
GROUP 35C

ACTIVE SKID CONTROL SYSTEM (ASC)

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GENERAL INFORMATION

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Active skid control (ASC) has been equipped as a standard.

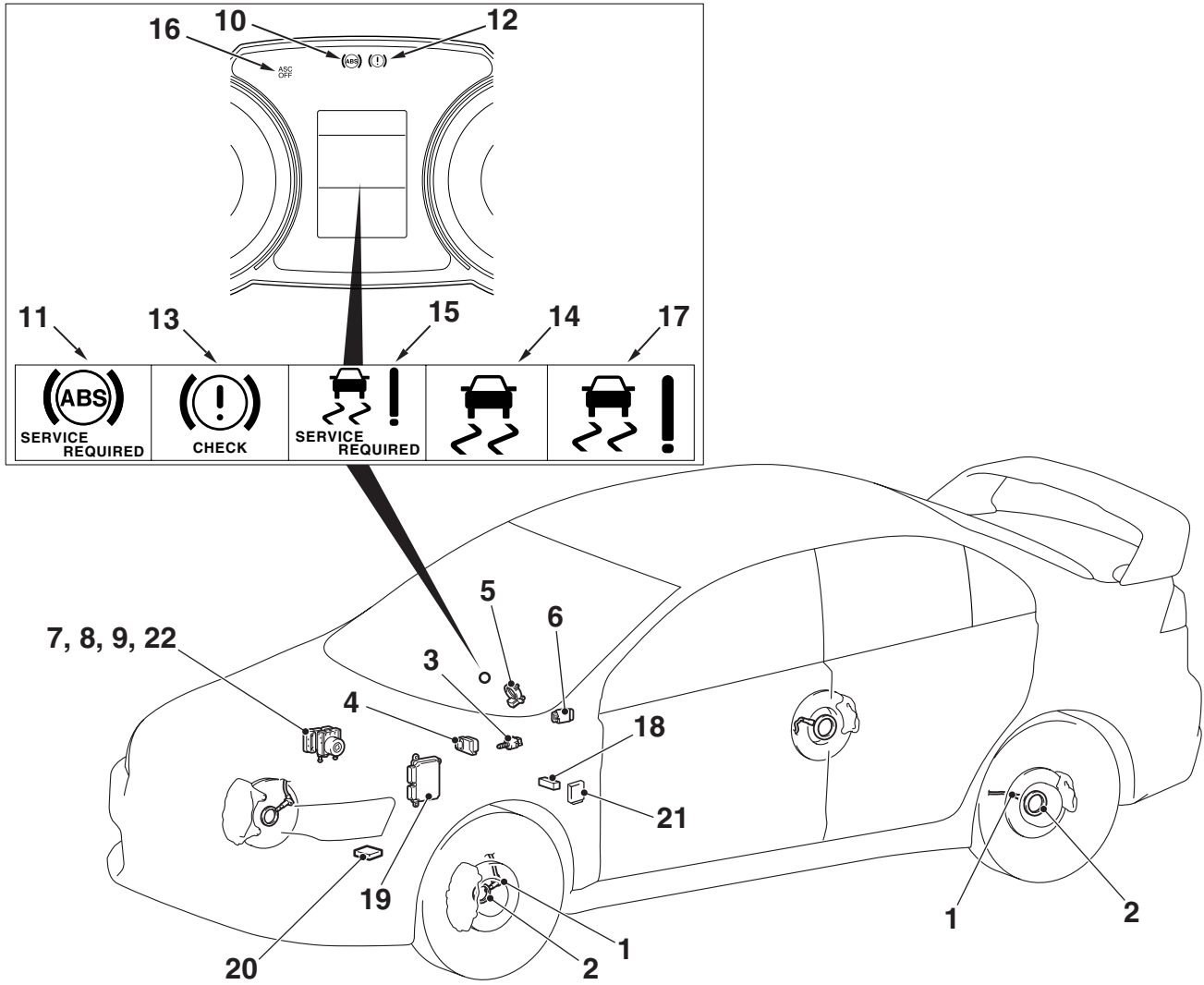
- ASC has been added to the transaxle <twin clutch sportronic shift transmission (TC-SST)^{*1}> control and AWD <super all wheel control (S-AWC)^{*2}>, and the controls are integrated to improve the vehicle stability.
- The ASC system integrates the traction control (TCL) function and skid control function.
- When the TCL function detects the slip of driving wheel (for example, during startup on slippery road), it automatically applies the braking force to the slipping driving wheel. At the same time, TCL reduces the engine output and prevents the wheel spin when it determines that the engine torque is too high for the road surface friction coefficient.
- When the skid control function determines that the vehicle behavior is in a critical state, it reduces the engine output and applies brake force to four wheels independently to control the vehicle behavior, avoiding the critical state.

- Brake performance at ASC system failure is ensured by the fail-safe function, and at the same time, the serviceability during service is improved.

NOTE:

- ^{*1}: For the details on twin clutch sportronic shift transmission (TC-SST), refer to GROUP 22B – Twin Clutch Sportronic Shift Transmission (TC-SST) [P.22B-2](#).
- ^{*2}: For the details on super all wheel control (S-AWC), refer to GROUP 22B – Super All Wheel Control (S-AWC) [P.22B-18](#).
- The active skid control (ASC) has the traction control function and the skid control function. By the integrated control with the anti-lock brake system, the system stabilizes the vehicle attitude and, at the same time, secures the driving force.

CONSTRUCTION DIAGRAM



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MAIN COMPONENTS AND FUNCTIONS

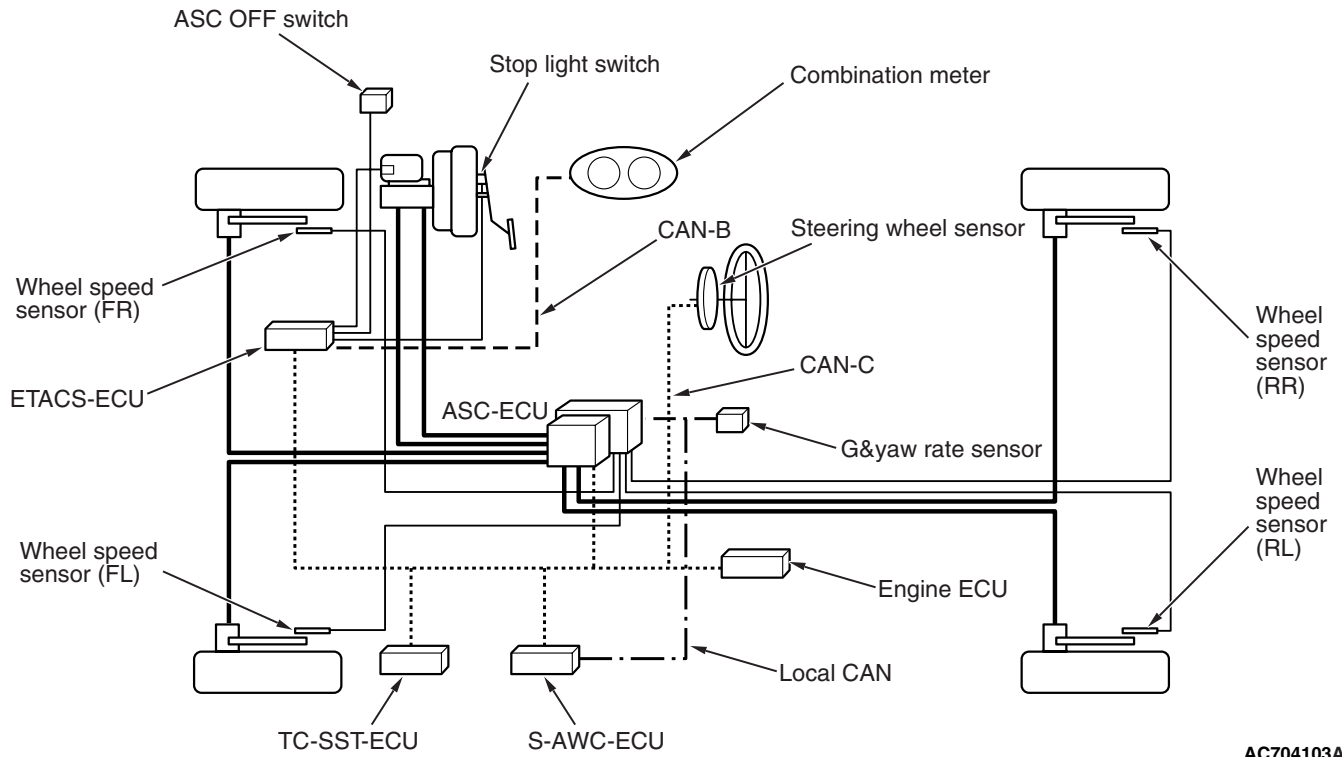
Parts name		No.	Functional description
Sensor	Wheel speed sensor	1	Outputs the frequency pulse signal in proportion to the rotation speed of each wheel to ASC-ECU.
	Magnetic encoder for wheel speed detection	2	When the magnetic encoder for wheel speed detection (a plate on which north and south pole sides of the magnets are arranged alternately) rotates, the wheel speed sensor outputs frequency pulse signal in proportion to each wheel speed.
	Stop light switch	3	Outputs the signal indicating whether the brake pedal is depressed or not to ASC-ECU.
	G and yaw rate sensor	4	Detects the yaw rate, and longitudinal and lateral acceleration of a vehicle, then outputs the signal to ASC-ECU via the CAN line.
	Steering wheel sensor	5	Detects the steering angle of steering wheel, and outputs the signal to ASC-ECU via the CAN bus line.
	ASC OFF switch	6	Outputs the ASC ON/OFF signal to ASC-ECU.
	Master cylinder pressure sensor	7	Integrated into the hydraulic unit, converts the signal of brake fluid pressure in master cylinder to the voltage value, then outputs the value to ASC-ECU.
	Wheel cylinder pressure sensor	8	Integrated into the hydraulic unit, converts the signal of brake fluid pressure in wheel cylinder of each wheel to the voltage value, then outputs the value to ASC-ECU.

Parts name		No.	Functional description
Actuator	Hydraulic unit	9	Drives the solenoid valve using the signal from ASC-ECU, and controls the brake fluid pressure for each wheel.
	ABS warning light	10	Informs the driver of the system status by illuminating, flashing, or turning off the warning light according to the signal from ASC-ECU.
	ABS warning display	11	Informs the driver of the system status by illuminating or turning off the warning light according to the signal from ASC-ECU.
	Brake warning light	12	Used as the warning light for the parking brake, brake fluid level, and EBD control. Informs the driver of the system status by illuminating or turning off the warning light according to the signal from ASC-ECU.
	Brake warning display	13	Used as the warning light for the brake fluid level and EBD control. Informs the driver of the system status by illuminating or turning off the warning light according to the signal from ASC-ECU.
	ASC operation display	14	According to the signal from ASC-ECU, flashes when the system is active to inform the driver of the status.
	ASC warning display	15	The TCL function and ASC function use the same display. According to the signal from ASC-ECU, the display is illuminated to inform the driver that the system is abnormal.
	ASC OFF light	16	Informs the driver of the ASC system shutdown by illuminating according to the signal from ASC-ECU.
	ASC OFF display	17	Using the signal from ASC-ECU, the display is illuminated to inform the driver that the ASC OFF switch is pressed and held for 3 seconds, and that the ASC and AYC* ¹ brake control is prohibited.
Data link connector	18	Outputs the diagnostic trouble code and establishes the communication with the scan tool.	
Engine control module	19	Controls the engine output based on the signal from ASC-ECU.	
TC-SST ECU* ²	20* ²	Outputs the shift position to ASC-ECU.	
S-AWC ECU	21	Outputs the drive status and brake fluid pressure request to ASC-ECU.	
ASC-ECU		22	Controls the actuators (described above) based on the signals coming from each sensors.
			Controls the self-diagnostic functions and fail-safe functions.
			Controls diagnostic function (Compatible with scan tool).

NOTE:

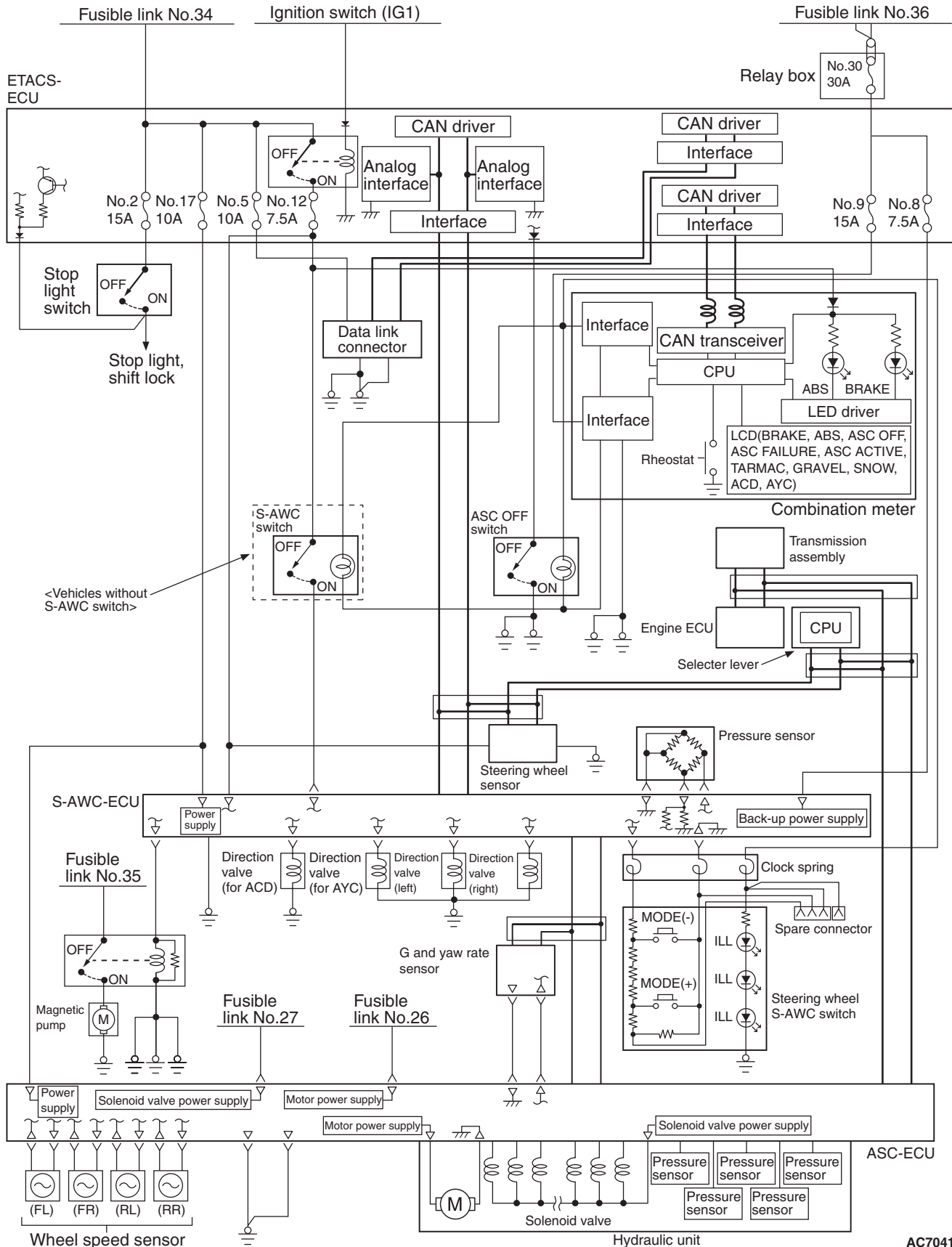
- *¹: For information on AYC (Active Yaw Control), refer to GROUP 22B – Super All Wheel Control (S-AWC), Description of Structure and Operation P.22B-18.
- *²: Only for vehicles with TC-SST

SYSTEM CONFIGURATION



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ASC ELECTRICAL DIAGRAM



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CONSTRUCTION DESCRIPTION

SENSOR

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WHEEL SPEED SENSOR

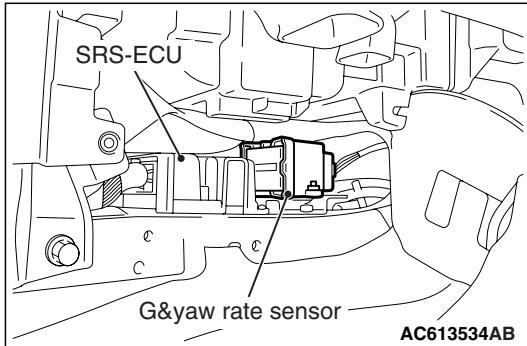
Refer to GROUP 35B – Sensor [P.35B-5](#).

STEERING WHEEL SENSOR

Refer to GROUP 35B – Sensor [P.35B-5](#).

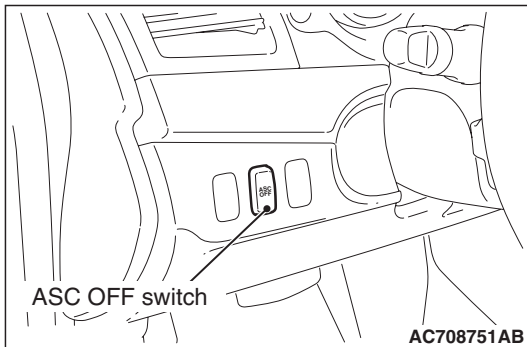
G AND YAW RATE SENSOR

This sensor is installed under the instrument panel center lower, and detects the yaw rate as well as the lateral and longitudinal acceleration of the vehicle.

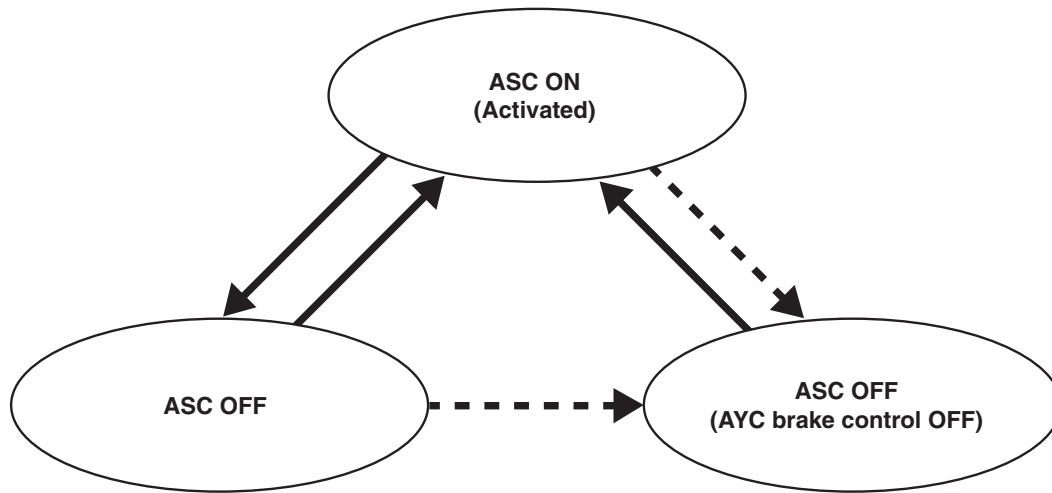


ASC OFF SWITCH

The ASC OFF switch is installed to the instrument panel to the right of driver seat. By the operation of this switch, the TCL function, skid control function, and AYC brake control can be enabled or prohibited. As a countermeasure against the ASC OFF switch sticking, the ASC system returns to the ON status when the ASC OFF switch is pressed and held for 15 seconds. When the ignition switch is turned from "LOCK" (OFF) to ON position, the TCL function and skid control function are constantly in the ON status.



ASC OFF switch operation and system operation



————— : Short press

- - - - - : Press and hold (3 seconds or more)

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Item	ASC ON	ASC OFF	ASC OFF (AYC brake control OFF)
EBD function	Enabled	Enabled	Enabled
ABS function	Enabled	Enabled	Enabled
TCL function	Enabled	Prohibited	Prohibited
Skid control function	Enabled	Prohibited	Prohibited
AYC function (brake control)	Enabled	Enabled	Prohibited

NOTE:

- When the ASC OFF switch is pressed and held for 15 seconds or more, the ASC function is turned ON.
- The ASC control is available when the vehicle speed is 15 km/h or more.

ACTUATOR

HYDRAULIC UNIT

With the hydraulic unit, the brake wheel cylinder pressure sensor is added to each wheel compared with the conventional ASC system, achieving more precise brake force control.

NOTE: For the internal hydraulic circuit of the hydraulic unit, refer to P.35C-14.

ASC OPERATION DISPLAY, ASC WARNING DISPLAY, ASC OFF LIGHT, ASC OFF DISPLAY

The ASC system illuminates or flashes the ASC operation display, ASC warning display, ASC OFF light, and ASC OFF display in the following operation patterns, and informs the driver of the ASC system status.

ASC operation display

- Flashes at 2-Hz interval during the ASC control.
- Flashes at 2-Hz interval during the TCL control.

ASC warning display

- Turns ON when the system malfunction occurs.

ASC OFF display and ASC OFF light

- Illuminates when the system is stopped by the ASC OFF switch operation.

ASC operation display, ASC warning display, ASC OFF light, ASC OFF display illumination and flashing patterns

State		ASC operation display	ASC warning display	ASC OFF light	ASC OFF display
Normal	Normal	–	–	–	–
	ASC operated	Flashing (2 Hz)	–	–	–
	TCL operated	Flashing (2 Hz)	–	–	–
	While the system is stopped by ASC OFF switch operation (short press for once)	–	–	ON	–
	While the system is stopped by ASC OFF switch operation (long press for 3 seconds)	–	–	ON	ON
Abnormal	ASC malfunction	–	ON	ON	–
	TCL malfunction	–	ON	ON	–
Scan tool connection	Actuator not operated	–	–	–	–
	Actuator operated	–	ON	ON	–

ASC-ECU

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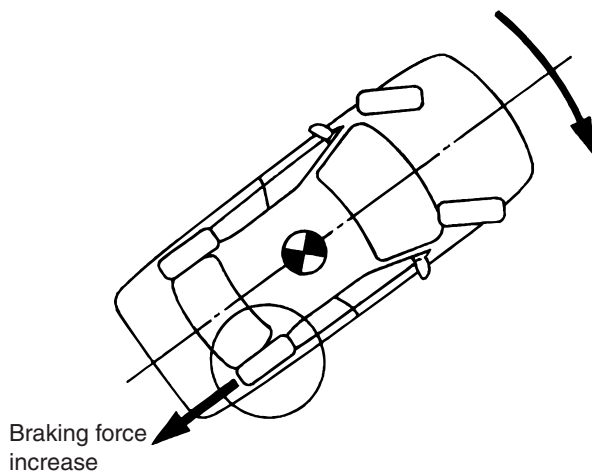
- This ECU incorporates the ABS function, EBD function, skid control function, and TCL function.
- The hydraulic units of the ASC and TCL systems employ the automatic pressurization function compared with the conventional ABS system. These systems also incorporate the G and yaw rate sensor, steering wheel sensor, master cylinder pressure sensor (integrated with hydraulic unit), and wheel cylinder brake fluid pressure sensor (integrated with hydraulic unit).

EXAMPLE OF ACTIVE SKID CONTROL OPERATION

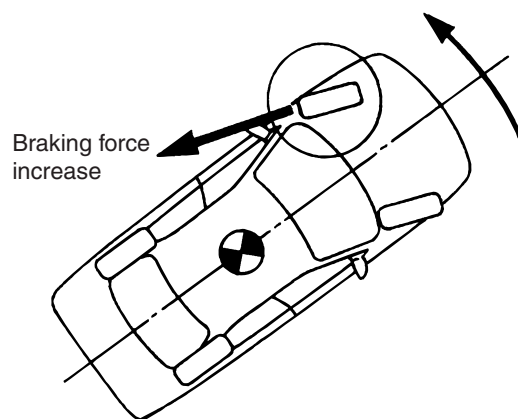
ASC-ECU detects the vehicle movement based on information from various sensors, and calculates the ideal vehicle movement model. ASC-ECU compares the actual vehicle movement with the ideal vehicle movement model, and controls the brake of specific wheel to approximate the vehicle movement to the ideal vehicle movement model by generating a yaw moment to the vehicle in order to suppress the side slip (spin and drift-out).

Example of control

Creating a rotational moment



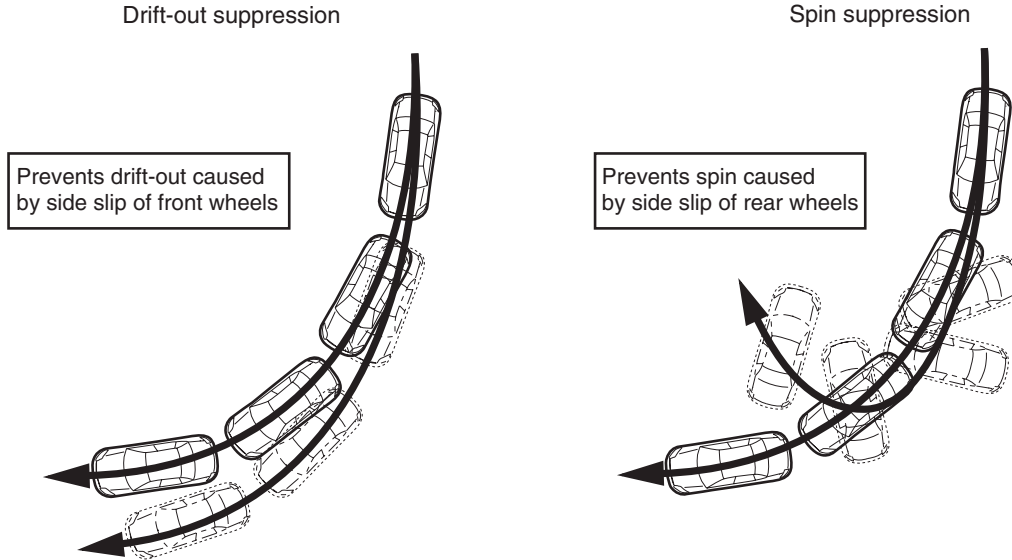
Creating a restorative moment



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The skid control function controls the vehicle attitude by creating a yaw moment to the vehicle from altering the balance between the wheel's braking force and cornering force.

Example of the effect of control



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For example, on a slippery surface, if the vehicle tends to drift-out contrary to the driver's intention, a yaw moment (rotational moment) is created to restrain the drift-out by an increase of rear-inside wheel braking force. On the other hand, when the vehicle tends to spin, a yaw moment (restorative moment) is created to restrain the spin by an

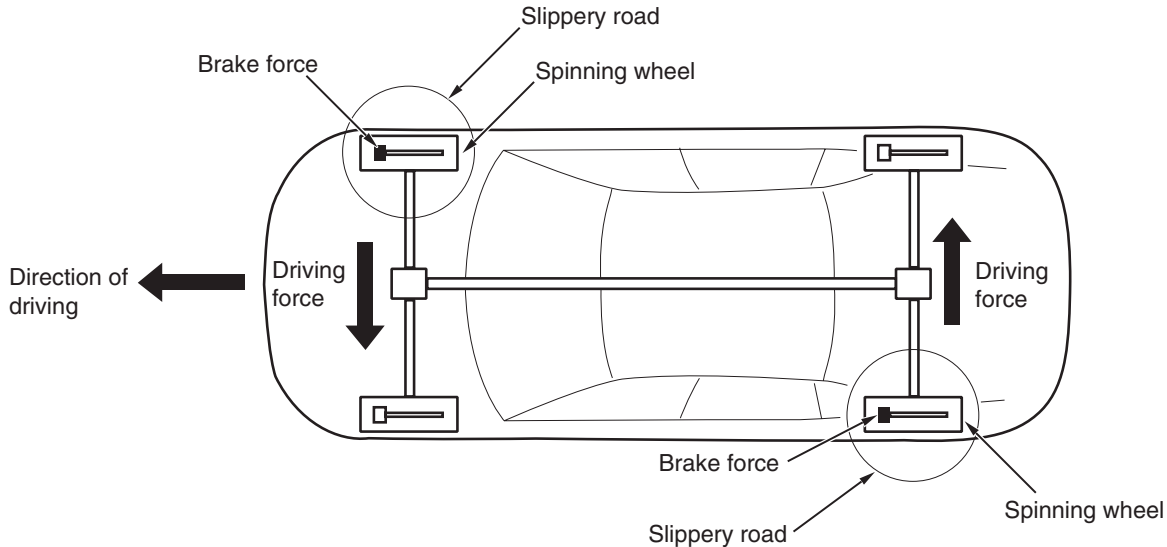
increase of front-outside wheel braking force. Furthermore, when it is determined that the vehicle is over-speeding, safe and stable cornering is ensured by a reduction of engine output to decelerate the vehicle.

Joint control

The skid control function communicates the data, necessary for control of each function, with the ABS function and TCL function, and performs the control in coordination with the functions.

Control system	Control content
ABS	Even during the skid control operation, ABS performance is improved by the joint operation with the skid control.
TCL	During acceleration, engine output is governed through a joint operation with the skid control.

EXAMPLE OF TCL CONTROL



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When the driving wheels slip on the slippery road surface, TCL applies the brake automatically, sends the signal requesting engine speed reduction to the engine control module, and prevents the loss of driving force resulting from the slippage of driving wheel.

FAIL-SAFE AND DIAGNOSTIC FUNCTIONS

ASC-ECU constantly monitors the input and output signals. If a malfunction is detected in the system, ASC-ECU sends a fail signal to illuminate or flash the corresponding warning light or warning display. At the same time, ASC-ECU prohibits the relevant control depending on the trouble symptom.

Also, ASC-ECU has the following functions to facilitate the system checks.

- Diagnostic trouble code set
- Service data output
- Actuator test

All the above items can be checked using scan tool.

Calibration

After ASC-ECU, G and yaw rate sensor, and steering wheel sensor have been replaced with new ones, calibration must be performed using scan tool*.

*NOTE: *: For calibration, refer to Workshop Manual.*

DESCRIPTION OF CONSTRUCTION AND OPERATION

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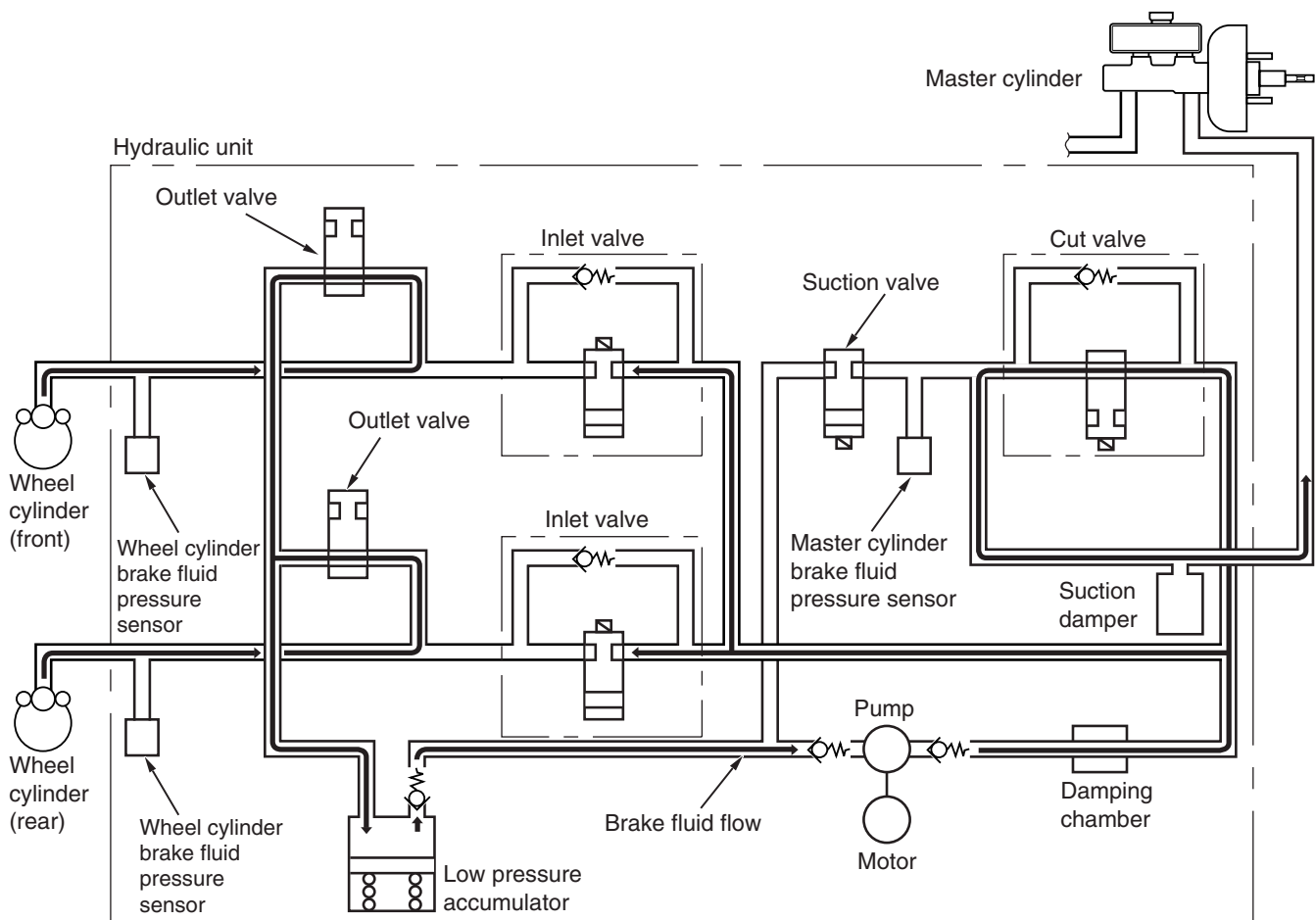
SKID CONTROL OPERATION

ASC-ECU receives various kinds of information from the engine control module, TC-SST-ECU, S-AWC-ECU, ETACS-ECU, steering wheel sensor, G and yaw rate sensor, and wheel speed sensor. When ECU determines that the vehicle has an oversteer or understeer tendency based on the signal sent from these sensors, ASC-ECU drives each valve and pump motor to control the braking force of each wheel.

When the system increases the fluid pressure automatically, it closes the cut valve to shut off the pressure line to the suction valve, and drives the pump motor. For example, when the vehicle has understeer while turning to the right, ASC-ECU supplies the brake fluid from the pump to rear right wheel to generate the braking force to the rear right wheel.

ASC-ECU, engine control module, TC-SST-ECU, and S-AWC-ECU communicate with each other via CAN. When the accelerator pedal is depressed too far, a signal requesting the reduction of engine output is sent to the engine control module. Depending on the situation, the AWD control level limitation signal is sent to S-AWC-ECU to secure the ASC controllability.

Brake fluid pressure reduction at ABS operation



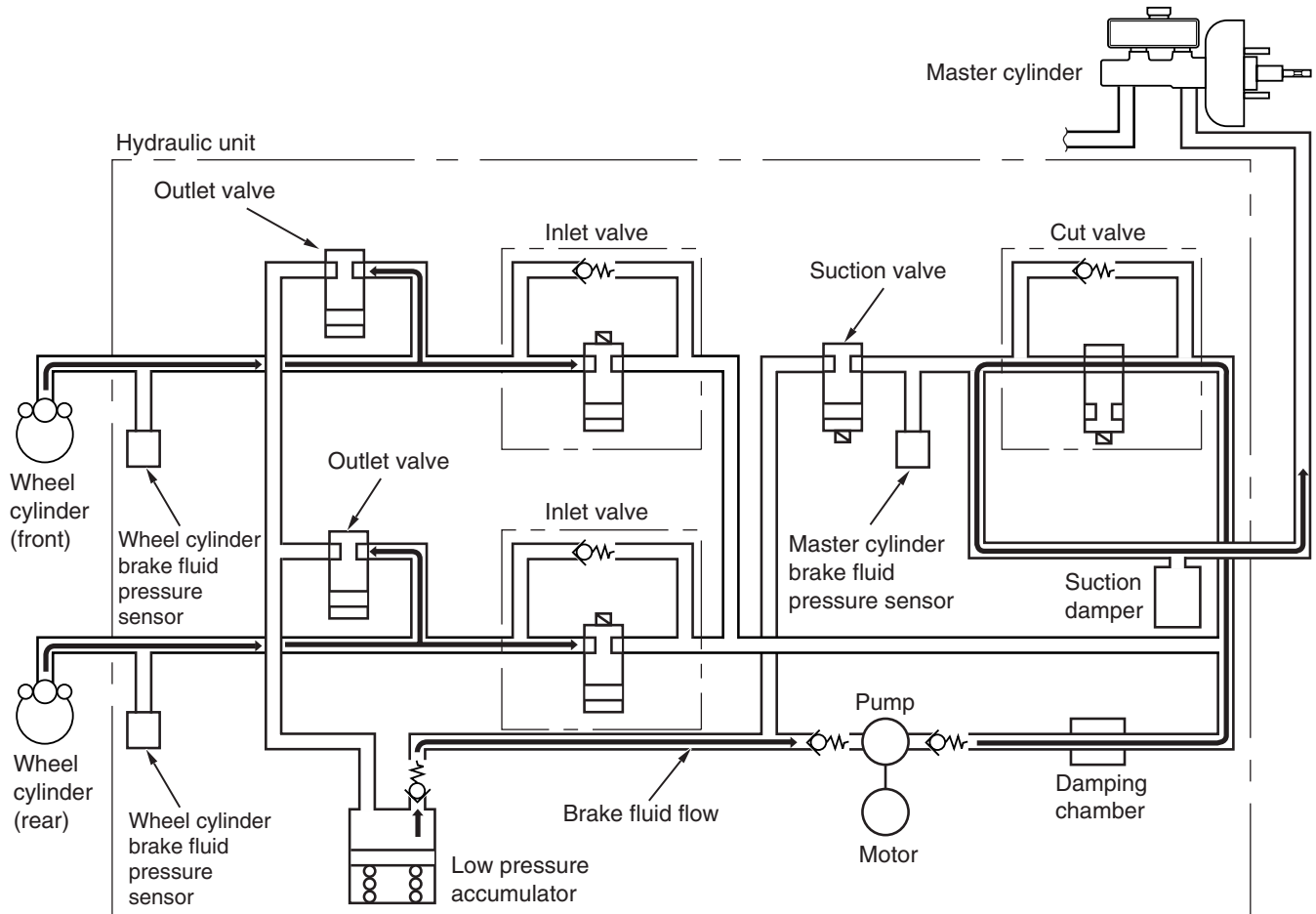
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The brake fluid supplied from the wheel cylinder is stored in the low pressure accumulator via the outlet valve. Then, the stored brake fluid is returned to the master cylinder with the driving of pump by the motor.

VALVE CONDITION

Item	Power status	Open/Close
Cut valve	OFF	Open
Suction valve	OFF	Closed
Inlet valve	ON	Closed
Outlet valve	ON	Open

When brake fluid pressure is held by ABS



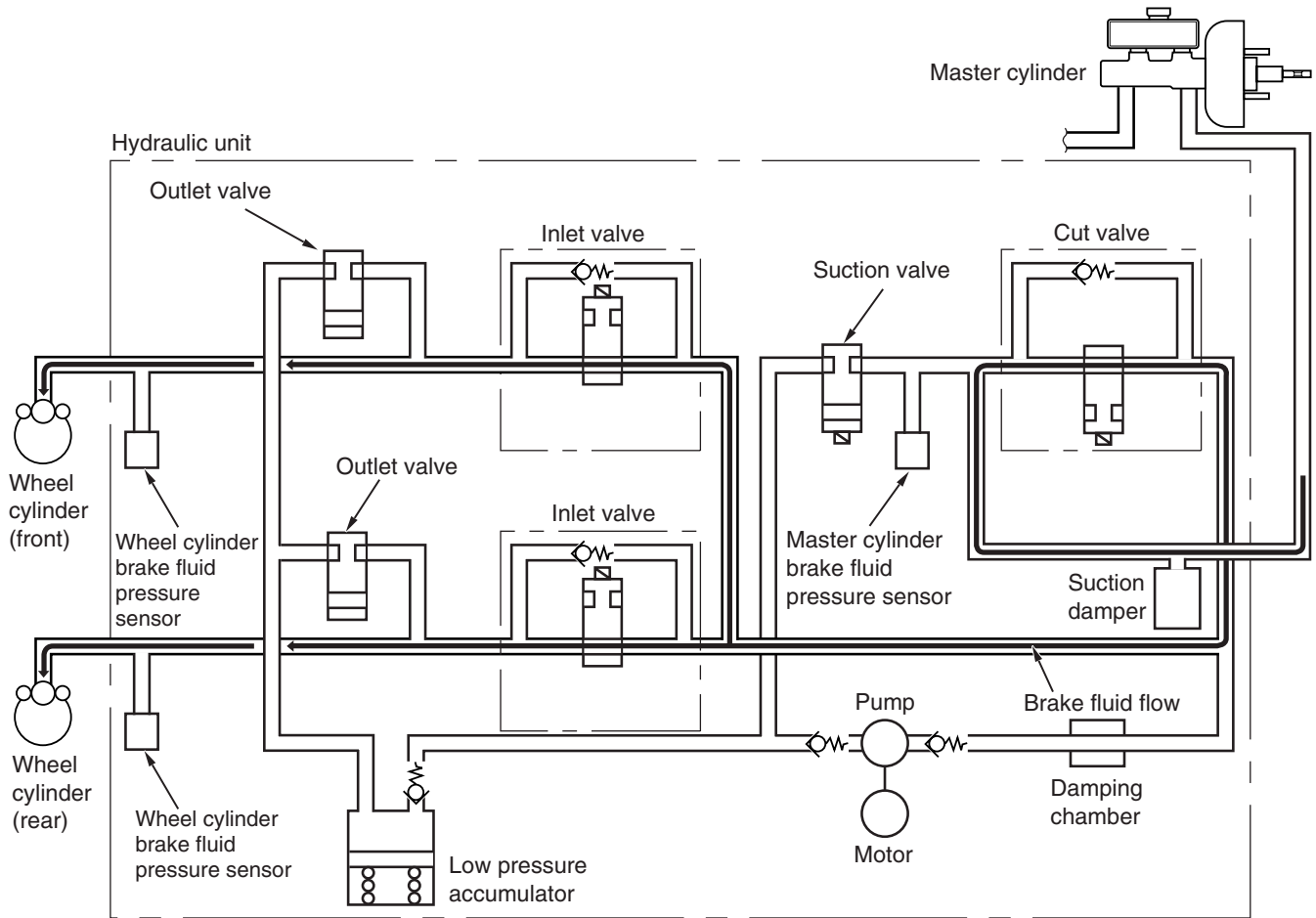
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The system closes the inlet valve and outlet valve to hold the brake fluid pressure in the wheel cylinder. If the brake fluid is stored in the low pressure accumulator, the brake fluid is returned to the master cylinder with the driving of pump by the motor.

VALVE CONDITION

Item	Power status	Open/Close
Cut valve	OFF	Open
Suction valve	OFF	Closed
Inlet valve	ON	Closed
Outlet valve	OFF	Closed

When brake is normally applied or brake fluid pressure is increased by ABS



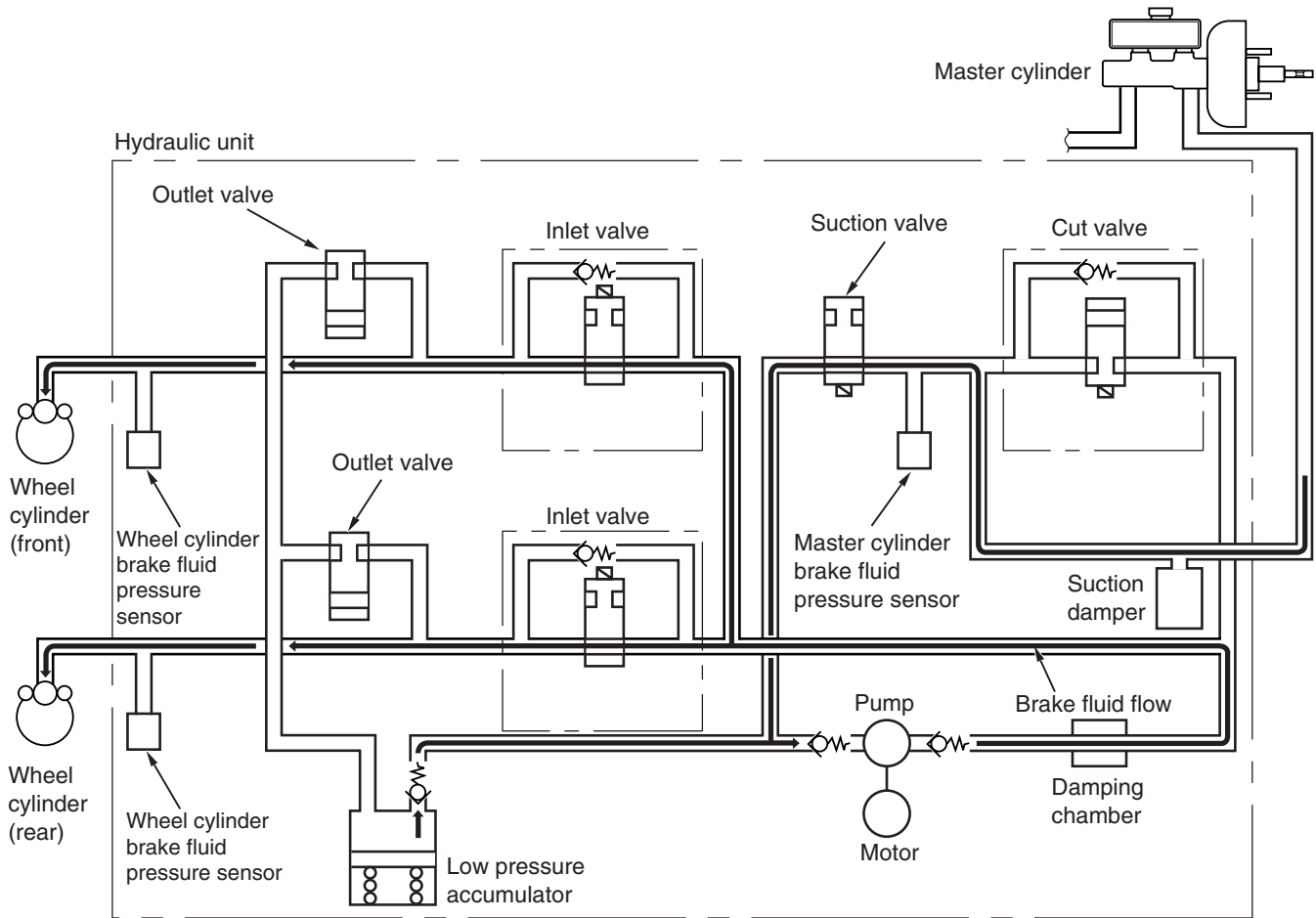
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The system opens the inlet valve while closing the outlet valve to increase the brake fluid pressure in the wheel cylinder.

VALVE CONDITION

Item	Power status	Open/Close
Cut valve	OFF	Open
Suction valve	OFF	Closed
Inlet valve	OFF	Open
Outlet valve	OFF	Closed

When brake fluid pressure is increased by skid control (or increased by TCL)



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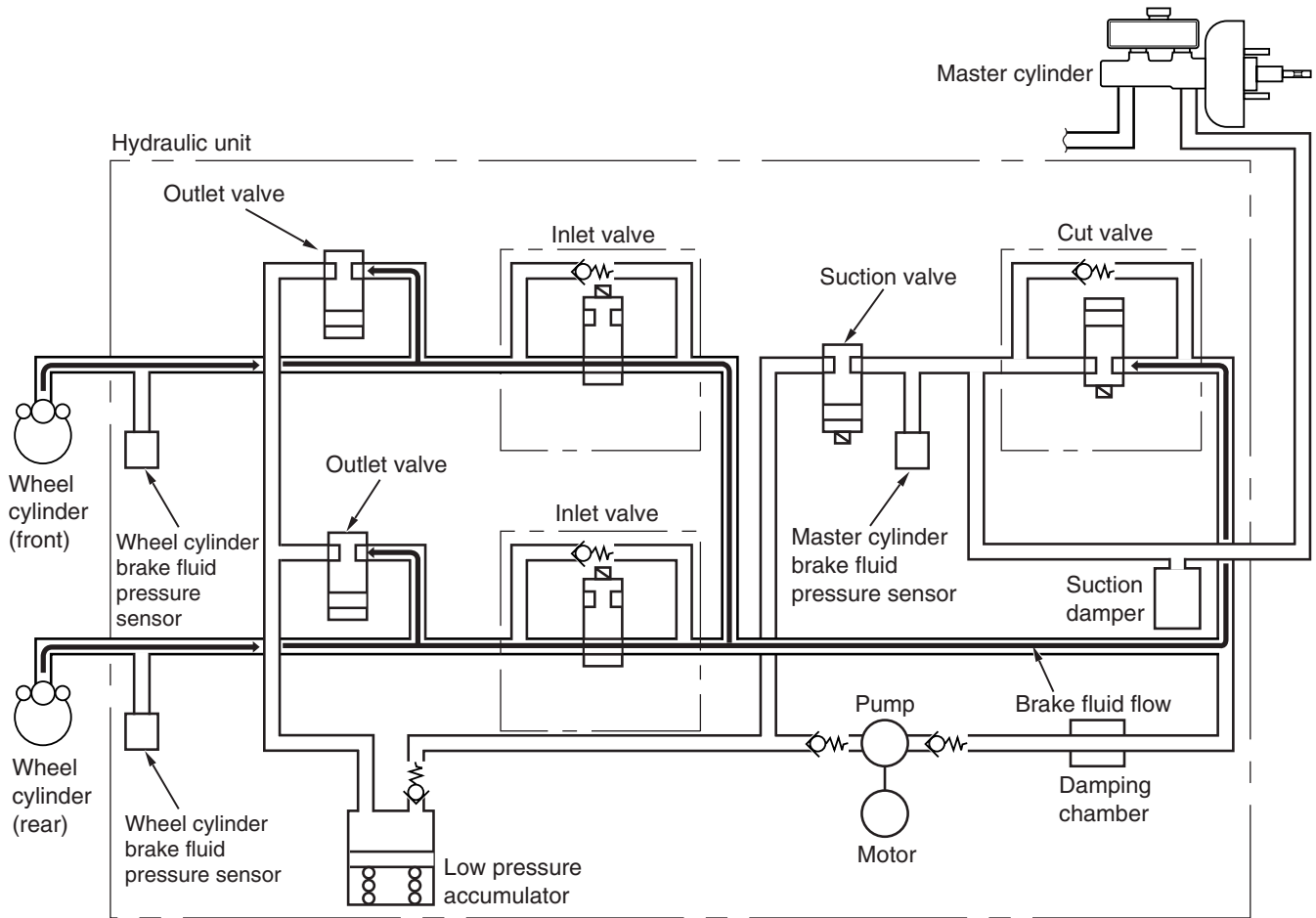
The system closes the cut valve to block the passage from the pump outlet to the master cylinder, and opens the suction valve, connecting the passage from the master cylinder to the pump inlet. The brake fluid drawn from the master cylinder inlet is supplied to the wheel cylinder.

VALVE CONDITION

Item	Power status	Open/Close
Cut valve	ON	Closed
Suction valve	ON	Open
Inlet valve*	OFF	Open
Outlet valve*	OFF	Closed

*NOTE: *: Because the brake fluid pressure for each wheel is controlled depending on the driving status, the open/close status of inlet valve and outlet valve changes according to the driving status.*

When brake fluid pressure is held by skid control (or held by TCL)



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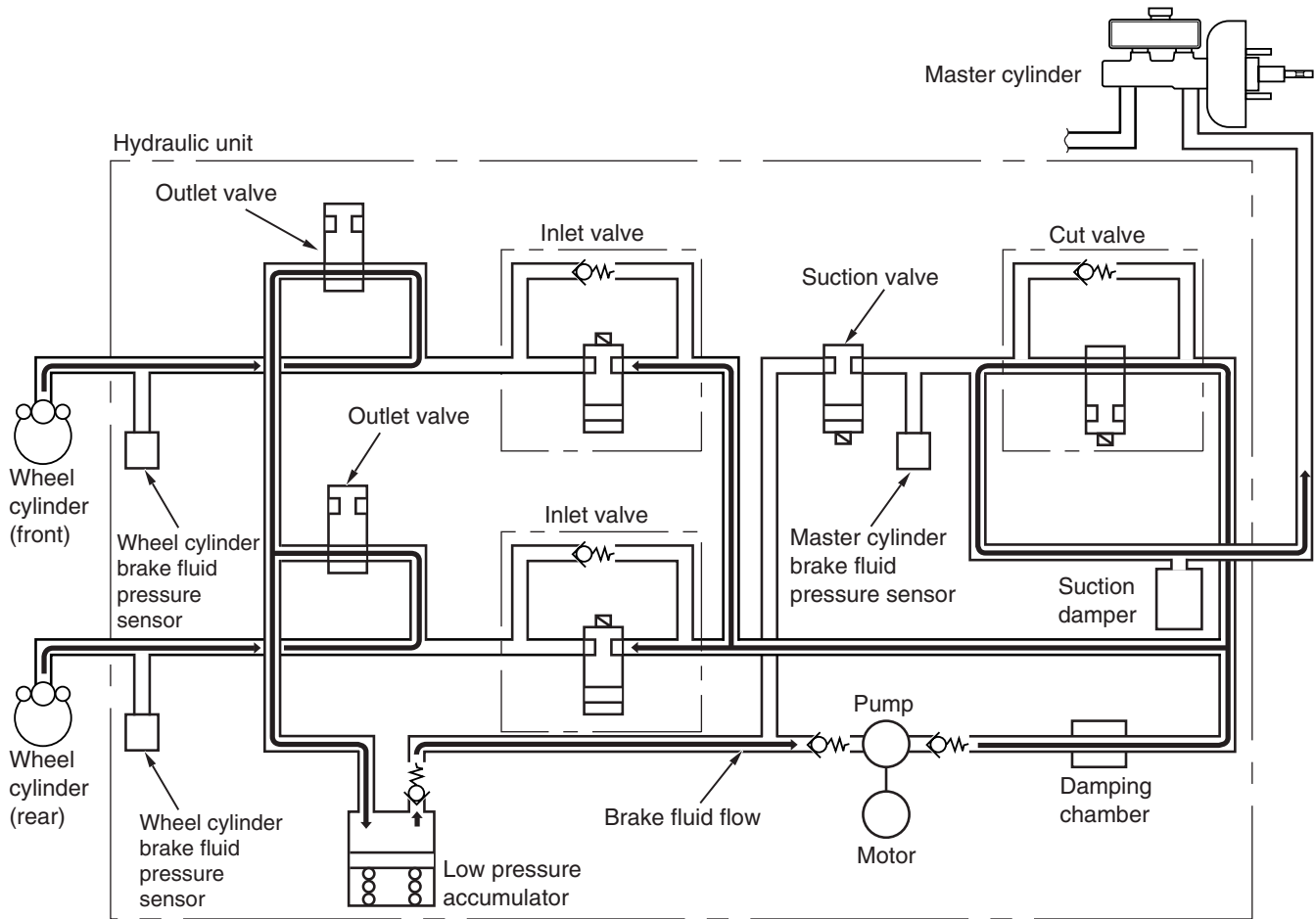
In order to hold the brake fluid pressure in the wheel cylinder, the system closes the cut valve, suction valve, and outlet valve.

Valve status

Item	Power status	Open/Close
Cut valve	ON	Closed
Suction valve	OFF	Closed
Inlet valve*	OFF	Open
Outlet valve*	OFF	Closed

*NOTE: *: In order to control the brake fluid pressure supplied to each wheel based on the vehicle driving status, the inlet valve and outlet valve are opened/closed.*

When brake fluid pressure is decreased by skid control (or decreased by TCL)



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The system opens the outlet valve while closing the inlet valve to store the brake fluid filled in the wheel cylinder in the low pressure accumulator. The brake fluid stored in the low pressure accumulator returns to the master cylinder for circulation when the pump is driven by the motor.

VALVE CONDITION

Item	Power status	Open/Close
Cut valve	OFF	Open
Suction valve	OFF	Closed
Inlet valve*	ON	Closed
Outlet valve*	ON	Open

*NOTE: * : In order to control the brake fluid pressure supplied to each wheel based on the vehicle driving status, the inlet valve and outlet valve are opened/closed.*

TCL OPERATION

ASC-ECU receives various kinds of information from the engine control module, TC-SST-ECU, S-AWC-ECU, steering wheel sensor, G and yaw rate sensor, and wheel speed sensor. When ASC-ECU determines that the driving wheel is slipping, it suppresses the wheel slippage. At this time, ASC-ECU controls the brake fluid pressure of the driving wheel determined to be slipping so that the torque is transferred to another driving wheel. Basically, the operations of ABS solenoid valve and ASC valve are the same as with the skid control. ASC-ECU, engine control module, TC-SST-ECU, and S-AWC-ECU communicate with each other via the CAN bus lines. When the accelerator pedal is depressed too far, a signal requesting to reduce the engine output is sent to the engine control module. Also, a joint control with TC-SST-ECU and S-AWC-ECU are performed to secure the TCL controllability.