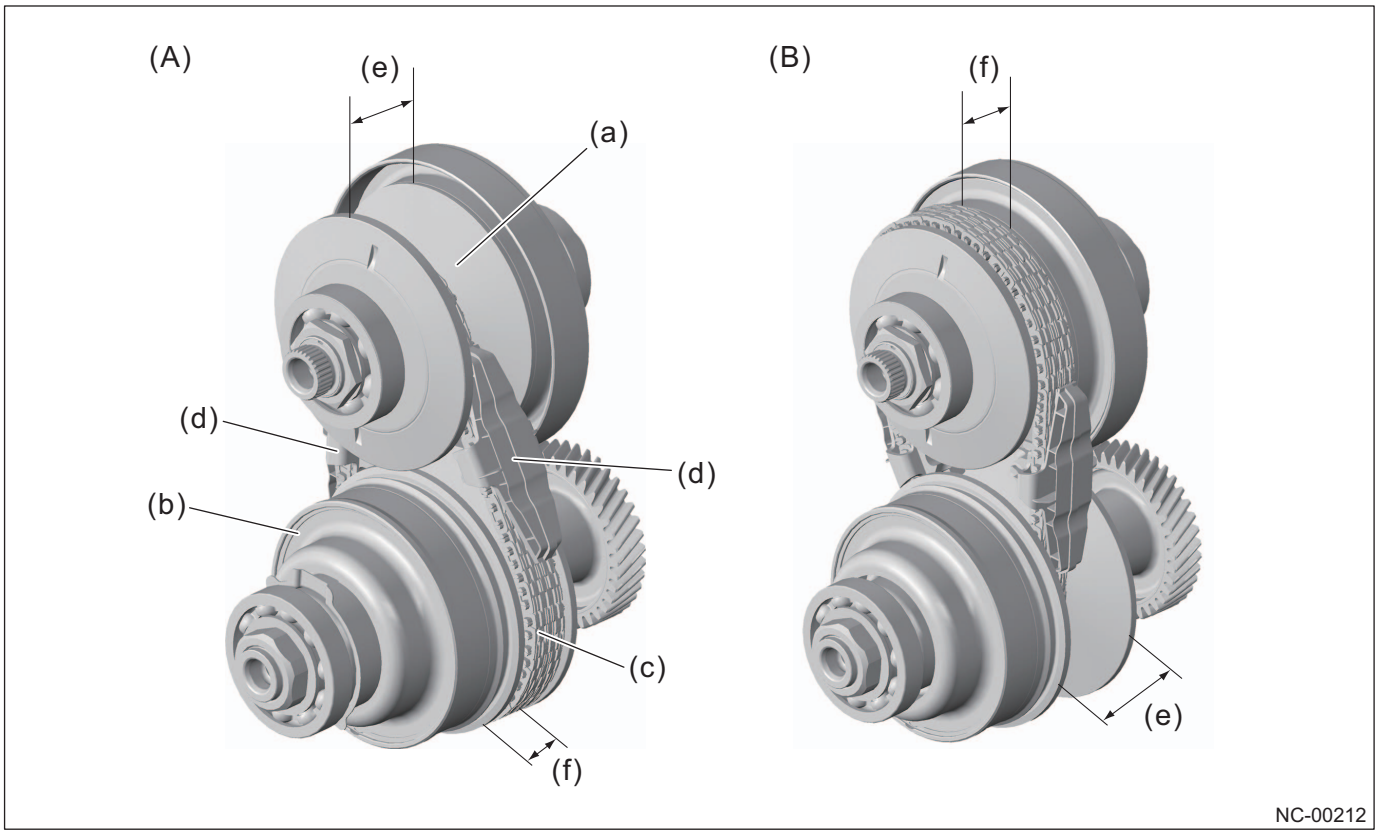
The link plate is thin steel and supports each pin at regular intervals. Strong tension force functions on the link plate.



(a) Rocker pin
(b) Link plate
(c) Pulley

■ Operation

The movable sheave slides on the spline shaft and changes the groove width of the pulley. By changing the operation pressures of the primary pulley and the secondary pulley, the groove width of the pulley is controlled with input signals such as the engine load (acceleration opening angle), the engine speed, and the gear ratio (vehicle speed). As the groove width of the pulley changes, the contact radius of the variator chain also changes. The speed changes continuously and steplessly from the low state (gear ratio: 3.600) to the overdrive state (gear ratio: 0.512). The contact radius ratio of each pulley that contacts with the belt is set as the gear ratio.



(A) At low gear
(B) At high gear

(a) Primary pulley
(b) Secondary pulley
(c) Variator chain
(d) Guide rail
(e) Large groove width
(f) Narrow groove width

The power is transmitted by frictional force generated between the pulley slope and variator chain. The mechanism of frictional force generation is as shown below.

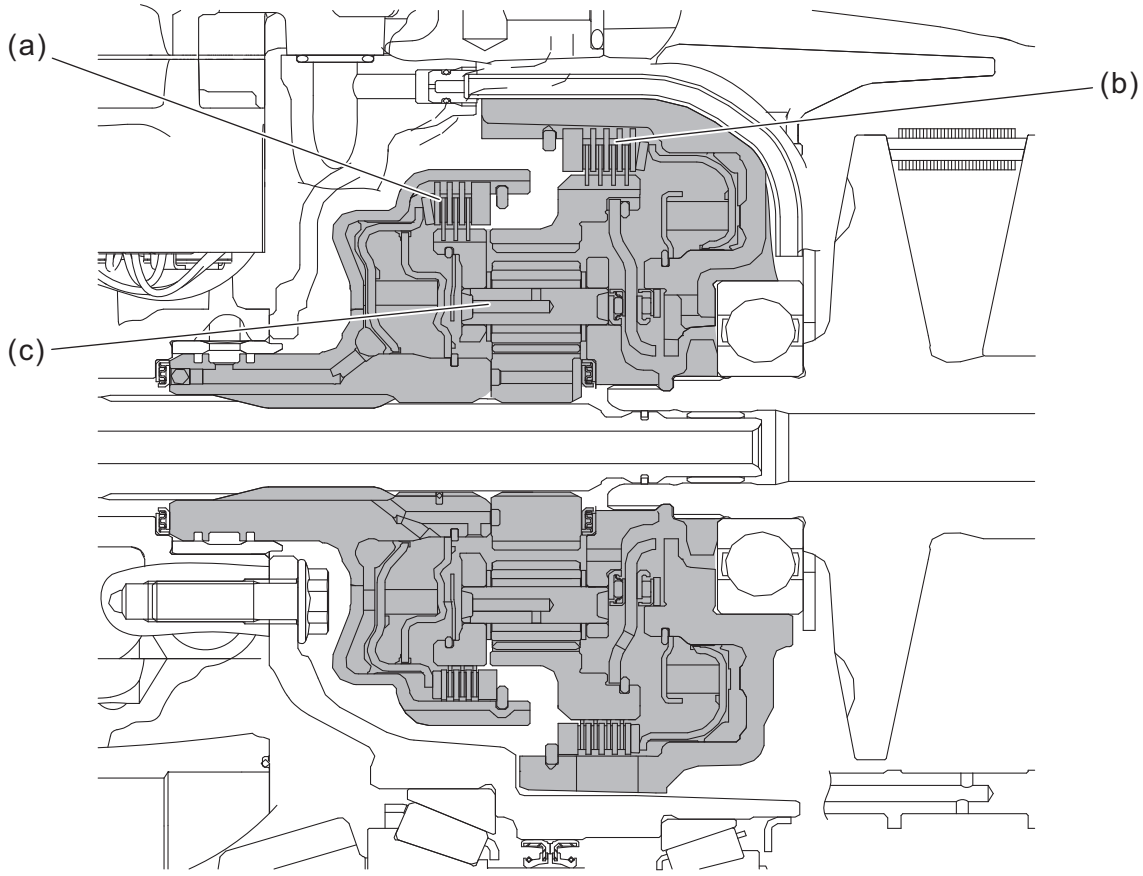
- When the oil pressure works on the secondary pulley, the secondary pulley contacts with the variator chain.
- The variator chain stretches outward in the pulley radial direction.
- Tension occurs on the variator chain.
- Frictional force occurs between the variator chain on the primary pulley and the pulley.

The frictional force generates tension on the variator chain and power is transmitted to the secondary pulley.

Forward and reverse switching mechanism

■ Construction

The forward and reverse switching mechanism is composed of one set of planetary gears (double-pinion planetary gear), one set of multi-plate clutches (forward clutch), and one set of multi-plate brakes (reverse brake).

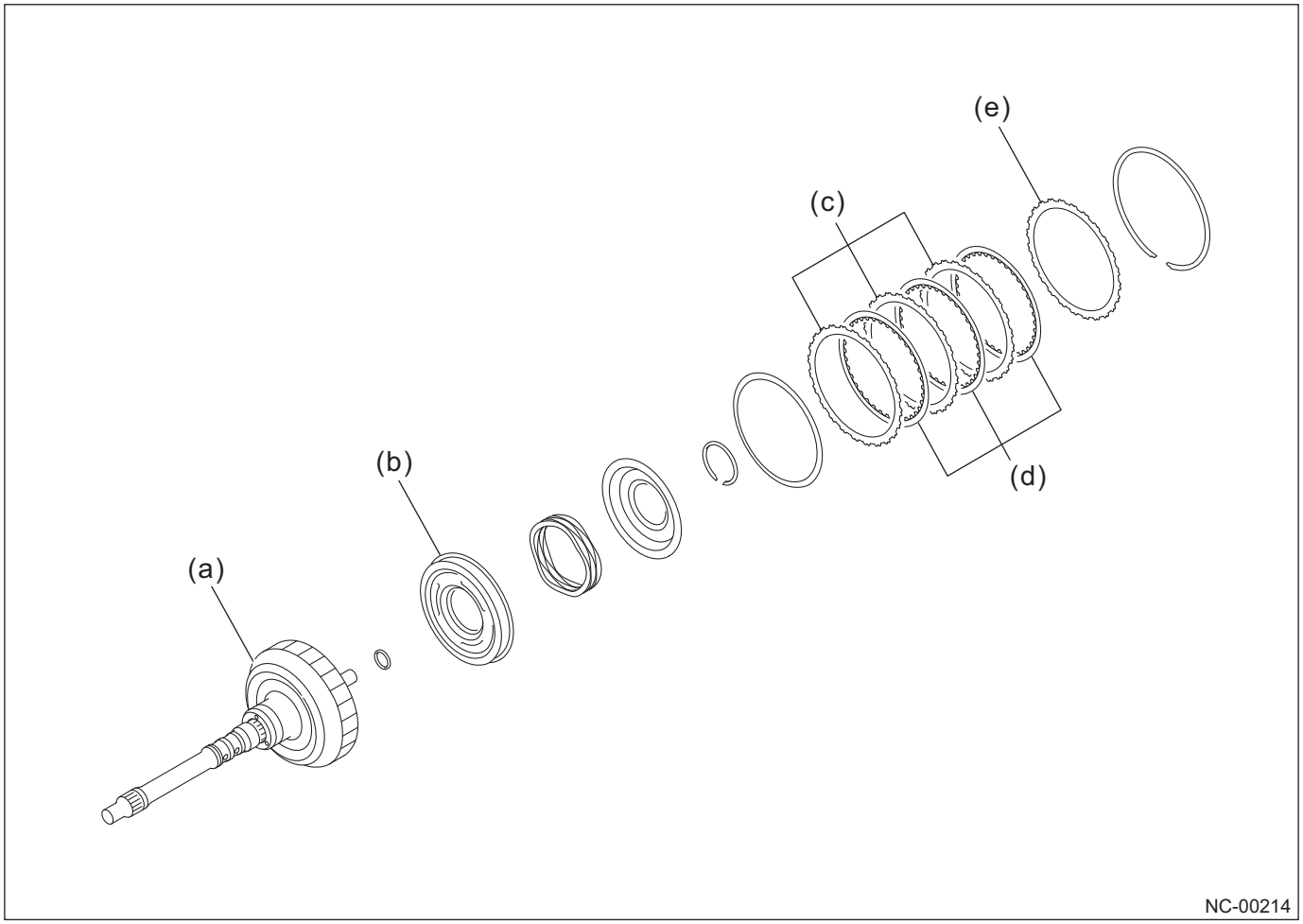


(a) Forward clutch
(b) Reverse brake
(c) Planetary gear

■ Forward clutch

The forward clutch is composed of the forward clutch drum, forward clutch piston, clutch plate, etc.

When selecting the D position, the manual valve moves and the oil passage to the forward clutch is formed. The acting oil pressure is controlled by the F&R clutch solenoid.

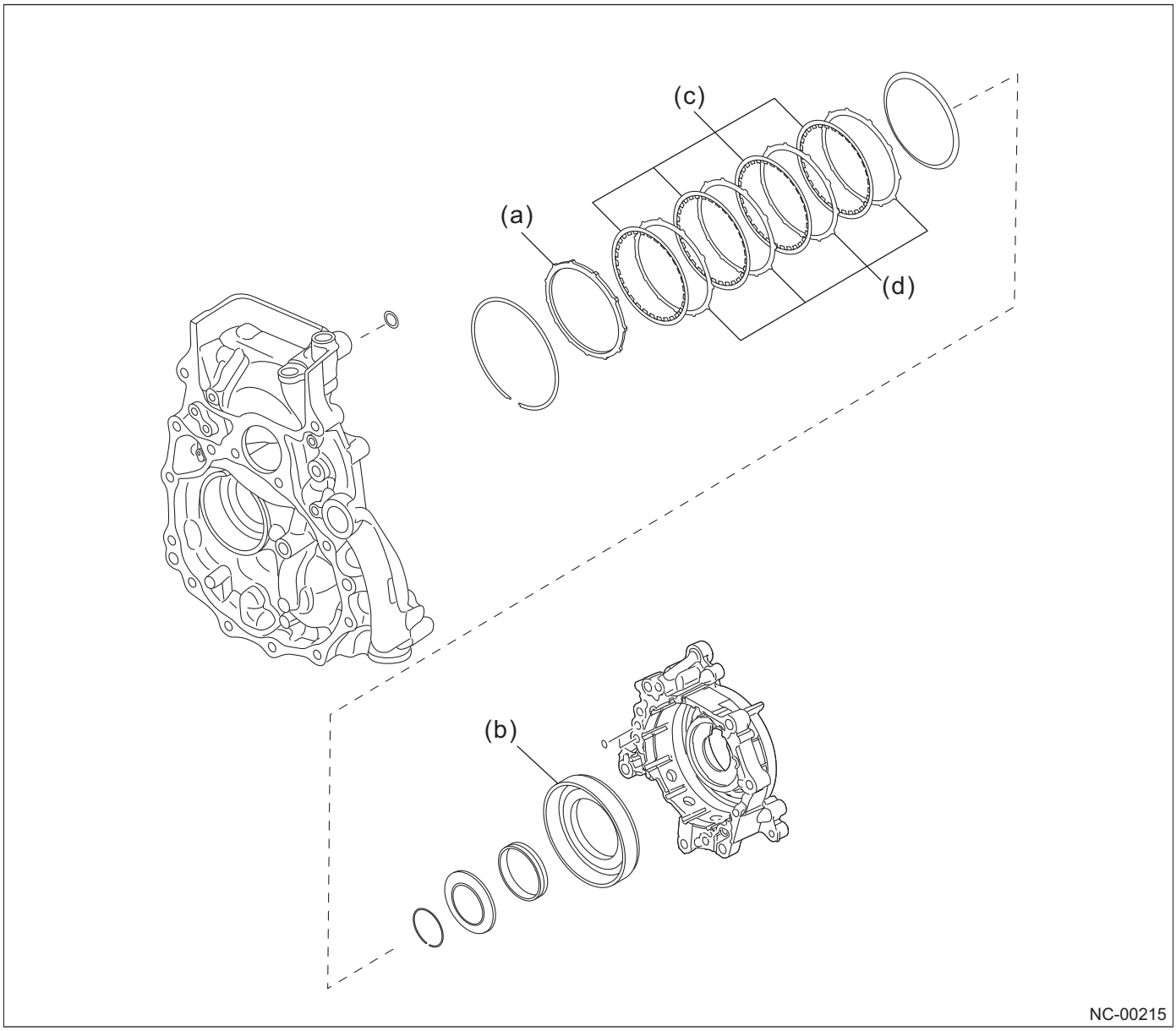


(a) Forward clutch drum
(b) Forward clutch piston
(c) Driven plate
(d) Drive plate
(e) Retaining plate

Reverse brake

The reverse brake is composed of the retaining plate, reverse brake piston, drive plate, driven plate, etc.

When selecting the R position, the manual valve moves, and the oil passage to the reverse brake is formed. The reverse brake is a hydraulic actuation brake, and the acting oil pressure is controlled by the F&R clutch solenoid.



(a) Retaining plate
(b) Reverse brake piston
(c) Drive plate
(d) Driven plate

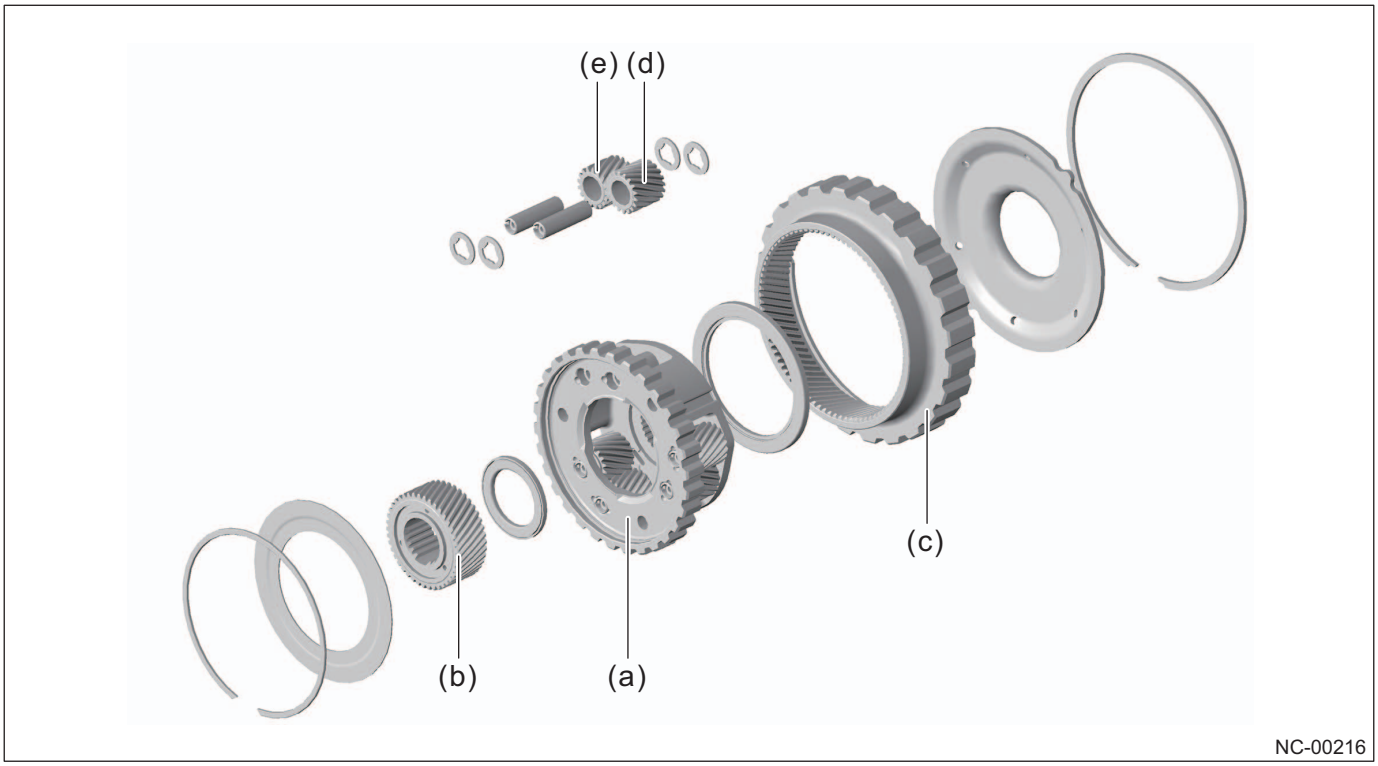
Planetary gear

The planetary gear is composed of planetary carrier, sun gear, planetary pinion gear, internal gear, etc.

The planetary gear has the sun gear at the central portion, the internal gear on the outer circumference, and the planetary pinion gear at the middle point between the sun gear and the internal gear. The outer and inner planetary pinion gears are each supported by the planetary carrier at equal distances.

The planetary carrier is connected to the forward clutch drum and primary pulley, and the internal gear is connected to the planetary pinion gear and reverse brake. The sun gear is splined to the input shaft.

When the internal gear is fixed with the reverse brake, the planetary carrier rotates in the reverse direction.



(a) Planetary carrier
(b) Sun gear
(c) Internal gear
(d) Outer planetary pinion gear
(e) Inner planetary pinion gear

■ Operation

The switching between forward and reverse is performed by the forward and reverse switching mechanism arranged in front of the primary pulley.

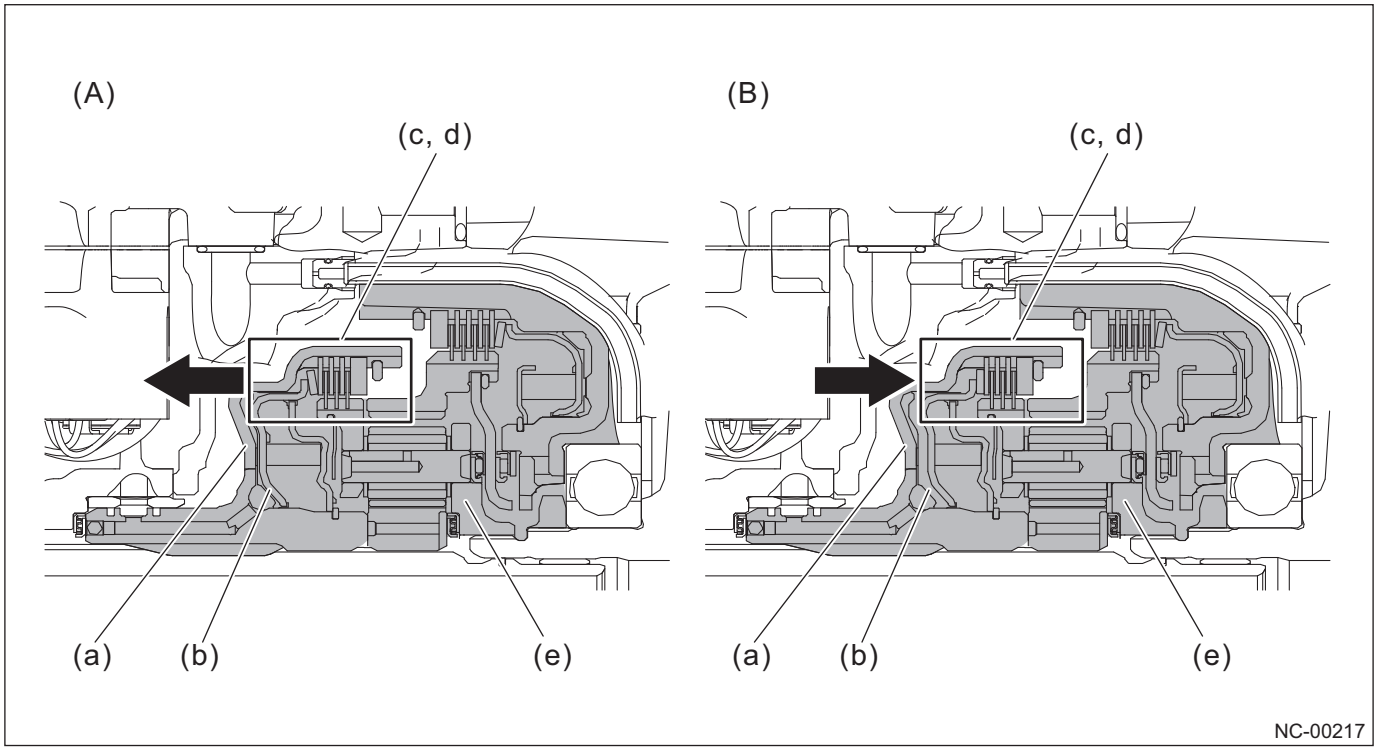
When the turbine in the torque converter rotates, the forward clutch drum and sun gear are always rotating. When the forward clutch and reverse brake are engaged and released, the switching between forward and reverse is performed.

When engaging the forward clutch and releasing the reverse brake, the vehicle moves forward. When releasing the forward clutch and engaging the reverse brake, the vehicle moves reversely.

▮ Forward clutch

When the oil pressure is applied to the forward clutch, the forward clutch piston moves and the drive plate and the driven plate are engaged. Accordingly, the drive force is transmitted from the forward clutch drum to the planetary carrier through the plate set to drive the primary pulley.

When the oil pressure is released from the forward clutch, the forward piston releases the engagement of the drive plate and the driven plate. Accordingly, the forward clutch drum independently rotates on the forward clutch and the drive force is not transmitted.



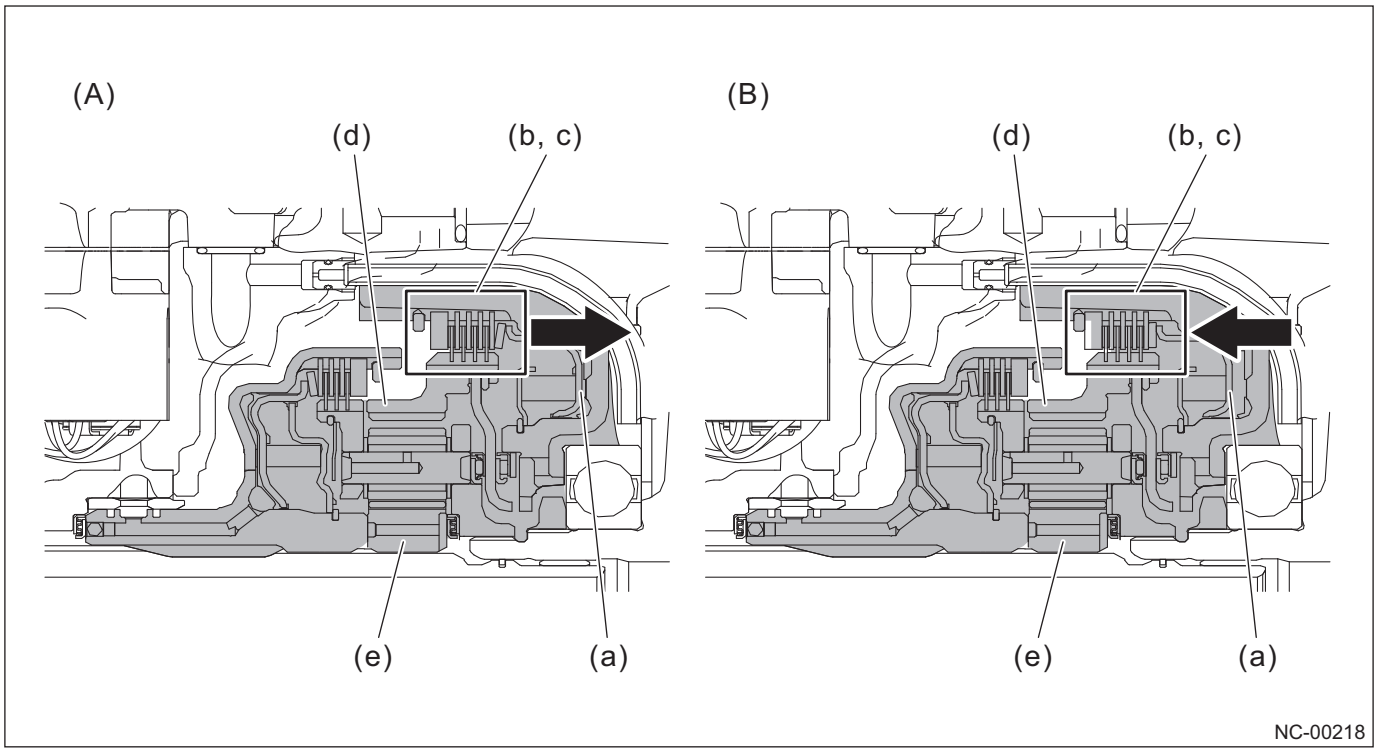
(A) When released
(B) When engaged

(a) Forward clutch drum
(b) Forward clutch piston
(c) Drive plate
(d) Driven plate
(e) Planetary carrier

Reverse brake

When the oil pressure is applied to the reverse brake, the reverse brake piston moves and the drive plate and the driven plate are engaged. Accordingly, the internal gear is fixed, and the drive force is transmitted from the sun gear to the planetary carrier through the planetary pinion gear to drive the primary pulley.

When the oil pressure is released from the reverse brake, the reverse brake piston releases the engagement of the drive plate and the driven plate. Accordingly, the fixed internal gear is released and the drive force generated by the planetary carrier is not transmitted.



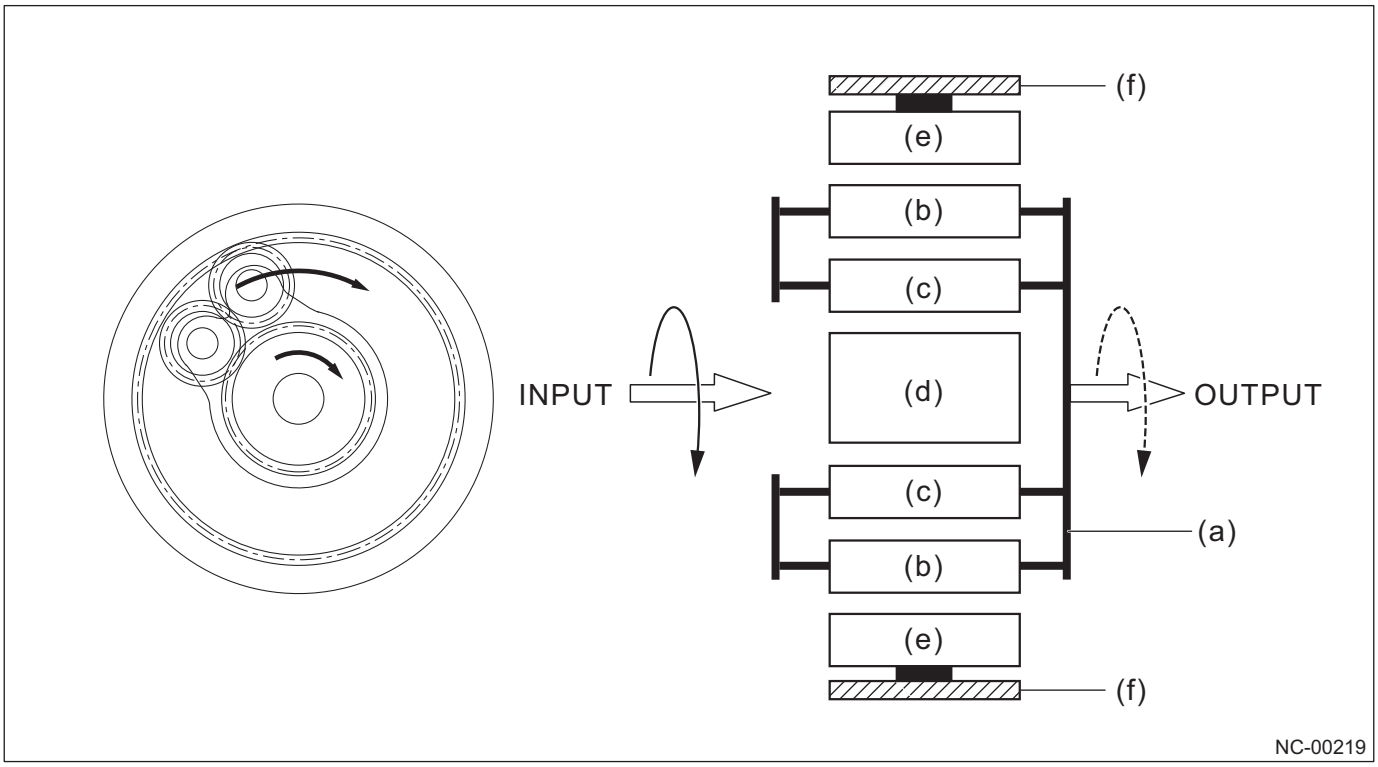
(A) When released
(B) When engaged

(a) Reverse brake piston
(b) Drive plate
(c) Driven plate
(d) Internal gear
(e) Sun gear

Planetary gear

When the vehicle drives forward, the forward clutch is engaged, and the power from the forward clutch drum is transmitted to the planetary carrier. At this time, the forward clutch drum and the planetary carrier rotate in the same direction.

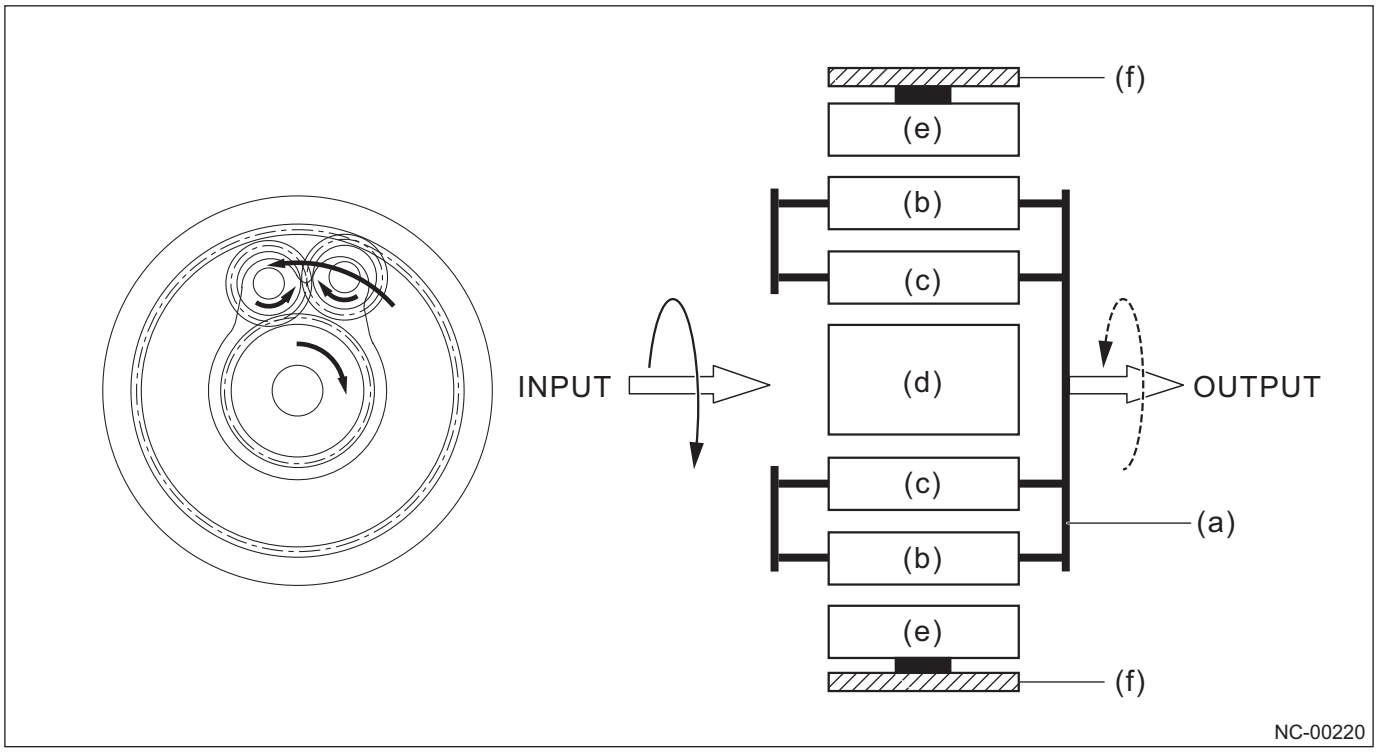
The sun gear, inner planetary pinion gear, outer planetary pinion gear, and internal gear also rotate; however, they are not involved with power transmission.



(a) Planetary carrier
(b) Outer planetary pinion gear
(c) Inner planetary pinion gear
(d) Sun gear
(e) Internal gear
(f) Reverse brake

When reversing, the reverse brake is engaged and the internal gear is fixed to the reverse brake housing. The power from the sun gear rotates the planetary carrier through the inner planetary pinion gear and outer planetary pinion gear. Since the internal gear is fixed with the reverse brake, the inner planetary pinion gear and outer planetary pinion gear rotate together with the entire planetary carrier in the opposite direction of rotation of the sun gear while rotating around their own axes.

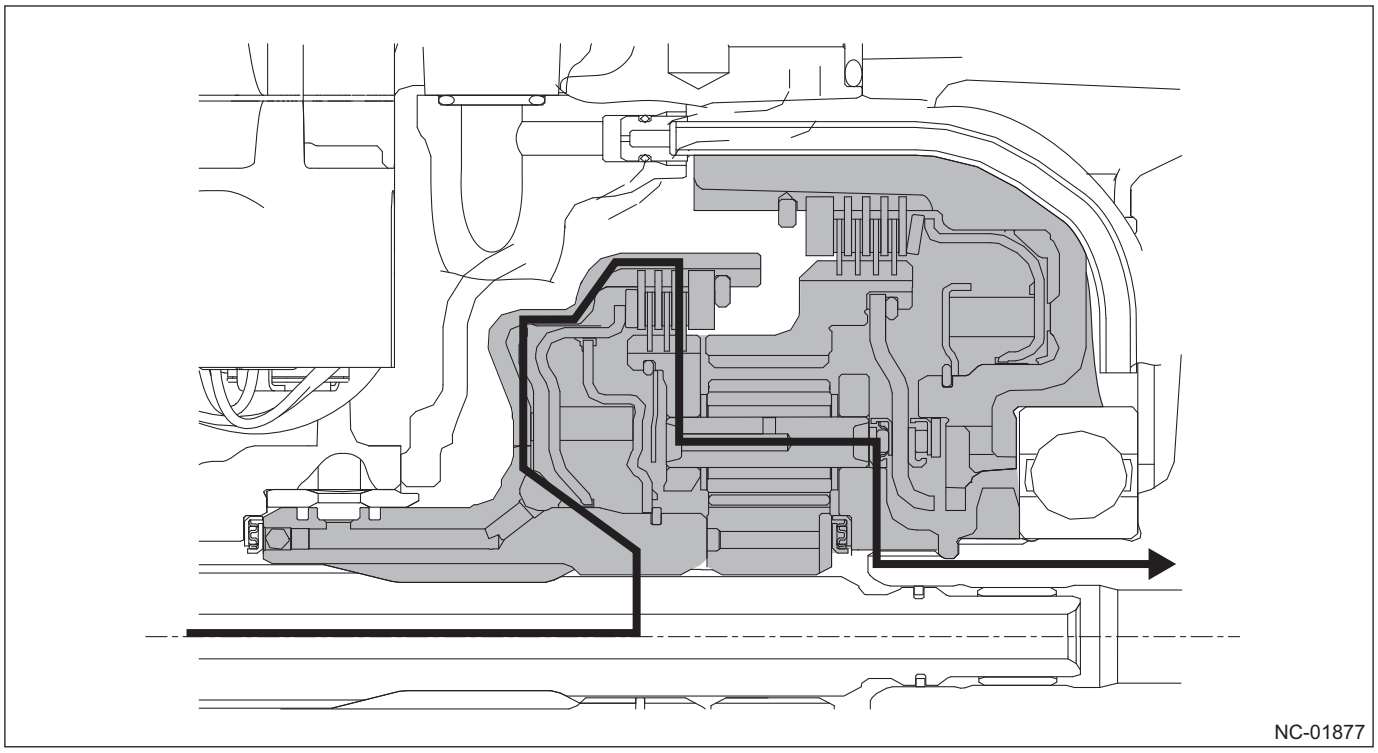
The drive force from the input shaft is transmitted to the pulley in the reverse rotation by the planetary gear actuation.



(a) Planetary carrier
(b) Outer planetary pinion gear
(c) Inner planetary pinion gear
(d) Sun gear
(e) Internal gear
(f) Reverse brake

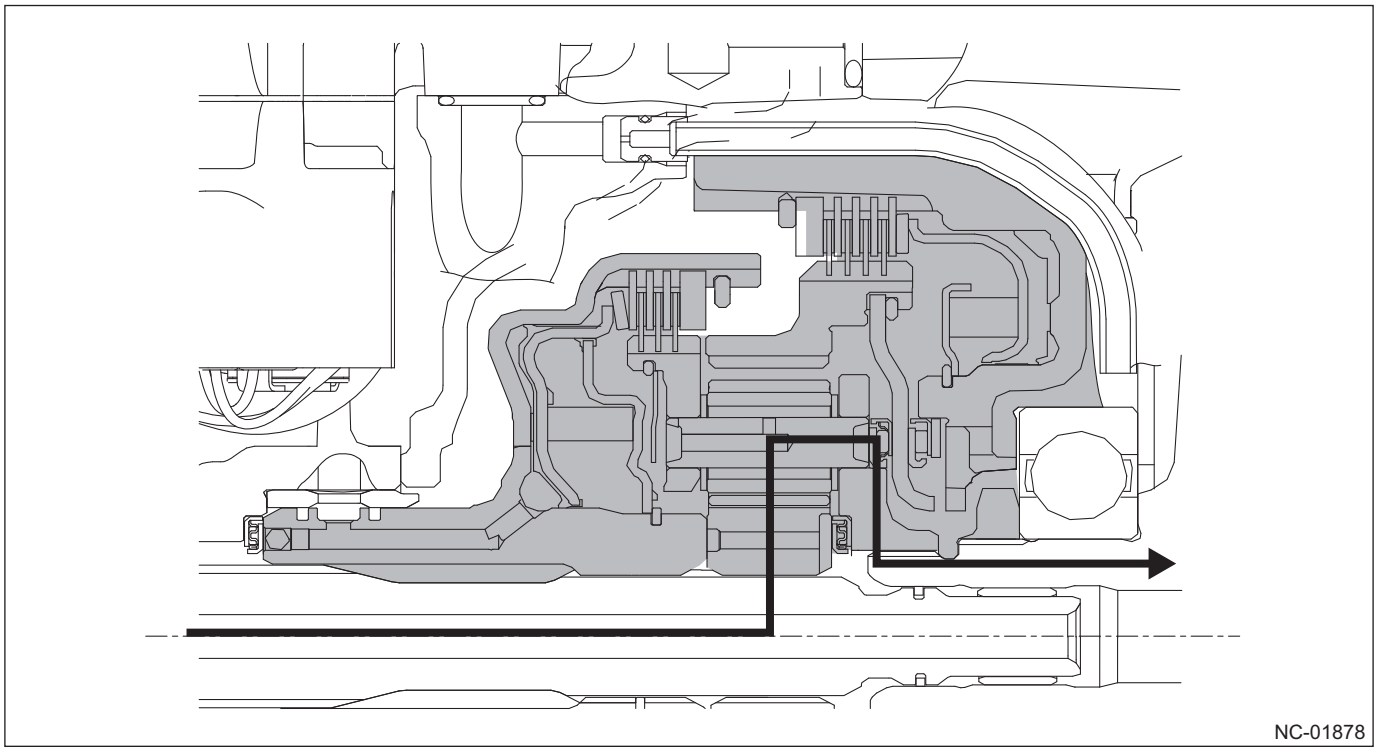
Power transmission when in forward range

When moving forward, the forward clutch is "ON" and the reverse brake is "OFF". The drive force from the input shaft is input to the forward clutch. Accordingly, the drive force is transmitted from the forward clutch to the primary pulley in the same rotation.



Power transmission when in reverse range

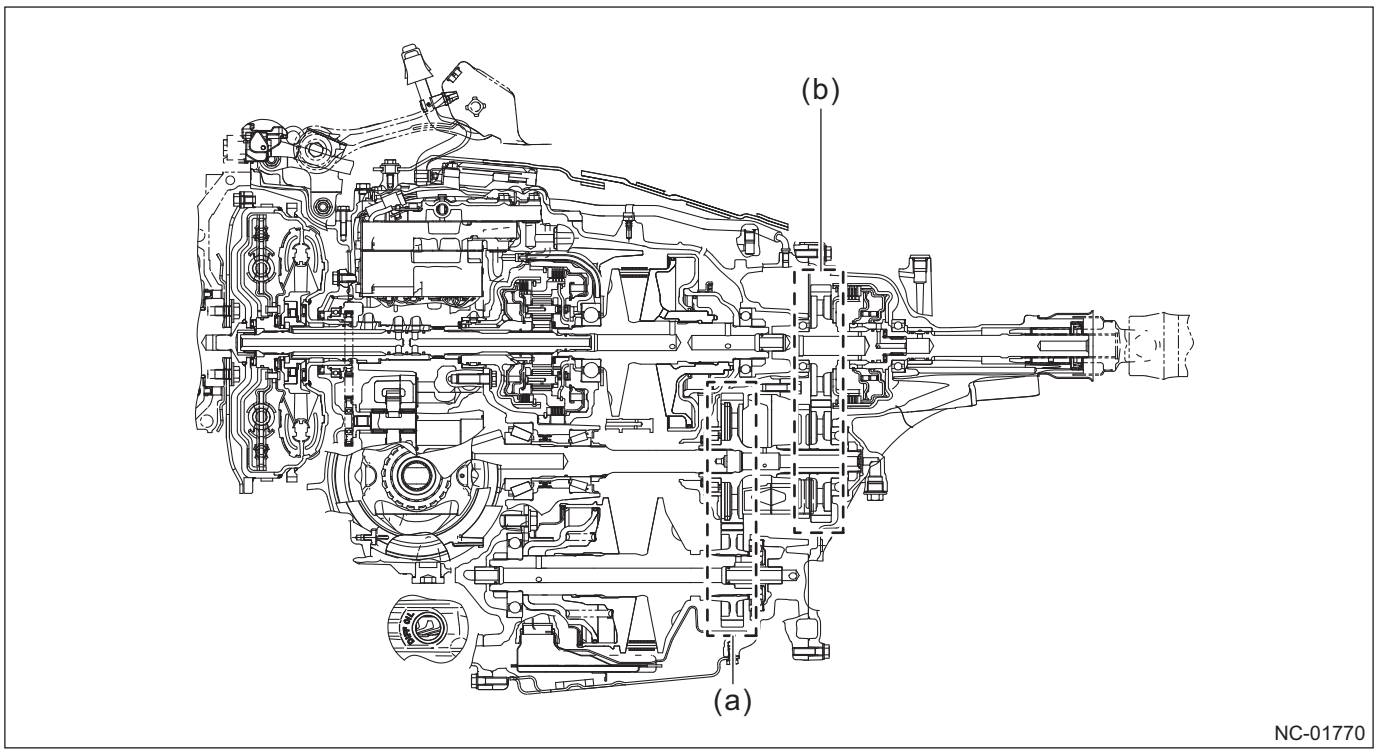
When reversing, the forward clutch is "OFF" and the reverse brake is "ON". Accordingly, the drive force from the input shaft is transmitted to the primary pulley in the reverse rotation by the actuation of the internal gear and sun gear fixed with the reverse brake.



Reduction gear mechanism

■ Construction

The reduction gear mechanism is composed of the reduction gear and transfer gear.



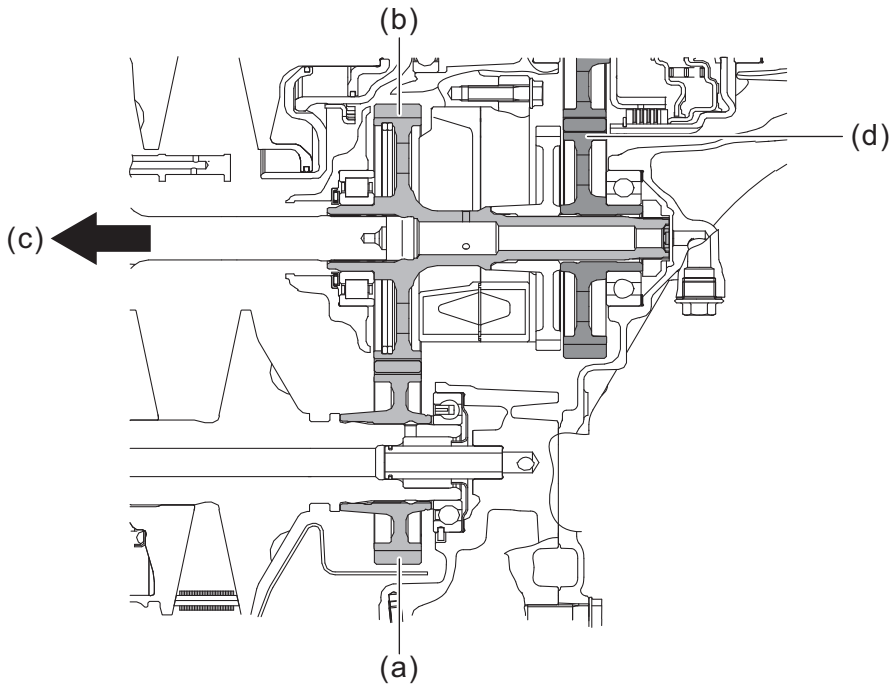
(a) Reduction gear

(b) Transfer gear

■ Operation

▮ Reduction gear

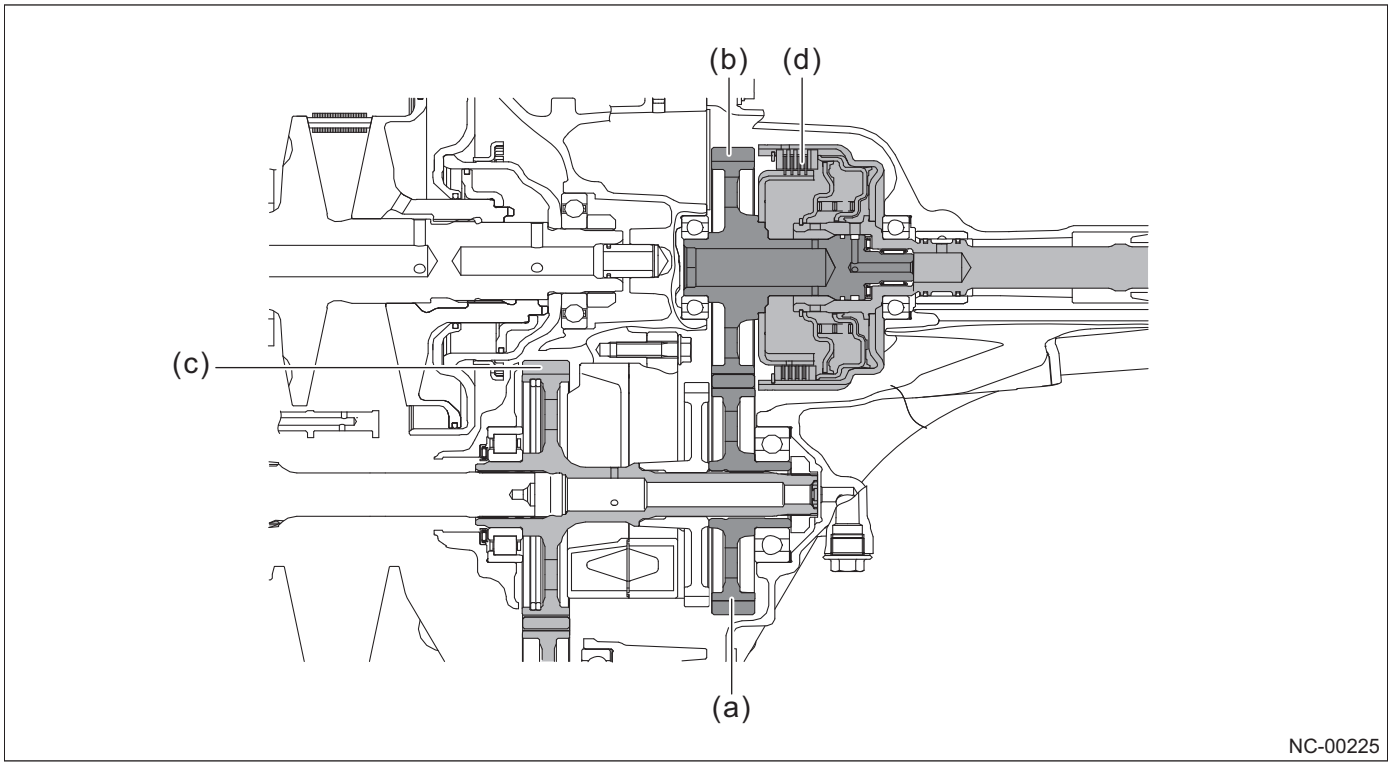
The reduction gear transmits the drive force output from the continuously variable transmission mechanism to the front differential and transfer gear while decelerating the drive force.



(a) Reduction drive gear
(b) Reduction driven gear
(c) Front differential
(d) Transfer gear

Transfer gear

The transfer gear transmits the drive force output from the reduction driven gear to the AWD mechanism.



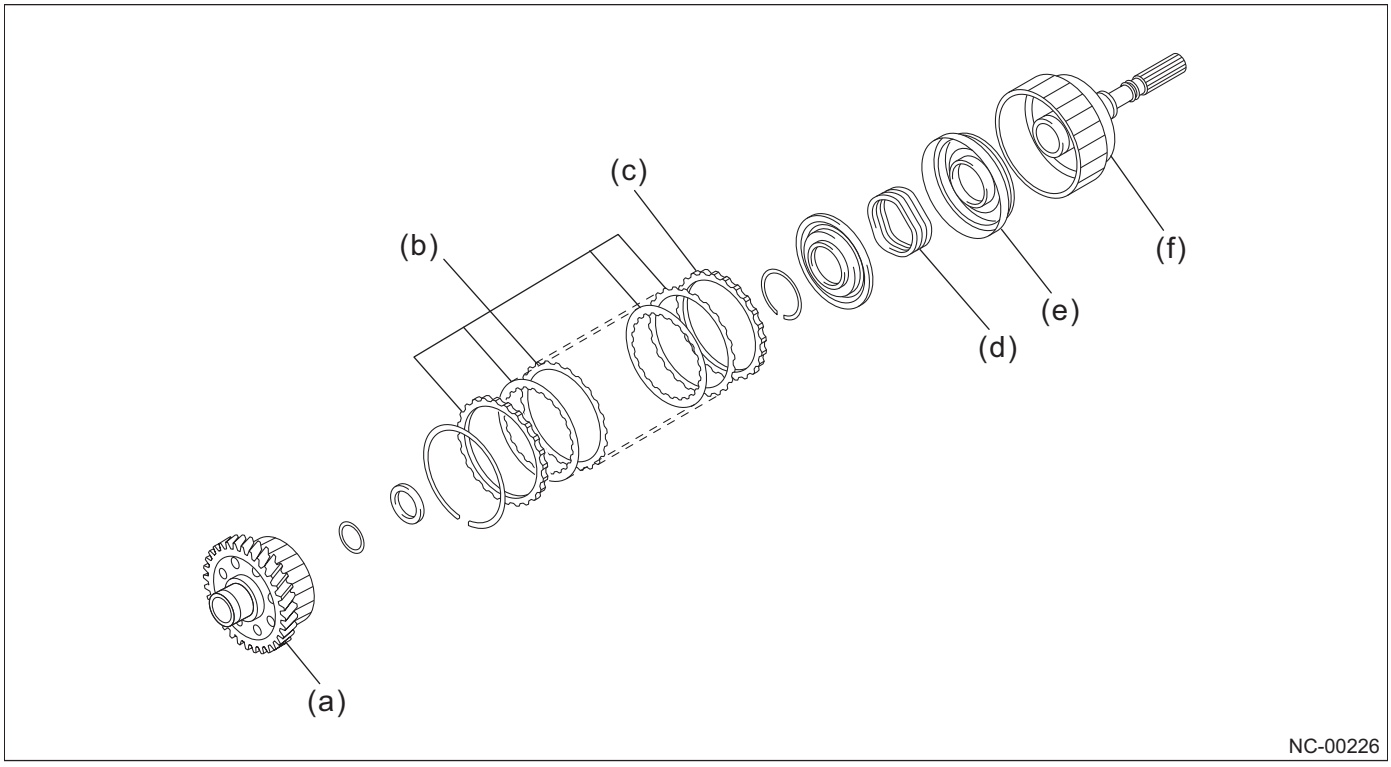
(a) Transfer drive gear
(b) Transfer driven gear
(c) Reduction driven gear
(d) AWD mechanism

AWD mechanism

■ Construction

MP-T (multi-plate [multi-plate clutch] transfer) is installed in the transfer mechanism that distributes torque to the rear wheel. The mechanism controls electronically the oil pressure of the clutch and has the center differential function and the LSD function.

The transfer clutch is a hydraulic actuation clutch and the acting oil pressure is controlled by the AWD solenoid.



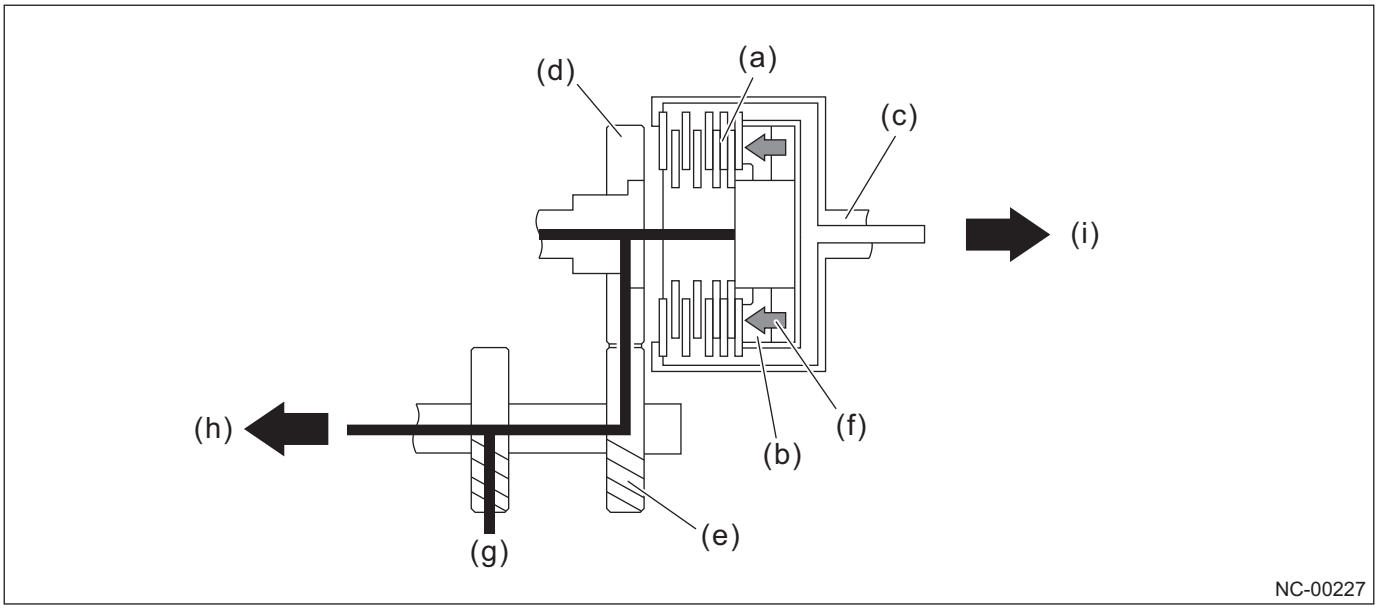
(a) Transfer driven gear
(b) Transfer clutch plate set
(c) Pressure plate
(d) Return spring
(e) Transfer clutch piston
(f) Rear drive shaft

■ Operation

When the oil pressure is applied to the transfer clutch, the transfer piston moves and the drive plate and the driven plate are engaged. Accordingly, the drive force is transmitted from the transfer driven gear to the rear drive shaft through the plate set.

The transfer clutch pressure is controlled by the AWD solenoid based on the signal sent from TCM.

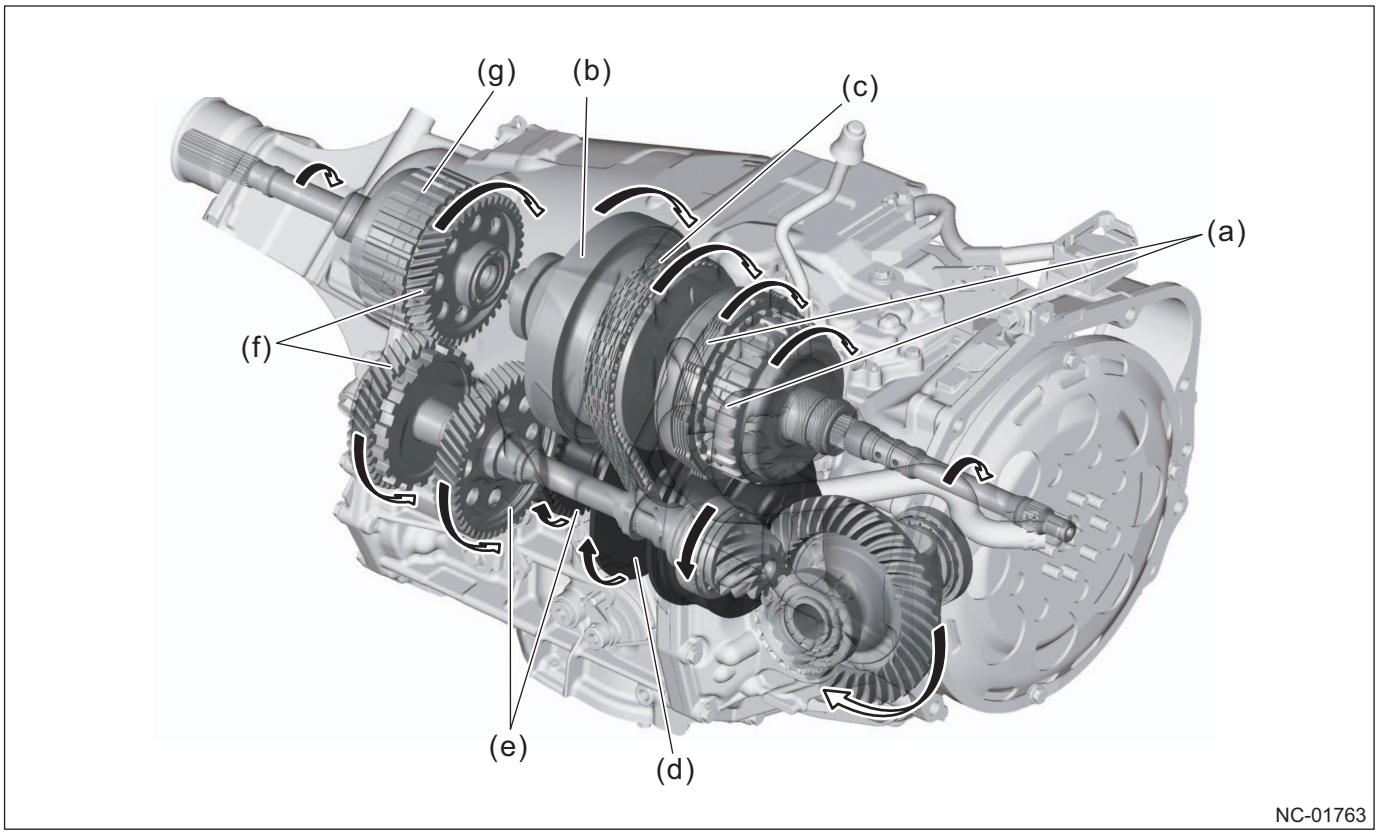
TCM controls the torque distribution of front and rear wheels in real time depending on driving conditions of accelerating, hill climbing, and turning, etc., based on the torque distribution (front wheel 60: rear wheel 40). When TCM detects that the front wheel slips, TCM increases the torque to the rear wheel to ensure the drive force.



(a) Transfer clutch plate set
(b) Transfer piston
(c) Rear drive shaft
(d) Transfer driven gear
(e) Transfer drive gear
(f) Oil pressure
(g) From continuously variable transmission mechanism
(h) To front wheels
(i) To rear wheels

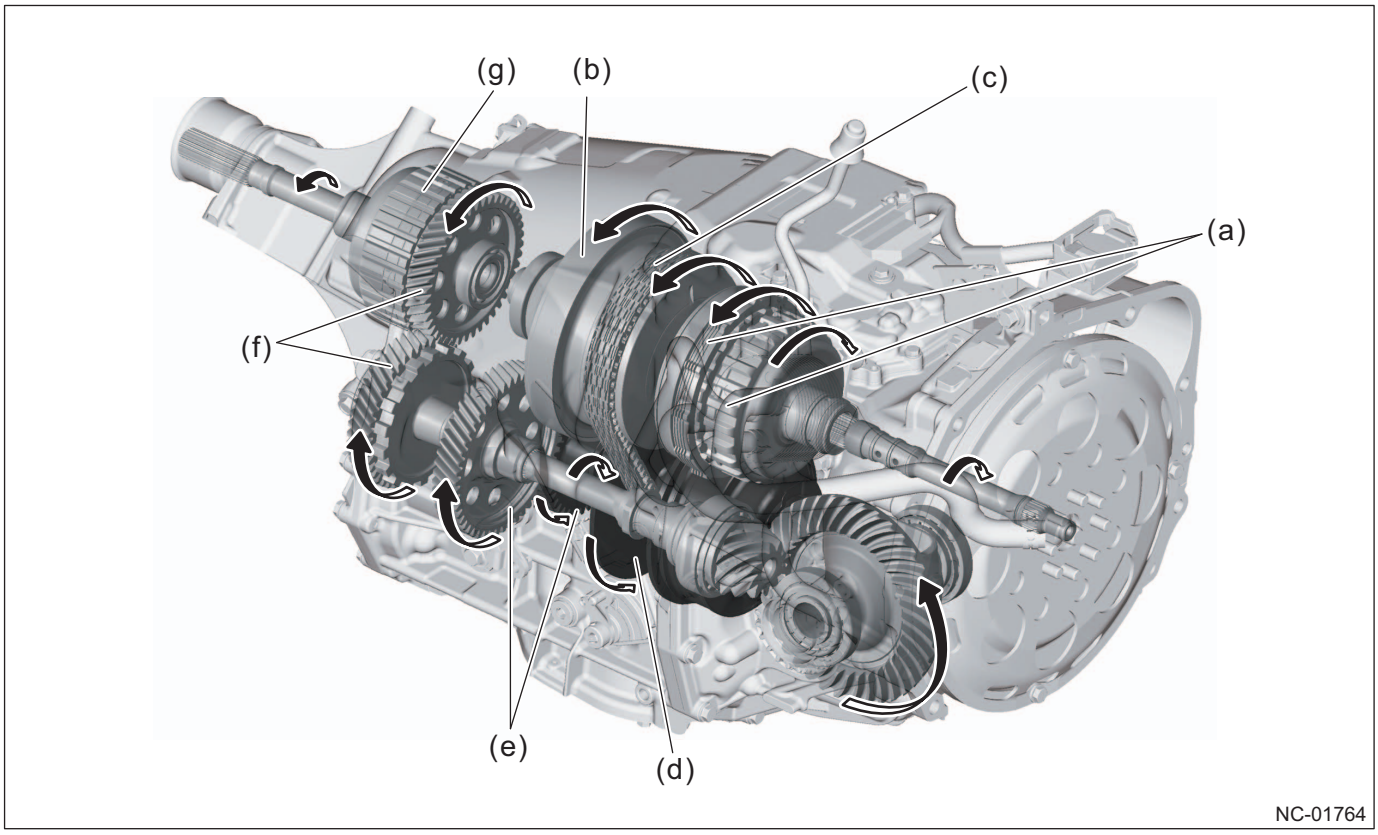
Power transmission

■ D range



(a) Forward and reverse switching mechanism
(b) Primary pulley
(c) Variator chain
(d) Secondary pulley
(e) Reduction gear mechanism
(f) Transfer gear
(g) AWD system

■ R range



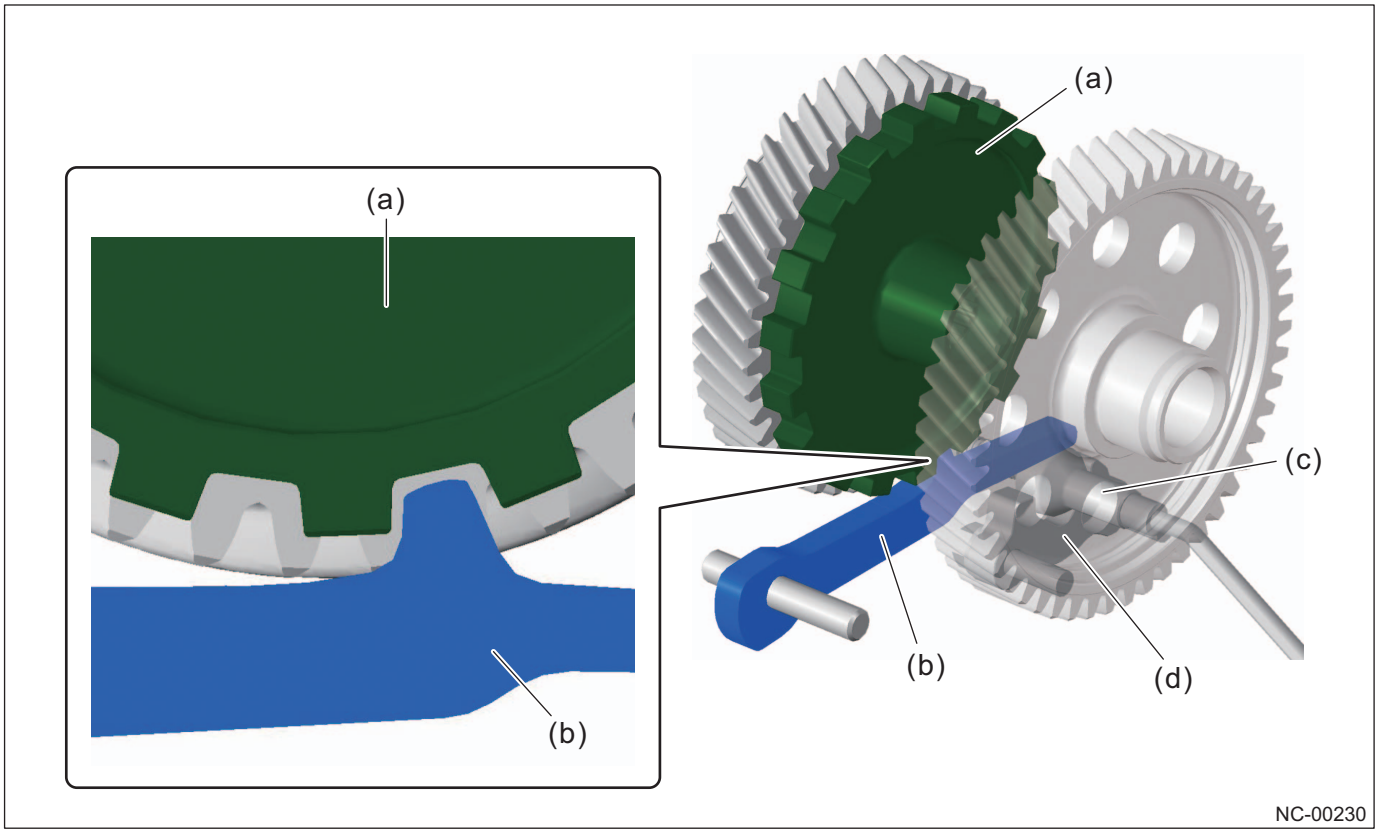
(a) Forward and reverse switching mechanism
(b) Primary pulley
(c) Variator chain
(d) Secondary pulley
(e) Reduction gear mechanism
(f) Transfer gear
(g) AWD system

■ N range

When the gear is shifted to the N range, the drive force from the input shaft is input to the forward clutch drum and the planetary pinion. However, since the forward clutch is "OFF" and the reverse brake is "OFF", the drive force is not transmitted to the wheels.

■ P range

When the gear is shifted to the P range, the drive force is not transmitted as in the N range. Furthermore, the parking pawl engages with the parking gear to lock the rotation of the reduction driven gear shaft.



(a) Parking gear
(b) Parking pawl
(c) Parking rod
(d) Parking support

Differential

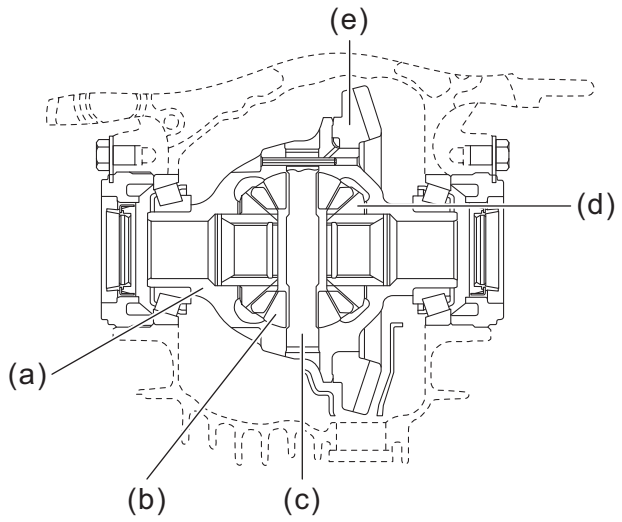
■ Construction

The front differential is composed of a differential case, a pinion gear (differential bevel pinion), a pinion shaft, and a side gear (differential bevel gear).

The pinion gear is installed in the differential case using the pinion shaft and rotates together with the differential case. Also, the pinion gear can freely rotate around the pinion shaft as an axis.

The side gear engages with the pinion gear. The center of the side gear with a spline shape is coupled with the drive shaft that is a drive axis.

The ring gear (hypoid driven gear) is installed outside the differential case.



NC-00231

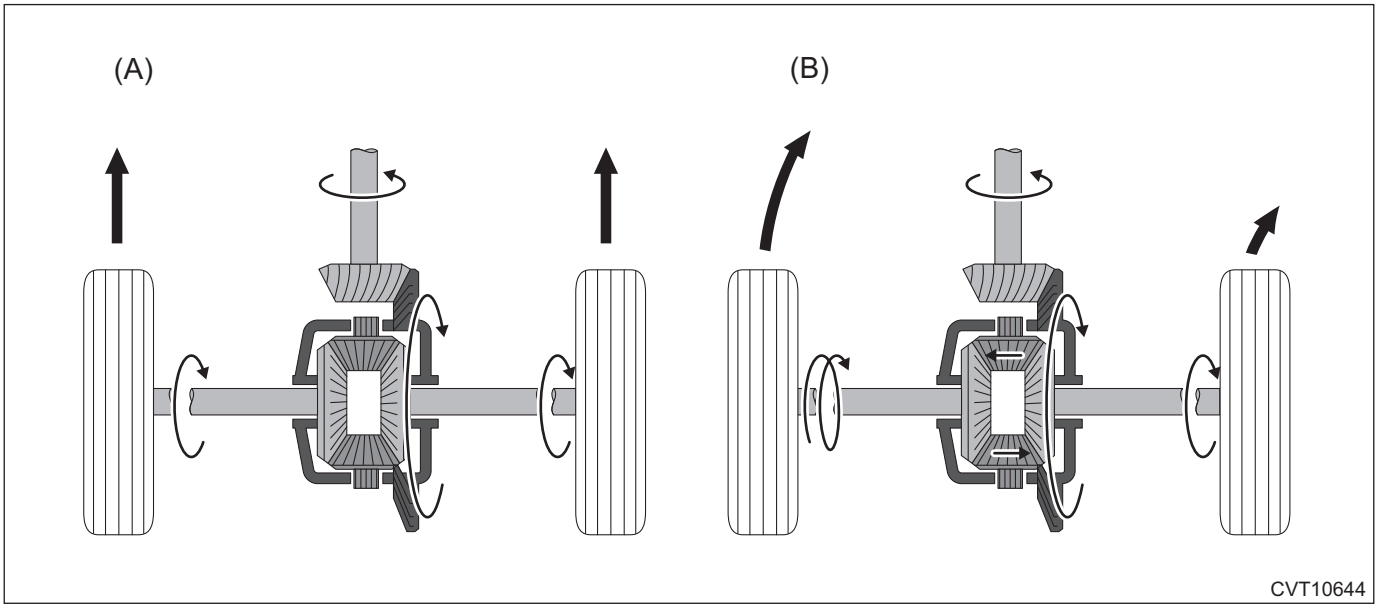
(a) Differential case
(b) Pinion gear
(c) Pinion shaft
(d) Side gear
(e) Ring gear

■ Operation

If there is no rotation difference between right and left wheels when traveling straight forward, rolling distances of the right and left wheels are the same. The pinion gear engaged with the side gear does not rotate on the pinion shaft and rotates (revolves) together with the differential case at this state. The right and left wheels rotate at the same speed.

When turning, since the rolling distances in the right and left wheels are different from each other, the inner wheel is required to decelerate and the outer wheel is required to accelerate. While the pinion gear rotates on the pinion shaft by the rotation difference, the pinion gear revolves on the side gear with larger resistance and drives the other side gear. As a result, differential action occurs.

When one wheel stops, the pinion gear itself starts to rotate. The pinion gear rotates at double speed because it rotates the other side gear quickly.



(A) When traveling straight forward

(B) When turning

Oil pressure control mechanism

Overview

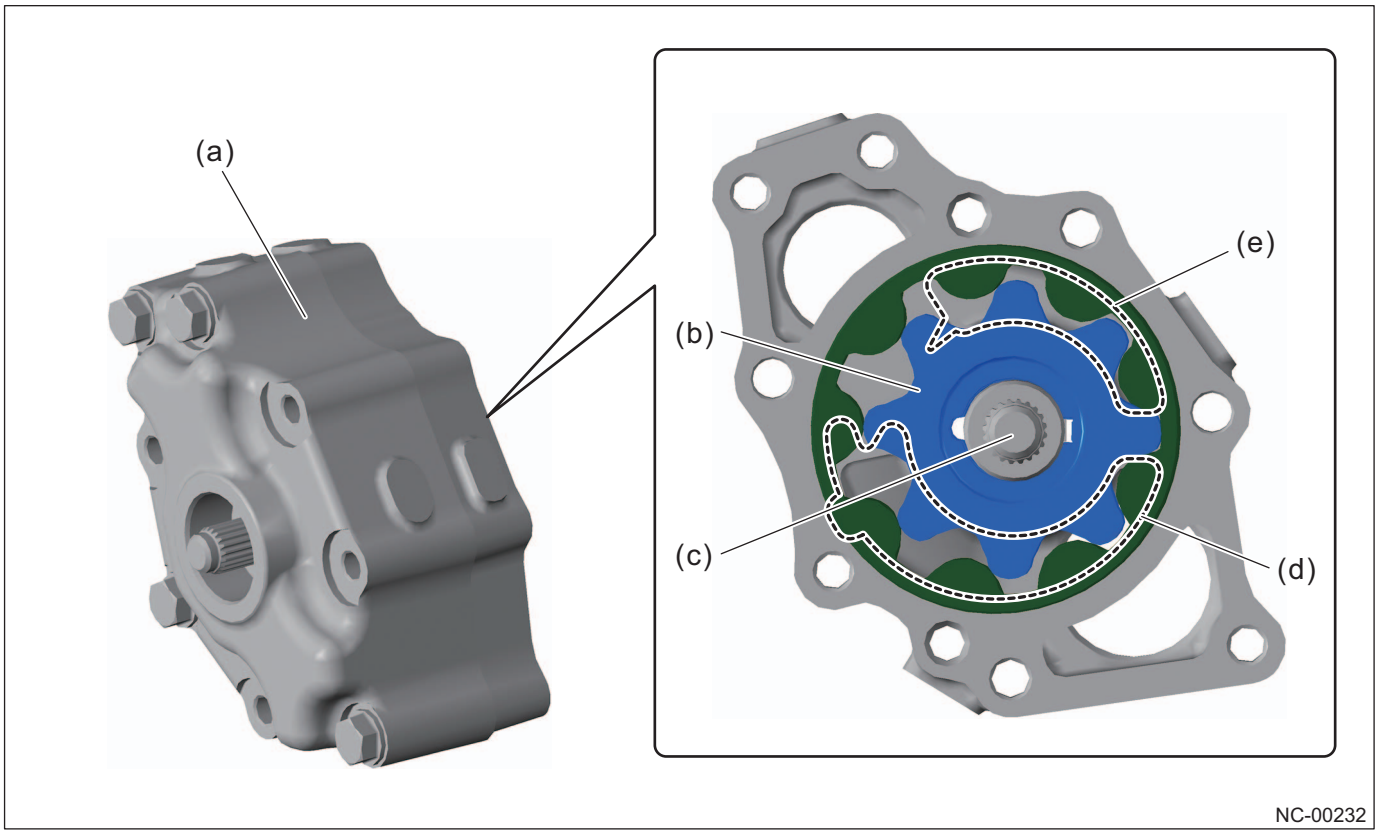
The oil pressure control system is composed of an oil pump that generates the oil pressure and the control valve with the built-in various valves that switch the oil passage and adjust the oil pressure.

The oil pressure generated in the oil pump is used to perform power control according to the driving conditions and lubricate each portion in the transmission.

Oil pump

■ Construction

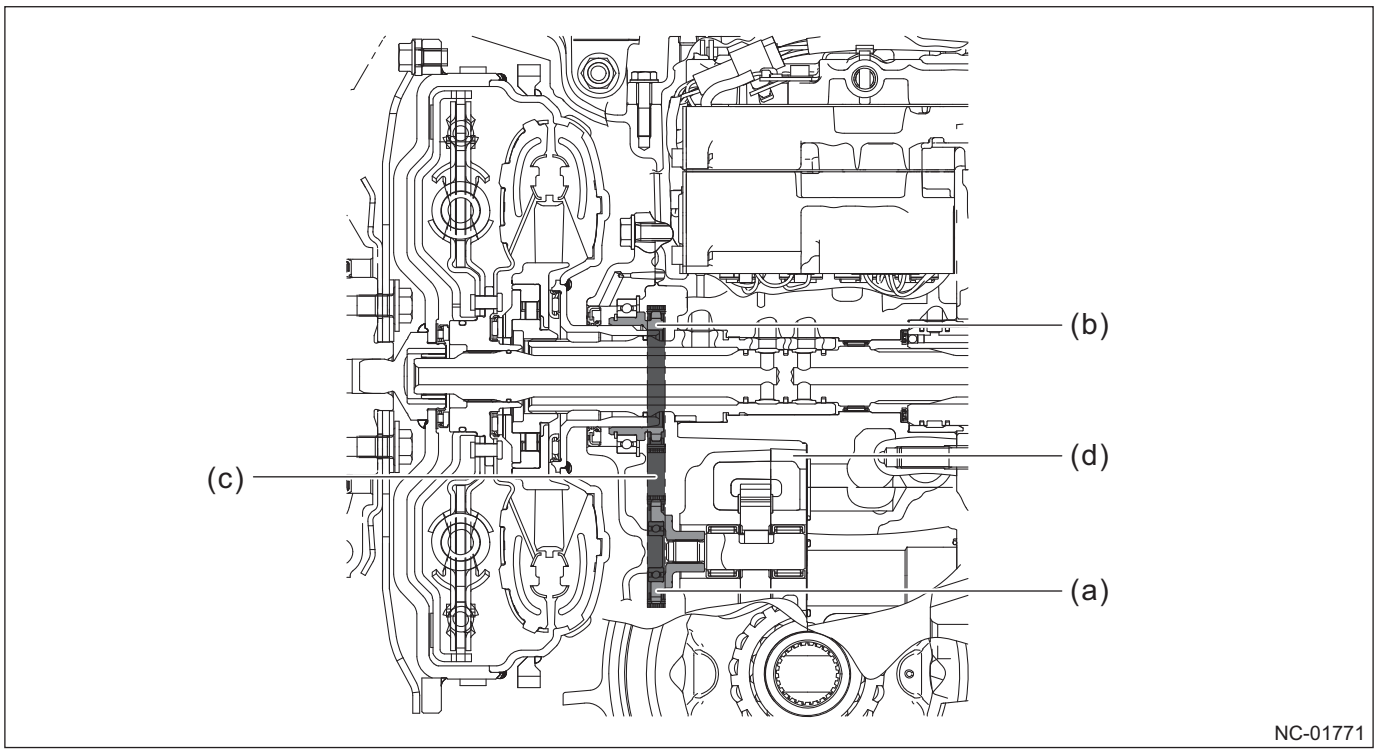
The oil pump is composed of housing, oil pump rotor and oil pump shaft.



(a) Housing
(b) Oil pump rotor
(c) Oil pump shaft
(d) Intake port
(e) Discharge port

■ Operation

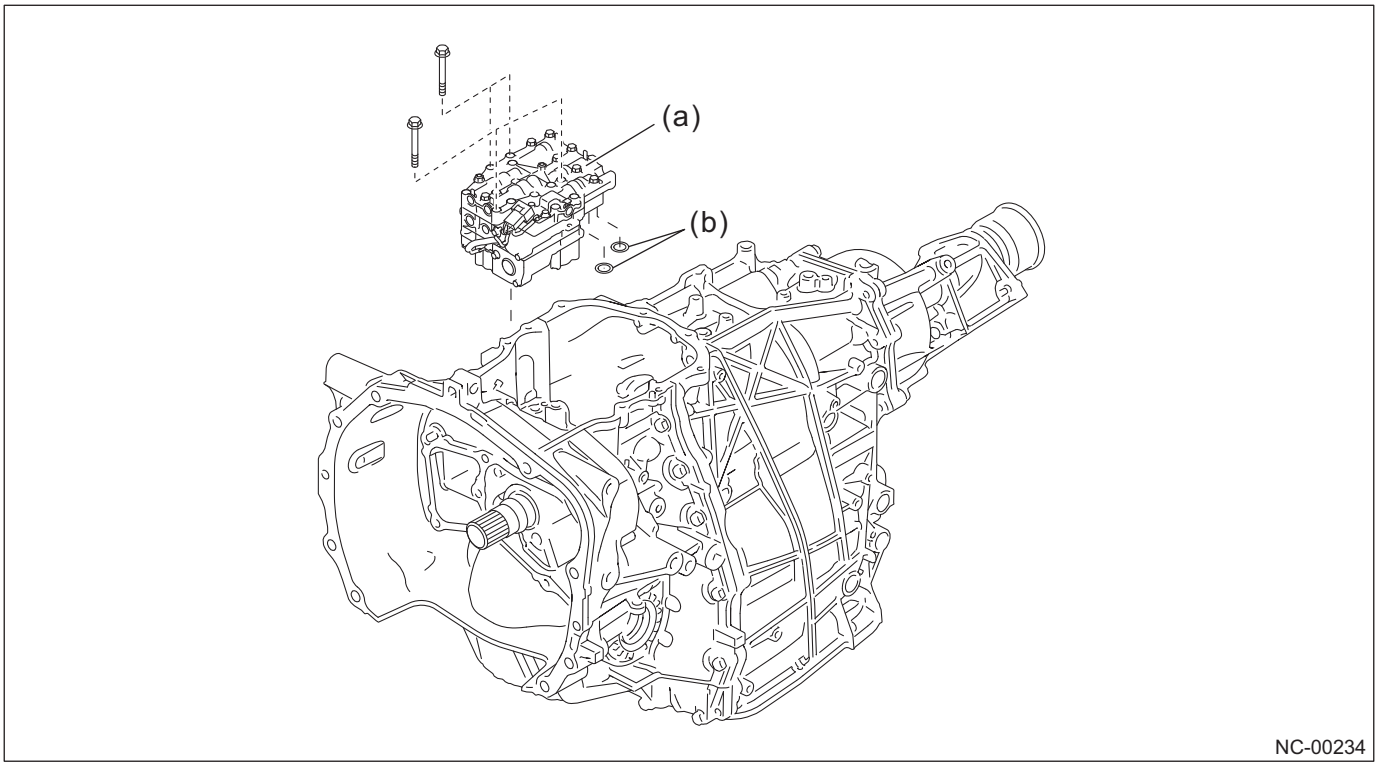
The oil pump couples with the oil pump drive sprocket installed in the converter case and the oil pump driven sprocket installed on the oil pump side, using the oil pump chain. While the engine rotates, the oil pump is always driven by the torque converter connected to the drive plate which directly connected to the engine crankshaft.



(a) Oil pump driven sprocket
(b) Oil pump drive sprocket
(c) Oil pump chain
(d) Oil pump

Control valve

The control valve is installed on top of the transmission case and contains various valves that switch the oil passage and adjust the oil pressure.

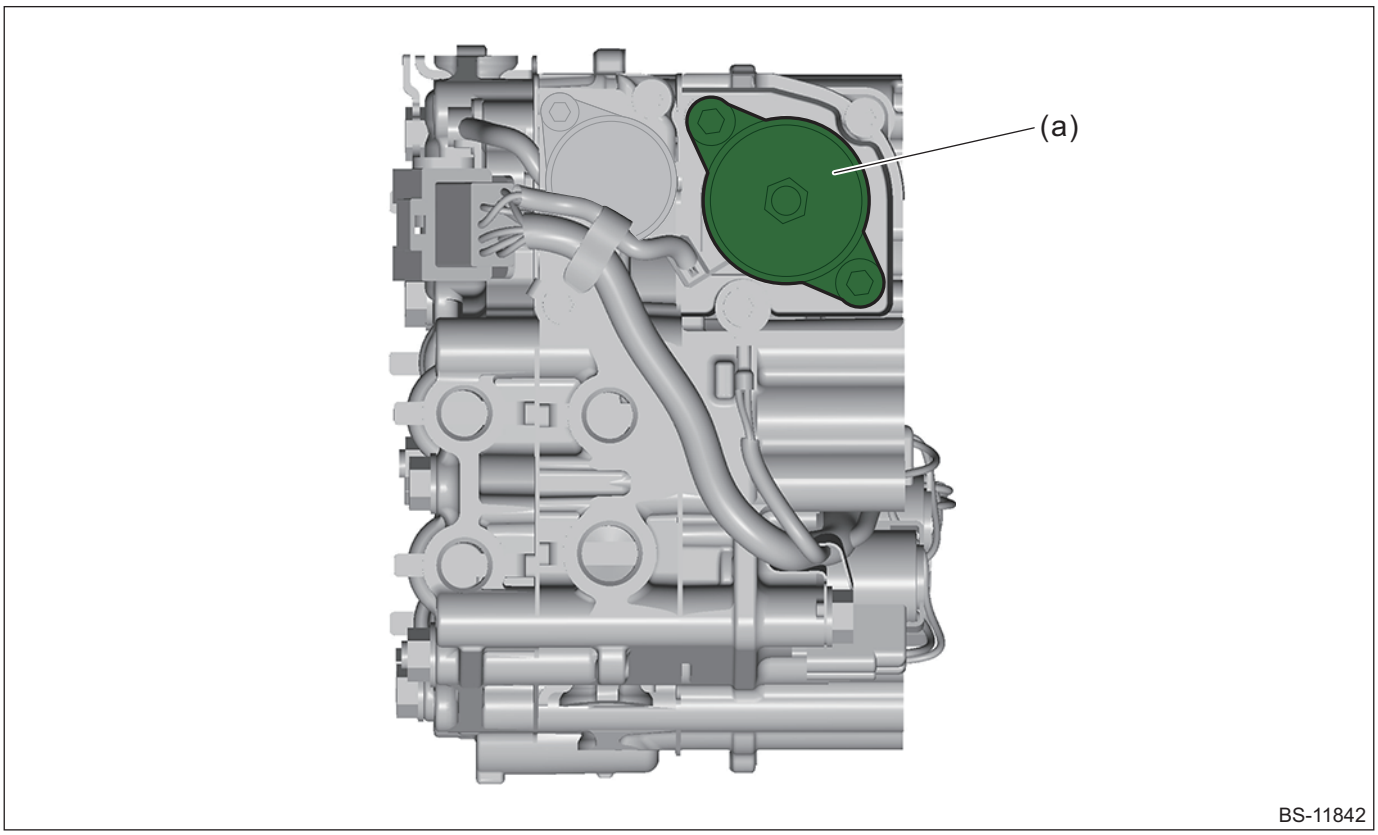


(a) Control valve

(b) O-ring

■ Secondary solenoid

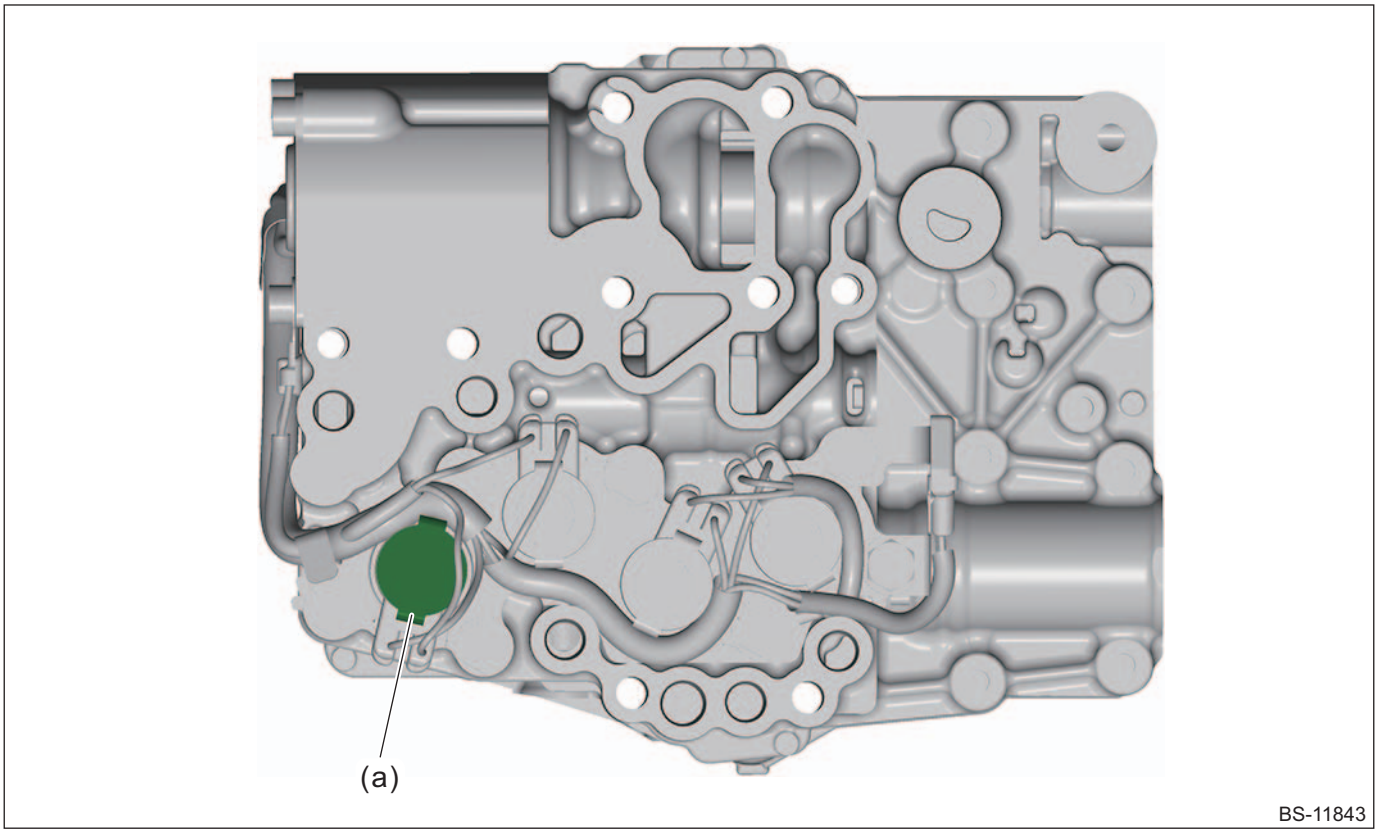
The secondary solenoid is installed on LWR side of the control valve body. The current is controlled by the signal sent from TCM. This adjusts the secondary pressure and controls the secondary pressure necessary for transmitting torque by the chain.



(a) Secondary solenoid

■ AWD solenoid

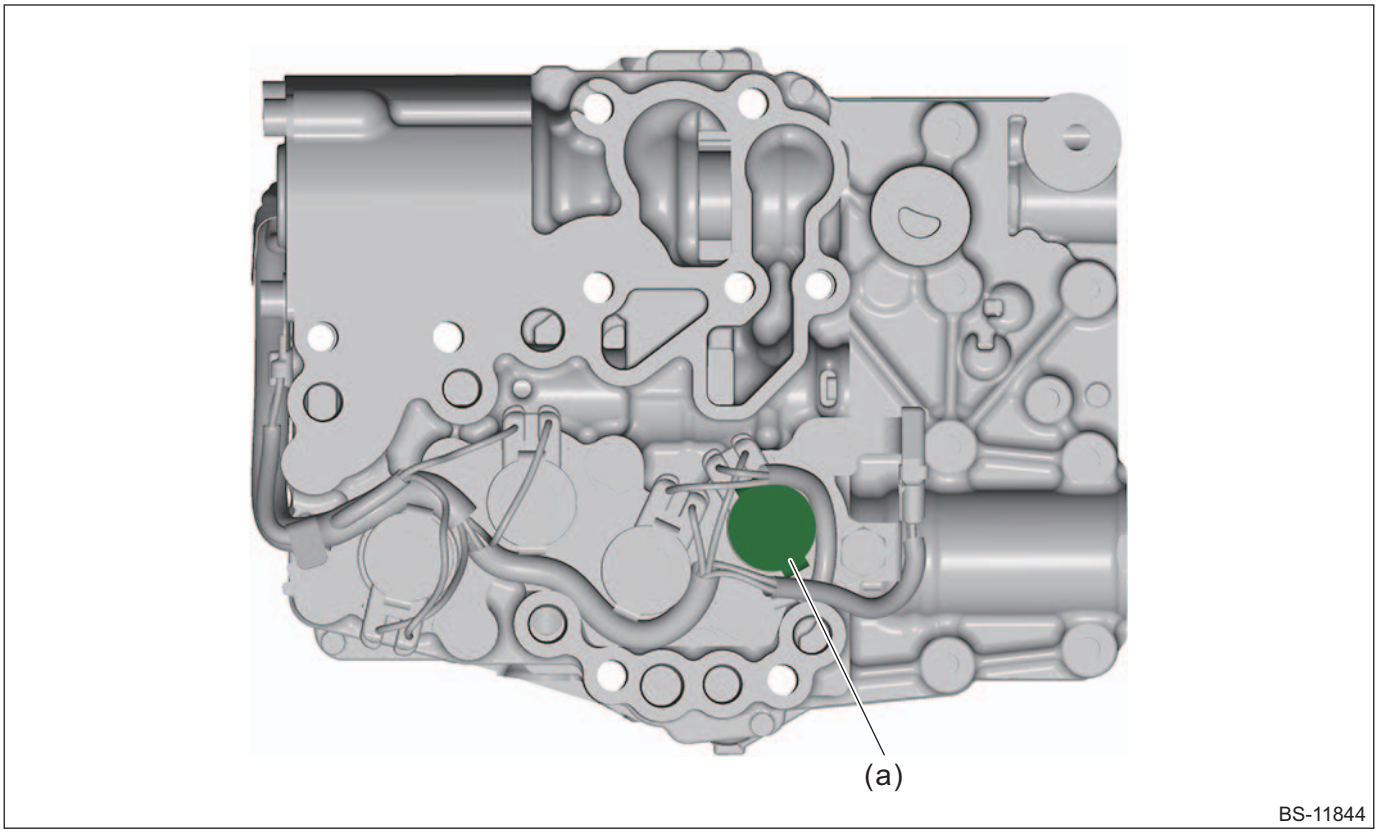
The AWD solenoid is installed on LWR side of the control valve body. The current is controlled by the signal sent from TCM. This adjusts the transfer clutch pressure and controls the transfer pressure.



(a) AWD solenoid

■ Lock-up duty solenoid

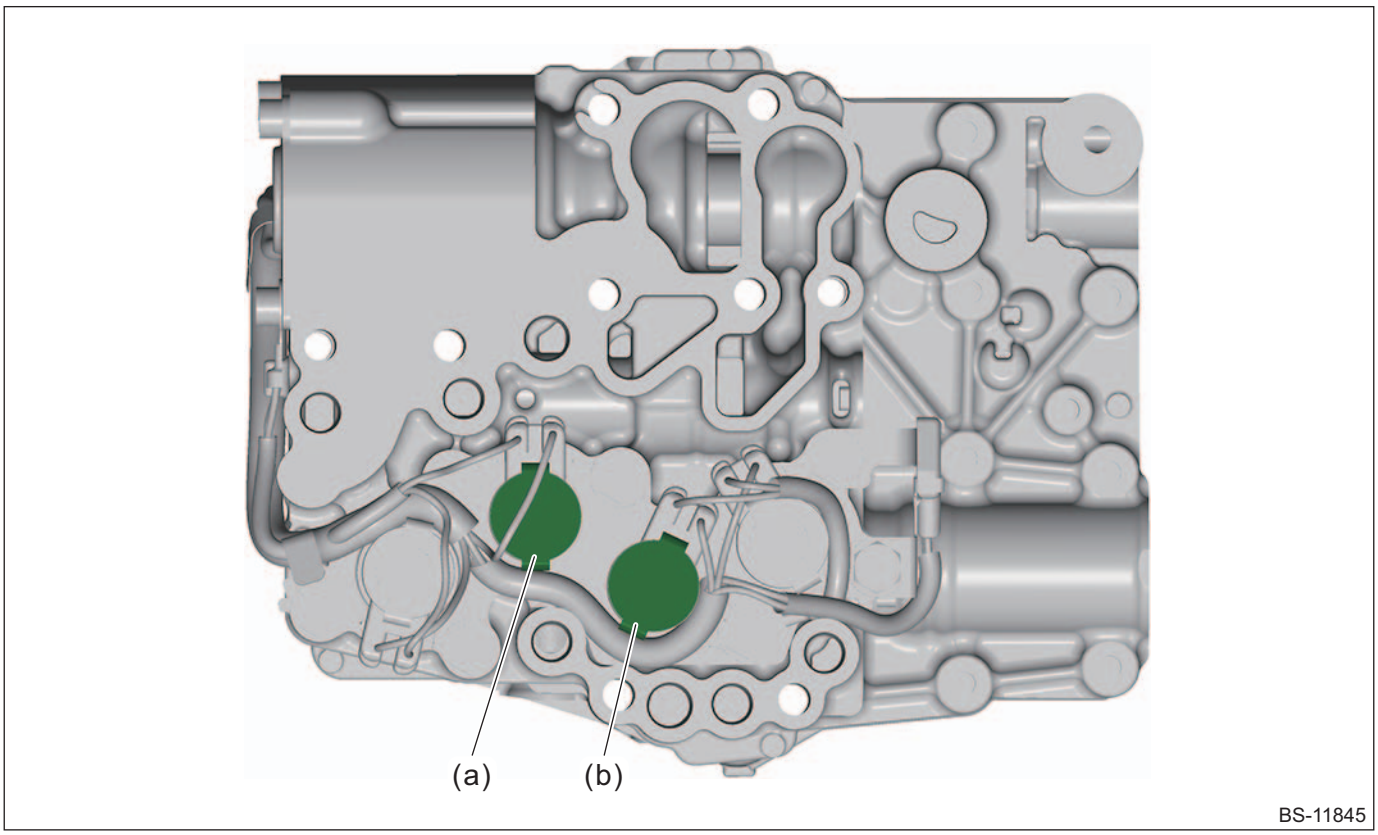
The lock-up duty solenoid is installed on the LWR side of the control valve body. The current is controlled by the signal sent from TCM. This engages and releases the lock-up clutch.



(a) Lock-up duty solenoid

■ Primary DOWN solenoid, UP solenoid

The primary DOWN solenoid and primary UP solenoid are installed on the LWR side of the control valve body. The current is controlled by the signal sent from TCM. This increases or decreases the pressure applied to the primary solenoid and adjusts the flow rate to control gear changes with the chain belt.

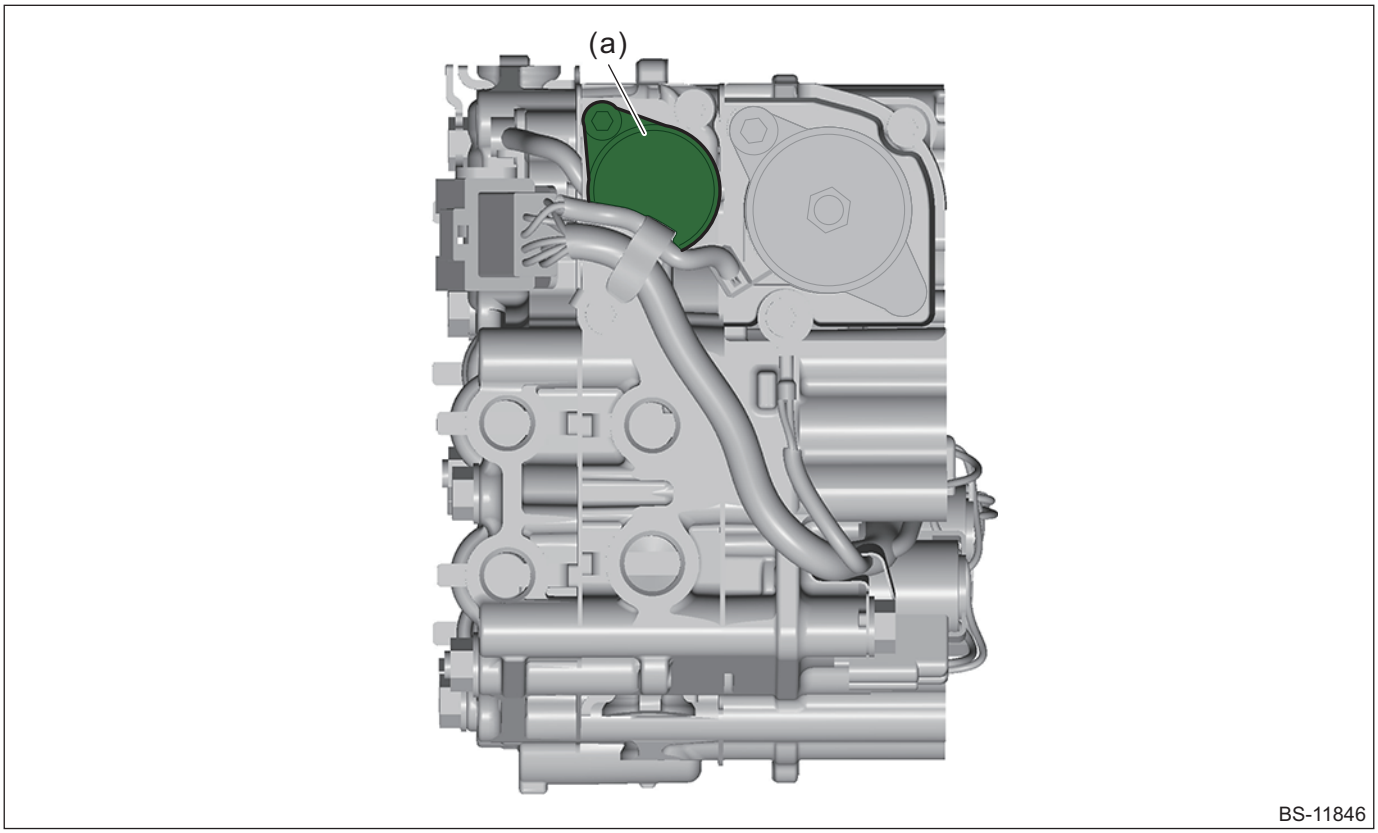


(a) Primary DOWN solenoid

(b) Primary UP solenoid

■ F&R clutch solenoid

The F&R clutch solenoid is installed on the INT side of the control valve body. The current is controlled by the signal sent from TCM. This adjusts the F&R clutch pressure and controls the F&R clutch pressure.



(a) F&R clutch solenoid

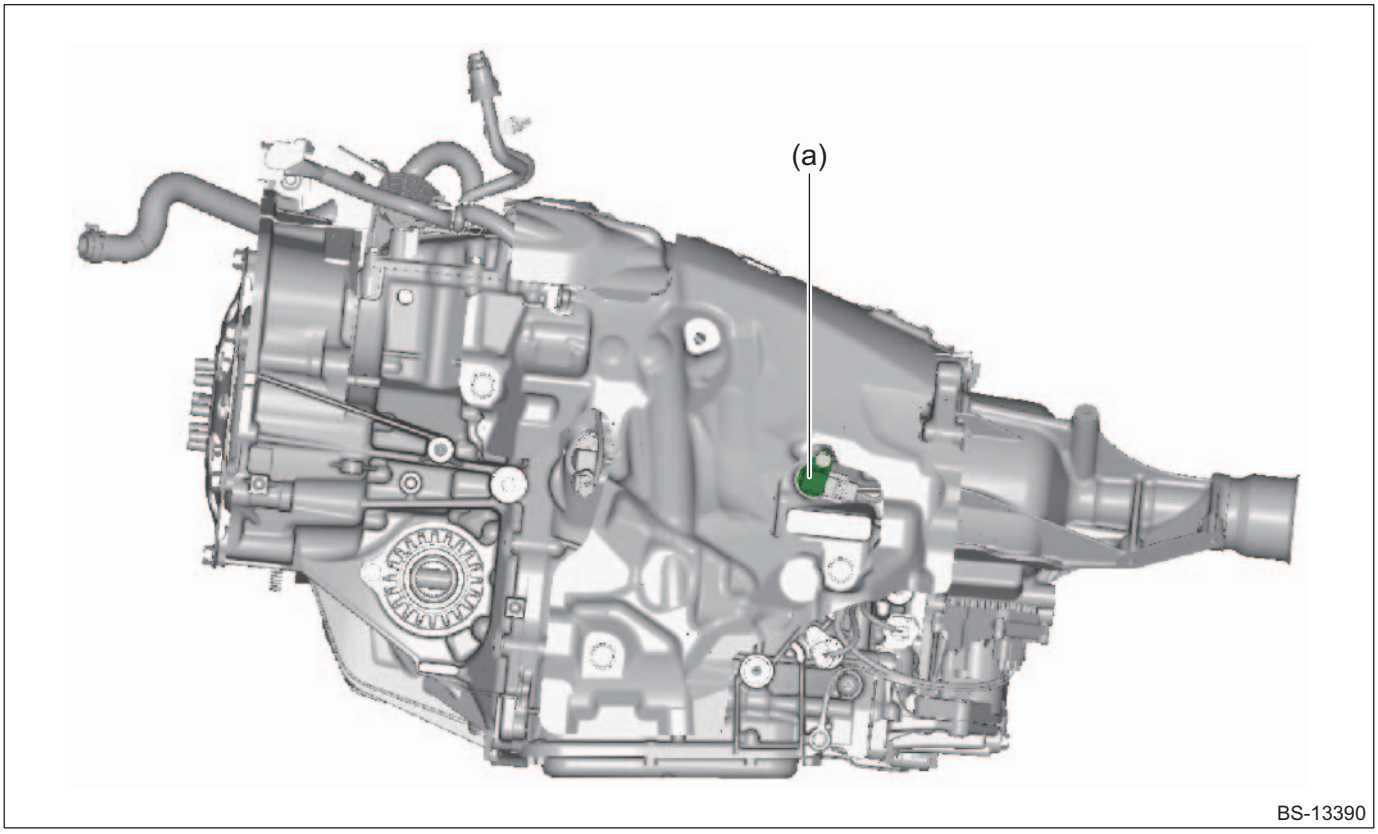
Switches, sensors

Switches and sensors are installed on the transmission body.

■ Primary speed sensor

The primary speed sensor is installed on the left side of the transmission case.

This sensor uses the hall element to detect the rotation speed of the primary pulley assembly, and sends the rectangle waveform signal to the TCM. This controls gear changes.

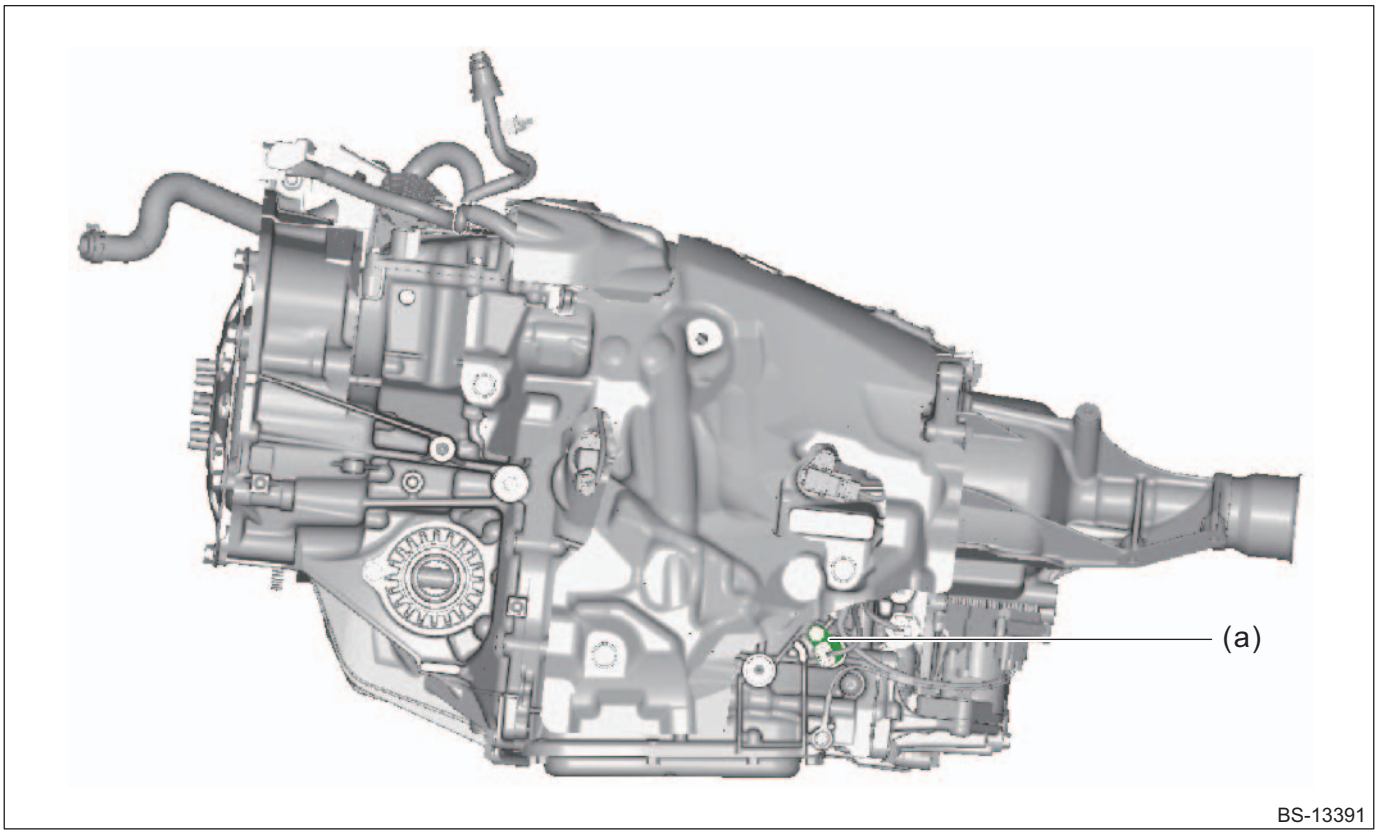


(a) Primary speed sensor

■ Secondary speed sensor

The secondary speed sensor is installed on the left side of the transmission case.

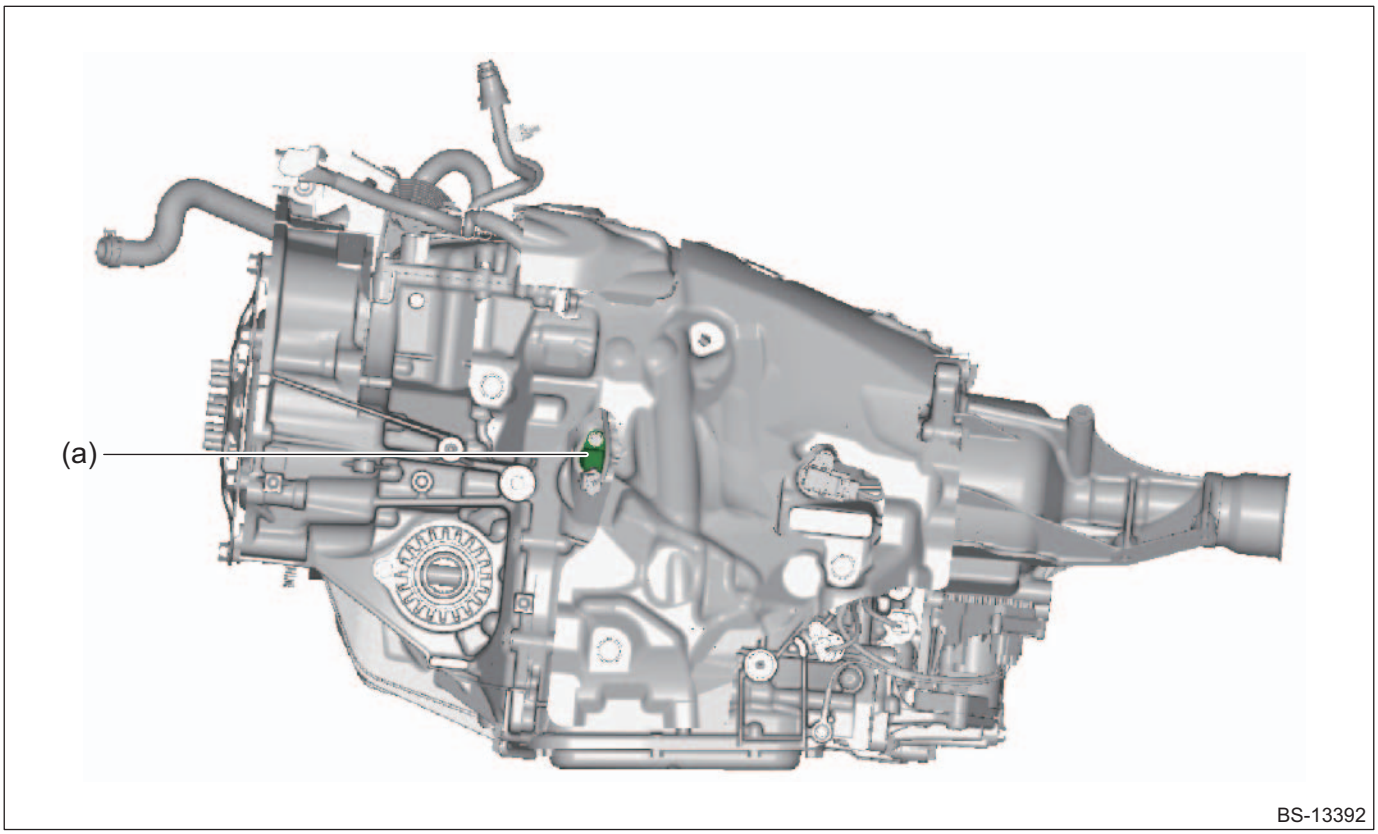
This sensor uses the hall element to detect the rotation speed of the reduction drive gear, and sends the rectangle waveform signal to the TCM. This controls gear changes.



(a) Secondary speed sensor

■ Turbine speed sensor

- The turbine speed sensor is installed on the left side of the transmission case.
- This sensor uses the hall element to detect the rotation speed of the forward clutch drum, and sends the rectangle waveform signal to the transmission control module (TCM). This controls gear changes.

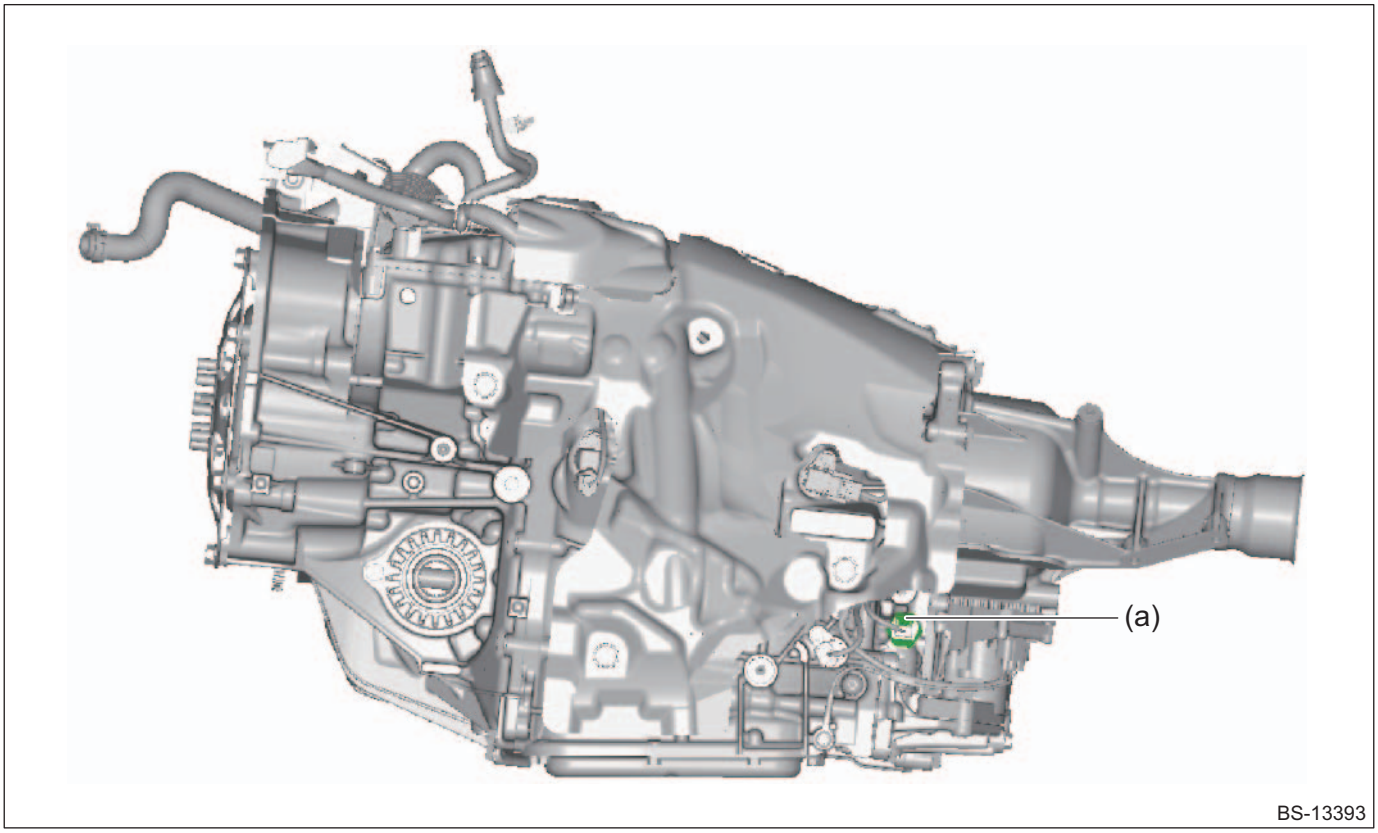


(a) Turbine speed sensor

■ Secondary pressure sensor

The secondary pressure sensor is installed on the left side of the transmission case.

This detects the oil pressure in the secondary pulley to control the oil pressure applied to the secondary piston.



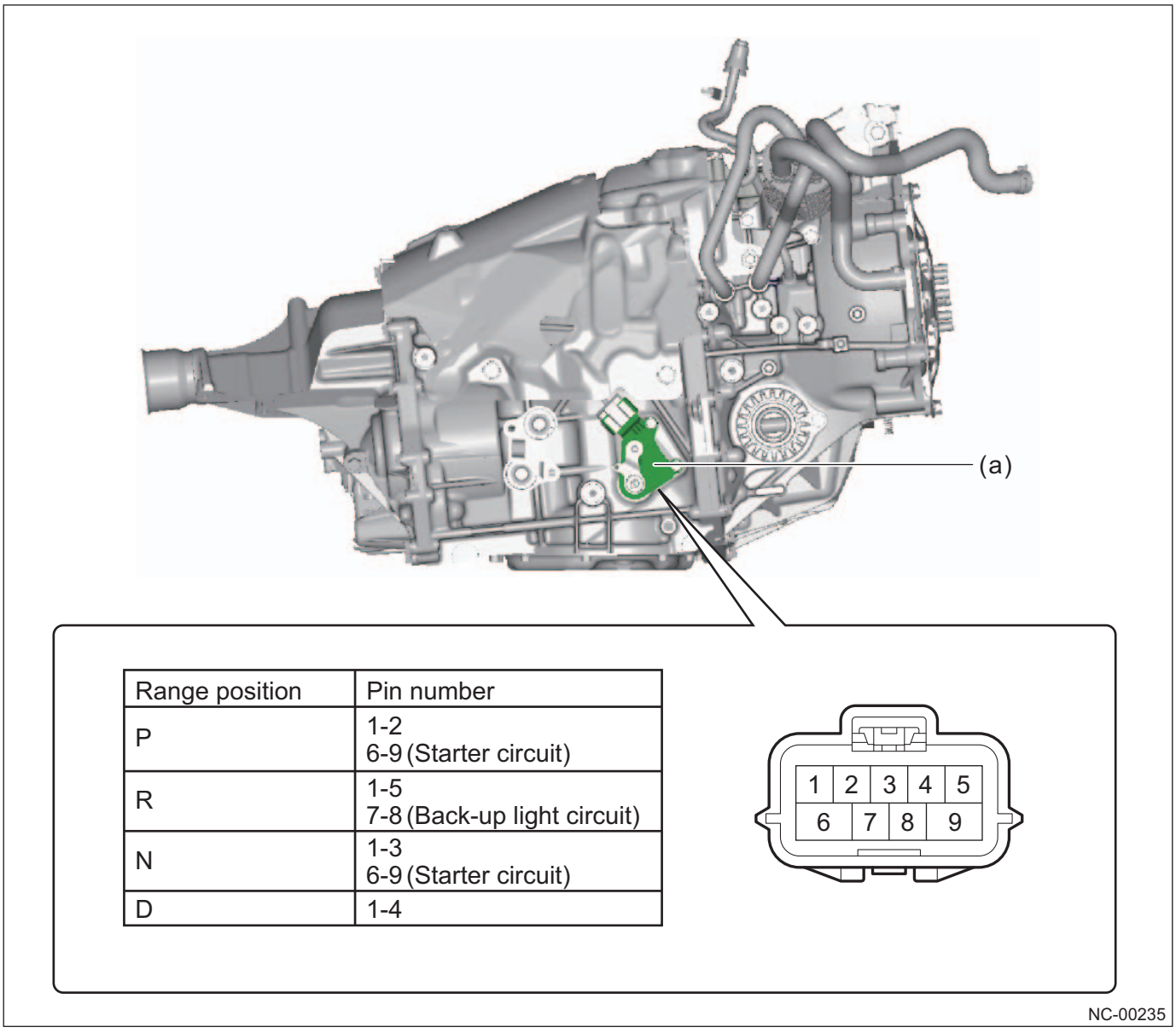
(a) Secondary pressure sensor

■ Inhibitor switch

The inhibitor switch ensures the safety when engine starts. The switch is installed on the right side of the transmission case and operates by the select lever. When the select lever is in P or N position, the electric circuit in the inhibitor switch is energized to activate the starter circuit and then the engine can start.

When the select lever is in R and D range, the P and N starter circuit in the inhibitor switch is cut off. This keeps the engine from cranking.

The switch connects to the backup light circuit to turn on the backup lights in the R-range. In addition to the above functions, the inhibitor switch also detects the selected range position and sends a range signal to the TCM.



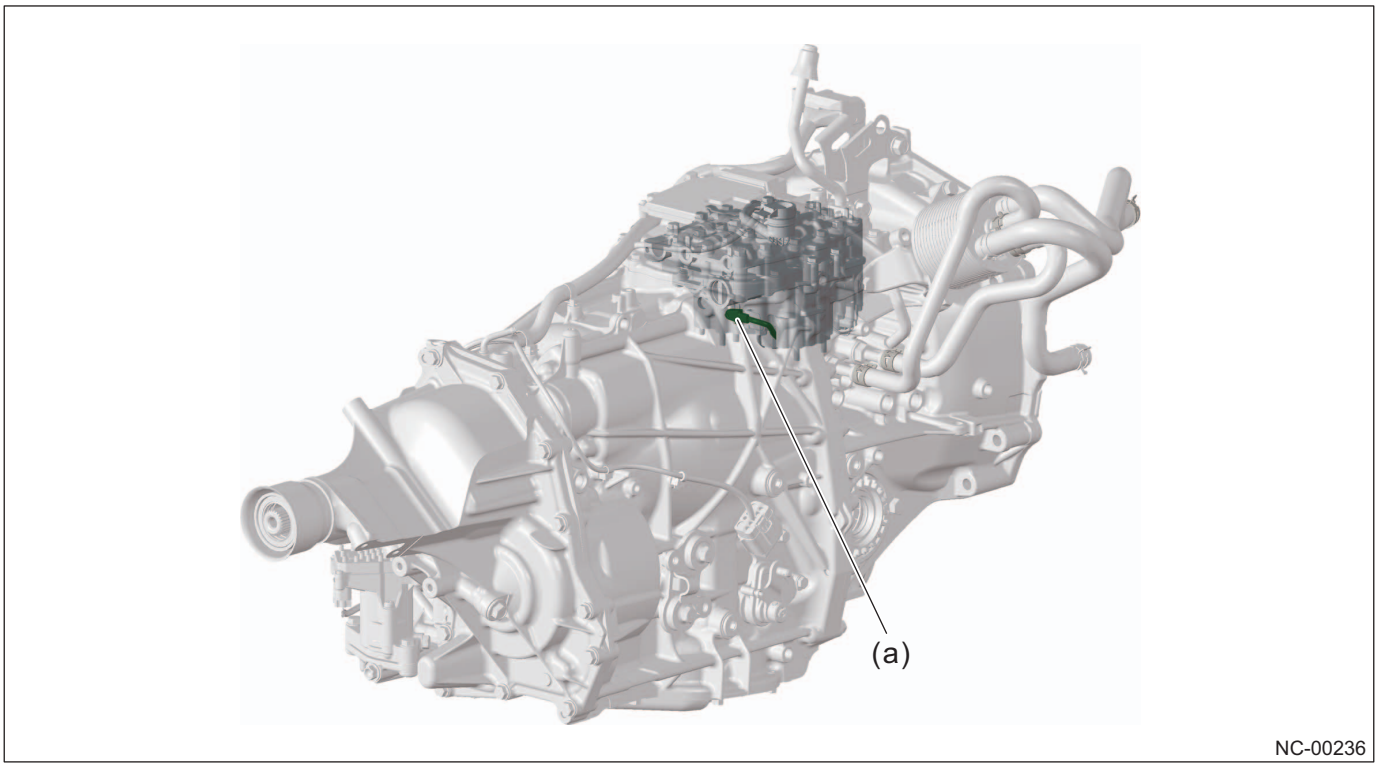
Range position	Pin number
P	1-2 6-9 (Starter circuit)
R	1-5 7-8 (Back-up light circuit)
N	1-3 6-9 (Starter circuit)
D	1-4

(a) Inhibitor switch

■ CVTF temperature sensor

CVTF temperature sensor is controlled in the thermistor type sensor and is installed in the shield of the transmission harness.

This detects the CVTF temperature in the oil pan and outputs the temperature as an electrical resistance signal.

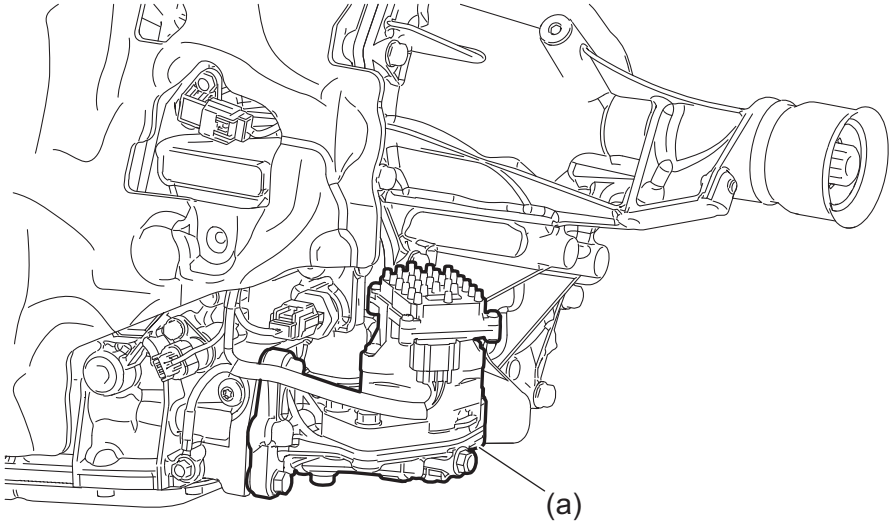


(a) CVTF temperature sensor

■ Electric oil pump

The electric oil pump adapter and electric oil pump are mounted at the back of to the transmission.

This feeds oil to the forward clutch oil pressure circuit while the engine is stopped with the Auto Start-Stop activated.



(a) Electric oil pump

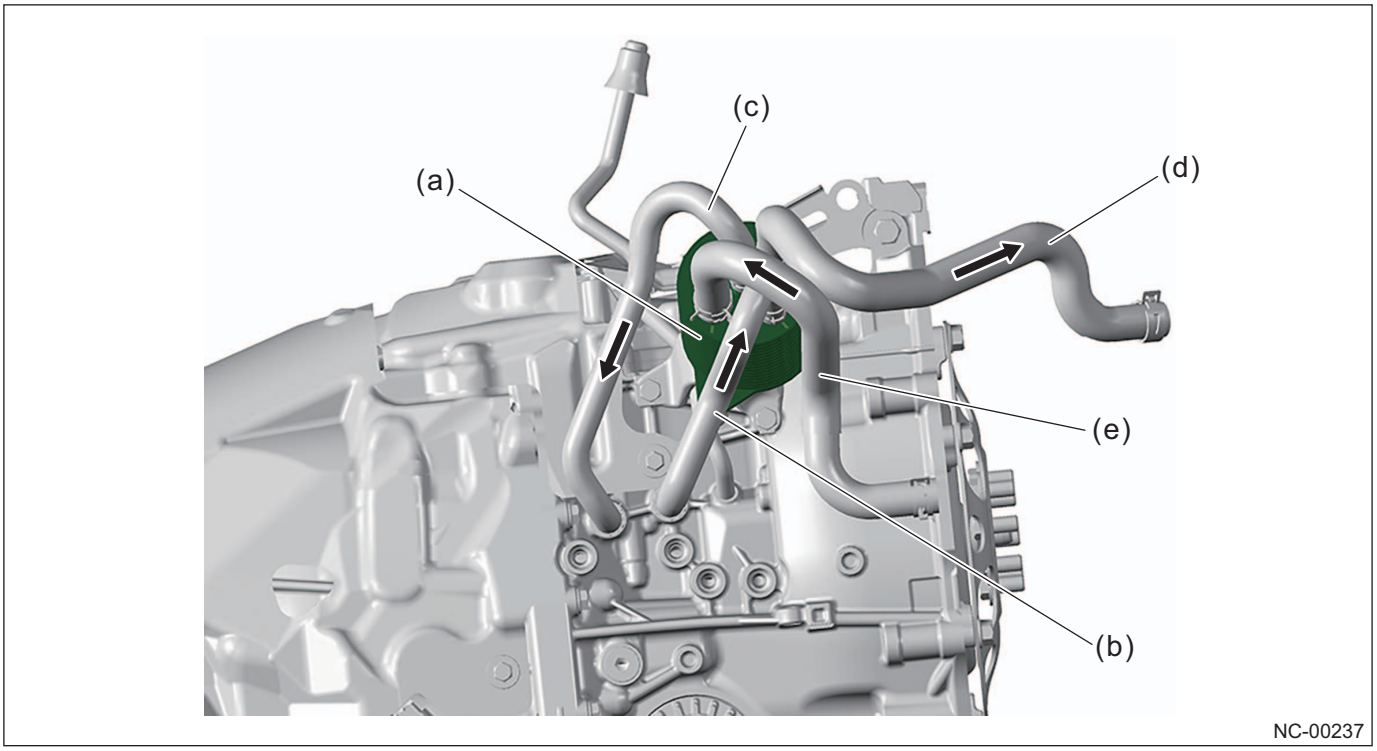
Cooling system

CVTF cooler (with warmer function)

CVTF cooler (with warmer function) is set. The system is controlled in heating and cooling methods and is composed of the CVTF cooler (with warmer function) and hoses, etc.

When the CVT fluid temperature is low, the system functions as the oil warmer for increasing rapidly the CVT fluid temperature to increase rapidly the CVT fluid temperature when the CVT unit cools.

When the CVT fluid temperature is high, the system functions as the oil cooler for decreasing the CVT fluid temperature and the CVT fluid is cooled to maintain the proper temperature.

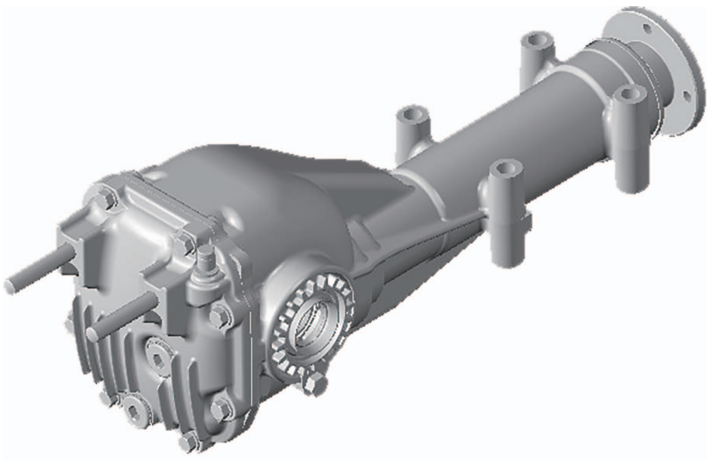


(a) CVTF cooler (with warmer function)
(b) CVTF cooler hose inlet
(c) CVTF cooler hose outlet
(d) Engine coolant hose outlet
(e) Engine coolant hose inlet

3.4 Rear Differential

3.4.1 Overview

The low-friction bearing is adopted to reduce driving resistance and improve fuel efficiency.



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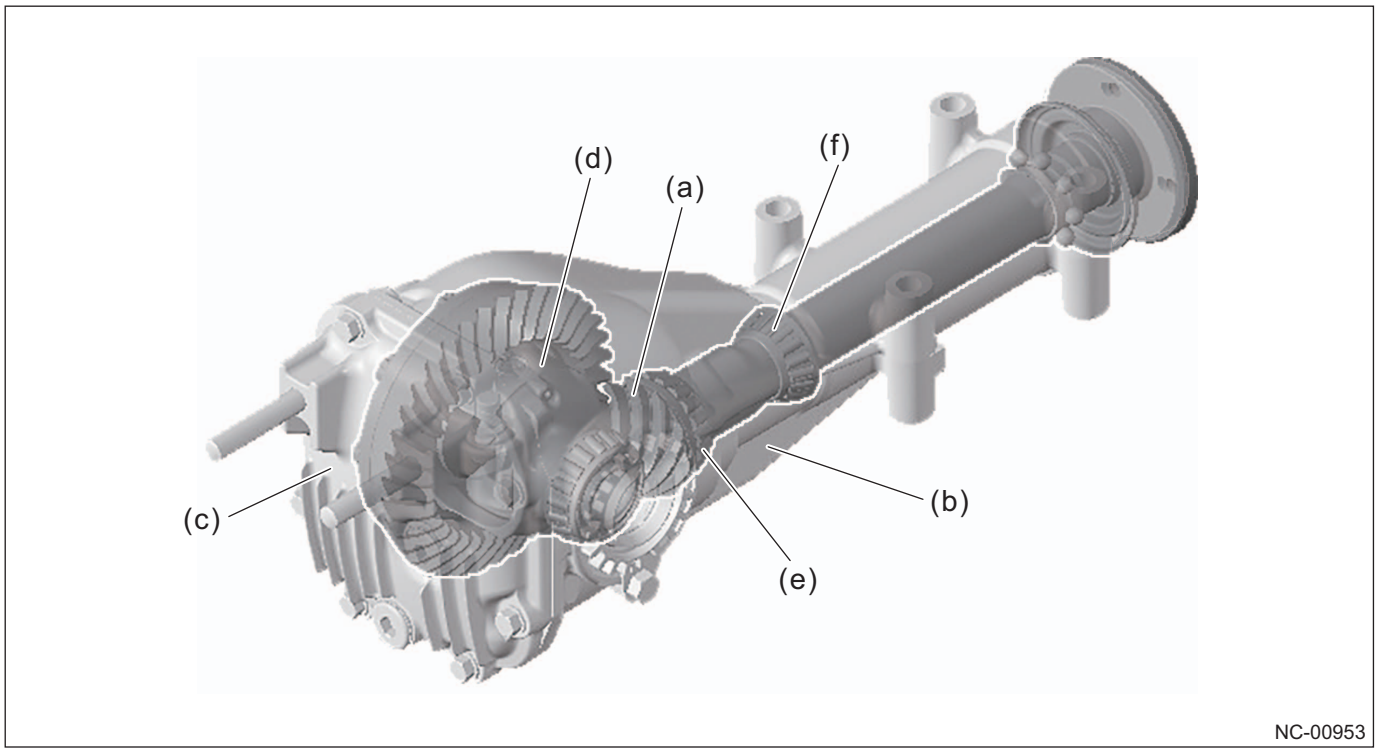
3.4.2 Component

Component layout drawing

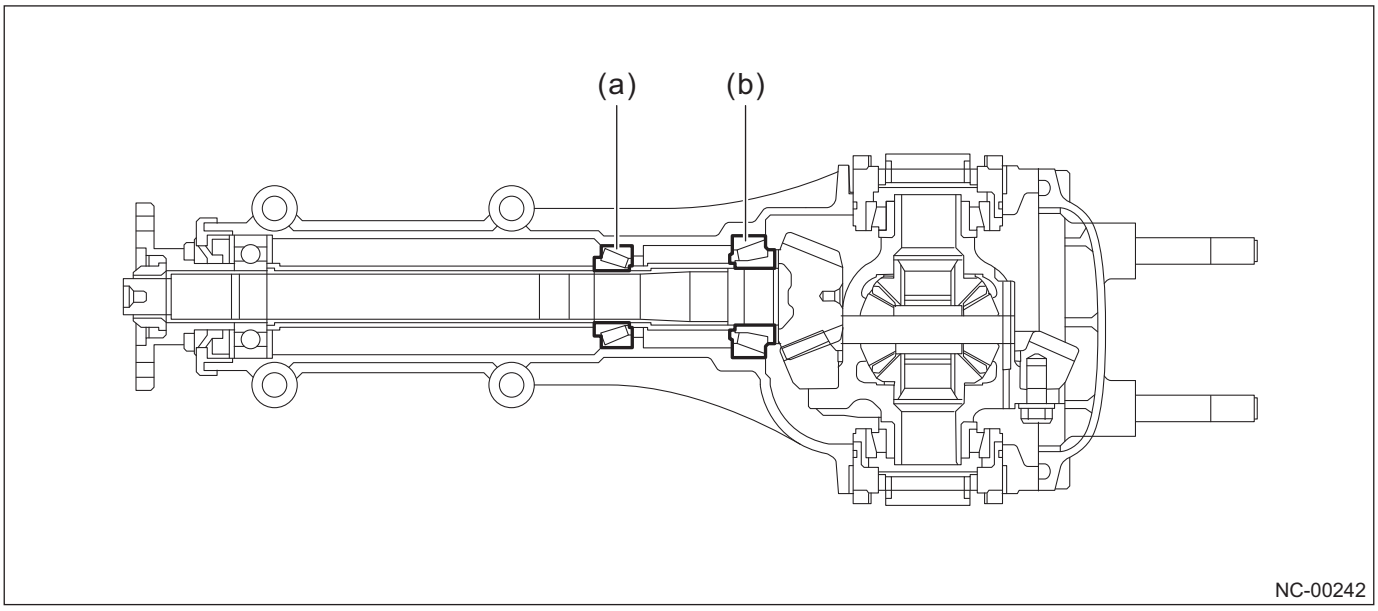


(a) Drive pinion
(b) Differential carrier
(c) Rear cover
(d) Differential case
(e) Front bearing
(f) Rear bearing

Component details

Low-friction bearing

Low-friction bearings are adopted for the front bearing and rear bearing of the drive pinion.



(a) Front bearing

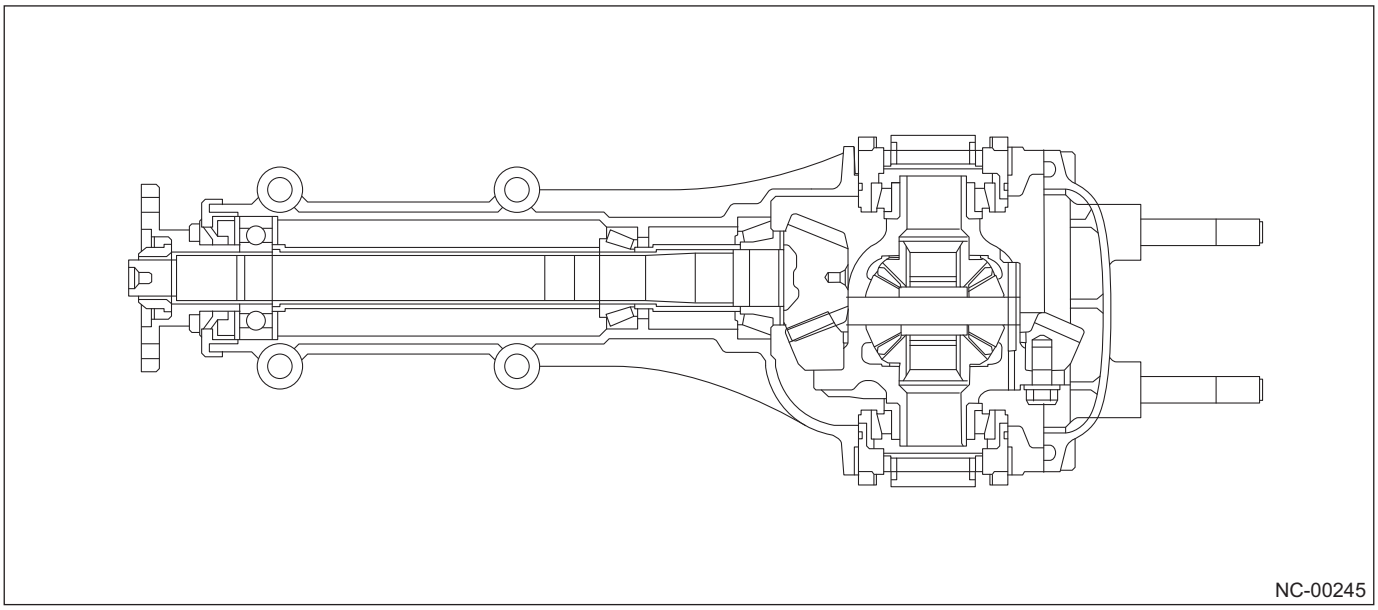
(b) Rear bearing

3.4.3 Construction and Operation

The drive gear is a nominal diameter 152 mm (5.98 in) hypoid gear.

The drive pinion shaft is supported by three bearings. The preload of each bearing is adjusted by selecting a combination of spacers and washers with the proper thickness. Drive pinion height is adjusted by appropriately selecting the thickness of the washers on the drive pinion neck using a dummy shaft and gauge.

The rear differential inspection mode is required to be performed when the transmission assembly, rear differential, front differential hypoid gear set, rear differential hypoid gear set, or the transfer gear in the transmission is replaced. In order to prevent the wrong combination of front and rear gear ratio, the rear differential inspection mode is used to determine whether the combined gear is proper or improper. In the determination, wheel rotation speed is used.



The operating principle of the rear differential is same as that of the front differential.

3.5 Drive Shaft/Propeller Shaft/Axle

3.5.1 Overview

On the front drive shaft, the ball fixed type constant velocity joint is adopted on the wheel side and the tripod type constant velocity joint is adopted on the transmission side.

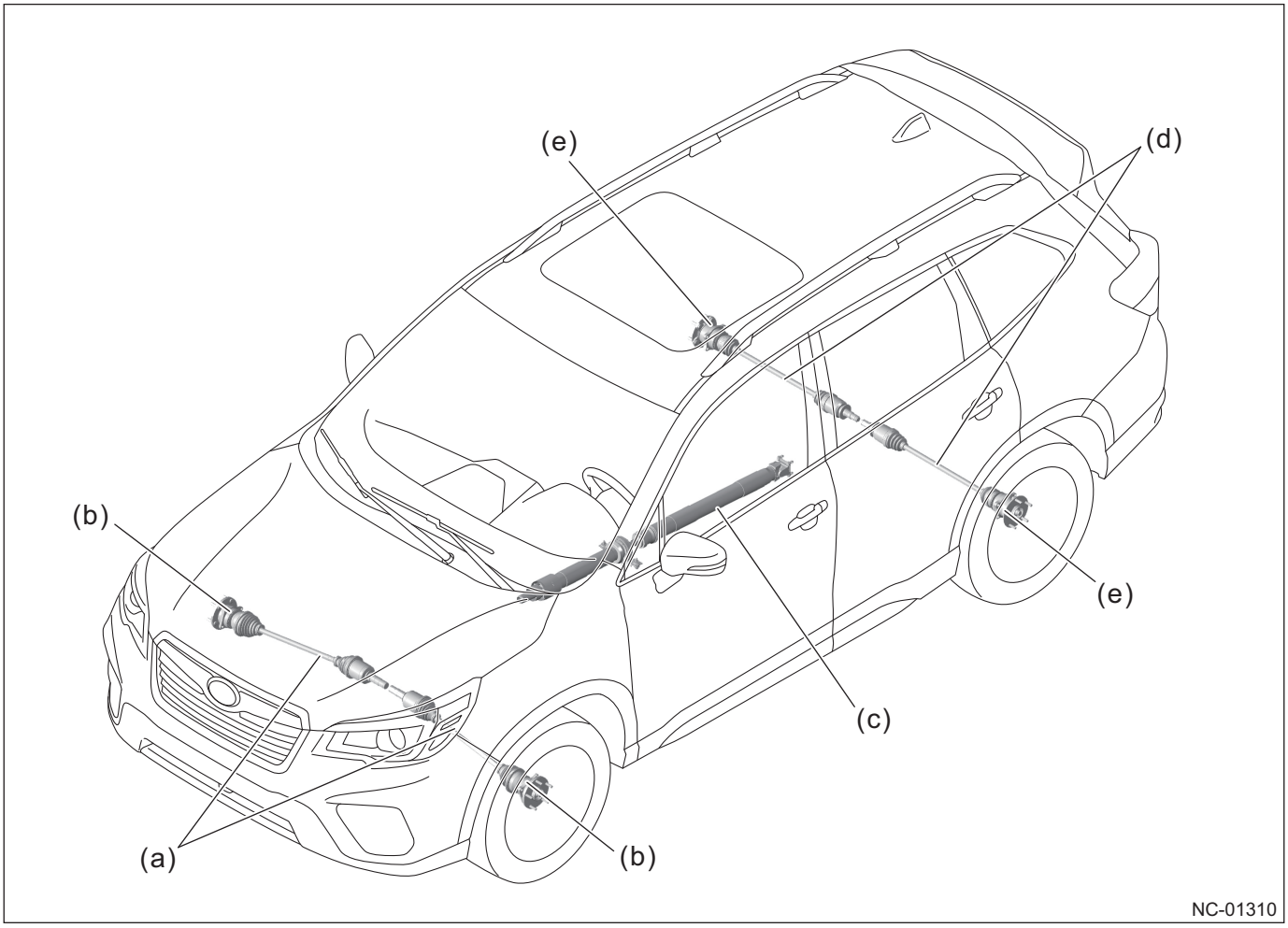
On the rear drive shaft, the ball fixed type constant velocity joint is adopted on the wheel side and the double offset type constant velocity joint is adopted on the rear differential side.

A propeller shaft with collapse mechanism is adopted for the propeller shaft.

An angular ball bearing is adopted for the hub unit bearing.

3.5.2 Component

Component layout drawing



(a) Front drive shaft
(b) Front axle
(c) Propeller shaft
(d) Rear drive shaft
(e) Rear axle

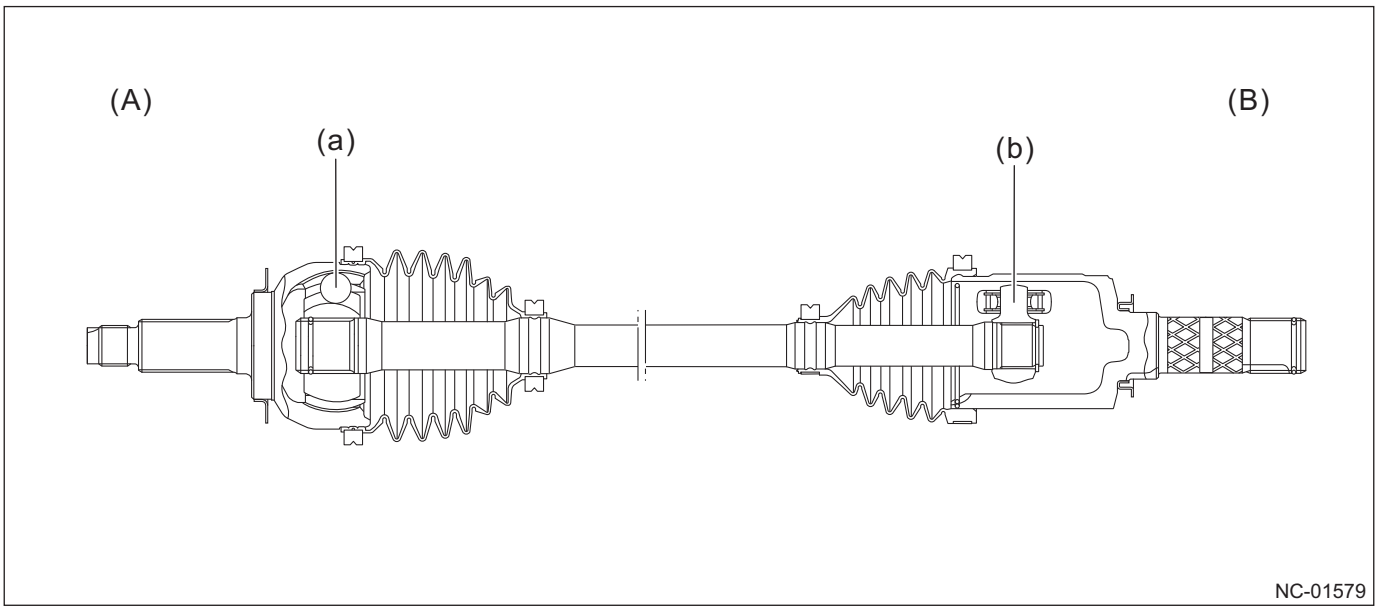
Component details

Drive shaft

■ Front drive shaft

PTJ (Pillow Tripod Joint) that corresponds to the change in the axle length when the suspension moves is adopted for the joint on the transmission side.

EBJ (High Efficiency Compact Ball Fixed Joint) that corresponds to the angle change in the steering wheel is adopted for the joint on the wheel side.



(A) Wheel side

(B) Transmission side

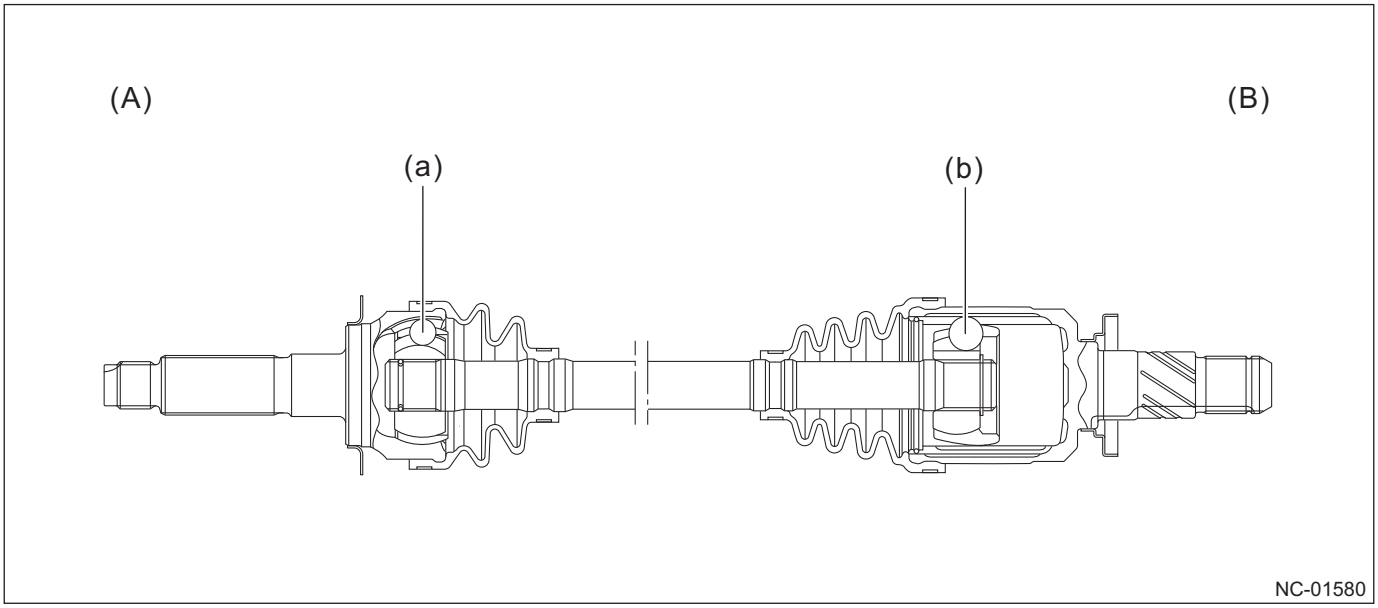
(a) EBJ

(b) PTJ

■ Rear drive shaft

DOJ (Double Offset Joint) that corresponds to the change in the axle length when the suspension moves is adopted for the joint on the rear differential side.

BJ (Ball Fixed Joint) that corresponds to the angle change in the rear wheels is adopted for the joint on the wheel side.



(A) Wheel side

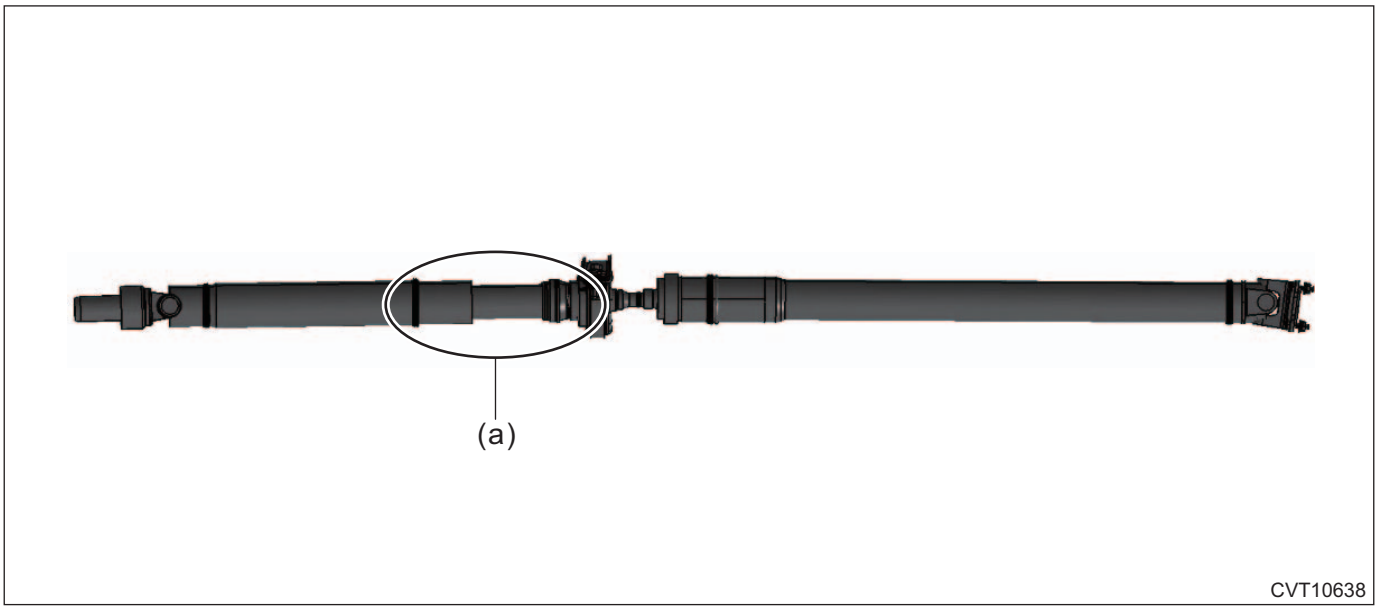
(B) Rear differential side

(a) BJ

(b) DOJ

Propeller shaft

A mechanism for reducing vehicular collision g-forces on collision is made by providing a collision stroke mechanism (spline collapse mechanism).



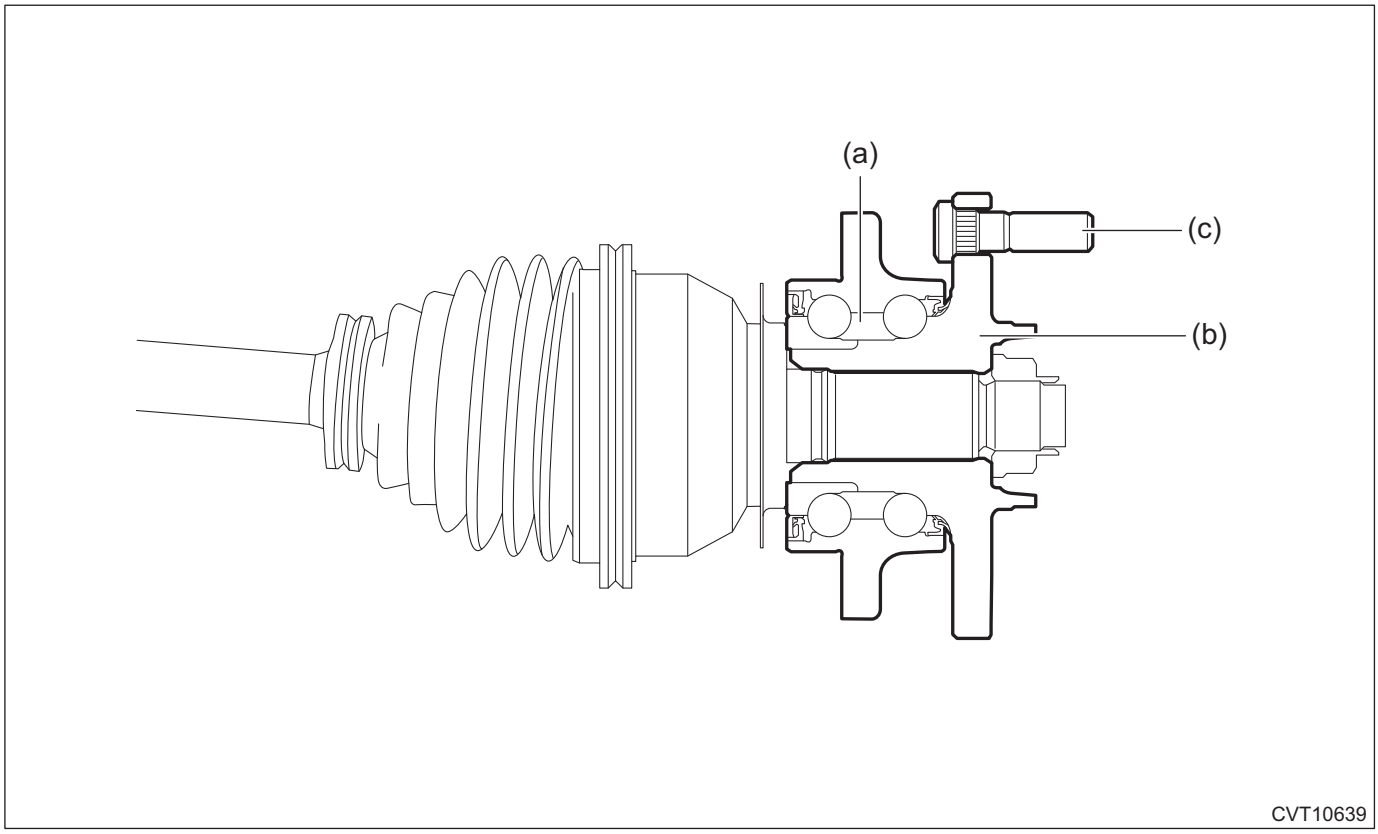
(a) Spline collapse mechanism

Axle

■ Front axle

A double-row angular ball bearing with low rolling resistance is adopted for the front axle hub unit bearing.

On the unit type front axle hub unit bearing, one side of the bearing inner race is integrated with the axle hub. This is integrated with the oil seal to reduce the weight, improve durability, and consider serviceability.

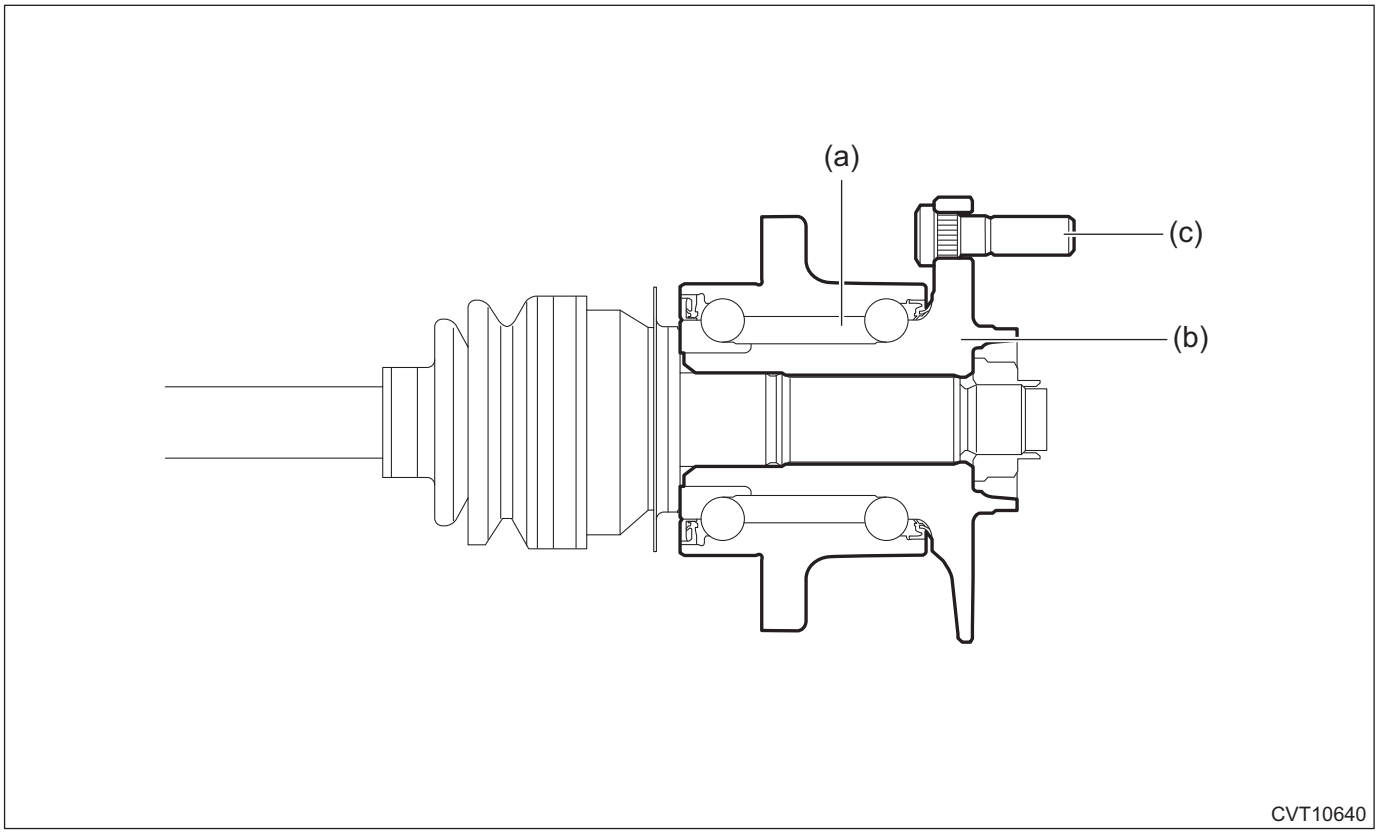


(a) Hub unit bearing
(b) Axle hub
(c) Hub bolt

■ Rear axle

A double-row angular ball bearing with low rolling resistance is adopted for the rear axle hub unit bearing.

On the unit type rear axle hub unit bearing, one side of the bearing inner race is integrated with the axle hub. This is integrated with the oil seal to reduce the weight, improve durability, and consider serviceability.



(a) Hub unit bearing
(b) Axle hub
(c) Hub bolt

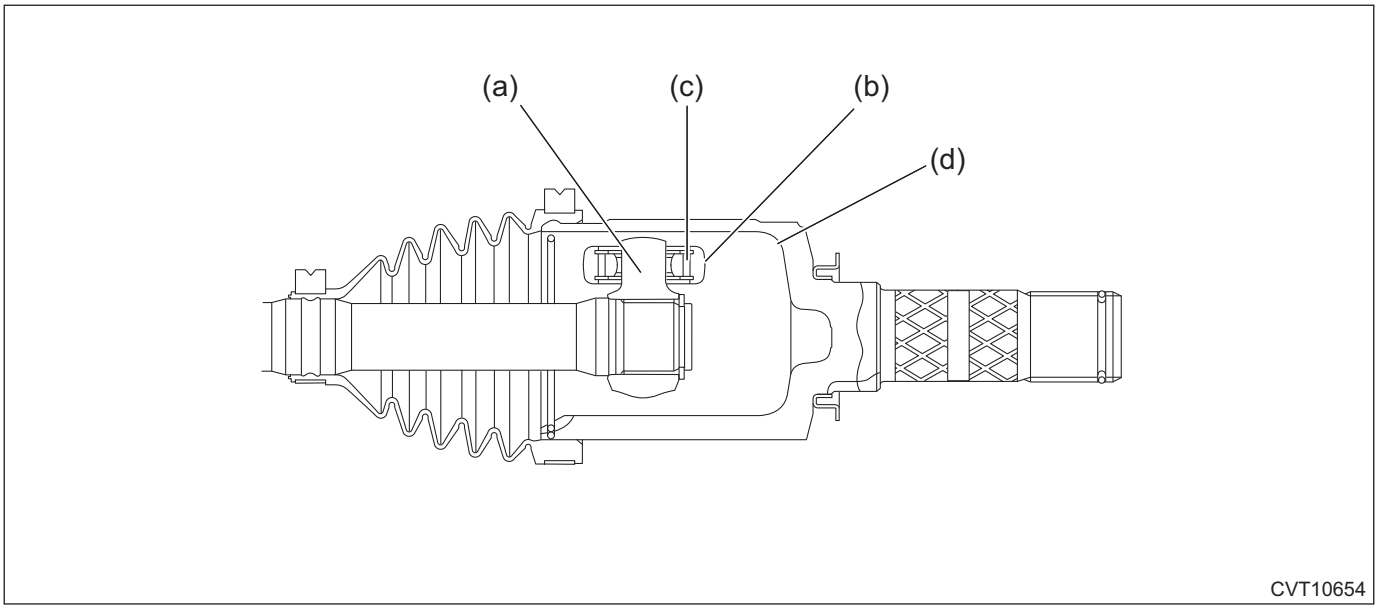
3.5.3 Construction and Operation

Drive shaft

Tripod type constant velocity joint (PTJ)

Three rollers are installed in the PTJ tripod through the needle bearing. Since the three rollers are inserted into three grooves of the outer race, they can move freely.

PTJ has the structure that slides while rolling in the axial direction, without inclination of the roller posture even when the operating angle occurs on the joint. The roller is not affected by the operating angle and moves on the inner surface smoothly in the axial direction to reduce friction.

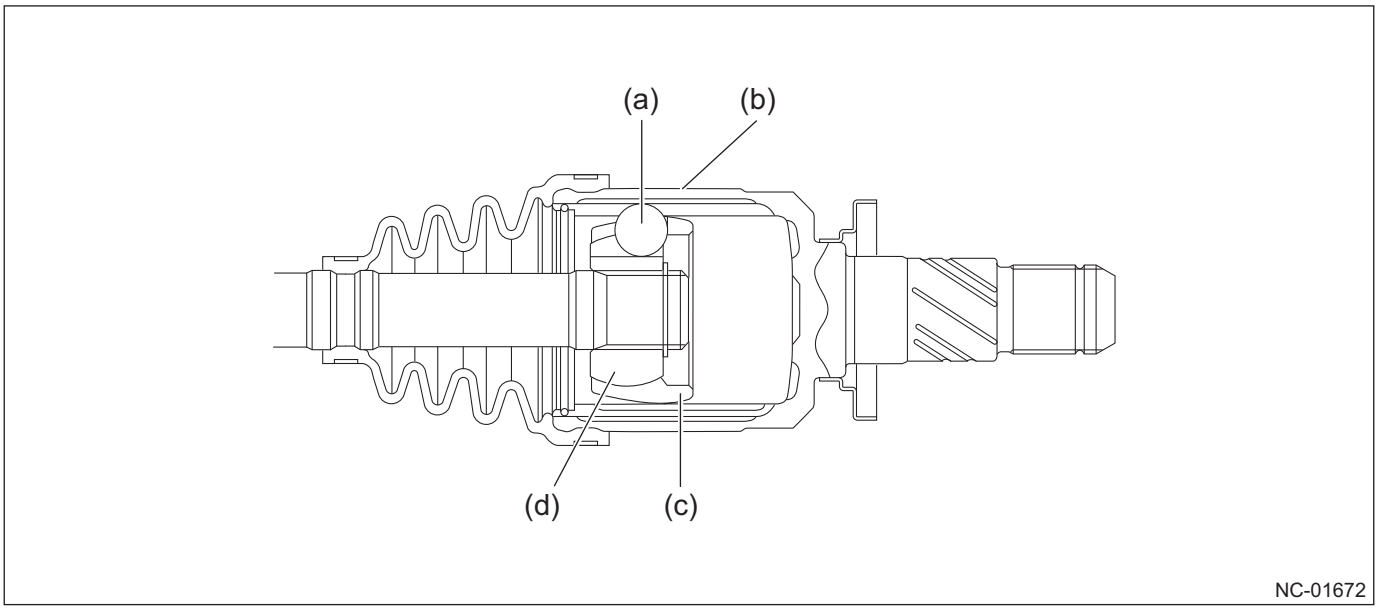


(a) Tripod
(b) Roller
(c) Needle bearing
(d) Outer race

Double offset type constant velocity joint (DOJ)

In DOJ, there are six balls in the grooves of the outer case and the inner case and the balls are held by the ball cage. Since the ball grooves of the outer case and the inner case are parallel to the axial direction, the ball can slide in the axial direction.

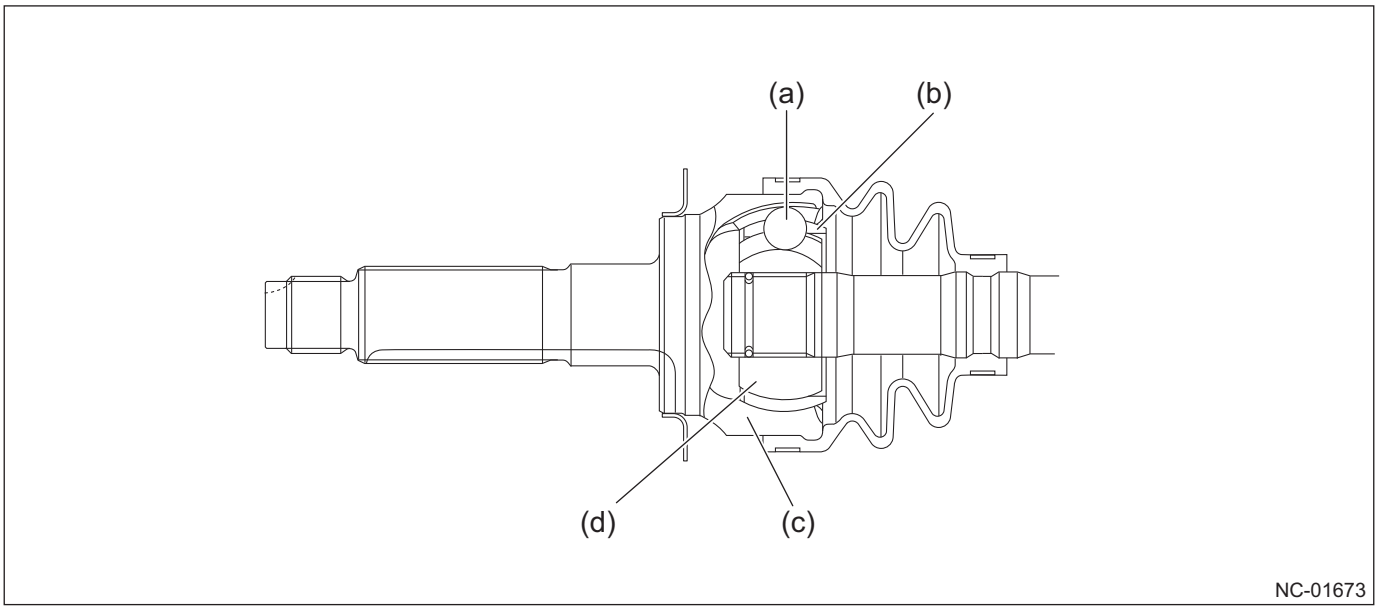
DOJ can transmit drive force while corresponding to change in the length between the wheel and the differential when the vehicle body moves up and down.



(a) Ball
(b) Outer race
(c) Ball cage
(d) Inner race

Ball fixed type constant velocity joint (BJ)

In BJ, there are six balls in the grooves of the outer race and the inner race, and the balls are held by the ball cage. Ball grooves inside the outer case and outside the inner race have spherical surface to form a large operating angle.



(a) Ball
(b) Ball cage
(c) Outer race
(d) Inner race

High-efficiency compact ball fixed joint (EBJ)

EBJ contains eight balls smaller than those in BJ to enable weight reduction and compact size.

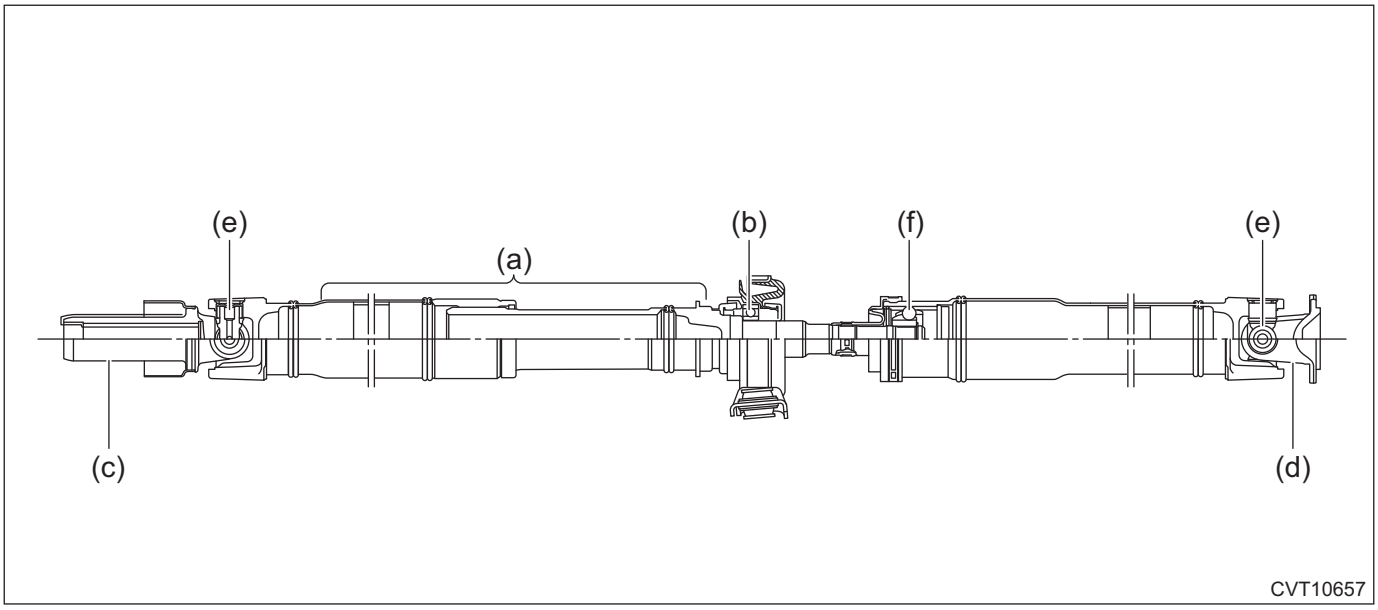
Propeller shaft

Construction

The three-joint type propeller shaft with collapse mechanism and center bearing is adopted.

The sleeve yoke on the transmission side and the yoke flange on the rear differential side are coupled with the cross joint using the needle bearing to move freely.

The spline of the sleeve yoke absorbs the length change and the center bearing prevents deflection of the shaft. Also, the constant velocity joint absorbs changes in length and angle, and reduces more rotational vibration to improve quietness.



(a) Collapse mechanism
(b) Center bearing
(c) Sleeve yoke
(d) Yoke flange
(e) Cross joint
(f) Constant velocity joint

Operation

The collapse mechanism strokes the propeller shaft on collision and reduces vehicular collision g-forces.

4 SUSPENSION SYSTEM

CONTENTS

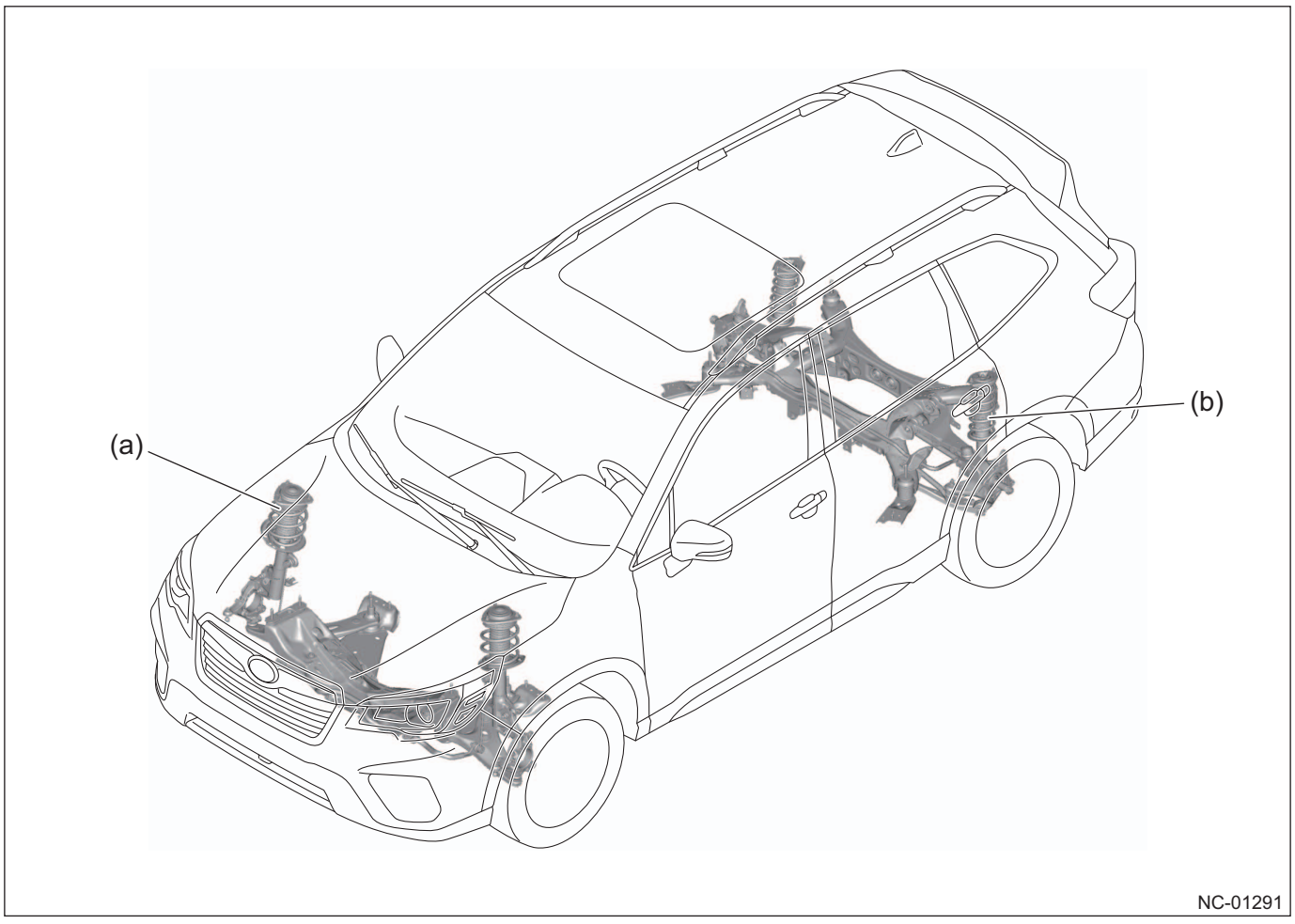
4.1 General Overview

4.1.1 Overview

The following performances are mainly improved for the suspension system.

- Rigidities of suspension mount section are improved to allow the suspension to sufficiently cushion passengers from rough road conditions for a comfortable ride.
- The rear housing material is changed to reduce the weight and improve fuel efficiency.
- The rear stabilizer is installed directly on the vehicle body to reduce the body sway by 50% from the level of existing models (company data).

4.1.2 Structure



(a) Front suspension

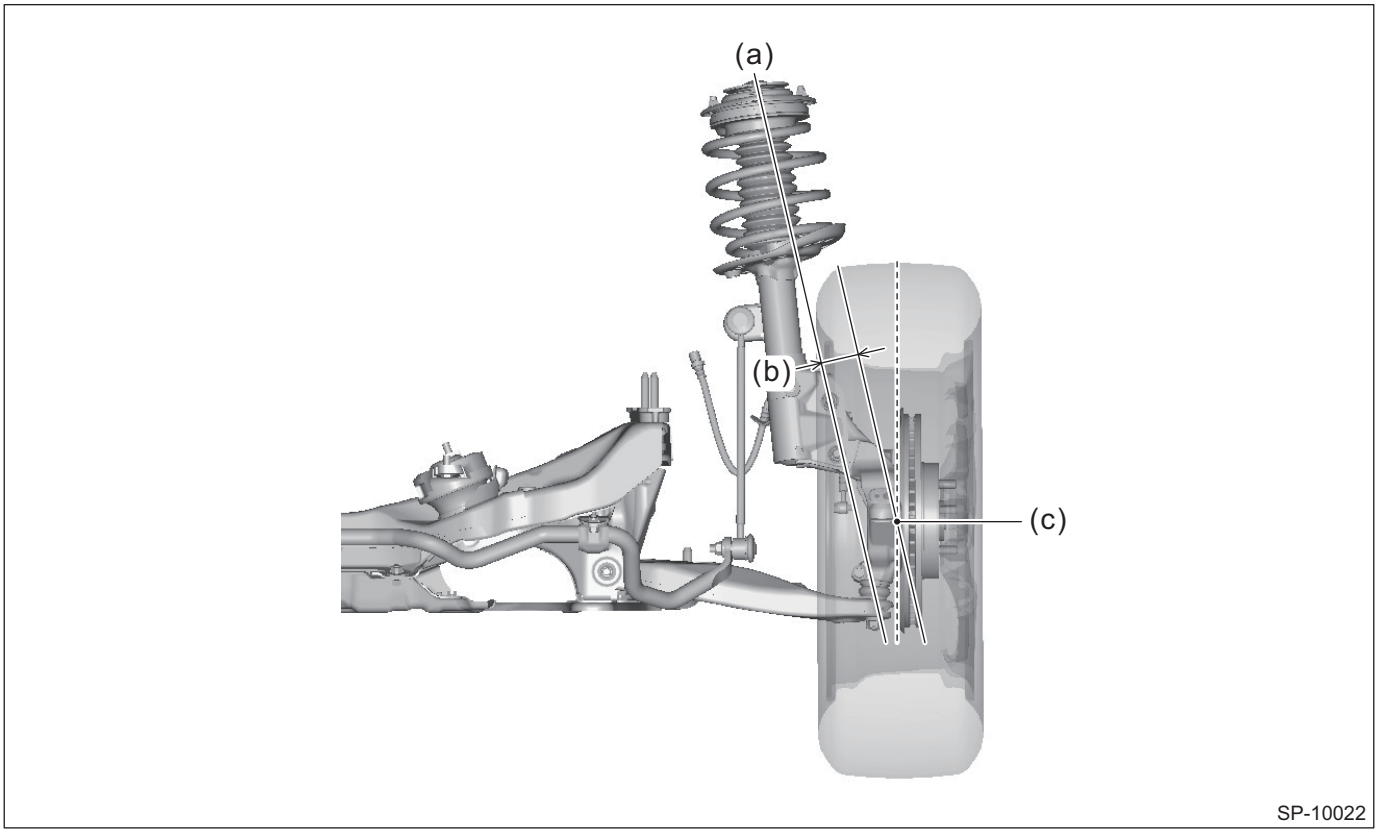
(b) Rear suspension

4.1.3 Suspension Structure

A strut type independent suspension is adopted for the front suspension and double-wishbone type independent suspension is adopted for the rear suspension.

Suppression of steering vibration

The mass offset is reduced to suppress the vibration of the steering. Since reducing the mass offset decreases the rotation moment caused by an external force, it is an effective factor to suppress the steering vibration.

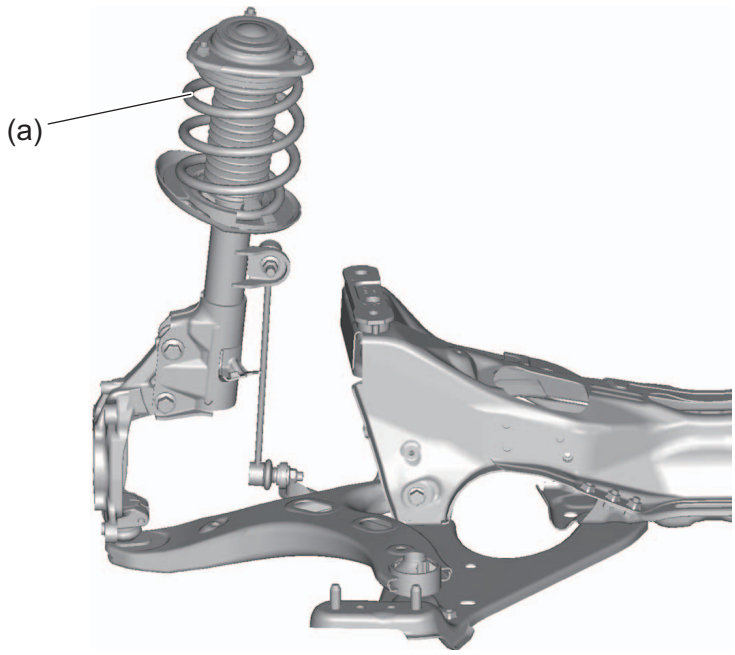


(a) Kingpin angle
(b) Mass offset
(c) Wheel center

Improvement of damper function (friction reduction and damper characteristics of front and rear)

Damper friction is reduced by ensuring smooth movement of the damper through optimizing the load axis control coil (front and rear), the mount installation angle (rear), and revising the shock absorber bush characteristics (rear).

Front



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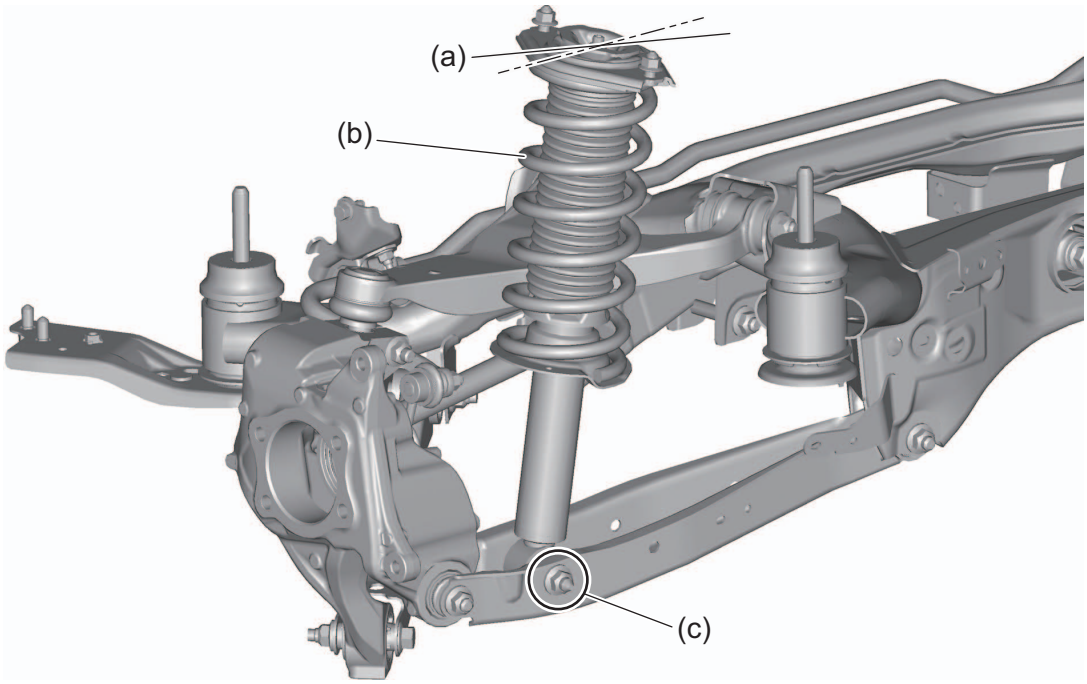
(a) Load axis control coil (control over lateral bending force)

Rear

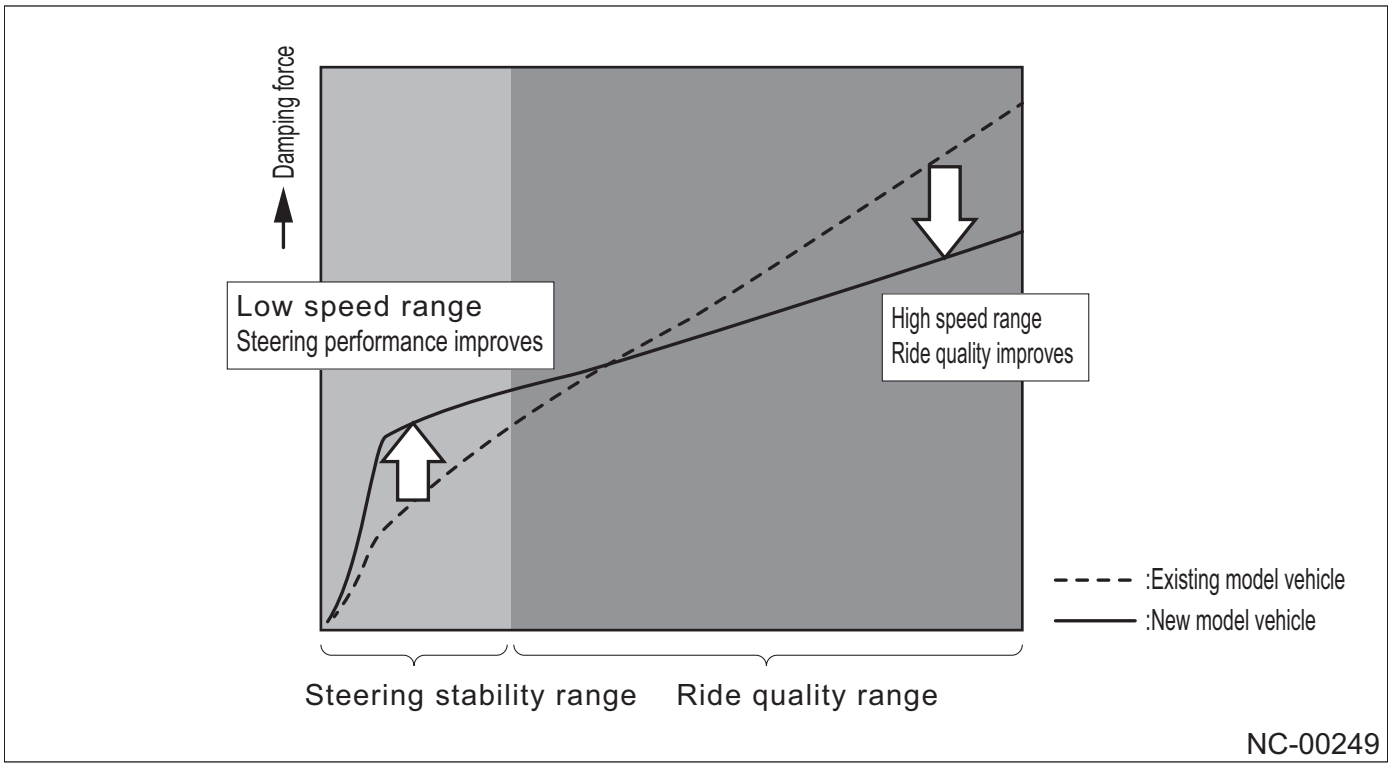


(a) Mount installation surface angle
(b) Load axis control coil (control over lateral bending force)
(c) Revising spring characteristics of the shock absorber bush

Damper characteristics

As for the damper characteristics, the rod guide bush and the hydraulic oil are changed and the damping force is optimized to reduce unpleasant vibration to realize steering stability with less stagger of the vehicle body and greater ride quality.

Damping force - Speed characteristics

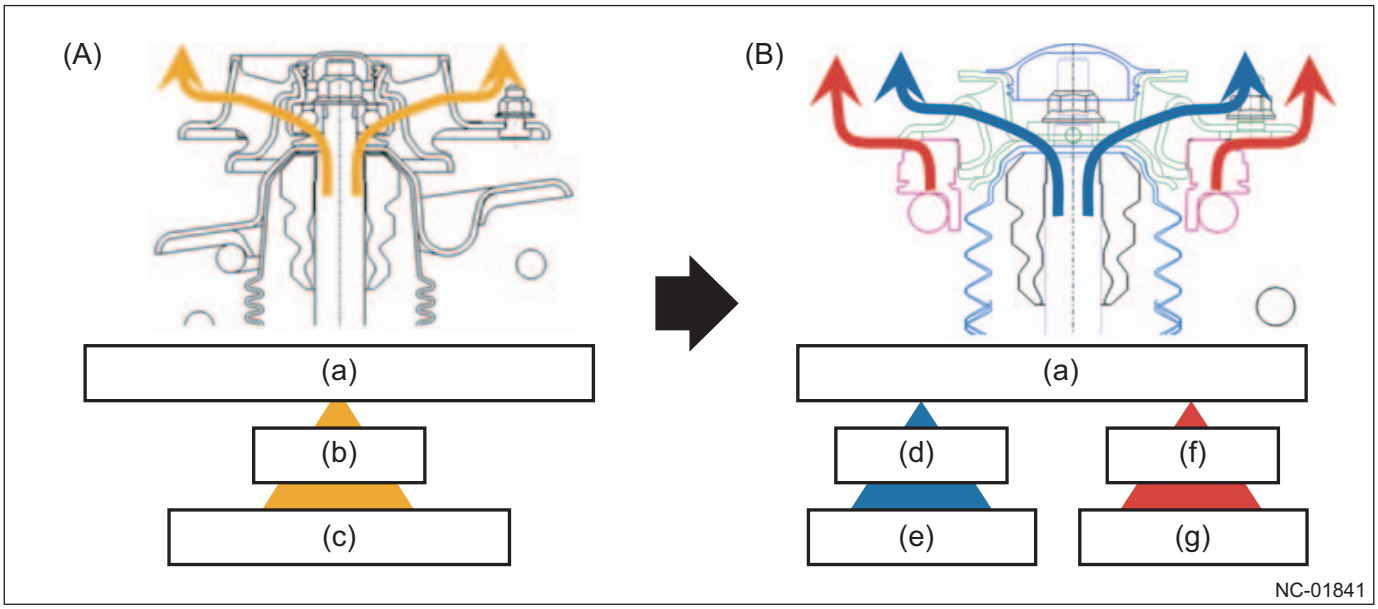


Input separating type mount

The coil input separating structure is adopted for new model vehicles to achieve both the vibration and noise restraining performance and the steering stability as below.

- The input of the coil is directly transmitted to the vehicle body without the rubber of the mount.
- The input of the helper and damper is transmitted to the vehicle body through the rubber of the mount.

Front



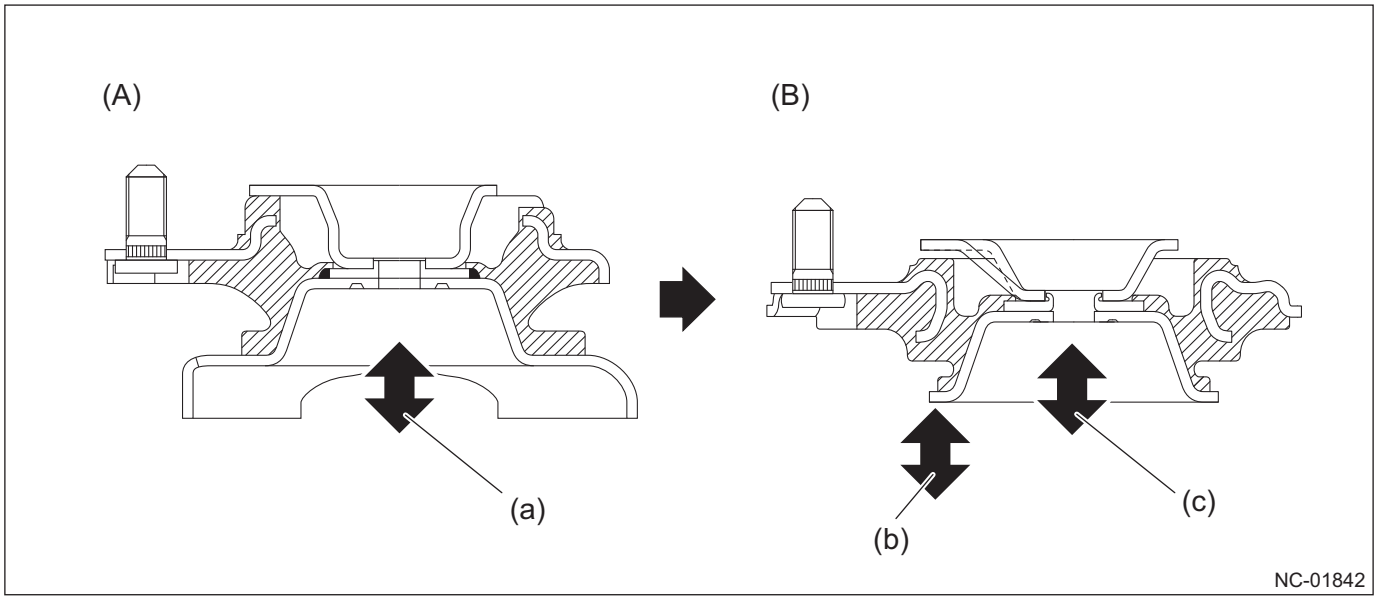
(A) Existing model vehicle

(a) Vehicle body
(b) Mount
(c) Coil + helper + damper
(d) Input separating type mount

(B) New model vehicle

(e) Helper + damper
(f) Bearing
(g) Coil

Rear



(A) Existing model vehicle

(B) New model vehicle

(a) Rod (damping force) + helper input + coil spring input
(b) Coil spring input
(c) Rod (damping force) + helper input

4.2 Front Suspension

4.2.1 Overview

The following performances of the front suspension are improved compared to existing model vehicles.

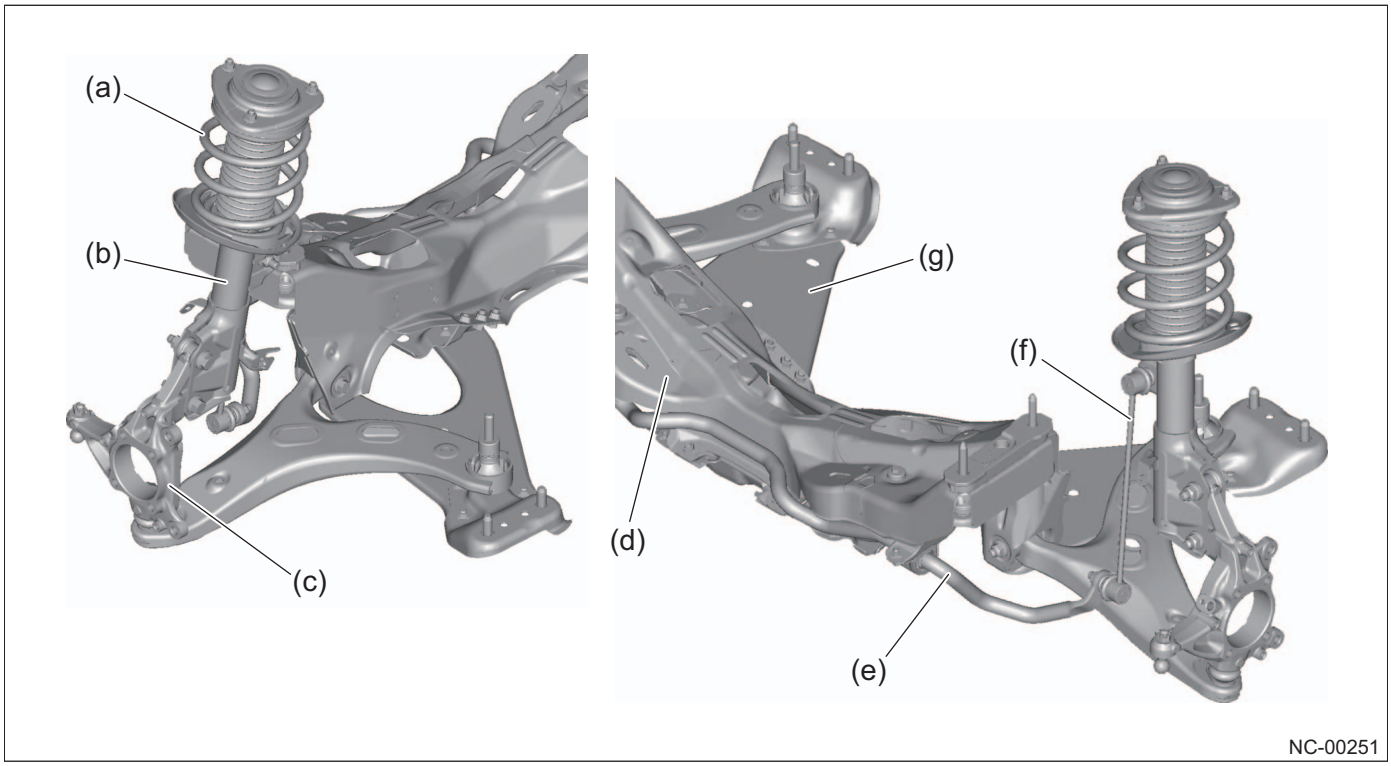
Improvement in accuracy and responsiveness during steering
The support cross member is added to improve the lateral bending rigidity.

Suppression of sense of shakiness during vehicle roll
The mounting position of the stabilizer is changed from front arm to strut to improve the efficiency of the stabilizer.

Improvement in ride quality
The structure of the suspension cross member is changed to improve the rigidities of the suspension/engine mount section.

4.2.2 Component

Component layout drawing



(a) Load axis control coil spring
(b) Front strut
(c) Front axle housing
(d) Front cross member COMPL
(e) Stabilizer
(f) Stabilizer link with strut
(g) Support cross member

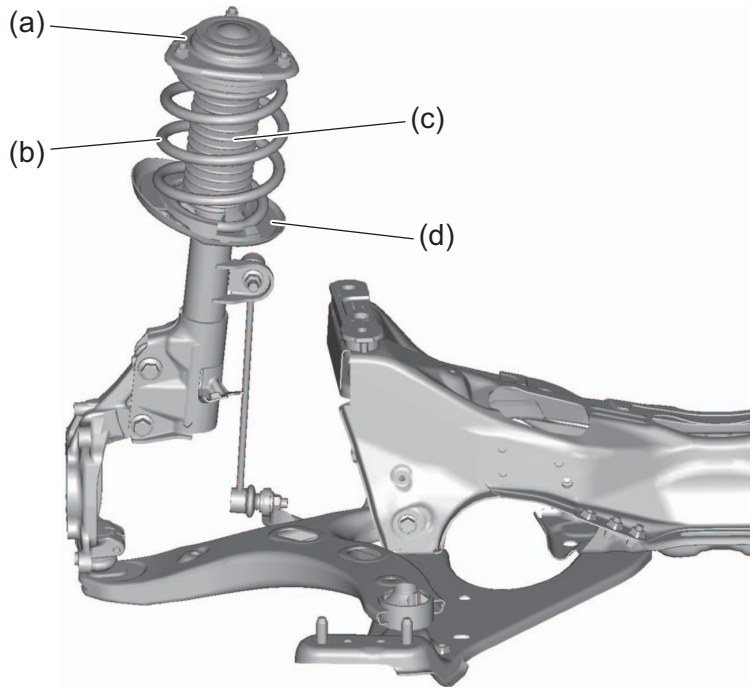
4.2.3 Construction and Operation

Front strut mount

The following performances are mainly improved for the front strut mount.

Achievement of both the vibration and noise restraining performance and the steering stability
The coil spring load input separating type is adopted for the front strut mount. This reduces unpleasant vibration and the road noise that are transmitted from the tires to the vehicle floor.

Countermeasure against dust entry
Newly designed rubber seat and dust cover that prevent dust absorption are adopted to reduce dust entering the rod slide portion of the front strut.



NC-00252

(a) Input separating type front strut mount
(b) Load axis control coil spring
(c) Dust cover
(d) Rubber seat

4.3 Rear Suspension

4.3.1 Overview

The following performances are mainly improved for the rear suspension.

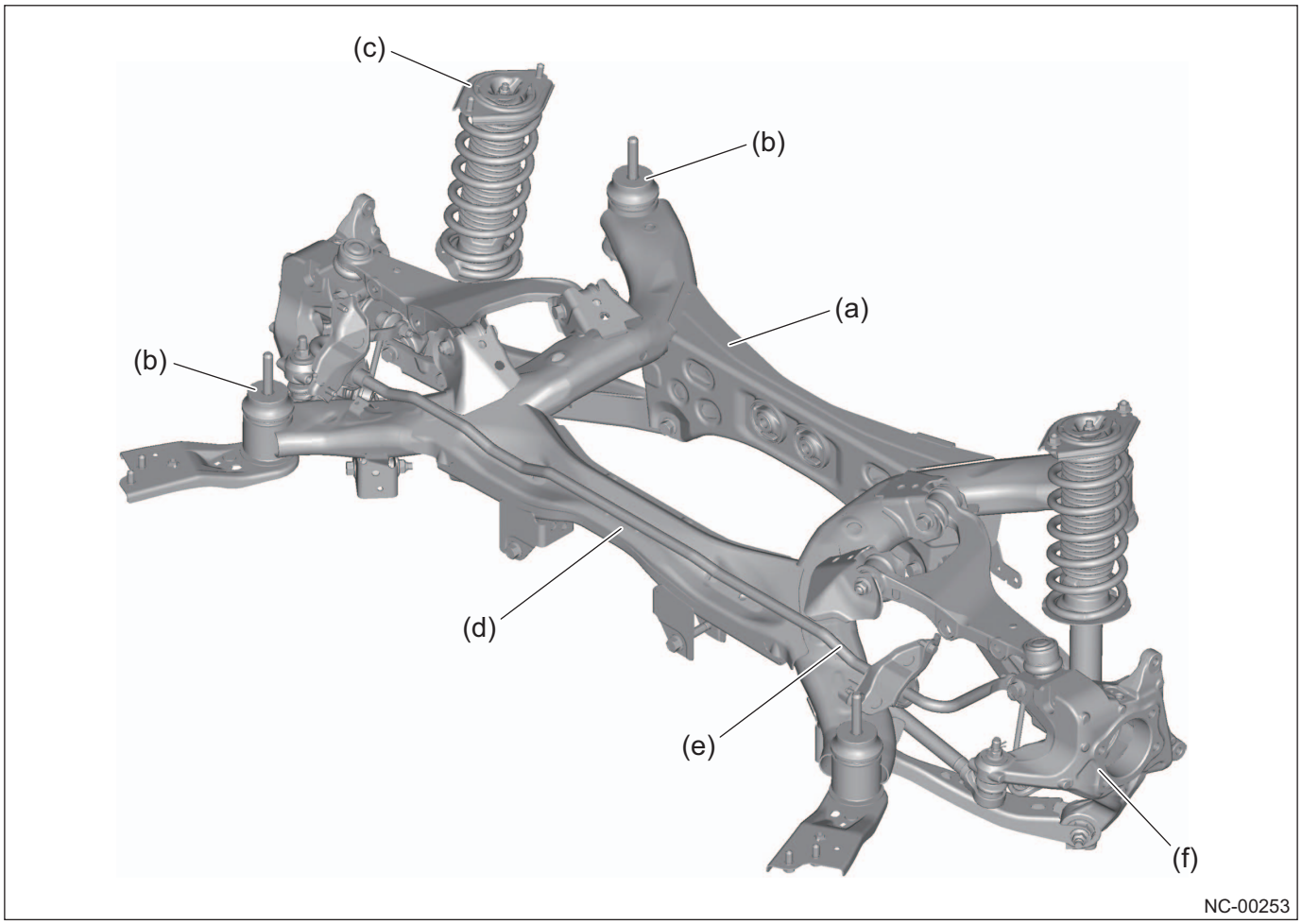
Reduction of vibration and noise, improvement in ride quality, and steering stability
The new structure sub frame bushing is adopted to reduce vibration and noise and improve ride quality and steering stability. A structure that directly installs the stabilizer reducing body sway is also adopted.

Improvement in accuracy and responsiveness during steering
The structure of the rear sub frame is changed to improve the rigidity of the rear suspension. The link layout, length, and shape of the dynamic geometry against uneven road surface and riding over steps are changed by reducing the roll steer.

Improvement of fuel efficiency by weight reduction
The housing material is changed from cast iron to aluminum to improve fuel efficiency.

4.3.2 Component

Component layout drawing

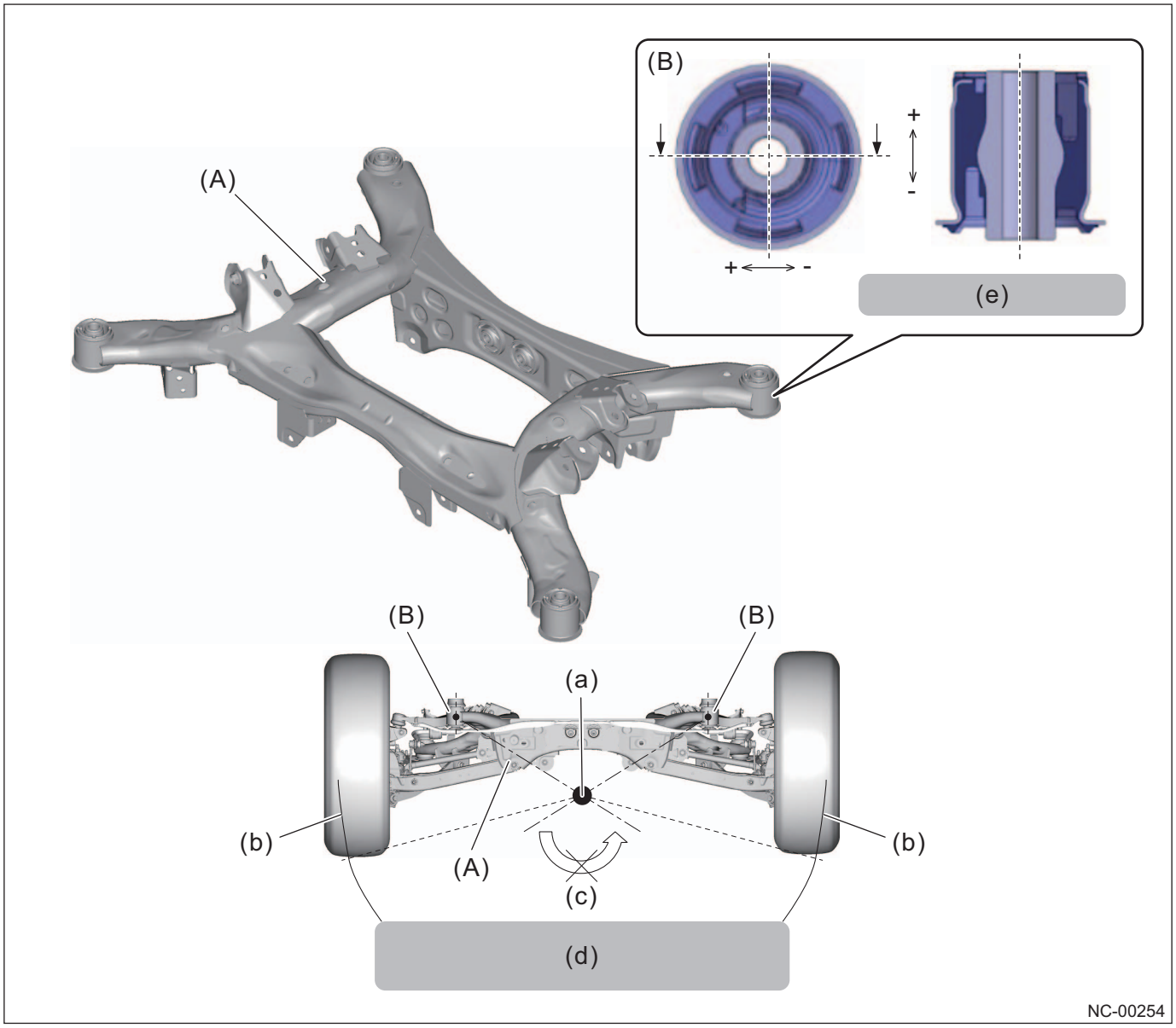


(a) Sub frame assembly
(b) Sub frame bushing
(c) Input separating type mount
(d) Sub frame COMPL
(e) Stabilizer
(f) Rear axle housing

4.3.3 Construction and Operation

New structure sub frame bushing

The shape of the sub frame bushing is reshaped to improve the tread rigidity and the steering stability, and the movement of the sub frame is also reduced to achieve the optimal characteristics of the bushing without hardening it. This improves ride quality and reduces vibration and noise.



(A) Sub frame assembly

(B) Rear frame bushing

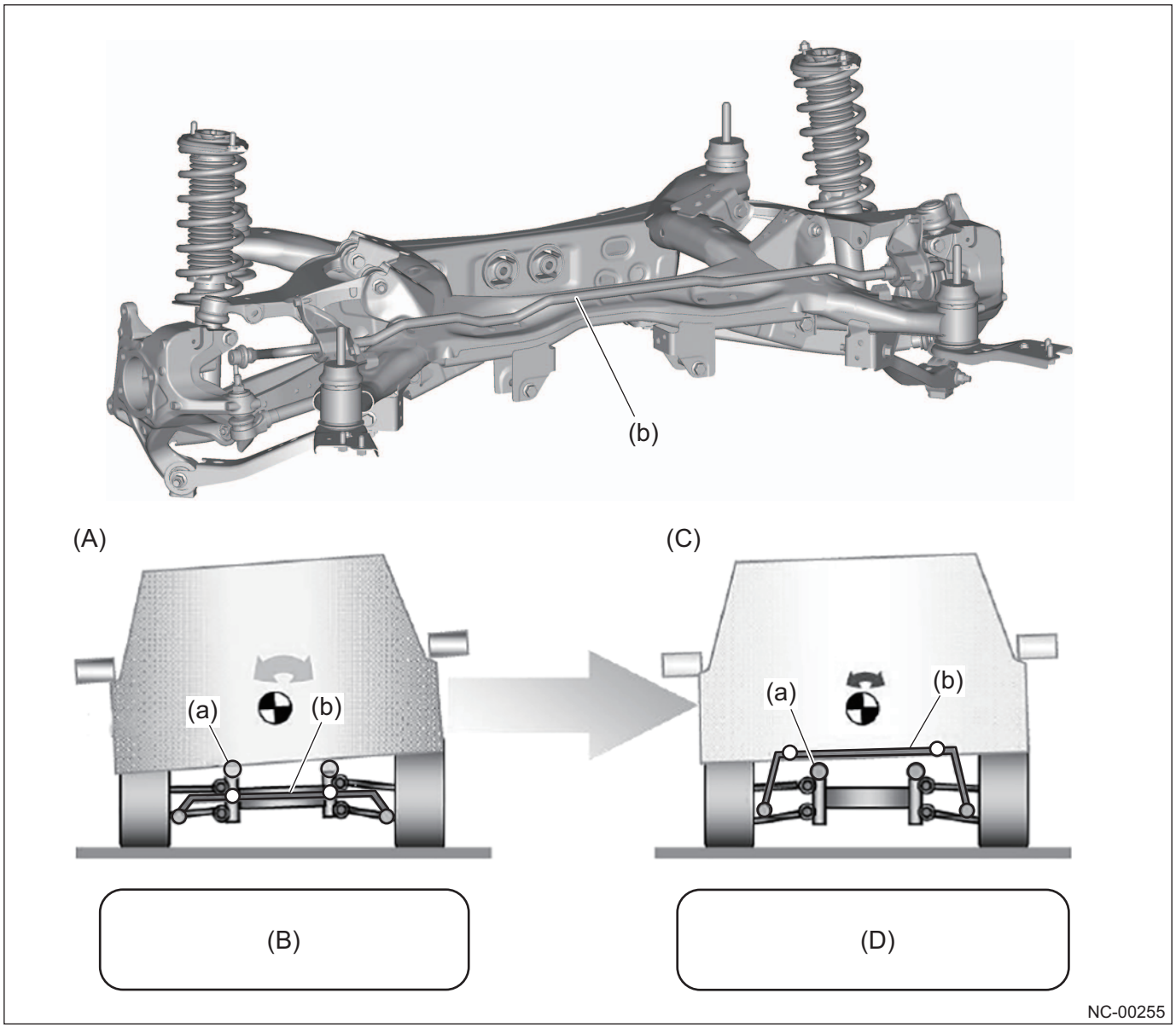
(a) Elastic center
(b) Grounding point track
(c) No rotation

(d) The elastic center is aligned with the roll center of the vehicle to reduce the moment force.
(e) The bushing can be softened due to the reduced moment input.

Rear stabilizer

The rear stabilizer is installed directly on the vehicle body to reduce the body sway by 50 %* from the level of existing model vehicles.

*Comparison with the company data



(A) Existing model vehicle
(B) Body sway does not stop.
(C) New model vehicle
(D) Stabilizer directly reduces the body sway.

(a) Rubber bushing
(b) Stabilizer

5 WHEEL & TIRE

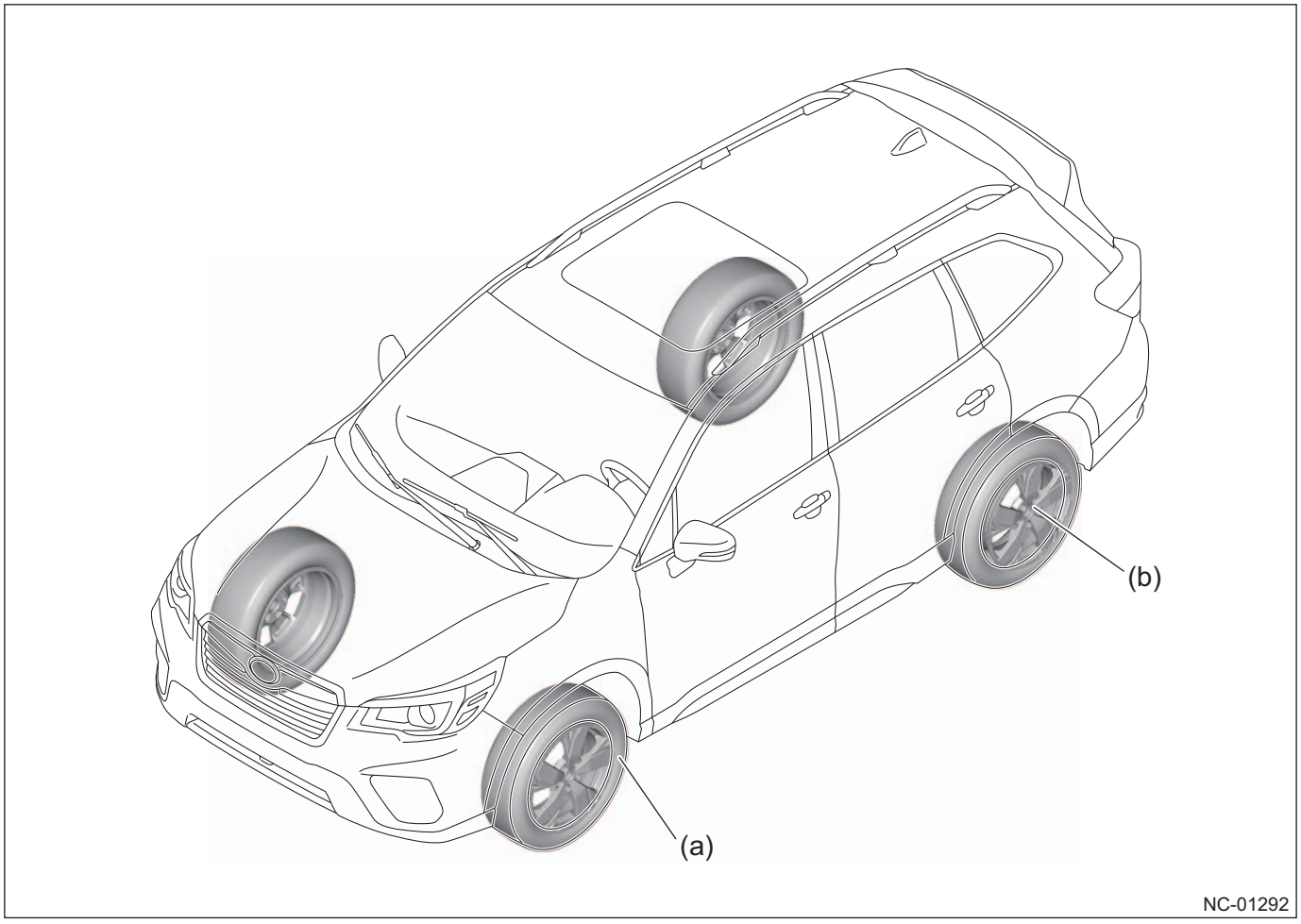
CONTENTS

5.1 General Overview

A new type of wheel with a PCD value of 114.3 is created to improve the steering stability. This design offers a sense of safety provided by the wheels that securely support the body even on a rough road, and expresses the strength to securely hold the ground.

With the aim of reducing vibration, noise, and rolling resistance, and improving brake performance, steering stability, and ride quality, two types of tires with 18 inches and 17 inches in size are newly developed to enhance the total balance of performance. The system (Tire Pressure Monitoring System: TPMS) that alerts tire air pressure decrease is also adopted as a safety device.

5.1.1 Structure

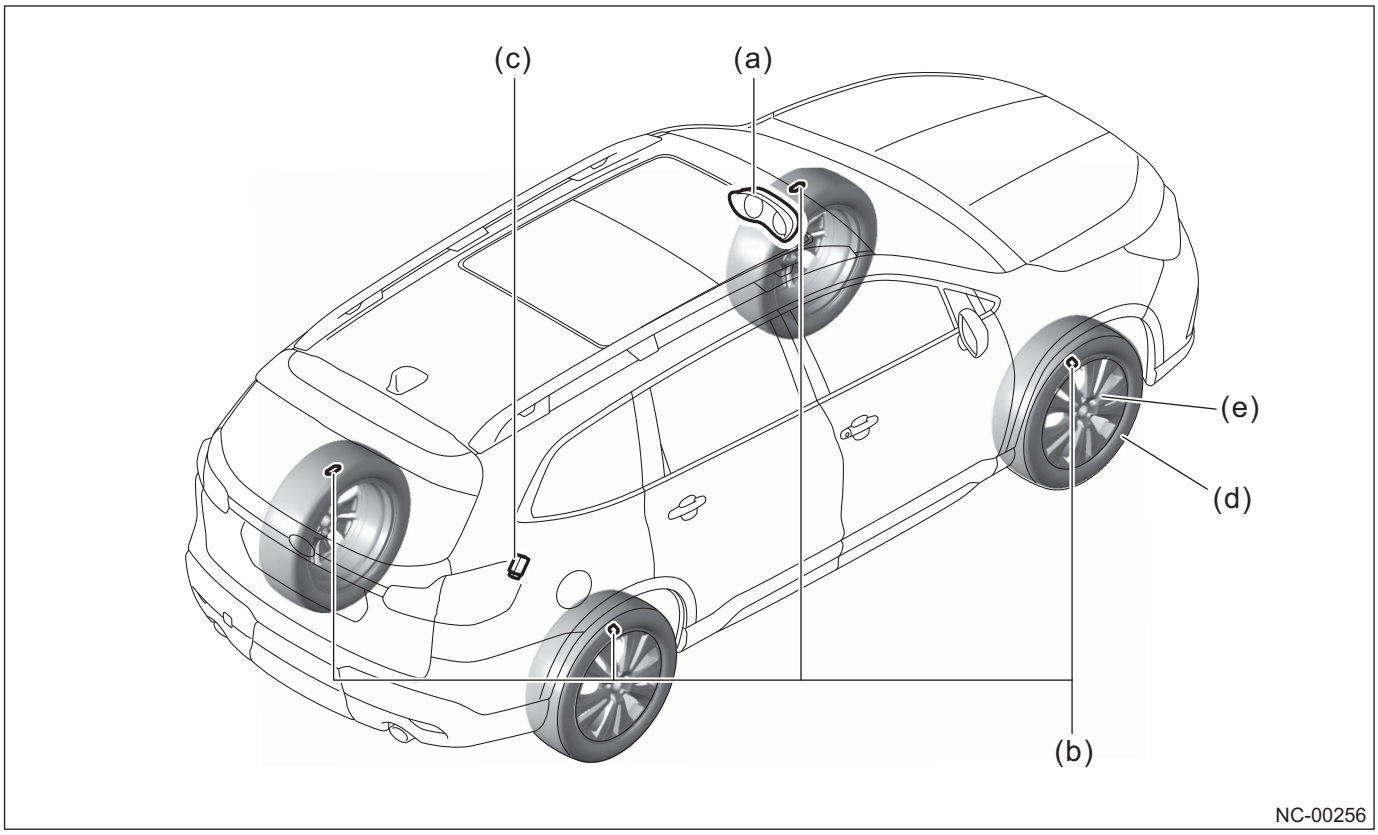


(a) Tire

(b) Wheel

5.1.2 Component

Component layout drawing



(a) Combination meter
(b) Transmitter (tire inflation pressure sensor)
(c) TPMS CM (for some grades)
(d) Tire
(e) Wheel

Component details

Tire (depending on grades)

Tire specifications

Size	
17-inch	225/60 R17 99H
18-inch	225/55 R18 98H

Wheel (depending on grades)

Wheel specifications

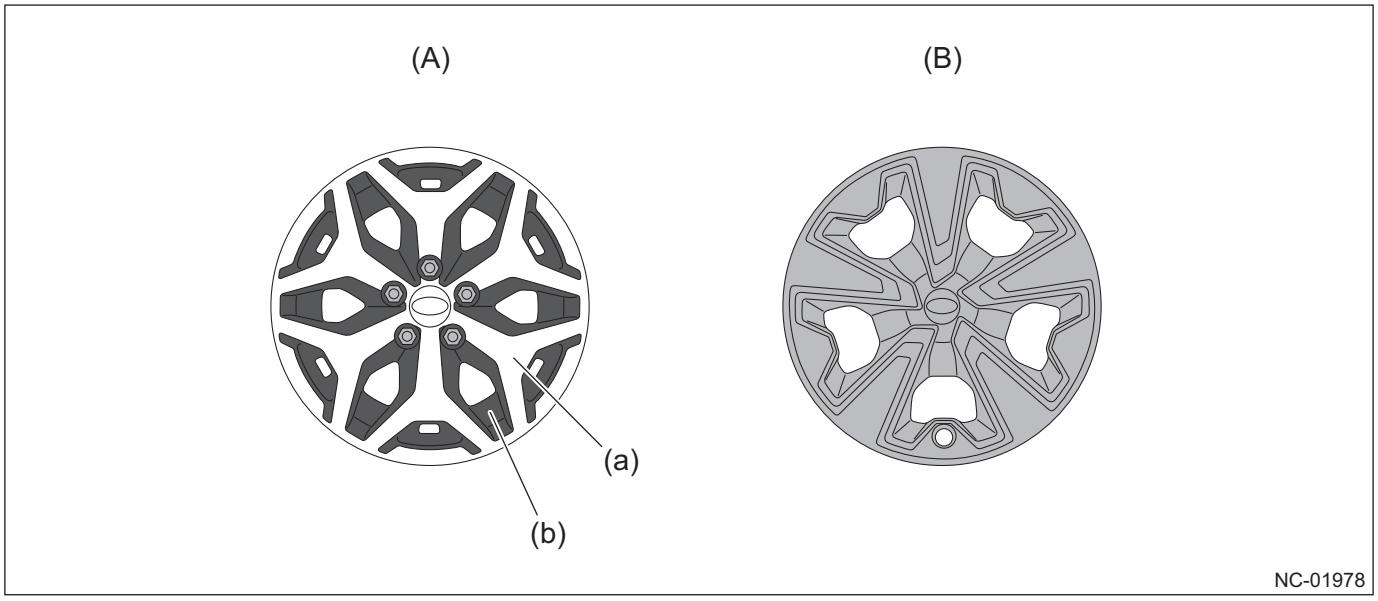
17-inch			
Size	17 × 7J		
Shape	6 spokes		Full cap
Material	Aluminum		Steel
Color	Dark metallic + machined surface	Silver	-

18-inch			
Size	18 × 7J		
Shape	10 spokes		5 spokes
Material	Aluminum		
Color	Dark metallic + machined surface	Dark metallic	Dark metallic + machined surface

■ 17-inch wheel

Three types of aluminum wheels are offered for the 17-inch wheel: dark metallic + machined surface, silver finish, and steel (full cap).

Activeness is expressed in the design and is emphasized in the machined surface, making the wheel look larger.



(A) Aluminum wheel (dark metallic + machined surface)

(B) Steel wheel (full cap)

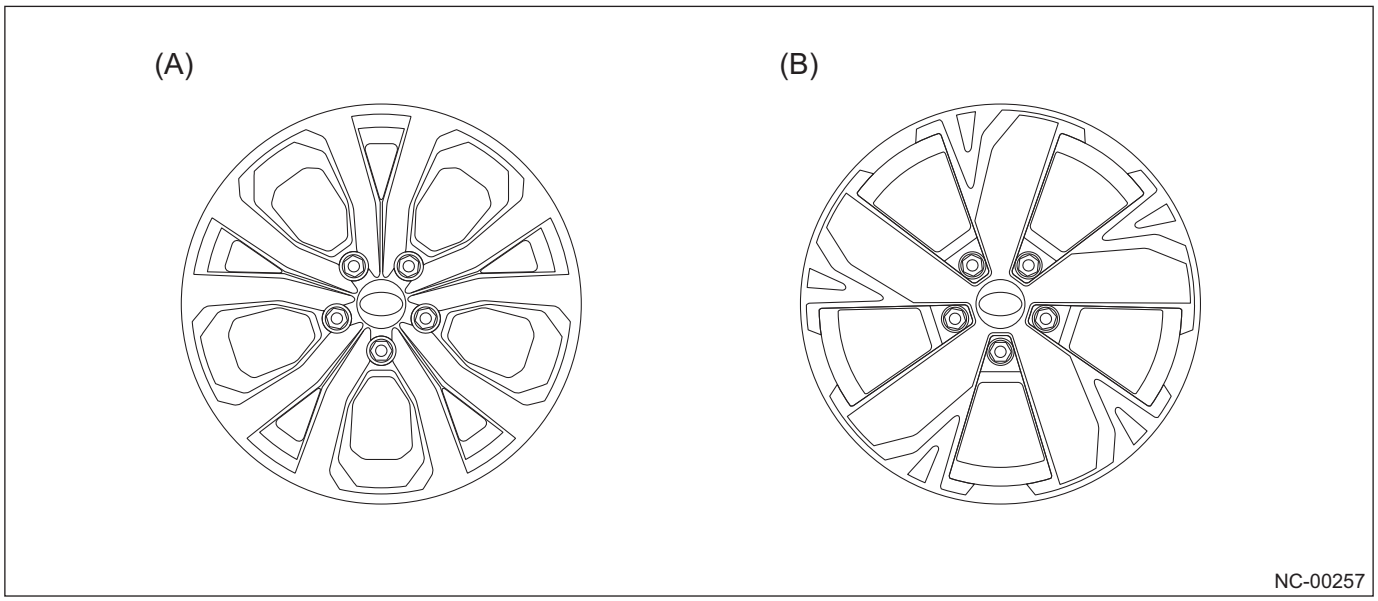
(a) Machined surface part

(b) Dark metallic part

■ 18-inch wheel

10-spoke type and 5-spoke type of aluminum wheels are offered for the 18-inch wheel with the dark metallic color and machined surface finish.

With a contrast of the shiny machined surface and dark metallic painted surface, this design offers a sense of safety that the body can be supported even on a rough road, and expresses the strength to securely hold the ground.

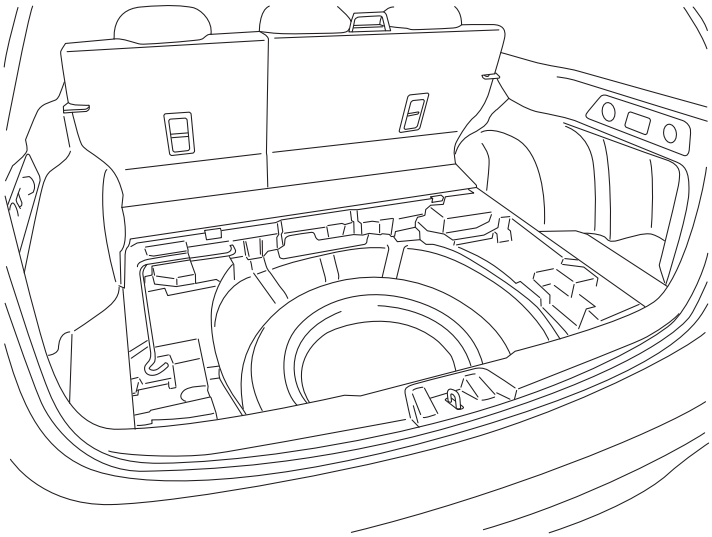


(A) 10 spokes

(B) 5 spokes

Wide temporary tire & temporary tire

A wide temporary tire and temporary tire are stored under the luggage room.



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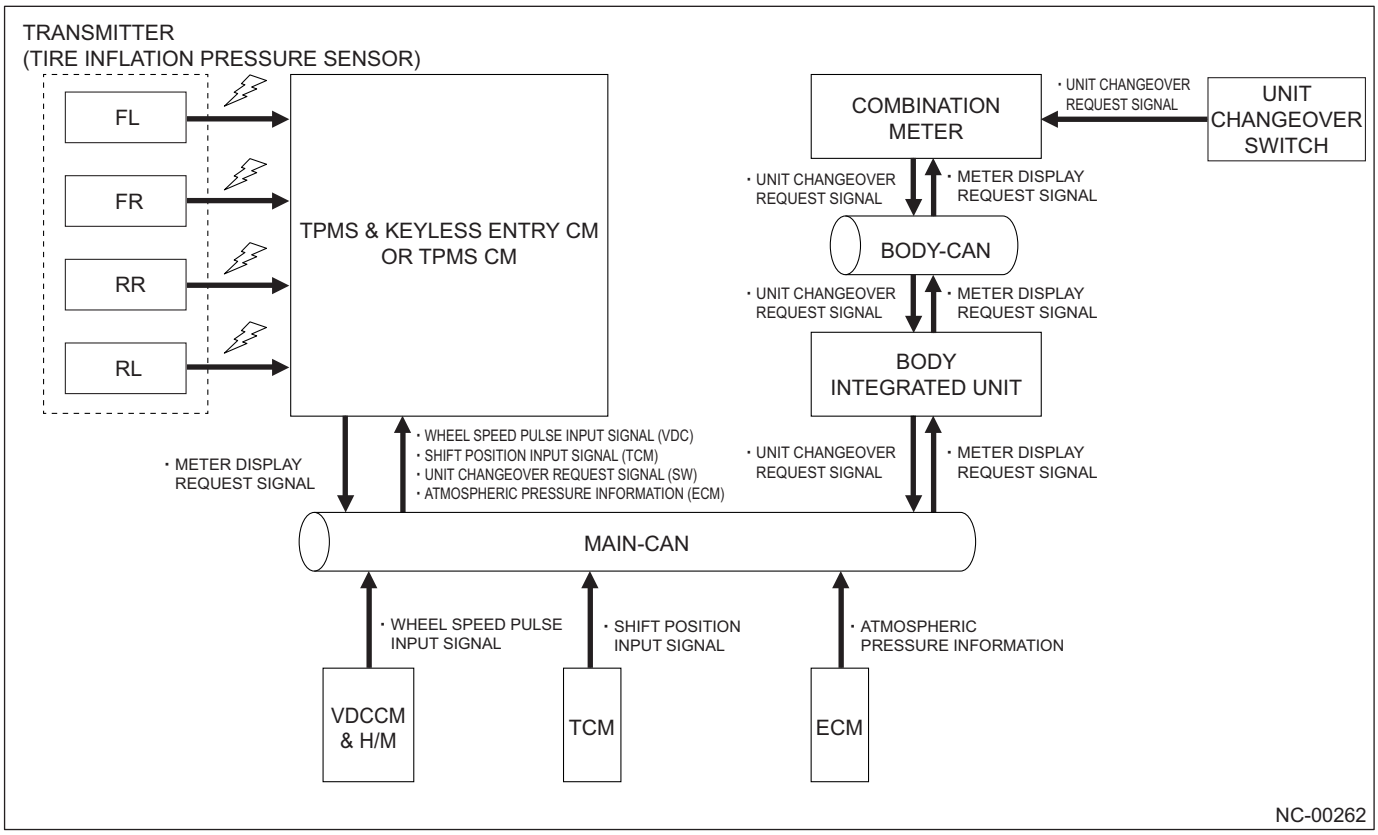
*A wide temporary tire and temporary tire differ depending on the grade.

5.1.3 Construction and Operation

System diagram

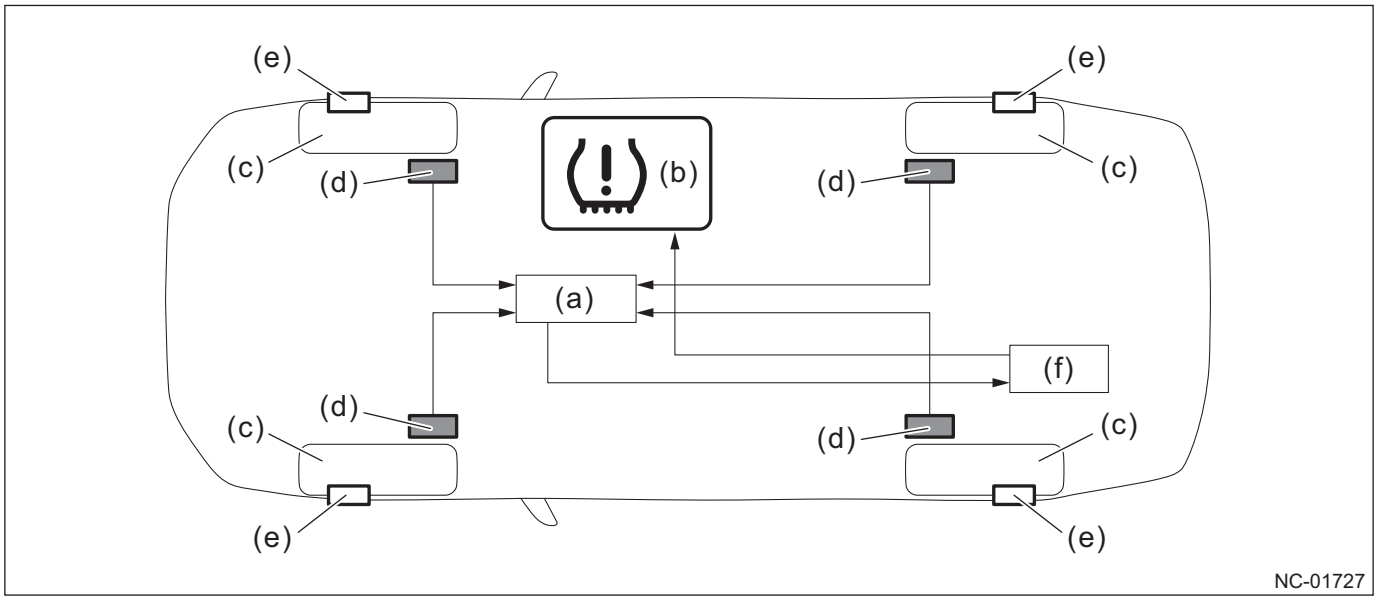
Tire Pressure Monitoring System (TPMS)



Tire Pressure Monitoring System (TPMS) (for some grades)

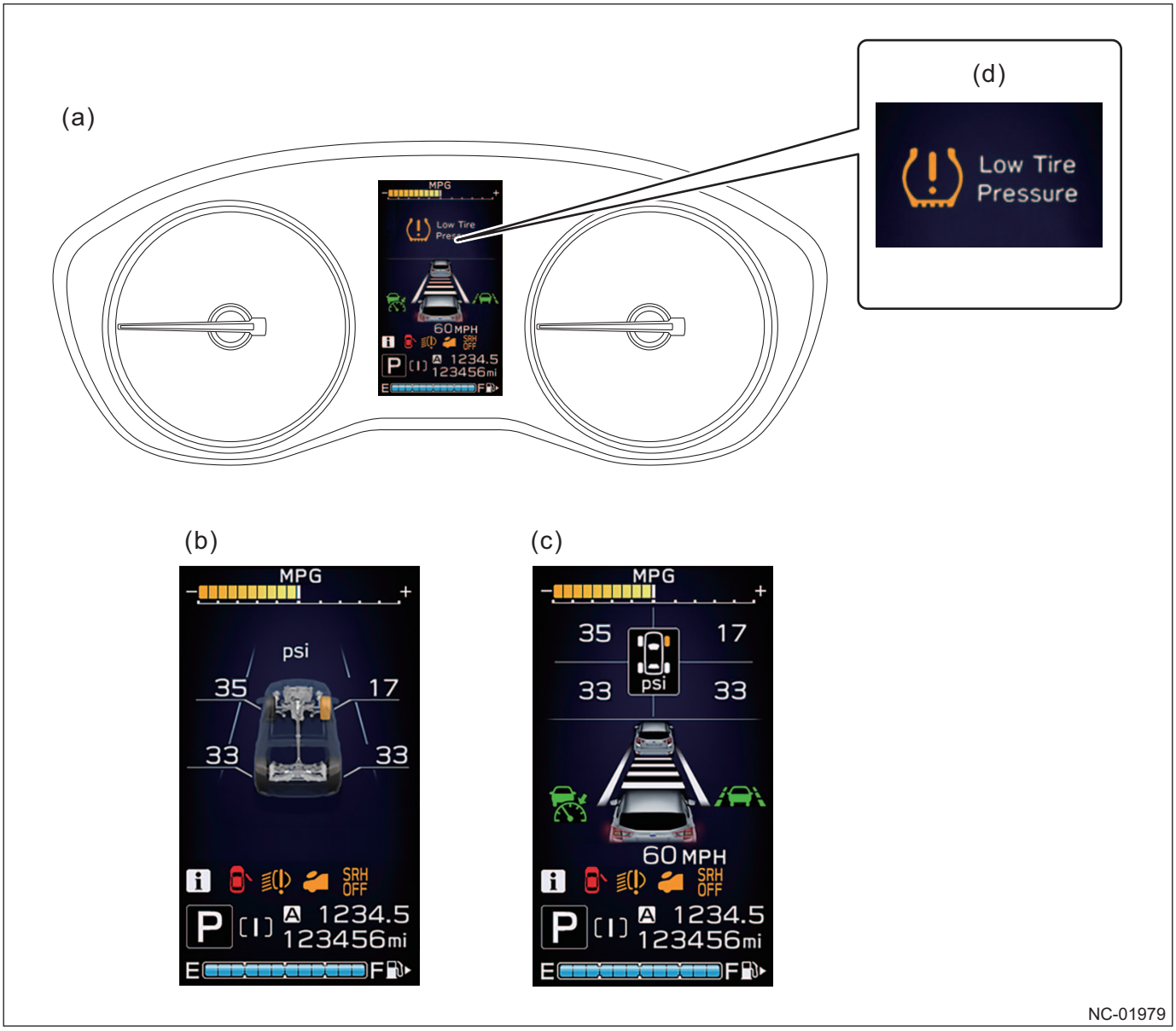
A system called Tire Pressure Monitoring System, TPMS is adopted. This system monitors the tire air pressure through the wheel speed counter of the ABS and the RF transmission cycle to identify the tire with low air pressure. Then it turns on the warning light on the multi-information display (MID) in the combination meter to alert the driver to low air pressure. For new model vehicles, the TPMS SET switch is arranged in the glove box.

TPMS quickly detects tire faulty due to low air pressure when driving at high speed and alerts the driver to the fault, to allow the driver to realize it and take action appropriately. TPMS prevents decreases in roll resistance and flat tires due to low air pressure, measures the air pressure for each of the left and right-front and rear tires, and issues the warning to a driver.



(a) VDCCM & H/M
(b) Warning light (MID)
(c) Tire
(d) Wheel speed sensor
(e) TPMS valve
(f) TPMS module

MID screen



(a) Combination meter
(b) Multi-information display screen when EyeSight is not operating
(c) Multi-information display screen when EyeSight is operating
(d) Interruption screen

6 BRAKE SYSTEM

CONTENTS

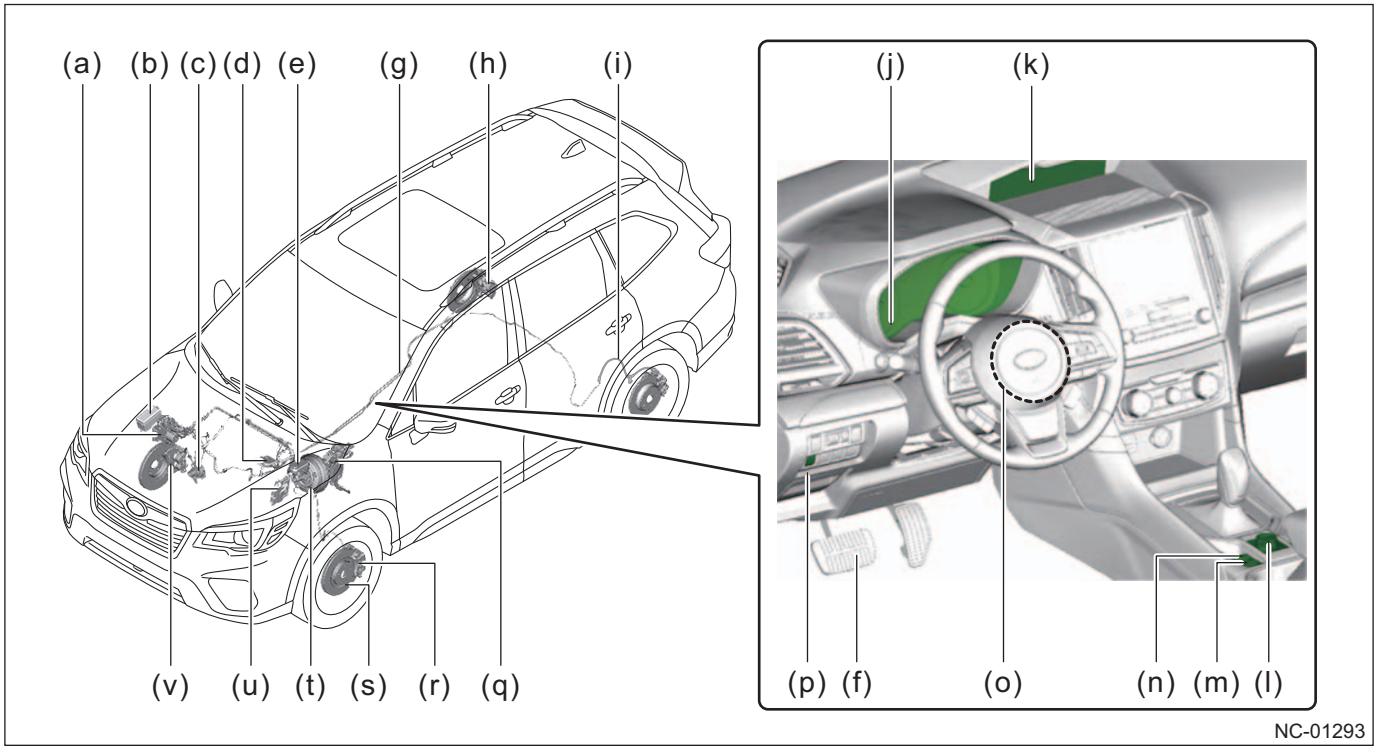
6.1 General Overview

6.1.1 Overview

This chapter describes the following systems configuring the brake system.

- Service brake
- Vehicle dynamics control (VDC)
- Electronic parking brake

6.1.2 Structure



(a) VDCCM & H/M
(b) Stop light relay
(c) Brake vacuum pump
(d) Transmission control module (TCM)
(e) Master cylinder
(f) Brake pedal
(g) Brake pipe
(h) Rear brake caliper
(i) Brake hose
(j) Combination meter
(k) Multi-function display (for some grades)
(l) X-MODE switch
(m) Auto vehicle hold switch
(n) Parking brake switch
(o) Steering angle sensor
(p) VDC OFF switch (for some grades)
(q) Stop light switch
(r) ABS wheel speed sensor
(s) Magnetic encoder
(t) Vacuum booster & negative pressure sensor
(u) Engine control module (ECM)
(v) Front brake caliper

6.2 Service Brake

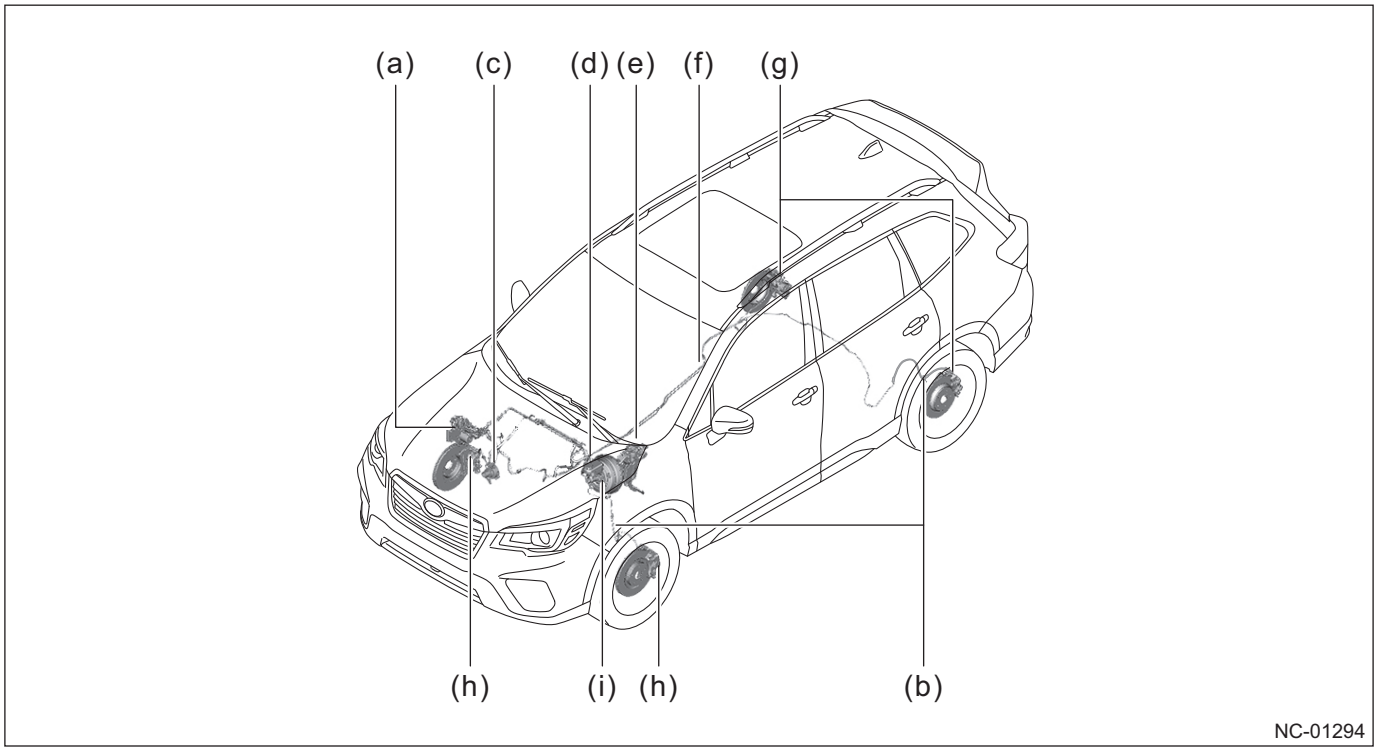
6.2.1 Overview

The following changes are made for the service brake to realize the brake performance with a feel of safety and immediate effect when the brake pedal is depressed.

- Vacuum booster with optimized characteristics
- Engine-driven brake vacuum pump
- Front brake with the size and weight reduced
- Brake pad with high μ material adopted
- Rear brake caliper with built-in electronic parking brake

6.2.2 Component

Component layout drawing

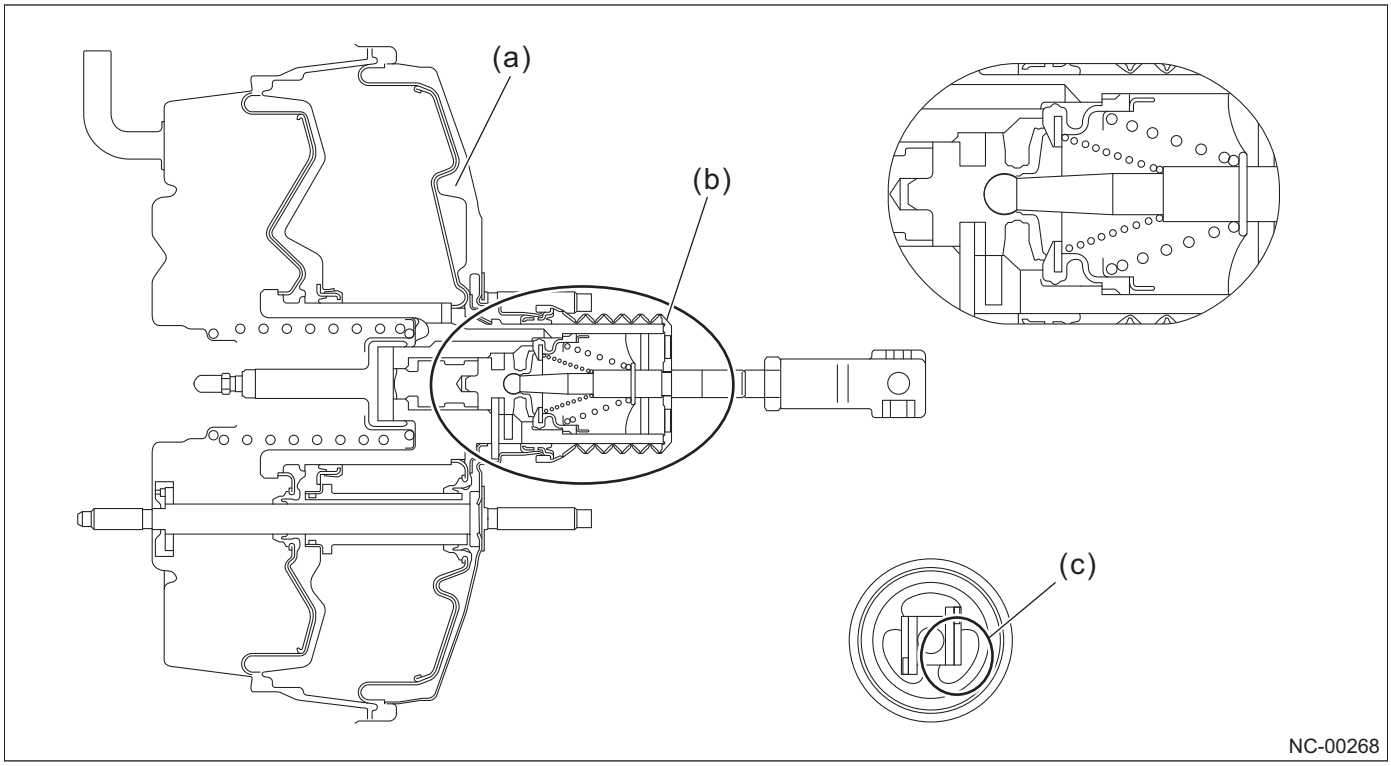


(a) VDCCM & H/M
(b) Brake hose
(c) Brake vacuum pump
(d) Master cylinder
(e) Brake pedal
(f) Brake pipe
(g) Rear brake caliper
(h) Front brake caliper
(i) Vacuum booster & vacuum sensor

Component details

Vacuum booster

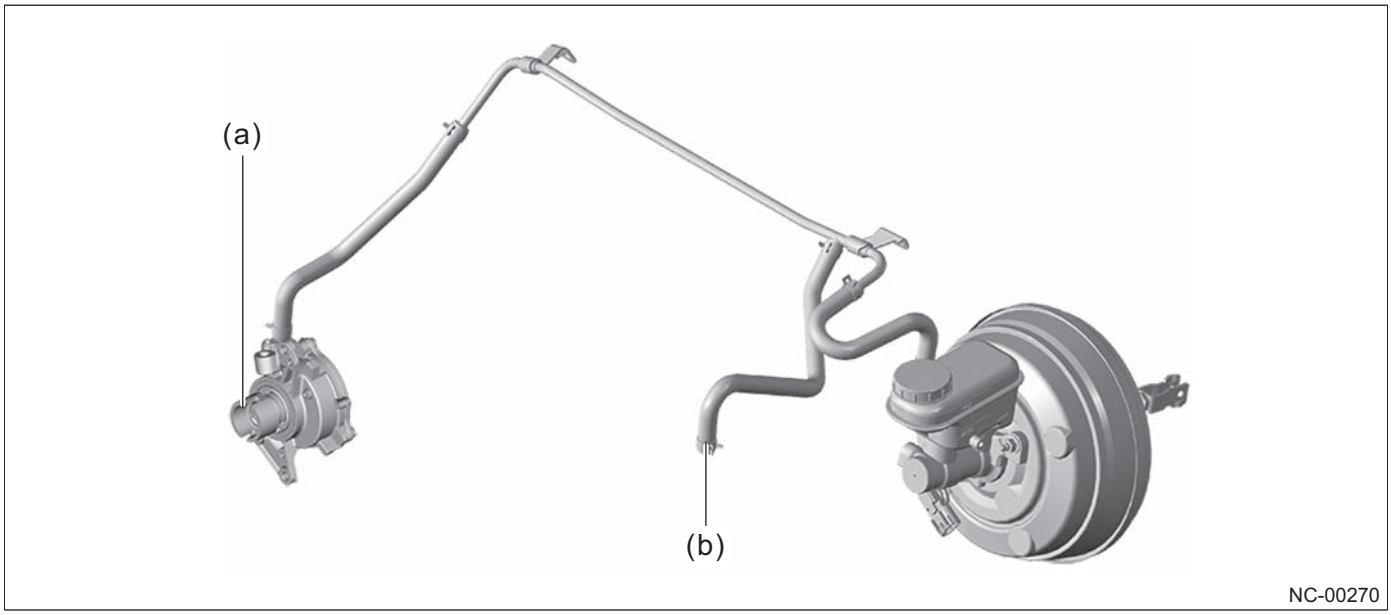
The vacuum booster is changed to the one with optimized characteristics to achieve the brake performance with a feel of safety and immediate effect when the brake pedal is depressed.



(a) Decreased operating pressure volume
(b) Enlarged air passage area and reduced airflow resistance
(c) Enlarged boot passage area

Brake vacuum pump

The brake vacuum pump driven by engine is adopted in combination with intake manifold negative pressure. This solves the problem of insufficient negative pressure supply speed at high altitudes (altitude of 2,000 m (6,562 ft) or higher). In addition, while ensuring stable feeling immediately after the engine is started, braking without a feeling of stepping on a stiff board is realized.



(a) Brake vacuum pump

(b) Connected to intake manifold

Front brake

■ Front brake caliper

The new types of brake caliper and brake pad with the following changes are adopted for the front brake caliper. This reduces invalid strokes of the brake pedal, and improves the brake effect.

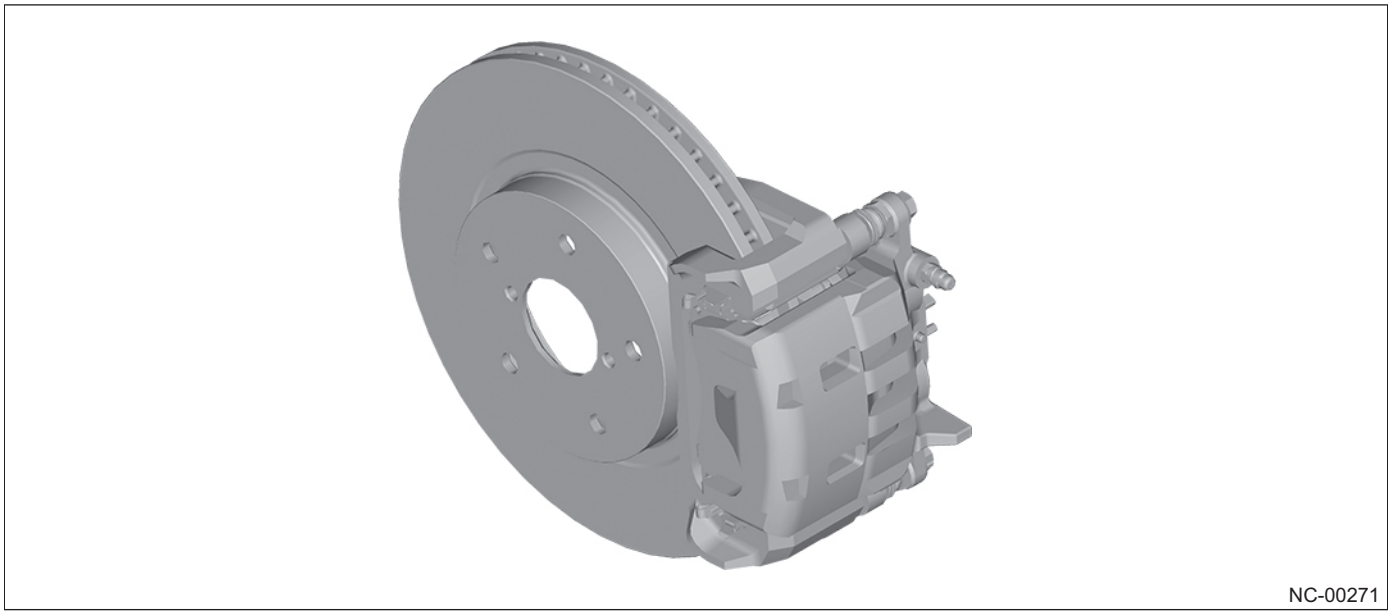
Brake caliper

- The cylinder diameter is reduced to reduce brake fluid.
- The cylinder rigidity is improved to reduce fluid loss.

Brake pad

- The brake pad with high μ material is adopted.

The parts are downsized to reduce the weight while ensuring the required braking force.



■ Front disc rotor

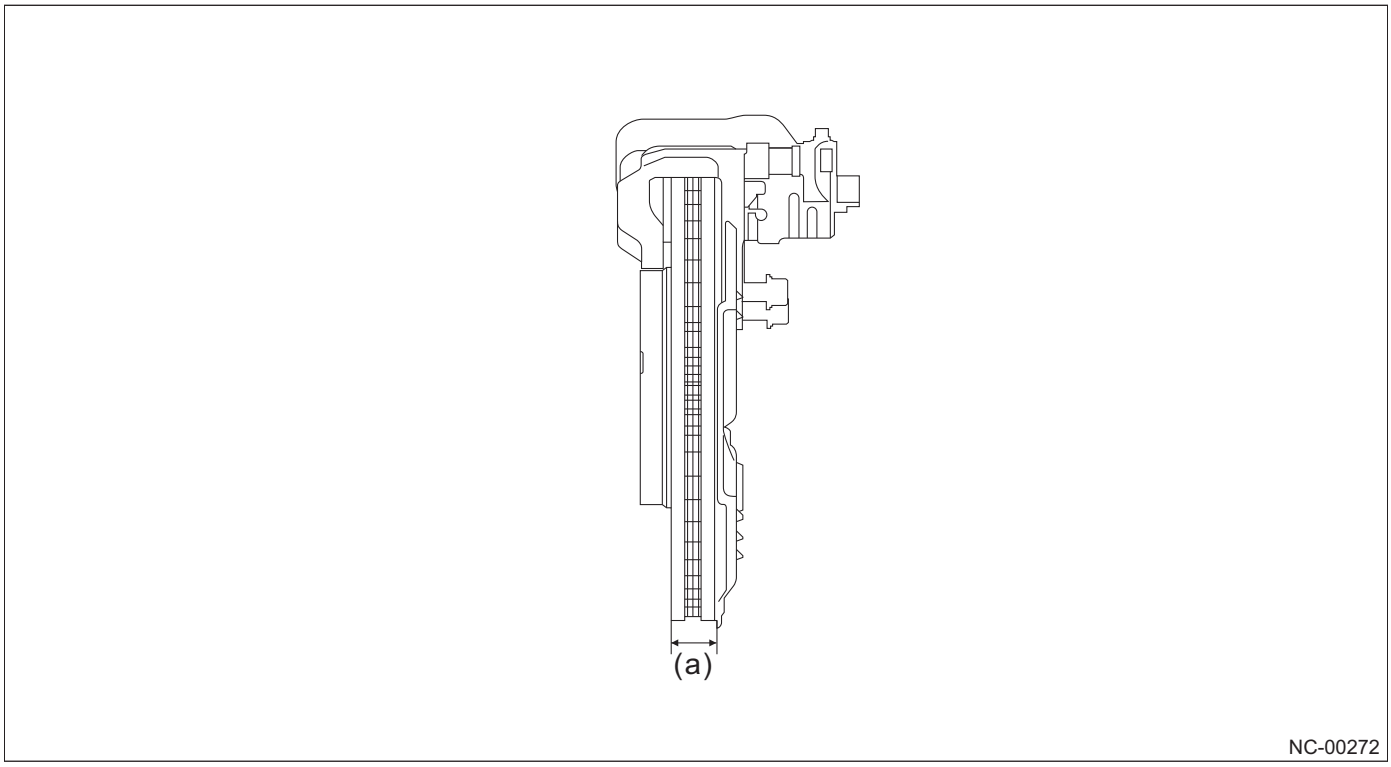
The parts are downsized to reduce the weight while achieving the required performance.

17-inch brake pedal

- Rotor thickness: 1.2 in (30 mm) to 1.1 in (28 mm)

16-inch brake pedal

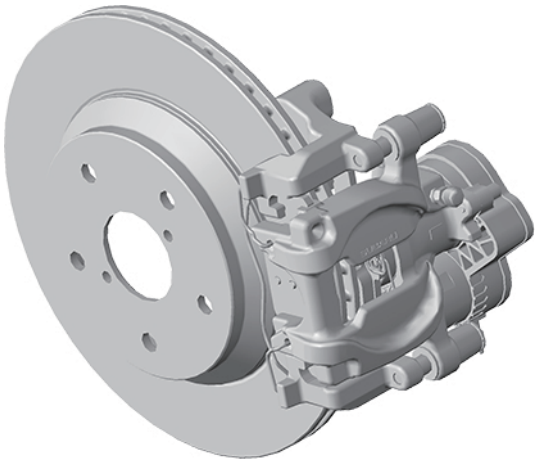
- Rotor thickness: 0.9 in (24 mm) to 0.9 in (24 mm)



(a) Rotor thickness

Rear brake

The electronic parking brake is adopted, and the actuator is built into the rear brake caliper.



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6.3 Vehicle Dynamics Control (VDC)

6.3.1 Overview

VDC always detects driving conditions of a vehicle with various types of sensors and assists the driver to achieve an ideal driving condition. Unstable behavior of the vehicle near the control limit such as side slipping is reduced through the braking control for each of the four wheels, engine output control, AWD torque distribution control, etc. The next-generation VDC system is adopted to support the electronic parking brake control and brake assist function at negative pressure failure time.

The sensor is changed from the absolute pressure/negative pressure sensor to the relative pressure/negative pressure sensor. The control is adopted that supports the braking power by the pressurizing function of the vehicle dynamics control (VDC) when the relative pressure/negative pressure sensor detects low negative pressure in the vacuum booster.

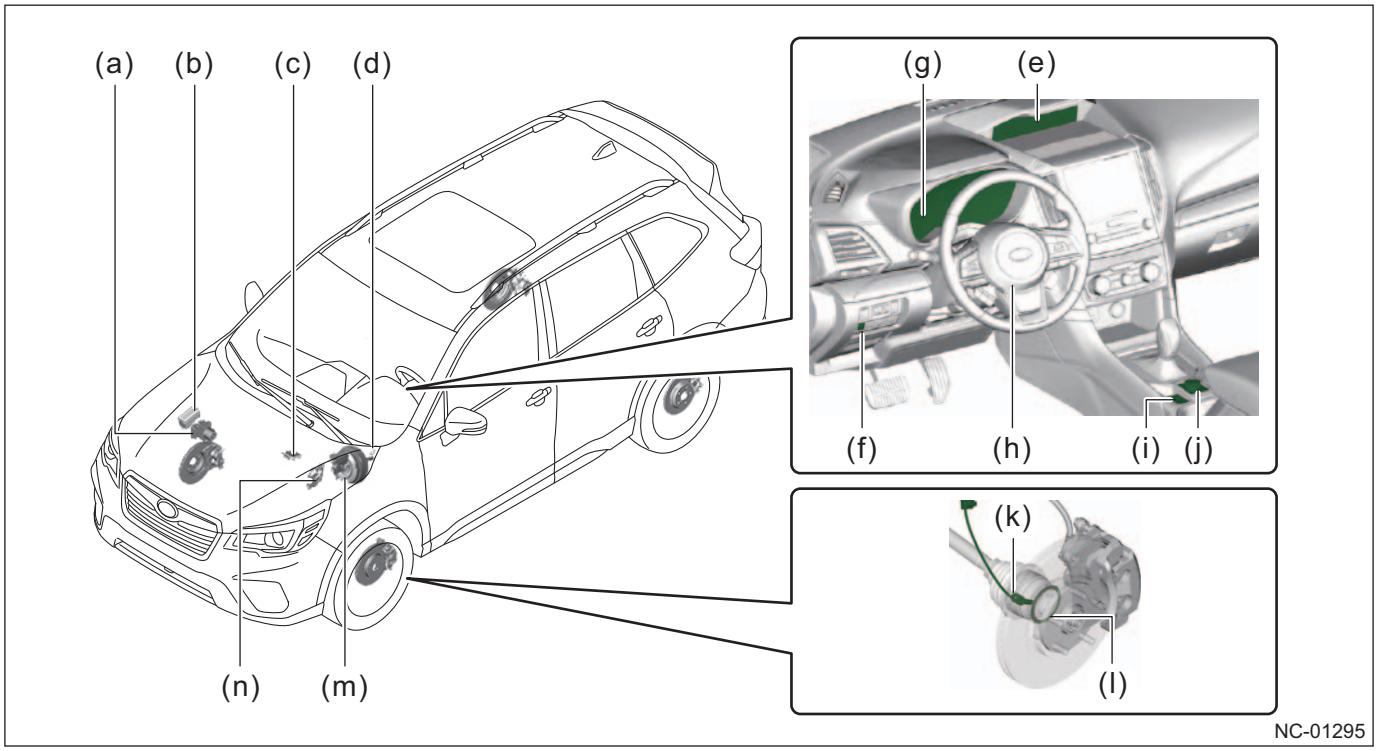
The auto vehicle hold (AVH) is adopted, which largely expands the usage of the brake hold function including the use on a level road as well as when starting the engine on an uphill road.

The vehicle dynamics control (VDC) performs the following controls.

- Active torque vectoring
- Brake assist
- Trailer Stability Assist (TSA)
- Hill descent control (HDC)
- Auto vehicle hold (AVH)
- Electronic parking brake

6.3.2 Component

Component layout drawing

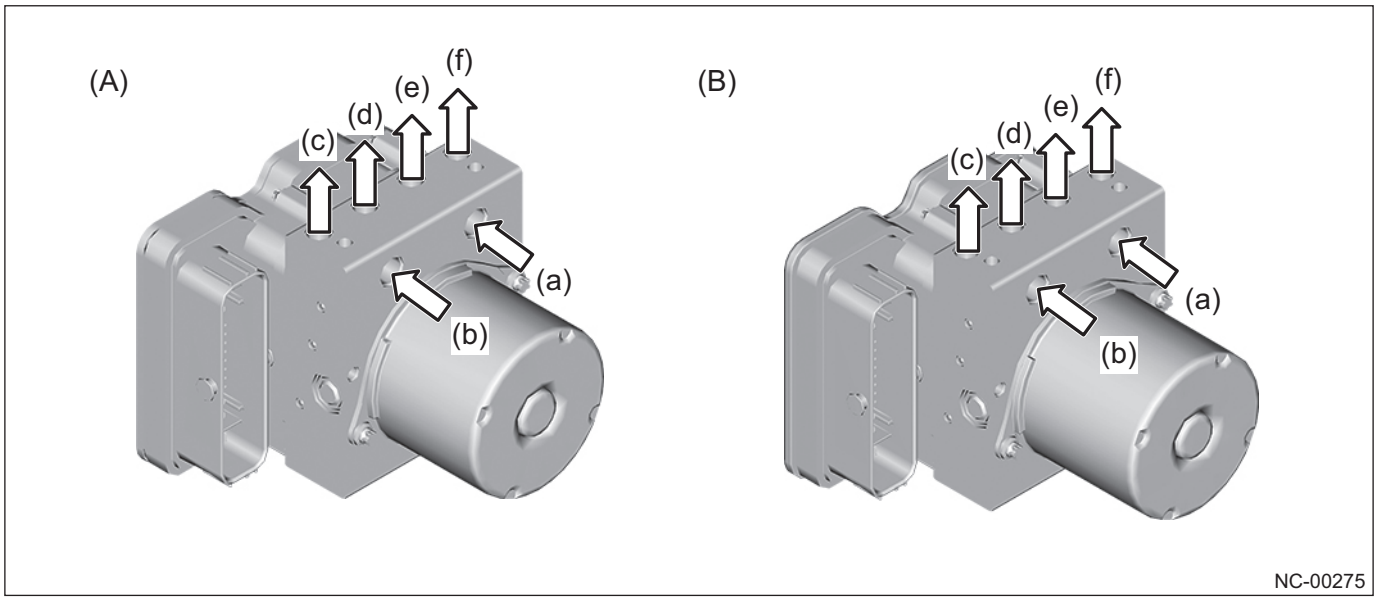


(a) VDCCM & H/M
(b) Stop light relay
(c) Transmission control module (TCM)
(d) Stop light switch
(e) Multi-function display (for some grades)
(f) VDC OFF switch (for some grades)
(g) Combination meter
(h) Steering angle sensor
(i) Auto vehicle hold switch
(j) X-MODE switch
(k) ABS wheel speed sensor
(l) Magnetic encoder
(m) Vacuum booster & vacuum sensor
(n) Engine control module (ECM)

Component details

VDC control module and hydraulic control module (VDCCM & H/M)

The VDC control module and hydraulic control module (VDCCM & H/M) with a lightweight, compact built-in yaw rate and longitudinal G, and lateral G sensors are adopted to support the electronic parking brake control and brake assist function for a negative pressure failure.



(A) Vehicle without EyeSight

(a) From primary cylinder
(b) From secondary cylinder
(c) To rear right side caliper

(B) Vehicle with EyeSight

(d) To front left side caliper
(e) To front right side caliper
(f) To rear left side caliper

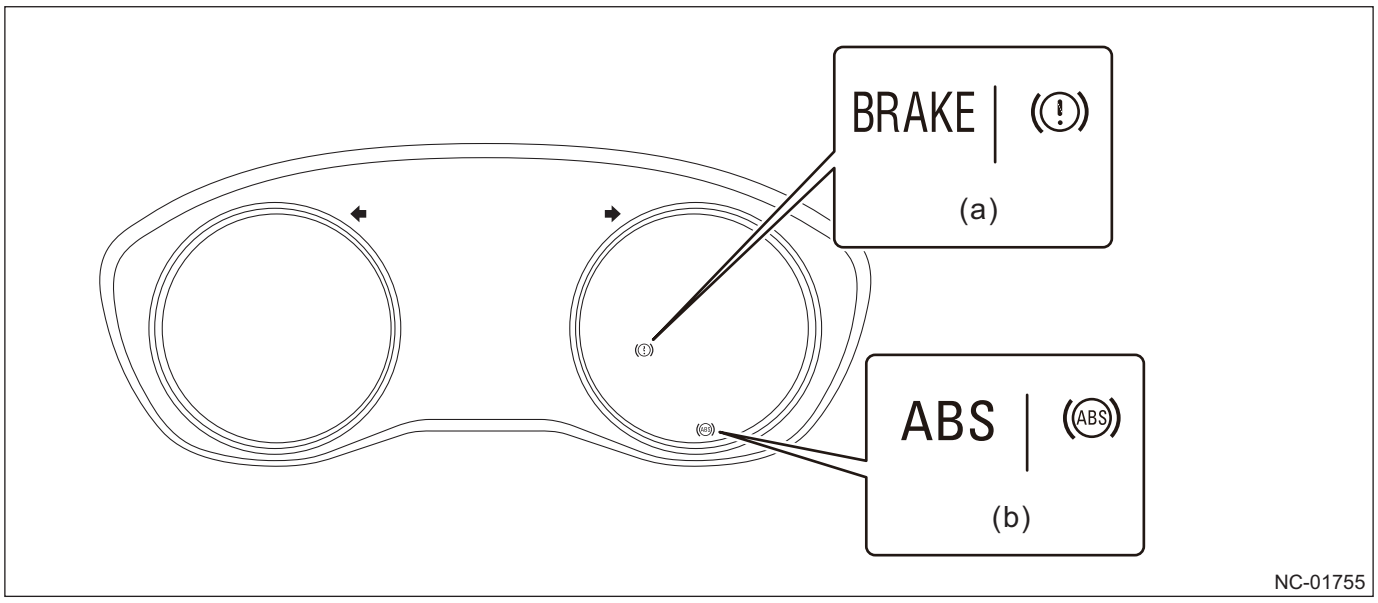
Warning light

■ Meter

The brake warning light (red) turns on (with the ABS warning light simultaneously) when the brake fluid level is extremely low or the EBD electronic control system is malfunctioning.

The electronic parking brake warning light (red)/brake negative pressure system warning light (red) turn on when there is an abnormality in the electronic parking brake system or the brake negative pressure system.

The ABS warning light turns on when there is an abnormality in the ABS system or EBD electronic control system.

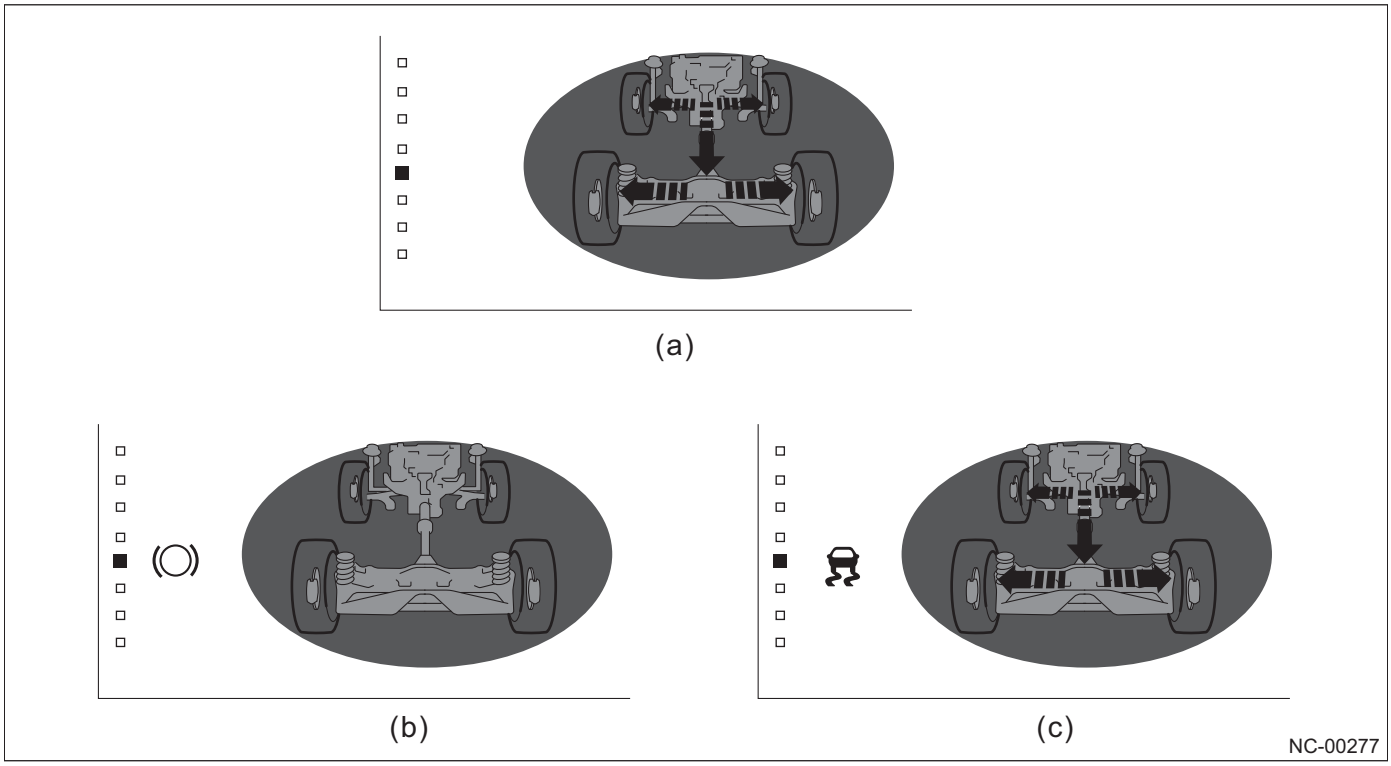


(a) Brake warning light (red)/electronic parking brake warning light (red)/brake negative pressure system warning light (red)

(b) ABS warning light (yellow)

Multi-function display (for some grades)

The function is added that displays the operating conditions of the vehicle dynamics control (VDC) and auto vehicle hold (AVH) on the multi-function display. This contributes to safe driving by notifying the driver of vehicle conditions in real time.

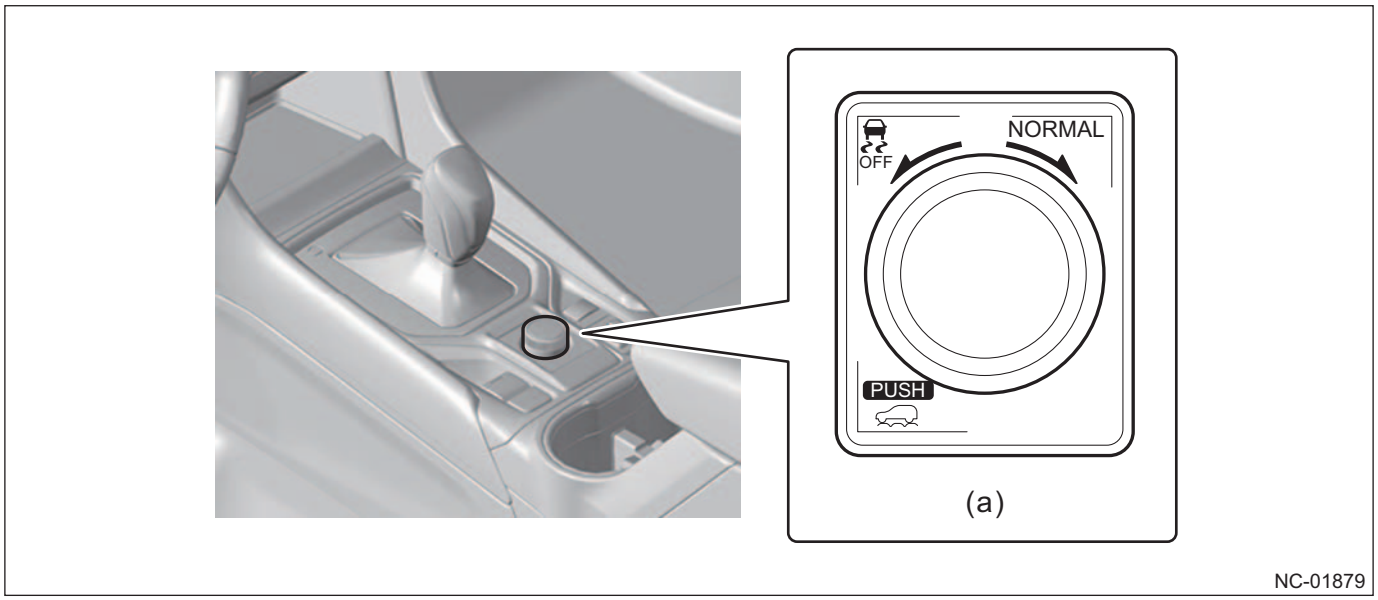


(a) Normal operating state
(b) AVH operating status display
(c) VDC operating status display

VDC OFF switch (for some grades)

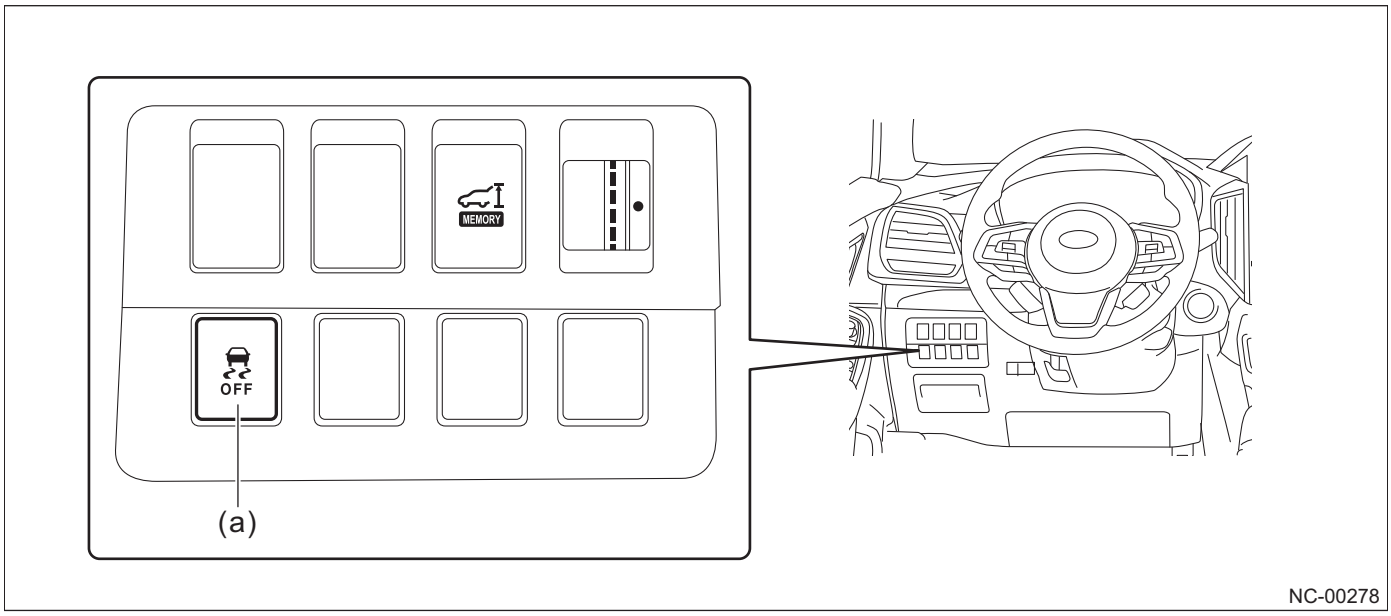
The VDC OFF switch that disables the engine torque suppressing function is installed on the X-MODE switch for the standard grade and on the instrument panel for the upper grade.

Standard grade



(a) VDC OFF switch

Upper grade

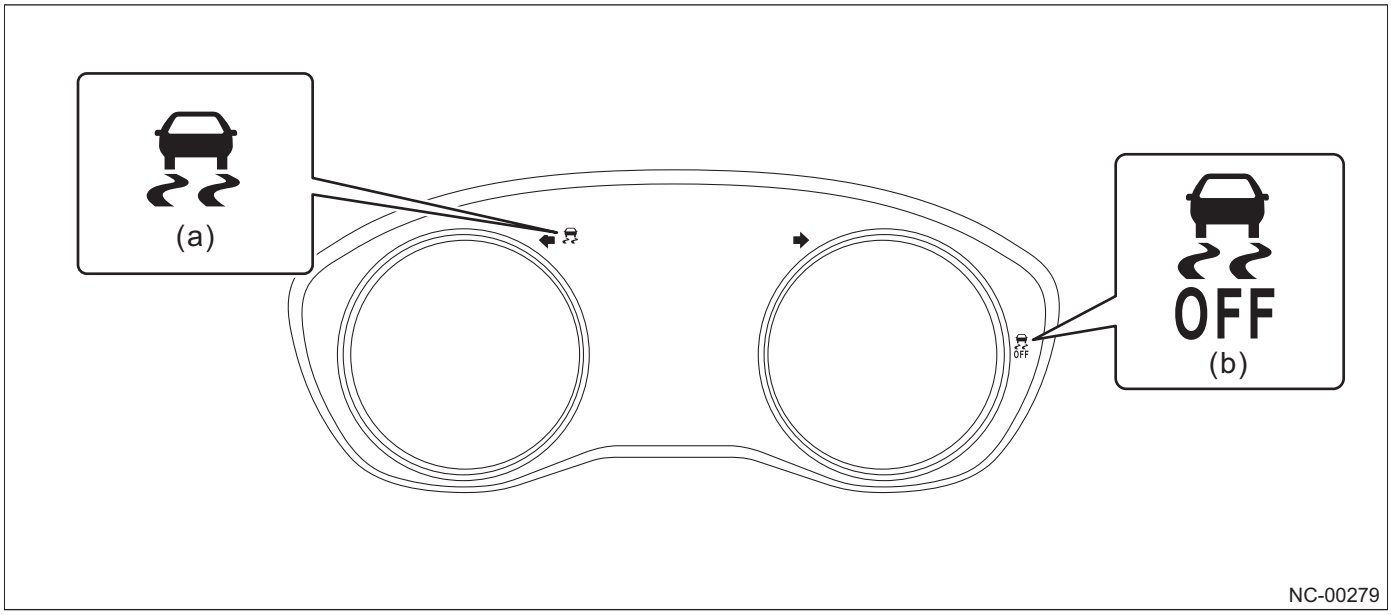


(a) VDC OFF switch

VDC warning light, VDC indicator light

The VDC warning light turns on when there is an abnormality in the VDC indicator light system.

Operating the VDC OFF switch (for some grades) or X-MODE switch (for some grades) disables the engine torque suppressing function which is effective for getting out of muddy or snowy roads, for example. When the torque suppressing function is turned off, the VDC OFF indicator light turns on in yellow so the driver can view the mode status at a glance.

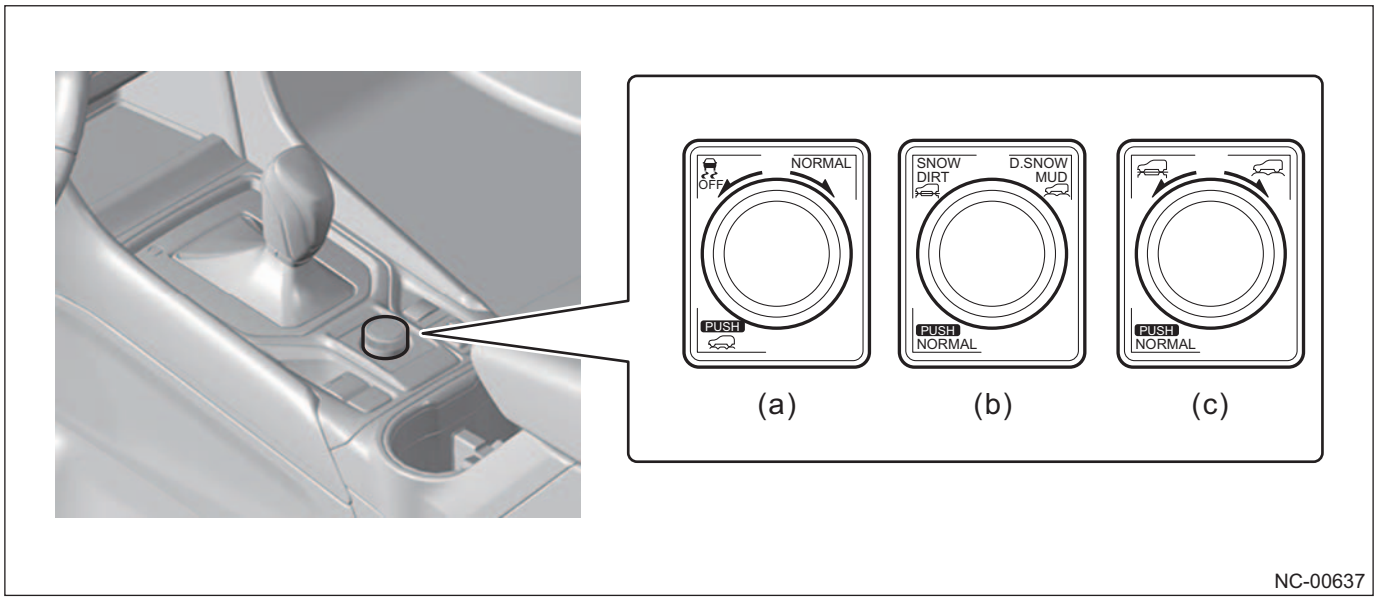


(a) VDC warning light

(b) VDC OFF indicator light

■ X-MODE switch

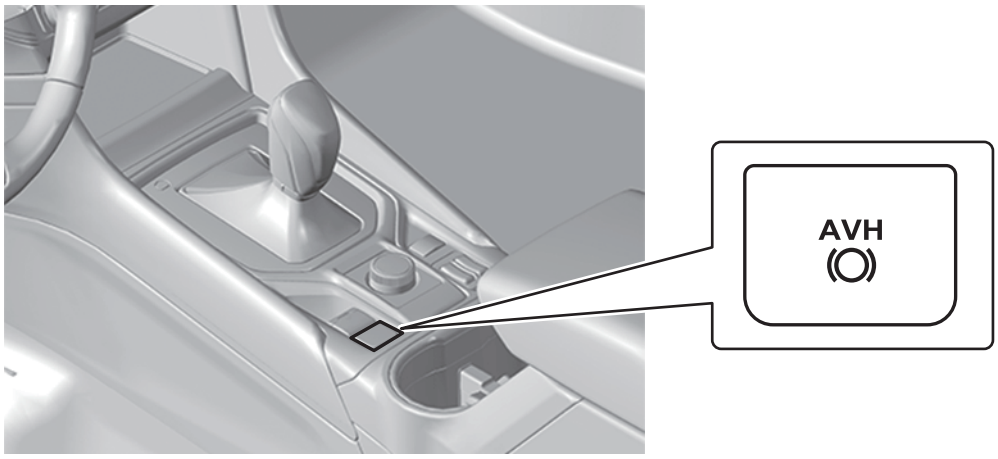
The switch is arranged on the center console so that the driver can operate it easily.



(a) Standard grade
(b) Upper grade
(c) Upper grade (for C5)

Auto vehicle hold switch

The switch is installed near driver position so that the driver can operate it easily.



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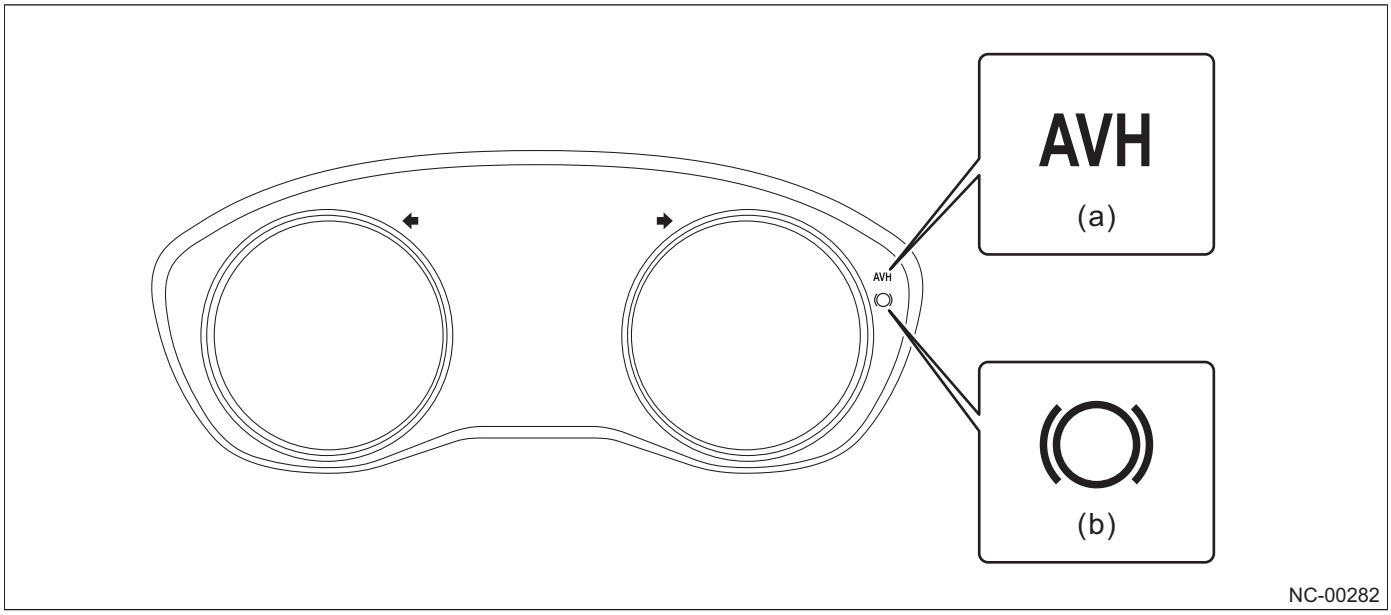
AVH indicator light, AVH operation light

The AVH indicator light and AVH operation light are arranged in the combination meter. These lights notify the driver of the status of the AVH system.

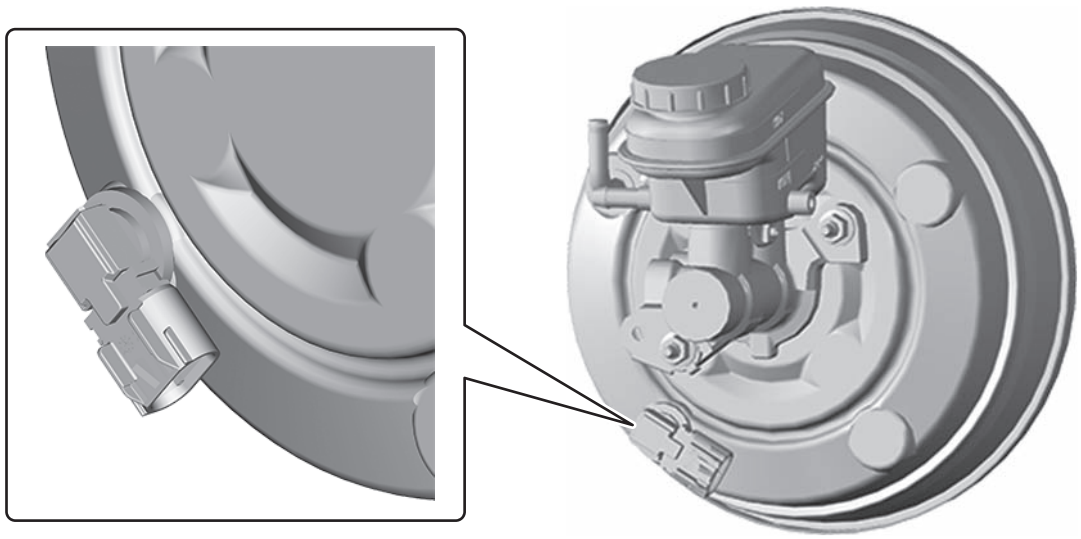


(a) AVH indicator light

(b) AVH operation light

Vacuum sensor

The relative pressure/negative pressure sensor is adopted to detect the negative pressure of the vacuum booster.



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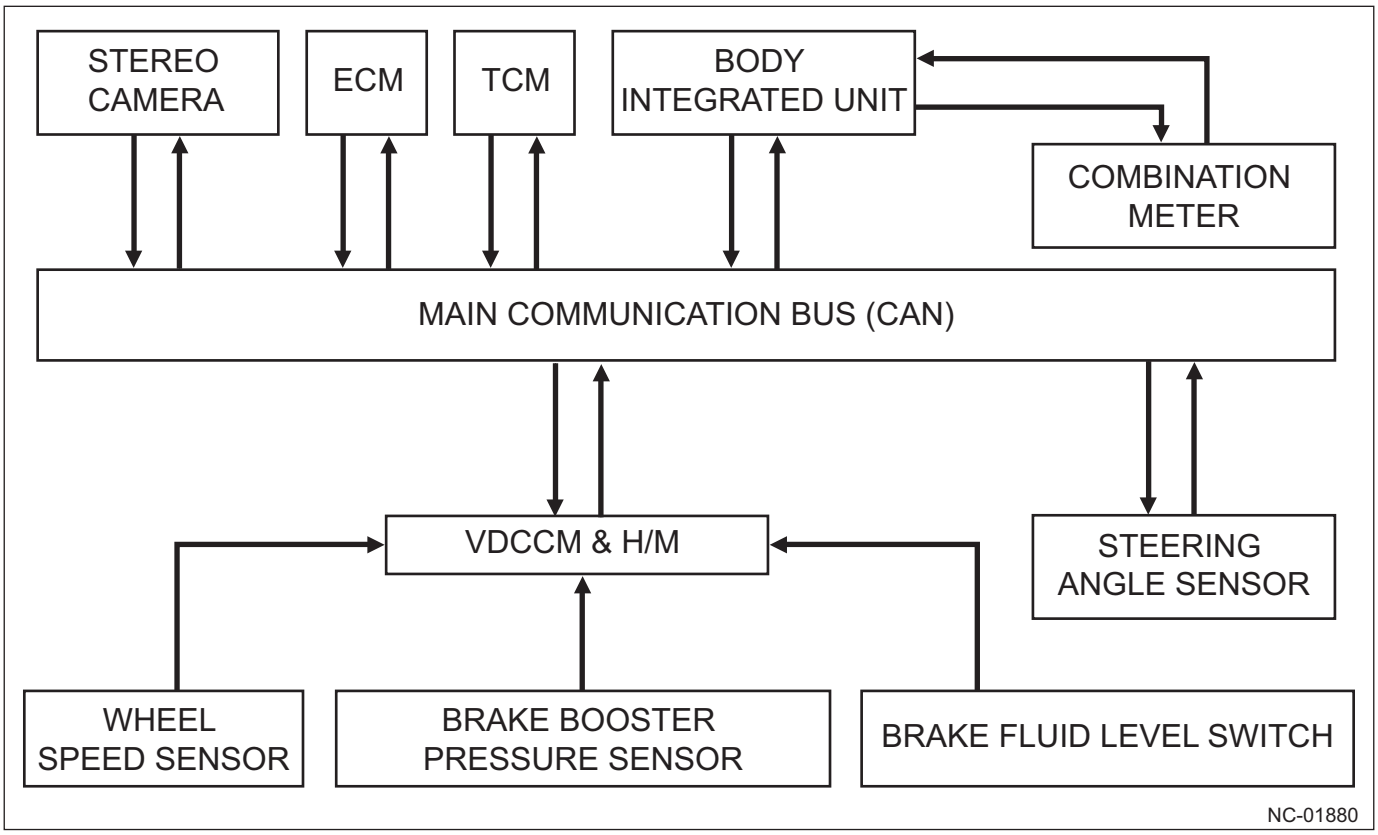
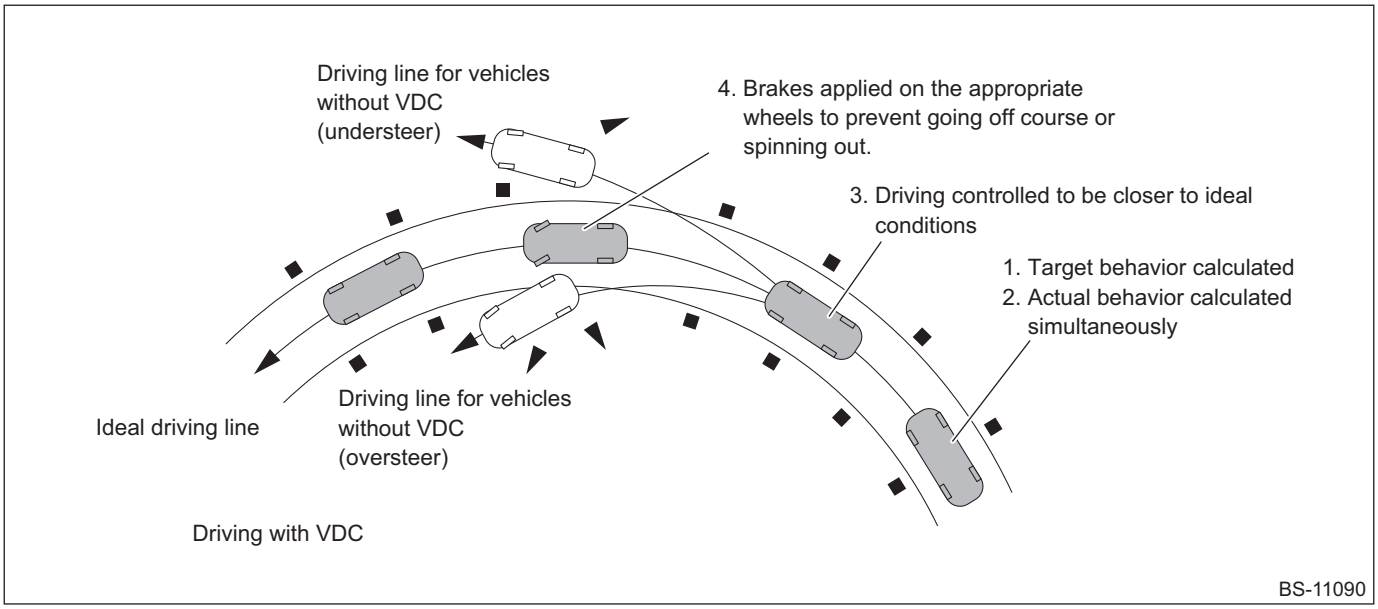
6.3.3 Construction and Operation

System diagram



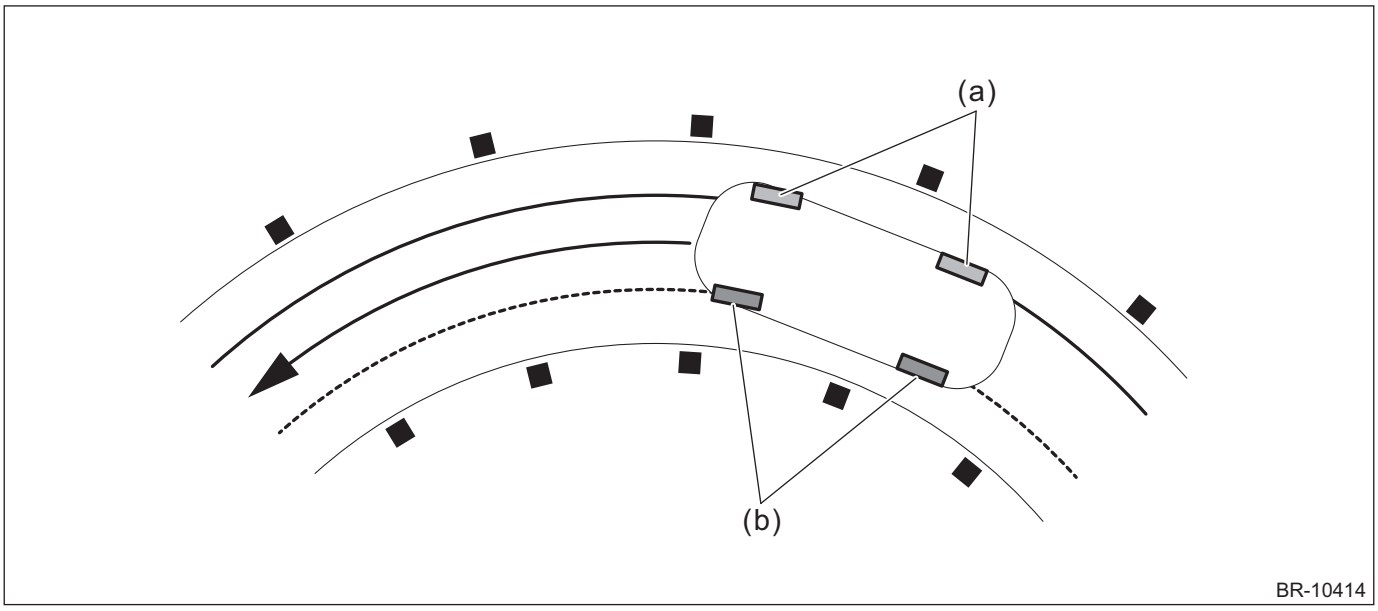
System details

The yaw rate and longitudinal G sensors, and lateral G sensors are integrated into the VDC control module and hydraulic control module (VDCCM & H/M). They constantly monitor the vehicle status to optimize the timing at which the ABS (anti-lock control), TCS (engine control and brake LSD control), and VDC (engine and brake control to prevent sideslip) are activated. Thus, high driving safety is ensured with these controls.



Active torque vectoring

A system is added that applies brake pressure to the inside wheel and distribute more torque to the outside wheel when the vehicle is cornering to improve the maximum turning performance.



(a) Driving force (b) Brake

Brake assist

A control system is installed that determines whether brake assist is required based not only to the force applied to the brake pedal but also to the speed at which the brake pedal is depressed, and applies brake assist accordingly to improve safety.

Trailer stability assist (TSA)

Trailer stability assist detects sway of a trailer (trailer sway) when towing and settles the sway before leading to dangerous behaviors (steering loss, jackknife, etc.).

Hill descent control (HDC)

Hill descent control operates automatically when the speed is likely to increase on a downhill slope etc. while the vehicle is controlled with X-MODE, enabling the vehicle to travel at a constant speed. Speed adjustment is controlled by controlling the brakes automatically.

- While the vehicle is traveling at 15 km/h (9.32 mph), depress the accelerator pedal to increase the speed to 20 km/h (12.43 mph). After that, the vehicle maintains its speed of 20 km/h (12.43 MPH) even if the accelerator pedal is released.
- While the vehicle is traveling at 20 km/h (12.43 MPH), depress the brake pedal to decrease the speed to 15 km/h (9.32 MPH). After that, the vehicle maintains its speed 15 km/h (9.32 MPH) even if the brake pedal is released.

Caution
Hill descent control (HDC) does not operate when the brake pedal or accelerator pedal is operated so that the driver's operation is prioritized.
Since the control is not performed by estimating an incline but by vehicle speed information, the vehicle speed can be maintained even when the vehicle enters a downward slope from a level road.
Also, as the brake is controlled by hill descent control (HDC), the driver can entrust brake operation to the vehicle when traveling downhill and in curves to concentrate on operating the steering wheel.

Auto vehicle hold (AVH)

When the foot is released from the brake pedal after the vehicle is completely stopped by depressing the brake pedal, the VDC control module and hydraulic control module (VDCCM & H/M) keep the brake fluid pressure.

This function detects start operations by the driver (accelerator pedal operation, etc.) to cancel the vehicle hold state.

■ Operation

When the AVH switch is pressed while the AVH indicator light is turned off, the function is activated and the AVH indicator light turns on (standby state). When the AVH switch is pressed while the AVH indicator light is turned on, the function is disabled and the AVH indicator light turns off. When the AVH function is activated while the AVH indicator light is turned on (standby state), the AVH operation light turns on in the combination meter or on the multi-function display (MFD).

When the ignition switch is OFF, the AVH is deactivated.

■ Activation and cancelation operations

The AVH function is activated in the following conditions.

- The system is in the standby state by pressing the AVH switch.
- The brake pedal is depressed to stop the vehicle.
- The door is closed.
- The driver is wearing the seat belt.
- The shift position is set to a position other than the P position.

The AVH function is canceled in the following conditions.

- The accelerator pedal is depressed or the brake pedal is depressed again.
- The shift position is set to the P position while the brake pedal is depressed.
- The auto vehicle hold switch is pressed while the brake pedal is depressed.
- ACC is set while the brake pedal is depressed deeply.
- The parking brake switch is pulled.

The AVH operation light turns off when the function is canceled.

In the following conditions where the AVH function is activated, the AVH function is canceled and then the brake setting shifts automatically to the electronic parking brake (EPB).

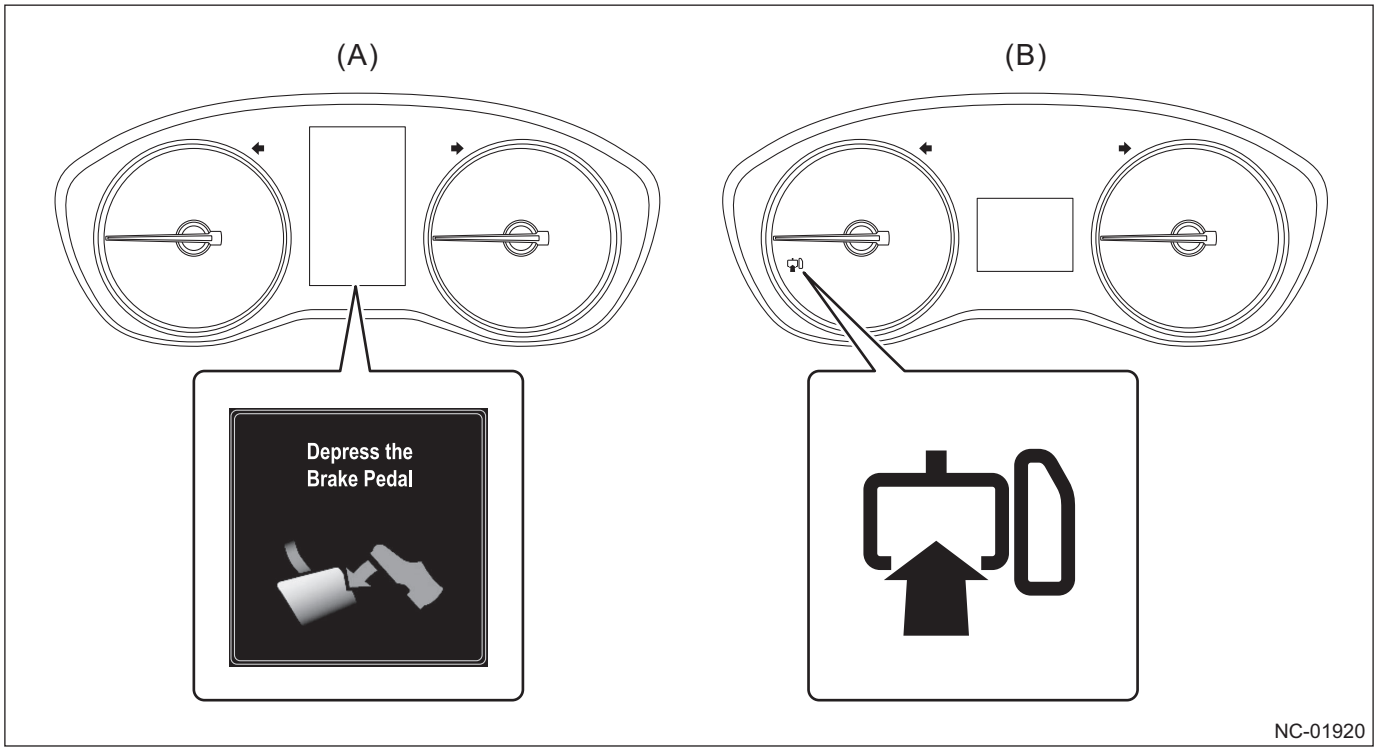
- Brake continues to be held for 10 minutes or longer.
- The driver's seat belt is unfastened.
- The driver's seat side door is opened.
- The ignition is set to OFF.
- A problem occurs in the AVH system.
- The vehicle stops on a sharp upslope.

The AVH operation light turns off when the function is canceled.

■ Brake depressing instruction display

If the AVH switch is turned off without depressing the brake pedal while the AVH is operating, a warning message is displayed or the warning light turns on in the combination meter to give a brake pedal-depressing instruction.

Also, if an abnormality is detected while the AVH is operating, a warning message is displayed or the warning light turns on in the combination meter.



(A) High grade meter (B) Normal meter

■ Warnings and cautions

Warning

Do not use the AVH function for the purpose of parking. The vehicle may begin to move suddenly and may cause serious injuries.
Make sure to turn off the AVH function when using a car washer or when the vehicle is towed by another vehicle.
Do not use the AVH function on a sharp upslope or a slippery road.

Caution

If the vehicle stops on a sharp upslope while the AVH function is activated, the electronic parking brake (EPB) may be activated and the electronic parking brake operation indicator may blink after the vehicle is stopped. In this case, since the vehicle may begin to move, keep the brake pedal depressed while the vehicle is stopped. When leaving the vehicle, move it to a level ground and activate the electronic parking brake (EPB) to park the vehicle.
Do not release the brake pedal until the AVH operation light turns on when using the AVH function. Doing so may cause the vehicle to move suddenly.
Depending on road surface conditions or how much the brake pedal is depressed, the vehicle may be temporarily held or the brake pedal may become hard, causing unusual operational feeling. This is not a malfunction.

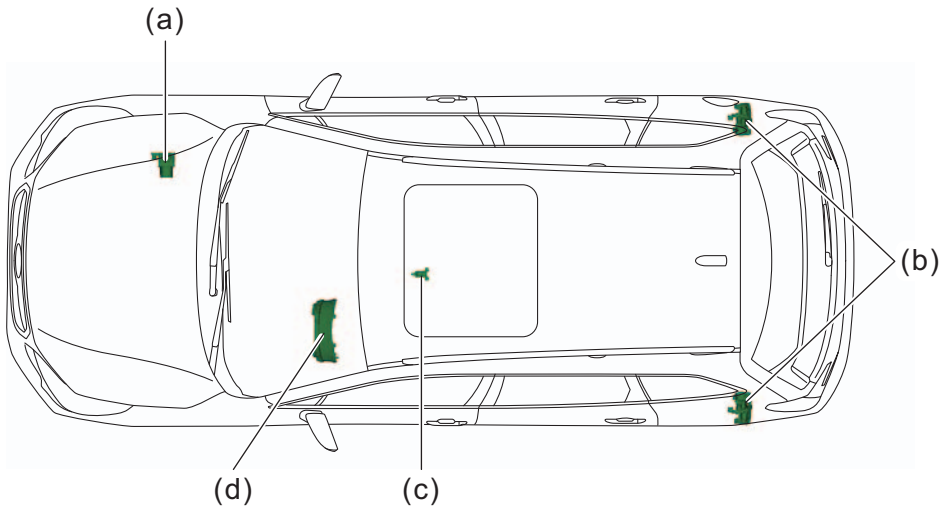
6.4 Electronic Parking Brake

6.4.1 Overview

The brake system is changed from the drum type parking brake system to the electronic parking brake (EPB). The parking brake lever is removed to realize comfortable indoor space. This also ensures the stable braking force of the parking brake while the parking brake lever operation is not required.

6.4.2 Component

Component layout drawing



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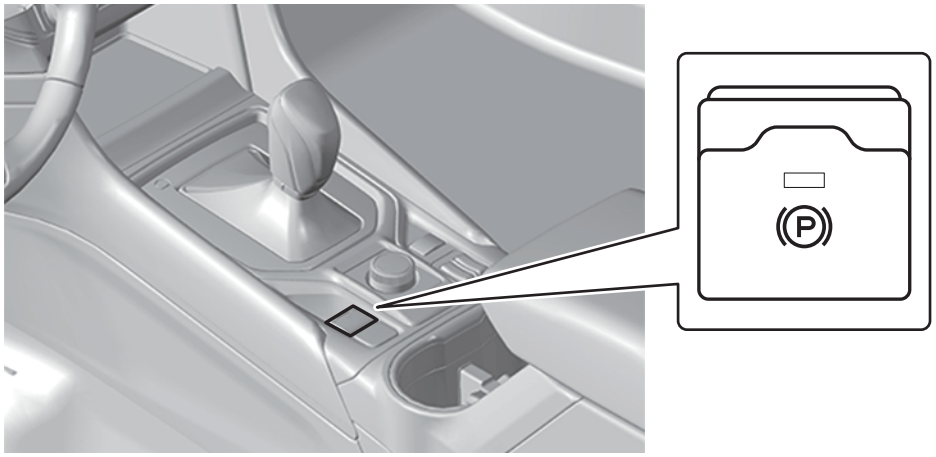
(a) VDC control module and hydraulic control module (VDCCM & H/M)
(b) Electronic parking brake actuator (with caliper built in)
(c) Parking brake switch
(d) Electronic parking brake operation indicator (in the combination meter)

Component details

Parking brake switch

A switch is installed on the center console so that the driver can operate it easily.



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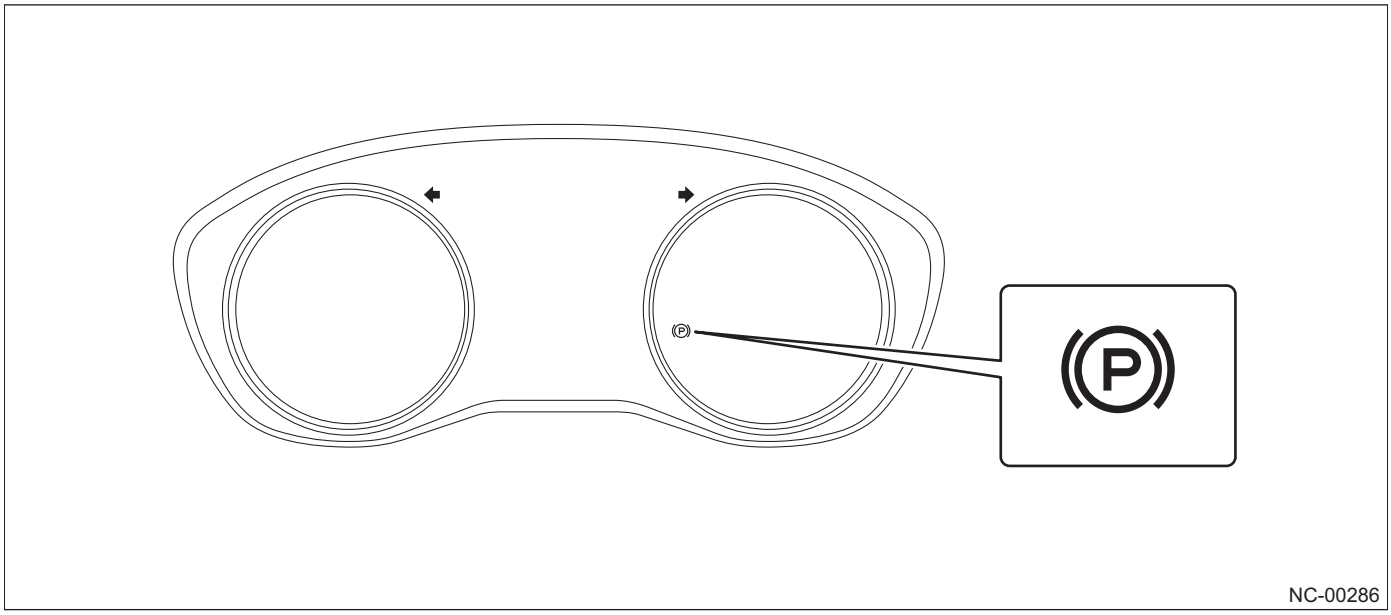
Electronic parking brake operation light

When the electronic parking brake is activated, the electronic parking brake operation light arranged in the combination meter turns on.



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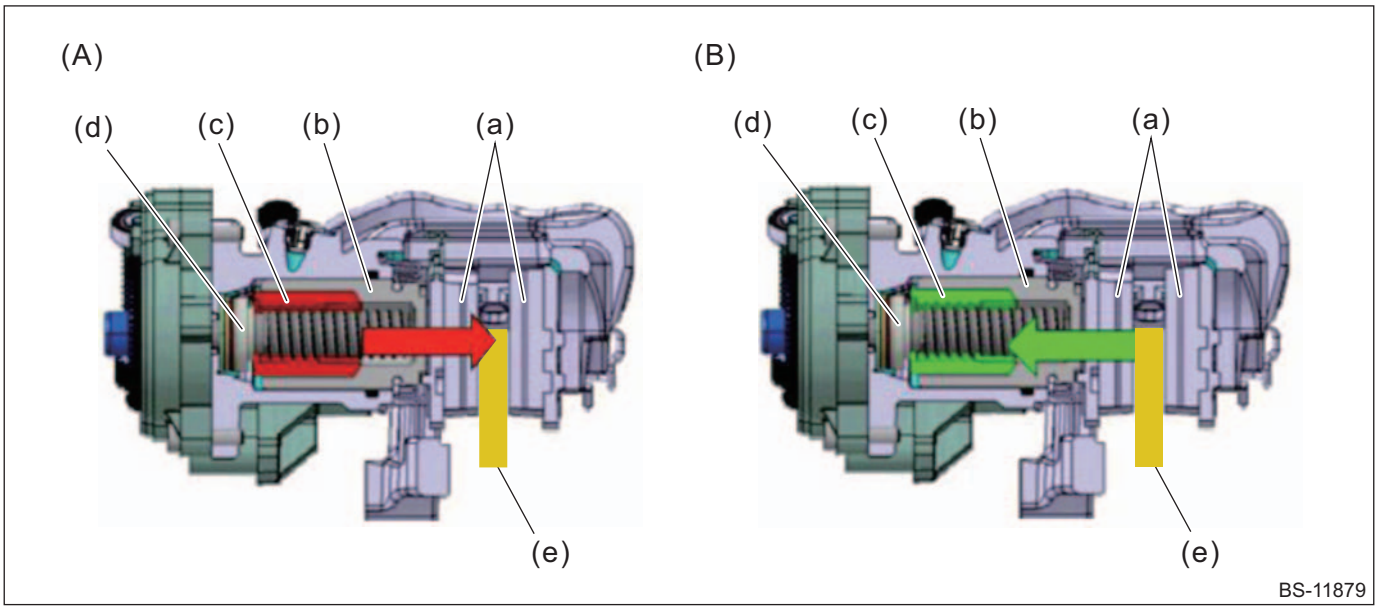
Electronic parking brake

An actuator is mounted inside the rear brake caliper. The motor is driven to push out the brake pad by the parking brake switch operation and the parking brake is applied.



(A) When operated

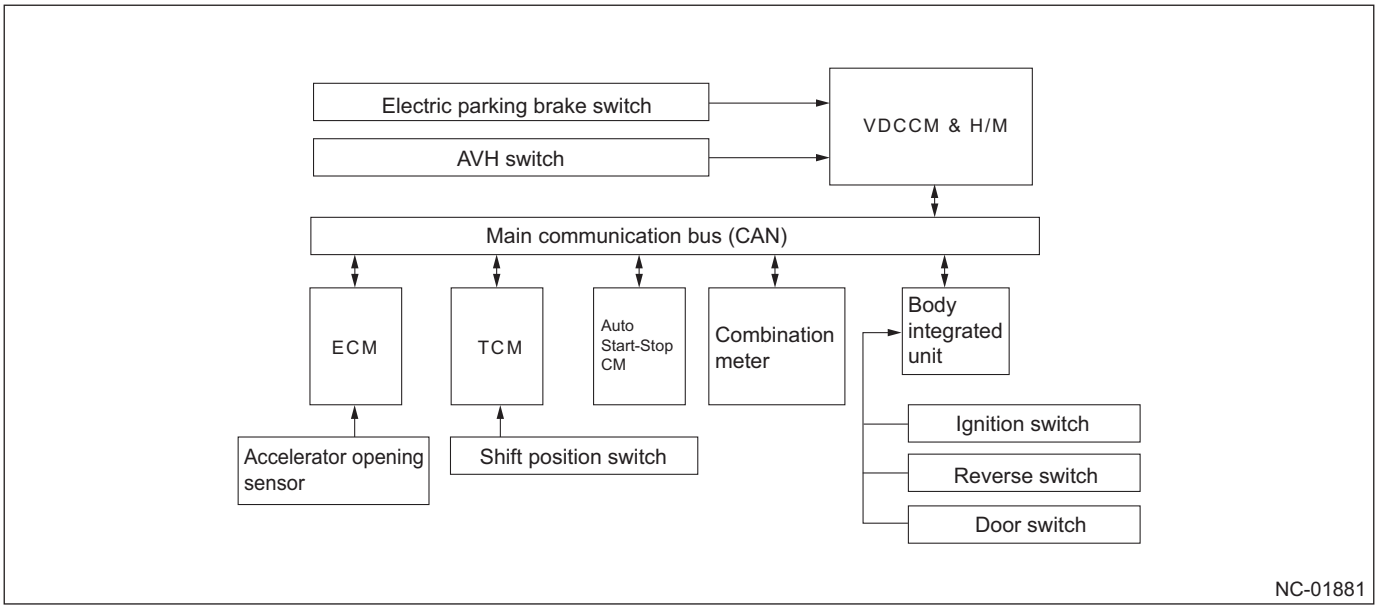
(a) Brake pad
(b) Piston
(c) Nut

(B) When released

(d) Motor section
(e) Disc rotor

6.4.3 Construction and Operation

System diagram

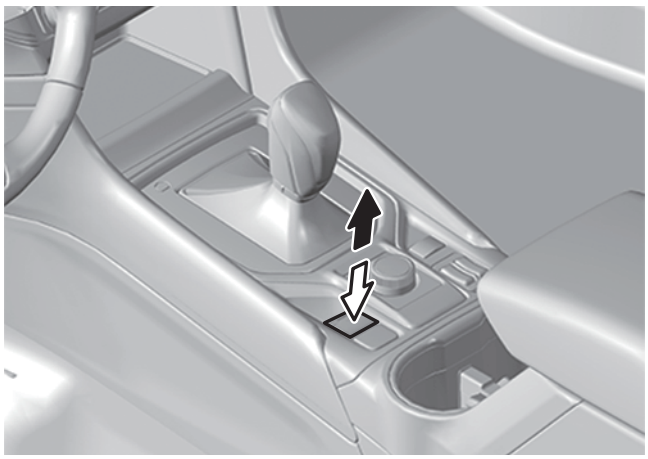


System details

Electronic parking brake (EPB) function

The electronic parking brake operates (EPB) by pulling up the parking brake switch (toward the black arrow) when the ignition is ON, and then the electronic parking brake operation indicator in the combination meter and LED of the parking brake switch unit turn on. The electronic parking brake (EPB) is released by pushing down the parking brake switch (toward the white arrow), and then the electronic parking brake operation indicator in the combination meter and LED of the parking brake switch unit turn off. Also, the electronic parking brake (EPB) can operate when the ignition is OFF.

If there is an abnormality in the electronic parking brake (EPB) system, the electronic parking brake warning light (red) turns on.



NC-00287

■ Accelerator interlocking function

This function detects start operations by the driver (accelerator pedal operation, etc.) to automatically release the electronic parking brake (EPB).

If the driver is not wearing a seat belt when opening the door, the automatic cancelation is prohibited to prevent erroneous cancelation. (Manual cancelation is possible.)

■ Warnings and cautions

Caution
While the auto vehicle hold (AVH) function is activated, if the driver's door is opened or the driver's seat belt is unfastened, the parking brake operates but is not released even by operating the accelerator pedal.

7 STEERING

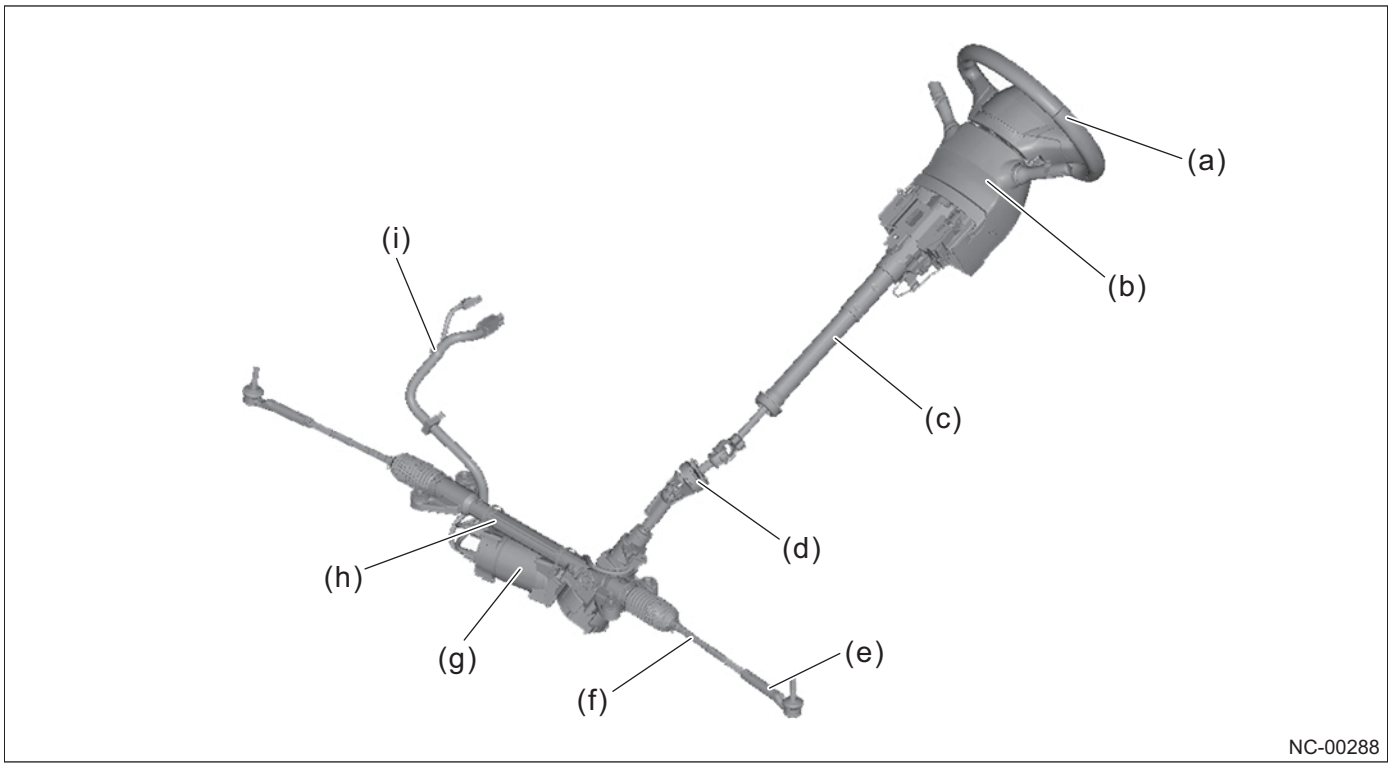
CONTENTS

7.1 General Overview

7.1.1 Overview

In this chapter, steering mechanisms such as a steering wheel and a steering column, and power assisted system that assists steering force are described.

7.1.2 Structure



(a) Steering wheel
(b) Column cover
(c) Steering column
(d) Universal joint assembly
(e) Tie-rod end
(f) Tie-rod
(g) Control module-integrated motor
(h) Gearbox
(i) Harness

7.2 Steering

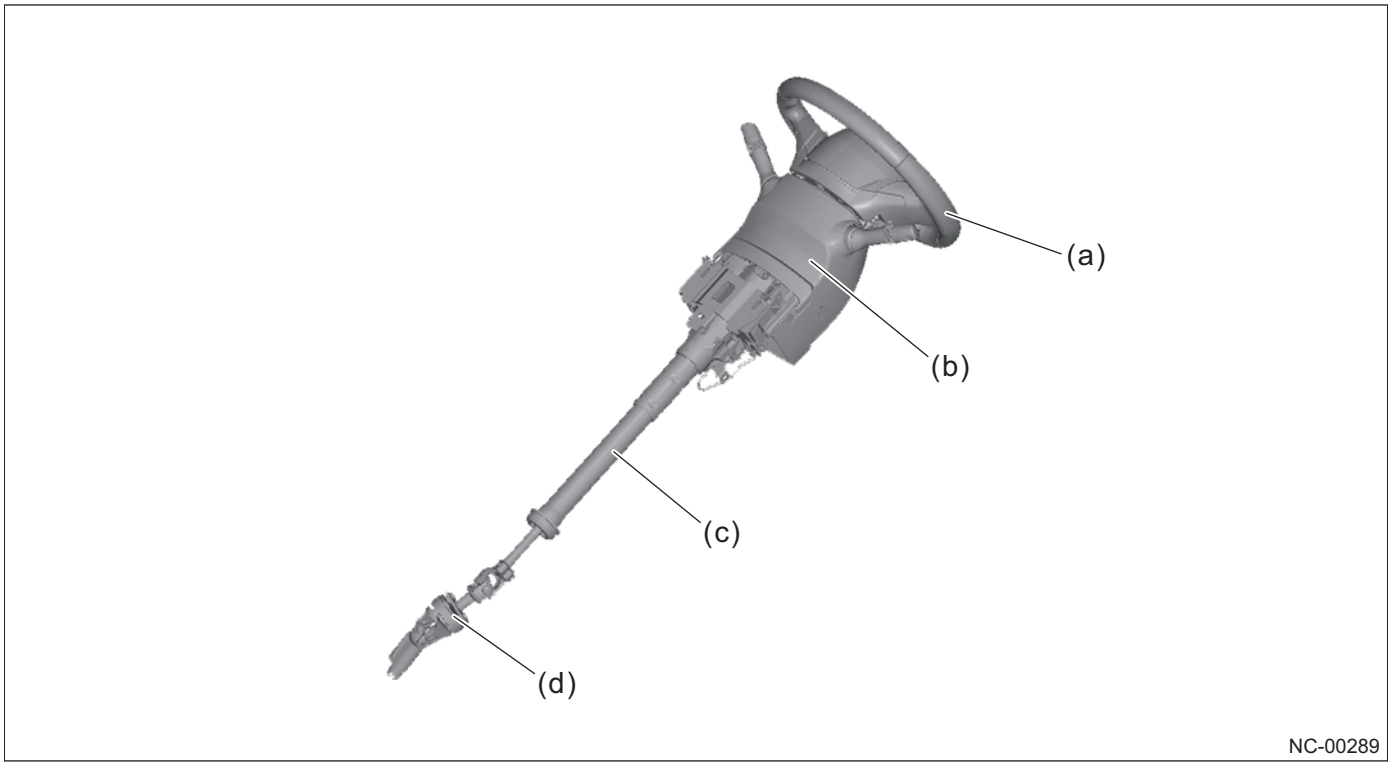
7.2.1 Overview

The following changes to steering are made to improve safety and operability.

- Steering wheel with smaller diameter
- Steering heater relay (for some grades)
- Steering column with sufficient collapse stroke amount and increased tilt/telescopic adjustment amount

7.2.2 Component

Component layout drawing



(a) Steering wheel
(b) Column cover
(c) Steering column
(d) Universal joint assembly

Component details

Steering wheel

The diameter of the steering wheel is reduced from ϕ 14.8 in to ϕ 14.6 in (from ϕ 375 mm to ϕ 370 mm) to achieve quick handling characteristics. The following materials are provided for the surface of the steering depending on the grade.

- Urethane
- Genuine leather (silver stitch)
- Genuine leather (red orange stitch)

NC-00290

Steering column

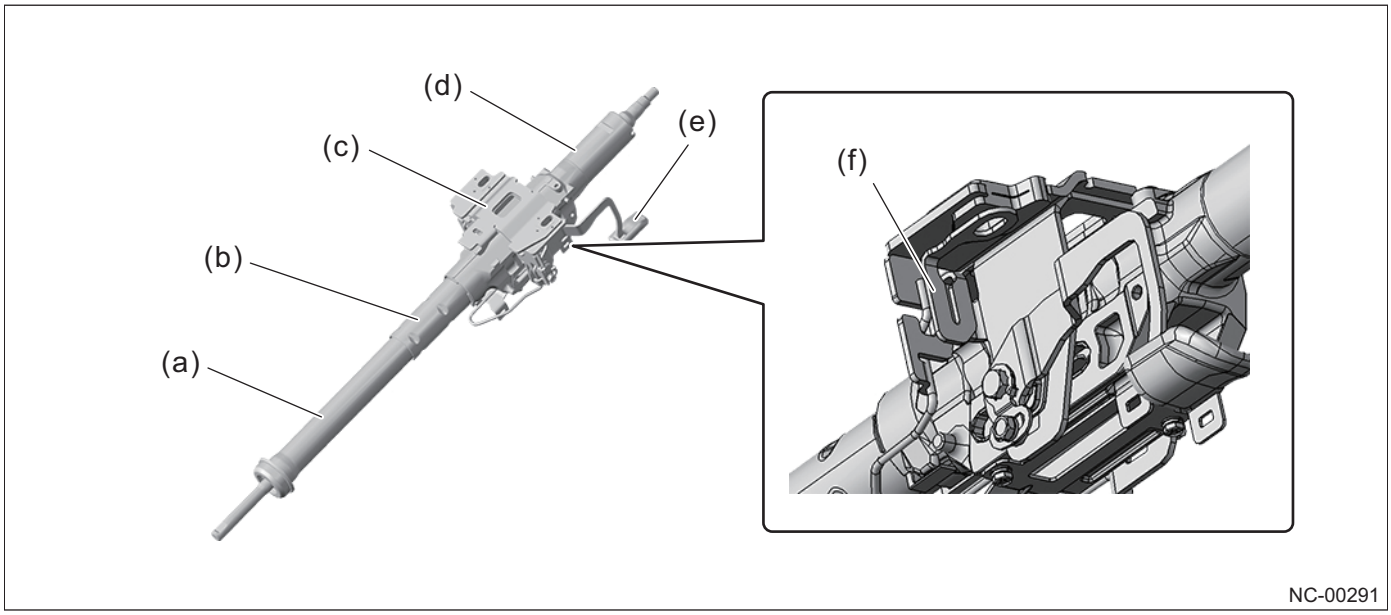
The following two structures are adopted to minimize the collision impact on passengers at front collision.

- The collapse (contraction) mechanism is provided between the lower jacket and the middle jacket to prevent the steering wheel from protruding to the cabin as the engine moves backward.
- The separation structure is provided between the vehicle body and the tilt bracket to minimize the collision impact of the steering wheel and passengers.

The movable range of the tilt and telescopic is enlarged to realize the most suitable driving posture.

- Tilt adjustment amount: 1.65 inch (42 mm) to 2.13 inch (54 mm)
- Telescopic adjustment amount: 1.57 inch (40 mm) to 2.17 inch (55 mm)

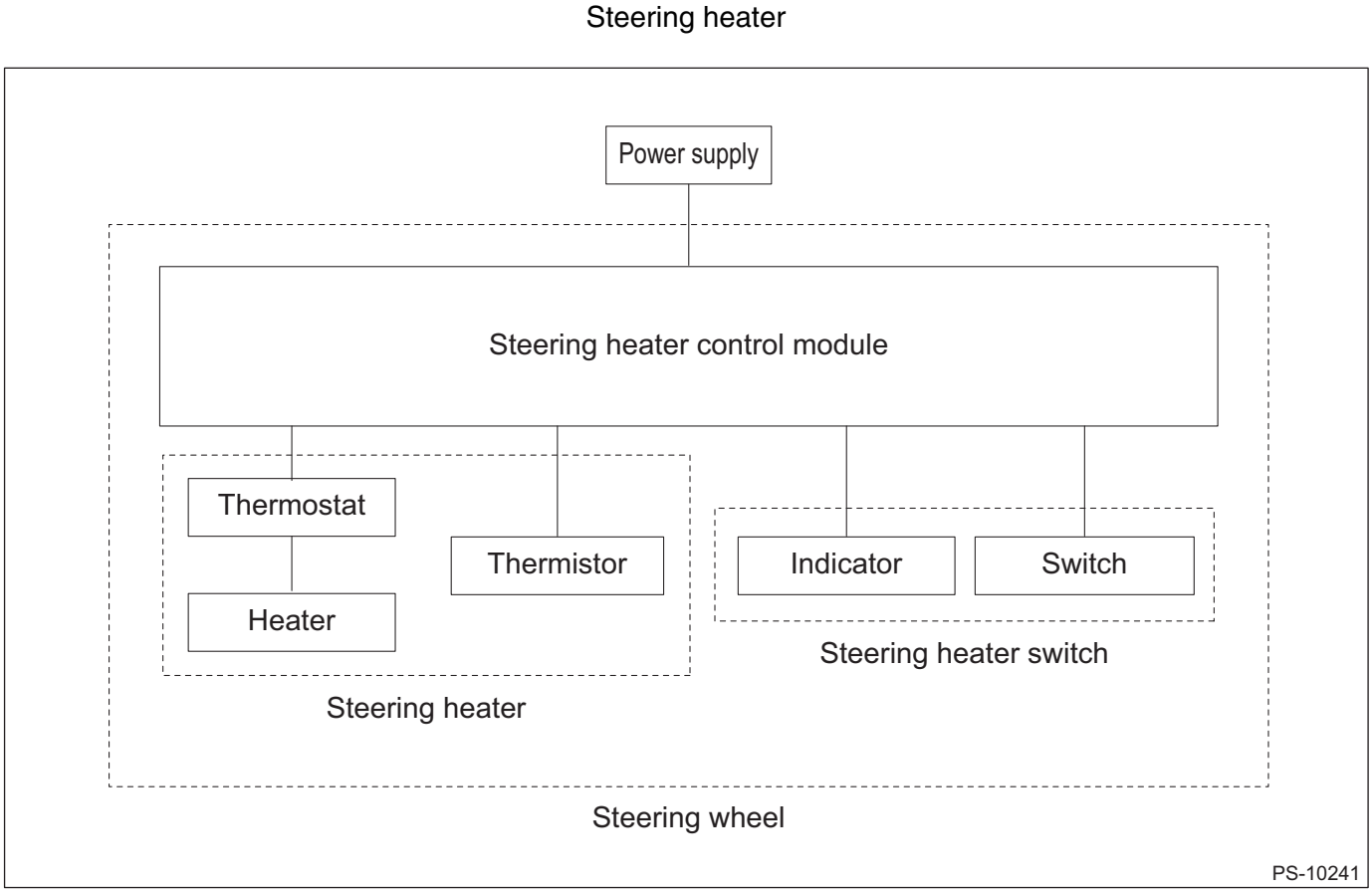
The high rigidity and lightweight steering column is adopted to enable stable steering and to reduce steering vibration.



(a) Lower jacket
(b) Middle jacket
(c) Tilt bracket
(d) Upper jacket
(e) Tilt lever
(f) Ripping plate

7.2.3 Construction and Operation

System diagram

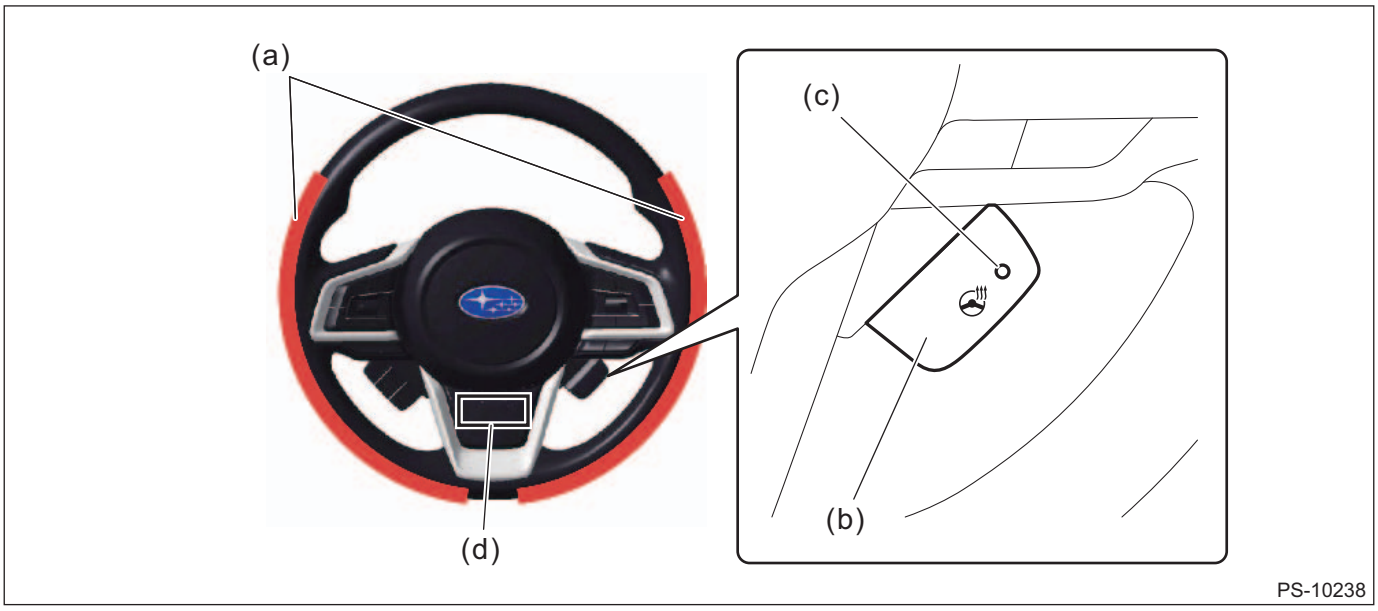


System details

Steering heater

A signal is input to the steering heater control module when the steering heater switch of the steering wheel is turned on while the ignition switch is ACC or ON. The steering heater control module turns on the steering heater and steering heater operation indicator light, and the steering heater operates. The steering heater gradually warms the heating area of the steering wheel and the steering heater control module controls the temperature to a constant value based on the temperature detected by the thermistor.

The steering heater control module starts countdown when the switch is turned on and then turns off the steering heater after approximately 30 minutes.



(a) Steering heater heating area
(b) Steering heater switch
(c) Steering heater operation indicator light
(d) Steering heater control module (built into steering hole)

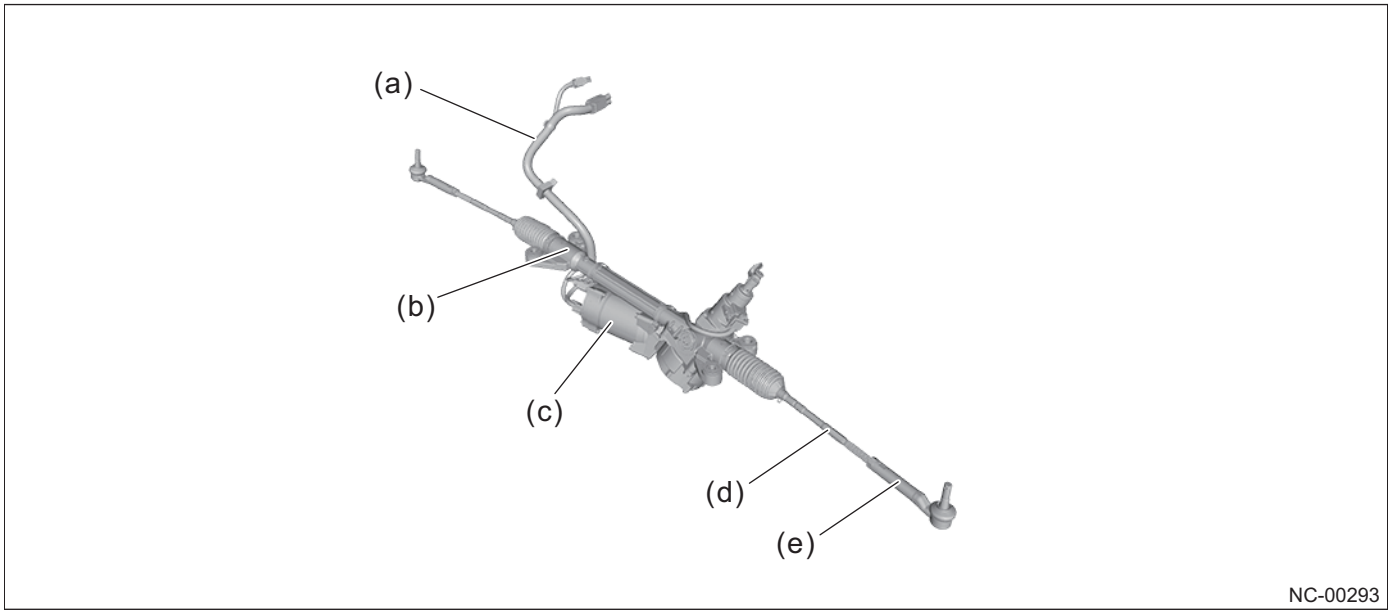
7.3 Power Assisted System

7.3.1 Overview

VGR (Variable Gear Ratio) is adopted for the power assisted system to improve handleability and vehicle stability.

7.3.2 Component

Component layout drawing

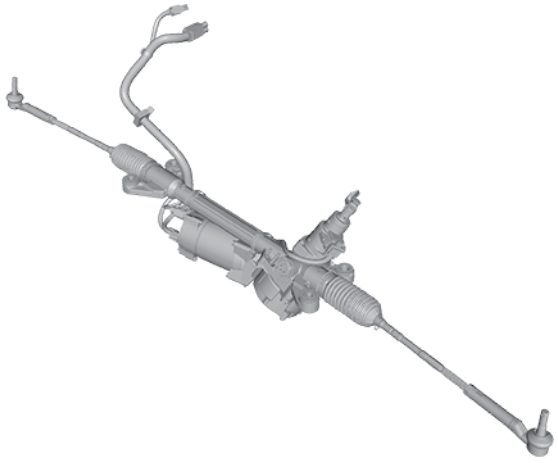


(a) Harness
(b) Gearbox
(c) Control module-integrated motor
(d) Tie-rod
(e) Tie-rod end

Component details

Gearbox

VGR (Variable Gear Ratio) which increases the gear ratio near the steering center and decreases the gear ratio as the steering angle increases is adopted to improve handleability at low speed and vehicle stability at high speed.



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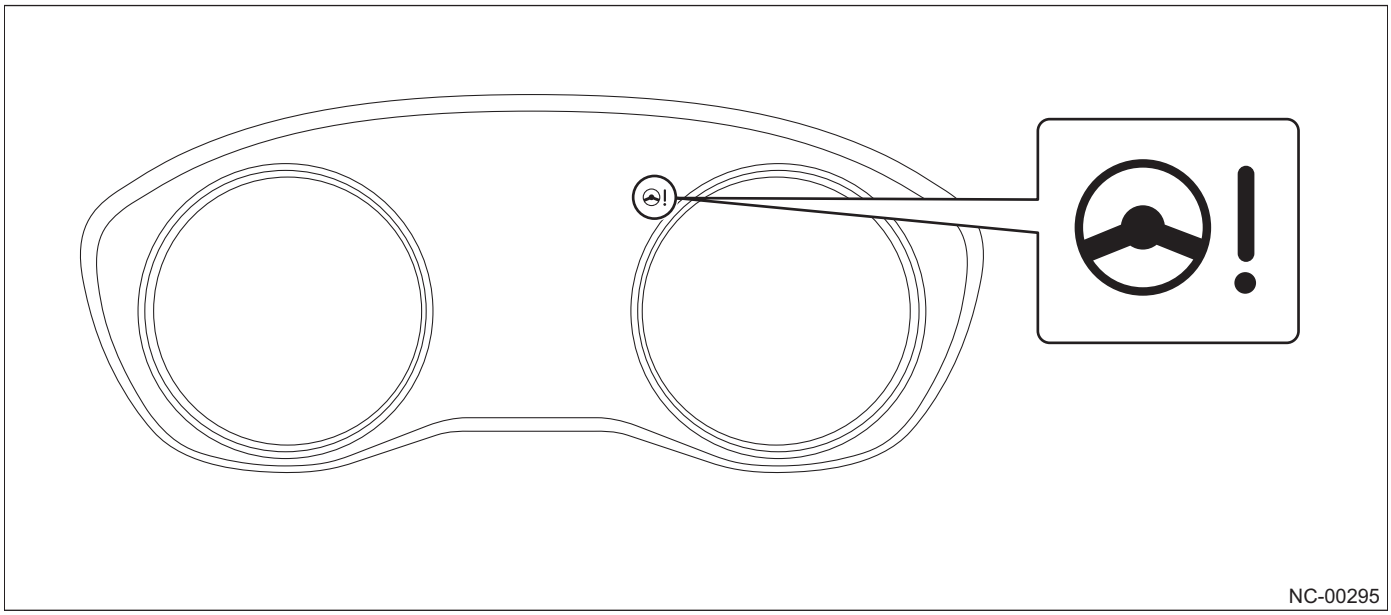
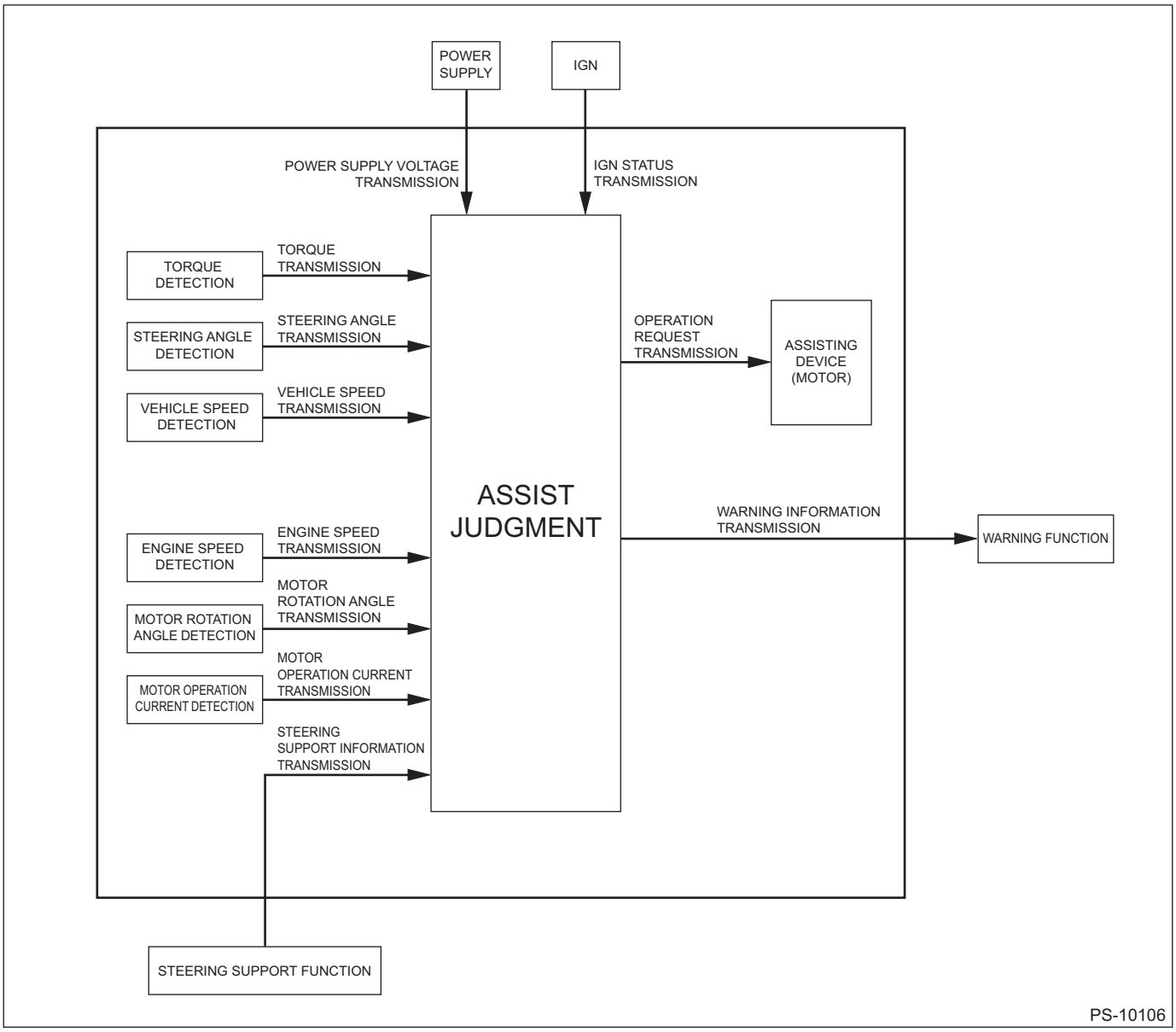
Steering control warning light

When an abnormality occurs in the system, the fail-safe function operates and the steering control warning light in the combination meter turns on to alert the driver to the abnormality. When the fail-safe function operates, the steering functions as manual steering (without assist).



7.3.3 Construction and Operation

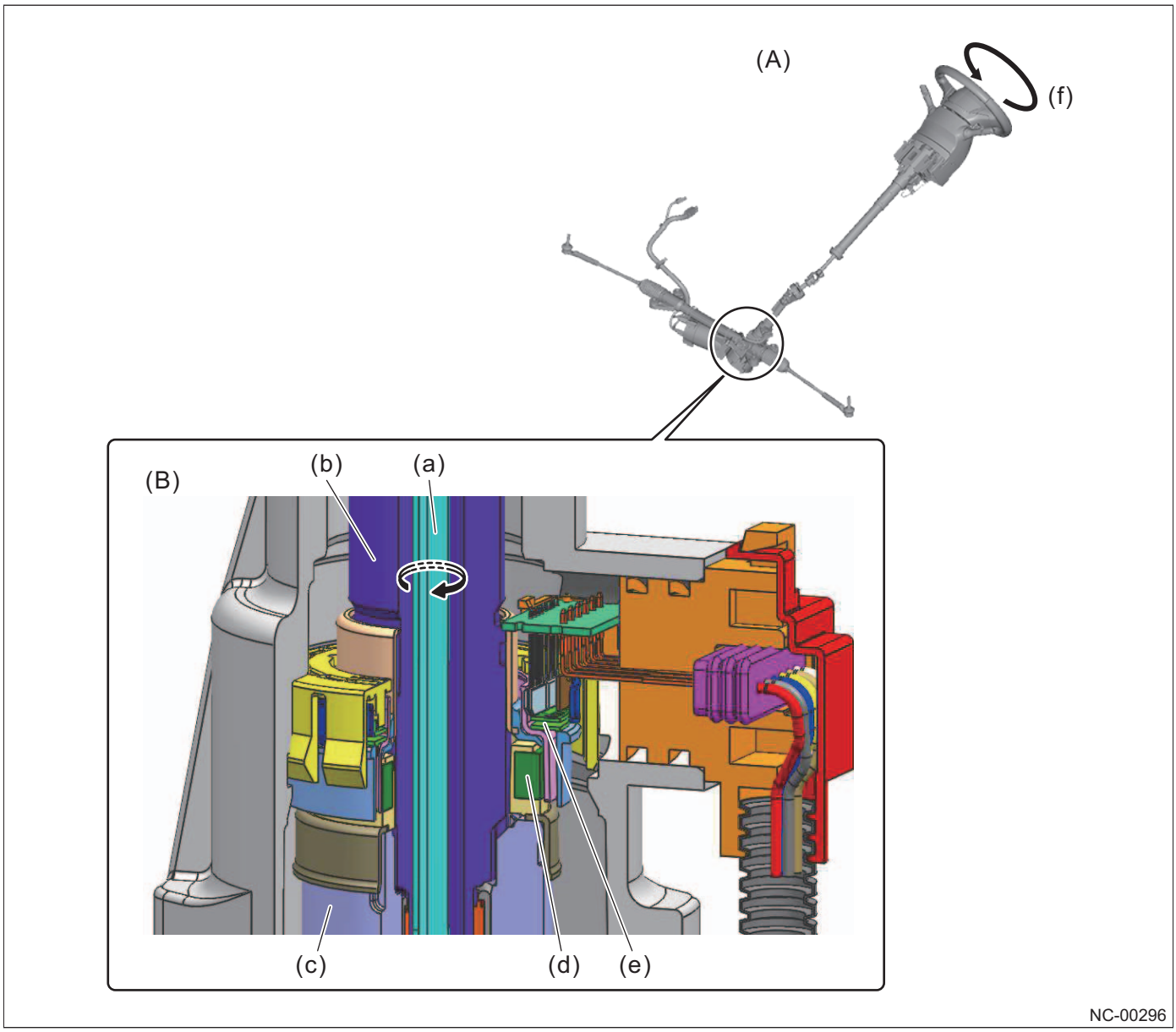
System diagram



System details

Electric power steering

The input shaft is coupled with the pinion shaft through the torsion bar. The relative angle change occurs between the input shaft and the pinion shaft when operating the steering due to a twist of the torsion bar caused by the steering torque. The torque sensor detects change in magnetic force caused by angle change using the hall IC and outputs the value of the change as steering torque value to the EPS control module. The EPS control module controls the motor assist based on the signal from the torque sensor.



(A) Overall steering system view

(B) Enlarged cross-section

(a) Torsion bar
(b) Input shaft
(c) Pinion shaft
(d) Magnet
(e) Hall IC
(f) Steering torque

8 BODY STRUCTURE

CONTENTS

8.1 General Overview

8.1.1 Overview

Subaru Global Platform is adopted and the following main measures are taken.

- Body rigidity and steering stability are improved to realize more comfortable ride quality.
- Reduction of vibration and noise
- The body structure is improved and high-strength materials are adopted to improve collision safety performance.

The body structure is improved and soundproofing is added to improve quietness.

Materials and structure are revised to reduce body weight.

The body shape is optimized to improve aerodynamic performance.

8.2 Subaru Global Platform (SGP)

8.2.1 SGP Overview

SGP is a next generation platform developed to be compatible with future electrification of vehicles and to realize development of all vehicle types with a single platform design concept.

While planning the major specification for all car lines at once, the platform is flexibly changed for each car line. This approach raises the base competitiveness of the entire SUBARU lineup and allows for development that takes advantage of the characteristics of each car line. SGP aims to improve safety performance as well as steering stability and response, reduce vibration and noise, and improve "dynamic quality feel" which will enhance safety and comfort of the driver and passengers.

In addition to gasoline engines, this single design concept is compatible with various power units that will be required in the future such as hybrid, plug-in hybrid, and electric vehicles.

Main characteristics of SGP

Improvement in steering stability and response

Quick response to steering operation and stable driving are made possible by significant improvement of rigidity of the body and chassis components, advancement in undercarriage mechanisms including suspensions, and lower center of gravity. Also, drivability which is realized with steering that has no unnecessary motion, providing a feel of firmly contacting the ground just like sticking to the road, and with straight-line stability that will be required for autonomous driving in the future.

Reduction of vibration and noise

The frame structure is optimized and component joints are strengthened to improve body torsional rigidity. In addition, body resonance and distortions are dispersed to greatly reduce steering, floor, and seat vibrations.

Improvement in comfort

Rigidities of suspension mount section are improved to allow the suspension to sufficiently cushion passengers from rough road conditions without any warp in vehicle body for a comfortable ride.

Improvement of collision safety performance

More stable ride is realized by further lowering the center of gravity, greatly improving the rigidity, and by making advancement in the undercarriage mechanism to realize hazard avoidance performance similar to a high performance sports model.

Collision energy absorption rate is improved by adopting frame structure that enables efficient energy absorption on collision and improving body strength by expanding the use of hot press molded material and other high-tensile strength steel.

8.2.2 Overview of Dedicated Design for New Vehicle Model

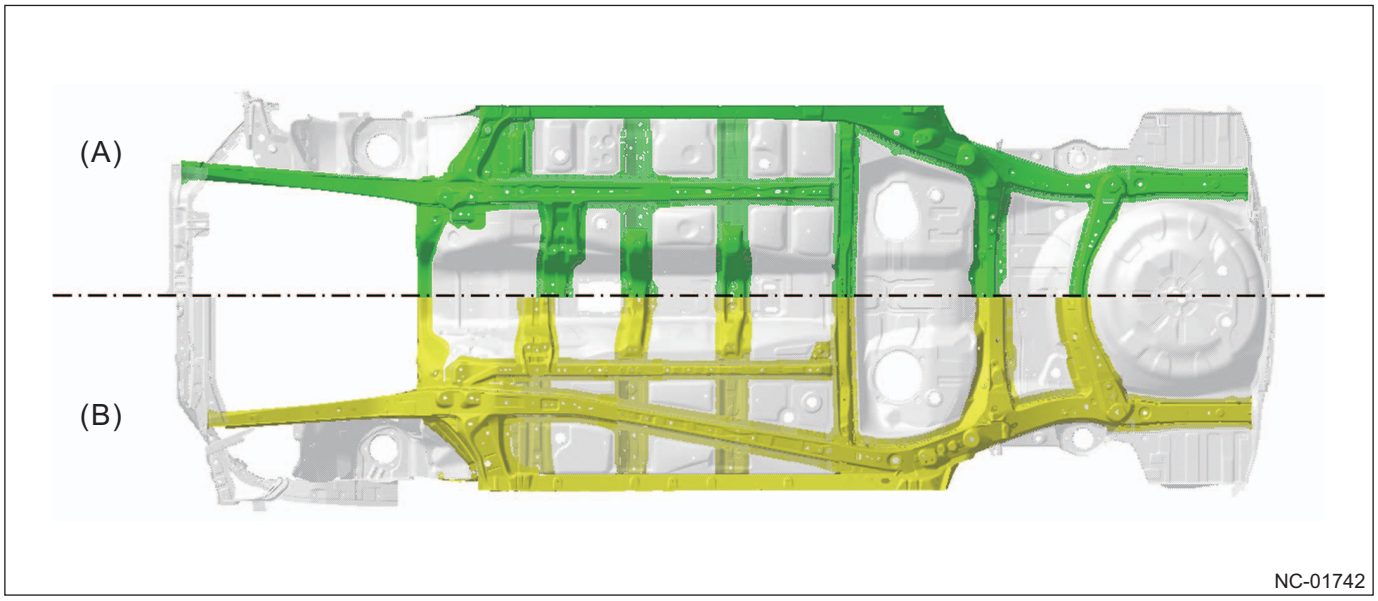
The following dedicated designs are adopted to further enhance "enjoyable driving" by balancing the maintenance of class-leading collision safety performance with the high dynamic quality feel.

Collision safety performance

- Improvement in efficiency of the energy absorption section
- Additional framework in the tunnel section
- Improvement in load bearing capacity of the cabin

Drastic improvement in rigidity of the whole body

- Strengthened coupling between the cabin and the front and rear frames by reinforcing the coupling around the front bulk and reviewing the plate assembly and the framework of the rear frame.
- Improvement in convergence of vibration by adopting the structural adhesive agent



(A) Existing model vehicle

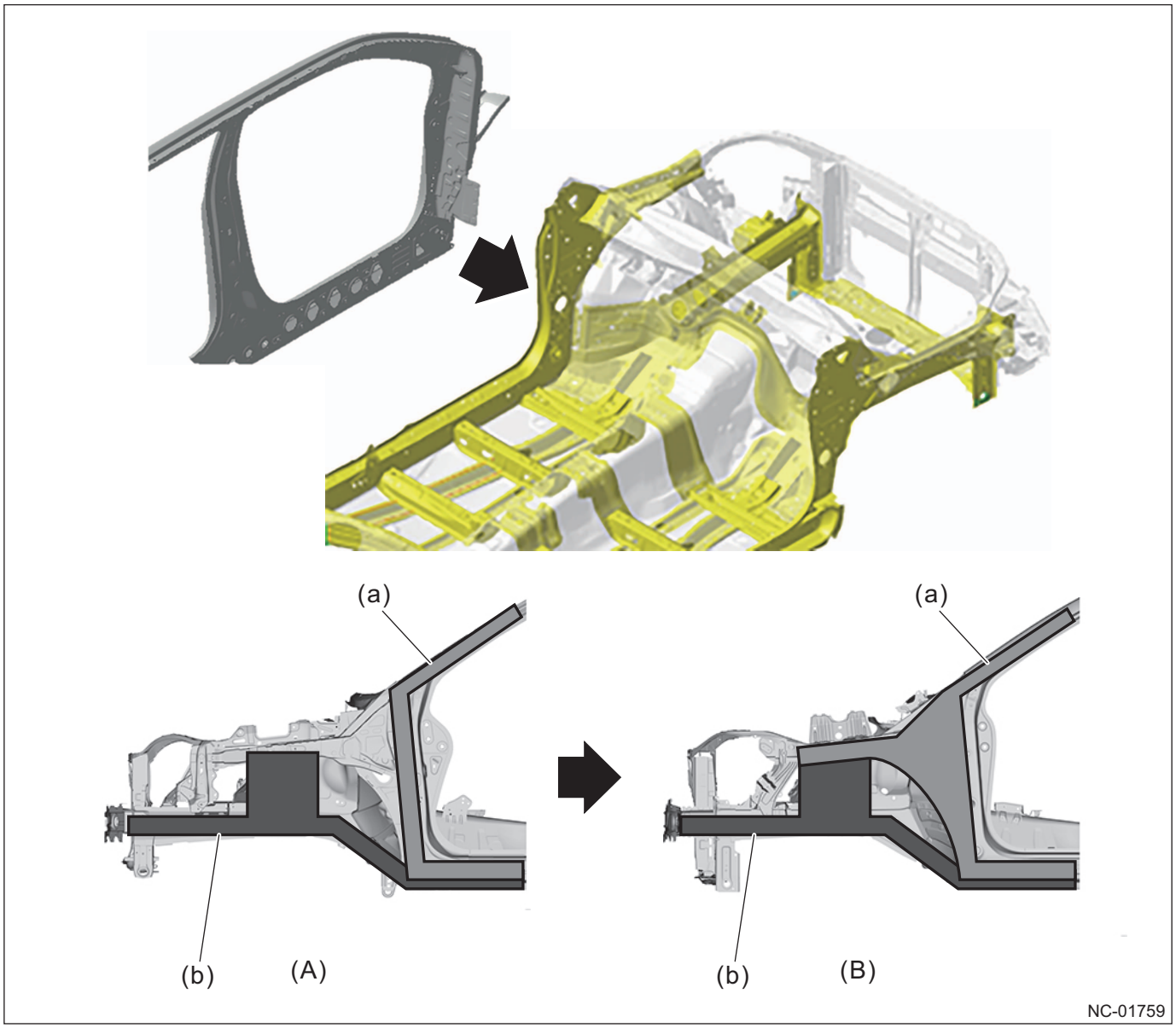
(B) New model vehicle

8.3 Body Structure Details

8.3.1 Body Structure that Realizes "Dynamic Quality Feel"

Around front bulk

To improve the dynamic quality feel, the inner body construction structure is adopted for the purpose of firmly coupling the framework of the upper body with the framework of the platform. The framework of the platform and the framework of the upper body are firmly coupled together using the inner panel.



(A) Existing model vehicle (weak coupling)

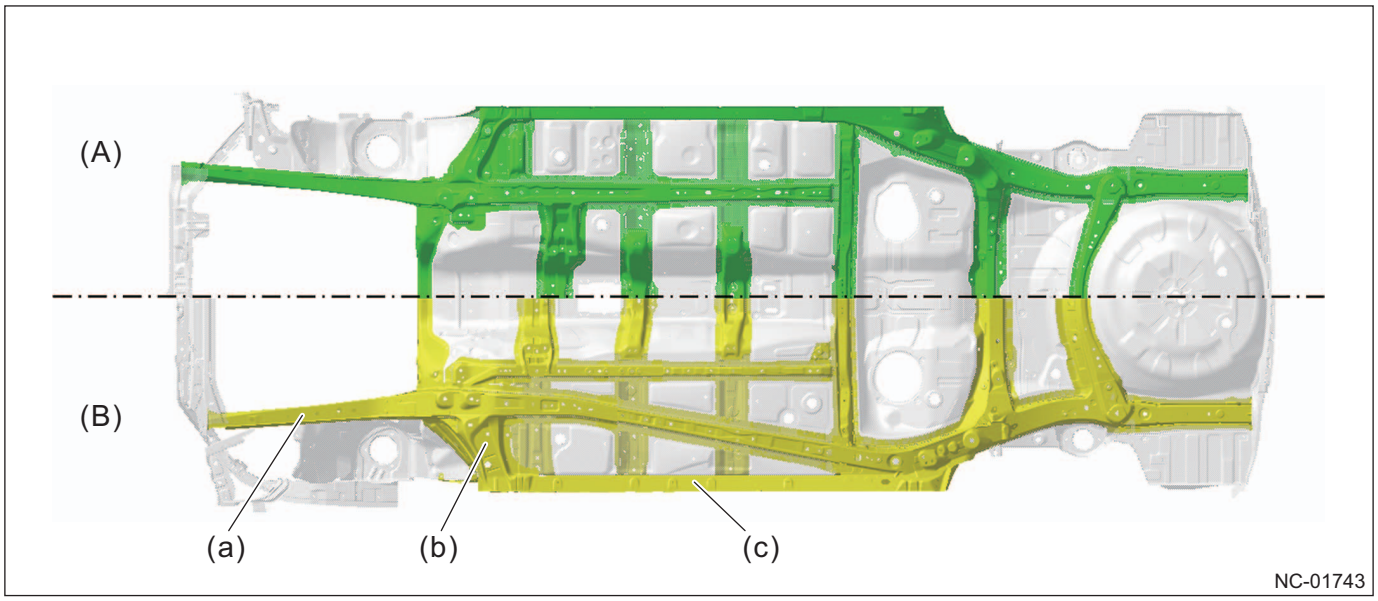
(B) New model vehicle (firm coupling)

(a) Framework of upper body

(b) Framework of platform

Front frame/torque box/side sill

The rigidity of the front frame is improved, and the rigidity from the torque box to the side sill is improved as well.



(A) Existing model vehicle

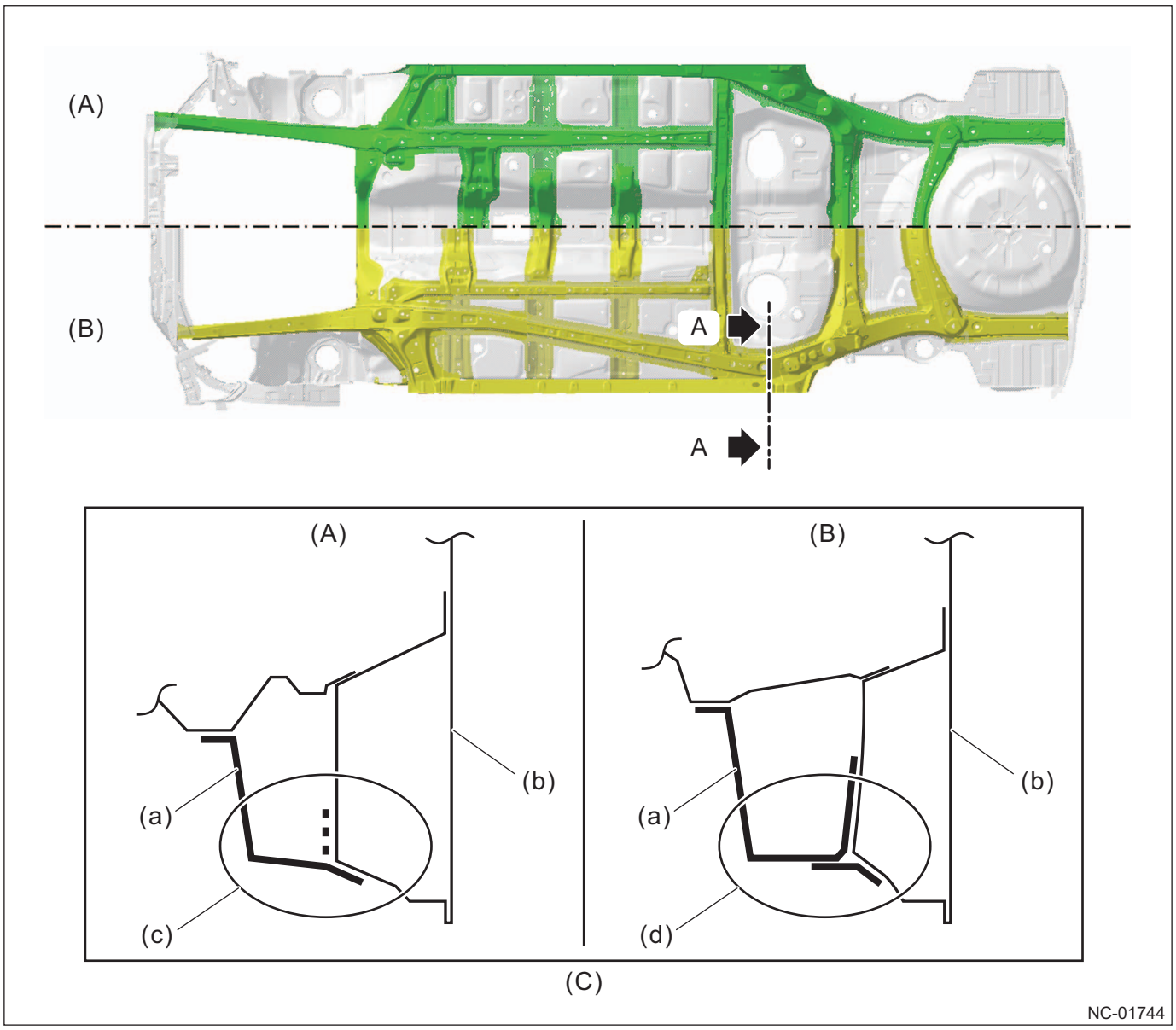
(B) New model vehicle

(a) Front side frame front
(b) Torque box

(c) Side sill

Rear frame

The coupling structure between the side sill and rear frame is strengthened to ensure the continuity of rigidity. The continuity is ensured by avoiding ridge line gap due to the bent back portion of the flange.



(A) Existing model vehicle
(B) New model vehicle

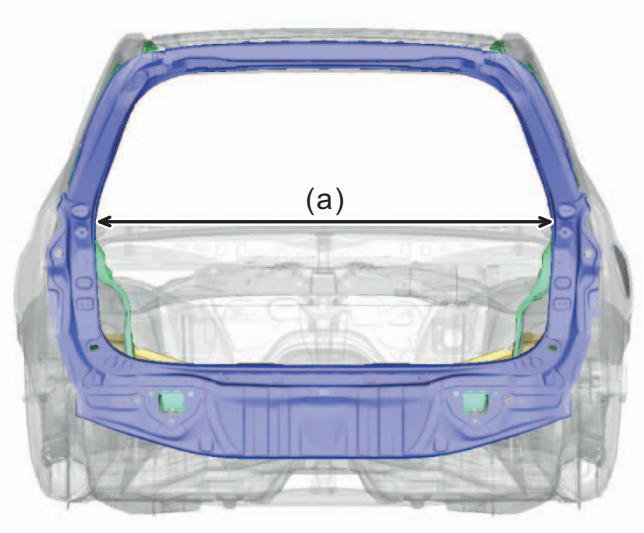
(C) A-A cross section

(a) Rear frame
(b) Side sill
(c) The ridge line is broken because the flange is bent back.

(d) The ridge line is not broken because the flange has no bent back portion.

Around rear

The structures around the rear quarter and rear gate opening are optimized to improve quietness, reduce unpleasant vibration, and improve ride quality. Also, the body rigidity around the rear gate is enhanced to enable the opening width of the rear gate to be expanded to 51.2 in (1,300 mm), by which the wide and easy-to-use luggage compartment is realized.



NC-00305

(a) Rear gate opening

Improvement in rigidity of the rear gate opening

Optimization of parts-dividing position at the upper end of the rear gate opening

Since deformation is concentrated around the corner of the upper end of the rear gate opening, the parts-dividing position is moved to inside the vehicle to improve the rigidity of the corner and reduce deformation.

Improvement in rigidity of the trifurcated section on the upper end of the rear gate opening

The cyclic structure is adopted so that the framework of the trifurcated section on the upper end passes through the D pillar to the rear rail.

The shape of cross section of the corner is reviewed to enable the spot welding section to be optimally arranged. Accordingly, the coupling is reinforced. In addition, the number of work holes is reduced to efficiently improve the rigidity of the rear gate opening.

Improvement in rigidity around the rear skirt

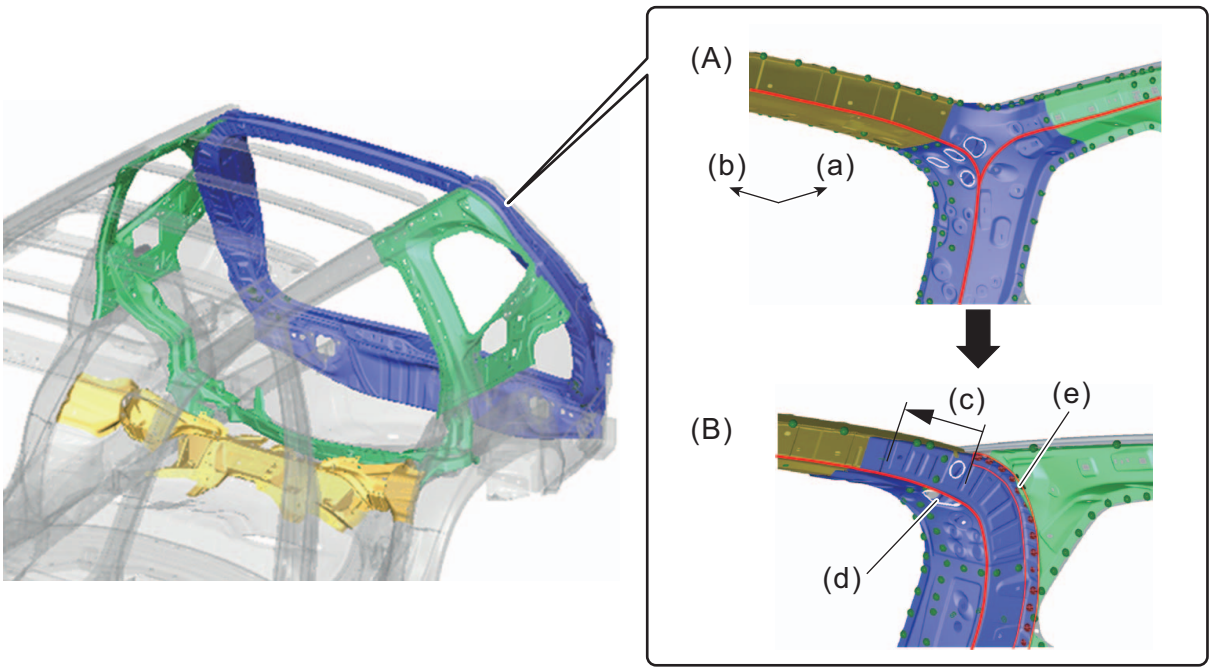
The cyclic structure is adopted so that the framework of the corner on the lower end of the rear gate passes through the rear end to the rear skirt. Also, the separator (stiffening member) is added in the cross section to improve the rigidity of the corner on the lower end. Also, the spot welding arrangement for the coupling section is optimized and the number of work holes is reduced to reduce deformation of the opening.

Improvement in rigidity of the C pillar

The coupling sections from the rear suspension installation to the C pillar are reinforced.

Improvement in rigidity of the stiffening member on the floor

The coupling from the wheel apron to the cross member is reinforced.



(A) Existing model vehicle

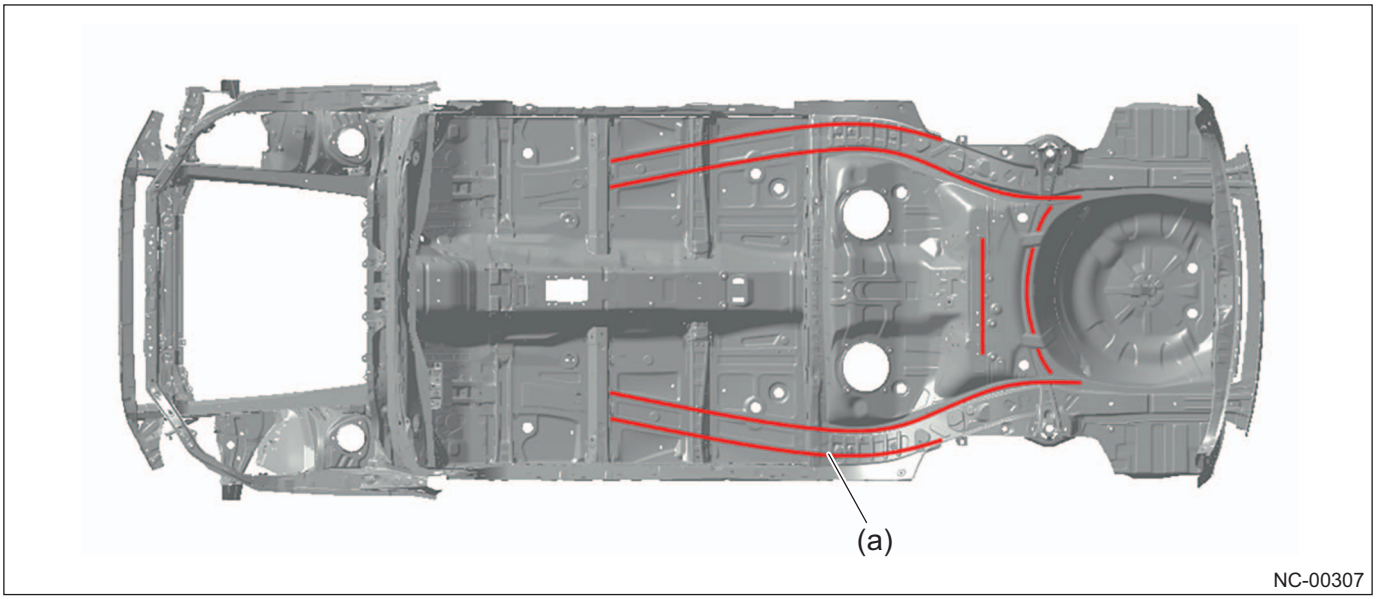
(a) Rear gate opening
(b) Front of vehicle
(c) Dividing position (optimized)

(B) New model vehicle

(d) Work hole (reduced)
(e) Spot welding section (coupling reinforced)

Structural adhesive agent

The structural adhesive agent is adopted to improve the body rigidity and vibration and noise restraining performance. The epoxy-based adhesive is used to fill the gaps between spot welding parts to minimize deformation and deflection of the body. Accordingly, the load transmission is enhanced to improve the steering responsiveness while vibration is reduced. (Applied length: 7 m (23 ft))



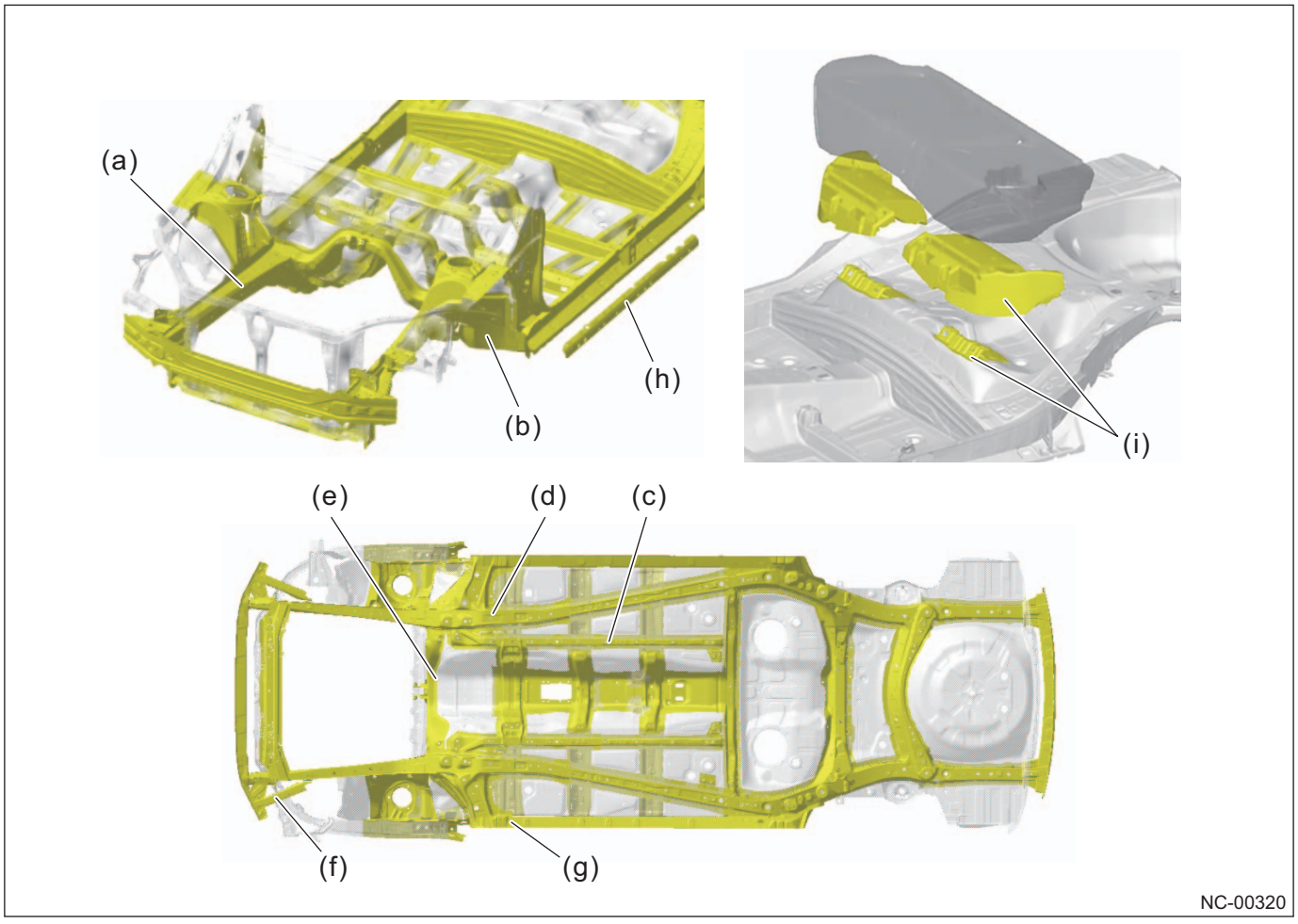
(a) Structural adhesive agent application location

8.3.2 Safety Performance

Collision safety body (against front collision)

In addition to improving performances against full-wrap collisions and offset collisions, the following measures are taken to meet U.S. small overlap (SOL) and oblique collision.

- The cross section of the front frame is enlarged to increase the resistance by 20% (from the level of existing model vehicles).
- Improvement in load bearing capacity of the cabin
- The framework layout is changed to disperse the load (framework added under floor (tunnel section)).
- The front side frame is hot-pressed.
- The contour of front portion of the tunnel is reinforced.
- Gusset structure
- Torque box to side sill reinforcement
- 1.2 GPa (12,236 kgf /cm^2, 173,998 psi) material is adopted in the cross section of the side sill.
- The structure to prevent passengers on the rear seat from sinking is adopted (structure to maintain the passengers at the position where the seat belts properly operate by adding polypropylene foam and the supporting member under the cushion of the rear seat).



(a) Front side frame front
(b) Section where the load bearing capacity of the cabin is improved
(c) Tunnel framework under floor
(d) Frame side front complete, rear
(e) Front portion of the tunnel
(f) Gusset
(g) Torque box
(h) Side sill
(i) Polypropylene foam and the supporting member

Collision safety body (against side collision)

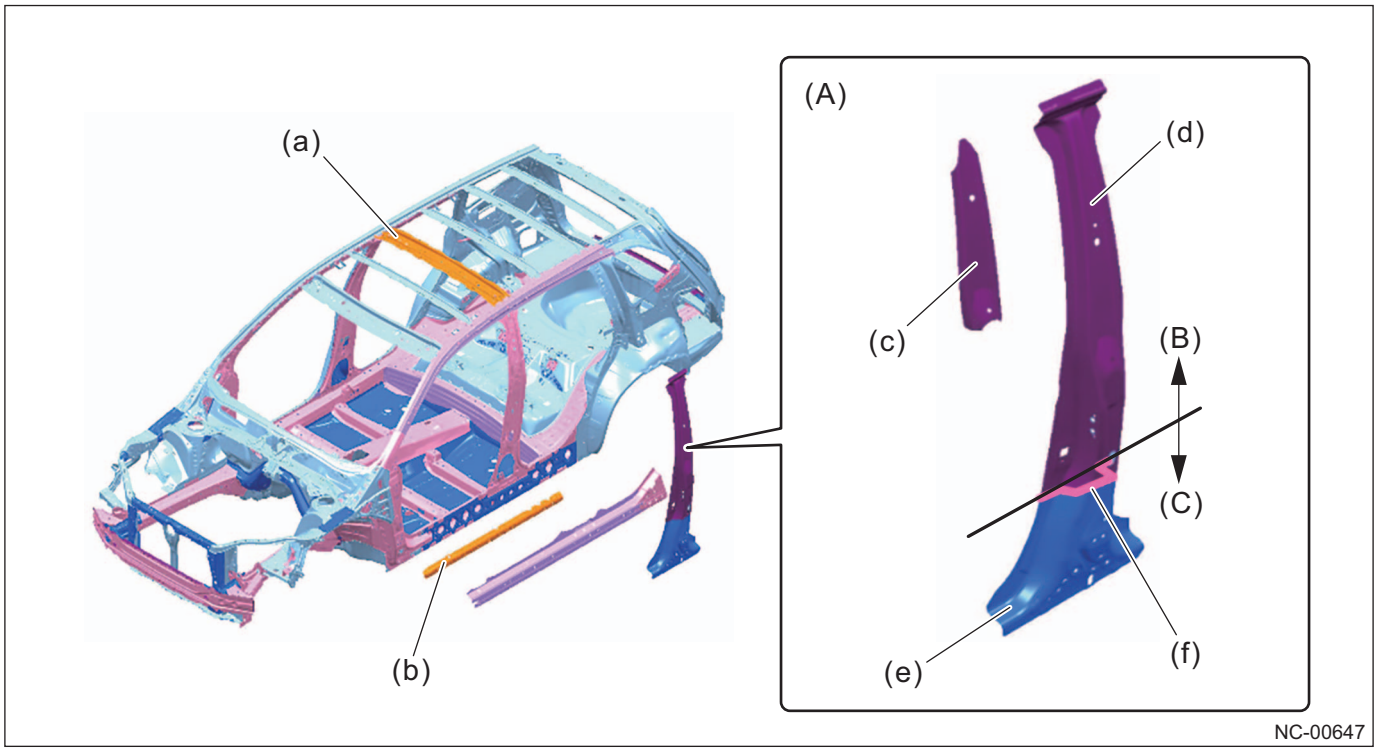
The body framework is strengthened to improve performance against side collision and reduce the body deformation. Also, the deformed shape is optimized and the survival space is expanded to reduce passenger injury and support the latest NCAP and IIHS.

Side structure and surrounding are reinforced

The cold rolling ultra-high tensile steel plate material of 1,180 MPa (12,032 kgf/cm^2, 171,098 psi) is adopted for the brace center and side sill doubler (SUBARU's first).

The hot press patchwork is adopted for the center pillar section to realize both weight reduction and high collision performance. In addition, the composite material steel plate, which is bonded with the hot press tailor tempered material in different strength and the hot press material, is adopted to improve robustness against the body deformation on side collision (SUBARU's first).

The strong material is used on the upper section of the center pillar to reduce deformation on collision and improve passenger protection performance. In addition, for the lower section of the center pillar, the material strength is reduced compared to that of the upper so that the lower section is deformed on collision to absorb the impact.

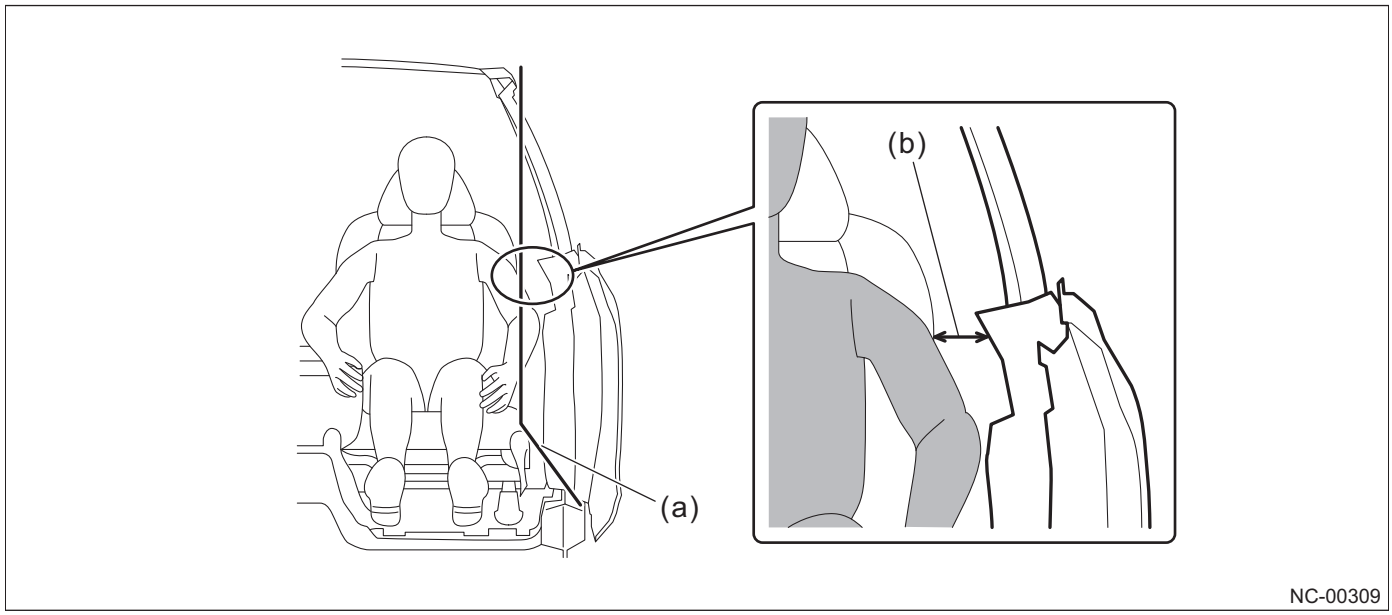


(A) Center pillar
(B) Material strength: 1,480 MPa (15,091 kgf/cm^2, 214,595 psi)
(C) Material strength: 440 MPa (4,487 kgf/cm^2, 63,799 psi)

(a) Brace complete roof center
(b) Side sill doubler
(c) Hot press patchwork
(d) Hot press
(e) Hot press baking material
(f) Laser weld section

Reinforcement of center pillar section

The junction location of the composite material steel plate is optimized so that the break position of the center pillar does not easily overlap human body even in case of a collision accident. This reduces occurrences of injury. Also, the gap lateral to passenger is expanded to 0.28 in (7 mm) to secure survival space and reduce passenger injury.

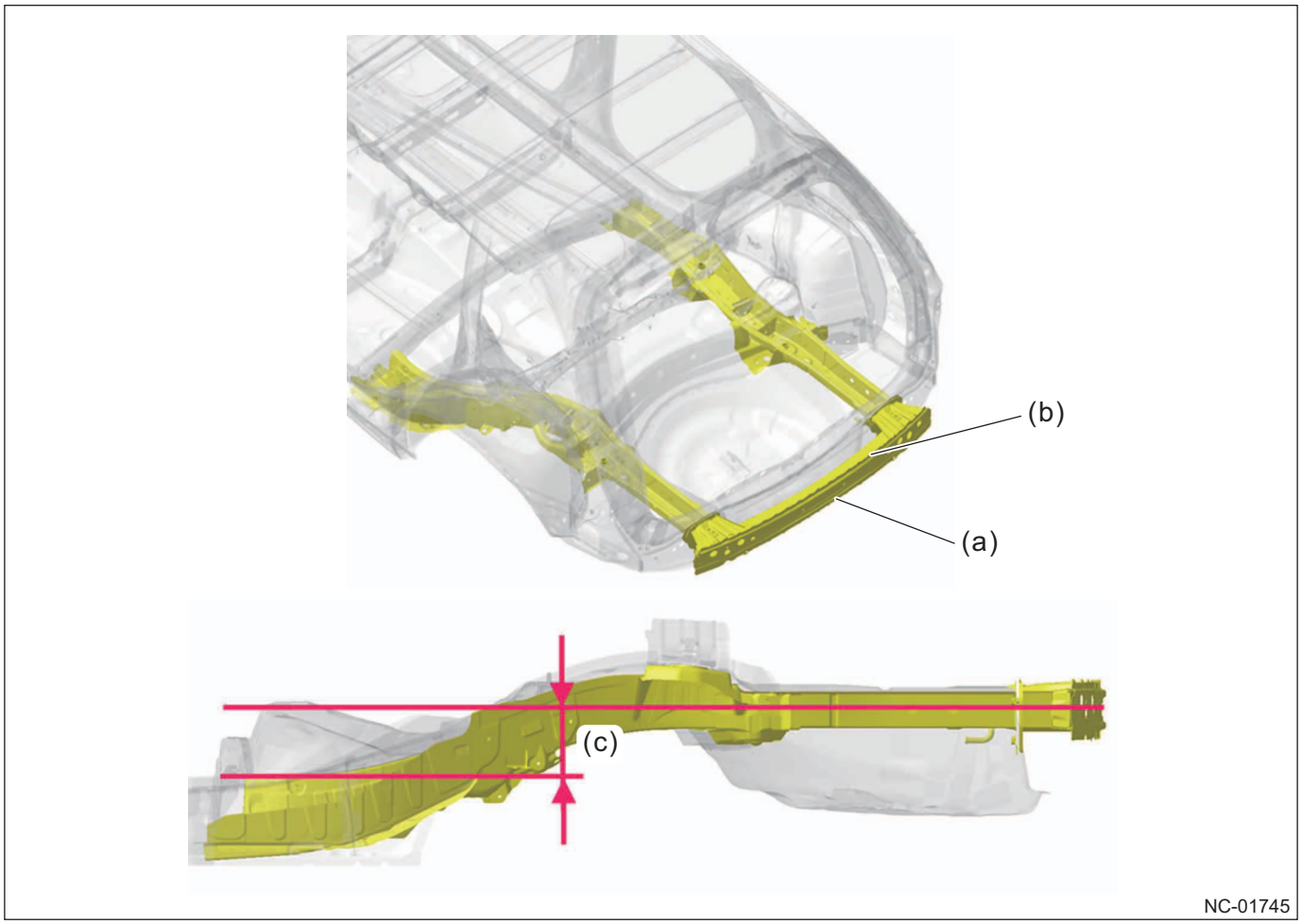


(a) Pillar break position

(b) Gap-expanded section

Collision safety body (against rear-end collision)

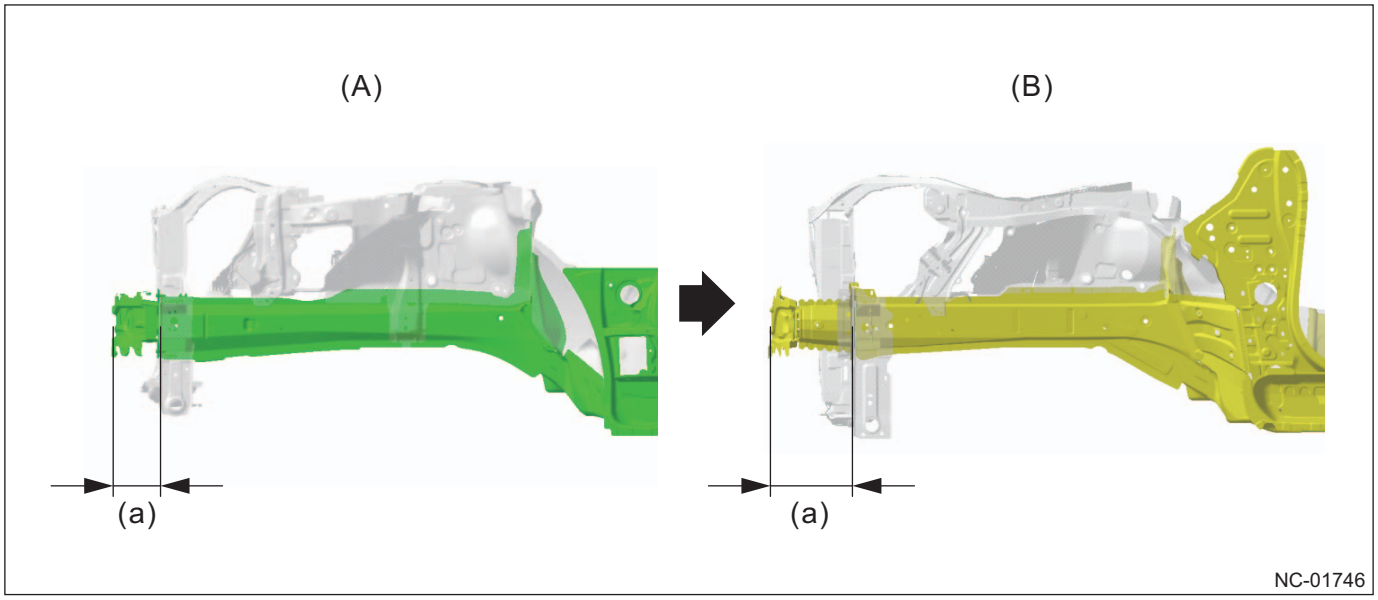
A structure is adopted that reduces body deformation amount by lowering the bending moment due to collision load against the frame and also reducing the offset amount of the rear frame. Also, the high-tensile strength steel and hot press material are adopted for the rear bumper beam to reduce the weight by approximately 3.0 kg (6.6 lb) (from the weight of existing model vehicles).



(a) High-tensile strength steel
(b) Hot press material
(c) Offset amount reduced section

Collision safety body (against low-speed collision)

The crushable zone at the front end of the frame is expanded to improve impact absorption performance. The possibility of frame damage is reduced, leading to less repair cost.



(A) Existing model vehicle

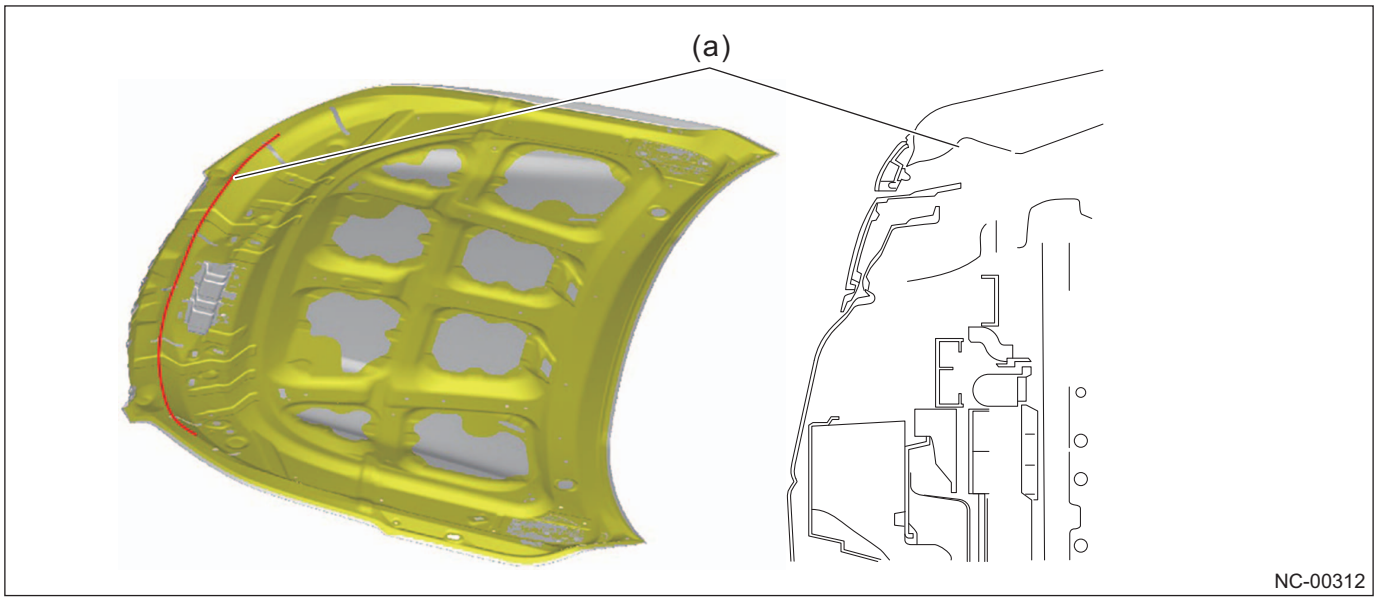
(B) New model vehicle

(a) Crushable zone

Pedestrian protection

Improvement in thigh protection performance

The ridge line and slit to facilitate deformation are provided for the hood inner so that the impact energy can be absorbed.



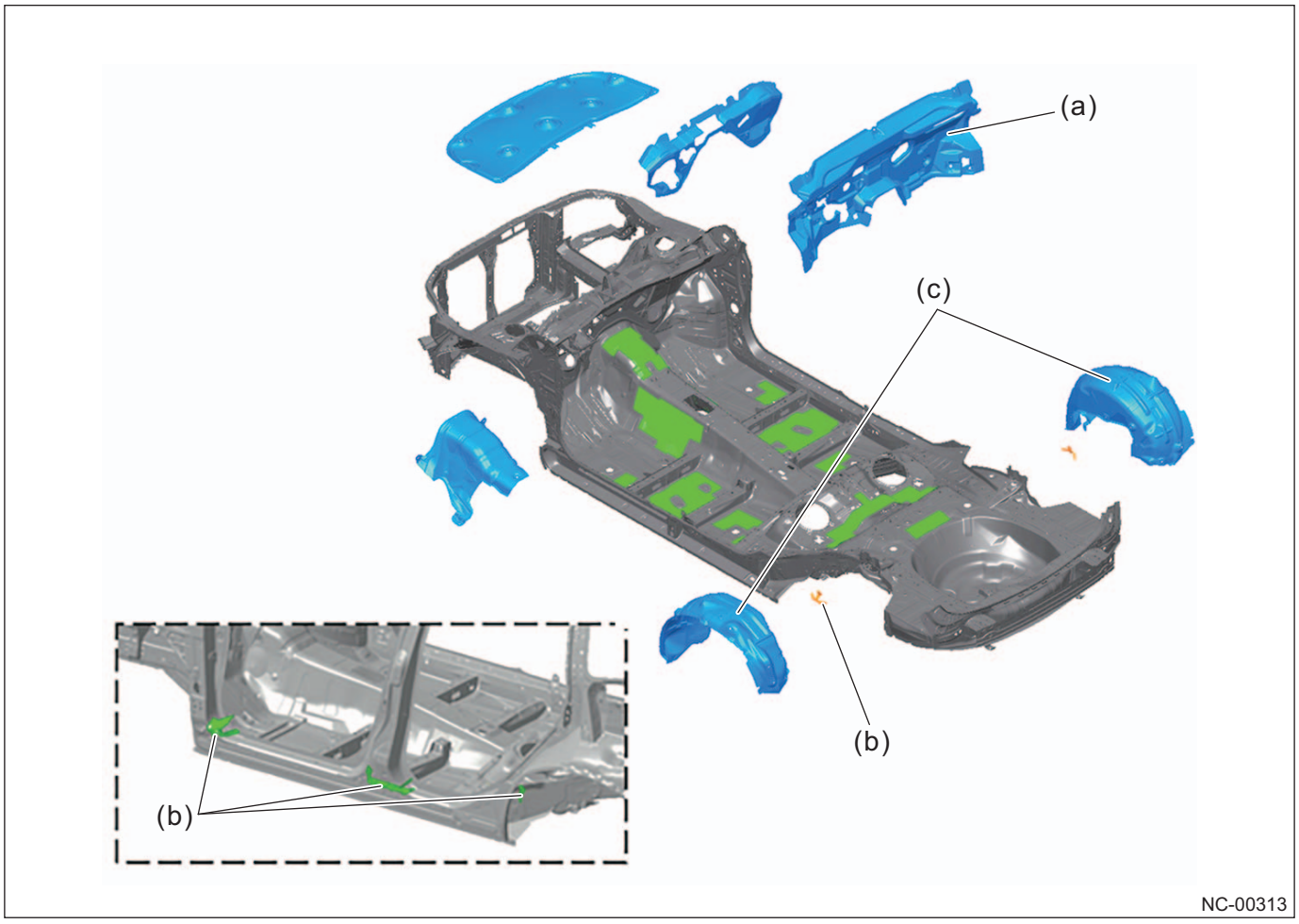
(a) Ridge line

8.3.3 Soundproof Performance

The following measures are taken to realize comfortable indoor space excellent in quietness.

Vehicle interior noise

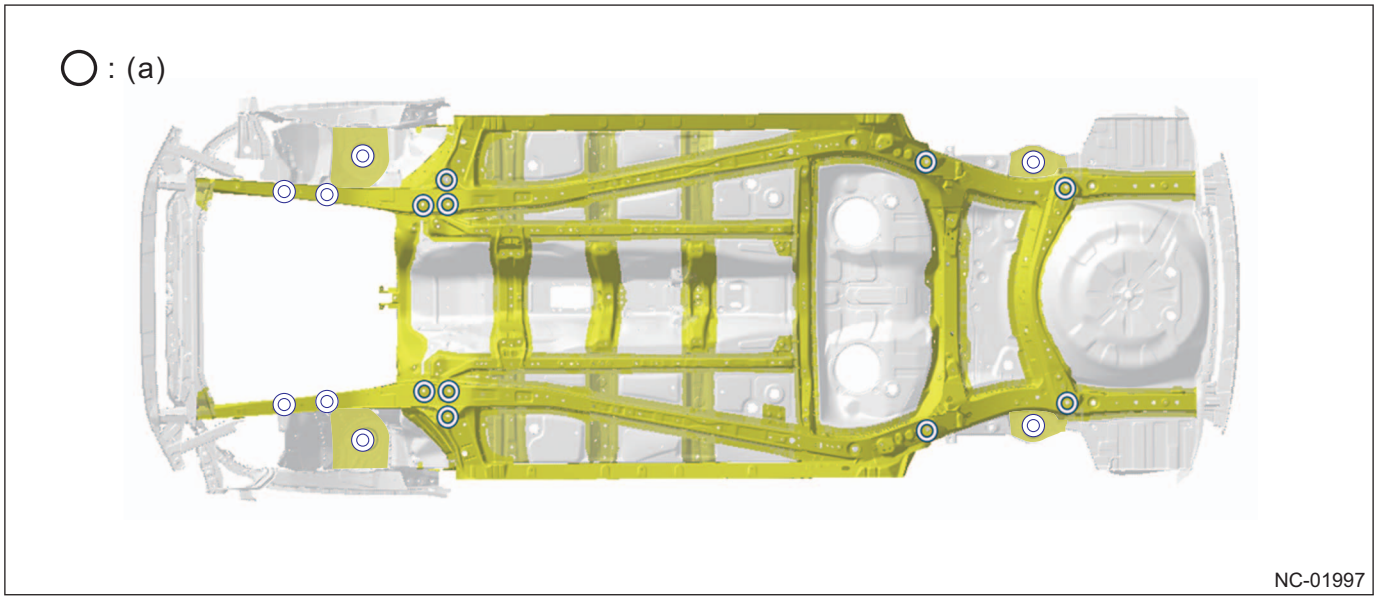
- The number of holes on the toe board and on the panel near the engine compartment of the front pillar is reduced.
- Performance of the toe board insulator separating the engine compartment and the cabin is improved.
- In order to improve sealability (airtightness) inside the cabin, the insulator is added to the inside of the body frame to reduce unnecessary holes and gaps.
- A sound-absorbing type of mud guard is adopted (only for rear) to absorb noise generated around the rear wheel housing by seams on roads, stone chips, water splash, etc.



(a) Insulator toe board
(b) Insulator
(c) Mud guard

Vibration sound

The rigidity of the mounting section is enhanced to improve the cut-off characteristic of vibration.

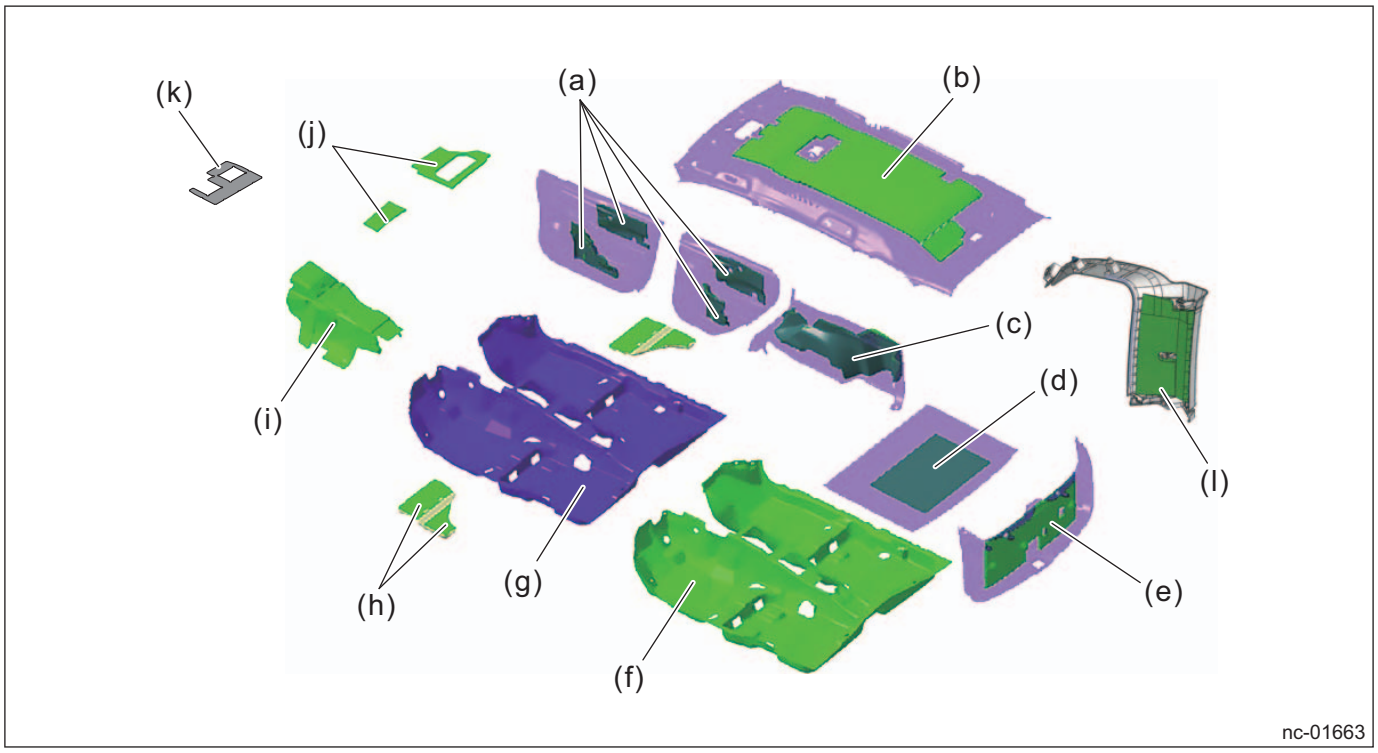


(a) Rigidity-enhanced section

Soundproofing material

The soundproofing material is adopted to cut off and absorb noise generated at the bottom surface of the body by seams on roads, stone chips, water splash, etc.

Sound-absorbing material	Back of door trim, back of roof trim, back of apron trim, back of rear floor mat, back of rear gate trim*1, back of floor mat (entire area), back of instrument panel, back of C pillar trim
Sound-insulating skin material	Floor mat (entire area)
Sound-insulating material	Back of spacer mat, tunnel section



(a) Back of door trim
(b) Back of roof trim (except for vehicles with sunroof)
(c) Back of apron trim
(d) Back of rear floor mat
(e) Back of rear gate trim
(f) Back of floor mat (entire area)
(g) Floor mat (entire area)
(h) Back of spacer mat
(i) Tunnel section
(j) Back of instrument panel
(k) Back of collector cover
(l) Back of C pillar trim

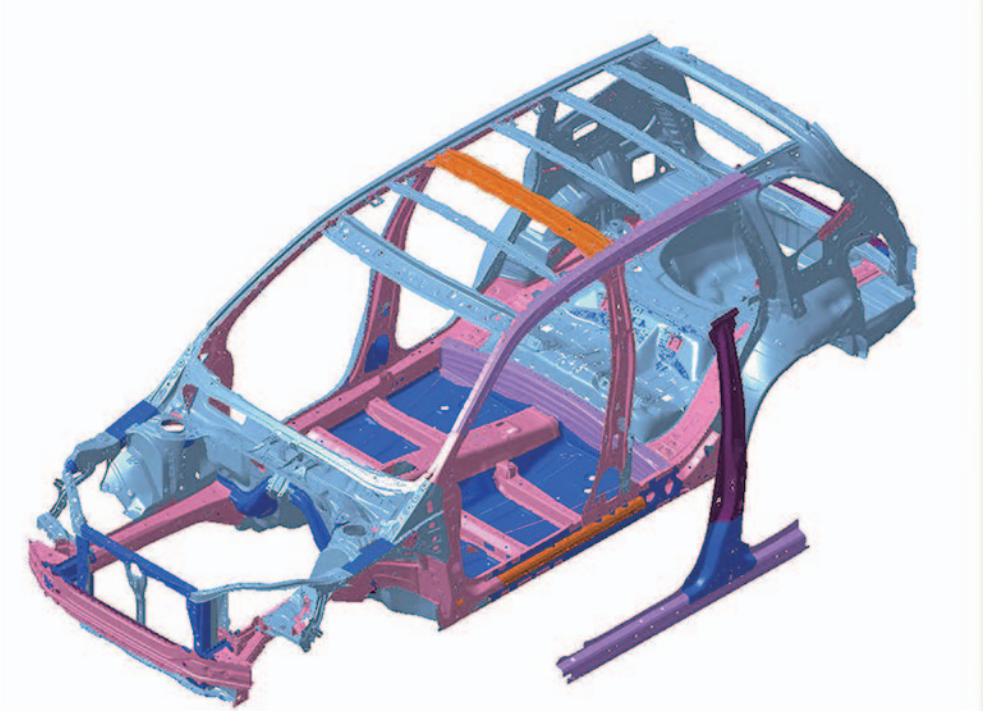
*1: Except for vehicles with sunroof

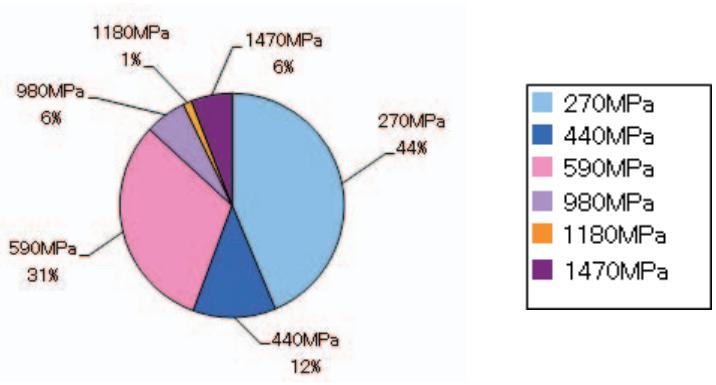
8.3.4 Other

Weight reduction

Sections with high-tensile strength steel

The high-tensile steel ratio of the body is 56% (+7% from the ratio of existing model vehicles) to reduce the weight and improve rigidity.





NC-00315

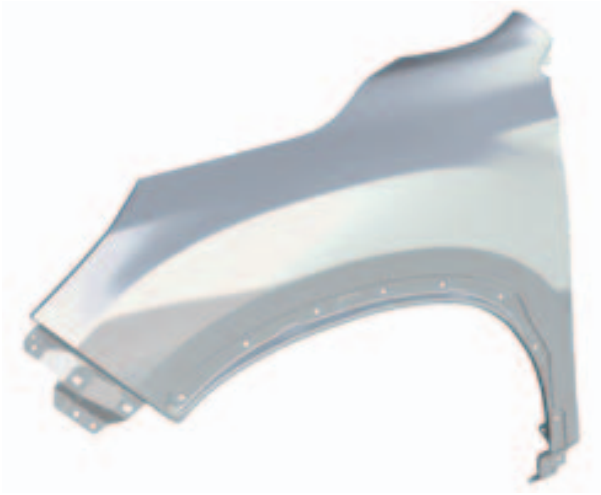
Hood

The aluminum hood is adopted for the hood panel to reduce the weight.

NC-01570

Fender

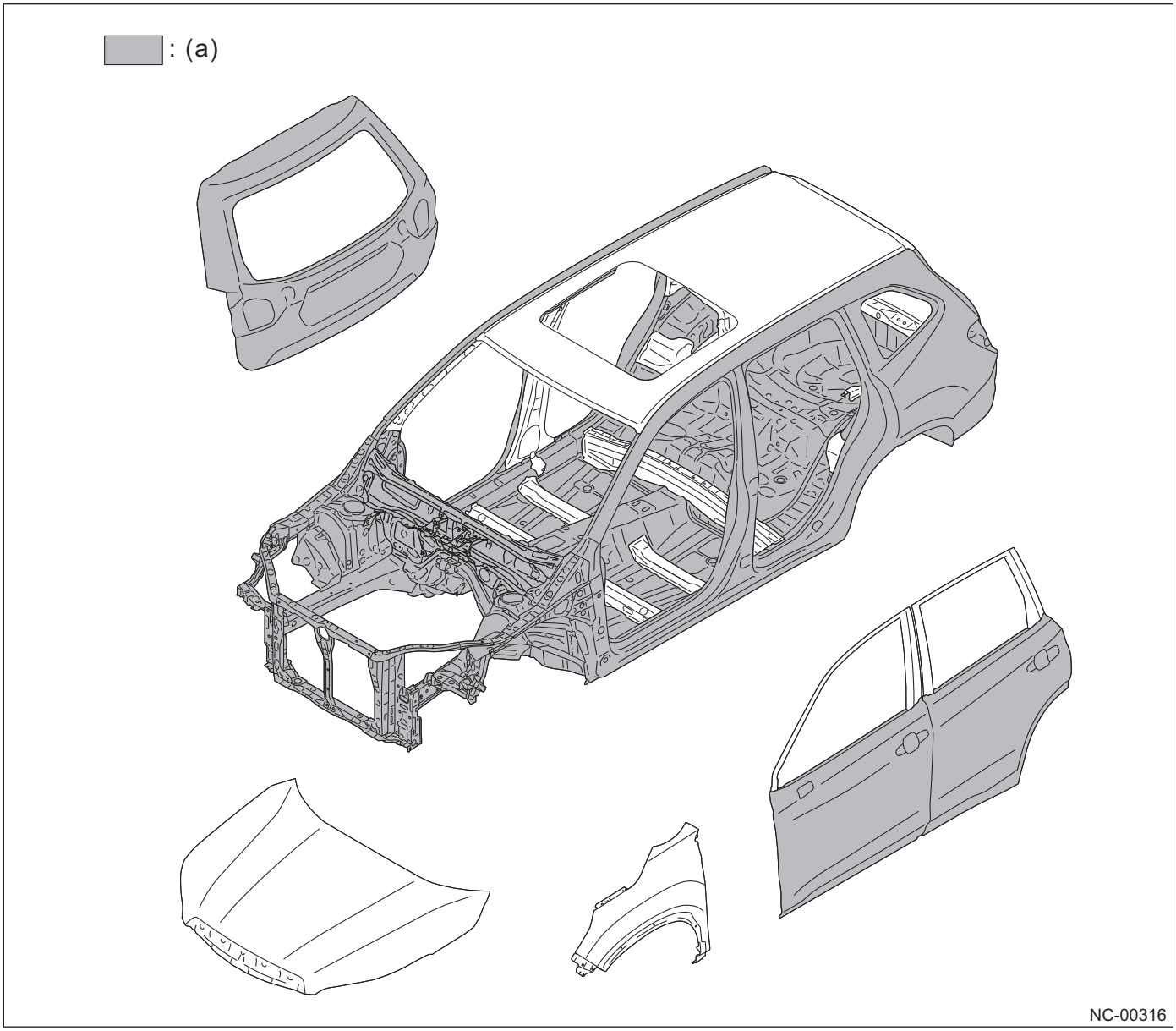
The aluminum fender is adopted for the fender to reduce the weight. The weight is reduced by approximately 2.4 kg (approximately 52%) compared to the existing model vehicle.



NC-01956

Portions with anti-corrosion strength steel

The anti-corrosion strength steel is adopted for portions with stringent corrosion-generation conditions to improve anti-corrosion performance.

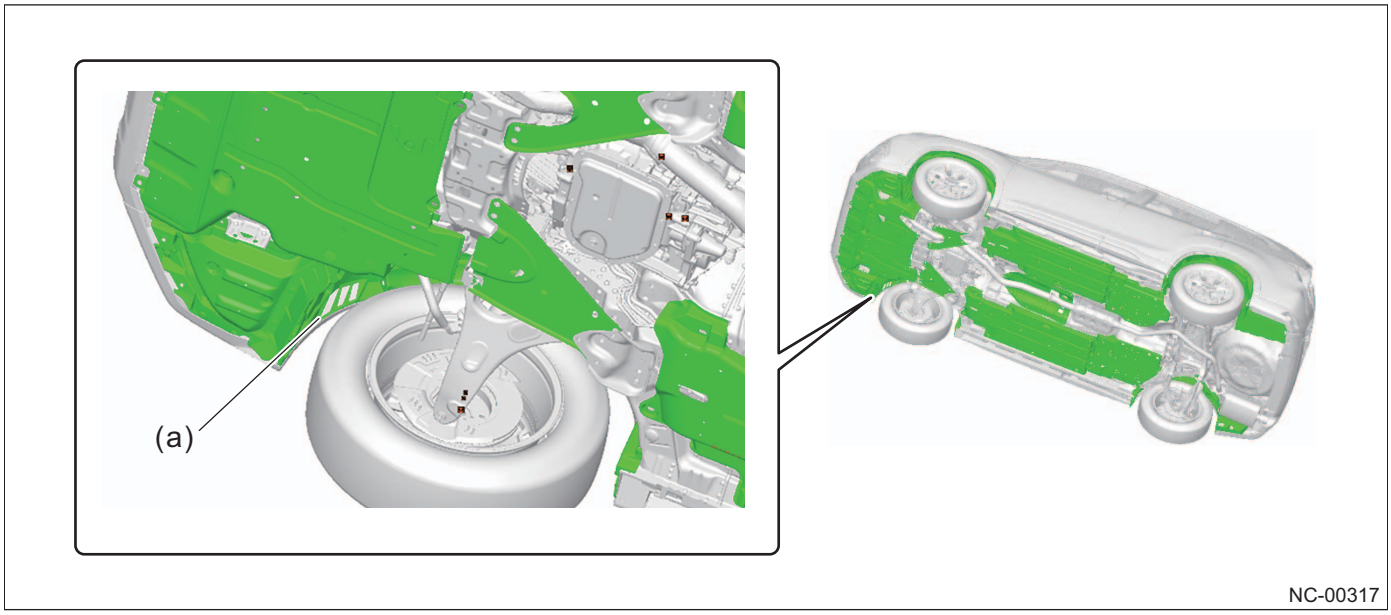


(a) Galvanized steel plate (both sides)

* Fuel flap is plastic.

Aerodynamic parts

The aerodynamic performance is improved compared to existing model vehicles by the enlarged aerodynamic parts, optimization of the under cover shape, enlarged flap in front of tire, and air duct added to the front mud guard (SUBARU's first).



(a) Air duct

9 EXTERIOR

CONTENTS

9.1 General Overview

9.1.1 Overview

In this chapter, the following components configuring the body exterior are described.

- Front bumper/front grille/horn/cowl panel
- Lighting system
- Side cladding
- Wiper and washer system
- Glass/windows/mirrors
- Sunroof (for some grades)
- Roof rail (for some grades)
- Door and fuel flap
- Rear gate
- Rear bumper/rear gate garnish/letter mark/muffler cutter (for some grades)
- Roof spoiler (for some grades)

9.2 Front Bumper/Front Grille/Horn/Cowl Panel

9.2.1 Overview

The front bumper combines collision safety performance and excellent texture at a high level while expressing active design characterizing SUV.

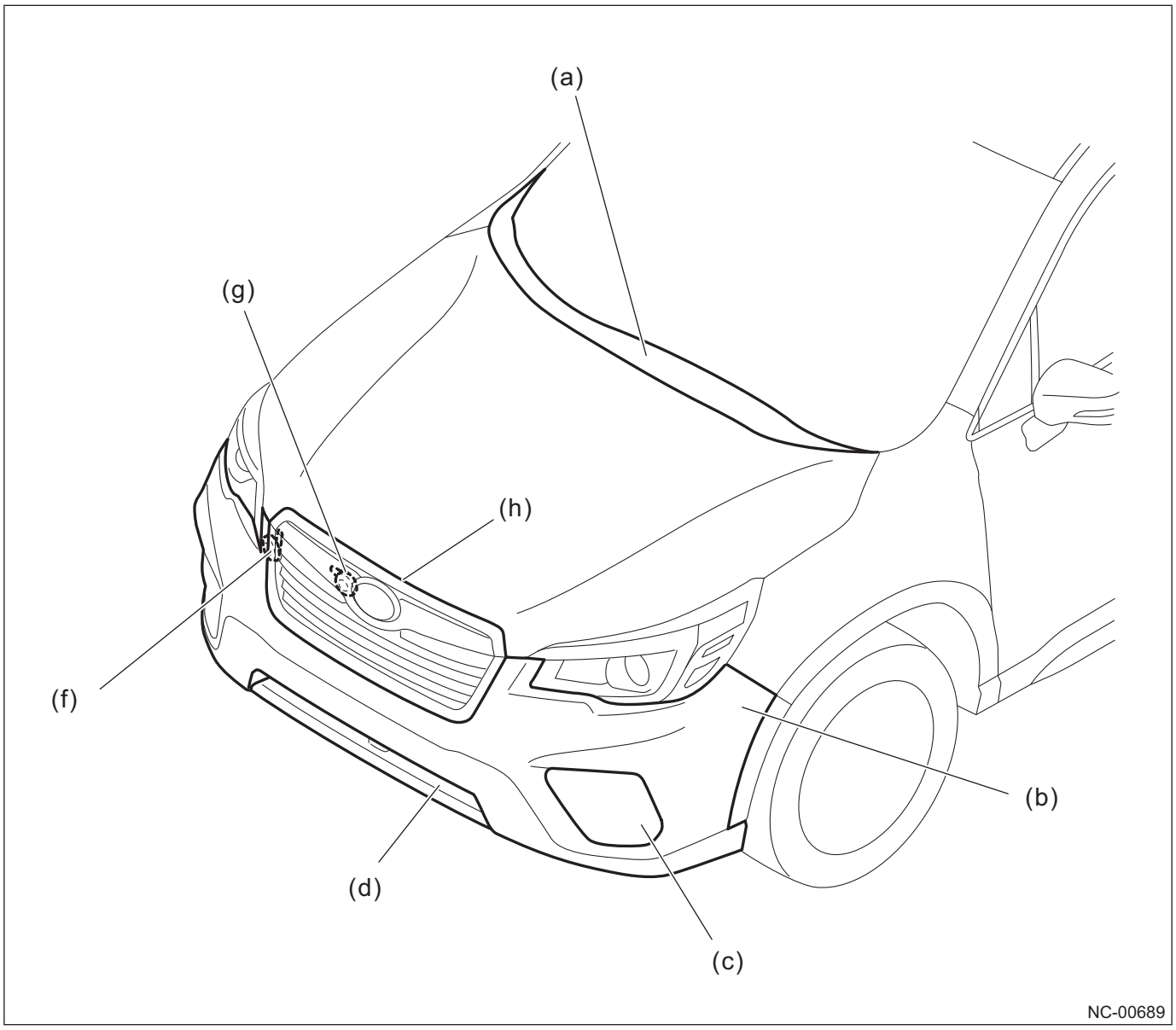
Also, it conforms to the pedestrian protection regulation introduced in North America, 2018 to improve safety performance.

A large grille with superior design and cooling performance is adopted for the front grille.

The double horn with high pitch and low pitch is adopted.

9.2.2 Component

Component layout drawing



(a) Cowl panel
(b) Bumper face front
(c) Fog light bezel
(d) Front under guard
(e) Active grille shutter
(f) Horn assembly Lo
(g) Horn assembly Hi
(h) Front grille

Component details

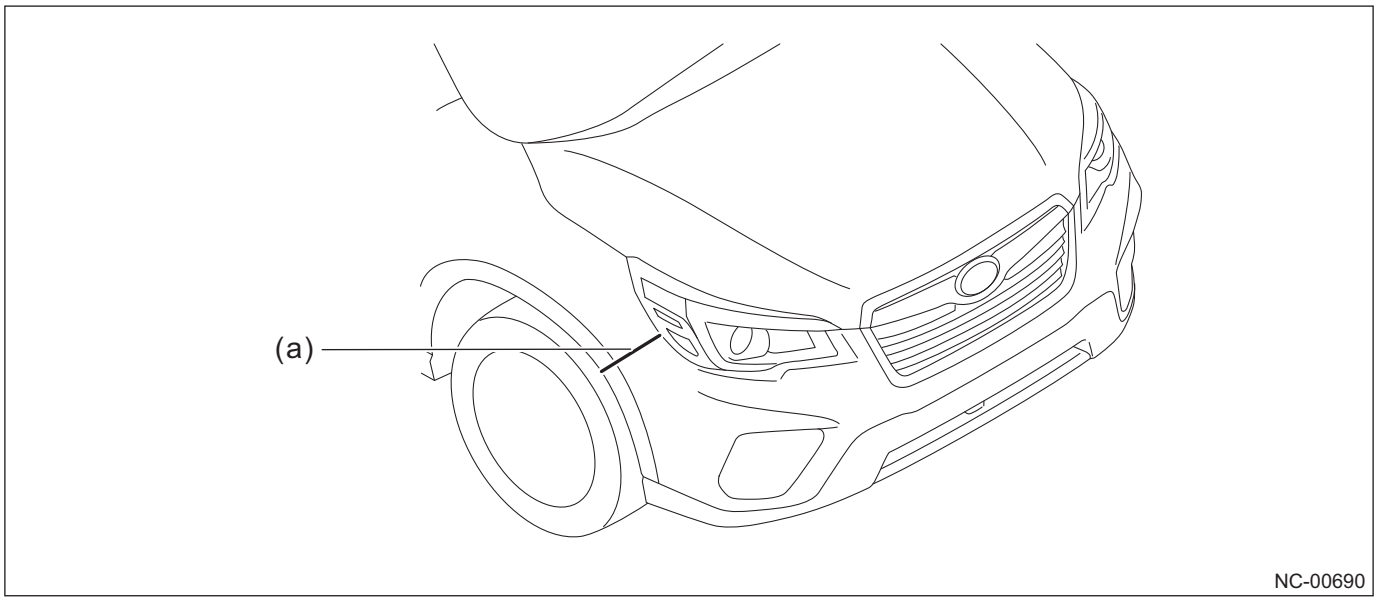
Front bumper

A geometry texture with clear ruggedness is adopted for the blacked-out cladding section to improve quality in appearance.

The structure of the bumper bracket is optimized to reduce the division gap between the bumper and fender by 0.008 in (0.2 mm) compared to existing model vehicles to improve the quality.

The energy absorber is optimally arranged to reduce the weight.

- The material of the energy absorber in front of the beam is changed from sheet metal to foamed material to reduce the weight by approximately 3.31 lb (1.5 kg).

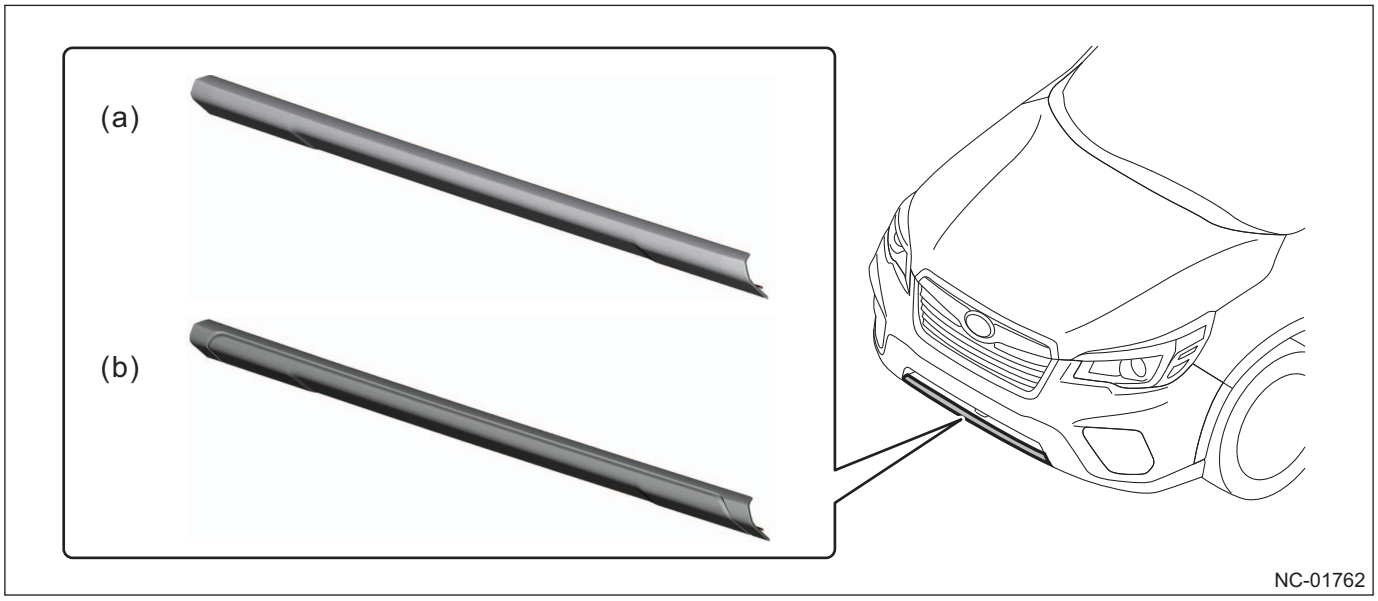


(a) Division gap between bumper and fender

■ Front under guard

A solid and strong design is adopted to prevent stone splash to the body. Also, a decoration is added to the upper grade vehicle to apply high-quality appearance that suits the rank of vehicle.

- Upper grade: silver paint
- SPORT: orange paint



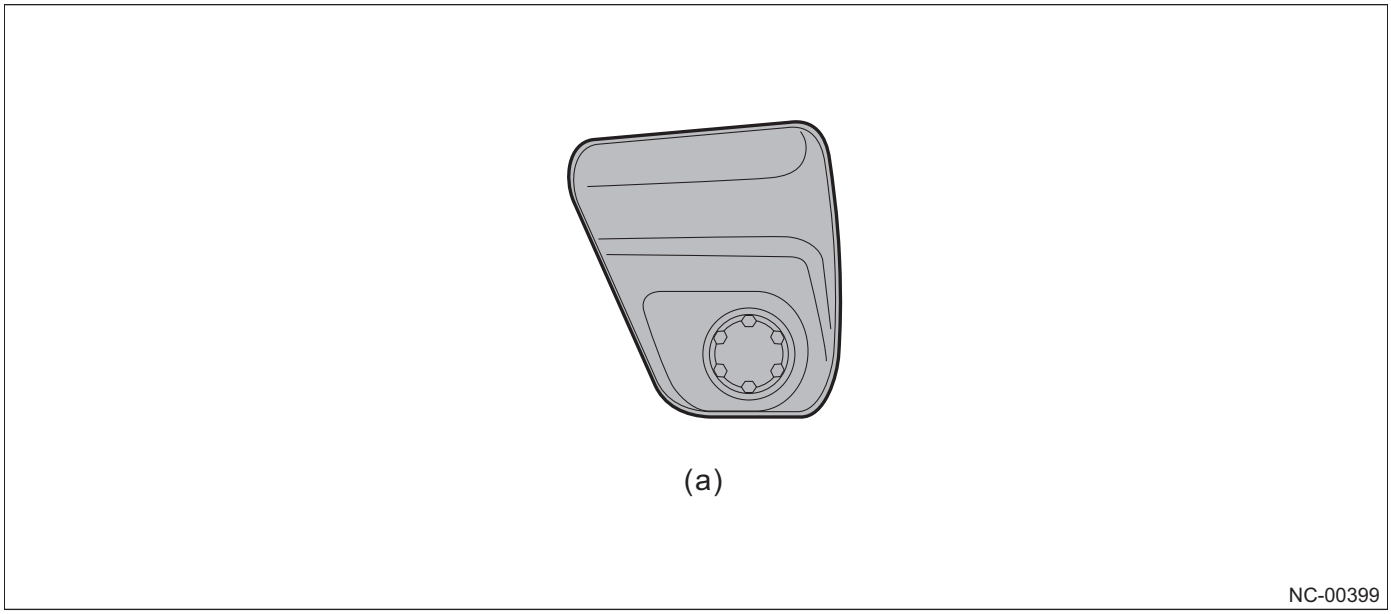
(a) Spin-dyeing black

(b) Silver paint/orange paint

■ Fog light bezel

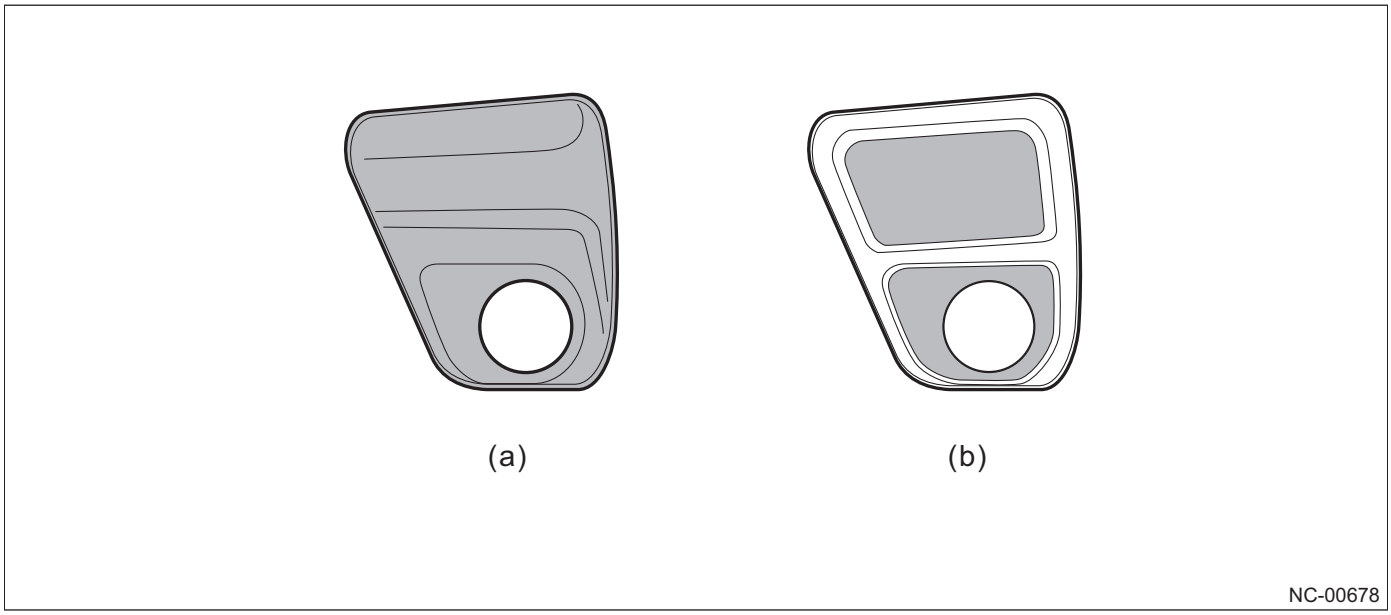
The surface processing and shape of the fog light bezel are changed to correspond with the character of each grade. Thus, the character is emphasized and the design is improved.

Without light specification (for some grades)



(a) Spin-dyeing black base

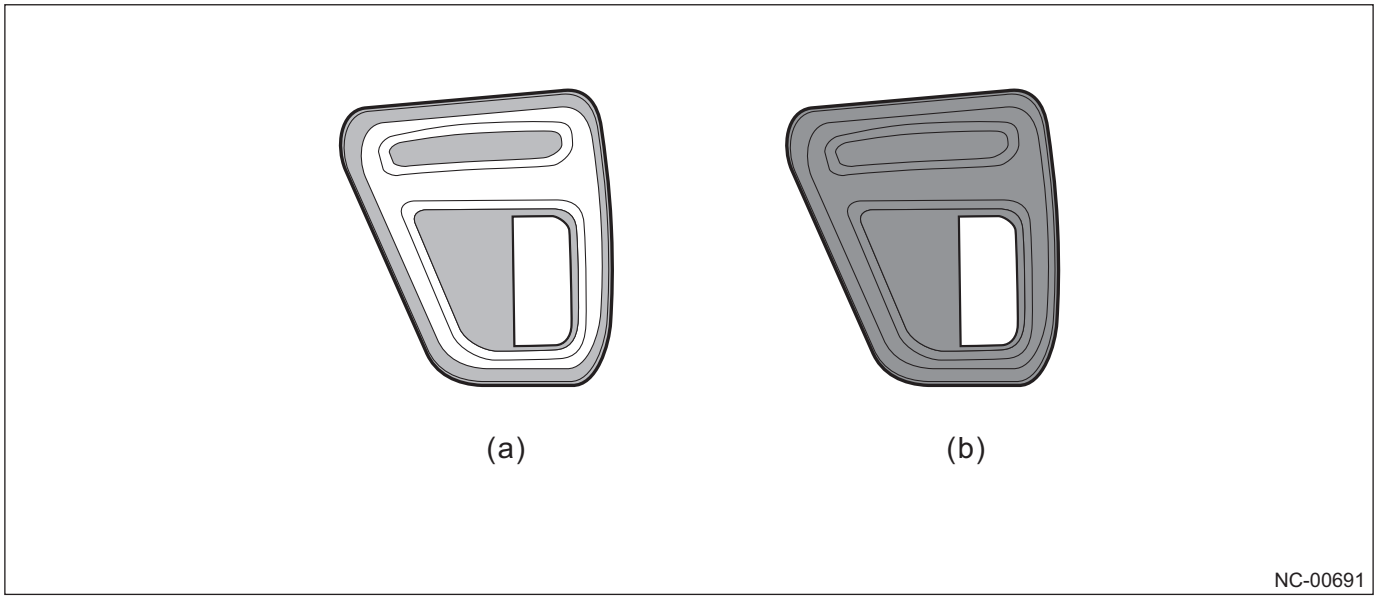
Bulb fog light specification (for some grades)



(a) Spin-dyeing black base

(b) Spin-dyeing black base + plate molding

LED fog light specification (for some grades)



(a) Spin-dyeing black base + plate molding

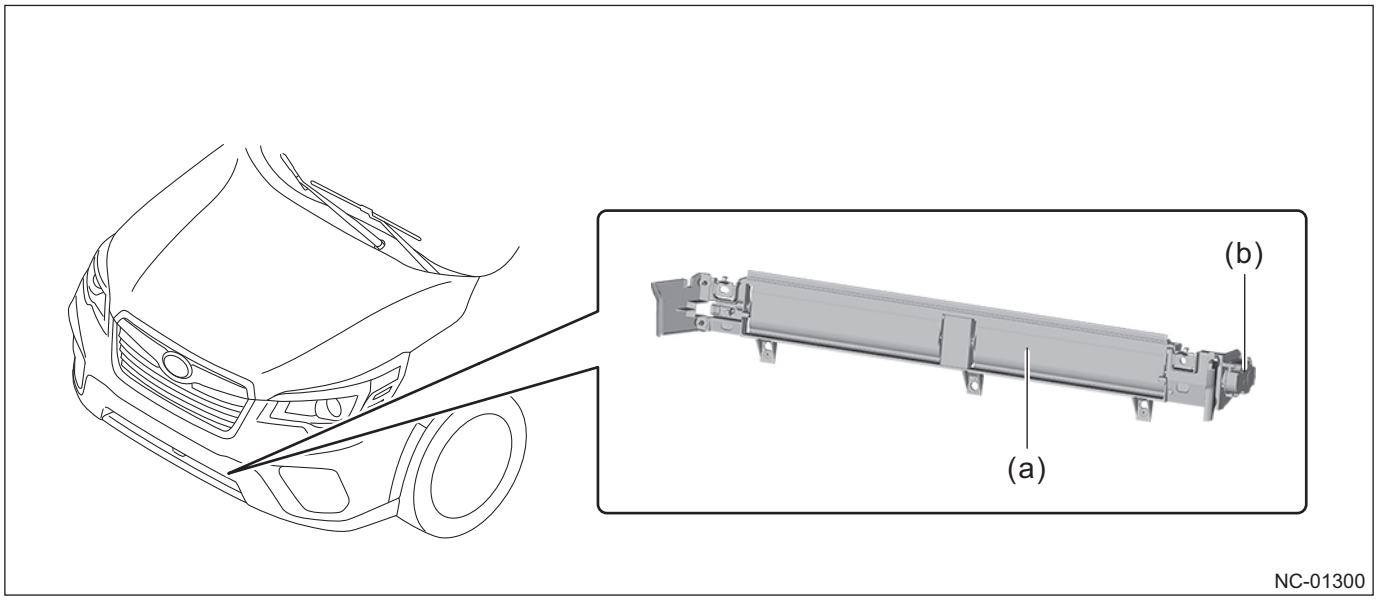
(b) Spin-dyeing black base + high-gloss black paint molding

■ Active grille shutter

Air resistance is reduced by closing the active grille shutter while traveling. Also, the friction in the engine is reduced by promoting engine warming-up. The fuel efficiency performance is improved accordingly.

If the temperature of the inside chamber rises, the active grille shutter is opened to take in cooling air.

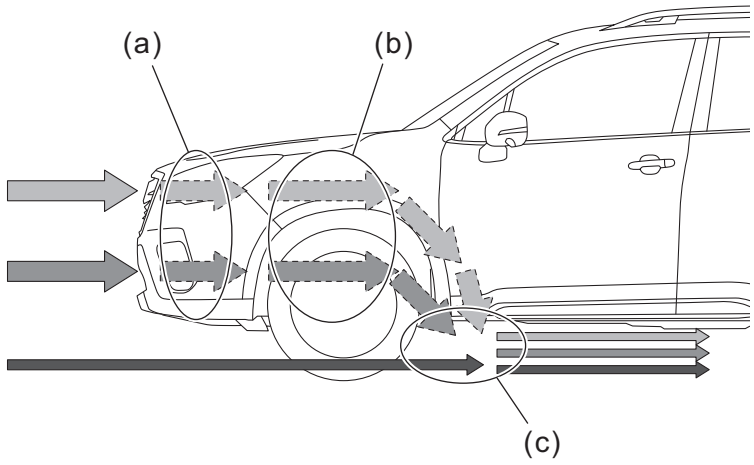
Opening and closing of the active grille shutter is driven by the actuator.



(a) Active grille shutter

(b) Actuator

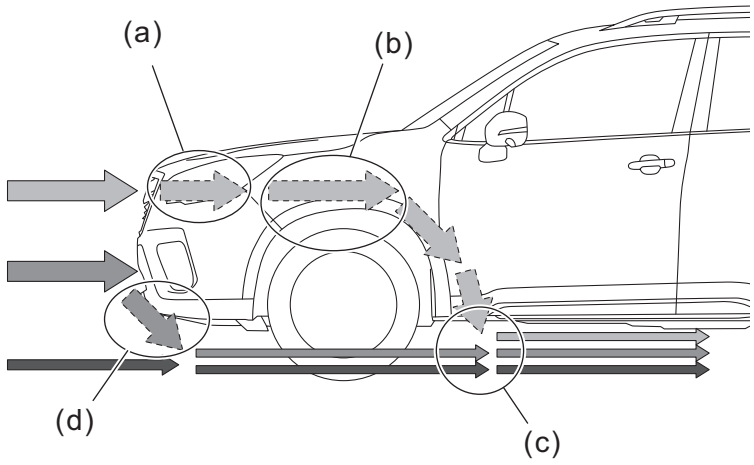
Active grille shutter open



NC-00403

(a) Winds when driving pass through the heat exchanger, and resistance is generated.
(b) Winds when driving pass through the inside of the chamber, and resistance is generated.
(c) Fast winds when driving passing under floor and slow winds when driving passing through the inside of the chamber collide with each other, and the wind flow becomes turbulent. Thus, resistance is generated.

Active grille shutter close

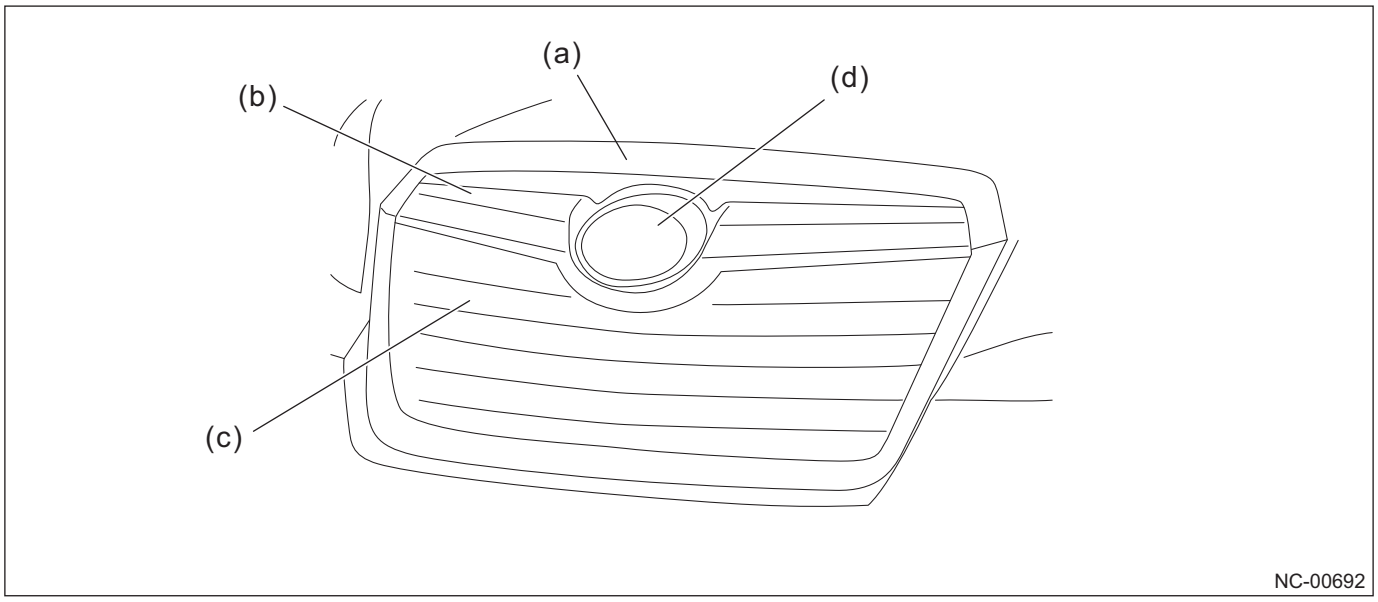


NC-00404

(a) Winds when driving passing through the heat exchange are decreased to improve air resistance and promote engine warming-up.
(b) Winds when driving entering the inside of the chamber are decreased to reduce air resistance.
(c) Low-speed winds when driving are decreased to reduce air resistance.
(d) Winds when driving entering the inside of the chamber are blocked.

Front grille

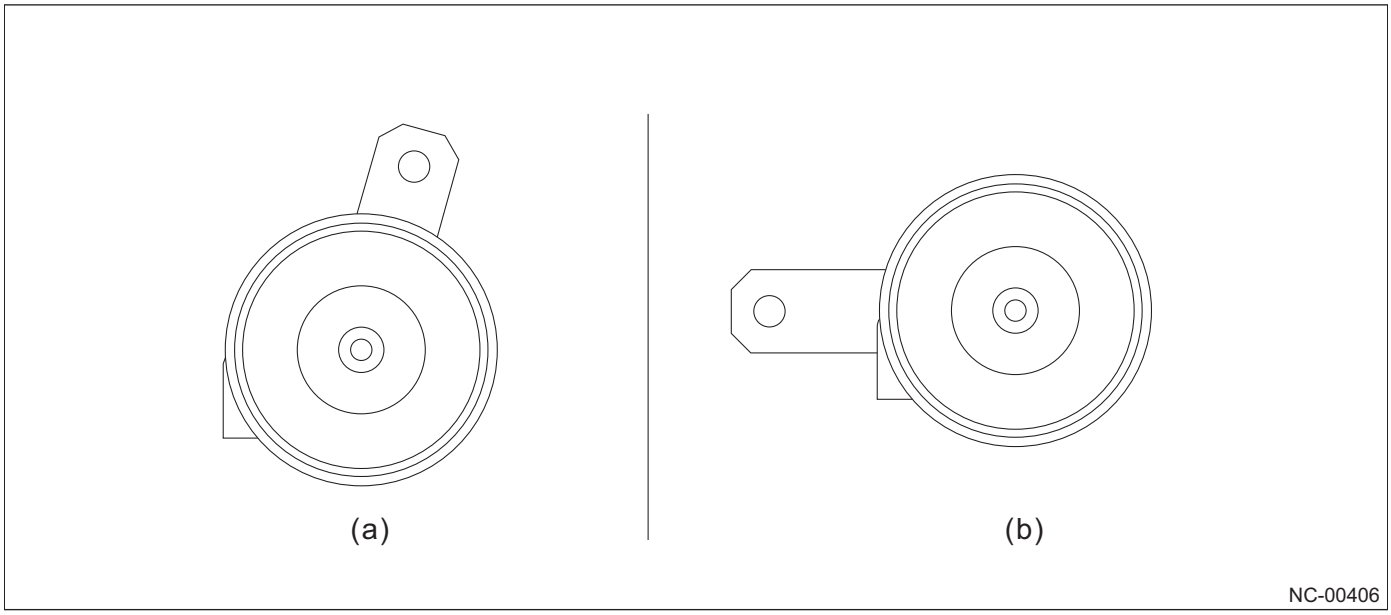
Specifications	Frame	Decorated section	Base section
Standard specification	Silver paint	Silver paint	Spin-dyeing black
Upper specification A	Plate	Plate	Spin-dyeing black
Upper specification B	High-gloss black	High-gloss black	Spin-dyeing black



(a) Frame
(b) Decorated section
(c) Base section
(d) Ornament

Horn

The double horn sounds high pitch and low pitch horns simultaneously at different notes.



(a) Horn assembly Lo (fender side)

(b) Horn assembly Hi (grille side)

Item	High pitch	Low pitch
Fundamental frequency [Hz]	420 ± 20	365 ± 20
Sound pressure level [dB]	113 ± 5	113 ± 5

9.3 Lighting System

9.3.1 Overview

The new LED headlight is adopted to express SUBARU's style at a glance even from a distance.

- The bi-functional projector LED lights that switch between high beam and low beam with one LED light source are adopted. (LED specification)
- LED is adopted for the side marker.
- Welcome Lighting is adopted to improve visibility when entering and exiting.

The following systems are also adopted to improve visibility of the travel direction.

- Automatic light
- Headlight beam leveler that automatically detects vehicle posture and keeps the optical axis angle of headlight constant.
- High beam assist (HBA)
- Steering responsive headlight ((SRH) LED specification) that moves the headlight automatically to the direction of the vehicle traveling according to steering operation.
- Wiper interlocked headlight

The following systems are also adopted to improve usability.

- Light reminder
- Direction indicator one-touch function
- Auto dimmer cancel function

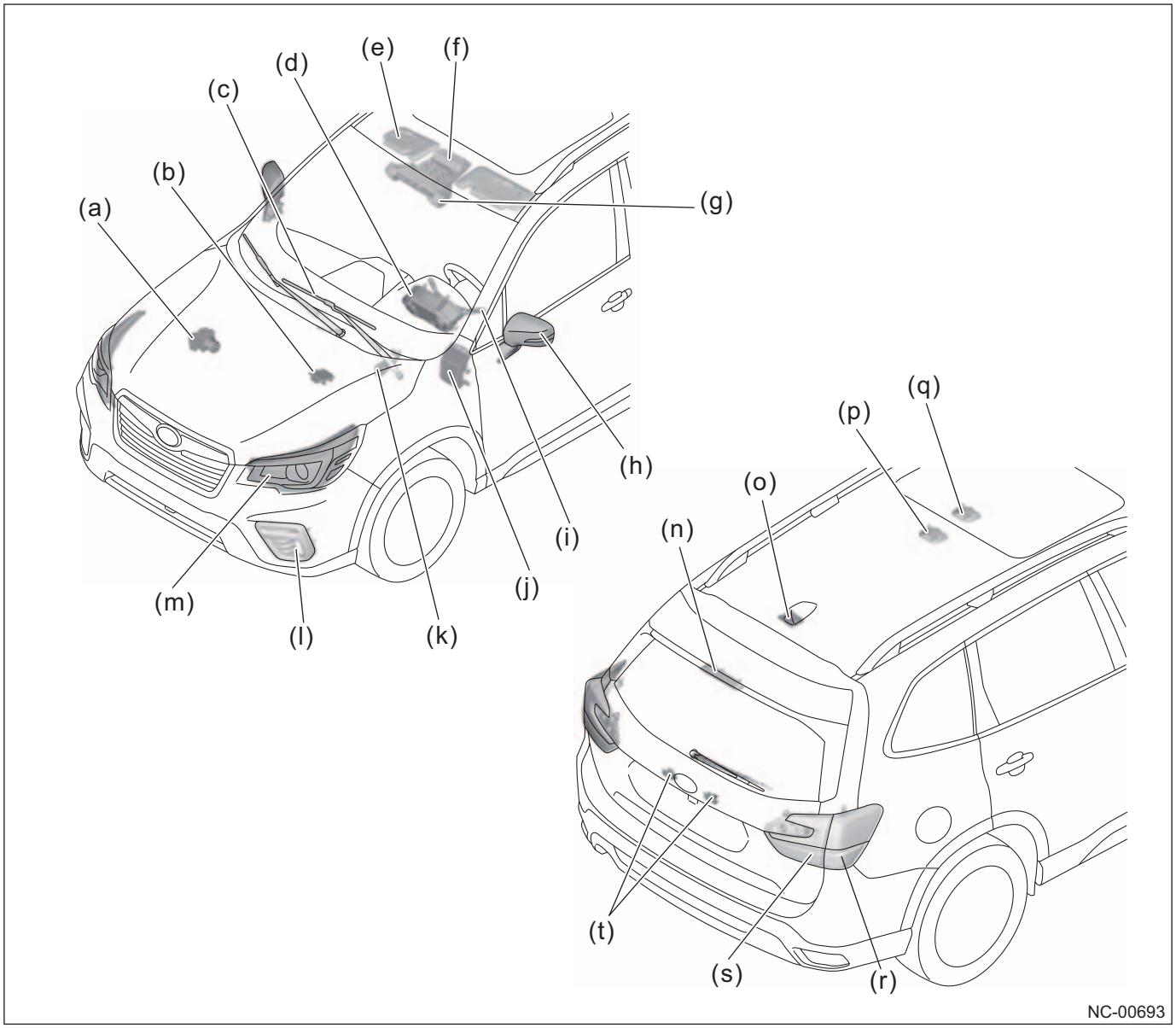
The design with the SUBARU common motif (C shape) is adopted for the rear combination light and rear finisher light, similar to the headlight.

The LED fog light is adopted to reduce power consumption and improve light distribution performance compared to the existing bulb specification.

*The specifications differ by vehicle grade.

9.3.2 Component

Component layout drawing



(a) VDCCM & H/M
(b) TCM
(c) Front wiper
(d) Combination meter
(e) Vanity mirror light
(f) Spot map light
(g) Stereo camera
(h) Side turn signal light
(i) Lighting switch
(j) Body integrated unit (in joint box)
(k) Auto headlight beam leveler CM
(l) Front fog light
(m) Headlight
(n) High-mounted stop light
(o) Luggage room light
(p) Room lights (vehicle with sunroof)
(q) Room lights (normal roof vehicle)
(r) Rear combination light
(s) Rear finisher light
(t) License plate light

Component details

Headlight

■ LED headlight

The LED headlight has a sharp shape and a design that can be recognized as a SUBARU vehicle at a glance with a SUBARU common motif (C shape).

LED light source is adopted to reduce power consumption of both low beam and high beam compared to halogen headlights. In addition, the position light and daytime running light are integrated and LED light source is adopted to reduce power consumption.

The LED headlight is combined with the steering responsive headlight (SRH) to ensure the right and left visibility in both the low beam and high beam ranges. (for some grades)

The position light with a SUBARU common motif (C shape) also functions as a daytime running light (DRL)* to improve conspicuousness during daytime. The appearance can be recognized as a SUBARU vehicle at a glance even it is seen from a distance. (for some grades)

The headlight built-in DRL is adopted.

The following advanced equipment improves the safety performance during nighttime traveling.

- Steering responsive headlight (SRH) (for some grades)
- High beam assist (HBA) (for some grades)

The inner lens is installed in front of the turn light to express the design having a sense of unity with the front grille.

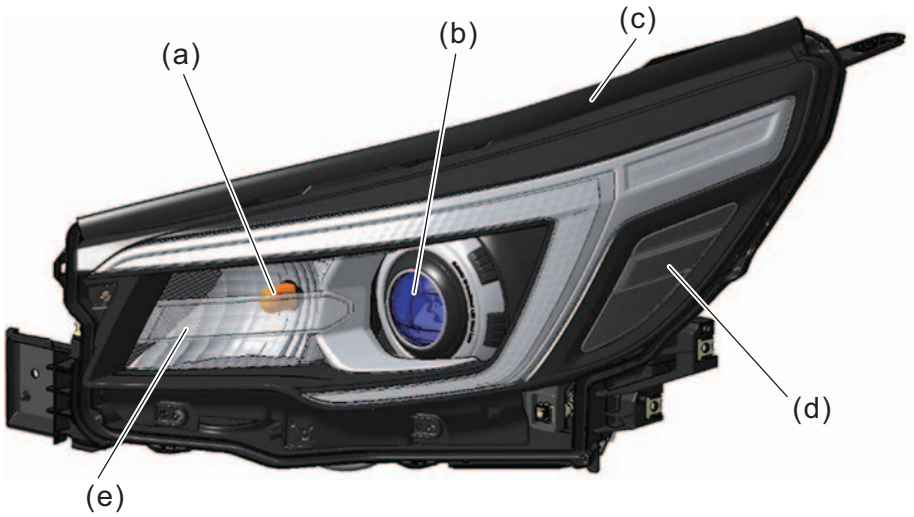
The LED light source is adopted for the headlight, position light, side marker light, etc. to reduce power consumption. (for some grades)

The hood seal rubber is adopted to improve fuel efficiency by reduction in air resistance.

*: The light intensity differs between the position light and DRL. (for some grades)

*The specifications differ by vehicle grade.

Standard grade

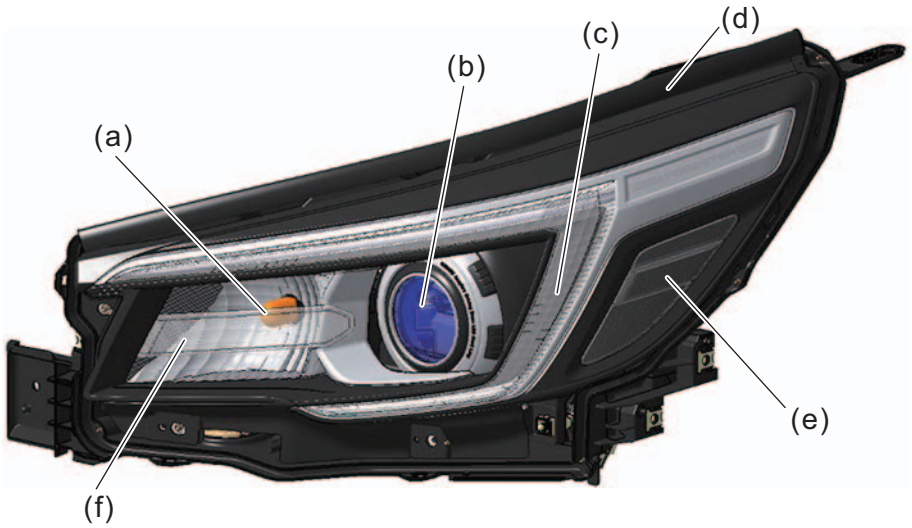


NC-01888

No.	Name	Capacity and wattage	Type
(a)	Position light/turn light (bulb)	12 V 8 W/28 W	7444NA
(b)	Low beam/high beam/DRL (bifunctional LED light)	12 V-23 W/28 W (LED)/8.2 W	*
(c)	Hood seal rubber	-	-
(d)	Side marker light (LED)/reflex reflector	12 V-5 W	W5W
(e)	Inner lens	-	-

*: Non-disassembly type

Upper grade



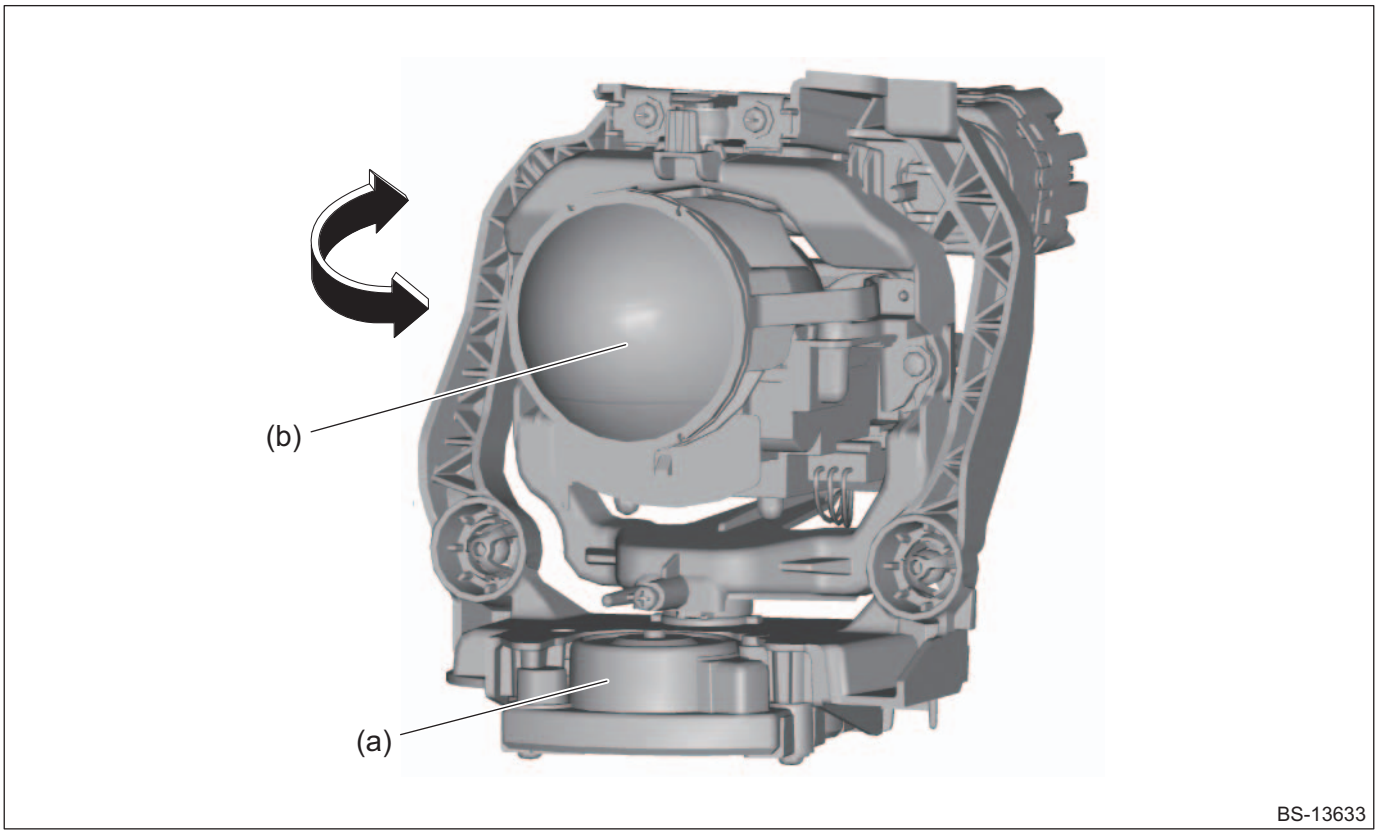
NC-00412

No.	Name	Capacity and wattage	Type
(a)	Turn light (bulb)	12 V-28 W	7444NA
(b)	Low beam/high beam (bifunctional LED light)	12 V-23 W/28 W (LED)	*
(c)	Position light/DRL (LED)	12 V-0.9/9.6 W (LED)	*
(d)	Hood seal rubber	-	-
(e)	Side marker light (LED)/reflex reflector	12 V-0.6 W (LED)	-
(f)	Inner lens	-	-

*: Non-disassembly type

Swivel actuator (for steering responsive headlight (SRH)) (for some grades)

The swivel actuator which moves the beam right and left (for some grades) is installed in the headlight.



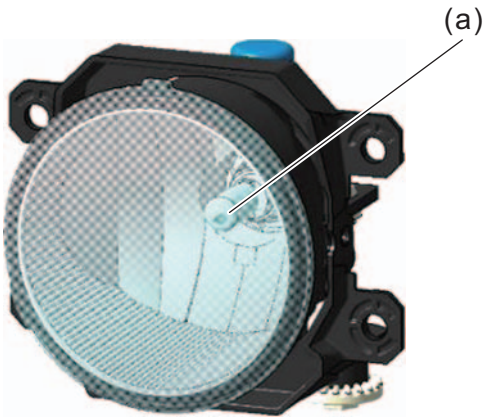
(a) Swivel actuator

(b) Bifunctional projector LED light

Fog light (for some grades)

The round-shaped bulb fog light (for some grades) and vertically long square-shaped LED fog light (for some grades) are installed.

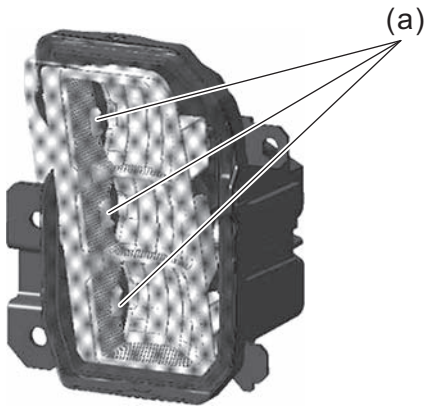
Bulb fog light (for some grades)



NC-00413

No.	Name	Capacity and wattage
(a)	Bulb light source	12 V-19 W

LED fog light (for some grades)



NC-00414

No.	Name	Capacity and wattage
(a)	LED light sources (three lights)	12 V-9 W (LED)

■ Bulb fog light (for some grades)

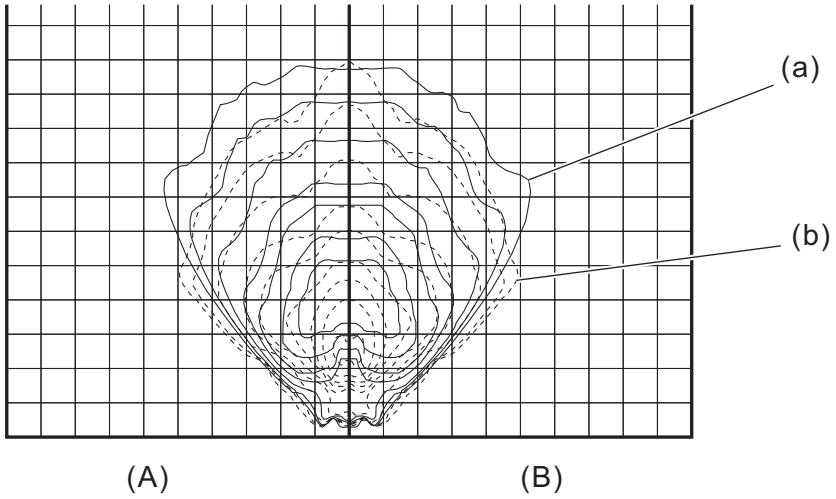
The light distribution is optimized to concentrate light in the practical range and reduce power consumption while the brightness felt by human is the same.

■ LED fog light (for some grades)

The vertically long square-shaped LED fog light is adopted, and the following measures are taken.

- The vertically long square-shaped design adopted by SUBARU for the first time uses the LED chip with three lights and expresses sporty appearance.
- The white light-emitting LED expresses an advanced image.
- Both right and left sides and distant light distribution areas are expanded from the areas of the bulb fog light to improve visibility at night.
- Since LED is adopted as the light source of the fog light, the power consumption is reduced by approximately 53% compared to the bulb fog light.

Light distribution performance (road isolux line diagram)



NC-00415

(A) Left side of vehicle

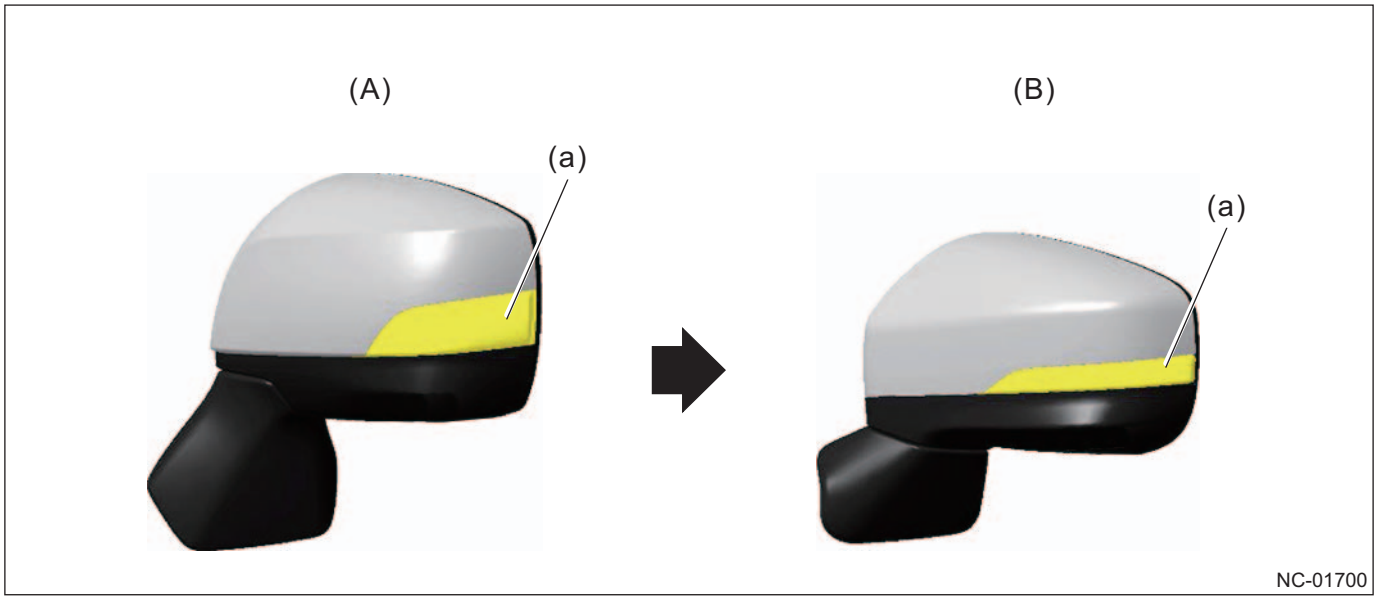
(B) Right side of vehicle

(a) Solid line: LED fog light

(b) Dashed line: Bulb fog light

Side turn signal light (door mirror)

The optical guiding type of LED light source whose entire body illuminates is adopted for the turn light. The light is longer and thinner than those of existing model vehicles to improve texture and visibility from the surrounding area.



(A) Existing model vehicle

(B) New model vehicle

(a) Side turn signal light

Rear combination light/rear finisher light

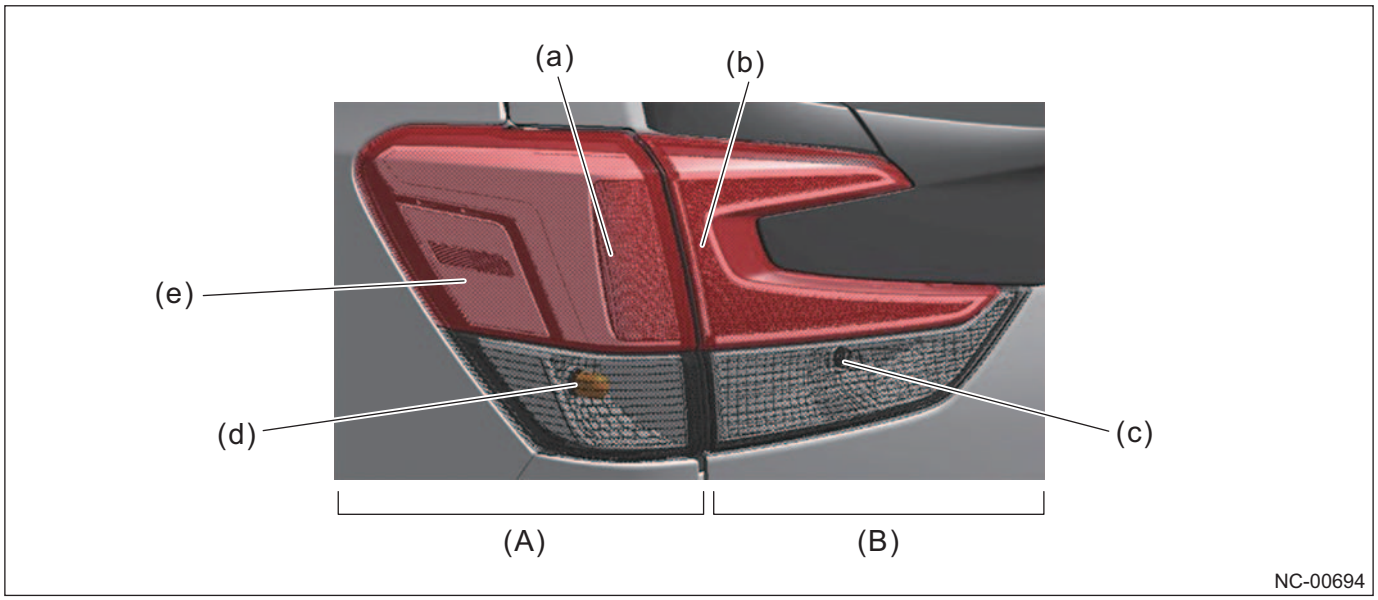
The width of the rear combination light is reduced to expand the rear gate opening. This makes the luggage compartment excellent in usability.

The tail light function is added to the rear finisher light.

Light is emitted in combination with the rear combination light. This new signature expression makes an appeal about the functionality and sense of width. (SUBARU's first)

LED light sources are adopted for the following lights to improve energy-saving and fuel efficiency performances.

- Stop light
- Tail light
- Side marker light

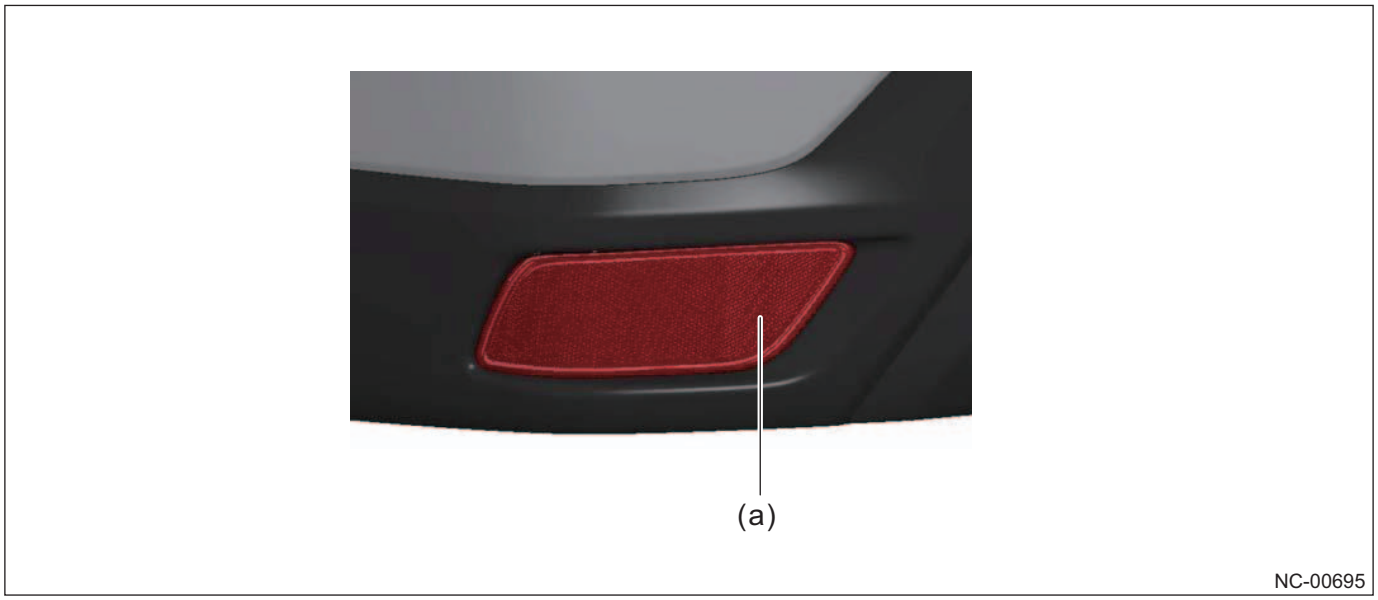


No.	Name	Capacity and wattage	Type
(A)	Rear combination light	-	-
(B)	Rear finisher light	-	-
(a)	Tail/stop light (LED)	13.5 V-0.3 W/4.3 W (LED)	*
(b)	Tail light (LED)	13.5 V-1.6 W (LED)	*
(c)	Back-up light (bulb)	12 V-16 W	W16W
(d)	Turn signal light (bulb)	12 V-21 W	WY21W
(e)	Side marker light (LED)	13.5 V-0.9 W	*

*: Non-disassembly type

Reflex reflector

Reflex reflector is arranged on the rear bumper.

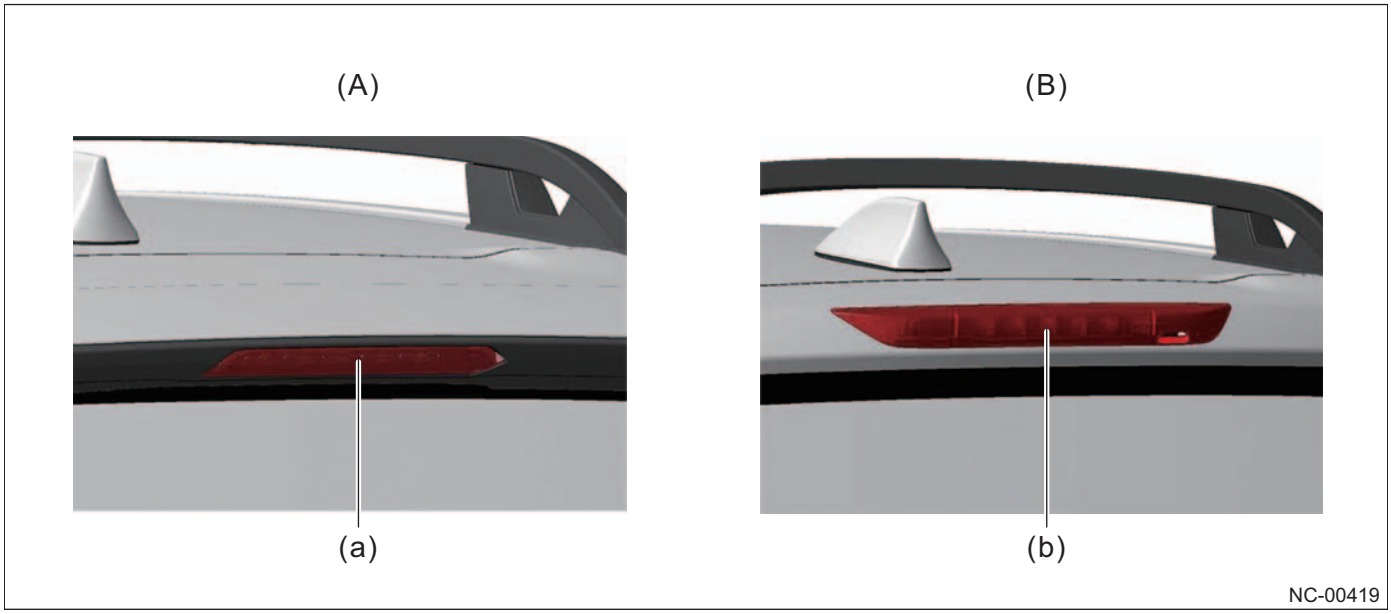


(a) Reflex reflector

High-mounted stop light

For vehicles without roof spoiler, the high-mounted stop light is arranged on the upper part of the rear gate.

For vehicles with roof spoiler, the high-mounted stop light is arranged on the roof spoiler.

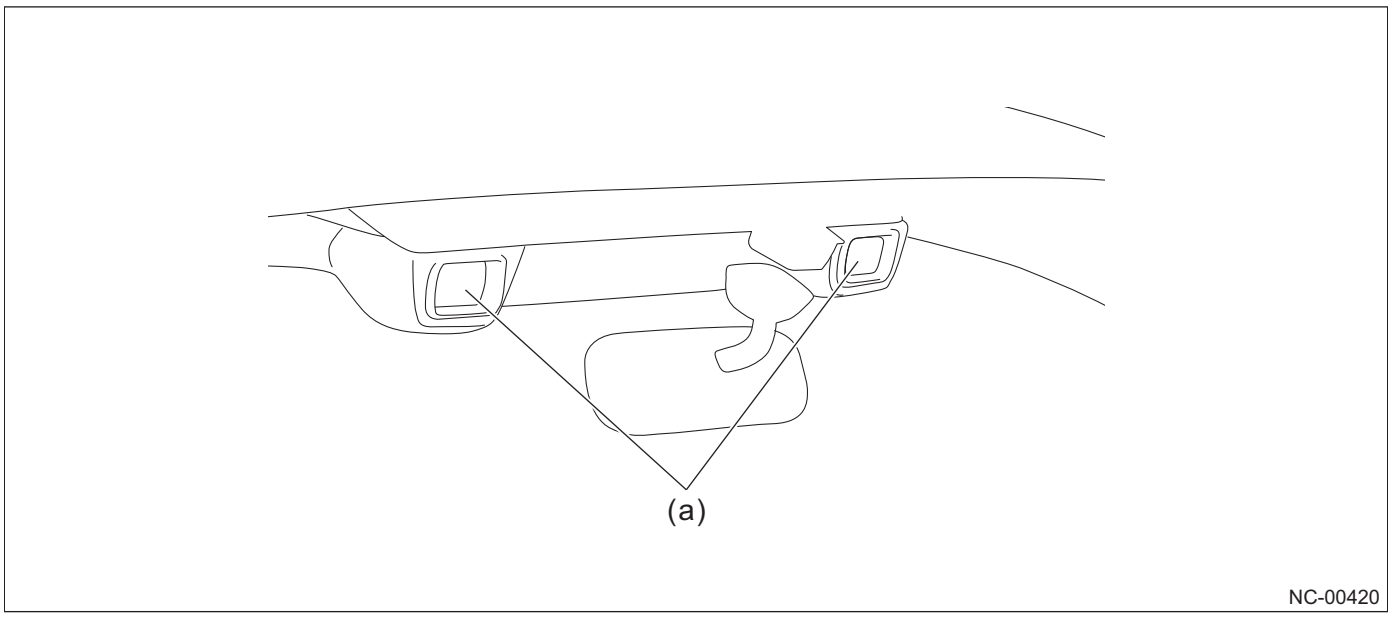


No.	Name	Capacity and wattage	Type
(A)	Vehicle with roof spoiler	-	-
(B)	Vehicle without roof spoiler	-	-
(a)	High-mounted stop light (LED)	12 V-1.1 W (LED)	*
(b)	High-mounted stop light (LED)	13.5 V-1.2 W (LED)	*

Camera unit for high beam assist (HBA) (for some grades)

The stereo camera detects light sources emitted by preceding vehicles, oncoming vehicles, and street lights, etc. Turning on/off the high beam is automatically controlled according to the conditions in front of the vehicle based on detection information from the stereo camera.

For details on the operation, refer to "High beam assist (HBA) (for some grades) " in "Construction and Operation".



(a) Camera

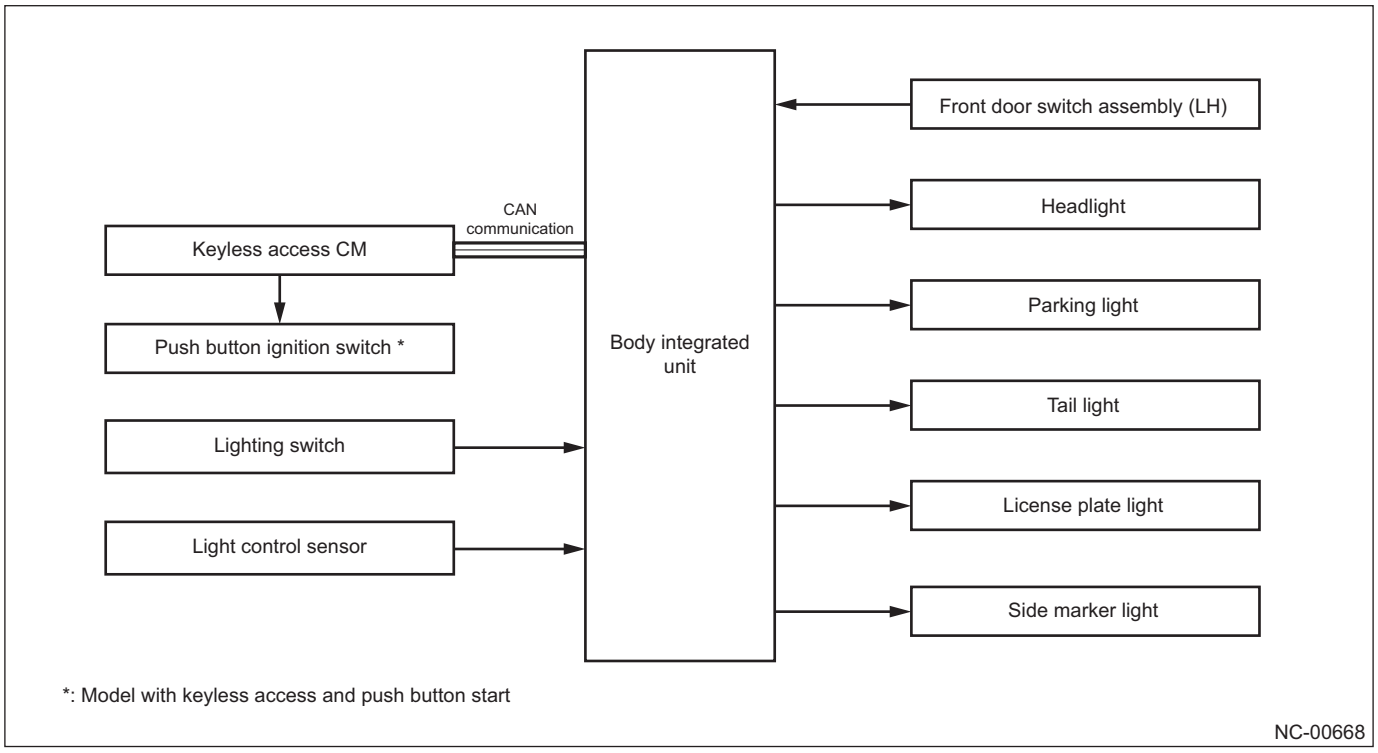
9.3.3 Construction and Operation

Welcome lighting

This is linked to the access key and keyless transmitter to turn on the low beam, parking light, tail light, and license plate light when entering/exiting the vehicle.

System diagram

The body integrated unit inputs status signals such as the push button ignition switch or ignition switch ON/OFF status, position of the lighting switch, and locking by keyless transmitter or access key, and also inputs light control sensor signals. If the system operation conditions of the Welcome Lighting are satisfied, the unit automatically turns on/off the headlight, parking light, side marker light, tail light, and license plate light.



Operation when riding

Lighting condition	When the lighting switch is at the AUTO position and unlocked with the keyless transmitter while the surroundings are dark
Lighting-off conditions after turned on	When 30 seconds have passed since the light has turned on
	When the lighting switch is in a position other than AUTO while the light is turned on
	When the vehicle is locked with the access key, touch sensor, request switch, rear gate lock switch, or keyless transmitter while the light is turned on

Operation when exiting

Lighting condition	The push button ignition switch or ignition switch is OFF while the lighting switch is in the AUTO position and the headlight/parking light is turned on.
Lighting-off conditions after turned on	When 30 seconds have passed since the driver's door has been opened and closed while the light is turned on
	When the lighting switch is in a position other than AUTO
	When the vehicle has been locked twice with the access key, touch sensor, request switch, keyless transmitter, or rear gate lock switch
	When 180 seconds have elapsed after turned on

Customization function

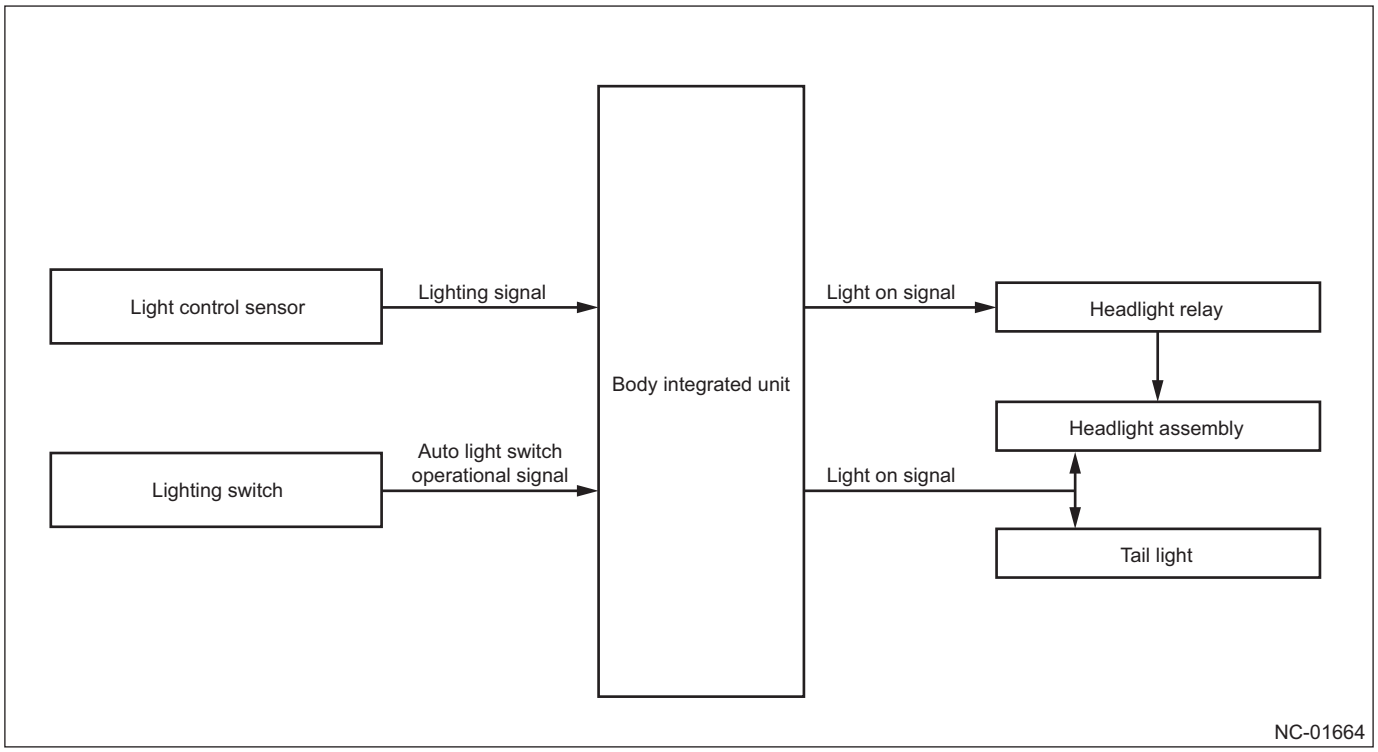
It is possible to customize the time until the light turns off by selecting from four patterns of OFF (0 seconds), 30 seconds, 60 seconds, and 90 seconds at the dealer using the Subaru Select Monitor 4. (The factory setting is 30 seconds.)

Automatic light (for some grades)

The surrounding brightness is judged by a light control sensor installed on the instrument panel. When the surroundings darken, headlight, side marker light, parking light, and tail light turn on automatically.

System diagram

The body integrated unit inputs a lighting signal from the light control sensor and a lighting switch signal. When the push button ignition switch or ignition switch is ON and the lighting switch is in the AUTO position, a signal to turning lights on is sent to the headlight and tail light from the body integrated unit through the relays or direct wire if the lighting signal of the light control sensor drops below the reference value.



Basic operations and operating conditions

When the light control switch is in the AUTO position with the push button ignition switch or ignition switch turned on, the headlight, parking light, and tail light are automatically turned on and off according to the brightness of the surroundings and the status of the vehicle.

Tail light turn on and turn off conditions, and others are described as follows.

- When the surroundings become darker than the standard illumination of tail light lighting, the headlight and tail light turn on.
- When the surroundings are dim, dark, or momentarily bright, the parking light will also turn on and off with the tail light.
  If the surroundings become momentarily bright due to street lights, etc. while the headlight is turned on, the headlight does not turn off.

Customization function

It is possible to customize turn on timing of the automatic light by selecting from among four stages at the dealer using the Subaru Select Monitor 4. (The factory setting is three stages.)

■ Tail light on reminder function

The driver may forget to turn on the tail light during nighttime traveling since DRL automatically turns on even when the lighting switch is at the " ○ " position.

By adding the automatic light function that automatically turns on the headlight/tail light etc. by detecting ambient illuminance, failure in turning on a light manually is prevented and conspicuousness at night is improved.

This function is activated when the following conditions are all satisfied.

- Ignition switch is ON.
- Shift lever is in other than P.
- Engine speed is at more than a certain level or in Auto Start-Stop.
- The electronic parking brake is released.

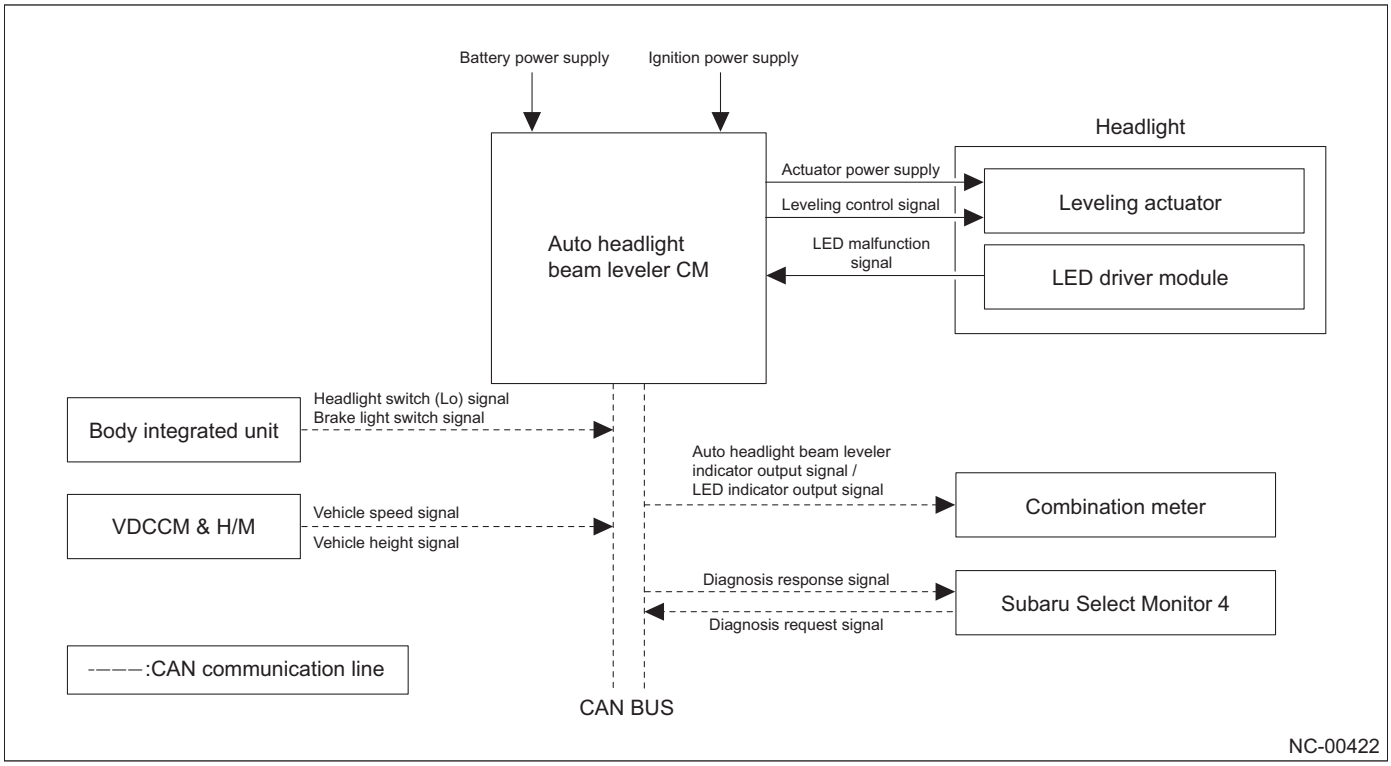
This function cannot be set to OFF or customized since it is related to safety.

Headlight beam leveler (for some grades)

This automatically maintains the headlight beams at constant angles when the vehicle is stopped or steadily traveling to prevent the glare light to oncoming vehicles, depending on changes in the vehicle attitude due to the luggage being loaded, etc. This system detects changes in the static load with the acceleration sensor while stopping to calculate the pitch angle to the basic attitude. The system also detects the vehicle attitude angle with the acceleration sensor while traveling to correct the error of the pitch angle while stopping.

The headlight beam leveler CM detects the tilt with the built-in G sensor and supports CAN communication.

System diagram



Control while vehicle stops

After a change in the vehicle attitude is detected when the headlights turn on and the changed attitude continues in a stabilized state for about three seconds, the headlight beam leveling actuator is driven depending on the average value of the pitch angle change in the last one second or so.

Control while traveling

The auto headlight beam leveler CM obtains the data of acceleration change while traveling for 100 seconds, and calculates the vehicle posture.

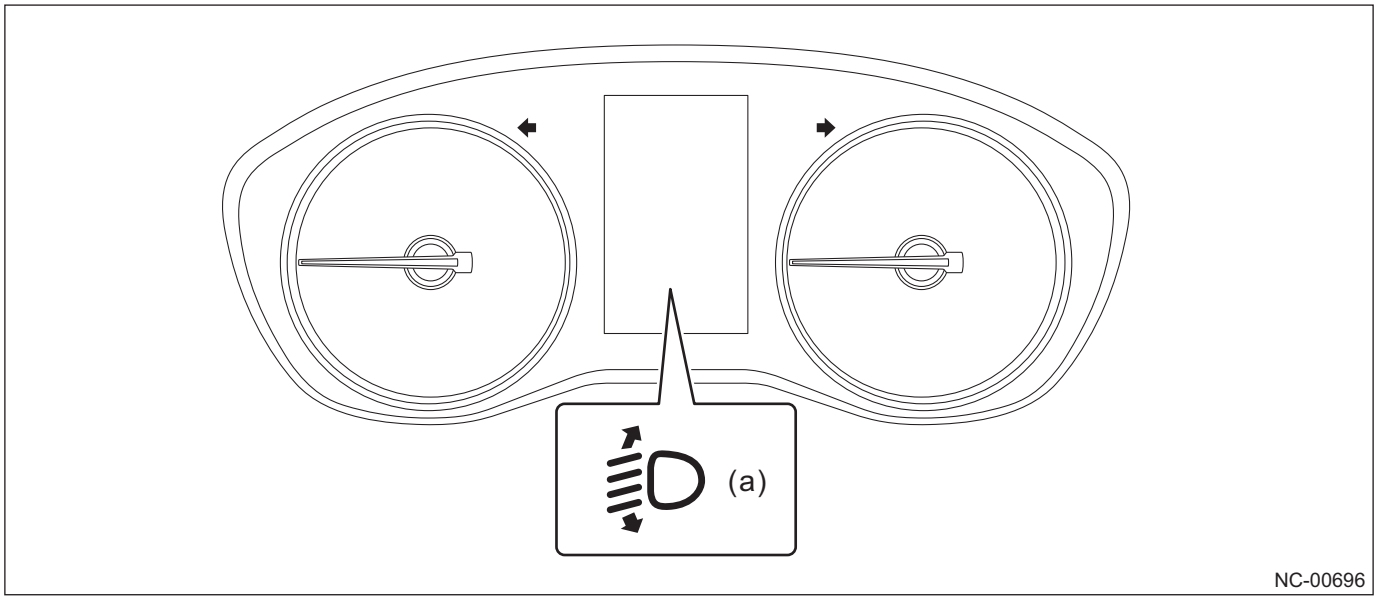
If there is a threshold value or more of difference from the currently recognized vehicle posture, the headlight actuator is driven.

In the following condition, the auto headlight beam leveler CM may misrecognize the vehicle posture, and the optical axis of headlight may be misaligned.

- When the road angle has changed while the engine or vehicle is stopped (vehicle speed 0 MPH (0 km/h)) (e.g. when the vehicle being stopped on a slope is moved to a level land by a wrecker truck)

System malfunction warning function

The auto headlight beam leveler control module displays headlight beam leveler warning on a color LCD screen when an anomaly is detected in the system.



(a) Headlight beam leveler warning light

High beam assist (HBA) (for some grades)

Light sources of a preceding vehicle in front of the vehicle, oncoming vehicles, street lights, etc. are detected by the EyeSight stereo camera, and high beam and low beam are automatically switched depending on conditions.

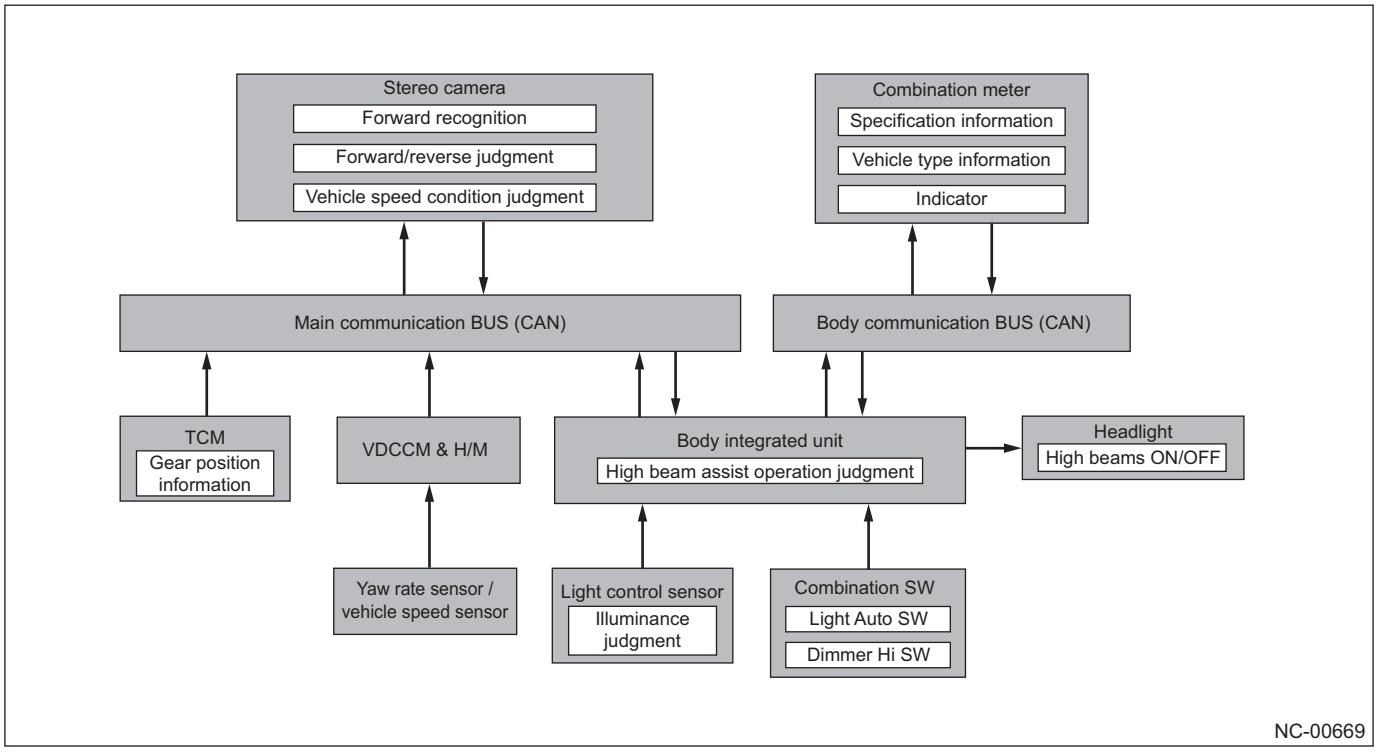
The following effects are expected for HBA when driving.

- Reduction in the operation load of the lighting switch
- Preventing the driver from forgetting to turn off the high beam
- Improvement in recognition performance for pedestrians and obstacles by the EyeSight

*The specifications differ by vehicle grade.

System diagram

The EyeSight stereo camera recognizes light sources such as the brightness of the surroundings, a preceding vehicle in front of the vehicle, and oncoming vehicles, and judges whether or not to allow high beam using the recognized brightness, light source information, vehicle's speed information, and gear position information and outputs this judgment to the body integrated unit. The body integrated unit selects and outputs a high beam or low beam drive signal to the headlight based on this signal as well as information from each of the light control sensor and combination switch, performing automatic high beam/low beam switching control.



Operability conditions

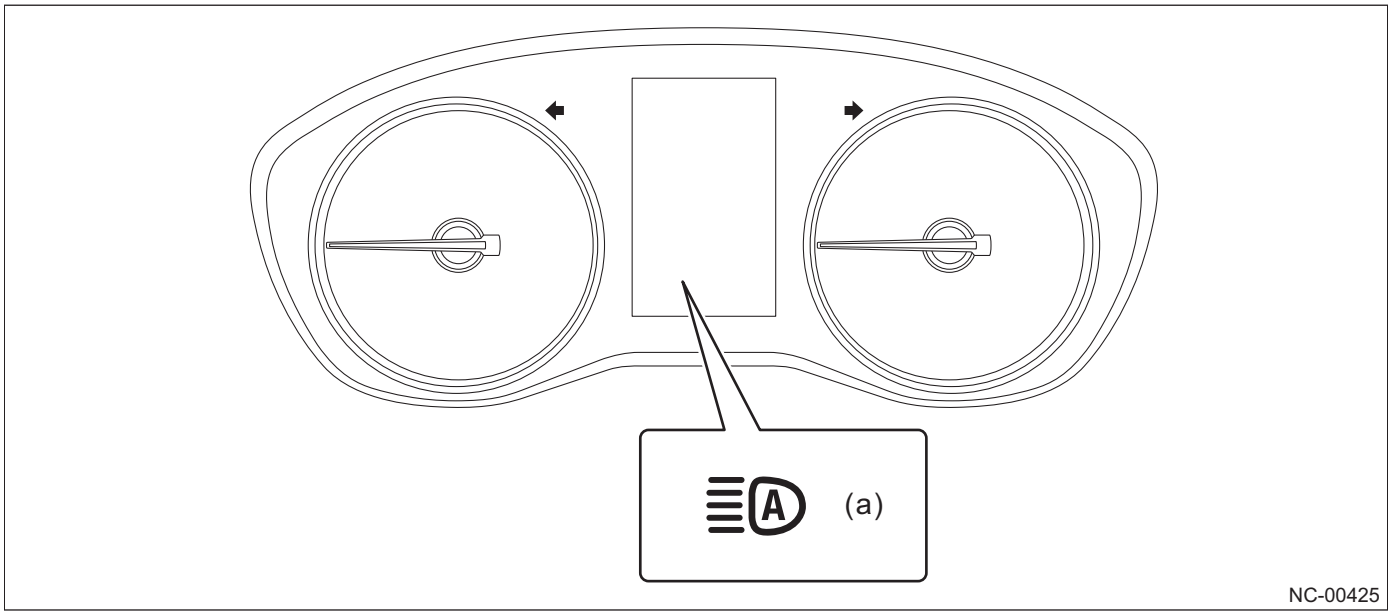
When the lighting switch is in the AUTO position while the high beam switch is ON and the headlight is turned on, the high beam assist (HBA) becomes operable.

If the following conditions are satisfied, the high beam assist (HBA) becomes operable and then the operation light in the combination meter turns on.

- The lighting switch is AUTO and the headlight turns on.
- The high beam switch is ON.

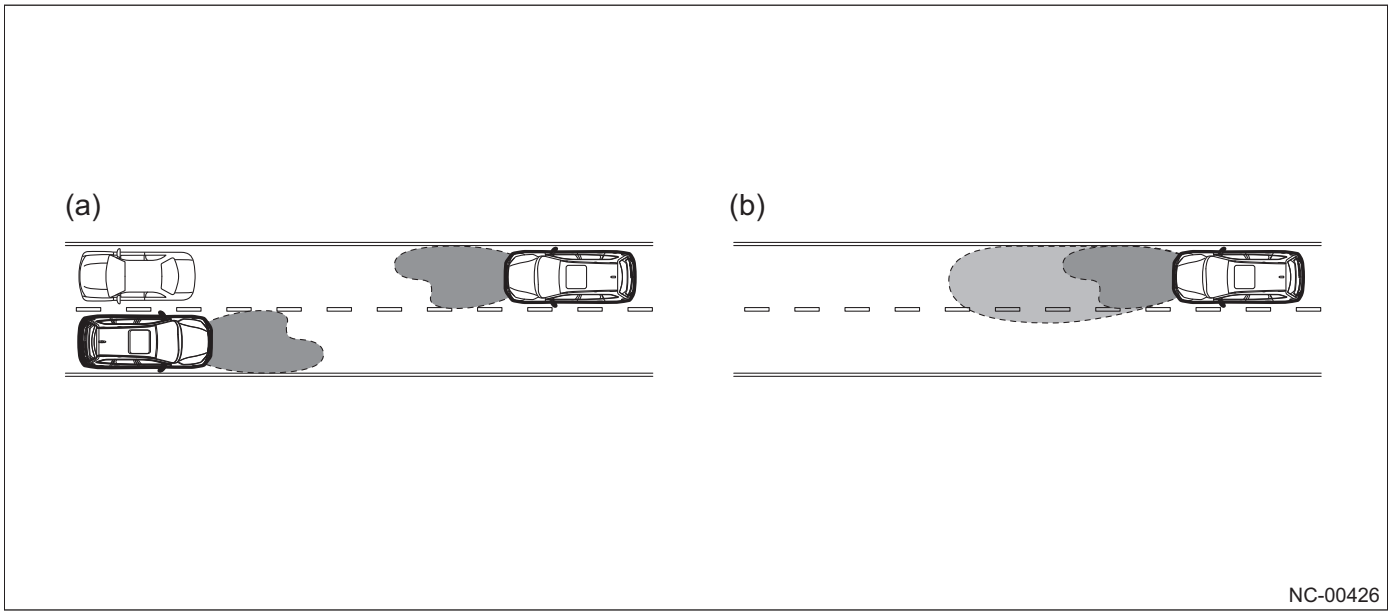
When the vehicle is traveling at the speed at which the control is ON (20 MPH (32 km/h)) or faster: the setting is automatically switched between high beam and low beam according to the condition in front of the vehicle.

When the vehicle is traveling at the speed at which the control is OFF (10 MPH (16km/h)) or slower: the setting is fixed to low beam (high beam turns off).



(a) Operation light (lighting: green)

Operation



(a) When there is a preceding vehicle or oncoming vehicle: low beam

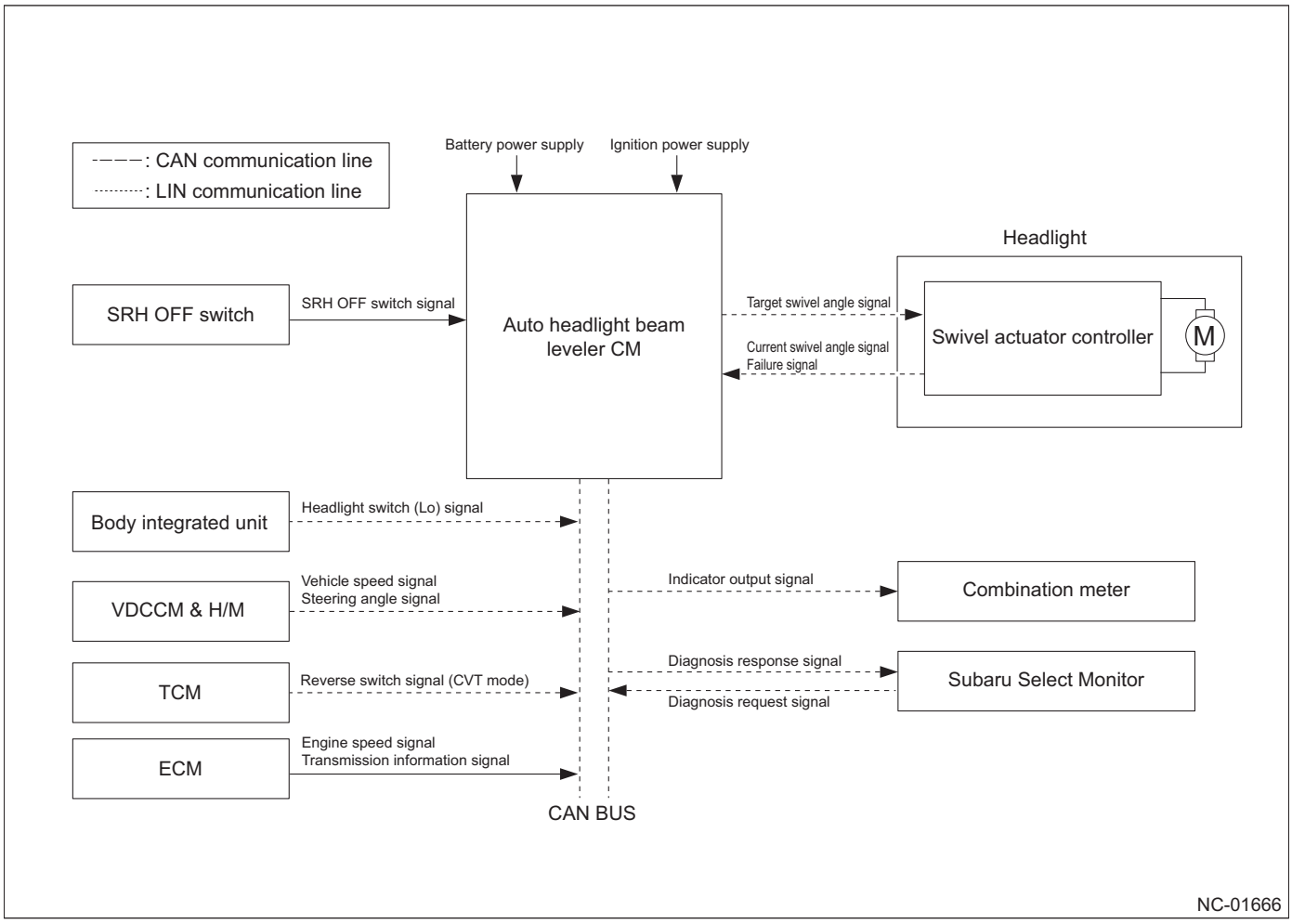
(b) When there is no preceding vehicle or oncoming vehicle: high beam

Steering responsive headlight (SRH) (for some grades)

The steering responsive headlight (SRH) is installed as with existing model vehicles to improve visibility beyond a curve. SRH is a function that moves the headlight beam horizontally according to the steering operation and the vehicle speed when the headlight turns on. The illumination direction of the low beam and high beam of the headlight at corners and intersections are changed according to the curve to improve the visibility of the traveling direction.

SRH can be combined with the bifunctional projector to also expand illuminating range of the high beam range.

System diagram



Operability conditions

The steering responsive headlight (SRH) operates under the following conditions.

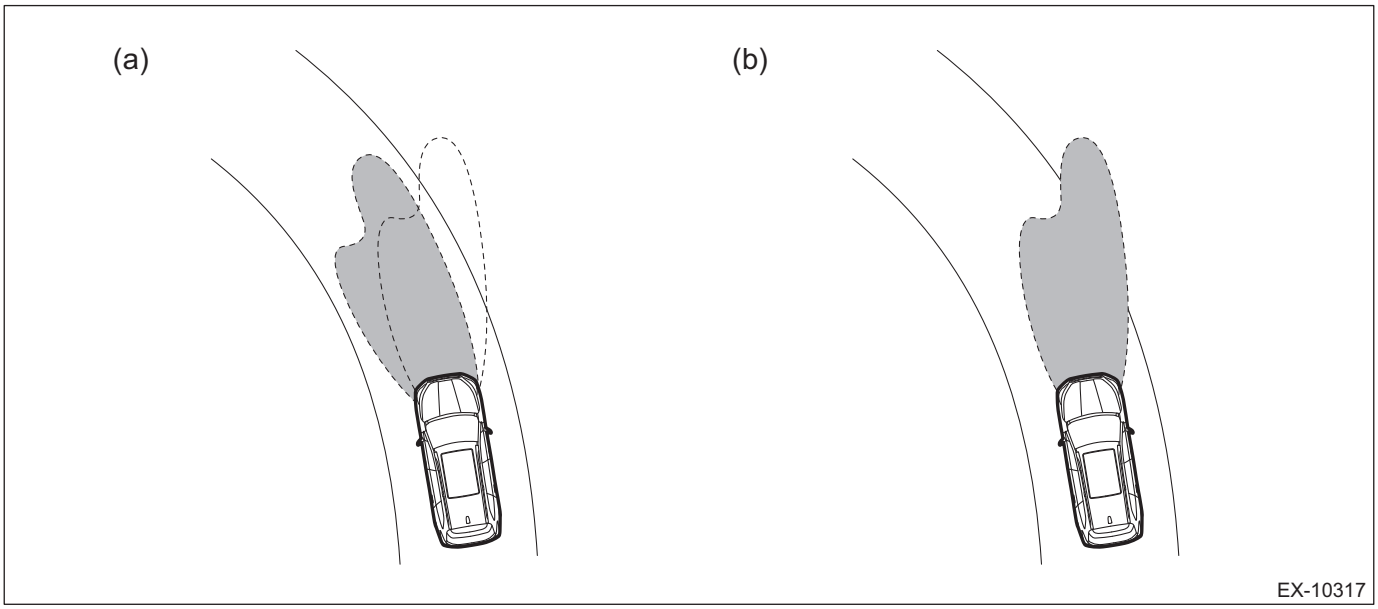
- When the vehicle is advancing
- When the vehicle speed is 5.0 MPH (8 km/h) or higher
- After initialization is complete
- When the SRH off indicator light is turned off

When the engine is started at a vehicle speed of 0 MPH (0 km/h), steering responsive headlight (SRH) executes initialization. The headlight beams move right and left and return to the center.

Turning on/off the steering responsive headlight (SRH) system can be set by the SRH-OFF switch on the instrument panel.

The SRH OFF indicator light in the meter turns on while SRH is off. Even if the steering responsive headlight (SRH) is turned off, when the engine switch turns off and then turns on again, the steering responsive headlight (SRH) turns on.

Operation



(a) Model with steering responsive headlight (SRH)

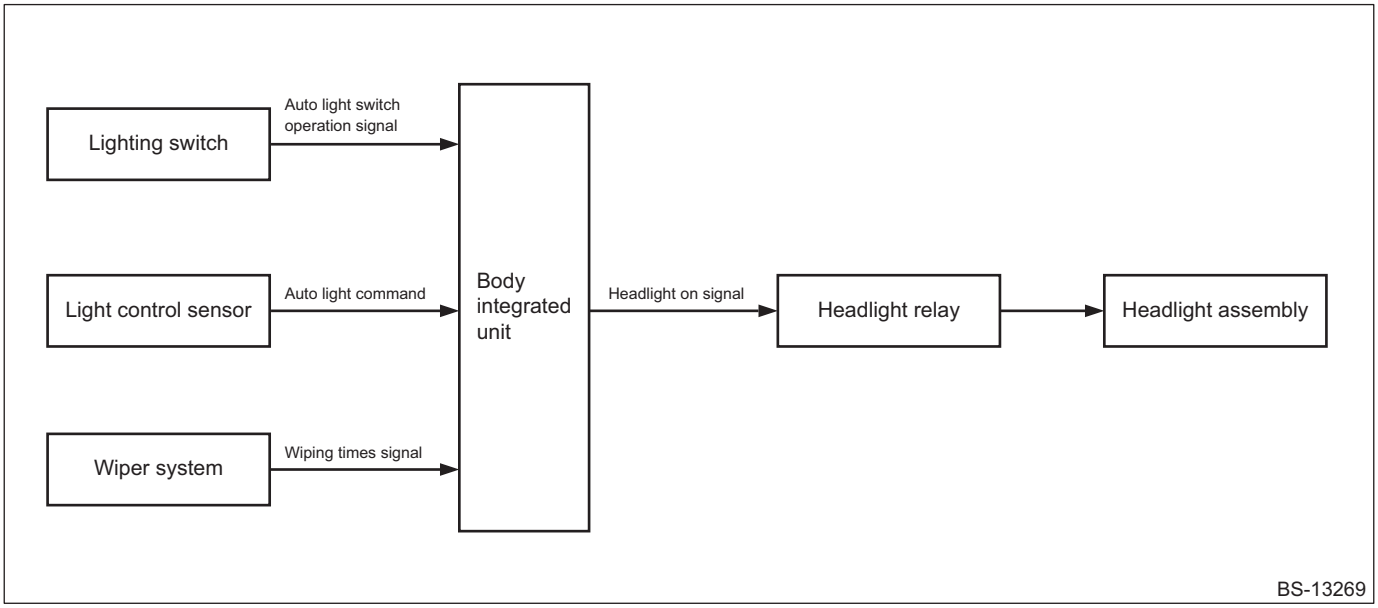
(b) Model without steering responsive headlight (SRH)

Wiper interlocked headlight

When the lighting switch is AUTO during traveling in the rain, and if the wiper operates approximately 10 seconds, the headlight, vehicle width light, etc. automatically turn on. Headlight illumination ensures the view field of the driver, and improves conspicuousness from the surroundings.

- The headlight turns off if the front wiper stops the operation for 60 seconds or more after the headlight turns on.
- The headlight turns off when the lighting switch is turned off.
- The wiper interlocked headlight does not operate when the front wiper operates by the front washer operation.
- Even when the headlight turns on interlocking with the wiper in the daytime, the meter illumination, etc. are not dimmed because the auto dimmer cancel function is activated.

System diagram



Operating conditions

When the light control switch is in the AUTO position with the push button ignition switch or ignition switch being turned on, and if the front wiper operates for approximately 10 seconds or more (cumulated), the headlight turns on automatically.

Customization function

It is possible to customize wiper interlocked headlight on/off at the dealer using the Subaru Select Monitor 4. (The factory setting is ON.)

Light reminder

If the driver's door opens with the headlight or tail light being turned on in a state where the key is removed from the key lock cylinder or a state where the push button ignition switch is OFF, a buzzer warning will sound reminding the driver to turn off the lights.

Operating conditions and basic operations

If the driver's door opens when the key is removed from the key lock cylinder or the push button ignition switch is OFF with the headlight or tail light turned on, the buzzer will sound continuously, reminding the driver to turn off the lights. The sound of the light reminder buzzer stops when the lights turn off or when the driver's door closes.

If the key is inserted into the key lock cylinder with the headlight or tail light turned on, the key reminder warning function is prioritized even if the driver's door opens, and the buzzer will sound intermittently in 1.2 second cycle.

When the driver forgets to turn off the lights, the automatic light is prioritized and operates, and when the light control switch is ON again after the lights turn off, the light reminder system operates.

Direction indicator one-touch function

The direction indicator one-touch function that flashes the turn signal in the pressed direction three times when the turn signal switch is lightly pressed (not pressed to the lock position) is adopted.

Basic operation

Previously, when making a lane change, the turn signal switch needed to be switched on and then switched off after the lane changes. Now, this operation can be done with a single operation using the direction indicator one-touch function (a short press of the turn signal switch). This simplifies the process of making a lane change.

Customization function

It is possible to customize direction indicator one-touch function on/off at the dealer using the Subaru Select Monitor 4. (The factory setting is ON.)

Auto dimmer cancel function

This added function improves visibility by canceling dimming of display and screen of the meter, air conditioner panel, navigation, etc. according to the surrounding brightness.

Operating conditions

This is effective when the vehicle travels with the headlight turned on in the daytime or the headlight turns on in the daytime due to wiper interlocked headlight installation.

*Brightness cannot be adjusted by the illumination control switch while auto dimmer cancel operates.

Customization function

It is possible to customize the auto dimmer cancel function on/off and the brightness with which the function operates in five stages using the Subaru Select Monitor 4 from dealer. (The factory setting is three stages of sensitivity (standard).)

9.4 Side Cladding

9.4.1 Overview

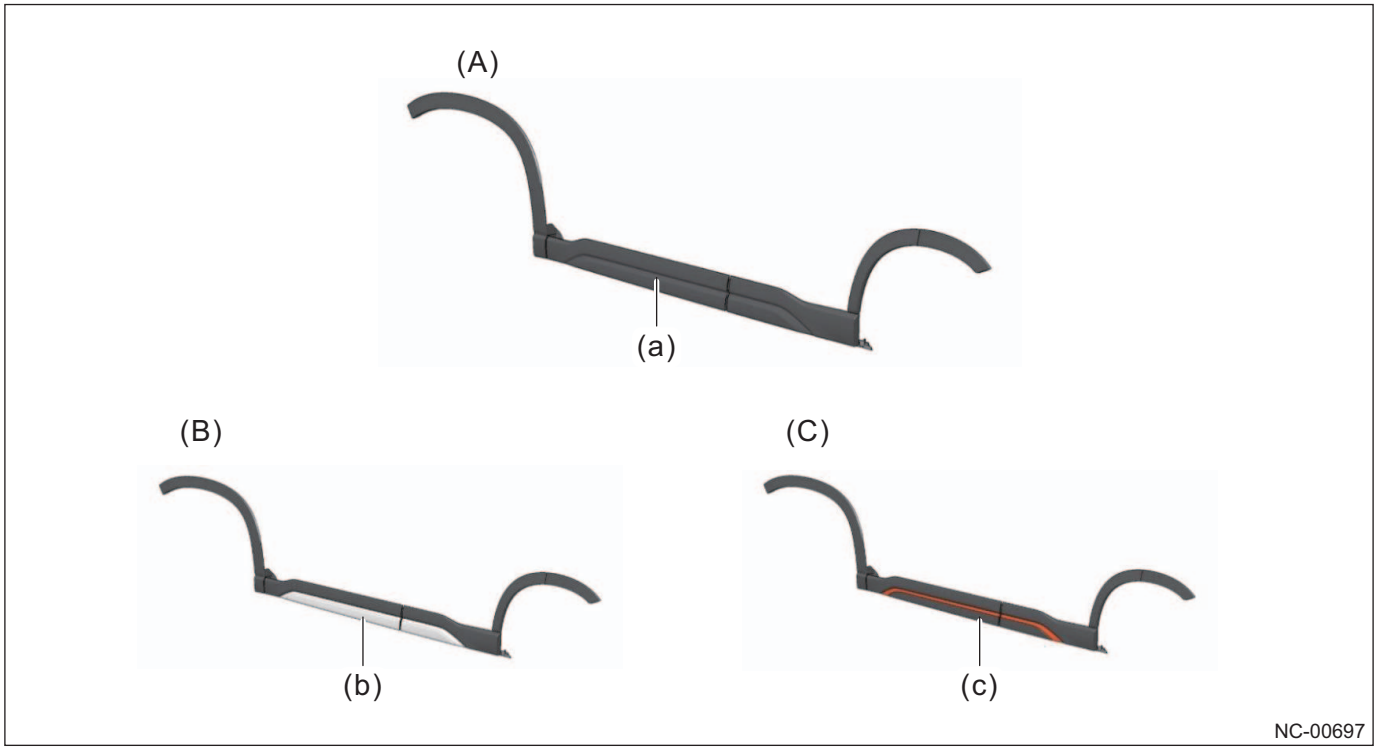
Arch garnishes that give a feeling of oneness with the body panel are adopted around the front and rear wheels. The strong SUV feature is expressed by the function to protect the entire tire areas.

The design with thickness is adopted for the door-under garnish to prevent stone splash to the body.

For upper grade, a decoration is added to the door-under garnish to apply high-quality appearance that suits the rank of vehicle.

- Upper grade: Silver paint
- SPORT: orange paint

A geometry texture with clear ruggedness is adopted for the cladding surface around the wheel to improve quality in appearance. Also, the weight is reduced by 10% compared to existing model vehicles by thinning to improve fuel efficiency.



(A) Standard grade
(B) Upper grade
(C) SPORT

(a) Surface: Geometry texture
(b) Silver paint
(c) Orange paint

9.5 Wiper and Washer System

9.5.1 Overview

The wet arm is adopted that wears the washer nozzle on the wiper arm on the front passenger's seat side and injects washer fluid directly to the glass surface in front of the EyeSight stereo camera.

The flat blade is adopted for the front wiper blade. The blade height is lowered to prevent shielding of visibility in wiper operation and reduce wind noise.

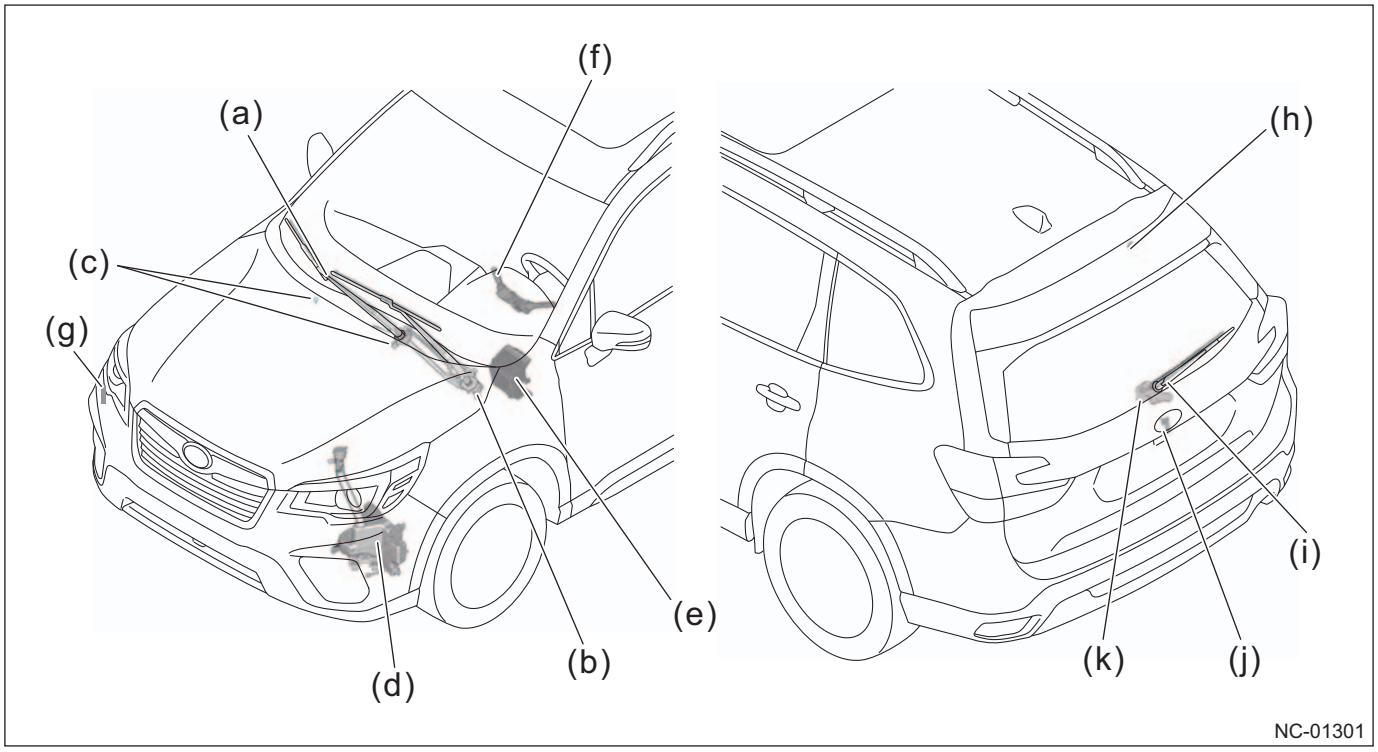
The wiper with reverse interlock function is adopted for the rear wiper. The visibility is improved when reversing.

The high-pressure pump* and the multi diffusion nozzle are adopted in the washer system. The high-pressure pump has enhanced jet force, and the multi diffusion nozzle can inject washer fluid in wide range.

*: Comparison with existing model vehicle

9.5.2 Component

Component layout drawing



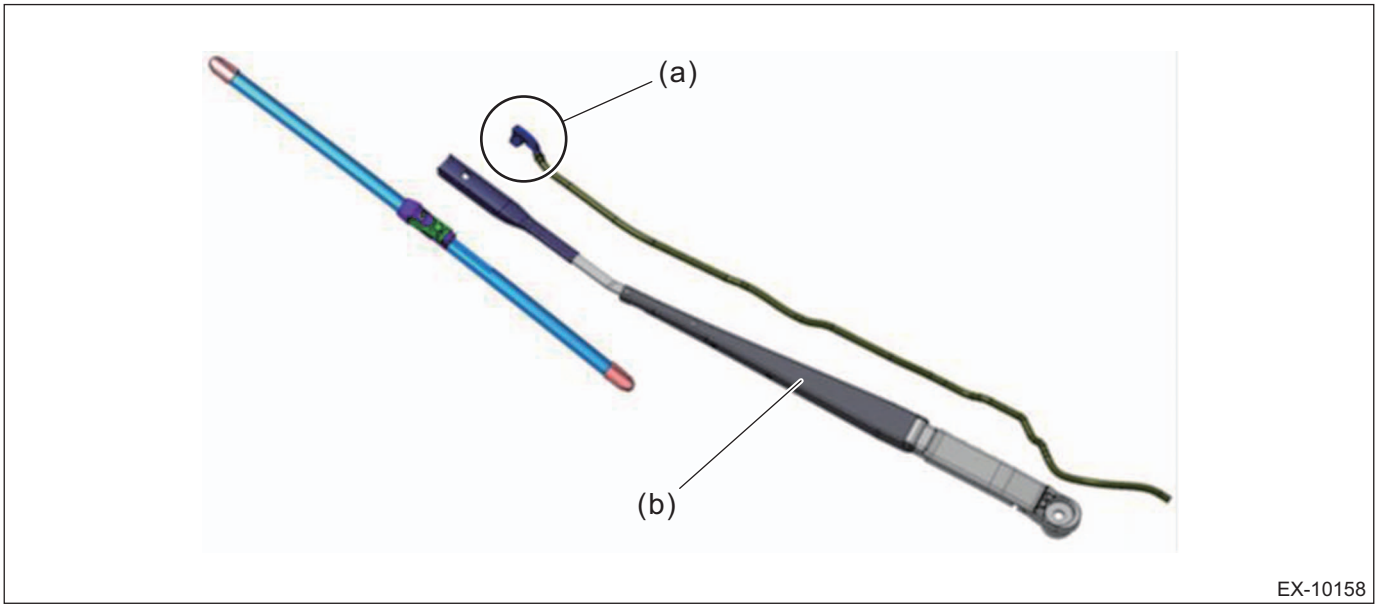
(a) Arm assembly windshield wiper and blade assembly windshield wiper
(b) Motor assembly windshield wiper
(c) Nozzle windshield washer
(d) Tank assembly washer
(e) Body integrated unit (BIU) (in joint box)
(f) Switch assembly combination wiper
(g) Wiper relay unit
(h) Nozzle rear washer
(i) Arm assembly rear wiper and blade assembly rear wiper
(j) Rearview camera washer
(k) Motor assembly rear wiper

Component details

Wiper

■ Wet arm

The wet arm is adopted that wears the washer nozzle at the wiper arm on the front passenger's seat side. Washer fluid is injected directly to the glass surface in front of the EyeSight stereo camera to improve washability in front of the camera and ensure EyeSight performance and safe visibility.

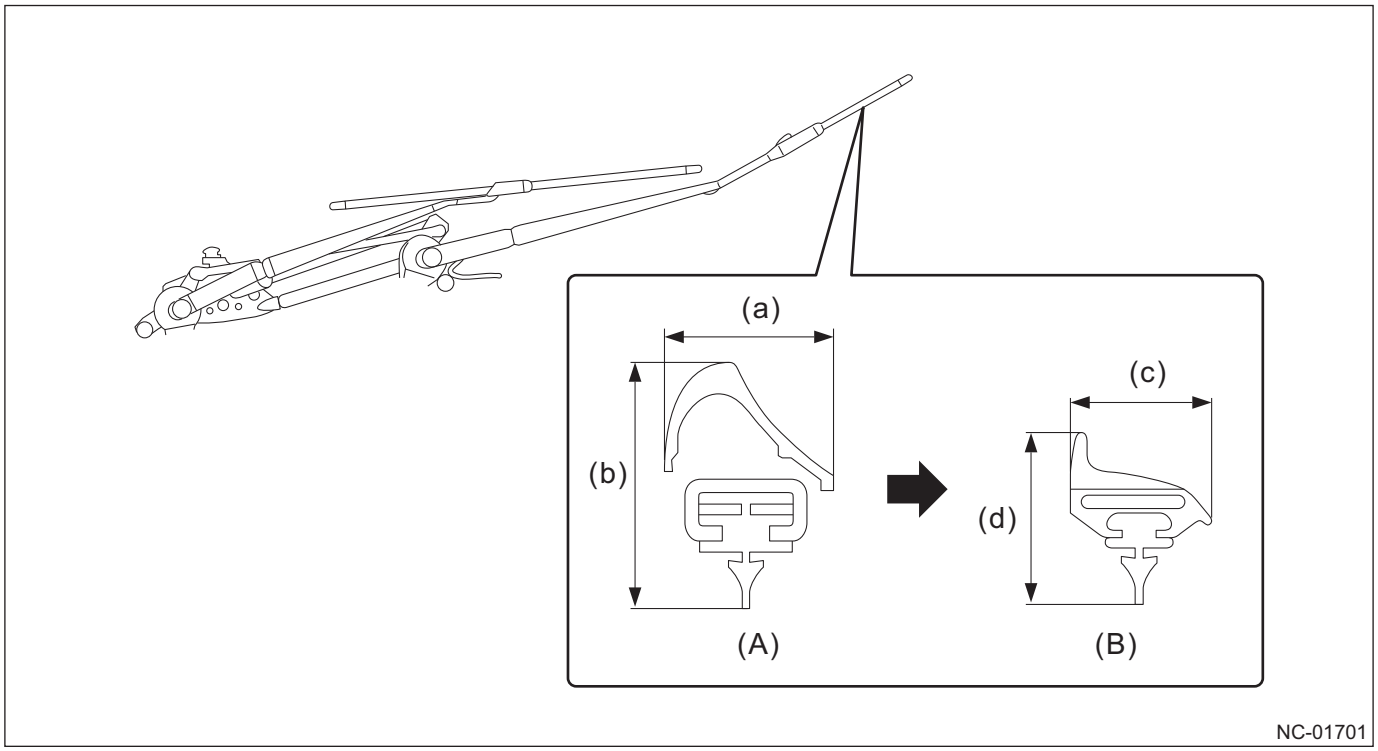


(a) Nozzle wiper arm washer

(b) Arm assembly windshield wiper assister

■ Flat blade

The flat blade is adopted for the front wiper blade. The blade height is lowered to prevent shielding of visibility in wiper operation and reduce wind noise. The wiper protrusion viewed from the vehicle interior is reduced.



(A) Existing blade (existing model vehicle)

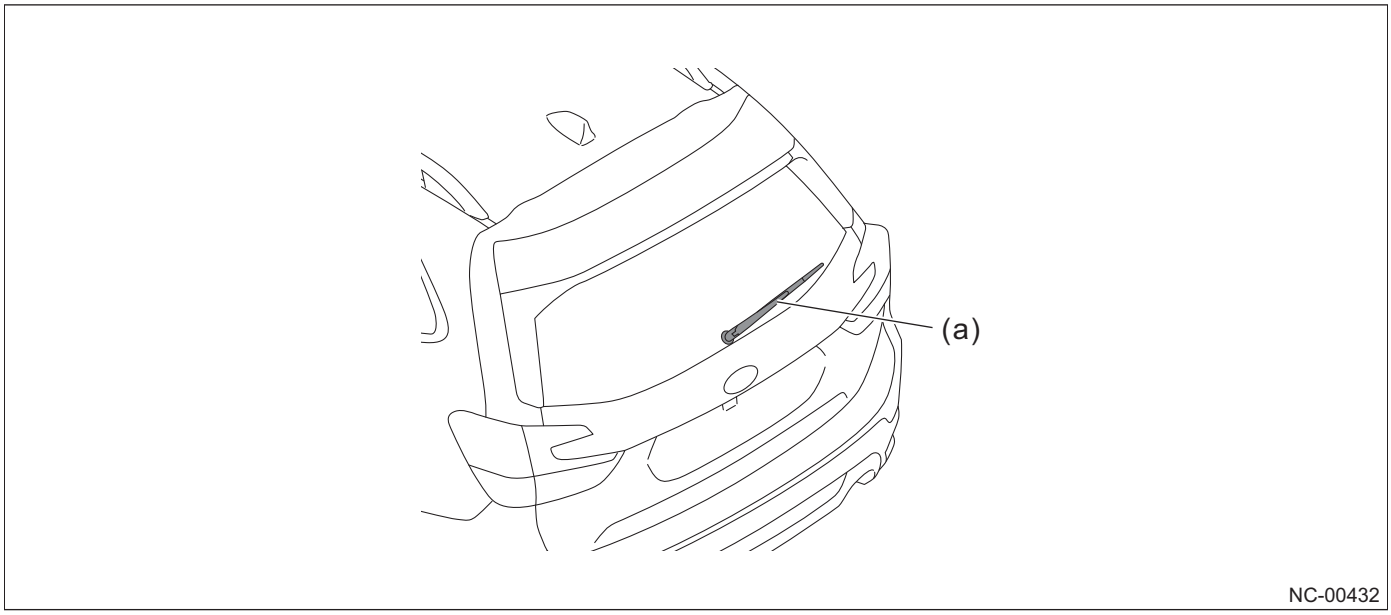
(B) Flat blade (new model vehicle)

(a) 0.62 in (15.82 mm)
(b) 0.89 in (22.6 mm)

(c) 0.5 in (12.6 mm)
(d) 0.6 in (15.3 mm)

■ Rear wiper

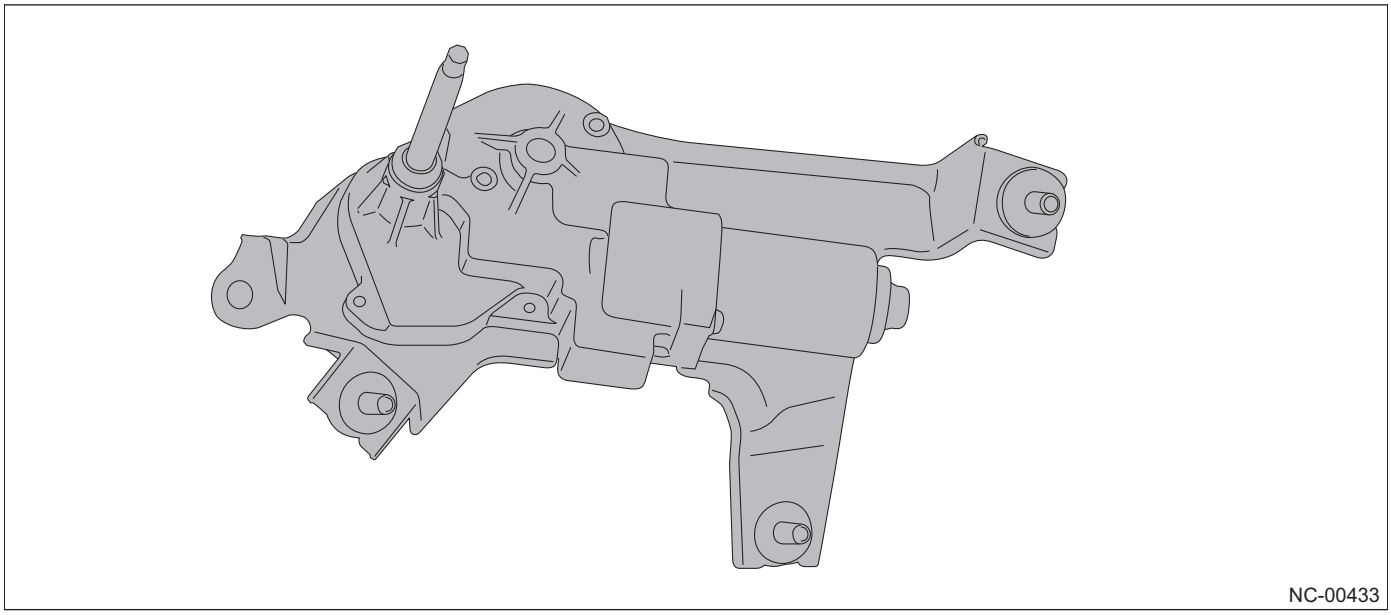
The vehicle speed sensitive intermittent wiper and the reverse interlock rear wiper are adopted for the rear wiper.



(a) Blade assembly rear wiper and arm assembly rear wiper

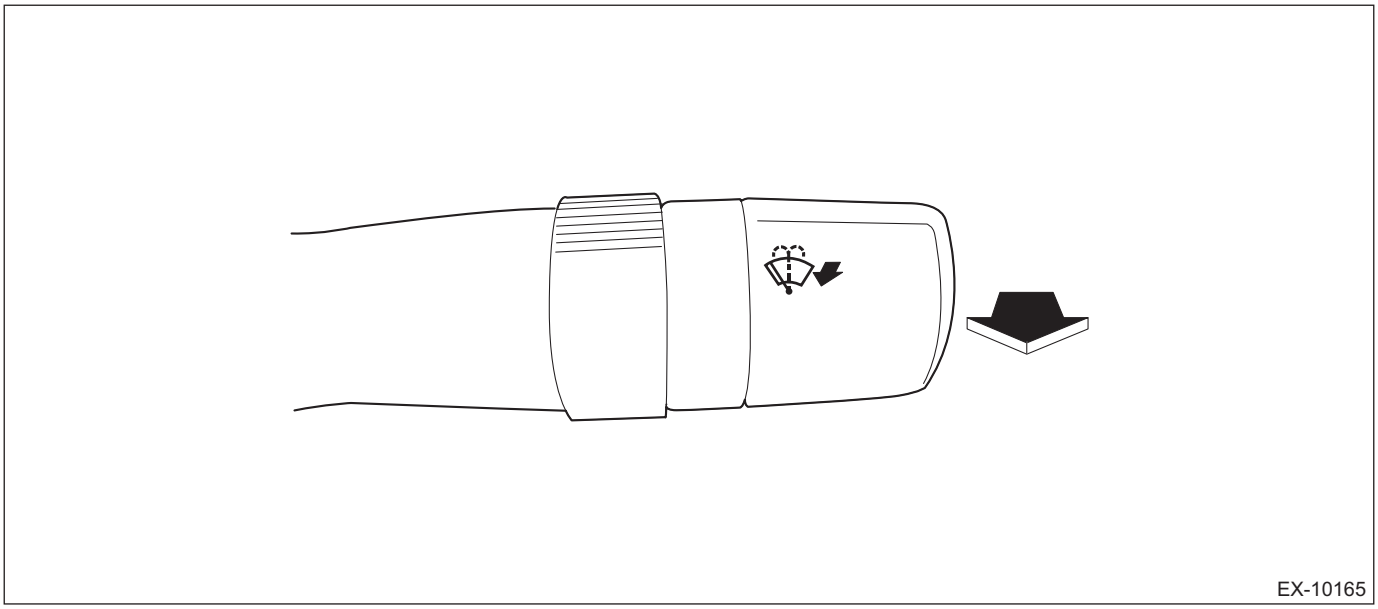
Rear wiper motor

The small-sized motor is adopted to reduce the weight. (Comparison with existing model vehicle: -2.6 oz (-75 g))



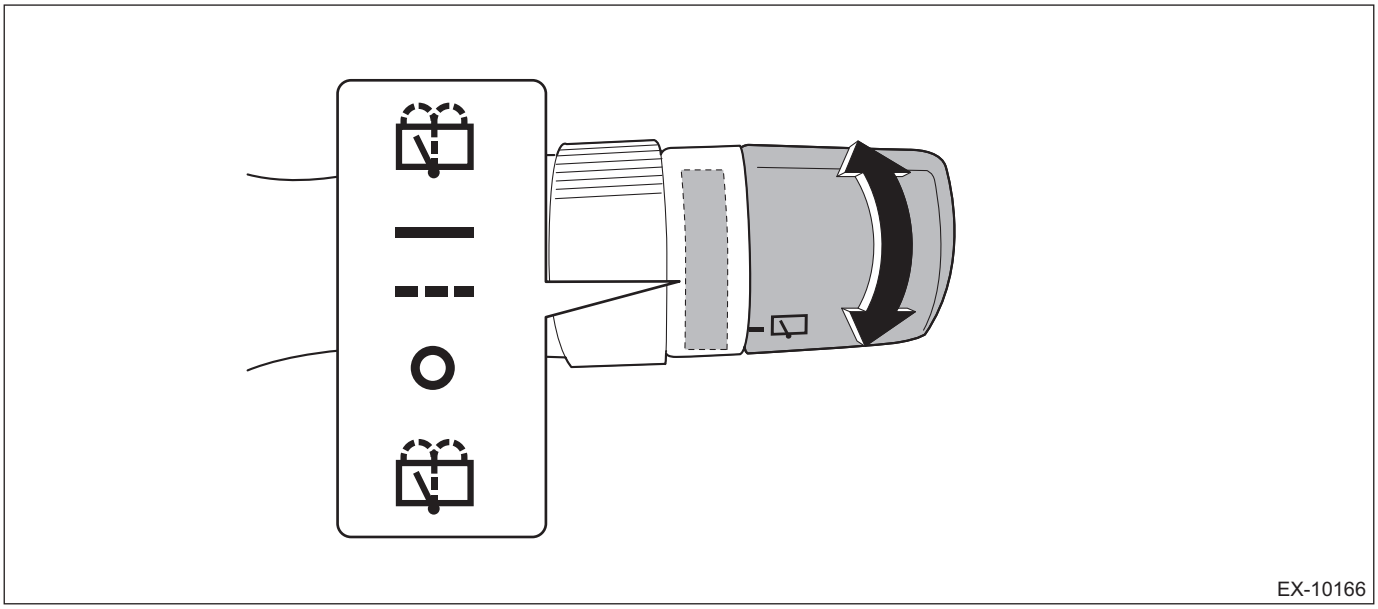
■ Front washer switch

The front washer operates by pulling the front wiper control switch toward the driver side. The front washer stops by returning the switch to the original position. In addition, when the body integrated unit receives the signal of the front washer switch on, the front wiper operates in cooperation with the washer after the delay time (300 ms) has elapsed.



■ Rear wiper control switch, rear washer switch

The rear wiper performs the intermittent operation that operates depending on continuous operation and vehicle speed. The system controls the intermittent stopping time depending on the vehicle signal in the intermittent operation. The rear wiper also operates in cooperation with the rear washer.

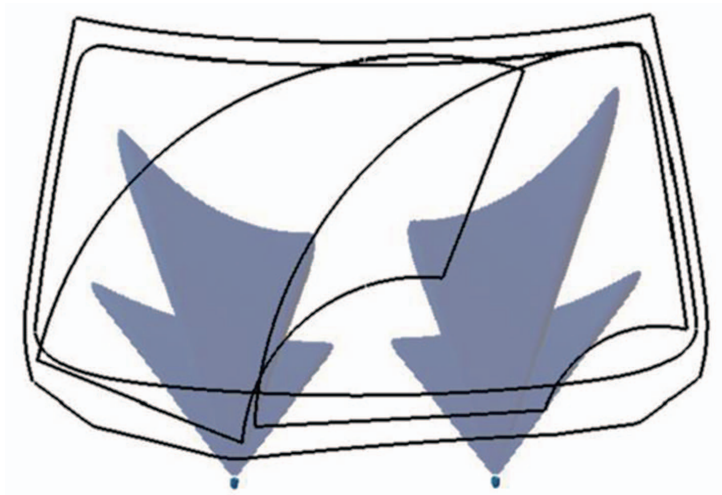


Washer

■ Nozzle windshield washer

While the high-pressure pump* is used to enhance jet force, the multi diffusion nozzle is adopted to inject washer fluid in a wider range to improve washability and ensure safer visibility even in a bad weather.

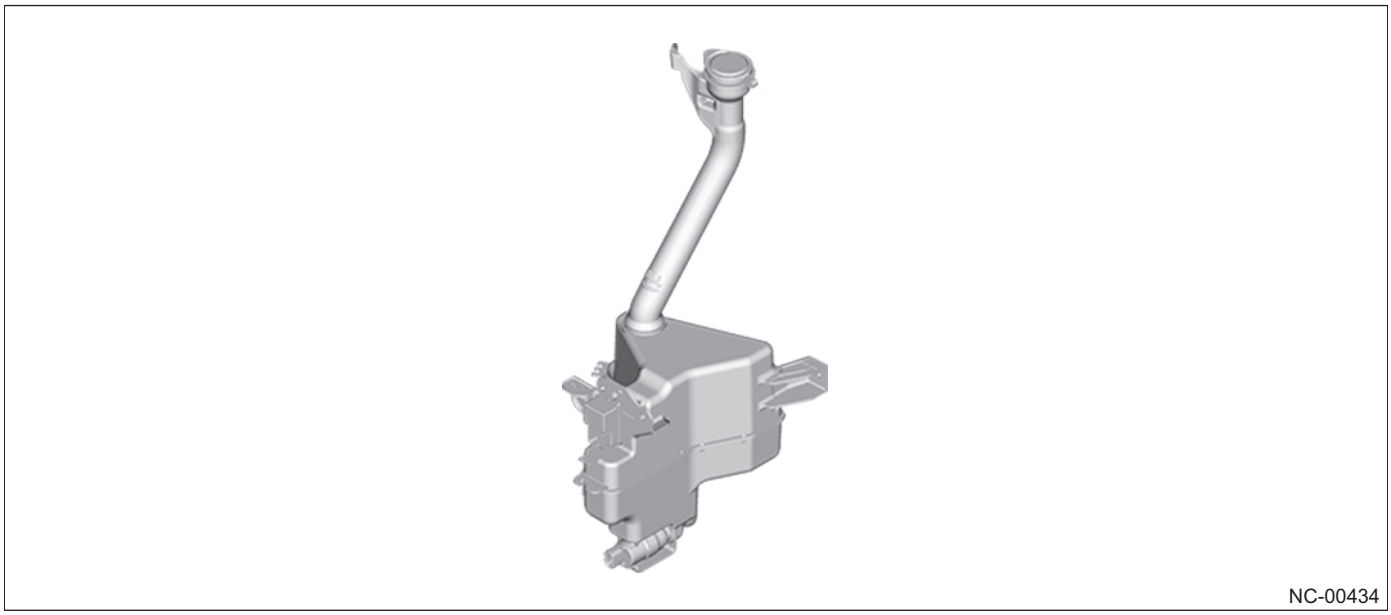
*: Comparison with existing model vehicle



EX-10162

■ Tank assembly washer

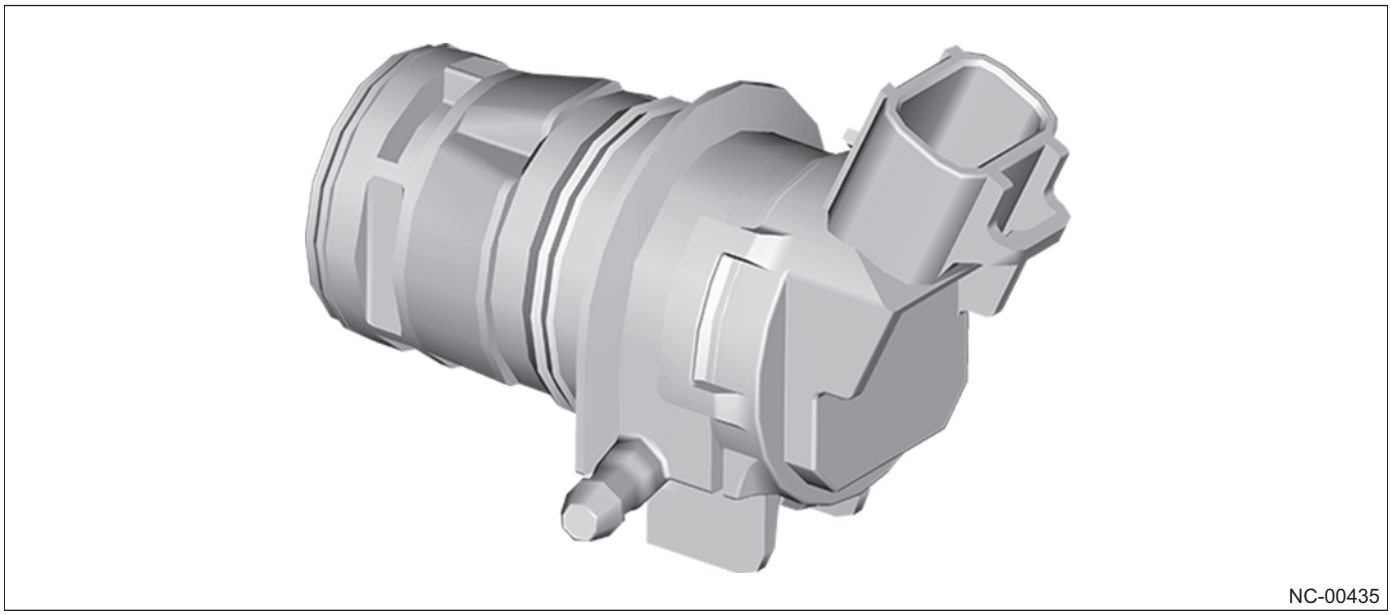
The tank assembly washer with a capacity of 4.23 US qt (4.0 L, 3.52 Imp qt) is adopted. Also, the remaining amount warning function (level sensor) is mounted to inform the decrease of washer fluid.



■ Motor pump assembly washer front

The high-pressure pump* with strong jet force of washer fluid is adopted to improve washability.

*: Comparison with existing model vehicle

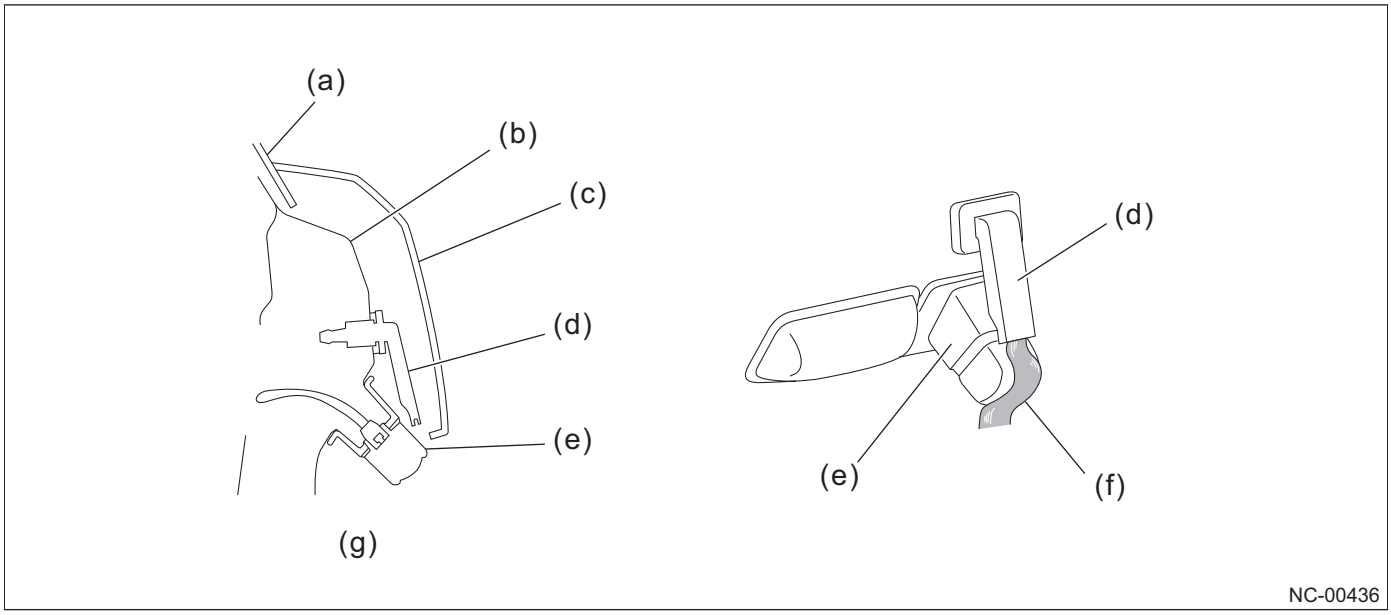


■ Rearview camera washer (SUBARU's first)

This operates interlocking with the rear washer. Stains and water droplets attached on the lens of the rearview camera are washed away by the water stream from the dedicated nozzle to ensure safe visibility when the vehicle moves backward.

Also, the dedicated nozzle is arranged just above the rearview camera to prevent the nozzle from being exposed. Thus, both the appearance quality and performance are ensured.

The washer hose is branched from the rear wiper washer. Thus, a washer pump and washer tank dedicated to the rearview camera washer are not required.

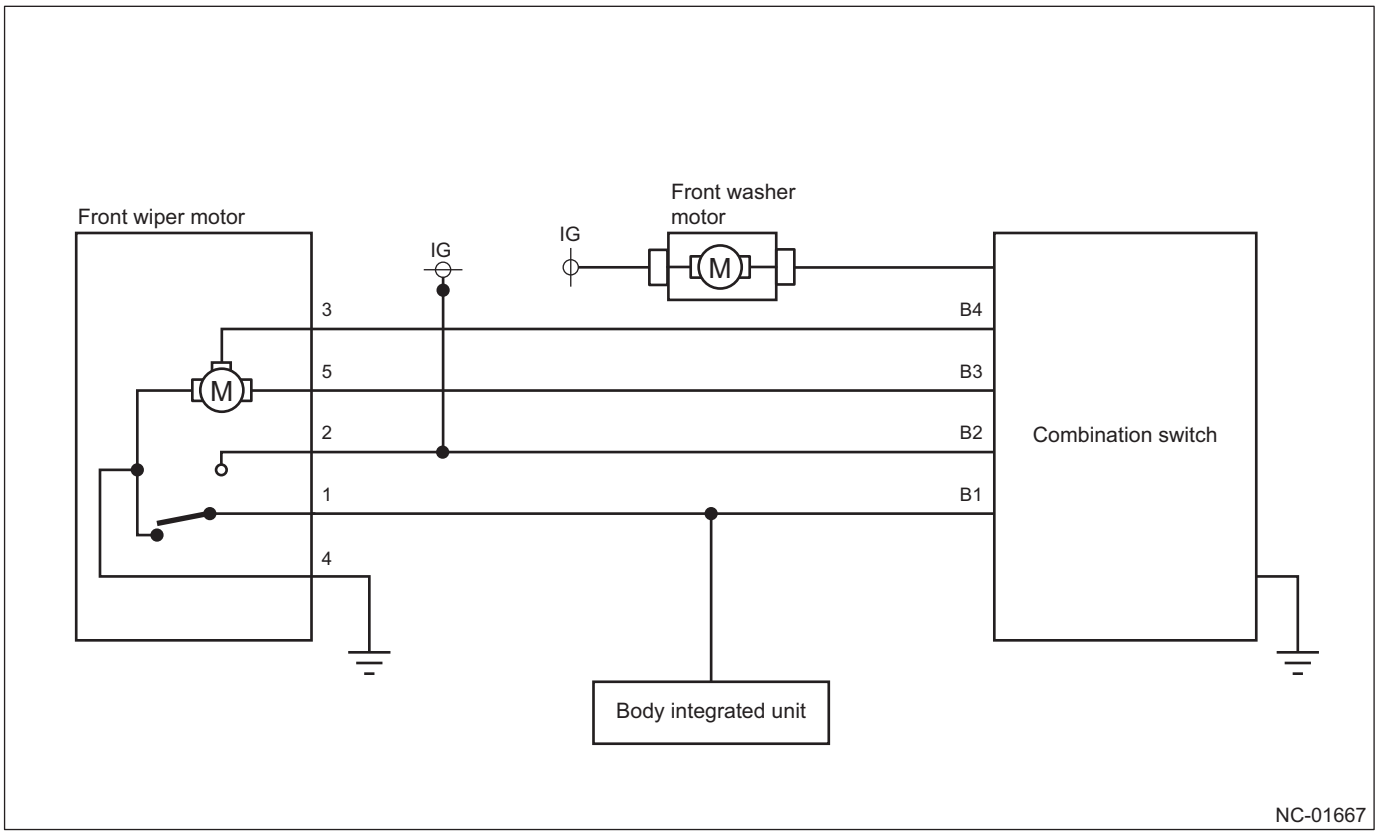


(a) Rear glass
(b) Body
(c) Garnish
(d) Rearview camera washer nozzle
(e) Rearview camera
(f) Rearview camera washer jet flow
(g) Vehicle layout (cross section)

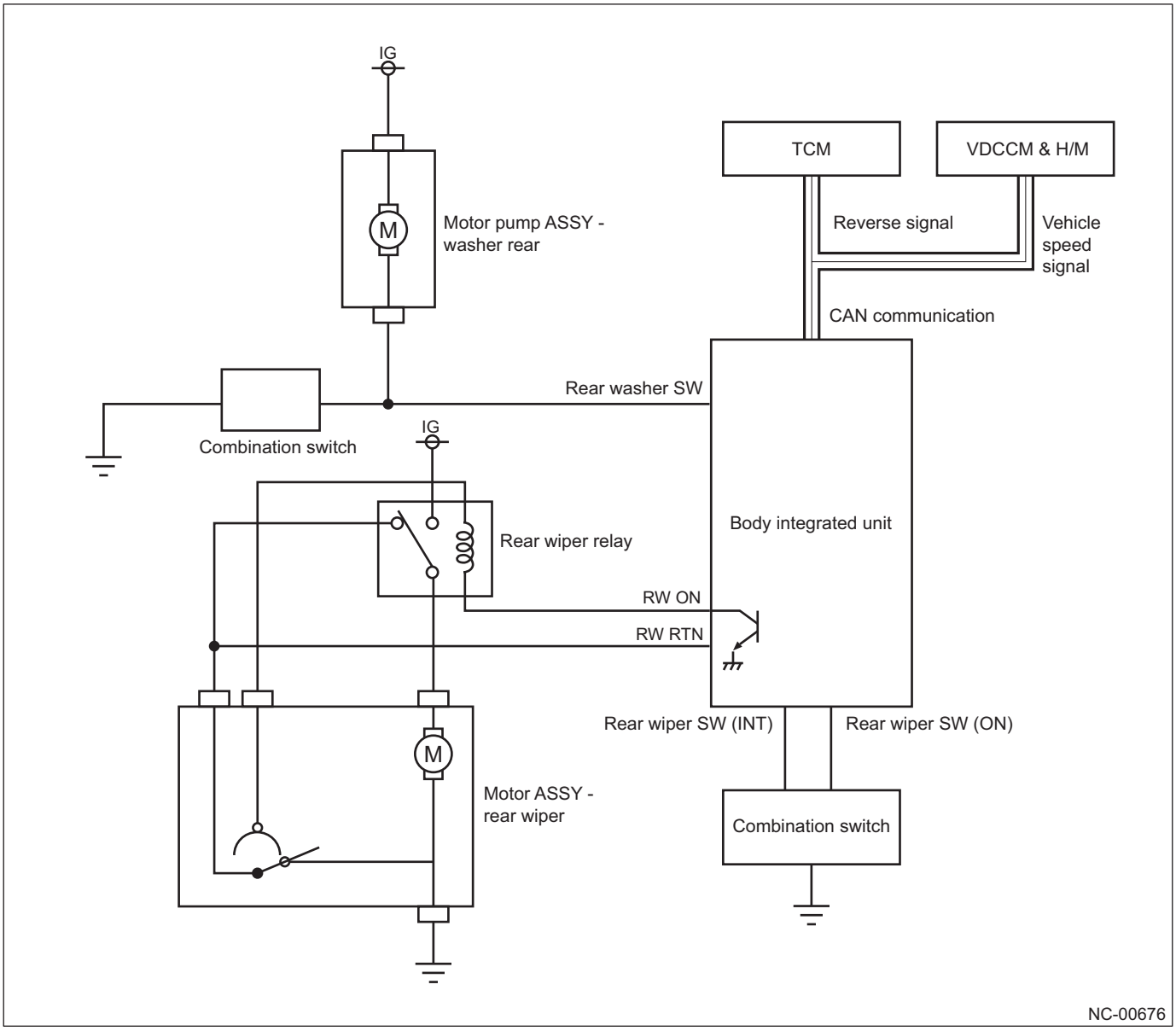
9.5.3 Construction and Operation

System diagram

Front wiper and washer system



Rear wiper and washer



System details

Rear wiper

The vehicle speed sensitive wiper is adopted for the rear wiper. The intermittent operation of the rear wiper is controlled by the body integrated unit (BIU) which controls intermittent stopping time according to vehicle signals sent from the VDC control module and the hydraulic control module (VDCCM & H/M). In addition, when the body integrated unit (BIU) receives the reverse signal from the transmission control module (TCM), it switches the operation of the rear wiper from intermittent operation to continuous operation.

By the reverse interlock rear wiper function, the rear wiper operates automatically and intermittently in cooperation with the front wiper when the body integrated unit (BIU) receives the reverse signal from the transmission control module (TCM) while the front wiper is operating at LO or HI for ten seconds or more.

It is possible to customize reverse interlock rear wiper on/off at the dealer using the Subaru Select Monitor 4. (The factory setting is OFF for U5 destination and ON for C5 destination.)

9.6 Glass/Windows/Mirrors

9.6.1 Overview

Glass

- A laminated glass with thickness 0.187 in (4.76 mm) and a sound-insulating intermediate film with the superior quietness are adopted for the glass front windshield. The glass has an ultraviolet protection effect.
- A glass with the ultraviolet protection effect is adopted for the glass assembly rear door and the glass rear gate.
- The ceramic pattern is optimized to ensure rear visibility. Secure and safe visibility is ensured.

Window

- A white illumination with luxury feel is adopted for the power window switch.
- A silver paint is adopted for the power window switch bezel. (for some grades)
- A smart motor with high quality when the glass rises and lowers is adopted for the power window motor assembly. (for some grades)
- LIN communication is adopted for all the power window switches. (for some grades)

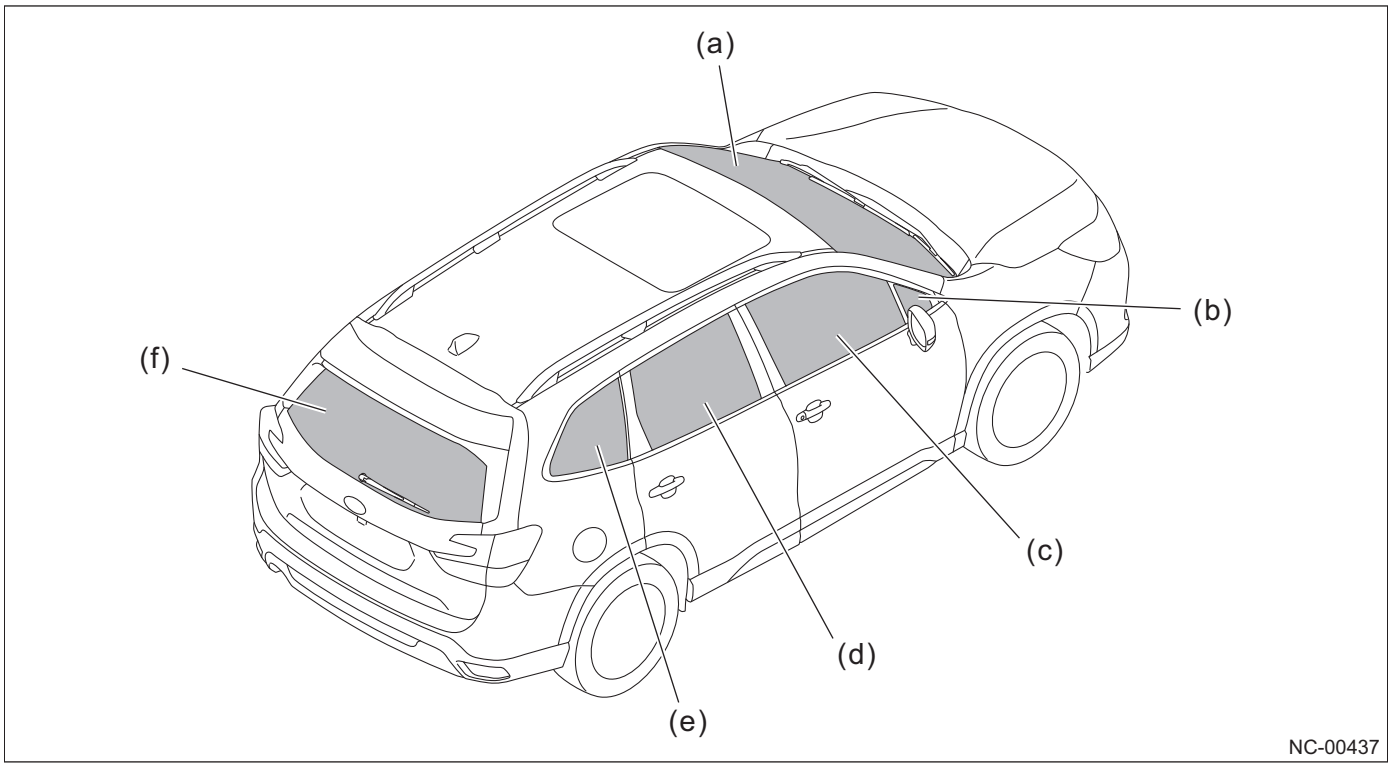
Mirror

- A sharp mirror body and a small mirror stay are adopted to realize the mirror with the superior appearance, aerodynamic performance, and quietness.
- The optical guiding type LED turn light whose whole body illuminates, with the superior surrounding visibility and quality feeling is adopted.
- A motor with the superior quietness is adopted for the electric remote control mirror.
- Satin plating with the superior appearance and quality feeling is adopted. (for some grades)
- Subaru Rear Vehicle Detection system indicator is located inside the mirror body of the door mirror so that visual line of a driver moves less.

9.6.2 Component

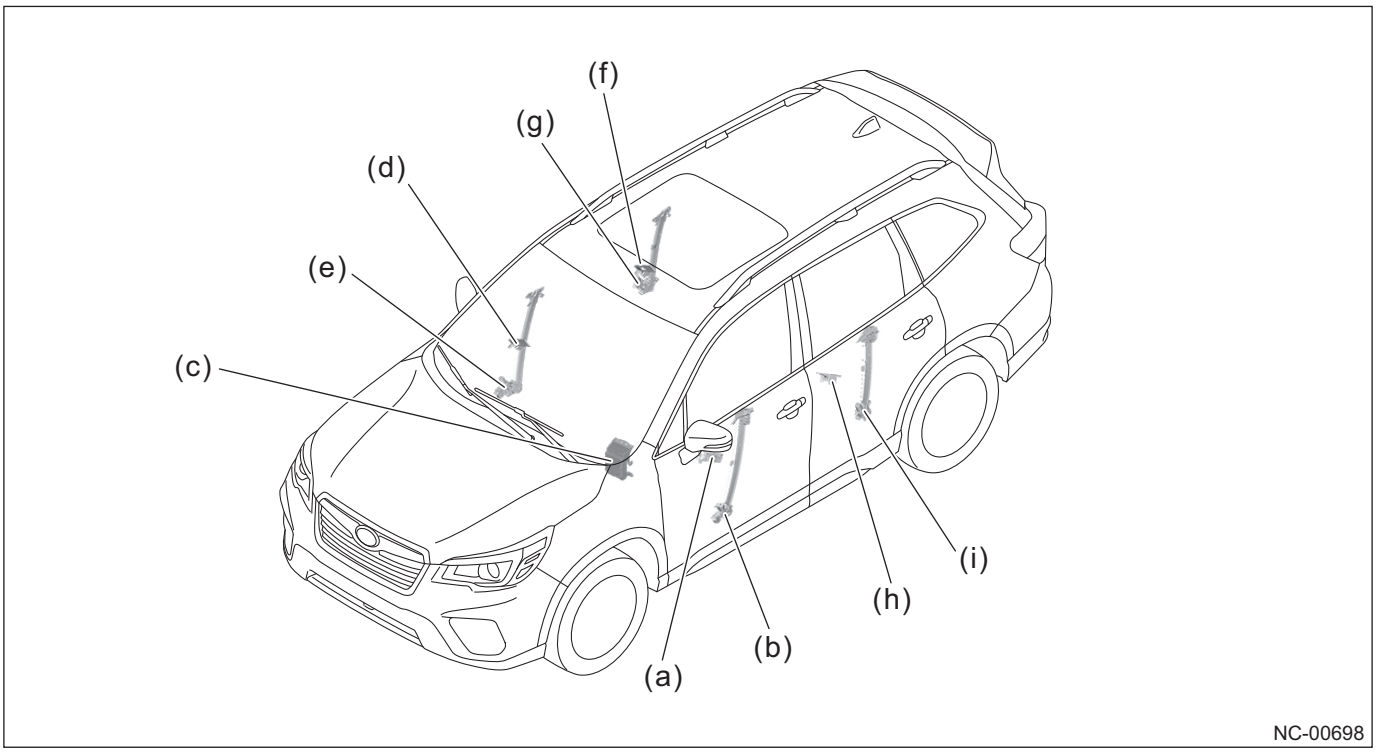
Component layout drawing

Glass



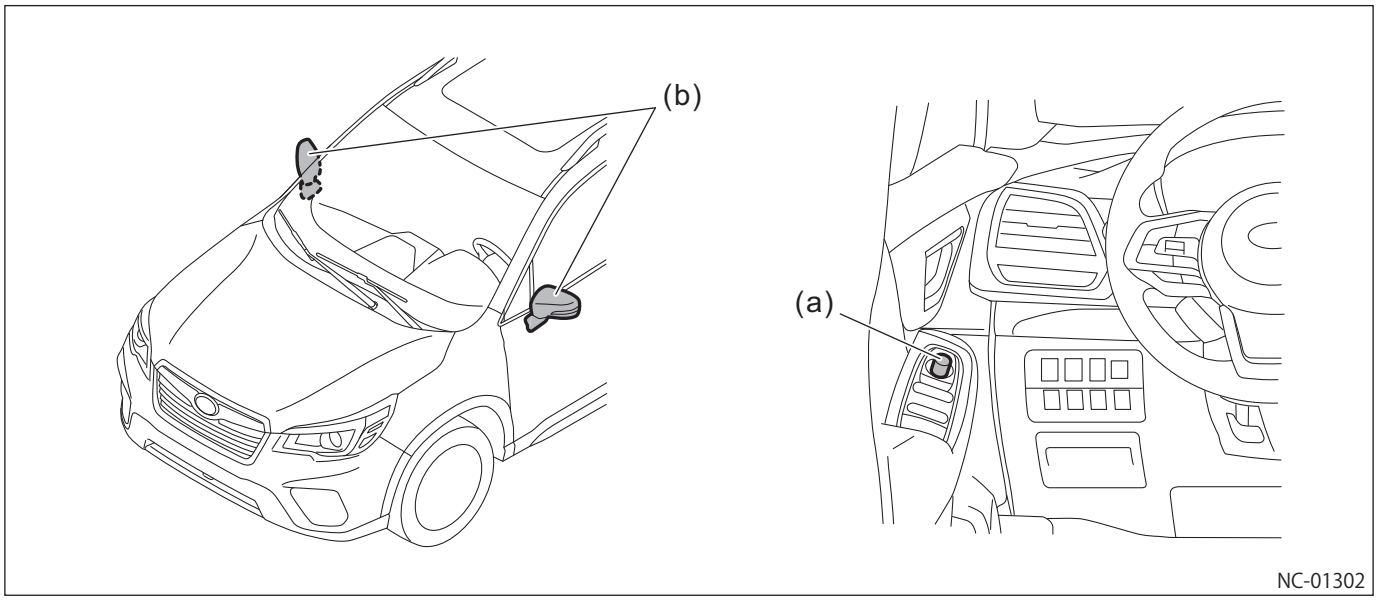
(a) Glass front windshield
(b) Glass front door partition
(c) Glass assembly front door
(d) Glass assembly rear door
(e) Glass rear quarter
(f) Glass rear gate

Power window



(a) Power window main switch
(b) Driver's door regulator and motor assembly
(c) Body integrated unit (BIU) (in joint box)
(d) Front RH power window switch
(e) Front RH regulator and motor assembly
(f) Rear RH power window switch
(g) Rear RH regulator and motor assembly
(h) Rear LH power window switch
(i) Rear LH regulator and motor assembly

Mirror



(a) Remote control mirror switch

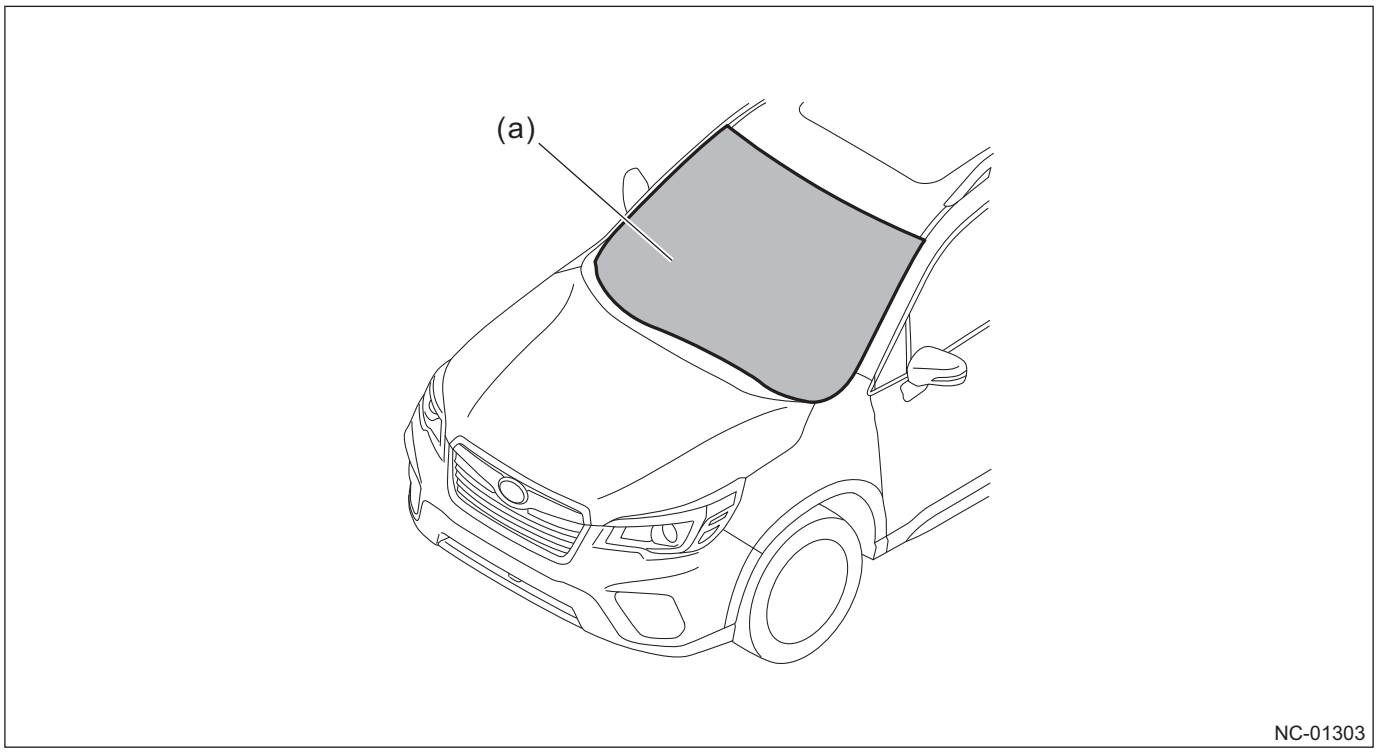
(b) Door mirror

Component details

Glass

■ Glass front windshield

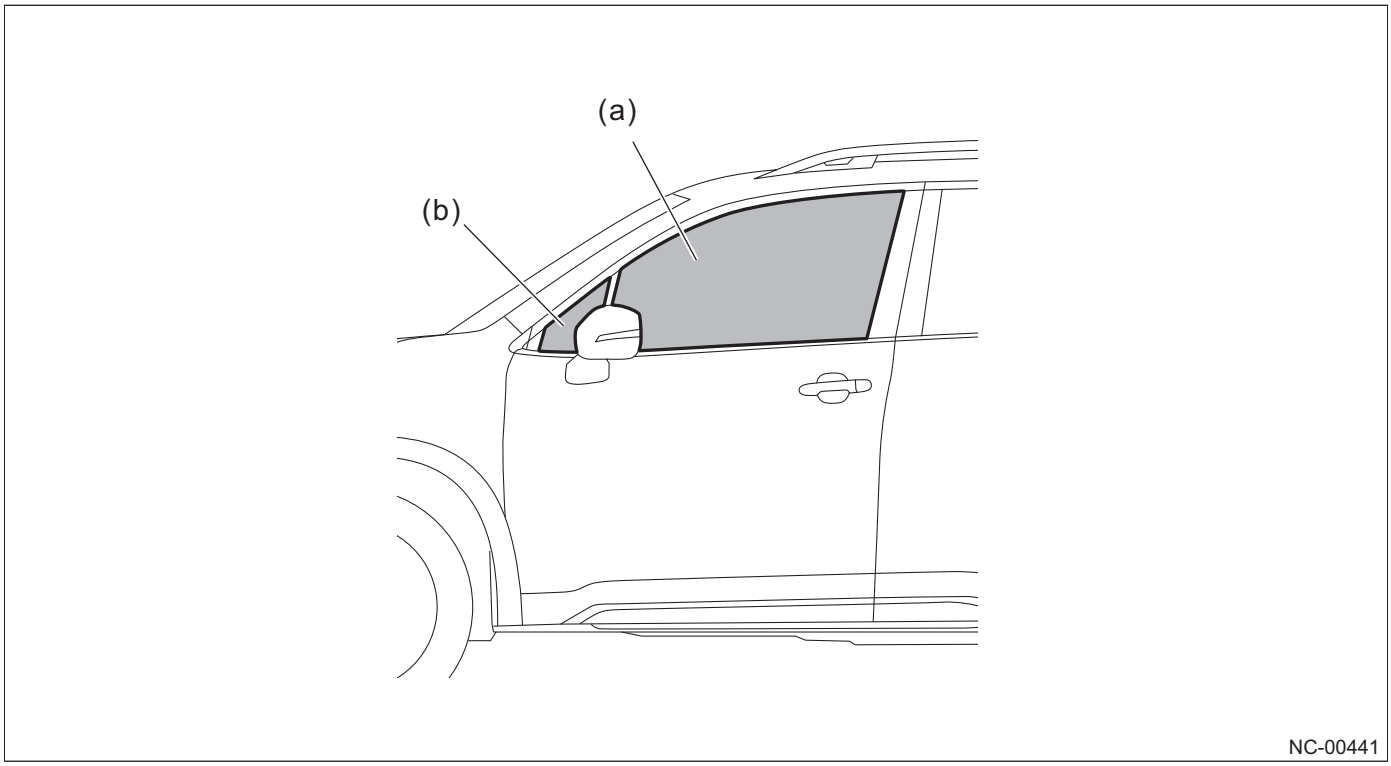
A laminated glass with thickness 0.187 in (4.76 mm) and a sound-insulating intermediate film with the superior quietness are adopted.



(a) Glass front windshield

■ Glass assembly front door

The glass assembly front door and the glass front door partition with ultraviolet protection effect are adopted.

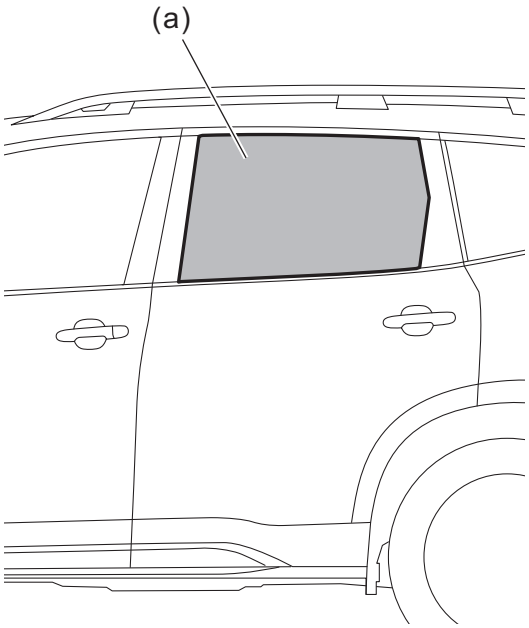


(a) Glass assembly front door

(b) Glass front door partition

■ Glass assembly rear door

The glass assembly rear door with the superior ultraviolet protection effect is adopted.

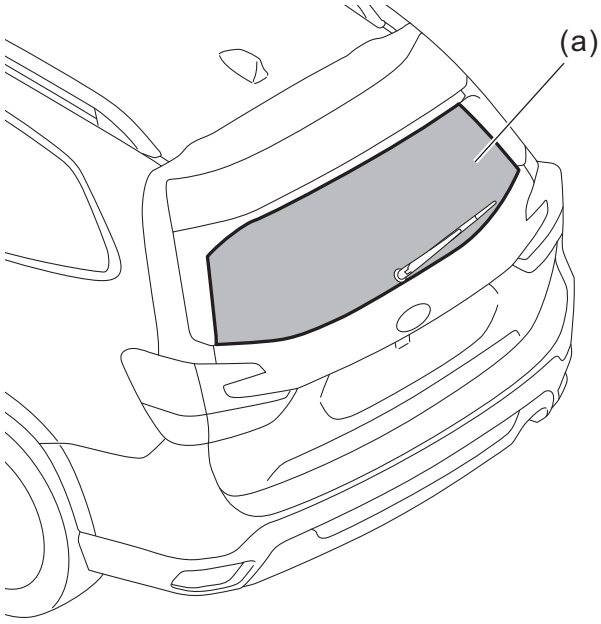


NC-00442

(a) Glass assembly rear door

■ Glass rear gate

The glass rear gate with the superior ultraviolet protection effect is adopted.



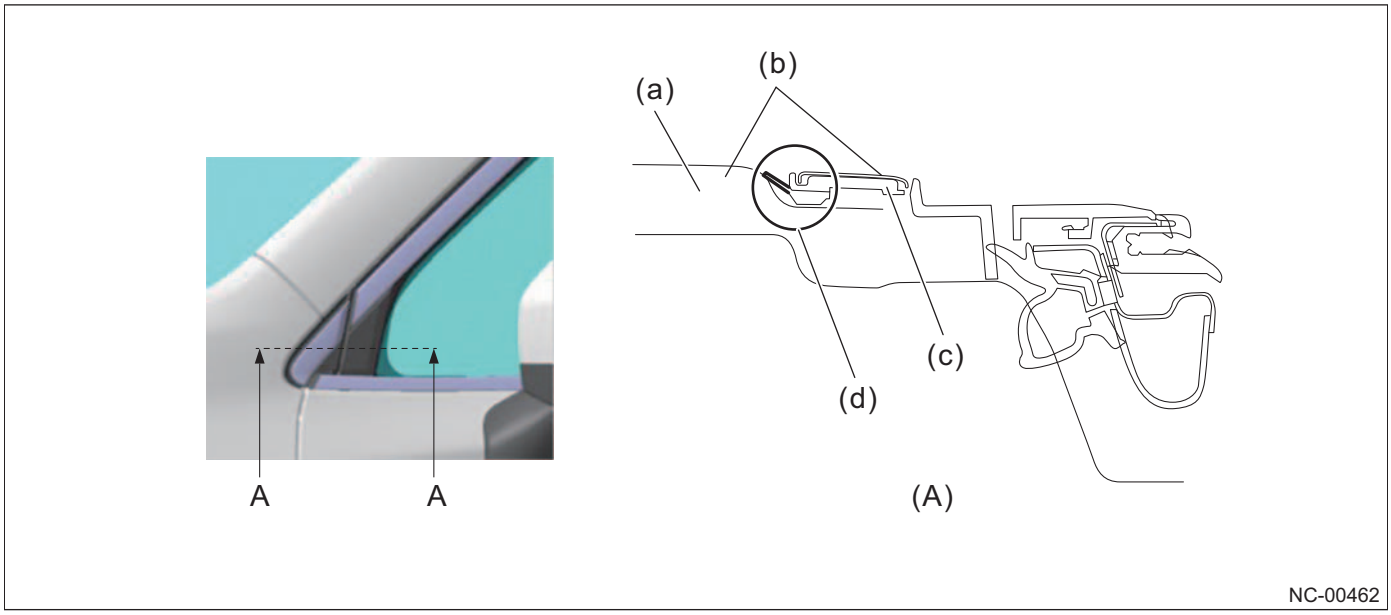
NC-00443

(a) Glass rear gate

A pillar cover

The shape to reduce the level difference with the A pillar (flush surface structure) is adopted to improve the aerodynamic performance (Cd value) and reduce wind noise by reducing the turbulence of airflow.

The protector is mounted to improve the appearance of the division section and take a measure against noise and tapping sound.



(A) A-A cross section

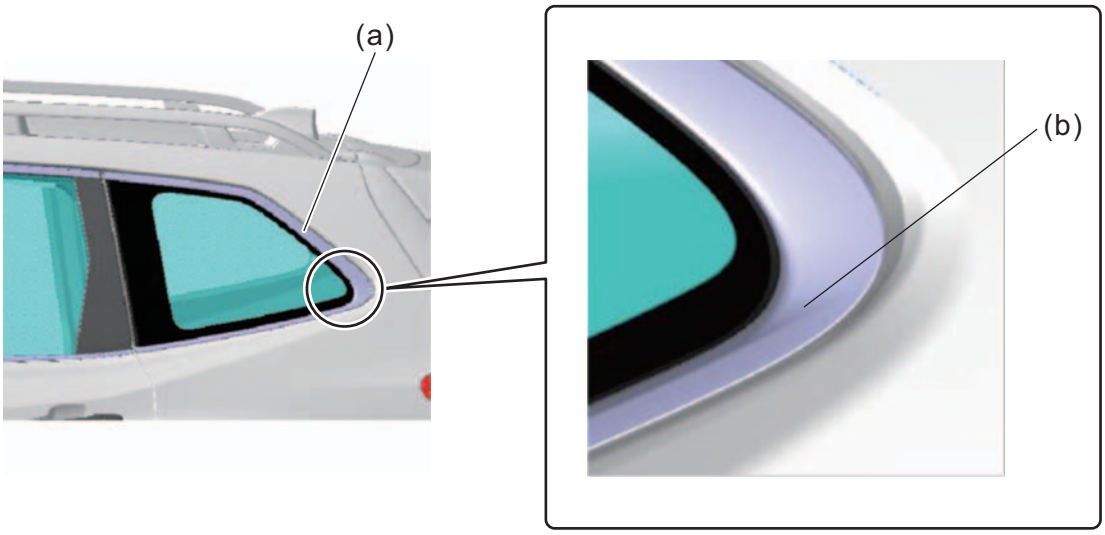
(a) A pillar
(b) Shape with level difference reduced (flush surface structure)
(c) Pillar molding
(d) Protector

Rear quarter glass molding

■ Bright molding (for some grades)

The bright stainless molding is applied (entire circumference of the window).

The character line is applied on the stainless corner section to emphasize the kick-up design of the window shoulder.

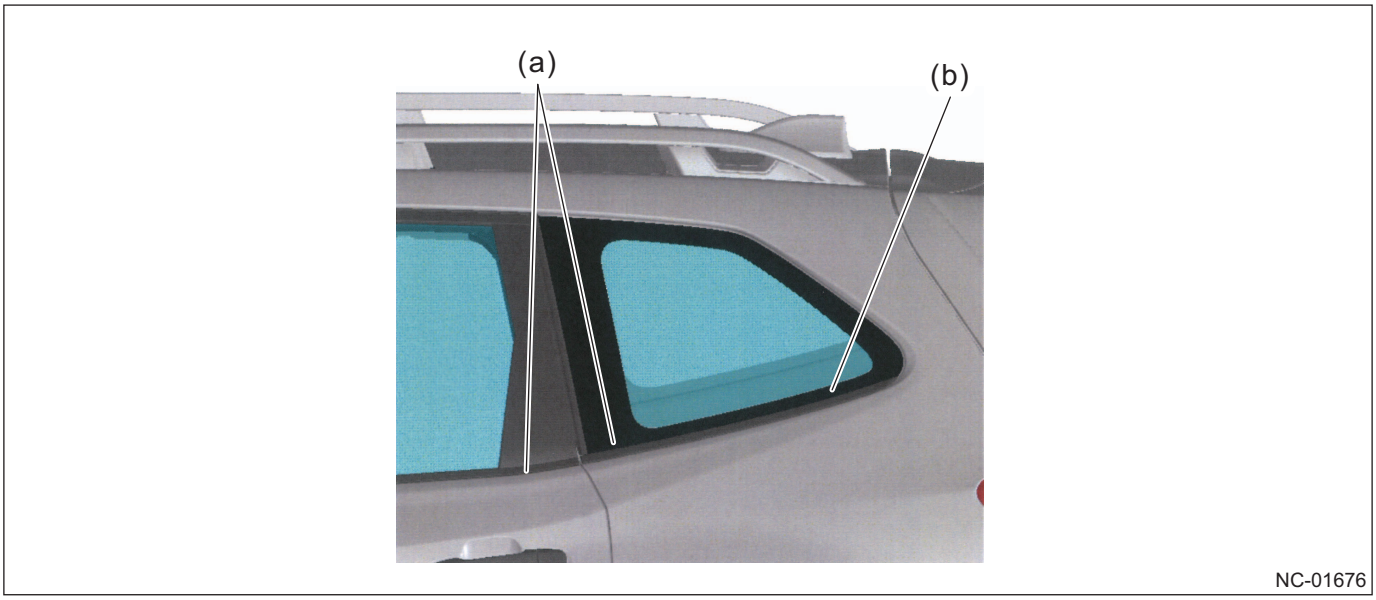


(a) Bright stainless

(b) Character line

■ Black molding (for some grades)

The engagement molding is applied to the lower side of the rear quarter glass to keep the design continuity with the door window shoulder molding.



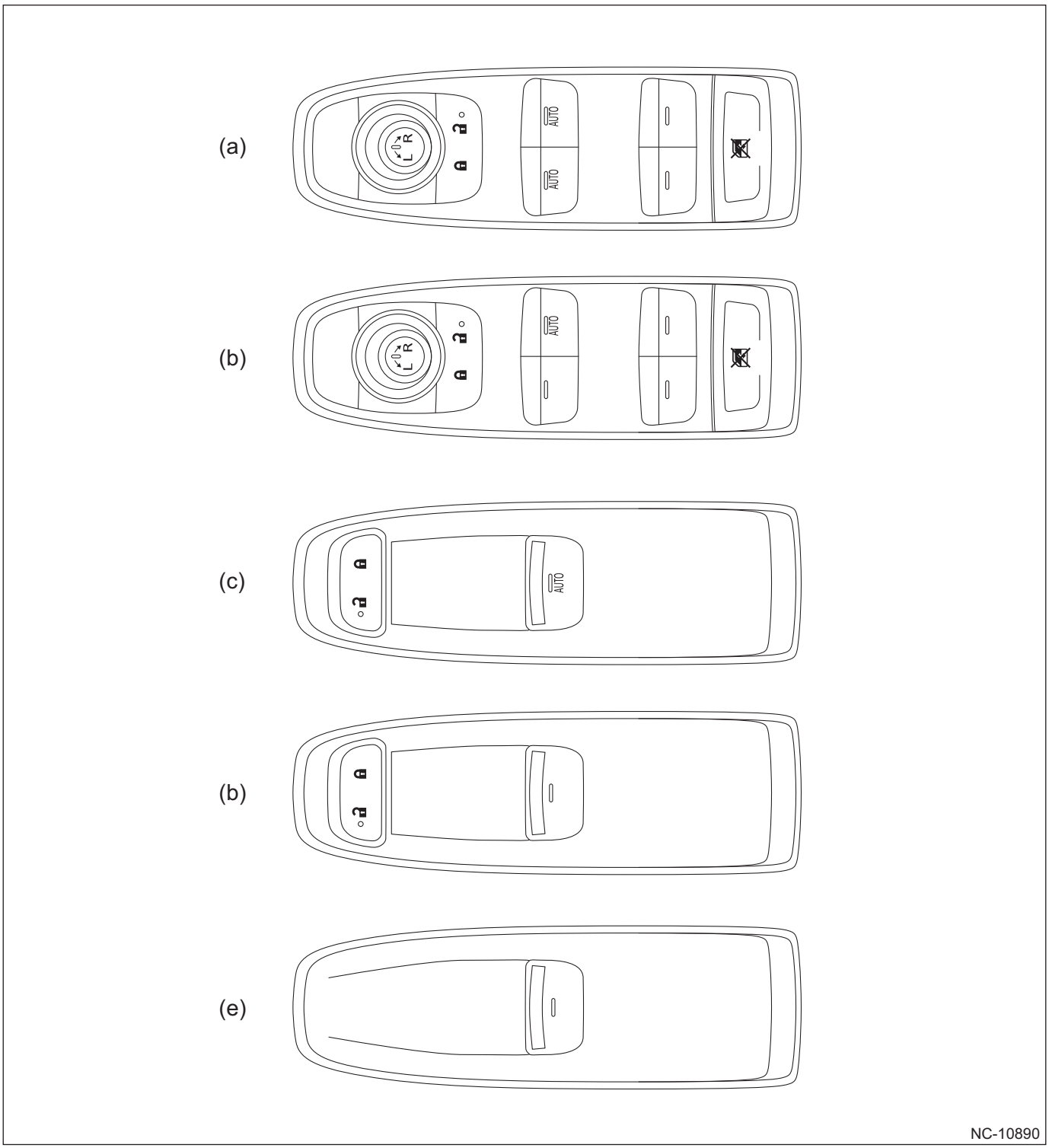
(a) Molding continuity

(b) Engagement molding

Power window

■ Power window switch

A red illumination with luxury feel is adopted for the power window switch.

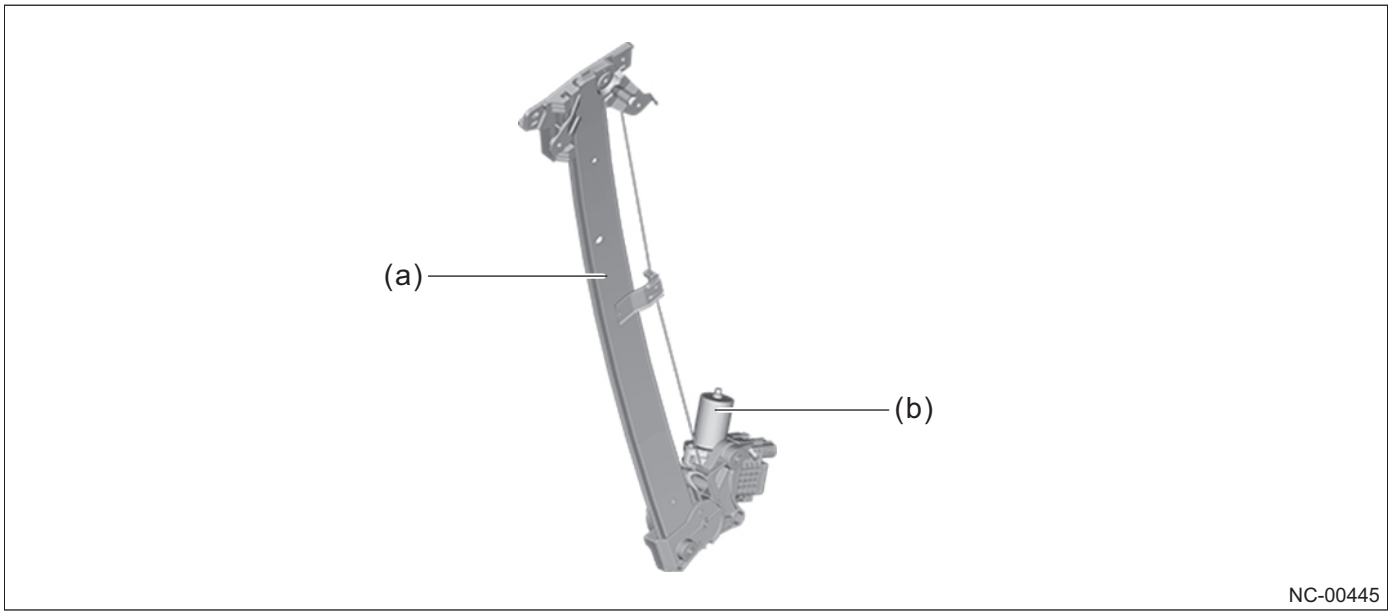


(a) Switch assembly power window main
(b) Switch assembly power window main (with the driver's seat AUTO function)
(c) Switch assembly power window front sub (with the AUTO function)
(d) Switch assembly power window front sub (without AUTO function)
(e) Switch assembly power window rear sub

■ Power window smart motor assembly

A smart motor with high quality when the glass rises and lowers is adopted for the power window motor assembly of the front door. The smart motor controls the speed when the glass rises and lowers to reduce pushing-up sound of the glass when fully closing and bottoming sound when fully opening. (depending on grades for front passenger's seat)

A smart motor with high quality when the glass rises and lowers is adopted for the power window motor assembly of the rear door. The smart motor controls the speed when the glass rises and lowers to reduce pushing-up sound of the glass when fully closing and bottoming sound when fully opening. (for some grades)



(a) Power window regulator

(b) Power window smart motor assembly

Mirror

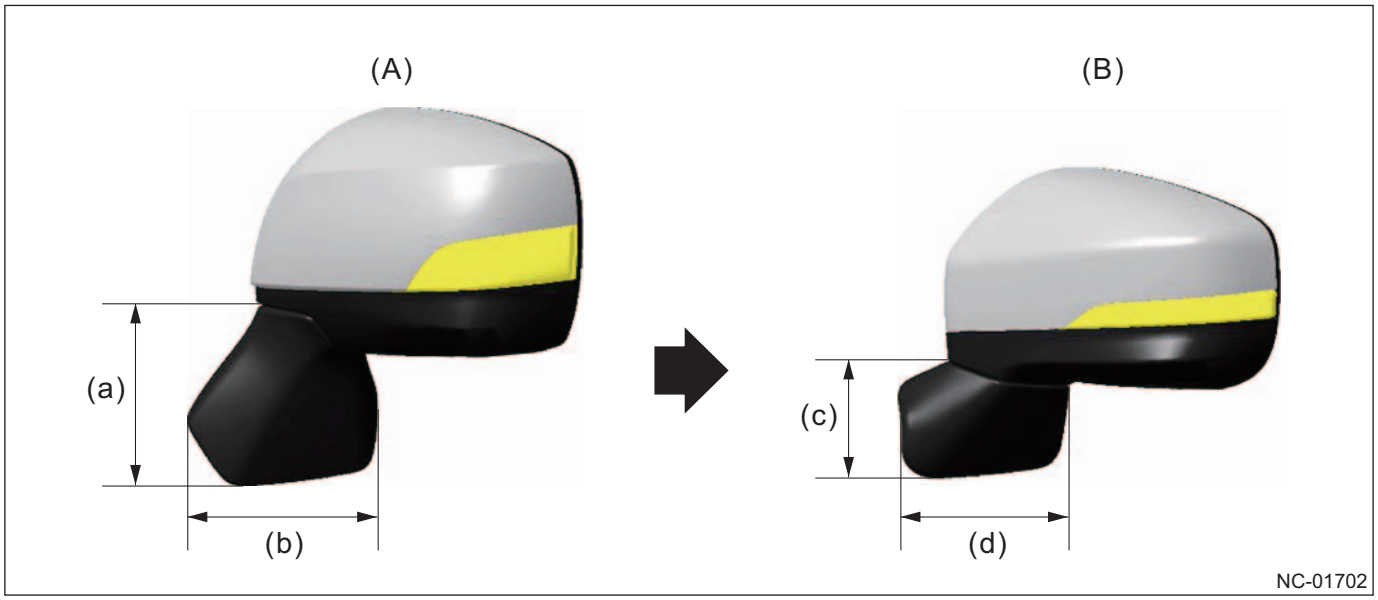
■ Door mirror

A sharp mirror body and a small mirror stay are adopted to realize the mirror with the superior appearance, aerodynamic performance, and quietness.

The optical guiding type LED turn light whose whole body illuminates, with the superior surrounding visibility and quality feeling is adopted.

A motor with the superior quietness is adopted for the electric remote control mirror.

Satin plating with the superior appearance and quality feeling is adopted. (for some grades)



(A) Existing model vehicle

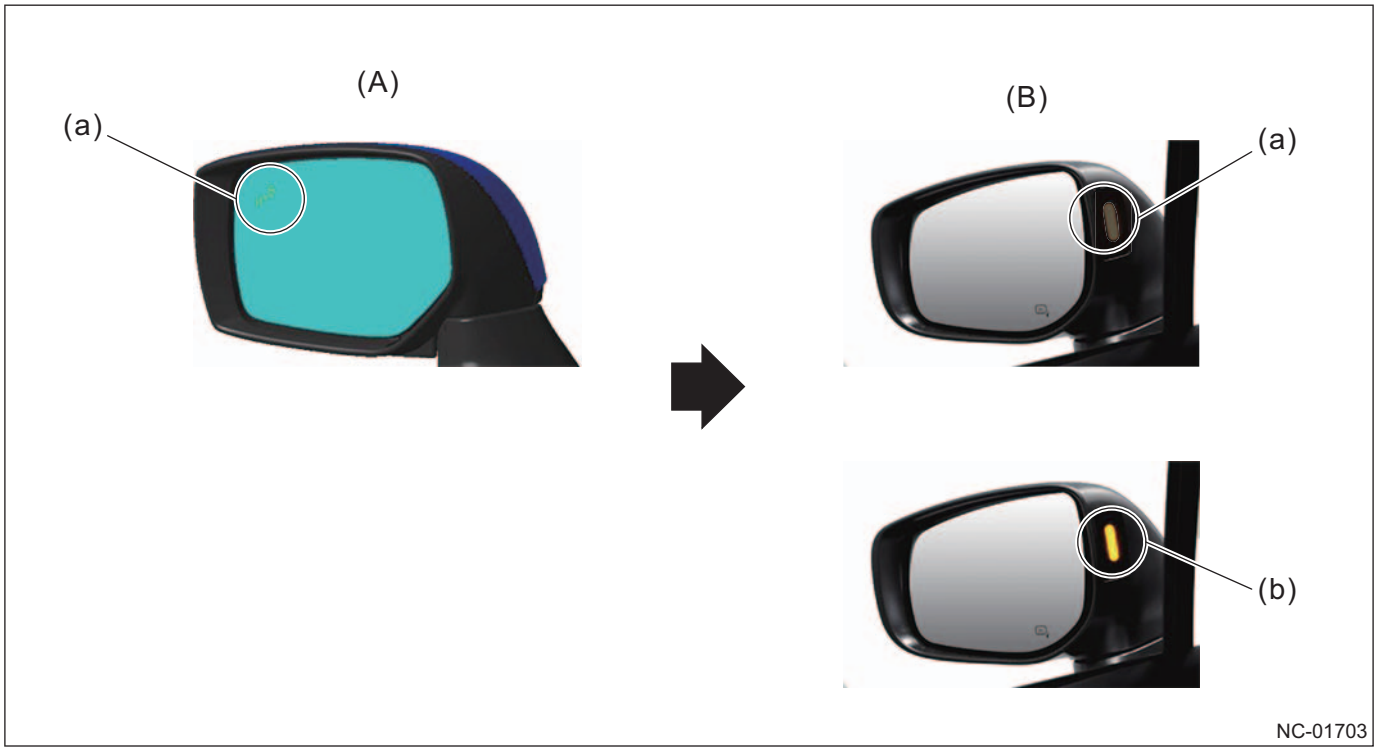
(a) 4.72 in (120 mm)
(b) 5.51 in (140 mm)

(B) New model vehicle

(c) 3.54 in (90 mm)
(d) 5.12 in (130 mm)

Subaru Rear Vehicle Detection system indicator is located inside the mirror body of the door mirror so that visual line of a driver moves less.

This reduces the movement of sight when the driver checks the rear side and the visual safety is improved compared to door mirrors of existing model vehicles.



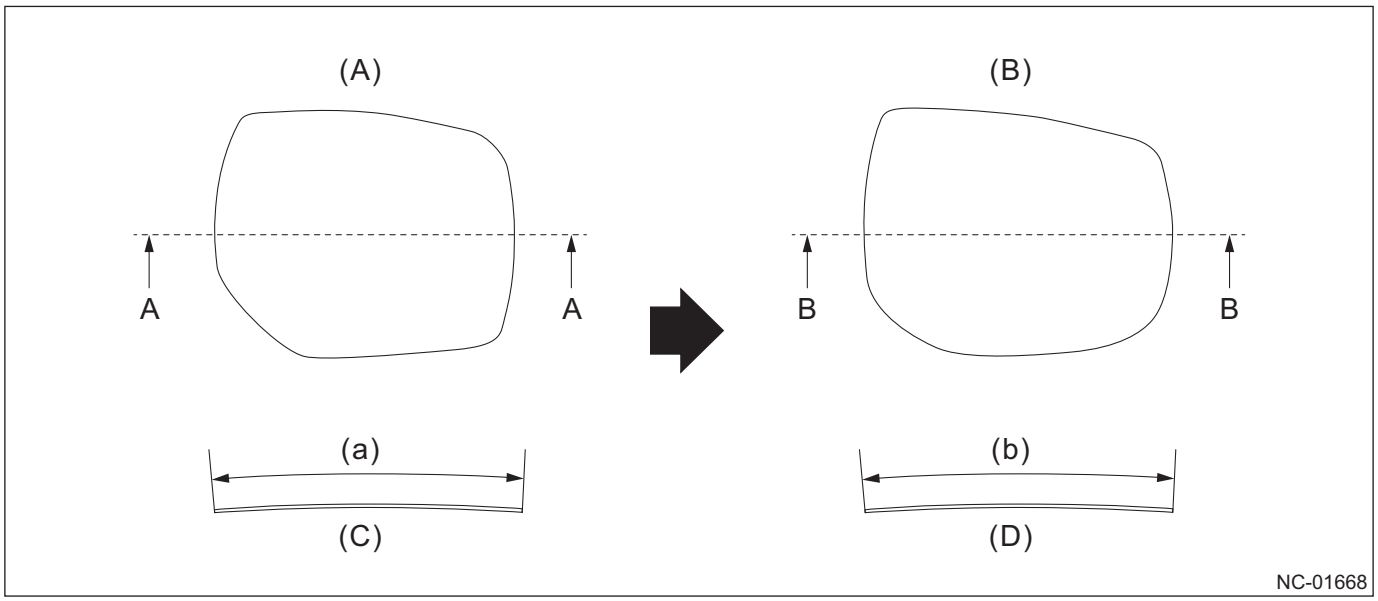
(A) Existing model vehicle (mirror surface illuminating type)

(B) New model vehicle (body illuminating type)

(a) LED indicator

(b) Illumination image

The R1270 curvature is adopted for the mirror surface of the door mirror on the front passenger's seat side so that a wider range can be checked during rear side confirmation.



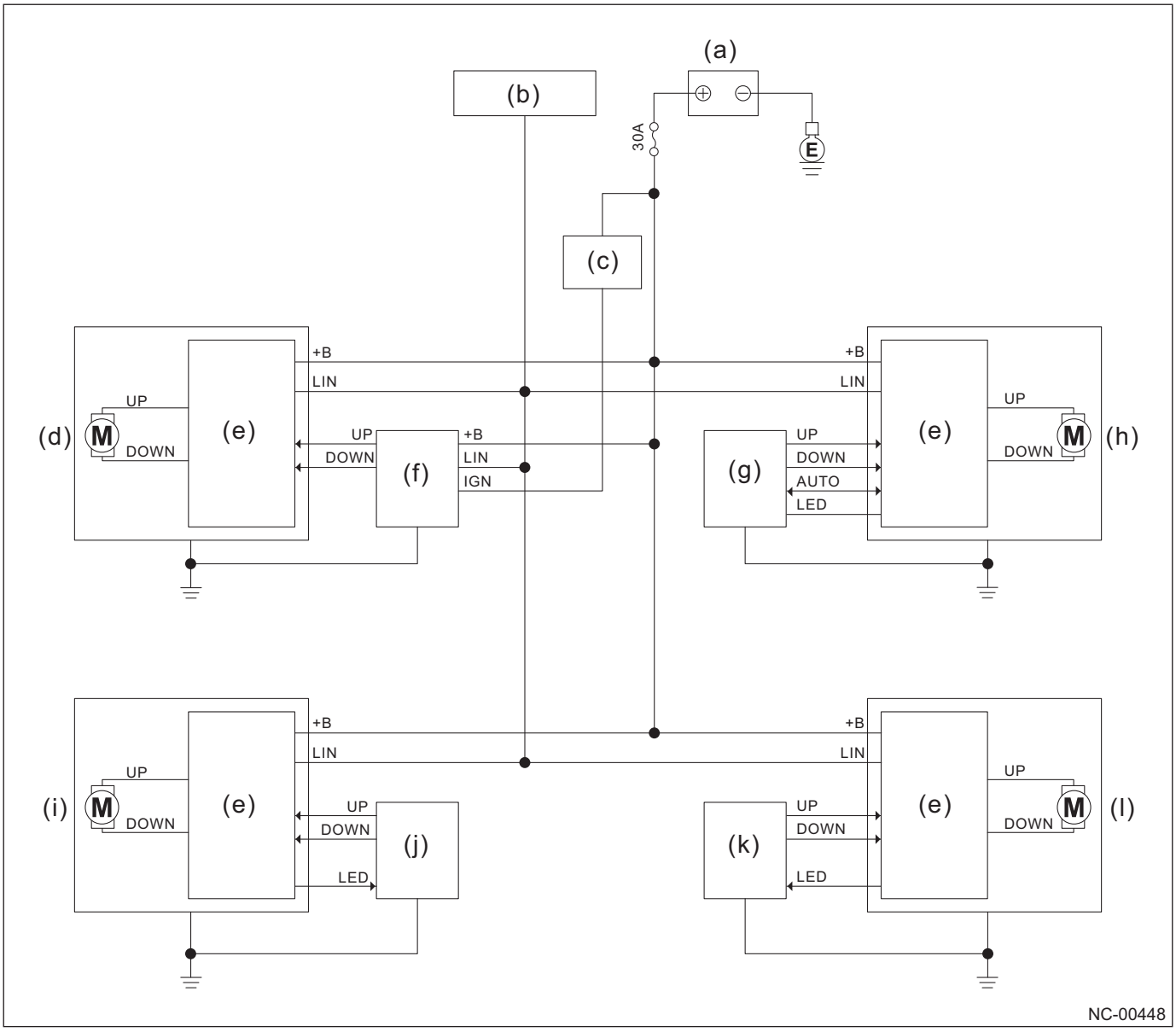
(A) Existing model vehicle
(B) New model vehicle
(C) A-A cross section
(D) B-B cross section

(a) R1300 portion
(b) R1270 portion

9.6.3 Construction and Operation

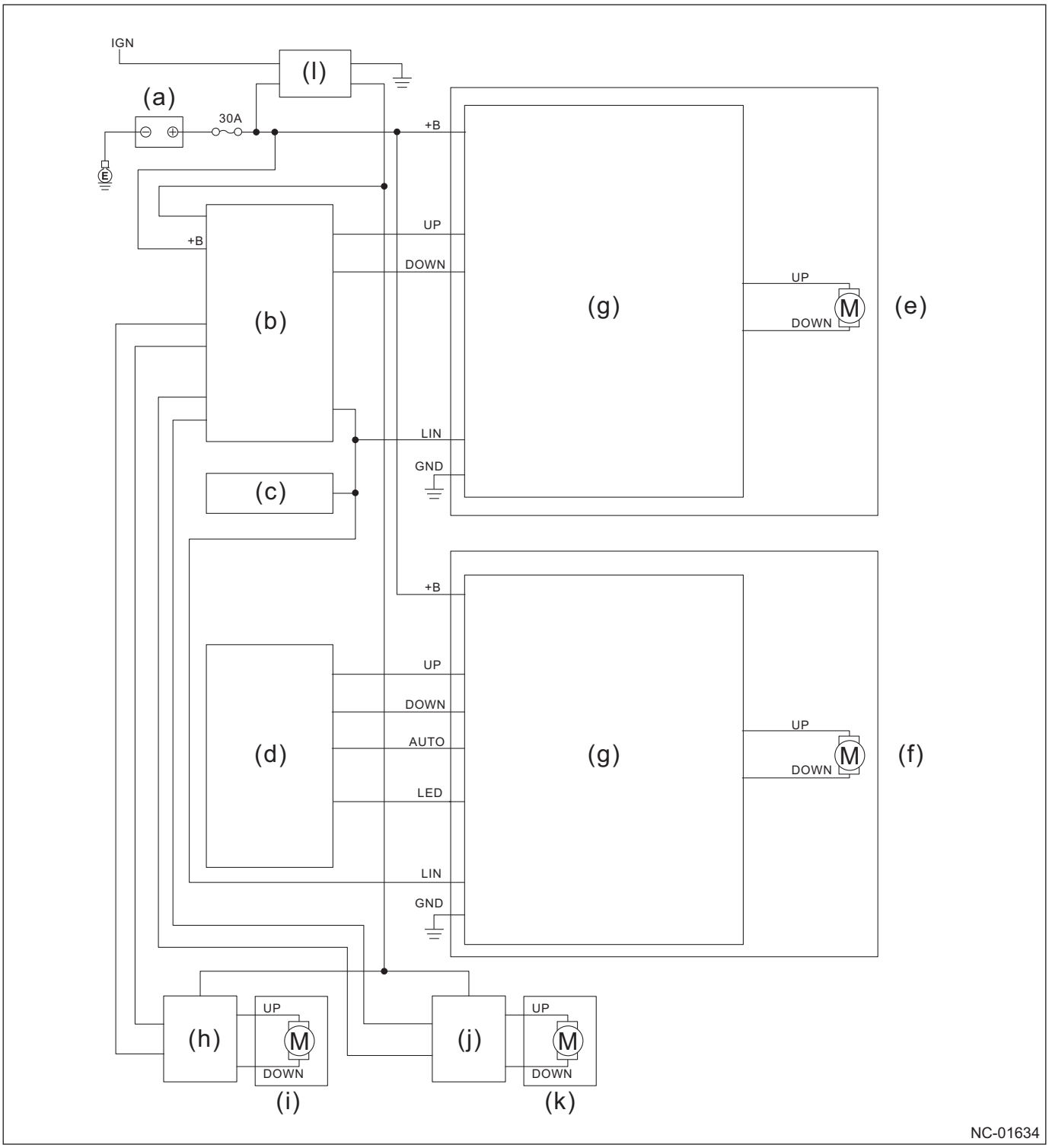
System diagram

Power window system with all seats supporting LIN (for some grades)



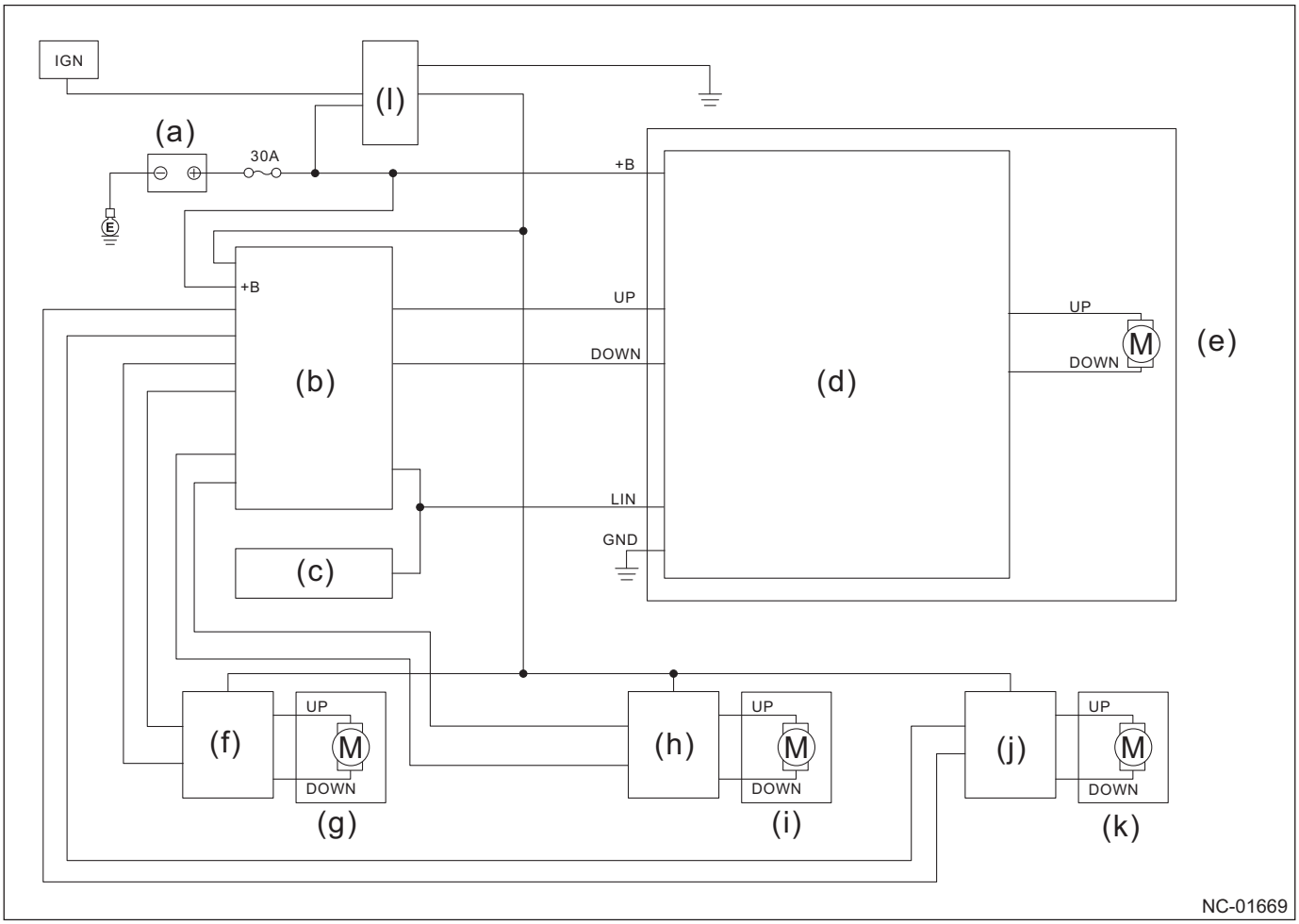
(a) Battery
(b) Body integrated unit (BIU)
(c) Power window relay
(d) Power window motor assembly of driver's seat
(e) Regulator
(f) Power window main switch
(g) Front RH power window switch
(h) Front RH power window motor assembly
(i) Rear LH power window motor assembly
(j) Rear LH power window switch
(k) Rear RH power window switch
(l) Rear RH power window motor assembly

Power window system with front seat supporting LIN (for some grades)



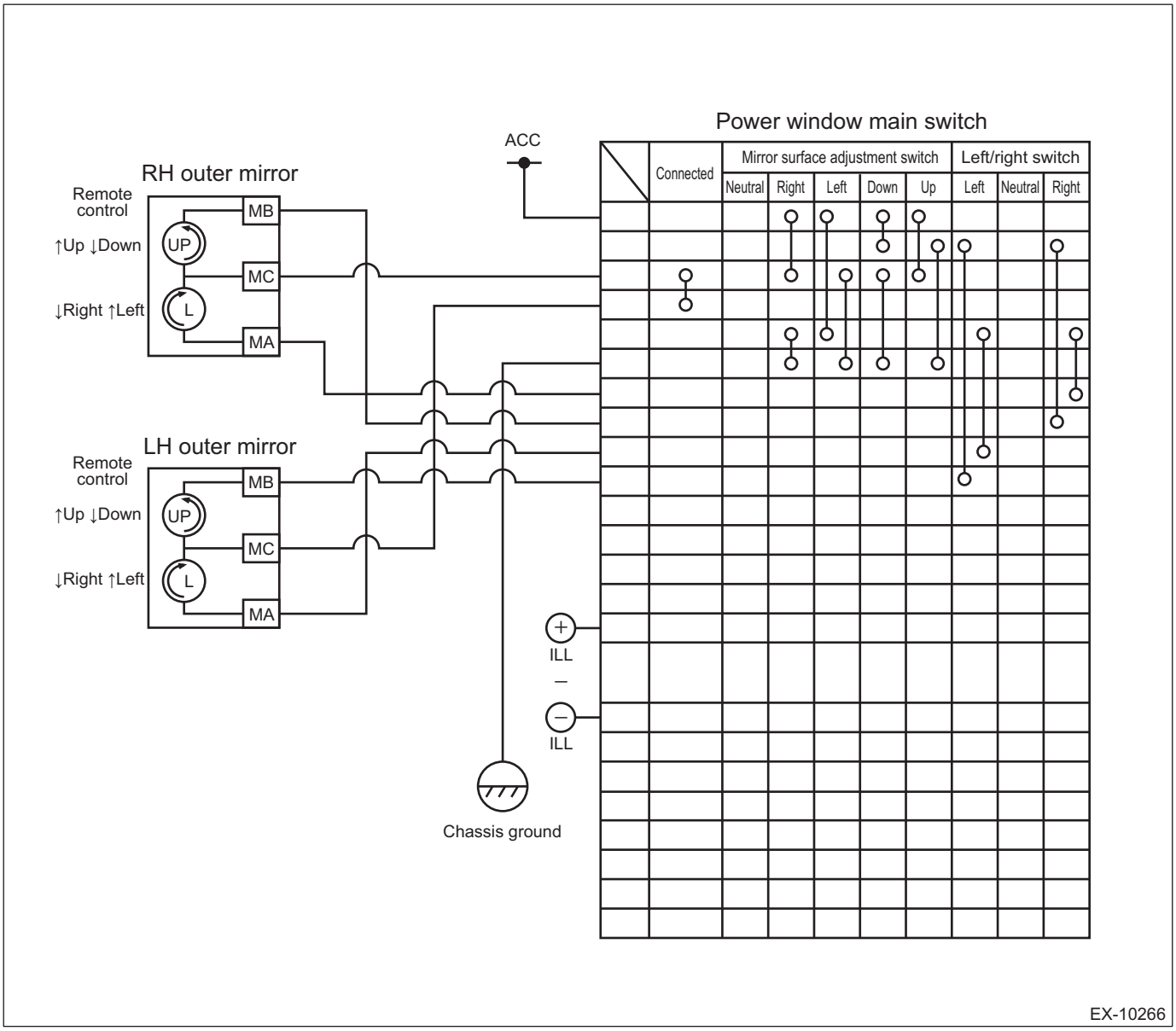
(a) Battery
(b) Power window main switch
(c) Body integrated unit (BIU) (in joint box)
(d) Front RH power window switch
(e) Power window motor assembly of driver's seat
(f) Front RH power window motor assembly
(g) Power window control module
(h) Rear LH power window switch
(i) Rear LH power window motor assembly
(j) Rear RH power window switch
(k) Rear RH power window motor assembly
(l) Power window relay

Power window system with the driver's seat supporting LIN (for some grades)

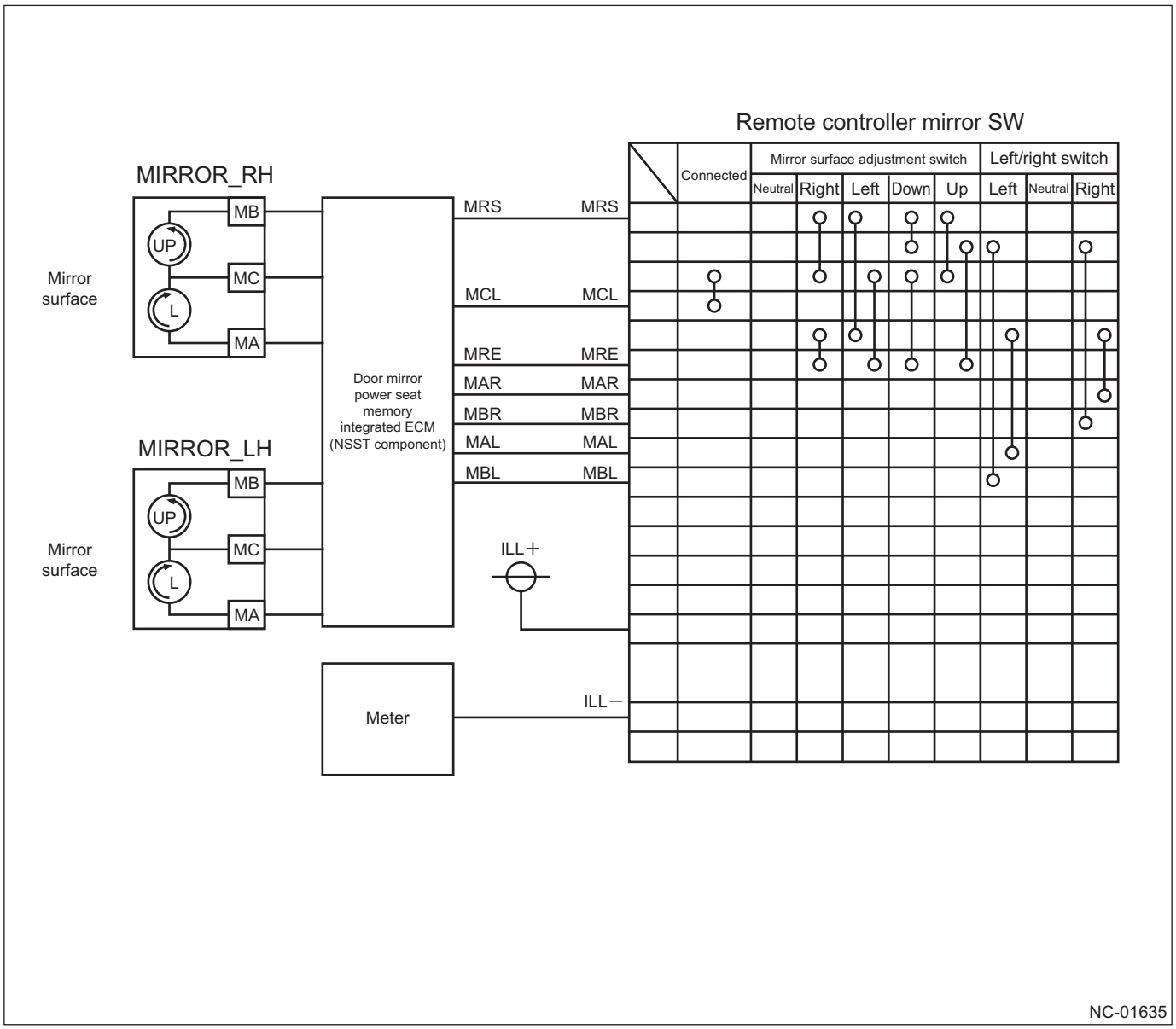


(a) Battery
(b) Power window main switch
(c) Body integrated unit (BIU) (in joint box)
(d) Power window control module
(e) Power window motor assembly of driver's seat
(f) Rear LH power window switch
(g) Rear LH power window motor assembly
(h) Rear RH power window switch
(i) Rear RH power window motor assembly
(j) Front RH power window switch
(k) Front RH power window motor assembly
(l) Power window relay

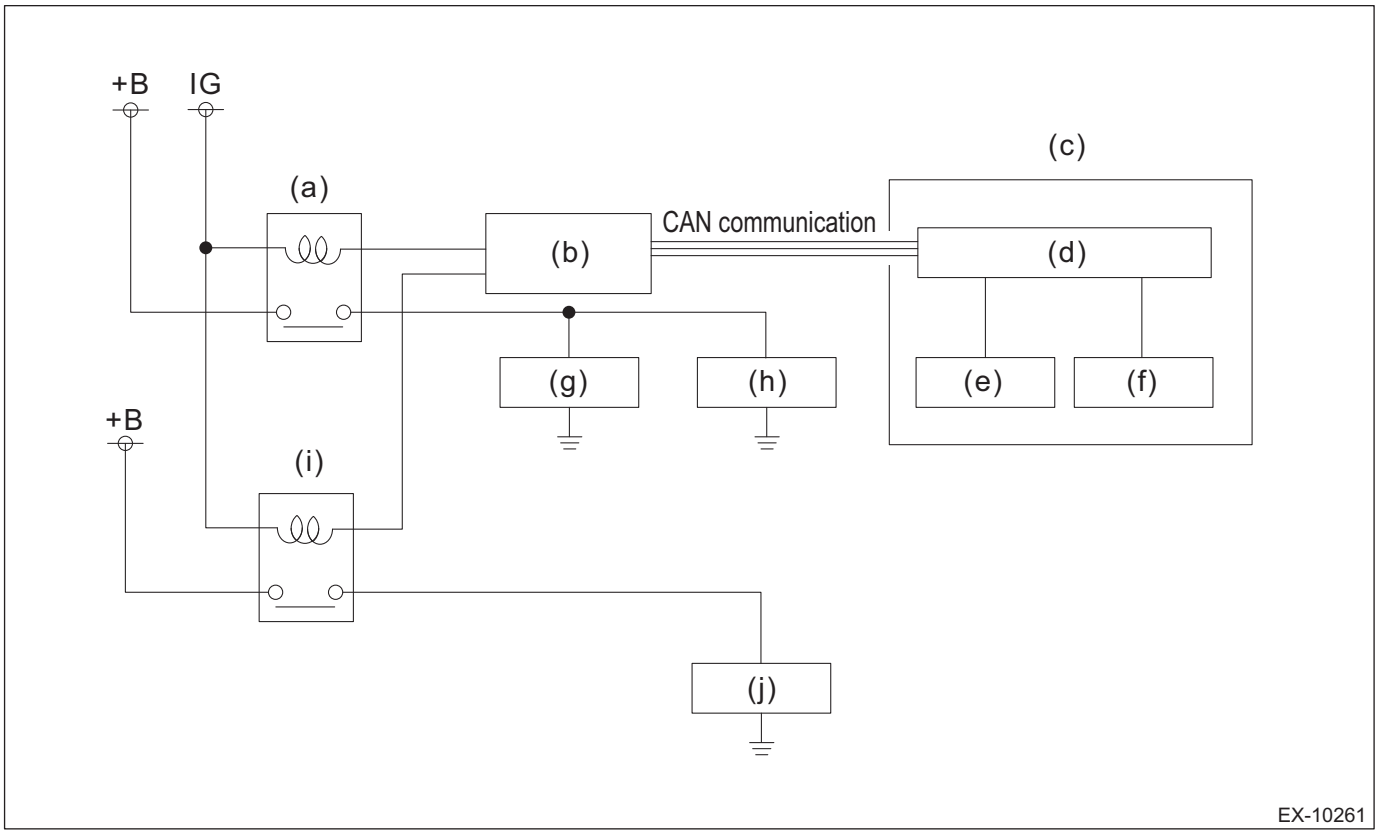
Electric mirror system (vehicle without driver's seat position memory function)



Electric mirror system (vehicle with driver's seat position memory function)



Mirror heater (for some grades)/wiper deicer/rear window defogger system



(a) Mirror heater relay (for some grades)/rear defogger relay
(b) Body integrated unit (BIU) (in joint box)
(c) Control panel
(d) Air conditioner control module
(e) Mirror heater switch (for some grades)/rear defogger switch
(f) Mirror heater (for some grades)/rear defogger operation indicator
(g) Mirror heater (for some grades)
(h) Rear defogger
(i) Wiper deicer relay (for some grades)
(j) Wiper deicer (for some grades)

System details

Power window system

The power window system varies in functions according to the type of power window motor (normal motor/smart motor) as shown below.

	Motor type	LIN communication	Manual up and down function	Auto up and down function	Remote control from the driver's seat	Elevation speed control function	Window lock function	Front passenger's seat remote function when the window lock switch is ON	Power window function after the ignition switch is OFF	Pinch prevention/ snag prevention function	Fail-safe function	Reverse operation function
Driver's seat	Smart	●	●	●	-	●	-	-	●	●	●	-
Front passenger's seat	Smart	●	●	●	●	●	●	●	●	●	●	-
	Normal	-	●	-	●	-	●	-	-	-	-	-
Rear seat	Smart	●	●	-	●	●	●	-	●	-	●	●
	Normal	-	●	-	●	-	●	-	-	-	-	-

● : Applicable

-: Not applicable

■ LIN communication

LIN (Local Interconnect Network) communication is adopted for the communication between power window switches. LIN communication is a multiplex communication network for the data communication mainly between body system control ECM, and each system is composed of a bus. LIN communication is a single communication line, and sends digital signal at the predetermined speed in accordance with the dedicated communication protocol (communication standard).

The power windows connected with the body integrated unit by LIN communication receive the steering information of the vehicle, identify the steering position (right or left side), and judge the driver's seat/front passenger's seat/right rear seat/left rear seat.

The power window motor assembly has the built-in power window control module, receives operation signals of switch by LIN communication, and performs the up/down control and window lock control, as well as performs the judgment and the control for the pinch prevention function and the snag prevention function.

■ Manual up and down function

▮ Manual operation by power window switches for each seat

If the driver's power window main switch or each passenger's power window switch is operated upward (downward) by one stage with the ignition switch turned on, a manual up (down) electric current is output to the corresponding regulator and motor assembly. The regulator and motor assembly rotate the power window motor upward (downward) while electric power is supplied.

When the power window switch operation is stopped, the power supply stops and the power window motor stops rotating.

Remote control manual operation by the driver side power window main switch

If the front passenger's or rear passenger's power window switch in the driver's power window main switch is operated upward (downward) by one stage with the ignition switch turned on and window lock switch turned off, a remote control manual up (down) control signal is output to the front passenger's or rear passenger's regulator and motor assembly. The front passenger's or rear passenger's regulator and motor assembly rotate the power window motor upward (downward) while the signal is being input.

When operation of the front passenger's or rear passenger's remote power window switch in the driver's power window main switch is stopped, the power supply stops and the power window motor stops rotating.

■ Auto up and down function

Automatic operation by the power window switch

If the driver's power window switch in the driver's power window main switch is operated upward (downward) by two stages with the ignition switch turned on, an auto up (down) control signal is output to the power window control module (built into the power window motor assembly). When the driver's power window control module inputs this signal, it rotates the driver's power window motor upward (downward).

If the front passenger's power window switch is operated upward (downward) by two stages with the ignition switch turned on and window lock switch turned off, an auto up (down) signal is output to the power window control module (built into the power window motor assembly). When the power window control module inputs this signal, it rotates the front passenger's power window motor upward (downward).

The power window control module (built into the power window motor assembly) counts a pulse signal from the Hall IC within the power window motor assembly, and rotates the power window motor until the window is fully close (fully open) based on the pulse signal, even if the power window switch operation is stopped.

Remote control automatic operation by the driver side power window main switch

If the front passenger's power window switch in the front driver's power window main switch is operated upward (downward) by two stages with the ignition switch turned on, a remote control auto up (down) control signal is sent to the power window control module (built into the front passenger's power window motor assembly) with LIN communication.

When the front passenger's power window control module receives the above signal, it rotates the front passenger's power window motor until the window reaches the fully close (fully open) position.

▮ Auto operation stop conditions

When any of the following conditions is satisfied, the auto operation stops

- When a fully close (fully open) window is detected
- When operation signal is input in an opposite direction from the driver's power window main switch or the front passenger's power window switch
- When pinching or snagging in the window is detected
- When the timer stop time (about ten seconds) has passed after auto operation begins
- When a fail item is detected

■ Elevation speed control function

The following elevation speed control performed during auto up and down operation and manual up and down operation is added.

Control description		Effect
Slow start/Slow stop	During up operation, the rising speed slows from just before the fully close position and the window closes slowly at the end. During down operation, the lowering speed slows from just before the fully open position and the window opens slowly at the end.	The windows are moved slower before being fully closed/opened to produce a more premium quality feel.

■ Window lock function

When the window lock switch is ON during the ignition switch being ON or post-key off operation, a window lock signal is sent from the driver's power window main switch to the power window control module.

When the window lock switch is turned on, the power window operation of each seat is restricted. For the front passenger's seat, operation can be performed with the driver's power window control switch even if the lock switch is turned on.

While the front passenger's and rear passenger's power window control modules receive the window lock signal, operations by the front passenger's and rear passenger's power window switches are prohibited. (for some grades)

Reference

When the window lock switch of the model with normal motor is operated, electricity via direct wire is blocked, and the power window switch operation is prohibited.

■ Power window function after the ignition switch is OFF (timer operation)

If the ignition switch is switched from ON to OFF, the body integrated unit detects this and begins a post-key off operation count for about 40 seconds, and sends power window operation permission signal to the power window control modules via LIN communication. This makes the power window operation possible.

When the body integrated unit receives a signal of approximately 40 seconds elapse or "Close" to "Open" of the front door switch of the driver's seat and front passenger's seat, it sends a post-key off operation signal as OFF. When the post-key off operation signal is OFF, the power window control module controls automatic operation (pinch prevention mechanism operates) until completion while manual operation is stopped.

▮ Front passenger's seat remote function when the window lock switch is ON

When the window lock switch is on, remote control operation of the front passenger's seat is possible from the driver's power window main switch.

■ Power window pinch prevention function

▮ Operation overview

The pinch prevention mechanism is controlled by the power window control module. If the power window motor is locked or its rotation speed changes when all of the following conditions are satisfied, the power window control module judges that pinching has occurred and performs reverse operation. In order to prevent a malfunction, pinching judgment is not performed when the window position is within a predetermined section.

▮ Pinch prevention mechanism operation preconditions (when all are satisfied)

- During upward operation of any one of manual operation, auto operation, and post-key off operation
- A state where the power window control module is "learning" the window fully opened/fully closed state as standard positions due to an initialization
- Other than immediately after the power window motor is driven
- When not in the fail mode

▮ Reversal conditions and descent amounts after pinch detection

If the pinch prevention mechanism operates and the amount of the window opening (gap) does not reach about 7.87 in (200 mm) even if it is down to about 1.97 in (50 mm), it continues its reverse operation until it reaches about 7.87 in (200 mm) or about 10 seconds have passed. However, if the window is in the fully open position before the down operation has reached about 1.97 in (50 mm), the operation stops at that point.

During the reverse operation, inputs of manual up, auto up, manual down, and auto down switch signals are prohibited. However, after the reverse operation has finished, switch input is received after a predetermined period has passed.

▮ Pinch reverse operation

When the power window control module judges pinching, the power window motor is operated in reverse by controlling the built-in drive circuit downward.

▮ Pinch prevention mechanism canceling operation

If the window does not close due to a malfunction of the pinch prevention mechanism, the operation of the pinch prevention mechanism can be canceled to close the window by repeating auto up operation of the power window switch three consecutive times (The absence of operations other than the auto up operation between the first and third operations is a precondition.).

■ Snag prevention function

▮ Operation overview

The snag prevention mechanism is controlled by the power window control module. If a predetermined amount of rotation speed change (decrease amount) of the power window motor is detected when all of the following conditions are satisfied, the power window control module judges that an extraneous body has been snagged and stops the down operation. In order to prevent a malfunction, snag prevention judgment is not performed when the window position is within a predetermined section.

▮ Snag prevention mechanism operation preconditions (when all are satisfied)

- During down operation of any one of manual operation, auto operation, and post-key off operation (except reverse down operation)
- Other than immediately after the power window motor is driven
- When not in the fail mode

▮ Stop operation after snag prevention detection

When the power window control module determines snagging, the down operation of the power window motor is stopped by drive stop control of the built-in motor drive circuit.

■ Fail-safe function

If an anomaly is detected in the pulse sensor (Hall IC), if the window position is not correctly read out from EEPROM when the power window control module is reset, or if an anomaly is detected in the LIN communication signal, the system transitions to fail safe.

▮ Operation while the vehicle is in the transition to the fail-safe function

When the pulse sensor signal error, incorrect inversion or glass position displacement occurs

	Manual up function	Manual down function	Auto up function	Auto down function	Remote control from the driver's seat (Manual up and down)
Driver's seat	●	●	-	-	-
Front passenger's seat	●	●	-	-	-
Rear seat	●	●	-	-	-

● : Applicable (without pinch prevention/snag prevention function)

-: Operation prohibited

When CPU reset occurs

	Manual up function	Manual down function	Auto up function	Auto down function	Remote control from the driver's seat (Manual up and down)
Driver's seat	●	●	-	-	●
Front passenger's seat	●	●	-	-	●
Rear seat	●	●	-	-	●

● : Applicable (without pinch prevention/snag prevention function)

-: Operation prohibited

When LIN communication error occurs

	Manual up function	Manual down function	Auto up function (LIN communication)	Auto down function (LIN communication)
Driver's seat	●	○	-	-
Front passenger's seat	●	○	●	○
Rear seat	●	○		

● : Applicable (with pinch prevention/snag prevention function)

○ : Applicable (without pinch prevention/snag prevention function)

-: Operation prohibited

When the pulse sensor signal error, incorrect inversion, glass position displacement or LIN communication error occurs

	Manual up function	Manual down function	Auto up function (LIN communication)	Auto down function (LIN communication)
Driver's seat	○	○	-	-
Front passenger's seat	○	○	-	-
Rear seat	○	○		

● : Applicable (with pinch prevention/snag prevention function)

○ : Applicable (without pinch prevention/snag prevention function)

-: Operation prohibited

When CPU reset or LIN communication error occurs

	Manual up function	Manual down function	Auto up function (LIN communication)	Auto down function (LIN communication)
Driver's seat	●	○	-	-
Front passenger's seat	●	○	-	-
Rear seat	●	○		

● : Applicable (with pinch prevention/snag prevention function)

○ : Applicable (without pinch prevention/snag prevention function)

-: Operation prohibited

▮ Fail-safe function for motor drive control

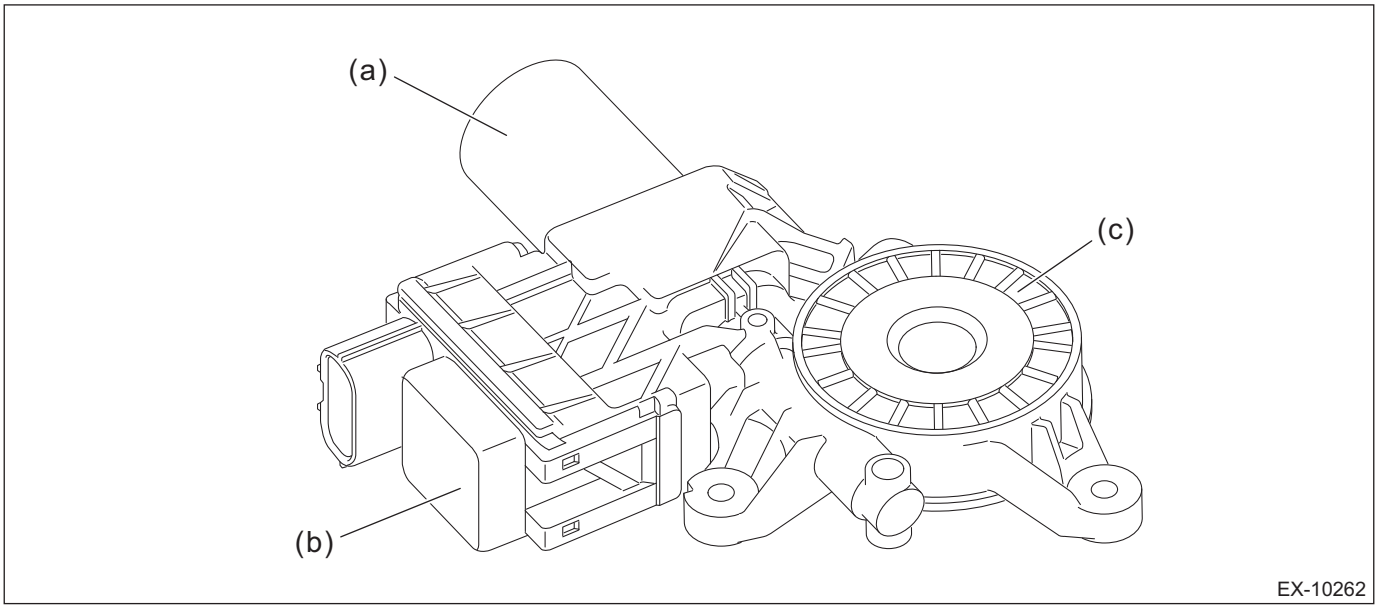
If the drive time of the power window motor is long, the motor is automatically stopped after about ten seconds have passed to protect the motor and circuit.

■ Construction

▮ Power window smart motor assembly

The power window smart motor assembly is composed of a motor section, a control module section, and a gear section.

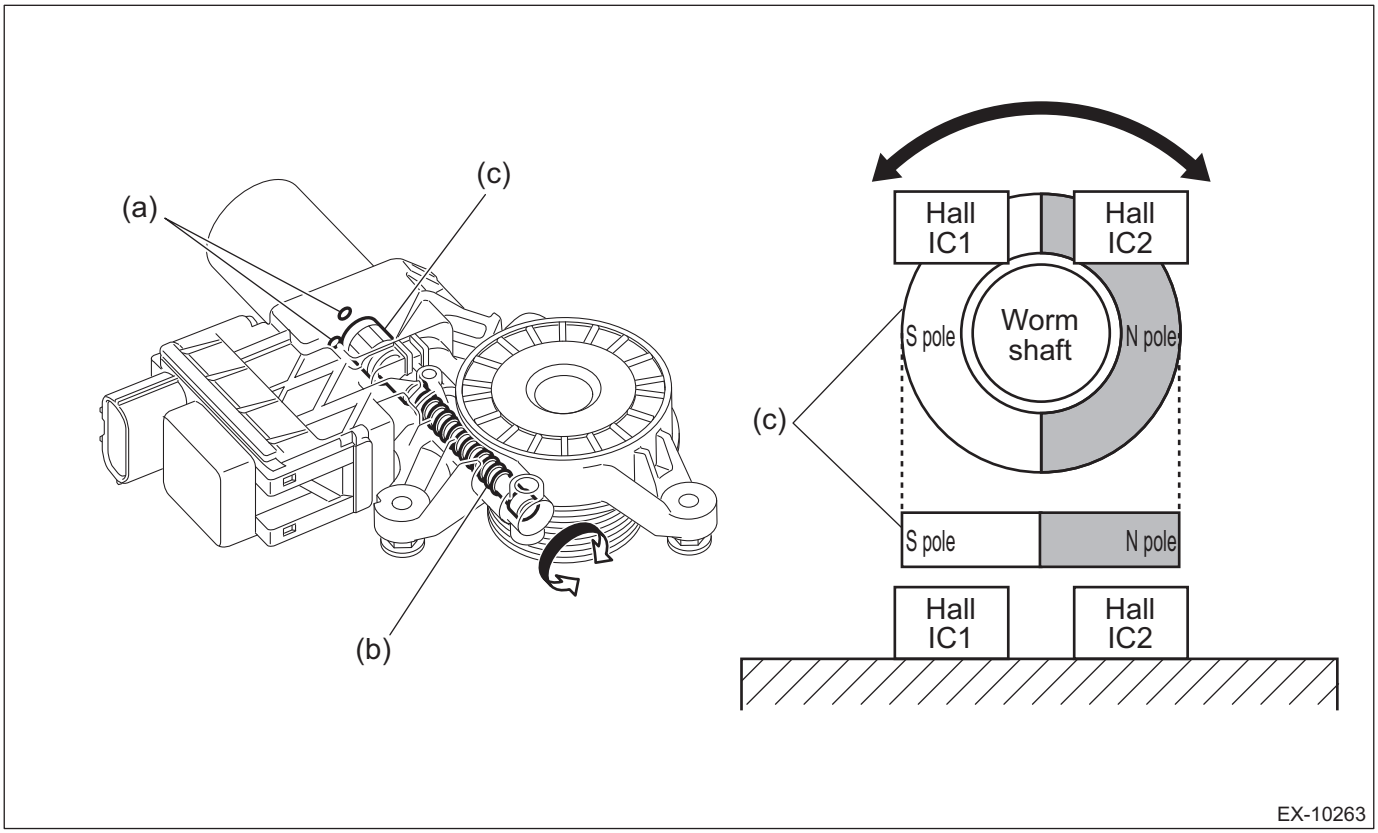
The power window smart motor assembly has a pulse sensor (Hall IC) integrated with the motor body for the pinch prevention mechanism and snag prevention mechanism, and this detects the rotation of the power window smart motor.



(a) Motor section
(b) Control module section
(c) Gear section

Hall IC

The Hall IC outputs pulse signals (two pulse signals with different phases) synchronized to the rotation of the motor to the power window control module by a magnet provided in the worm shaft of the power window smart motor assembly.



(a) Hall IC
(b) Worm shaft
(c) Magnet (for rotation detection)

Electric mirror system

The mirror surface adjustment and left/right changeover switch is located within the power window main switch.

When the left/right changeover switch operates, it is placed in a state where only the internal contacts on the selected mirror side can be turned on.

When the mirror surface adjustment switch operates, it switches to the corresponding internal contacts and rotates/reverse rotates the up/down angle or left/right angle motor to change the angle of the mirror surface.

■ Driver position memory function (for some grades)

Corresponding to the memory switch (Mem1 or Mem2), access key ID and each user ID of the driver monitoring system, the mirror surface position is recalled interlocking with the recall of seat position.

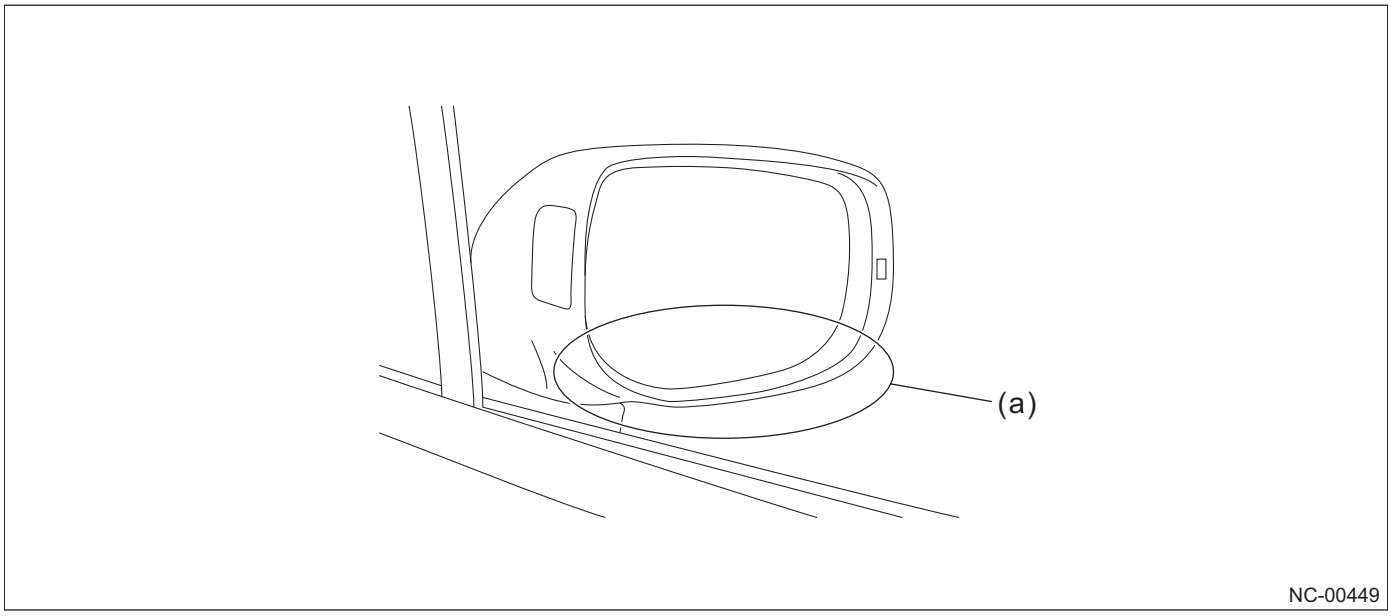
*The memory registration method is the same as that of each seat.

When the best mirror surface position for each user is registered, the same position can be offered for the subsequent driving to improve convenience.

Also, the mirror surface position of the reverse-interlocking tilt down door mirror is registered at the same time.

■ Reverse-interlocking tilt down door mirror (for some grades)

The visibility required to drive the vehicle in reverse is supplementally ensured by automatically directing the door mirror surface of the front passenger's seat downward interlocking with the operation to set the shift position to reverse. The visibility for easy parking is provided by reflecting the ground around the rear tire.



(a) The mirror surface is lowered to ensure the visibility around the rear tire.

For users using the driver position memory function, the mirror surface position of the reverse-interlocking tilt down is registered at the same time when the mirror surface position of each user ID is registered.

Also, for users using this function without using the driver position memory switch, the last position holding function is provided to store and hold the mirror surface position of the reverse-interlocking tilt down adjusted last. (The default is OFF.)

Since the last position is held even after the engine switch is set to OFF, the same position can be offered next time the vehicle is driven in reverse. (Note that after the mirror surface position is recalled by the driver position memory function, the last position is changed to the position registered by each user.)

*This function can be customized by the customization function. For details, refer to "Customization function".

■ Customization function

Each function can be customized on the multi-information display or Subaru Select Monitor 4 from dealer. Also, the customization reset to restore customized settings to the default values can be performed on the multi-information display.

Setting item		Default value	Customization method	
			Multi-information display	Subaru Select Monitor 4, available from dealer
Reverse-interlocking tilt down door mirror	Function (ON/OFF)	ON	●	●
	Operation target (Front passenger's seat side only or both sides)	Front passenger's seat side only	-	●
	Last position holding function (ON/OFF)	OFF	-	●

● : Applicable

-: Not applicable

Mirror heater (for some grades)/wiper deicer (for some grades)/rear defogger system

If mirror heater switch (for some grades)/rear defogger switch is turned on with the ignition switch turned on, a mirror heater switch (for some grades)/rear defogger switch on signals are output to the air conditioner control module. The air conditioner control module to which the signal is input, outputs a relay drive signal to the body integrated unit, and the body integrated unit turns on the mirror heater relay (for some grades), rear defogger relay, and wiper deicer relay (for some grades) to heat the mirror heater (for some grades), wiper deicer (for some grades), and rear defogger.

The wiper deicer (for some grades) does not operate when the ambient temperature becomes 41°F (5°C) or more. It is possible to perform a forced operation if the driver keeps holding the mirror heater switch (for some grades)/rear defogger switch for three seconds or more.

A timer period count is performed by the body integrated unit, and if the relay drive signal is output continuously for about 15 minutes, output of the relay drive signal is stopped and the mirror heater (for some grades), the wiper deicer (for some grades), and the rear defogger turn off.

It is possible to customize operations of the mirror heater (for some grades), wiper deicer (for some grades), and rear defogger to the continuous operation at the dealer using the Subaru Select Monitor 4. (The factory setting is normal.)

9.7 Sunroof (For Some Grades)

9.7.1 Overview

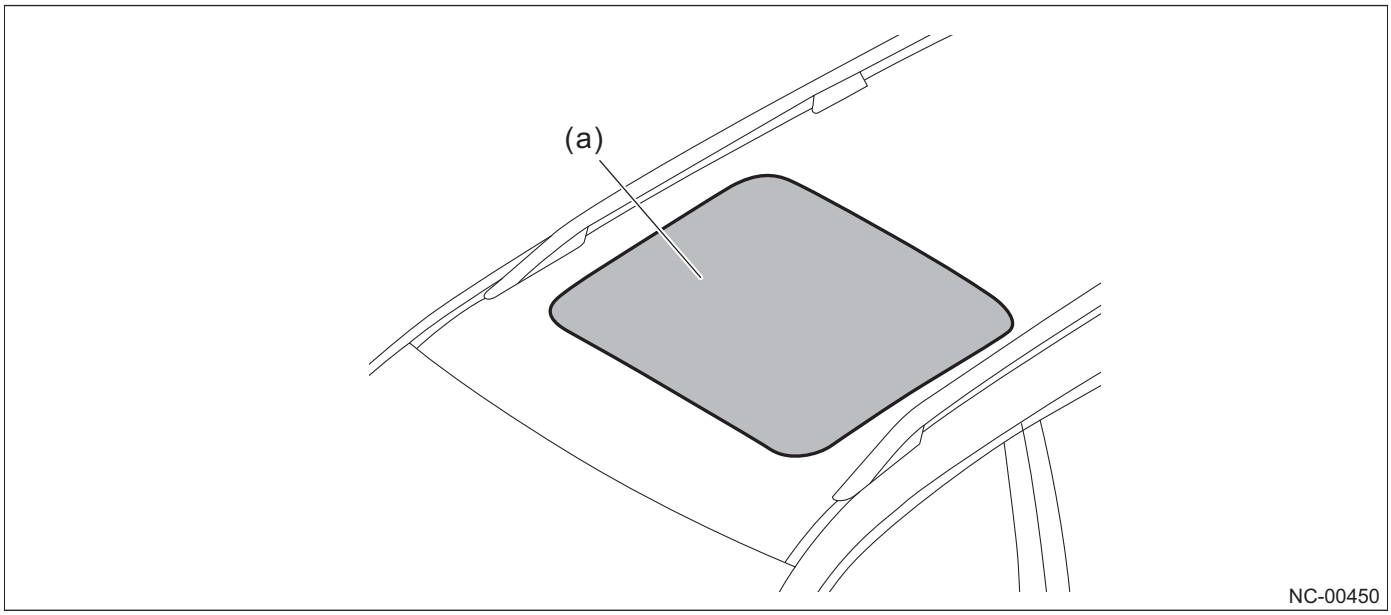
The sunroof equipped with the inner slide and the pinch prevention function is adopted.

The concept of large-open sunroof in existing model vehicles is followed to ensure a sense of space.

9.7.2 Component

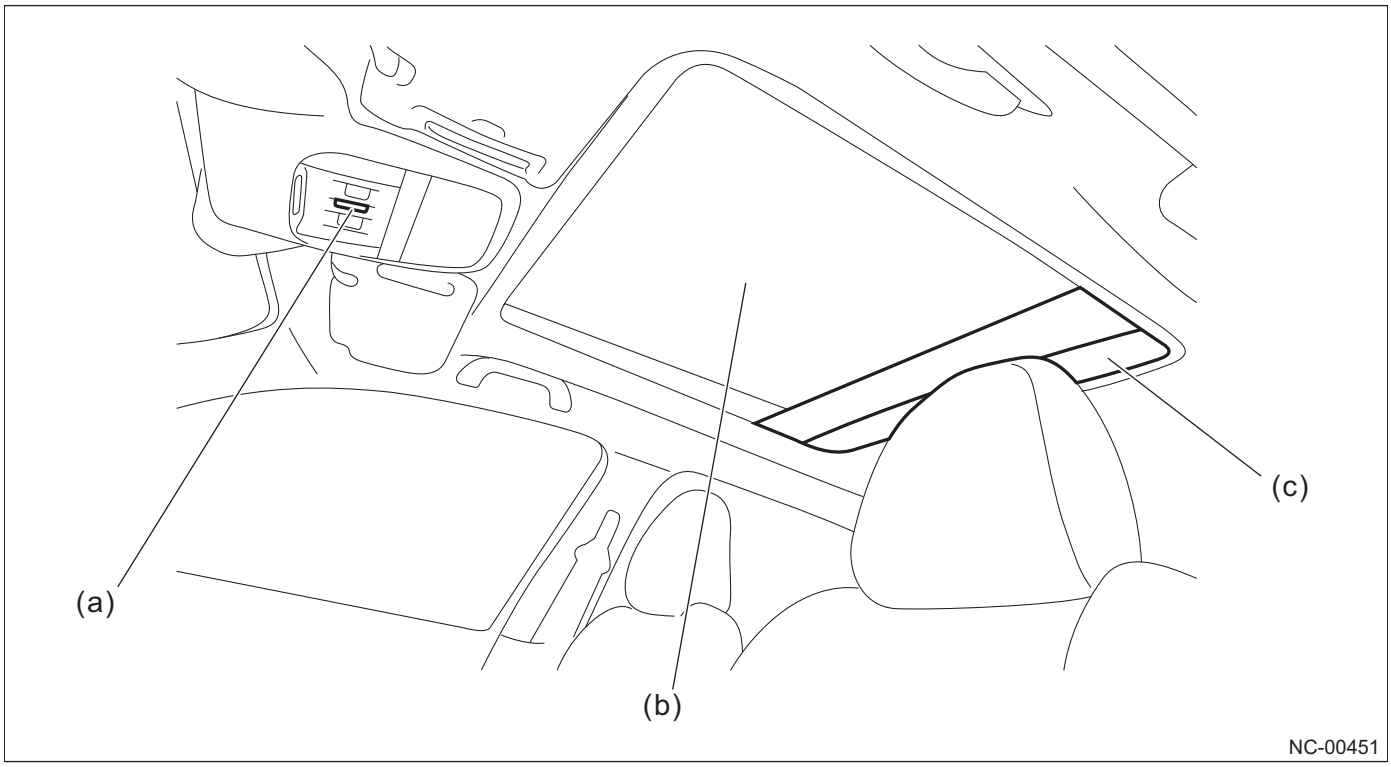
Component layout drawing

Exterior appearance



(a) Sunroof

Interior appearance

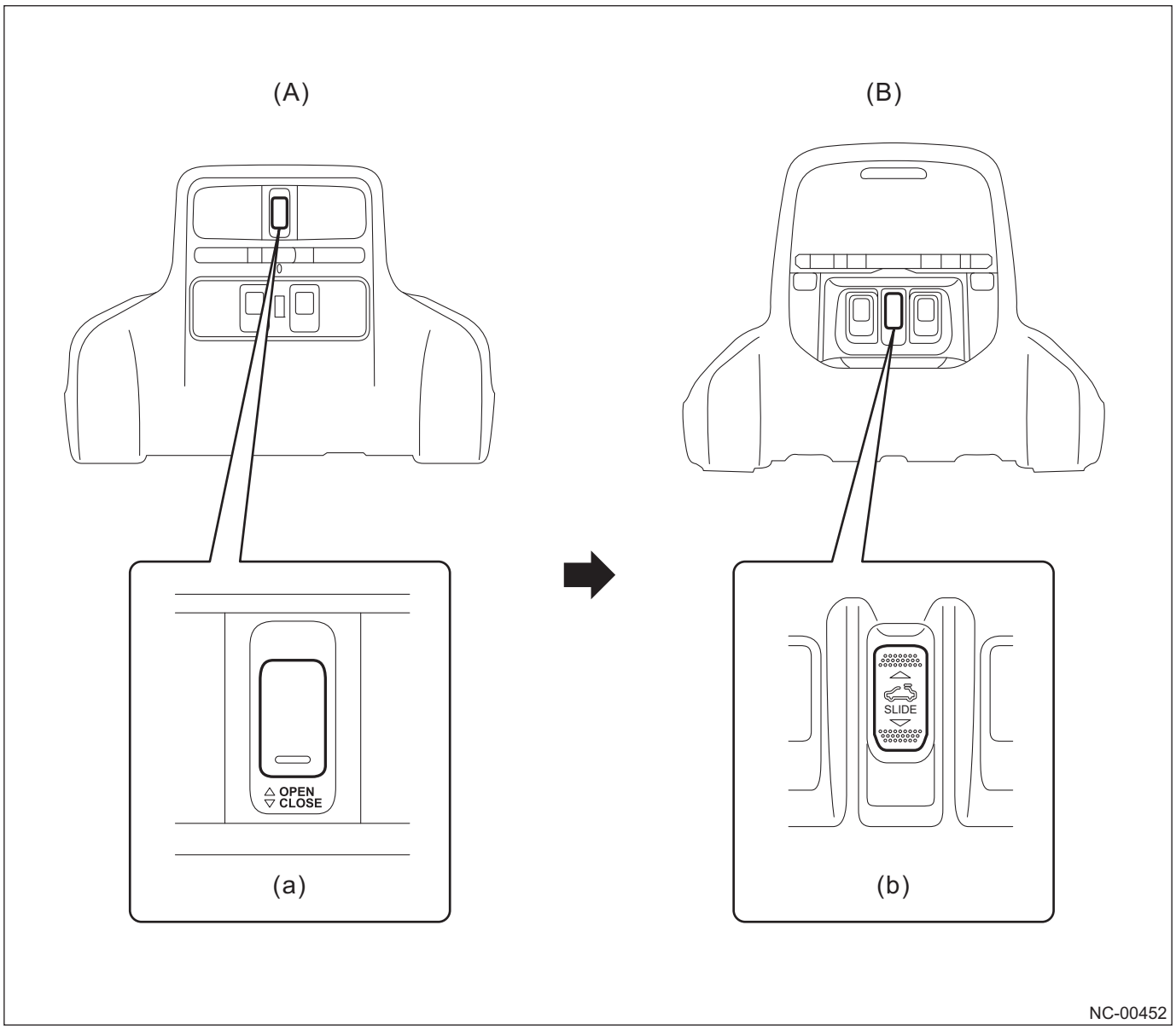


(a) Sunroof switch
(b) Inner slide glass
(c) Sunshade

Component details

Sunroof switch

A mark is added on the sunroof switch to improve visibility.



(A) Existing model vehicle

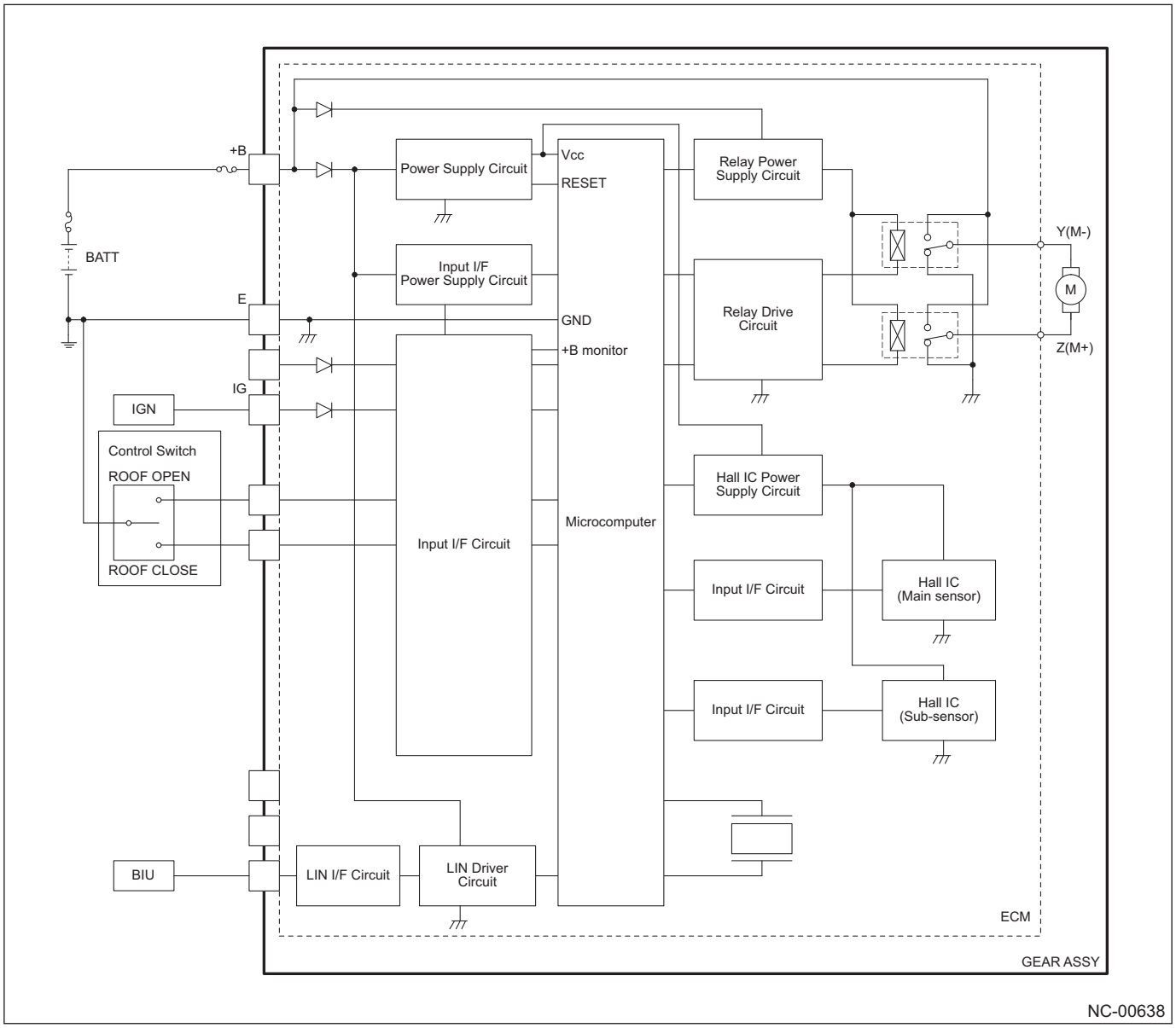
(B) New model vehicle

(a) Sunroof switch (without mark)

(b) Sunroof switch (with mark)

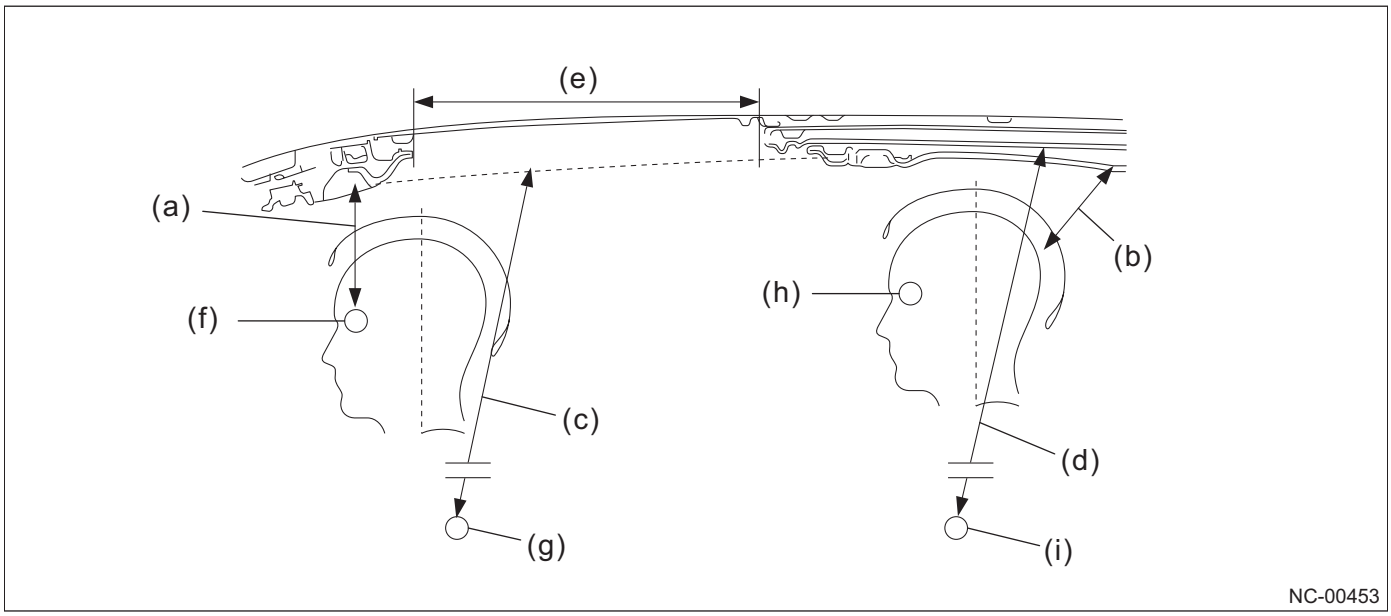
9.7.3 Construction and Operation

System diagram



Indoor space

The mechanism is thinned and the layout is devised to reduce the unit thickness by -0.59 in (-15 mm) compared to the thickness of existing model vehicles Thus, the overall height of the vehicle is reduced by 0.2 in (5 mm) while the space on the front seat side is ensured and an oppressive feeling is alleviated.



Name and dimension

Name		New model vehicle	Existing model vehicle
(a)	Just above eye point	Without sunroof: 9.8 in (251 mm) With sunroof: 9.6 in (245 mm)	8.3 in (212 mm)
(b)	Rear seat head top path clearance (left/right seats)	Without sunroof: 5.6 in (141 mm) With sunroof: 3.6 in (91 mm)	3.4 in (87 mm)
(c)	Front head room (by SAE measurement)	Without sunroof: 41.22 in (1,047 mm) With sunroof: 40.15 in (1,020 mm)	40.0 in (1,016 mm)
(d)	Rear head room (by SAE measurement)	Without sunroof: 39.65 in (1,070 mm) With sunroof: 37.68 in (957 mm)	37.5 in (953 mm)
(e)	Opening size	25.7 in (653 mm)	27.5 in (698 mm)
(f)	Front seat eye point	-	-
(g)	Front seat hip point	-	-
(h)	Rear seat eye point	-	-
(i)	Rear seat hip point	-	-

Opening and closing operation

By operating the switch on the overhead console, the sunroof can be opened and closed. The open/close operation is controlled in auto and manual modes.

Sunroof opening and closing operation

Opening and closing operation of the sunroof is performed until the inner slide glass is full-open.

Auto operation performs when the sunroof switch is pressed for 0.3 seconds or more. On the other hand, the switch operates manually if pressed for less than 0.3 seconds.

9.8 Roof Rail (For Some Grades)

9.8.1 Overview

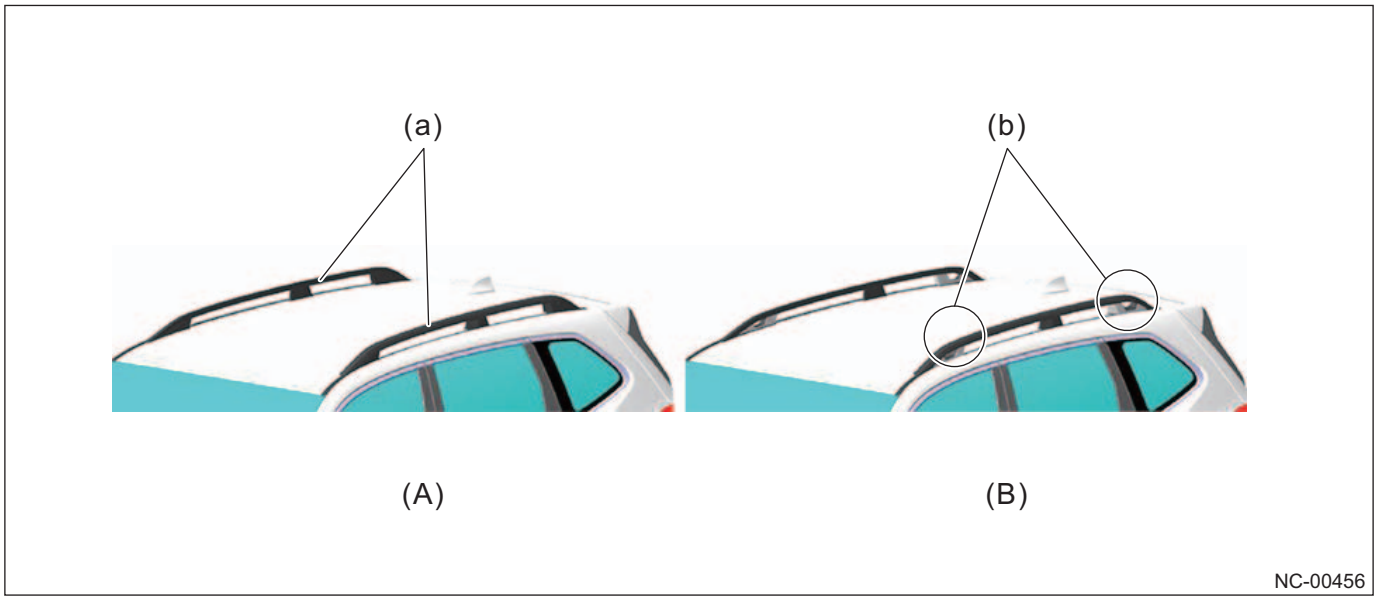
Aluminum-extruded material is adopted for the roof rail.

Rope holes through which a rope or belt can be directly fastened to the front leg and rear leg are arranged to realize the functional roof rail that enables a variety of loading methods. In addition, special decoration is applied to each specification to express high quality according to each grade. (for some grades)

- Standard grade: spin-dyeing black
- Upper grade: silver decoration
- SPORT: orange decoration

The height of the roof rail cross section is reduced to realize the Cd value equivalent to the value of existing model vehicles. Thus, both the aerodynamic performance and quality design are achieved.

With a maximum loading capacity of 80 kg (176 lb) as before, the functional roof rail can be used outdoors.



(A) Standard grade

(B) Upper grade, SPORT

(a) Roof rail

(b) Rope and belt hole

9.9 Door and Fuel Flap

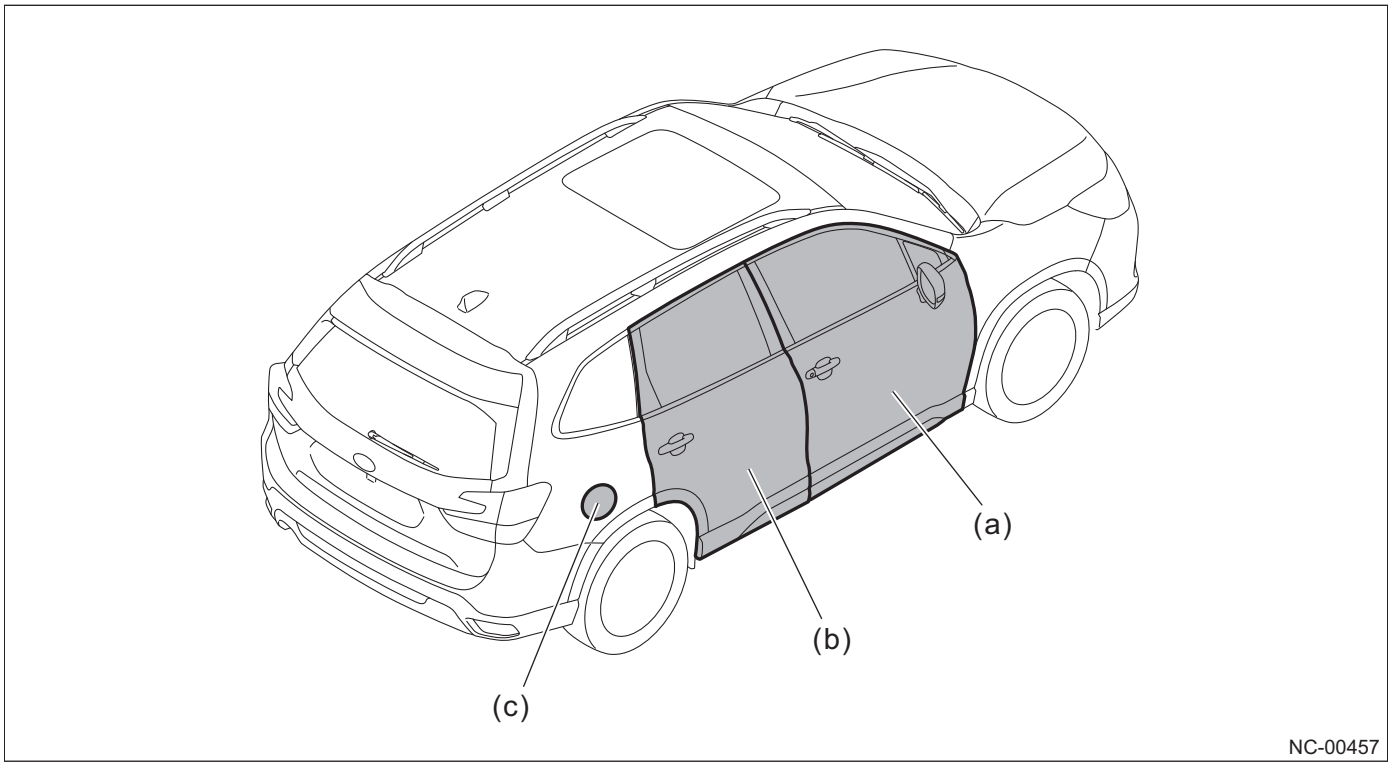
9.9.1 Overview

The following mechanisms are adopted for the door and the fuel flap.

- The side door beam is adopted.
- The weather strip with high quietness is adopted.
- The rear door with large opening angle is adopted.
- The operational force when opening and closing the door is optimized.
- The push open type opening and closing function is adopted for the fuel flap.

9.9.2 Component

Component layout drawing



(a) Front door
(b) Rear door
(c) Fuel flap

Component details

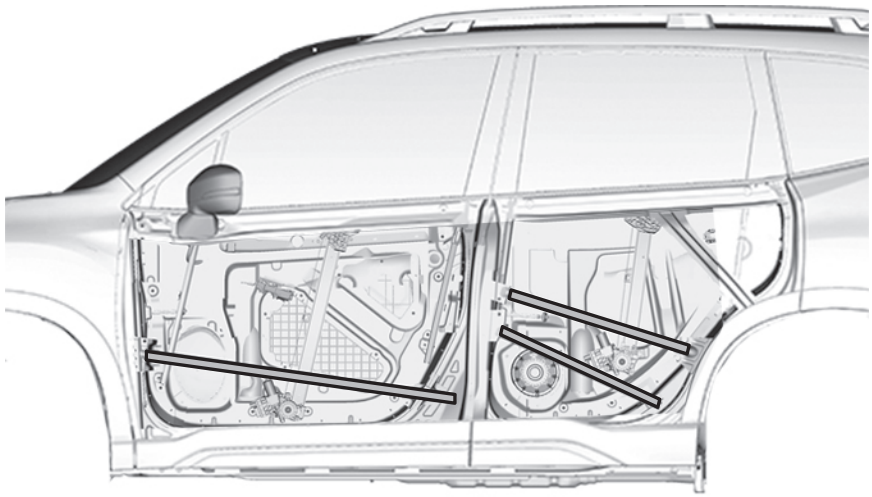
Door

The front door and the rear door are improved for safety and operability as well as quietness.

■ Side door beam

The side door beam with high rigidity in doors on both sides of the vehicle is adopted to protect passengers on side collision.

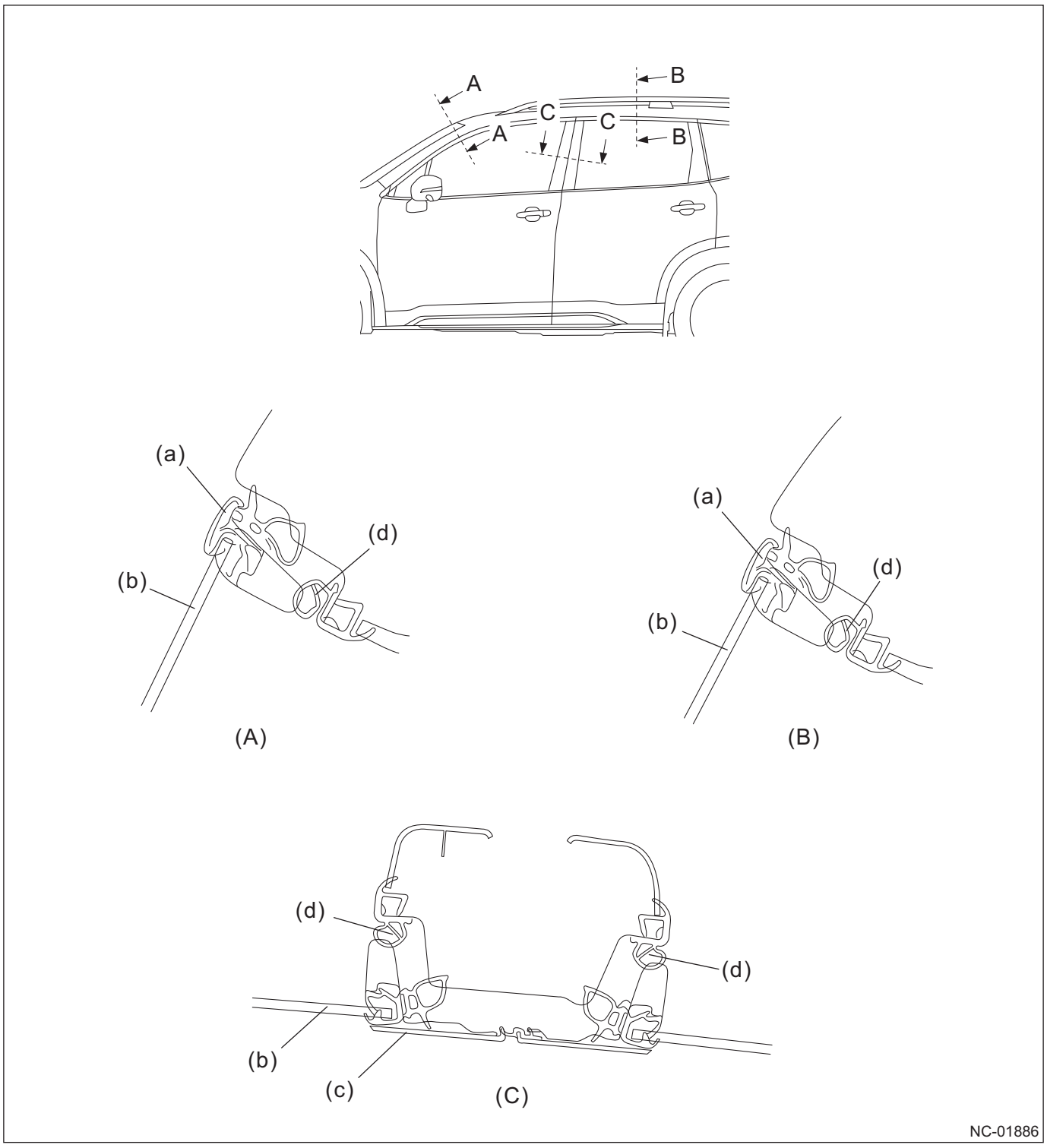
The side door beam is added in the door frame to absorb any impact on side collision, prevent cabin twisting, and ensure safety for passengers.



NC-01760

■ Weather strip

The partition wall is adopted for the hollow part of the body side weather strip to improve quietness.

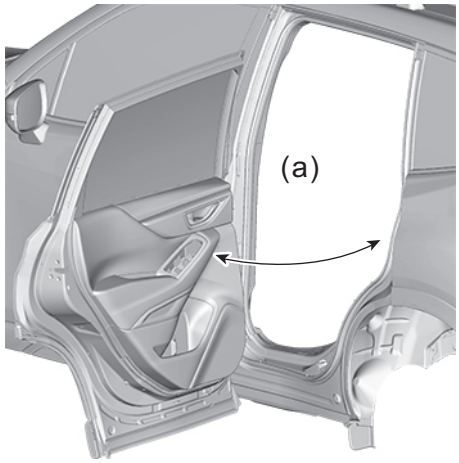


(A) A-A cross section
(B) B-B cross section
(C) C-C cross section

(a) Upper sash
(b) Glass
(c) Pillar cover
(d) Weather strip body side flange

■ Rear door opening angle

The opening angle of the rear door is expanded from 75° to 80° to improve convenience when a passenger enters or exits the vehicle. Mountability of the child seat is also improved.



NC-00460

(a) 80°

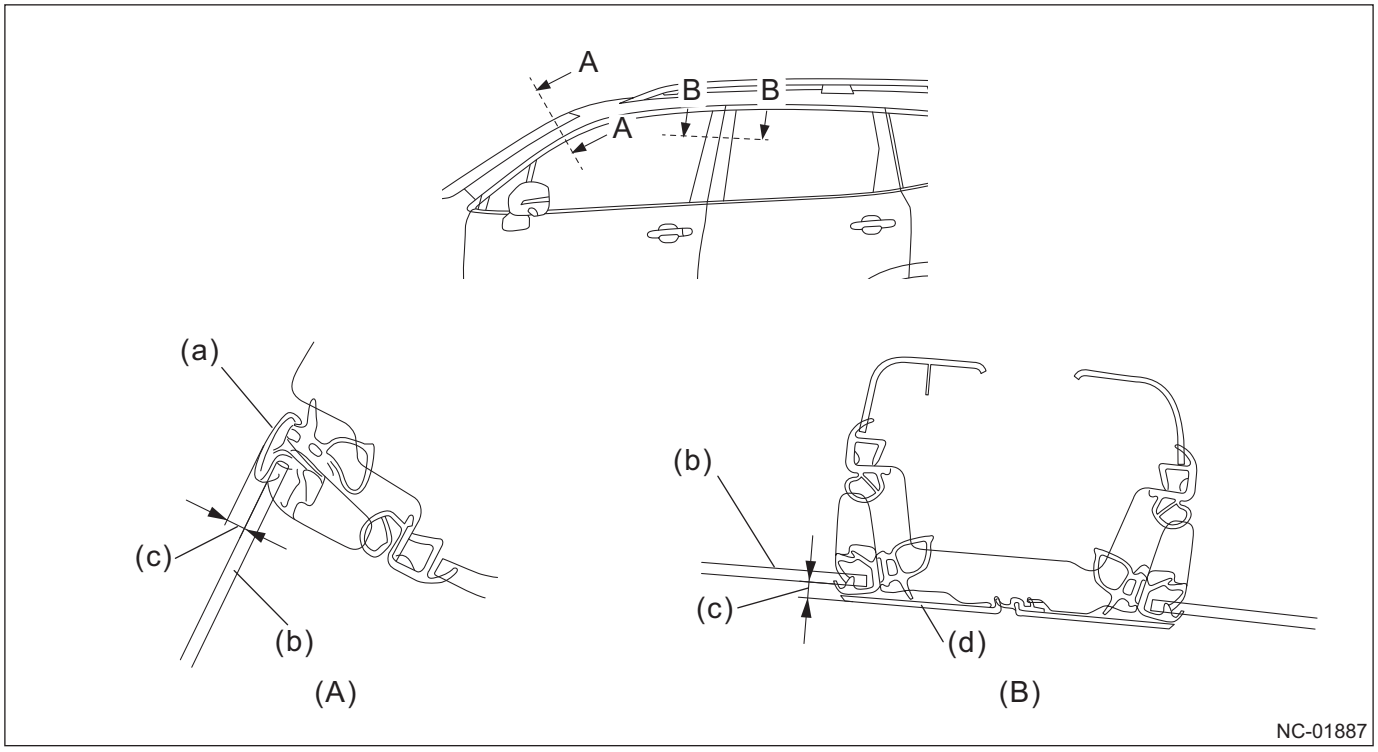
■ Rear door clearance above the head of a passenger

The clearance above the head of a passenger is secured to improve convenience when a passenger enters or exits from the rear door.

■ Around the side door glass

The following sections around the side door glass are improved to reduce the difference in level between the glass and sash/pillar and enhance product appeal.

- The molding is applied on the upper sash section.
- The cover is mounted on each pillar section.



(A) A-A cross section
(B) B-B cross section

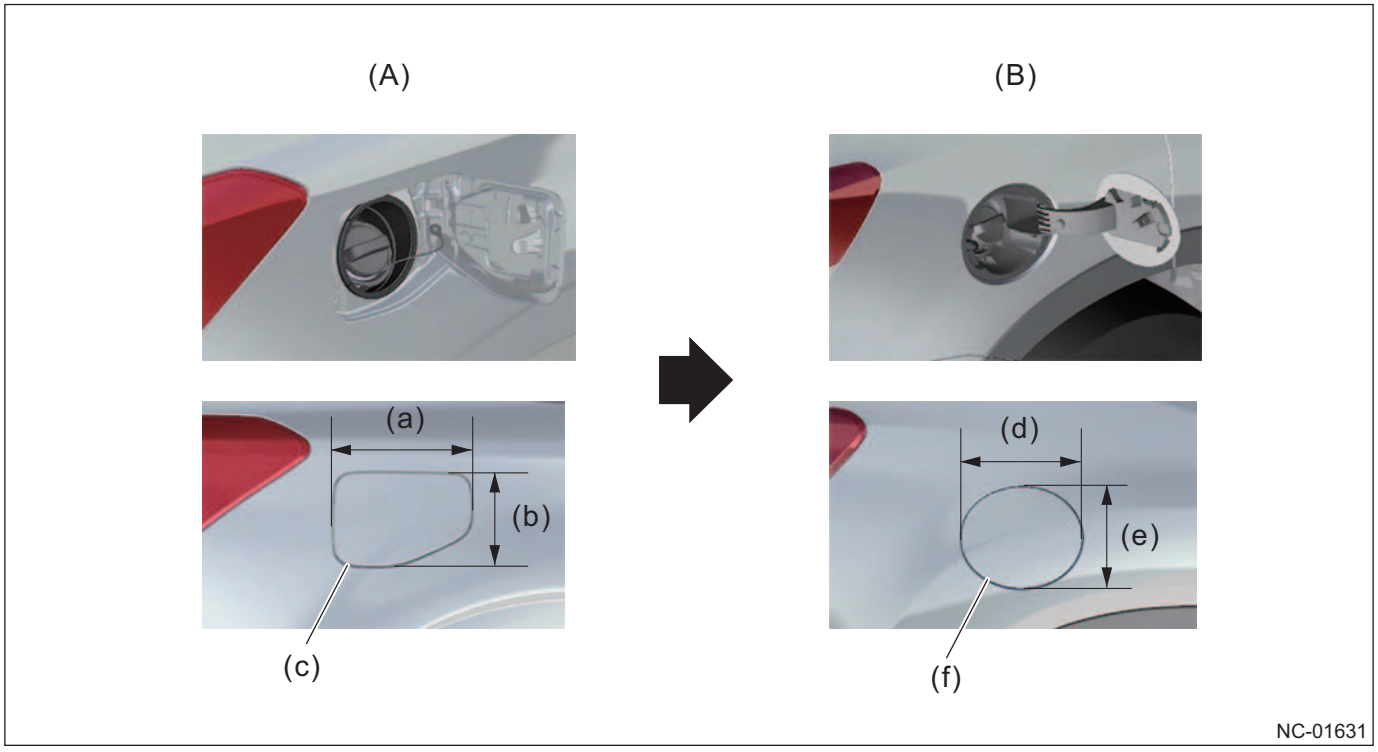
(a) Upper sash
(b) Glass
(c) Reduction in level difference with the glass
(d) Pillar cover

Fuel flap

A protrusion type of hinge structure is adopted for the fuel flap to realize the small-sized and round-shaped fuel flap.

The fuel flap is made of plastic to reduce the weight by -4 oz (-65%) (-177 g (-65 %)) compared to existing model vehicles while the appearance quality is considered. (SUBARU's first)

The division width of the opening and closing section is reduced from 0.14 in (3.6 mm) to 0.1 in (2.5 mm) to improve the appearance.



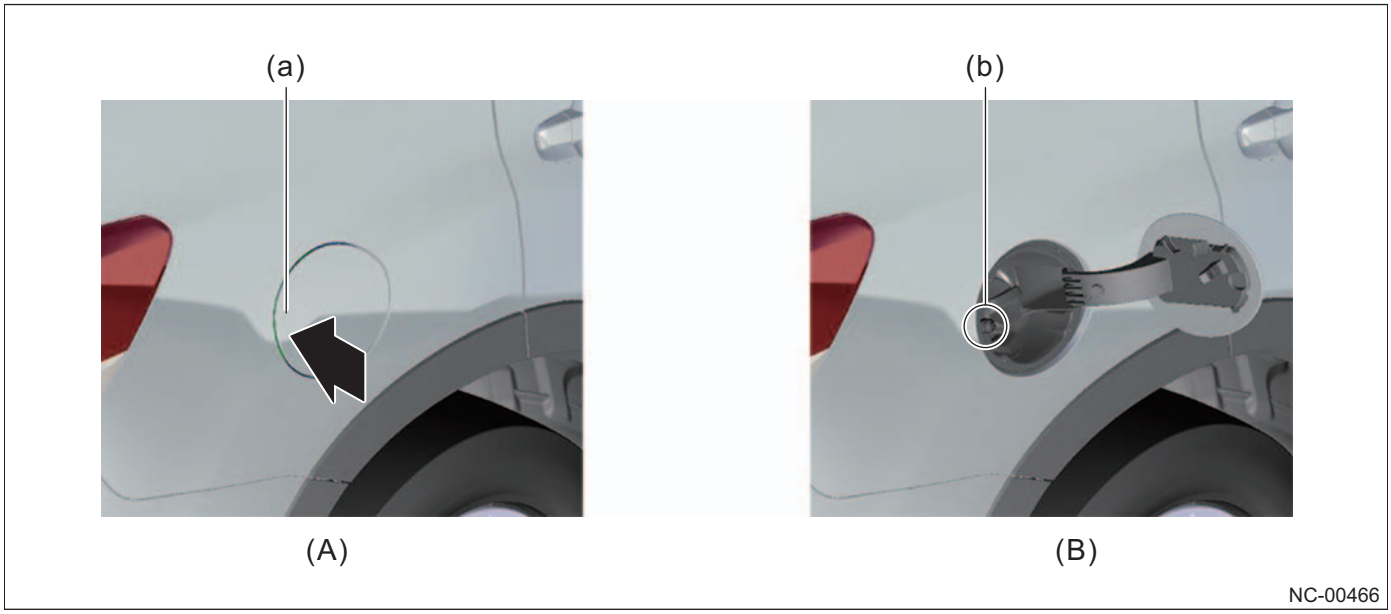
(A) Existing model vehicle

(a) 8.27 in (210 mm)
(b) 5.9 in (150 mm)
(c) Division width: 0.14 in (3.6 mm)

(B) New model vehicle

(d) 7.64 in (194 mm)
(e) 6.3 in (160 mm)
(f) Division width: 0.1 in (2.5 mm)

The interior opener lever of the fuel flap is removed and changed to the push open type of fuel flap while electric lock/unlock system with the actuator is adopted. The lever is eliminated to improve convenience and realize a wider space in the foot area of the driver's seat.



(A) Fuel flap closed

(B) Fuel flap opened

(a) In unlocked state, push the fuel flap to open.

(b) Push lifter

■ Fuel flap lock/unlock

The fuel flap is locked in the following conditions.

- When the door is locked by the keyless transmitter/access key operation, keyless access, or central door lock
- When the auto door lock function operates

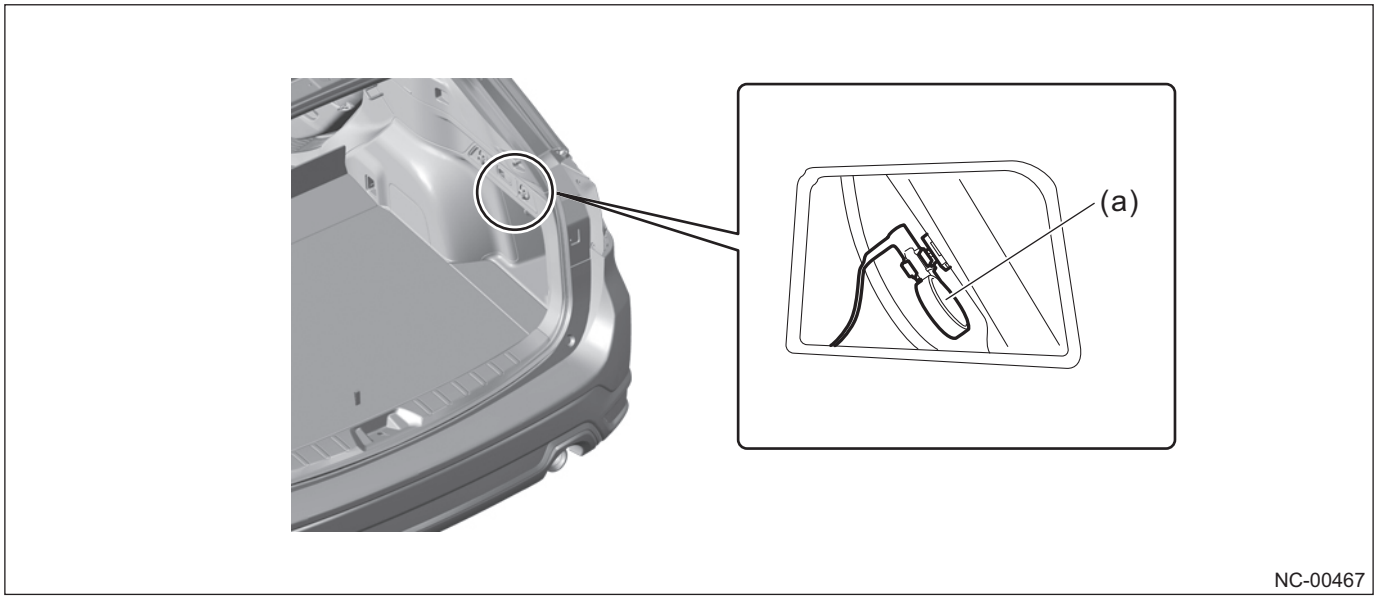
The fuel flap is unlocked in the following conditions.

- When the door is unlocked by the keyless transmitter/access key operation, keyless access, or central door lock
- When the engine switch is set from ON to OFF (The lock is released when the ignition switch is restored to ACC or OFF.)
- When the auto door unlock function operates

■ Emergency cable

In order to handle the case where the fuel flap cannot unlock (for example, the case where the battery has been running out), the emergency cable is installed that can unlock the fuel flap.

The emergency cable can be accessed by removing the shopping bag hook on the right side of the luggage compartment with a flat-head screwdriver, etc. Remove the cable from the holder and pull the cable towards the driver side to unlock the fuel flap. The cable is colored with orange that has high visibility. The front end of the cable is adopted that has shape with easy touching.



(a) Emergency cable

9.10 Rear Gate

9.10.1 Overview

The power rear gate (for some grades) that can be easily opened and closed with a single touch of a button is adopted. Also, the auto transition control by manual operation is adopted that automatically operates the power rear gate when the rear gate is manually opened or closed with the rear gate open.

The memory function that is useful in the parking lot with low ceiling or when lengthy cargo is loaded on the roof career is provided.

The auto closer function is also added that can close the gate gently.

Even if the gate operates by the wrong operation of the switch, the function is installed that reverses when contacting objects or persons.

In addition, the new model vehicle reduces the time to open and close the power rear gate to eliminate nuisance when it is opened and closed.

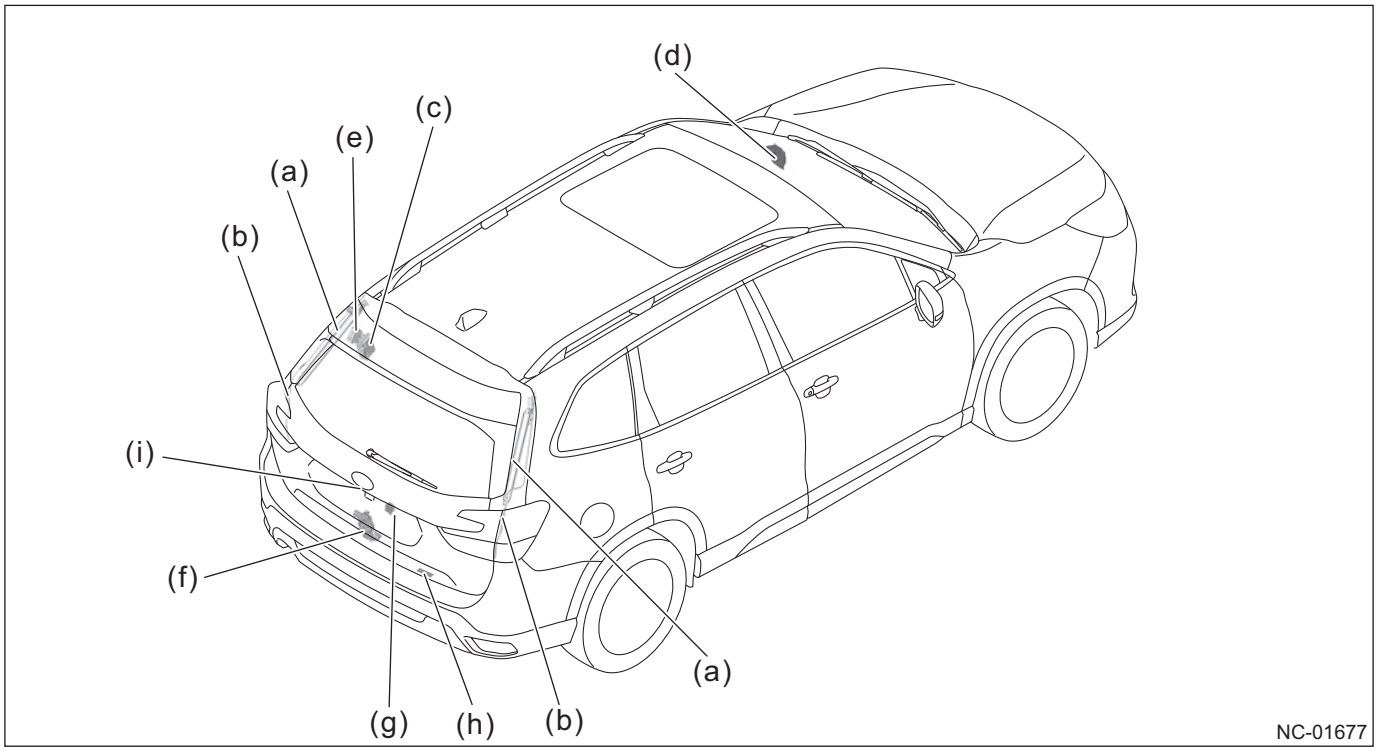
Automatic open and close time of the rear gate

	New model vehicle	Existing model vehicle
Open time [s]	5.0	9.2

The power rear gate lock switch (only for vehicle with keyless access and push button start) is added to improve operability.

9.10.2 Component

Component layout drawing



(a) Power rear gate stay (for some grades)
(b) Touch sensor (for some grades)
(c) Power rear gate CM (for some grades)
(d) Body integrated unit (in joint box)
(e) Keyless entry CM
(f) Power rear gate auto closer (for some grades)
(g) Power rear gate buzzer (for some grades)
(h) Power rear gate inner switch and power rear gate lock switch (for some grades)
(i) Rear gate opener button

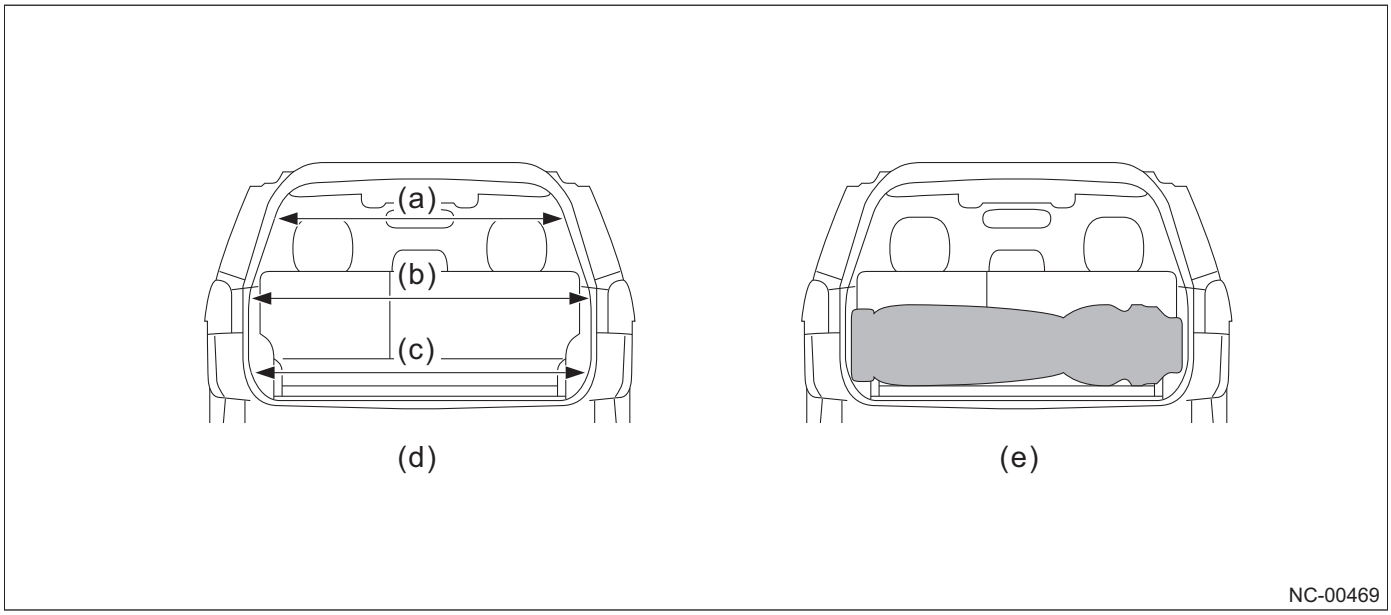
Component details

Rear gate

The rear gate mechanism aimed at expanding the frontage of the luggage compartment is adopted. The maximum opening width of the luggage compartment is 51 in (1,300 mm) to realize excellent usability of the luggage compartment. The width and usability are understood at a glance. The luggage compartment gives an active impression to users.

Opening width

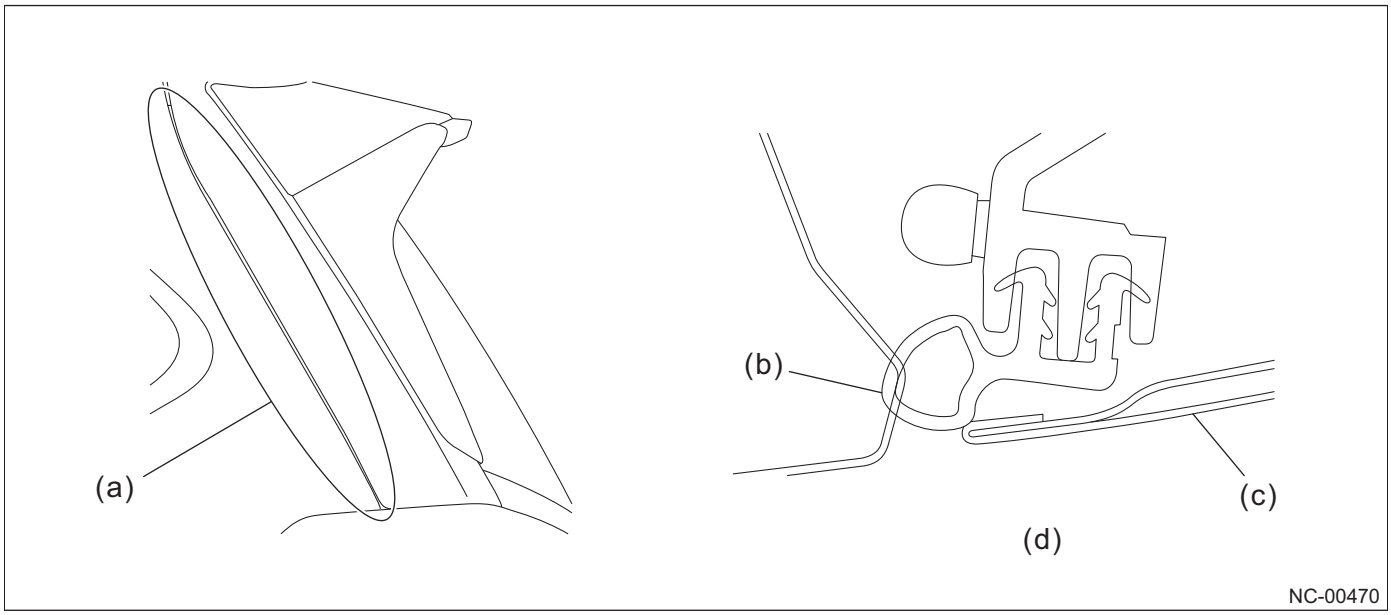
	Upper end opening	Maximum opening	Lower end opening
New model vehicle	41 in (1,035 mm)	51 in (1,300 mm)	50 in (1,258 mm)
Existing model vehicle	41 in (1,035 mm)	46 in (1,166 mm)	43 in (1,100 mm)



(a) Upper end opening
(b) Maximum opening
(c) Lower end opening
(d) Opening usable dimension
(e) Easy to load long objects (laying down golf bag, etc.)

■ Rear gate side seal

The aerodynamic seal (rear gate side seal) is adopted for the side division section of the rear gate to reduce a swirl occurring from the division section and decrease air resistance around the rear.

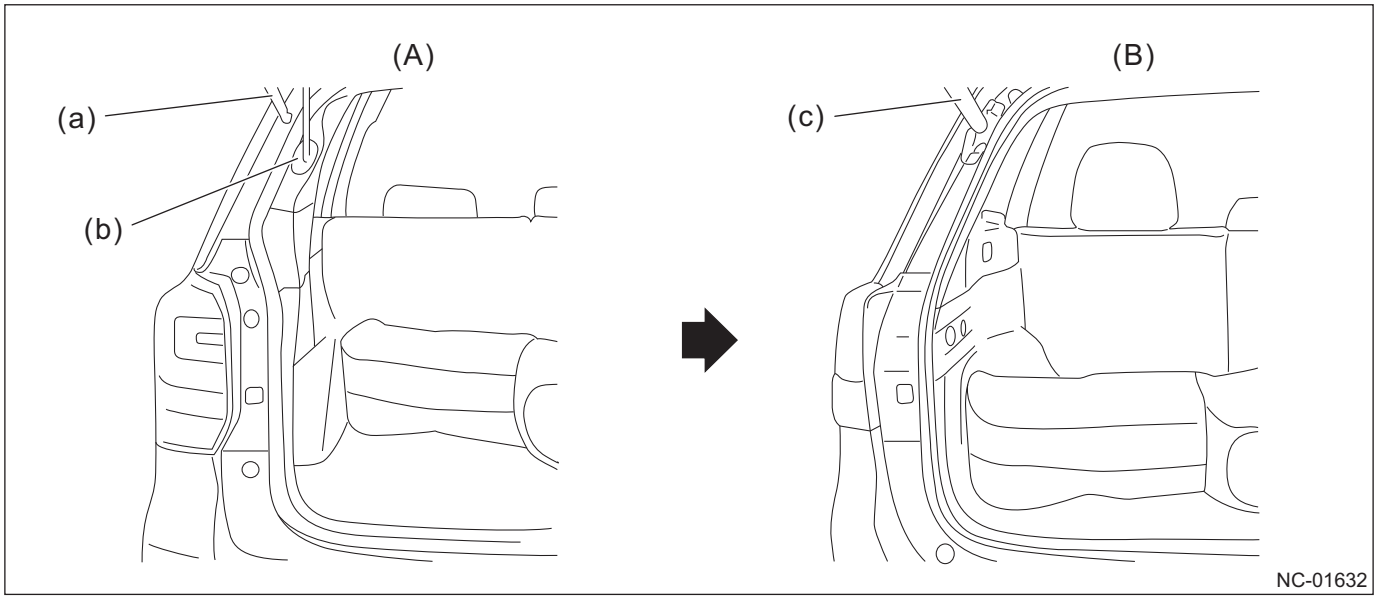


(a) Rear gate side seal application area
(b) Rear gate side seal
(c) Rear gate panel
(d) General section cross section

Power rear gate (for some grades)

■ Power rear gate stay

The power rear gate stay with a built-in motor is adopted. Since there is no drive unit in the luggage compartment, the spacious and clear opening portion and luggage compartment space are ensured.



(A) Existing model vehicle

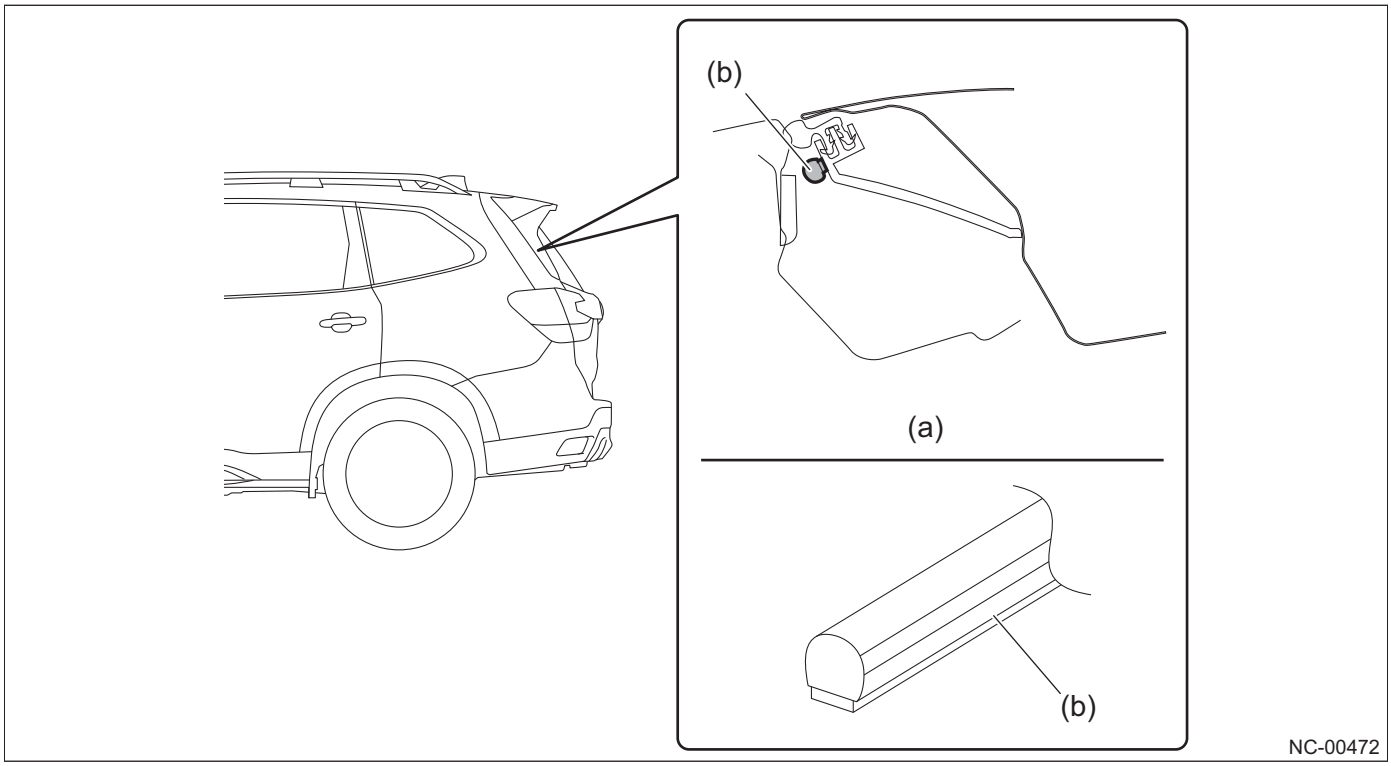
(a) Gas stay
(b) The rear gate is opened from the drive unit in the luggage compartment via the rod.

(B) New model vehicle

(c) Power rear gate stay (with the motor built into the stay)

Touch sensor

The rod-shaped touch sensor is located at right and left portions of the rear gate.

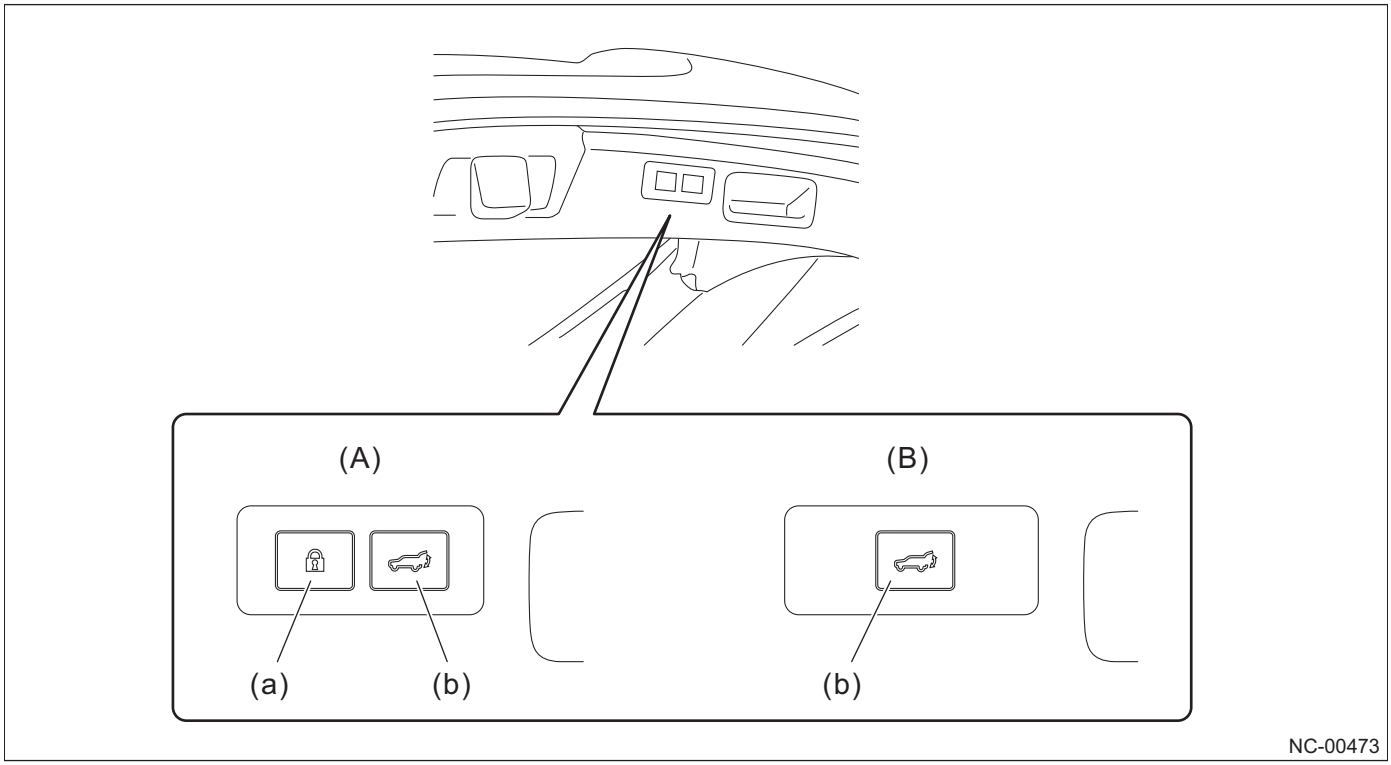


(a) Rear gate cross section

(b) Touch sensor

Power rear gate lock switch (SUBARU's first) (for some grades)

By pressing the power rear gate lock switch, the rear gate is automatically closed and the vehicle is locked. The power rear gate inner switch is made smaller than the existing one, and thus can be arranged side by side. The shorter stroke switch compared to existing model vehicles is adopted to improve operability.



(A) Vehicle with power rear gate lock switch

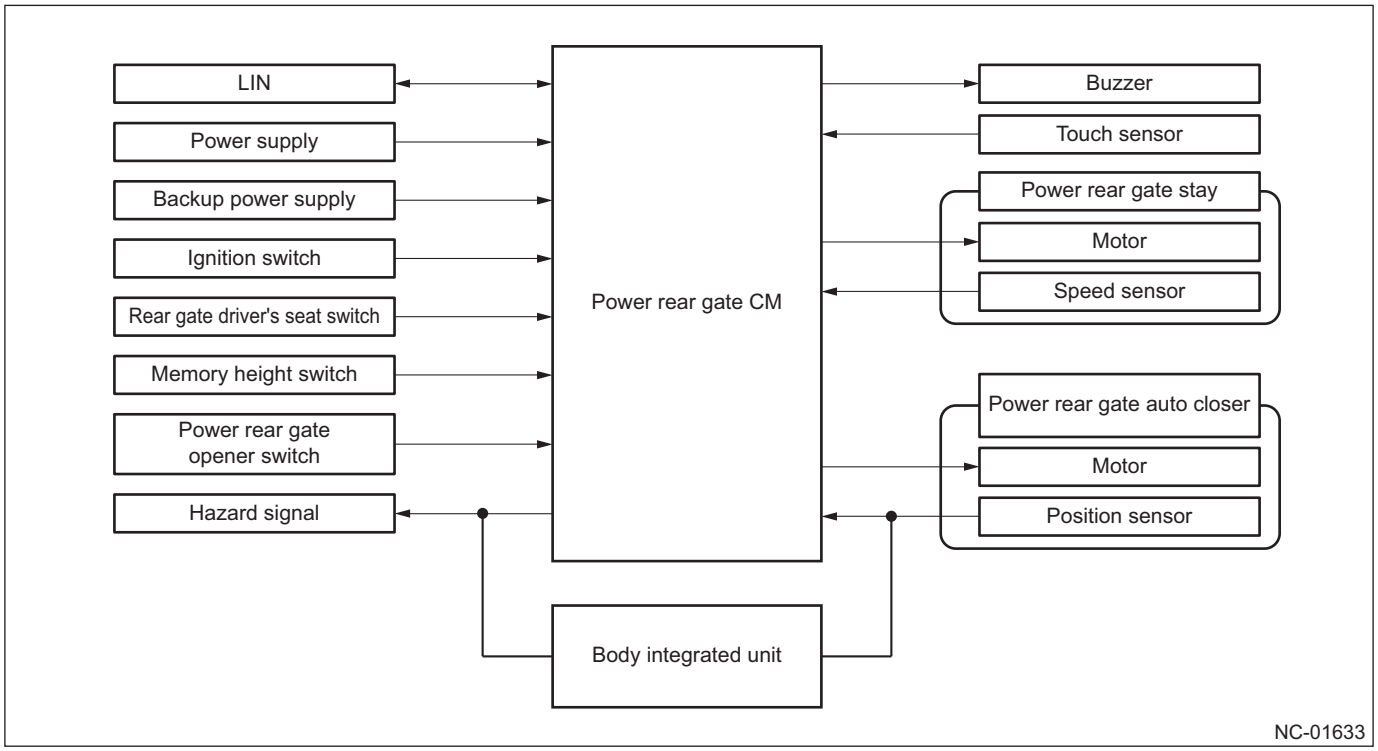
(B) Vehicle without power rear gate lock switch

(a) Power rear gate lock switch

(b) Power rear gate inner switch

Construction and operation

System diagram



Operation

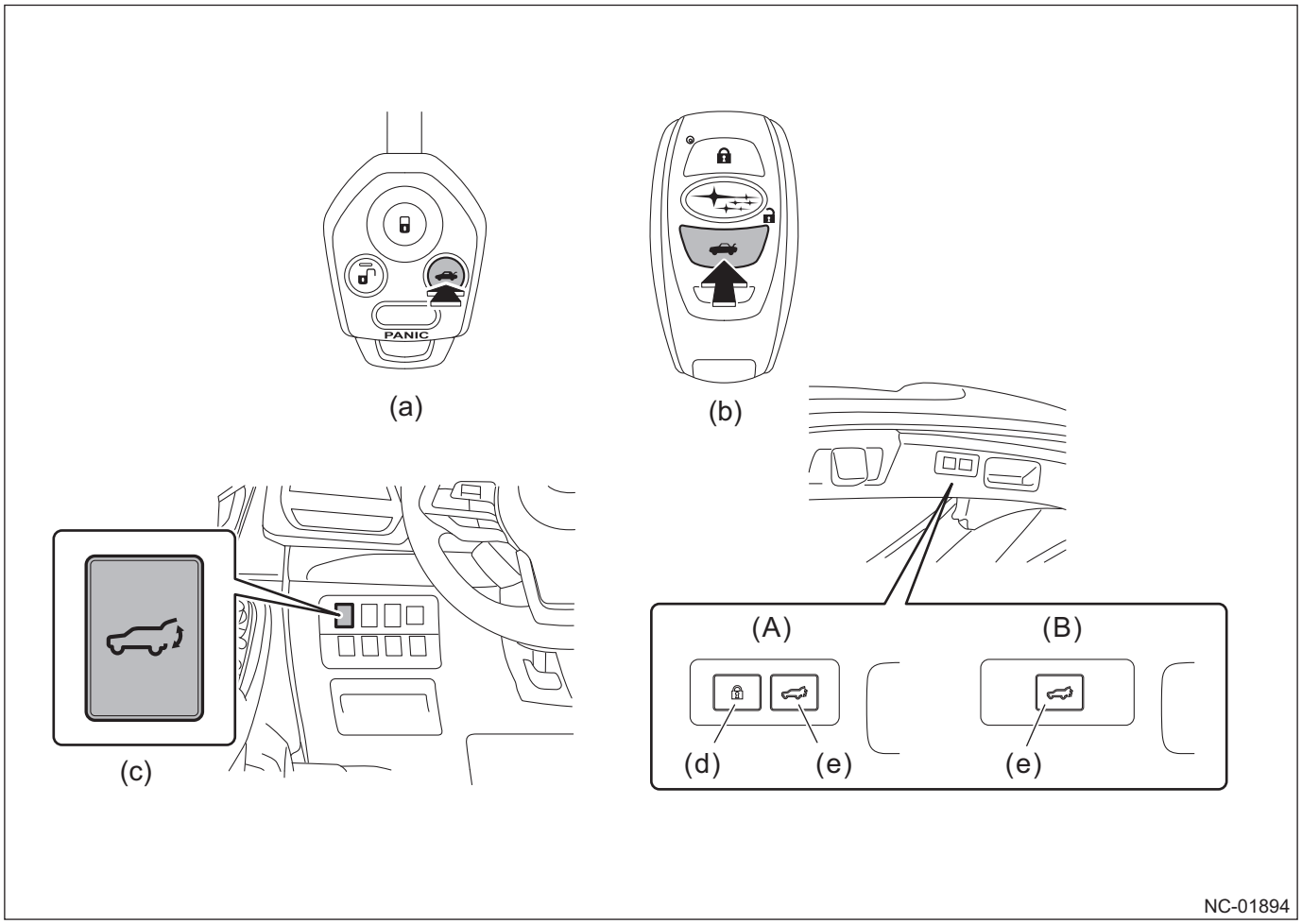
The power rear gate operation is controlled by the power rear gate CM.

The power rear gate CM controls the power rear gate auto closer to open and close the rear gate, based on the rear gate button operation of the access key or the keyless transmitter, the indoor switch, the rear gate switch signal, and the information from each sensor signal.

The rear gate can be automatically opened or closed by pressing and holding the switch of the driver's seat or the keyless key rear gate switch, or pressing the switch mounted on the rear gate.

When the touch sensor installed on the rear gate senses contact with a foreign object, the automatic closing operation is stopped and moves to the reverse operation, and notifies with an electronic sound.

If the switch is pressed while the rear gate is being opened, the gate can be stopped at that position. When the switch is pressed in the halfway-stopped state, the gate is automatically closed.



(A) Vehicle with power rear gate lock switch

(B) Vehicle without power rear gate lock switch

(a) Keyless transmitter *1
(b) Access key *2
(c) Rear gate driver's switch (instrument panel)

(d) Power rear gate lock switch (rear gate)
(e) Power rear gate inner switch (rear gate)

*1: Vehicle without keyless access with push button start system

*2: Vehicle with keyless access with push button start system

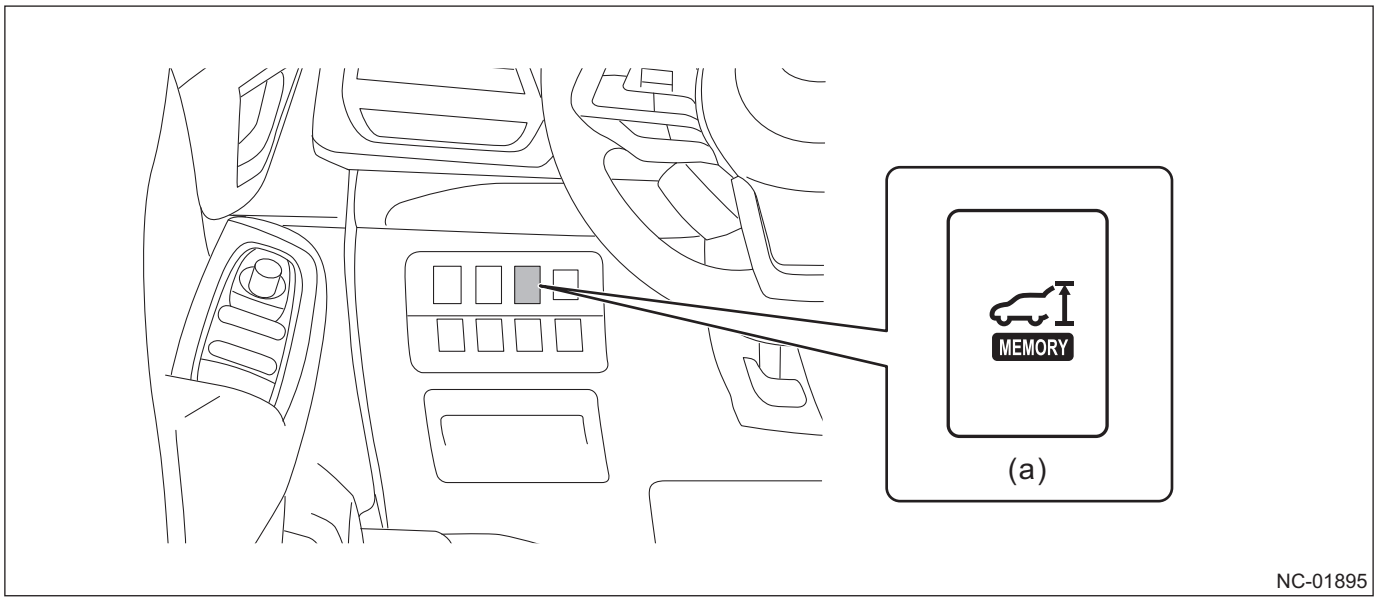
■ Operating conditions

The power rear gate operates in the following conditions.

- While the vehicle is stopped
- When the rear gate opening angle is 5° or less
- When the ambient temperature is -22°F to 140°F (-30°C to 60°C)
- When the ignition switch is LOCK/OFF or ACC

■ Memory function

By pressing the memory height switch on the instrument panel, the automatic opening operation can be stopped at the position at which the rear gate full-open angle is memorized.



(a) Memory height switch

■ Reverse function

The function is installed that reverses in the close direction at opening and reverses in the open direction at closing when the touch sensor senses the contact with objects or persons. In addition, this function notifies of the operation with an electronic sound. On the other hand, the reverse function does not operate when the rear gate fully opens, closes, and is at the opening angle registered by the memory function.

■ Manual operation auto transition control

If a user directly operates the gate, the sensor reads the user's intention to open or close the gate even if the switch is not operated, and switches to the automatic open/close operation of the gate.

9.11 Rear Bumper/Rear Gate Garnish/Letter Mark/Muffler Cutter (For Some Grades)

9.11.1 Overview

A decoration that express the vehicle as a SUBARU vehicle at a glance to provide joy and pride of owning a SUBARU vehicle.

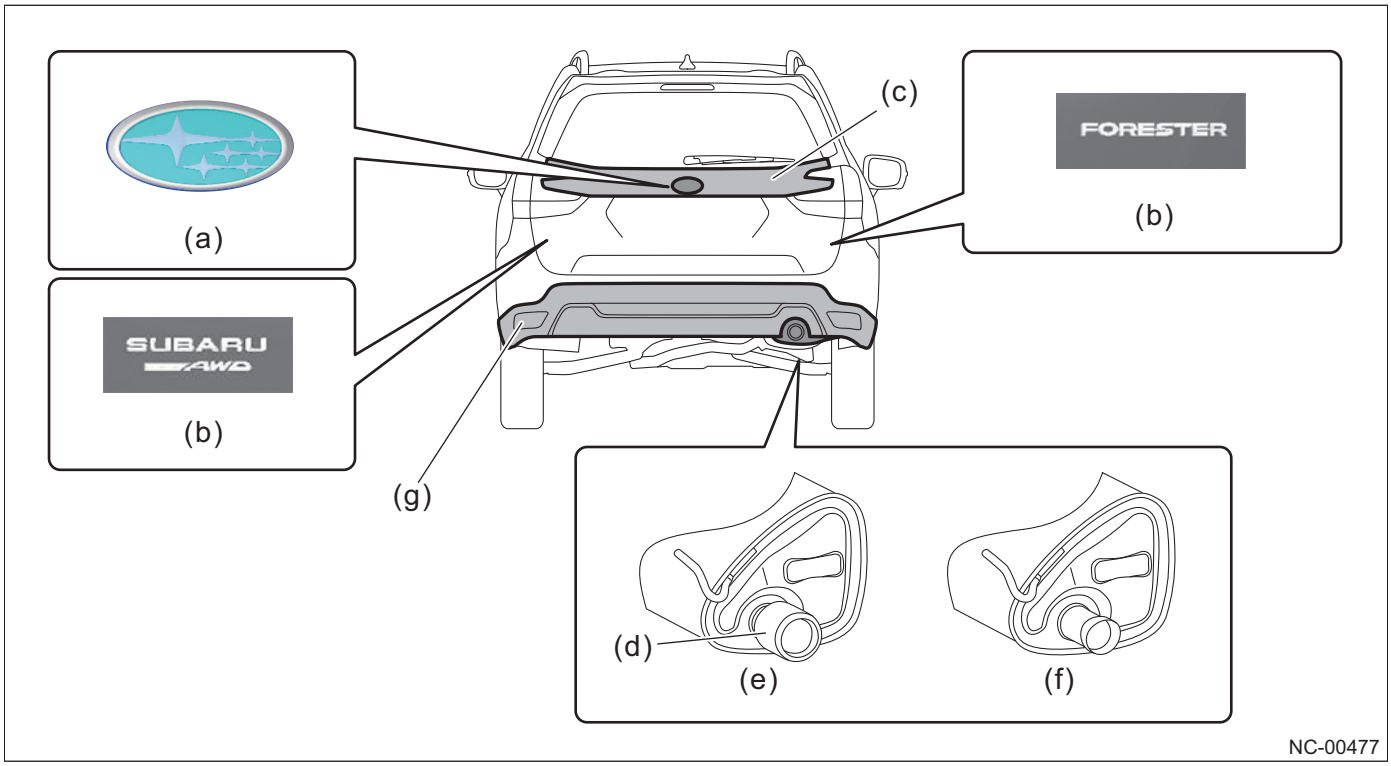
The adopted large rear gate garnish is made of plastic.

The SUBARU Pleiades ornament suitable to the vehicle class is adopted to produce the presence of SUBARU.

The muffler cutter with the superior product performance is adopted. (for some grades)

9.11.2 Component

Component layout drawing



(a) Ornament rear
(b) Letter mark
(c) Rear gate garnish
(d) Muffler cutter (for some grades)
(e) Vehicle with muffler cutter
(f) Vehicle without muffler cutter
(g) Bumper guard rear

Component details

Rear bumper

The structure of the bumper bracket is optimized to reduce the gap with the vehicle body by 0.008 in (0.2 mm) compared to existing model vehicles.

The side cladding is installed as standard equipment to enhance the functionality and emphasize the SUV feature.

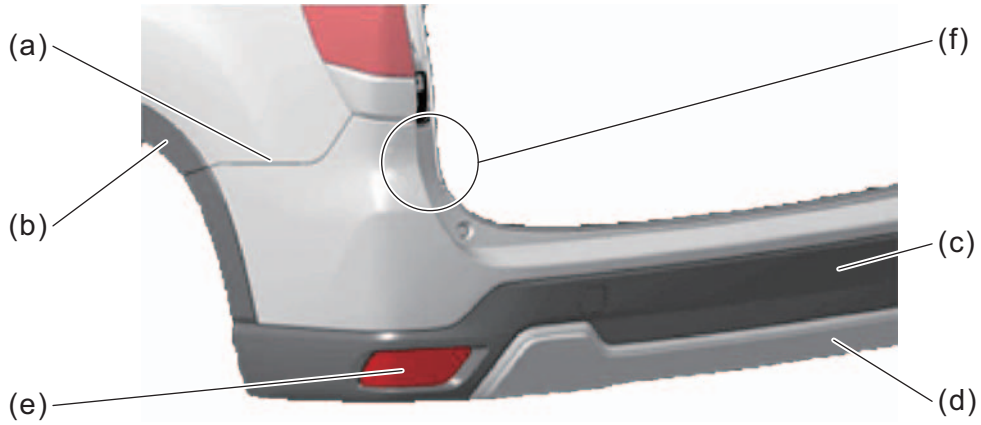
The ruggedness of geometry texture of the blacked-out cladding portion is made clearer to improve quality in appearance.

The under guard is separately painted to express the specification difference between grades.

A low specific gravity material is adopted to reduce the weight. (Comparison with existing model vehicle: -3%)

The rear fog light is integrated into the reflex reflector and installed on the bumper to expand the opening width of the gate.

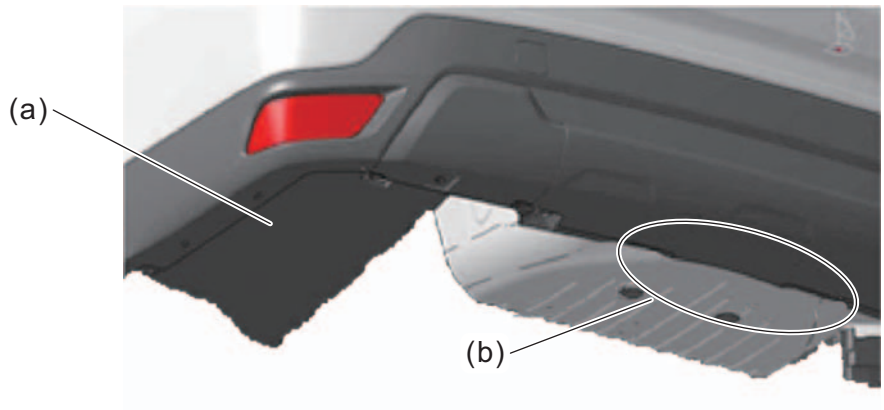
While the rigidity is maintained by expanding the bracket corner, the mounting screw visible on the gate opening section is removed to improve the appearance when the rear gate is opened.



NC-00478

(a) Clearance with vehicle
(b) Side cladding
(c) Blacked-out portion
(d) Under guard
(e) Reflex reflector
(f) Mounting screw removed

The cover side lower is enlarged and the under surface of the rear bumper is extended to improve the airflow under the vehicle body. Thus, the aerodynamic performance is improved.

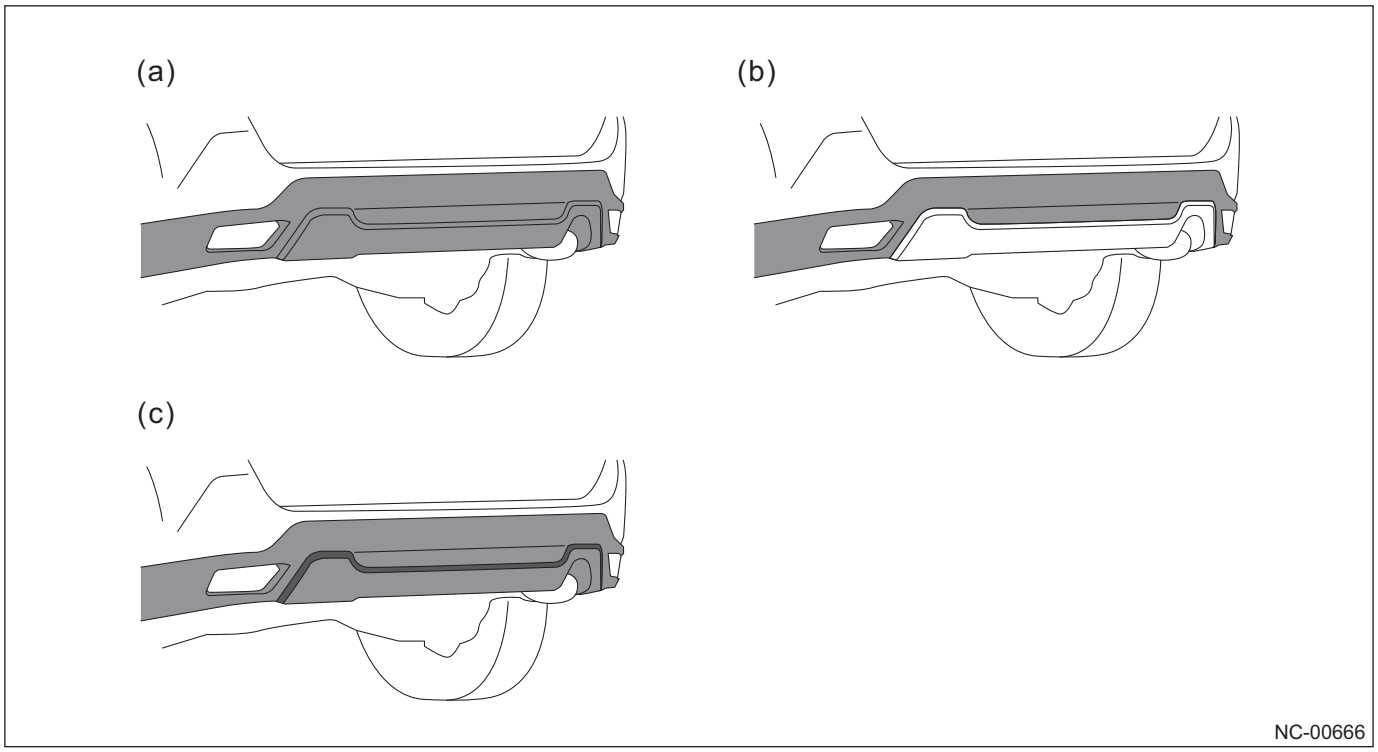


NC-00479

(a) Cover side lower

(b) Under surface of rear bumper

■ Under guard decoration



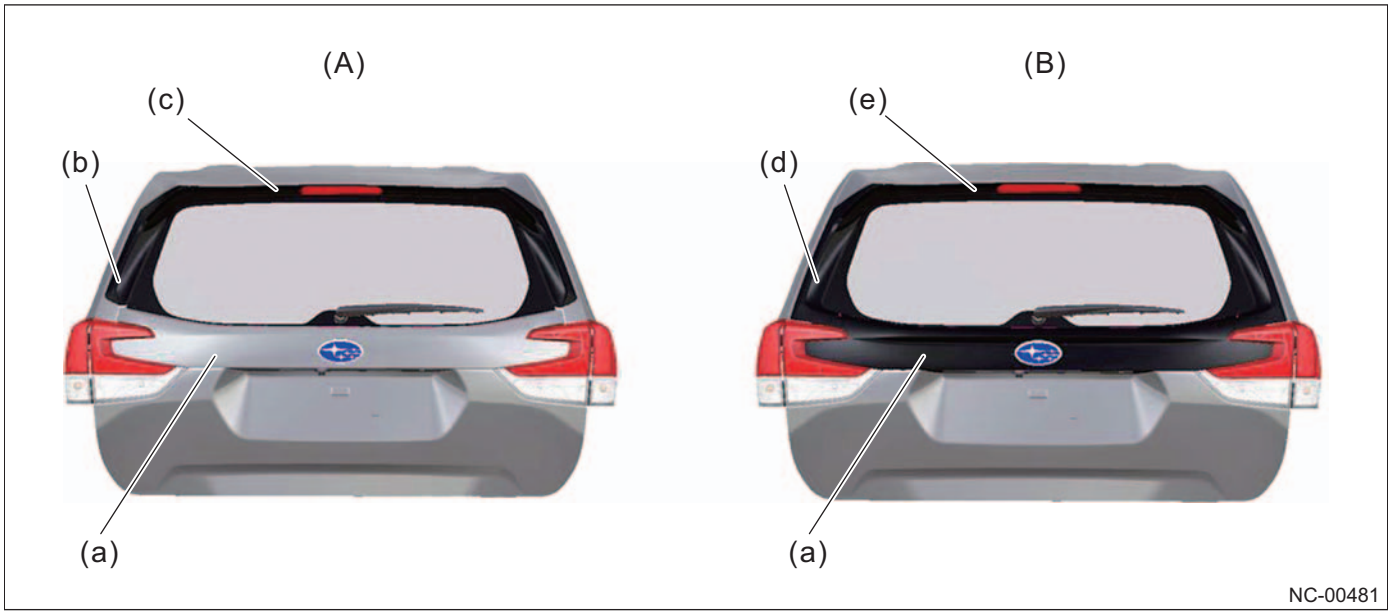
(a) Spin-dyeing black (for some grades)
(b) Silver paint (for some grades)
(c) Spin-dyeing black + orange decoration (for some grades)

Rear gate garnish

By adopting the large plastic rear gate garnish, functionalities such as the built-in smart entry switch, ensuring rearview camera space, etc. and the shape impossible to be formed with sheet metal are both achieved.

The rear gate garnish is separately painted according to the specification to express the specification difference between grades. For upper grade, the high-gloss black paint is applied to maintain continuity with the roof spoiler with the same high-gloss black paint applied. This gives a feeling of oneness around the rear.

- Standard grade: same color as body
- Upper grade: high-gloss black paint



(A) Standard grade

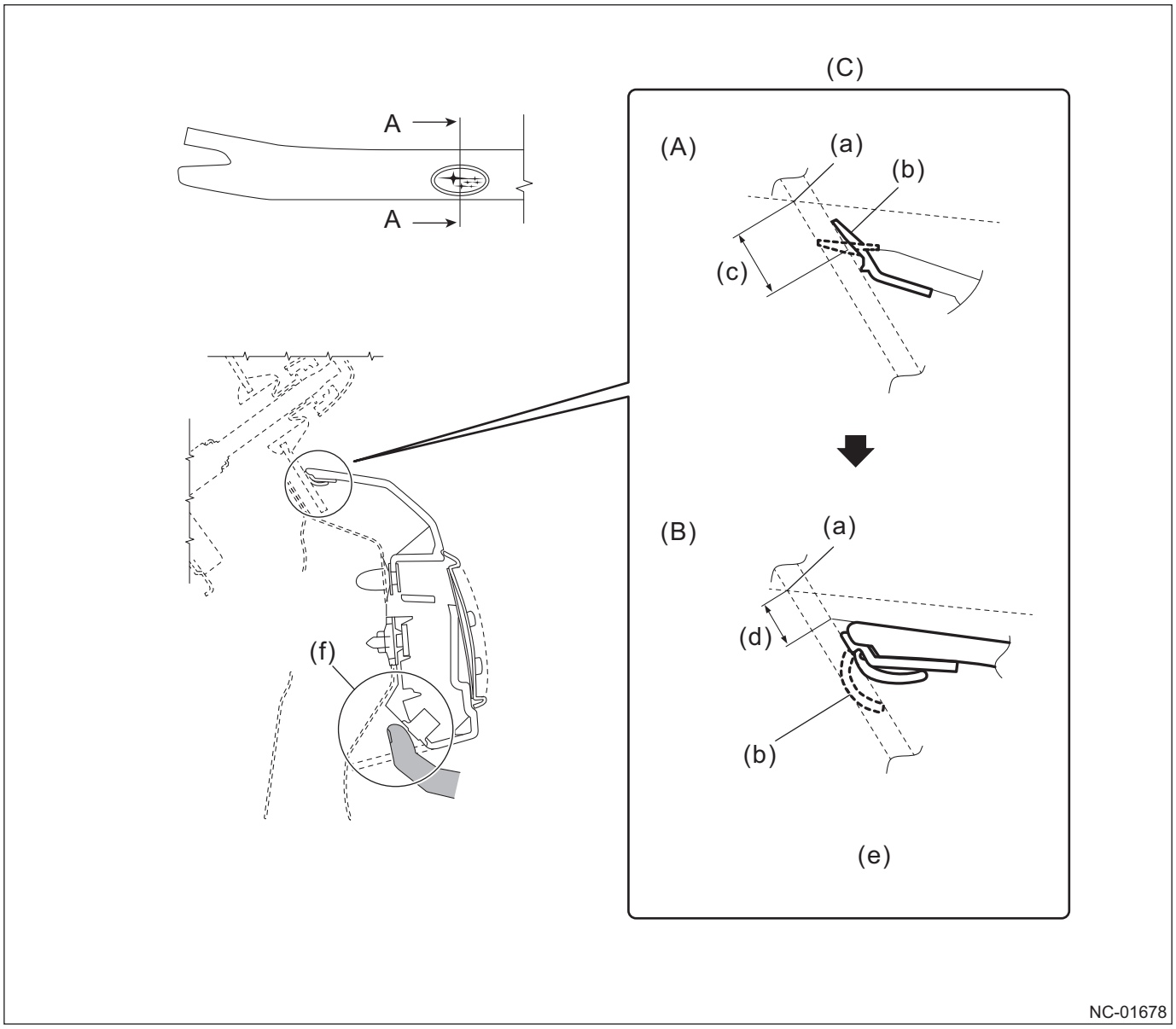
(a) Rear gate garnish
(b) Roof spoiler end plate (spin-dyeing black)
(c) Roof spoiler leading end (spin-dyeing black)

(B) Upper grade

(d) Roof spoiler end plate (high-gloss black paint)
(e) Roof spoiler leading end (high-gloss black paint)

The lip on top of the garnish is placed inside to make it look tidy and improve the appearance. Also, the ceramic line of the rear glass can be lowered to improve rearward visibility.

The handle section is tilted 45° in longitudinal direction so that fingers can be easily hooked. Thus, the operability of gate opening and closing is improved.



(A) Existing model vehicle
(B) New model vehicle
(C) A-A cross section

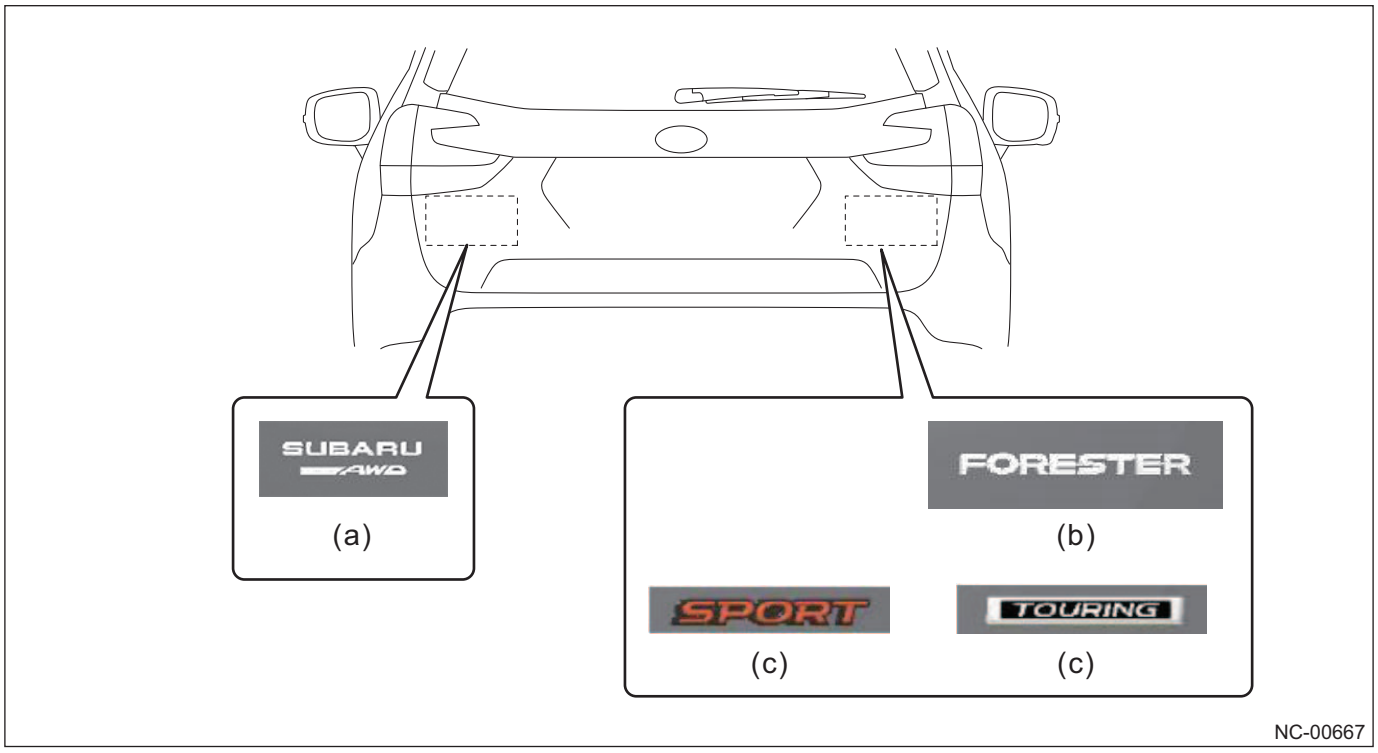
(a) Ceramic line
(b) Lip
(c) 0.34 in (8.7 mm)
(d) 0.24 in (6 mm)
(e) Appearance structure with invisible lip
(f) Angle of handle section enabling fingers to be hooked easily

Letter mark

Letter marks are provided according to destinations and grades.

The special mark is provided for SPORT and the new color orange is adopted. It matches with the roof rail and door garnish to express dynamic feeling. The special mark is also provided for TOURING.

A corrosion-resistant hexavalent chromium coating is adopted for environment protection.



(a) SUBARU AWD mark
(b) Name of vehicle
(c) Grade mark (for some grades)

9.12 Roof Spoiler (For Some Grades)

9.12.1 Overview

The roof spoiler is enlarged by extending by 2 in (55 mm) compared to existing model vehicles with the end plate added.

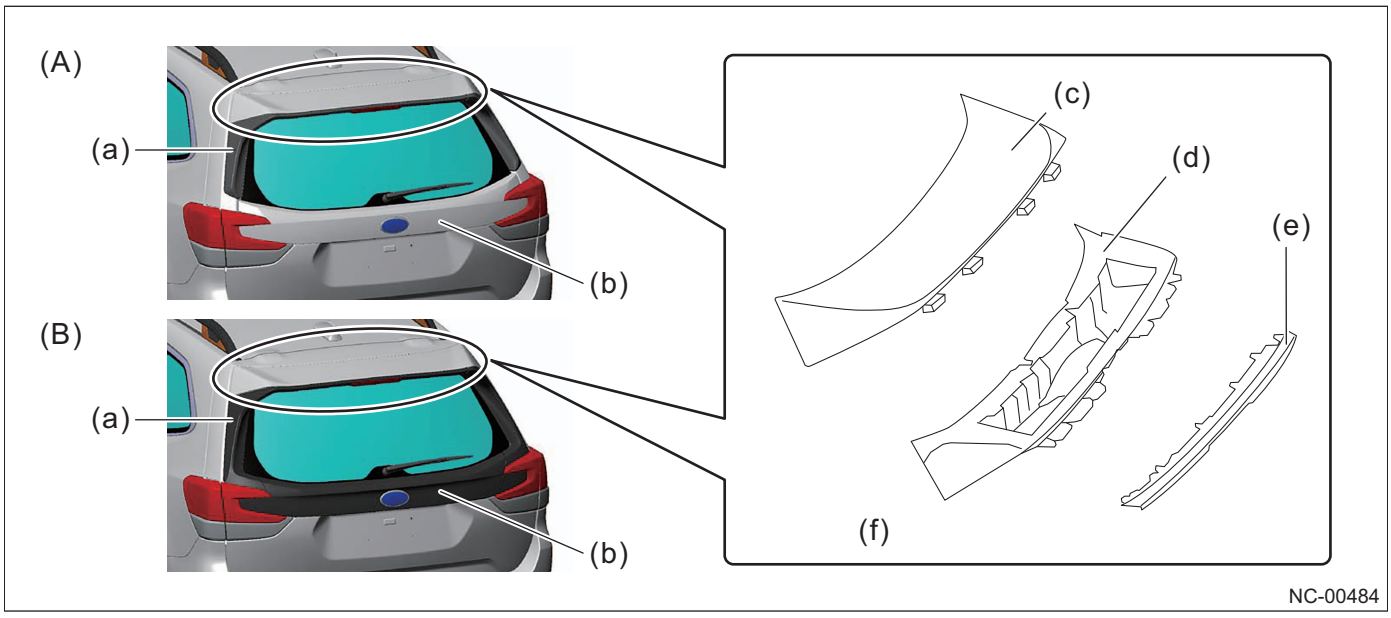
Thus, the spiral airflow generated on the back side of the vehicle is reduced and the air resistance is decreased to contribute to the improvement in fuel efficiency.

(Comparison with existing model vehicle: HWY fuel efficiency 0.4 mile/L (0.7 km/L), (CTY fuel efficiency 0.03 mile/L (0.05 km/L) expected to improve)

The end plate, spoiler lower, and spoiler top are separately painted according to the specification to express the specification difference between grades. For upper grade, the high-gloss black paint is applied to maintain continuity with the rear gate garnish with the same high-gloss black paint applied. This gives a feeling of oneness around the rear.

- Standard grade: spin-dyeing texture
- Upper grade: high-gloss black paint

For the high-mounted stop light, refer to the "Lighting System".



(A) Standard grade
(B) Upper grade

(a) Roof spoiler end plate (different design depending on the grade)
(b) Rear gate garnish (different design depending on the grade)
(c) Spoiler upper
(d) Spoiler lower
(e) Spoiler top
(f) Spoiler center

10 INTERIOR TRIM

CONTENTS

10.1 General Overview

10.1.1 Overview

In this chapter, the following components configuring the body interior are described.

- Air conditioner system
- Airbag system
- Seat and seat belt
- Instrument panel
- Interior trim/interior equipment
- Door lock and security system
- Inner mirror

10.2 Air Conditioner System

10.2.1 Overview

The following performances are mainly improved for the air conditioner system.

- The new air conditioning module integrated with the heater blower module is developed to enable lower noise, improved air conditioning, and an even indoor temperature space.
- The rear A/C duct is adopted for the first time to improve comfort on the rear seat.
- A humidity sensor (for only 2.5 L gasoline vehicle) is mounted for the first time as the existing model vehicle to improve fuel efficiency.
- The air conditioner system is linked with the driver monitoring system, which is adopted for the first time by SUBARU to memorize the air conditioning setting for the driver and realize automatic switching to the user setting.
- Two functions, the air conditioning basic setting selection, and the air conditioning linking with passengers are provided as the air conditioning HMI, which is adopted for the first time by SUBARU.
- Cooperating with telematics, a setting operation for air conditioning when the engine starter is operated by a smartphone is realized.

10.2.2 Specification

HVAC system

Heater system

Item	Specifications	Condition
Heating capacity	5.5 kW (4,730 kcal/h, 18,770 BTU/h) or more	Mode switching dial or switch: FOOT Temperature control dial: HI (MAX HOT) Fan dial: HI (MAX) Temperature difference between warm water and inlet air: 65°C (149°F) Warm water amount: 360 L (95.1 US gal, 79.2 Imp gal)/h
Air flow amount	370 m^3(13,066 cu ft)/h	FOOT mode (FRESH) Temperature control dial: HI (MAX HOT) Fan dial: HI (MAX)

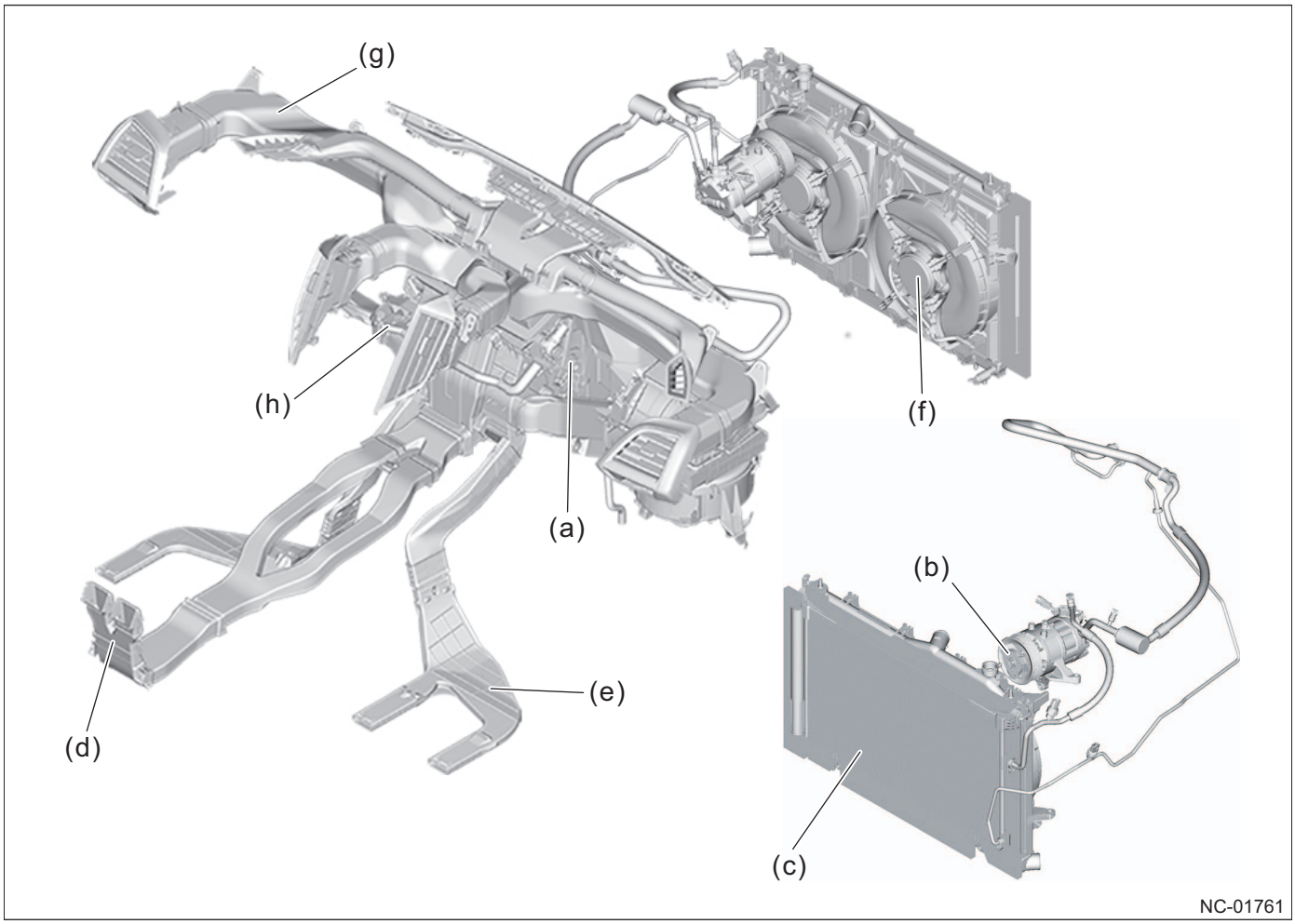
A/C system

Item	Specifications
Type of air conditioner type	Reheat air-mix type
Refrigerant	HFO-1234yf (CH2=CFCF3) [0.410 ± 0.025 kg (0.9 ± 0.06 lb)]
Compressor	Variable capacity type

10.2.3 Component

Component layout drawing

Air conditioning component layout drawing



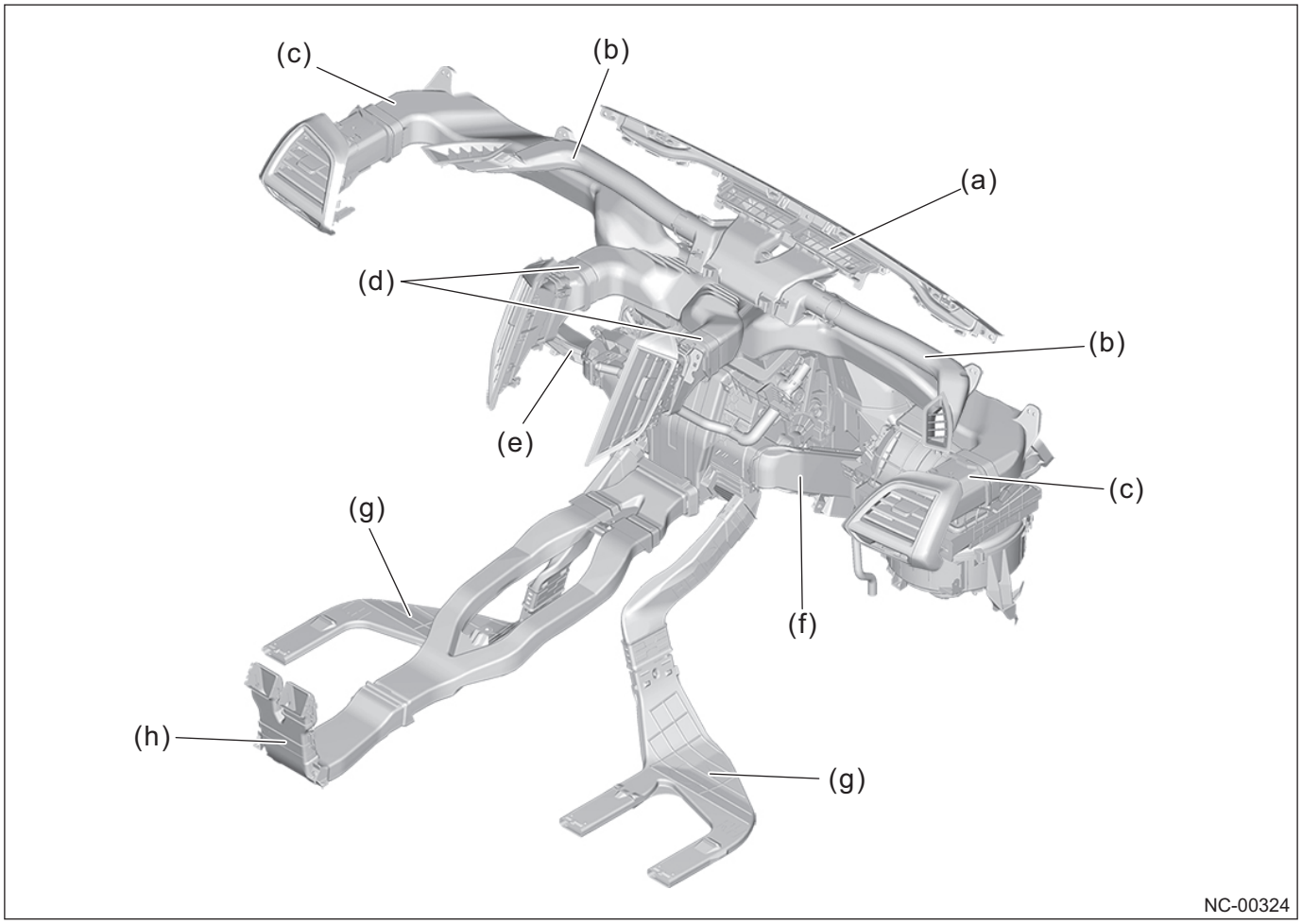
(a) New air conditioning module (HVAC)
(b) Compressor
(c) Condenser
(d) Rear passenger's vent duct
(e) Duct rear heater
(f) Fan motor
(g) Duct for front air conditioning
(h) Humidity sensor

Component details

Duct for air conditioning

■ Front

The enlarged air passage and the changed wind flow control within the air conditioning module contribute to the decrease in disturbed flow and air conditioning noise. Also, the structure is designed so that wind blows directly around the whole feet by the adopted large foot duct.

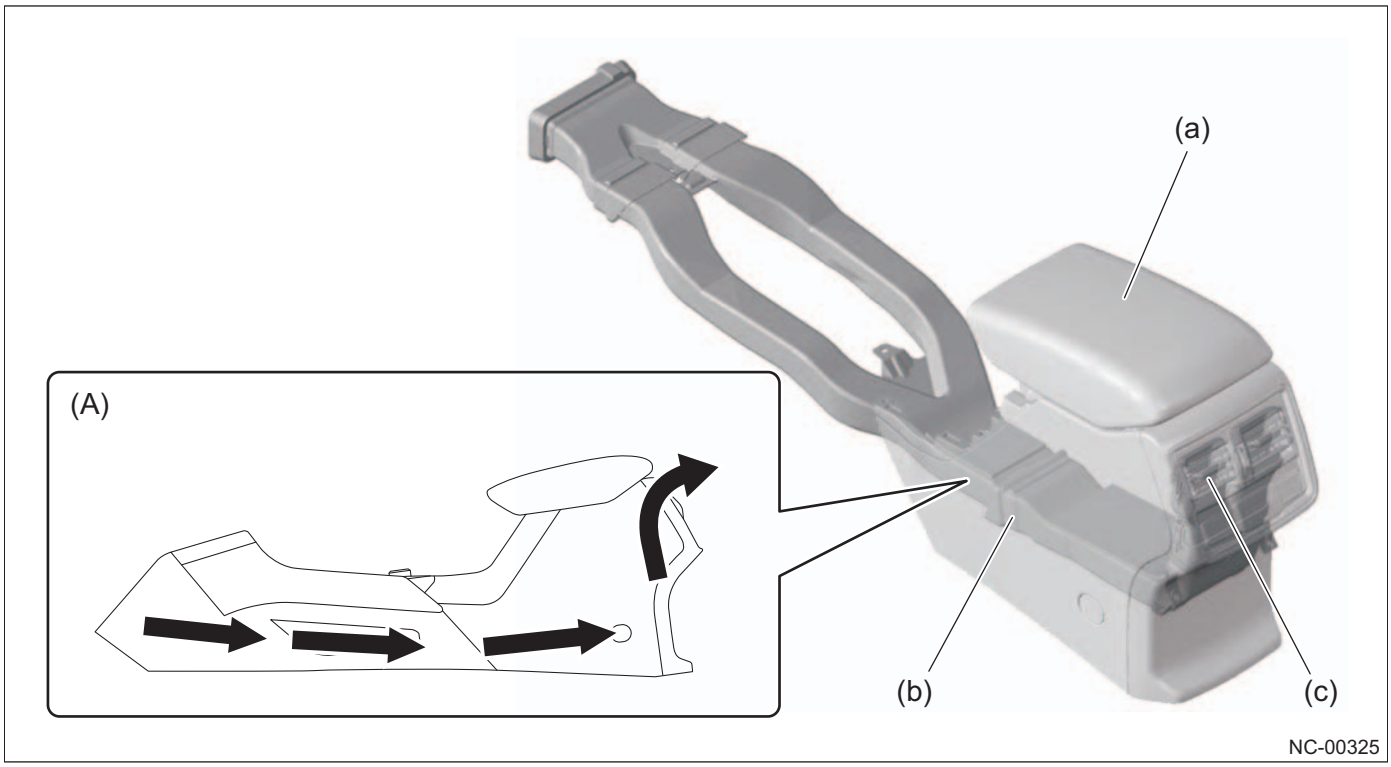


(a) Center defroster
(b) Side defroster
(c) Front side
(d) Front center
(e) Foot duct (driver's seat side)
(f) Foot duct (front passenger's seat side)
(g) Duct rear heater
(h) Rear passenger's duct

■ Rear passenger's vent grille

The rear passenger's air conditioning, which is not equipped on the existing model vehicle, is adopted to provide the further comfortable interior condition for all passengers.

Rear seat's comfort is increased by improving the air conditioning module, adding passage for the rear seat, and controlling the air conditioning wind to flow from the air conditioning module through the center console through a duct and flow out from the outlet grille at the rear of the center console to reach the rear seat passengers.



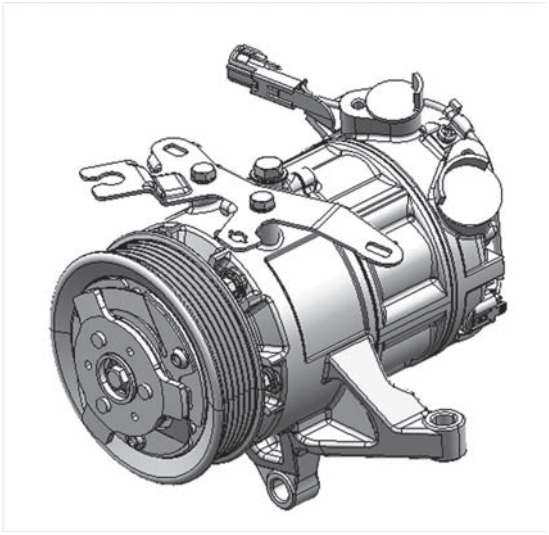
(A) Air conditioning route

(a) Center console
(b) Vent duct
(c) Rear passenger's vent grille (outlet)

Compressor

To improve actual fuel consumption, the variable capacity compressor is equipped for the first time for Forester.

This improves fuel efficiency when the air conditioner is ON by 3 % compared to the existing model vehicle.

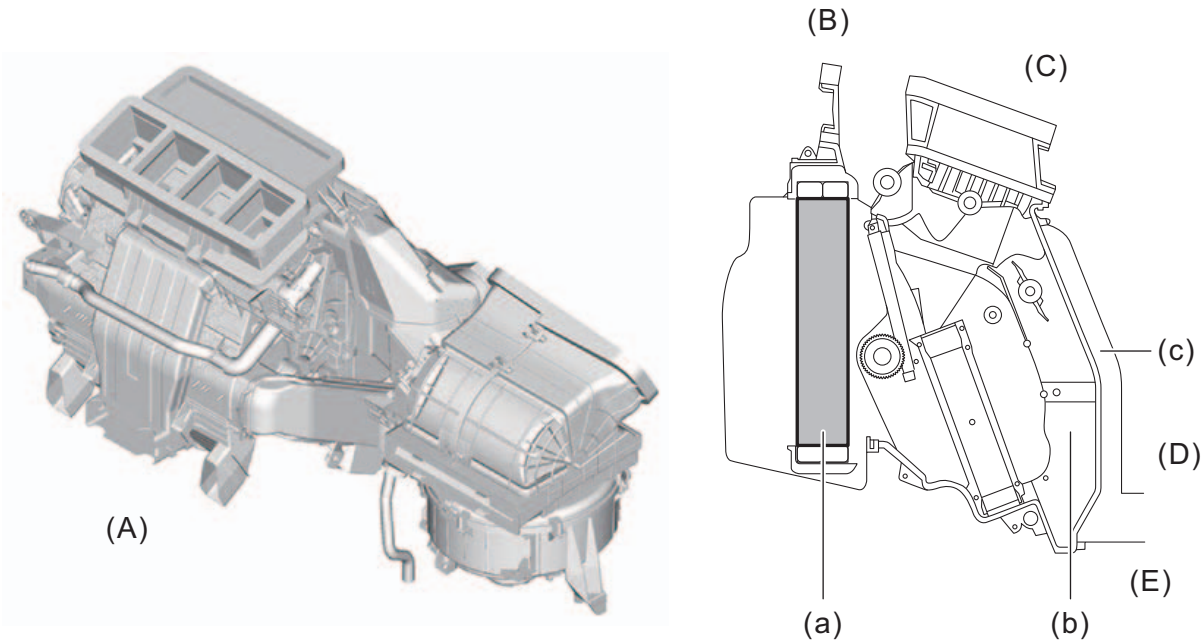


NC-01980

New air conditioning module (HVAC)

Air passage is enlarged and the wind flow control is changed within the module to lower noise and improve air conditioning performance. Large evaporator is also adopted to improve cooling performance.

In order to ensure even temperature, air volume of the blower motor is increased and the motor is downsized to reduce electricity consumption and weight of HVAC. In addition, a large foot duct is adopted to realize even flow of warm air around the feet.

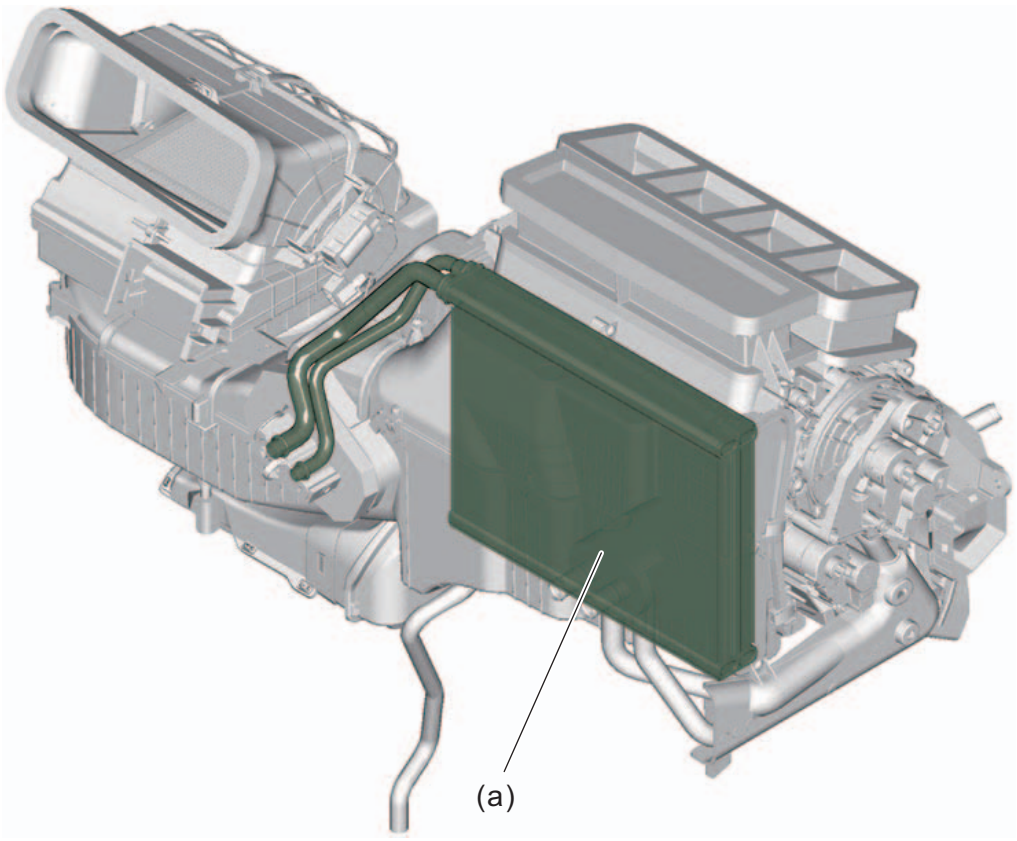


(A) New air conditioning module (HVAC)
(B) DEF
(C) VENT
(D) REAR VENT
(E) FOOT

(a) Large evaporator
(b) Supports large foot duct
(c) Supports rear A/C duct

■ Evaporator

In order to ensure the cooling performance for the new air conditioning module, the large evaporator is installed to improve the heat exchange performance.



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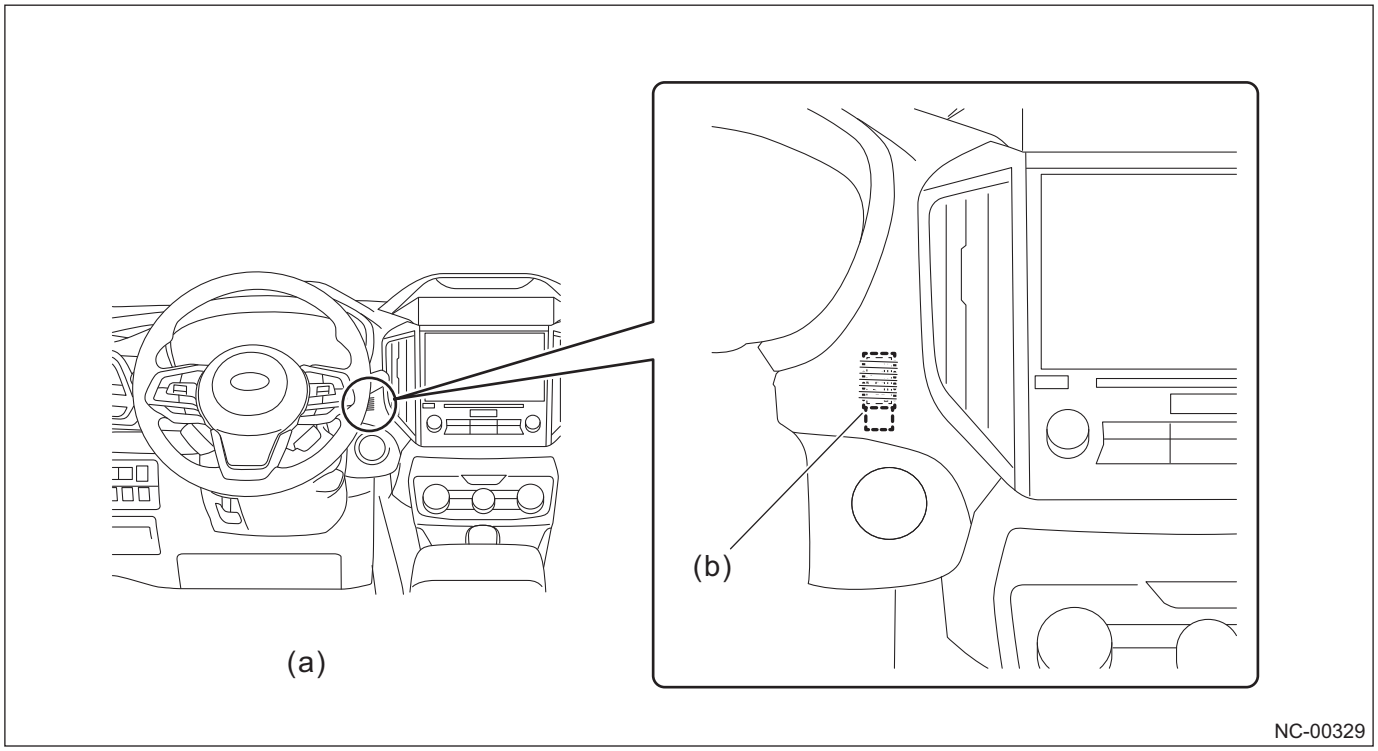
(a) Evaporator

Humidity sensor

A humidity sensor is adopted for the first time for a gasoline vehicle to improve comfort and fuel efficiency.

The air conditioning control also utilizes humidity to provide the air conditioning more appropriate to the environment and reduce power consumption by efficient air conditioning operation.



(a) Sensor position

(b) Integrated internal air sensor

A/C control panel (depending on grades)

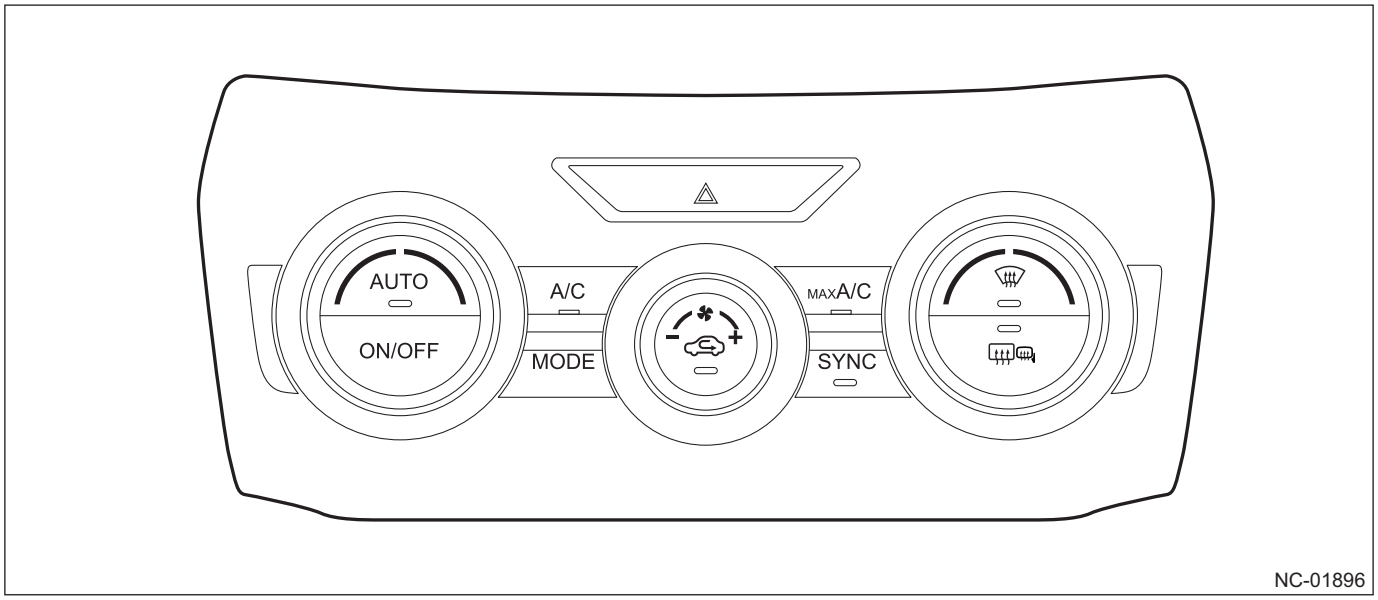
Following the design of the existing models, a triple dial type control panel with superior design, functionality, and operability is adopted. A white night time illumination is also adopted around the dial to improve quality feeling and visibility.

Comfort, convenience, and usability are improved by continuing "Integrated hazard switch", "MAX A/C", "Multistage outlet mode", "Air conditioner screen popup of multi-function display (MFD)", "Sound recognition air conditioning", and "Air conditioning ON", implemented in the existing models.

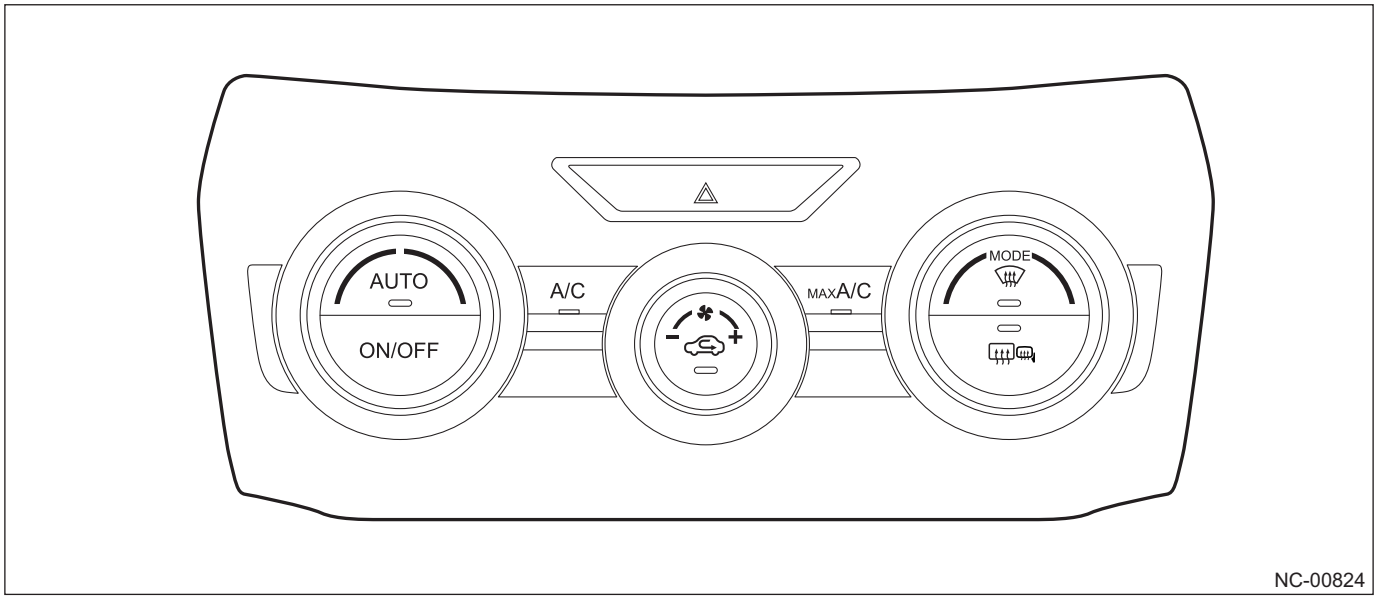
Control panel specifications

Panel color	High-gloss black		Matte black
Panel type	Type A Full automatic air conditioner (triple dial, left/right independent type, model with multi-function display)	Type B Full automatic air conditioner (triple dial, left/right linked type, model with multi-function display)	Type C Full automatic air conditioner (triple dial, left/right linked type, model with information meter)

Type A (left/right independent type)



Type B (left/right linked type)



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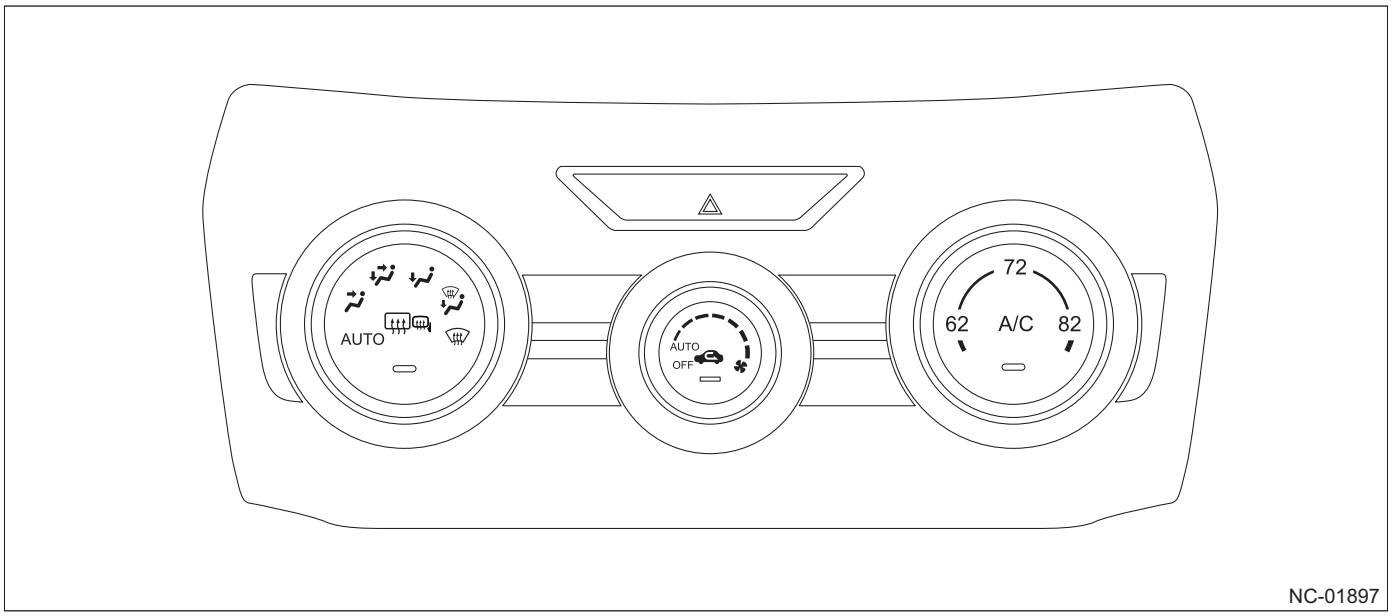
Type C (left/right linked)



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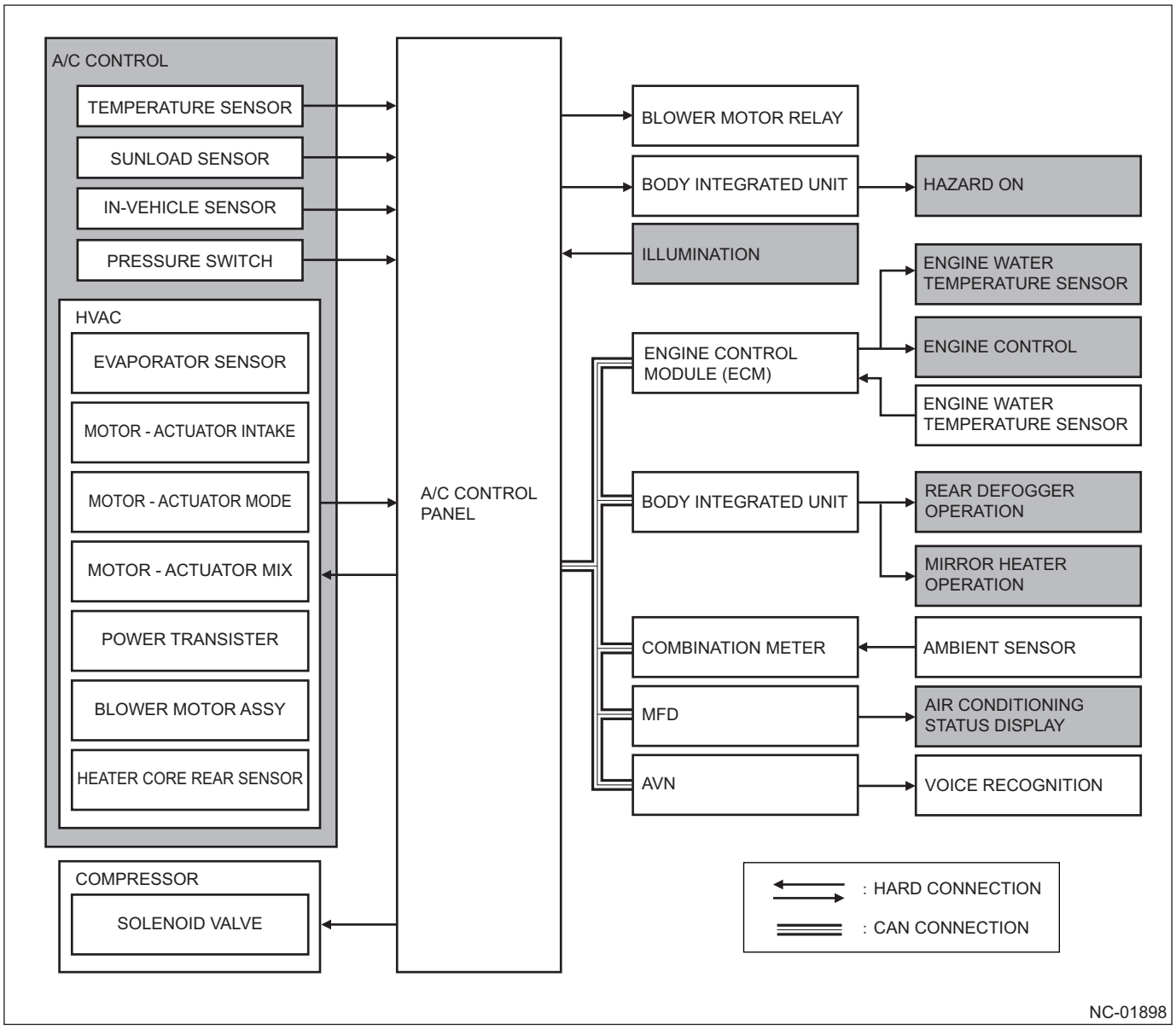
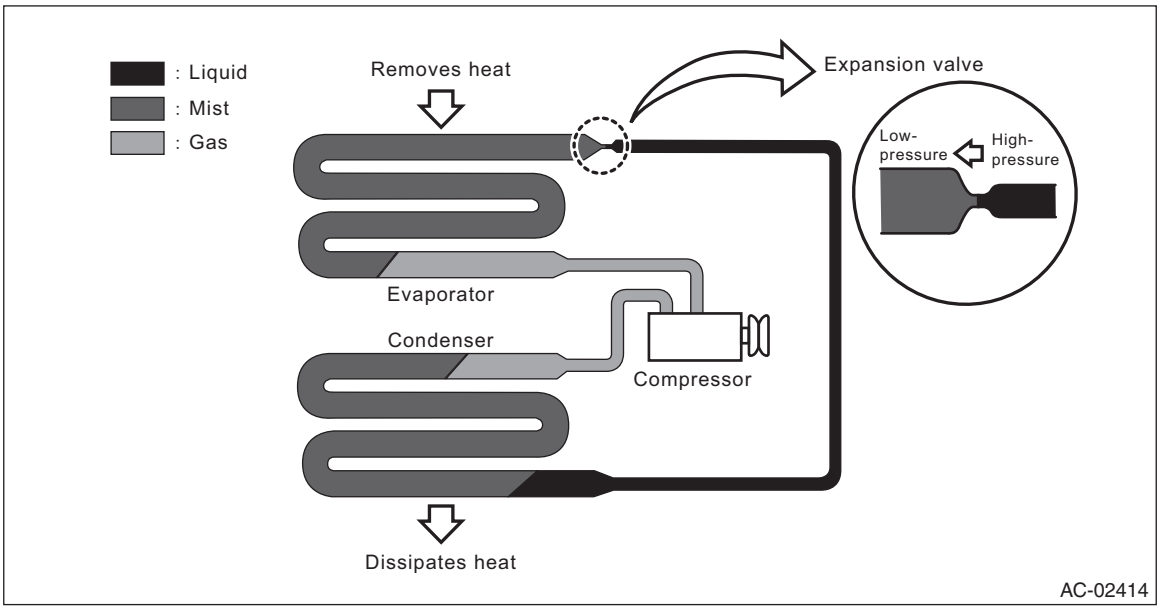
10.2.4 Construction and Operation

System block diagram



Refrigeration cycle

In the refrigeration cycle, refrigerant (gas) is sealed in a pipe to circulate the gas into the cycle that is composed of components such as a compressor, a condenser, and an evaporator. In the process where the refrigerant circulates into the cycle, changes (vaporization to liquid to vaporization) are repeated to perform cooling by absorbing the heat in the passenger room or releasing the heat outside the passenger room.

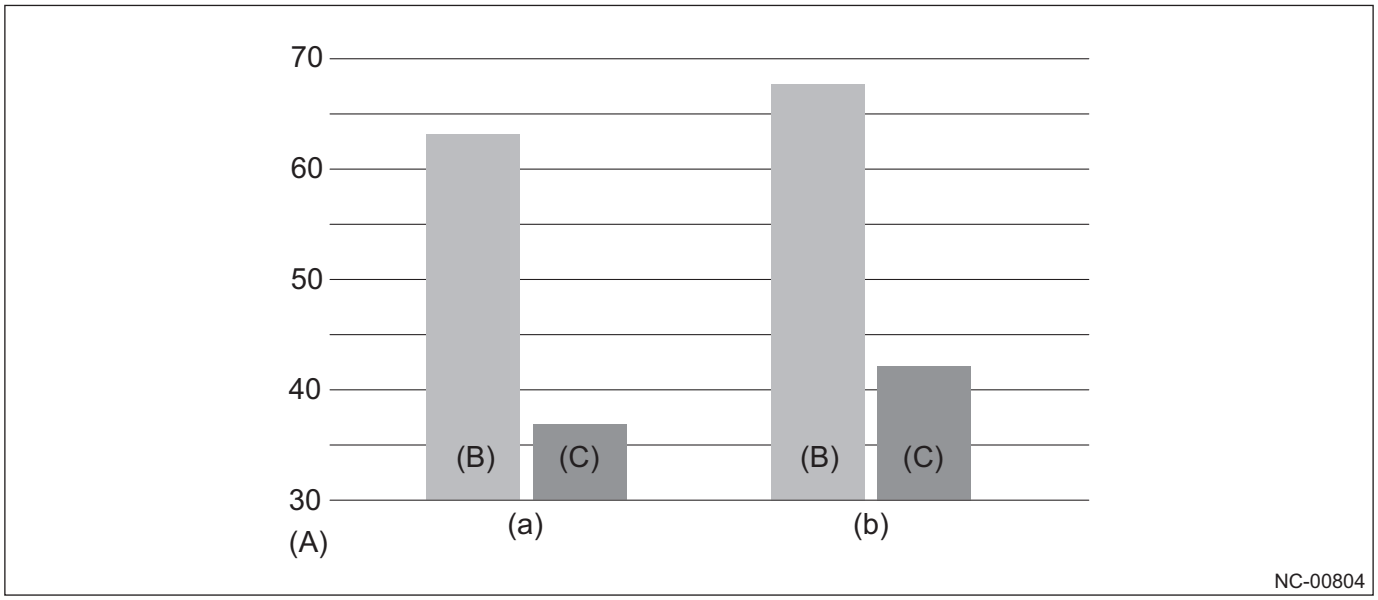


Main part name	Operations
Compressor	The compressor takes in low temperature, low pressure refrigerant gas vaporized by removing the heat in the evaporator, and then compresses the gas to make it high temperature, high pressure gas to feed it to the condenser.
Condenser	The condenser cools the refrigerant gas with high temperature and high pressure fed from the compressor and then condenses and liquefies the gas.
Expansion valve	• The expansion valve injects the liquid refrigerant with high temperature and high pressure from a small hole and inflates it rapidly. This causes the liquid refrigerant to become low temperature and low pressure misty refrigerant. • The expansion valve adjusts the refrigerant amount depending on refrigerant evaporation status in the evaporator.
Evaporator	When the misty refrigerant with lowered temperature and lowered pressure by the expansion valve is evaporated in large amount in the evaporator, the evaporator becomes a low temperature state. Cold air flows out when the wind passes through the low temperature evaporator.

Silent air conditioner (low noise)

The new air conditioning module developed based on the module used in the existing models has enlarged internal air passage and changes the flow to reduce disturbance of the flow and air conditioning noise. Also, noise is significantly reduced compared to the existing models. Same quietness as the other signature models is secured.

Noise comparison (during cooling)

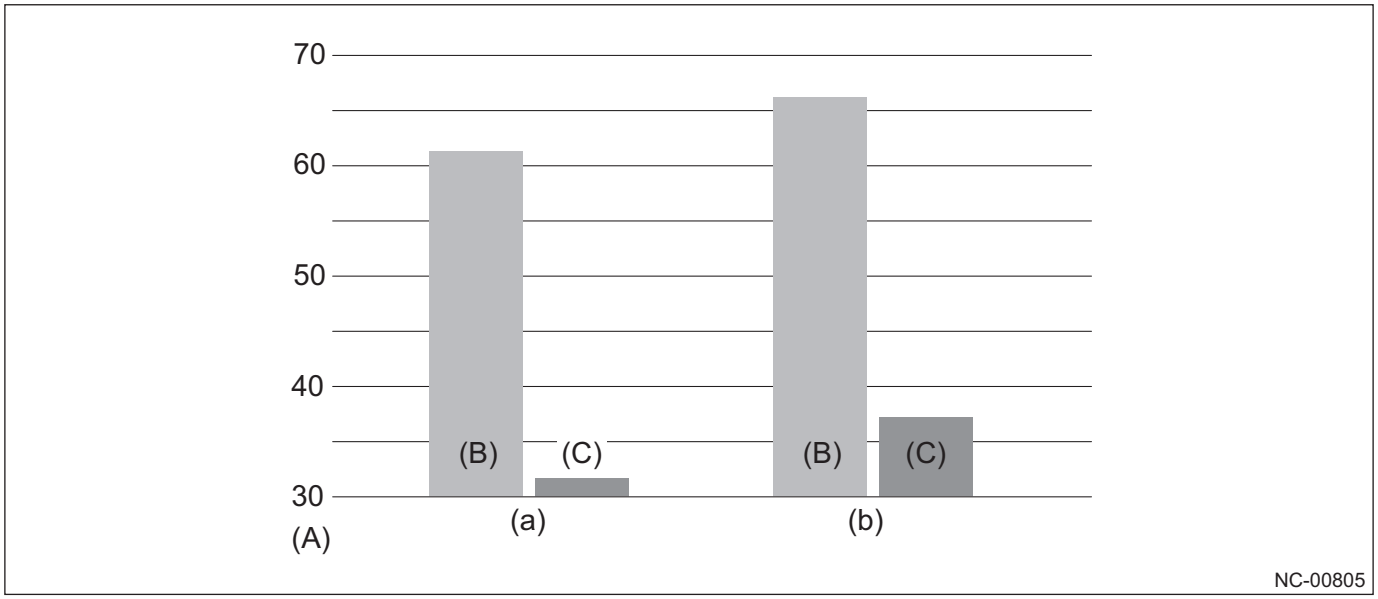


Mode (internal air circulation)	VENT
Outer air	40°C
Insolation	1 kW

(A) Noise (dB)
(B) MAX air volume
(C) MIN air volume

(a) New model vehicle
(b) Existing model vehicle

Noise comparison (during warming)



Mode (outer air introduction)	HEAT
Outer air	-10°C
Insolation	None

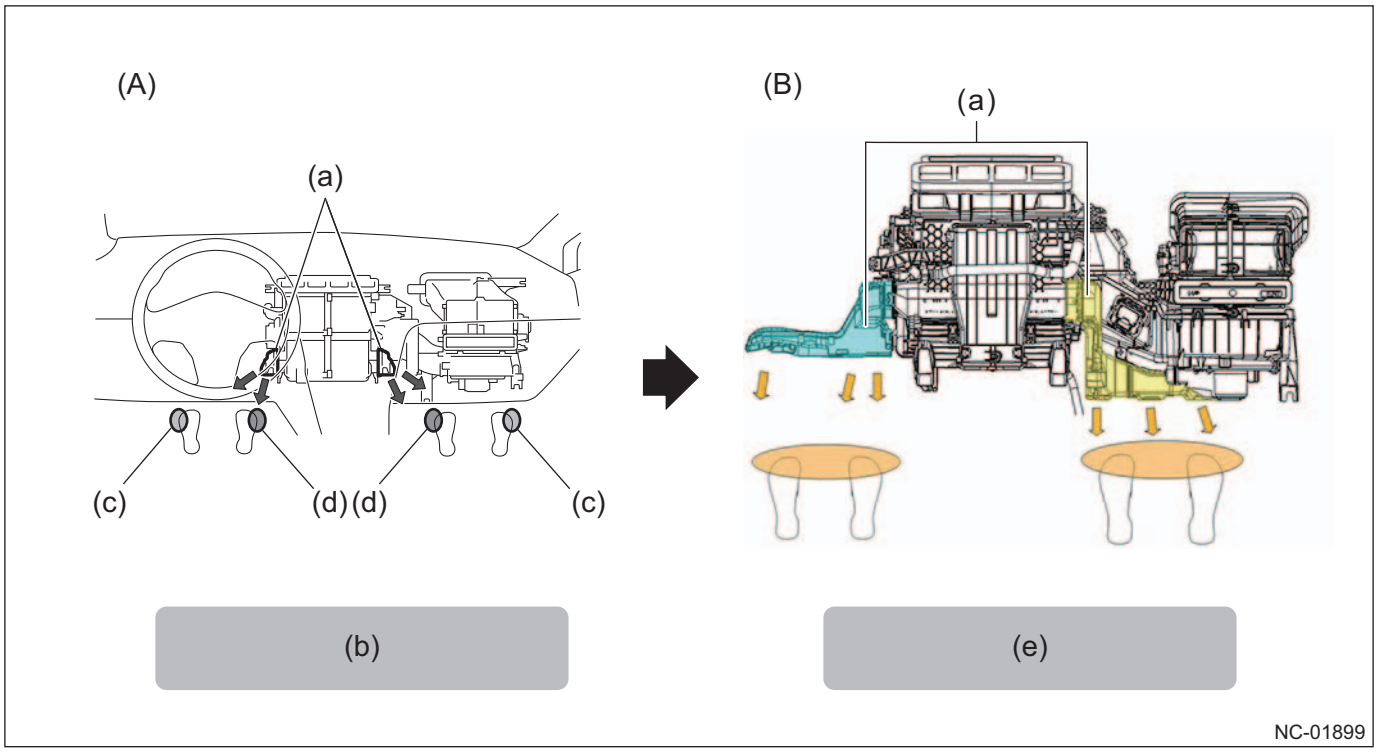
(A) Noise (dB)
(B) MAX air volume
(C) MIN air volume

(a) New model vehicle
(b) Existing model vehicle

Realization for even temperature space

■ Large foot duct

In order to realize an even indoor temperature, large foot duct is adopted for the feet temperature. A design where wind blows directly around the whole feet by wind blowing on the feet of both the driver and front passenger's seats during both cooling and warming is adopted to realize comfort around the feet.



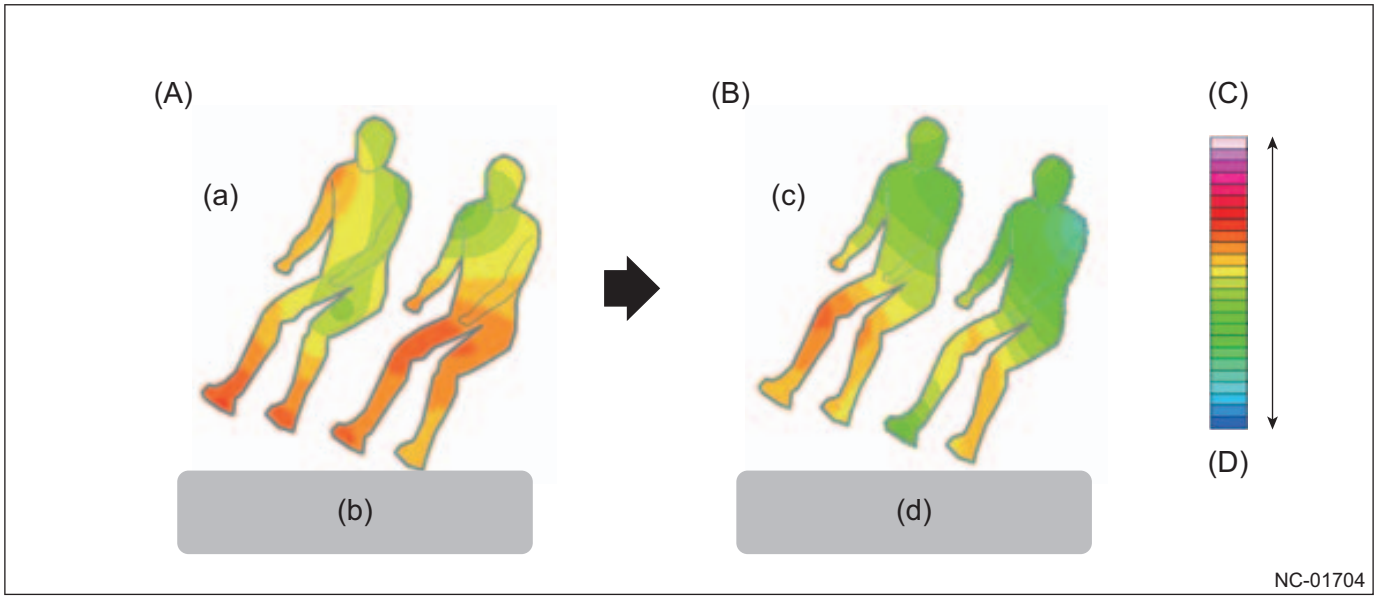
(A) Existing model vehicle

(a) Foot duct
(b) Since the outlet was located on a single side (inside vehicle), temperature felt by the passengers were uneven.
(c) Hot during cooling/Cold during warming

(B) New model vehicle

(d) Cool during cooling/Warm during warming
(e) The outlets are located near the feet to feed an even wind flow around the feet.

Cooling performance comparison



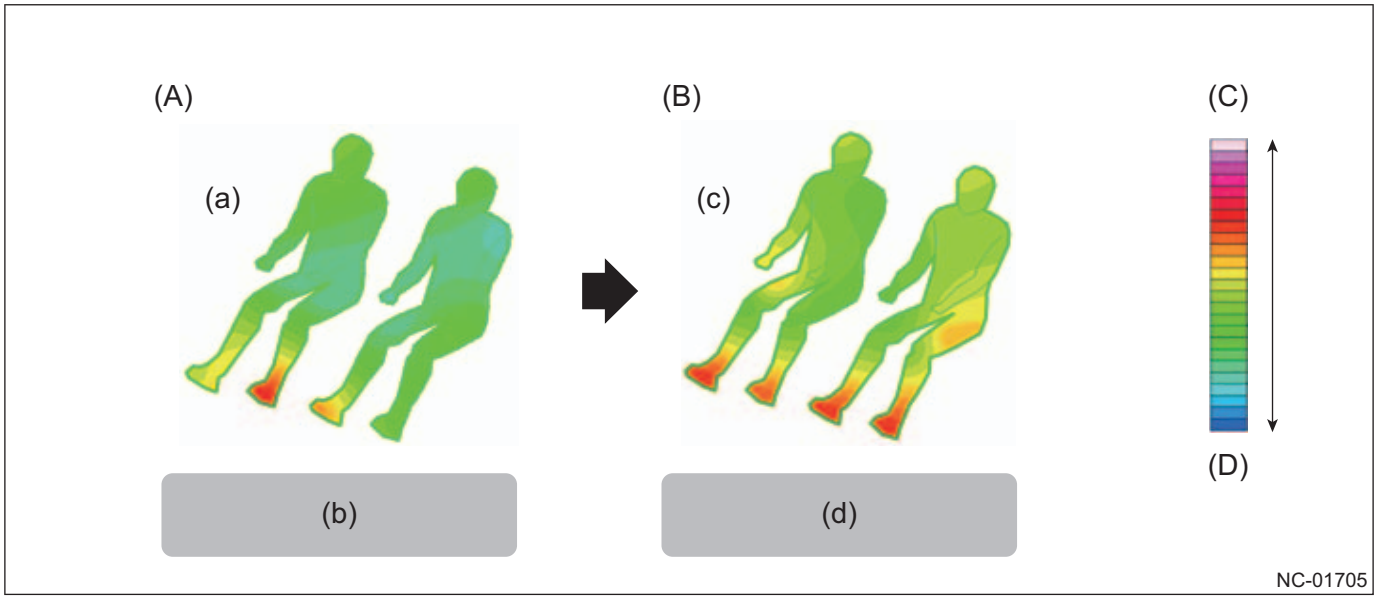
(A) Existing model vehicle
(B) New model vehicle

(a) VENT mode
(b) Passengers' upper body feels cool but hot around the feet.
(c) VENT II mode

(C) High temperature
(D) Low temperature

(d) Passengers' entire body feels cool with even temperature distribution.

Warming performance comparison



(A) Existing model vehicle
(B) New model vehicle
(C) High temperature
(D) Low temperature

(a) HEAT mode
(b) Foot on the door side is warmed weakly, and the whole body is also warmed weakly.
(c) HEAT mode
(d) Both feet are evenly warmed, and entire body is also warm.

■ Multistage outlet mode

The multistage outlet mode is adopted to create a comfortable temperature space.

In particular, "VENT II" mode that sends a small amount of cool air around the feet during cooling is added to solve the moist feeling around the feet when hot. In addition to "VENT II", an intermediate mode is added during the AUTO control to enable optimal wind flow and provide more comfortable temperature space compared to existing models.

Cold hand can be warmed with warm wind from the vent while warming the feet when "B/L" and "HEAT" modes are operated during initial warming period.

Outlet mode control list

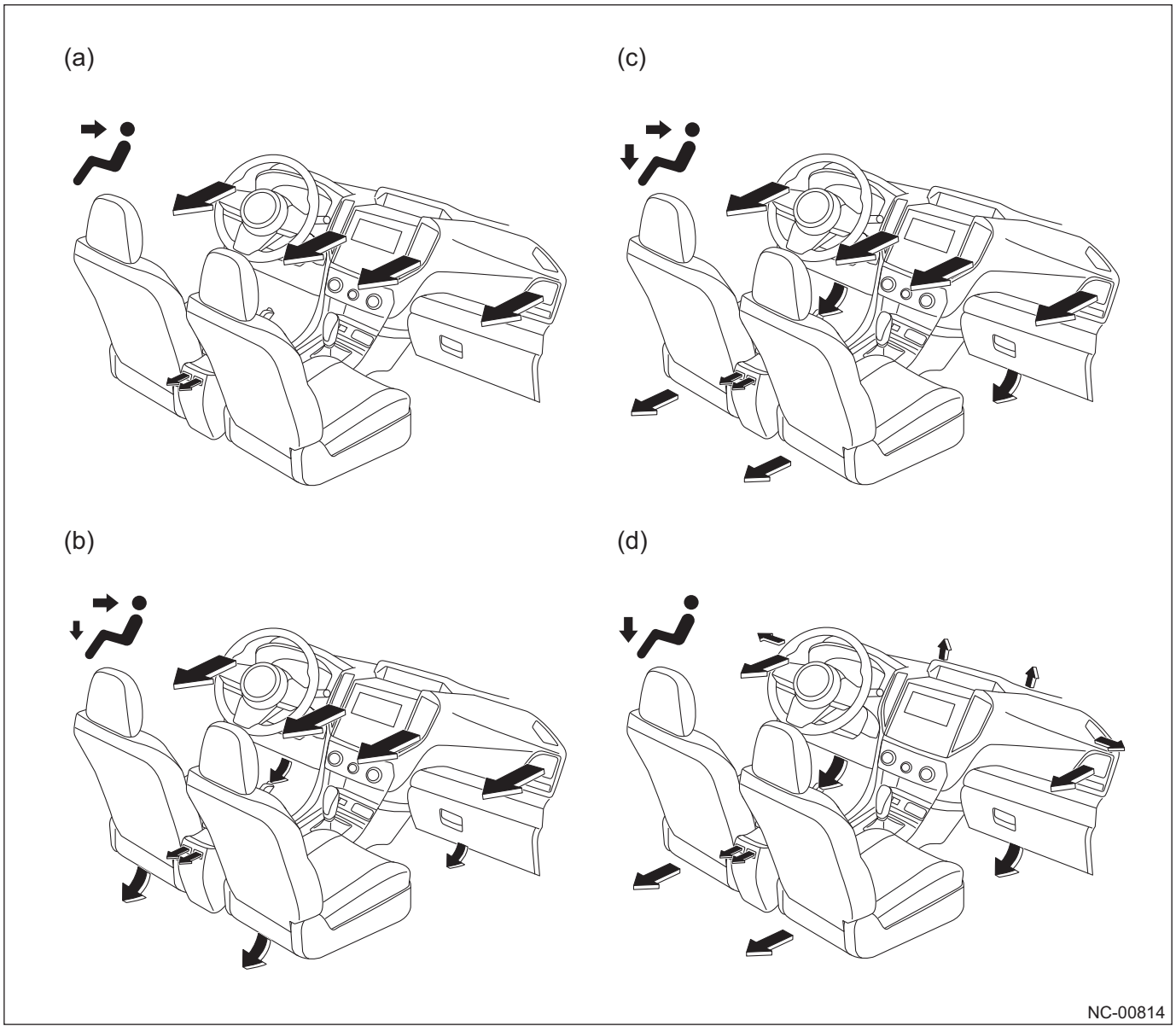
[Symbol] ✓: Selectable, ★ : During AUTO control, -: Not selectable

Specifications	Car line	Mode							
		VENT 	VENT II 	B/L 	Inter-mediate mode ●	HEAT 	Inter-mediate mode ●	D/H 	DEF 
Full automatic air conditioner (Type A/B)	New model vehicle	✓	✓	✓	★	✓	★	✓	✓
	Existing model vehicle	✓	-	✓	-	✓	-	✓	✓
Full automatic air conditioner (Type C)	New model vehicle	✓	★	✓	★	✓	★	✓	✓
	Existing model vehicle	✓	-	✓	-	✓	-	✓	✓

■ Mode display and air flow outlet

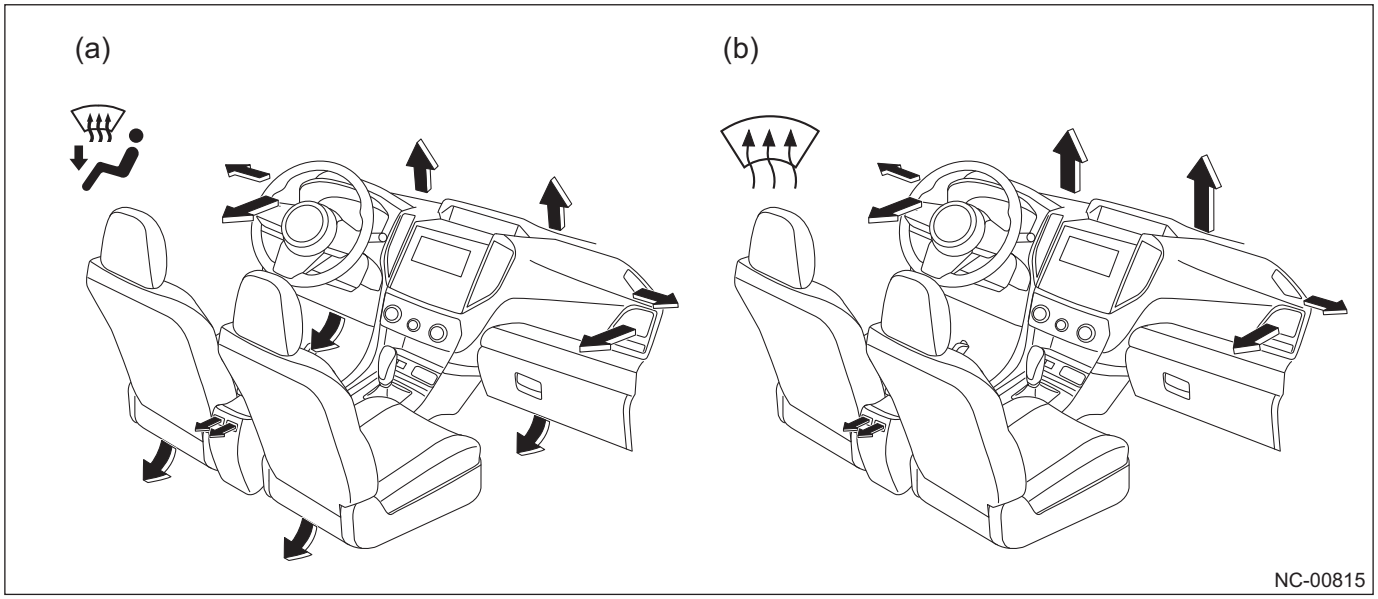
Each mode display and air flow outlet are shown in this view.

Driver/front passenger/rear seats



(a) VENT
(b) VENT 2
(c) B/L
(d) HEAT

Defroster and heater



(a) D/H

(b) DEF

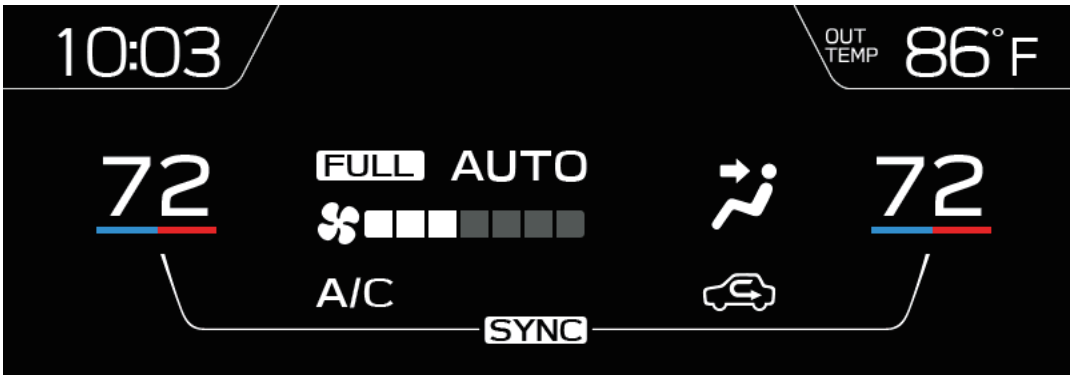
■ MAX A/C function (only A/B type)

MAX A/C function that is helpful when quickly lowering the temperature is needed during summer, etc. is adopted.

When this function is activated, cooling is tuned on and the setting is automatically switched to temperature LO, air volume MAX, VENT mode, or internal air circulation to improve usability.

Air conditioner screen popup of multi-function display (MFD) (only A/B type)

Popup of the air conditioner screen appears on multi-function display (MFD) when the air conditioner operates to improve readability and usability.



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Sound recognition air conditioning (only A/B type)

The system is linked with Gen.3.1 head unit to enable operation of the air conditioner by following voice command.

Air conditioner specifications	Purpose	Voice command
Full automatic air conditioner (left/right independent type)	Set temperatures for both the driver and front passenger's seats.	Set both temperatures to [*1]. Set both temperatures to [*1] degrees. Set temperature to [*1]. Set temperature to [*1] degrees. Temperatures to [*1]. Temperatures to [*1] degrees.
	Set temperature for the driver's seat.	Set driver temperature to [*1]. Set driver temperature to [*1] degrees. Driver temperature to [*1]. Driver temperature to [*1] degrees.
	Set temperature for the front passenger's seat.	Set passenger temperature to [*1]. Set passenger temperature to [*1] degrees. Passenger temperature to [*1]. Passenger temperature to [*1] degrees.
Full automatic air conditioner (left and right independent type/ left and right linked type)	Turn on the automatic air conditioner.	Auto AC On Auto AC mode On
	Change the fan speed.	Set fan speed to [*2] Set fan speed [*2]. Fan speed to [*2]. Fan speed [*2].

*1: Temperature value to be set (*temperature range varies depending on destination.) or Low/High

*2: Fan speed value (one to seven) or Low/High

Air conditioning HMI (only A/B type)

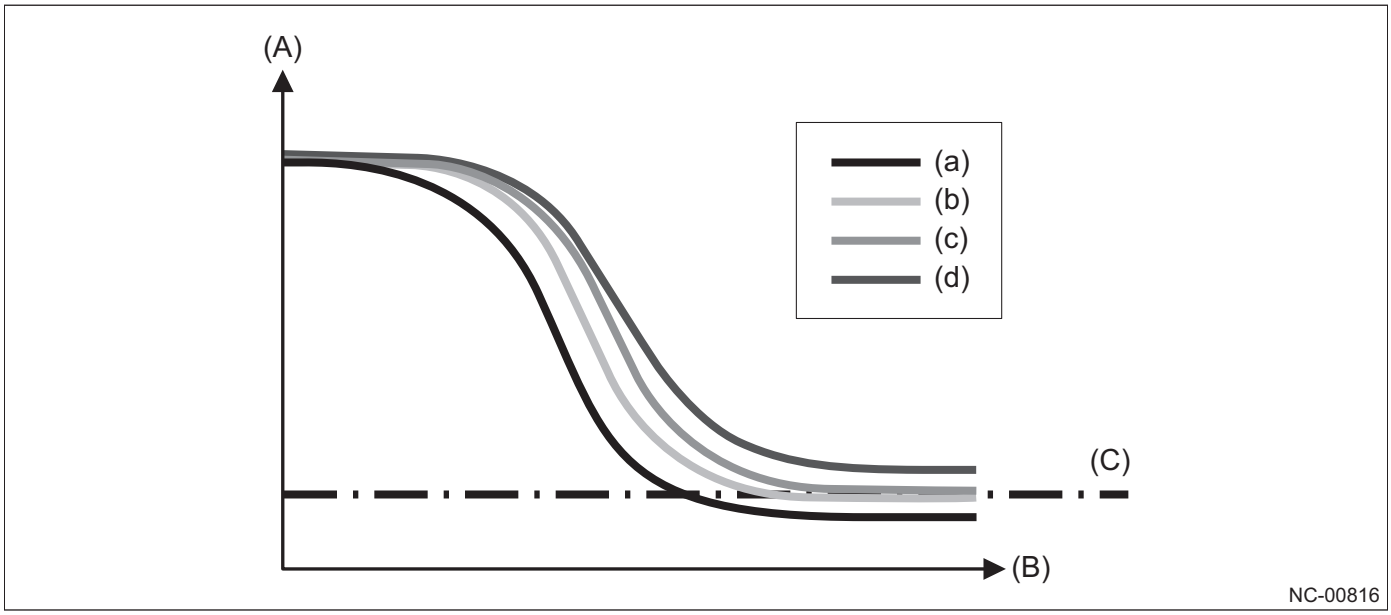
Air conditioning HMI which is adopted for the first time by SUBARU is installed with functions of air conditioning basic setting selection and settings linked to passengers.

Air conditioning basic setting selection

Normal/Mild/Powerful/Eco operations are provided as the basic operation of the air conditioning to enable choosing the strength of air conditioning depending on preference. This eliminates the needs to adjust the temperature setting and air volume as existing model when setting the preferred air conditioning operation such as "you prefer low air volume", and can provide the preferred air conditioning operation with the selection only from the four air conditioning basic settings, to improve comfort and convenience.

Settings can be switched with the screen operation of the multi-function display (MFD) to provide the air conditioning that is more suitable to preference.

Operation of each air conditioning basic setting for cooling



(A) Room temperature
(B) Time
(C) Setting temperature

(a) Powerful
(b) Normal
(c) Mild
(d) Eco

Operation overview

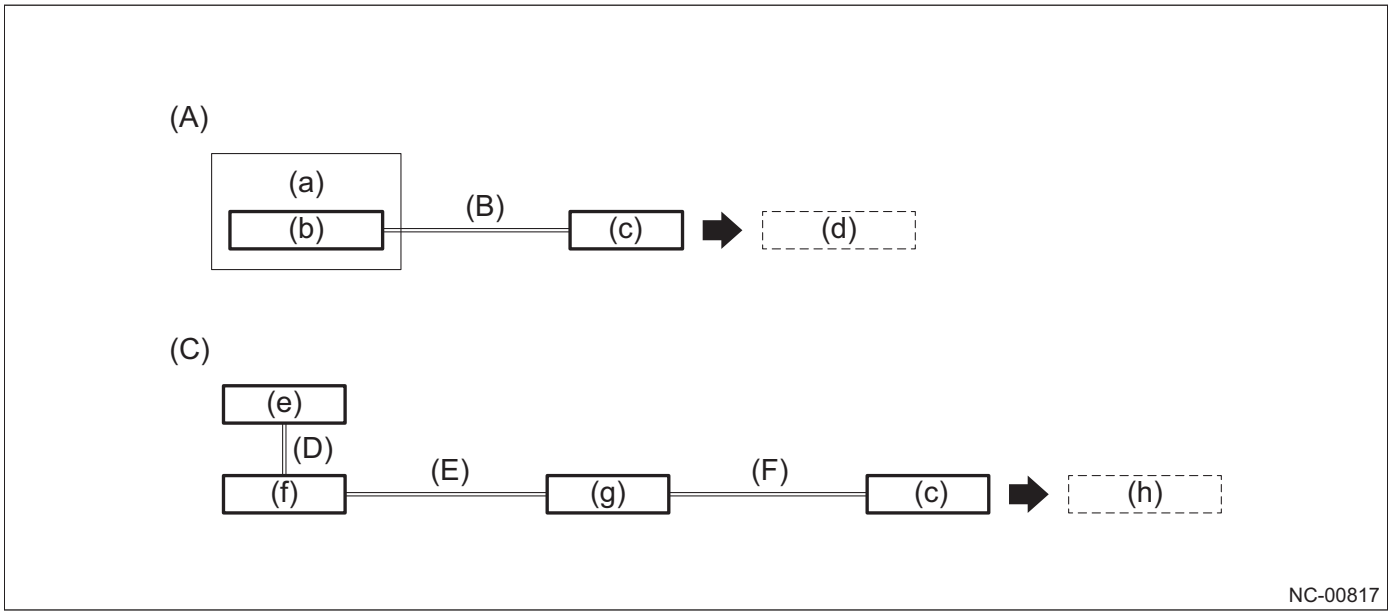
Type of air conditioning basic setting	Operation
Powerful	Air conditioning mode that surely gives a feeling of the air conditioner operation Strong cooling/strong warming Auto Start-Stop is shortened to prioritize air conditioning.
Normal	Normal air conditioning mode
Mild	Air conditioning mode gentle to passengers Air volume is reduced to weaken the feeling of change.
Eco	Eco air conditioning mode with all air conditioning operations weakened Auto Start-Stop is made longer to prioritize fuel efficiency.

Air conditioning linked with passengers

With the addition of rear A/C, a system is adopted that adjusts air conditioning depending on the passengers on the driver's seat, front passenger's seat, and rear seat. This allows the air conditioning operation to automatically switch depending on the passenger's presence in the front passenger's seat and rear seat to improve comfort and usability.

- The operation can also be turned on or off with MFD.
- The system uses the occupant detection sensor to determine the passenger's presence in the front passenger's seat.
- The system determines the passenger's presence in the rear seat with the open and close record of the rear door.
- The passenger recognition is reset in 30 minutes after the ignition switch is turned off.

Operation of air conditioning linked with passengers



(A) Air conditioning linked with the front passenger's seat
(B) Passenger's presence information
(C) Air conditioning linked with the rear seat

(a) Front passenger's seat
(b) Occupant detection sensor
(c) Air conditioner
(d) Air conditioning linked with the passenger on the front passenger's seat

(D) Door open and close
(E) Door open and close information
(F) Door open and close record information

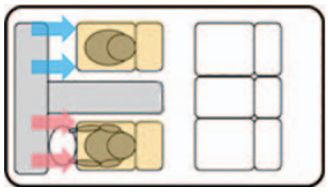
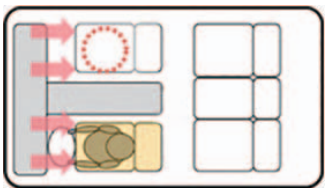
(e) Rear door
(f) BIU
(g) Meter
(h) Air conditioning linked with the passengers on the rear seat

■ Air conditioning linked with the passenger on the front passenger's seat* (air conditioning switching when passenger is not in the front passenger's seat)

The setting (temperature setting) for the front passenger's seat side is automatically switched when there is no passenger in the front passenger's seat. The driver does not have to change the setting for the front passenger's seat side, which improves usability.

- For example, even after the vehicle was used by a family and the temperature was set for the passenger in the front passenger's seat on weekend, the driver, who is using the vehicle for commuting next day, does not need to change the setting because the setting for the unnecessary front passenger's seat is automatically switched (set temperature to link with the driver's seat). This eliminates the driver's effort to manually change the setting and improves usability.

Air conditioning operation 1

Condition	There is a passenger on front passenger's seat.	There is no passenger on front passenger's seat.
Control image	The temperature can be set independently on each of right and left seats as normal operation.  NC-00818	When the system detects that there is no passenger in the front passenger's seat, it automatically switches the air conditioning setting to the left/right linked (SYNC).  NC-00819

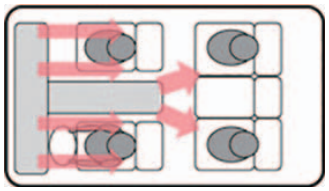
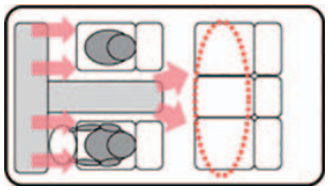
* Only for vehicles with occupant detection sensor. Since the presence of the passenger on the front passenger's seat is determined by the judgment value of the occupant detection sensor, the presence of the passenger may not be correctly determined due to the posture/body type/weight, etc. (such as when a child is on the seat, luggage is on the seat, etc.). Also, the system detects the presence when the vehicle speed exceeds 20 km/h (12.4 MPH).

■ Air conditioning linked with the passengers on the rear seat* (front seats control/all seats control switching)

Conventionally, since the air conditioning control (air volume, etc.) was performed to make all seats comfortable, there were cases in which front seats' passengers felt strong air conditioning. If there are no passengers in the rear seat, the system lowers the air volume and prioritizes the front seats to improve comfort and convenience.

- For example, on the existing model vehicle, in order to weaken the air conditioning when passengers are seated on the front seats only, air volume/temperature adjustments were required. However, the system now determines whether the passenger is seated on the rear seat, which realizes air conditioning dedicated to comfort in the front seats without a special operation.

Air conditioning operation 2

Condition	There is a passenger in the rear seat.	There is no passenger in the rear seat.
Control image	The air conditioning is controlled so that passengers feel comfortable on every seat. The newly installed rear seat's vent grille quickly provides comfortable air conditioning to the rear seat's passengers.  NC-00821	When the system detects that there is no passenger on the rear seat, it automatically controls the air volume and adjusts the air conditioning so front seats' passengers feel comfortable.  NC-00822

* Since the detection of the presence of the rear seat's passengers is performed using the open and close record, the detection of the passenger's presence may not be correctly determined (such as when the door was opened to load a luggage or a passenger moved inside the vehicle from the front seat to the rear seat).

Air conditioner personal recognition (only A/B type)

The air conditioner personal recognition is linked with the driver monitoring system, which is adopted for the first time by SUBARU, to link the driver information with the air conditioning setting. This allows the system to store the preferred setting. Also, when a driver, who is registered as a user, rides in the vehicle, the setting is automatically switched to the recorded air conditioning basic setting to improve convenience. The driver monitoring system link function can be turned on/off in the customizing screen of the multi-function display (MFD).

Telematics, remote starter air conditioner (only A/B type)

Cooperating with telematics, the air conditioning setting can be operated when the engine is started by a smartphone. In addition, the vehicle can travel with the same setting after passengers ride on the vehicle.

10.3 Airbag System

10.3.1 Overview

In the airbag system, the following systems are adopted to improve passenger protection performance.

- Driver's and front passenger's airbags
- Driver's knee airbag
- Side airbag
- Curtain airbag
- Lap belt pretensioner (driver's seat and front passenger's seat)
- Pretensioner with force limiter (the shoulder belts of the driver's seat, passenger's seat, and outer rear seat)
- Adaptive belt (driver's seat and front passenger's seat)

The occupant detection sensor is adopted for the front passenger's seat.

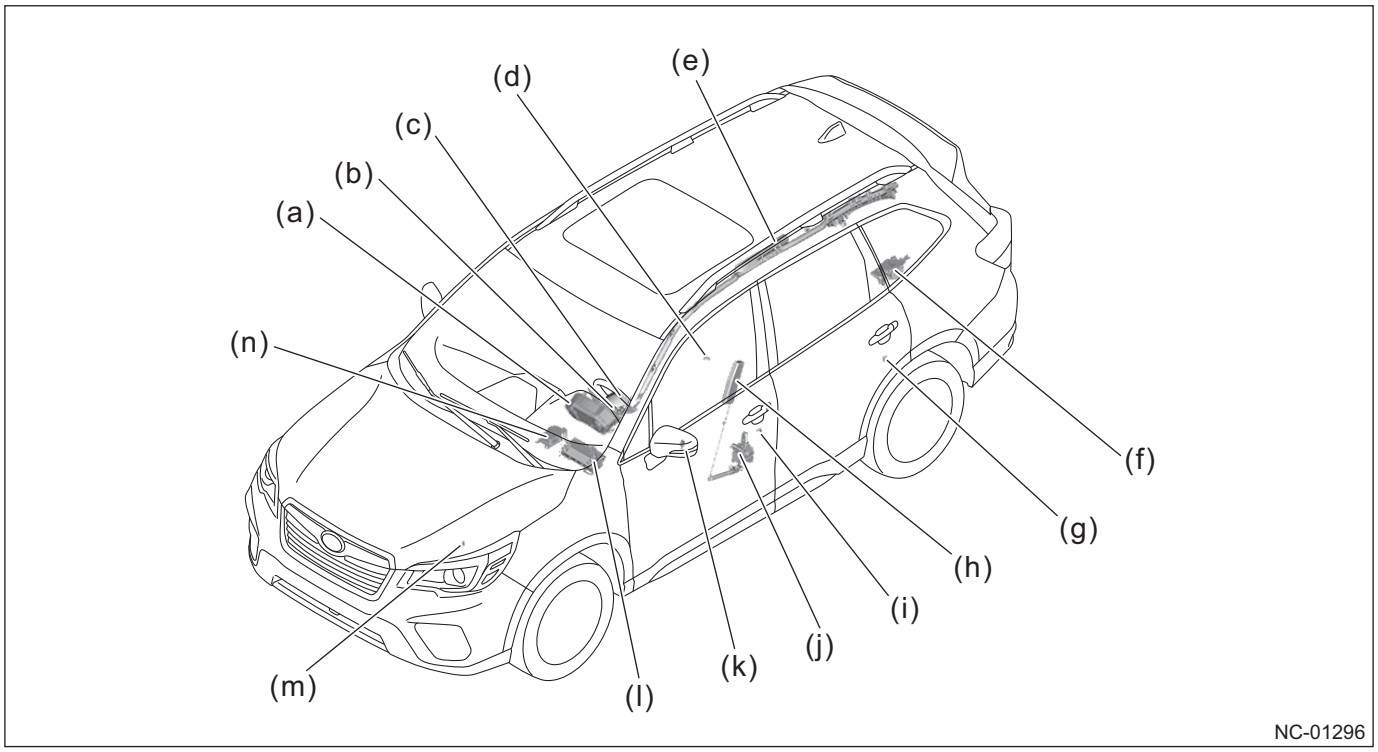
In the layout of each sensor, the pressure sensor is arranged within the front door to enable early and stable collision sensing and operate the airbag safely to improve passenger protection performance.

The seat belt locking tongues are adopted for the driver's and front passenger's seats, and the outer rear seat.

10.3.2 Component

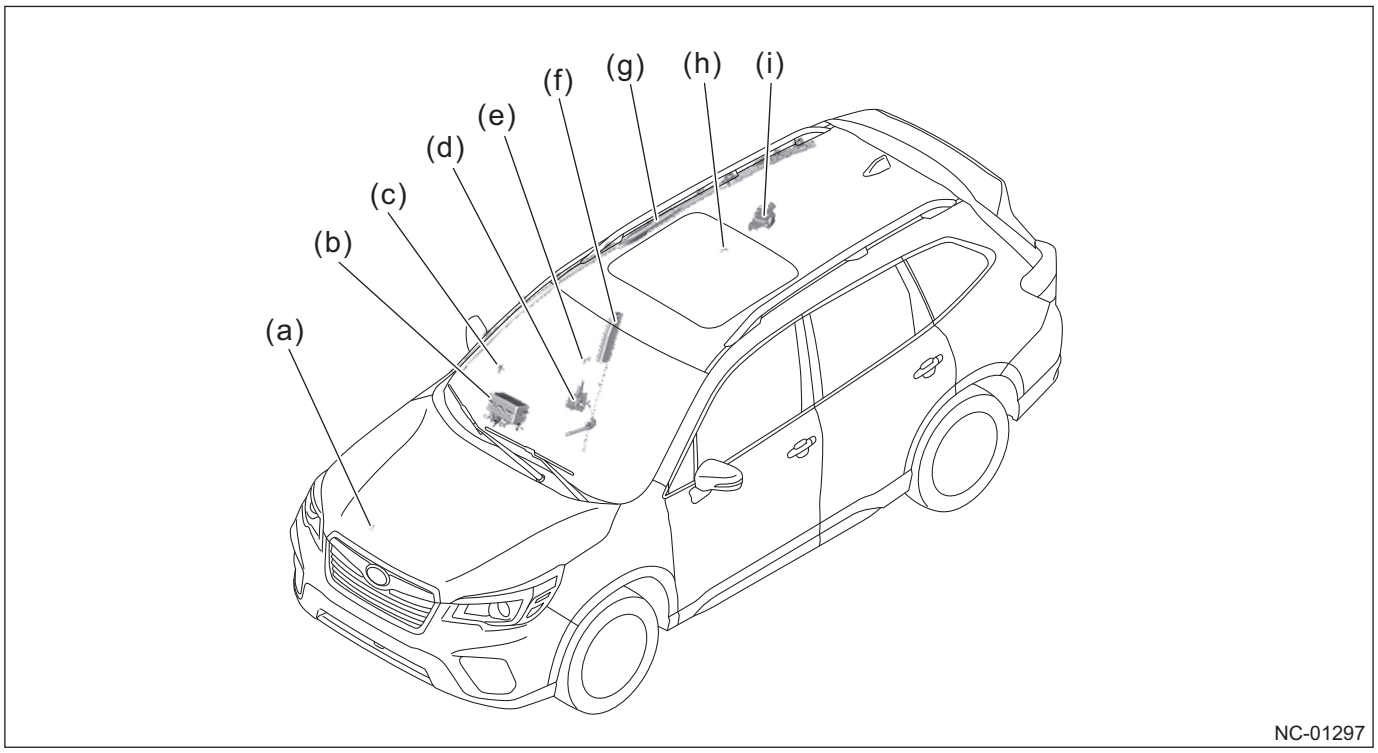
Component layout drawing

Airbag system, seat belt pretensioner 1



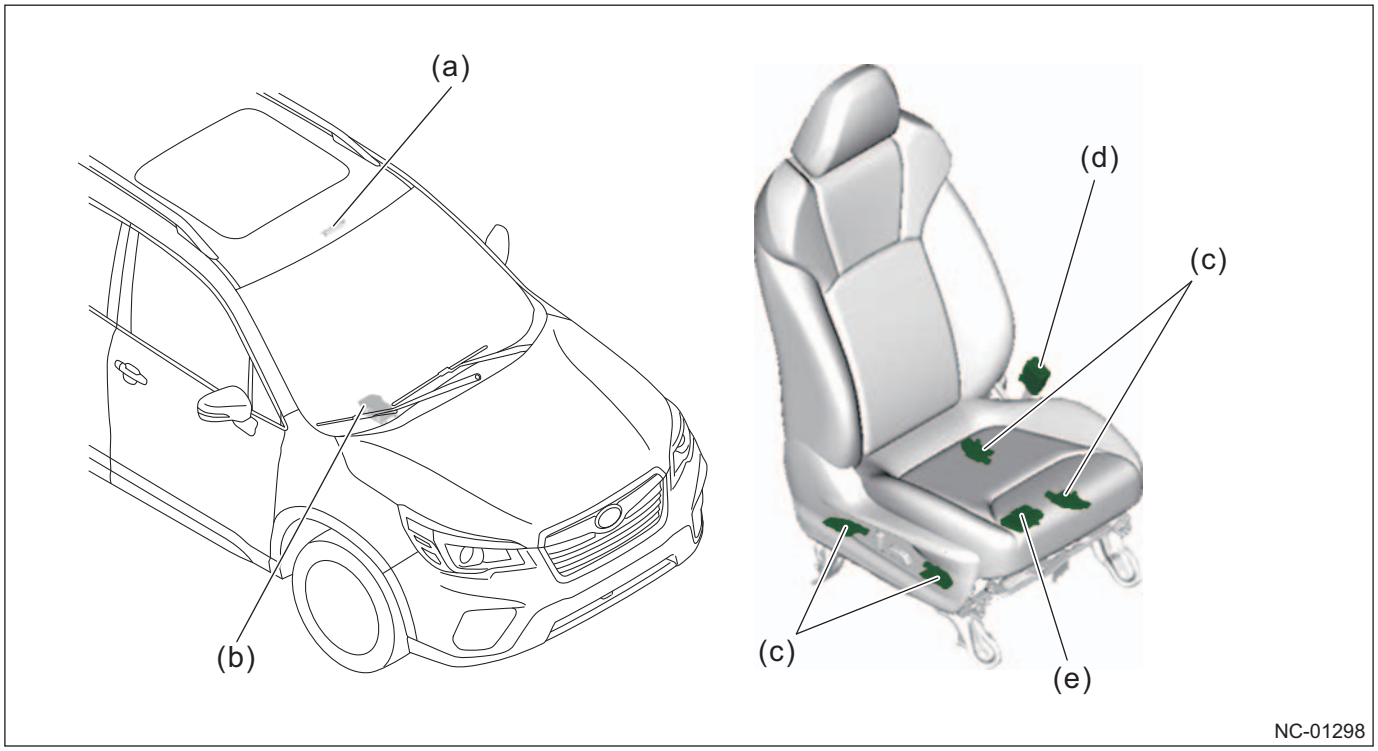
(a) Airbag warning light (in combination meter)
(b) Steering roll connector
(c) Driver's airbag module
(d) Side impact sensor (under the center of rear seat)
(e) Curtain airbag module LH
(f) Rear seat belt pretensioner LH
(g) Side impact sensor LH (rear wheel housing)
(h) Side airbag module LH
(i) Side impact sensor LH (center pillar)
(j) Seat belt pretensioner (with adaptive force limiter) and lap seat belt pretensioner LH
(k) Side impact sensor LH (front door)
(l) Knee airbag module
(m) Front impact sensor LH
(n) Airbag control module

Airbag system, seat belt pretensioner 2



(a) Front impact sensor RH
(b) Front passenger's airbag module
(c) Side impact sensor RH (front door)
(d) Seat belt pretensioner (with adaptive force limiter) and lap seat belt pretensioner RH
(e) Side impact sensor RH (center pillar)
(f) Side airbag module RH
(g) Curtain airbag module RH
(h) Side impact sensor RH (rear wheel housing)
(i) Rear seat belt pretensioner RH

Occupant detection system (front passenger's seat)



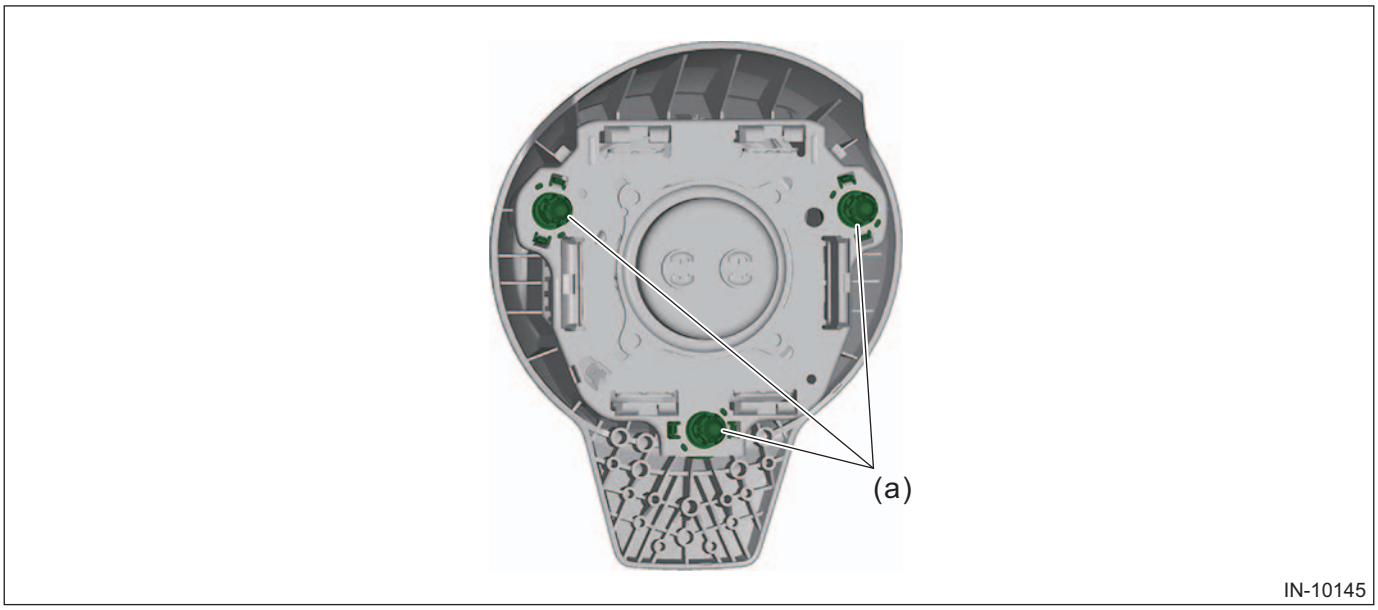
(a) Front passenger's airbag ON/OFF indicator light
(b) Airbag control module
(c) Occupant detection sensor
(d) Buckle switch (front passenger's seat)
(e) Occupant detection control module

Component details

Driver's airbag module

The driver's airbag module is built in the steering wheel pad.

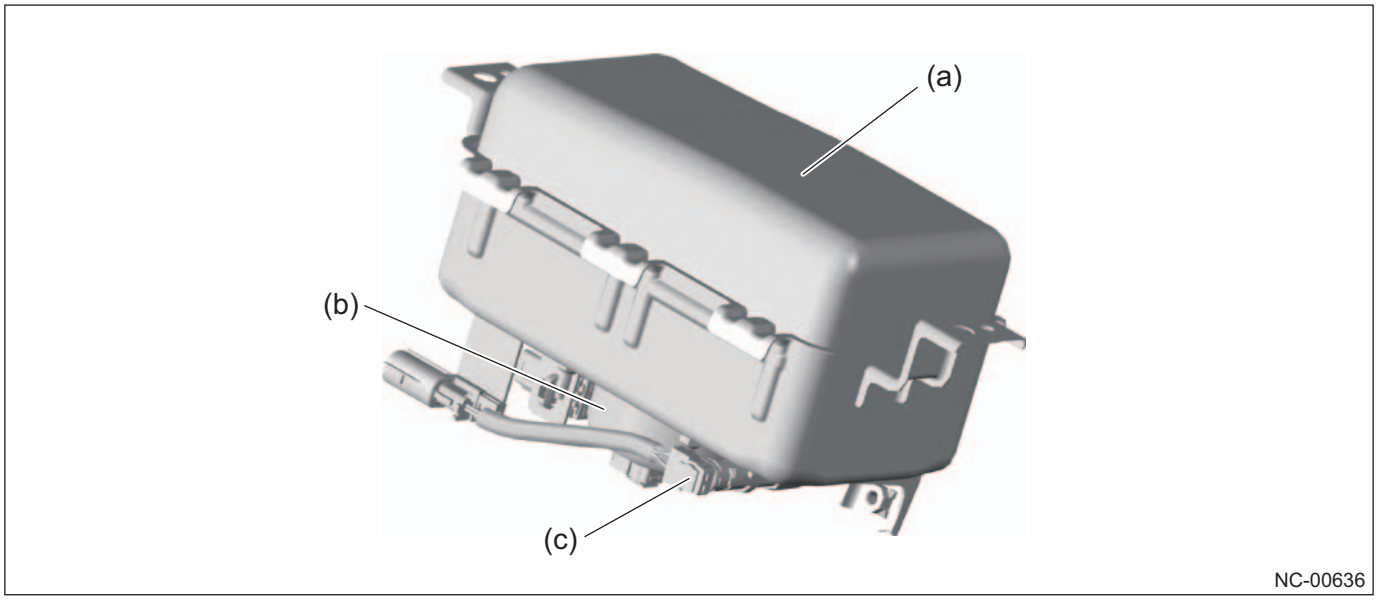
The driver's airbag module is changed to a structure that is made to function as a steering wheel mass damper to reduce vibrations transmitted from the road to the driver's hands while driving. Compared to existing model vehicles using inflator as a mass damper, new model vehicles adopt rubber for the attachment structure of the airbag module, and the entire airbag module functions as a mass damper. Thus, while the entire module is lightened, the damper mass is increased. This allows the steering wheel vibration to be reduced.



(a) Airbag module attachment section (rubber construction)

Front passenger's airbag module

The front passenger's airbag module is installed in the upper part in instrument panel on the front passenger's seat side. The front passenger's airbag module is a non-disassembling type, and is composed of a case, inflator, airbag, etc.

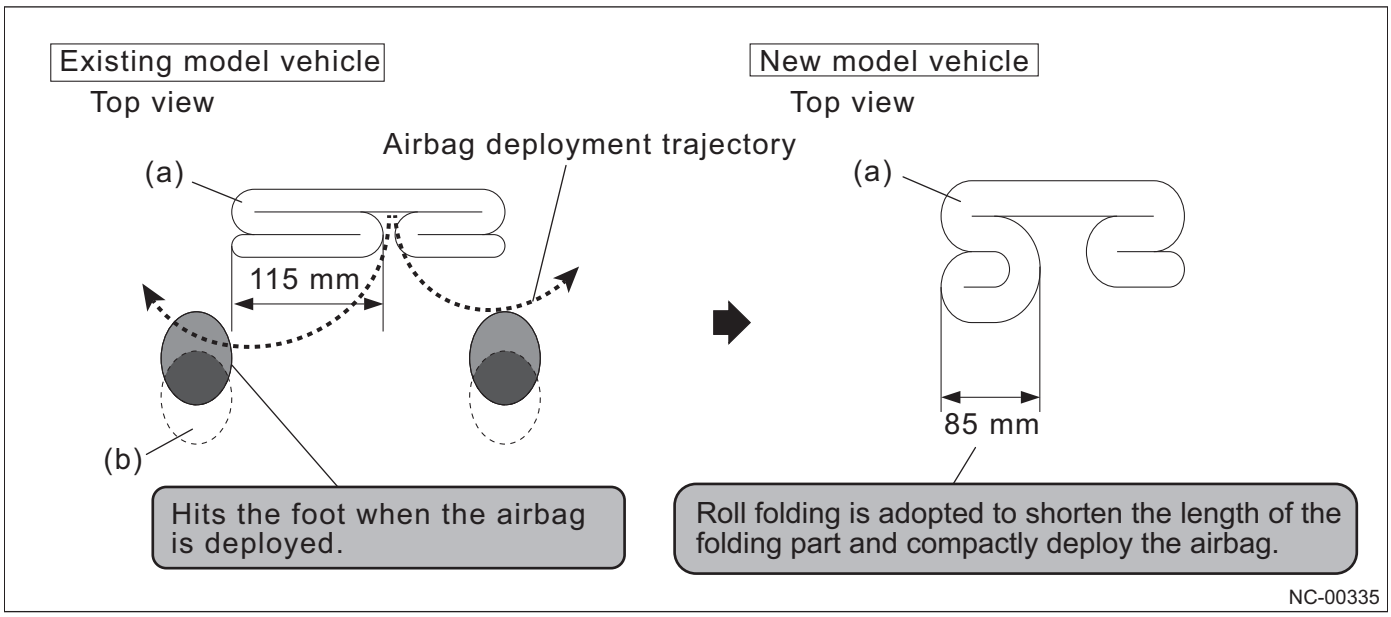


(a) Airbag
(b) Inflator
(c) Variable vent hall operation actuator

Driver's knee airbag module

The knee airbag module is a non-disassembling type, and is composed of an inflator, bag, etc.

The knee airbag is adopted with the modified folded state when stored and the modified shape when deployed. This allows the airbag to deploy stably in the even state where space between the knee airbag and the legs is narrow, improving passenger protection performance.



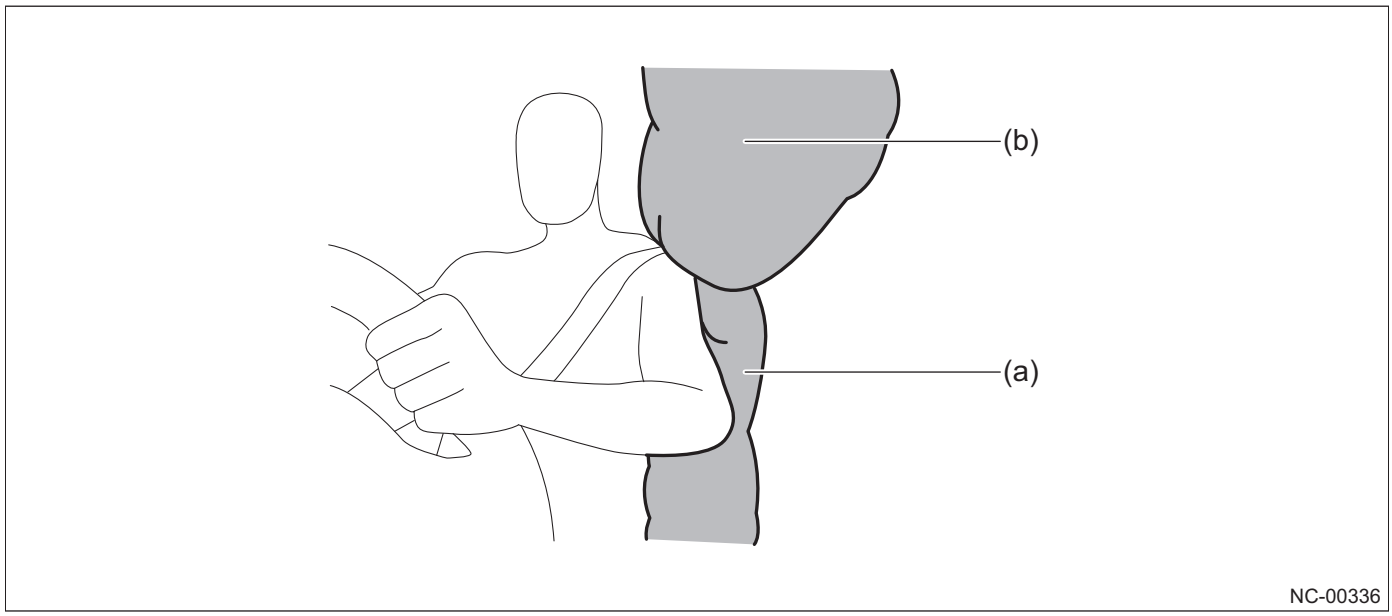
(a) Knee airbag

(b) Legs

Side airbag module

The side airbag modules larger than those of the existing model vehicle are arranged in the seat backs of the driver's seat and front passenger's seat. The side airbag module is a non-disassembling type, and is composed of an inflator, bag, retainer, etc.

On side collision accident, the airbag, which is thick and deployed at high inner pressure, pushes the passengers' shoulder to decrease the state speed of them. This reduces injury of the breast area and realizes high passenger protection performance.

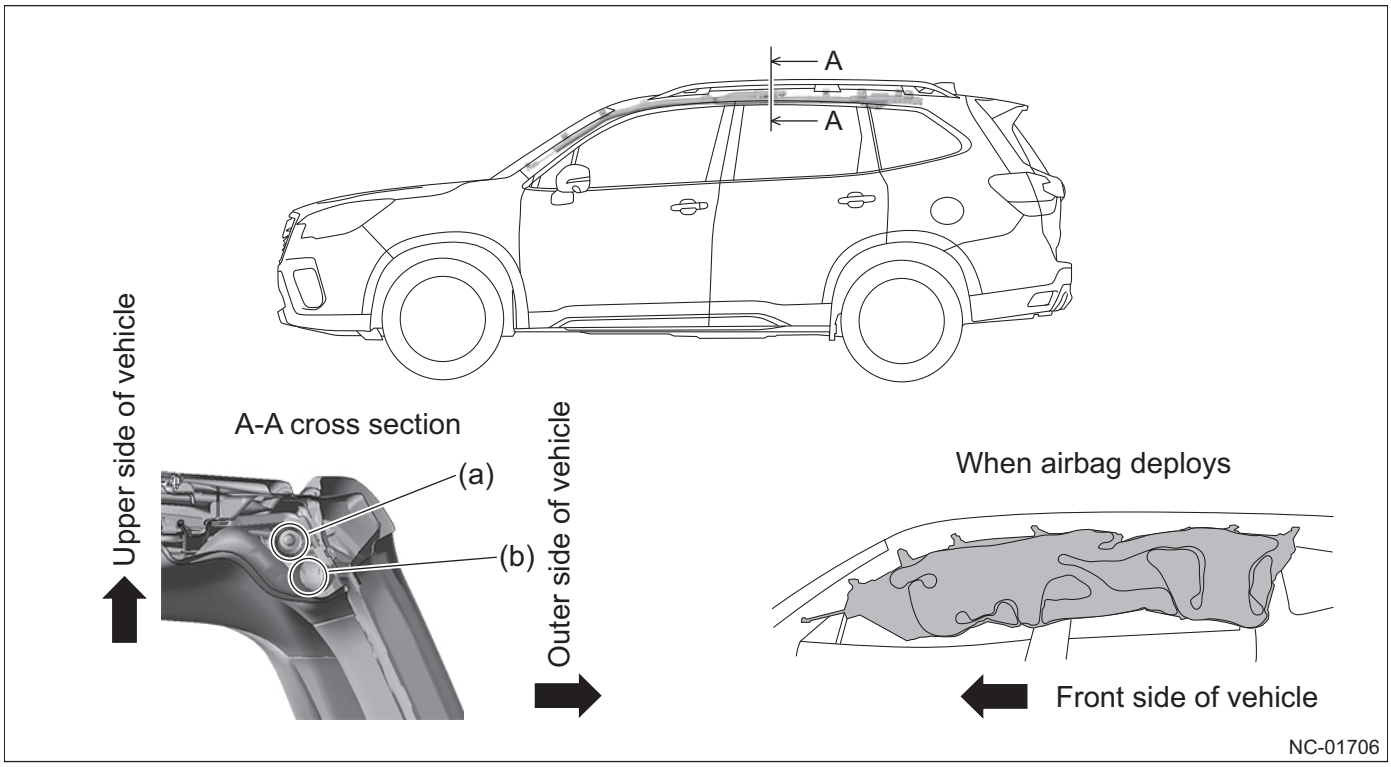


(a) Side airbag module

(b) Curtain airbag module

Curtain airbag module

The curtain airbags that are thicker than those of the existing model vehicle are adopted for the sides of the front seat and rear seat passengers' head. The curtain airbag module is a non-disassembling type, and is composed of an inflator, airbag, etc.

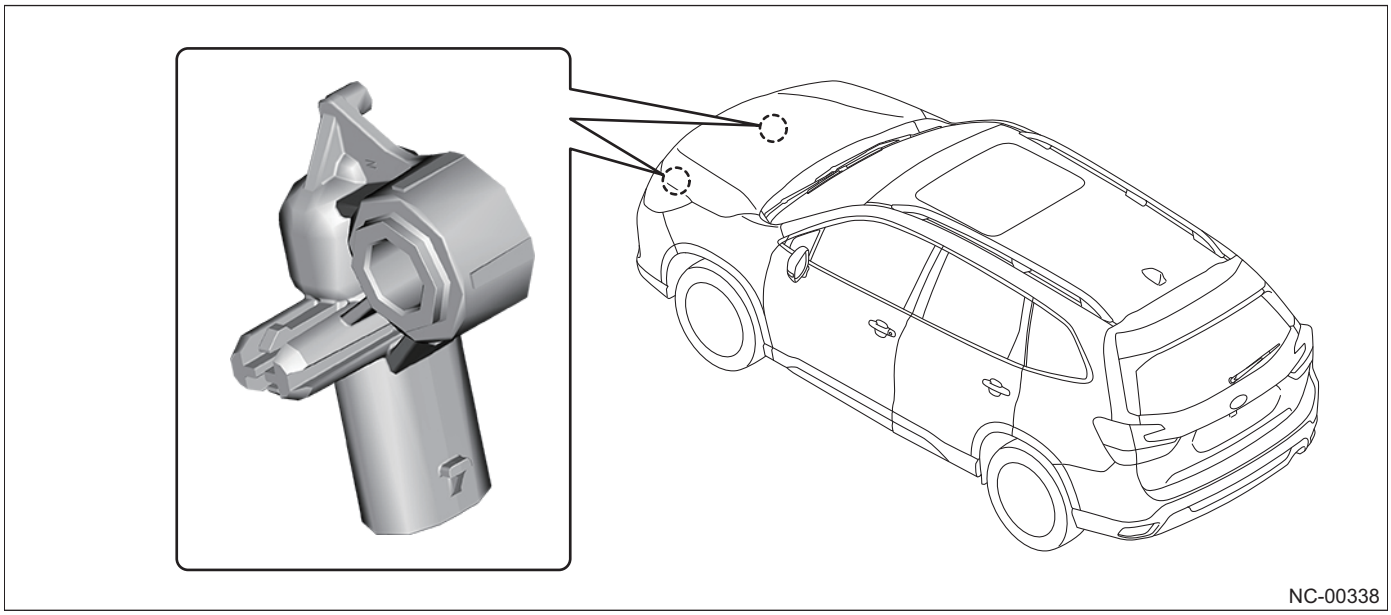


(a) Inflator

(b) Airbag

Front impact sensor

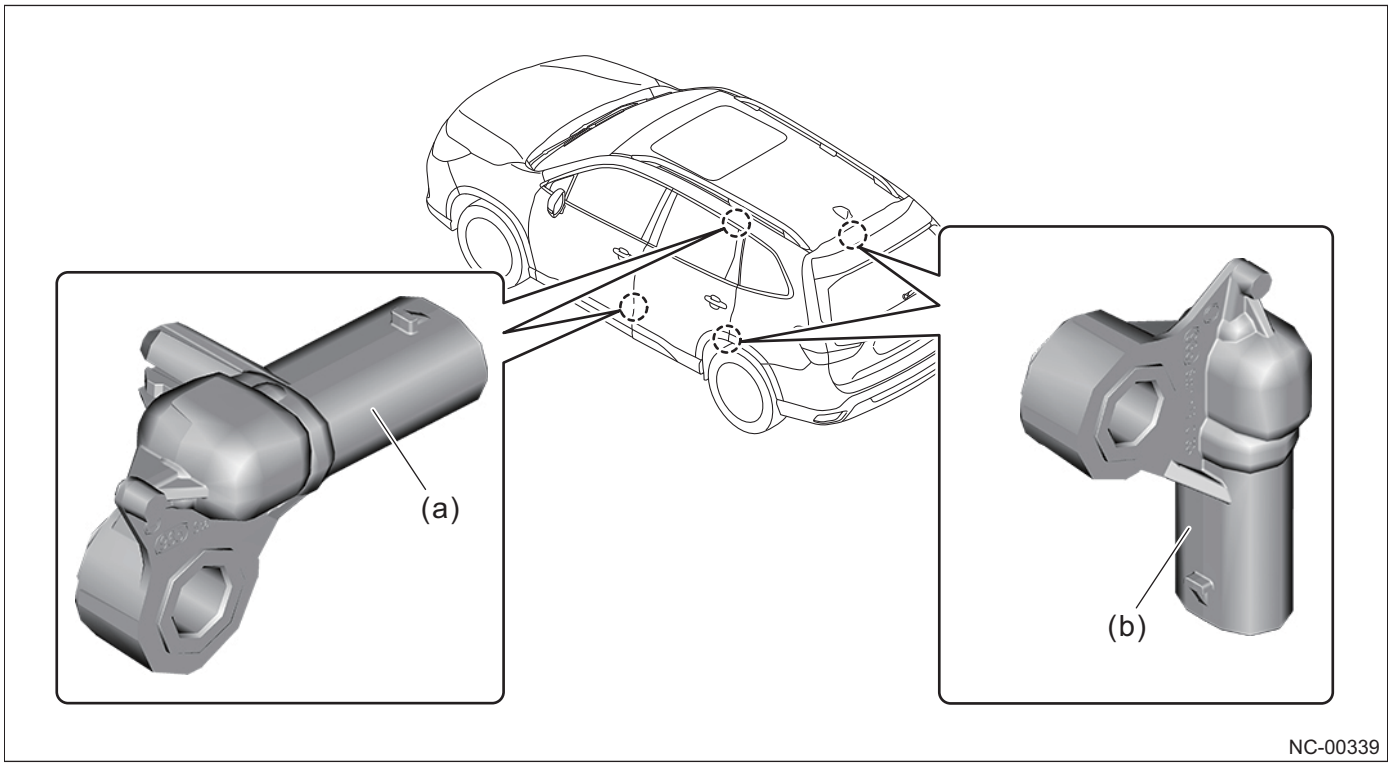
The front sub sensors are composed of a semiconductor type G sensor, a communication circuit etc., and sense the impact from the front and send the deceleration signal to the airbag control module.



(a) Front impact sensor

Side impact sensor (center pillar), side impact sensor (rear wheel housing)

Side impact sensor (center pillar) is installed on the bottom of the B pillar and the side impact sensors (rear wheel housings) are installed at front of the rear wheel housing. They are composed of a semiconductor type G sensor, a communication circuit etc., and sense the impact from the side and send the deceleration signal to the airbag control module.

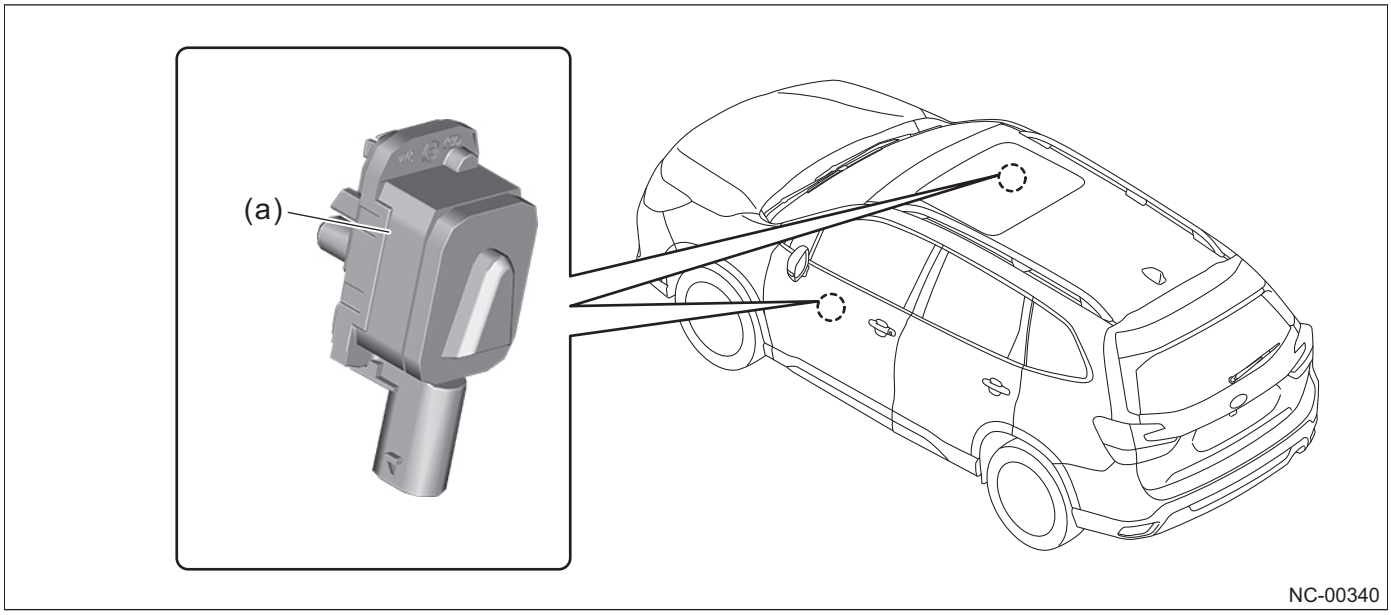


(a) Side impact sensor (center pillar)

(b) Side impact sensor (rear wheel housing)

Side impact sensor (front door)

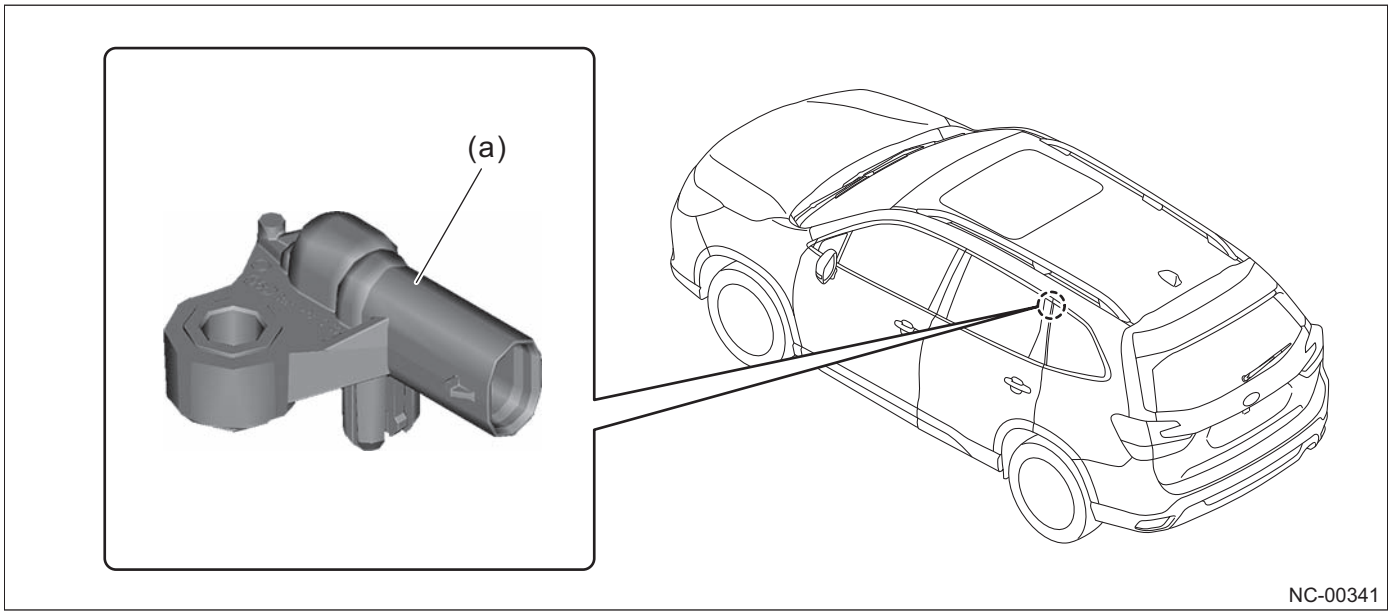
The pressure sensor is installed on the front door panel passenger room side. It is possible to make the sensing earlier by detecting the deformation of the door as a pressure instead of the G sensor which relies on transmission of amount of deceleration on collision. Also, since the dependence on the amount of deceleration is low, the risk of erroneous ignition is reduced.



(a) Side impact sensor (front door)

Side impact sensor (under the center of rear seat)

The side impact sensor is installed under the center of rear seat. They are composed of a semiconductor type G sensor, a communication circuit etc., and sense the impact from the side and send the deceleration signal to the airbag control module.

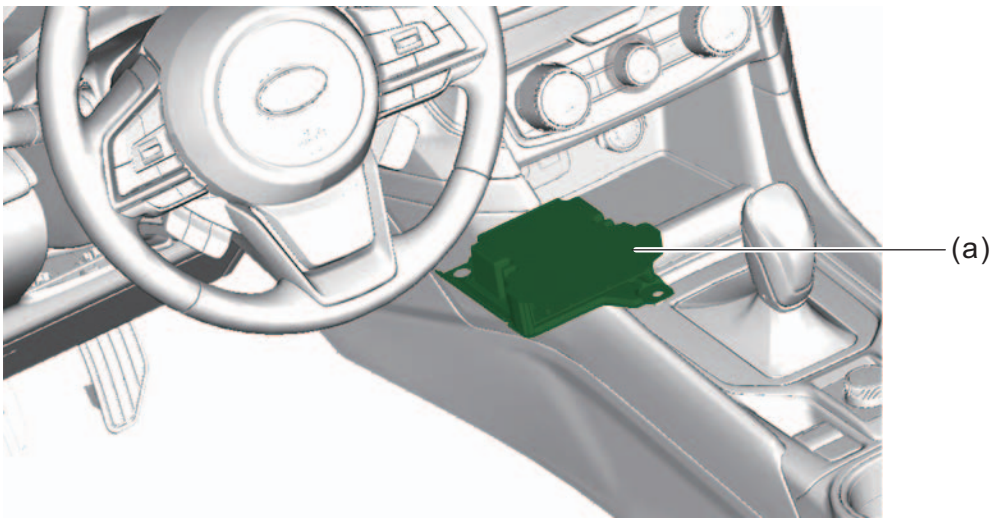


(a) Side impact sensor (under the center of rear seat)

Airbag control module

The airbag control module is installed in front of the shift lever under the center console. The airbag control module is composed of G sensor, ignition determination circuit, a backup power supply, etc.

The airbag control module, based on signals from each of the sensors and sensor signals inside the airbag control module, determines ignition of the driver's airbag, front passenger's airbag, driver's knee airbag, side airbag, and curtain airbag modules, as well as the seat belt pretensioners and lap seat belt pretensioner, depending on conditions. The airbag control module is also provided with a diagnosis function and performs self-diagnosis when there is a system anomaly.



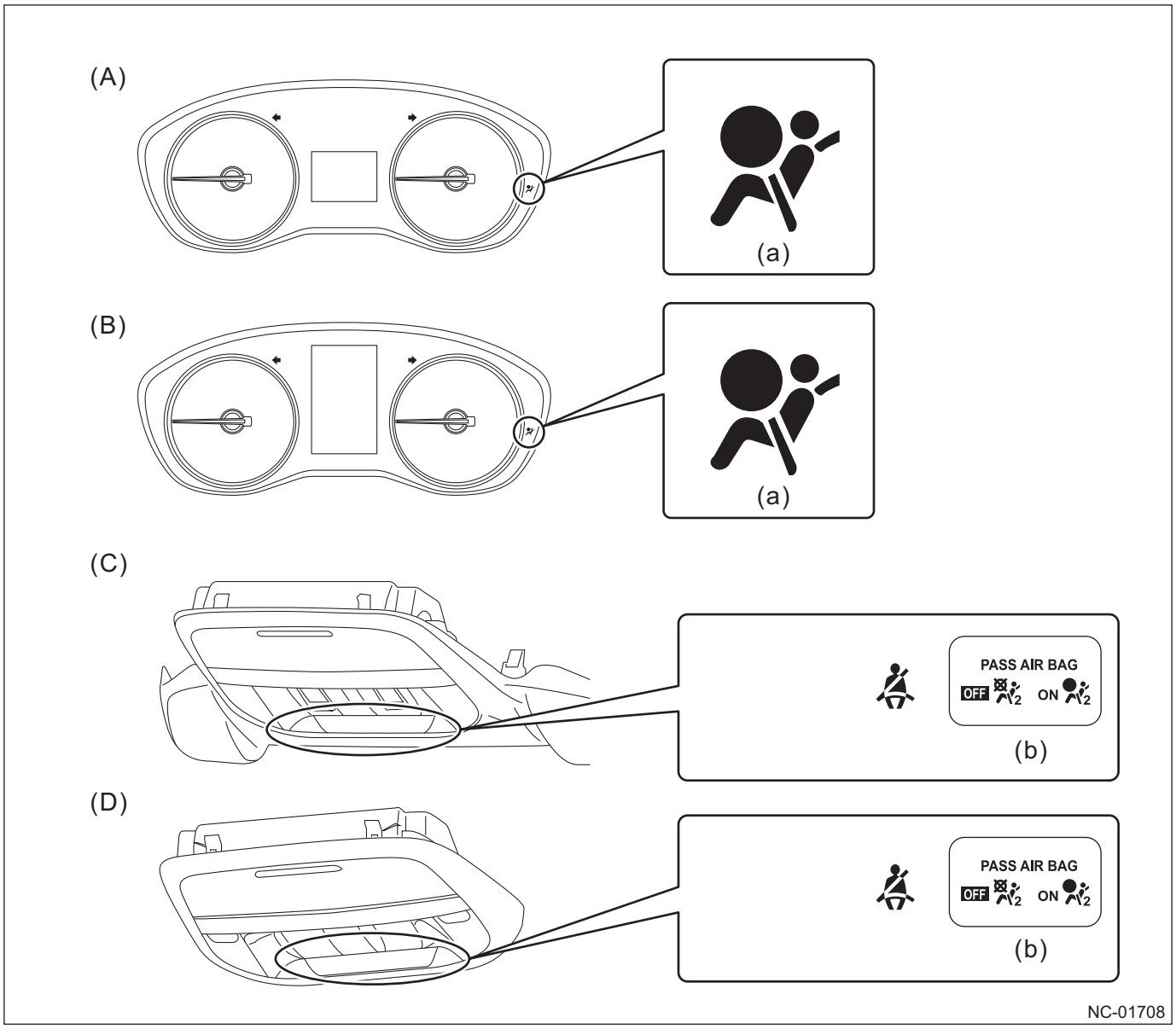
NC-01707

(a) Airbag control module

Airbag warning light

When there is a system anomaly, the airbag warning light arranged in the combination meter turns on to warn the driver.

The status of the front passenger's airbag (ON or OFF) is displayed by the front passenger's seat airbag indicator light arranged in the warning box.



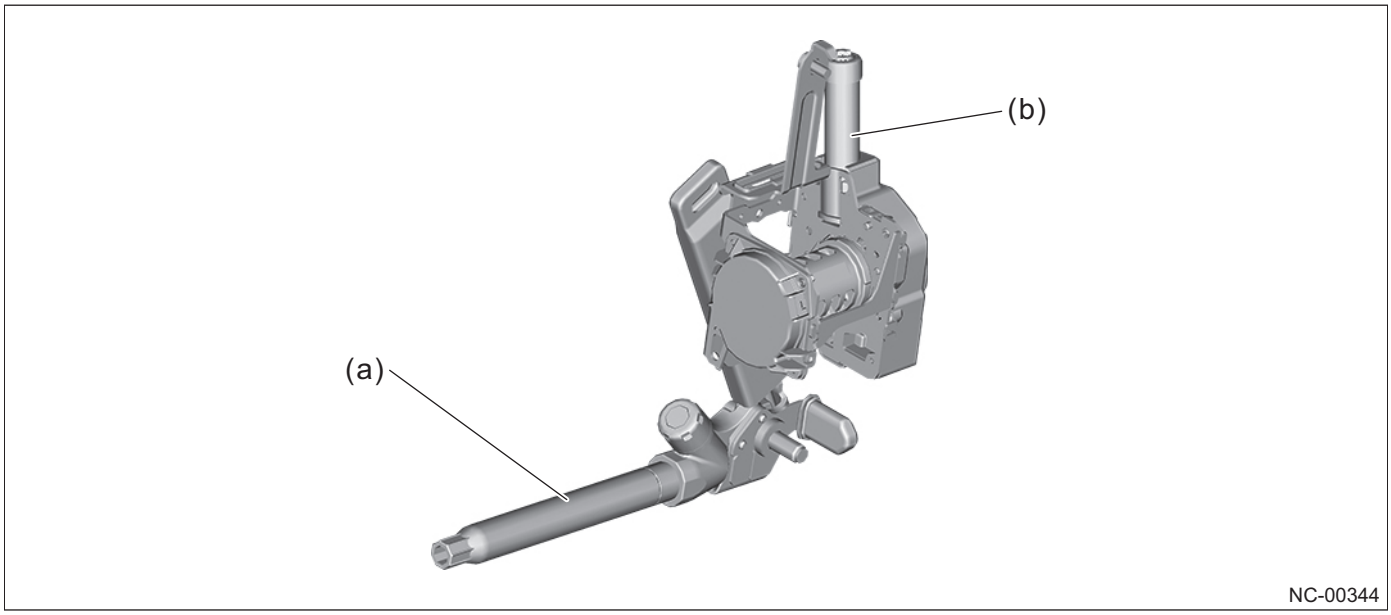
(A) Normal meter
(B) High grade meter
(C) Warning box (model with EyeSight)
(D) Warning box (model without EyeSight)

(a) Airbag warning light
(b) Front passenger's airbag ON/OFF indicator light

Seat belt pretensioner

The seat belt pretensioner is adopted that increases passenger restraint to reduce injury on collision, for the driver's and front passenger's seats, and the outer rear seat.

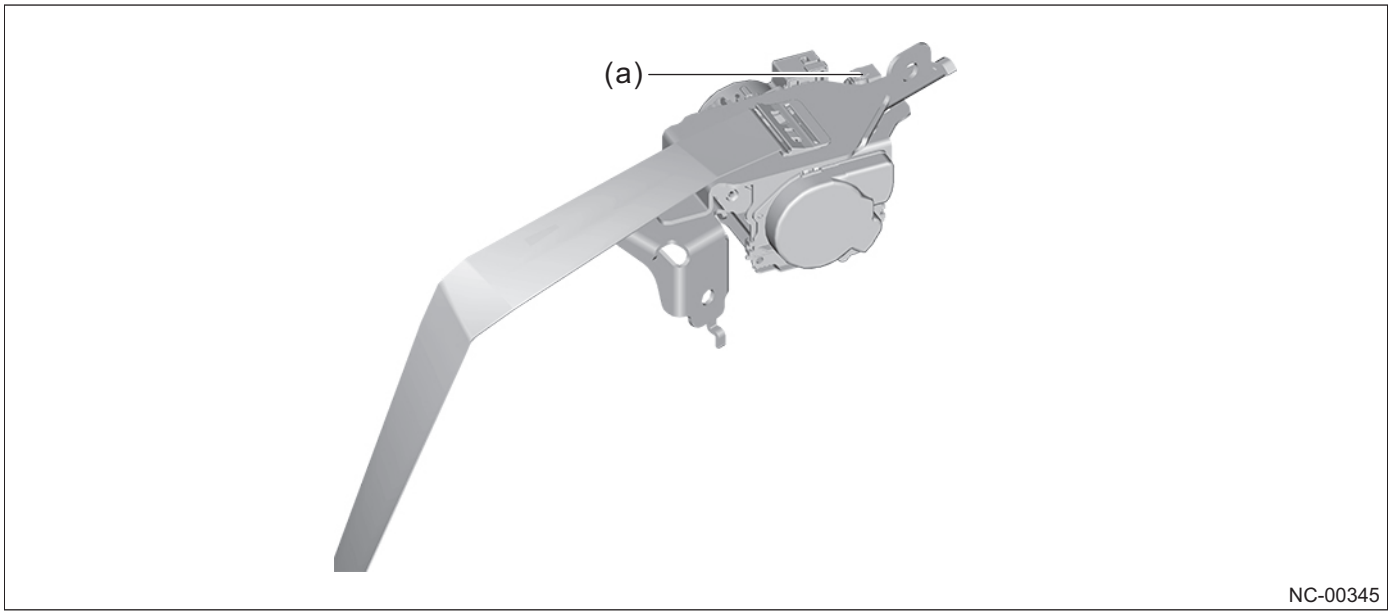
Driver's and front passenger's seat belt pretensioner



(a) Lap belt pretensioner

(b) Shoulder belt pretensioner

Seat belt pretensioner for outer rear seat



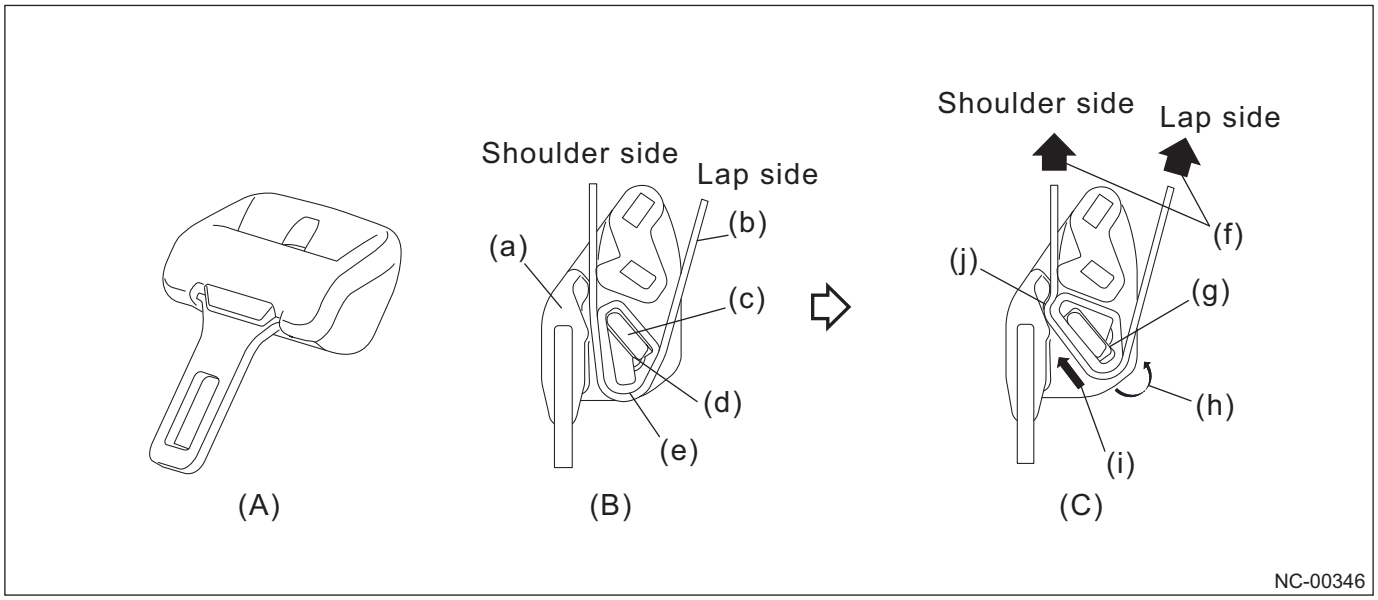
(a) Seat belt pretensioner

Locking tongue

The locking tongues that lock the lap belt, increase passenger restraint, and reduce injury if a collision occurs are adopted for the driver's and front passenger's seats, and the outer rear seat.

Normally, the belt freely moves on the cam of the tongue. When a certain load is applied to the belt on collision, etc., the shear rib is disconnected, and the cam rotates to lock the belt between the cam and the tongue. This keeps the shoulder belt from being pulled down on the lap belt side to suppress tension on the shoulder belt.

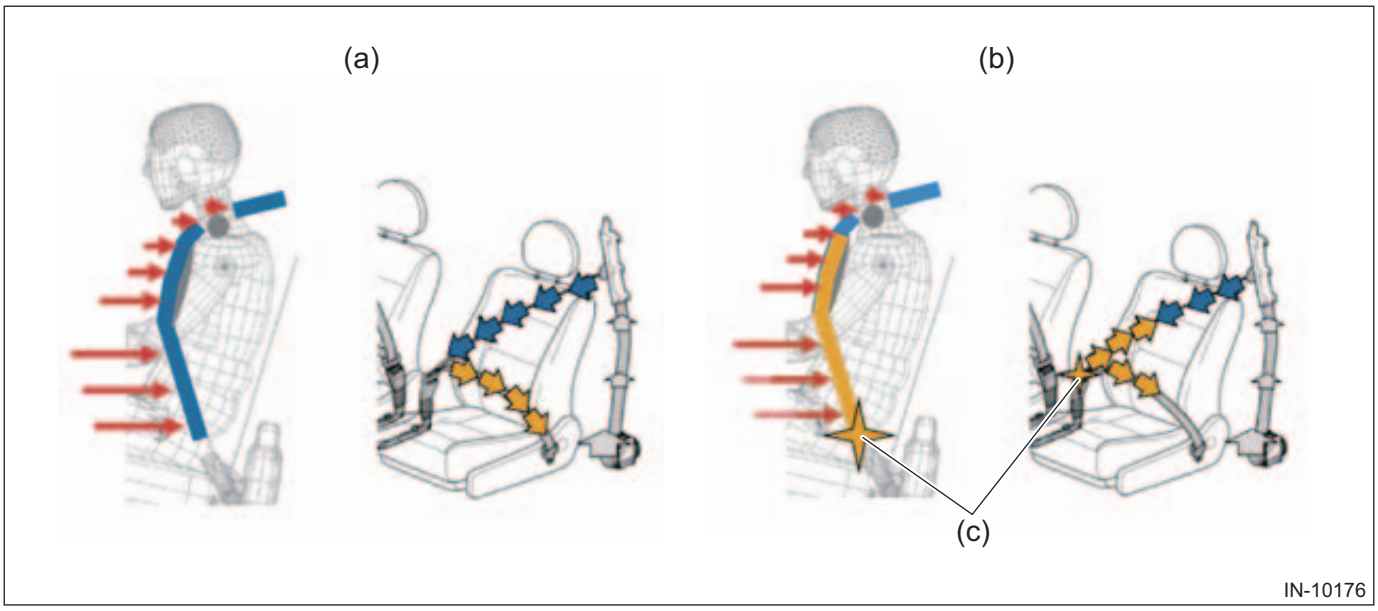
Inner structure of locking tongue



(A) Locking tongue
(B) When wearing belt
(C) When locking member operates

(a) Tongue
(b) Belt
(c) Bar
(d) Shear rib
(e) Cam
(f) Belt load occurring (hip is greater than shoulder)
(g) Shear rib is disconnected
(h) Cam rotates
(i) Cam slides
(j) Seat belt is locked

Breast area protection mechanism on collision due to the locking tongue



(a) When the lap moves forward on collision, the load on the lap belt increases, and the load under the breast area also increases.

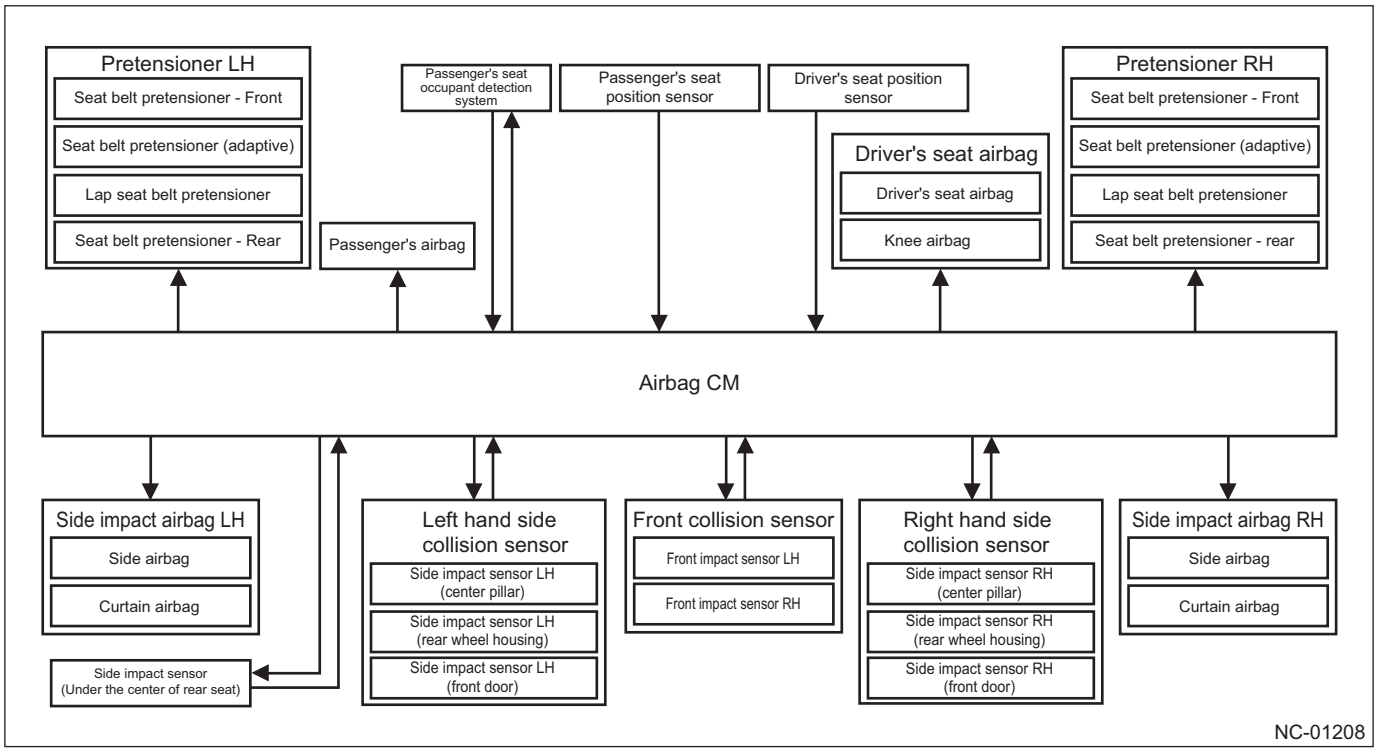
(b) The belt is locked with the locking tongue on collision to suppress the lap belt movement and reduce the load under the breast area.

(c) Lock

10.3.3 Construction and Operation

System diagram

Airbag system



System details

Airbag system

The airbag system protects passengers in the vehicle on collision in combination with the following systems.

Airbag	If the passengers receive a strong impact force that could lead to serious injury, bags which act as cushions are instantly inflated along with the physical restraining actions of the seat belts to alleviate the impact on the passenger's heads, chests, and legs (driver).
Seat belt pretensioner	The seat belt pretensioner increases the restraining effect on the passenger by instantaneously pulling the seat belt inward when the vehicle receives a strong impact force.
Adaptive force limiter	The adaptive force limiter switches the force limiter (EA: energy absorber) load according to a collision form to optimally control the passenger restraint.

Caution
The airbag system is effective when the seat belts are correctly fastened with the passengers in the correct seating posture. Do not place objects or attach accessories close to the airbag deployment areas. Passengers may result in injury when operating. Also, if there is any cracking or damage in the airbag deployment sections, do not use the airbag as is and consult your retailer.
Refer to the user's manual and service manual for the detailed precautions and warnings.

■ Airbag sensing system

In order to improve passenger protection performance, the optimum impact sensing system and optimum deployment control of passenger protection devices have been realized.

The system is composed of an airbag control module located in the front of the shift lever (center console) and sensors arranged in the front and sides of the vehicle.

Pressure detection type sensors are adopted for the side impact sensors (front doors) to improve sensing performance. This supports passenger protection on inclined pole collisions at low speeds.

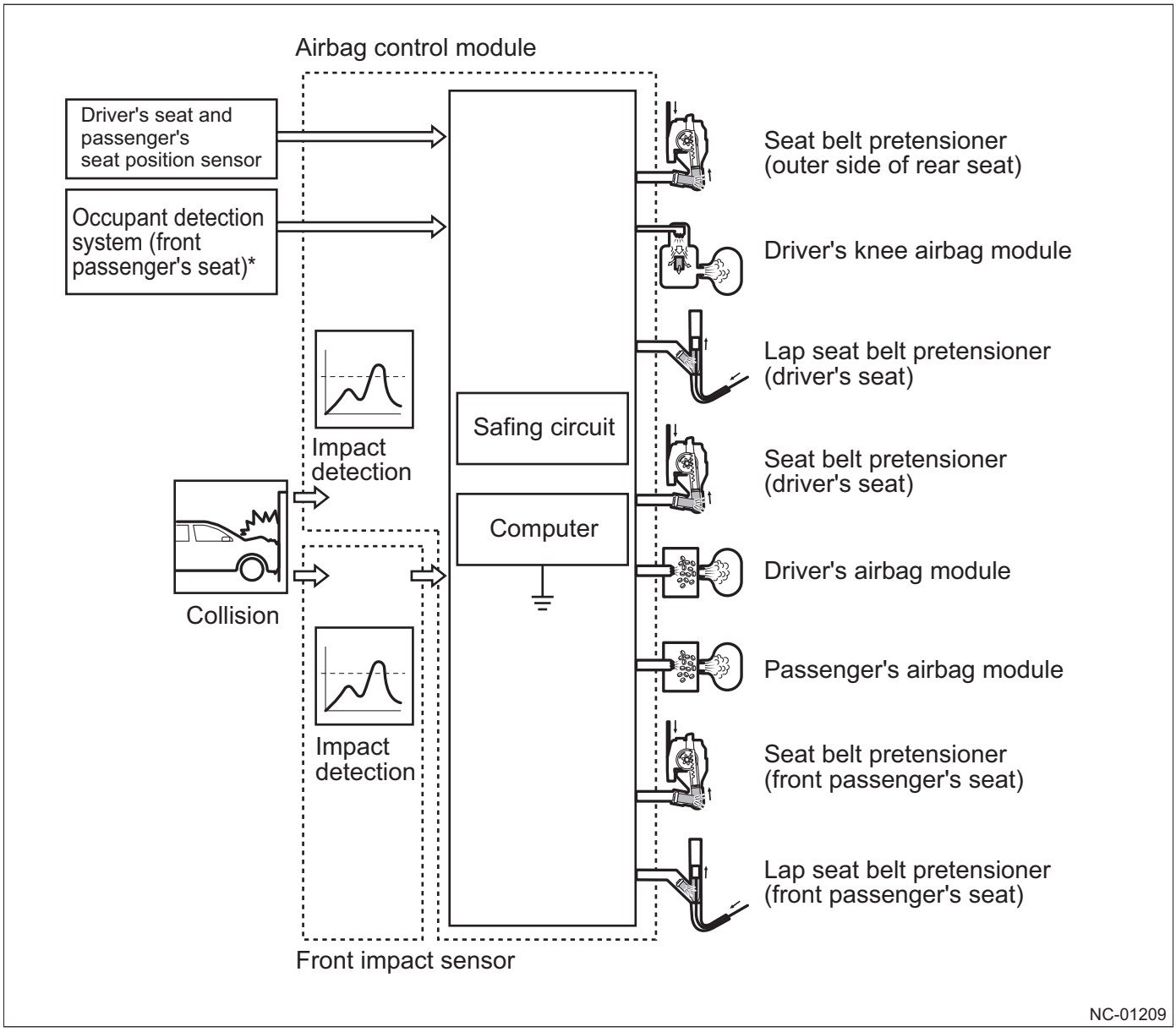
The system controls the deployment or non-deployment of the front passenger's airbags and the lighting of the front passenger's airbag ON/OFF indicator based on front passenger's seat occupant status information detected by the front passenger's seat occupant detection system, and sends information on whether the front passenger's seat belt is buckled or unbuckled to the meter based on front passenger's seat belt buckle switch information detected by the system.

On front collision

Ignitions of the driver's airbag modules, front passenger's airbag modules, knee airbag modules, seat belt pretensioners, and the lap seat belt pretensioners are determined by signals from the front impact sensors and G sensor in the airbag control module.

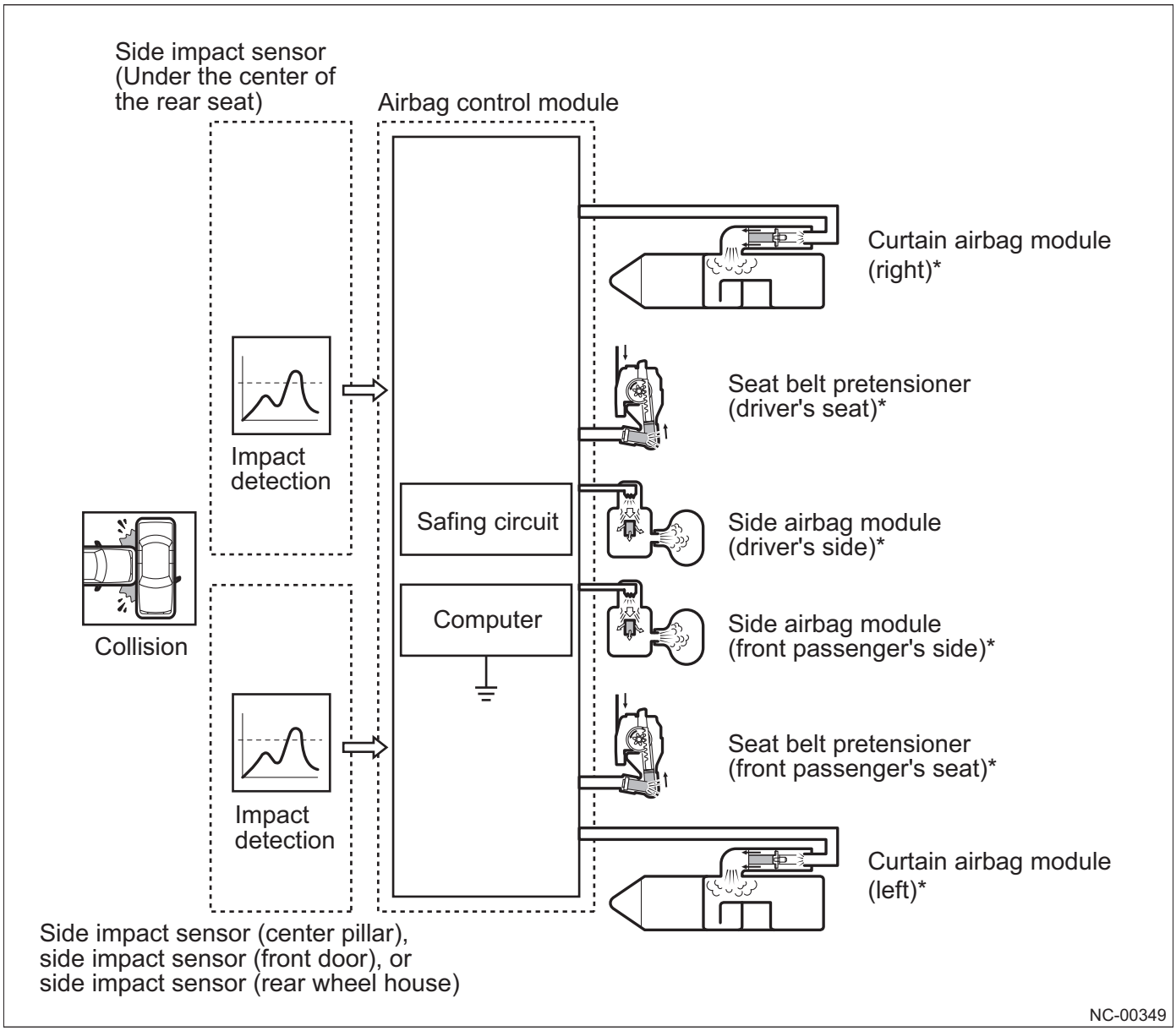
For the front seats, the seat belt load on collision is selected based on the occupant status detected by the driver's seat and passenger's seat position sensors.

For the front passenger's seat, selection of the seat belt load and airbag deployment/non-deployment on collision are controlled based on front passenger occupant status information determined by the occupant detection system (occupant detection sensors and occupant detection control module).



On side collision

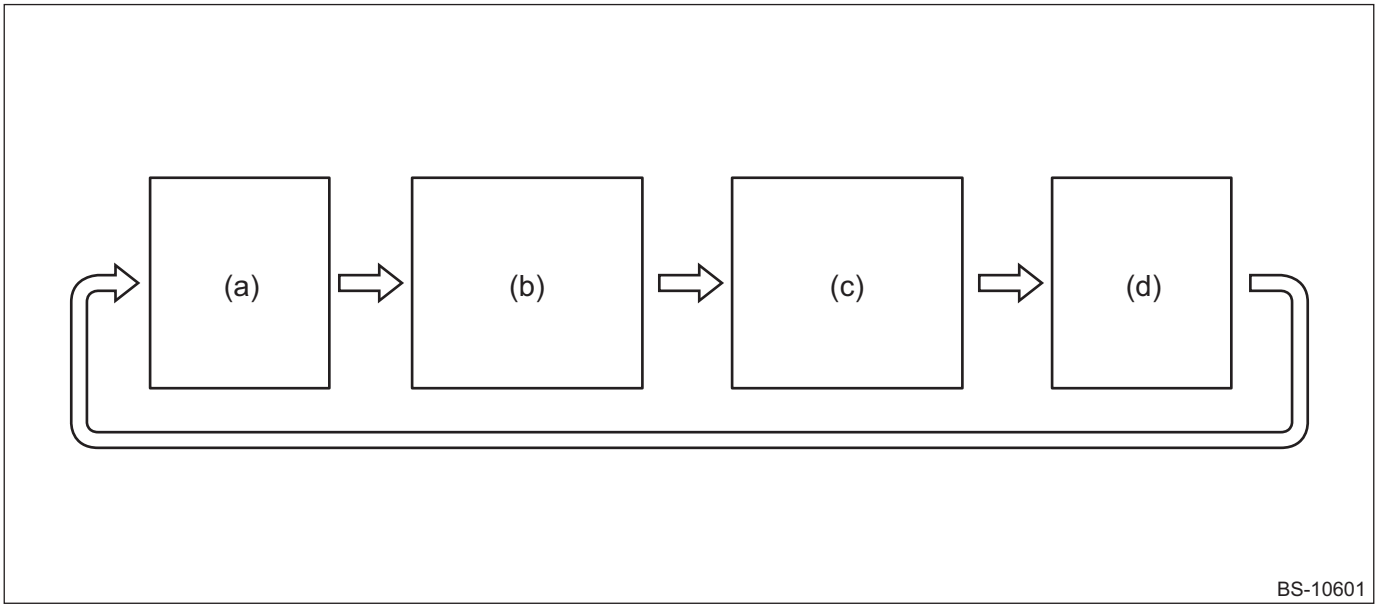
The system determines whether to ignite the side airbags, curtain airbags and seat belt pretensioners on the collision side based on the signals from the side impact sensors (center pillar), side impact sensor (front door), side impact sensor (rear wheel housing), and side impact sensor (under the center of rear seat).



* Operation is on impact side only.

■ Diagnostic circuit

Operation of the diagnostic circuit is displayed by the airbag warning light in the combination meter. The diagnostic circuit operates over two periods of the primary check and the normal check.



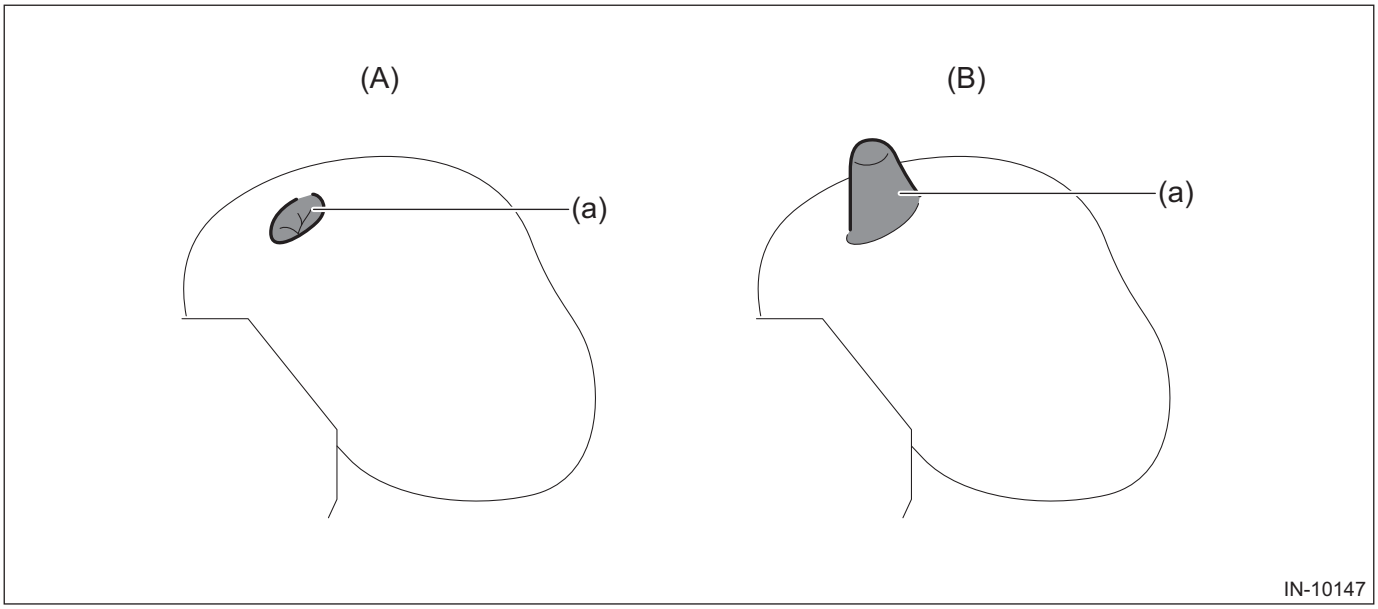
(a) Ignition switch ON
(b) Primary check (the airbag warning light turns on for about six seconds)
(c) Normal check (the airbag warning light turns off)
(d) Ignition switch OFF

Primary check	When the ignition switch is ON, the airbag warning light turns on for about 6 seconds to perform the primary check. During this period, an operational diagnosis of the airbag control module is also performed in an ignition inhibited state.
	If an anomaly is detected by the primary check, the airbag warning light does not turn off for over 6 seconds and continues to illuminate.
	Regardless of whether the fault occurred or not, the deployed airbag control module keeps the airbag warning light tuning on after the primary check.
Normal check	After the primary check, the system enters an ignitable state after the airbag warning light turns off, and the diagnostic circuit performs a normal check to detect whether there are any anomalies in the system. If a fault is detected during the normal check, the airbag warning light turns on. (The warning display on power supply voltage dropping turns off after the power supply voltage returns to normal.)

■ Front passenger's airbag variable vent hall construction

The variable vent hall is adopted to improve the proper passenger protection performance.

The sensor determines weight, a seat position, and the fastening/unfastening of a seat belt, and active/inactive conditions and operation timing of the variable vent hall are changed to realize the optimal control.



(A) When variable vent hall does not operate

(B) When variable vent hall operates

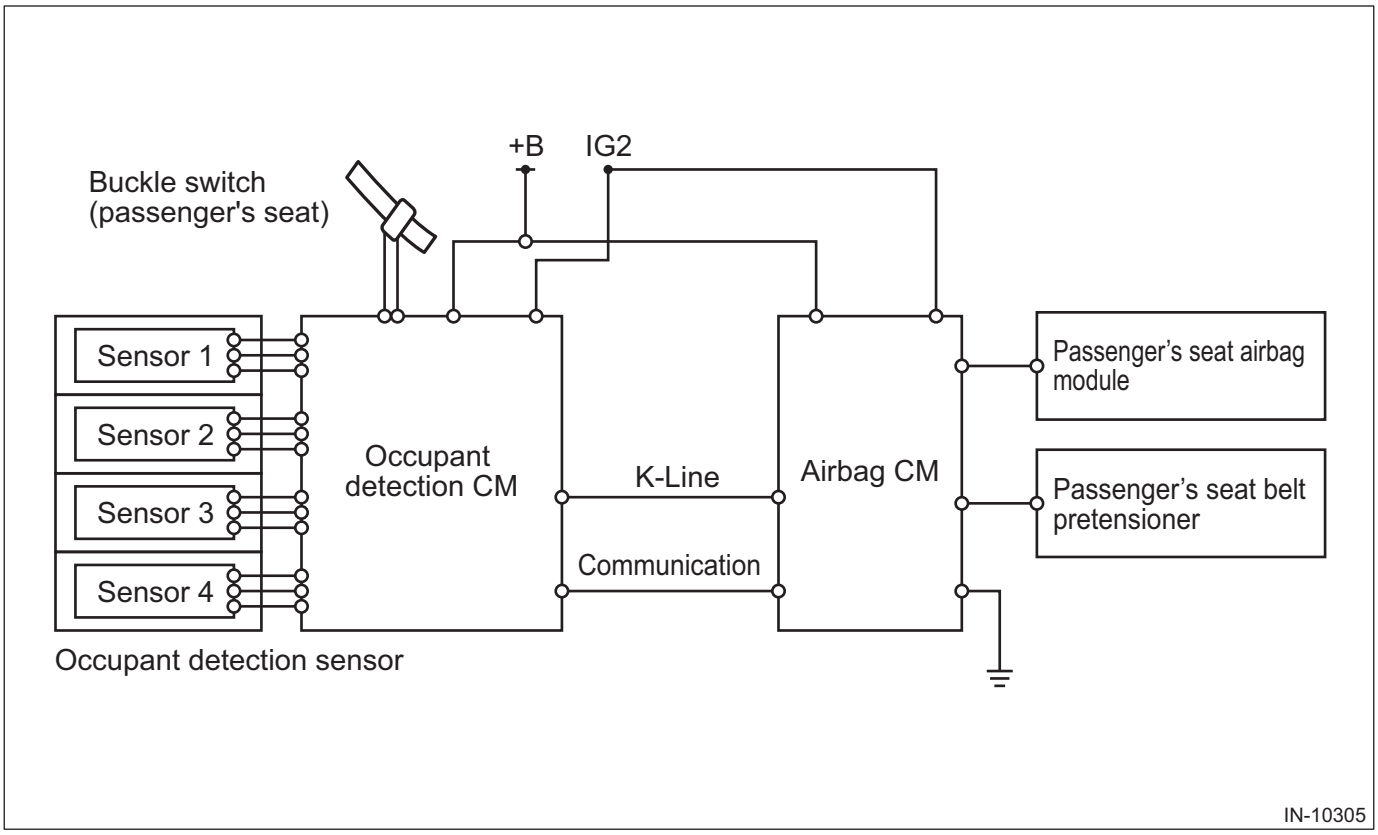
(a) Variable vent hall

■ Occupant detection system (front passenger's seat)

The occupant detection system is composed of four occupant detection sensors (distortion type weight detection sensors) installed between the front passenger's seat side frame and seat slide rails, and an occupant detection control module installed to the frame under the front passenger's seat, and determines the front passenger's seat occupant status based on information about sensor output and buckle switch (front passenger's seat).

The occupant detection sensors detect distortion of the seats as weight when occupants are present, and send information to the occupant detection control module.

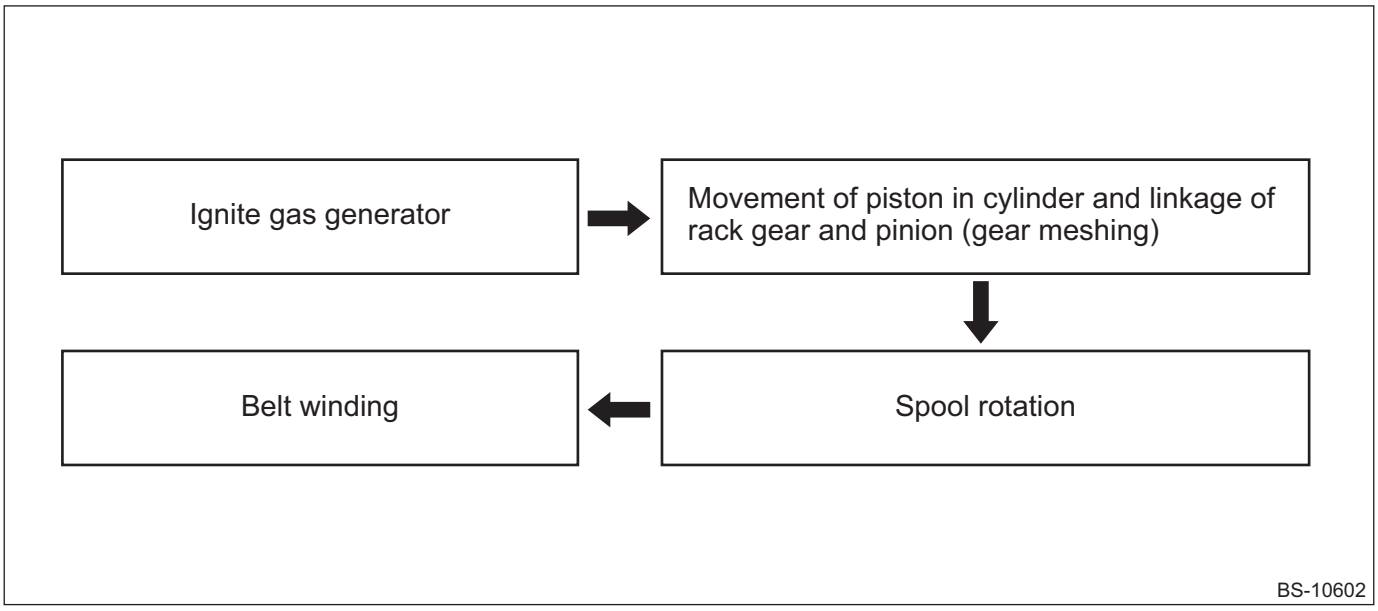
The occupant detection control module automatically determines the status of the front passenger's seat occupant (empty seat or infant + child seat, child + child seat, or adult) and sends information about the occupant status to the airbag control module. The airbag control module controls selection of the seat belt load and deployment/non-deployment of the airbags on collision based on the above information.



Seat belt pretensioner

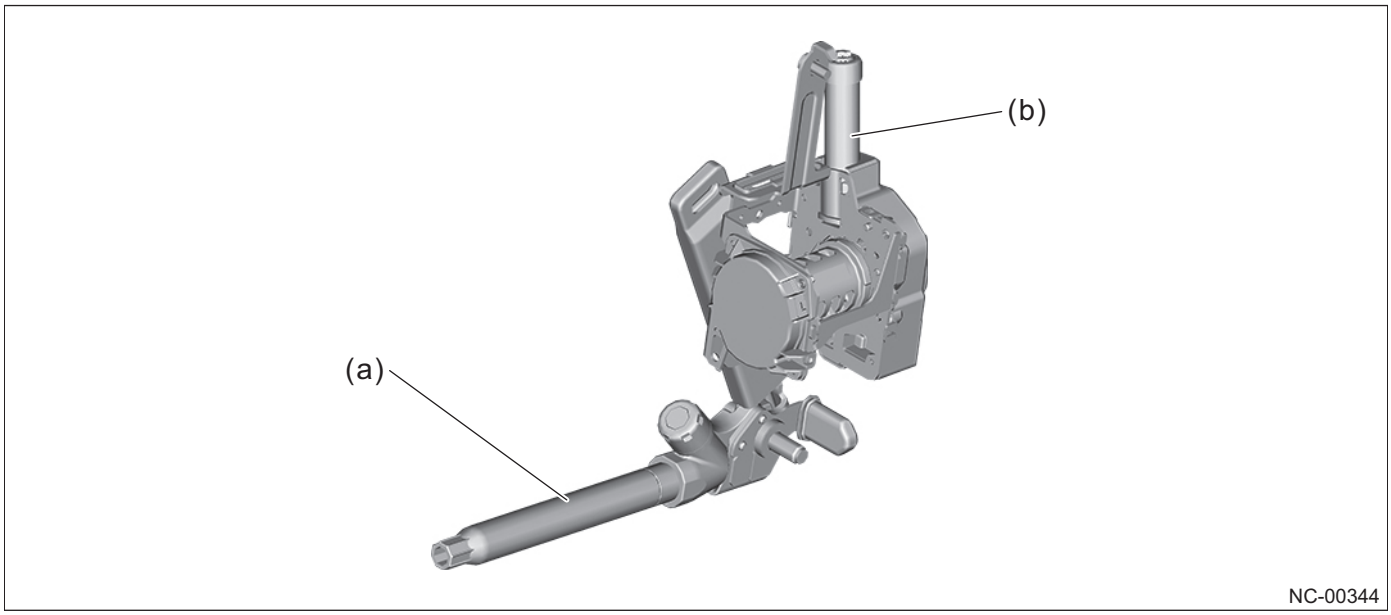
For the driver's and front passenger's seat belt, the lap belt pretensioner is installed that adopts pretensioners for both the shoulder belt and lap belt, and for the seat belt of the outer rear seat, the pretensioner and force limiter are installed to improve the passenger restraining on collision.

Diagram of pretensioner operation



■ Lap belt pretensioner

The lap belt pretensioner is installed that adopts pretensioners for both the shoulder belt and lap belt of the driver's and front passenger's seat belt.



(a) Lap belt pretensioner

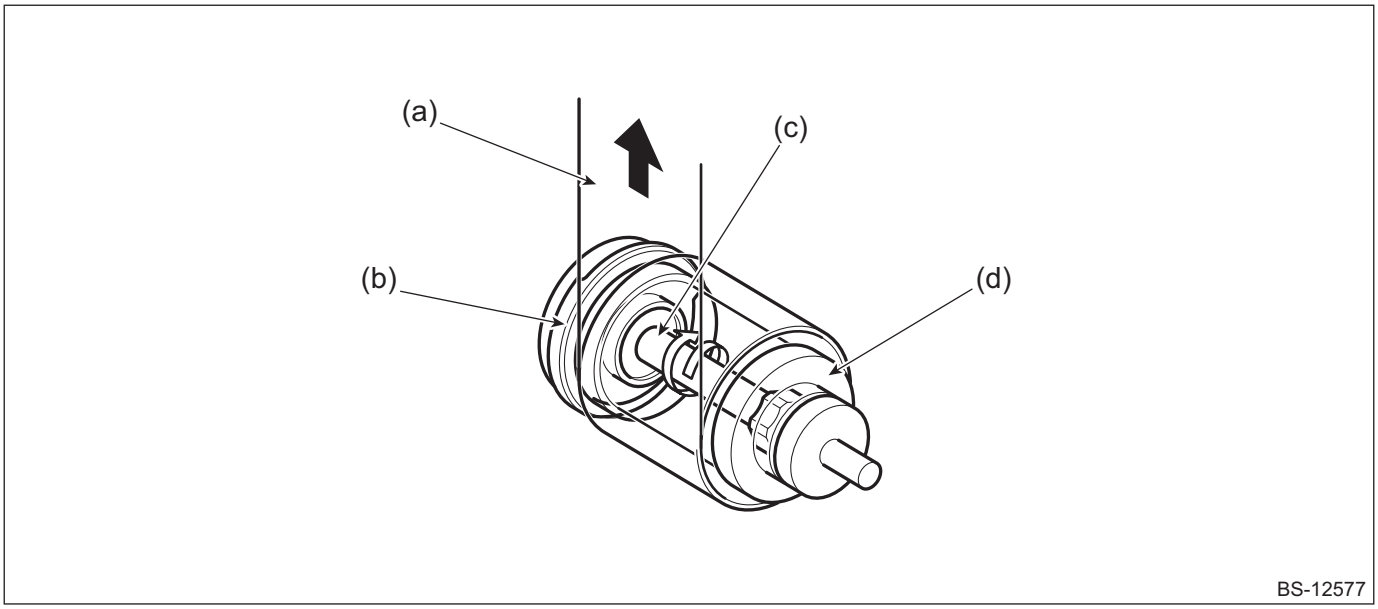
(b) Shoulder belt pretensioner

■ Force limiter mechanism

The force limiter mechanism is composed of a torsion bar, spool, etc. The force limiter function of the seat belt is a function that loosens the seat belt to prevent a load above a certain amount (energy absorption load) from being applied to the passengers when the vehicle collides.

When the pretensioner completes its operation and the seat belt is drawn by passenger motion, the ELR mechanism locks and the force limiter starts to operate. The ELR mechanism operates when the belt is drawn out faster than a specified acceleration value or when acceleration faster than a specified value is applied to the vehicle to lock the belt from being drawn out.

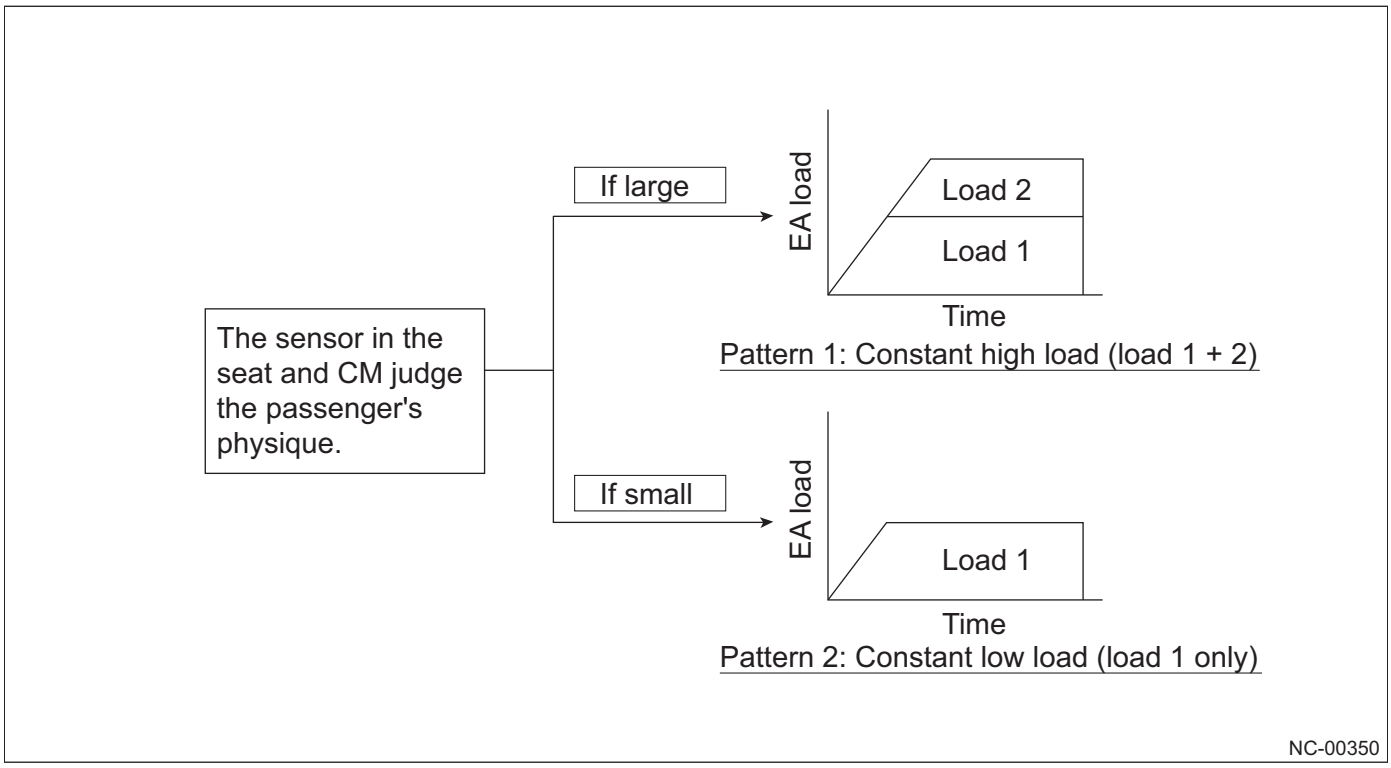
If tension in excess of the specified load is applied to the belt with the ELR locked, the torsion bar twists and the spool mated with the torsion bar spins to pull the belt and keep belt tension constant.



(a) Belt
(b) ELR mechanism
(c) Torsion bar
(d) Spool

■ Adaptive belt mechanism

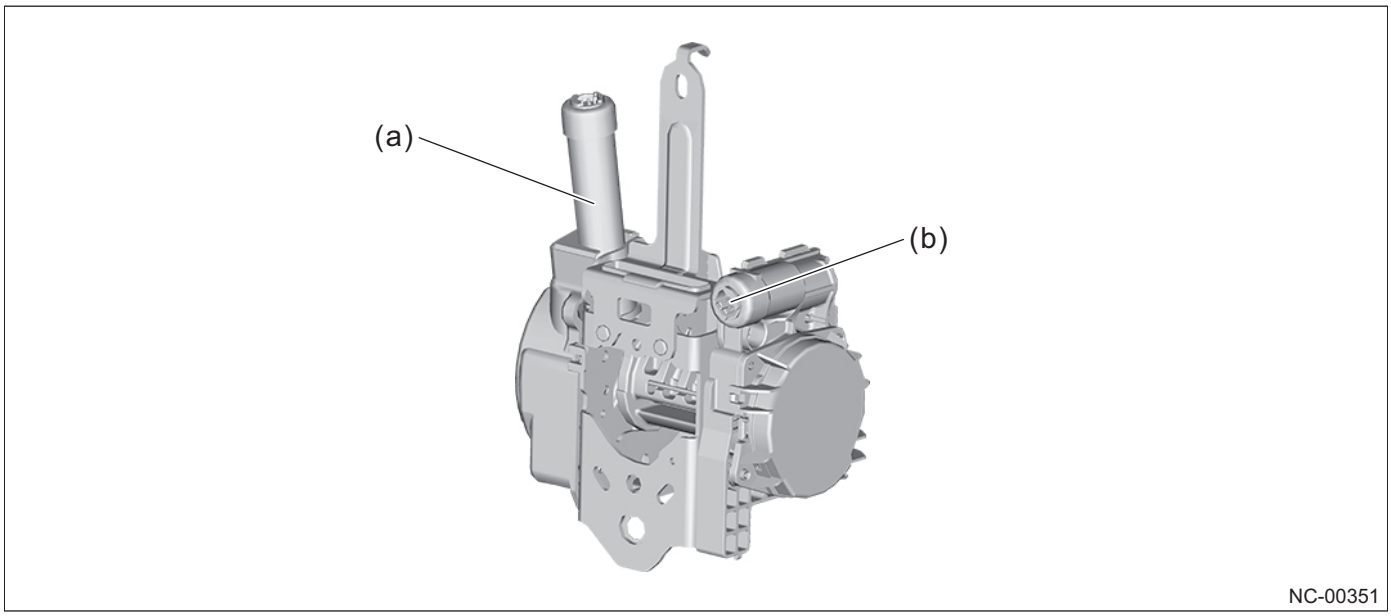
The adaptive force limiter is adopted that can switch the optimal energy absorption load by determining body type of a passenger based on signals from the vehicle.



The gas generator for an adaptive belt is included in the retractor with pretensioner.

On front collision, after the pretensioner is activated, the force limiter maintains seat belt tension at a fixed level while gradually loosening the seat belt to ease pressure on the chest so the excess load of a given level are not applied to the passenger. The fixed load applied to the passenger at that time can be switched according to the collision form and the body type of the passenger.

The fixed load to passengers is switched by activating or deactivating the gas generator for the adaptive belt and selectively operating one of the two torsion bars (for high load and low load) which have different twisting forces.



(a) Gas generator for pretensioner

(b) Gas generator for adaptive belt

10.4 Seat and Seat Belt

10.4.1 Overview

The following changes are implemented for the seats.

Front seat

- The seat cushion shape is changed.
- The plate is added to the lumbar of the backrest.
- The number of divisions on the seat surface is increased.
- The plastic cover is added to the slide rail front end.
- The seat heater area is widened.
- The feet space is widened by changing the slide rail.
- The memory seat is adopted.
- 8-WAY power seat for the front passenger's seat is adopted.
- The plastic cover on the seat side is changed.
- The small article pocket is changed.

Rear seat

- The seat cushion length is extended.
- The number of divisions on the seat surface is increased.
- The seat heater area is widened.
- The rear seat reclining is adopted.
- The level difference of the backrest that is pushed forward is reduced.

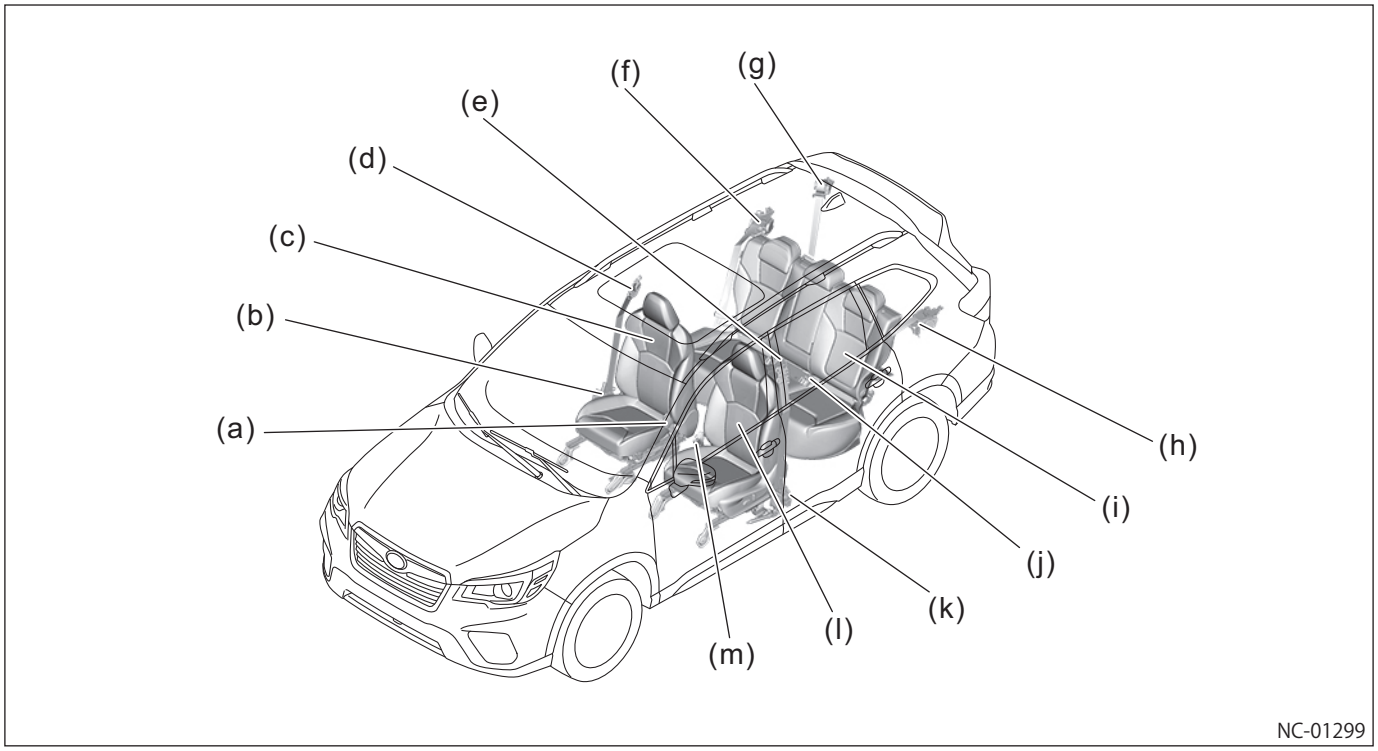
Seat belt

- The tongue cushion is adopted.

10.4.2 Component

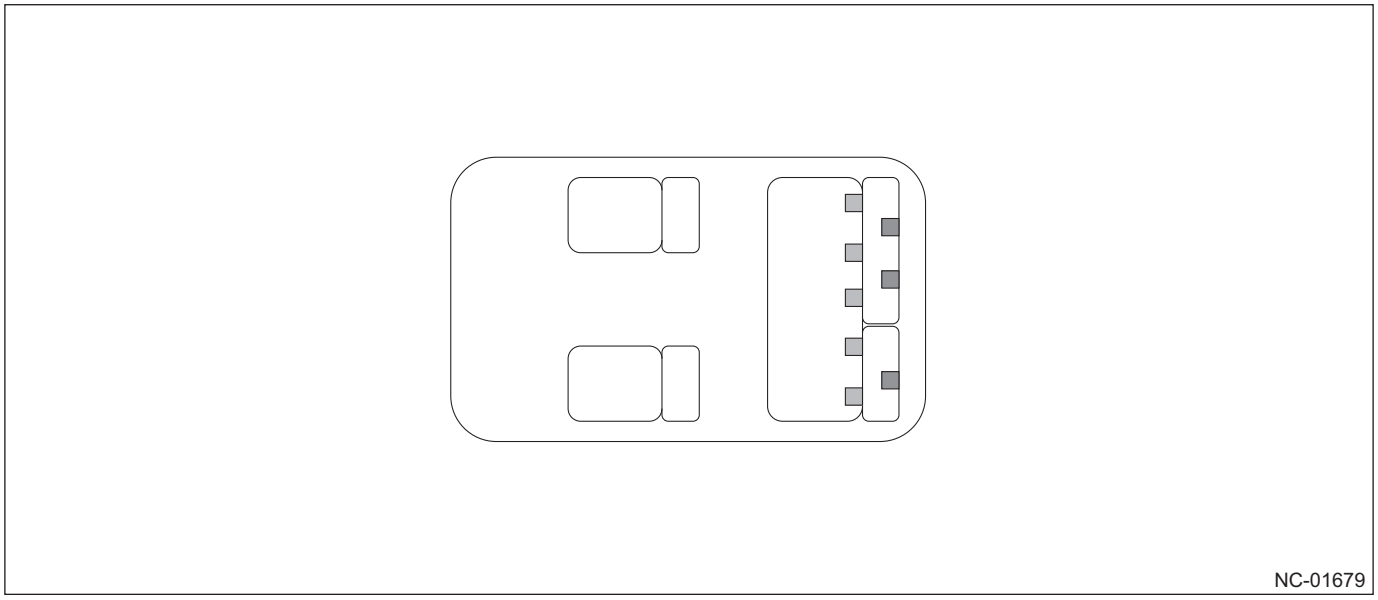
Component layout drawing

Seat layout



(a) Belt assembly front INN RH
(b) Belt assembly front OUT RH
(c) Front seat RH
(d) Seat belt guide
(e) Belt assembly INN center RH
(f) Belt assembly rear OUT RH
(g) Belt assembly rear OUT center
(h) Belt assembly rear OUT RH
(i) Rear seat
(j) Belt assembly rear INN center
(k) Belt assembly front OUT LH
(l) Front seat LH
(m) Belt assembly front INN RH

Layout of anchor for installing child seat



The specification about the anchor for installing child seat (lower anchor, tether anchor) is in accordance with ISO FIX.

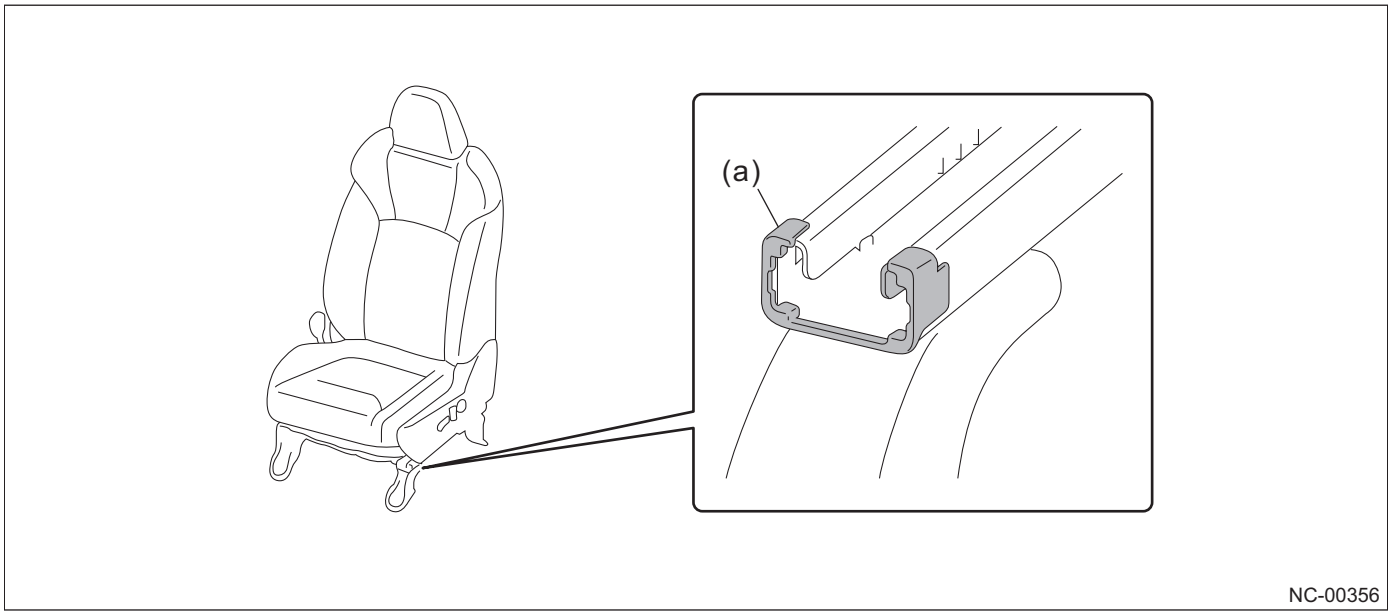
Component details

Front seat

■ Improvement in seating comfort

The following changes are made to realize the front seat that is reliable and comfort when driving.

- The shape of the seat cushion side is optimized in consideration of cushioning and accessibility. A wire is also built in the seat cushion side to improve rigidity and support.
- The plate is added to the lumbar of the backrest to improve face rigidity and support of the upper body.



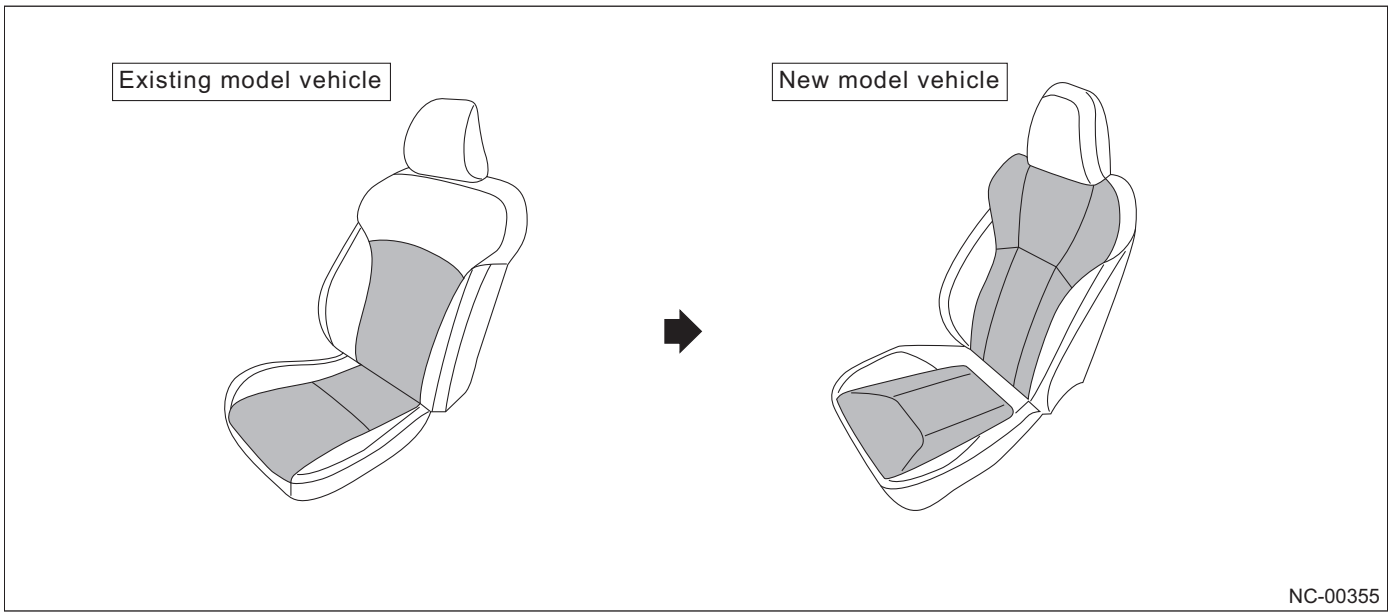
(a) The plate is added to the lumbar of the backrest.

(b) Wire is made with insert molding.

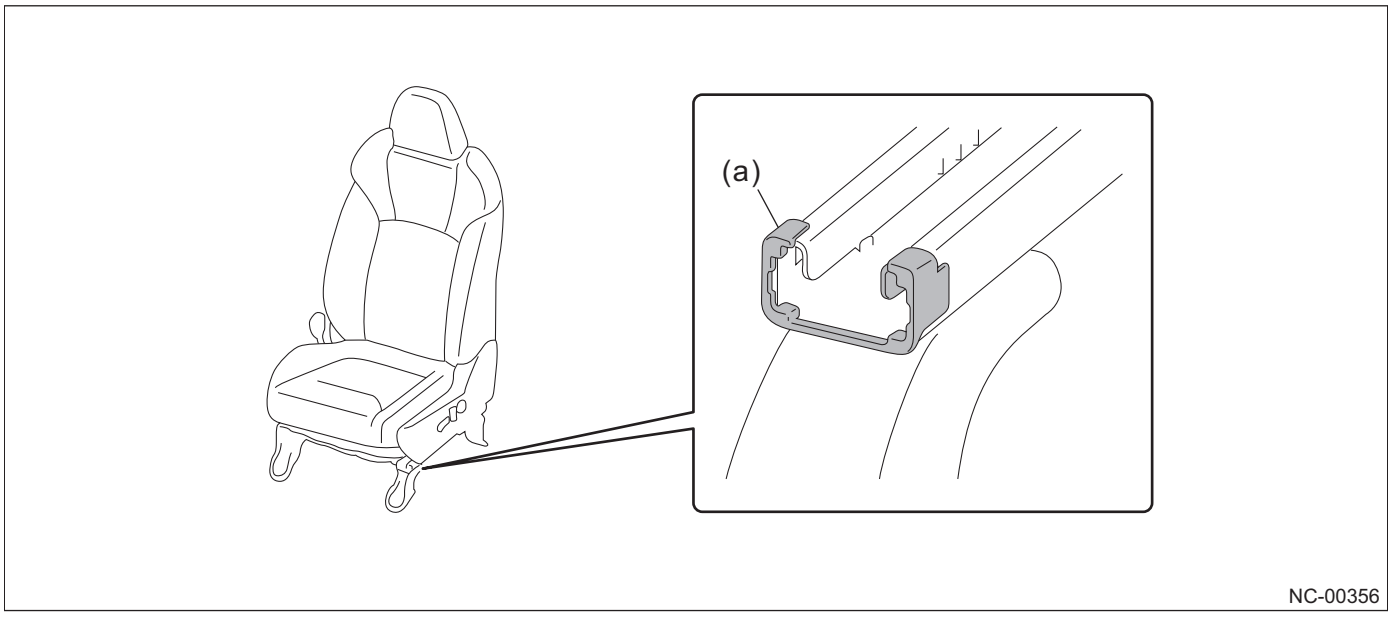
■ Improvement in quality feeling

The number of divisions on the front seat surface is increased for three-dimensional design to improve quality feeling.

The thickness of the urethane on the back side of the surface material for the seating surface is increased to form a shape in three dimensions and improve hand feeling and touch feeling.



A plastic cover is added to the slide rail front end to improve quality feeling and reduce seemingly harmful appearance.

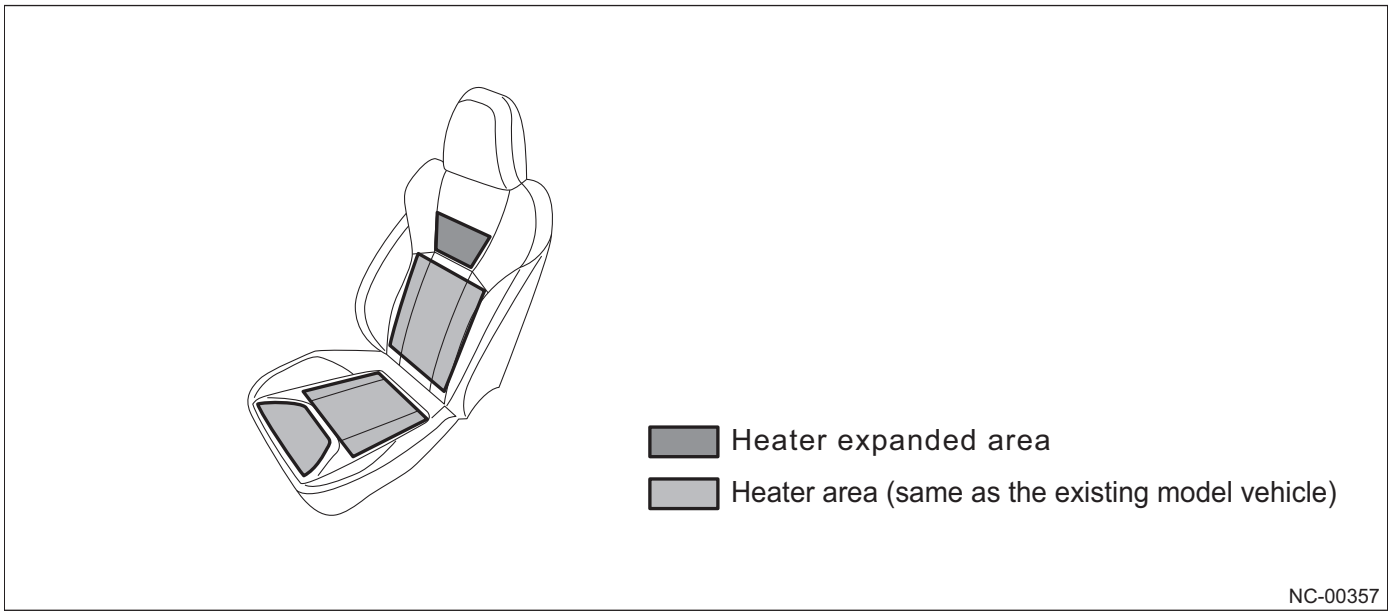


(a) End cap

■ Improvement in comfort

▮ Seat heater

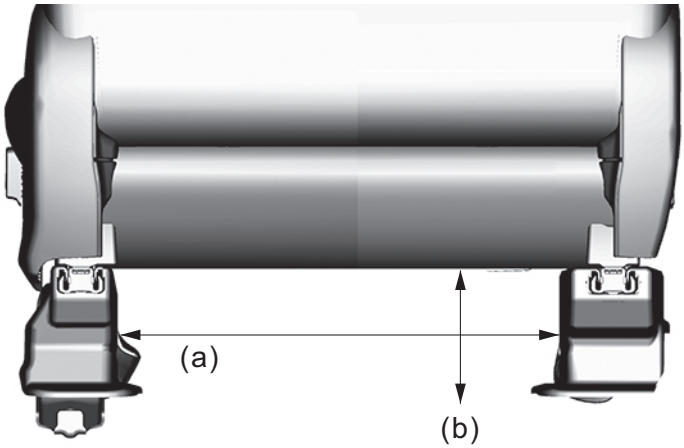
The seat heater area is widened to the backrest upper side to improve comfort.



Slide rail

The width between slide rails and the height between the floor and the seat cushion lower end are widened so that the space of rear seat passengers' feet is widened to improve comfort of the rear seat passengers.

- The width between slide rails is widened by 1.4 in (35 mm).
- The height between the floor and the seat cushion lower end is widened by 0.6 in (14 mm).



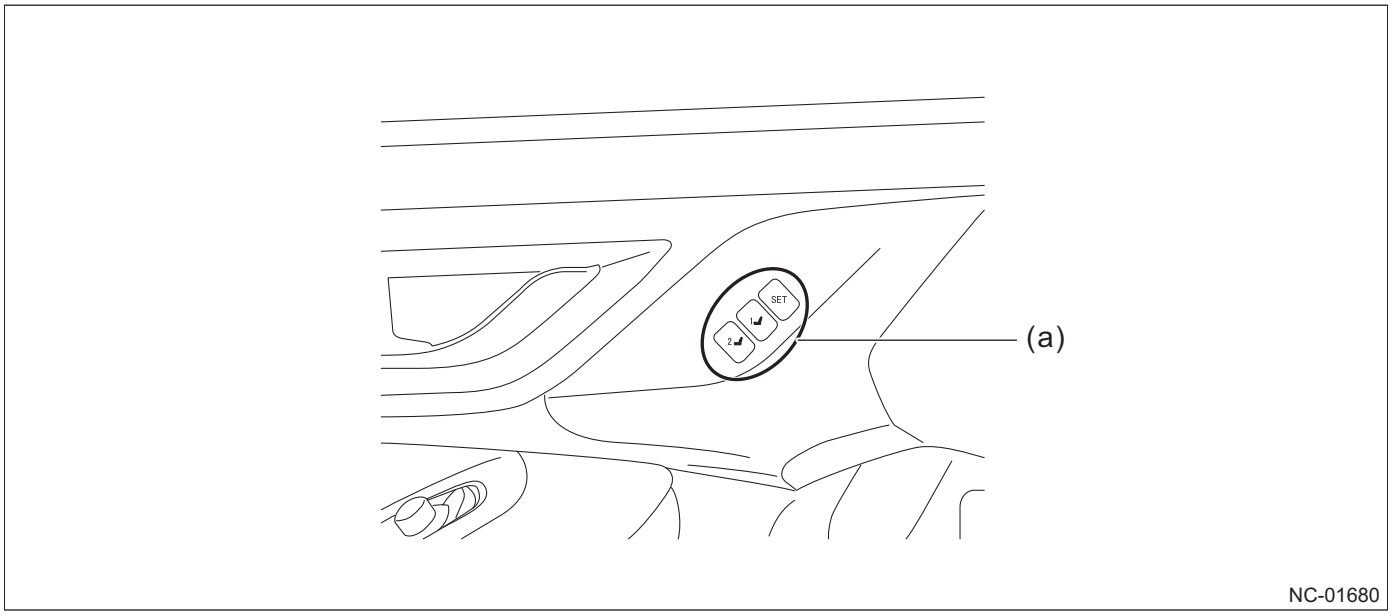
NC-00358

(a) Width between slide rails

(b) Height between the floor and the seat cushion lower end

Memory seat

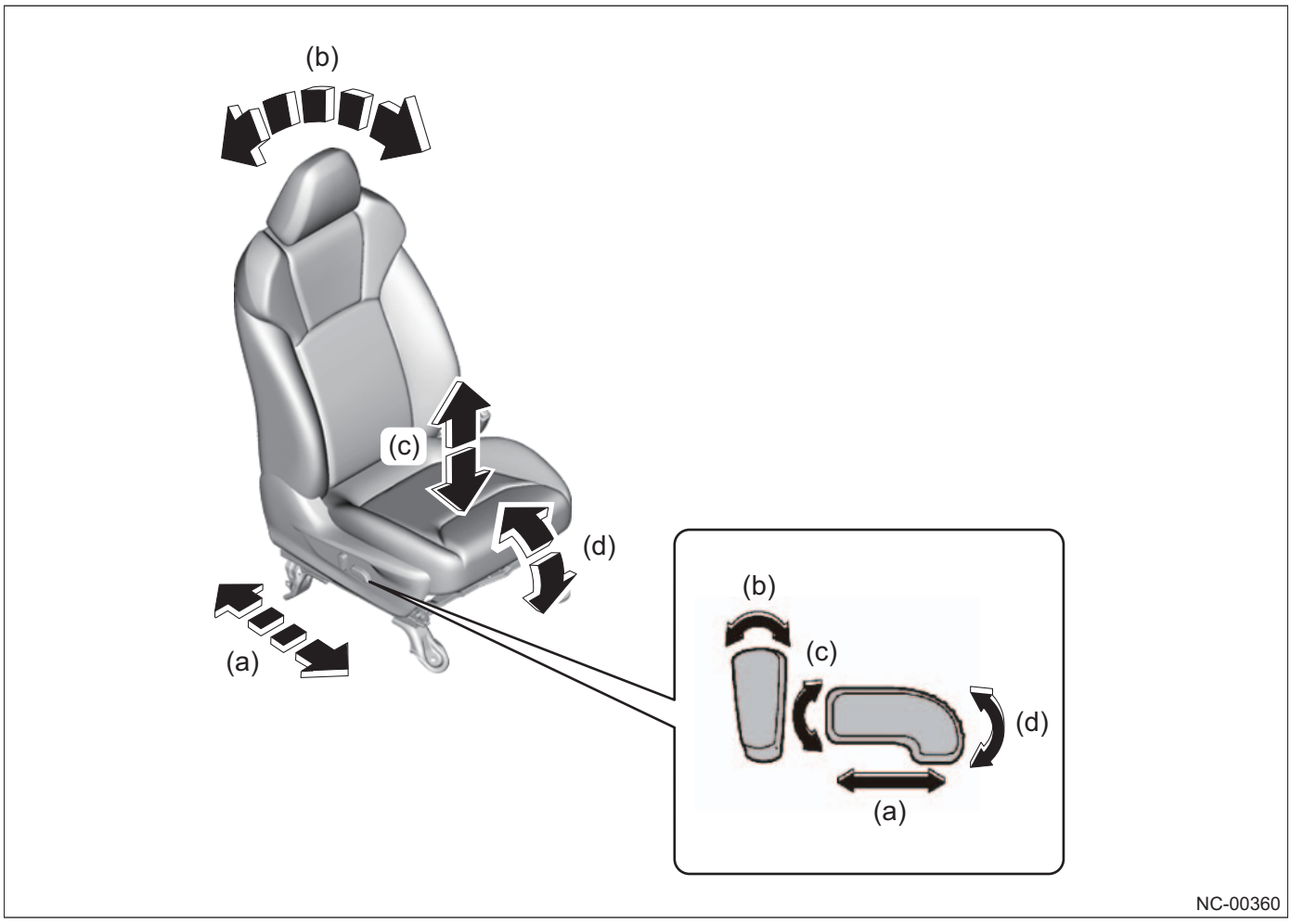
The seat memory function linked with the door mirror is adopted. The function is linked with the driver monitoring system and a function to recall the position of the recognized passenger is added to eliminate the burden of changing driving position when there are multiple drivers. (for some grades)



(a) Seat position memory switch

Power seat

The 8-WAY power seat with the occupant detection function for the front passenger's seat is adopted to improve the comfort in the front passenger's seat. (for some grades)

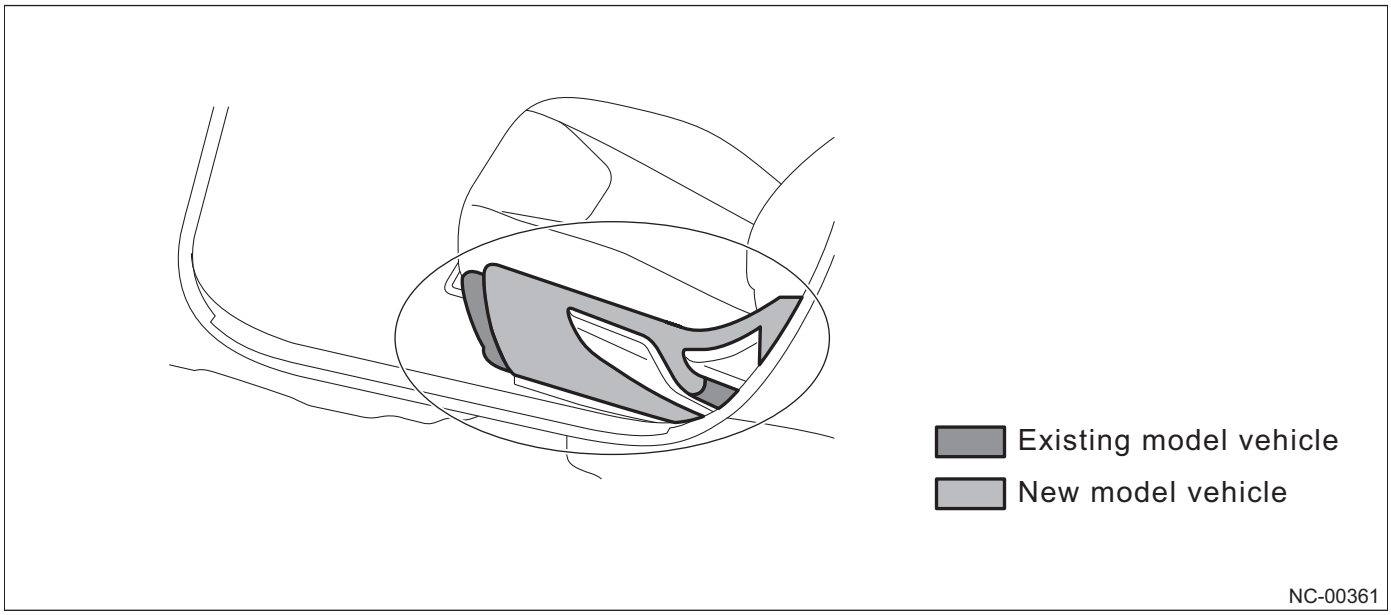


(a) Slide adjustment
(b) Reclining adjustment
(c) Lifter adjustment
(d) Tilt adjustment

■ Improvement in accessibility

▮ Hinge cover

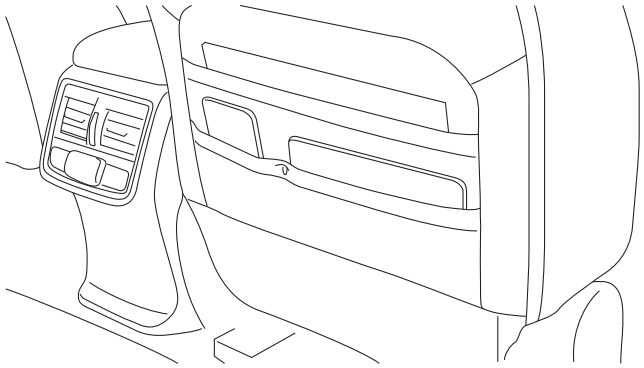
The plastic cover shape on the seat side is changed so passengers' feet do not hit when exiting the vehicle. Also, the hinge cover front end position is moved backward to widen the space where feet pass to easily enter and exit the vehicle. In addition, a function that slides the seat backward for an easy entry if the seat is positioned significantly forward when entering the vehicle is added to models with the driver monitoring system.



■ Improvement in practicability

▮ Seat back pocket

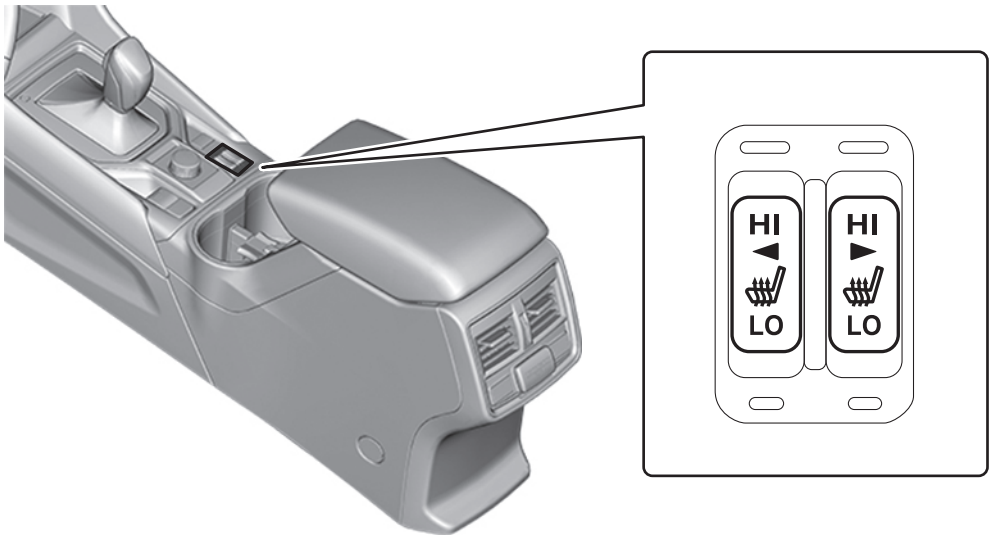
In addition to the existing magazine pocket, a small article pocket is added. Usability is improved by allowing rear seat's passengers to put a tablet device or a smartphone. (for some grades)



NC-00362

Seat heater switch

The driver's and front passenger's seat heater switches are installed in the center console. (for some grades)

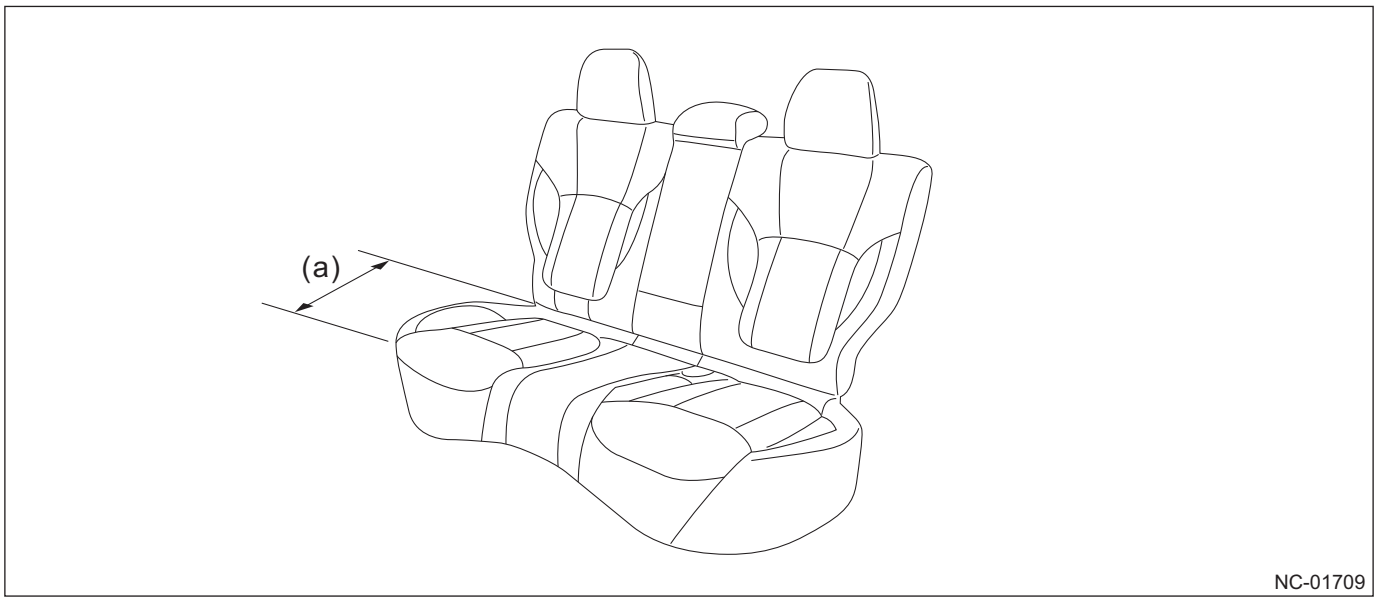


NC-01681

Rear seat

■ Improvement in seating comfort

The seat cushion length is extended by 0.6 in (15 mm) compared to the existing model vehicle to improve the support for the thighs. In addition, the supporting reaction force of the cushion surface is enhanced to improve the stability of the passenger's posture. Also, the backrest shape is revised to be along the passenger's back to improve the fit.

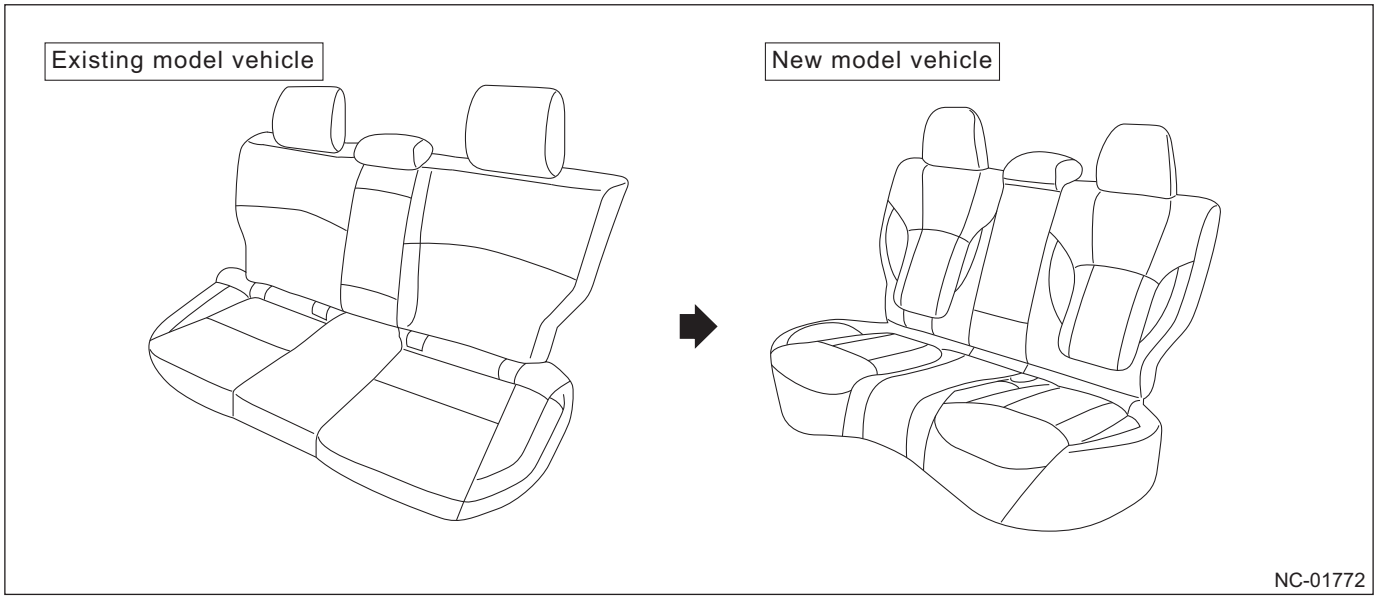


(a) Cushion length

■ Improvement in quality feeling

The number of divisions on the rear seat surface is increased for three-dimensional design to improve quality feeling.

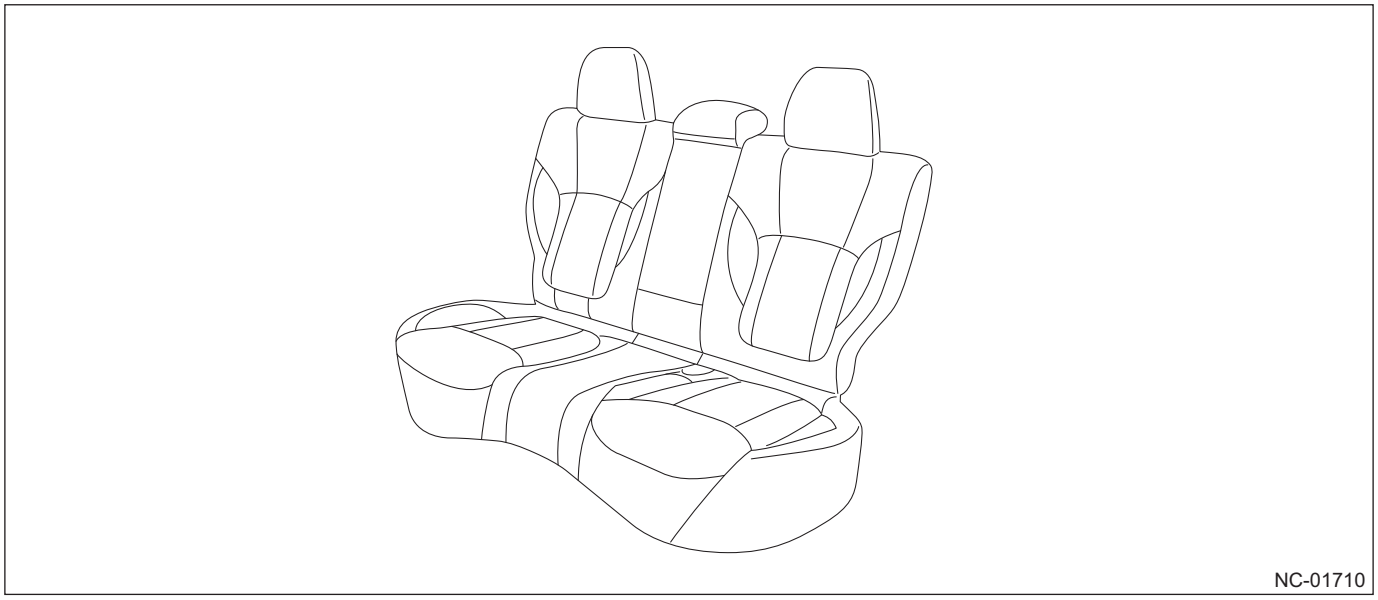
The thickness of the seat cushion is increased to form a shape in three dimensions and improve hand feeling and touch feeling.



■ Improvement in comfort

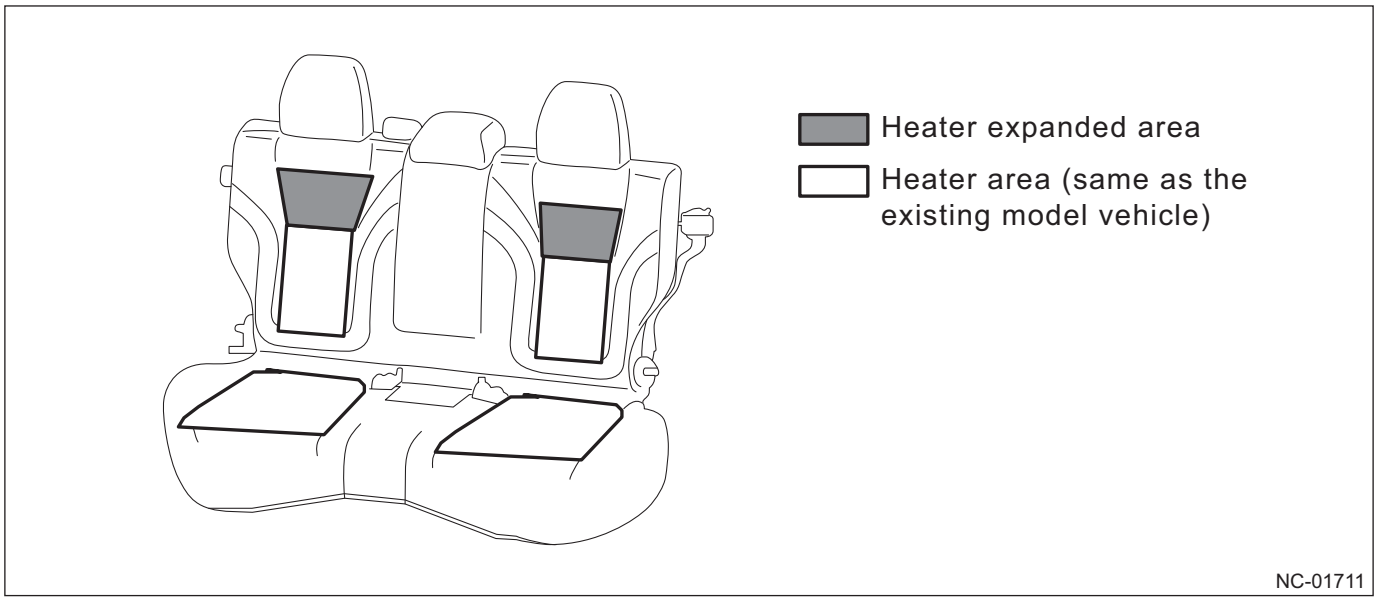
▮ Seat cushion

The length of the seat cushion is extended and the hip point is moved backward by 0.98 in (25 mm) compared to the existing model vehicle to optimize the front seat backrest and widen the rear seat occupied space.



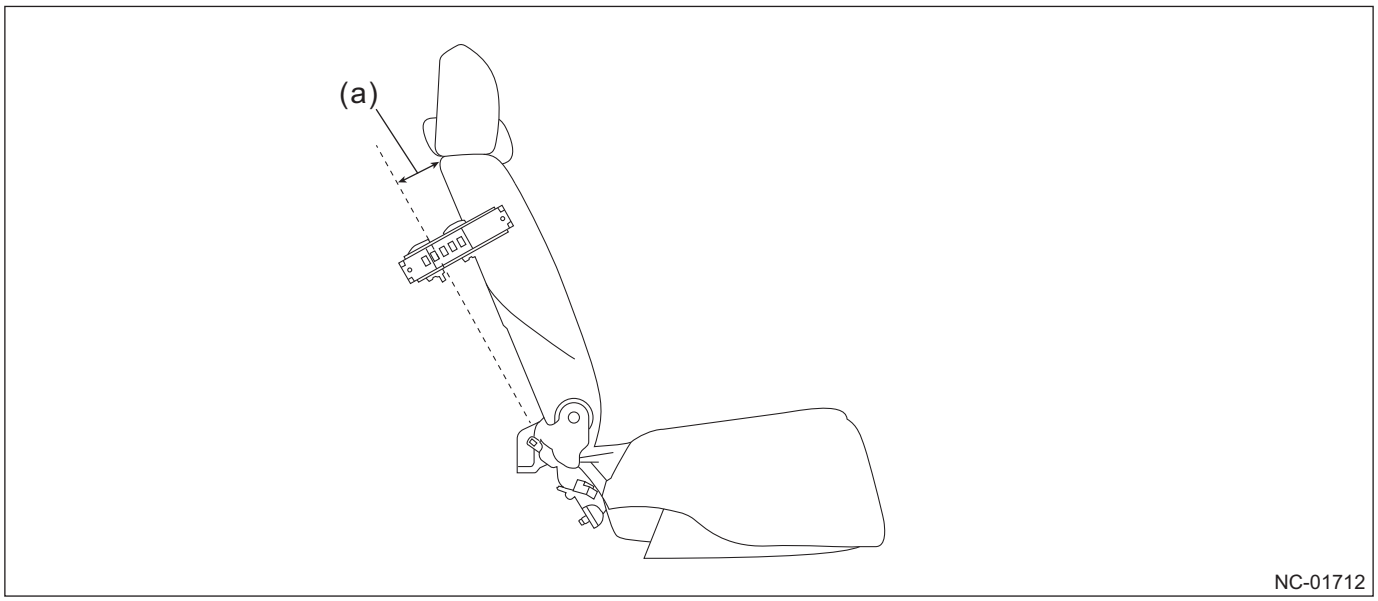
▮ Seat heater

The rear seat heater heating area is widened to the backrest upper side to improve comfort. (for some grades)



Rear seat reclining (for some grades)

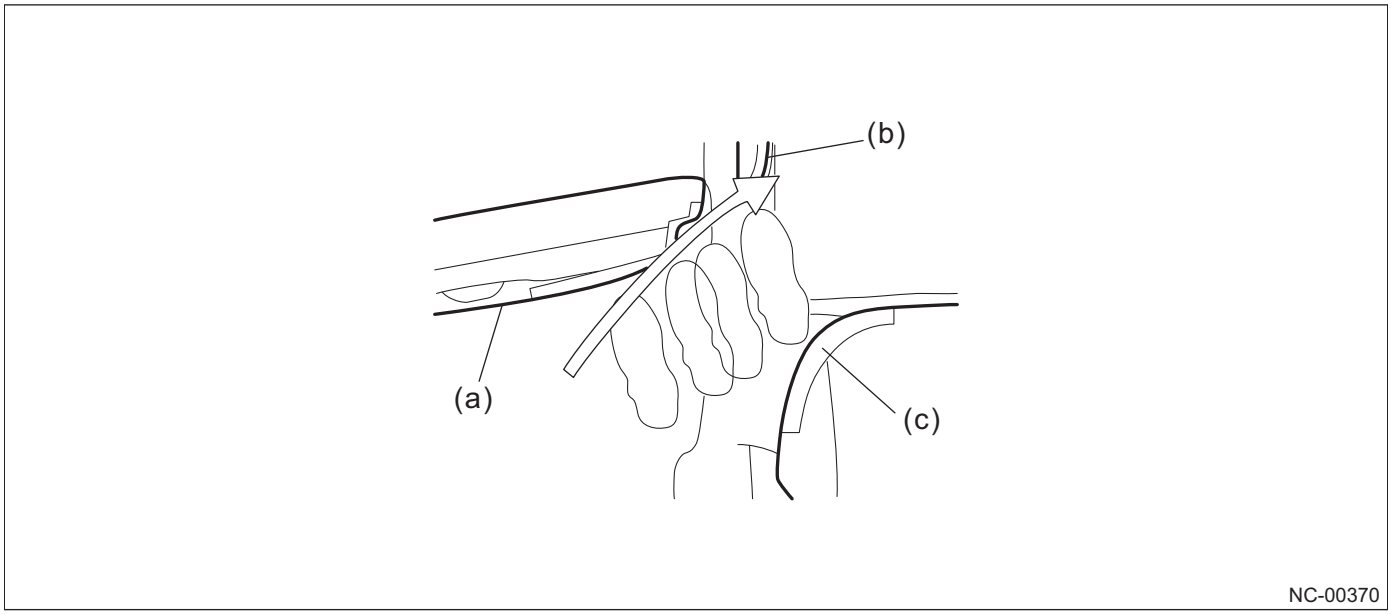
The reclining mechanism that can adjust the angle of the rear seat backrest in five levels is adopted.



(a) Reclining movement range

■ Improvement in accessibility

The shape of the rear seat cushion corner (where passenger's feet pass through) is revised to improve accessibility.

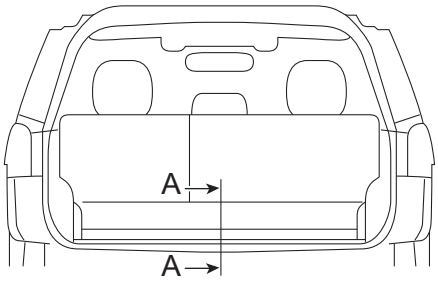


(a) Rear door
(b) B pillar trim
(c) Rear seat cushion corner

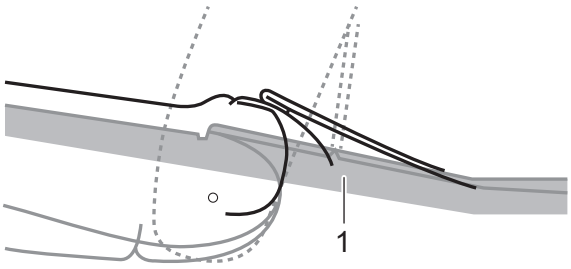
■ Improvement in practicability

When the backrest is tilted to serve as a luggage compartment surface, the level difference with the luggage compartment at the front and back side and the level difference with the backrests at the right and left side are reduced compared to the existing models to improve practicability and usability.

Step between the front and rear



A-A cross section

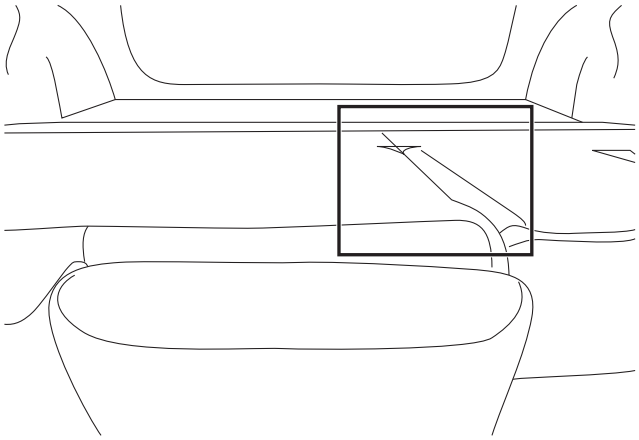


Existing model vehicle

New model vehicle

(1) Floor

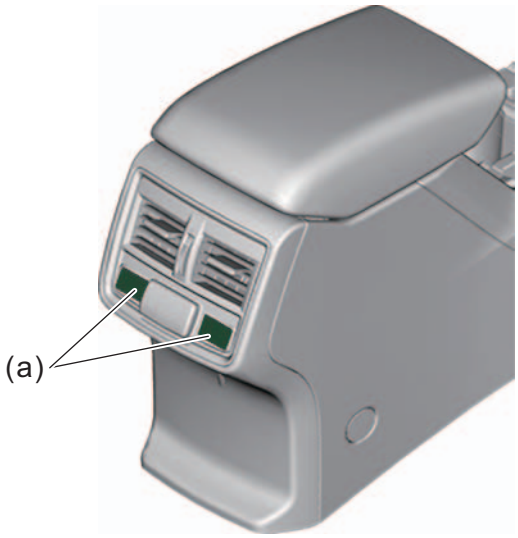
Step between the left and right



NC-00371

Rear seat heater switch (for some grades)

The rear seat heater switch is installed at the center console rear portion.



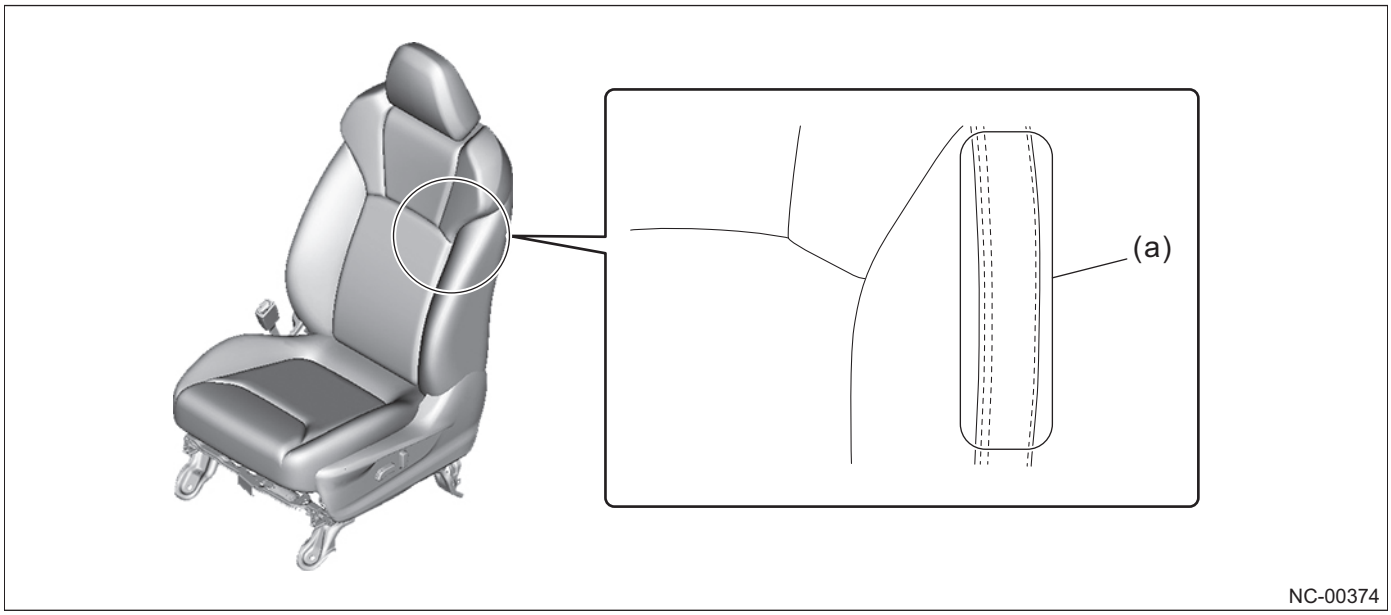
NC-00372

(a) Rear seat heater switch

Seat surface

■ Fabric seat (for some grades)

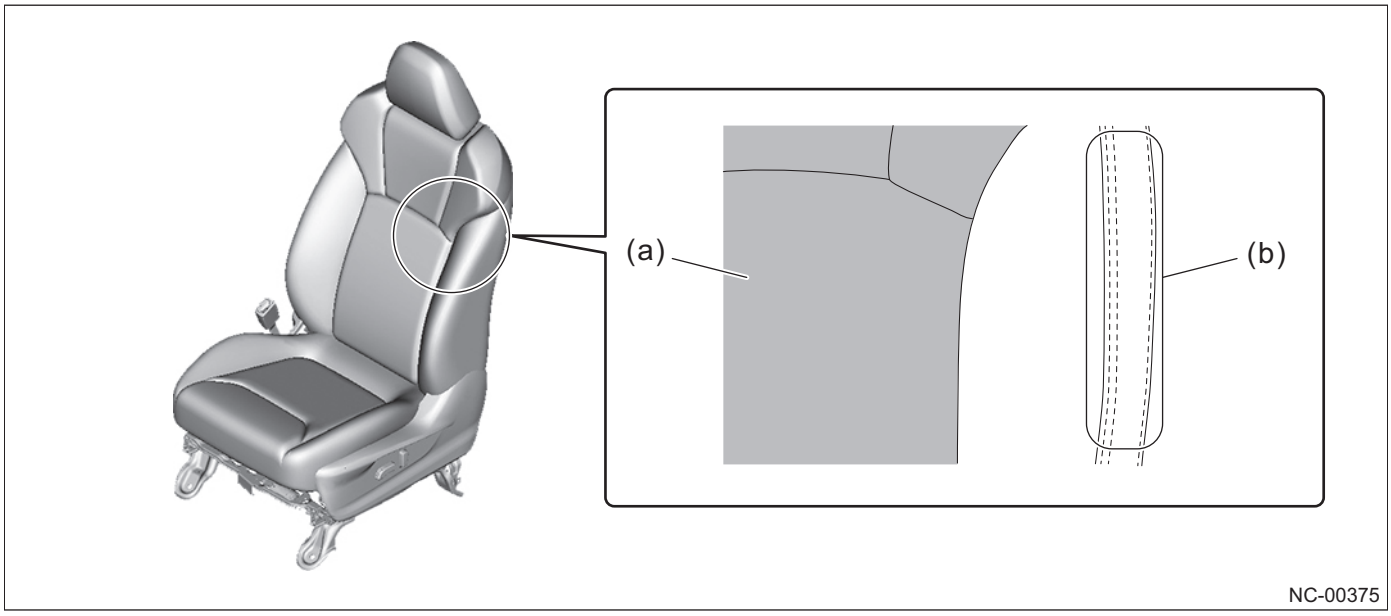
The SUV toughness of accommodating to various usages is expressed through three-dimensional blocky geometric patterns. A comfortable seat surface with superior texture is realized. For places that tend to be worn by passengers' getting in and out of the vehicle, a band shaped material is added so that the area is hard to be torn, with quality feeling enhanced.



(a) Band shaped fabric

■ Leather seat (for some grades)

High quality rich leather, functional punching processing, and three-dimensional texture with quilt-sewing are adopted to realize soft and comfortable premium seat. The silver stitch located on the band provides contrast to the seat and further enriches the interior design of the vehicle.



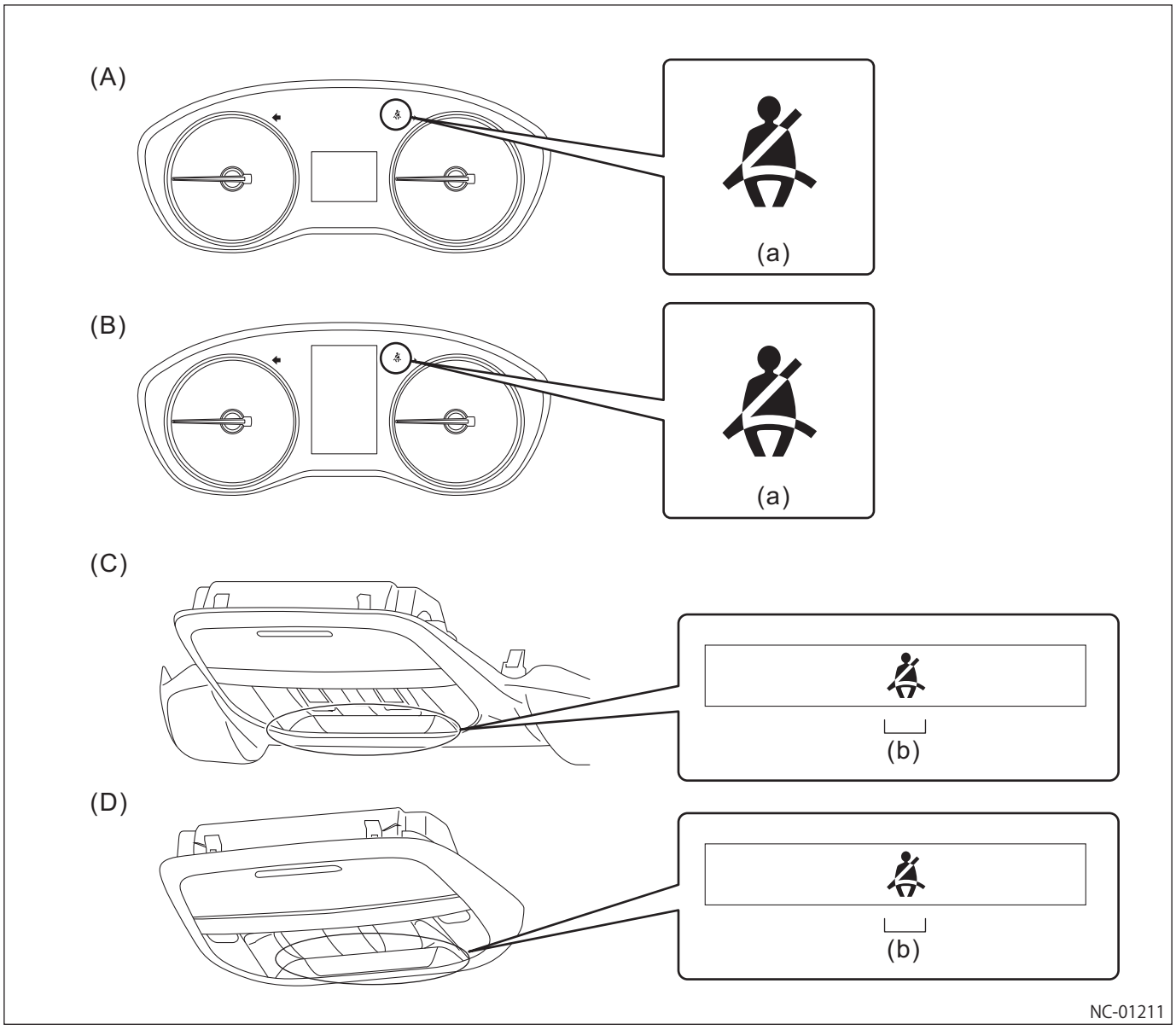
(a) Punching processed area

(b) Band area

Seat belt

■ Seat belt warning light

The driver's seat belt warning light is located in the combination meter. The front passenger's seat belt warning light is also located in the warning box.

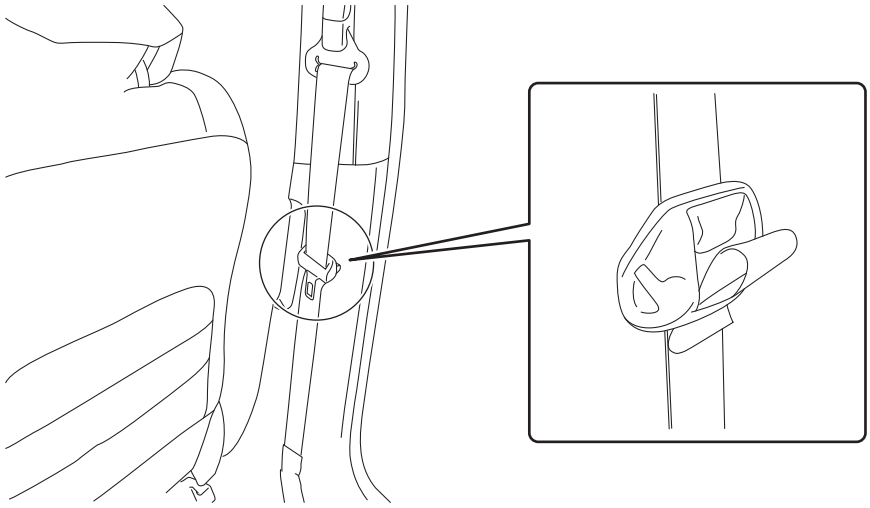


(A) Normal meter
(B) High grade meter
(C) Warning box (model with EyeSight)
(D) Warning box (model without EyeSight)

(a) Driver's seat belt warning light
(b) Front passenger's seat belt warning light

■ Tongue cushion

The tongue cushion is adopted to eliminate the sound of tongue hitting the trim when the vehicle is traveling without a passenger in the front seat and outer rear seat.

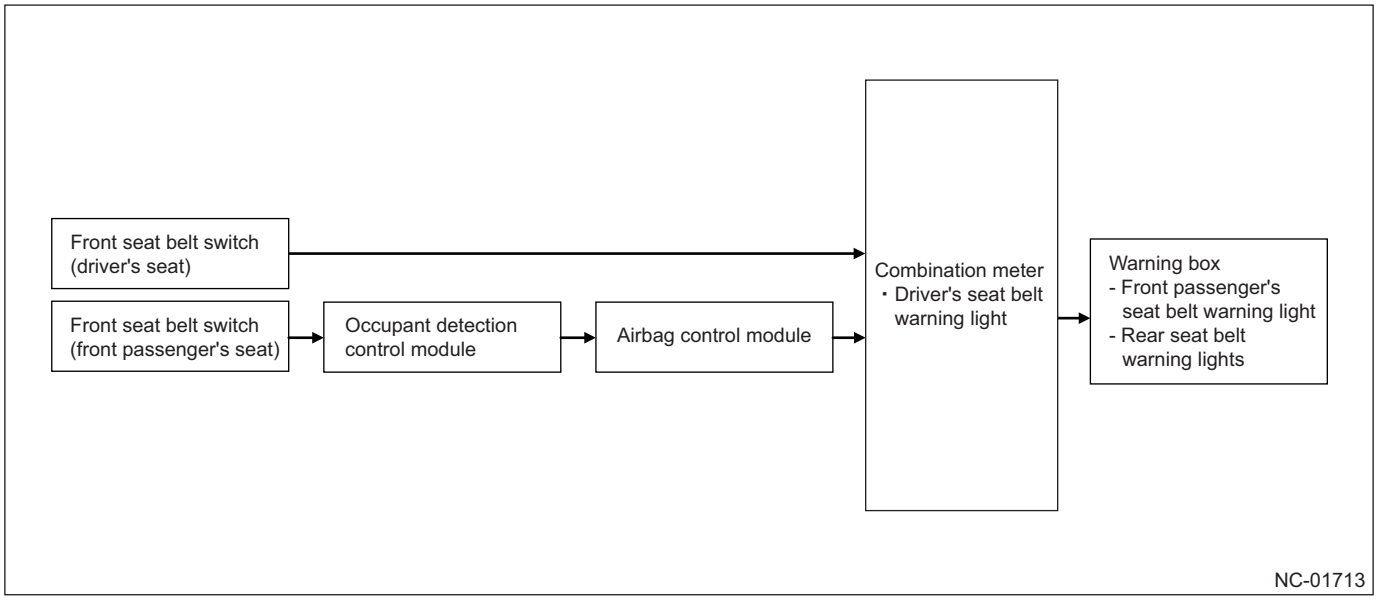


NC-00377

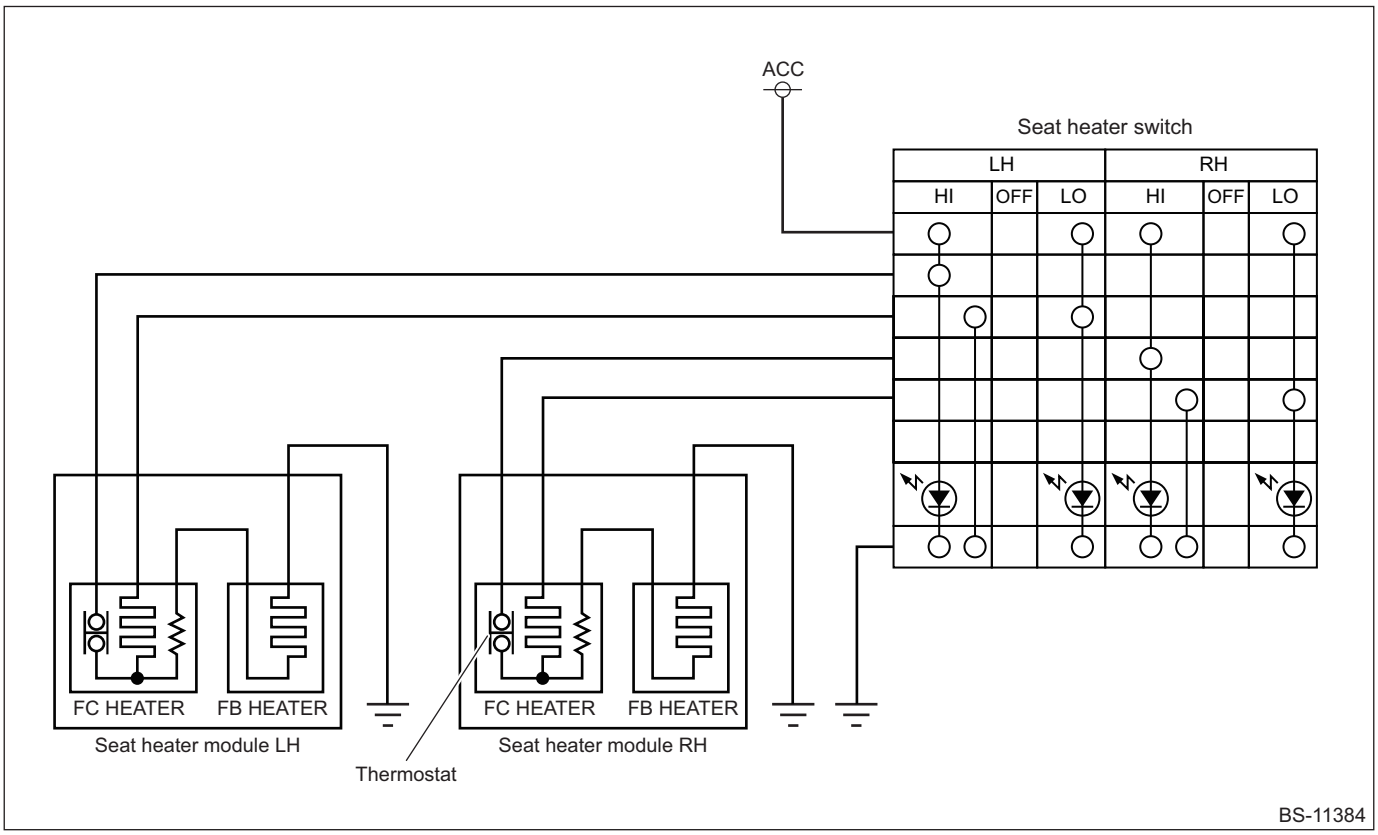
10.4.3 Construction and Operation

System diagram

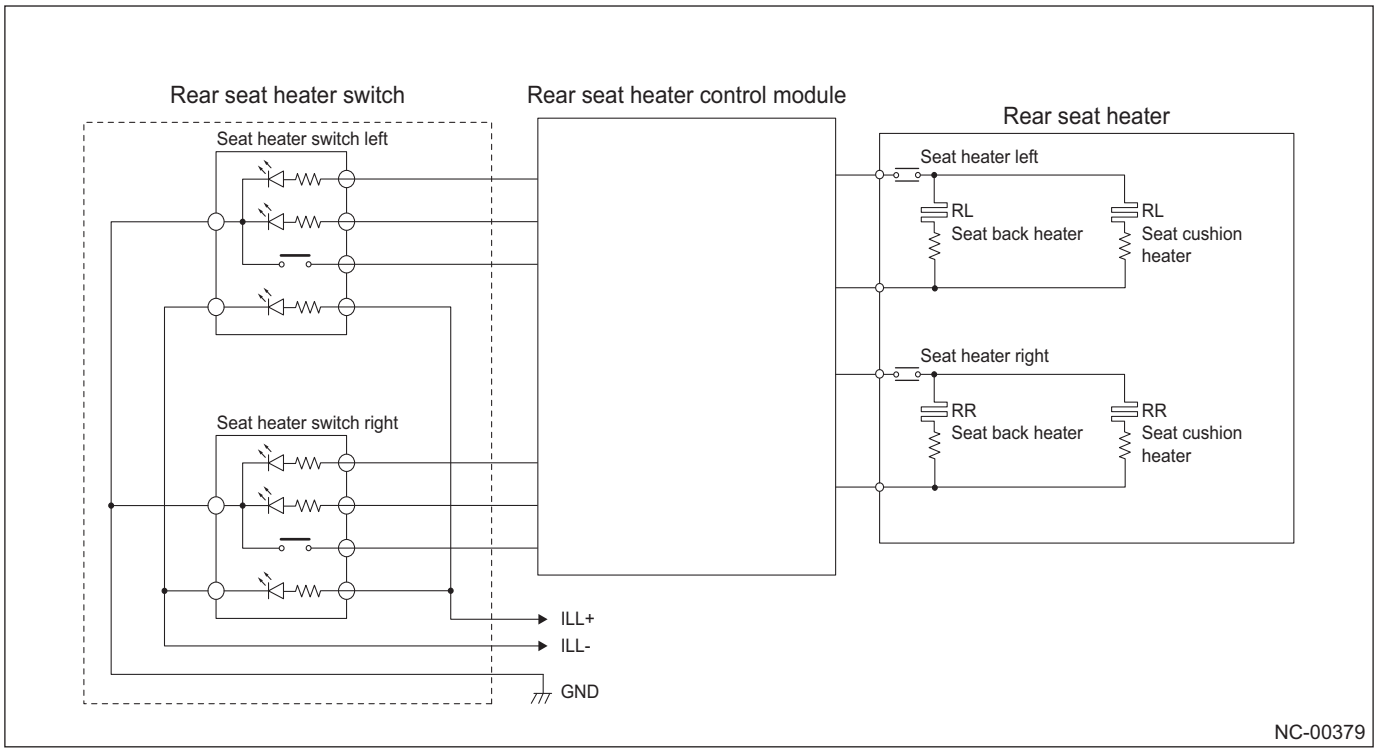
Seat belt warning light



Front seat heater



Rear seat heater



System details

Seat belt warning light

If a driver is not wearing the seat belt when the ignition switch is turned on, the system warns the driver by illuminating the driver's seat belt warning light in the combination meter. Also, if a front seat passenger is not wearing a seat belt, the system warns the driver by illuminating the front passenger's seat belt warning light in the warning box.

When an occupant on the driver's seat or front passenger's seat doesn't wear a seat belt and the vehicle travels (at the vehicle speed of 12.4 MPH (20 km/h) or more), the seat belt warning light flashes and the buzzer sounds.

Front seat heater (for some grades)

The all seat heater switches have two settings: HI mode and LO mode. An indicator light is installed in the switch to make seat heater status visible.

Rear seat heater (for some grades)

The rear seat heater is composed of a seat heater switch, a seat heater control module, and a heater. The seat heater turns on by operating the seat heater switch to input a signal to the seat heater control module. The mode of the heater is switched in the order of LO, HI, and OFF every time the switched is operated. The seat heater control module turns on the operation indicator light installed in the switch depending on the heater mode to confirm the operating status of the seat heater.

Seat memory linked door mirror (for some grades)

The seat memory function is installed to allow seat position and the door mirror surface position to be easily adjusted in case there are multiple drivers. Seat positions and door mirror surface positions are registered for each of the "1" or "2" button inside the driver's seat door and the access key to recall each seat position and the door mirror surface angle. Also, the function is linked with the driver monitoring system and eliminates the burden of changing driving position when there are multiple drivers. The driver monitoring system link function can be turned on/off in the customizing screen of the multi-function display (MFD).

Seat belt structure

Equipment list

Equipment	Front seat	Outer rear seat
Locking tongue	✓	✓
Adaptive belt	✓	-
Lap belt pretensioner	✓	-
Tongue cushion	✓	✓
Pretensioner and force limiter	✓	✓

Refer to "10.3 Airbag System" for the following equipment.

- Locking tongue
- Adaptive belt
- Lap belt pretensioner
- Seat belt pretensioner
- Force limiter

10.5 Instrument Panel

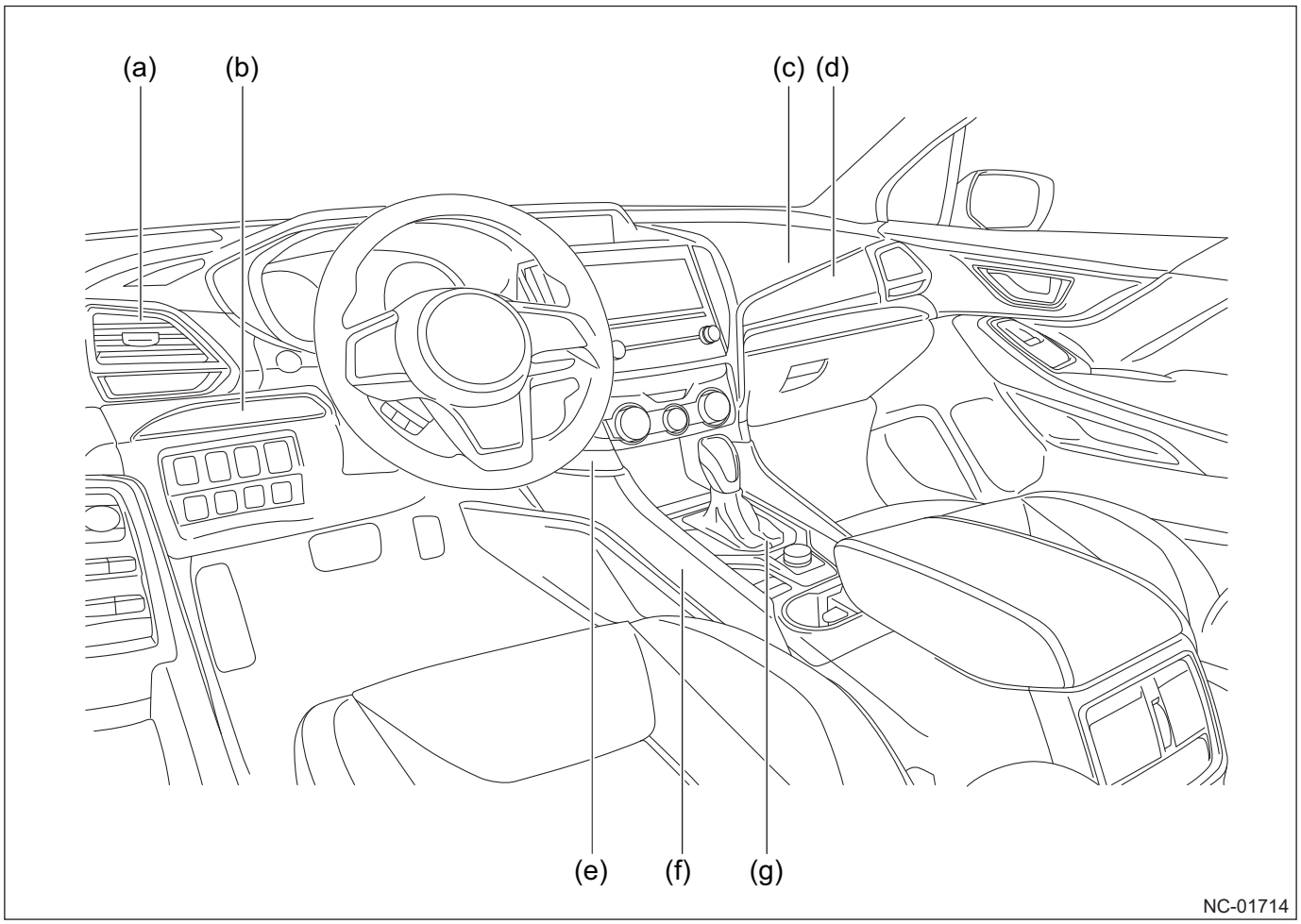
10.5.1 Overview

Quality feeling of the instrument panel is improved by providing stitch and decoration at any place. The air flow outlet of the air conditioner, the speaker, each switch, and the lever are improved in both the design and function. Also, material, surface material, and stitch are tailored according to the characteristic of each grade.

*The specifications differ by vehicle grade.

10.5.2 Component

Component layout drawing



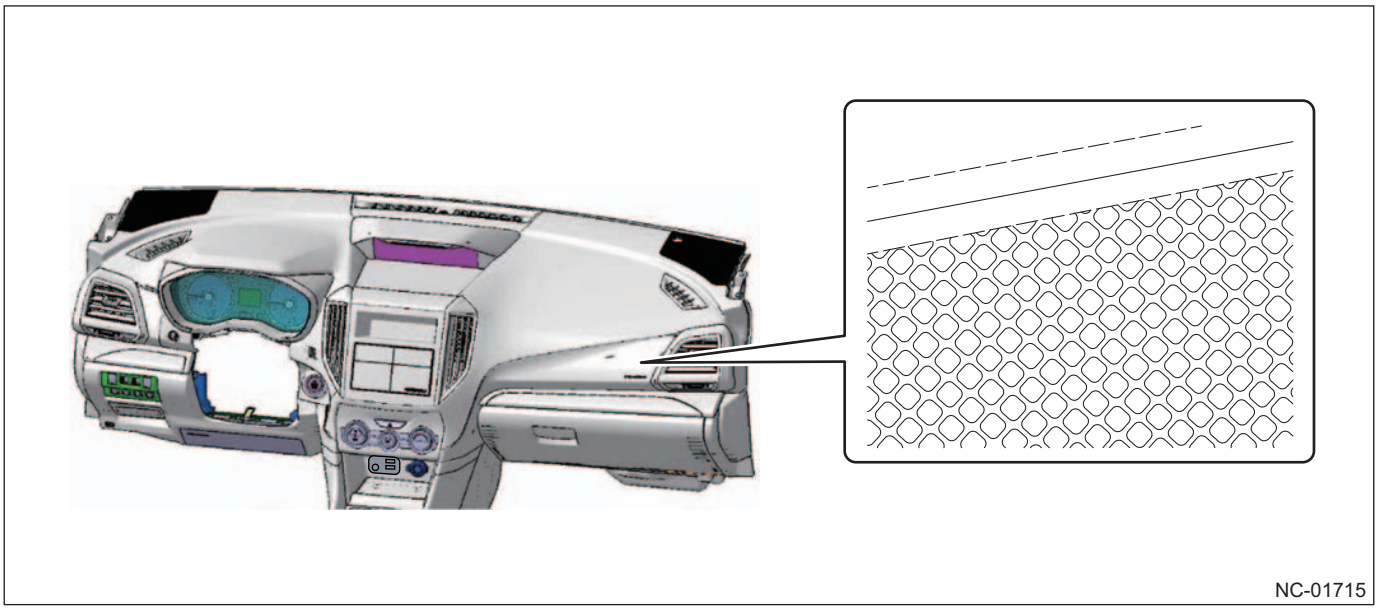
(a) Side vent grille decoration
(b) Four types of decoration specification
(c) Double stitch
(d) Geometry texture
(e) Silver decoration on upper side
(f) Upholstered console side + double stitch
(g) Decoration around the shift panel

Component details

Instrument panel

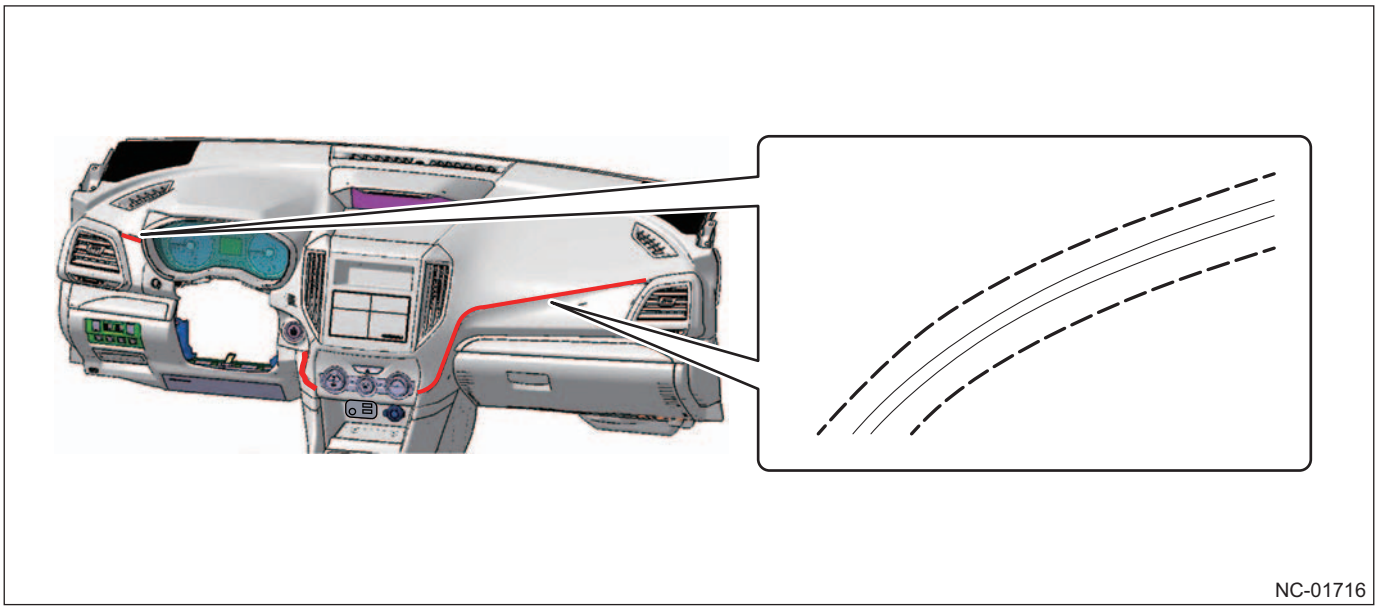
Quality feeling is improved by placing texture and the stitch at points and type and coloring is tailored to the characteristic of each grade.

■ **Geometry texture**



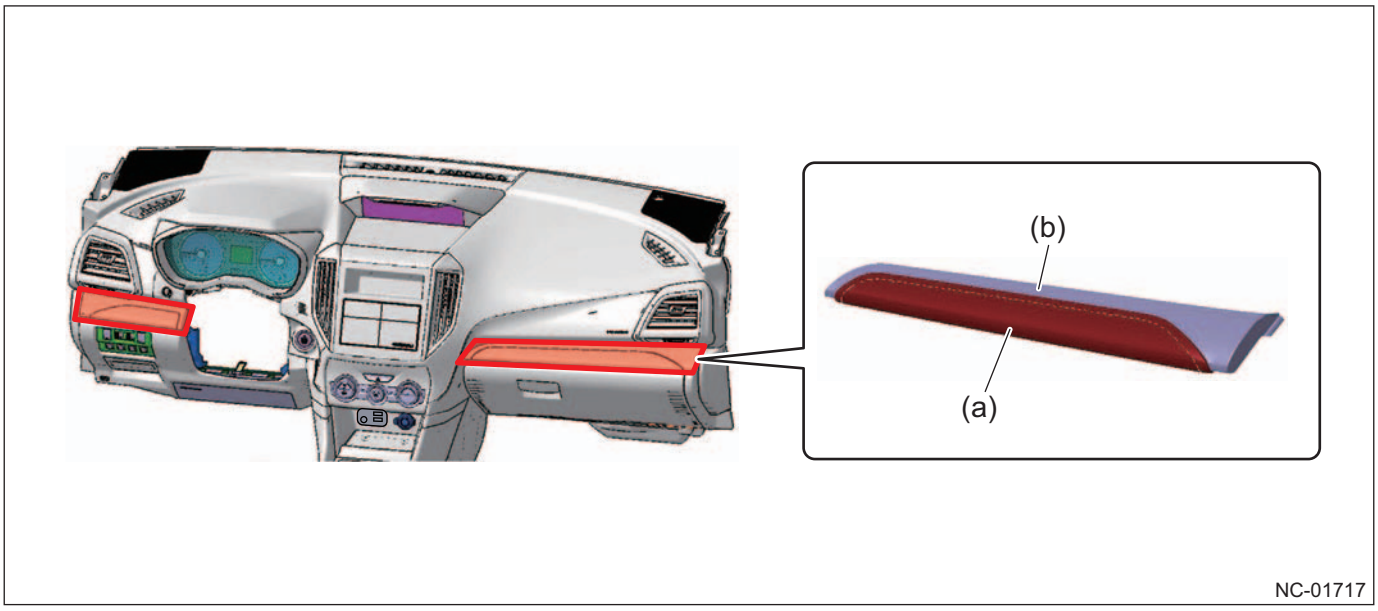
■ Double stitch

One of three types of double stitch with the dummy shape, silver color, or orange color is provided for each grade.



■ Instrument panel decoration

The panel is tailored according to characteristic of each grade by combining paint color, dot pattern, and smooth leather.



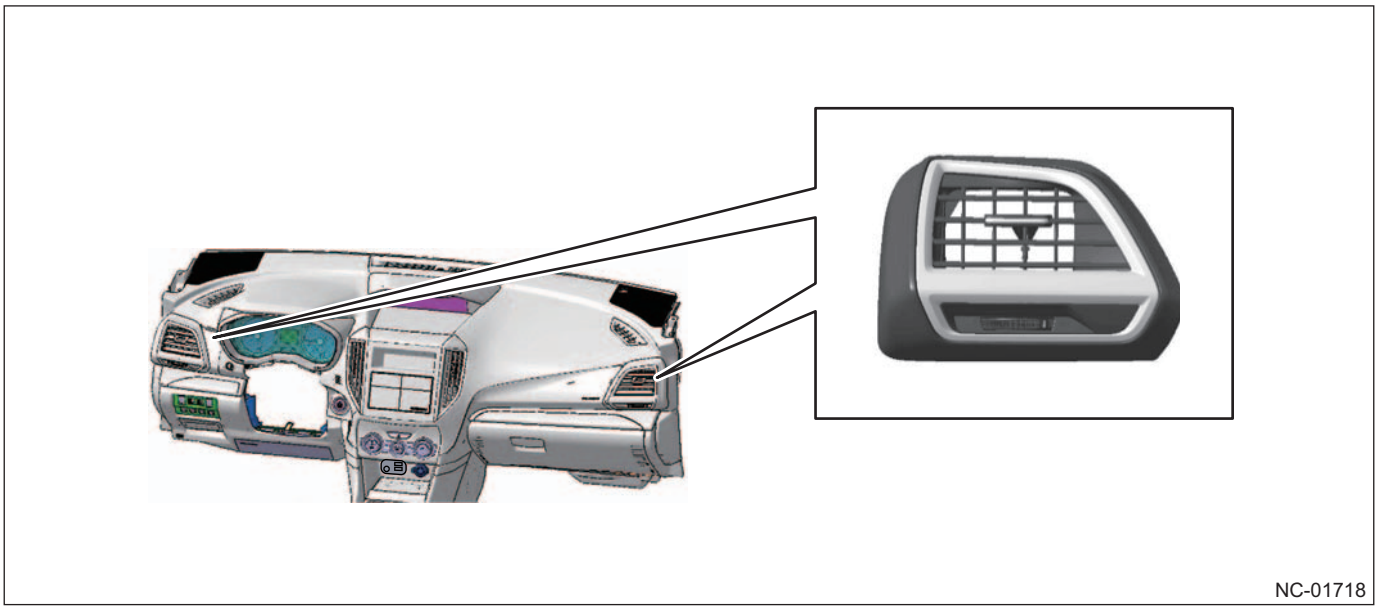
(a) Decoration portion A

(b) Decoration portion B

Specifications	Decoration portion A	Decoration portion B
Standard specification	Black paint	Black paint + dimple texture
Combination specification	Silver paint	
Film specification	Oval dot pattern	
Upholstered PVC + stitch specification	Smooth leather + silver stitch	

■ Side vent grille decoration

A silver or orange large decoration is applied for the side vent grille of each grade.

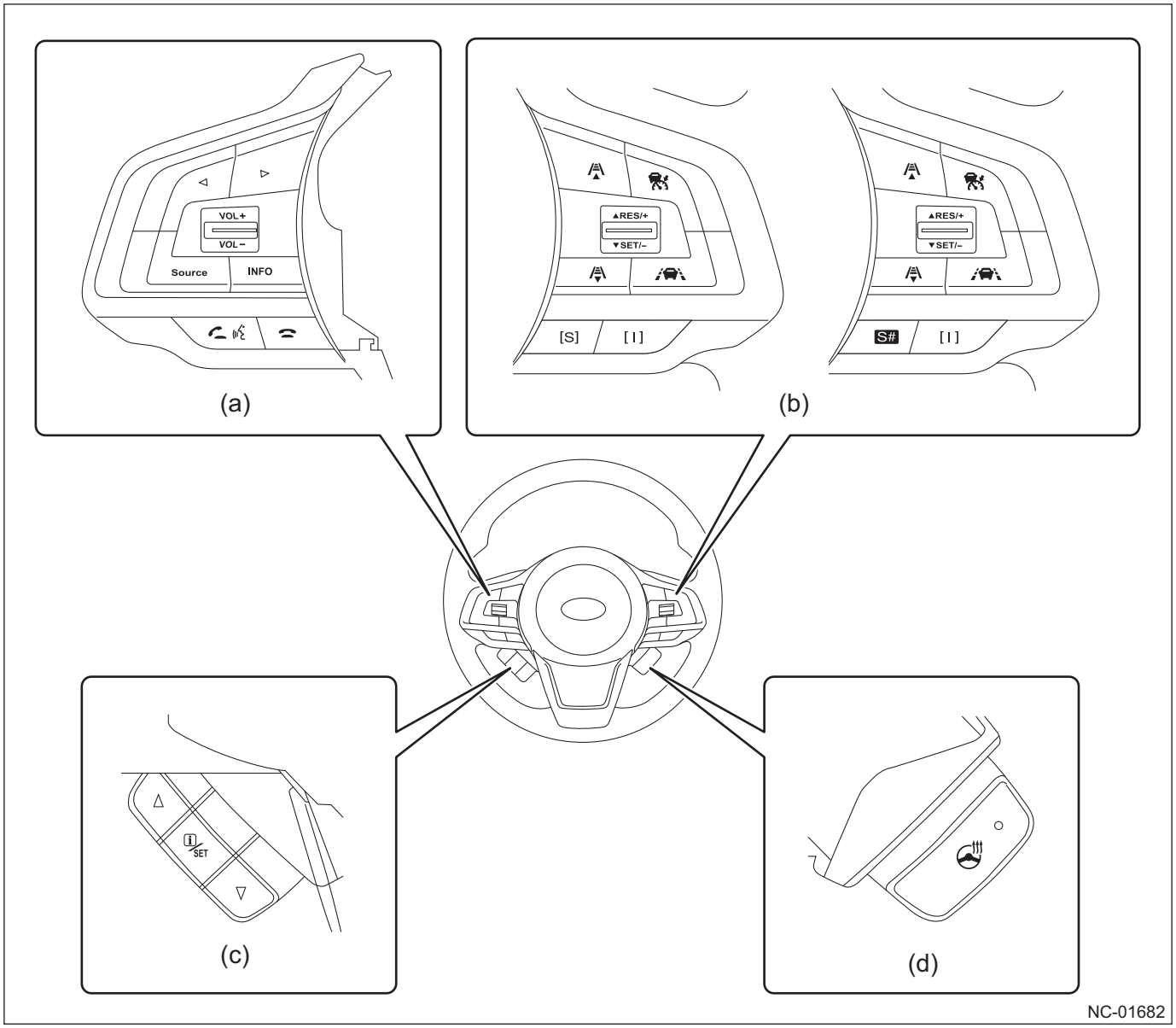


Switch

■ Steering switch

Steering switches are laid out to group necessary functions and allow for direct, quick operation.

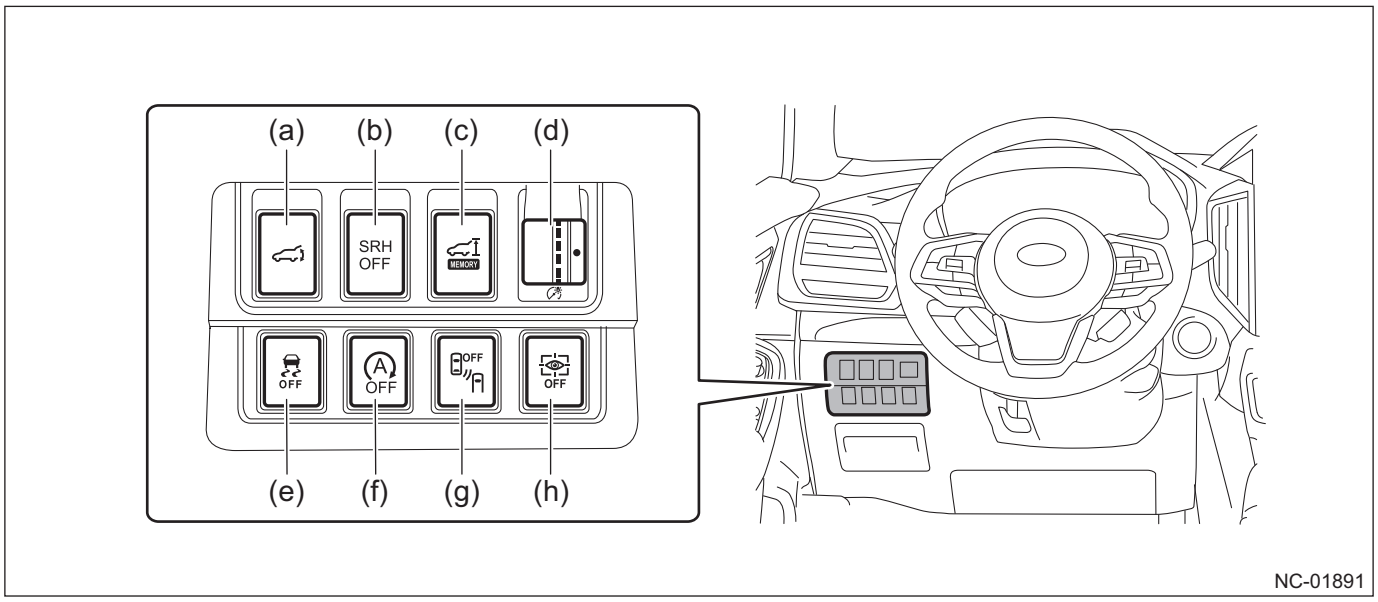
- The white nighttime lighting of the switch is adopted to improve quality feeling.
- The meter changeover switch is arranged under the satellite switch to perform operations such as the screen shift without releasing hands from the steering wheel.



(a) Satellite switch (audio side)
(b) Satellite switch (cruise control side)
(c) Meter changeover switch
(d) Steering heater switch

■ Instrument panel combination switch

The switches are intensively arranged in consideration of operability and visibility.

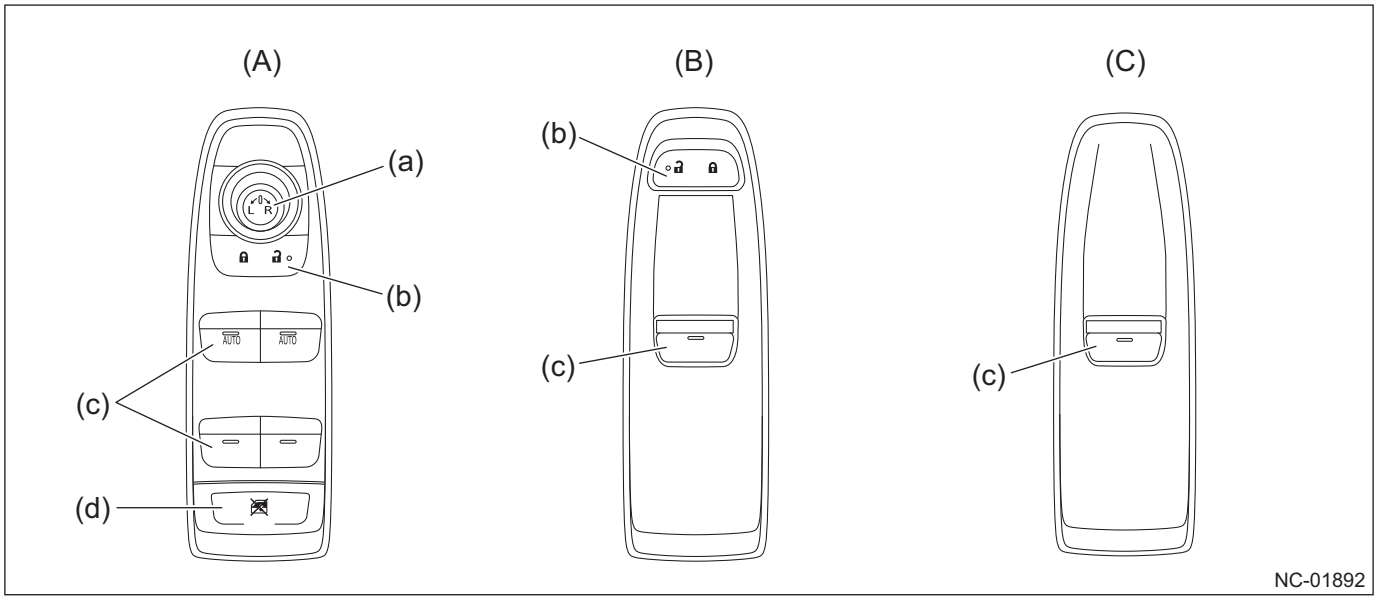


(a) Power rear gate driver's switch
(b) Steering responsive headlight (SRH) OFF switch
(c) Power rear gate memory height switch
(d) Illumination control dial
(e) VDC OFF switch
(f) Auto Start-Stop OFF switch
(g) Subaru Rear Vehicle Detection system (BSD/RCTA) OFF switch
(h) Driver monitoring system OFF switch

*The specifications differ by vehicle grade.

■ Door panel combination switch

The red nighttime lighting of the switch is adopted to produce luxury feel, and the satin silver paint is installed for some grades to improve quality feeling.

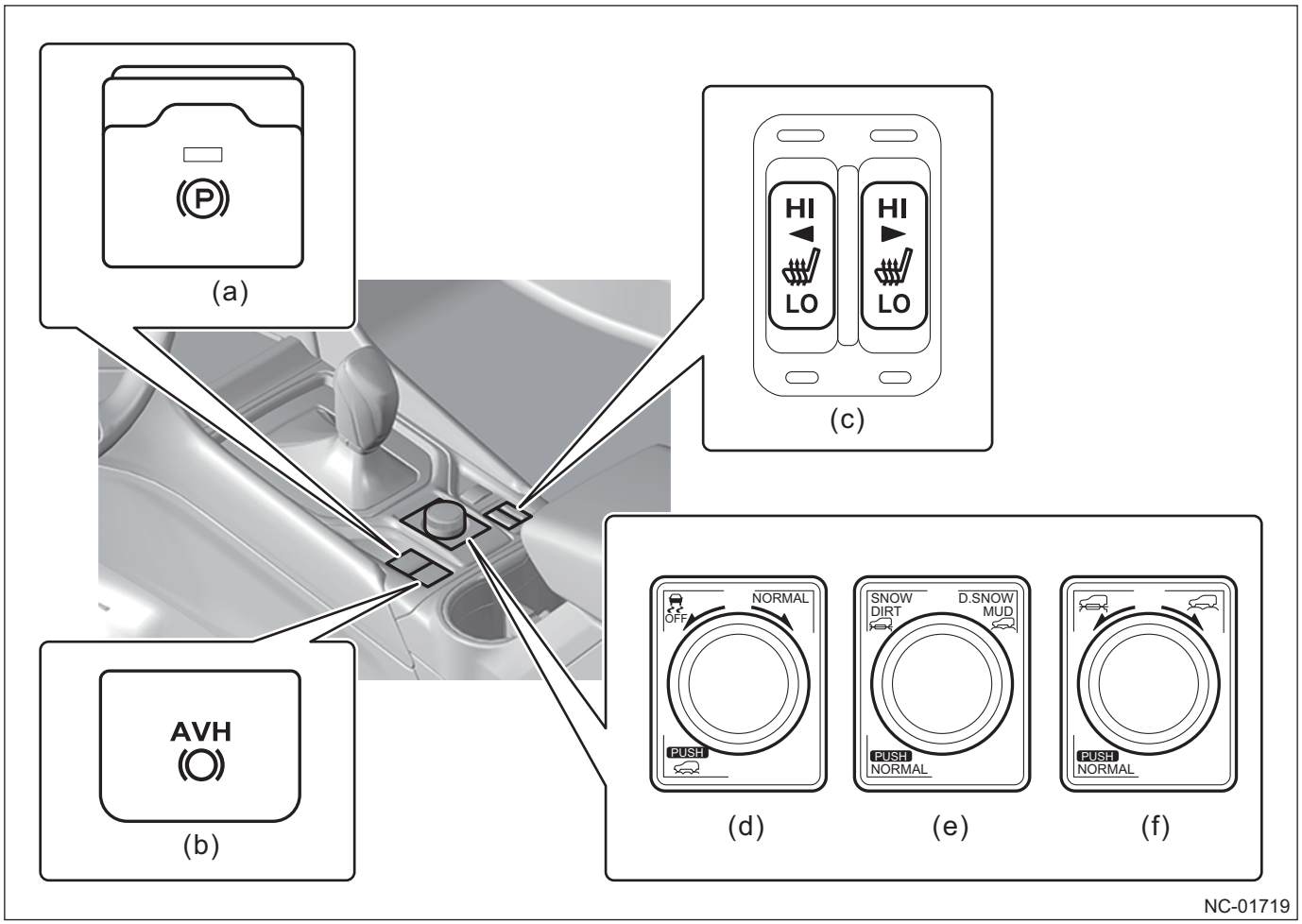


(A) Driver's seat
(B) Front passenger's seat
(C) Rear seat

(a) Mirror control switch
(b) Central door lock switch
(c) Power window switch
(d) Window lock switch

■ Center console combination switch

The switch is arranged on the center console so that the driver can operate it easily.



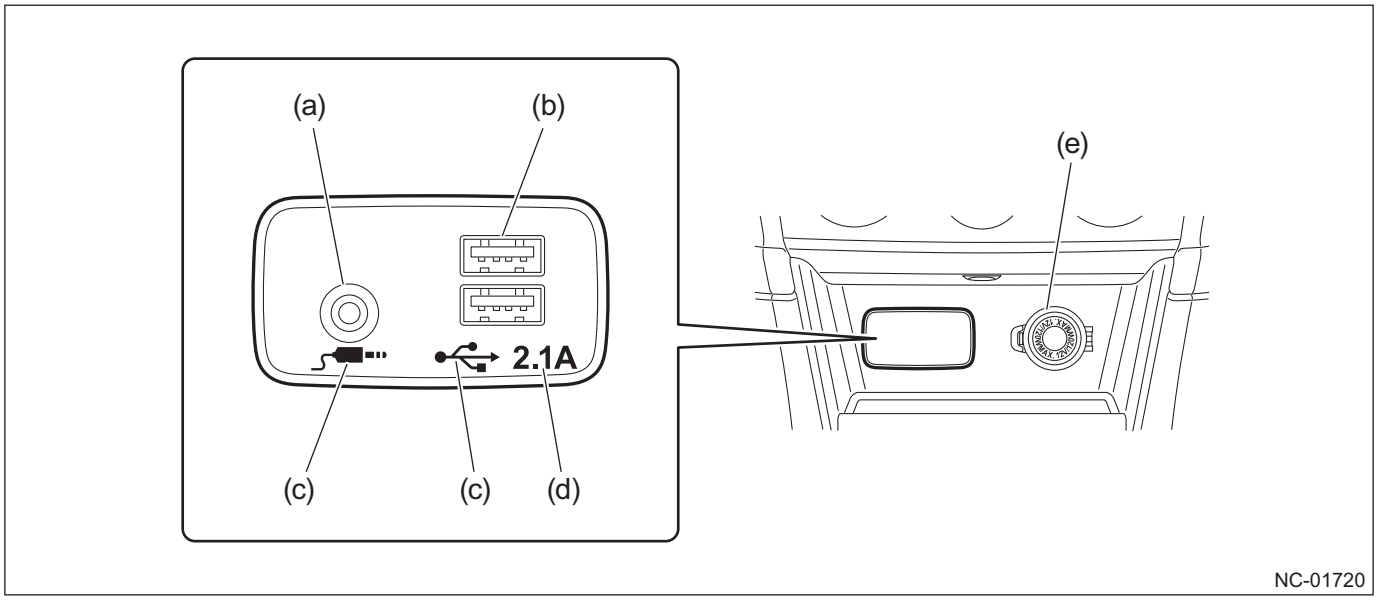
(a) Parking brake switch
(b) Auto vehicle hold switch
(c) Seat heater switch
(d) X-MODE switch (standard grade)
(e) X-MODE switch (upper grade)
(f) X-MODE switch (for C5)

■ Power supply/external input terminal

The USB power supply, DC12 V power socket and external input terminal are adopted on the lower side of the instrument panel.

Types of terminals that have been indicated with characters for existing model vehicles are now indicated with symbols to be more recognizable for customers.

The maximum rated current is indicated on the USB port for easy determination of equipment that can be quick charged to improve convenience.



(a) External input terminal
(b) USB port
(c) Terminal type symbol
(d) Maximum rated current indication
(e) DC 12 V power socket

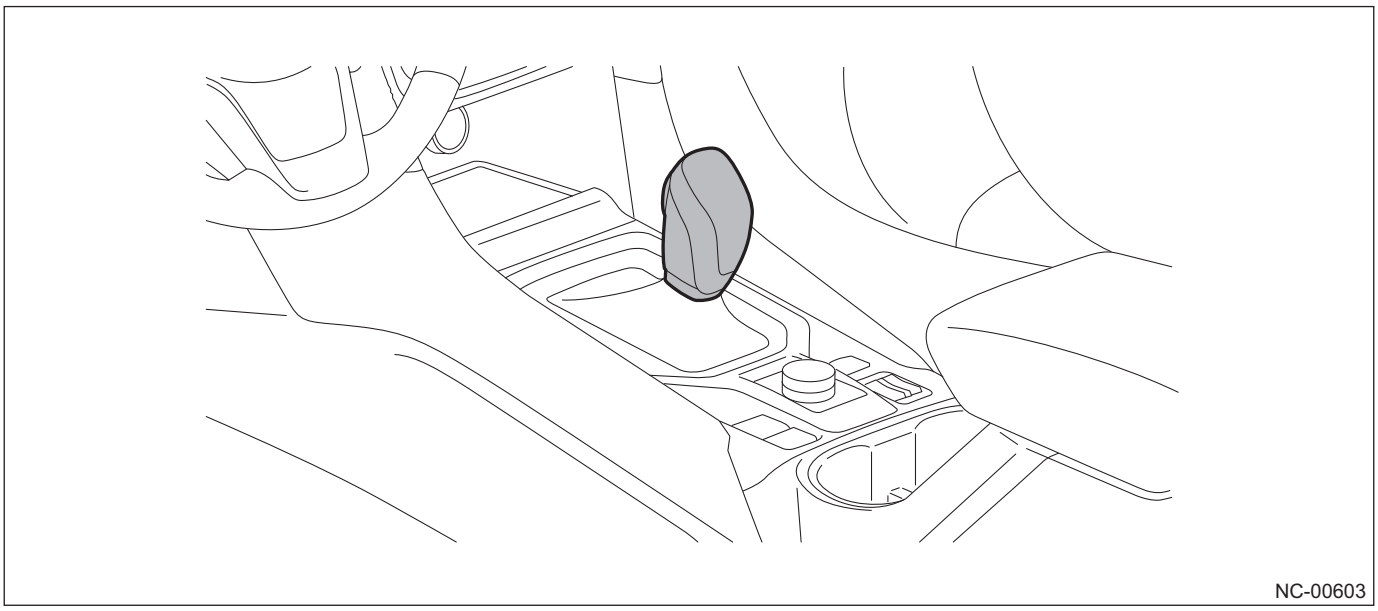
Indication by symbol

Usage	New model vehicle	Existing model vehicle
USB port for communication	 NC-01458	USB

Usage	New model vehicle	Existing model vehicle
External input terminal	 NC-01990	AUX

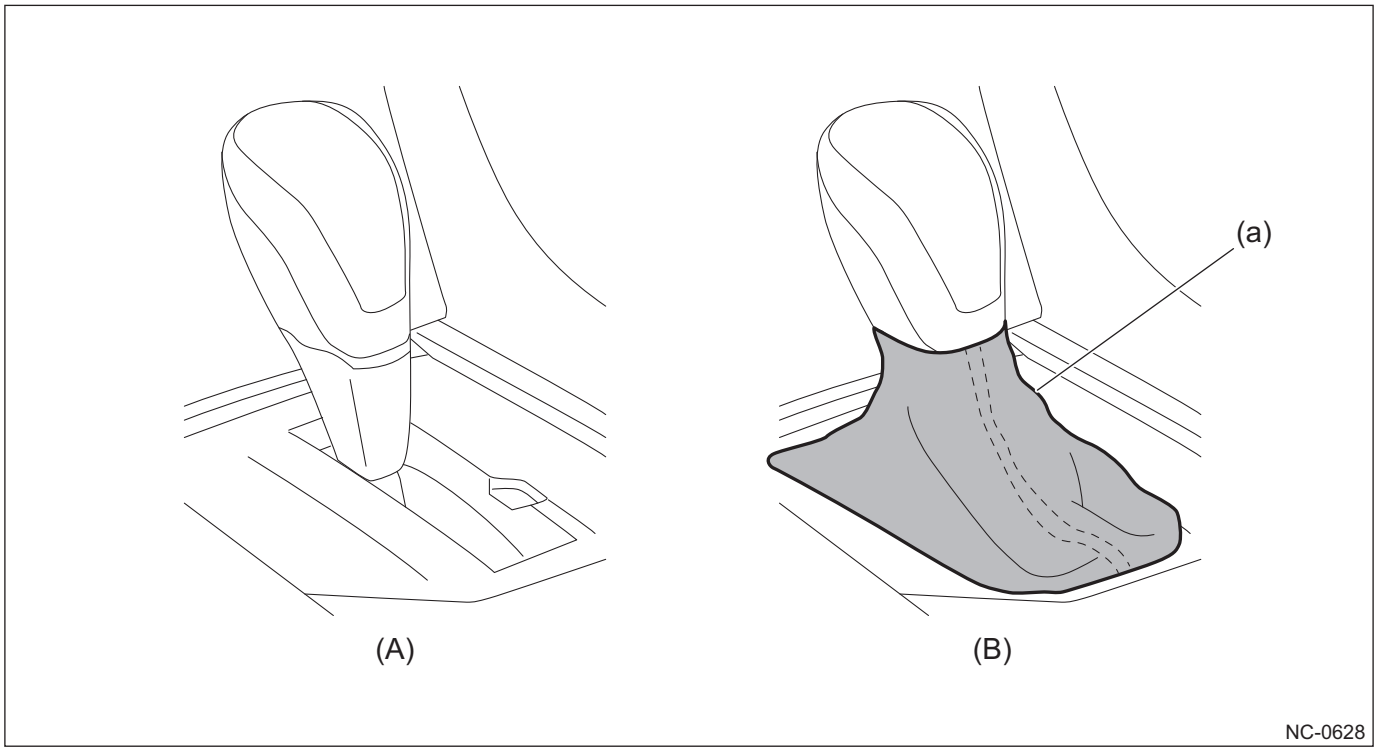
Shift lever

Two types of materials such as plastic (PVC) and leather are provided on the grip surface of the shift lever. (depending on grades)



Shift boot

The high-quality feeling shift boot stitched in silver or orange is adopted for each grade.



(A) Without shift boot

(B) With shift boot

(a) Shift boot

Shift panel

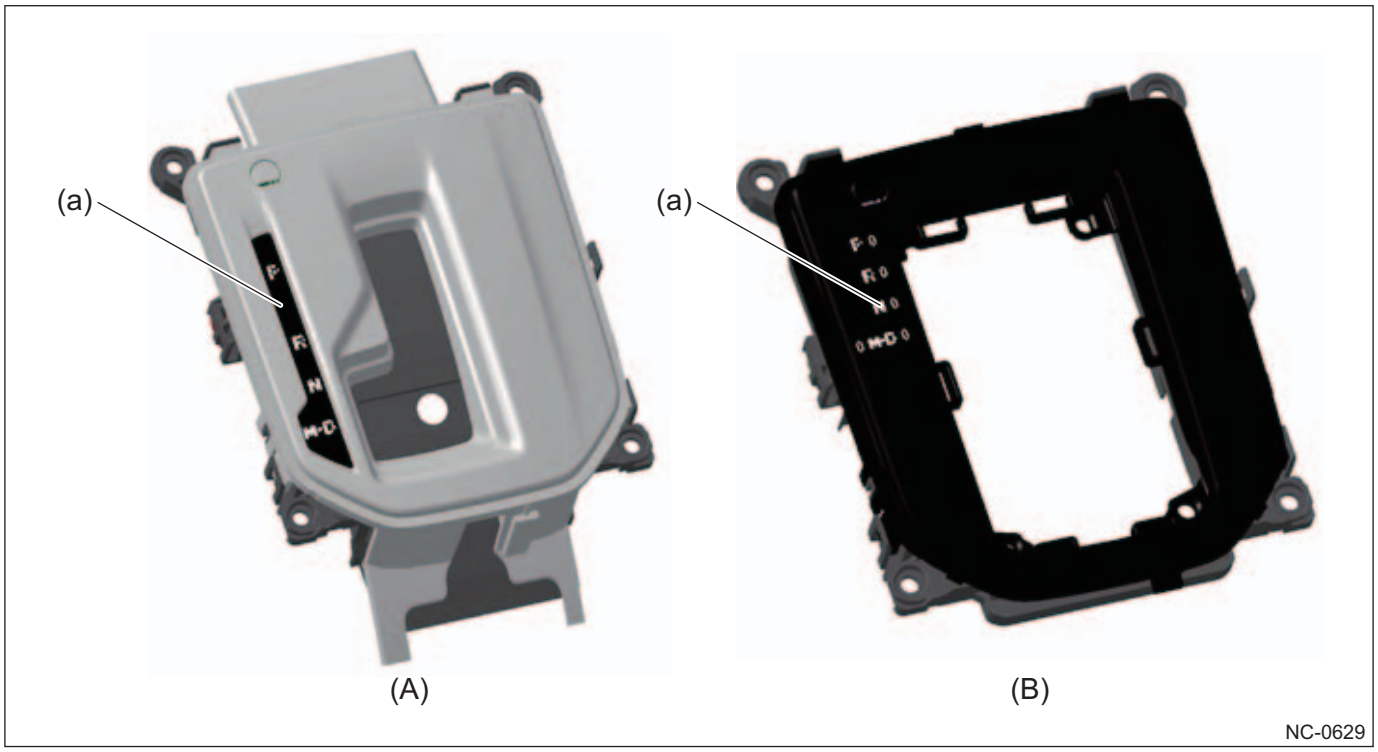
The bright silver and orange decoration is applied on the shift panel depending on grades.

Shift panel

NC-00605

The red nighttime lighting of the indicator is adopted and the dial face color is painted with high-gloss black to improve quality feeling. Also, depending on whether the shift boot is installed or not, the silver paint specification or high gross black specification is adopted on the indicator housing.

Indicator



(A) Without shift boot

(B) With shift boot

(a) Indicator

10.6 Interior Trim/Interior Equipment

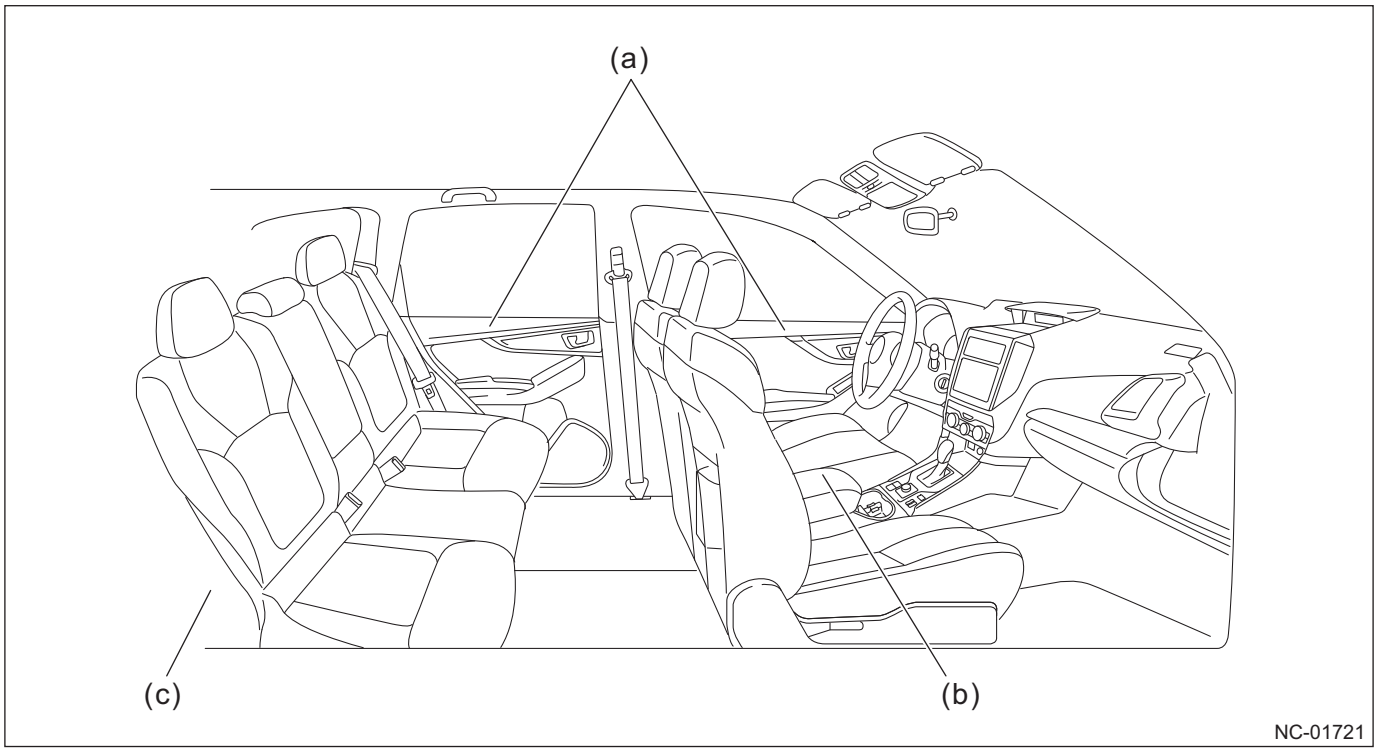
10.6.1 Overview

Similar to the instrument panel, material, surface material, and stitching of the interior trim are used differently by the grade, and are tailored according to the characteristic of each grade. In addition, equipment for comfort in consideration of the passengers in the rear seat is provided, as well as equipment with superior usability such as the large luggage compartment with a large opening.

*The specifications differ by vehicle grade.

10.6.2 Component

Component layout drawing



(a) Door trim
(b) Center console
(c) Luggage room

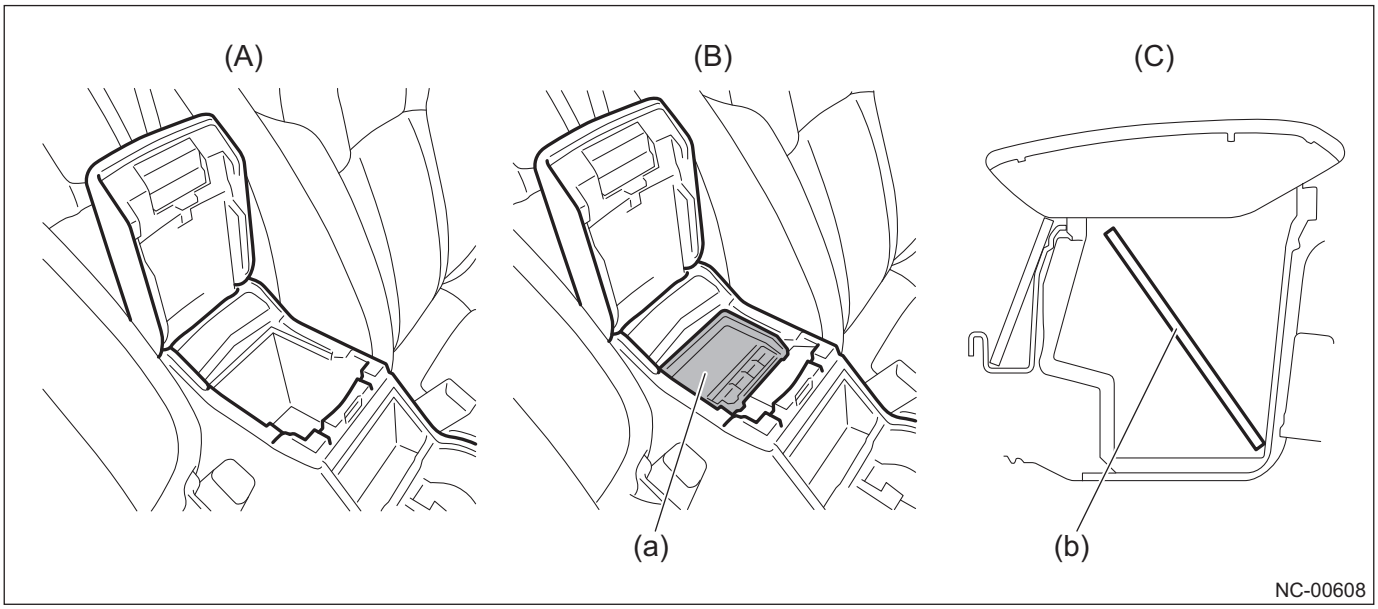
Component details

Center console

■ Console box with large capacity, and tray in box

The center console ensures storage capacity that allows a small tablet etc. to be stored while charging, and the lid of the console box can be closed considering prevention of theft when away from the vehicle.

A removable tray in the box is also adopted considering the storability for smartphones, etc.

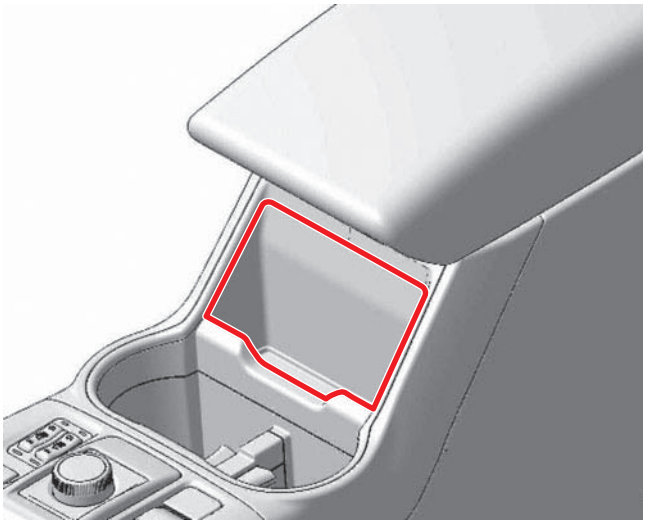


(A) When not using tray
(B) When using tray
(C) Cross section

(a) Tray in box
(b) Small tablet terminal

■ Console upper surface pocket

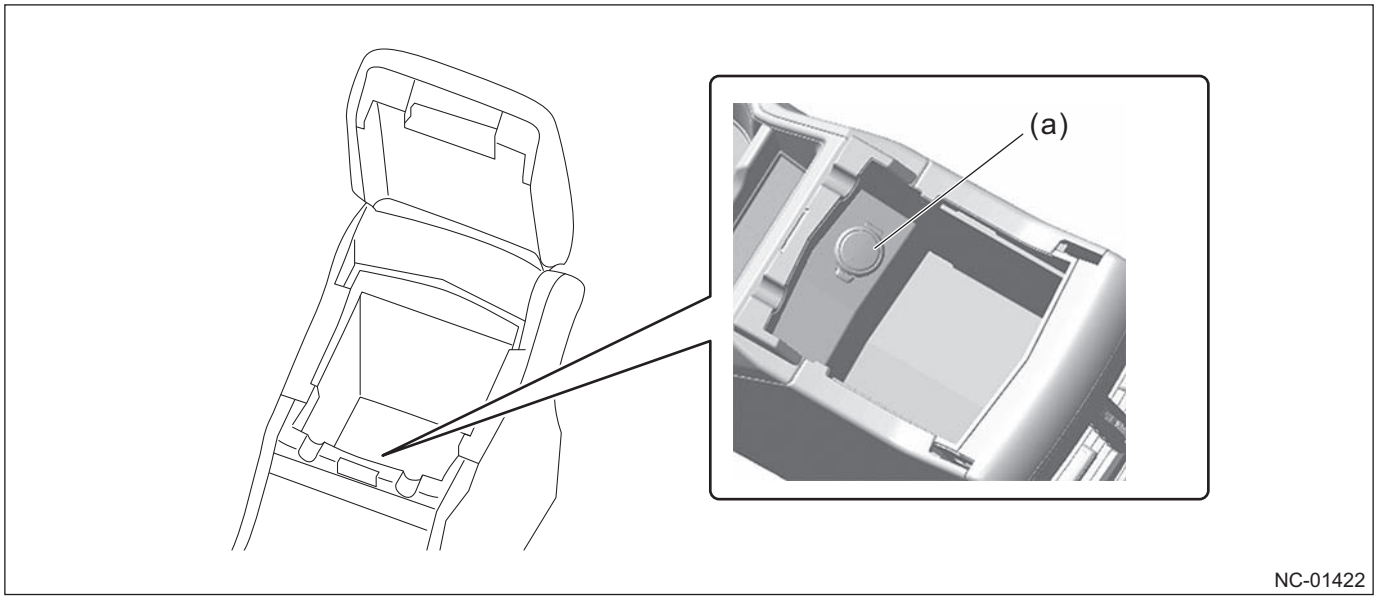
Pocket with a mat that houses a smartphone, etc. is installed at the rear of the cup holder. The storage position is located where the hand can easily reach from the front seat and where the stored item is visible so it is not forgotten and left behind.



NC-00609

■ DC 12 V power socket in the center console

The DC 12 V power socket is adopted in the console box to improve convenience.

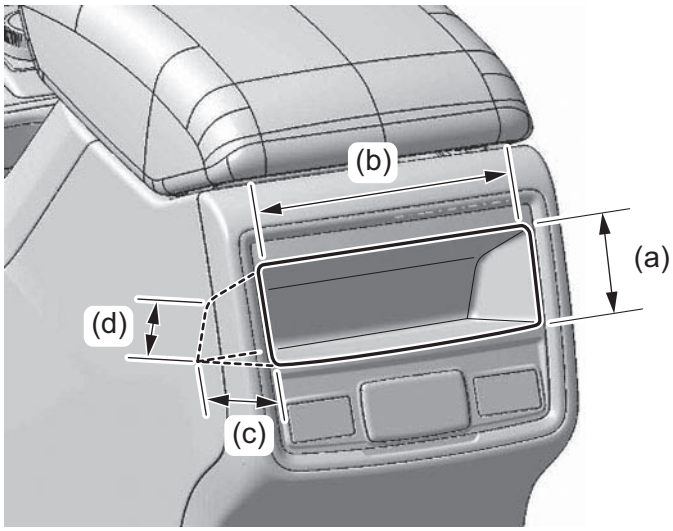


(a) DC 12 V power socket

■ Pocket for rear seat (for some grades)

The pocket that can receive small articles is installed at the console rear end in consideration of convenience.

L: 1.97 in (50 mm)/W: 5.91 in (150 mm)/D: 2.56 in (65 mm)



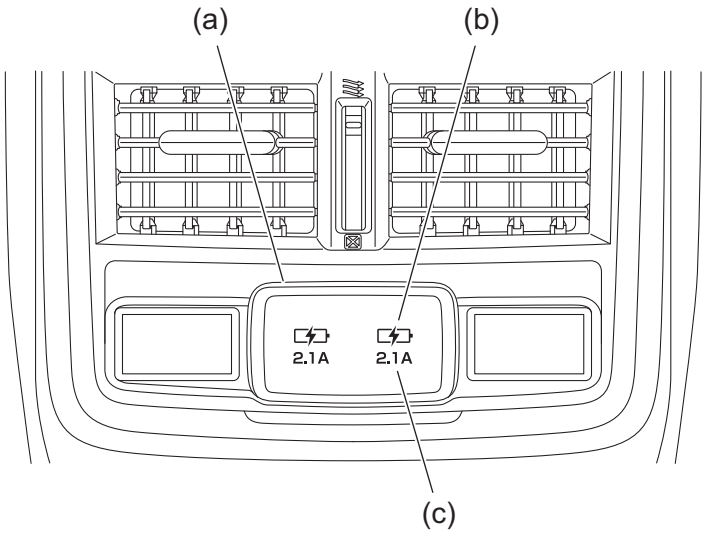
NC-00610

(a) 1.97 in (50 mm)
(b) 5.91 in (150 mm)
(c) 2.65 in (65 mm)
(d) 0.98 in (25 mm)

■ USB power supply for rear seat

Two USB power supply ports are adopted at the rear end of the center console for rear seat passengers.

Types of terminals that have been indicated with characters for existing model vehicles are now indicated with symbols to be more recognizable for customers. The maximum rated current is indicated to easily determine equipment for which quick charging is possible. Thus, the convenience is improved.



NC-01424

(a) USB power supply for rear seat
(b) Terminal type symbol
(c) Maximum rated current indication

Indication by symbol

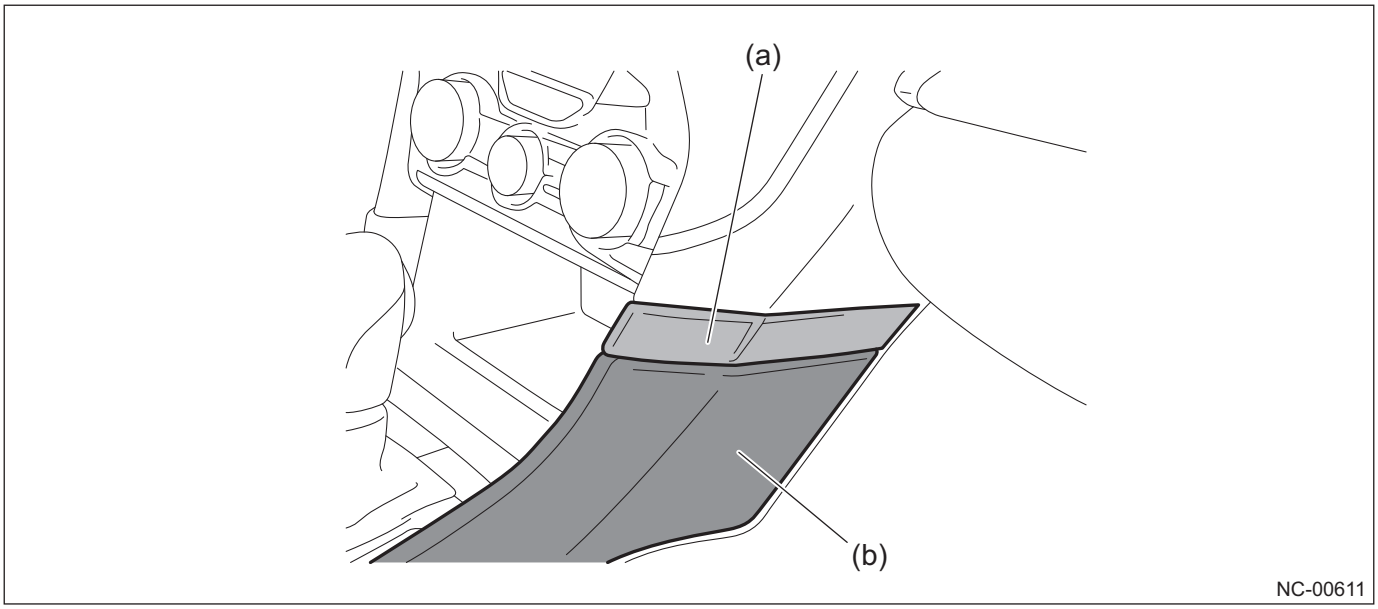
Usage	New model vehicle	Existing model vehicle
USB port for charging	 NC-01459	USB POWER OUT

■ Center console

A silver decoration is adopted above the center console and painted or vapor deposed is applied depending on the grade so that the decoration matches the quality feeling for each grade.

The upholstery is adopted for the console side that contacts hands and knees for some grades. The double stitch with the same color as the instrument panel and the door trim is adopted to realize high quality feeling of the vehicle interior.

Center console decoration

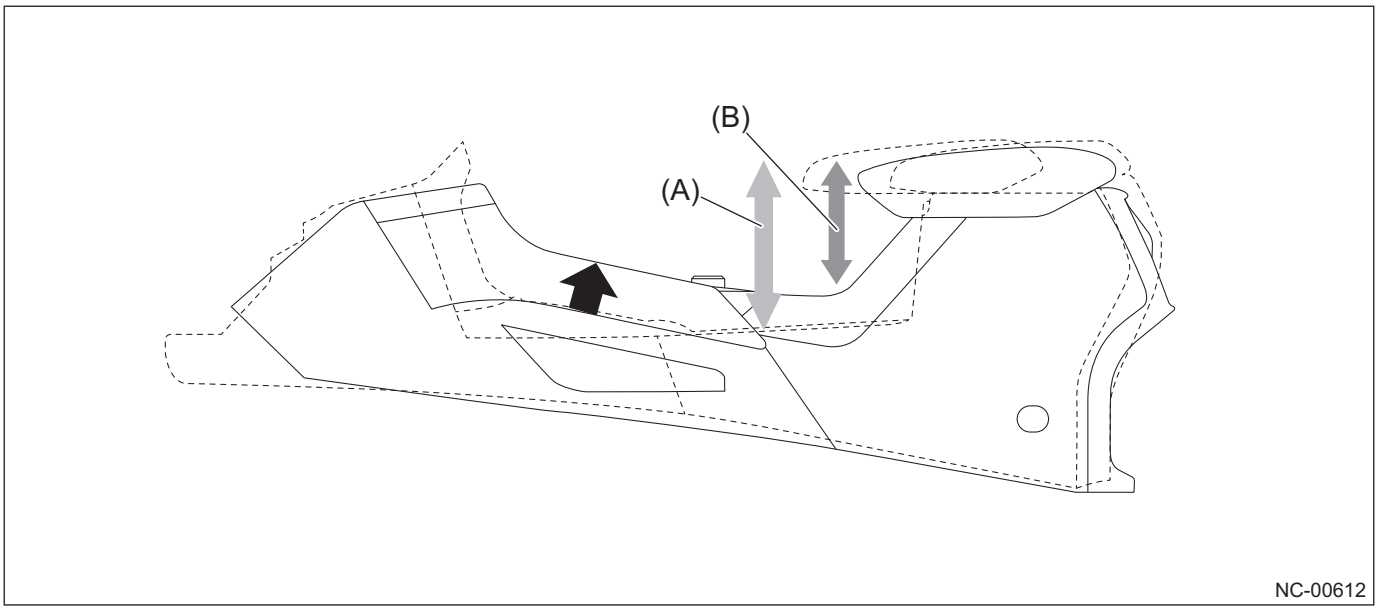


(a) Silver decoration

(b) Console side (upholstery)

The console upper surface is heightened by 0.67 in (17 mm) compared to the existing models to reduce the level difference between the console and the armrest. A shape that is integrated with the surrounding of the console and the instrument panel is adopted.

Reduction in level difference between console and armrest



(A) Existing model vehicle

(B) New model vehicle

Door trim

■ Front door upper area

PVC upholstery is applied for the front door upper to realize large soft pad area. Negative vacuum forming is used as the processing method to refine the texture of the soft layer and realize high quality feel.

NC-00614

■ Front door mid area

The cutting design that is applied up to the window shoulder area is adopted for the front door mid area to realize a large surface. Surface specification differs depending on the grade.

PVC specification

Splitted artificial leather design is adopted for the mid area surface, and also twin stitching and quilt stitching are used in combination to provide more craftsmanship.

Fabric specification

For the mid area surface, divided fabric is adopted and both the twin stitch and quilt stitch with the same orange color as the instrument panel and the door trim are used. The special tag is adopted for the division section according to the grade.

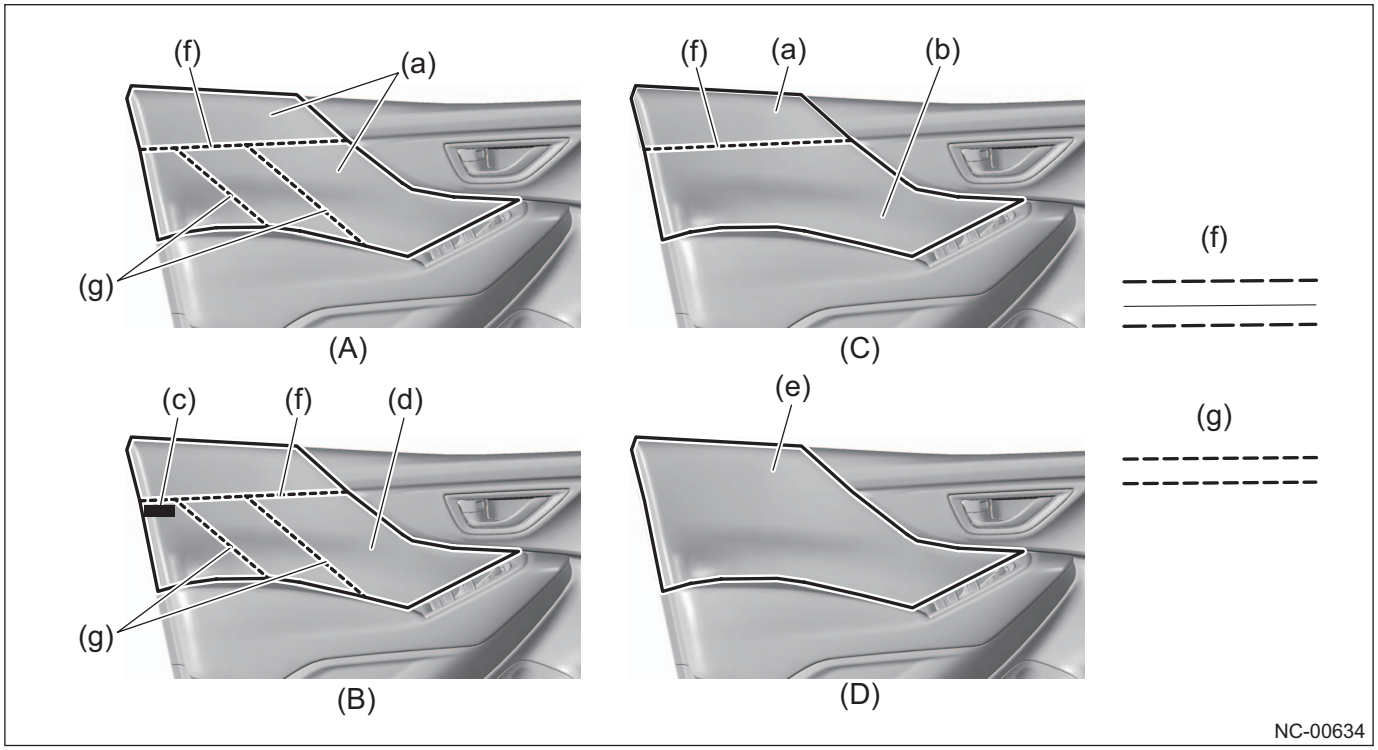
PVC + tricot specification

Combination of artificial leather and tricot is adopted for the mid area surface and 0.16 in (4 mm) laminate is applied on the tricot area.

Tricot specification

Laminate of 0.12 in (3 mm) thickness is applied on the entire area.

Front door mid area decoration type



(A) PVC specification
(B) Fabric specification

(a) Pore leather-like texture PVC
(b) Tricot surface (laminate thickness: 0.16 in (4 mm))
(c) Special tag
(d) Fabric surface

(C) PVC + tricot specification
(D) Tricot specification

(e) Tricot surface (laminate thickness: 0.08 in (2 mm))
(f) Twin stitch
(g) Quilt stitch

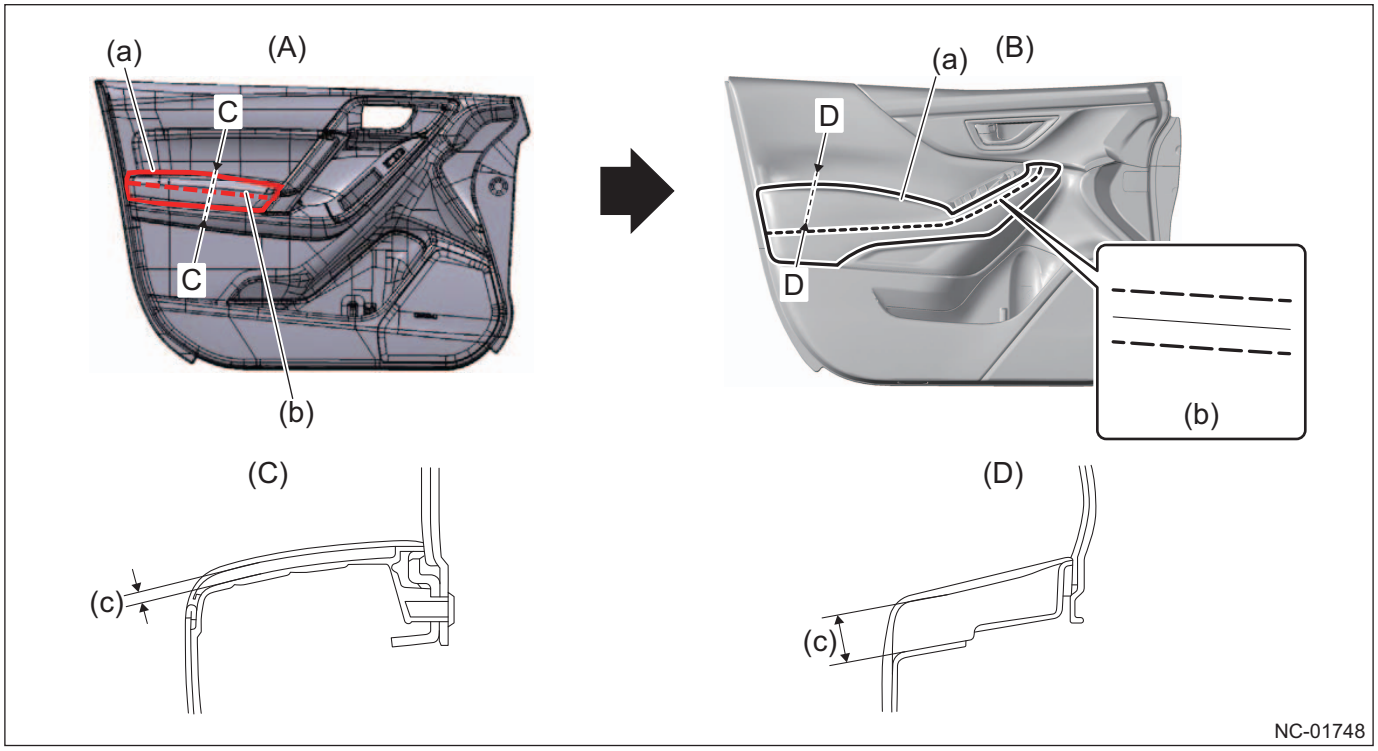
■ Armrest

The large upholstery surface is adopted to realize the whole surface upholstery.

The leather-like smooth and goof touch texture is adopted and the thickness of the cushion is increased to realize rich quality and touch.

A double stitching with high quality texture is also applied over the entire armrest to give an impression of craftsmanship. The unified stitching in the whole cabin surrounds the passengers, giving them comfort with the armrests.

Comparison of armrest with existing models



(A) Existing model vehicle
(B) New model vehicle

(a) Upholstery area
(b) Double stitch

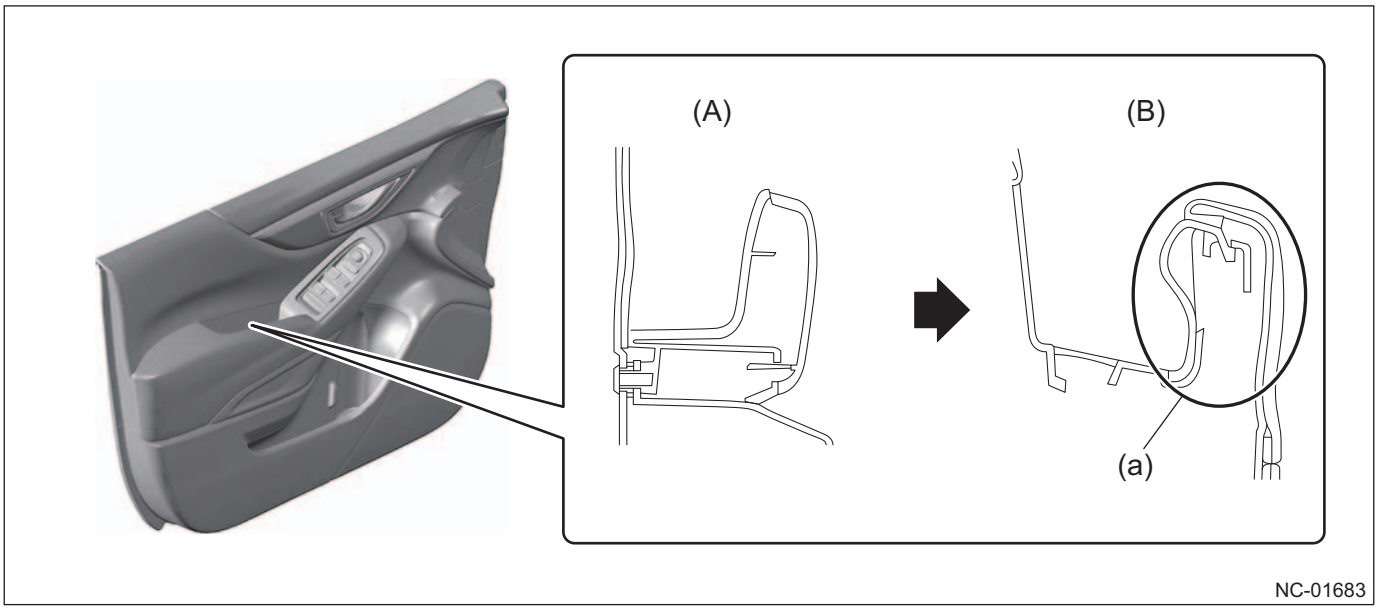
(C) C-C cross section
(D) D-D cross section

(c) Cushion thickness

■ Door grip

The door grip is changed to improve texture and grip feeling.

The grip of the pull cup is changed to soft material that does not easily slip so the fingers do not slip. The door grip is shaped to fit hands and easily be caught by fingers, making it easy to grip. Also, length and capacity to store small articles are secured.



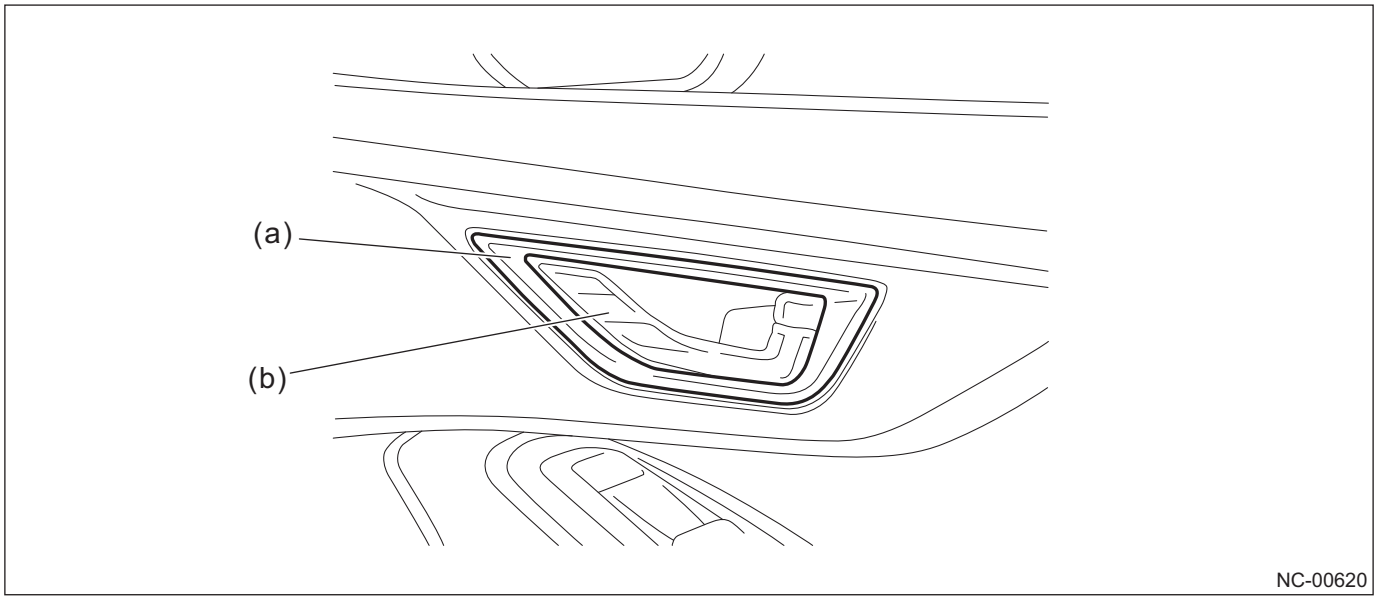
(A) Existing model vehicle

(B) New model vehicle

(a) Grip

■ Silver paint on door handle outer ring

The width of the door handle outer ring is widened and the silver paint is adopted to produce interior space with strong image of SUV.

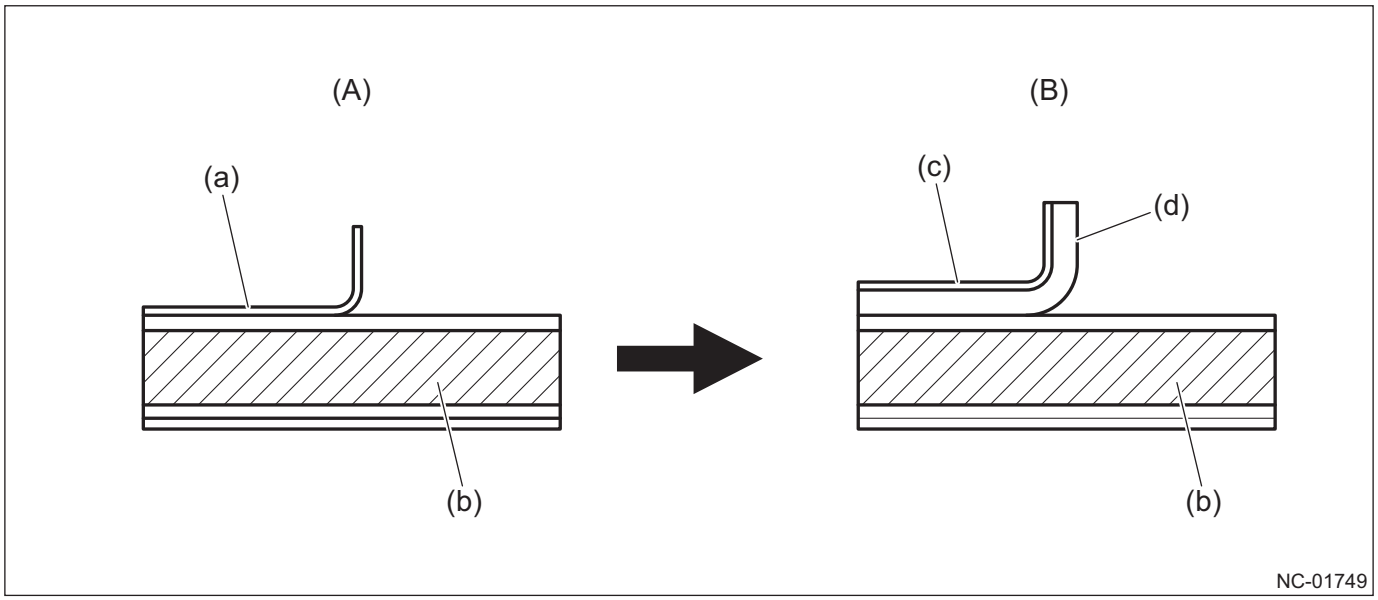


(a) Outer ring

(b) Raw material coloring or plate

■ Roof trim

The tricot with good hand feeling is adopted for the roof trim surface, instead of the unwoven cloth in the existing models. The cushion layer of the urethane laminate is also added to the roof trim to realize quality feeling in cooperation with texture and pillar trim.



(A) Existing model vehicle

(a) Unwoven cloth surface
(b) Roof base material

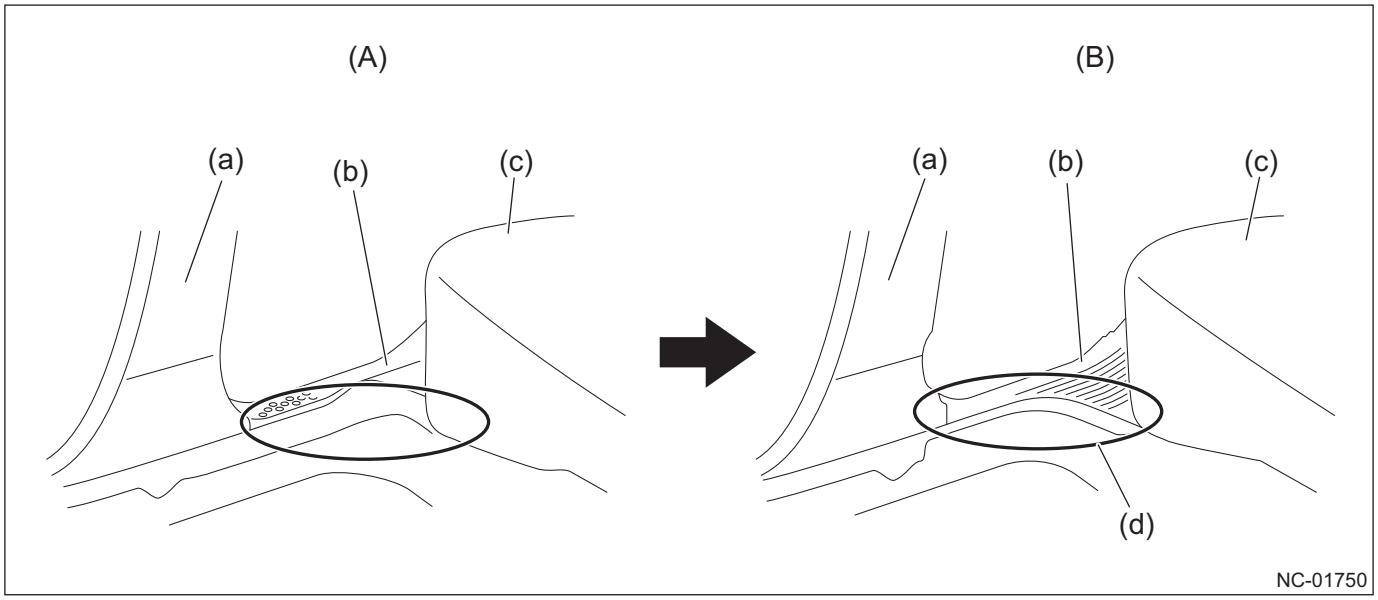
(B) New model vehicle

(c) Tricot surface
(d) Urethane laminate

Side sill

Protuberance of rear seat feet corner is reduced to easily get over the side sill when a passenger rides and exits.

Protuberance of rear seat feet corner

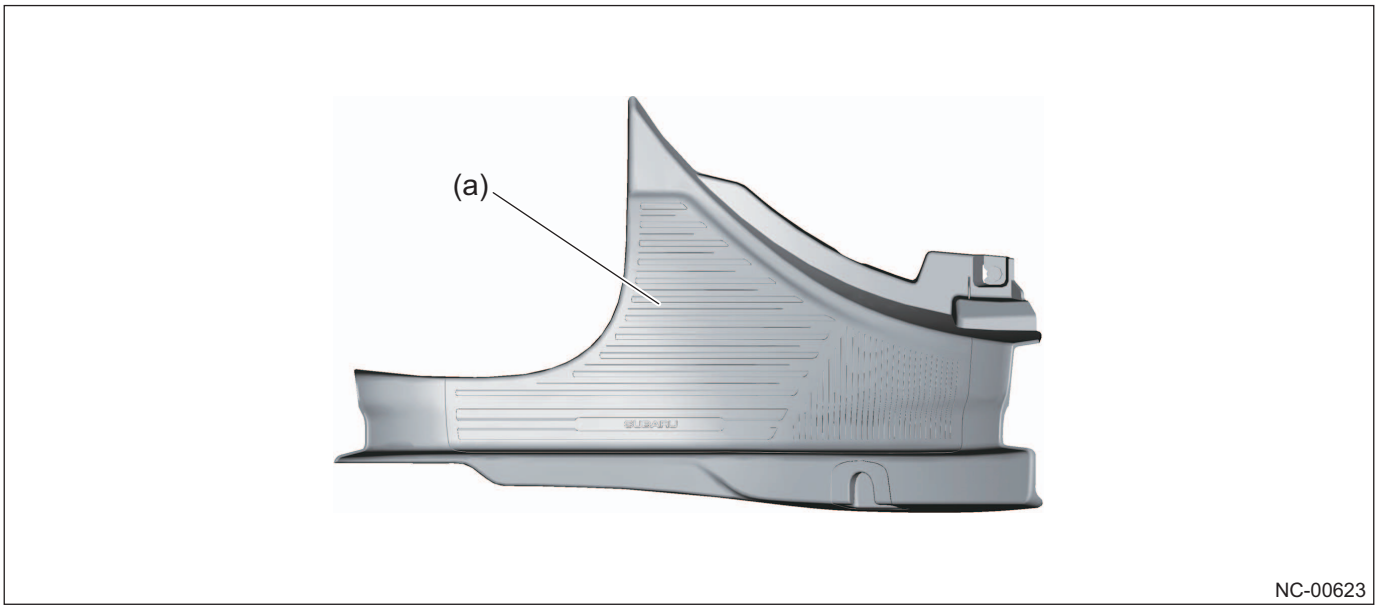


(A) Existing model vehicle
(B) New model vehicle

(a) B pillar
(b) Step face
(c) Rear seat cushion
(d) Protuberance reduced area

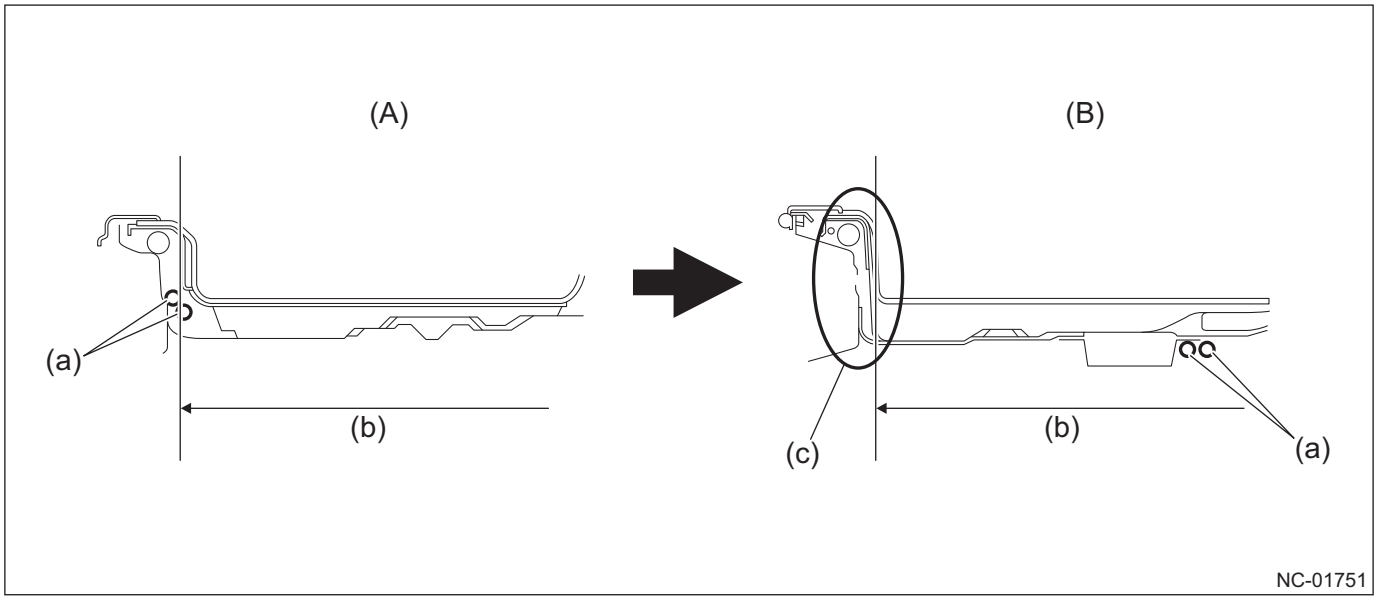
The width of the step surface of the rear door opening area is widened and the protuberance reduced area is changed to a flatter shape. In addition, the antiskid pattern is added to the rear and front surfaces.

Step surface of the rear door opening area



(a) Antiskid pattern

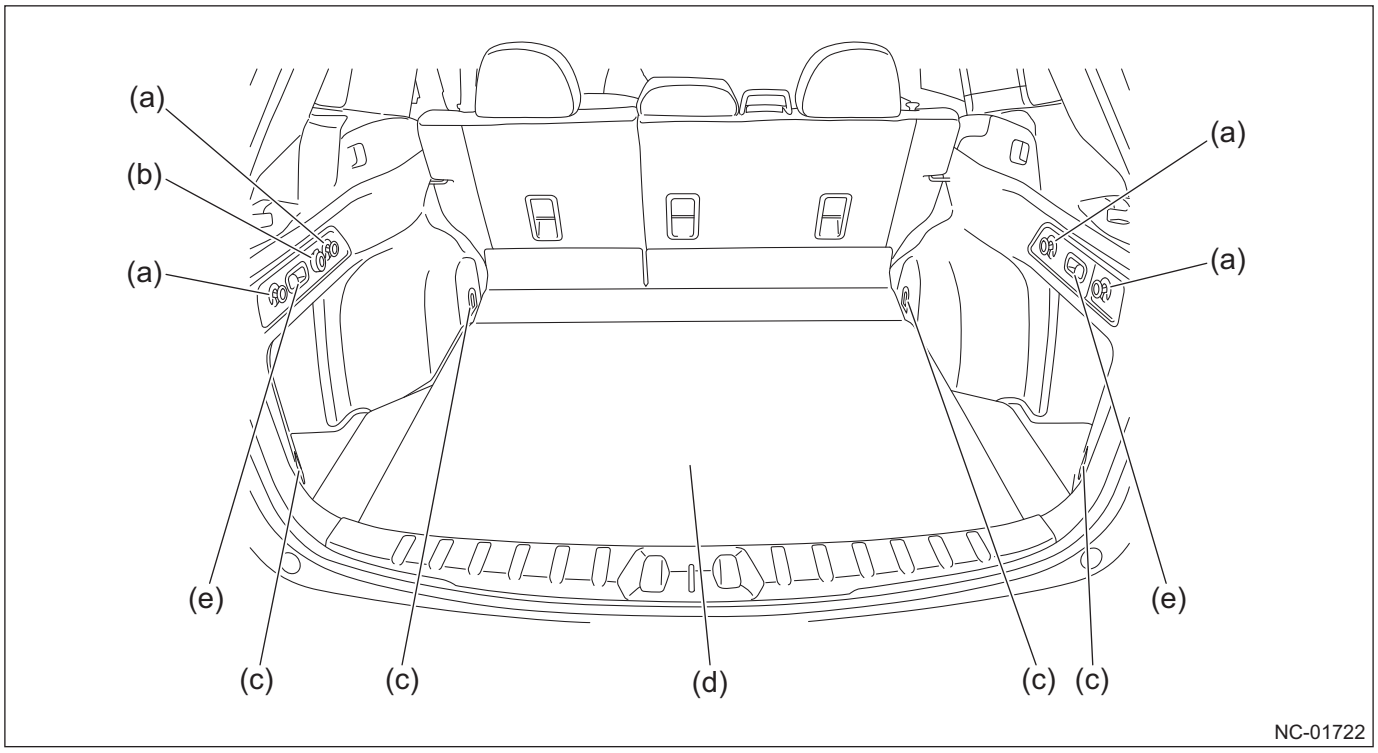
The pipes in the existing model vehicle are moved outside in the new model vehicle by adopting the Subaru Global Platform. This allows the side sill to be thinner and expand the interior space by 0.94 in (24 mm) for the front seat and 3.78 in (96 mm) at maximum for the rear seat compared to the existing models.



(A) Existing model vehicle
(B) New model vehicle

(a) Pipe
(b) Interior space
(c) Thinned area

Luggage room

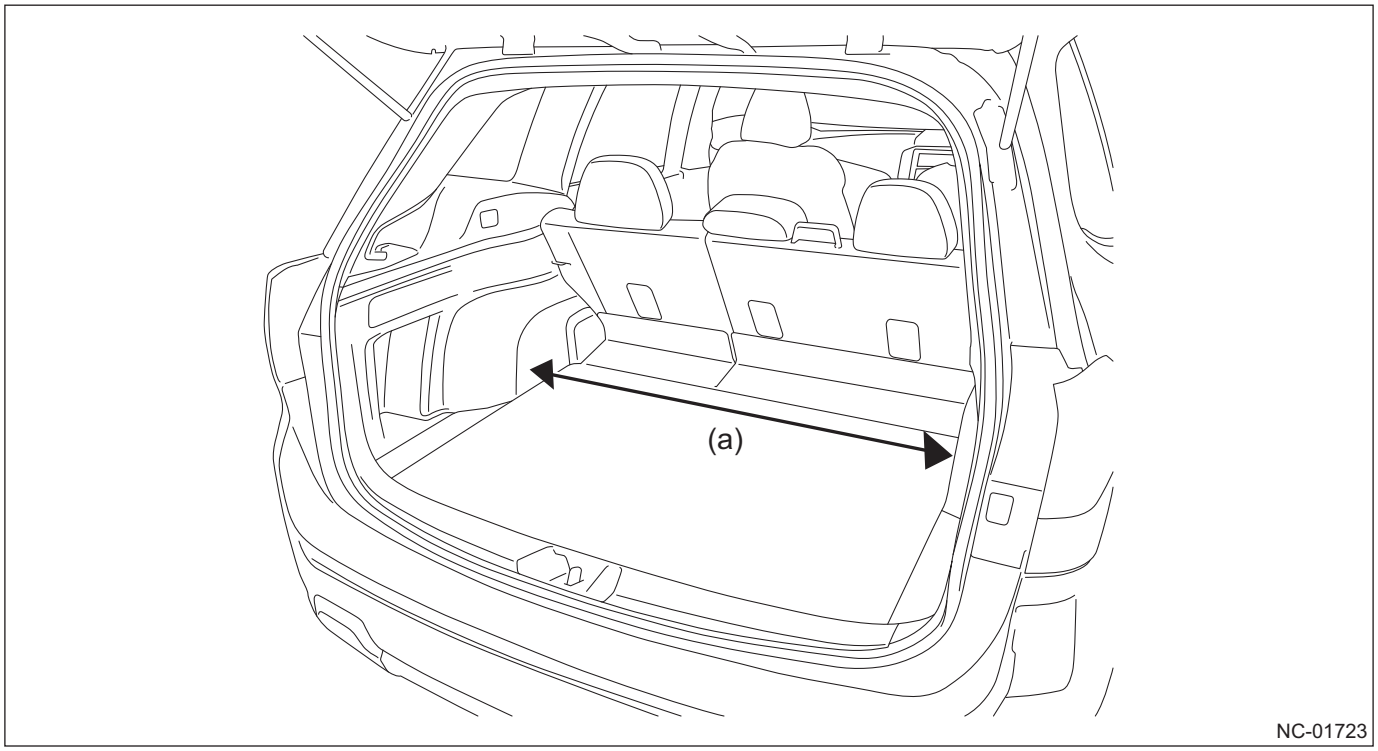


(a) Shopping bag hook
(b) DC 12 V power supply
(c) Cargo hook
(d) Sub trunk (luggage compartment under floor)
(e) Rear seat tilting switch

■ Luggage compartment dimension

The back side structure of the apron trim is optimized and the dimension between wheel aprons is expanded. The interior shape is also optimized to realize greater luggage compartment capacity.

Dimension between wheel aprons



No.	New model vehicle	Existing model vehicle	17MY IMPREZA	17MY LEGACY
(a)	43.31 in (1,100 mm)	42.24 in (1,073 mm)	42.91 in (1,090 mm)	42.52 in (1,080 mm)

Luggage compartment capacity

		Spare tire type		
		Temporary tire	Narrow-width tire	Standard tire
New model vehicle	On floor	130.5 US gal (494 L, 108.7 Imp gal)	130.5 US gal (494 L, 108.7 Imp gal)	130.5 US gal (494 L, 108.7 Imp gal)
	Under floor	6.9 US gal (26 L, 5.7 Imp gal)	2.9 US gal (11 L, 2.4 Imp gal)	4.2 US gal (4 L, 0.9 Imp gal)
	Total	137.4 US gal (520 L, 114.4 Imp gal)	133.4 US gal (505 L, 111.1 Imp gal)	131.6 US gal (498 L, 109.6 Imp gal)
Existing model vehicle	On floor	19.3 US gal (481 L, 16.1 Imp gal)	19.3 US gal (481 L, 16.1 Imp gal)	19.3 US gal (481 L, 16.1 Imp gal)
	Under floor	6.3 US gal (24 L, 5.3 Imp gal)	2.4 US gal (9 L, 1.98 Imp gal)	0 US gal (0 L, 0 Imp gal)
	Total	133.4 US gal (505 L, 111.1 Imp gal)	129.5 US gal (490 L, 107.8 Imp gal)	19.3 US gal (481 L, 16.1 Imp gal)

10.7 Door Lock and Security System

10.7.1 Overview

For the door lock system, the keyless entry system (for some grades) and the keyless access & push button start system (for some grades) are provided.

- Keyless entry system (for some grades): keyless transmitter is used.
- Keyless access & push button start system (for some grades): access key is used.

The immobilizer system and the security alarm system are adopted for the security system.

The following measures are taken to enhance security.

Security system enhancement (keyless access & push button start system)

Wireless communication encryption enhancement	In order to take measures against the advanced theft technology, encryption processing of the transponder and the RKE communication are enhanced.
Change of encryption processing of communication between modules	Encryption processing of communication between the keyless access control module and the steering lock control module is enhanced.
Other	To add function and take measures against new theft means rapidly, the specification is changed to be capable of re-programing by the service tool.

Security system enhancement (keyless entry system)

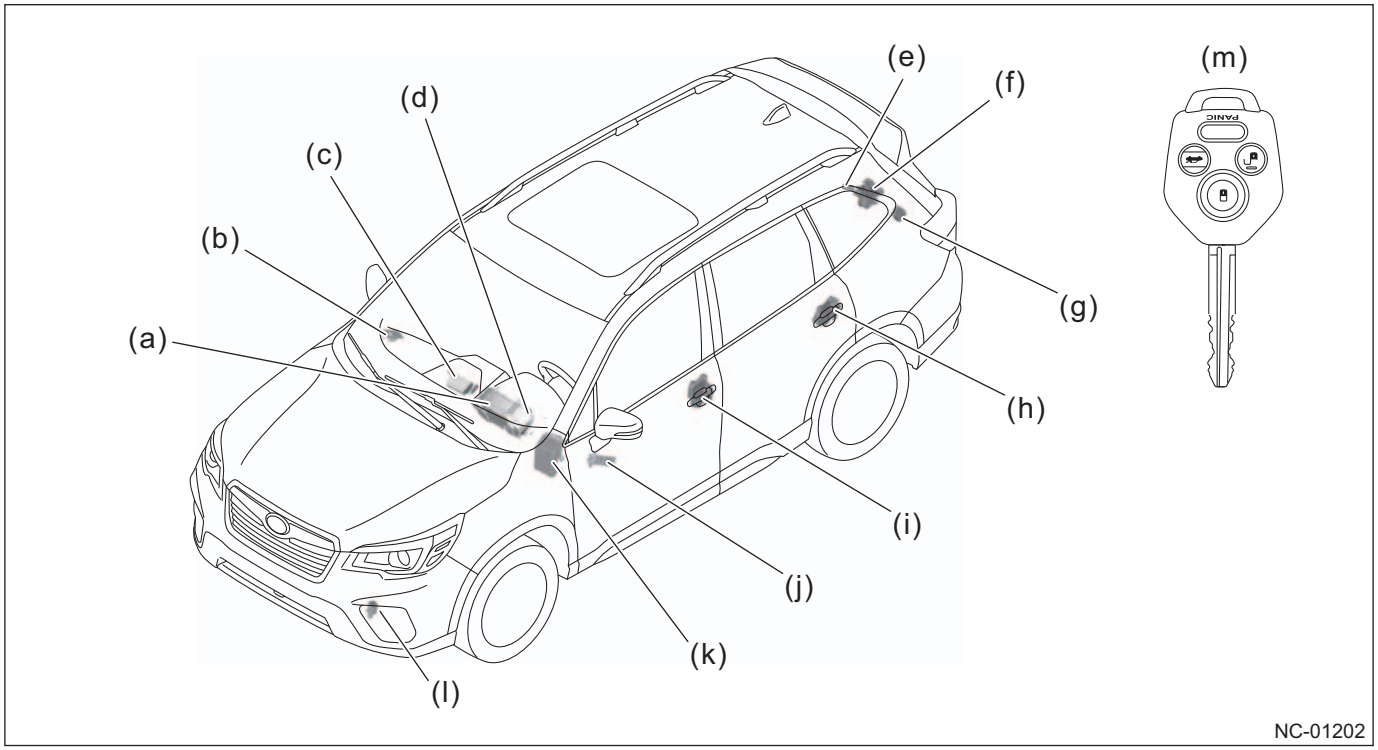
Reliability enhancement of the encryption system	The number of cypher bits used for encryption collation for the transponder or between units is increased, and the encryption system is changed to a more reliable system.

10.7.2 Component

Component layout drawing

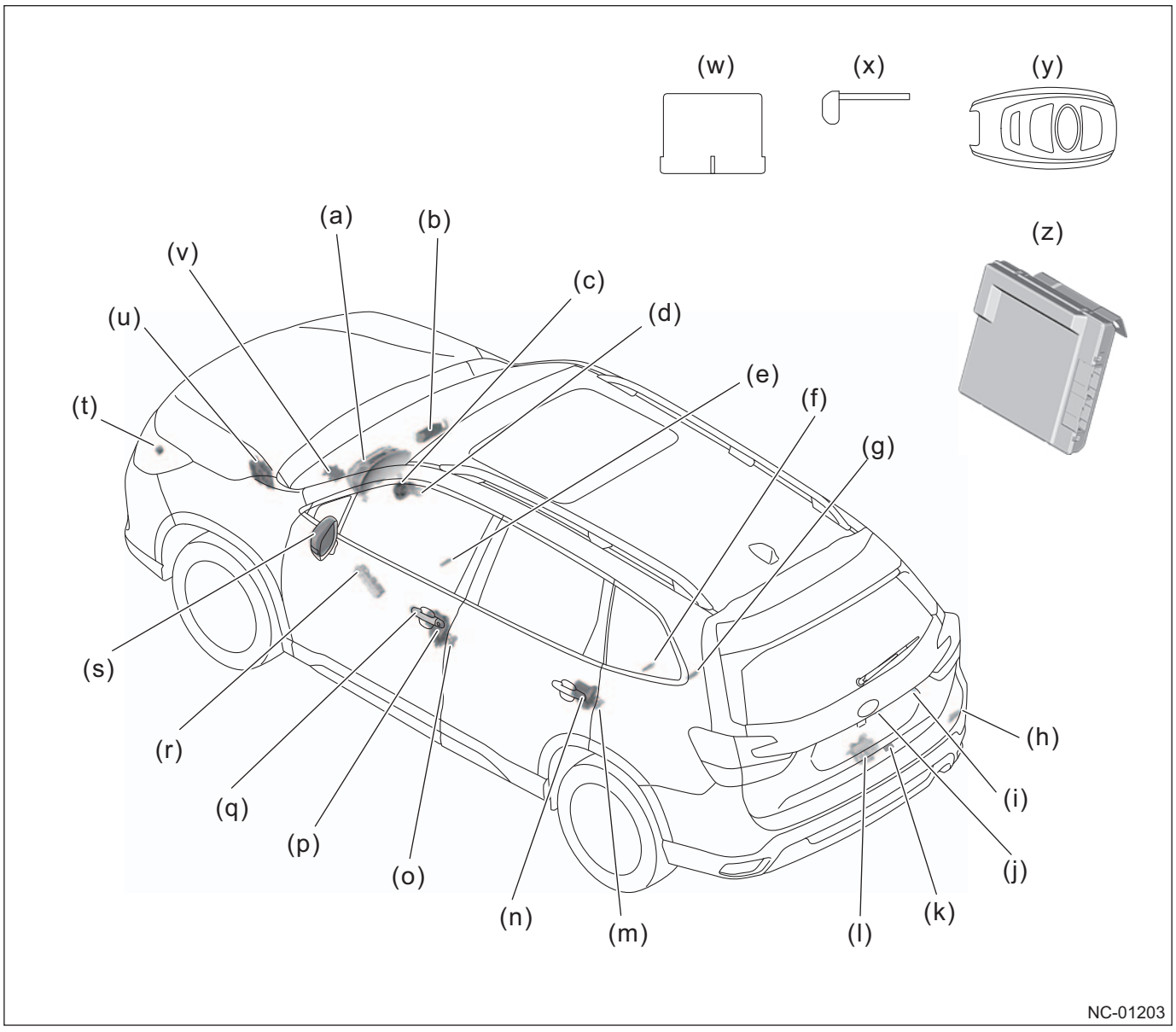
Door lock system

Vehicle with keyless entry system (for some grades)



(a) Combination meter assembly
(b) Switch power window sub front
(c) Backup unit assembly
(d) Access key warning light
(e) Power rear gate close switch
(f) Latch and actuator assembly rear gate
(g) TPMS & keyless entry control module or keyless entry control module
(h) Latch & actuator assembly rear
(i) Latch & actuator assembly front
(j) Switch power window main
(k) Body integrated unit (in joint box)
(l) Keyless buzzer
(m) Keyless transmitter

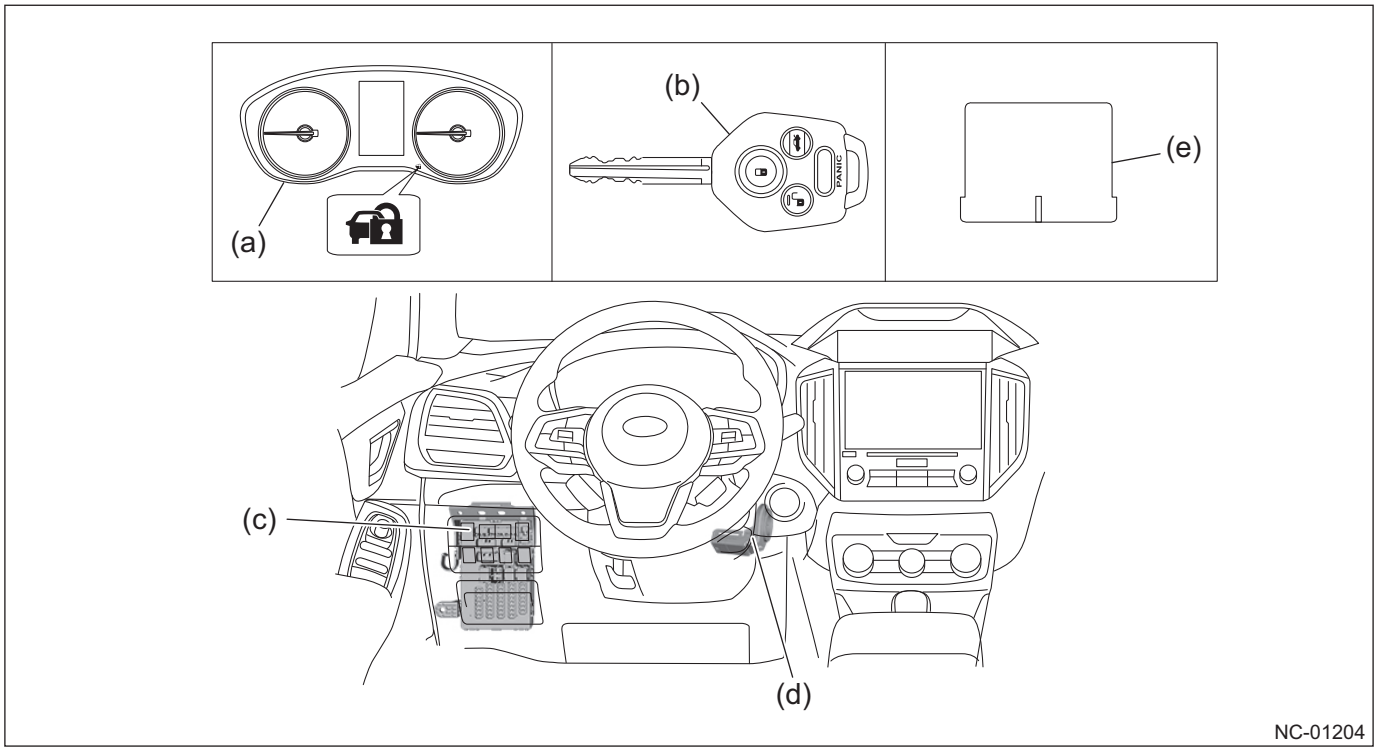
Vehicle with keyless access & push button start system (for some grades)



(a) Combination meter assembly
(b) Backup unit assembly
(c) Steering lock CM
(d) Push button ignition switch
(e) Front interior antenna
(f) Center interior antenna
(g) Rear interior antenna
(h) Rear exterior antenna
(i) Rear request switch (lock)
(j) Rear gate opener button
(k) Power rear gate inner switch and power rear gate lock switch
(l) Latch and actuator rear gate
(m) Door switch
(n) Latch and actuator rear
(o) Door switch
(p) Latch & actuator assembly front
(q) Handle front door outer
(r) Switch power window main
(s) Body integrated unit (in joint box)
(t) Access buzzer
(u) Engine control module (ECM)
(v) Transmission control module (TCM)
(w) ID code box
(x) Mechanical key
(y) Access key
(z) Keyless access control module

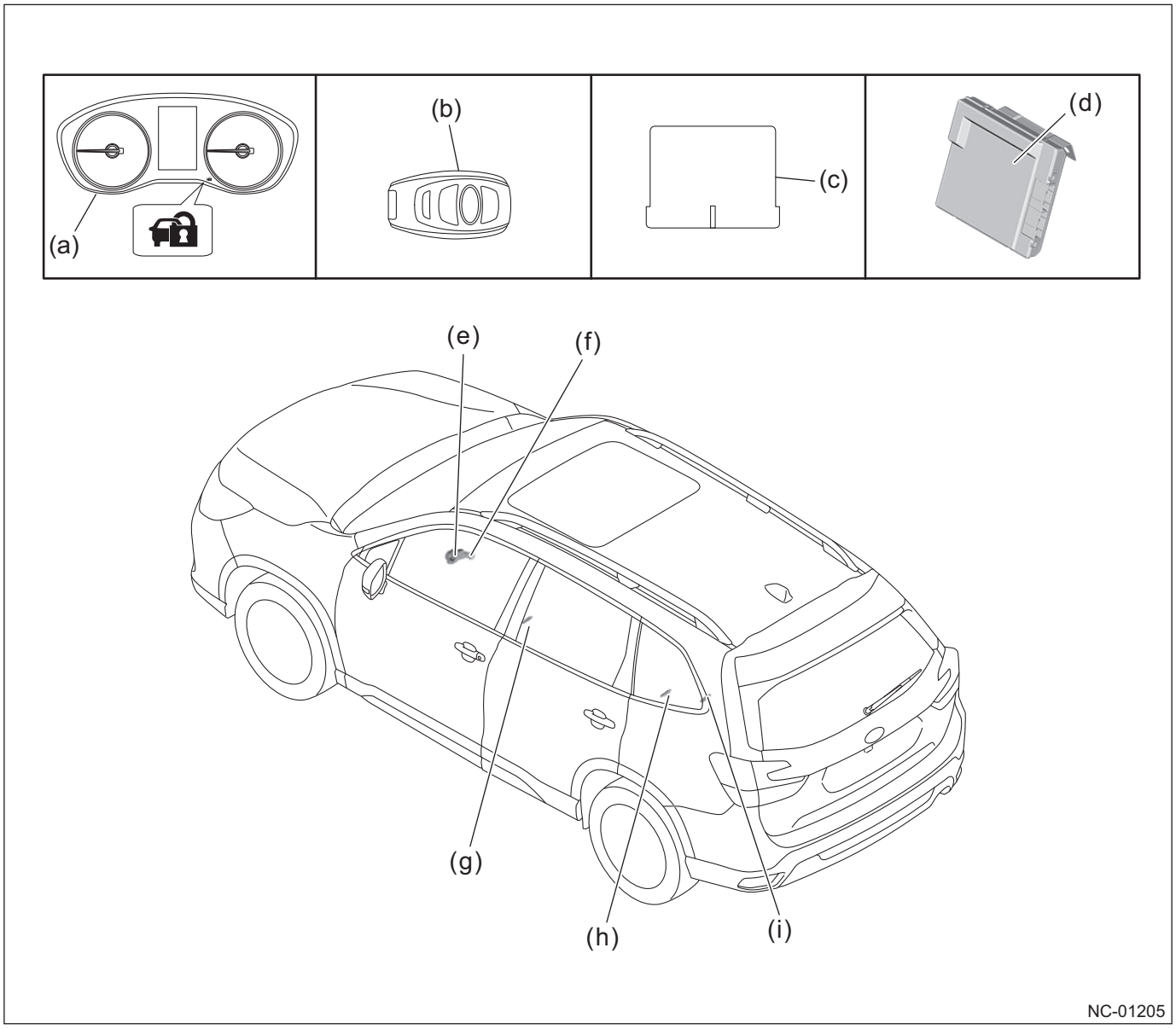
Security system

Immobilizer system
Vehicle with keyless entry system (for some grades)



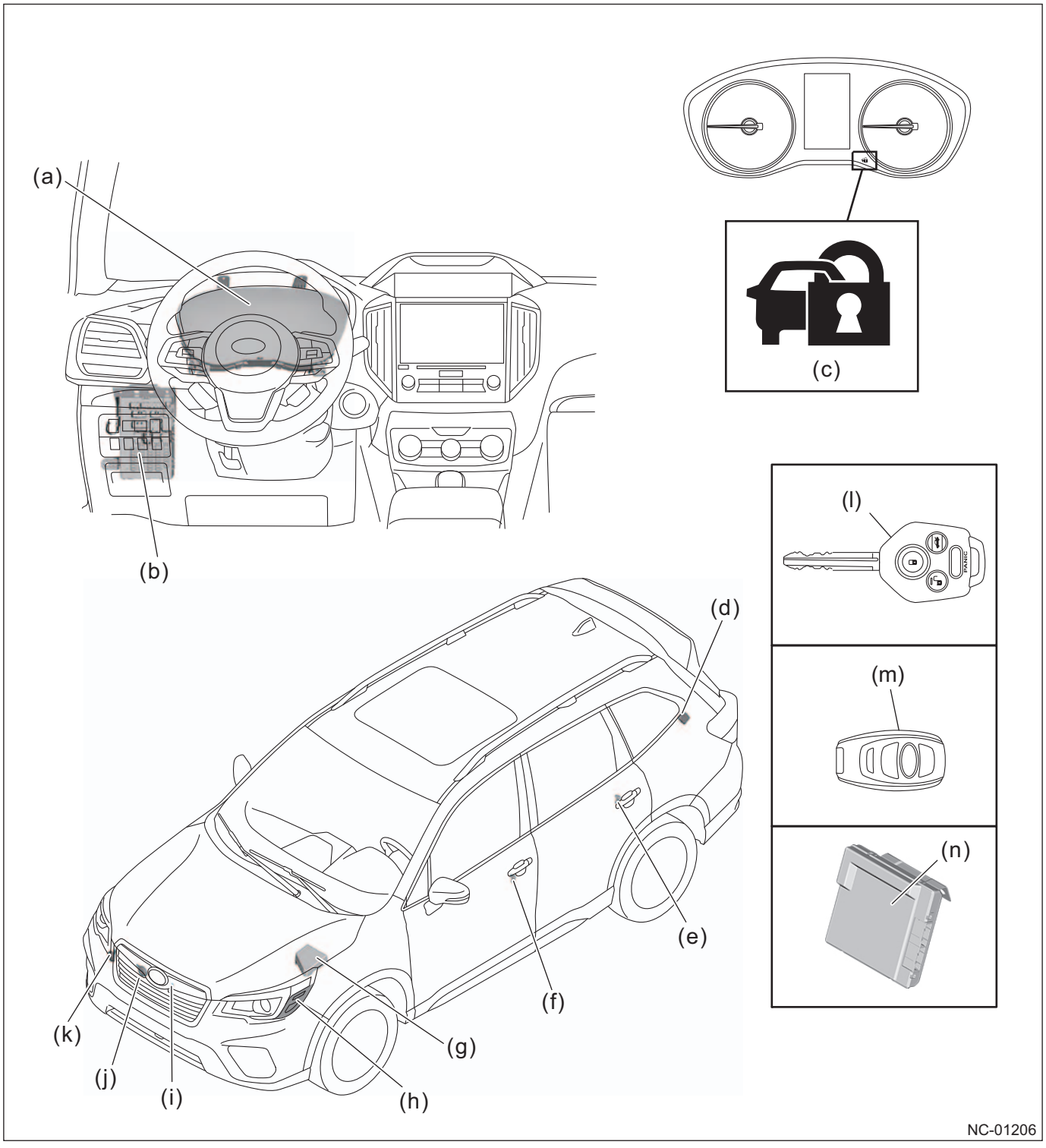
(a) Combination meter assembly (security indicator light)
(b) Keyless transmitter (transponder)
(c) Body integrated unit (in joint box)
(d) Immobilizer antenna assembly
(e) Immobilizer control module (only for C5)

Vehicle with keyless access & push button start system (for some grades)



(a) Combination meter assembly (security indicator light)
(b) Access key (transponder)
(c) ID code box (only for C5)
(d) Keyless access control module
(e) Steering lock CM
(f) Push button ignition switch (immobilizer antenna)
(g) Front interior antenna
(h) Center interior antenna
(i) Rear interior antenna

Security alarm system



(a) Combination meter assembly
(b) Body integrated unit (in joint box)
(c) Security indicator light
(d) TPMS & keyless entry control module or keyless entry control module *1
(e) Door switch
(f) Door switch
(g) Horn relay (in main fuse box)
(h) Turn signal light
(i) Hood switch
(j) Horn assembly Hi
(k) Horn assembly Lo
(l) Keyless transmitter *1
(m) Access key *2
(n) Keyless access control module *2

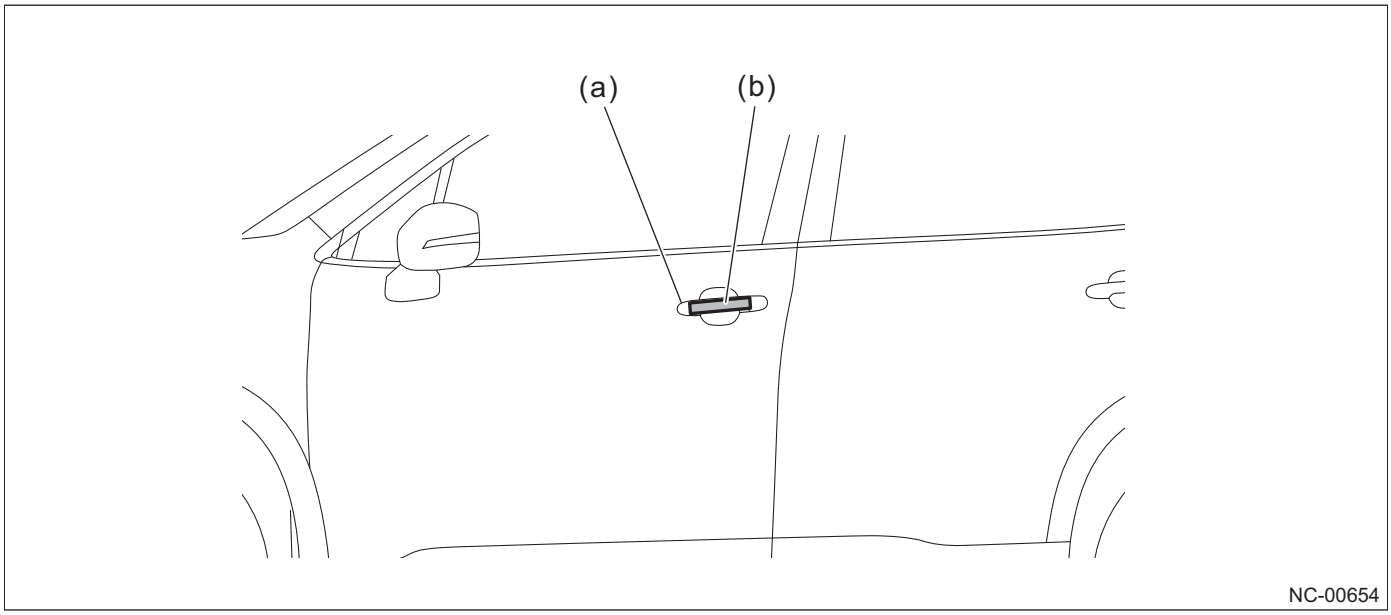
*1: Model without keyless access & push button start system

*2: Model with keyless access & push button start system

Component details

Door outer handle

A touch sensor is adopted for the request switch of the front door outer handle of the model with keyless access & push button start system.



(a) Handle front door outer

(b) Touch sensor (reverse side)

Keyless transmitter (vehicle with keyless entry system)

An external toothed key is adopted.

The external toothed key has a lock button, unlock button, and rear gate unlock button attached to enable operation of the keyless entry system. CR1620 battery is used for the keyless transmitter.

A transponder is built in the keyless transmitter.

Access key (vehicle with keyless access & push button start system)

The access key has a lock button, unlock button, and rear gate unlock button attached to enable operation of the keyless entry system. CR2032 battery is used for the access key.

It has a built-in mechanical key and transponder function, and when the system does not operate correctly, such as when the battery of the access key runs down, when the peripheral radio wave environment is bad (there is high noise), etc., you can lock/unlock the doors by inserting the mechanical key in the driver's door key cylinder. By touching the access key with the button side facing you to the push button ignition switch while depressing the brake pedal, the switch position is set to ACC or ignition switch ON.

Antenna

A front interior antenna, a front exterior antenna, a rear interior antenna, a center interior antenna, and rear exterior antenna are installed for the keyless access & push button start system.

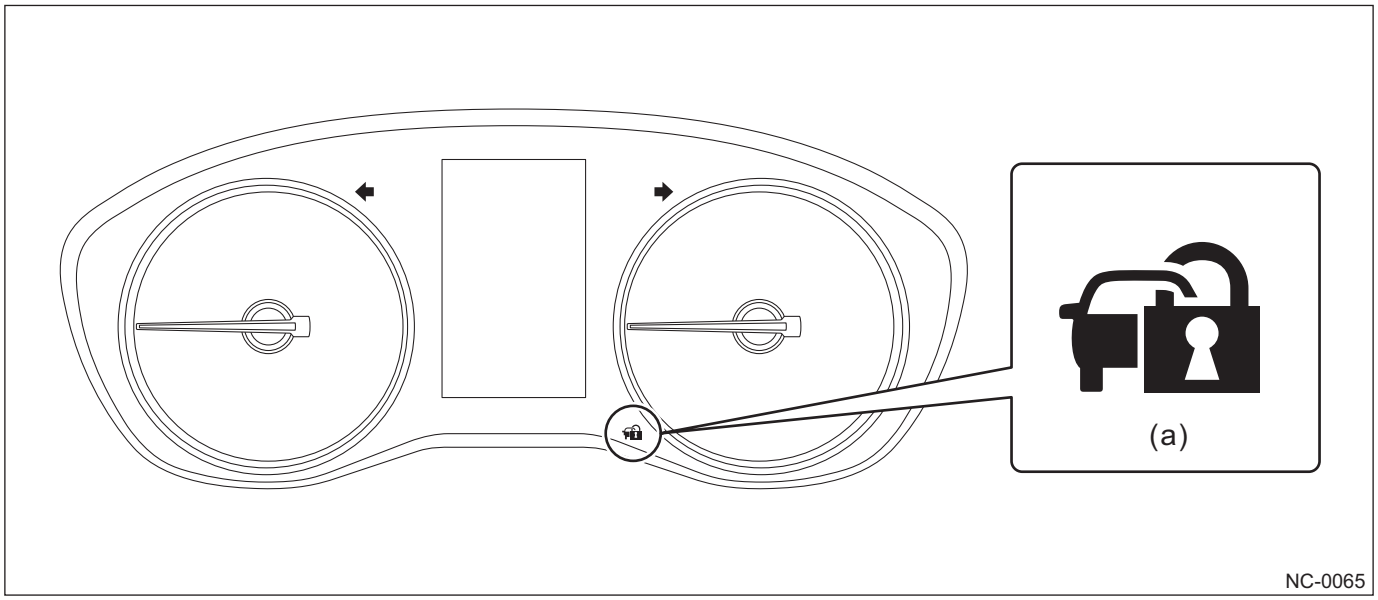
■ Precautions for people using implanted cardiac pacemakers, etc.

There is a risk of the radio waves used in the keyless access and the push button start system affecting medical electrical equipment such as cardiac pacemakers etc. When using the system, avoid approaching implanted cardiac pacemakers etc. within about 22 cm (8.7 in) from each antenna, referring to the following description. There is a risk of influencing operation; caution is necessary.

The keyless access & push button start system uses the radio waves of the radio wave type remote control door lock and the radio frequency of 134 kHz. These radio waves are output from each interior and exterior antenna. A continuous radio wave is output from the exterior antennae inside the front door handles when all of the doors are closed and locked. Radio waves are output from the interior antennae by door opening and closing, brake pedal, and push button ignition switch operations, etc. This function can be stopped by a customization function.

Security indicator light

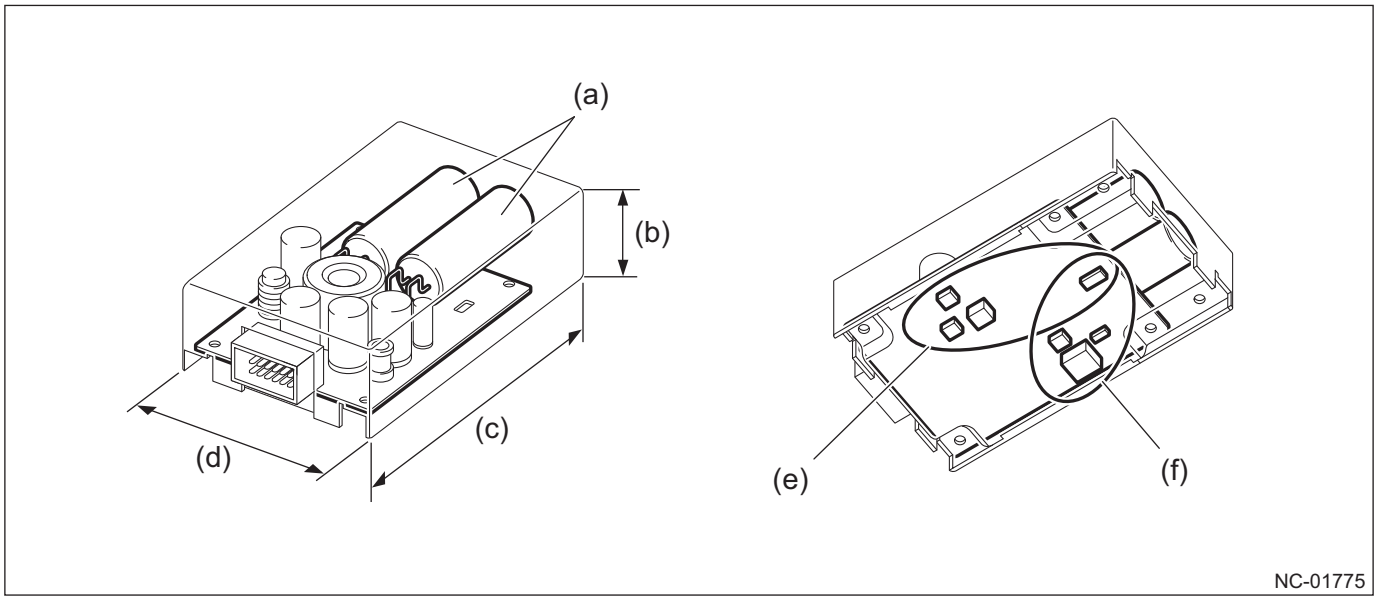
A security indicator light that indicates the warning status of the security system and the operating status of the immobilizer system is arranged in the combination meter.



(a) Security indicator light

Backup unit (sub battery)

The backup battery unit is arranged on the center of the instrument panel so as not to damage the battery on collision.



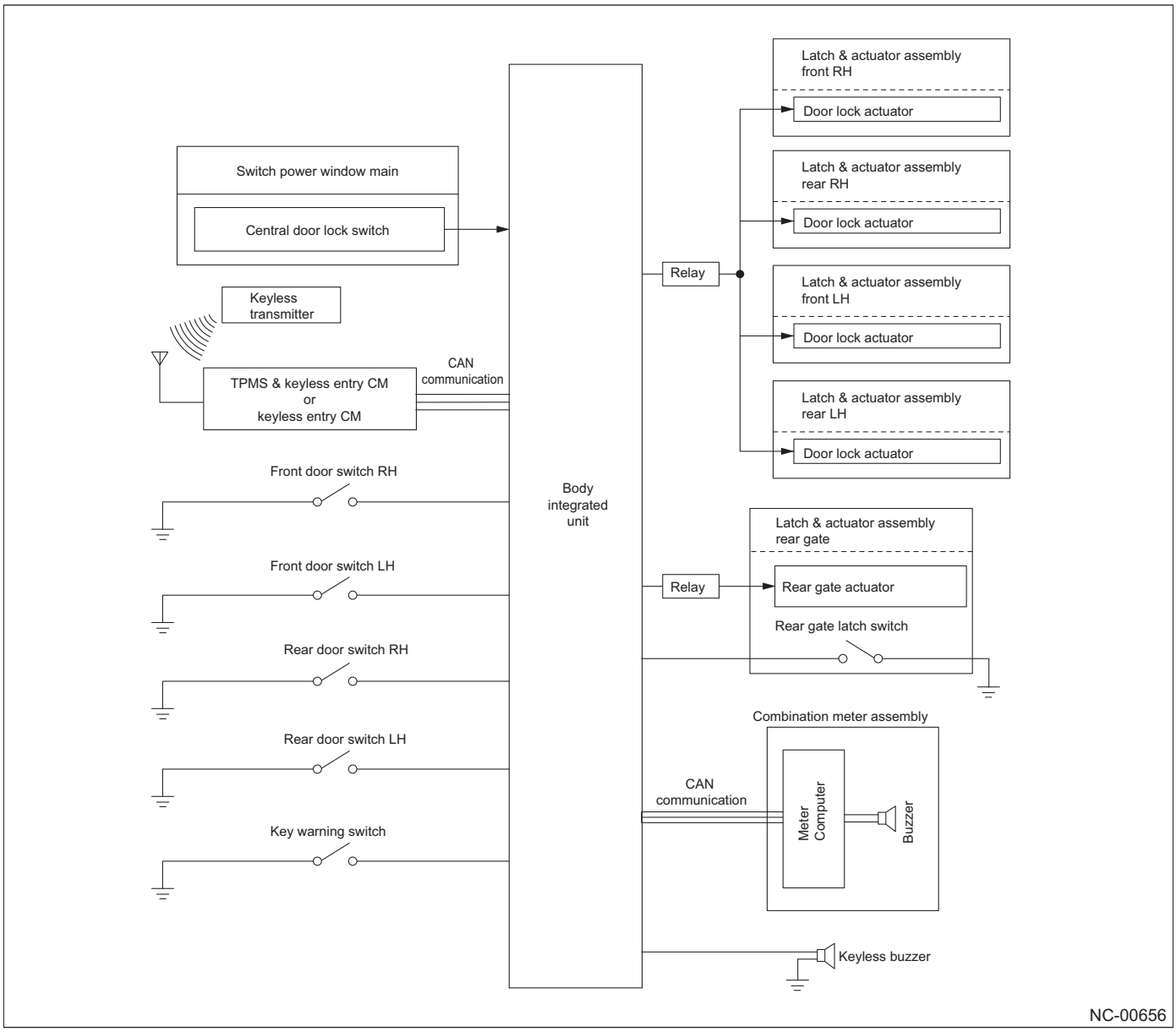
(a) Capacitor
(b) 1.4 in (35 mm)
(c) 4.53 in (115 mm)
(d) 2.6 in (65 mm)
(e) Charging DC/DC converter
(f) Output DC/DC converter

10.7.3 Construction and Operation

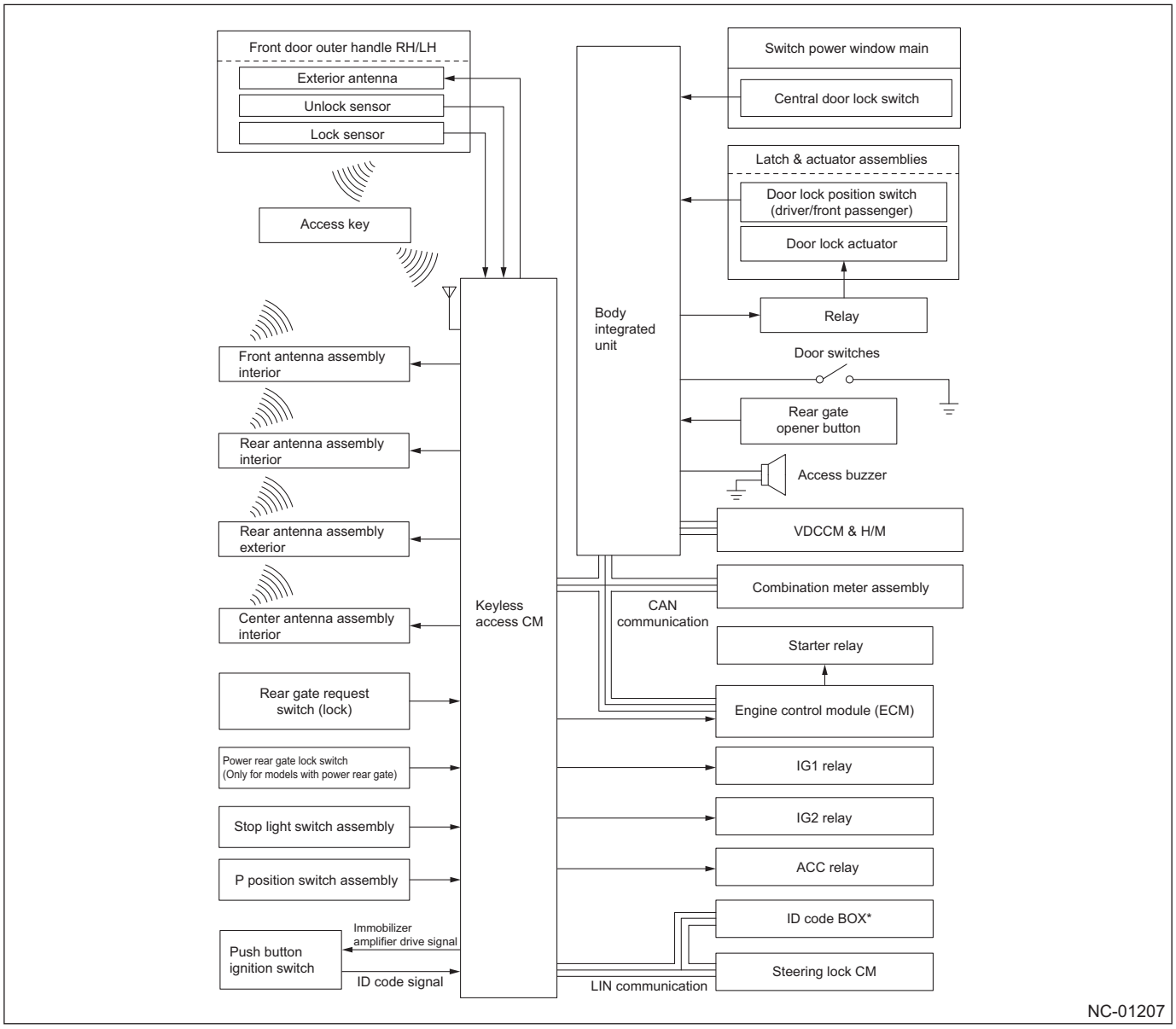
System diagram

Door lock system

Keyless entry system (for some grades)



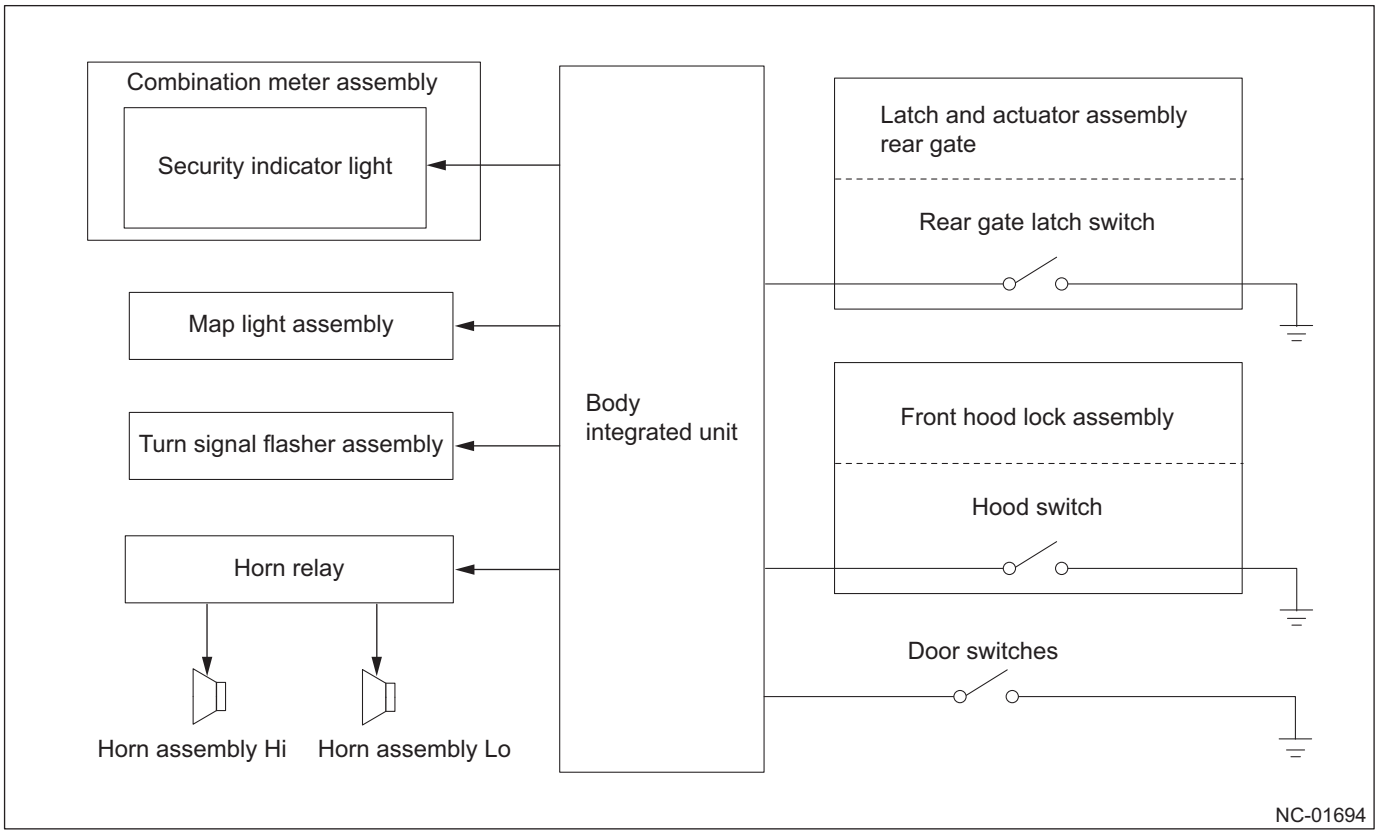
Keyless access & push button start system (for some grades)



*: Only for C5

Security system

Security alarm system



Door lock system

Common functions (keyless entry system/keyless access & push button start system)

■ Manual lock (unlock) function

This is a function to lock/unlock doors with all the doors interlocked by operating the central door lock switch toward the lock (unlock) side.

If the central door lock switch is operated toward lock (unlock) side, a manual lock (unlock) switch signal is output from the door lock control switch to the body integrated unit. The body integrated unit with the signal input, sends a door lock (unlock) drive signal to each door lock actuator and locks (unlocks) each door by driving each door lock actuator.

■ Automatic door lock (unlock) function

▮ Automatic door lock

This is a function to lock automatically all the doors, the rear gate, and the fuel flap when riding (when starting to travel).

This function has customization items. A user can select and set operation conditions with the meter and the navigation system.

Automatic door lock operation conditions

Name	Setting	Default
Vehicle automatic door lock	OFF: Function OFF	Vehicle speed
	Vehicle speed: When the vehicle speed is at 13 mph (20 km/h) or more	
	Select lever P: When select lever is in any position except P	

▮ Automatic door unlock

This is a function to automatically unlock all the doors, the rear gate, and the fuel flap when exiting to make the door unlock operation unnecessary.

This function has customization items. A user can select and set operation conditions with the meter and the navigation system.

Automatic door unlock operation conditions

Name	Setting	Default
Vehicle automatic door unlock	OFF: Function OFF	Driver's door open
	Select lever P: When select lever is in P	
	Power supply OFF: When power supply position is switched from ON to OFF	
	Driver's door open: When driver's door opens	

Reference

As for CAN signals used in the control over the automatic locking (customization: vehicle speed, select lever P)/unlock (select lever P), the customization setting does not operate automatic door lock/unlock when the corresponding CAN signal is not received or malfunction is detected.

▮ One-motion open mechanism

With adoption of the vehicle speed detection automatic door lock, the one-motion open mechanism is adopted.

Even when the doors of the vehicle are locked, the door lock can be released by pulling the inner remote lever of the driver's seat/passenger's seat.

The door can be opened without operating the lock knob even after the automatic door lock is activated. This eliminates the burden of releasing the lock.

■ Collision detection unlock function

When the vehicle receives strong impacts, all the doors and the rear gate are automatically unlocked so as not to trap passengers.

Caution

This function may not operate depending on the strength of the impact.
After collision detection unlock function operates, to cancel the system (automatic door lock is performed again), turn on the IGN power after turning off IGN power.
Since this function operates as function for safety, this cannot be deactivated with customization.

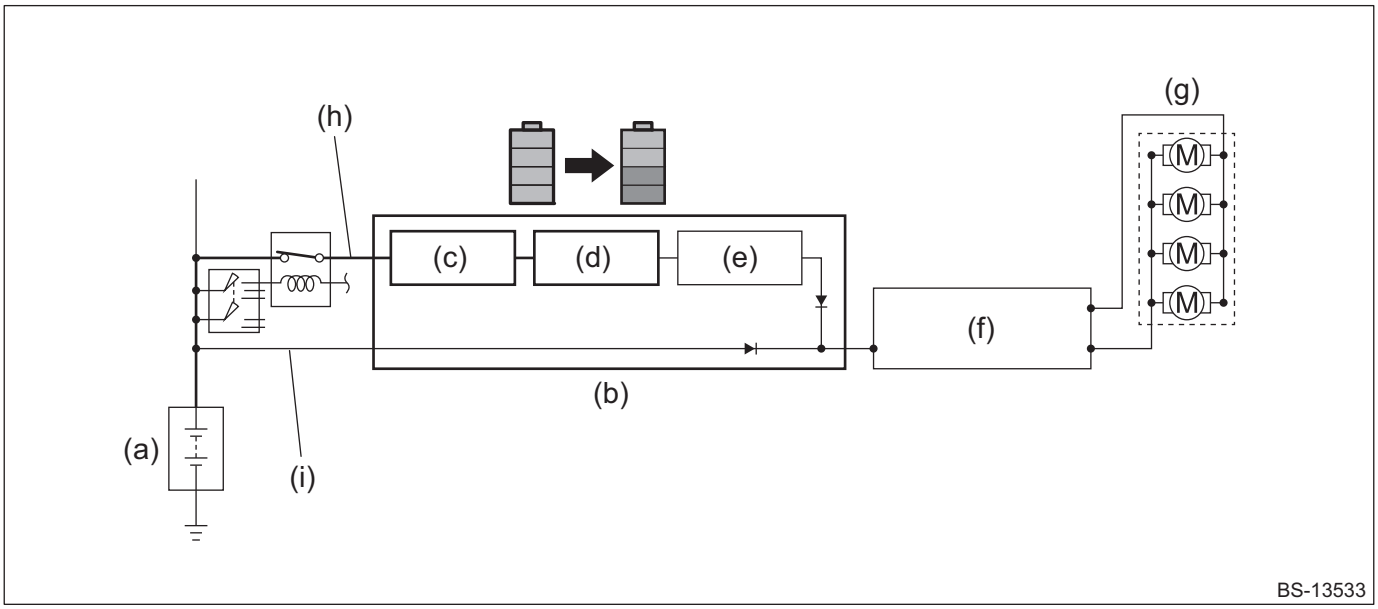
Backup unit

The backup unit is adopted for the collision detection unlock function. The backup unit normally charges and stores the electricity necessary for operating each door lock actuator. If the power supply of the body integrated unit malfunctions when receiving the strong impact such as collision, etc. the backup unit supplies the electricity necessary for unlocking.

If signals cannot be received normally due to some abnormality, all seats are unlocked and the automatic locking/unlocking cannot be performed until the engine switch turns off.

When charging backup unit (normal condition)

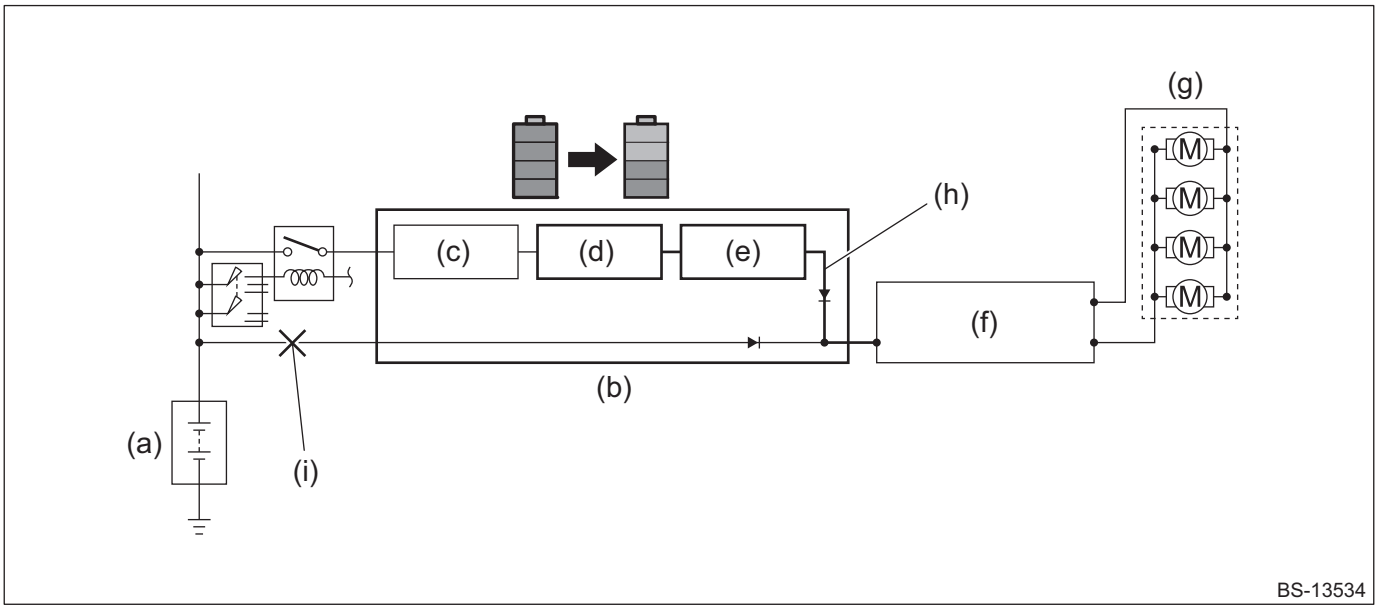
When the ignition switch is ON, the capacitor in the backup unit is charged for about 90 seconds.



(a) Battery
(b) Backup unit assembly
(c) Charging DC/DC converter
(d) Capacitor
(e) Output DC/DC converter
(f) Body integrated unit
(g) Each door lock actuator
(h) Charging path
(i) Power supply path of body integrated unit

When backup unit operates (on collision)

When the power supply malfunctions on collision accidents, etc., electricity is supplied from the charged capacitor to the body integrated unit and each door lock actuator to cancel the door lock.



(a) Battery
(b) Backup unit assembly
(c) Charging DC/DC converter
(d) Capacitor
(e) Output DC/DC converter
(f) Body integrated unit
(g) Each door lock actuator
(h) Backup power supply path (on collision)
(i) Malfunction in power supply path of body integrated unit

Function of keyless entry system (for some grades)

Locking/unlocking operation of the keyless entry system is controlled by the body integrated unit.

The body integrated unit receives a key identification code signal by operating the lock/unlock button of the keyless transmitter. When the lock/unlock signal is received, the door lock actuator of each latch and actuator assembly is driven and all the doors and the rear gate are locked/unlocked.

■ Wireless lock (unlock) function

When the lock button of the keyless transmitter is pressed, all the doors (including the rear gate) are locked. When the unlock button of the keyless transmitter is pressed once, only the driver's door is unlocked. If it is pressed once more within 5 seconds, all the doors (including the rear gate) are unlocked.

When the lock button (unlock button) of the keyless transmitter is pressed, a key identification code signal is sent to the keyless entry control module. The keyless entry control module with the signal received outputs a door lock (unlock) request signal to the body integrated unit.

The keyless entry control module verifies the ID code and distinguishes the function code, and if the ID code matches the vehicle code, outputs the door lock (unlock) request signal to the body integrated unit, then the body integrated unit outputs a lock (unlock) operation request signal to each door lock actuator.

When the body integrated unit inputs the lock (unlock) signal, the door lock actuators of all the doors (including the rear gate) are driven and all the doors (including the rear gate) are locked (unlocked) in the same way as the manual lock (unlock) operation of the electric door lock system.

■ Lock in and malfunction prevention function

When the key is inserted in the key lock cylinder, keyless transmitter operation is disabled.

■ Key reminder warning function

If the driver's door is opened when the key is inserted in the key lock cylinder with the ignition switch being OFF, the body integrated unit outputs a buzzer emission request from each signal to the combination meter. The meter computer intermittently sounds the buzzer based on the request received from the body integrated unit, warning that the driver has forgotten to remove the key.

If the ignition switch is set to ON, if the driver's door is closed, or if the key is extracted, sounding of the buzzer stops.

■ Answer-back function

When the lock/unlock button of the keyless transmitter is pressed, the hazard lights flash and the keyless buzzer sounds, once when locking and twice when unlocking.

■ Illuminated entry function

If the unlock button of the keyless transmitter is pressed when the map light switch is in the "DOOR" position, some of the interior lights such as the map light etc. illuminate for 30 seconds (default setting).

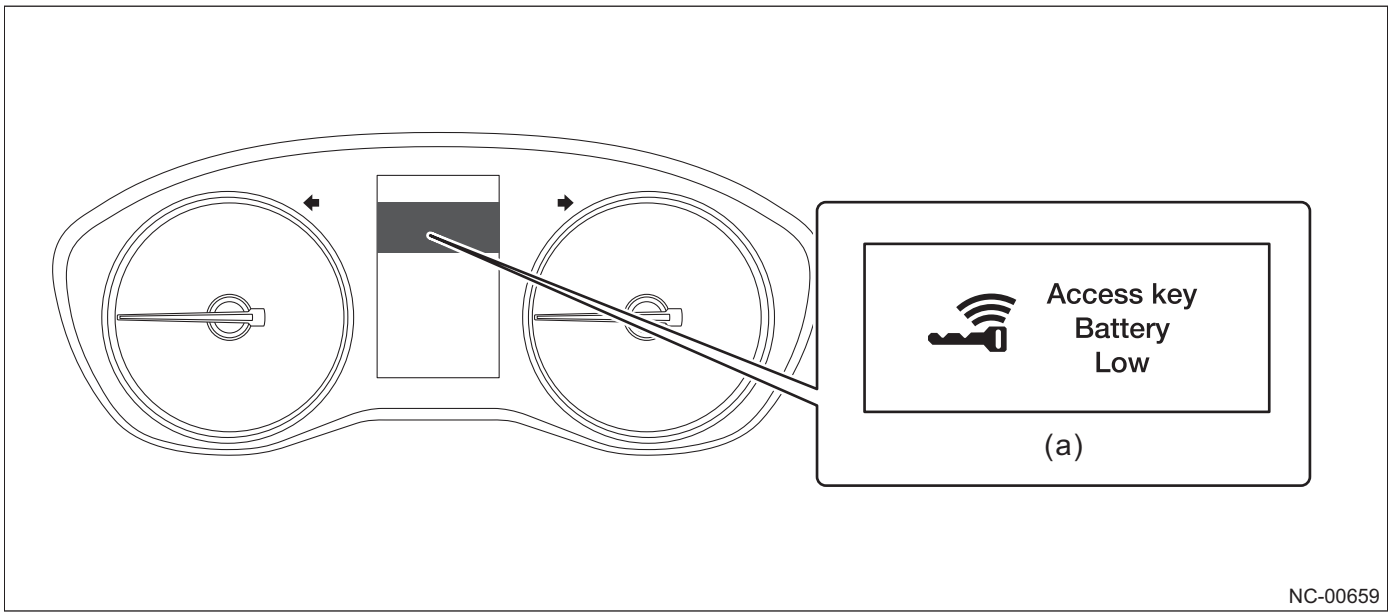
■ Keyless transmitter registration function

A maximum of four keys can be registered using Subaru Select Monitor 4, available from dealers.

■ Keyless transmitter remaining battery charge warning function (for some grades)

The remaining battery charge warning function for the keyless transmitter is adopted.

When the remaining capacity of the battery in the keyless transmitter is low, an internal buzzer sounds and a warning is displayed in the meter, prompting the user to replace the battery.



(a) Keyless transmitter remaining battery charge indicator

Function of keyless access & push button start system (for some grades)

The system is controlled by the keyless access control module communicating with the body integrated unit etc. based on the access key and vehicle ID code verification result etc.

In order to perform "verification for access key and ID code" and "position confirmation of access key (person carrying the key)" depending on functions performed by the keyless access control module, a request signal is output to the interior antennae and exterior antennae. When an ID code including response code is received from the access key that received the request signal, discrimination/verification is performed and an operation instruction signal is output to each control module depending on the function.

■ Keyless access function

By operating the lock/unlock button of the access key, operations such as door locking/unlocking are performed in the same way as the "wireless lock (unlock) function" of the keyless transmitter.

■ Keyless access door unlock function

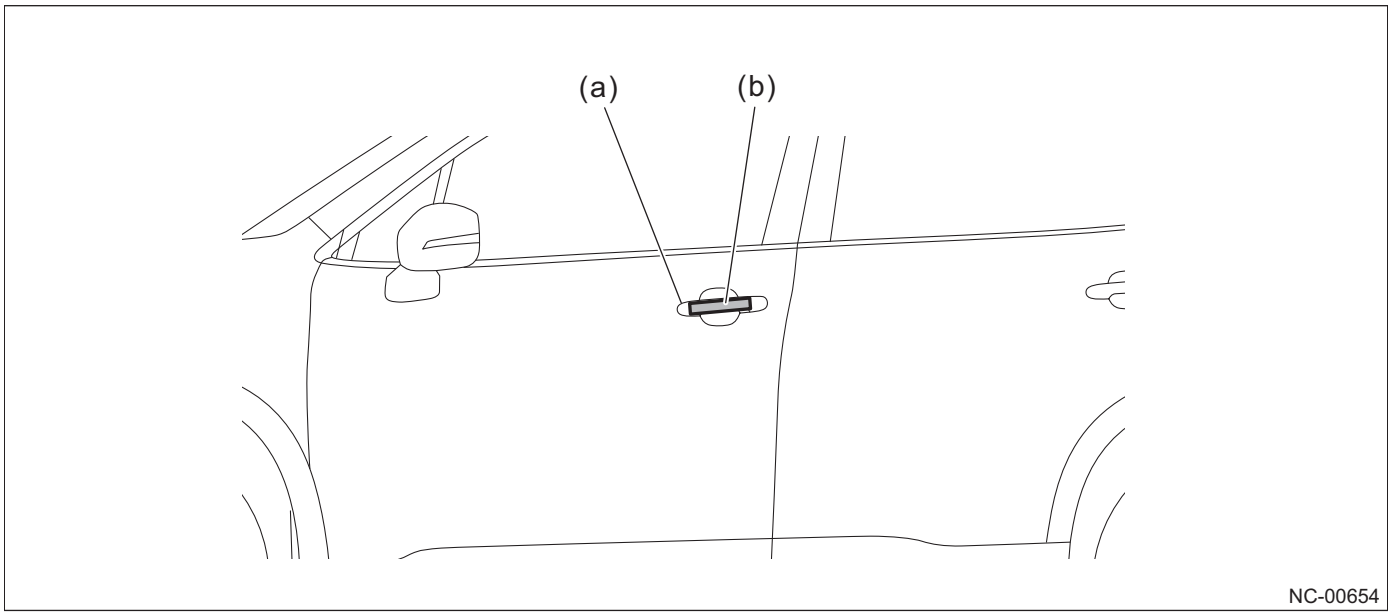
If the driver's door outer handle is gripped while carrying the access key, the driver's door is unlocked.

If the front passenger's door outer handle is gripped while carrying the access key, all the doors (including the rear gate) are unlocked.

When the doors (including the rear gate) are unlocked, the hazard lights flash twice and the keyless buzzer sounds twice as an answer back.

The rear gate is unlocked when pressing the rear gate opener button.

Caution
If the doors cannot be unlocked when you suddenly operate the door outer handle (gripping the door outer handle), or when you suddenly enter the cabin external detection area to operate the door outer handle, release hands once from the door outer handle to perform the door outer handle operation again.
If the door outer handle operation is performed using gloves, the door may not unlock.



(a) Handle front door outer

(b) Touch sensor (handle reverse side)

■ Keyless access door lock function

When the lock button (unlock button) of the access key is pressed, an ID code/function code signal is sent to the keyless access control module. The keyless access control module which received the signal outputs a door lock (unlock) request signal to the body integrated unit.

When you exit the vehicle carrying the access key with all the doors closed, and if you touch the touch sensor on the surface of the door outer handle in the cabin external detection area, all the doors (including the rear gate) lock.

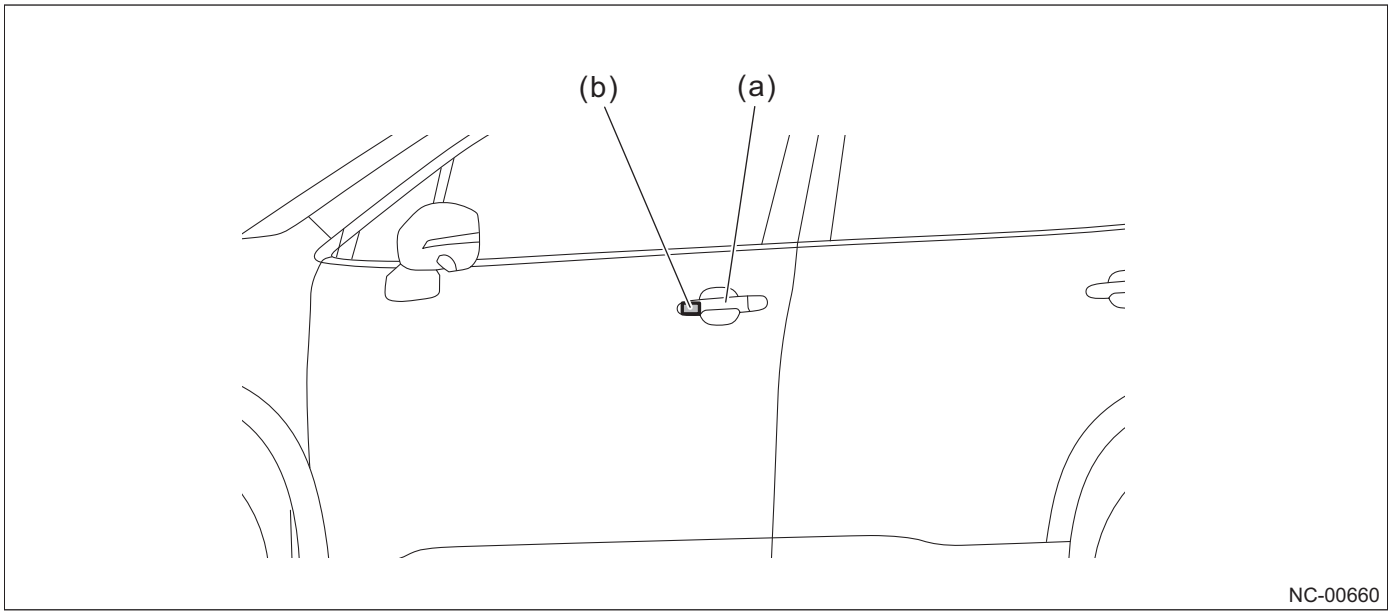
When you are carrying the access key with all the doors opened, and if you press the rear gate request switch (lock) in the rear gate external detection area, all the doors (including the rear gate) lock.

When you are carrying the access key with the rear gate opened, and if you press the power rear gate lock switch in the rear gate external detection area, all the doors lock and the rear gate automatically closes. (Only model with power rear gate)

When all the doors (including the rear gate) lock, the hazard lights flash once and the keyless buzzer sounds once as an answer back.

Caution

The keyless access door lock function is valid up to two consecutive times and inoperative at the third time or more.
If the doors do not lock when you touch the touch sensor on the surface of the door outer handle, touch the touch sensor with palm to lock the doors.
If you touch the touch sensor using gloves, the door may not lock.
If the door outer handle is splashed with water while carrying the access key when washing, the doors may lock and unlock repeatedly. In that case, wash the vehicle when the access key is away from the vehicle by about 2 m (6.6 ft) or more.
If the door outer handle is splashed with water when the vehicle is washed by a car washer with the access key being in the passenger room, the keyless buzzer may sound a warning. In that case, lock all the doors (including the rear gate) and stop the warning.
If ice, snow, or dirt is adhered on the surface of the touch sensor, the sensor may not respond.



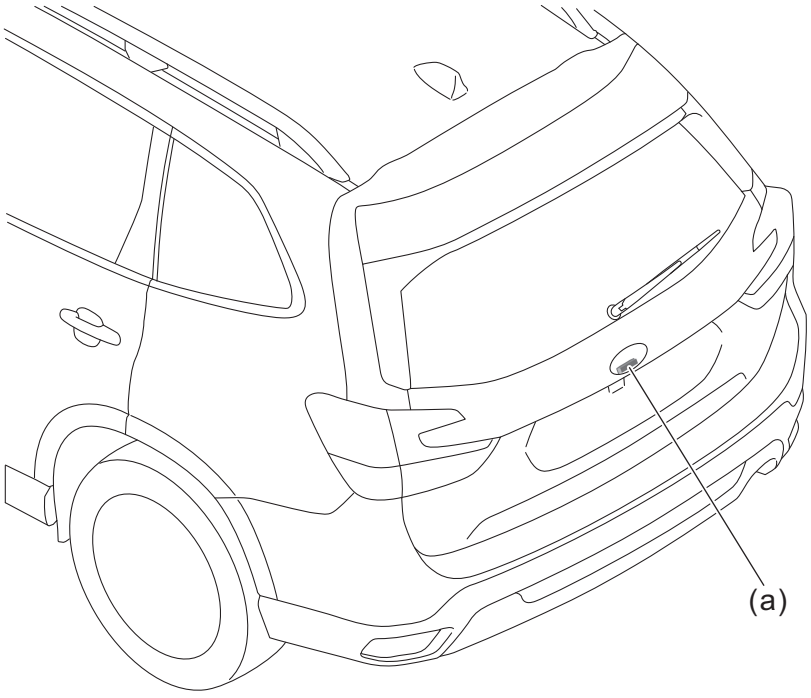
(a) Handle front door outer

(b) Touch sensor

■ Keyless access rear gate unlock function

The rear gate is unlocked when pressing the rear gate opener button while carrying the access key.

The rear gate is unlocked when pressing the rear gate opener button while carrying the access key in the rear gate external detection area.



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(a) Rear gate opener button

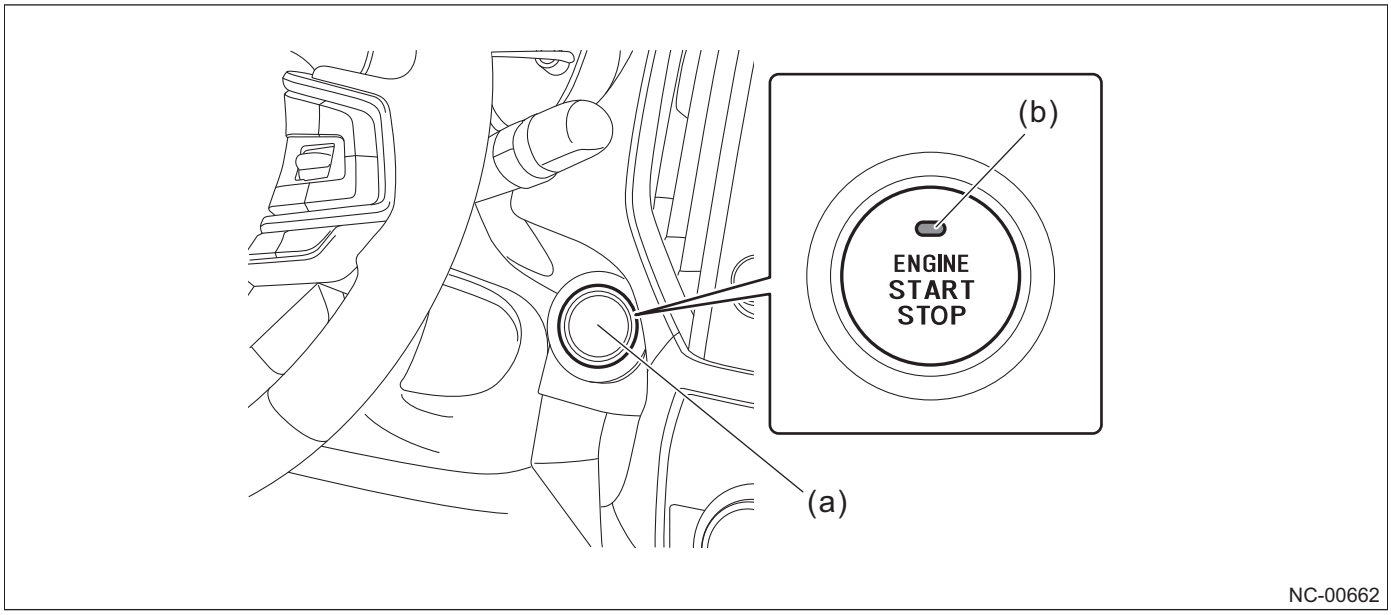
■ Push button start function

By pressing the push button ignition switch in combination with brake pedal operation while carrying the access key in the cabin internal detection area, the power supply switching and the engine start can be performed.

If you press the push button ignition switch without depressing the brake pedal when entering the vehicle while carrying the access key with the power being OFF, the power transitions to ACC and the access key warning light flashes green. Each time the push button ignition switch is pressed, the power supply position switches to OFF to ACC to ignition switch ON to OFF (repeated).

If you depress the brake pedal with the shift position in "P" (only when in the steering unlock condition) when entering the vehicle while carrying the access key with the power being OFF, the operation indicator light in the push button ignition switch turns on green. If you press the push button ignition switch while the operation indicator light turns on green, the engine starts.

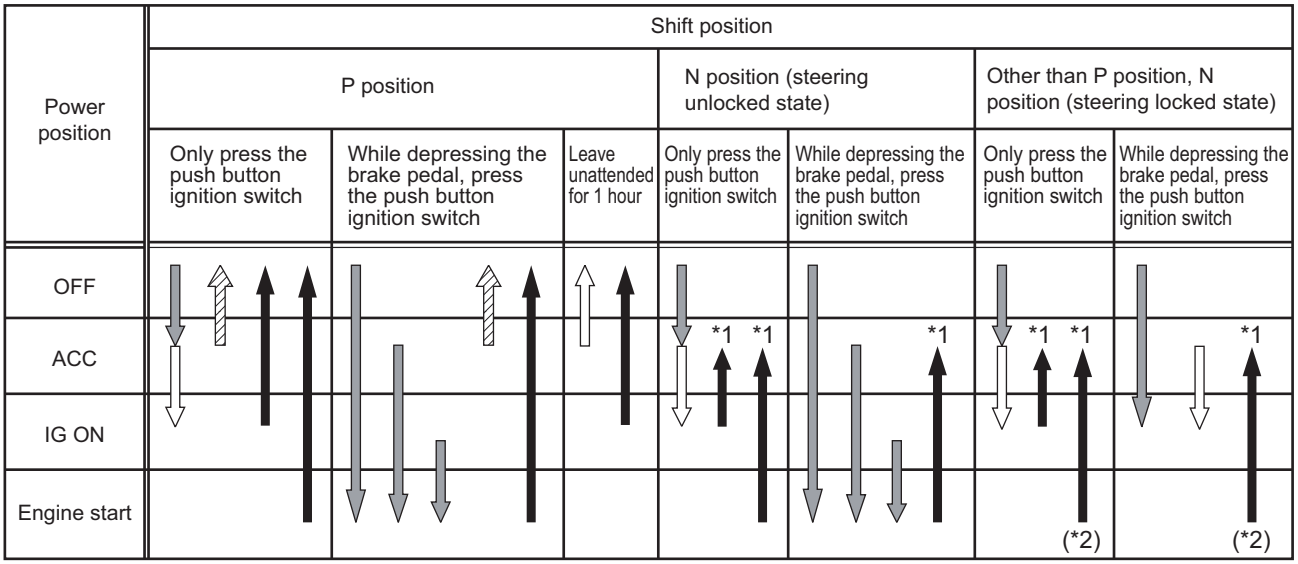
When the vehicle has stopped, if the push button ignition switch is pressed with the shift position in "P" while the engine is starting, the power position transitions to OFF. If the push button ignition switch is pressed with the shift in a position other than "P", the shift position transitions to ACC.



(a) Push button ignition switch

(b) Operation indicator light

Power position transition diagram



: Power transition

: Power transition possible when key collation is OK.

: Power transition possible when the vehicle is stopped.
(While driving, the engine stops and transfers to ACC if either the push button ignition switch is rapidly pressed 3 times or more, or held for 3 or more seconds.)

: Power transition possible only after *1 has been established and the shift position is set to “P”.

*2: Excluding N position (steering locked state)

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Power transition when the access key does not operate correctly due to a flat access key battery or radio wave jamming

Unlock the door with the mechanical key built into the access key and enter the vehicle while carrying the access key.

When touching the access key with the button side facing you to the front of the push button ignition switch, while depressing the brake pedal with the shift position in "P", the ignition switch transitions to ON. (The position transitions to ACC when the keyless access & push button start system is canceled.)

Each time the brake pedal is released and the push button ignition switch is pressed, the power supply position switches to ACC*, to ignition switch ON, and to OFF. After the position is OFF, it is necessary to touch the access key to the push button ignition switch again to restart the power.

*When the keyless access & push button start system is canceled.

Engine start when the access key does not operate correctly due to a flat access key battery or radio wave jamming

Unlock the door with the mechanical key built into the access key and enter the vehicle while carrying the access key.

Touch the ornament side of the access key to the front of the push button ignition switch, while depressing the brake pedal with the shift position in "P" to turn on the ignition switch.

If the push button ignition switch is pressed while depressing the brake pedal, the engine starts.

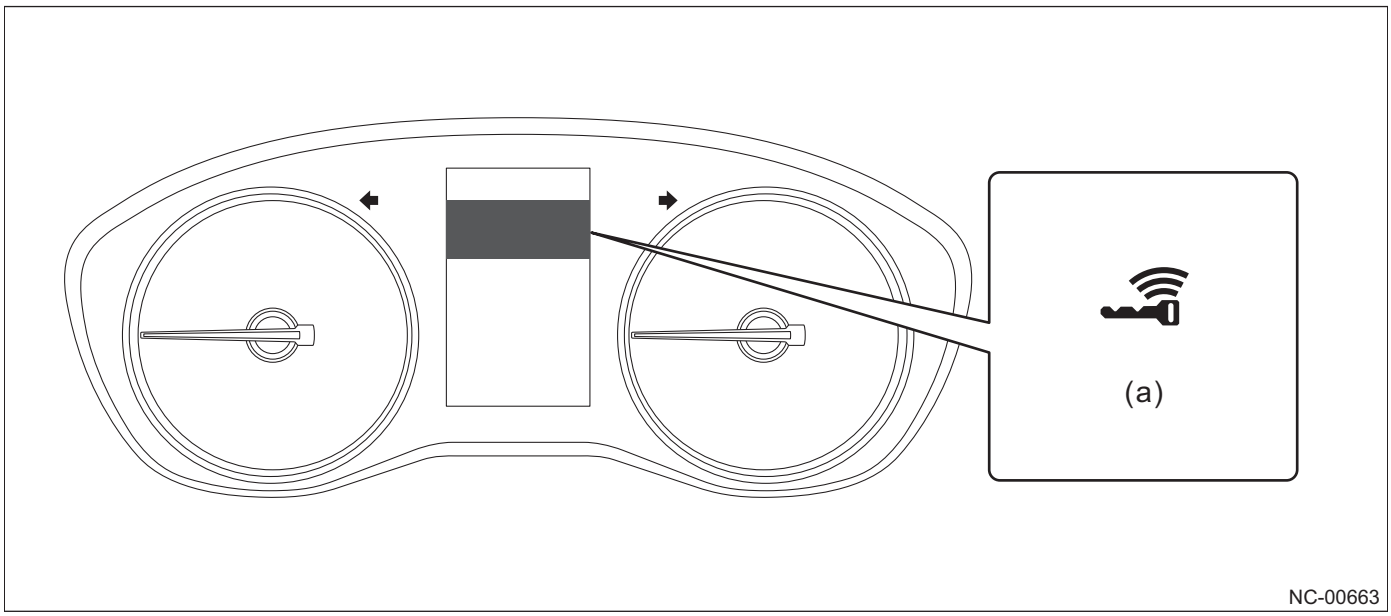
Illuminated entry function

When you enter the cabin external detection area while carrying the access key, the map light, reading light, and push button ignition switch lighting turn on.

■ Warning/alarm function

Keyless access & push button start system warnings are given by a buzzer, access buzzer, access key warning light, etc. in the combination meter.

It is possible for the driver to become unaware of the access key due to the convenience of the keyless access & push button start system. Therefore, it is possible for problems such as "access key going outside the vehicle without noticing it (a passenger carries it out)", "driver exiting the vehicle while the engine is running", and "driver exiting the vehicle while the shift is not in P position" etc. to occur. The warning function issues a warning/alarm to the driver and passengers by sounding a buzzer built into the combination meter, keyless buzzer and with the access key warning light to prevent problems like above from occurring.



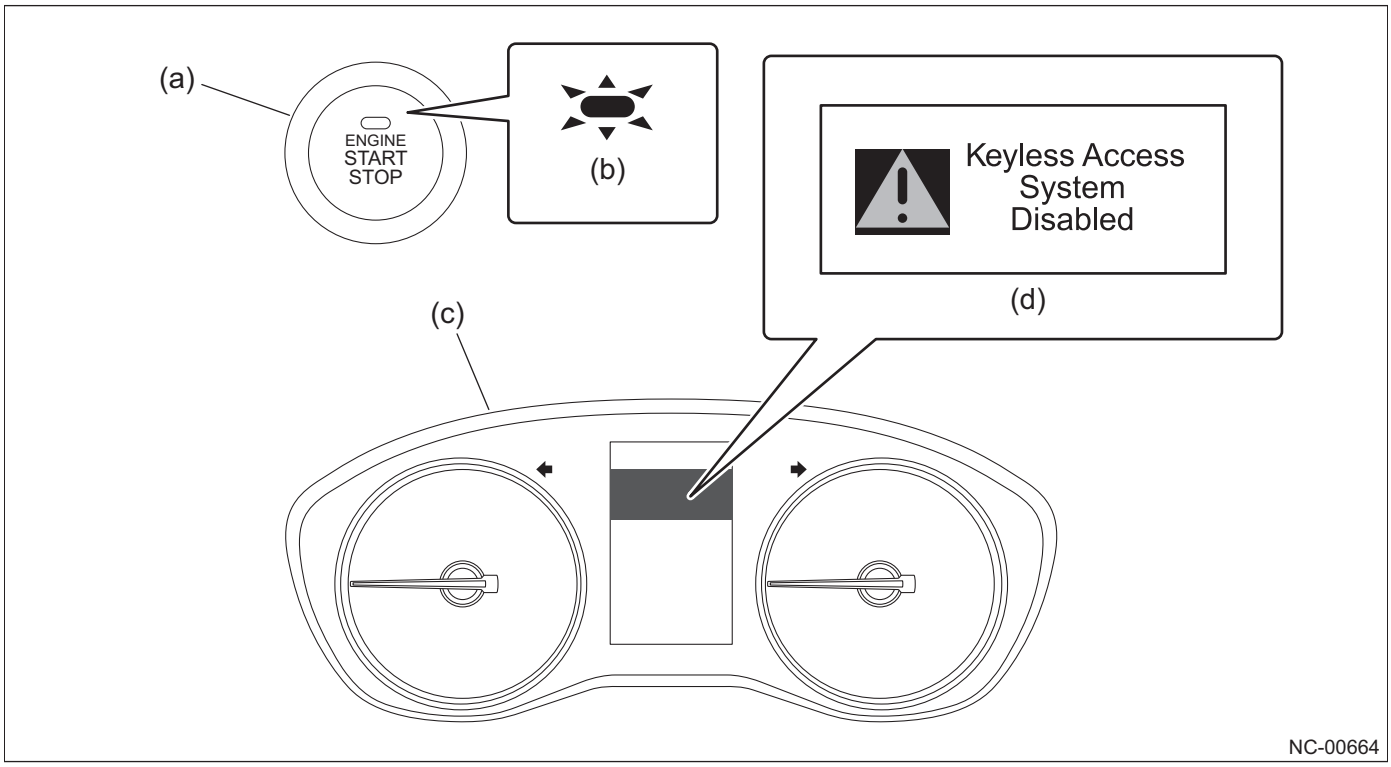
(a) Access key warning light

Alarm function list

Item	Function
Door open warning	An alarm sounds when a locking operation is performed by the touch sensor (lock) of the door outer handle, rear gate request switch (lock), power rear gate lock switch, or access key with any of the doors (including the rear gate) opened.
Lock-in prevention warning	If you attempt to lock all the doors by "locking from outside the vehicle without using the key" in a state where the access key is left in the vehicle, an exterior buzzer sounds for 2 seconds and all the doors (including the rear gate) are unlocked.
Mislaid key warning	This sounds an exterior buzzer for 2 seconds if the doors are closed and a locking operation is performed by the touch sensor (lock) of the door outer handle or rear gate request switch (lock) in a state where the access key is left in the vehicle when the power is OFF.
Access key warning	When traveling with no access key in the vehicle, an internal buzzer sounds and the access key warning light in the meter is displayed.
Power off reminder warning	This continuously sounds the exterior buzzer for the maximum 60 seconds if the touch sensor (lock) of the door outer handle, rear gate request switch (lock), or power rear gate lock switch is pressed while carrying the access key when the power is in a position other than OFF.
Engine start warning	If the push button ignition switch is pressed when there is no access key, an alarm sounds and the access key warning light in the meter is displayed.
Key removal warning	This sounds a buzzer and displays the access key warning light in the meter if the driver leaves the vehicle and closes the driver's door while carrying the access key when the power is in a position other than OFF.
	If a person riding in the vehicle takes the access key out of the vehicle and closes a door other than the driver's door when the power is in a position other than OFF, an alarm sounds.
Push button ignition switch or communication line fault warning	If the push button ignition switch or communication line is faulty, an internal buzzer sounds, the indicator in the push button ignition switch turns on in a 2 second cycle, and an interrupt warning is displayed in the combination meter.
Key reminder warning	With the select lever being in P range and the power source being in a state other than OFF and if the access key is taken out of the vehicle, or the power is turned off with the door opened, an alarm sounds.

■ Push button ignition switch or communication line fault notification function

If the push button ignition switch or communication line is faulty, an internal buzzer sounds (warning buzzer: bleep) and a warning is issued by an operation indicator light (yellow: two-second cycle) in the push button ignition switch and a warning display (interrupt display) in the combination meter, notifying the driver of the fault before the vehicle gets into danger during travel.



(a) Push button ignition switch
(b) Operation indicator light in push button ignition switch
(c) Combination meter assembly
(d) Warning indicator (interrupt indicator) in combination meter display

■ Cabin interior lockout prevention function

If you attempt to forcibly lock the door (open the door, lower the lock knob to the lock position, and close the door) with the access key left in the passenger room (including the luggage room), the access key is determined to be left inside the cabin. To prevent the access key from being left inside, the doors are unlocked, and simultaneously, a vehicle outside buzzer sounds for 2 seconds.

■ Power saving function

Reduction of the battery power is suppressed by stopping periodic transmission of request signals and restricting keyless access & push button start system functions for doors other than the driver's door when the vehicle is not used for an extended period of time.

When the access key is in the cabin external detection area for about 10 minutes or more, periodic transmission of request signals is stopped to save the access key battery power.

Since the keyless access & push button start system forms a detection area by periodically transmitting request signals every about 0.25 seconds, if the vehicle is left for a long period, there is a possibility of the battery mounted in the vehicle going flat. The following controls are set to prevent the battery going flat.

▮ Power saving control

If the engine has not been started for 5 days or more, the periodic transmission of the front exterior antennae is stopped. (Locking/unlocking of the doors is enabled by the keyless access & push button start system and access key buttons.)

If the engine has not been started for 14 days or more, the lock/unlock sensors in the door outer handles other than the driver's door are disabled. (Locking/unlocking of the doors is enabled by the access key buttons.)

If any one of the following recovery conditions is satisfied, the lock/unlock sensors in the door outer handles other than the driver's door are enabled.

Recovery conditions:

- The door is locked/unlocked by the button on the access key.
- The door is locked/unlocked by a door lock/unlock sensor in the driver's door outer handle.
- The door is opened and then closed.

▮ Access key battery power saving function

If the access key is left for an extended period in the cabin external detection area, there is a possibility of the access key battery going flat because the access key continues to send its ID code to the antennae. The following controls are set to prevent the battery going flat.

Also, switching to the power saving mode is possible by operating the buttons of the access key. If you press the unlock button twice while pressing and holding the lock button on the access key, the mode changes to power saving mode after the indicator flashes four times. In the power saving mode, standby for radio wave transmission by the access key stops and the access key's battery consumption is suppressed. (However, use of the keyless access & push button start system is not possible during power saving mode.) When pressing any of the buttons on the access key, the power saving mode can be canceled.

▮ Automatic power saving control

If the key is in the cabin external detection area for about 10 minutes or more, the request signal periodic transmission (creation of the detection area) of each front exterior antenna of the door outer handles that detect the access key is stopped.

If any one of the following recovery conditions is satisfied, the vehicle returns from power saving control to normal keyless access & push button start system control.

Recovery conditions:

- The door is locked/unlocked by the button on the access key.
- The door is locked/unlocked by a door lock/unlock sensor in the door outer handle.
- The door is unlocked by inserting a mechanical key in the driver's door key cylinder.
- The driver's door or front passenger's seat door is closed and then opened.

■ Keyless access & push button start system cancellation function

The following keyless access & push button start system control can be canceled by performing a specified operation.

You can lock/unlock the doors by operating the access key buttons or using the mechanical key while the keyless access & push button start system canceled. Also, ACC can be set to ON by touching the access key on the front of the push button ignition switch.

Items that can be canceled:

- Keyless access with push button start system control
- Warning function
- Lockout protection function

▮ Switching ON/OFF the cancel function

When the power is OFF, and the driver's door is closed but unlocked, you can switch the cancel function ON/OFF by performing the following operations.

Keyless access & push button start system cancellation methods

Initial state	Power OFF, driver's door "Closed", driver's door unlocked
Operation 1	Perform door unlocking once with central door lock switch.
Operation 2	Open driver's door within about 5 seconds after Operation 1 (driver's door "Close" to "Open").
Operation 3	Perform door unlocking twice with central door unlock switch within about 5 seconds after Operation 2.*
Operation 4	Repeat "Open" → "Close" of driver's door twice within about 30 seconds after Operation 3 and reopen driver's door. (Driver's door "Open" → "Close" → "Open" → "Close" → "Open")
Operation 5	Perform door unlocking twice with central door lock switch within about 30 seconds after Operation 4.*
Operation 6	Repeat "Open" → "Close" of driver's door once within about 30 seconds after Operation 5 and reopens driver's door. (Driver's door "Open" → "Close" → "Open")
Operation 7	Close the driver's door within about 5 seconds after Operation 6.

*: If there has been a driver's door "Open" → "Close" operation in a part of Operation 3 and 5, the keyless access & push button start system cancellation operation is cleared.

Reference

To return to a state where the keyless access & push button start system can be used, from a state where the keyless access & push button start system is canceled, perform again the above "keyless access & push button start system cancellation methods".

▮ Quick cancellation function

The following keyless access & push button start system control can be canceled by pressing the lock button and trunk button of the access key or keyless transmitter simultaneously for five seconds or more.

Items that can be canceled:

- Keyless access with push button start system control
- Warning function
- Lockout protection function

Reference
To return to a state where the keyless access & push button start system can be used, from a state where the keyless access & push button start system is canceled, "Keyless access & push button start system cancellation methods" in "Switching ON/OFF the cancel function".

▮ Answer back during canceling function

When the "cancellation operation of keyless access & push button start system/recovery operation from system cancellation" are complete, the keyless buzzer sounds as an answer back.

Answer back

When canceling the keyless access & push button start system	Keyless buzzer sounds for two seconds.
When recovering from keyless access & push button start system cancellation	Keyless buzzer sounds once.

▮ Customization function

In addition to keyless access & push button start system control cancellation by certain operations, customizations such as turning on/off functions are possible using the Subaru Select Monitor 4, available from dealers.

Functions that can only be changed by a SUBARU dealer

Function	Changeable range of settings	Initial setting
Answer-back buzzer sound volume	OFF, 1 (soft) to 7 (loud)	5

■ Keyless access & push button start system detection area

A request signal sent from the keyless access control module is transmitted from the front exterior antenna and rear exterior antenna of the door outer handle to form an access key detection area. The formed detection area is a range of about 0.4 to 0.8 m (1.3 to 2.6 ft) from the door outer handle/rear bumper central area.

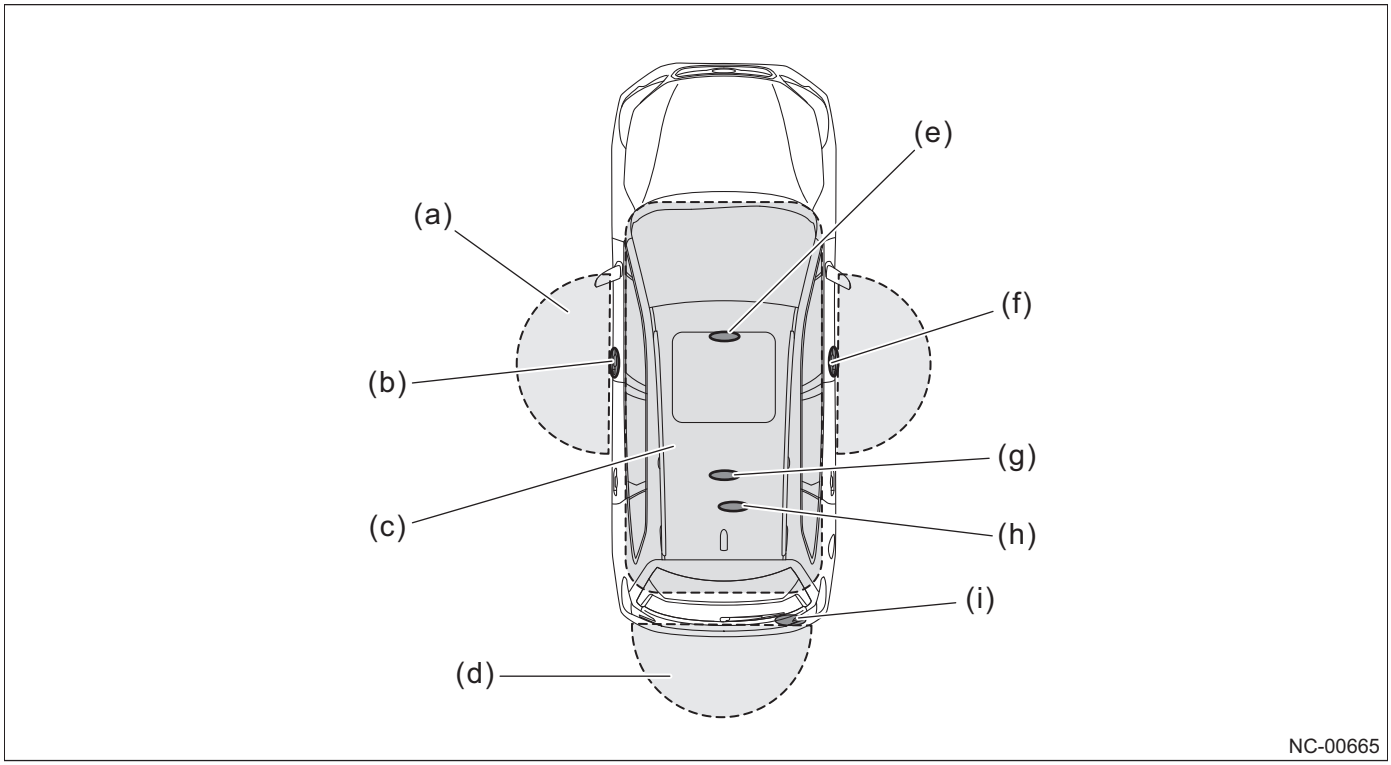
The detection area of the front exterior antennae is formed by request signals periodically transmitted every about 0.25 seconds when parked (power OFF, door locked) to sense the approach of the access key (person carrying the key). Also, by touching the lock sensor when the doors are locked, the existence of the access key (person carrying the key) in the cabin external detection area formed by transmitted request signals is detected.

The detection area of the rear exterior antenna is formed by turning on the rear gate request switch (lock) or rear gate opener button.

The cabin internal detection areas are formed when the following operations are performed to detect whether the access key (person carrying the key) is inside the passenger room.

- When opening and closing the driver's door
- When depressing brake pedal
- When operating the ignition
- When the necessary conditions for each type of warning are satisfied
- When the keyless access door lock operation is performed

Antenna and detection area



(a) Cabin external detection area
(b) Handle front door outer LH (front exterior antenna)
(c) Cabin internal detection area
(d) Rear gate external detection area
(e) Front antenna assembly interior
(f) Handle front door outer RH (front exterior antenna)
(g) Center antenna assembly interior
(h) Rear antenna assembly interior
(i) Rear antenna assembly exterior

Security system

Security alarm system

This starts the warning automatically against theft on the vehicle side, when the doors are locked by the keyless access door lock function or the wireless door lock function with all of the seat door/rear gate/hood (bonnet) closed.

If any of the seat door/rear gate/hood (bonnet) are forcibly opened in wrong methods during warning, warning operations (horn intermittent sounding, hazard warning light flashing, map light illuminating) are performed.

The security alarm system can be set by the customization function. For details, refer to the repair manual.

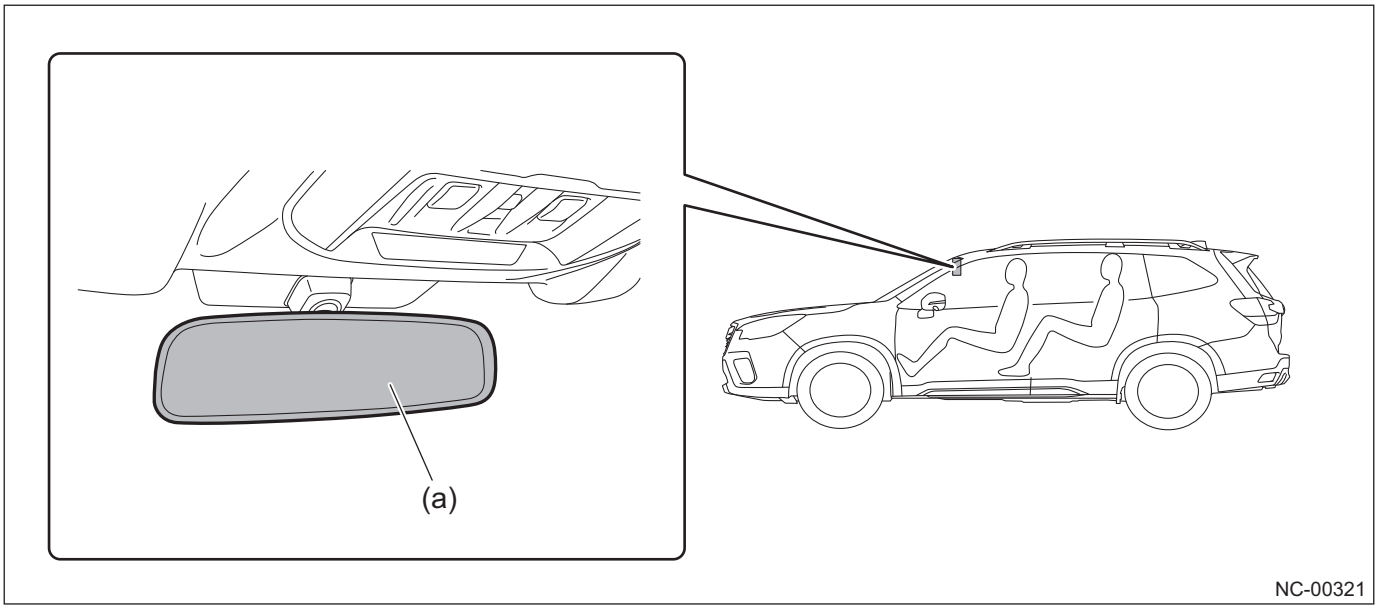
10.8 Inner Mirror

10.8.1 Overview

For the inner mirror structure, the anti-glare mirror common to the existing model vehicles is adopted.

10.8.2 Component

Component layout drawing

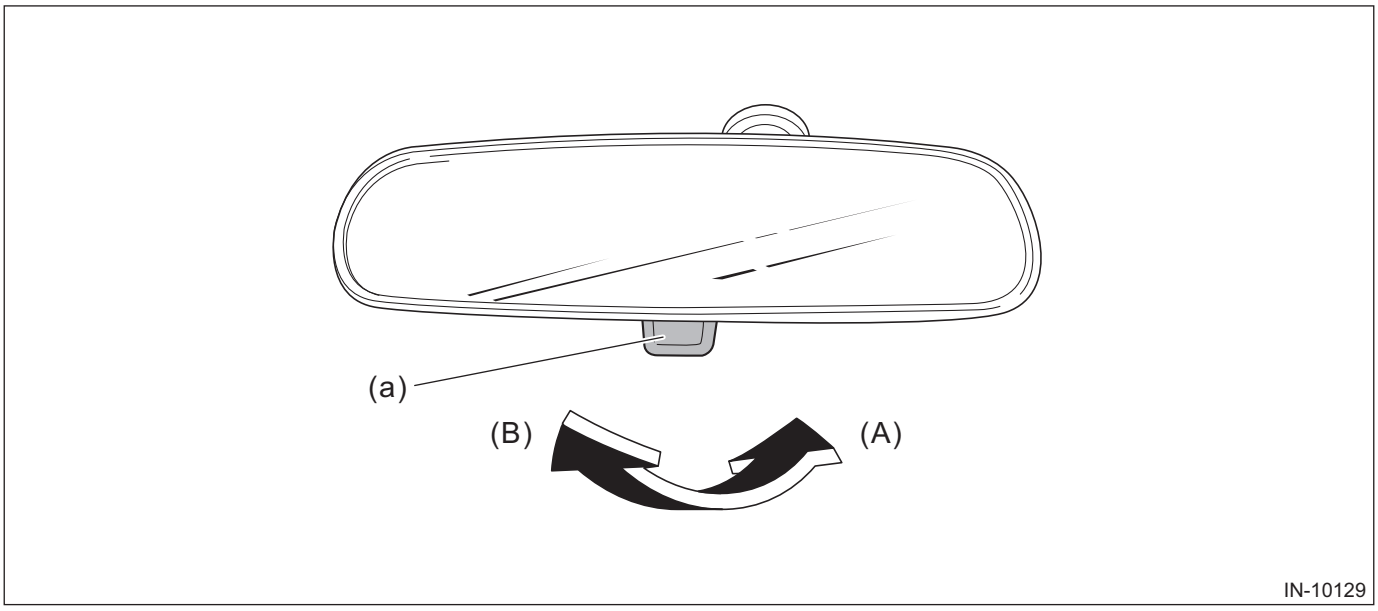


(a) Anti-glare mirror

Component details

Anti-glare mirror

Using this mirror, anti-glare operation can be switched to reduce glare when feeling the glare caused by lighting of a head light of an automobile (that comes from a normal position during daylight and from the rear side during night) being reflected to a mirror.



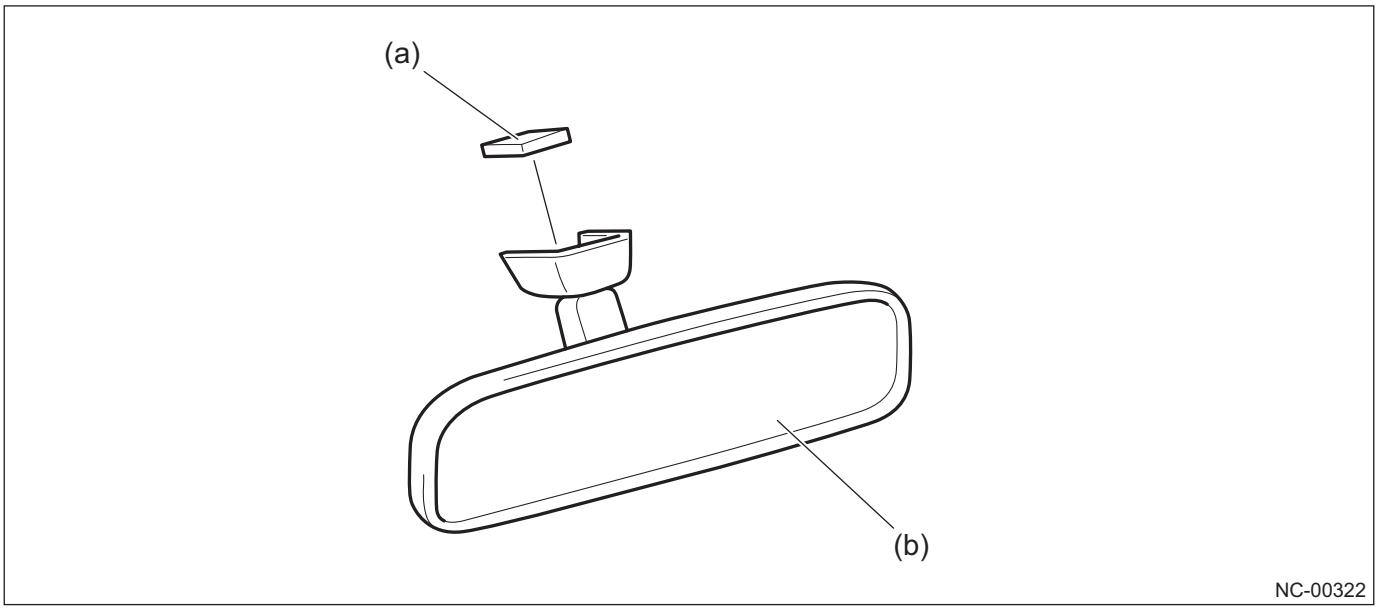
(A) Normal position

(B) Anti-glare position

(a) Switching lever

■ Combined structure

For the combined structure, the button and the mirror body are common to the existing model vehicles.



(a) Button (common to the existing model vehicles)

(b) Mirror body (common to the existing model vehicles)

11 ENTERTAINMENT

CONTENTS

11.1 General Overview

11.1.1 Overview

In this chapter, the following items configuring the entertainment system are described.

- Audio/Navigation and Speaker System
- Telematics System
- Combination Meter/MFD/MID
- Antenna

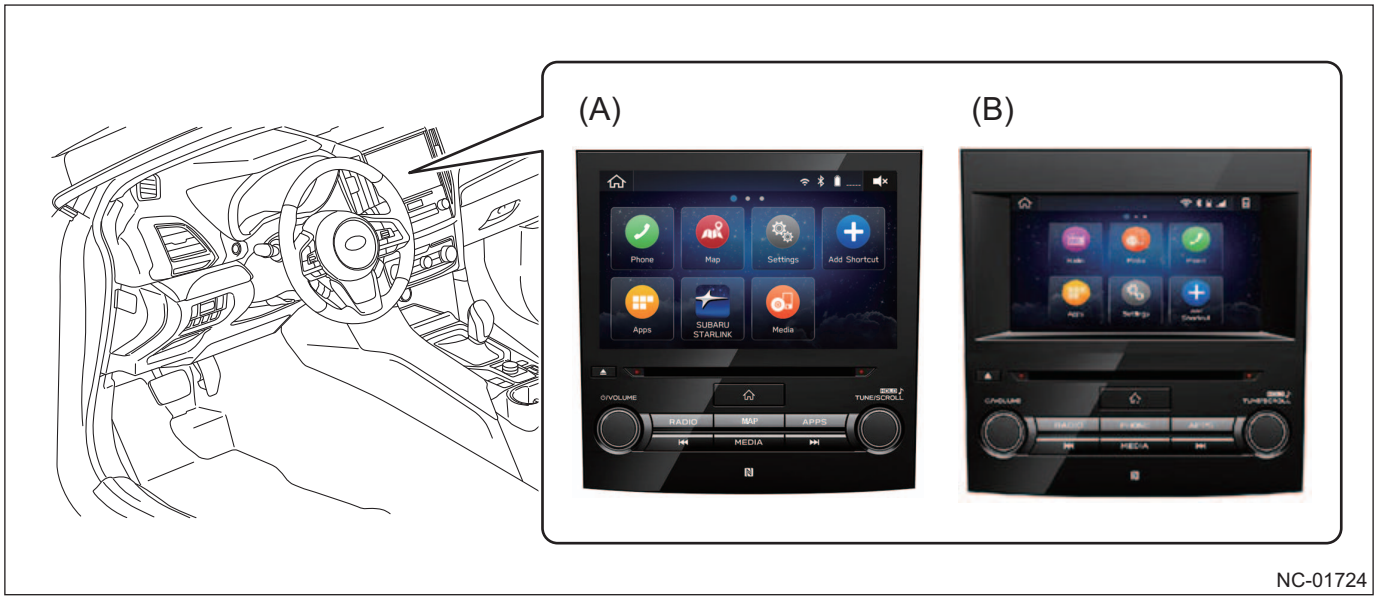
11.2 Audio/Navigation and Speaker System

11.2.1 Overview

The Gen.3.1 Infotainment System is adopted for audio/navigation system to enhance the following items.

- 6.5-inch display audio, 8-inch display audio, and 8-inch navigation are adopted.
- Smartphone connectivity such as Apple CarPlay, Android Auto, etc.
- A design integrating the advanced feeling and user friendliness
- GUI considering the use case
- A hardware full of high-performance functions

A four-speaker, six-speaker (standard system), and Harman/Kardon® audio system are adopted as the speaker system (depending of grades).



(A) Navi & High grade audio/High grade audio (B) Base + audio

11.2.2 Specification

Audio/navigation specification list

Specification list [symbol]✓: Applicable, -: Not applicable

Specifications			Type		
			Base + audio	High grade audio	Navi & High grade audio
Display	Size/Resolution		6.5 inch/WVGA	8 inch/WVGA	8 inch/WVGA
Touch screen	Capacitive/Multi touch		✓		
Control	Steering switch		8 buttons		
Navi	On-board navi		-		✓
	Navigation vender (on-board)		-		TomTom
Traffic information	SXM		-		✓
Radio tuner	AM/FM		✓		
	RBDS		✓		
	RDS		-		
	HD (ver.1.5 dual tuner)		✓		
	SXM (SXM 2.0/3.0)		✓		
	DAB/DAB +, other		-		
Media (in-dash slot)	CD/CD-R/CD-RW		✓		
Media format	MP3/MP4		✓/-		
	WMA/WMV		✓/-		
	MPEG/FLV/AVI		-		
	AAC		✓		
CDDB (Gracenote)			-	✓	
Connectivity (Wireless)	Bluetooth	Version	3.0EDR		
		Audio	✓		
		Hands Free Control	✓		
	Wi-Fi		-	✓	
	NFC		-	✓	
Connectivity (Wired)	USB version and quantity		USB2.0 × 2		
	AUX		✓		
	USB audio (iPod/SD/microSD)		✓		

Smartphone link	Mirror Link (ver.1.2)	-		
	CarPlay	✓		
	Android Auto	✓		
Server Service	Aha Radio (by Harman)	✓		
	Pandora	✓ (USA Only)		
	SUBARU STARLINK (Clarion Cloud Service)	✓		
Sxm Travel Link	Traffic, Weather, Fuel, Sports, Stocks	✓		
Voice control	Head unit function all control	✓		
	Air conditioning control	-	✓	
Camera	Camera input number	NTSC × 2		
Language/Display		English (USA), French (Canadian), Spanish (Mexican)		
Language/Voice recognition		English (USA), French (Canadian), Spanish (Mexican)		
Map data update	Wired (USB)			✓
	Wireless Wi-Fi			✓
	Wireless Smartphone Tethering	-		
Software update	Wired (USB)	✓	✓	✓
	Wireless Wi-Fi	-	✓	✓
	Wireless Smartphone Tethering	-	✓	✓
Update Server	Redbend	-	✓	

Speaker function list: Standard audio system (four speakers) (for some grades)

Speaker	Size, type	Usage	Playback frequency range
Front door speaker	6 × 9 in woofer	Bass to midrange	70 Hz to 10 kHz
Rear door speaker	160 mm full range speaker	Midrange to treble	70 Hz to 10 kHz

Speaker function list: Standard audio system (six speakers) (for some grades)

Speaker	Size, type	Usage	Playback frequency range
Instrument panel side speaker	25 mm tweeter	Midrange to treble	4 kHz to 20 kHz
Front door speaker	6 × 9 in woofer	Bass to midrange	70 Hz to 10 kHz
Rear door speaker	160 mm full range speaker	Midrange to treble	70 Hz to 10 kHz

Speaker function list: Harman/Kardon® audio system (for some grades)

Speaker	Size, type	Usage	Playback frequency range
Instrument panel side speaker	80 mm + 16 mm unity speaker	Midrange to treble	250 Hz to 20 kHz
Front door speaker	7 × 10 in mid woofer	Bass to midrange	40 Hz to 1.6 kHz
Rear door speaker	150 mm speaker	Midrange to treble	80 Hz to 20 kHz
Rear quarter speaker	200 mm dual voice coil sub woofer + box enclosure	Bass	30 Hz to 1 kHz

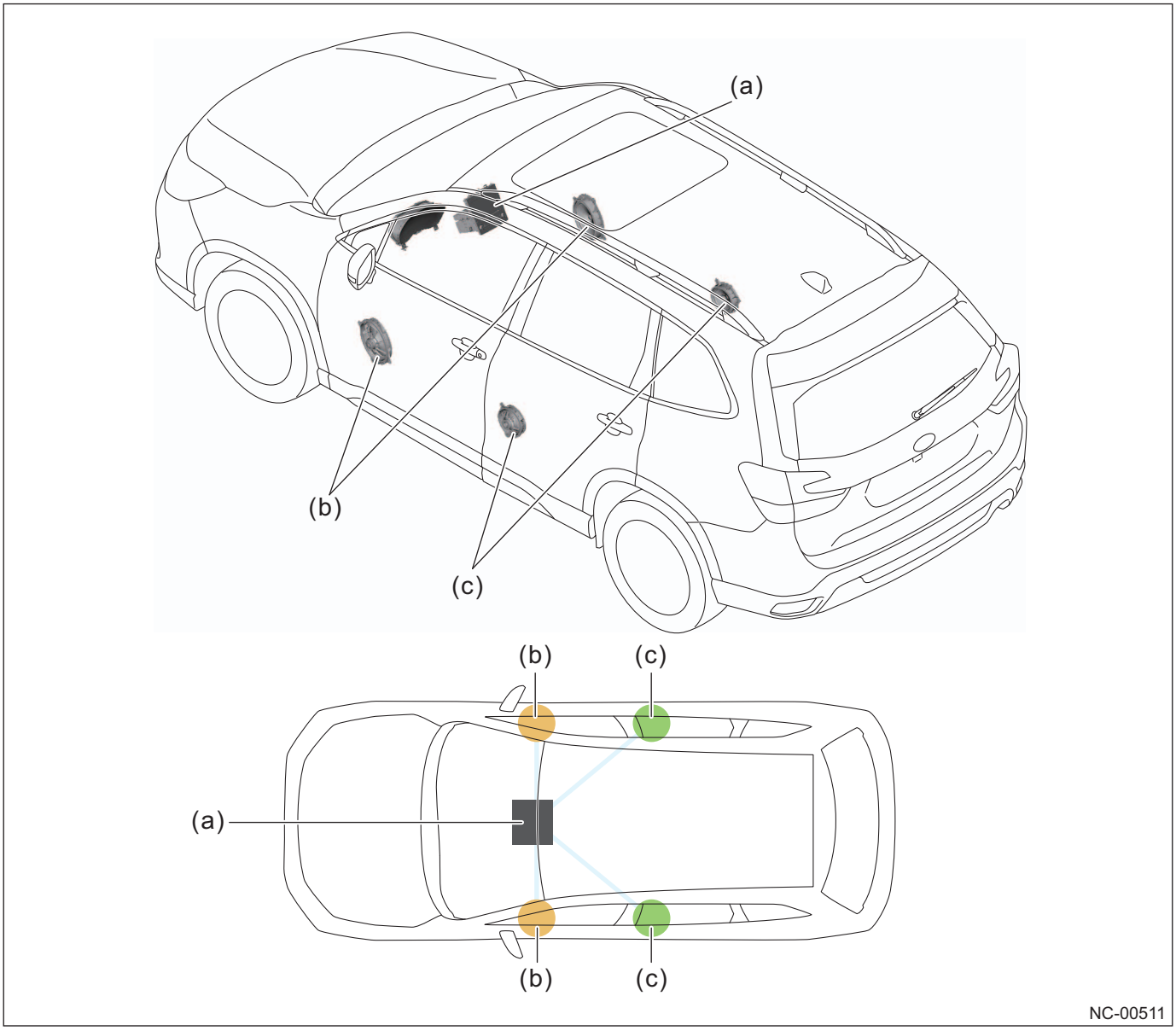
Hardware

Device		Gen.3.1		
		Base + audio	High grade audio	Navi & High grade audio
CPU	Name	TI Jacinto-6eco		TI Jacinto-6
	Spec.	5,250 MIPS		10,500 MIPS
Main memory		8 GB		32 GB
Display	LCD	6.5-inch WVGA	8-inch WVGA Normally Black	
	Touch panel	Capacitance		
Smartphone link	SUBARU STARLINK	✓		
	Apple CarPlay	✓		
	Android Auto	✓		
SXM module (model number)		X65HA		
Wi-Fi module		-	2.4 GHz/5 GHz	
NFC module		-	ISO/IEC 14443 Type A/B	
Bluetooth module		3.0EDR		
Voice recognition	Recognition engine	Nuance		
	Number of microphones	2		
USB terminal		USB2.0 × 2 (each max 2.1 A)		

11.2.3 Component

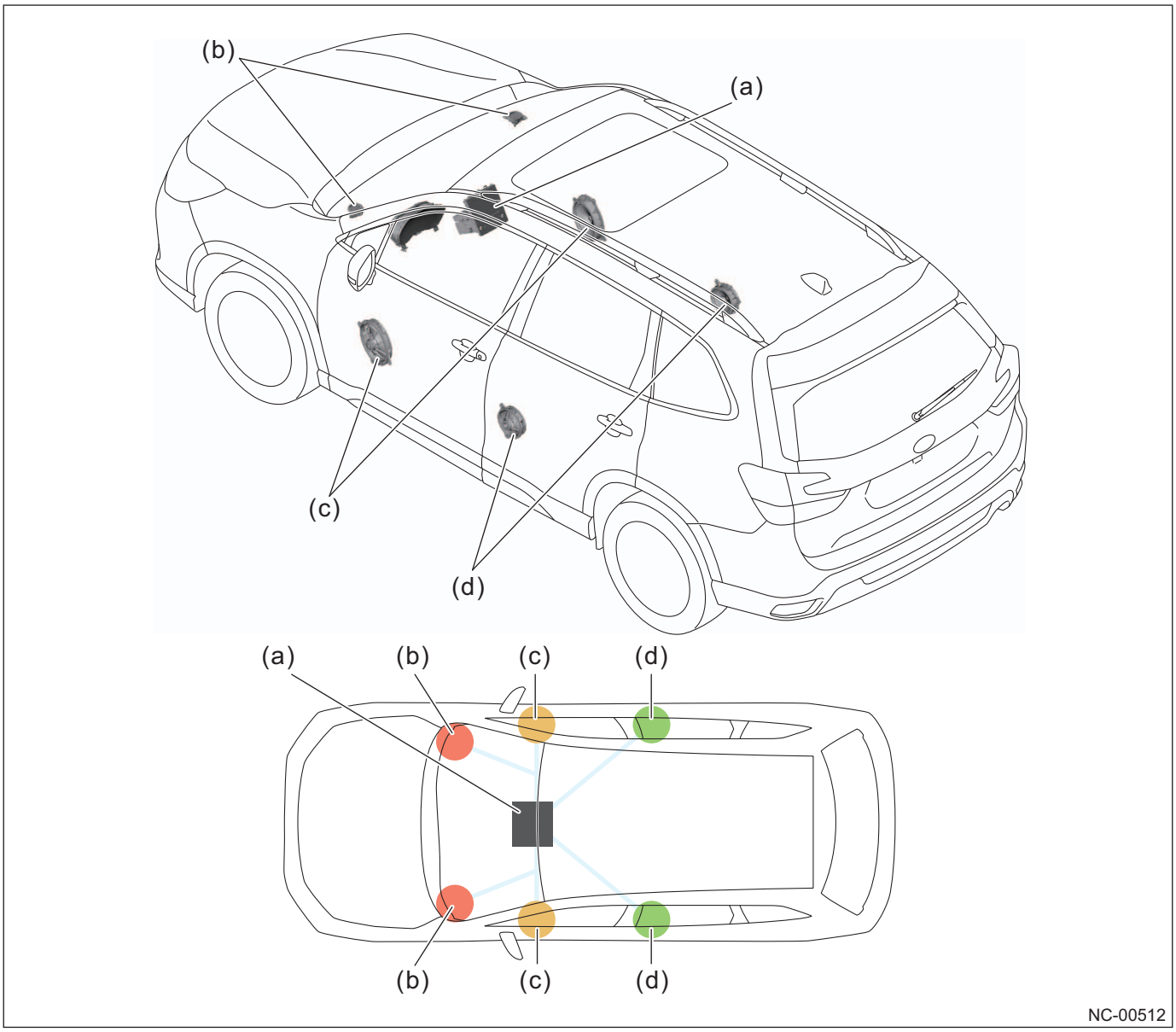
Component layout drawing

Standard audio system (four speakers) (for some grades)



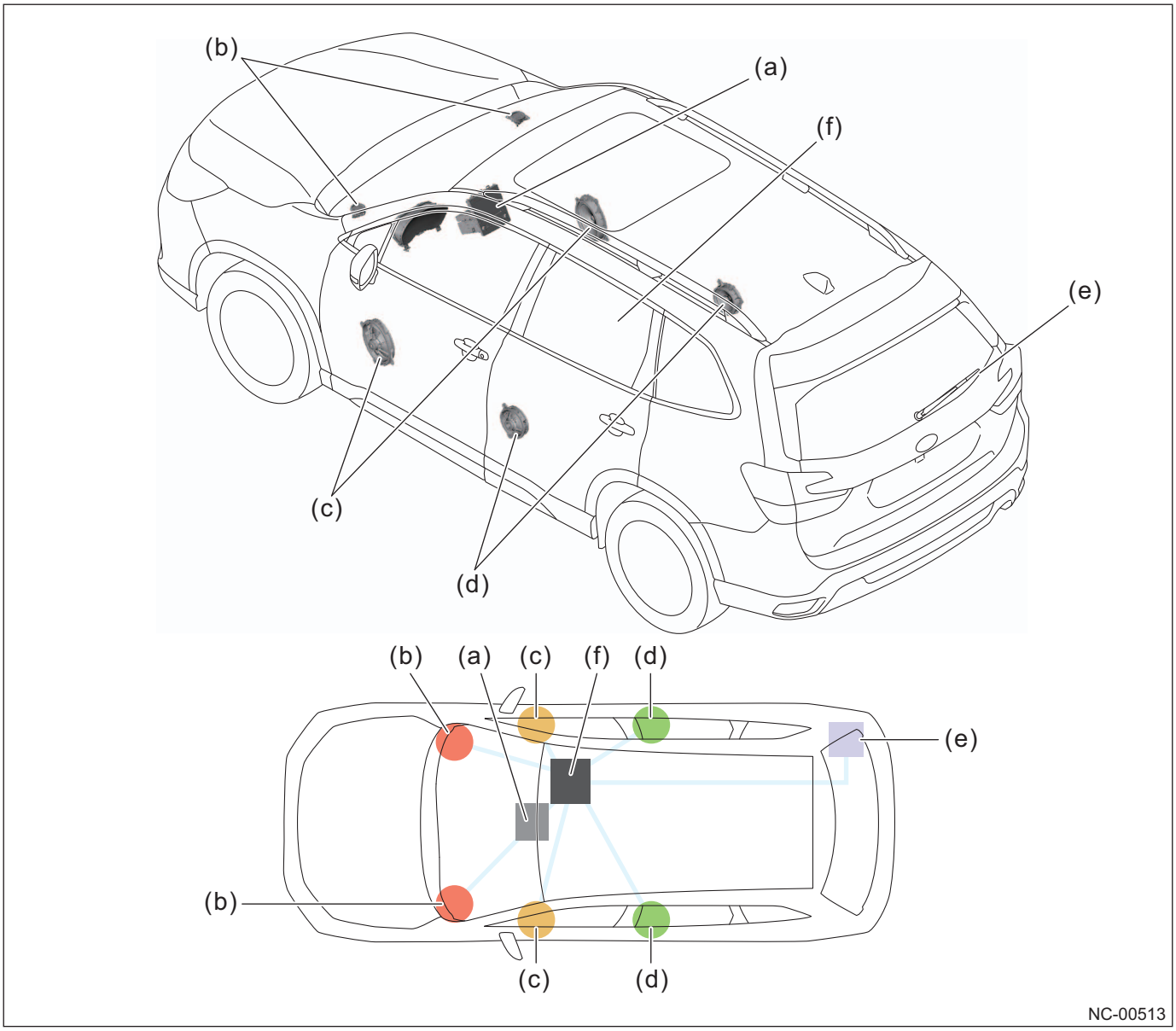
(a) Audio
(b) Speaker assembly front
(c) Speaker assembly rear

Standard audio/navigation system (six speakers) (for some grades)



(a) Gen.3.1 audio/navigation
(b) Speaker assembly tweeter
(c) Speaker assembly front
(d) Speaker assembly rear

Harman/Kardon® audio navigation system (for some grades)



(a) Gen.3.1 audio/navigation
(b) Speaker assembly tweeter
(c) Speaker assembly front
(d) Speaker assembly rear
(e) Speaker assembly woofer
(f) Power amplifier assembly

Component details

Hardware

The specification with enhanced functionality is adopted by equipping TI Jacinto-6 series high processing capacity CPU, WVGA liquid crystal display, latest SXM, Wi-Fi, Near Field Communication (NFC), and voice recognition module.

Visual design

■ Navi & High grade audio/High grade audio

Advanced feeling is rendered by GUI that pursues user friendliness of a smartphone by adopting the capacitance touch panel for the large screen LCD together with the following features.

- Premium feeling is expressed with a seamless design by an acrylic panel and Normally Black LCD screen.
- The physical buttons are crafted to be easy to use and unified to the acrylic panel.
- The dial knobs and physical buttons are important for intuitive user experience and they also secure safety during driving.
- Separate knobs are adopted for volume and tuning operations.
- Shortcuts to frequently used function screens are set on the physical buttons.

(a) Acrylic panel and Normally Black LCD screen
(b) 8-inch WVGA (800 × 480) capacitance touch panel
(c) Home button
(d) Dial knob × 2 (push and turn)
(e) Physical button with acrylic lens × 6

■ Base + audio

High-gloss black panel is adopted in the appearance and capacitance touch panel is adopted in the LCD screen for intuitive operation that is simple and like a smartphone.

(a) High-gloss black panel
(b) 6.5-inch WVGA (800 × 400) capacitance touch panel
(c) Home button
(d) Dial knob × 2 (push and turn)
(e) Physical button × 6

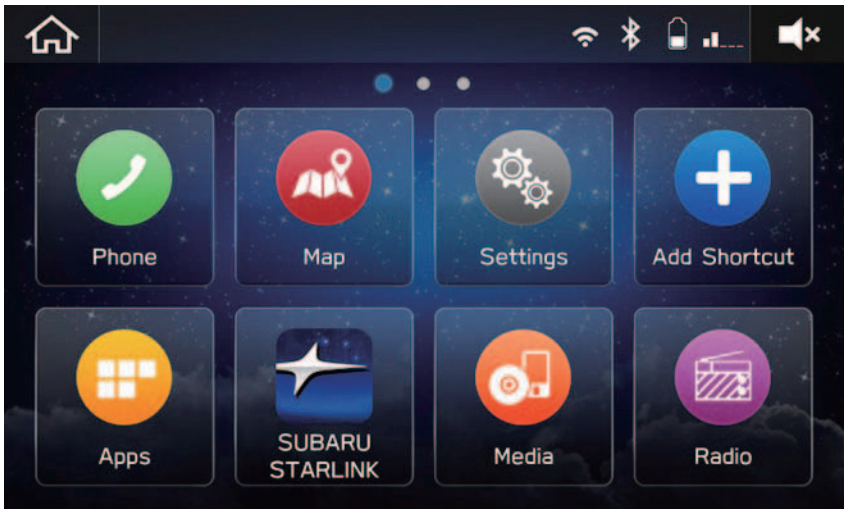
GUI

Infotainment system, which can be complicated, adopts an intuitive and easy to use GUI like a smartphone so that the user can easily get accustomed to it.

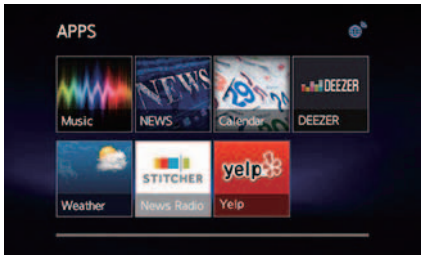
- A gesture operation similar to a tablet or smartphone is now possible.
- The Bluetooth connecting operation for the mobile phone is simplified by the Near Field Communication (NFC).

The screen is divided into three layers (first layer: Home screen, second layer: Function screen, third layer: Popup) in the standpoint of the user operation, and realized simple GUI that is easy to operate even though there are many functions by making the screens in the same layer have same layout.

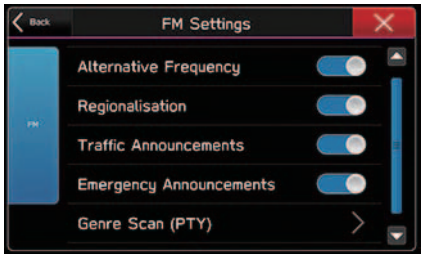
(a)

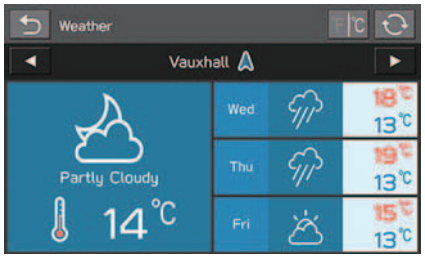


(b)



(c)





NC-00516

(a) First layer: Home screen
(b) Second layer: Function screen
(c) Third layer: Popup

Navigation screen (only Navi & High grade audio)

TomTom navigation screen

ET-10616

One-Shot search screen

ET-10617

Speaker

A four-speaker/six-speaker (standard system), and Harman/Kardon® audio system (for some grades) are adopted as the speaker system according to the grade.

■ Standard audio system (for some grades)

An audio system with superior reproducibility and spread of sound that is closer to the audio source data is developed so that the user can enjoy compressed audio sources in various formats with high sound quality.

- Durability is enhanced than the conventional standard speaker, the distortion of the sound in large volume is reduced, and higher efficiency and flat frequency characteristics are realized.
- The acoustic design inside the cabin enables wide effective playback frequency range by utilizing the enhancement of the speaker performance and widens the playback frequency in bass and treble.
- Compressed audio source restoration technology "Clari-Fi" is adopted to enable a technology to restore the music component lost by compressing to a sound quality equivalent to CD. Also, a technology is adopted to restore MP3 (MPEG1 Audio layer 3), ACC (Advanced Audio Coding), and various audio sources with different compression rate with their appropriate correction amount through real-time calculation process.

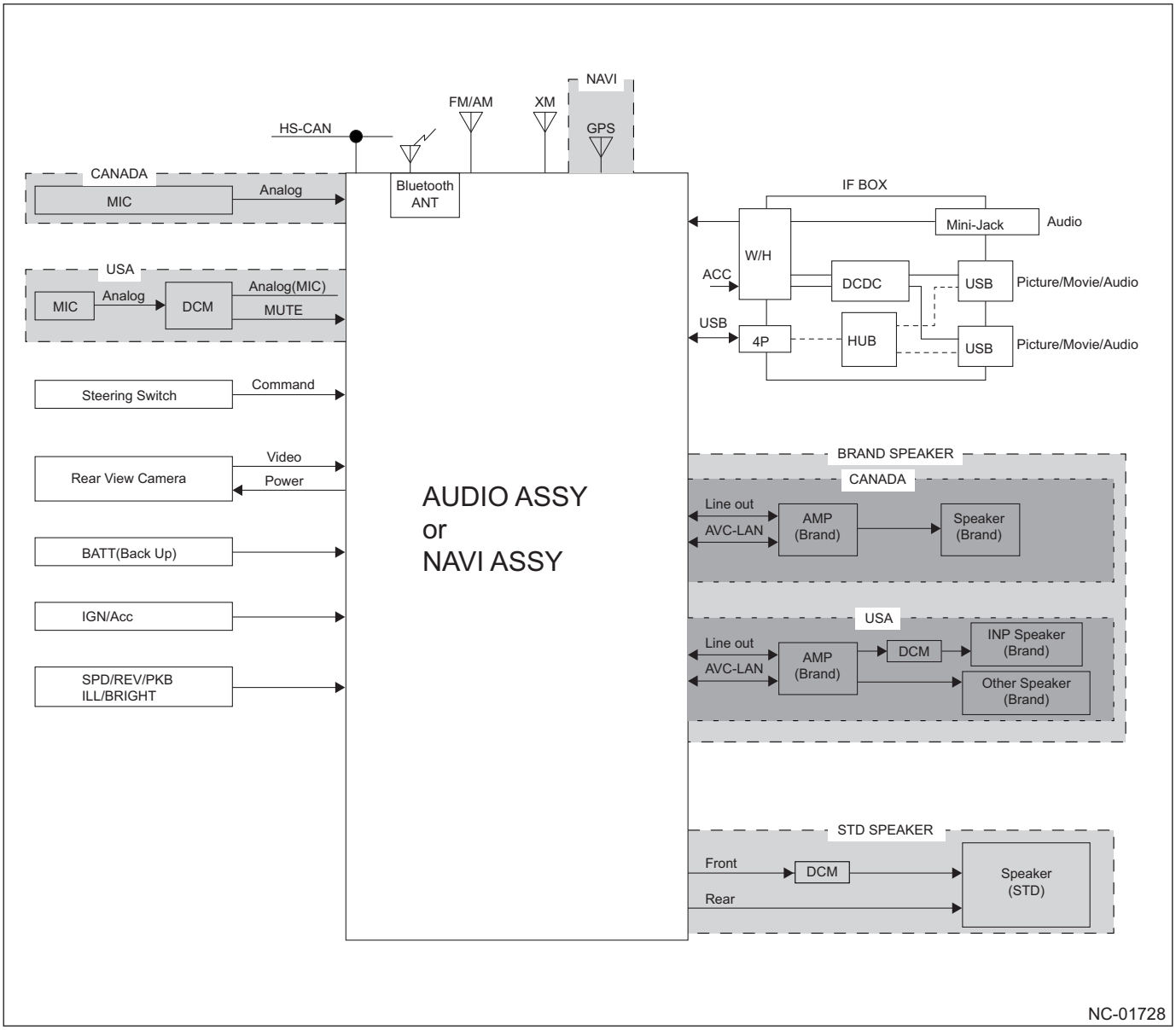
■ Harman/Kardon® audio system (for some grades)

The audio system adopting the clear acoustics and latest technology of Harman is realized as follows.

- A small size boxed type is adopted for the sub woofer to avoid decrease of acoustic performance by the surrounding body design, and maintain the performance of the woofer.
- "GreenEdge" system is adopted to reduce the power that was lost in the vehicle wiring and inside the circuit to its limit with high efficiency speaker and power amplifier that is optimally designed to match the speaker. Also, larger volume than the conventional system can be output depending on the condition, while low power consumption is realized on mid to small volume.
- This system is also equipped with compressed audio source restoring technology "Clari-Fi" adopted in the standard audio system.

11.2.4 Construction and Operation

System diagram

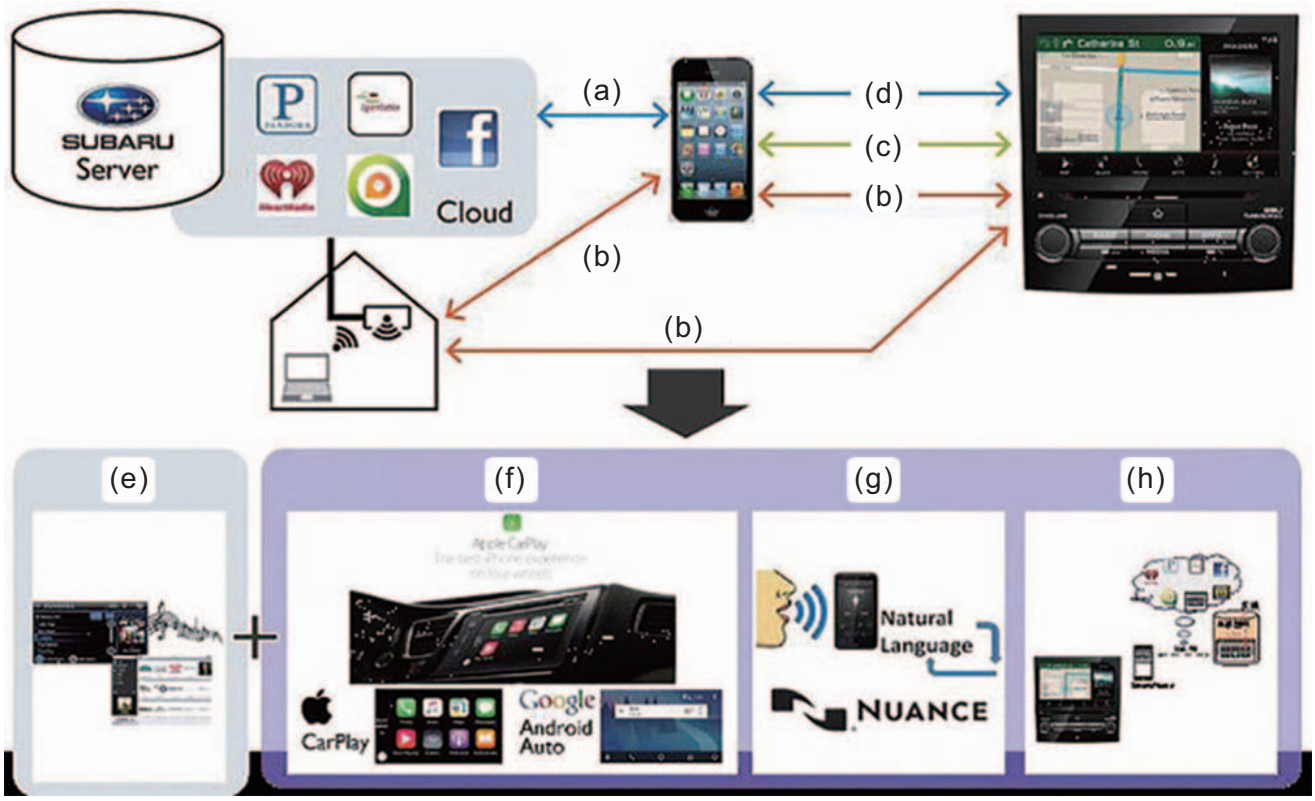


Gen.3.1 audio/navigation system

Connectivity for smartphone link

In addition to the SUBARU Server, the system supports linking with smartphone with Apple CarPlay and Android Auto.

The system supports software and map data update using Wi-Fi (OTA) and easy pairing function using the Near Field Communication (NFC).

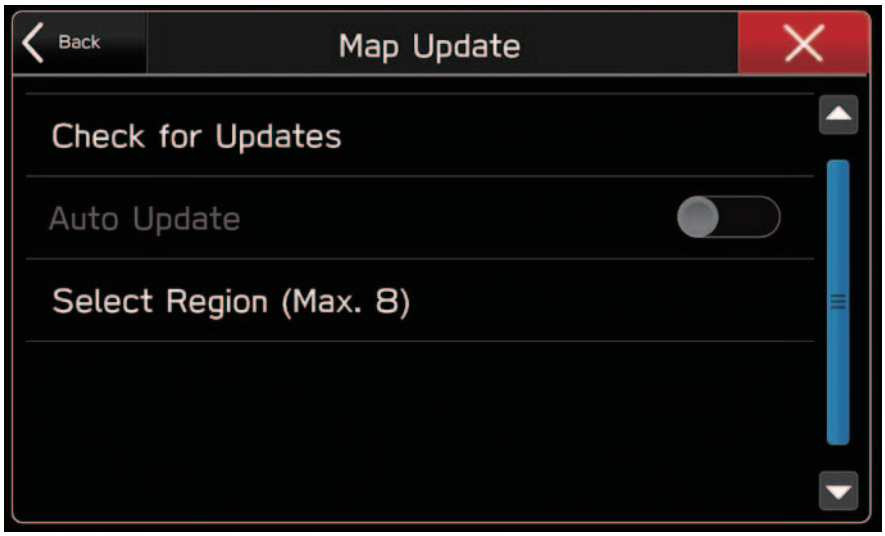


NC-00520

(a) 3G/4G
(b) Wi-Fi
(c) USB
(d) Bluetooth
(e) Internet radio
(f) Smartphone link enhancement
(g) Voice recognition enhancement
(h) Wireless update

Map update Over The Air (MOTA)

This is a function to update the map of the on-board navigation using Wi-Fi.



NC-00528

* The Wi-Fi function is turned off as a default, so it is necessary to turn it on.

11.3 Telematics System

11.3.1 Overview

Telematics system is a coined word created from "telecommunication" and "informatics", and it indicates the information, contents service, and service provided by external source through integrating a communication system into a mobile unit such as an automobile and the use of bidirectional communication technology.

SUBARU has already adopted telematics services such as remote door lock/unlock and SOS/roadside assistance, but a new generation telematics system is installed to provide more fulfilling service.

Providing "security through connection"

A speedy support through communicating with an operator or information notification during an accident or vehicle breakdown is realized.

Providing maintenance information which is the foundation of improving customer satisfaction

By linking with the "Care Connect", a function to notify the health condition (Health Report) and maintenance period (oil, periodic maintenance) of the vehicle is installed.

Data Communication Module (DCM) and security measure

The data communication module is installed inside the cabin at the center of the vehicle where effect of collision is low. Also, a structure that operates on built-in battery in the DCM if the power supply from the vehicle battery stops is adopted to continue emergency reporting.

In the DCM, microcomputer connecting to the antenna (external) and microcomputer for communication inside the vehicle (CAN etc.) are separated. Communication protocol between these two microcomputers are encrypted by the manufactures original method. A structure that blocks intrusions from the antenna inside the DCM is adopted. Also, the DCM will not operate even if it is installed into another vehicle.

The telecommunication method supports LTE in addition to 3G

The shark fin antenna on the roof is set as the main antenna, and the antenna in the instrument panel (behind the meters) is set as the sub antenna.

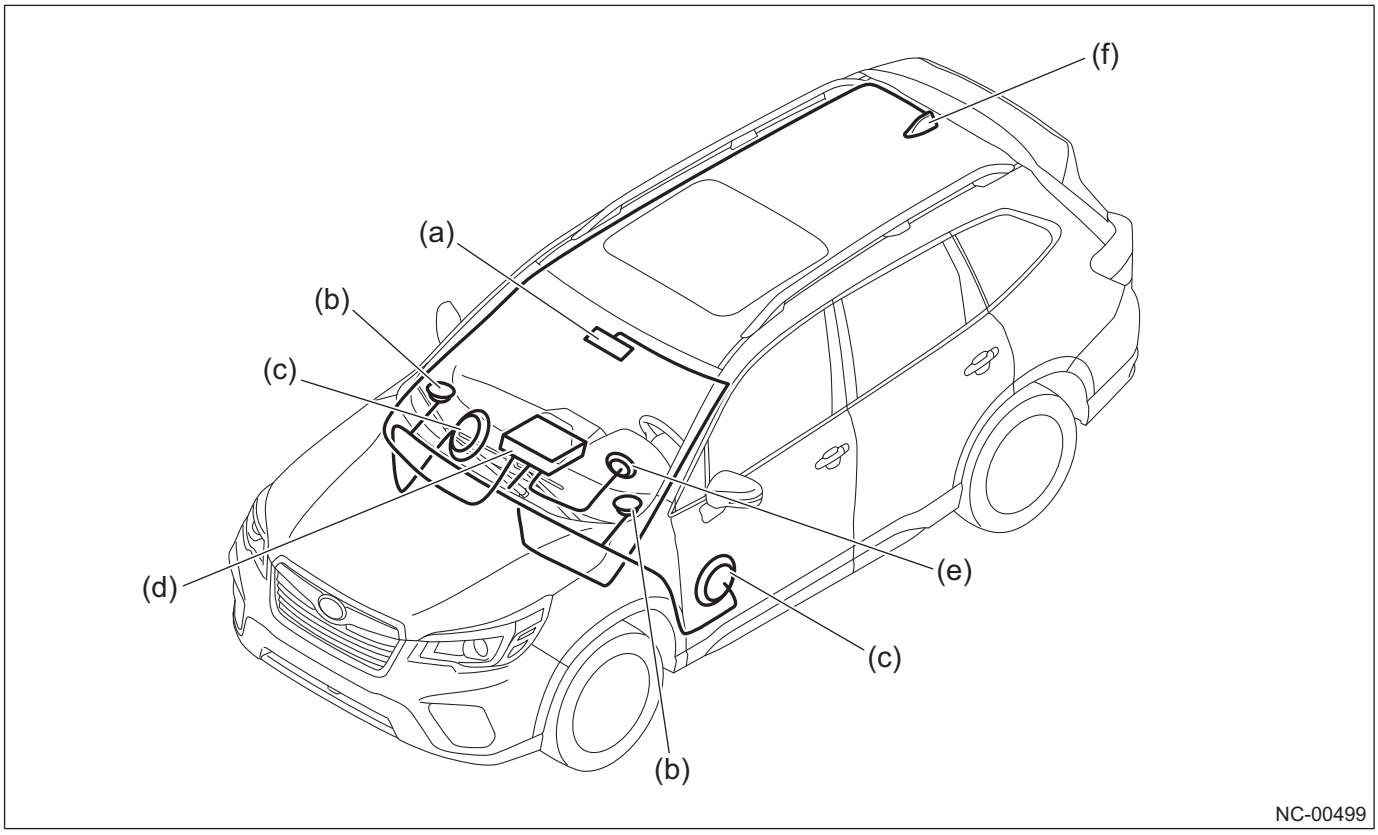
Service function list

The following services are provided by telematics.

Voice Call	SUBARU Concierge	
	Advanced Automatic Collision Notification	
	SOS Emergency Assistance	
	Enhanced Roadside Assistance	
Remote Services	Remote Engine Start (Includes Climate Control/Heated Seats)	
	Remote Lock & Unlock	
	Remote Horn & Lights	
	Remote Vehicle Locator	
	Destination to Vehicle (to Navi or Text depends on the vehicle type)	
	Vehicle Condition Check	
Vehicle Alerts	Boundary Alert	
	Speed Alert	
	Curfew Alert	
Customer Touch Point	Service Appointment Scheduler	
	Maintenance Notifications	
	Diagnostic Alerts	
	Vehicle Health Report	
Security	Stolen Vehicle Recovery Plus (SVR Plus includes Vehicle Immobilization/Mobilization)	
		Stolen Vehicle Immobilizer
		Stolen Vehicle Flashing Lights
	Vehicle Security Alarm Notification	
Connected Vehicle Feature	SUBARU STARLINK system Update	
	Wi-Fi Hotspot	
	Call volume change function during telematics call	

11.3.2 Component

Component layout drawing



(a) Integrated microphone/indicator switch
(b) Speaker assembly tweeter
(c) Speaker assembly front
(d) DCM
(e) GPS antenna
(f) Antenna assembly roof (AM/FM/XM/TEL)

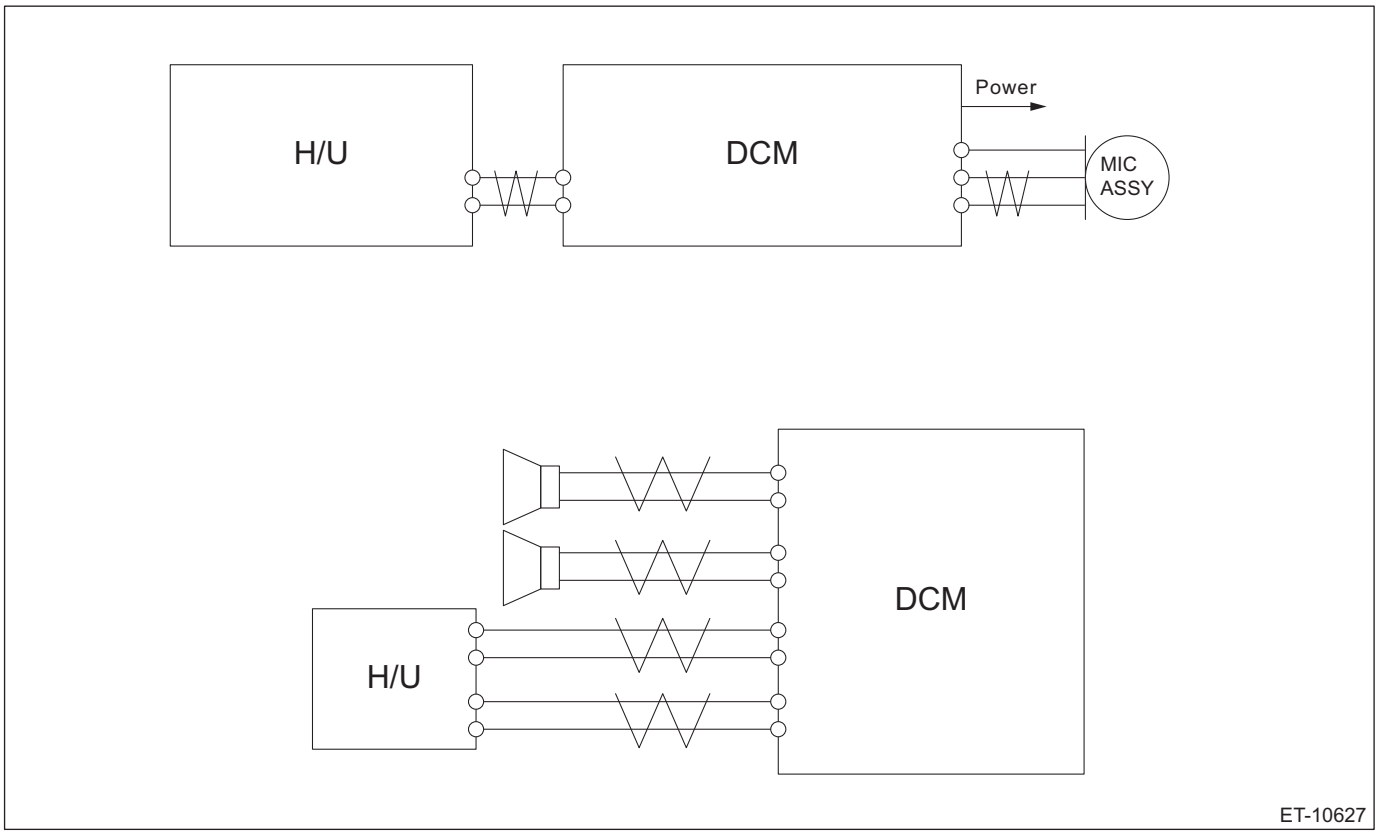
Component details

Microphone and speaker

The microphone and speaker for talking to the operator during emergency notification are shared with existing parts connected to the head unit of the navigation system or the audio.

■ Microphone and speaker connection configuration diagram

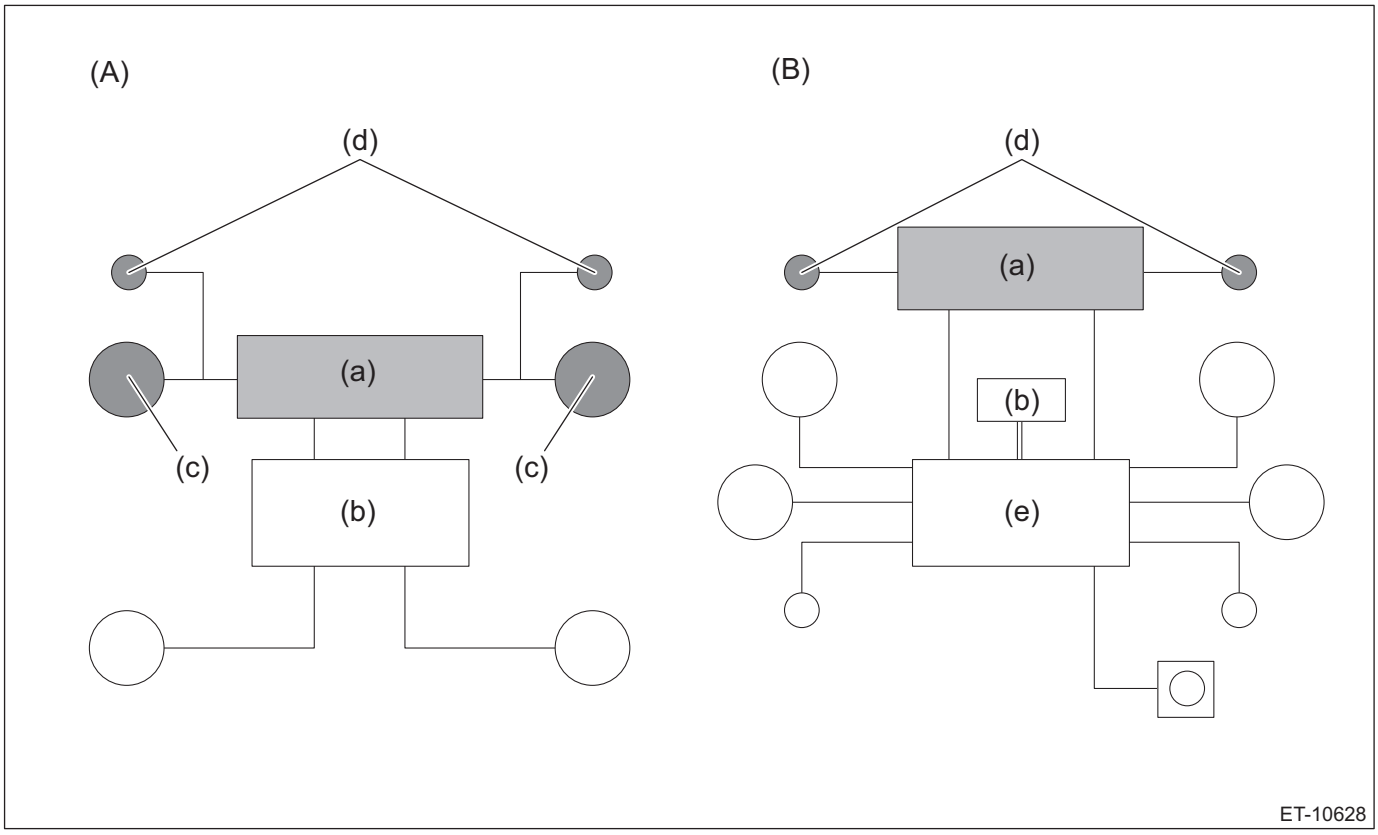
DCM will send a mute signal to the head unit to drive the microphone and speaker from the DCM when the emergency notification is to be operated.



■ Speaker configuration diagram

Side speaker on both sides of the instrument panel are installed to ensure the call audio from the speaker on the other side can be heard even if the speaker on one side is damaged during collision (side collision).

Sound is output from both sides to make the call audio easy to hear similar to normal handsfree calling.



(A) Standard audio system

(a) DCM
(b) Head unit
(c) Speaker assembly front

(B) Harman/Kardon® audio system

(d) Speaker assembly tweeter
(e) Power amplifier assembly

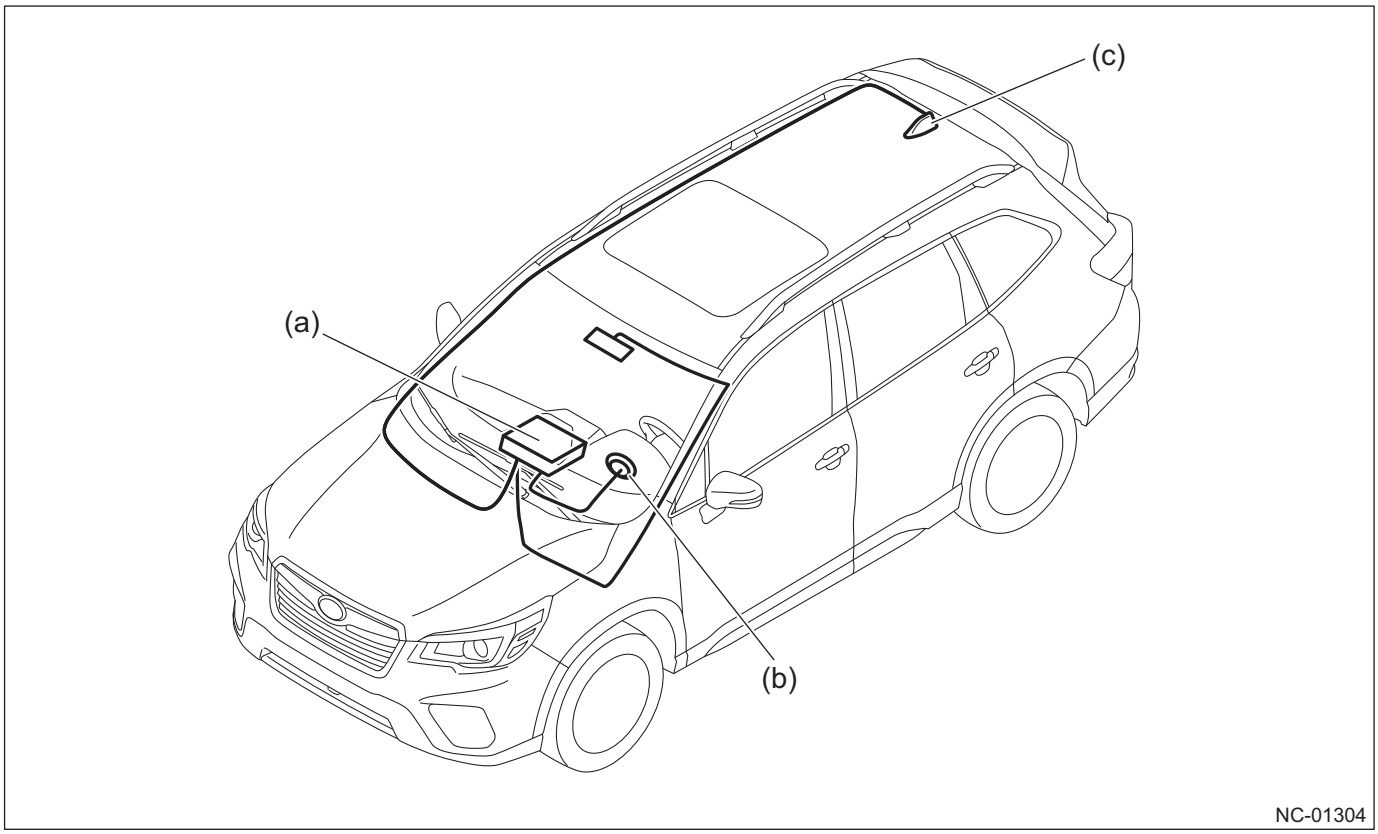
Antenna for telephone

The communication method of telephone supports LTE in addition to 3G.

High speed and large volume communication is realized by using Multi-Input Multi-Output (MIMO) technology that transfers information using multiple antennas for both sending and receiving.

Shark fin antenna on the roof is set as the main antenna and the antenna in the instrument panel (behind the meters) is set as the sub antenna as multiple antennas are required to support LTE.

By placing two antennas at front and rear of the vehicle (outside the vehicle and inside the cabin), it can still communicate even when one of the antennas is damaged at the time of collision.

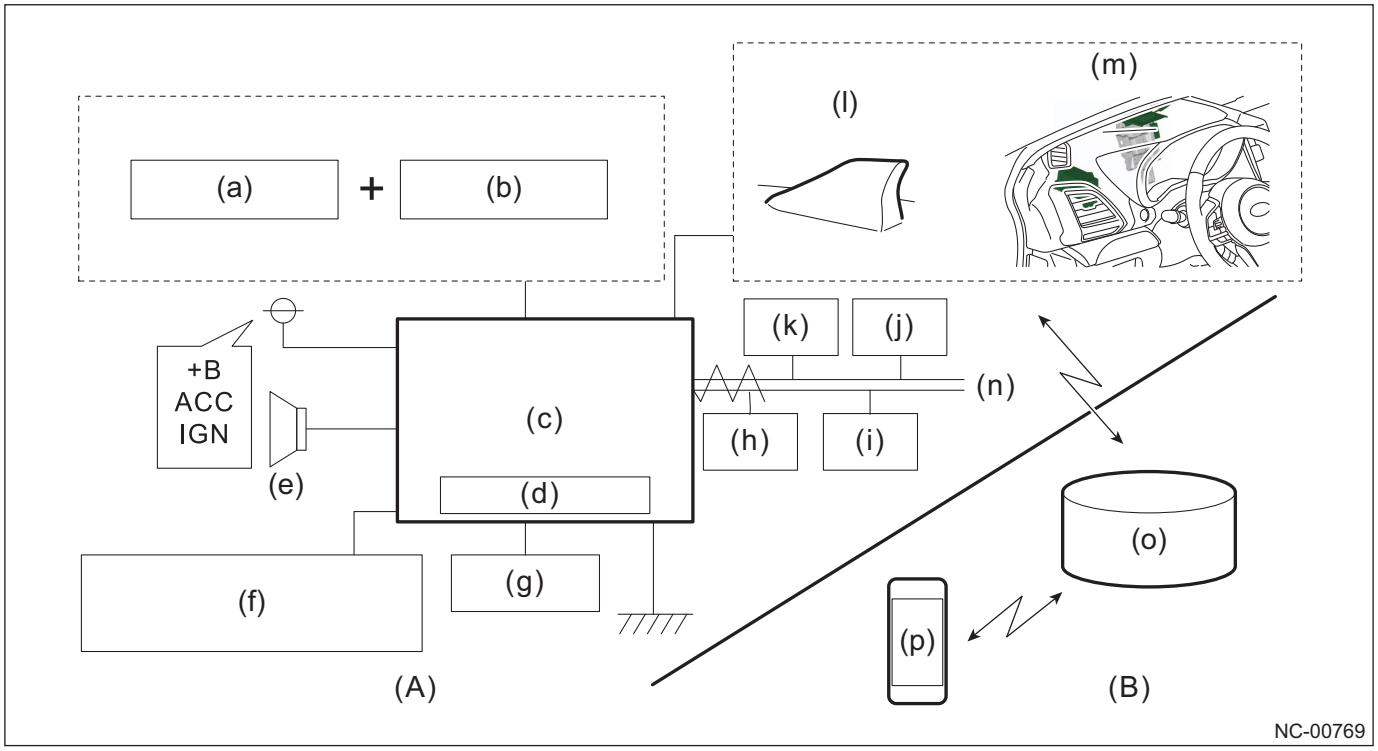


(a) DCM
(b) GPS antenna (TEL/GPS)
(c) Antenna assembly roof (AM/FM/XM/TEL)

11.3.3 Construction and Operation

System diagram

System configuration diagram



(A) SUBARU PART

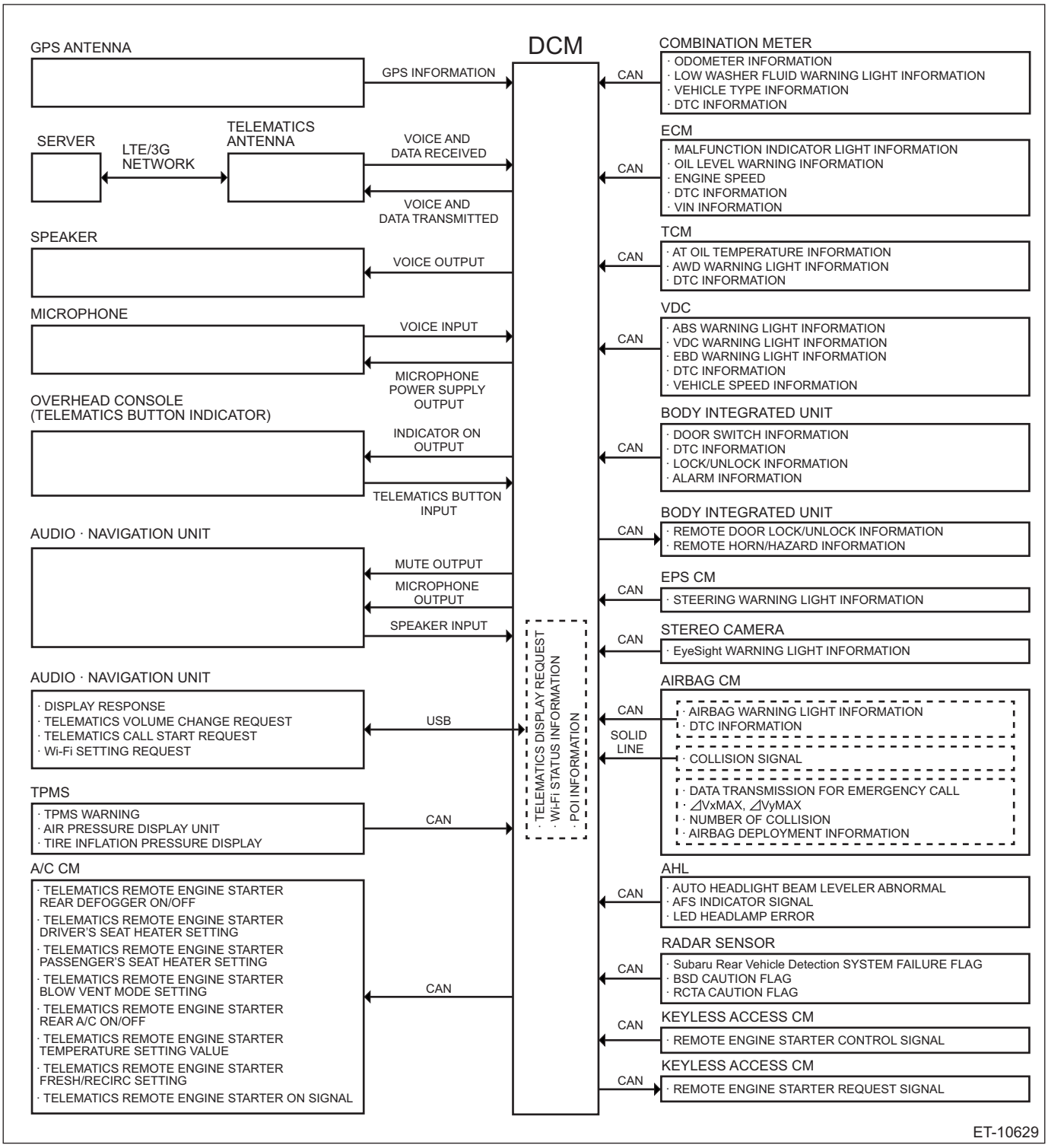
(a) Microphone
(b) Integrated indicator switch
(c) Data Communication Module (DCM)
(d) Backup battery
(e) Speaker
(f) Navi/Display Audio
(g) A/B ECM
(h) BIU

(B) SOA PART

(i) Meter
(j) E/G ECM
(k) TCM
(l) Antenna assembly roof (AM/FM/XM/TEL)
(m) GPS antenna (TEL/GPS)
(n) CAN communication
(o) External server
(p) Smartphone

System block diagram

Major signals used by the Data Communication Module (DCM) and related CM



Data Communication Module (DCM)

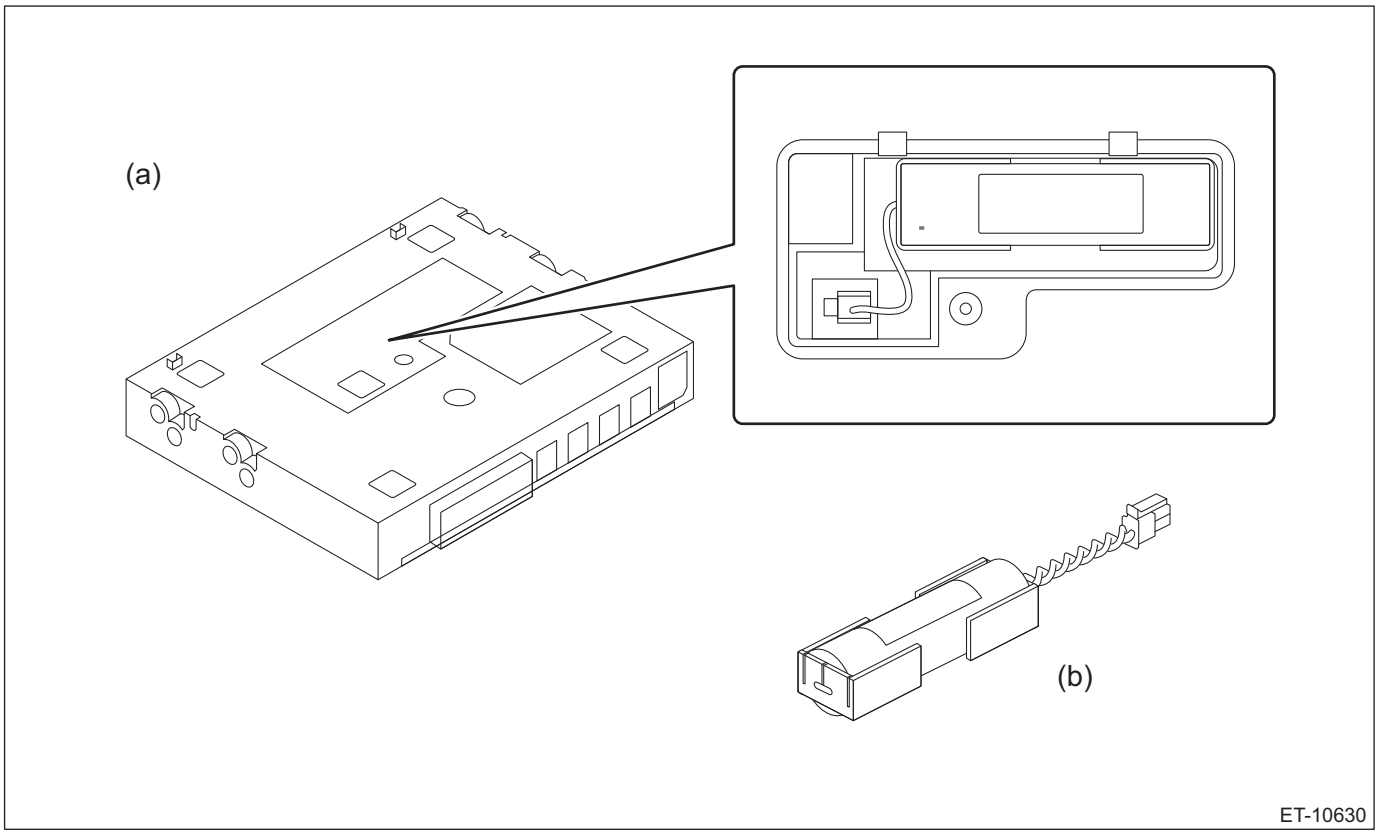
The data communication inside the cabin uses CAN for send/receive the data between each unit, and as for the external communication, the telematics service is provided by communicating with servers via the roof antenna and the sub antenna inside the instrument panel.

The data communication module, which is the heart of the system, is installed in the center of the vehicle, inside the cabin, which is affected least during a crash.

It will operate with the battery built-in the DCM (BUB: Back Up Battery) even when power is not supplied from the battery of the vehicle at the time of a collision (front collision) or during the SOS call, allowing to continue the emergency call.

It has adopted the secondary battery, which will be charged from the vehicle battery while the ignition is ON.

The degradation of the secondary battery is monitored, and notifies the replacement time with an indicator before it will not work as a backup power source.



(a) DCM

(b) Backup battery (BUB)

User interface

There are communication with outside by the integrated indicator switch, display of service with the H/U display of the navigation system or the audio, and guidance by audio function as the UI of the system.

Integrated indicator switch

Immediate communication with outside is possible by operating the switch, and the switch is placed in the overhead console/EyeSight camera cover section considering the operability during emergency.

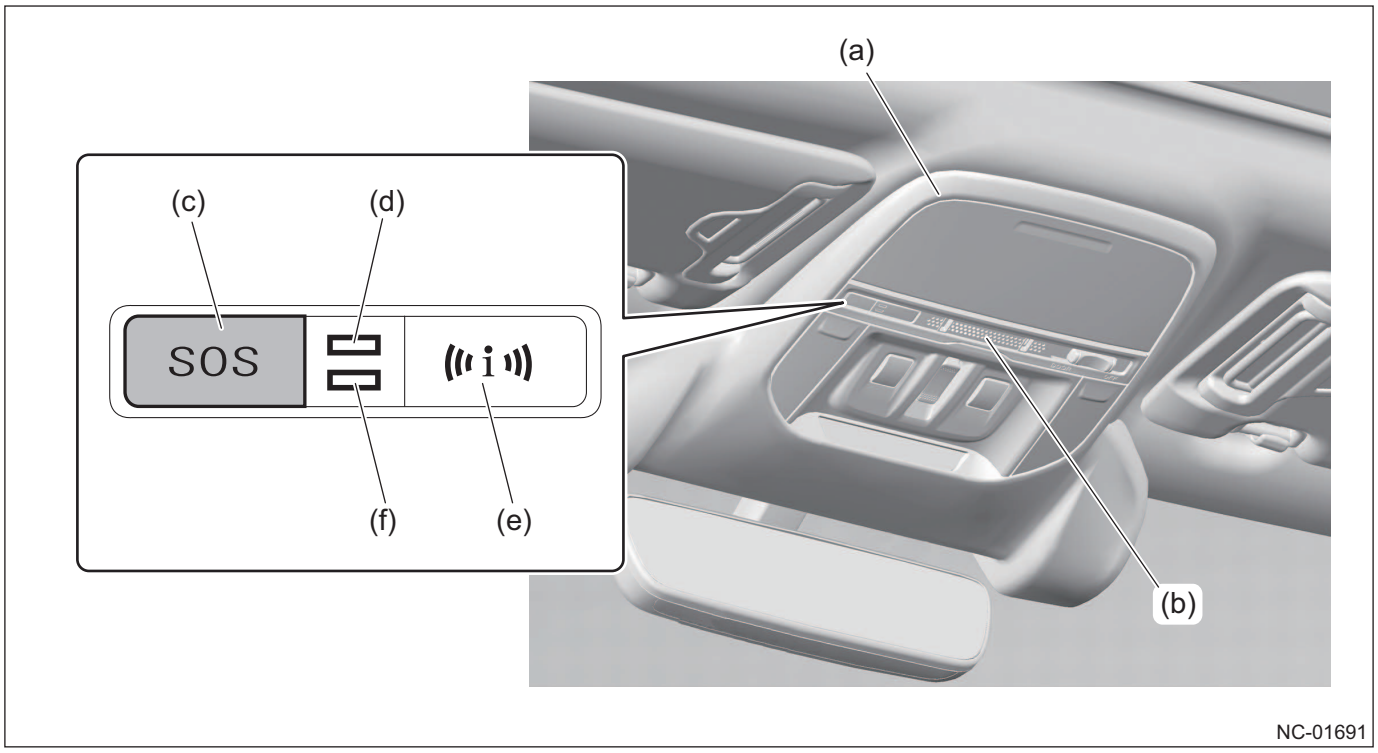
Communication to each service is initiated by pressing the switch, and the communication is cancelled by pressing and holding the switch.

■ SOS switch (SOS Emergency Assistance)

Customer contacts the Telematics Customer Care Advisor during an emergency.

■ iCall switch (Enhanced Roadside Assistance)

You can contact the road service during vehicle breakdown, etc. Or, you can select either the road service or concierge with the head unit.



(a) Overhead console
(b) Microphone opening
(c) SOS switch (SOS Emergency Assistance)
(d) GREEN LED indicator
(e) iCall switch (Enhanced Roadside Assistance)
(f) RED LED indicator

Light status	System status
Green ON	Normal
Red ON	Abnormal (with DTC*1)
Green flash/red flash	AACN*2/SOS /iCall communicating (It will operate if service is possible even if there is DTC*1)
Both green and red OFF	No service subscription/not operating

*1: Diagnostic Trouble Code

*2: Advanced Automatic Collision Notification

Display screen

When the H/U of the navigation system or the audio receives a mute signal from DCM, the navigation system or the audio will stop the audio being played back, and following screen is displayed on whole touch panel display, notifying the user visually that the service has started.

ET-10632

Audio guidance

Depending on the operation status of the telematics system, the following guidance is played back from DCM.

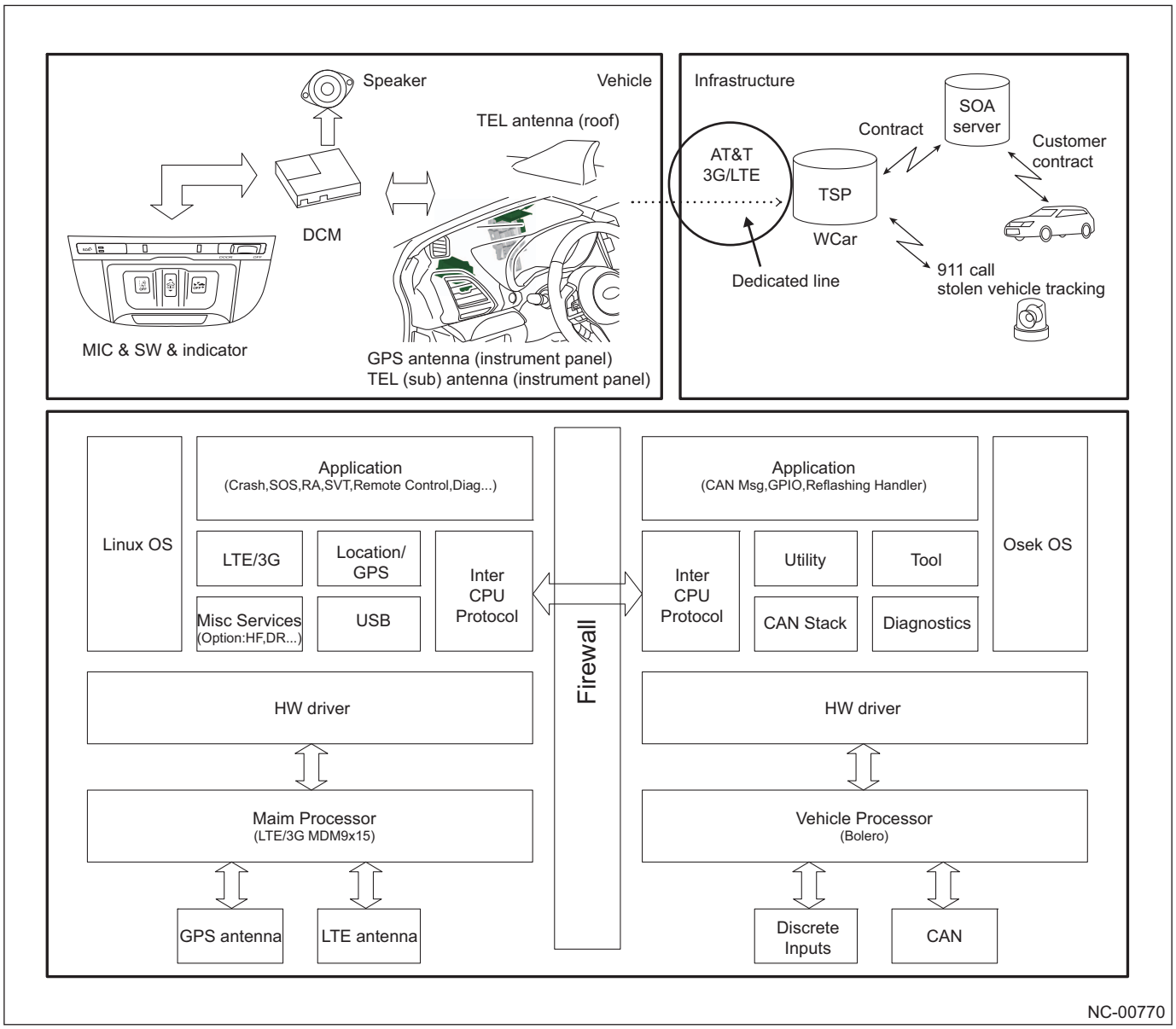
Status	Audio guidance
When a collision that airbag to deploy has occurred	"Call connecting to SUBARU STARLINK emergency services."
When manually sending SOS with the SOS switch	"Connecting to SUBARU STARLINK emergency assistance."
When asking for roadside assistance	"Connecting to SUBARU STARLINK Roadside Assistance."
When the iCall switch is pressed while the roadside assistance and concierge service are activated	"Please use touch screen to select a STARLINK service."
When sending to concierge	"Connecting to SUBARU STARLINK Concierge services."
When notifying that the conversation will be recorded before connecting to the operator	"This call may be recorded or monitored for quality purposes."
When ACN/SOS/iCall is operated without subscription	"You are not currently subscribed to SUBARU STARLINK. Please visit Mysubaru.com to upgrade your service."
When the telephone connection is weak and cannot connect even after multiple retries	"Due to cellular network or hardware problems, your call cannot be connected at this time."
When the service is started in the stolen vehicle	"Stolen Vehicle Recovery Service has been activated."

Security

The protocol between the vehicle and the server is exclusive, making it difficult to be hacked from outside the vehicle.

The microcomputer connecting to the antenna (outside the vehicle) and the microcomputer for communication inside the vehicle (CAN etc.) are separated, and the communication protocol between these 2 microcomputers are encrypted by the manufactures original method, so it will be blocked inside the DCM even if it gets intruded from the antenna.

The DCM receives the VIN information written in the EGI as a line via CAN, and stores in the DCM. In addition, the vehicle and DCM are linked one-to-one, and the subscribed DCM will not work when installed on another vehicle.



Voice Call

SUBARU Concierge

This is a function to set the destination of the navigation by calling the call center and select the place to go (destination) through conversation with an operator.

Once the destination is decided, the operator will send the destination information to the vehicle, and the destination will be automatically set in the on-board navigation, making it possible to safely set the destination even while driving.

The concierge service can be selected by pressing the iCall switch and selecting the concierge service in the navigation system or the audio H/U display. It can also start the service from the audio H/U screen even without pressing the iCall switch.

ET-10635

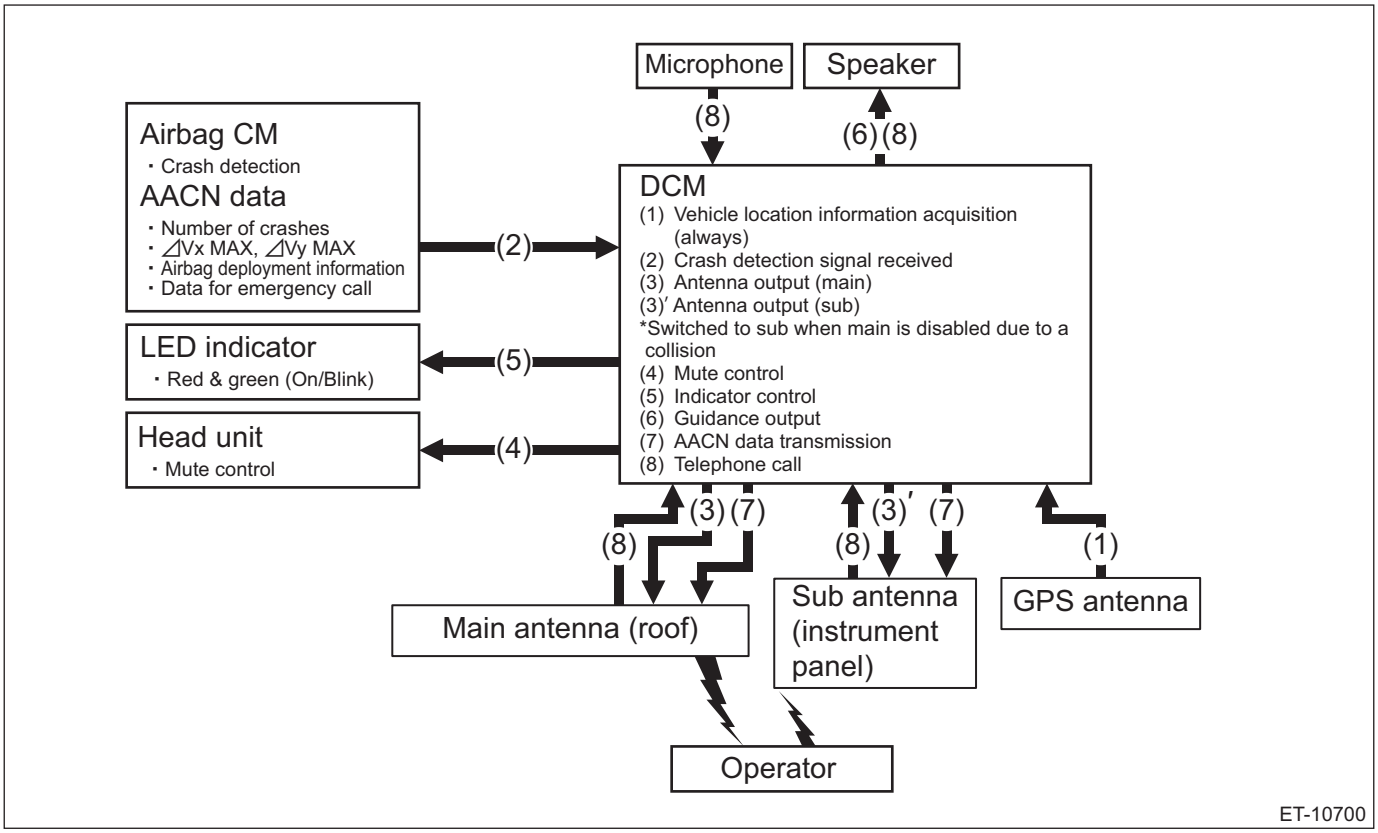
Advanced Automatic Collision Notification

This is a function to automatically notify the operator with highest priority against other services when there is a large impact due to collision, and the DCM will receive collision detection signal.

Telematics Customer Care Advisor will communicate with the occupant, and provide appropriate service depending on the condition of the occupant. Also, an audio guidance of "Call connecting to SUBARU STARLINK emergency services." is played when connecting to an operator.

The following items are functions during operation (cancelling by the customer is not possible).

- The DCM will continue to operate with the built-in battery even if the vehicle battery power source is disconnected.
- Red or green LED indicator will flash during the call.



No.	Control	Supported unit
1	Acquires the location information from the GPS.	DCM
2	Sends the collision detection signal.	Airbag control module
3	Sends the collision notification (including result of 1) to the server.	DCM
4	Mutes the head unit.	DCM
5	Flashes the LED indicator.	DCM
6	Outputs the audio prompt to the speaker.	DCM
7	Sends AACN data.	Airbag → DCM → server
8	Communicates with an operator.	DCM

■ Notification of detailed information of an accident condition

The vehicle condition information (collision form, number of times, etc.) when an accident occurred is collected to notify the call center of the information. The call center presumes the scale of the accident based on this information and considers taking appropriate action.

SOS Emergency Assistance

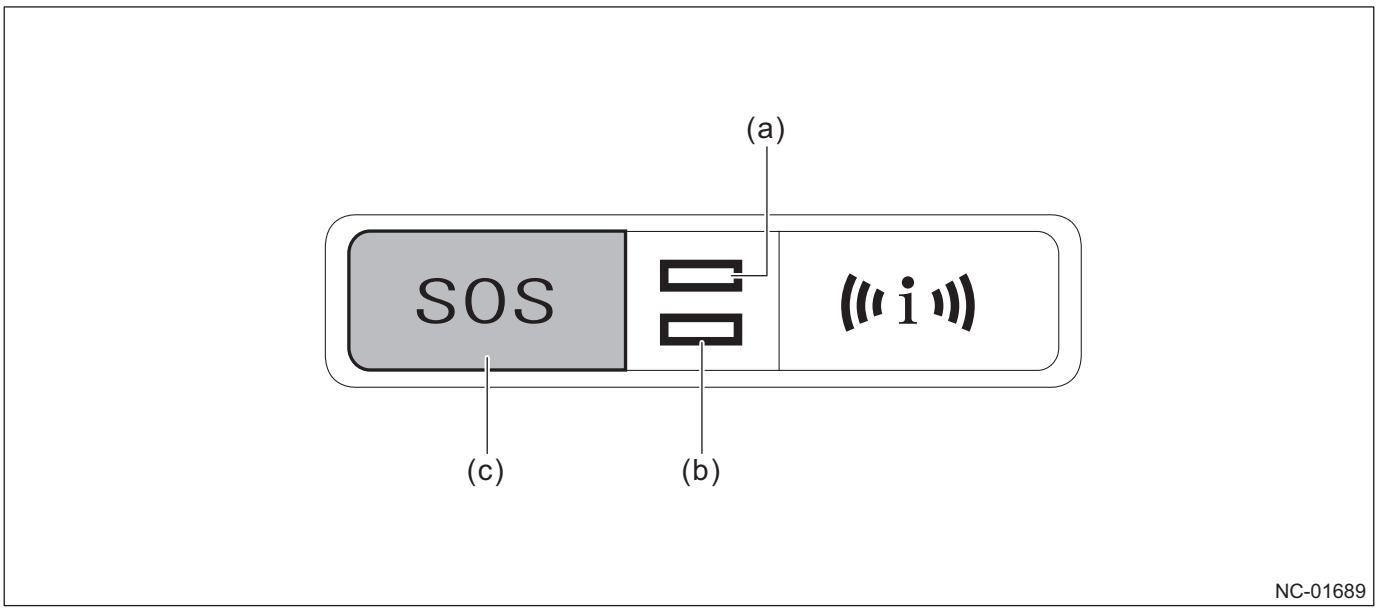
This is a function that receives emergency assistance by pressing the dedicated SOS button in the vehicle when an emergency occurs.

Telematics Customer Care Advisor will communicate with the occupant, confirm the degree of emergency, and provide appropriate emergency assistance. Also, an audio guidance of "Connecting to SUBARU STARLINK emergency assistance." is played when connecting to an operator.

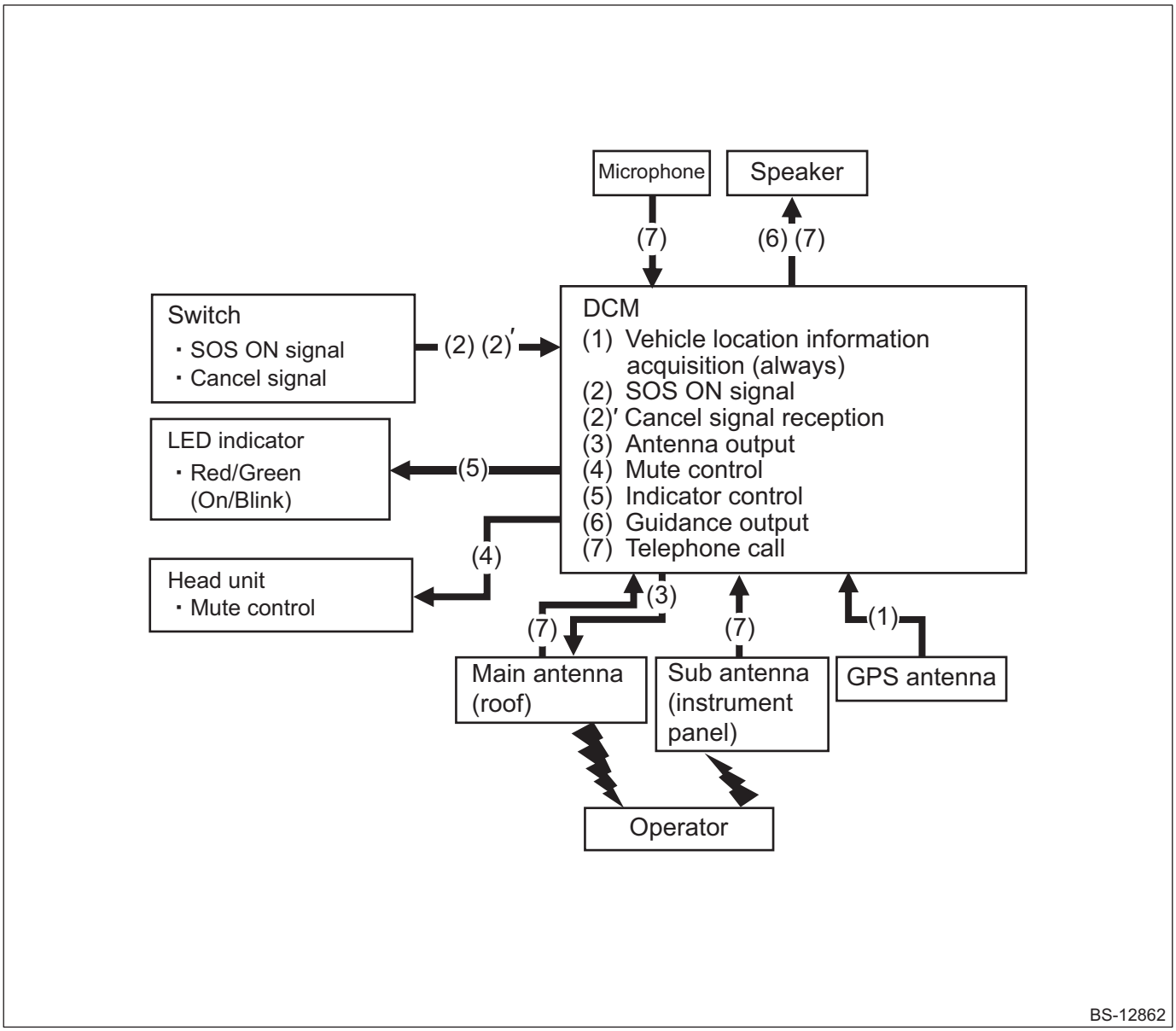
Following items are the functions during operation.

- To prevent calling by mistake, an audio guidance to prompt cancel operation is played when connecting to the server.
- It will be cancelled by pressing and holding the button.
- Red or green LED indicator will flash during the call.

SOS switch



(a) GREEN LED indicator
(b) RED LED indicator
(c) SOS switch (SOS Emergency Assistance)



No.	Control	Supported unit
1	Acquires the location information from the GPS.	DCM
2	Determines as ON by pressing the SOS button, and determine as cancel by pressing and holding.	DCM
3	Sends the SOS notification (including result of 1) to the server.	DCM
4	Mutes the head unit.	DCM
5	Flashes the LED indicator.	DCM
6	Outputs the audio prompt to the speaker.	DCM
7	Communicates with an operator.	DCM

Enhanced Roadside Assistance

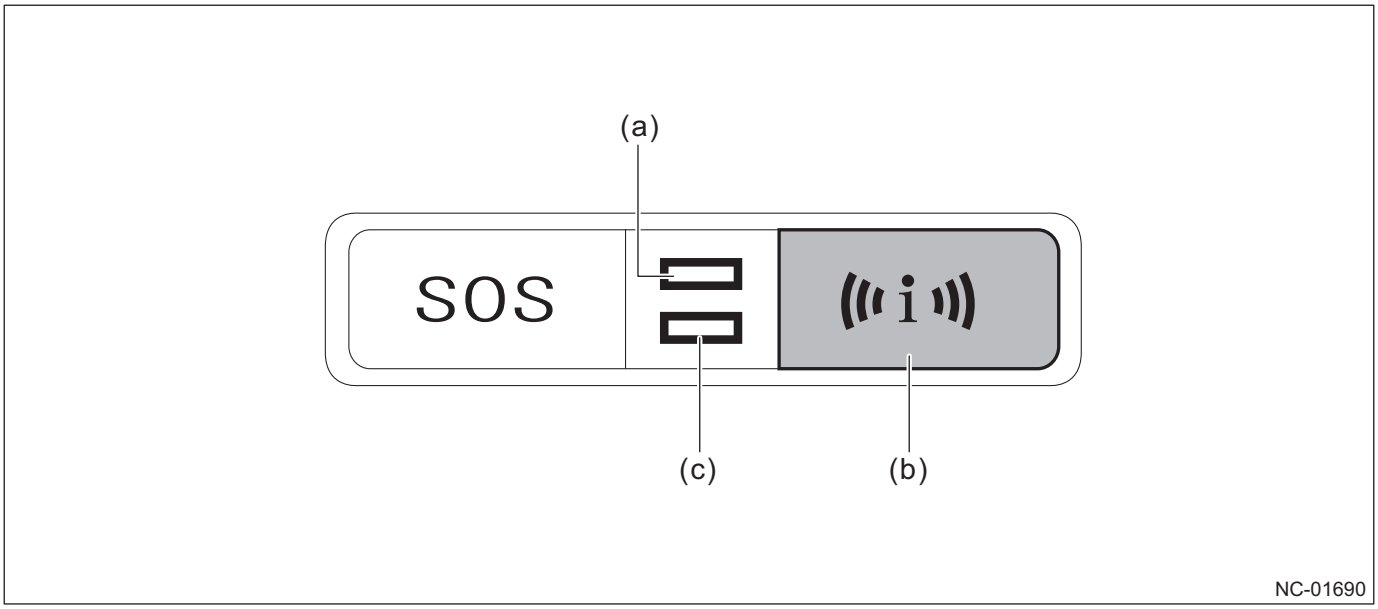
This is a function to receive a roadside assistance by pressing the i-button during vehicle breakdown, etc., and connecting to the dedicated operator.

Telematics Customer Care Advisor in charge of roadside assistance will confirm the situation, and provide appropriate roadside assistance. Also, an audio guidance of "Connecting to SUBARU STARLINK Roadside Assistance." is played when connecting to an operator.

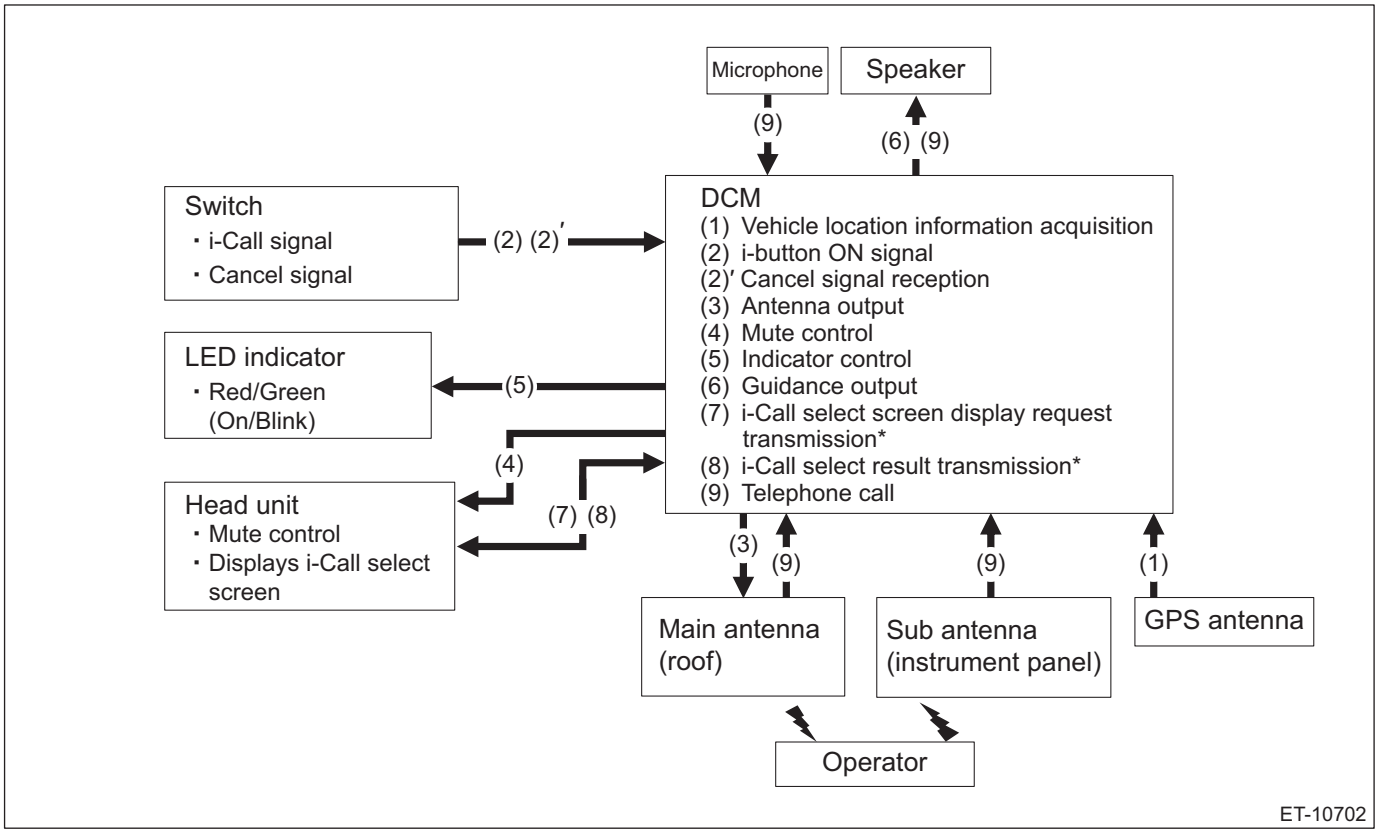
Following items are the functions during operation.

- It will be cancelled by pressing and holding the button.
- Red or green LED indicator will flash during the call.

iCall switch



(a) GREEN LED indicator
(b) iCall switch (Enhanced Roadside Assistance)
(c) RED LED indicator



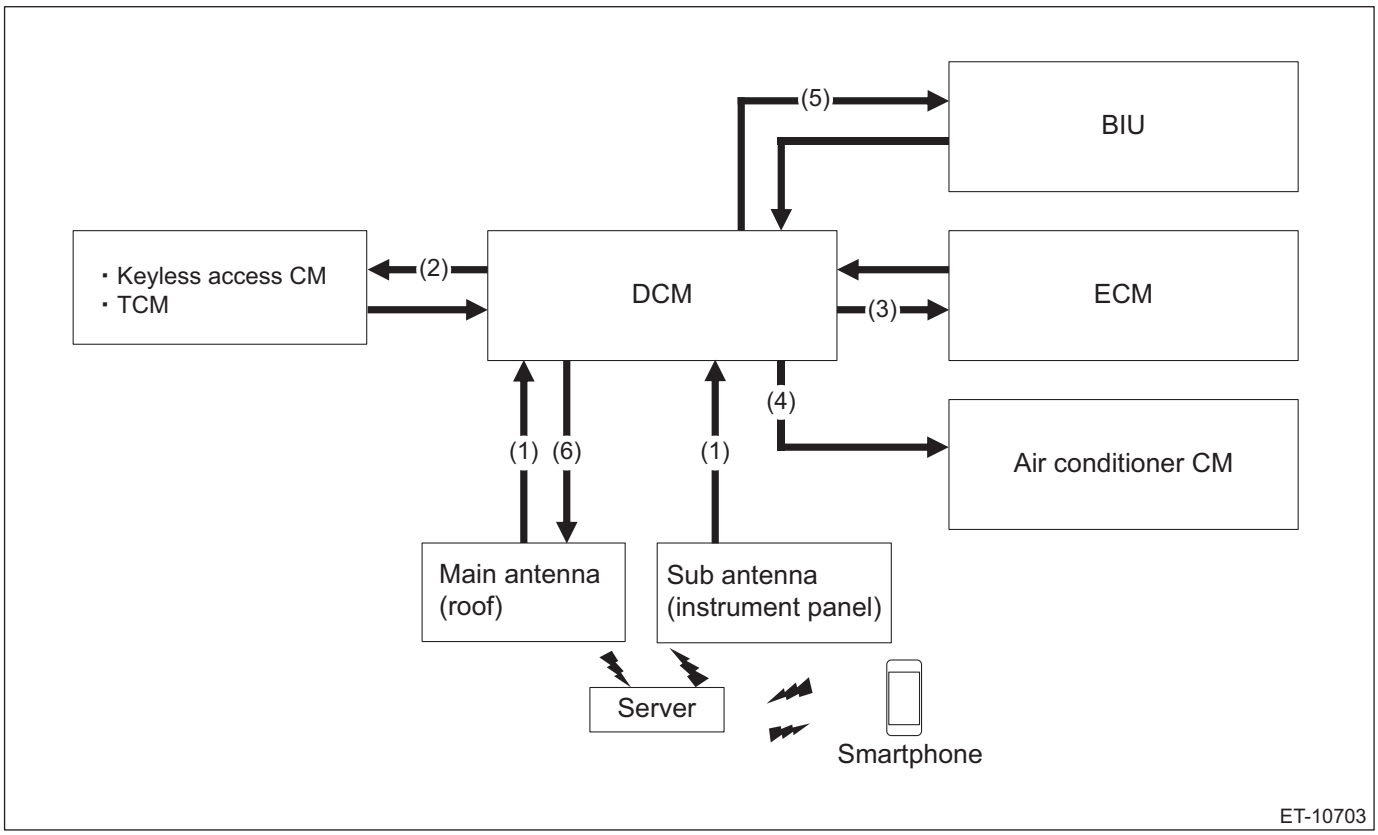
*: Only with concierge service subscription

No.	Control	Supported unit
1	Acquires the location information from the GPS.	DCM
2	Determines as ON by pressing the i-button, and determine as cancel by pressing and holding.	DCM
3	Sends the i-Call notification (including result of 1) to the server.	DCM
4	Mutes the head unit.	DCM
5	Flashes the LED indicator.	DCM
6	Outputs the audio prompt to the speaker.	DCM
7	Communicates with an operator.	DCM

Remote Engine Start (Includes Climate Control/Heated Seats)

This is a function to start the engine of the vehicle remotely using the dedicated mobile application on a smartphone.

By setting the air conditioner from the dedicated app, the cabin can be cooled before going into the vehicle in the summer, and not only warming the cabin but to operate the defroster to de-ice in the winter.

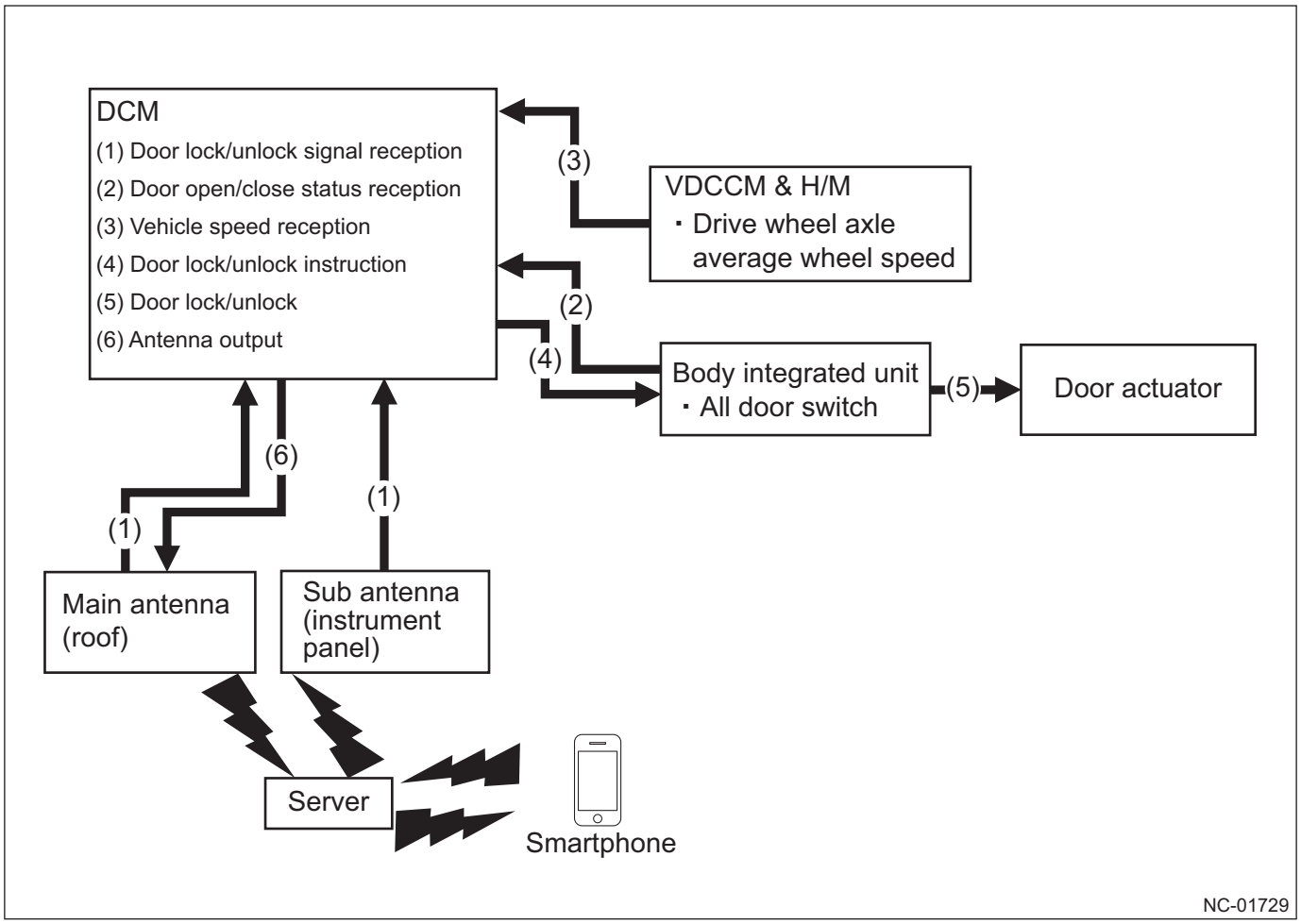


No.	Control	Supported unit
1	Sends engine start request from the server to DCM (antenna).	Server
2	Confirms the vehicle status.	DCM
3	Sends the engine start request.	DCM
4	Sends the air conditioner start request.	DCM
5	Outputs the horn & light request.	Body integrated unit
6	Sends the result to the server.	DCM

Remote Lock & Unlock

This is a function to lock/unlock the doors remotely using the smartphone dedicated mobile application Customer Web Portal when you forgot to lock the doors or left the keys inside a locked vehicle.

- Unlocking of the doors can be either driver door only or all doors at once (locking is for all doors including the rear gate).
- Operation is not accepted while driving (however, unlocking operation is accepted when the vehicle speed is 5 km/h or lower).
- Even if it is unlocked by mistake, the doors are locked automatically after 60 seconds of unlocking if no door is opened.



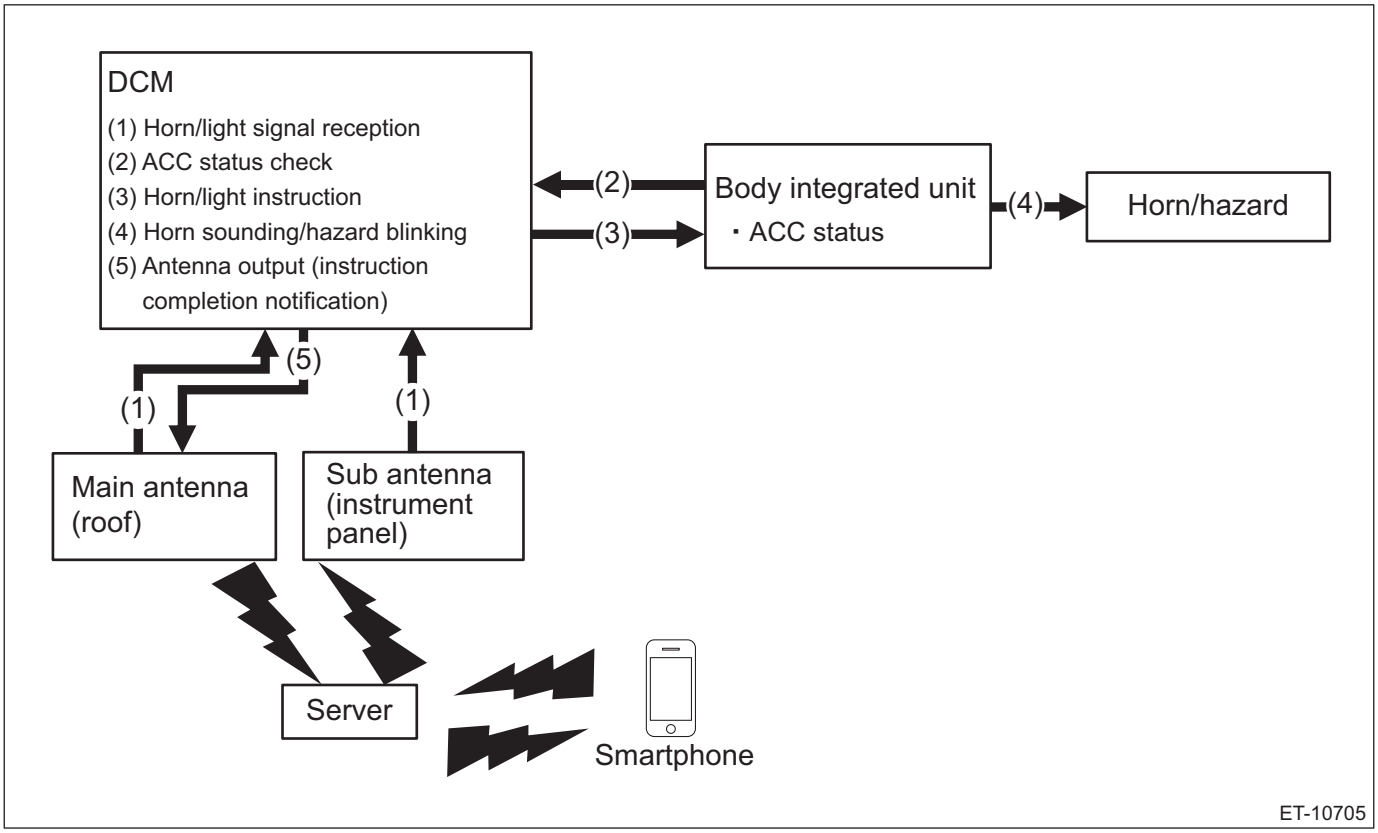
No.	Control	Supported unit
1	Sends lock/unlock request from the server to DCM (antenna).	Server
2	Determines the vehicle condition.	DCM
3		
4	Outputs the lock/unlock request based on the results of 2 and 3.	DCM
5	Locks/unlocks the door based on the signal from 4.	Body integrated unit
6	Sends the result of lock/unlock to the server.	DCM

Remote Horn & Lights

This is a function to start the hazard lights and the horn remotely using the smartphone dedicated mobile application Customer Web Portal to confirm the position of the vehicle in parking lot, etc.

A pattern to operate both the hazard lights and the horn to operate simultaneously, and a pattern to only the hazard lights to operate can be selected.

*Operation time of above is 30 seconds. Also, the operation is not accepted while driving.



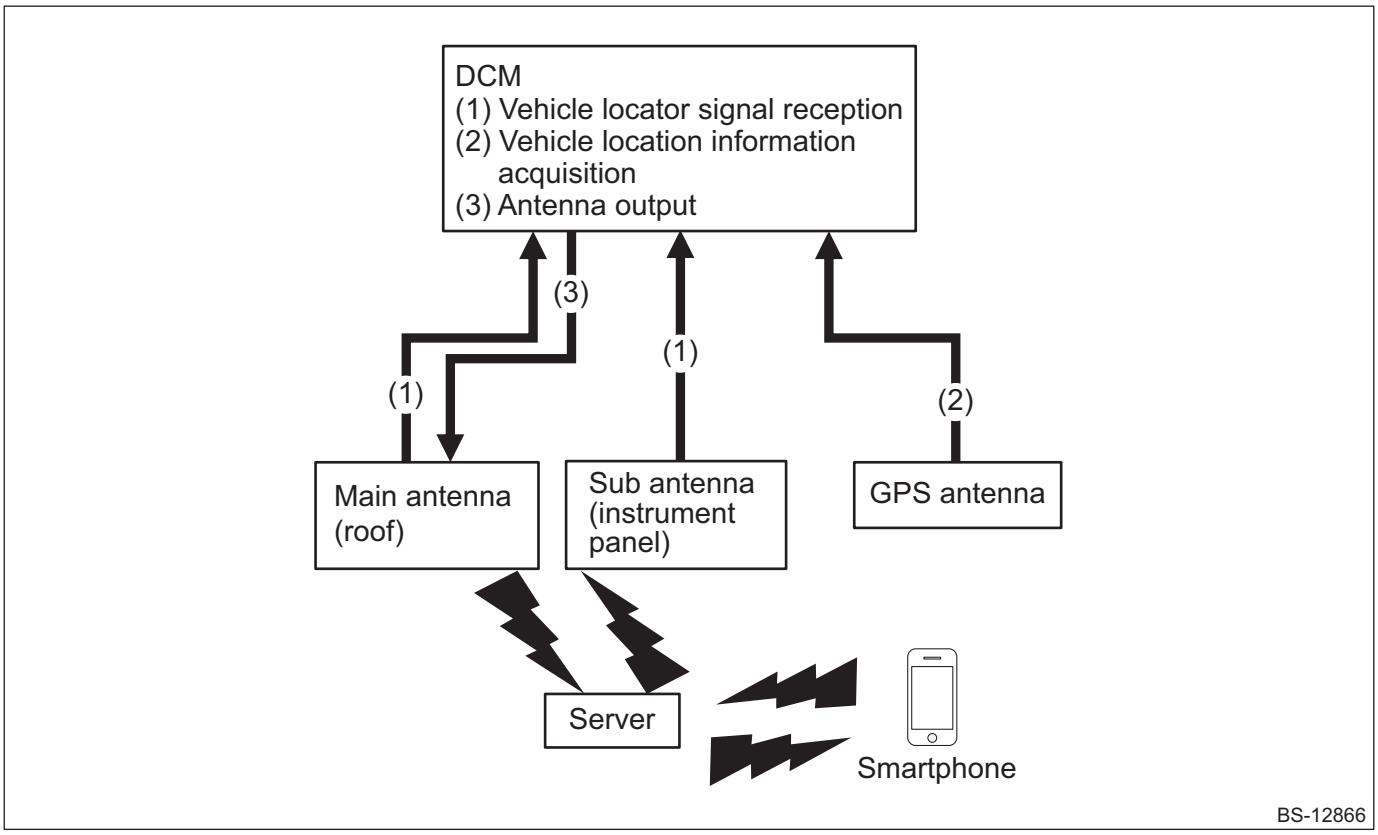
No.	Control	Supported unit
1	Sends horn & hazard light/only hazard light request from the server to DCM (antenna).	Server
2	Confirms the ACC condition.	DCM
3	Outputs horn & hazard light/only hazard light request based on the result of 2.	DCM
4	Performs horn sounding & hazard light flashing/only hazard light flashing based on the signal of 3.	Body integrated unit
5	Sends the result of 3 to the server.	DCM
6	Stops the operation during the operation of 4 with following conditions. - IGN ON - Stop request from DCM - Timer fulfilled (30 seconds) - Lock/unlock signal from smart/keyless	Body integrated unit

Remote Vehicle Locator

This is a function to quickly and simply determine the location of the vehicle using the GPS equipped in the vehicle.

The vehicle location information acquired from the GPS is sent to the server, and forwarded to the smartphone or PC of the user. Also, the location information can be used linked to the smartphone app or the online map.

*Depending on the app, it may be able to show the route to that location or store the location information.

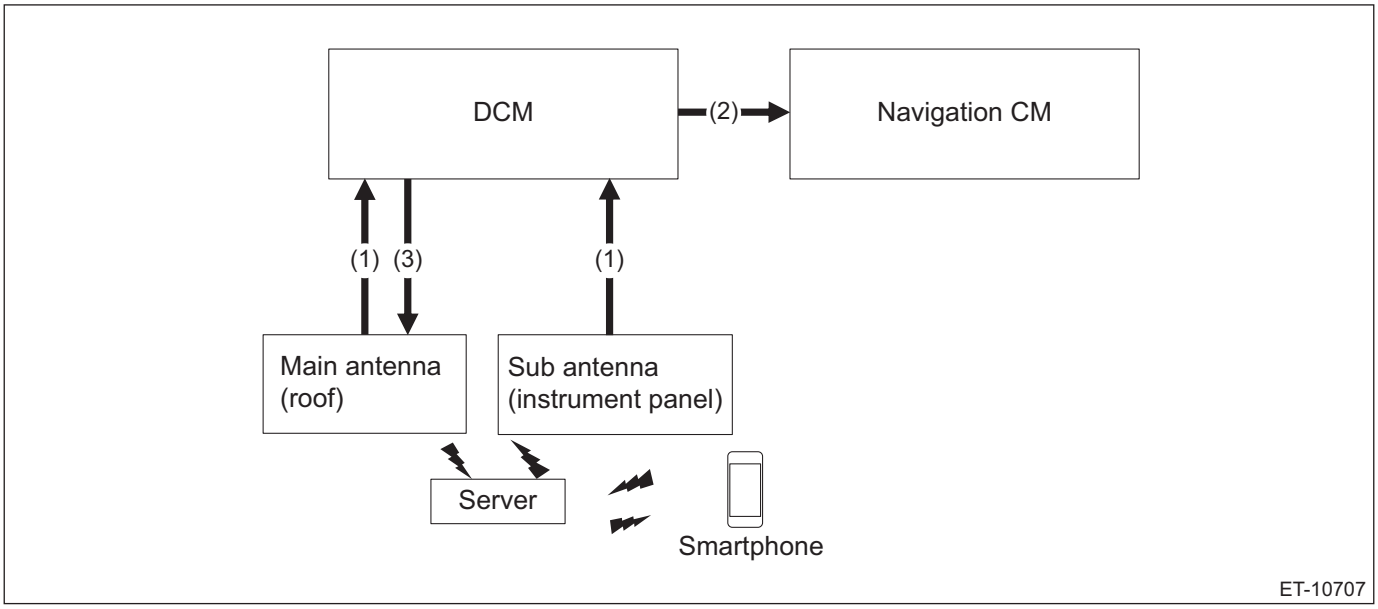


No.	Control	Supported unit
1	Sends vehicle locator request from the server to DCM (antenna).	Server
2	Acquires the location information from the GPS.	DCM
3	Sends the result of 2 to the server.	DCM

Destination to Vehicle (to Navi or Text depends on the vehicle type)

This is a function to set the destination of the on-board navigation by sending the destination information to the vehicle from the smartphone dedicated mobile app.

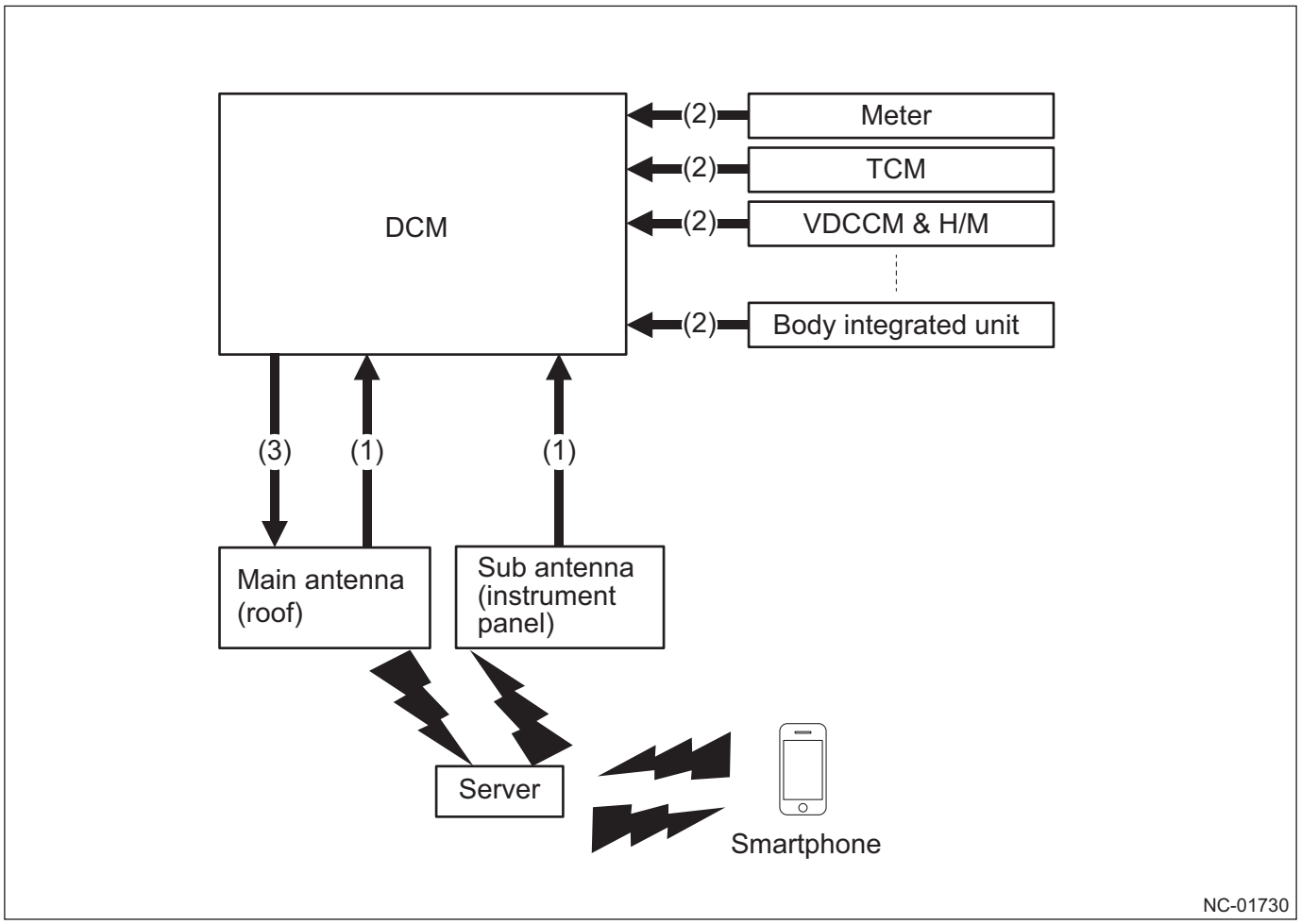
It is possible to depart immediately after boarding the vehicle by setting the destination from the app before boarding the vehicle.



No.	Control	Supported unit
1	Sends destination setting information from the server to DCM (antenna).	Server
2	Sends the destination information to the navigation.	DCM
3	Sends the result to the server.	DCM

Vehicle Condition Check

This is a function to confirm the condition of the vehicle from the Customer Web Portal.



No.	Control	Supported unit
1	Receives the vehicle information send request from the server.	DCM
2	Receives the vehicle condition information from each unit.	Each unit
3	Sends the vehicle condition information to the server.	Server

Vehicle Alerts

Boundary Alert

This is a function to set a circular or rectangular virtual fence on the map, and notifies when the vehicle goes in or goes out of the set fence.

Either to receive a notification when the vehicle goes in or goes out of the set range can be selected.

Speed Alert

This is a function to set a certain speed, and notifies when the vehicle exceeds the set speed.

The exceeded time can be set in addition to the speed, and it can set conditions such as whether to send a notification when the vehicle is driven exceeding the set speed and the time.

Curfew Alert

This is a function to set a certain time of the day, and notifies when the vehicle is being used during the set time period.

This can notify the driver via the on-board audio/navigation system that the set time is approaching.

Customer Touch Point

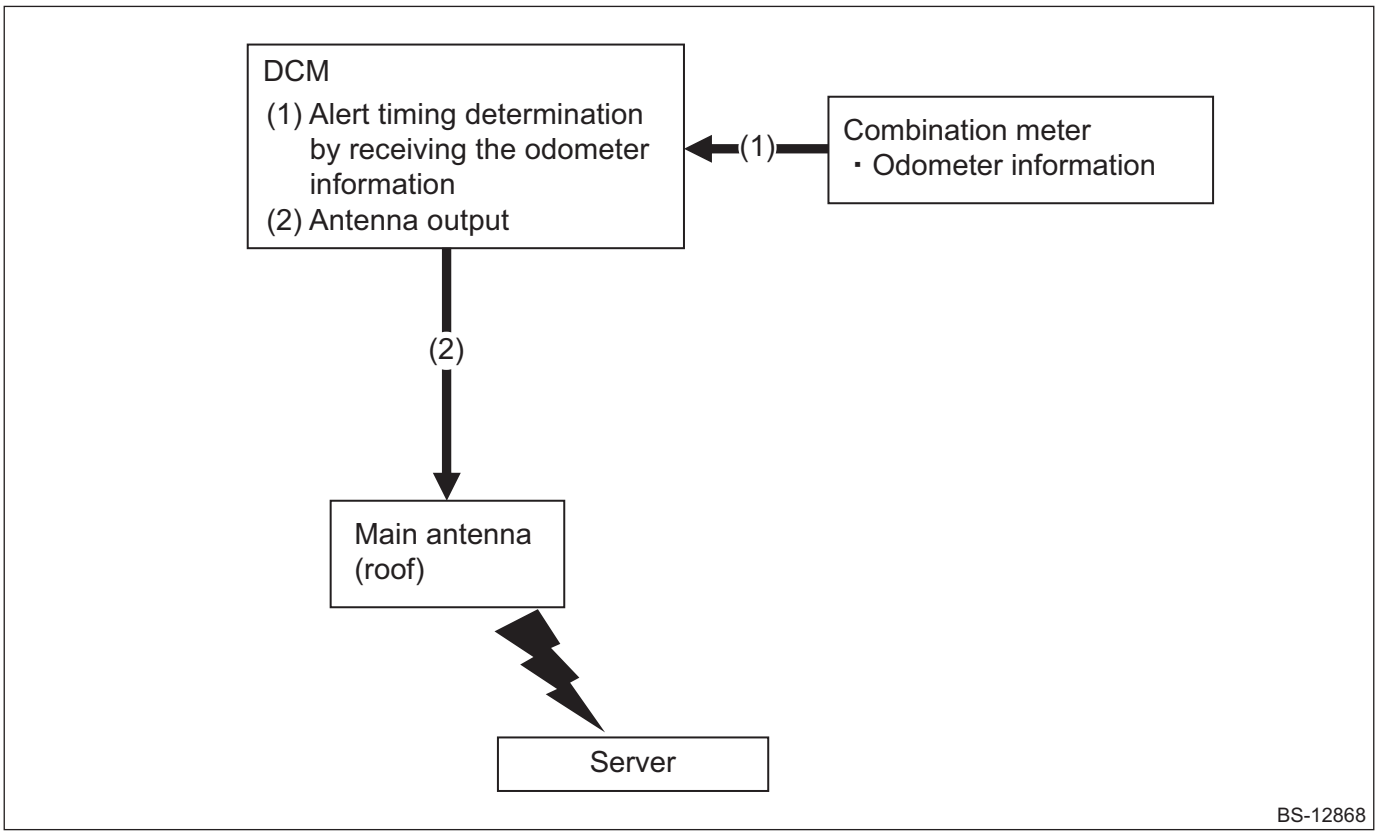
Service Appointment Scheduler

This is a function to display the dedicated dealer scheduling screen by accessing the SUBARU of America server with the on-board audio/navigation system, and to schedule appointment with the dealer from inside the vehicle. It can also offer an appointment depending on the vehicle condition or availability of any service campaign and make a call to a specific dealer.

*This is available only when making a handsfree call is possible on the on-board audio/navigation system.

Maintenance Notifications

This is a function to acquire the mileage of the vehicle and notify the time for engine oil change and periodic maintenance.



No.	Control	Supported unit
1	Receives the information of the odometer and determine if it is time to alert.	DCM
2	Notifies the server based on the result of 1.	DCM

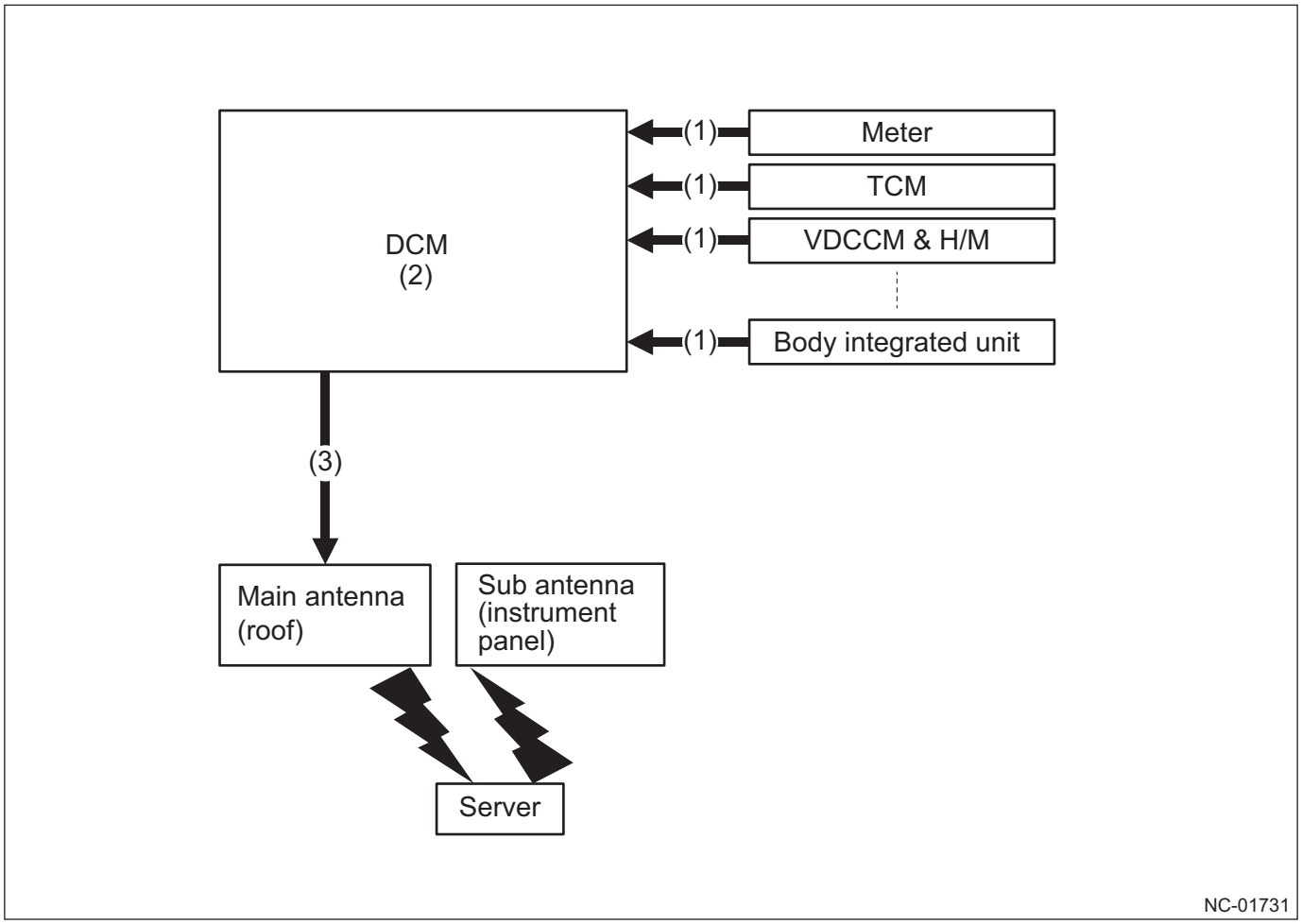
Diagnostic Alerts

This is the function to illuminate the warning light on the instrument panel together with notifying the user with an e-mail.

Vehicle Health Report

This is a function to send an easy to understand vehicle diagnostic report including various elements of the vehicle performance via e-mail.

System check, mileage, future maintenance schedule, etc., are sent.



No.	Control	Supported unit
1	Receives the vehicle condition information from each unit.	Each unit
2	Detects IGN OFF.	DCM
3	Sends the vehicle condition information to the server.	DCM

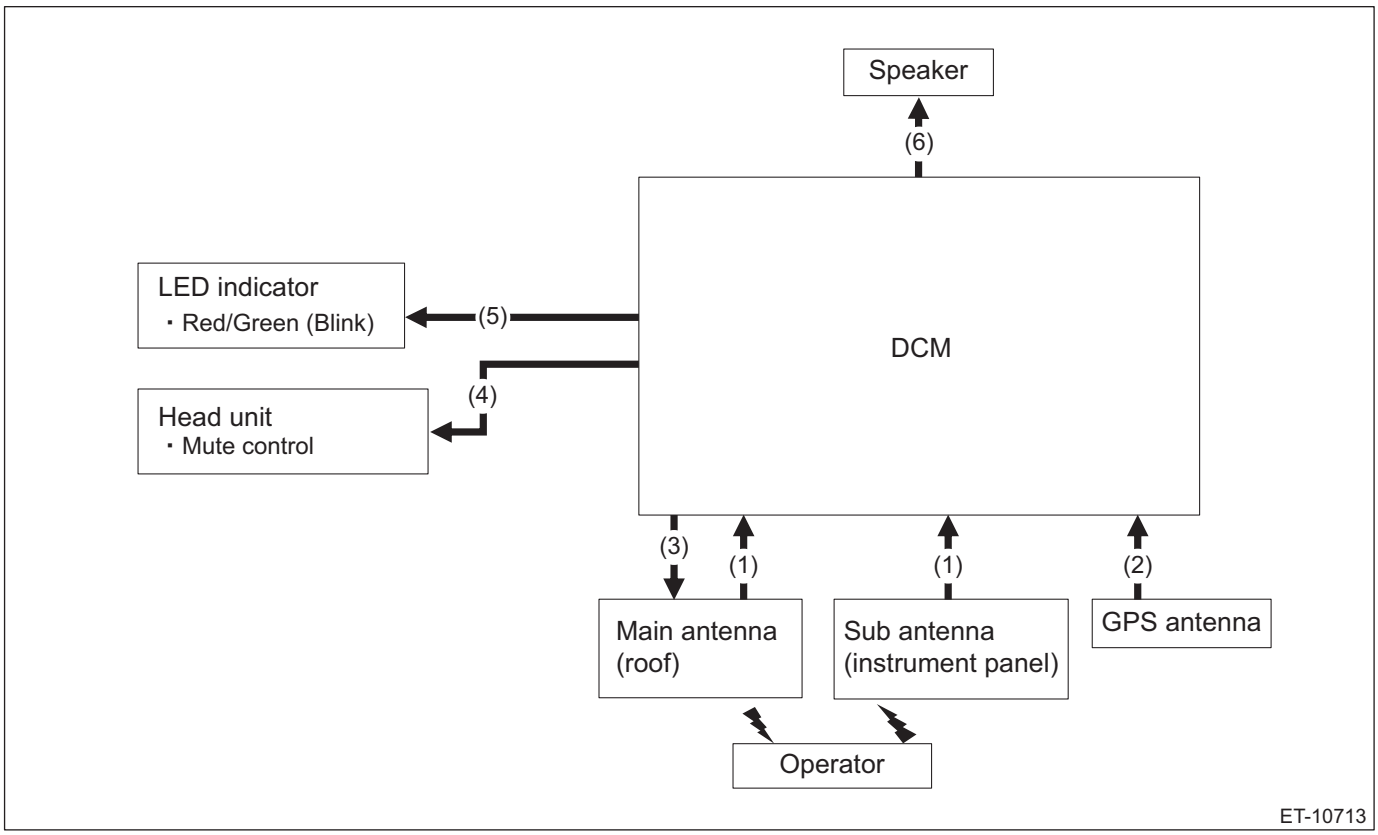
Security

Stolen Vehicle Recovery Plus (SVR Plus includes Vehicle Immobilization/Mobilization)

This is a function to assist recovering of the vehicle by the Telematics Customer Care Advisor working together with local law enforcement.

When the user notices that the vehicle was stolen and contacts the police, the case number is given, and by notifying that case number to the operator, the location information of the vehicle is acquired from DCM. However, the acquired location information is only notified to police and not to the user to prevent any danger.

An audio guidance of "Stolen Vehicle Recovery Service has been activated." is sounded when the service is started (It can acquire the location information even if the ignition is OFF. Also, the user will be notified by an e-mail when police has recovered the vehicle).



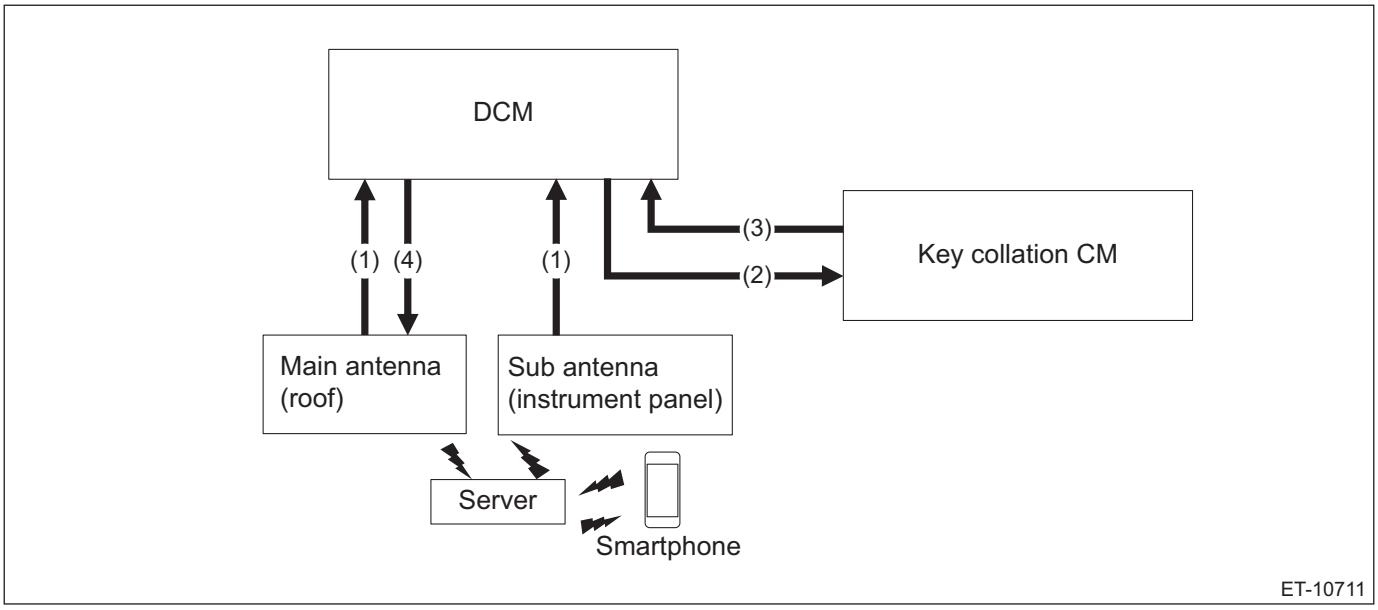
No.	Control	Supported unit
1	Stolen vehicle recovery request is sent to DCM from the server via an operator.	Operator → server
2	Acquires the location information from the GPS.	DCM
3	Sends the result of 2 to the server.	DCM
4	Mutes the head unit.	DCM
5	Flashes the LED indicator (red/green).	DCM
6	Outputs the guidance to the speaker.	DCM

■ Stolen Vehicle Immobilizer

This is a function to disable the starting of the engine of the vehicle by sending a signal from the server to the stolen vehicle with the request from police.

It will make moving of the stolen vehicle difficult and assist recovery of the vehicle by combining with the location information of the stolen vehicle. It is also possible to disable the stolen vehicle immobilizer when there is a request from police.

* It is not possible to stop the engine forcefully while driving.

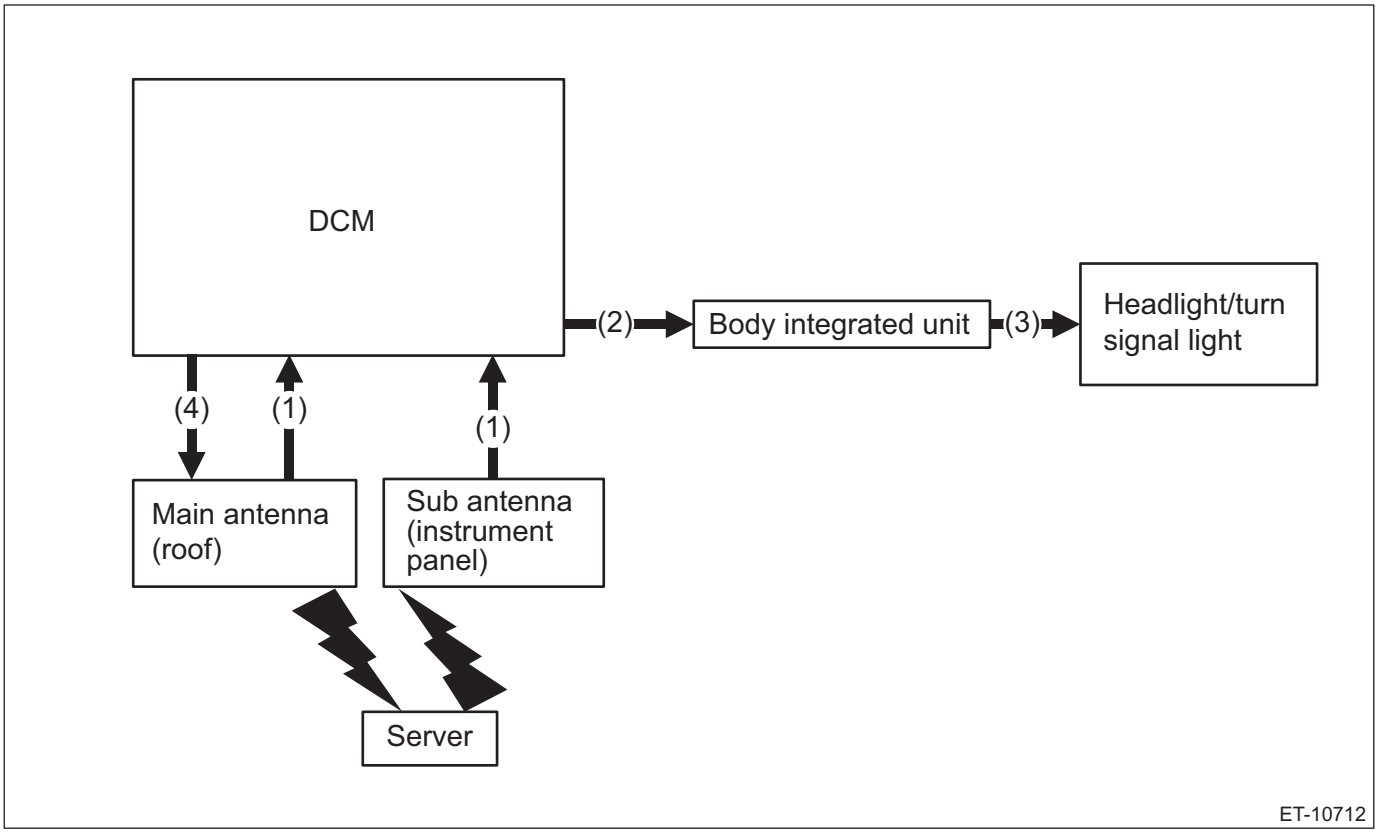


No.	Control	Supported unit
1	Sends engine stop signal from the server to DCM (antenna).	Server
2	Sends the stolen vehicle immobilizer set request.	DCM
3	Sends the result to DCM.	Key collation CM
4	Sends the result to the server.	DCM

■ Stolen Vehicle Flashing Lights

This is a function to flash the lights of the stolen vehicle by sending a signal from the server to the stolen vehicle with the request from police.

This assists police identifying the stolen vehicle.

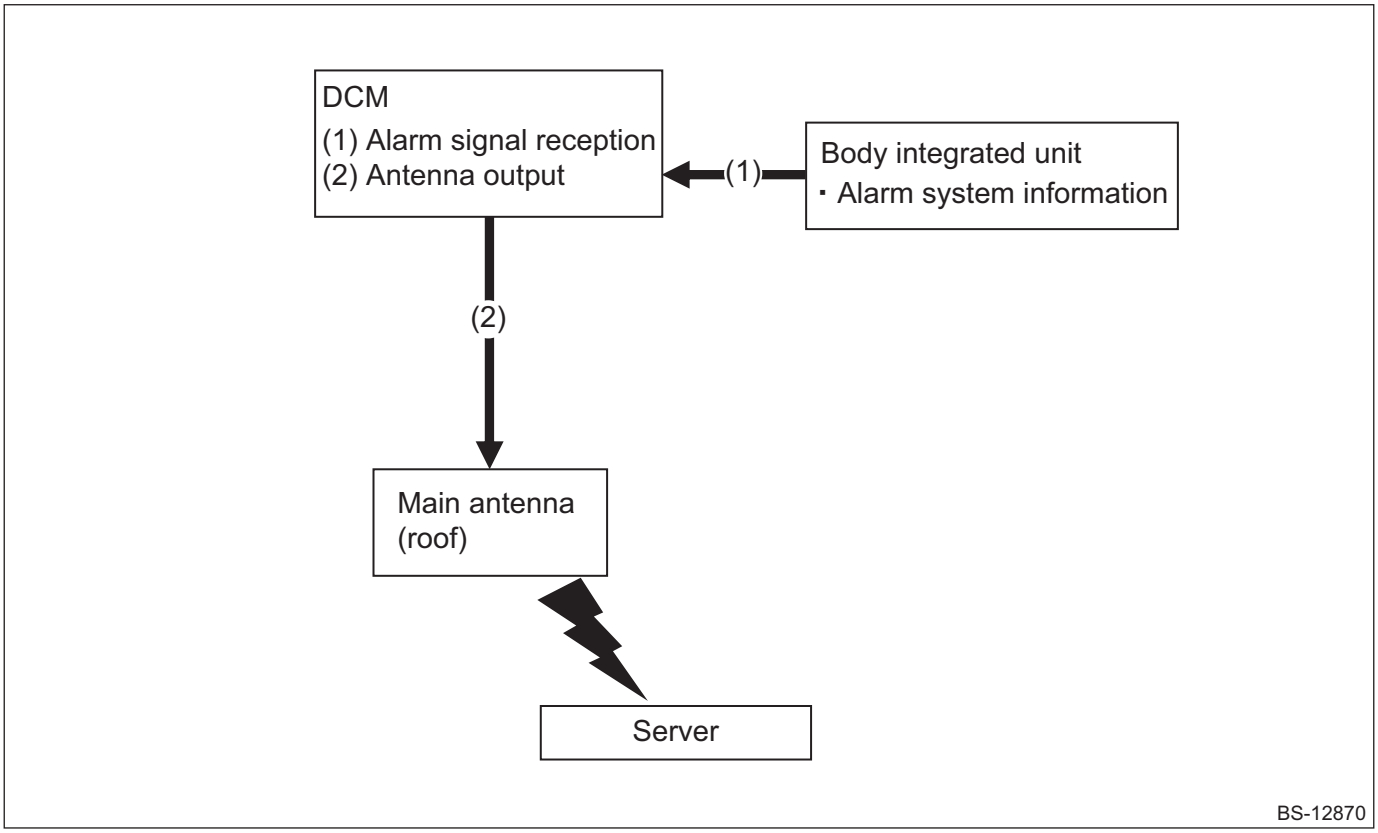


No.	Control	Supported unit
1	Sends light flashing signal from the server to DCM (antenna).	Server
2	Sends the light flashing signal.	DCM
3	Flashes the lights.	Body integrated unit
4	Sends the result to the server.	DCM

Vehicle Security Alarm Notification

This is a function to notify when the security alarm has activated.

The alarm system information and the location information of the vehicle are sent from DCM to the server when the security alarm of the vehicle is activated, and that is notified to the user from the server via telephone or e-mail.



No.	Control	Supported unit
1	Sends the security alarm signal.	Body integrated unit
2	Notifies the server that 1 was received.	DCM

Connected Vehicle Feature

SUBARU STARLINK system Update

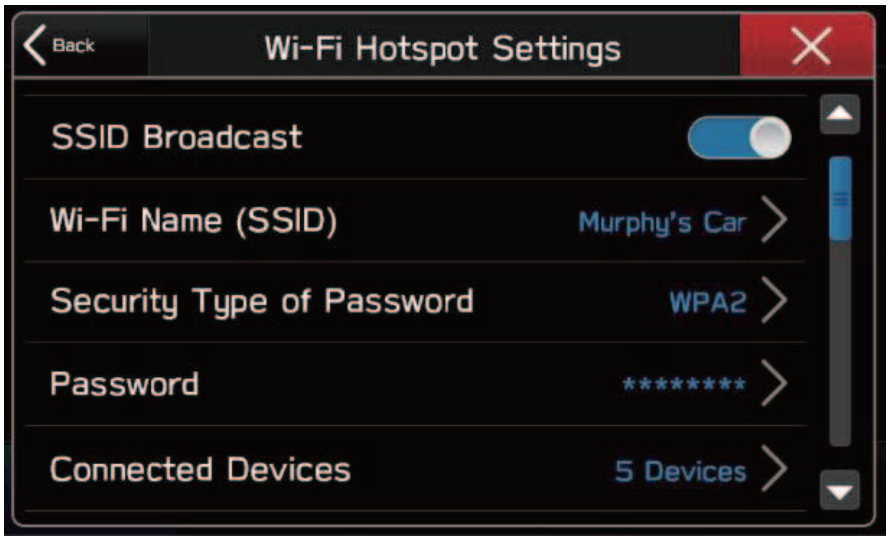
This is a function to download the DCM update data from the server using a wireless communication, and update the DCM.

It was necessary for the user to schedule maintenance with a dealer and bring the vehicle to the dealer when an update was required with a service campaign or similar, but that frequency can be reduced by this function.

Wi-Fi Hotspot

This is a function that provides an Internet connection service by the vehicle acting as a wireless LAN access point using the LTE high speed communication.

Users can bring a PC, game, tablet, etc. and connect them to the vehicle to use the Internet service.



ET-10638

Call volume change function during telematics call

This is a function to adjust the call volume of the telematics call such as Advanced Automatic Collision Notification (AACN), SOS Emergency Assistance, and Emergency Roadside Assistance using the H/U volume dial knob.

11.4 Combination Meter/MFD/MID

11.4.1 Overview

This is a system to display icons and messages on the following meters and displays to securely provide various types of information to the driver and passengers.

Combination meter

Multi-information display (MID)

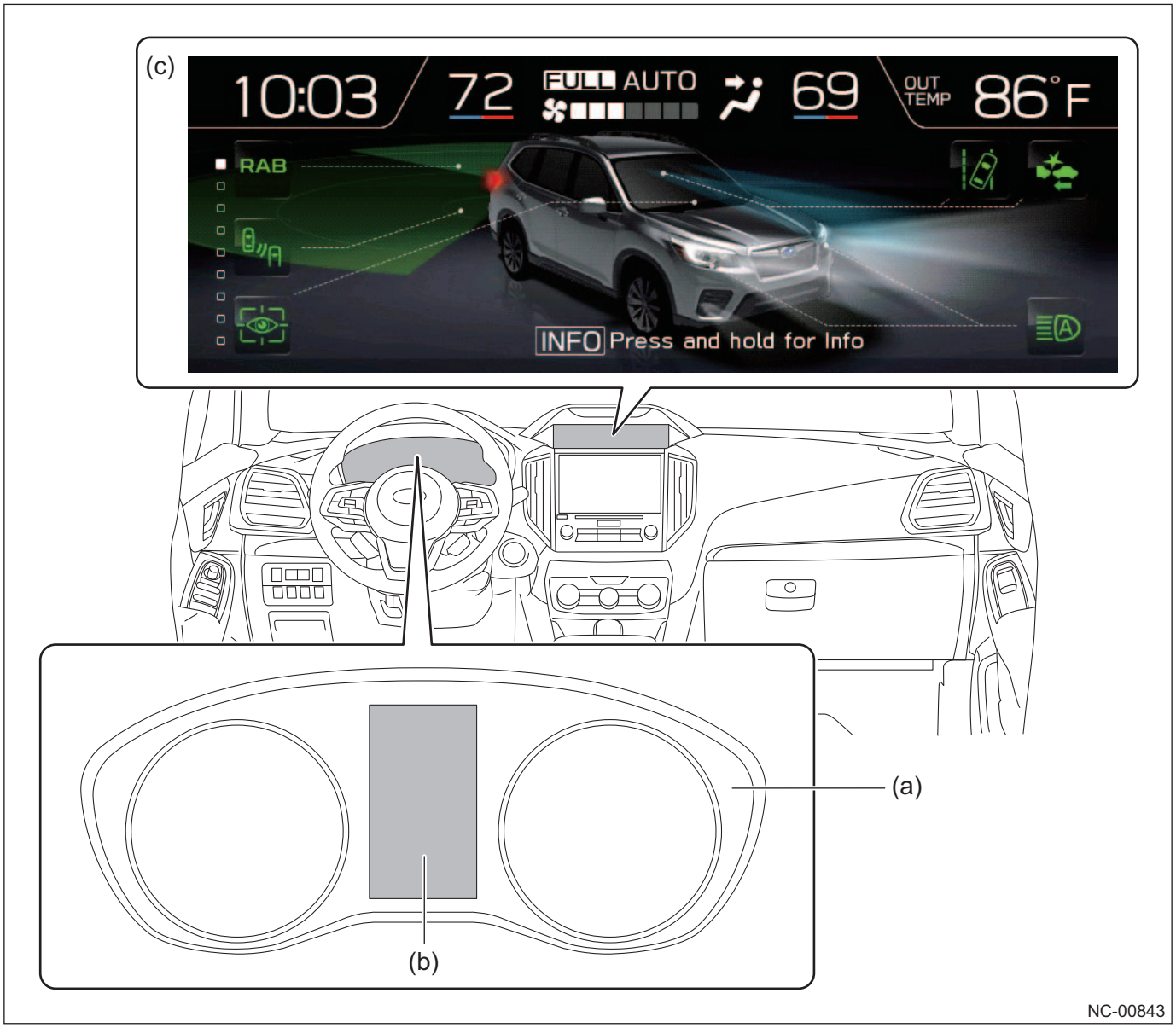
Multi-function display (MFD)

11.4.2 Specifications

	Standard	Upper grade			
		Type A	Type B	Type C	Type D
Meter ring	Silver (paint)	Spin-dyeing black	Silver (paint)	Silver (plating)	Spin-dyeing black
Illumination	Red (night illumination)	White (constant illumination)			
Indicator needle color	Red	White (overall length illumination)		White (overall length illumination) + plating	White (overall length illumination) + red orange plating
Dial face	Black (normal)	Black (texture printing)		Black (texture printing) + high-gloss black printing	Black (texture printing) + high-gloss black printing + red orange band printing
Multi-information display	Segment type	Color TFT			

11.4.3 Component

Component layout drawing



(a) Combination meter
(b) Multi-information display
(c) Multi-function display

Component details

Combination meter (for North America)

Five types of combination meters equipped with either standard specification or upper specification are set depending on the vehicle grades.

The following items are adopted around the meter for upper specification, enhancing the merchantability.

- Color TFT LCD is adopted in the center of the combination meter to seek practicality.
- The texture is integrated with the instrument panel leather.
- The texture is enhanced by increasing the brightness of the meter dial face.
- Merchantability is enhanced by adopting the texture printing on the meter dial face.

Combination meter (standard specification)

NC-00841

Combination meter upper specification (Type A)

NC-01607

Combination meter upper specification (Type B)

NC-00846

Combination meter upper specification (Type C)

NC-00847

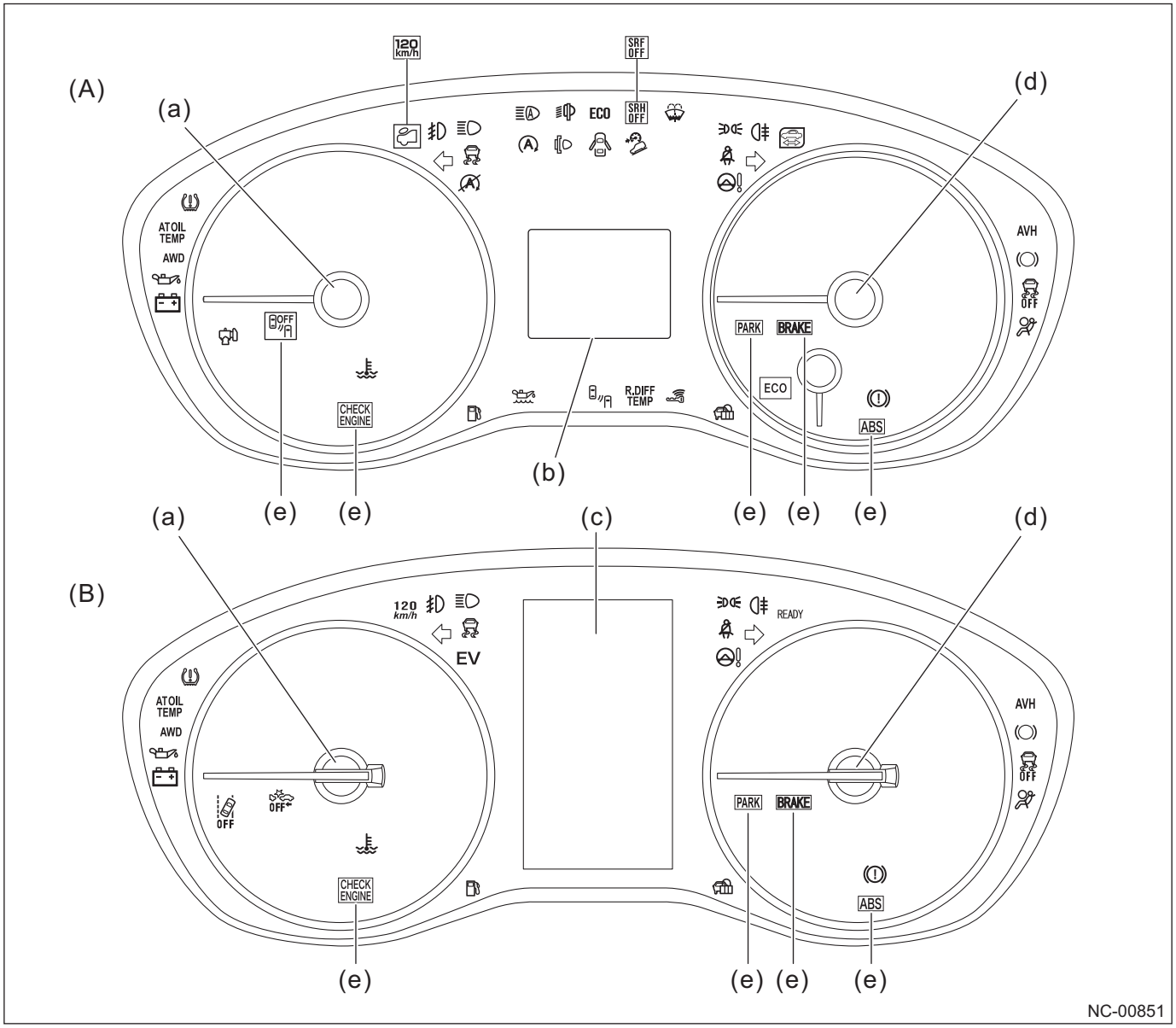
Combination meter upper specification (Type D)

NC-00848

Telltale (for some destinations/grades)

Two types of standard specification and upper specification are adopted.

Layout



(A) Standard specification
(B) Upper specification

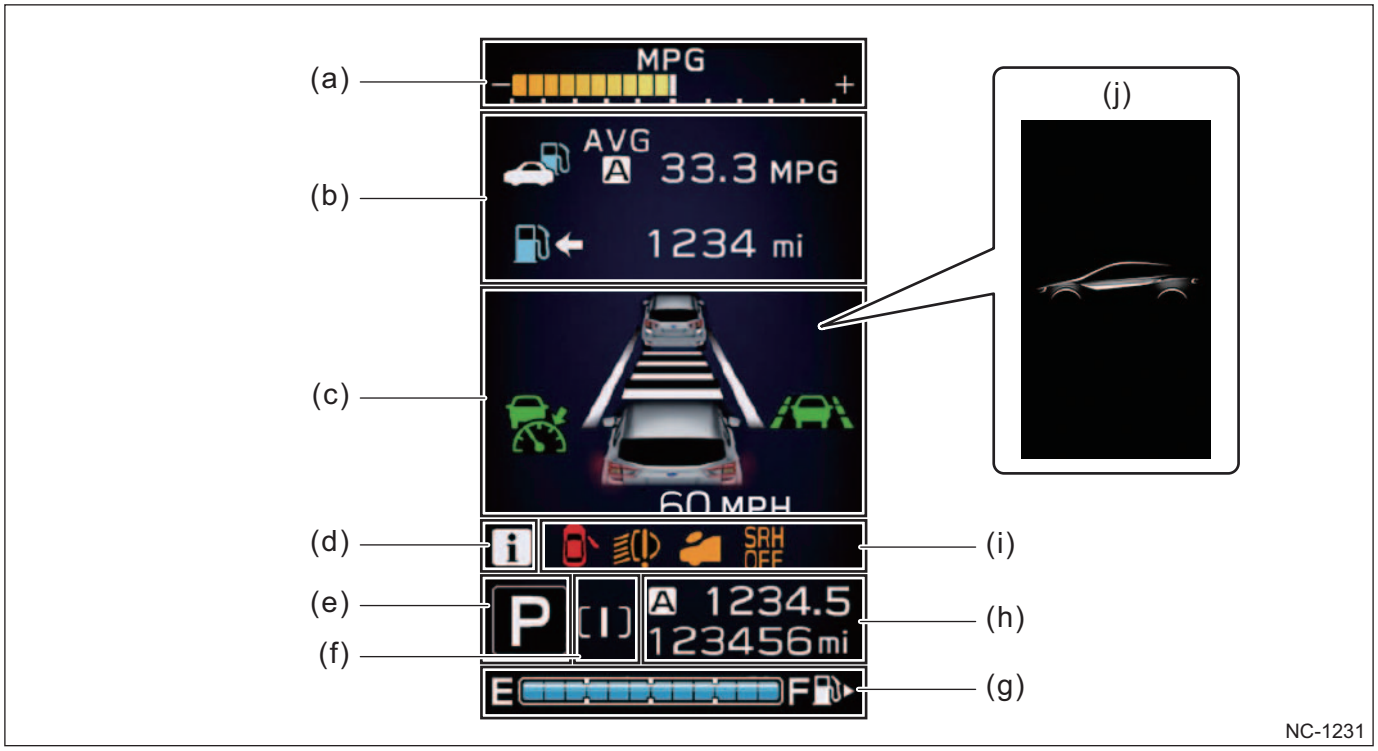
(a) Tachometer
(b) Standard specification LCD type
(c) Upper specification TFT LCD type (MID)
(d) Speedometer
(e) Warning lights

*Existence of telltale and its design varies depending on the destination, grade, equipment, etc.

Multi-information display (MID)

■ Upper specification display (for some grades)

A multi-information display will display the driving conditions and warnings while using the EyeSight, together with various types of information regarding the driving in a 4.2-inch screen. Also, hospitality is expressed by displaying "Welcome" along with the (c) screen when the driver enters the vehicle (opening and closing of the driver's seat door with IGN-OFF).

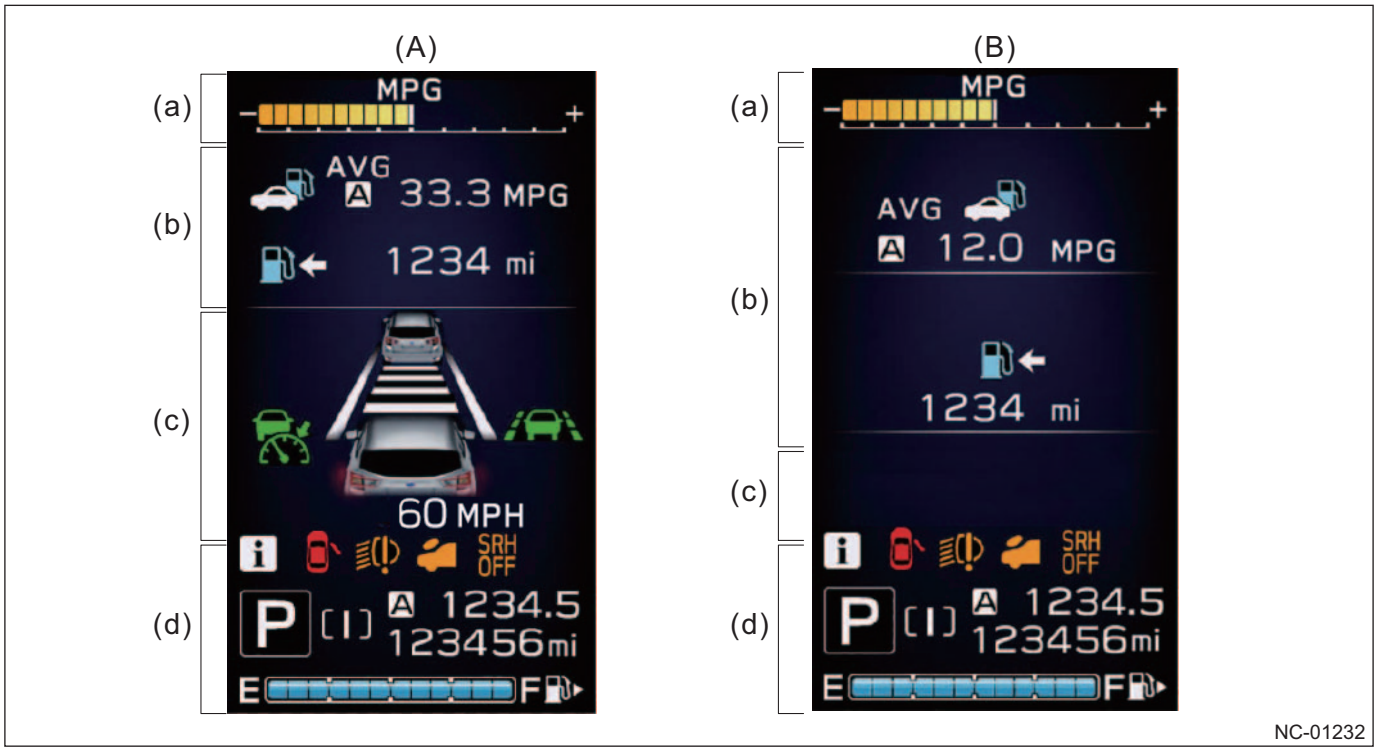


(a) ECO gauge
(b) Basic screen
(c) Cruise control screen/EyeSight screen
(d) Information mark
(e) Shift indicator
(f) SI-DRIVE display/X-MODE display
(g) Fuel gauge
(h) Trip meter/odometer
(i) Fixed warning display
(j) "Welcome" screen

* The screen is when EyeSight is operating.

Screen details

The contents displayed in the display vary for the vehicle with or without the EyeSight.



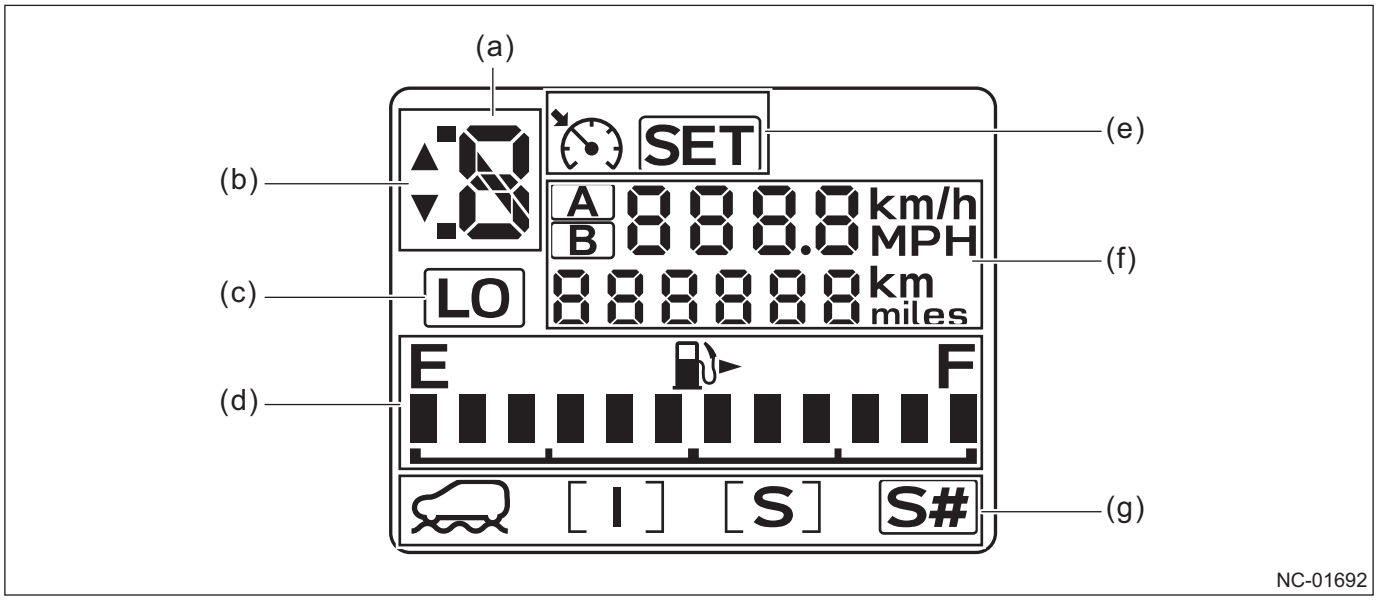
(A) When EyeSight main is ON

(B) When EyeSight main is OFF, or vehicle without EyeSight

	Display area	Display contents
(a)	ECO gauge	Momentary fuel efficiency display
(b)	Basic screen	Normal screen, interruption screen
(c)	EyeSight/cruise control	EyeSight screen, interruption screen
(d)	Fixed display	Information mark, fixed warning display shift indicator, SI-DRIVE display, X-MODE display, trip meter/odometer display, fuel gauge

■ Standard specification display (for some grades)

The display for the standard specification is mainly as follows.

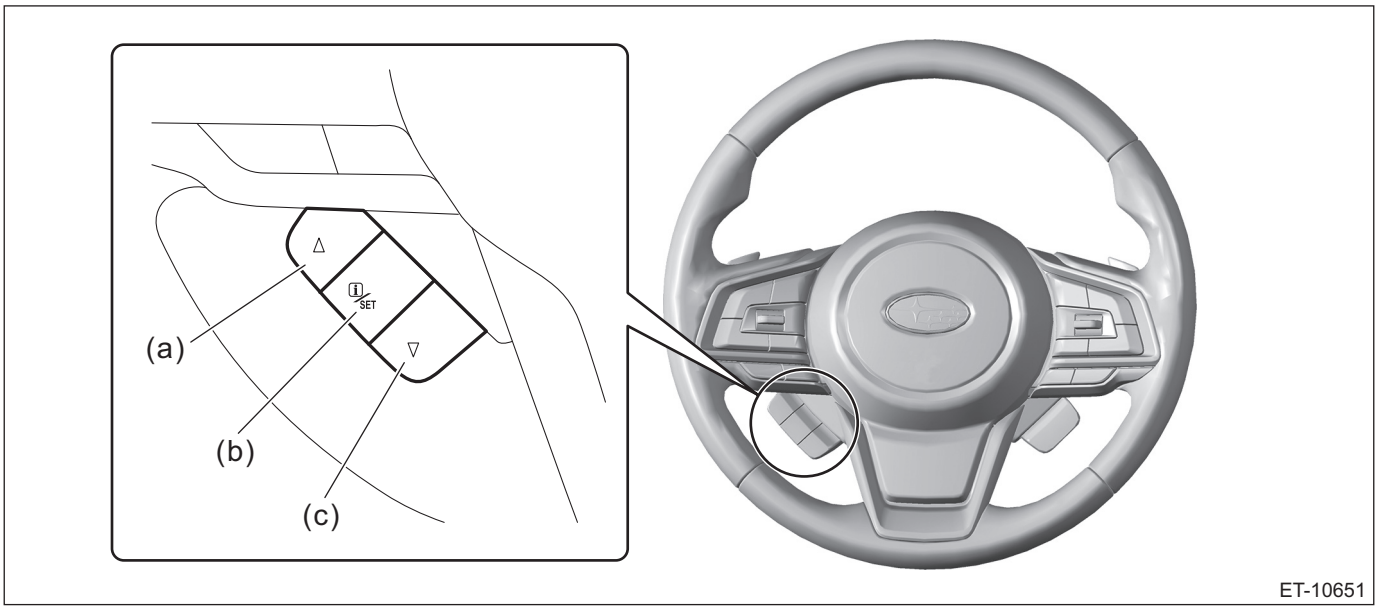


(a) Transmission gear display
(b) Shift up/down enable display (▲/▼)*
(c) Lo mode display
(d) Fuel gauge
(e) Cruise control related display
(f) Trip meter/odometer display
(g) SI-DRIVE display/X-MODE display

*Display may not be available depending on the transmission or destination.

MID operation switch

By placing a multi-information toggle switch on the steering wheel, it can be safely operated even while driving.



(a) △ (previous) switch
(b) i/SET switch
(c) ▽ (next) switch

Multi-function display (MFD) upper specification (for some grades)

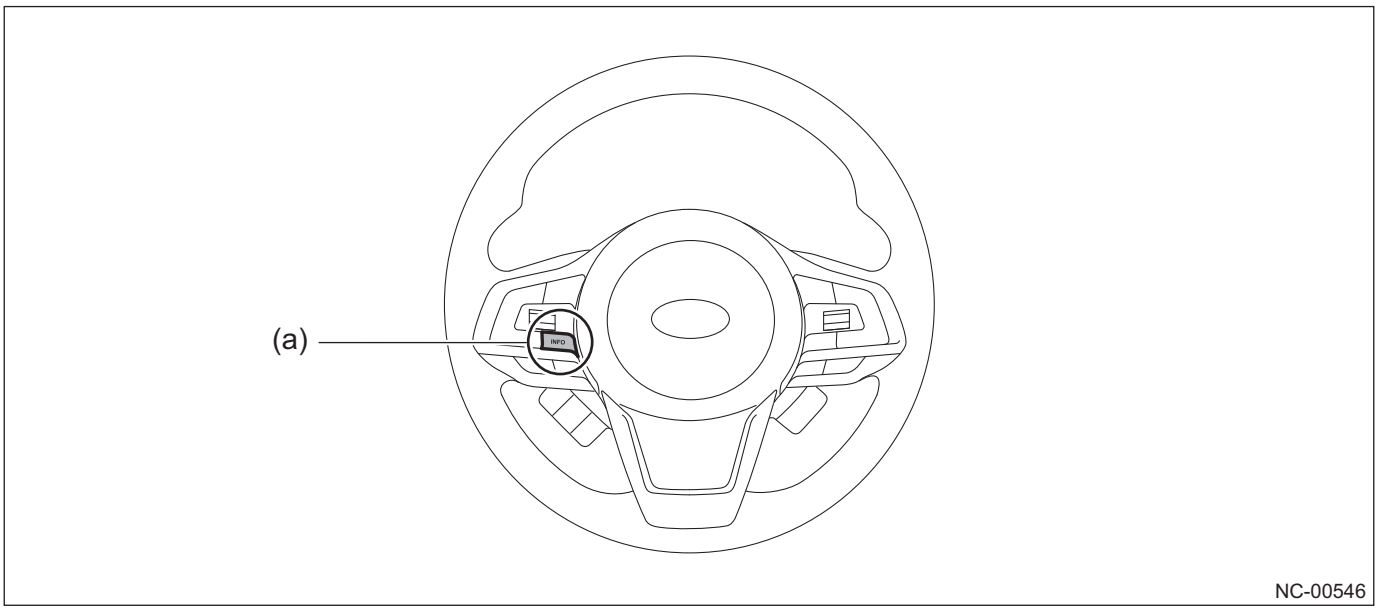
6.3-inch color liquid crystal display is adopted at the top center of the instrument panel. Also, the combination meter and the head unit are linked to provide information to the user when required without operation.

It is designed to make the riding for all occupants' fun with contents such as description and operating status of the cutting edge functions, and displaying easy to understand operation method.

NC-01233

MFD operation switch

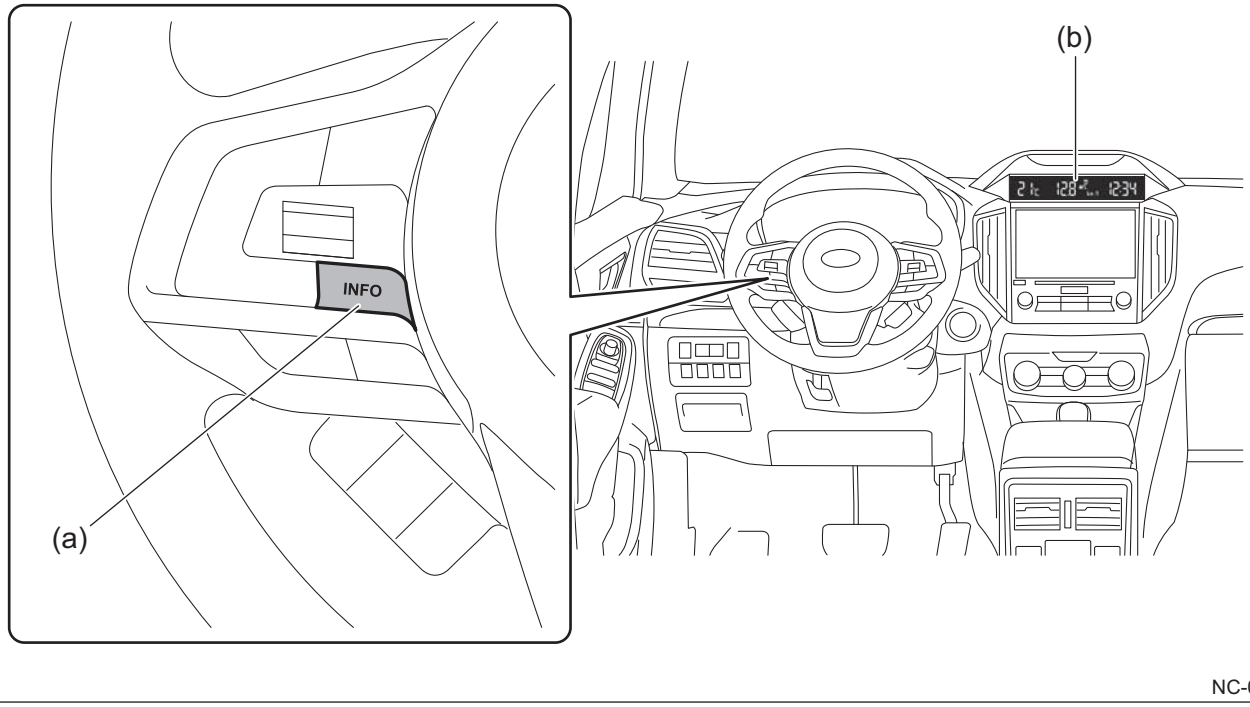
A simple operation switch (INFO) just to scroll the screen is installed on the steering wheel. The switch is placed on the steering wheel and can be safely operated even while driving.



(a) Operation switch (INFO)

Multi-function display (standard)

A segment type liquid crystal display displaying the contents is adopted at the top center of the instrument panel. Also, the basic screen area can be switched by operating the INFO switch on the steering wheel in consideration of convenience.

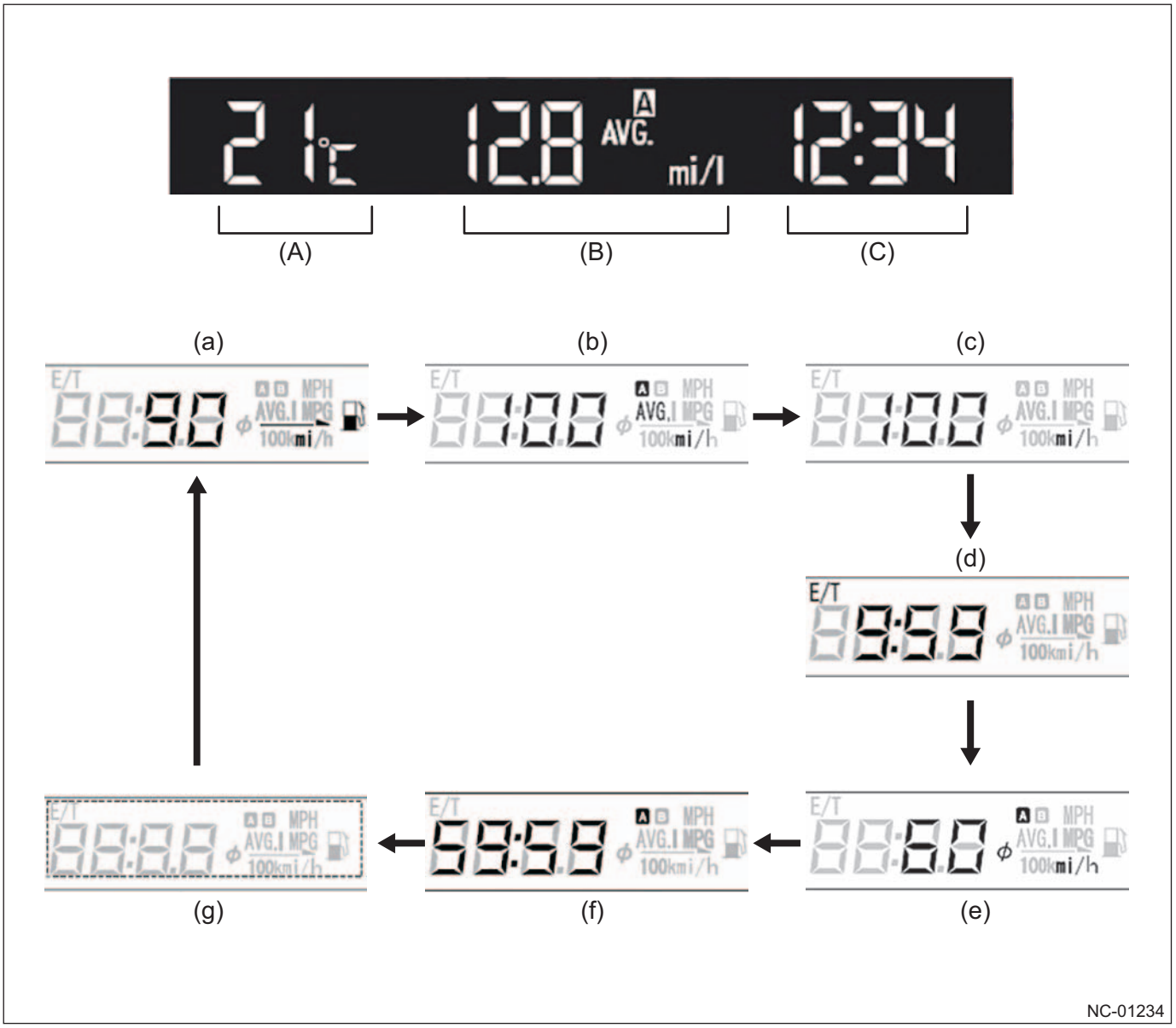


(a) Operation switch (INFO)

(b) Multi-function display

■ Screen contents

The basic screen area will display seven types of contents (including the blank display), and the ambient temperature and clock are displayed constantly. Also, the content will transit in order every time the INFO switch is pressed.



(A) Ambient temperature
(B) Basic screen area
(C) Clock

(a) Remaining fuel cruising distance
(b) Average fuel efficiency
(c) Momentary fuel efficiency
(d) Continuous driving time*1
(e) Average speed
(f) Stop time by Auto Start-Stop*1*2
(g) Blank

*1: Not displayed on the vehicle with upper specification meter.

*2: Setting may not be available depending on the grade and the destination.

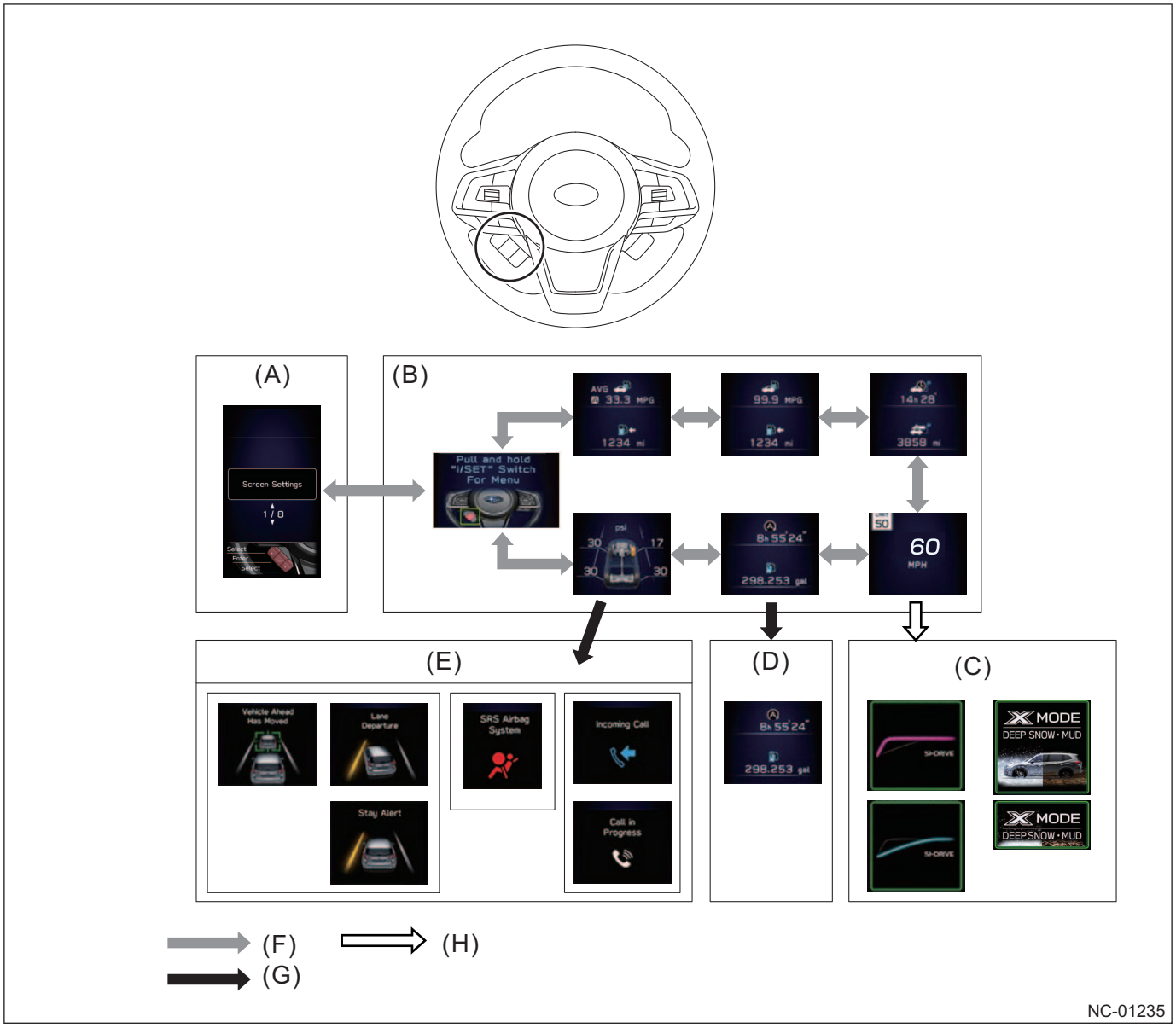
11.4.4 System Display Screen Details

Multi-information display (MID) upper specification screen structure

MID screen transition

The screen can be changed with the switch on the steering wheel.

Display on the screen transitions from the standard screen and customizing screen to interruption screen, SI-DRIVE, and Auto Start-Stop.



(A) Customizing screen
(B) Normal screen
(C) SI-DRIVE/X-MODE
(D) Auto Start-Stop
(E) Interruption screen
(F) Switch the screen with the switch operation
(G) Screen is automatically switched depending on the status of the vehicle
(H) X-MODE SW operation, SI-DRIVE SW operation

*Display may not be available depending on the grade and the destination.

MID contents

■ Basic screen

Switching is possible using the INFO switch on the steering wheel.

▮ Fuel consumption screen 1

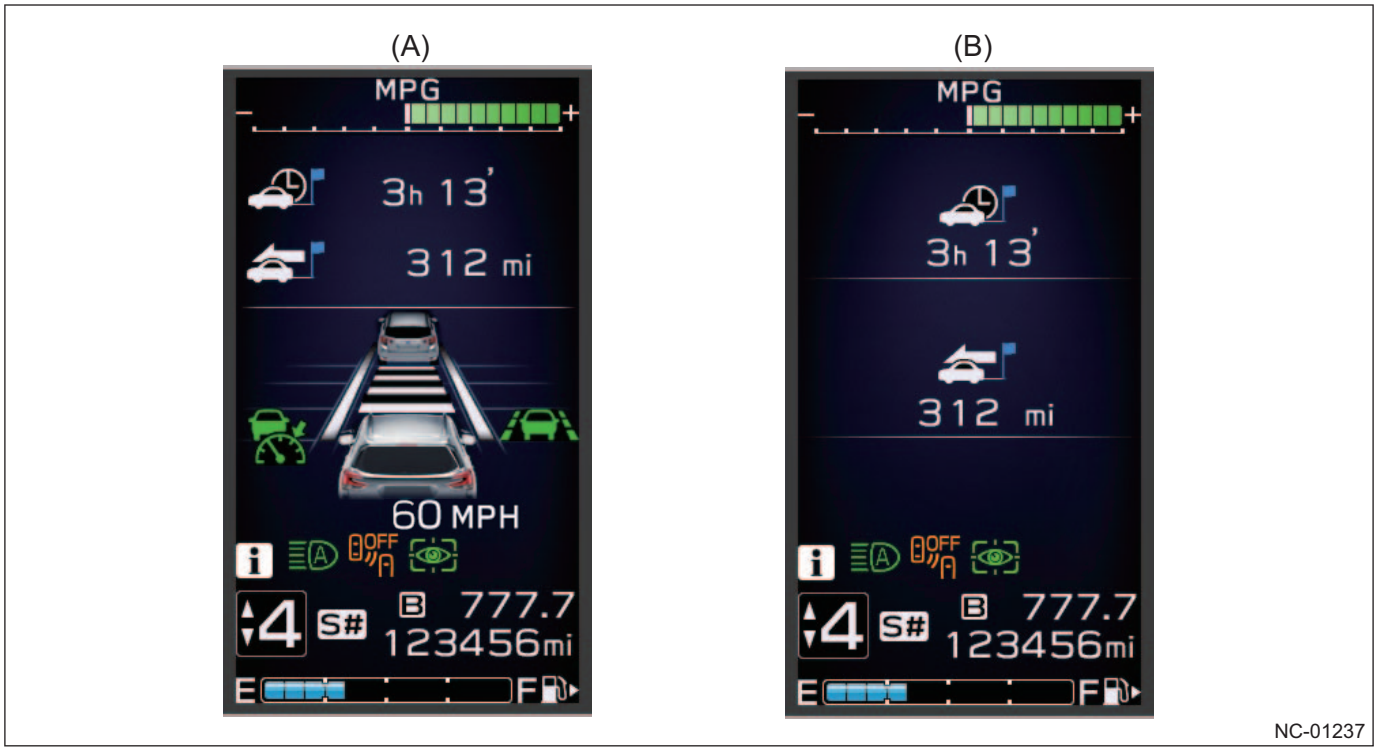
Fuel consumption screen 1 displays the average fuel consumption and remaining fuel cruising distance.

(A) When EyeSight is operating

(B) When EyeSight is not operating

Fuel consumption screen 2

Fuel consumption screen 2 displays the momentary fuel consumption and remaining fuel cruising distance.

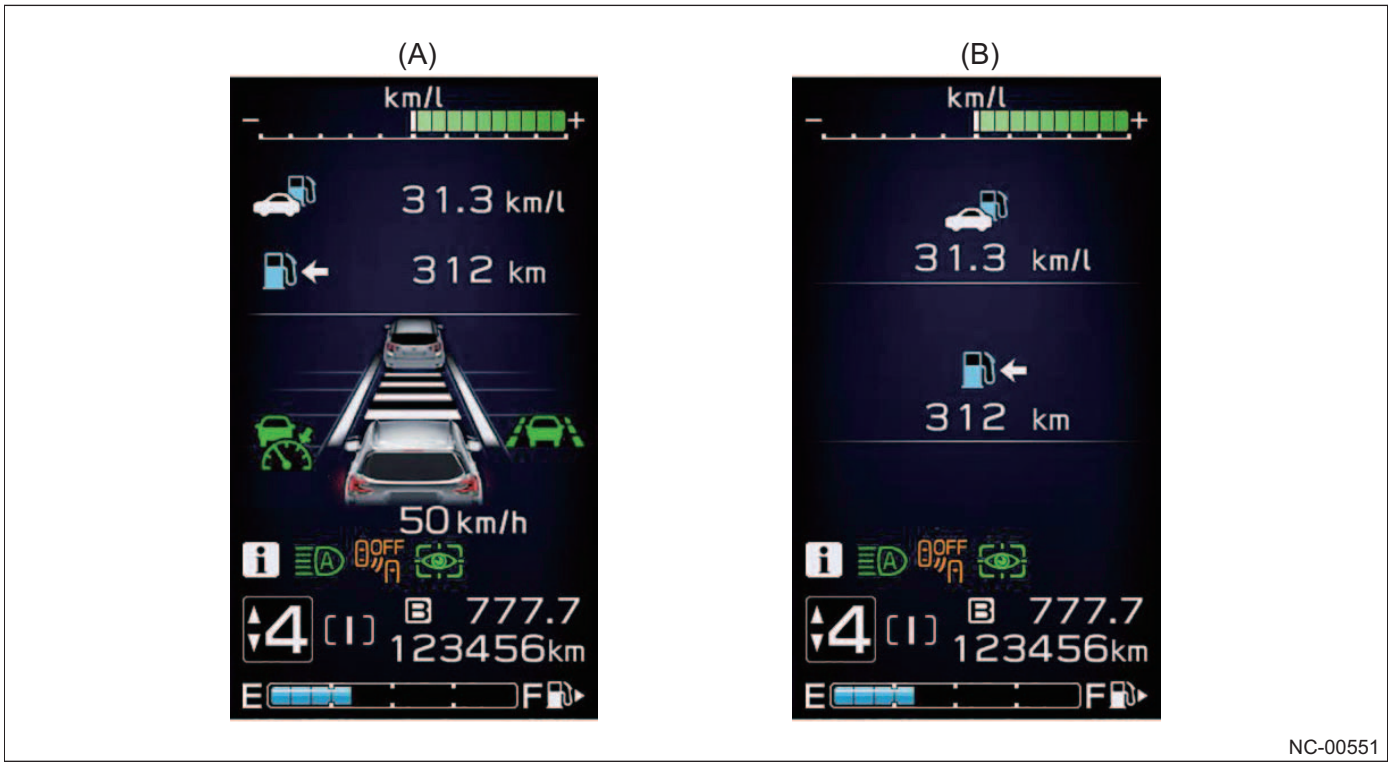


(A) When EyeSight is operating

(B) When EyeSight is not operating

Driving information screen

Driving information screen displays the continuous driving time and continuous driving distance.

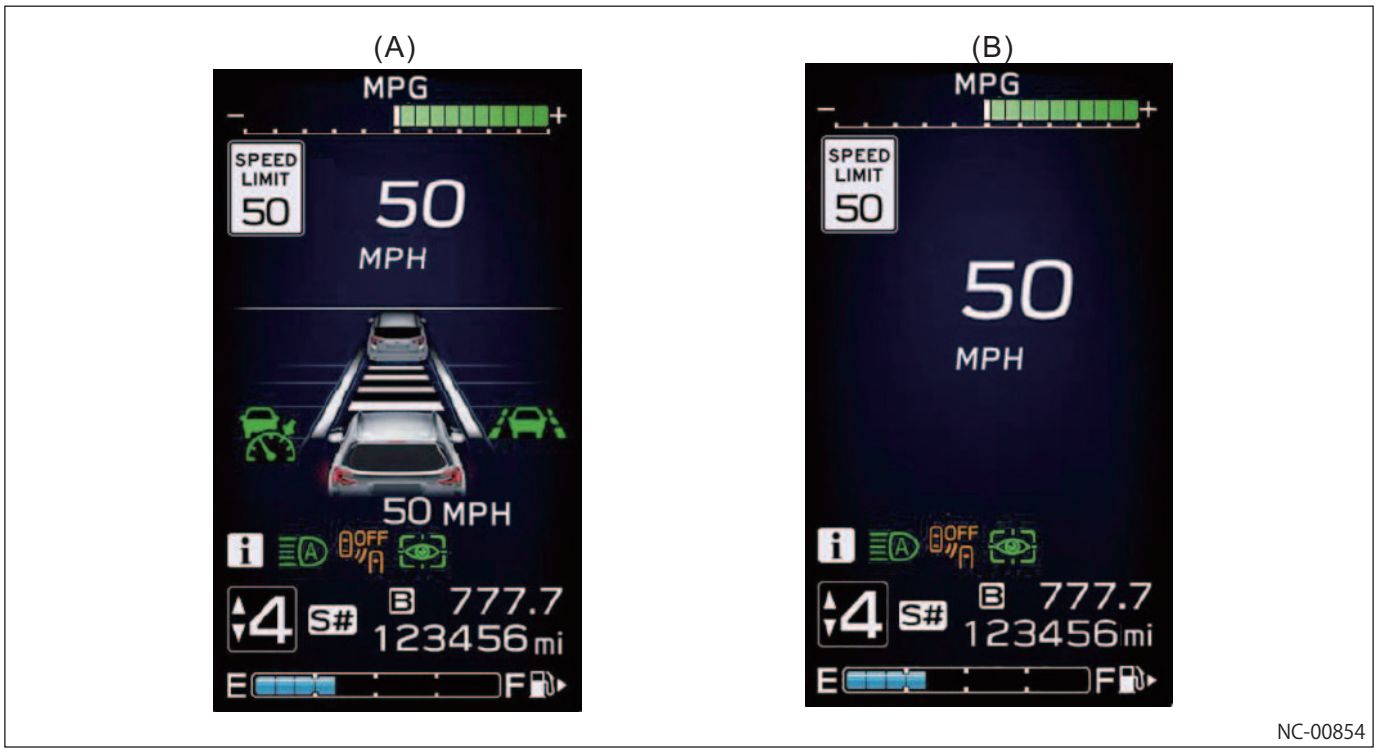


(A) When EyeSight is operating

(B) When EyeSight is not operating

Vehicle speed screen

The vehicle speed is digitally displayed on the meter and the display.



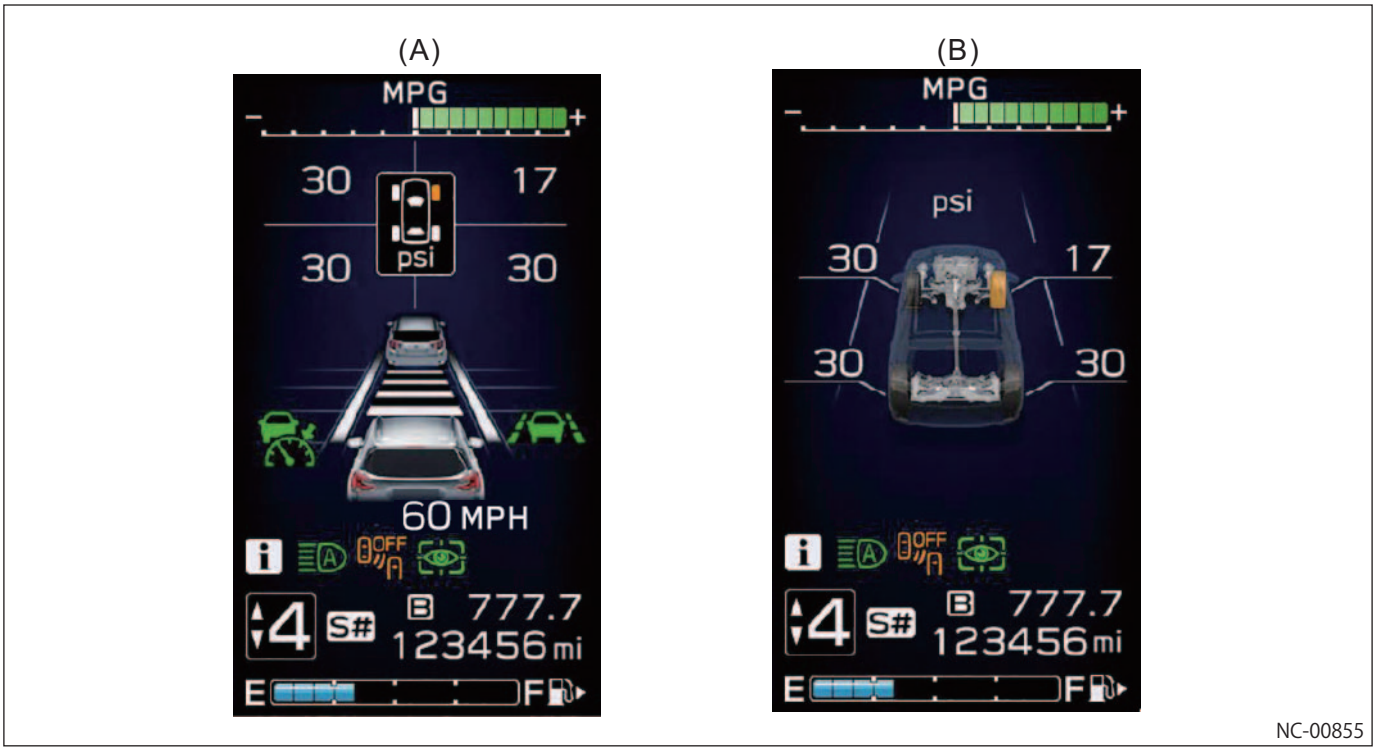
(A) When EyeSight is operating

(B) When EyeSight is not operating

* The speed limit is displayed only on the vehicle with the navigation system.

▮ TPMS screen*

The air pressures of the tires are monitored by the TPMS and their status is displayed on the screen.



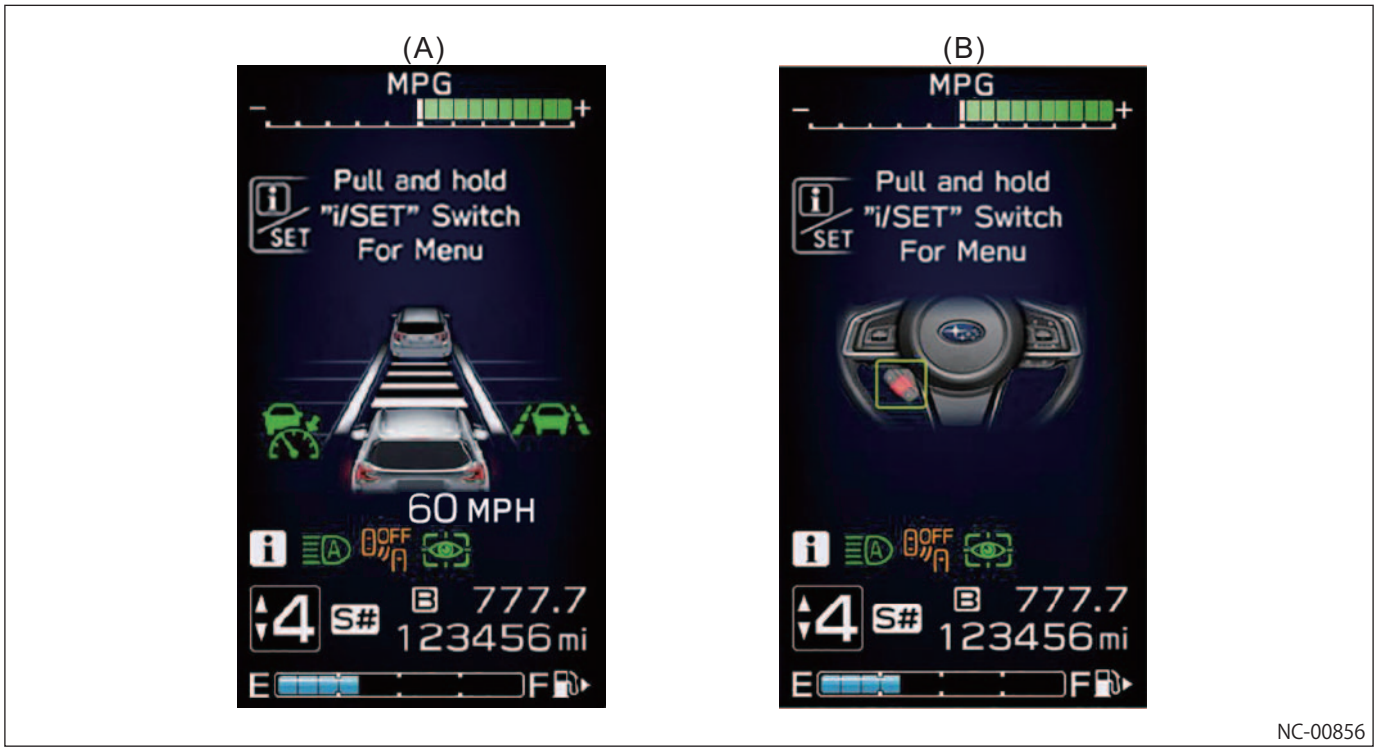
(A) When EyeSight is operating

(B) When EyeSight is not operating

* TPMS (Tire Pressure Monitoring System) is an option.

■ Customizing screen

The displayed contents can be customized to suit the user's taste by pressing and holding the switch.



(A) When EyeSight is operating

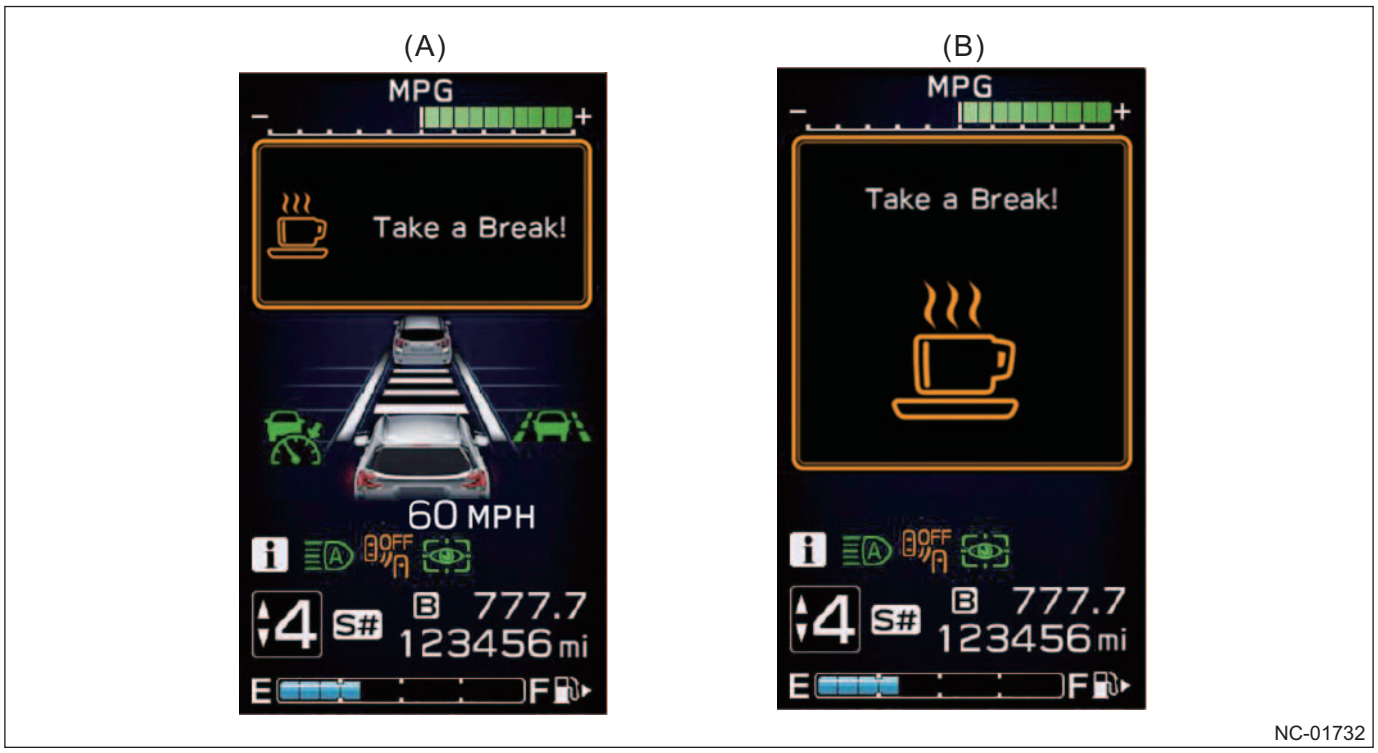
(B) When EyeSight is not operating

■ Interruption screen

▮ Warning screen 1

Displayed as an interruption screen in the basic screen contents depending on the vehicle status.

There are EyeSight related and multimedia screens in addition to warnings as an interruption screen.



(A) When EyeSight is operating

(B) When EyeSight is not operating

Warning screen 2

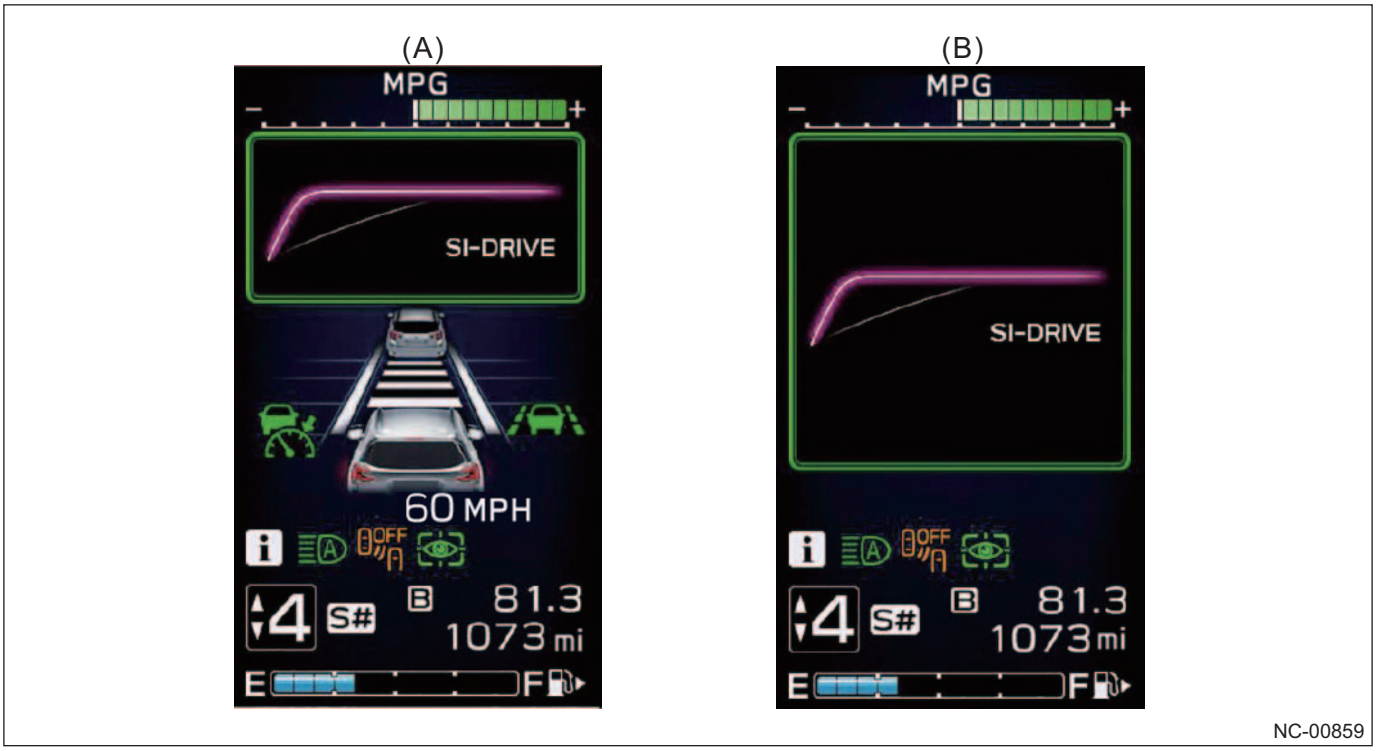
NC-00858

*When EyeSight is not operating

SI-DRIVE screen

Displays the status of the SI-DRIVE on the screen.

Acceleration characteristics are selected by the dedicated switch.

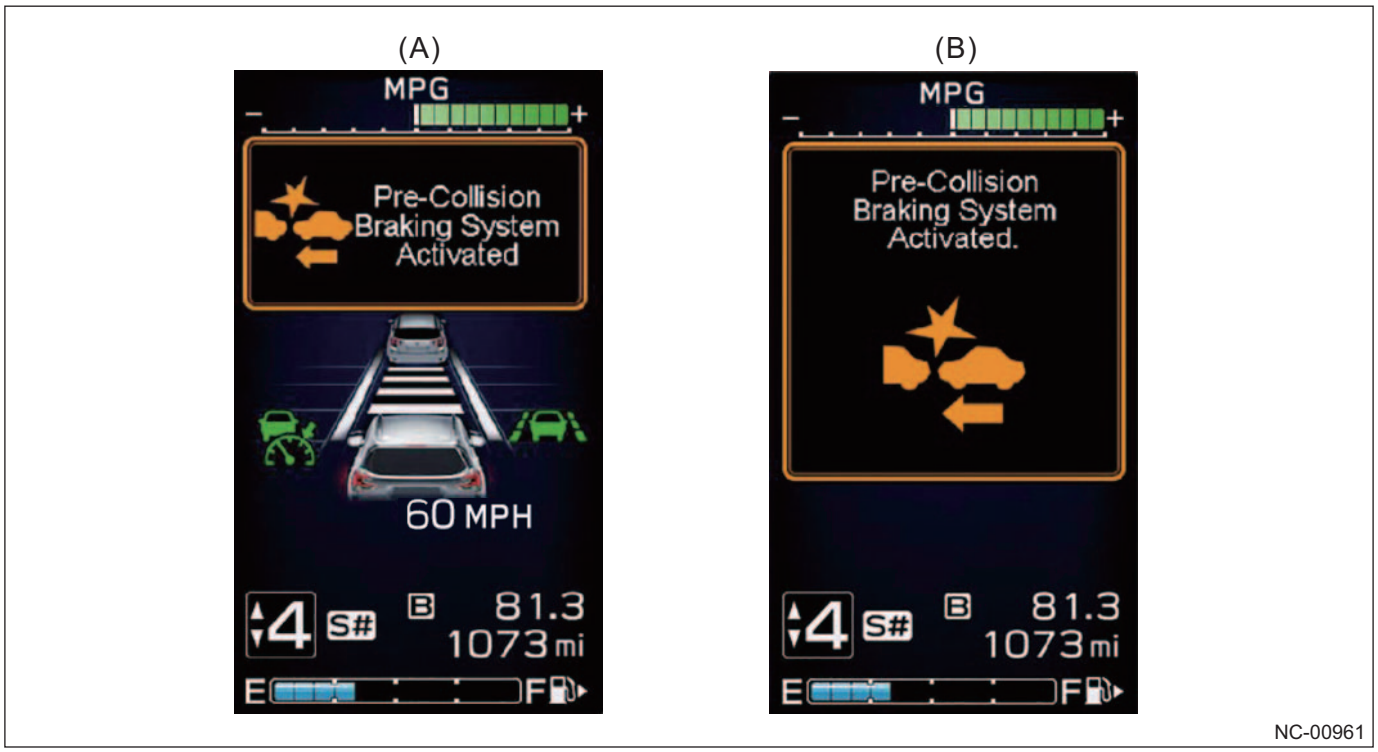


(A) When EyeSight is operating

(B) When EyeSight is not operating

Pre-collision brake screen

Displayed when the pre-collision brake operates as an interrupt screen.



(A) When EyeSight is operating

(B) When EyeSight is not operating

Other

In the MID contents, the following items are set as a specification in addition to the basic contents.

Addition of the vehicle customization function

Applicable range	Contents list
High grade meter	Keyless entry system/keyless access & push button start system • Answer back (buzzer, hazard lights) • Driver's seat door unlock • Rear gate unlock Rear defogger Interior light OFF time Vehicle automatic door lock/unlock • Vehicle automatic door lock • Vehicle automatic door unlock Automatic light sensitivity Welcome light Direction indicator one-touch function Reverse-interlocking tilt down door mirror function
All vehicles	A speaker is adopted for the meter acoustics and the operation sound of the direction indicator is made electronic.

Multi-function display (MFD) screen structure

MFD screen transition

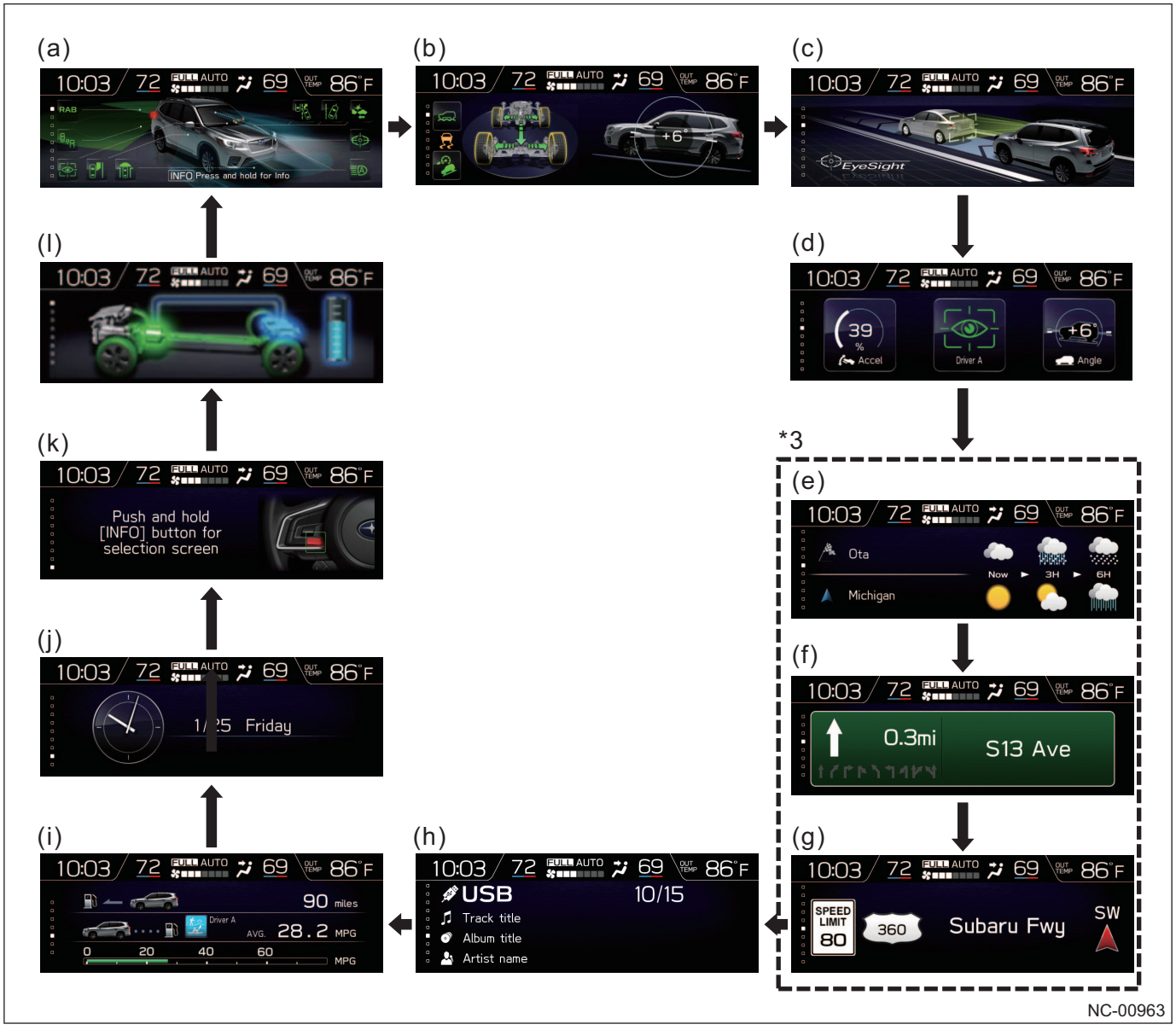
The display contents screen is structured with "constant display area" displaying the clock, air conditioner operating status, and ambient temperature, and "basic screen area" displaying various contents in larger size.

(a) Constant display area (clock, air conditioner operating status, ambient temperature)

(b) Basic screen area*

* The screen for contents to display is switched every time the operation switch is pressed.

Screen transition of the basic screen area



(a) Cutting edge features operating status (for some grades)
(b) Preventive safety (X-MODE 1 mode HDC/VDC operation condition)
(c) EyeSight*1
(d) Favorite*2
(e) Weather*4
(f) Turn By Turn*5
(g) Bearing*6
(h) Audio
(i) Fuel efficiency*2
(j) Clock/calendar
(k) Transfer to setting

*1: Only for vehicle with EyeSight

*2: Screen of vehicle with driver monitoring system (The screen of vehicle without driver monitoring system differs.)

*3: Only for vehicle with navigation system

*4: Only when the navigation system with XM is installed and subscribed to XM

*5: When the destination is set

*6: When the destination is not set

MFD contents

Basic screen

■ Cutting edge features screen

These are the contents to display the screen visualizing all the SUBARU cutting edge safety features. The driver can explain the cutting edge functions equipped in the vehicle visually to the passenger.

Turning on/off and operating status of the functions whose operations cannot be seen, such as the Reverse Automatic Braking (RAB), automatic light, Subaru Rear Vehicle Detection system (BSD/RCTA) etc., can be visually confirmed (functions not equipped are not displayed). Also, the illumination status of the small light, fog light, high beam, brake light, etc., can be confirmed from inside the vehicle.

By pressing and holding the INFO switch and then selecting the advanced feature to confirm on the advanced feature selection screen, the operation/function and the operating status can be displayed.

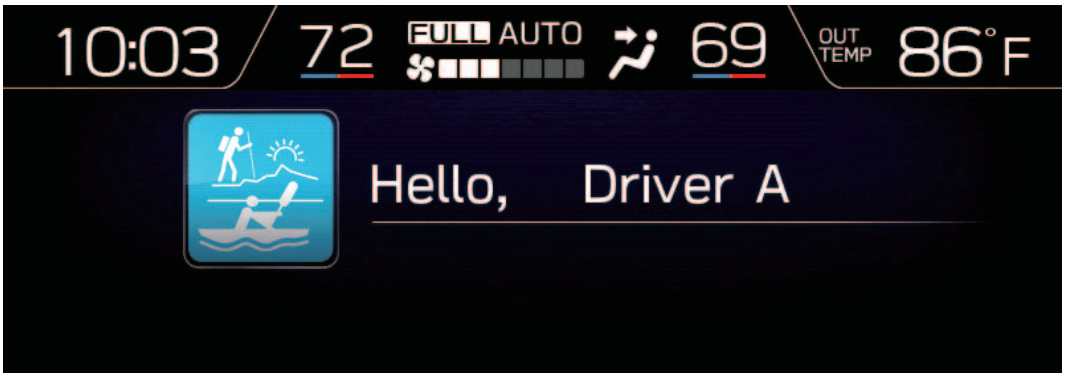
(a) Reverse Automatic Braking (RAB)
(b) Subaru rear vehicle detection system (BSD/RCTA)
(c) Driver monitoring system
(d) High beam assist (HBA)
(e) Pre-collision brake
(f) Lane departure warning
(g) Screen when the INFO switch is pressed and held (selection screen)
(h) Screen when the i/set switch is pressed (description screen)

Driver monitoring system display

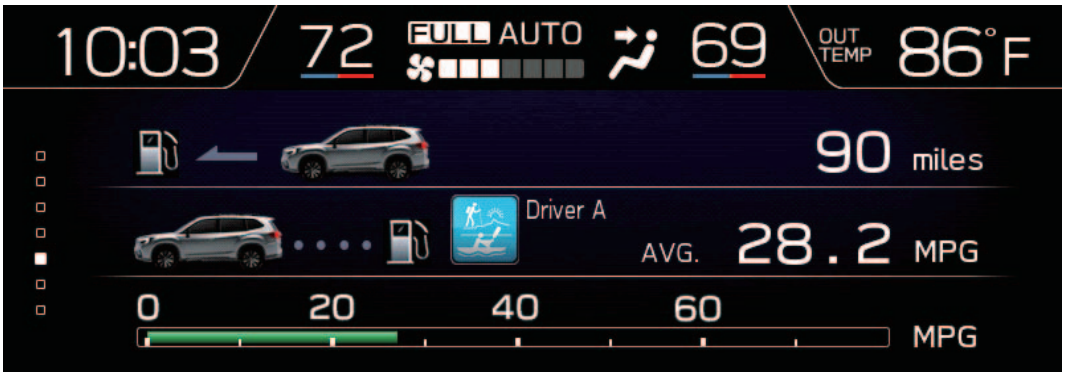
This content performs the personal recognition by interlocking with the door opening/closing, recognizes the driver's seating, and displays the recognition result.

The recognition result of the driver can be graphically confirmed by adding the personalize display/setting through the driver monitoring system. It also supports the individual fuel efficiency display which displays the fuel efficiency for each of the recognized driver.

(A)



(B)



NC-00966

(A) Recognition result display screen

(B) Individual fuel efficiency display screen

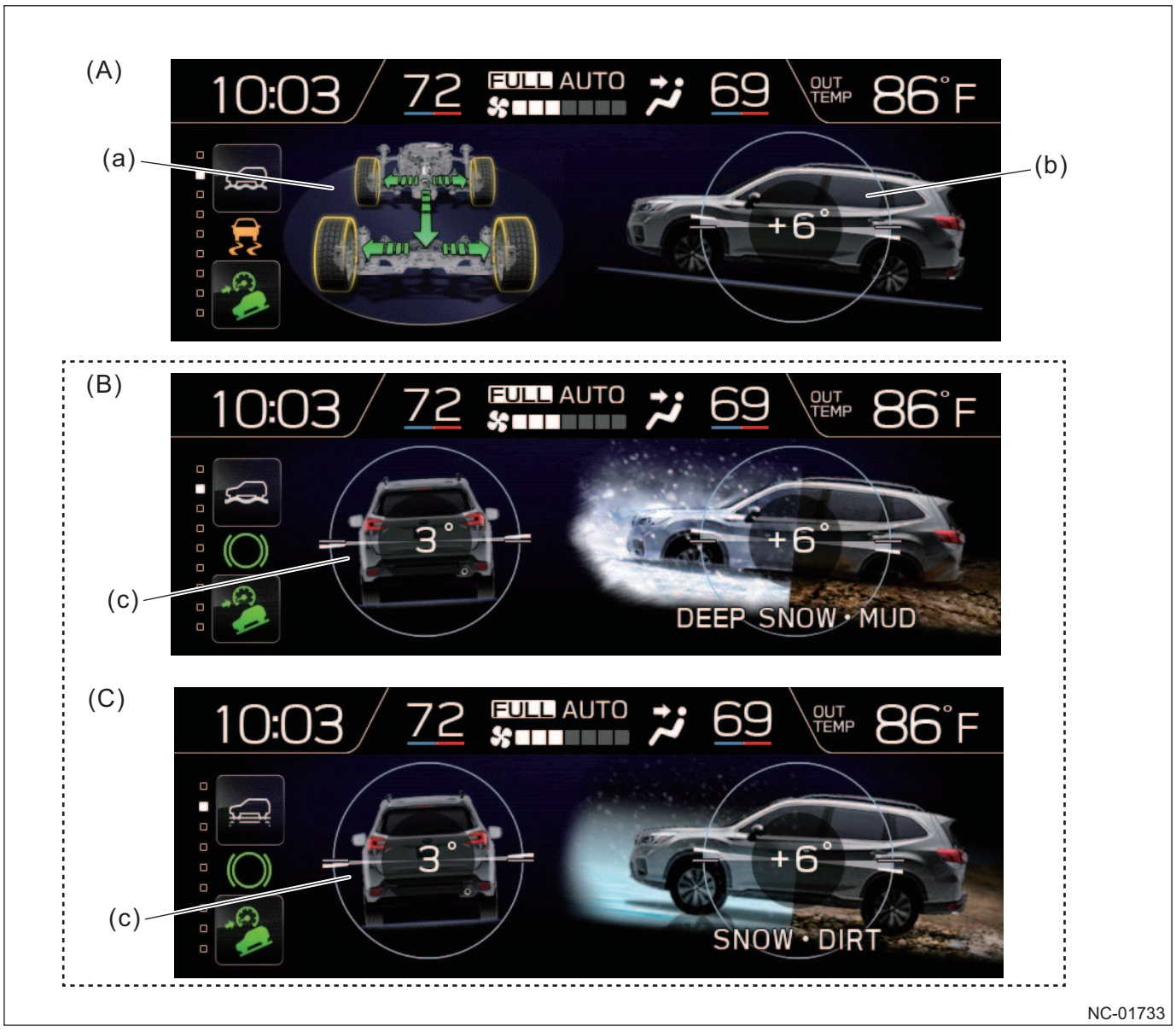
■ Preventive safety screen

This screen displays contents on the safety thoughts and superiority of SUBARU.

The feeling of security from safety features of the vehicle operating is visualized by representing initial operating status of the Vehicle Dynamics Control (VDC) with changing the color of the tires. Also, when VDC is operating, flashing icons, as well as changing the color of the tires that are being controlled on the state of the oversteer, understeer, and traction control, it shows that the VDC is controlling the vehicle in a safe state.

The reason of slowing down can be understood when driving an uphill freeway by viewing the vehicle orientation display and avoid vehicle to slow down.

Rough road performance is displayed on the screen to visually show the vehicle attitude through the roll angle display when "SNOW/DIRT" or "D.SNOW/MUD" is selected in the X-MODE.



(A) Preventive safety screen 1*1
(B) Preventive safety screen 2*2 (D.SNOW/MUD) selection
(C) Preventive safety screen 2*2 (SNOW/DIRT) selection

(a) Vehicle driving status display
(b) Vehicle inclination angle
(c) Roll angle display

*1: Screen is for vehicle with X-MODE 1 mode (HDC/VDC operating)

*2: Screen is for vehicle with X-MODE 2 mode (HDC/AVH operating)

■ EyeSight screen (vehicle with EyeSight)

A content that displays a screen visualizing the function and operation of the EyeSight for all occupants.

The control of the adaptive cruise control which changes depending on the distance from the preceding vehicle can be confirmed visually.

The status of the steering support can be confirmed visually.

NC-00968

* EyeSight screen when brake ON

■ Favorite screen

This is a content that displays three favorite contents of your choice on the screen. The driver monitoring system content is also added to enable confirming the individual recognition status and the registered name.

(A)

(B)

NC-00969

(A) Vehicle with the driver monitoring system

(B) Vehicle without the driver monitoring system

The content can be selected from the ten types.

Water temperature	 NC-00970	Oil temperature	 NC-00570
Average speed	 NC-01608	Acceleration opening angle	 NC-00751
Gradient	 NC-00752	Momentary fuel efficiency	 NC-01609
Bearing[*1]	 NC-00754	Weather[*2]	 NC-00971

Speed limit*1	 NC-00755	Calendar	 NC-00972
Driver monitoring system*3	 NC-00973	OFF (no screen display)	 NC-00758

*1: Only for vehicle with navigation system

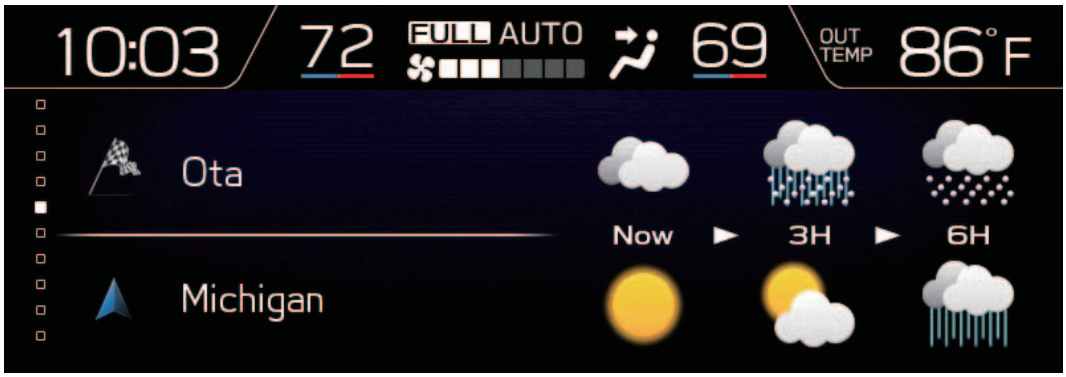
*2: Only when the navigation system with XM is installed and subscribed to XM

*3: Only for vehicle with the driver monitoring system

■ Weather screen (vehicle with navigation system)

This content displays the weather of the current location and of the destination set on the navigation system.

When the destination is set on the navigation system, the weather information of the destination is automatically displayed on the pop-up display. Thus, the drive plan can be reviewed before departure when the weather of the destination is bad. However, this is only displayed for vehicles with XM function and XM subscription.



NC-00974

■ Turn by turn screen (for vehicles with navigation system)

This content displays the route (shows which way to go at intersections, etc., with audio and arrow icon) when the destination is set in the navigation system.

The turning point (intersections) and the lane to drive in can be confirmed to make the driving more comfortable. Also, the turn by turn display is automatically displayed as a popup when getting close to an intersection.

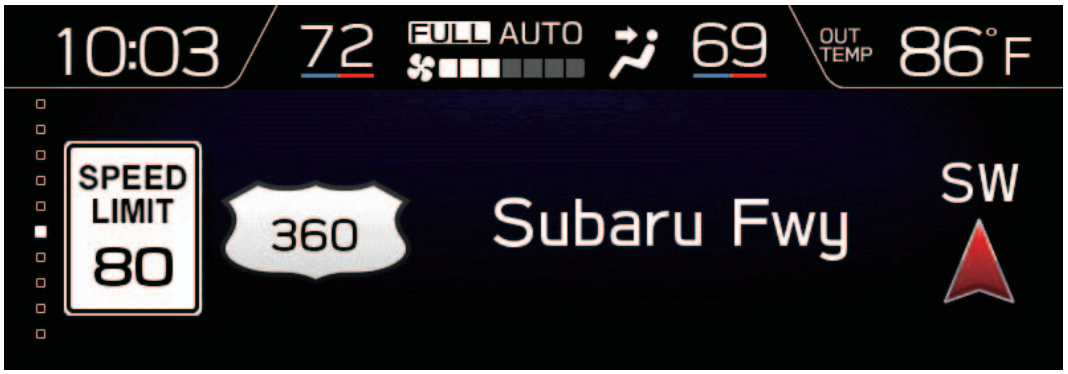
Unlike other vehicles, guidance to the destination can be confirmed in the screen and there is no need to switch the head unit to the map display while driving, making it possible to enjoy entertainment contents such as favorite music or APPS on the large screen of the head unit.

NC-00975

■ Orientation screen (for vehicles with navigation system)

The content displays the orientation which the vehicle is facing.

This is displayed when a destination is not set in the navigation system.

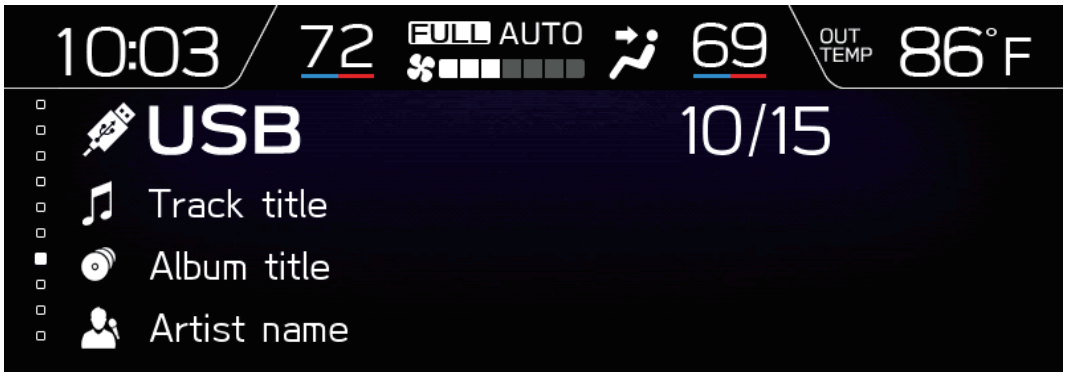


NC-00976

■ Audio screen

This content displays the information of the audio currently listening.

Large amount of text information can be displayed since the LCD screen is horizontally long, making it possible to select music (or station) by operating the steering switch while looking at the display. Also, operation to switch the display of the head unit from the map to audio is not required.



NC-00977

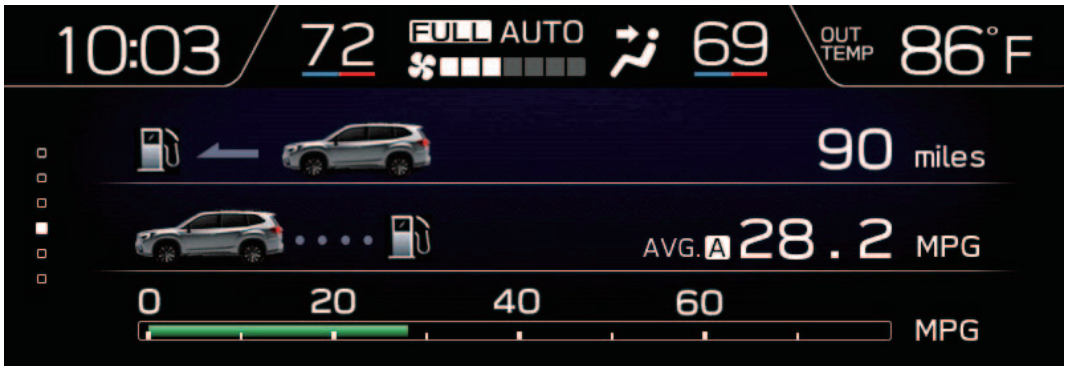
■ Fuel efficiency screen

This content displays the momentary fuel efficiency, average fuel efficiency, and remaining fuel cruising distance.

This supports the eco driving of the driver.

(A)

(B)



NC-01734

(A) Vehicle with the driver monitoring system

(B) Vehicle without the driver monitoring system

■ Clock/calendar screen

A chic and poised design is adopted.

This design was adopted in consideration of users that prefer simple display. The time is automatically corrected by linking to the GPS or a smartphone.

NC-00979

■ Setting transition screen

This content explains about the transition to the setting screen.

The position of the operating switch (INFO button) can be confirmed graphically. Also, users can personalize to their liking in the setting screen.

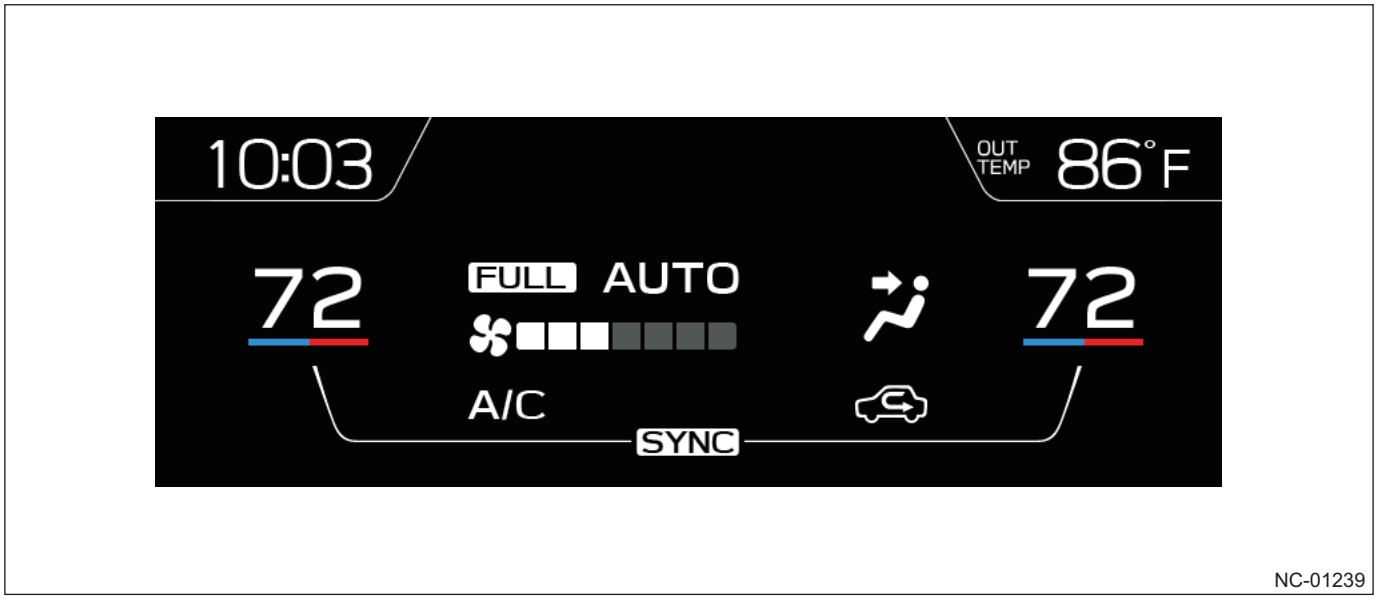
(A) Setting transfer screen

(B) (Example) Time/date setting screen

Interruption screen

■ Air conditioner status screen

The air conditioner display pops up when the air conditioner is operated, and the operation status can be confirmed in the large screen.



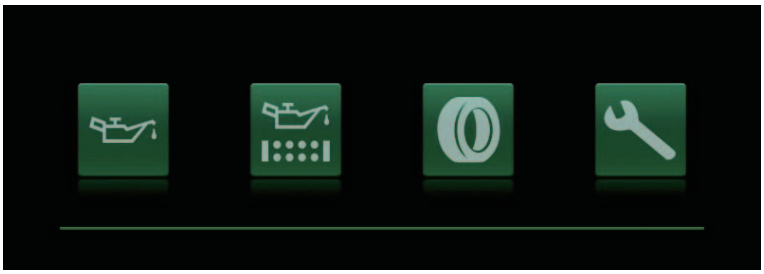
* Interrupt screen is shown using the air conditioner display screen as an example.

■ Other screen (maintenance check screen)

The self check screen is displayed when the ignition is ON*, and displays the maintenance screen of an item exceeding the determination criteria.

The maintenance screen (only self check ON, etc.) is displayed as an interruption screen when the remaining distance goes under 311 miles, or within 15 days from the maintenance period (date and distance) that the user has set.

*: The default is OFF and only displayed if set to ON in the MFD customize setting.

Self check screen	 ET-10689
Maintenance screen (engine oil)	 ET-10690
Maintenance screen (oil filter)	 ET-10691
Maintenance screen (tire)	 ET-10692

Maintenance screen (periodic inspection)	 ET-10693

Startup/end screen

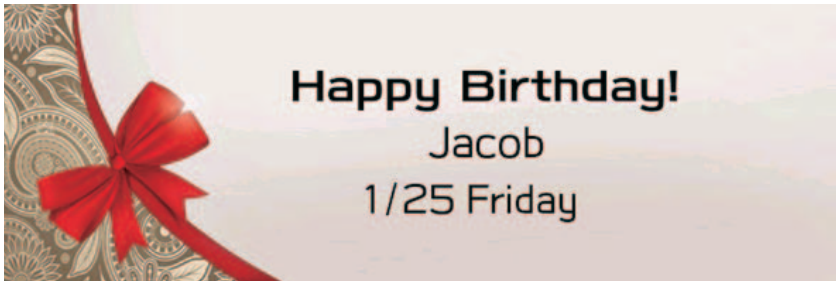
■ Date/birthday/anniversary display screen

This displays the screen indicating dates and events when entering the vehicle.

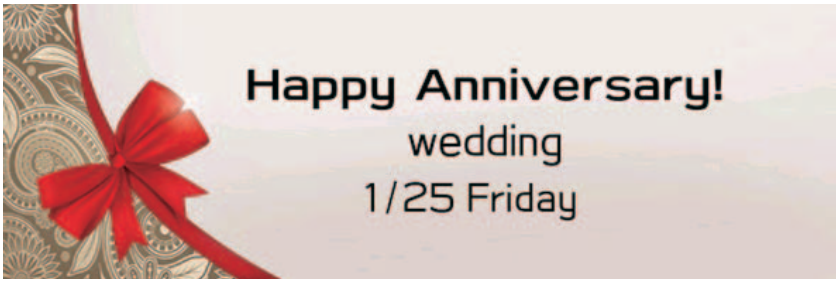
Special screens to celebrate are set for birthdays and anniversaries.

(A)

(B)



(C)



NC-01610

(A) Date display
(B) Birthday notification screen
(C) Anniversary notification screen

11.5 Antenna

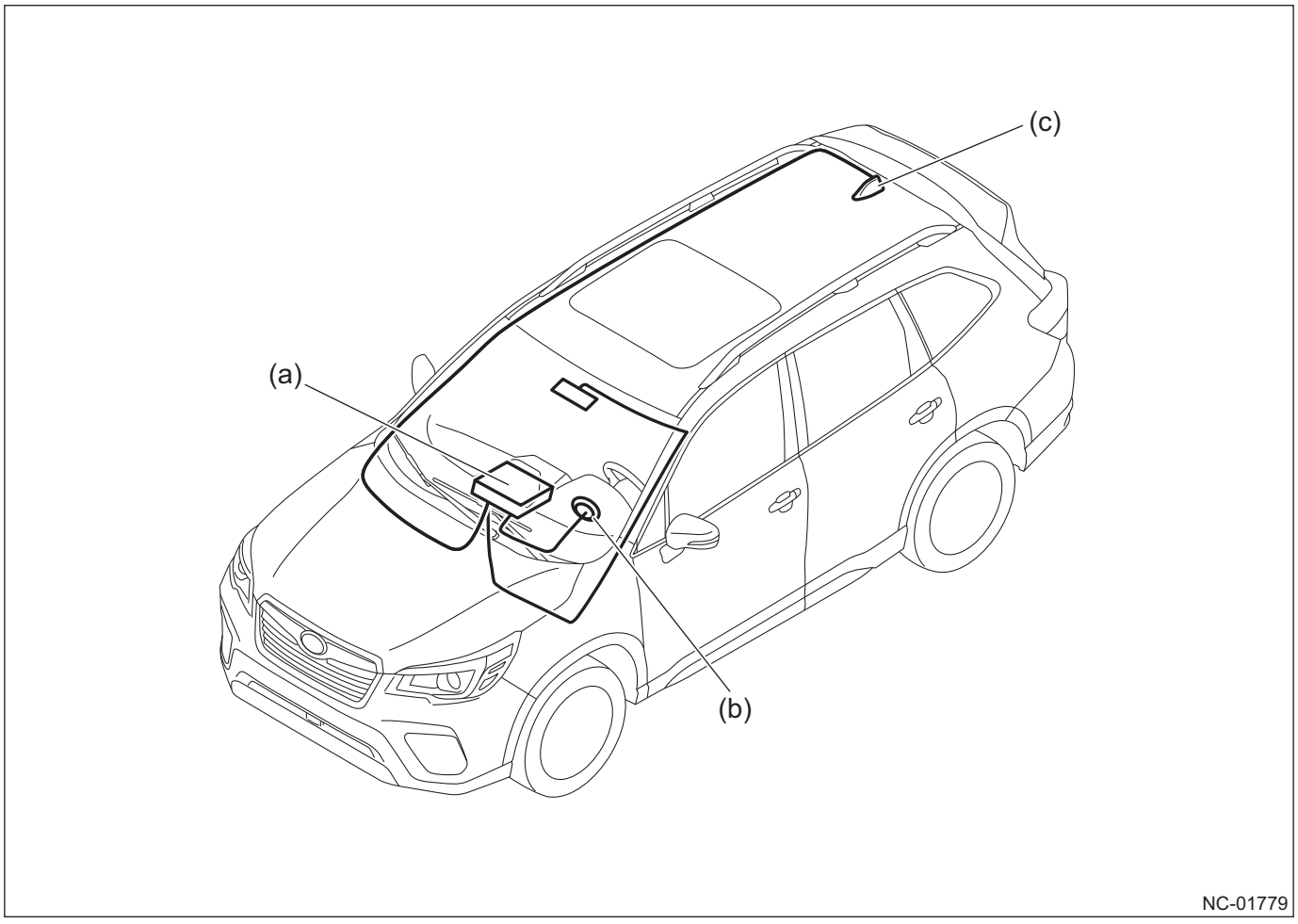
11.5.1 Overview

A roof antenna is adopted as the integrated antenna for telephone (main) that supports data communication compatible for the telematics system and for receiving XM radio. Also, a telephone (sub)/GPS antenna is installed on the reverse side of the instrument panel.

11.5.2 Component

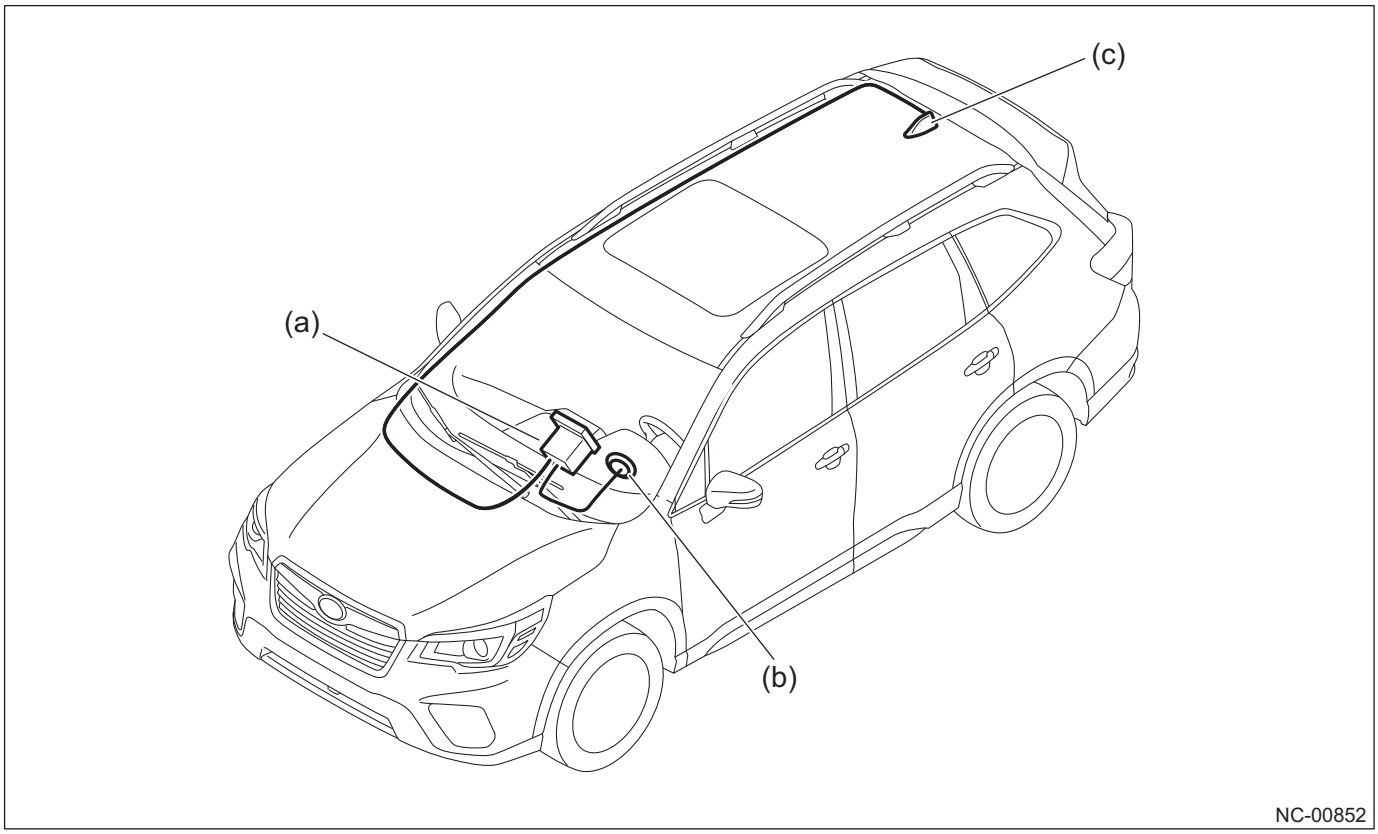
Component layout drawing

Vehicle with telematics



(a) Audio/DCM
(b) GPS antenna assembly (TEL/GPS)
(c) Antenna assembly roof (XM/TEL)

Vehicle without telematics



(a) Audio
(b) GPS antenna assembly (GPS)
(c) Antenna assembly roof (AM/FM/XM)

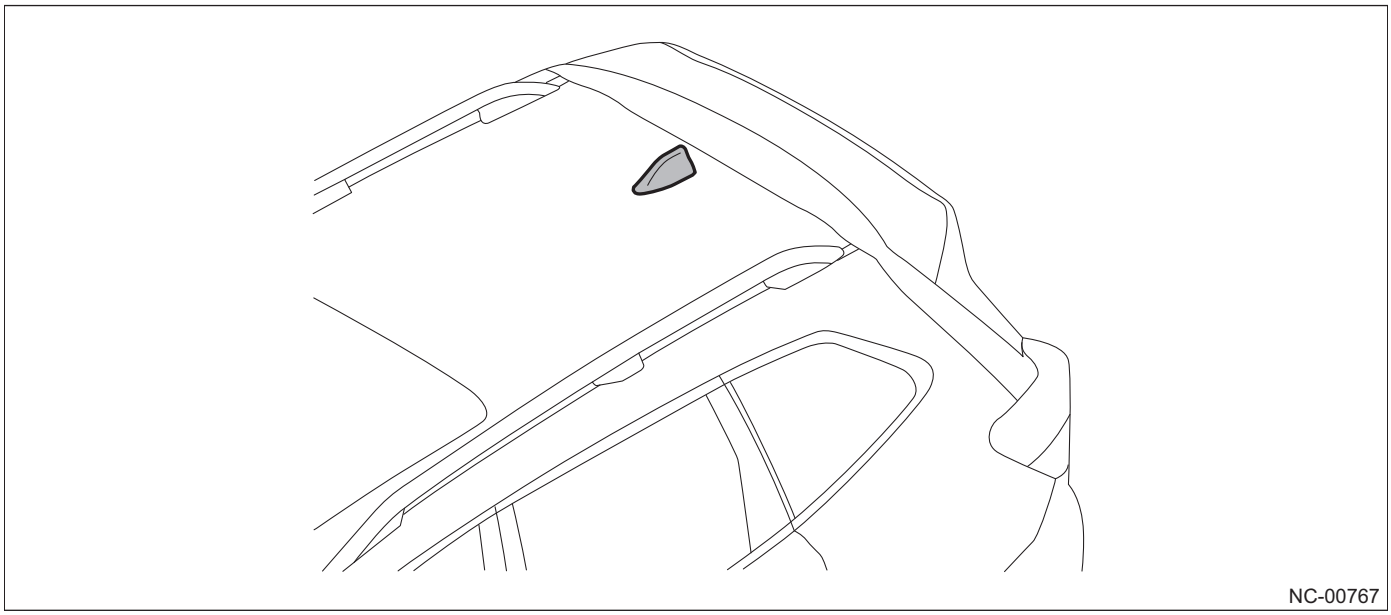
Component details

Roof antenna

LTE (Long Term Evolution) is also adopted as the data communication supporting the telematics system and telephone antenna as communication method to support the high speed communication in addition to 3G. Also, high speed and large volume communication is realized by using MIMO (Multi-Input Multi-Output) technology that transfers information using multiple antennas for both sending and receiving to link with the telematics system.

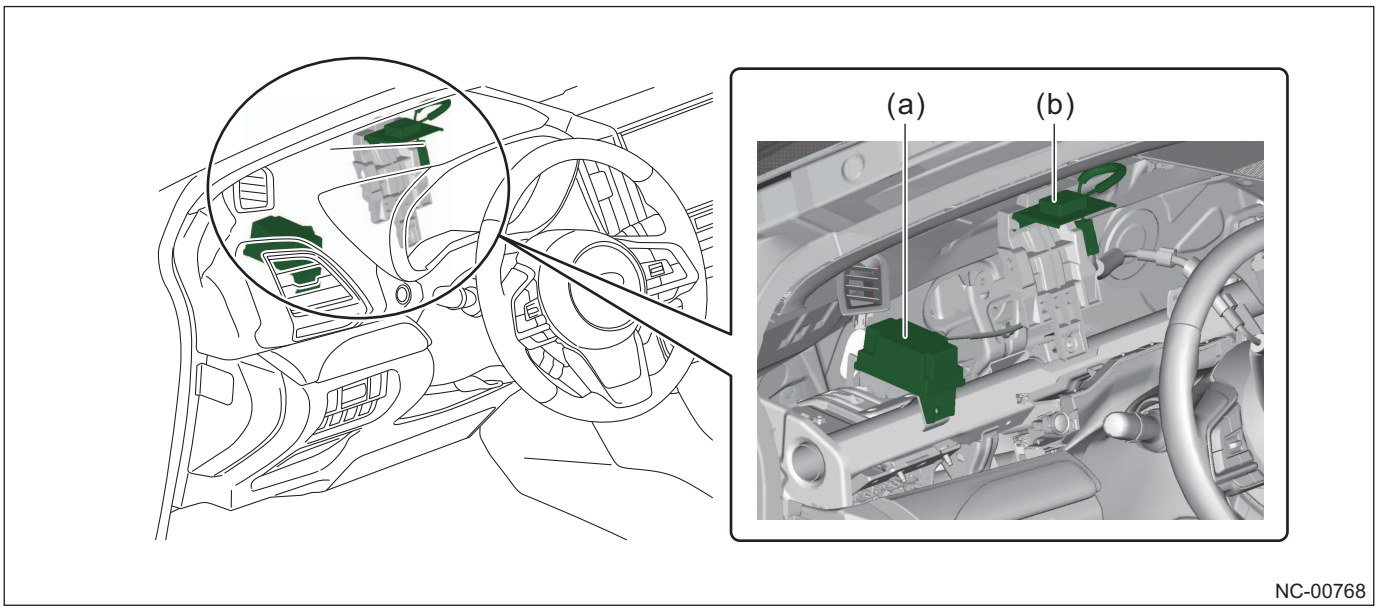
■ Antenna assembly roof (AM/FM/XM/TEL)

A sleek appearance is adopted to avoid giving sense of unevenness with the vehicle design, avoid wind noise while driving, eliminate the need of removal or folding, and to support integration of antennas.



Instrument panel sub antenna

A sub-antenna (telephone/GPS) is installed in the reverse side of the instrument panel. A structured that enable communication/call even when one (roof antenna) of the antennas is damaged by collision.



(a) Telematics sub antenna

(b) GPS antenna

12 ADVANCED SAFETY SYSTEM

CONTENTS

12.1 Overview

SUBARU categorizes safety measures into the following four processes to enhance the comprehensive safety performance of the vehicle. Each process is structured by linking various components and systems. Refer to chapters describing each measure for more details.

This chapter describes the "preventive safety" utilizing the advanced safety system.

"Primary Safety"
Superior visibility from the driver's seat is secured so the driver can rapidly detect the danger and visibility performance is ensured to safely drive during cornering, turning left or right, and backing up to enhance the safety of the vehicle even before starting to drive.

"Active Safety"
Prevent accidents by avoiding danger during driving. Safety during driving is ensured by a system that controls the vehicle in any condition regardless of the road conditions or weather. (page 6-11)

"Passive Safety"
Secures safety of the passengers when the vehicle has collided and protects the passengers from impact of collision. (page 8-3) (page 10-31)

"Preventive Safety"
The vehicle is equipped with an advanced system that forecasts the danger in advance and notifies the driver or assists driving, leading to safe driving.

The system automatically intervenes when determined to be in dangerous state to realize accident prevention and damage reduction.

12.1.1 Structure

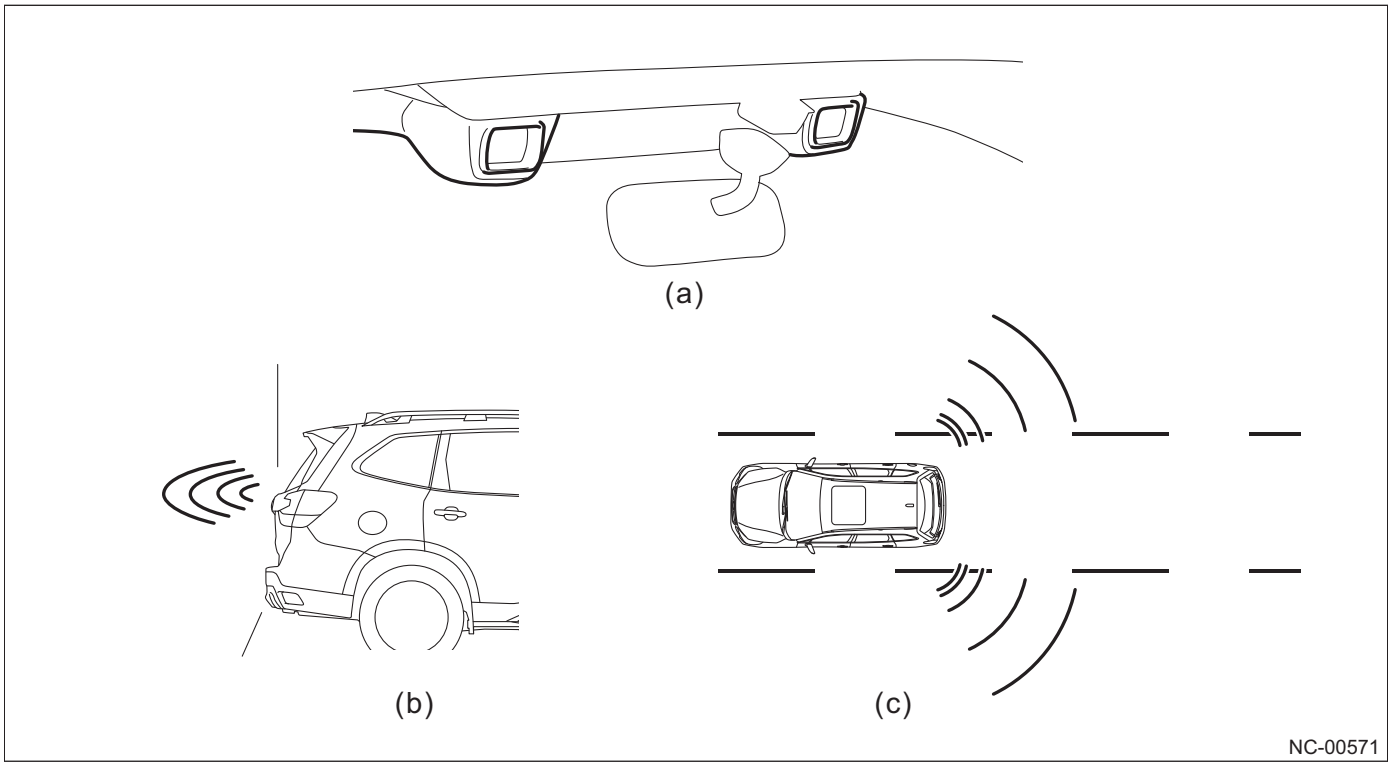
The following four systems are installed as advanced safety system to realize preventive safety.

EyeSight
Front view is constantly monitored with a stereo camera and warns the driver. Brake will be applied automatically to reduce the speed or stop the vehicle if no avoidance operation is performed. There are also adaptive cruise control that follows leading vehicle, active lane keep that keeps the vehicle in the lane, and AT rapid start prevention control that prevents sudden acceleration due to incorrect operation of the shift lever or pedals.

Subaru Rear Vehicle Detection system
This system detects the vehicle approaching from the rear sides of the vehicle with the sensors installed at the rear of the vehicle. It will call for attention to the driver with the LED indicator on the door mirror and warning buzzer.

Reverse Automatic Braking system
This system notifies the obstacles in the rear with display on the audio/navigation screen and warning buzzer so the vehicle will not hit the obstacles when backing up. Also, the system will automatically apply the brake when there is high possibility of collision to prevent collision or reduce the damage caused by the collision.

Driver monitoring system
The system presumes the driver's inattentiveness and dozing by the camera for the cabin. The system warns the driver with a buzzer, meter display (MID), and multi-function display (MFD).



(a) EyeSight
(b) Reverse Automatic Braking system
(c) Subaru Rear Vehicle Detection system

12.2 EyeSight

12.2.1 Overview

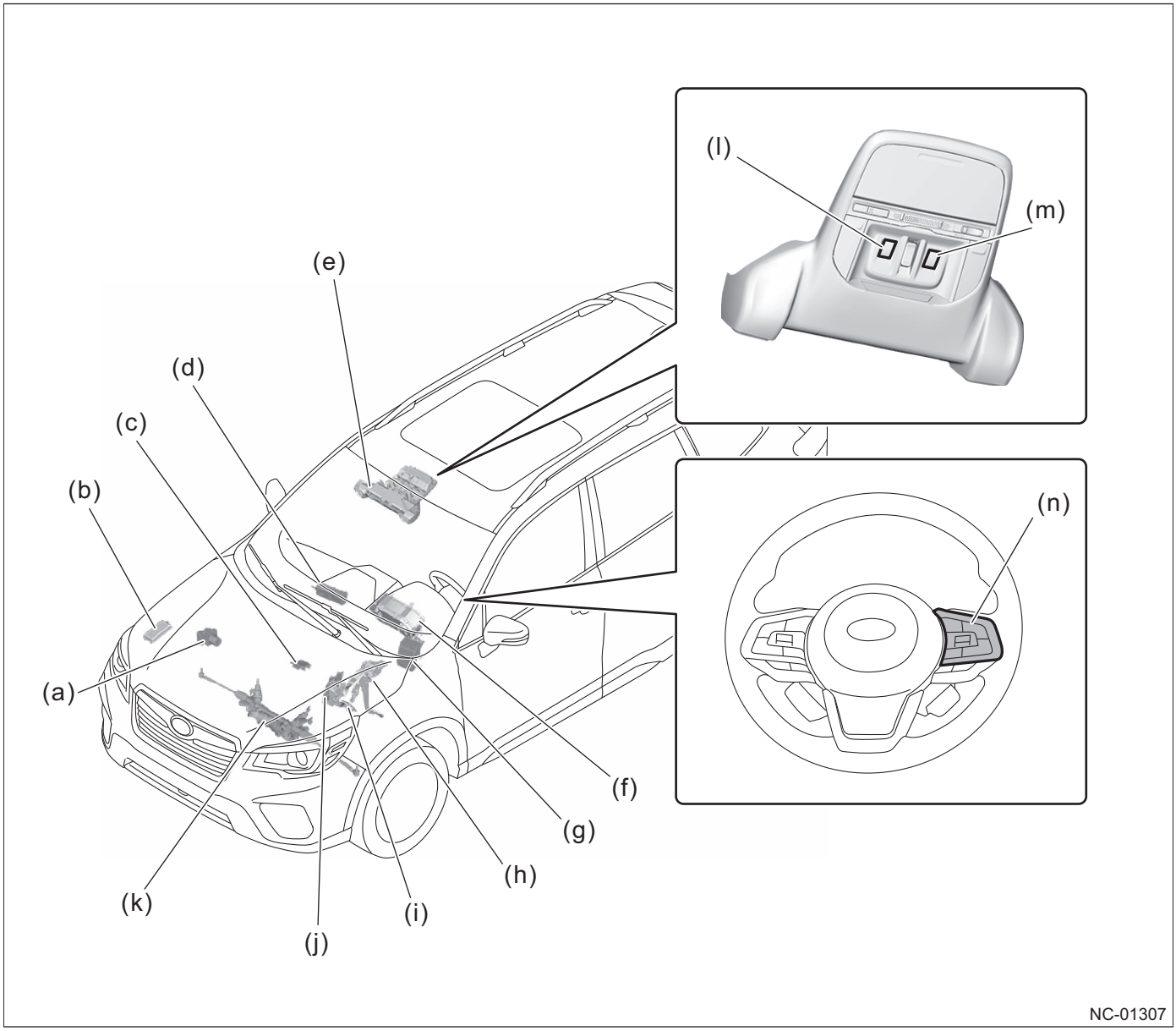
EyeSight is a driving assistant system that recognizes a preceding vehicle, obstacle, lane, etc. by processing the image from stereo camera and cooperatively controls the vehicle dynamics control, engine, transmission, and steering, etc. depending on conditions. The operating status of the system and warning are displayed on the display of the combination meter.

The following functions can be used with the EyeSight.

- Pre-collision brake
- Cruise control
- Lane departure prevention function
- AT rapid start prevention control
- Lane departure warning
- Sway warning
- Preceding vehicle start notification

12.2.2 Component

Component layout drawing

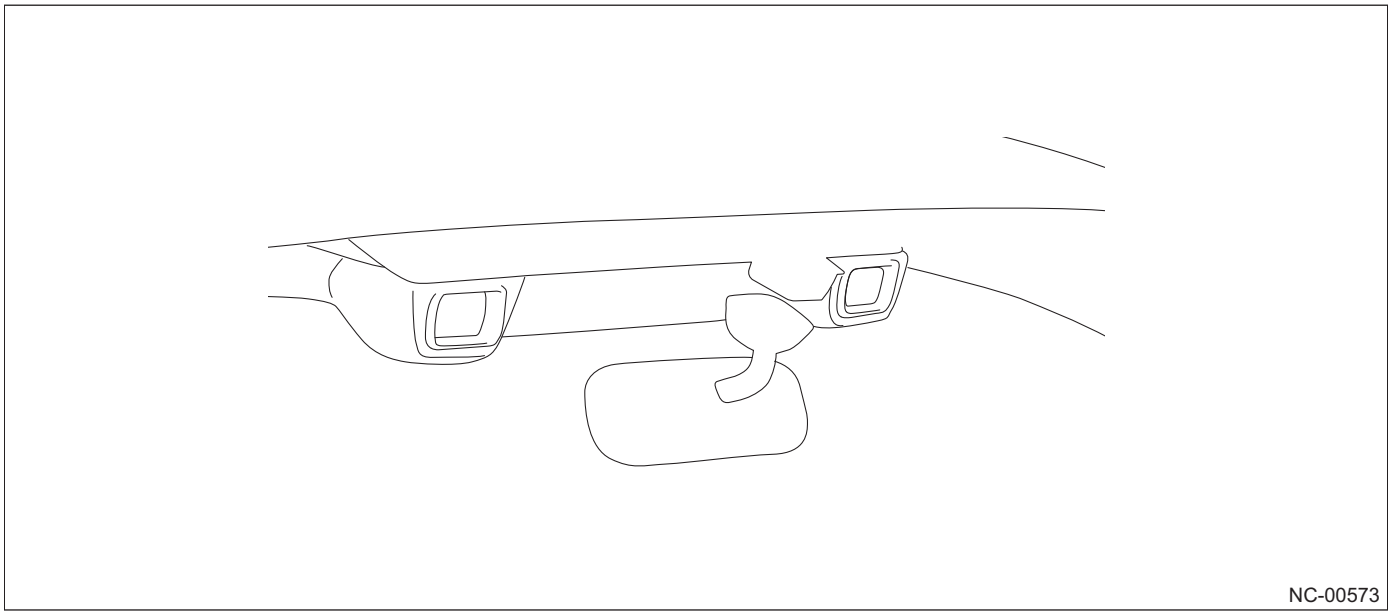


(a) VDCCM & H/M
(b) Brake light relay (in relay box)
(c) TCM
(d) MFD
(e) Stereo camera
(f) Combination meter assembly
(g) Body integrated unit (in joint box)
(h) Stop light switch
(i) Accelerator sensor
(j) ECM
(k) EPS CM
(l) Lane departure warning OFF switch
(m) Pre-collision brake OFF switch
(n) EyeSight steering switch

Component details

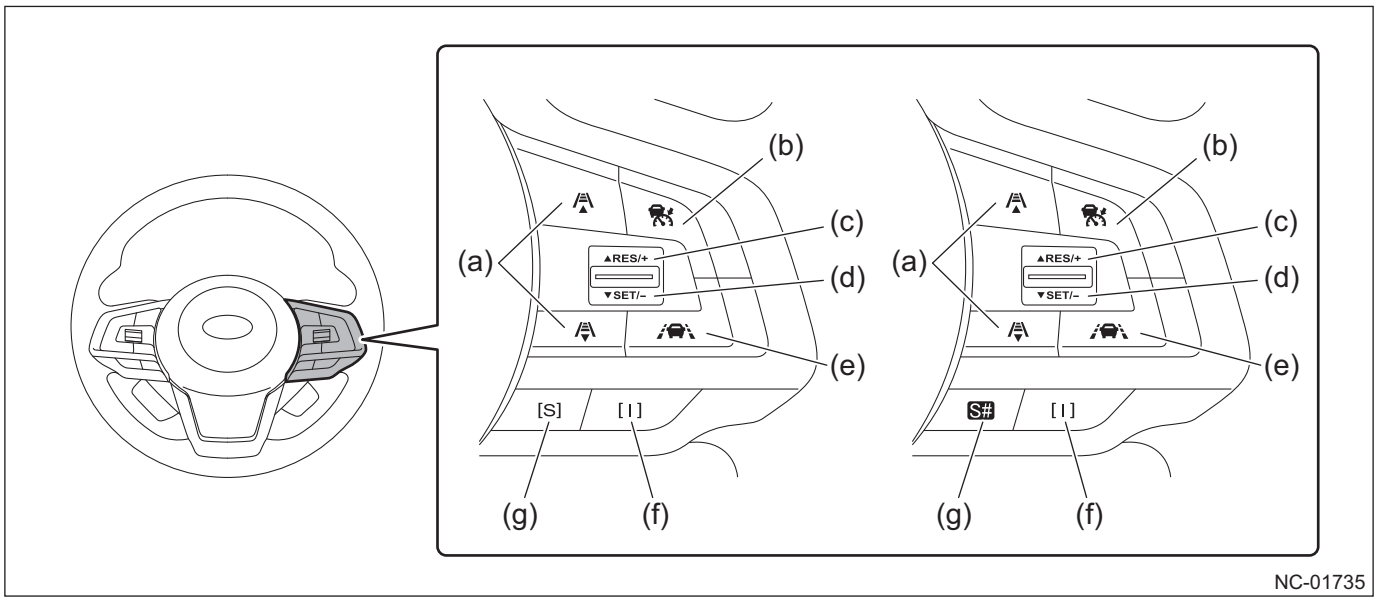
Stereo camera

The stereo camera recognizes the distance and object using cameras mounted at left and right and performs preventive safety and driving load reduction by controlling each unit appropriately.



Switch

■ Steering switch



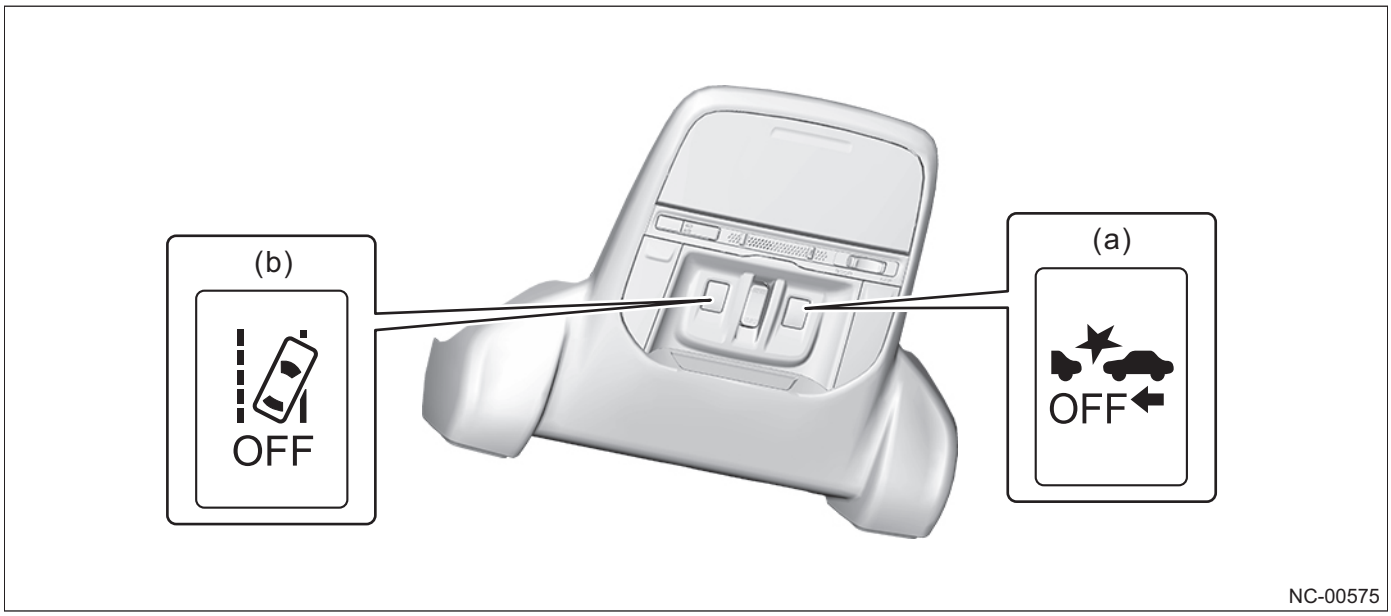
Name		Function
(a)	Distance between vehicles setting switch	Switches distance between vehicles in four levels during setting for adaptive cruise control.
(b)	Cruise switch	Turns on and off the cruise control*.
(c)	RES/+ switch	Sets the cruise control* (re-sets a setting of set vehicle speed before cancelation after canceling the cruise control). Increases set vehicle speed (when the cruise control* is set).
(d)	SET/- switch	Sets the cruise control*. Decreases set vehicle speed (when the cruise control* is set).
(e)	Lane keep switch	Turns on and off the lane keep assist.
(f)	I switch	Switches to I (intelligent mode)
(g)	S switch	Switches to S (sport mode)

* Adaptive cruise control and constant speed cruise control
(the switch specification differs depending on with/without each equipment, and destination)

■ Pre-collision brake OFF switch, lane departure warning OFF switch

The switch is placed on the overhead console and the EyeSight camera cover.

The function can be turned on and off by pressing and holding the switch. Also, indicator light in the combination meter turns on when the function turns off.



(a) Pre-collision brake OFF switch

(b) Lane departure warning OFF switch

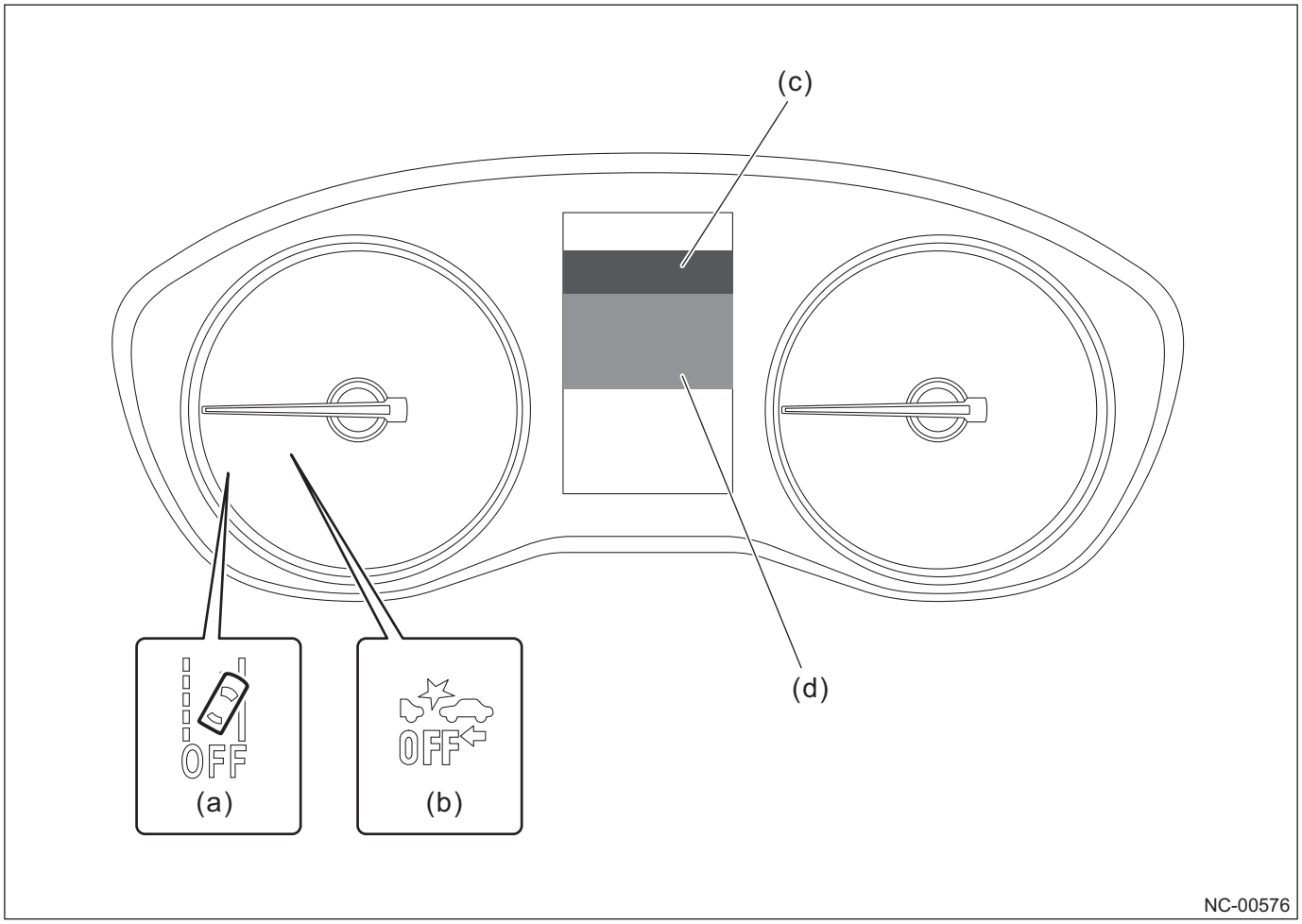
Pre-collision brake OFF indicator light, lane departure warning OFF indicator light

The pre-collision brake OFF indicator light and lane departure warning OFF indicator light are arranged in the combination meter.

Fuel efficiency and vehicle speed are displayed on the basic screen area. Also, if a warning from EyeSight or system failure occurs, the interruption screen is displayed.

The operating statuses of the following functions are displayed on the EyeSight display area.

- Adaptive cruise control, constant speed cruise control
- Lane keep assist
- Lane departure warning
- Sway warning

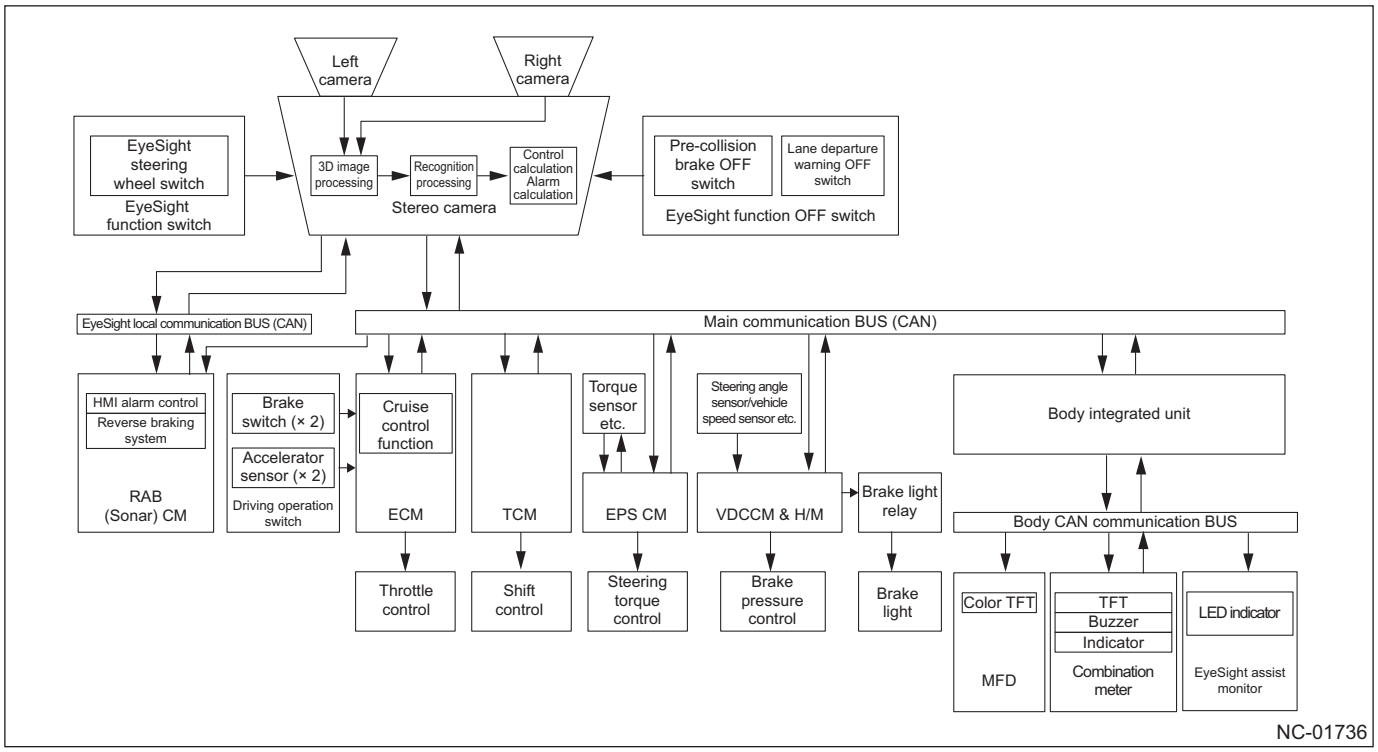


(a) Lane departure warning OFF indicator light
(b) Pre-collision brake OFF indicator light
(c) Basic screen area
(d) EyeSight display area

For the combination meter details, refer to the "Combination Meter/MFD/MID". (page 11-56)

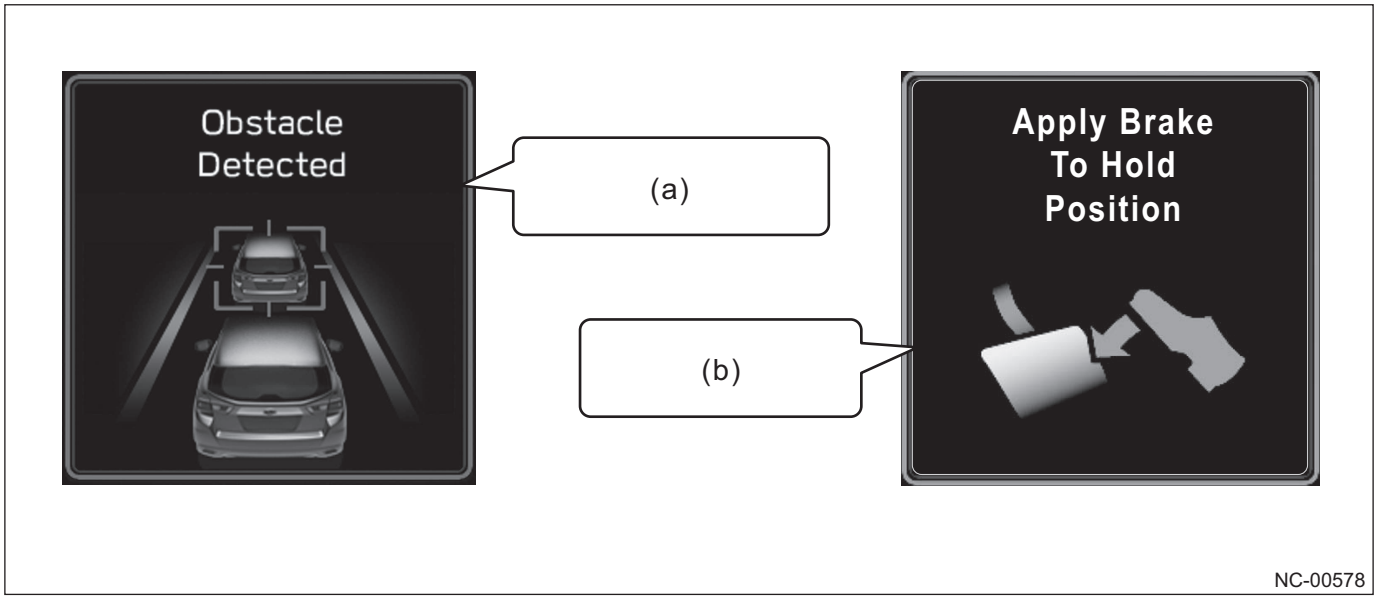
12.2.3 Construction and Operation

System diagram



Pre-collision brake

When there is a possibility to collide to the preceding vehicle, it will assist the driver to prevent collision by warning the driver. If the driver still does not perform the avoiding action, an emergency brake is applied immediately before the collision, which will reduce the collision damage or prevent the collision, and displays warning in the meter panel.

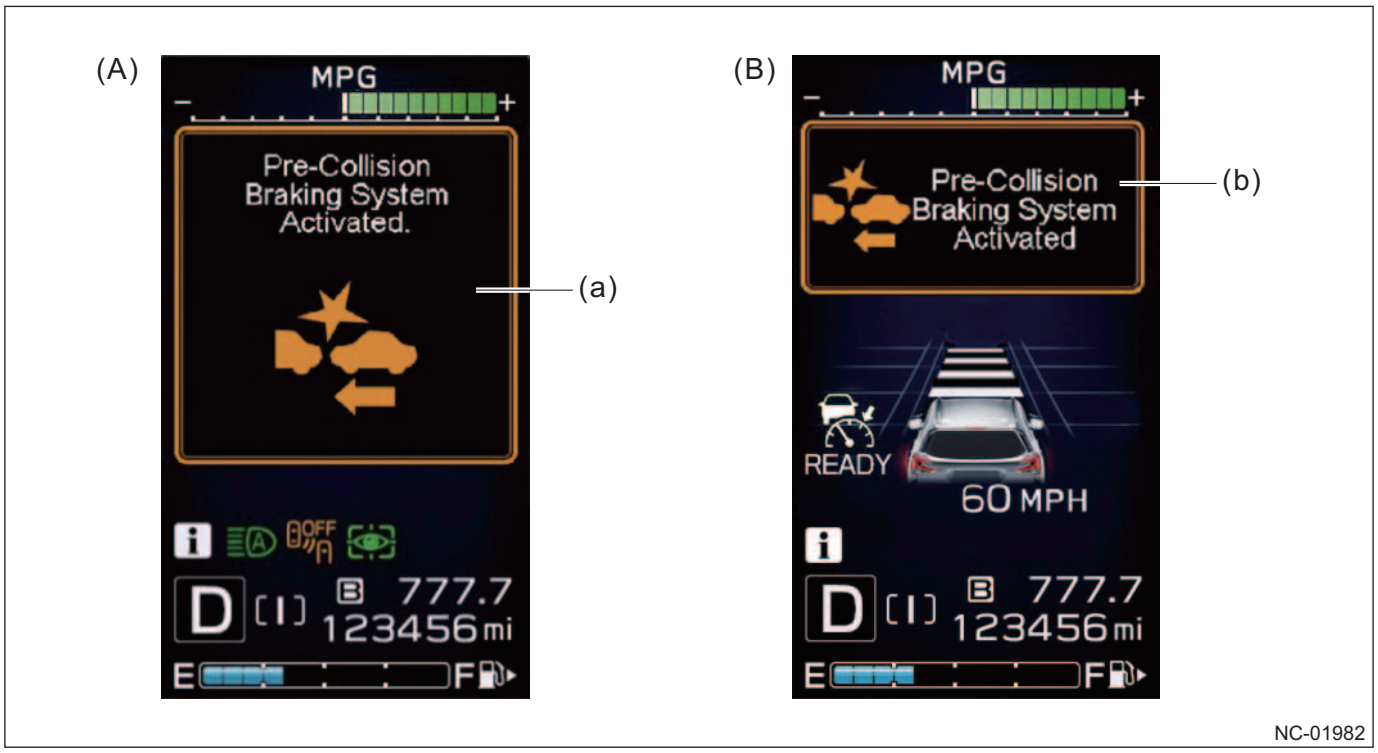


(a) Red frame and preceding vehicle flash.

(b) Yellow frame turns on.

Operation notification

In existing models, a warning screen is displayed only when the pre-collision brake is operating. When the pre-collision brake is released in a short time, the driver may not notice that the pre-collision brake is operating. The interruption screen is displayed on the multi-information display for a certain time and the display time has become longer. This enables the driver to notice more easily that the pre-collision brake is operating during driving.



(A) The case where the system transitions to the half-stop after pre-collision brake operates.

(a) Warning display for certain time + buzzer sound

(B) The case where the system does not transition to the half-stop after pre-collision brake operates.

(b) Warning display for certain time

Cruise control

The speed control range is widened to improve the driver's sense of safety. Also, in order to improve product performance, the lower limit of the set vehicle speed is standardized at 20 MPH (30 km/h).

Adaptive cruise control

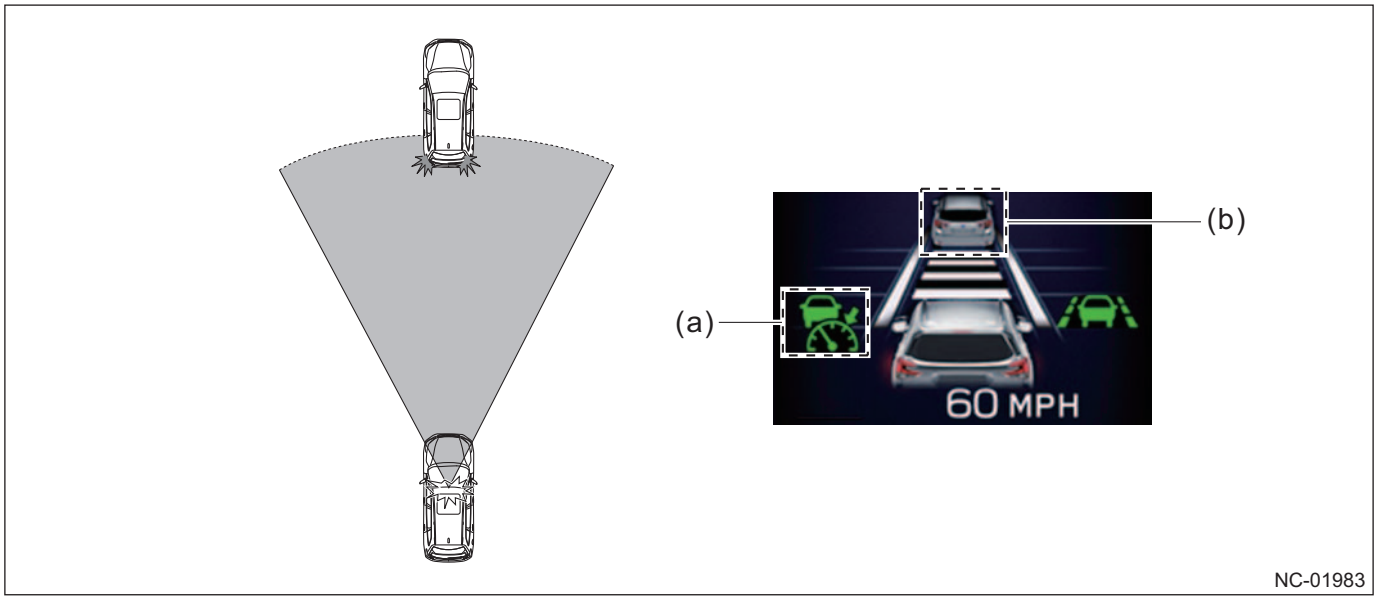
The system follows the preceding vehicle in wide range of speeds from approximately 0 to 90 MPH (0 to 145 km/h) for other than C4 and 0 to 110 MPH (0 to 180 km/h) for C4 by detecting the distance and speed difference between the own vehicle and preceding vehicle with the stereo camera, and controls the engine, transmission, brake, etc., based on that information while maintaining the vehicle speed set by the driver and the distance with the preceding vehicle.

The system can follow the preceding vehicle without much stress even if the preceding vehicle may decrease the speed drastically such as in the limited highway in an urban area by securing sufficient automatic braking performance.

Above function may not be fully performed depending on the road condition, weather, or vehicle condition.

High following performance is realized even for cut ins during congestion and on the highways by realizing high precision vehicle recognition.

Icon display during operation



(a) Indicator light (green)

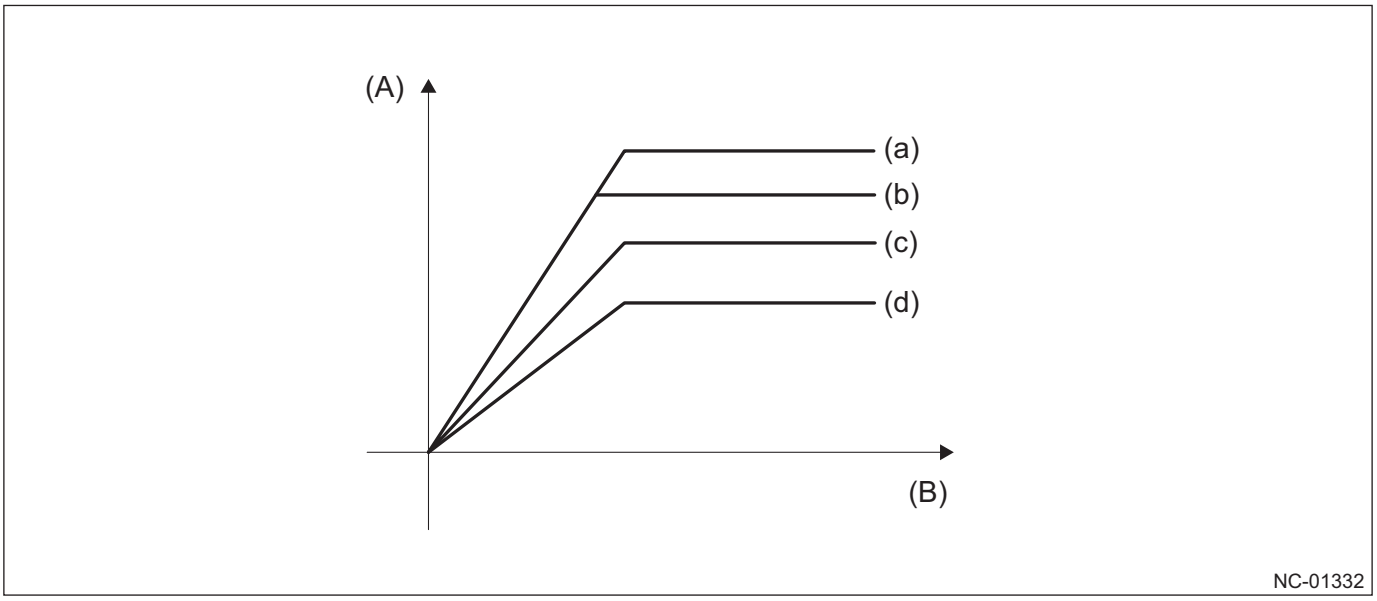
(b) There is a preceding vehicle.

Previously, the acceleration characteristics of the adaptive cruise control depended on the condition selected in the SI drive. The SI drive could only change the acceleration characteristics in two levels and models without the SI drive could not change acceleration characteristics. The acceleration characteristics of the cruise control can now be switched in four levels by changing the setting in the customization function of the meter without depending on the SI drive. The acceleration mode can be selected according to preference and the driving conditions.

Acceleration characteristic

Level	Condition
Lv. 4 (dynamic)	A mode for drivers preferring high acceleration. Maximum acceleration is 1.2 times the base (standard). Initial rise of the acceleration (jerk) is equivalent to standard.
Lv. 3 (standard) *Initial setting value	Equivalent to the acceleration of the S mode which was the prior standard.
Lv. 2 (comfort)	Maximum acceleration is 80% of the standard.
Lv. 1 (eco)	A mode for scenes that does not require much acceleration, such as during congestion. Maximum acceleration is 60% of the standard.

Acceleration characteristic chart



(A) Acceleration
(B) Time

(a) 100 to 120% dynamic
(b) 100% standard
(c) 80% comfort
(d) 60% eco

■ Controllable speed range

The speed control range is widened to improve the driver's sense of safety.

*: Comparison with existing model vehicle

	Destination	Existing model vehicle	New model vehicle
Settable vehicle speed	For other than C4	25 MPH (40 km/h) to 90 MPH (145 km/h)	20 MPH (30 km/h) to 90 MPH (145 km/h)
	For C4	None	20 MPH (30 km/h) to 110 MPH (180 km/h)

■ Notification when operation is canceled

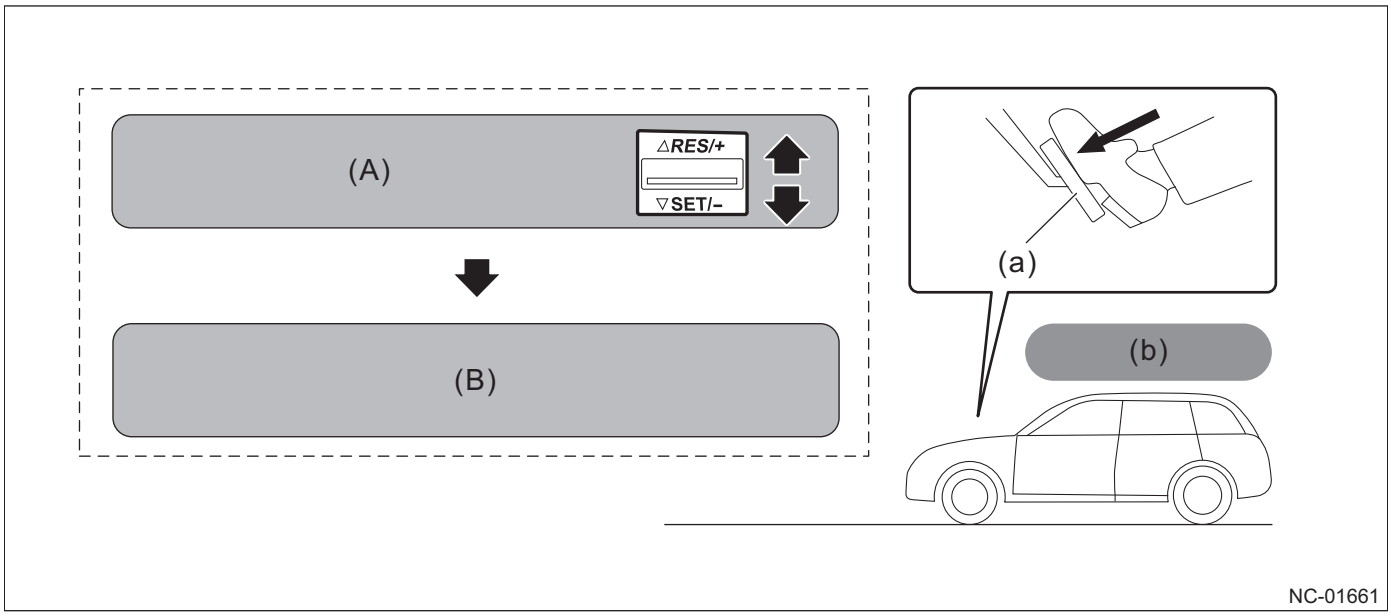
If the adaptive cruise control is canceled by the system while it is operating (such as when the speed is out of the controllable vehicle speed range), the system notifies the driver of the cancelation with a cancel sound and a display on the meter.

NC-00582

■ Settable conditions

In the existing model vehicle, adaptive cruise control could not be set (start the operation) when the vehicle is stopped by depressing the brake pedal. Specification is changed to allow to set (start the operation) when the driver depresses the brake pedal and the vehicle is stopped. In addition, if the control is set (start the operation) while the vehicle is stopped, the system transitions to half-stop.

However, in order to secure fluid pressure necessary for the half-stop, the control cannot be set unless the brake pedal is firmly depressed.



(A) Switch to SET or RES when "READY" is indicated on the meter LCD.

(B) Half-stop

(a) Brake pedal

(b) Vehicle speed = 0 MPH

Operation per situation

Situation	Existing model vehicle	New model vehicle
To set the control when the vehicle is stopped by the driver's brake operation from the adaptive cruise control	The control can be set by releasing the brake pedal if there is a preceding vehicle, but the control cannot be set if the distance between the vehicles is short (it is dangerous since the vehicle advances with creep).	Since the system enters the half-stop if the control is set with the brake pedal depressed, the brake pedal can be safely released.
To set the control when the vehicle is stopped at the forefront of a line at red signal	Since the vehicle accelerates when the control is set with the brake pedal released, the control cannot be set until the red signal turns green.	(Same as above)

Constant speed cruise control

A mode to drive at constant speed.

* This function does not follow the preceding vehicle.

Weak brake control will be performed to maintain the set speed when driving down a slope while the cruise control is set or when the set speed is decreased.

This can be used even when the stereo camera is paused.

* This function is used by switching from the adaptive cruise control function.

■ Controllable speed range

The speed control range is widened to improve the driver's sense of safety.

Comparison with existing model vehicle

Item	Destination	Existing model vehicle	New model vehicle
Settable vehicle speed	For other than C4	25 MPH (40 km/h) to 90 MPH (145 km/h)	20 MPH (30 km/h) to 90 MPH (145 km/h)
	For C4	None	20 MPH (30 km/h) to 110 MPH (180 km/h)
Speed at which the condition of automatic cancelation by the system is met	For other than C4	When the vehicle speed is below approximately 19 MPH (30 km/h) or above approximately 100 MPH (160 km/h).	When the vehicle speed is below approximately 16 MPH (25 km/h) or above approximately 100 MPH (160 km/h).
	For C4	None	When the vehicle speed is below approximately 16 MPH (25 km/h) or above approximately 137 MPH (220 km/h).

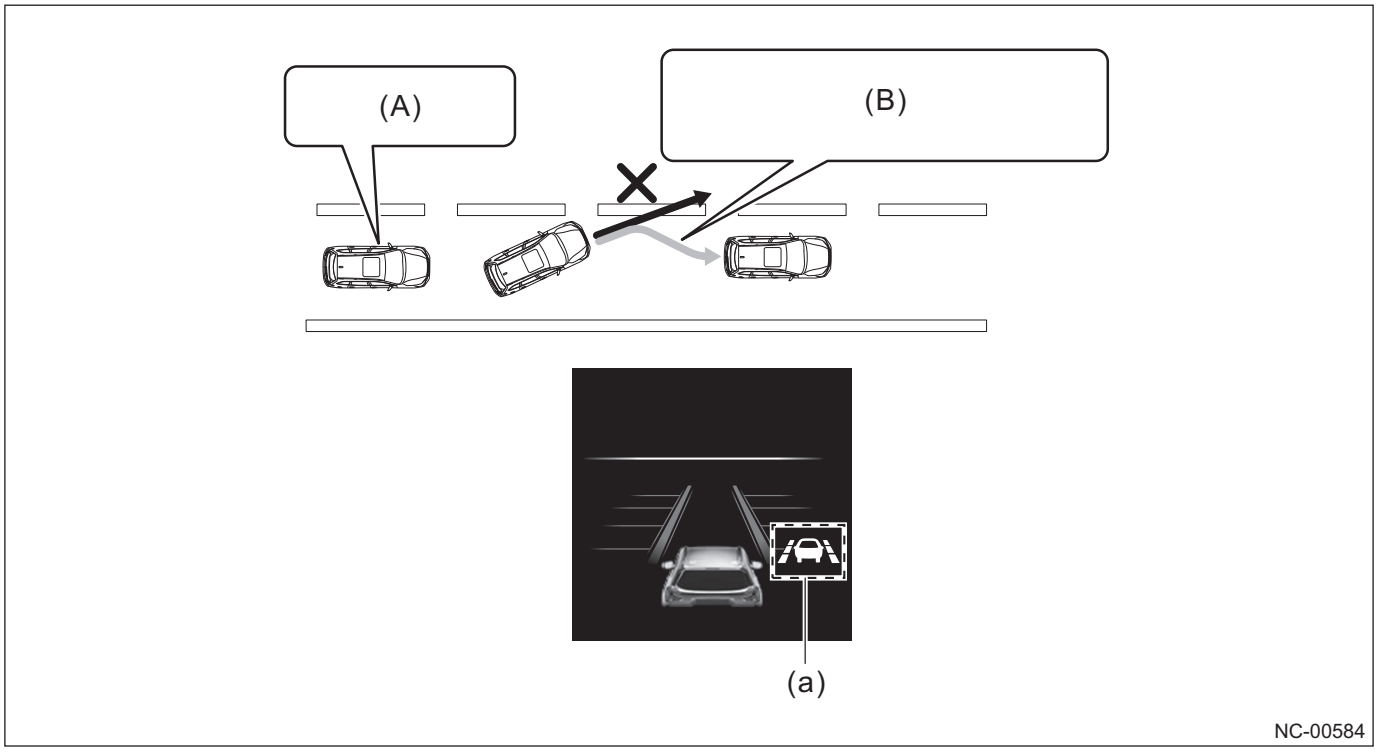
Lane departure prevention function

When the vehicle is about to depart from a lane while recognizing one side lane marking at the vehicle speed of approximately 37 to 90 MPH (60 to 145 km/h) for U5 and C5 or approximately 37 to 124 MPH (60 to 200 km/h) for C4, the system assists the steering operation in the direction of departure prevention to avoid the lane departure.

The lane departure control is activated (indicator light is changed from white to green) when the following conditions are met.

- The vehicle is traveling at the vehicle speed of approximately 37 to 90 MPH (60 to 145 km/h) for U5 and C5 or approximately 37 to 124 MPH (60 to 200 km/h) for C4.
- The system recognizes the lane marker on one side.
- The driver is operating the steering wheel.
- The vehicle is driving on a road with lane width of approximately 10 to 15 ft (3 to 4.5 m).
- The vehicle is traveling in straight line or mild curve.

Operation



(A) Operated with lane keep switch.

(B) This function supports the steering control when the vehicle is about to depart from the lane.
This function assists lane departure prevention.

(a) Indicator light (during operation: green light turns on)

Notification when operation is canceled

If the function is canceled by the system (when the speed become a speed out of the controllable vehicle speed range), the system notifies with a cancel sound and a meter display.

NC-00585

■ Operation cancelation condition

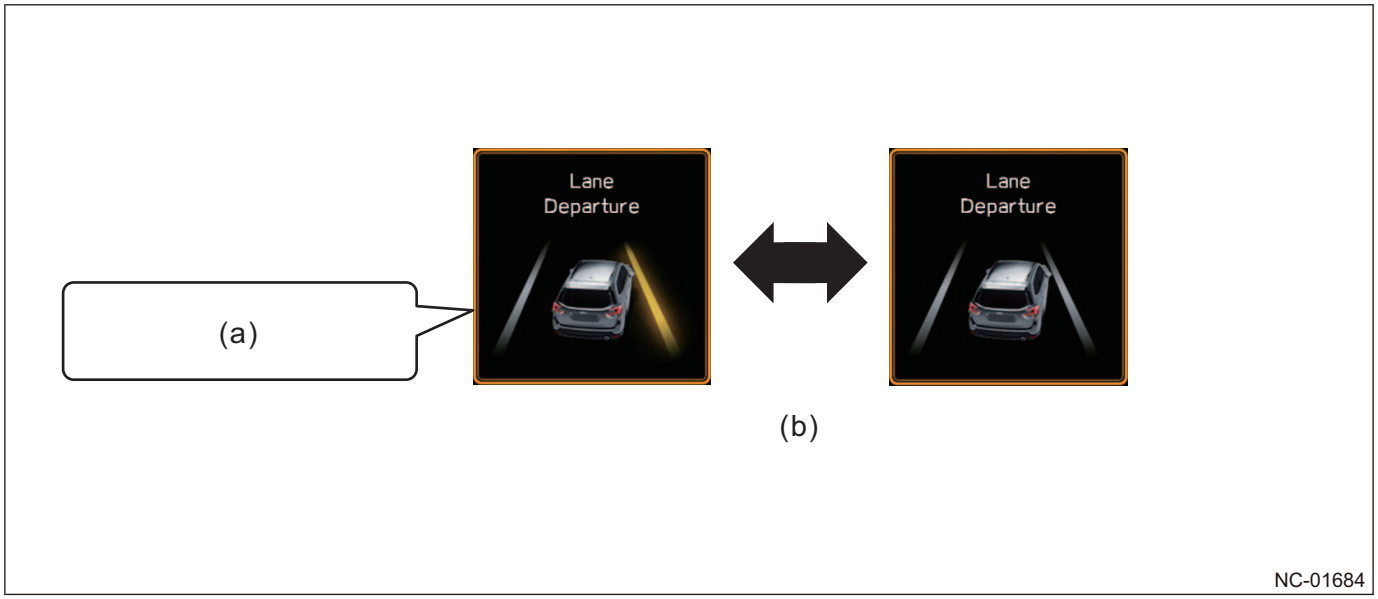
In the existing model vehicle, the control of the lane departure prevention function is immediately canceled with the brake operation of the driver. In the new model vehicle, the specification that keeps the control even during the brake operation if the vehicle is decelerating at a certain deceleration rate or less is adopted in consideration of improvement in the driver's safety feeling.

AT rapid start prevention control

The engine output is restricted to suppress forwarding movement together with warning the driver with warning display and warning buzzer, when the vehicle is in D range or M range and an obstacle in front of the vehicle is recognized by the EyeSight camera, and the system has determined that the accelerator pedal is depressed more than necessary by driver's mistake.

Lane departure warning

This function displays a warning and sounds a warning buzzer when the vehicle is about to depart from the lane while driving. (When vehicle speed is 30 MPH (50 km/h) or higher)

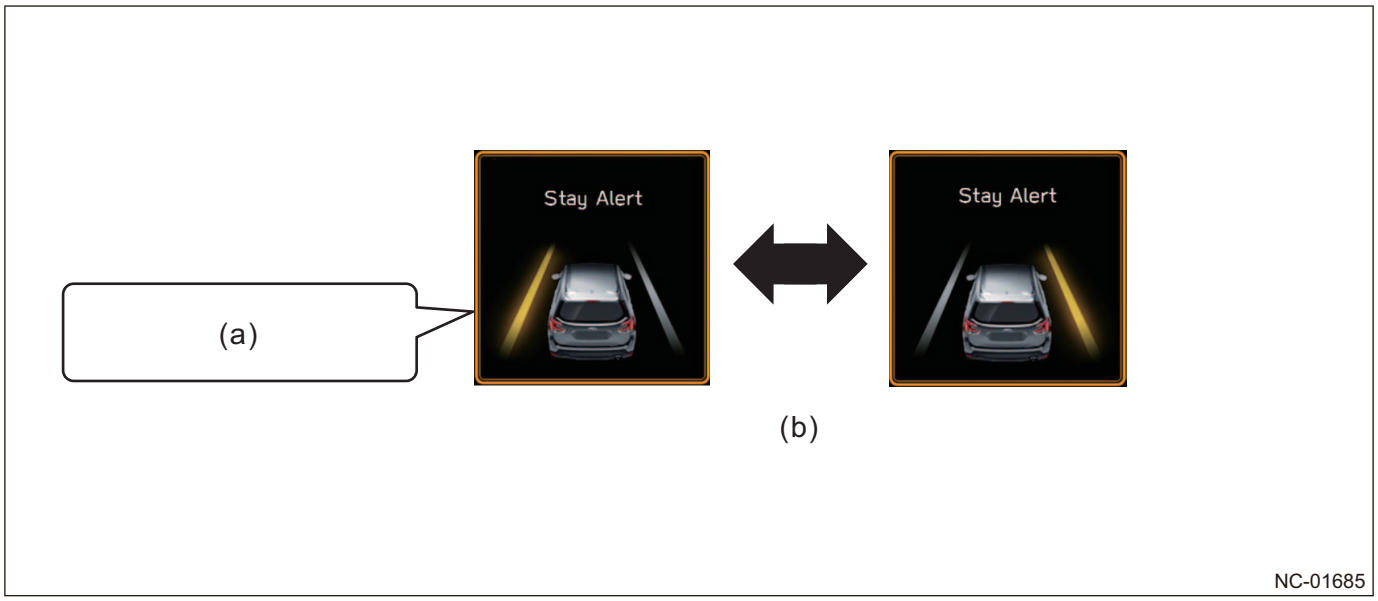


(a) Yellow frame lights up and lanes flash.

(b) Lane departure warning display

Sway warning

Swaying by fatigue, looking away, hazy driving, side winds, etc. are determined by the vehicle movement and warns with a warning display and warning buzzer. (When vehicle speed is 37 MPH (60 km/h) or higher)

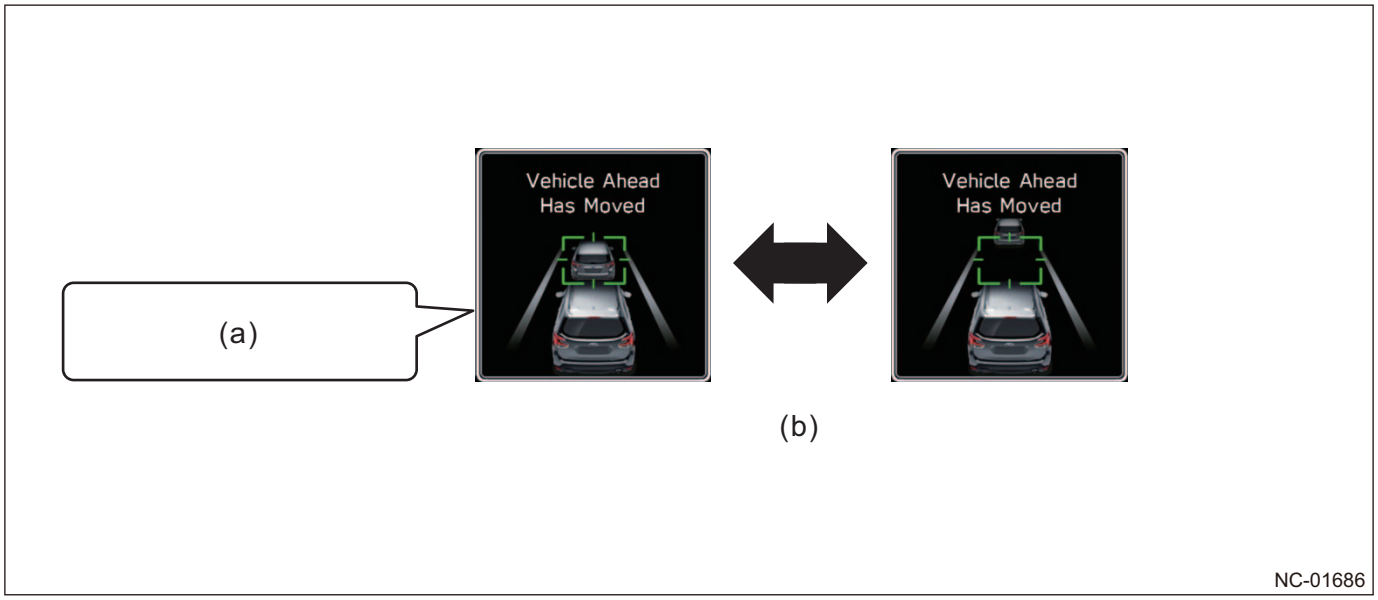


(a) Yellow frame lights up and lanes flash alternately

(b) Sway warning display

Preceding vehicle start notification

This notifies the vehicle has not started moving even when the preceding vehicle has started moving with a sound and preceding vehicle switch indication.



(a) White frame flashes

(b) Preceding vehicle start notification display

12.3 Subaru Rear Vehicle Detection System (BSD/RCTA)

12.3.1 Overview

To further expand the preventive safety idea, the Subaru Rear Vehicle Detection system is adopted as the next step to aim full surrounding preventive safety. (for some grades)

The Subaru Rear Vehicle Detection (BSD/RCTA) system is a collective term for blind spot vehicle detection assistance (BSD), lane change assistance (LCA), and reversing assistance (RCTA). The radar sensor installed at the rear of the vehicle detects vehicle behind.

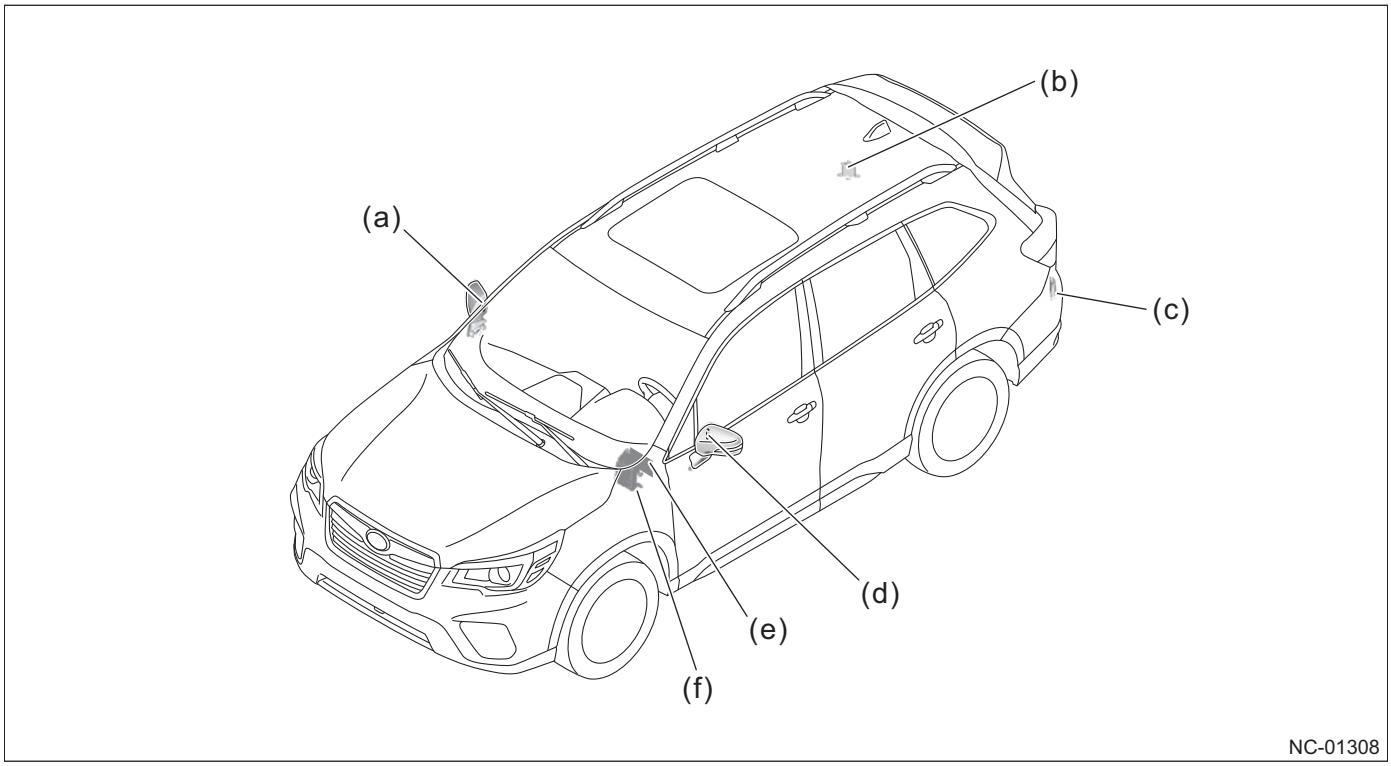
The system warns the driver with the LED indicator on the door mirror or the warning buzzer from the combination meter.

This supports the "peace of mind and enjoyable driving" by calling attention and warning about the rear vehicle.

"To restrict the movement of view" and "to let the mirror take the dedicated role as a mirror", an indicator is placed inside the door mirror. Also, the BSD/RCTA OFF switch is placed in the instrument panel combination switch.

12.3.2 Component

Component layout drawing

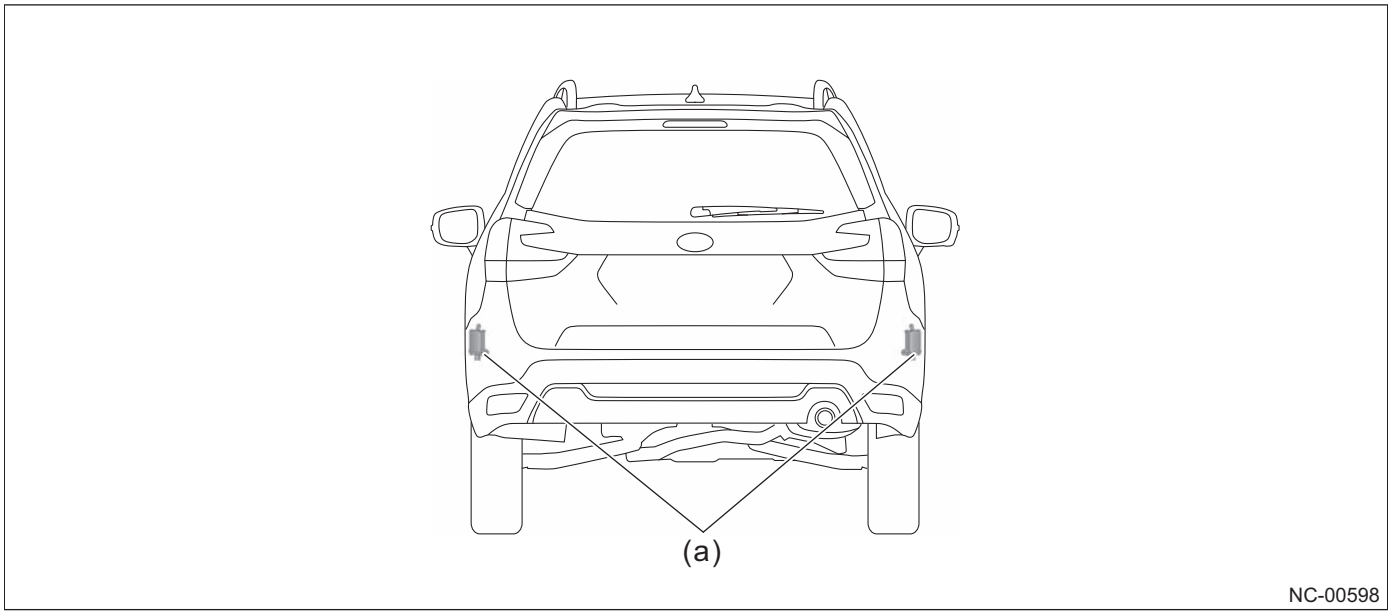


(a) Reversing assistance system indicator (RH)
(b) Radar sensor (RH) (slave)
(c) Radar sensor (LH) (master)
(d) Reversing assistance system indicator (LH)
(e) Subaru Rear Vehicle Detection system (BSD/RCTA) OFF switch
(f) Body integrated unit (in joint box)

Component details

Radar sensor

The radar sensors are attached with the vehicle body under the rear combination light via brackets, and each one of them is installed at both sides. Each radar sensor detects vehicles on its installed side. The radars cannot be also seen from outside since they are covered with the rear bumper face.

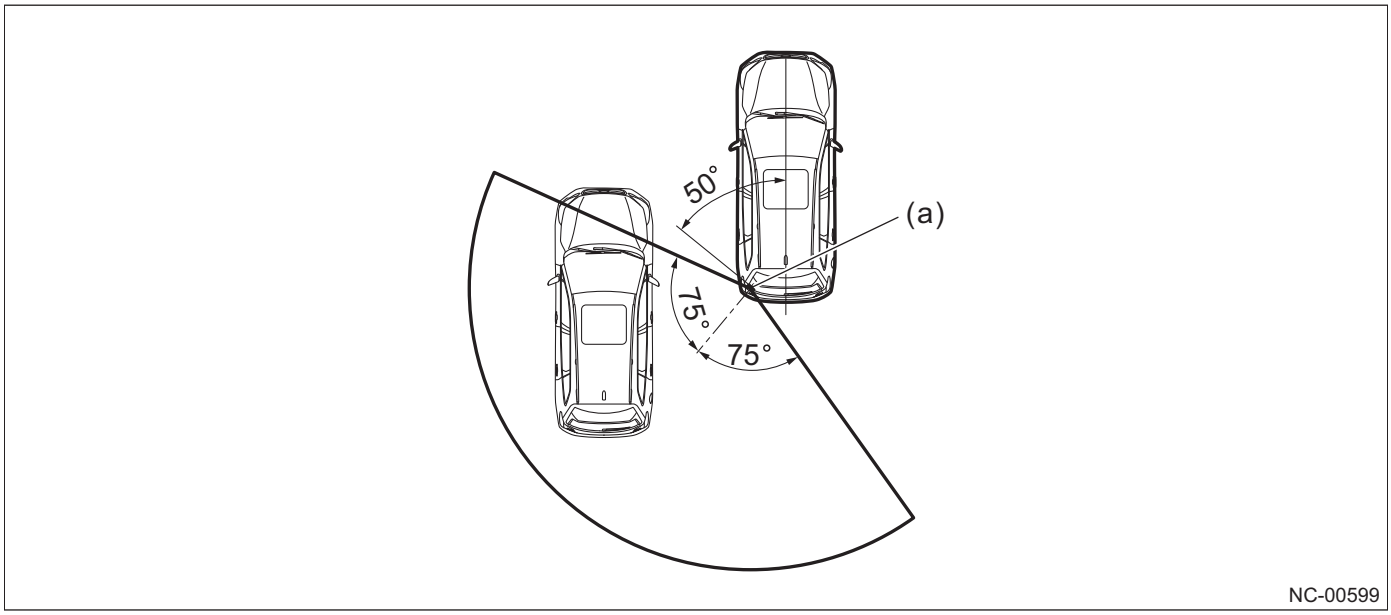


(a) Radar sensor (master & slave)

Sensor specifications

Detection distance	Approx. 230 ft (70 m)
Azimuth direction detection angle	± 75°

Radar sensor irradiation image (one side only)

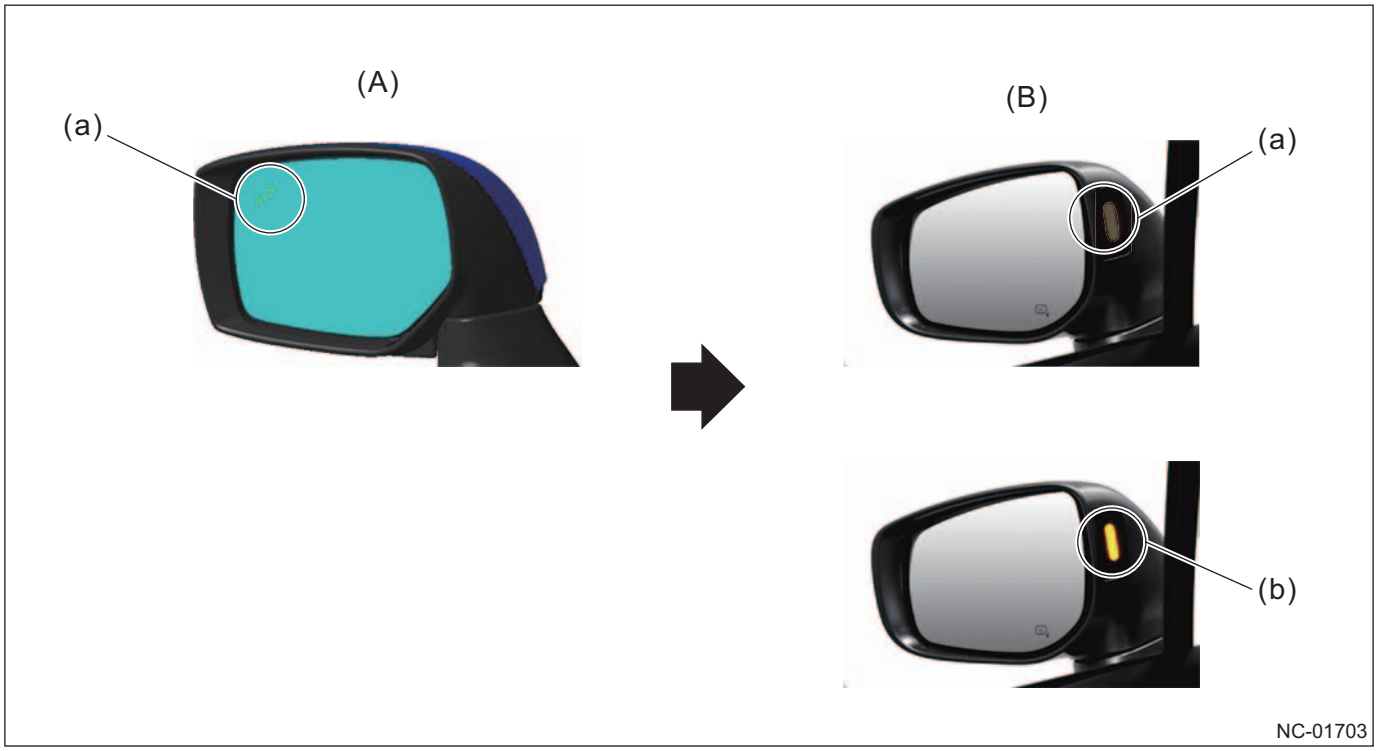


(a) Radar sensor

BSD/RCTA indicator

In the existing model vehicle, warning is issued without disrupting the movement of view when checking the rear side by illuminating/flashing the LED indicator set inside the outer mirror when there is a vehicle in the blind spot of the rear side. In the new model vehicle, lighting portion of the LED indicator is moved from the mirror surface to inner side of the door mirror.

This reduces the movement of sight when the driver checks the rear side and the visual safety is improved compared to door mirrors of existing model vehicles.



(A) Existing model vehicle (mirror surface illuminating type)

(B) New model vehicle (body illuminating type)

(a) LED indicator

(b) Illumination image

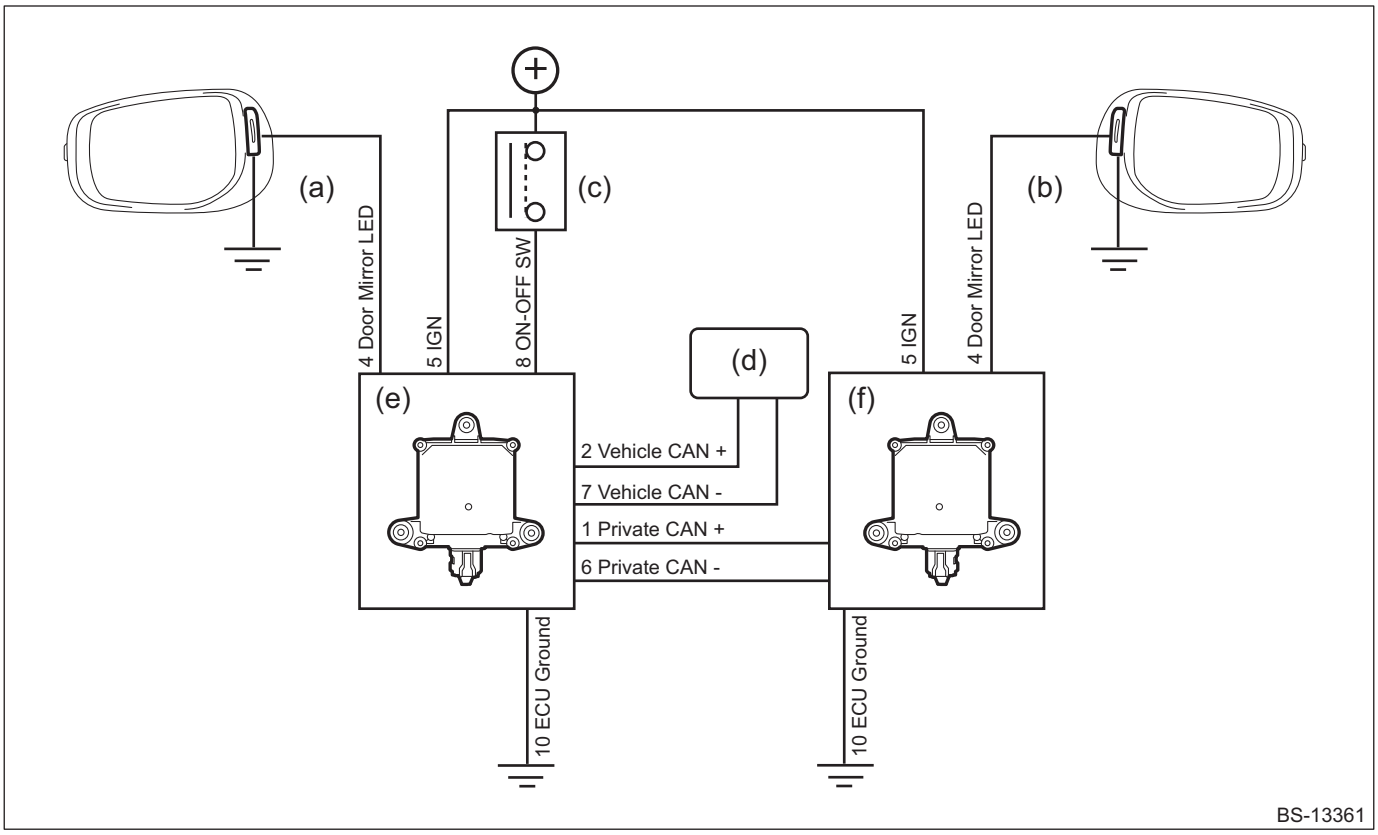
12.3.3 Construction and Operation

System diagram

A control CM is built into the radar sensor itself, and performs the vehicle recognition and warning determination control.

The left and right radar sensors are identified as master and slave for control purposes and are connected by the private CAN to execute controls through mutual communication. The master side radar receives the input from the vehicle CAN and the BSD/RCTA OFF switch, and information necessary for control can be obtained from other units via the vehicle CAN.

The LED indicators installed inside the outer mirrors are driven directly by the Subaru rear vehicle detection system radar sensor.



(a) Reversing assistance system indicator (LH)
(b) Reversing assistance system indicator (RH)
(c) BSD/RCTA OFF switch
(d) Junction box
(e) Radar sensor (LH) (master)
(f) Radar sensor (RH) (slave)

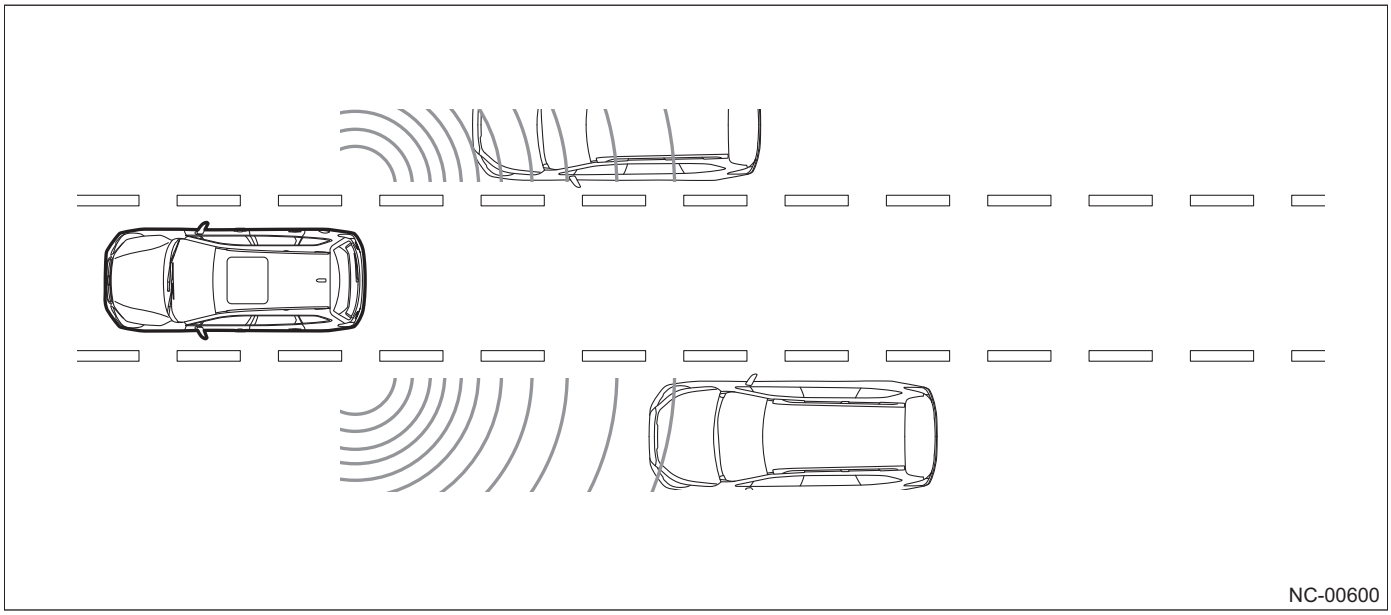
Blind spot vehicle detection (BSD)

This function warns the driver with the illuminating indicator when it detects a (rear) vehicle in the blind spot created by the C pillar and the D pillar,

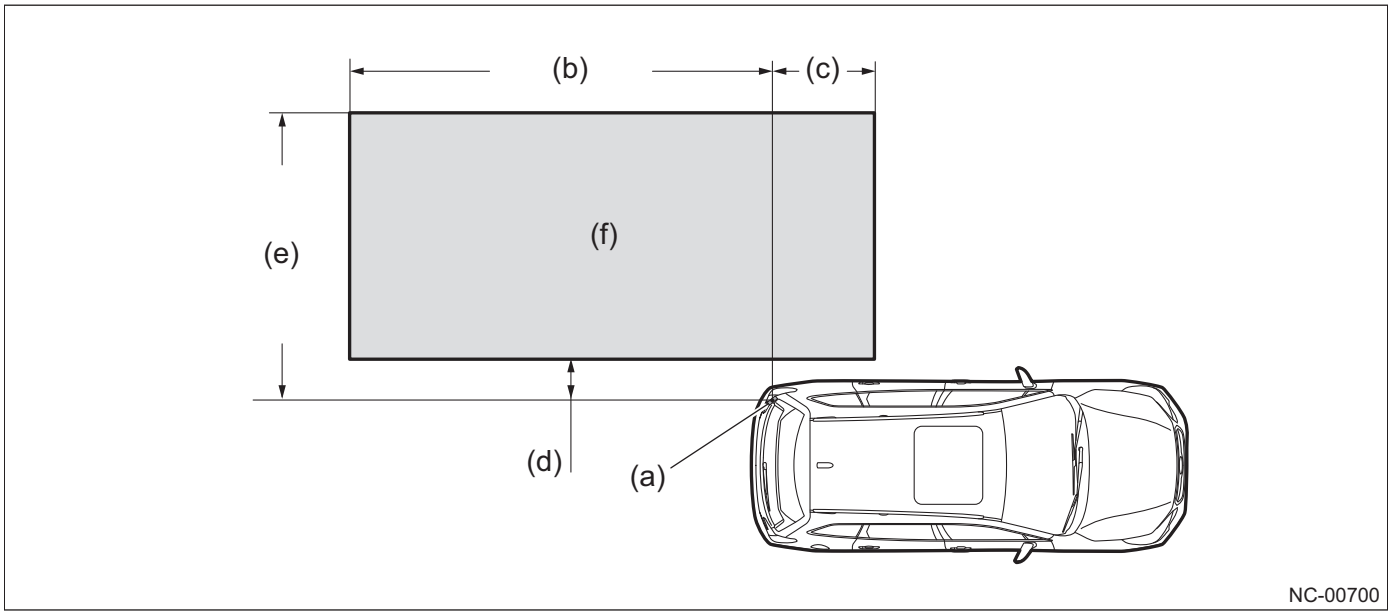
If the driver operates the turn light while a dangerous vehicle is detected, the system determines that the driver's intention to change the lane and warns the driver by flashing the indicator.

Control starts when the vehicle speed is 7.5 MPH (12 km/h) or higher.

Vehicle detection image



Vehicle detection range



(a) Radar sensor (LH) (master)
(b) 157 in (4 m)
(c) 39.4 in (1 m)
(d) 19.7 in (0.5 m)
(e) 138 in (3.5 m)
(f) Vehicle detection range

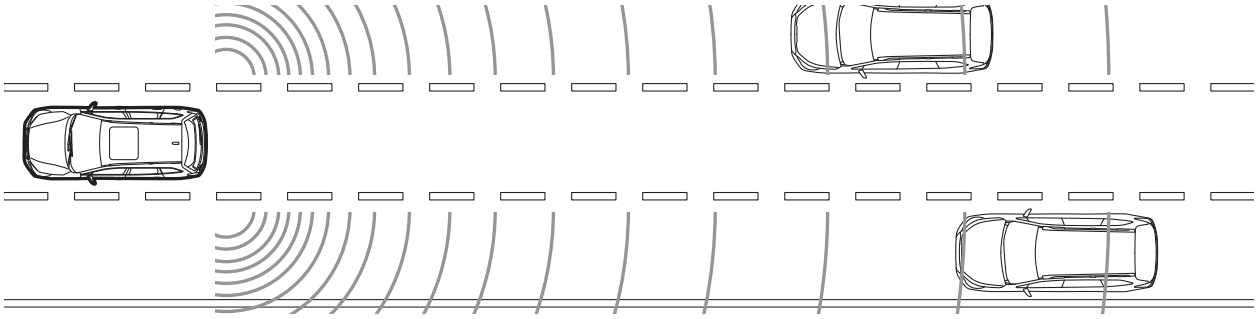
Lane change assistance (LCA)

This function warns the driver with the illuminating indicator when there is a vehicle approaching from the rear side in the neighboring lane and the function determines as there is a danger of collision if the lane is changed.

If the driver operates the turn light while a dangerous vehicle is detected, the system determines that the driver's intention to change the lane and warns the driver by flashing the indicator.

Control starts when the vehicle speed is 7.5 MPH (12 km/h) or higher.

- Vehicles in neighboring lane approximately 230 ft (70 m) behind are detected.
- The vehicles with 4.0 seconds collision time will be the target of warning.



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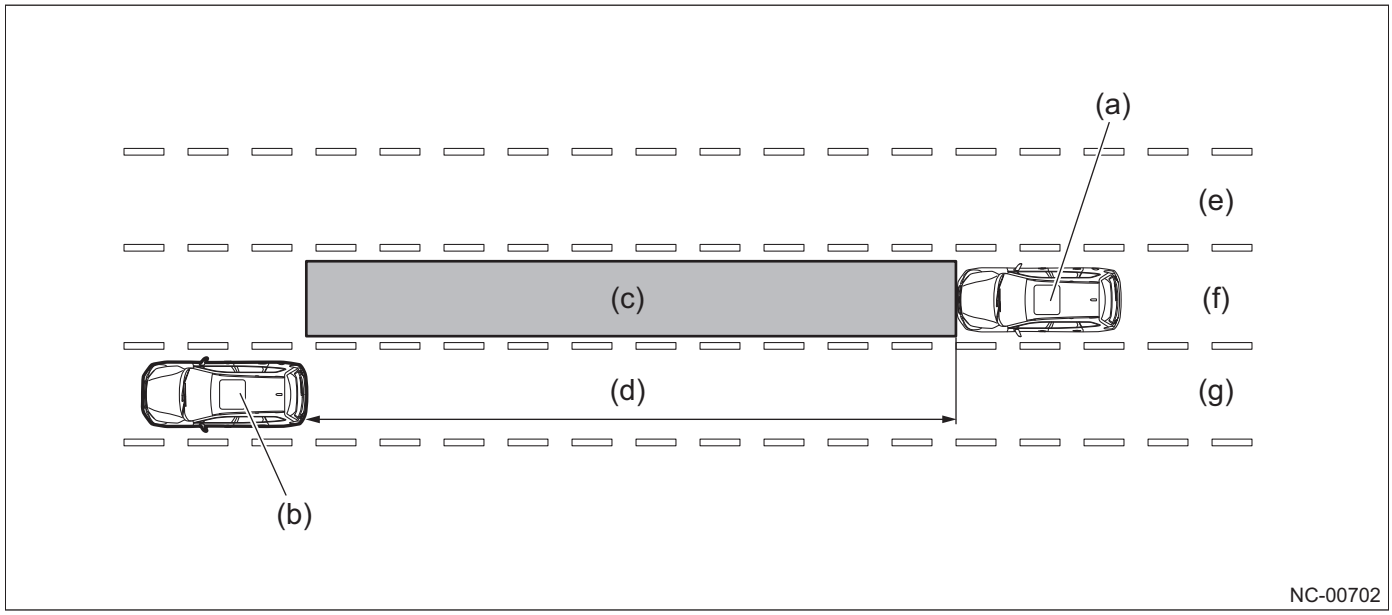
Vehicle detection range



(a) Vehicle target of warning
(b) Own vehicle
(c) Vehicle detection range
(d) Maximum detection distance ≒ 230 ft (70 m)
(e) 3rd Lane
(f) 2nd Lane
(g) Own Lane

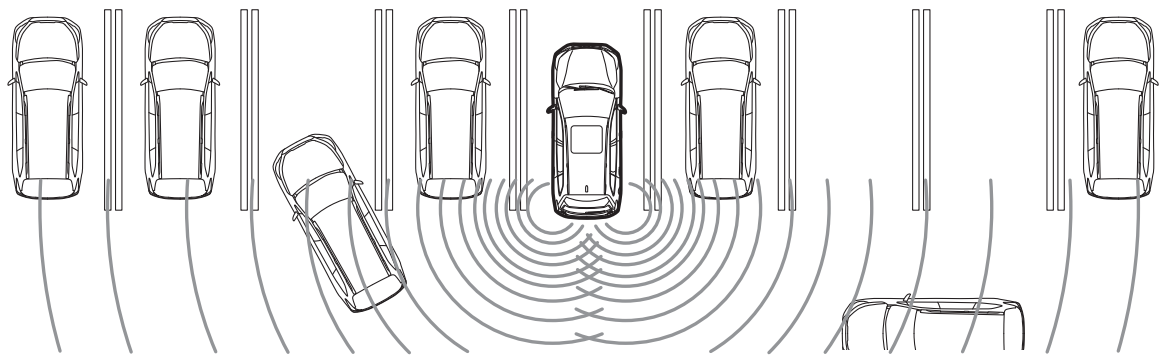
Relationship between the relative speed difference and the distance with the vehicle target of warning

Relative speed difference	Distance
6.2 MPH (10 km/h)	Within 437 in (11.1 m)
12.4 MPH (20 km/h)	Within 874 in (22.2 m)
18.6 MPH (30 km/h)	Within 1,311 in (33.3 m)
24.9 MPH (40 km/h)	Within 1,748 in (44.4 m)

Reversing assistance (RCTA)

This function warns the driver with the flashing indicator and the warning buzzer when there is a cross-traffic approaching from left or right during reversing and determines as there is a danger of collision.

The vehicle that may collide in 3.5 sec will be the target of warning.



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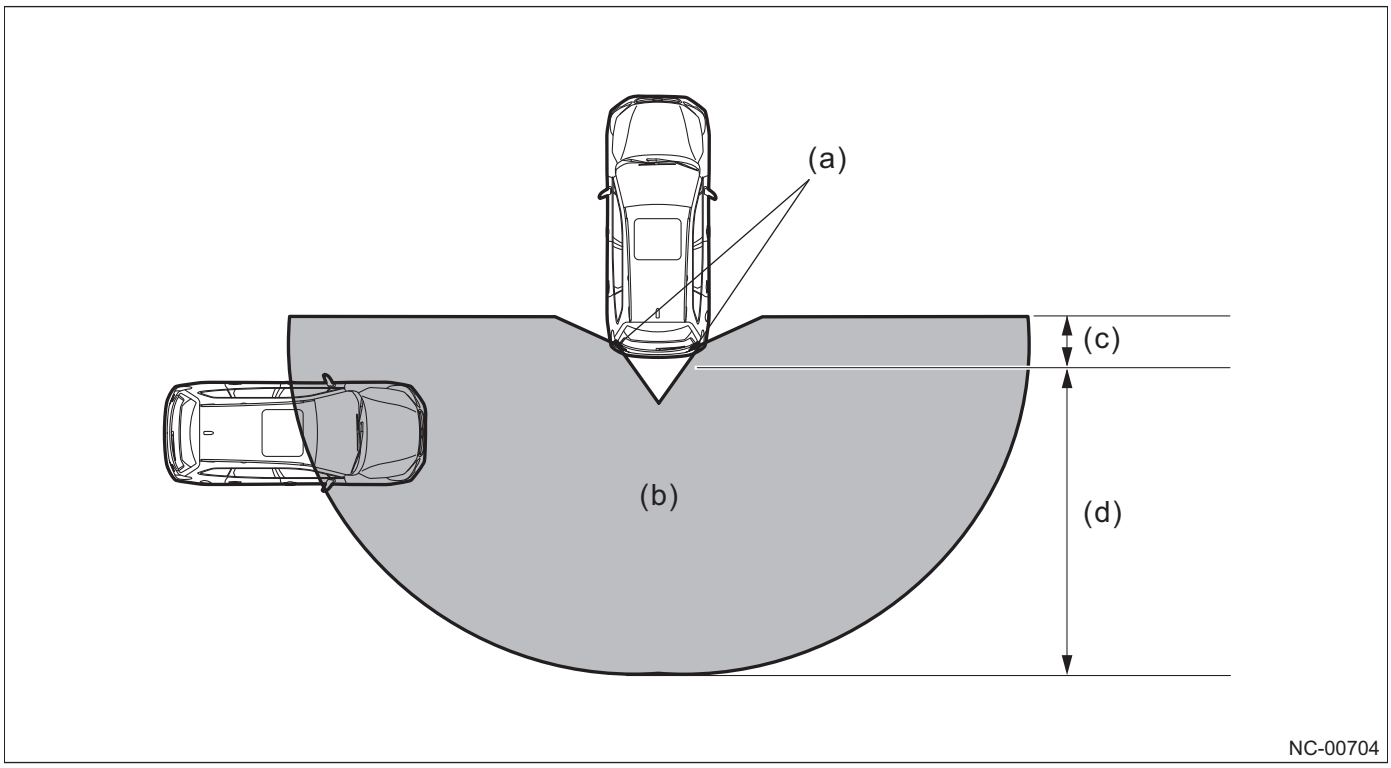
Vehicle detection range



(a) Radar sensor (master & slave)
(b) Vehicle detection range
(c) 39.4 in (1 m)
(d) 276 in (7 m)

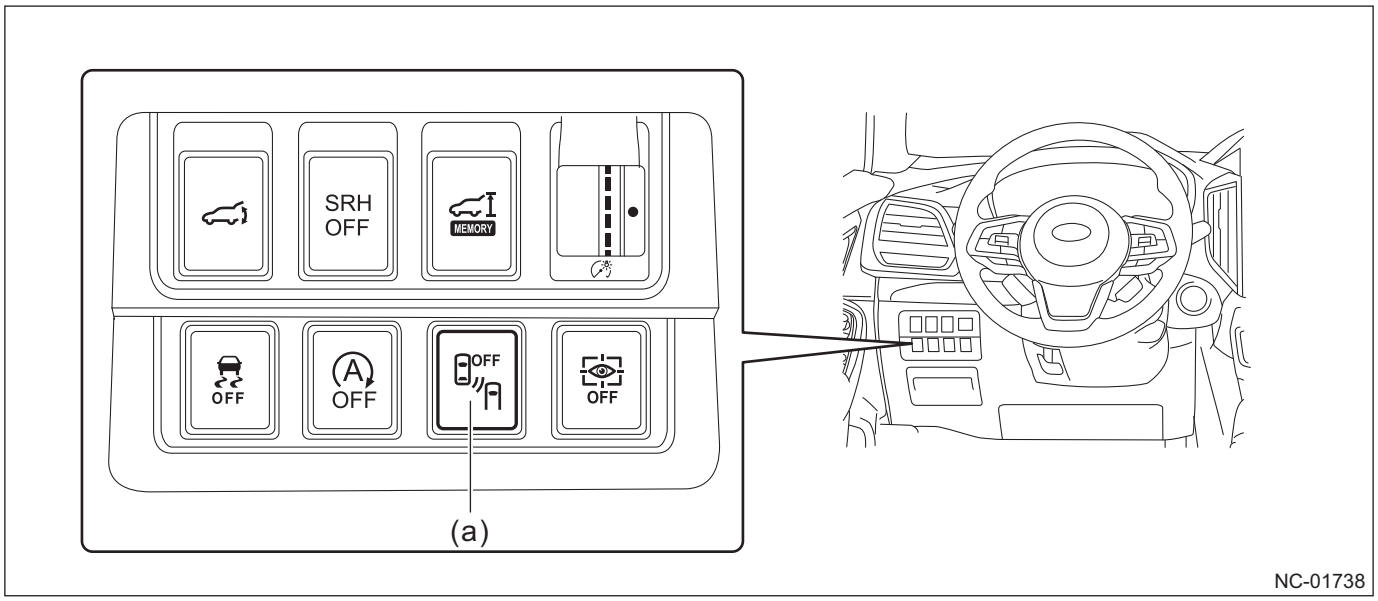
Subaru rear vehicle detection system off function

Turning on/off of the Subaru Rear Vehicle Detection system can be switched with the OFF switch arranged in the instrument panel combination switch.

The on/off status of the system is memorized (last memory) when the ignition switch is OFF.

The default is ON, and the OFF indicator light turns on in the combination meter LCD when the function is turned off.

* Set the function to OFF when towing a trailer, etc.



(a) Subaru Rear Vehicle Detection system (BSD/RCTA) OFF switch

* The switch specification differs depending on with/without each equipment, and destination

Switch transition

Switch transitions are performed by shortly pressing BSD/RCTA ON/OFF (last memory) in the same way as existing model vehicles.

12.4 Reverse Automatic Braking System (RAB)

12.4.1 Overview

The Reverse Automatic Braking system (RAB) is developed as the next step toward a full surrounding preventive safety and to expand the preventive safety idea. This system consists of the "rear obstacle warning function" and the "Reverse Automatic Braking function". This function supports accident prevention during reversing by warning, warning buzzer, and automatic braking against an obstacle at the rear. (for some grades)

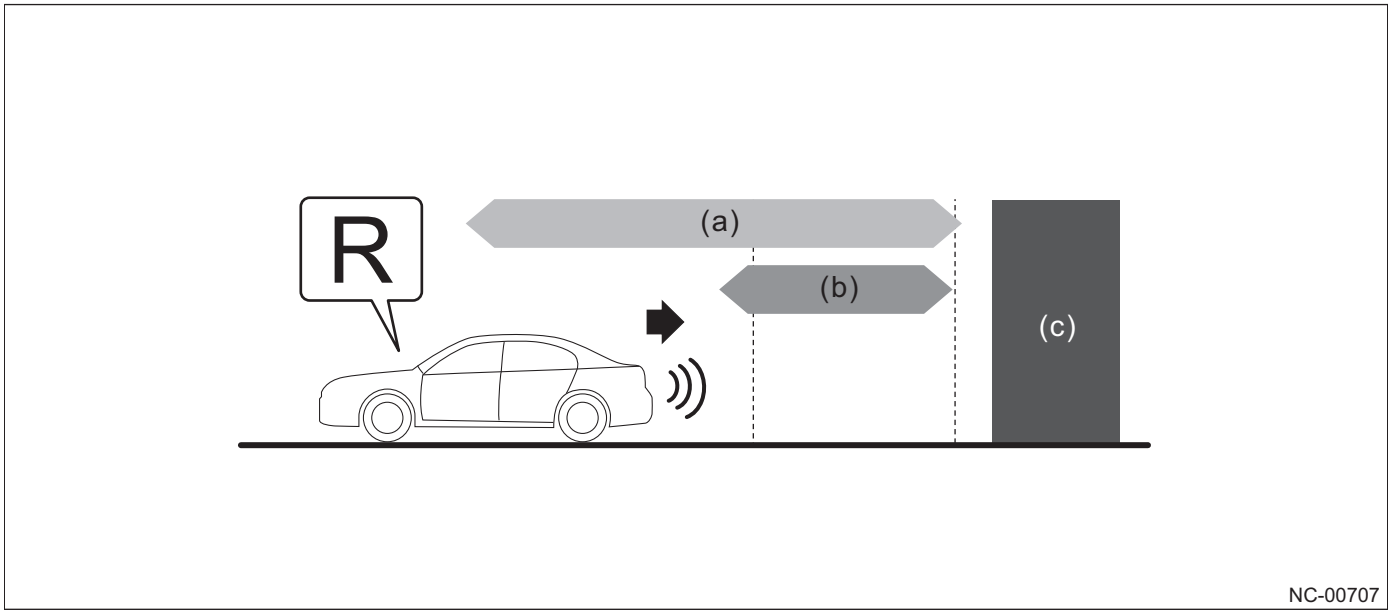
Rear obstacle warning function

Four sonar sensors install in the rear bumper detect the obstacle at the rear side of vehicle during reversing. This function warns the driver with a warning buzzer if there is a possibility of colliding.

Reverse Automatic Braking function

If there is no avoiding action such as braking by the driver, and the system has determined that there is high possibility of collision, this function will suppress the acceleration and apply brake automatically to prevent collision or reduce the damage by the collision.

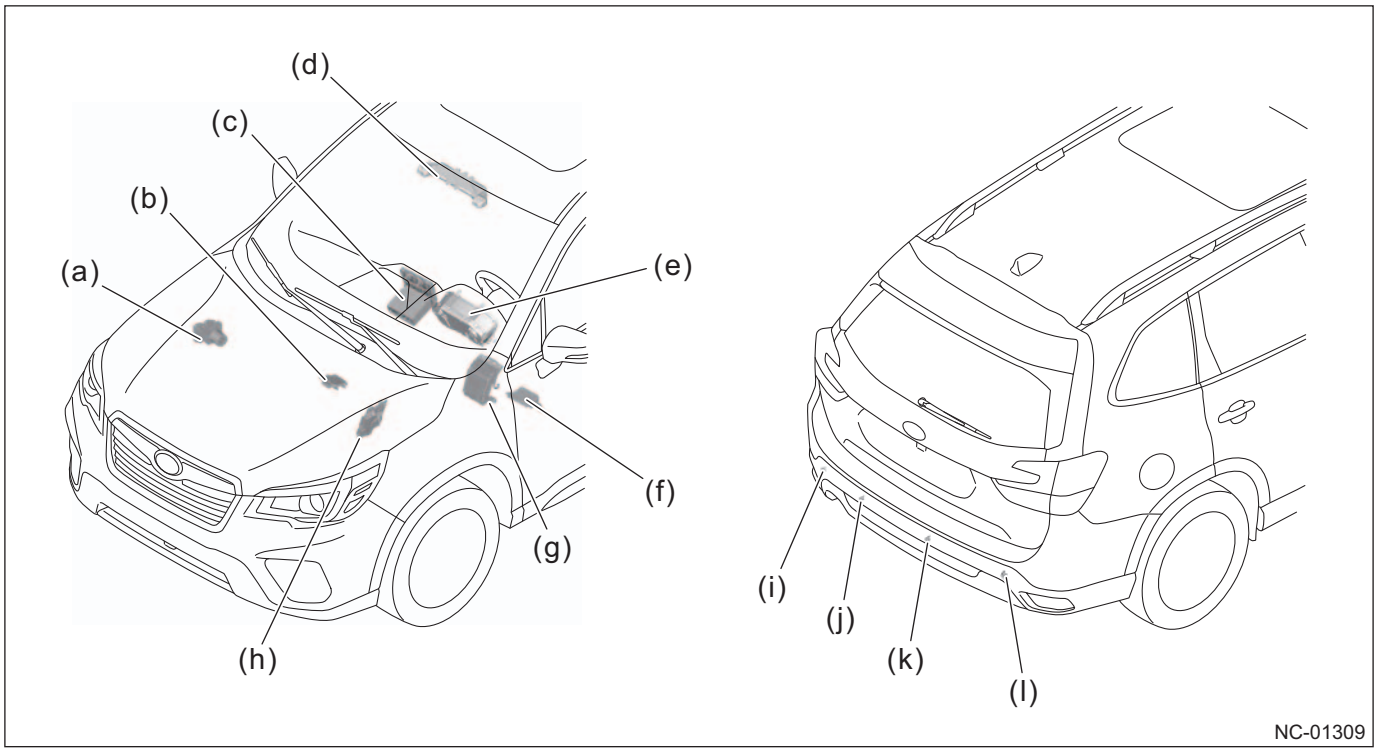
Turning on/off of the Reverse Automatic Braking and warning buzzer can be switched by touching the button displayed in the head unit, and the icon display notifies the driver of the operating status of the system and the warning buzzer.



(a) Rear obstacle warning function
(b) Reverse Automatic Braking function
(c) Obstacle (wall etc.)

12.4.2 Component

Component layout drawing

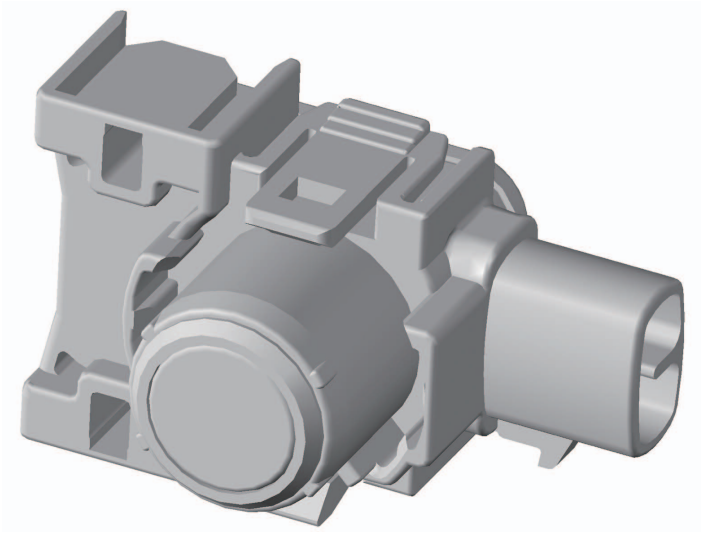


(a) VDCCM & H/M
(b) TCM
(c) Audio/navigation system
(d) Stereo camera
(e) Combination meter (built-in warning speaker)
(f) Sonar ECM assembly
(g) Body integrated unit (in joint box)
(h) ECM
(i) Sonar sensor (left corner)
(j) Sonar sensor (left inner)
(k) Sonar sensor (right inner)
(l) Sonar sensor (right corner)

Component details

Sonar sensor

The sonar sensor is a sensor measuring the distance. Four sensors are installed in the rear bumper (two for corners and two for inner).



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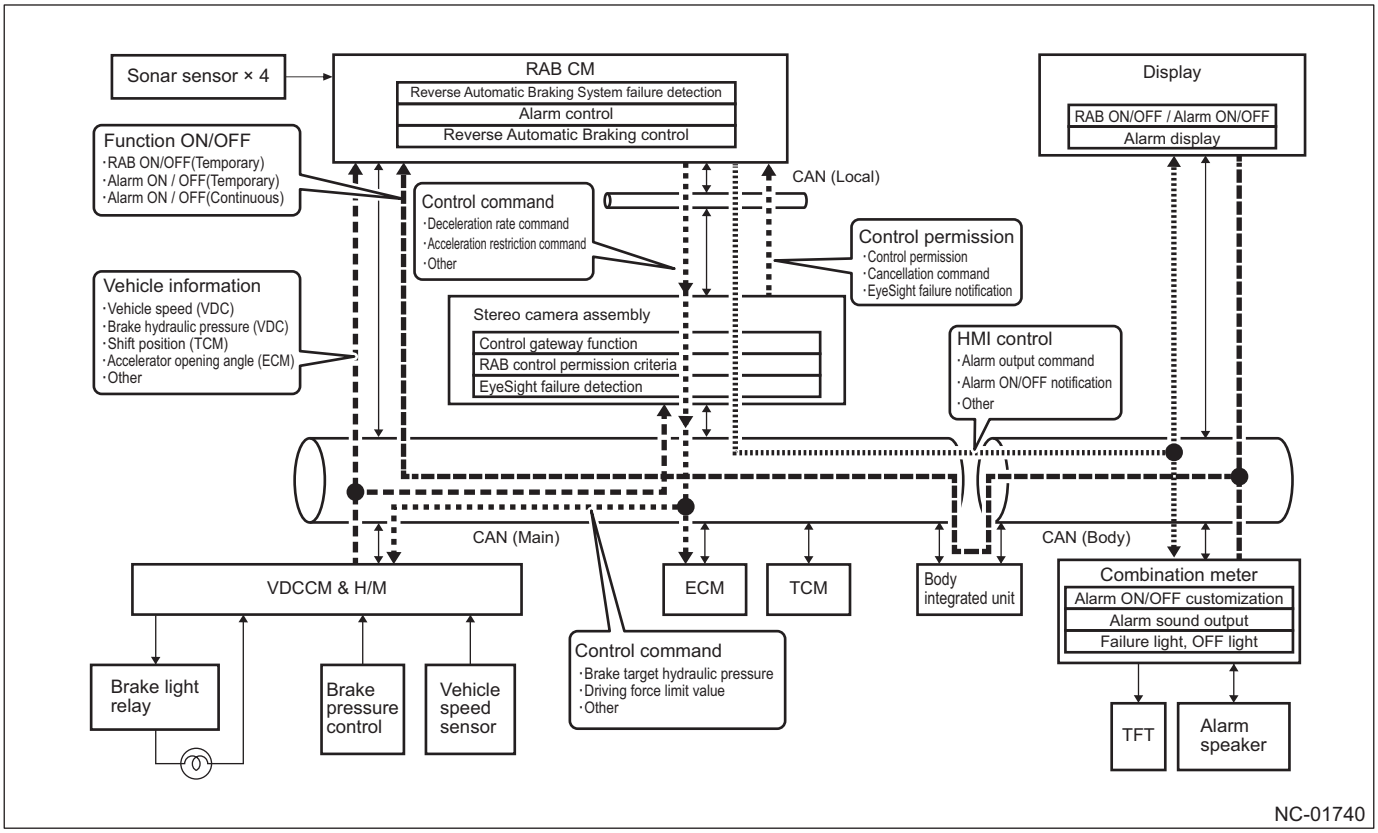
Warning speaker

The warning speaker is installed inside the combination meter and notifies the approximate distance to the obstacle.

The approximate distance to the obstacle is notified by three sound patterns of "mid-distance warning", "proximity warning", and "close proximity warning" from the warning speaker when the sonar sensors detect an obstacle.

12.4.3 Construction and Operation

System diagram



Rear obstacle warning function

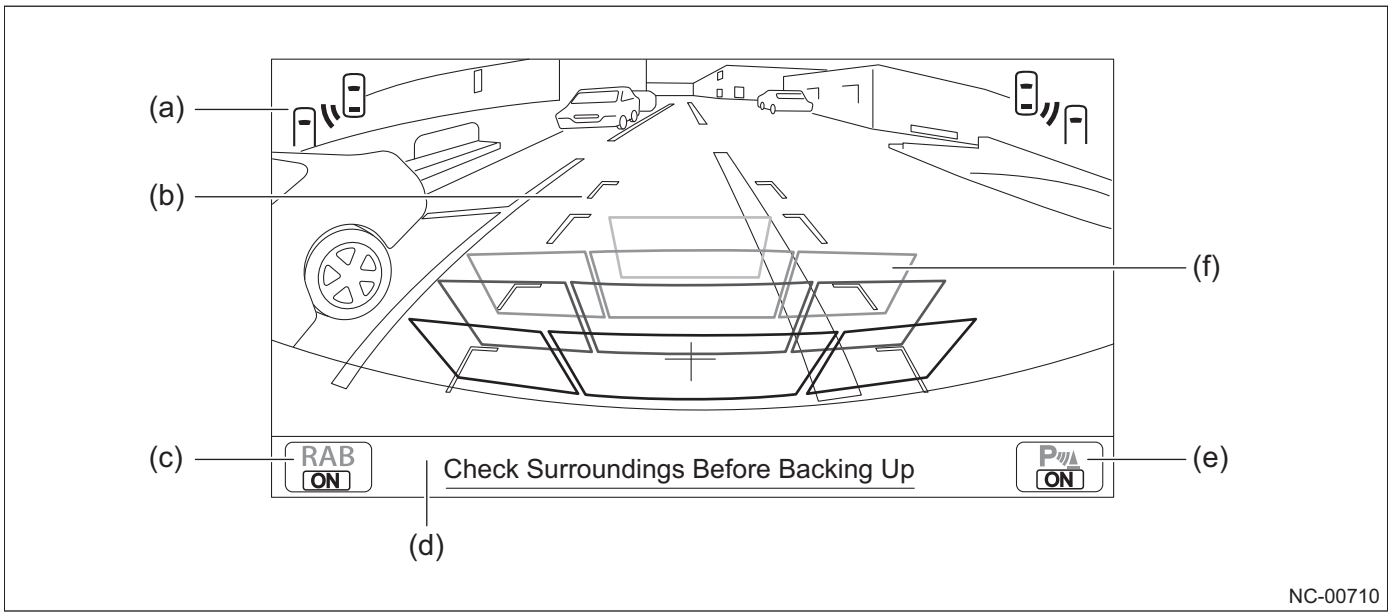
The system warns the driver with the navigation screen and the warning buzzer depending on the distance to an obstacle such as a wall at the rear of the vehicle.

List of warning buzzers

Warning buzzer pattern	Distance to the obstacle*	Display pattern	Warning buzzer
Close proximity warning	Less than 20 in (50 cm)	Red	Beep (continuous sound)
Proximity warning	20 in (50 cm) or more to less than 28 in (70 cm)	Orange	Pi pi pi pi pi
Mid-distance warning	28 in (70 cm) or more to less than 35 in (90 cm)	Yellow	Beep beep beep... (intermittent sound)
Long distance warning	35 in (90 cm) or more to 60 in (1.5 m) or less	Green (Only the center section)	None

* The detection distance may vary depending on the vehicle and surrounding environment.

Warning display on navigation screen



(a) Rear radar warning
(b) Fixed guide line
(c) Reverse Automatic Braking function temporal ON/OFF button*
(d) RAB warning text display
(e) Rear obstacle warning function temporal ON/OFF button*
(f) Rear sonar distance warning display (displays the wall-like warning on the area where the sonar is responding to)

* When the reverse is set again after canceling the reverse position, ON/OFF of the changed "pause" is not memorized and the setting is reset to the meter customization setting.

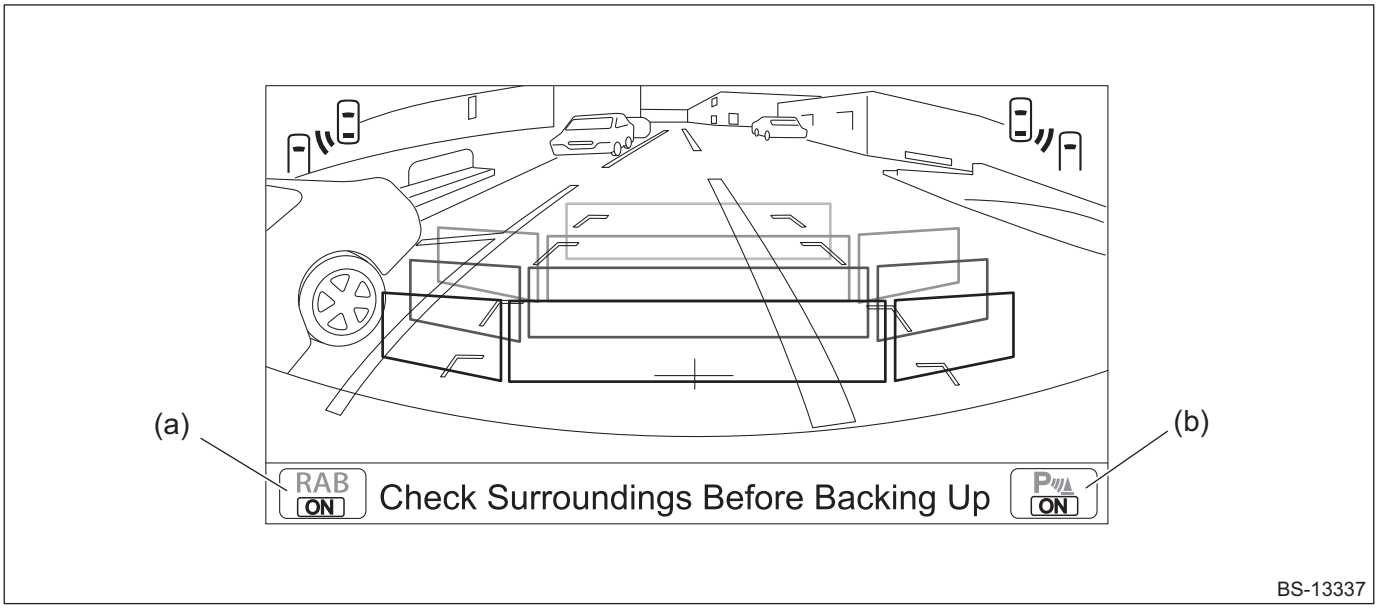
The operating status is notified by the screen display on the audio/navigation system screen and by sounding the warning buzzer when the Reverse Automatic Braking is in operation. Vehicle condition is made easier to understand as this function is linked to the image of the rearview camera.

This function warns the driver by displaying in the head unit and issuing a warning buzzer when a rear obstacle is detected using four sonar sensors installed in the rear bumper.

The warning buzzer sounds from the combination meter.

The distance warning will switch in three levels for two corner sonar sensors and four levels for a center sonar sensor.

Distance warning display



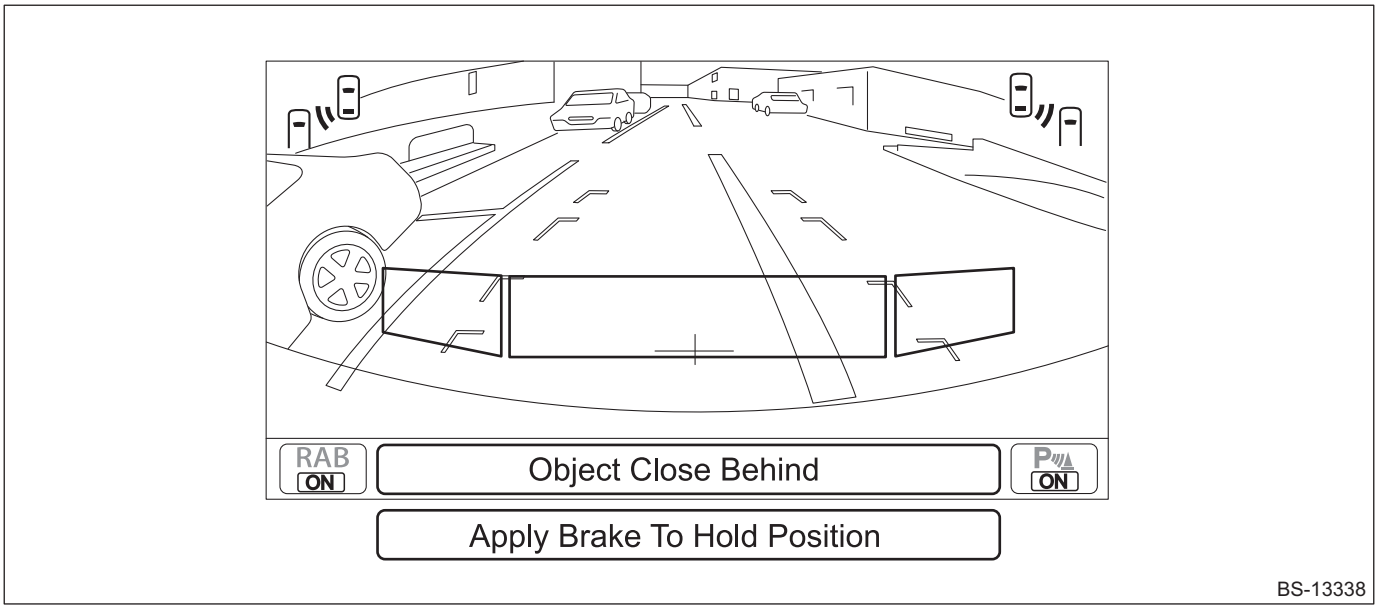
(a) Reverse Automatic Braking function temporal ON/OFF button*

(b) Rear obstacle warning function temporal ON/OFF button*

* When the reverse is set again after canceling the reverse position, ON/OFF of the changed "pause" is not memorized and the setting is reset to the meter customization setting.

As a distance warning display, semitransparent walls equivalent to width of 23.6 in (60 cm) (corner), 31.5 in (80 cm) (center), and height of 15.7 in (40 cm) for near proximity (red), proximity (orange), mid distance (yellow), and long distance (green) are displayed on the image from the rearview camera.

Display when RAB operates

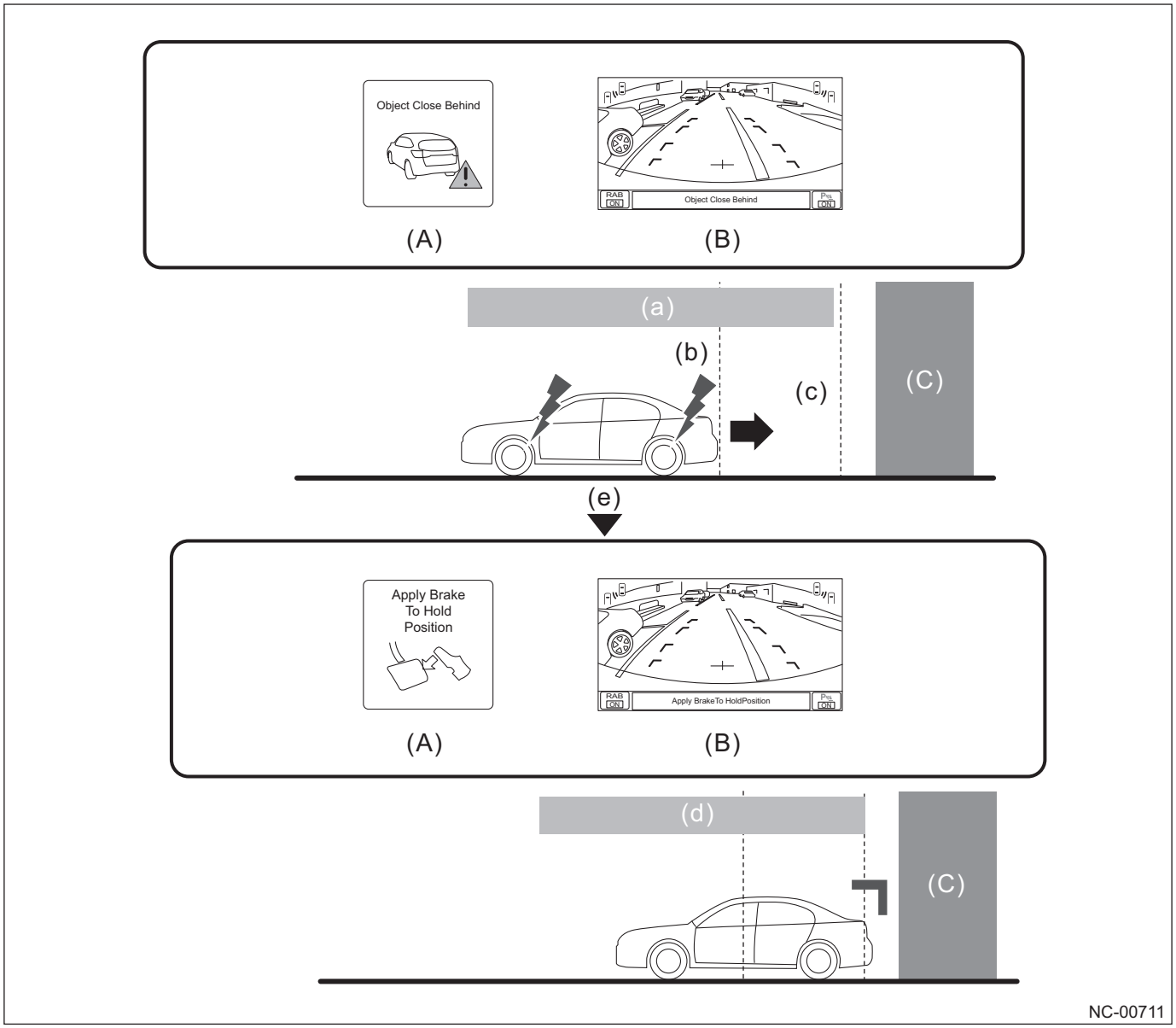


- The "Object Close Behind" display interrupts as a warning into the head unit and the combination meter while the RAB is operating.
- The "Apply Brake To Hold Position" display interrupts as a warning into the head unit and the combination meter after RAB operates.

Reverse Automatic Braking (RAB) function

If the system detects an obstacle such as a wall at rear of the vehicle and has determined that there is high possibility of collision, this function will suppress the acceleration and apply brake automatically to prevent collision or reduce the damage by the collision.

Upper limit vehicle speed for operation	Approx. 9 MPH (15 km/h) or less
Collision prevention target vehicle speed	Approx. 3 MPH (5 km/h) or lower
The Reverse Automatic Braking function is activated when the following conditions are met.	When Select lever is "R"
	When vehicle speed is 1 to 9 MPH (1.5 to 15 km/h)
	When an obstacle is detected while this function is enabled
The Reverse Automatic Braking function will be canceled in one of the following cases.	When the brake pedal or accelerator pedal is operated
	When 120 seconds have elapsed without any operation after the vehicle is stopped, and the electronic parking brake (EPB) is operating



(A) Multi-information display
(B) Navigation screen
(C) Obstacle (wall etc.)

(a) Acceleration restricting + Automatic brake
(b) Phase 1: Acceleration restricting (warning buzzer: pi pi pi pi...)
(c) Phase 2: Automatic brake operation (warning buzzer: continuous beep)
(d) After the automatic brake operates

Operating conditions

Reverse Automatic Braking (RAB) system will operate in the following conditions.

- When RAB is operating
- When the select lever is in the "R" range
- When the vehicle is reversing at approximately 1 to 9 MPH (1.5 to 15 km/h)
- The obstacle is approximately 1.64 ft (0.5 m) or more away from the bumper when the select lever is shifted to "R" range.

* RAB has limitations in its performance, and it may not be able to avoid collision.

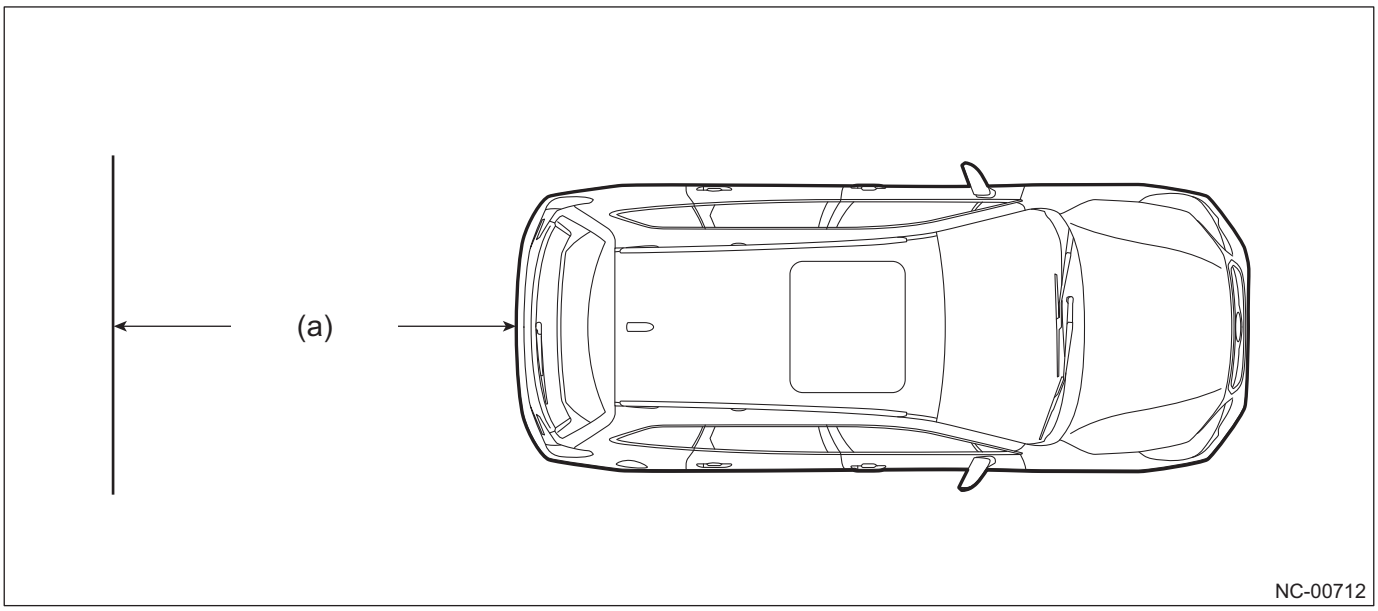
Cancel conditions

Reverse Automatic Braking (RAB) system will cancel its operation in the following conditions.

- When the driver depresses the brake pedal after the automatic brake operates
- When the driver depresses the accelerator pedal after the automatic brake operates
- When the obstacle is no longer detected
- When the driver kept depressing the accelerator pedal while restricting the acceleration
- When the select lever is shifted to a range other than "R" range

Detection range and detection object

An obstacle in the detection range of approximately 4.9 ft (1.5 m) from the bumper in rear, and approximately 5.9 in (150 mm) from the width of the vehicle can be detected.



(a) 4.9 ft (1.5 m)

Detection range and detection condition

Object cannot be detected when the object is in the following conditions.	Moving object	
	Too close obstacle	
The following objects may not be detected.	Narrow objects such as sharp object, narrow pole, fence, rope, etc.	
	Surface condition of the object	
	Object that does not reflect the sound waves well such as human, cotton, snow, etc.	
	Wall in a tilted angle	
	Objects with low height	
The vehicle condition or the surrounding environment may affect the detection by the sonar sensors.	The braking by the system may be weak in a steep incline.	
	It may not correctly detect in the following cases.	Seal is affixed, or paint or chemical is applied near the sonar sensor in the bumper.
		The bumper is modified or disassembled/assembled.
		The vehicle height has changed due to cargo load or modification.
	Ice, snow, or dirt is attached to the bumper.	
	Perform an inspection when a strong impact is applied or there is deformation of the bumper.	
	The Reverse Automatic Braking cannot operate when the EyeSight is broken.	
	The Reverse Automatic Braking may not operate when the EyeSight is paused.	
The detection may be difficult in the following conditions.	When sound waves close to the frequency used by this system are mixed up.	
	When the vehicles with the same system are backing up to each other.	
	When reversing in a downhill direction	

<table>
<tr><td rowspan="12">The system may operate even without possibility of collision in the following conditions.</td><td colspan="2">Effect of the surrounding environment
When reversing over pebbles or grasses</td></tr>
<tr><td colspan="2">When reversing toward banner, flag, drooping branch, or crossing bar</td></tr>
<tr><td colspan="2">When there is an obstacle at the side of the road (narrow tunnel, narrow iron bridge, narrow road, narrow garage)</td></tr>
<tr><td colspan="2">When there is track or hole in the ground</td></tr>
<tr><td colspan="2">When reversing over a metal cover (grating) of water drain</td></tr>
<tr><td colspan="2">When reversing on a steep uphill</td></tr>
<tr><td colspan="2">When reversing toward a curb</td></tr>
<tr><td colspan="2">When reversing on a bump</td></tr>
<tr><td rowspan="2">Effect of weather</td><td>In heavy rain or when water is splashed</td></tr>
<tr><td>Adverse weather condition such as fog, snow, spray of snow, sand storm, etc.</td></tr>
<tr><td>Effect of other sound waves</td><td>When object that generates ultrasonic sound wave such as horn of another vehicle, engine sound of motorcycle, sound of air brake, vehicle detector, or sonar sensor of another vehicle is near by</td></tr>
<tr><td>Attached objects around the sonar sensor</td><td>When commercially available electric parts (fog light, fender pole, radio antenna, etc.), or accessories (trailer hitch, bicycle carrier, etc.) are attached close to the sonar sensor in the rear bumper</td></tr>
<tr><td rowspan="3">Change in vehicle</td><td>When the vehicle posture has tilted excessively</td></tr>
<tr><td>When the vehicle height has changed excessively due to cargo condition, etc.</td></tr>
<tr><td>When the direction of the sonar sensor has shifted due to collision, etc.</td></tr>
</table>

The system may not operate correctly or the operation may be canceled in the following conditions.	Effect of the surrounding environment	When there is an obstacle that cannot be detected between the detectable obstacle and the vehicle
	Effect of weather	When the surrounding area of the sonar sensor is excessively hot or cold due to hot or cold weather
		When heavy rain or water is splashed onto the sonar sensor surface
		Adverse weather condition such as fog, snow, spray of snow, sand storm, etc.
	Effect of other sound waves	When object that generates ultrasonic sound wave such as horn of another vehicle, engine sound of motorcycle, sound of air brake, vehicle detector, or sonar sensor of another vehicle is near by
	Attached objects around the sonar sensor	When commercially available electric parts (fog light, fender pole, radio antenna, etc.), or accessories (trailer hitch, bicycle carrier, etc.) are attached close to the sonar sensor in the bumper
	Change in vehicle	When the vehicle posture has tilted excessively
		When the vehicle height has changed excessively due to cargo condition, etc.
		When the direction of the sonar sensor has shifted due to collision, etc.

Customization function

Temporarily switching ON/OFF the function

There is a function to temporarily turn the Reverse Automatic Braking function and the rear obstacle warning function ON/OFF depending on the condition such as towing a trailer.

- Navigation screen: Temporarily switching ON/OFF the Reverse Automatic Braking function, and rear obstacle warning function
- Customizing screen of meter: Constantly switching ON/OFF the rear obstacle warning function

The Reverse Automatic Braking function and rear obstacle warning function can be temporarily switched ON/OFF by touching the button displayed on the navigation screen.

Reverse Automatic Braking (RAB) system and warning buzzer icon display

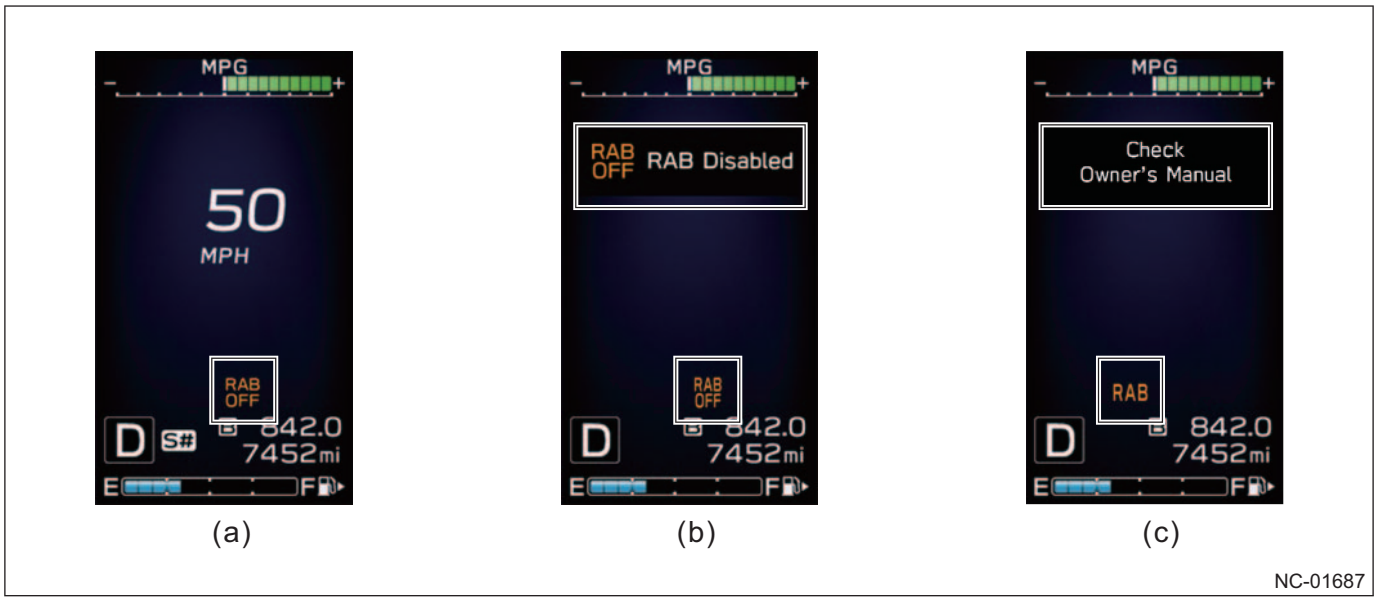
Function	On condition	Off condition	Non-usable state*1
Reverse Automatic Braking function (RAB)	 ADA10656	 ADA10657	 ADA10658
Rear obstacle warning function (Sonar warning buzzer*2)	 ADA10659	 ADA10660	 ADA10661

*1: When system failure has occurred, or during pause or initialization (startup), etc.

*2: The sound volume of the sonar warning buzzer follows the customizing setting of the combination meter.

System status display (multi-information display)

The multi-information display will display as follows depending on the condition of the Reverse Automatic Braking (RAB) system.



(a) When the RAB system is temporarily turned off by a user operation

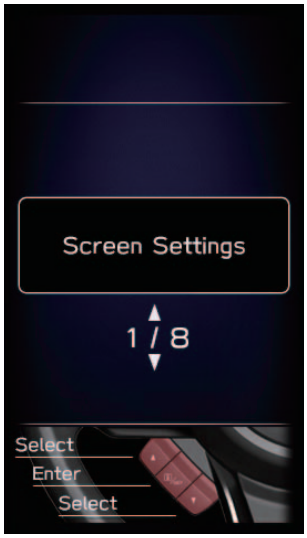
(b) When the system detects abnormality and temporarily turns the RAB system off

(c) When a RAB system failure occurred

Reverse Automatic Braking (RAB) operation setting

Turning on/off the RAB function can be set on the user customizing screen of the multi-information display.

Item		Setting	Initial setting
RAB	Sonar warning buzzer	ON/OFF	Follow the vehicle setting



ADA10645

Setting method

- Pull i/SET switch of the multi-information display change switch continuously to switch to the setting screen.
- Select RAB with ▲▼ switches, and pull i/SET switch.
- Select sonar warning buzzer or automatic brake with ▲▼ switches, and pull i/SET switch.
- Change the setting with ▲▼ switches, and pull i/SET switch.

12.5 Driver Monitoring System

12.5.1 Overview

The system embodies SUBARU's commitment focused on customers and watches for customers from the center of the vehicle (safety) and provides hospitality (pleasantness).

The system presumes the driver's inattentiveness and dozing by the installed camera for the cabin to continuously watch over the driver's safety and issues warning to the driver.

The system recognizes registered individual and provides comfortable interior space for each person.

Background/purpose for adoption

With the drivers aging or becoming younger, collision accidents have been increasing due to the driver's carelessness (inattentiveness or dozing), advanced safety technologies such as EyeSight have been installed in recent vehicles. While the advanced safety technologies help reduce the burden of the driver, they may result in inducing the driver's carelessness due to the inattention of thinking "the vehicle should not collide with objects because it has advanced safety equipment installed". In order to prevent the inattention, a driver monitoring system is developed as "eyes" for monitoring the cabin so that the vehicle can monitor the driver's status and warn the driver at the proper timing.

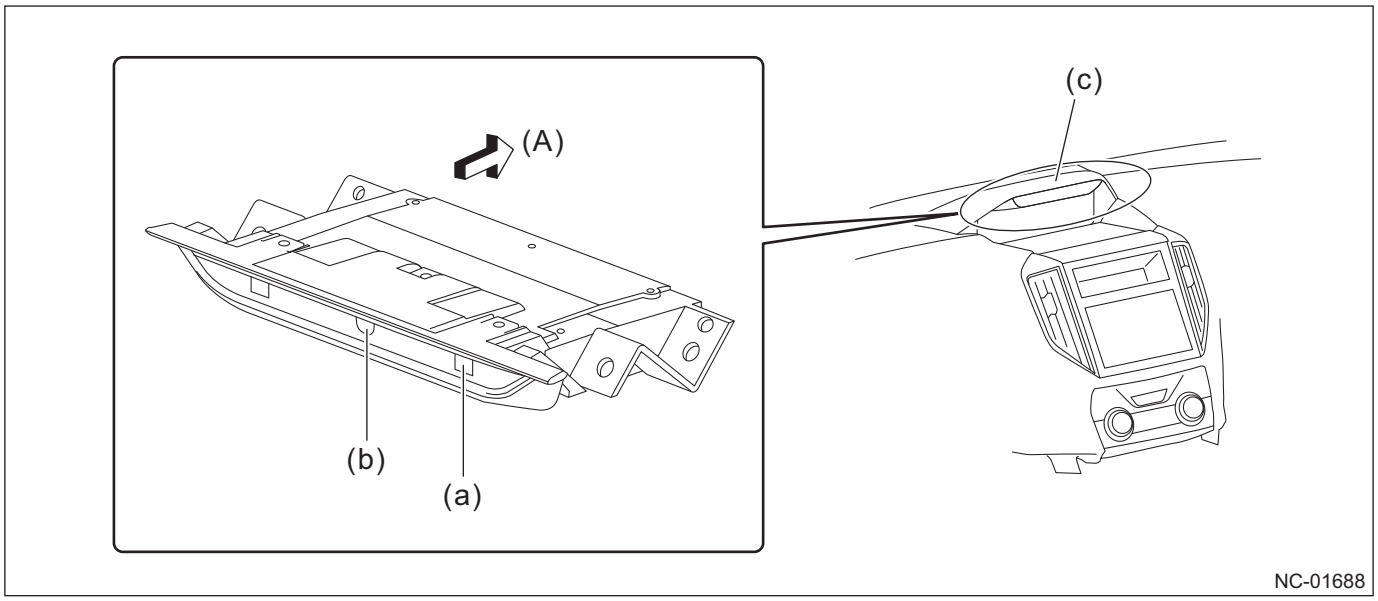
In addition, SUBARU aims to make customers feel a vehicle as the more intimate existence by using the system for the driver safety and providing the comfortable interior space for customers.

Since SUBARU vehicles aim to be closer to all generations from children to adults as well as married couples, the system is able to register up to five persons.

12.5.2 Component

Component layout drawing

The components of the driver monitoring system are arranged in the multi-function display (MFD) visor.



(A) Front of vehicle

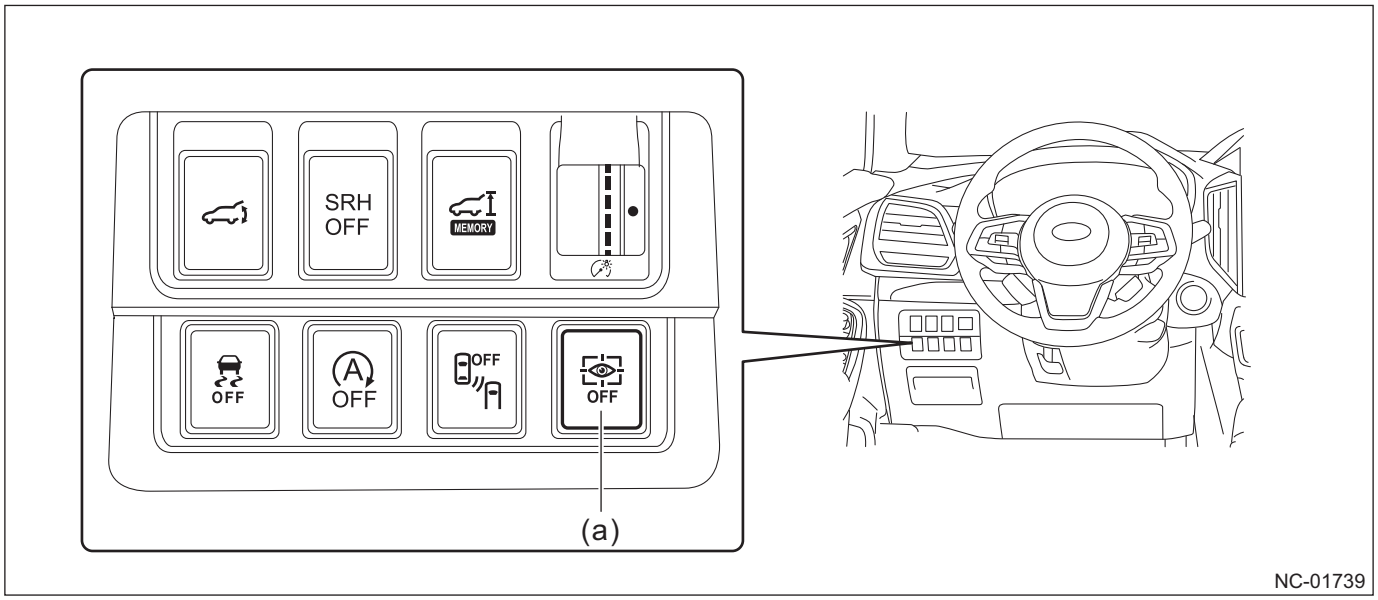
(a) Near infrared rays LED
(b) Camera
(c) Multi-function display (MFD) visor

Component details

OFF switch

The OFF switch for switching the driver monitoring system function ON/OFF is placed in the instrument panel combination switch.

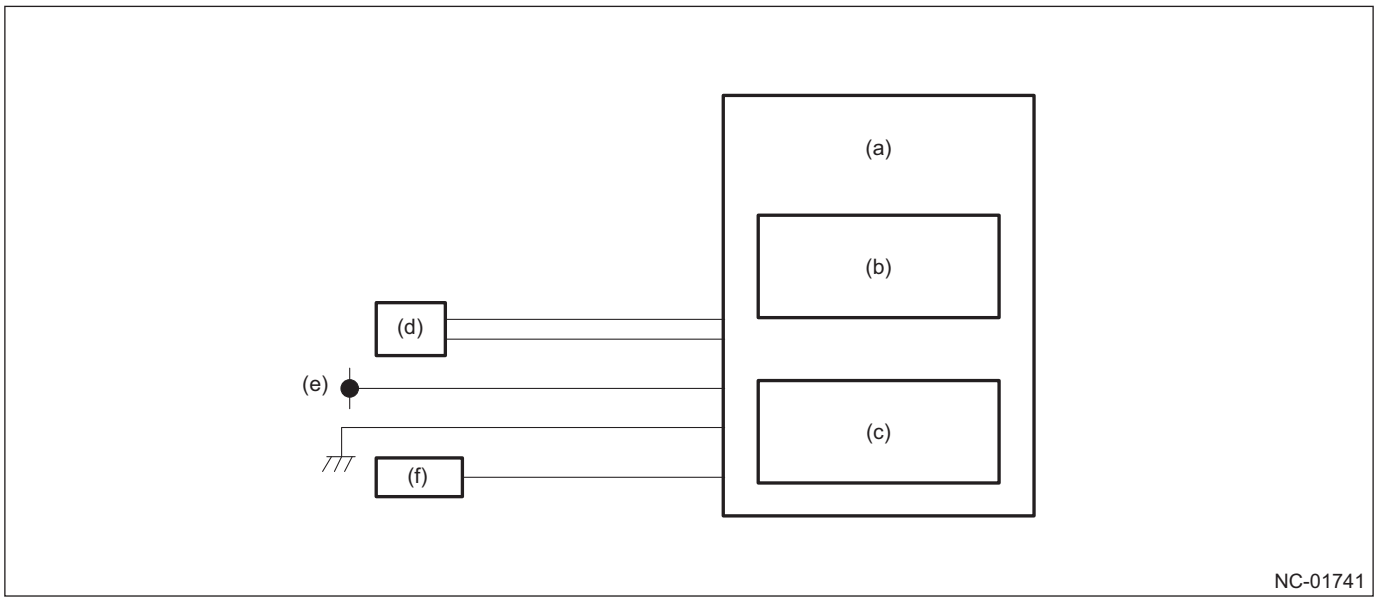
* The switch specification differs depending on with/without each equipment, and destination.



(a) Driver monitoring system OFF switch

12.5.3 Construction and Operation

System diagram



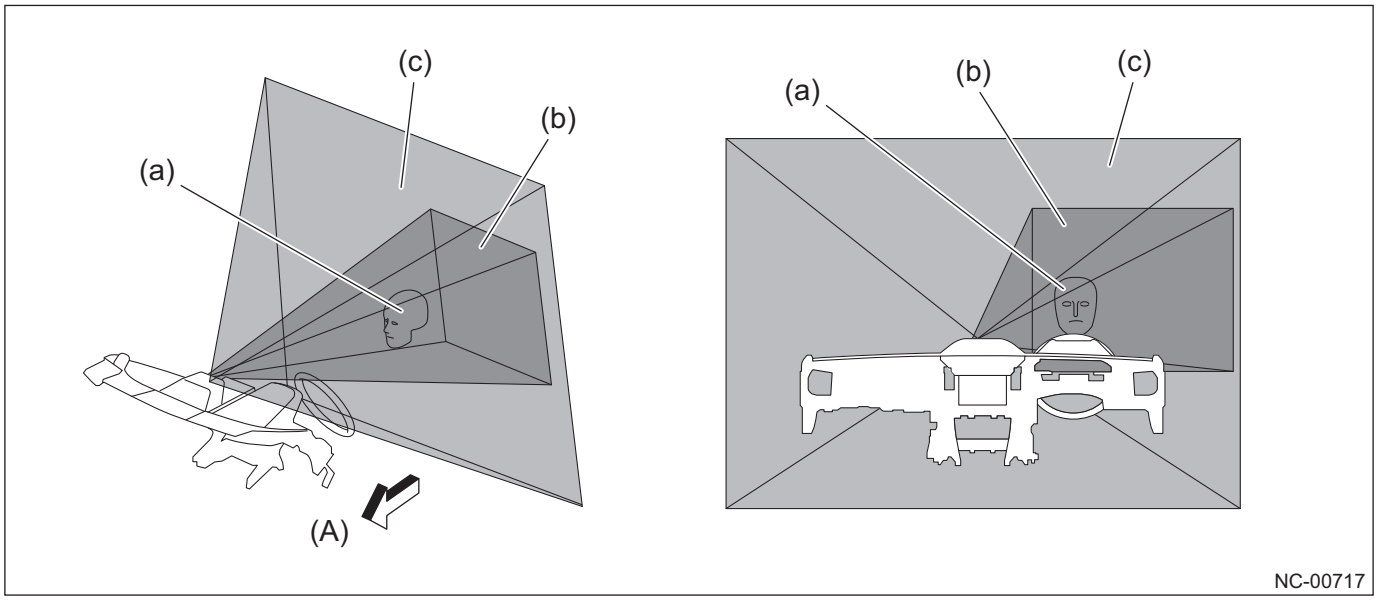
(a) Driver monitoring system control module
(b) Near infrared rays LED (for LHD)
(c) Camera
(d) Body CAN
(e) + B
(f) Driver monitoring system OFF switch

System details

Driver monitoring system principle

The system irradiates near infrared ray LED to the driver and takes an image with a camera. The system calculates the direction of the face, open/close state of the eyes, and facial characteristics based on the taken image.

Taken image



(A) Front of vehicle

(a) Driver
(b) Irradiates near infrared ray
(c) Camera takes an image

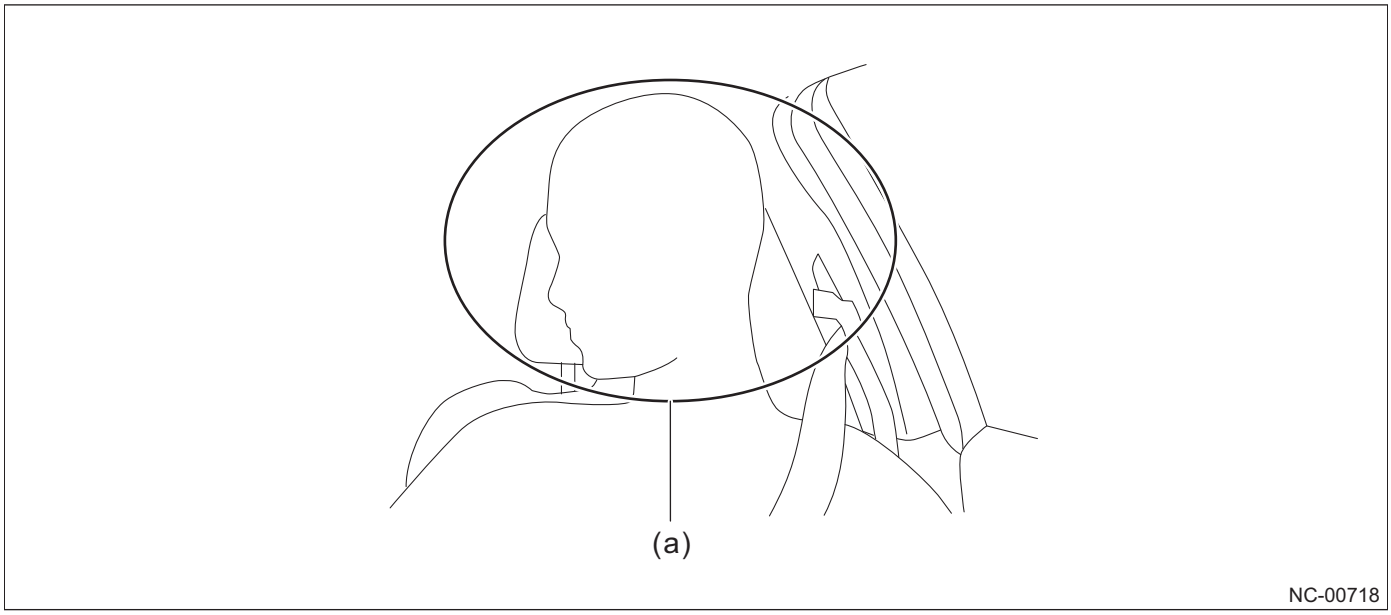
Inattentive warning buzzer

The function presumes an inattentive driving if the angle of the driver's face continues to be larger than the predetermined range.

The inattentive driving presumption is performed only during driving. (Warning is not issued when the turn signal is turned on or when the vehicle is stopped.)

If the system presumes the inattentive driving, the system warns the driver with a buzzer and meter display (MID).

When EyeSight recognizes a preceding vehicle, it presumes an inattentive driving earlier and warns the driver with a buzzer.



(a) Capturing the face direction and presuming an inattentive driving

Dozing/sleepiness warning buzzer

If the driver's eyes are continuously closed, the system presumes that the driver is dozing.

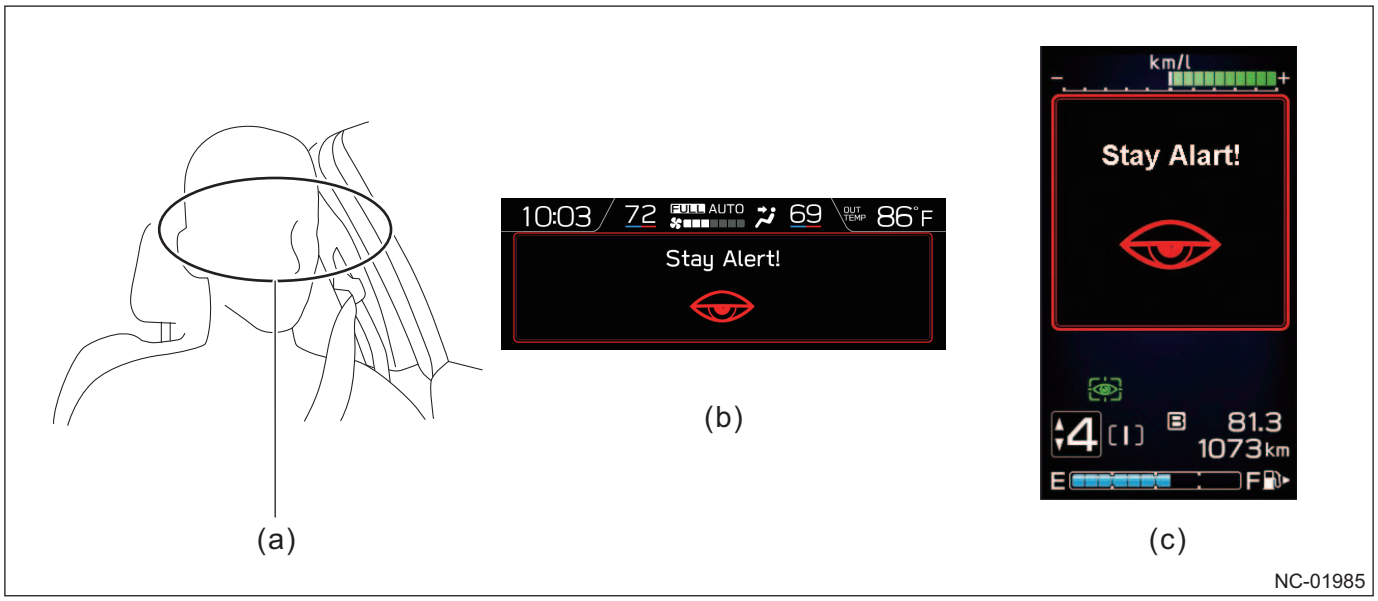
The system calculates the level of sleepiness based on the duration of the driver's eyes closed and presumes the sleepiness when the level exceeds the predetermined level. (System presumes the state as two levels of sleepy and very sleepy.)

Dozing and sleepiness presumptions are performed only during driving. (Presumption is not performed when the vehicle is stopped.)

If the system presumes the state as the light sleepiness, the system warns the driver with the meter display (MID).

If the system presumes that the driver is dozing or very sleepy, the system warns the driver with the buzzer, meter display (MID), and multi-function display (MFD).

In addition, the system mutes the audio volume so that the driver can easily hear the buzzer sound only when the system presumes that the driver is dozing or very sleeping. (Only models with navigation)



(a) Watching the eye opening degree and presuming dozing/ sleepiness
(b) Dozing warning display (MFD screen display)
(c) Dozing warning display (MID screen display)

Personal recognition

When the system performs personal recognition with the opening and closing of the door, the system graphically displays the recognition result on the multi-function display (MFD) when the driver sits down and recognition is completed.

The system then automatically sets the seat position, door mirror angle, contents displayed on the multi-function display (MFD) and the meter screen, and air conditioner according to the recognized driver. This seamlessly provides the optimal interior space to each driver.

The personal registration is performed on the customizing screen of the multi-function display (MFD) by the satellite switch (INFO) on the steering wheel and the meter operation switch when the ignition is ON.

Up to five drivers can be saved.

Individual fuel efficiency that shows the driving fuel efficiency for each driver recognized can be displayed on the multi-function display (MFD).

Multi-function display (MFD)

(a) Recognition result display

(b) Personal fuel efficiency display