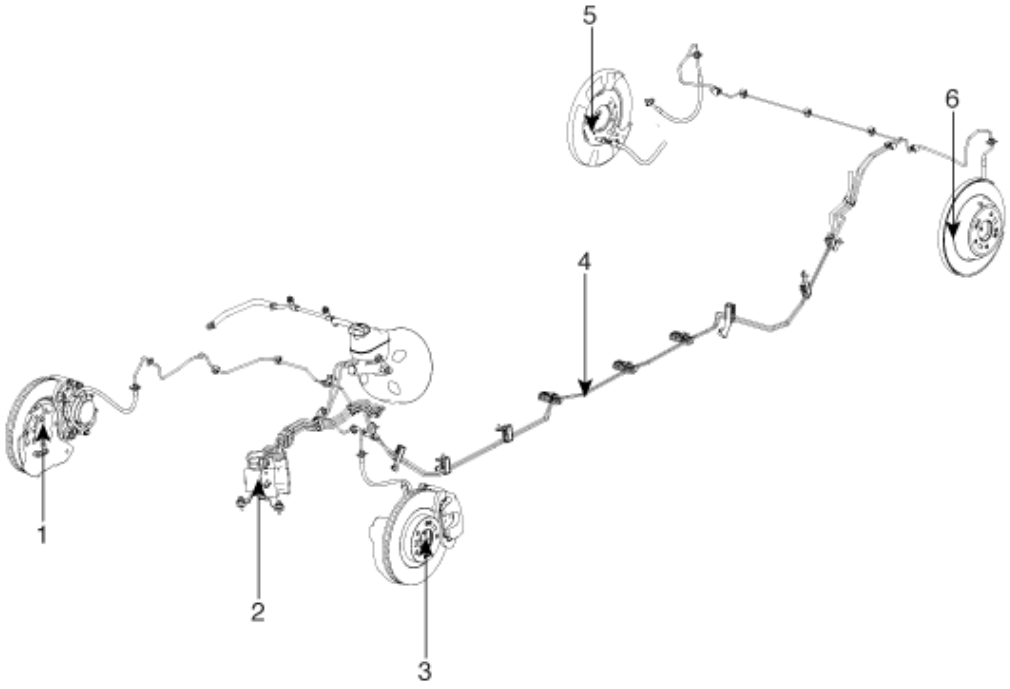
Components



1. Front right wheel speed sensor	4. Hydrauric line
2. ABS control module (HECU)	5. Rear right wheel speed sensor
3. Front left wheel speed sensor	6. Rear left wheel speed sensor

Description

This specification applies to HCU(Hydraulic Control Unit) and ECU(Electronic Control Unit) of the HECU.(Hydraulic and Electronic Control Unit)
This specification is for the wiring design and installation of ABS/ESC ECU.
This unit has the functions as follows.

- Input of signal from Pressure sensor, Steering angle sensor, Yaw & Lateral G sensor,the wheel speed sensors attached to each wheel.
- Control of braking force / traction force / yaw moment.
- Failsafe function.
- Self diagnosis function.
- Interface with the external diagnosis tester.

Installation position : engine compartment

- Brake tube length from Master cylinder port to HECU inlet port should be max. 1m
- The position should not be close to the engine block and not lower than the wheel.

Operation

The ECU shall be put into operation by switching on the operating voltage (IGN).
On completion of the initialization phase, the ECU shall be ready for operation.
In the operating condition, the ECU shall be ready, within the specified limits (voltage and temperature), to process the signals offered by the various sensors and switches in accordance with the control algorithm defined by the software and to control the hydraulic and electrical actuators.

Wheel sensor signal processing

The ECU shall receive wheel speed signal from the four active wheel sensors.
The wheel signals are converted to voltage signal by the signal conditioning circuit after receiving current signal from active wheel sensors and given as input to the MCU.

Solenoid valve control

When one side of the valve coil is connected to the positive voltage that is provided through the valve relay and the other side is connected to the ground by the semiconductor circuit, the solenoid valve goes into operation.
The electrical function of the coils are always monitored by the valve test pulse under normal operation conditions.

Voltage limits

- Overvoltage
  When overvoltage is detected(above 17 ± 0.5 V), the ECU switches off the valve relay and shuts down the system.
  When voltage is returned to operating range, the system goes back to the normal condition after the initialization phase.
- Undervoltage
  In the event of undervoltage(below 10V), ABS control shall be inhibited and the warning lamp shall be turned on.
  When voltage is returned to operating range, the warning lamp is switched off and ECU returns to normal operating mode.

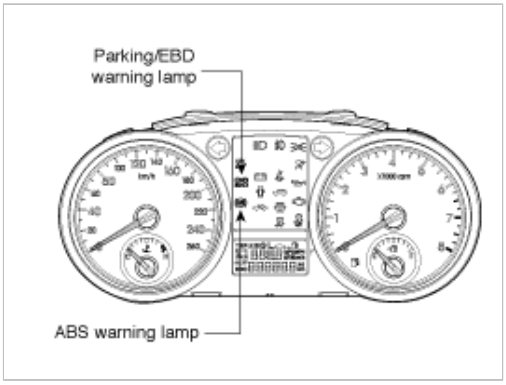
Pump motor checking

The ECU performs a pump motor test at a speed of 15 km/h(9 MPH) once after IGN is switched on.

Diagnostic interface

Failures detected by the ECU are encoded on the ECU, stored in a EEPROM and read out by diagnostic equipment when the ignition switch is turned on.
The diagnosis interface can also be used for testing the ECU during production of the ECU and for actuating the HCU in the test line of manufactories (Air-bleeding line or Roll and Brake Test line).

Warning lamp module

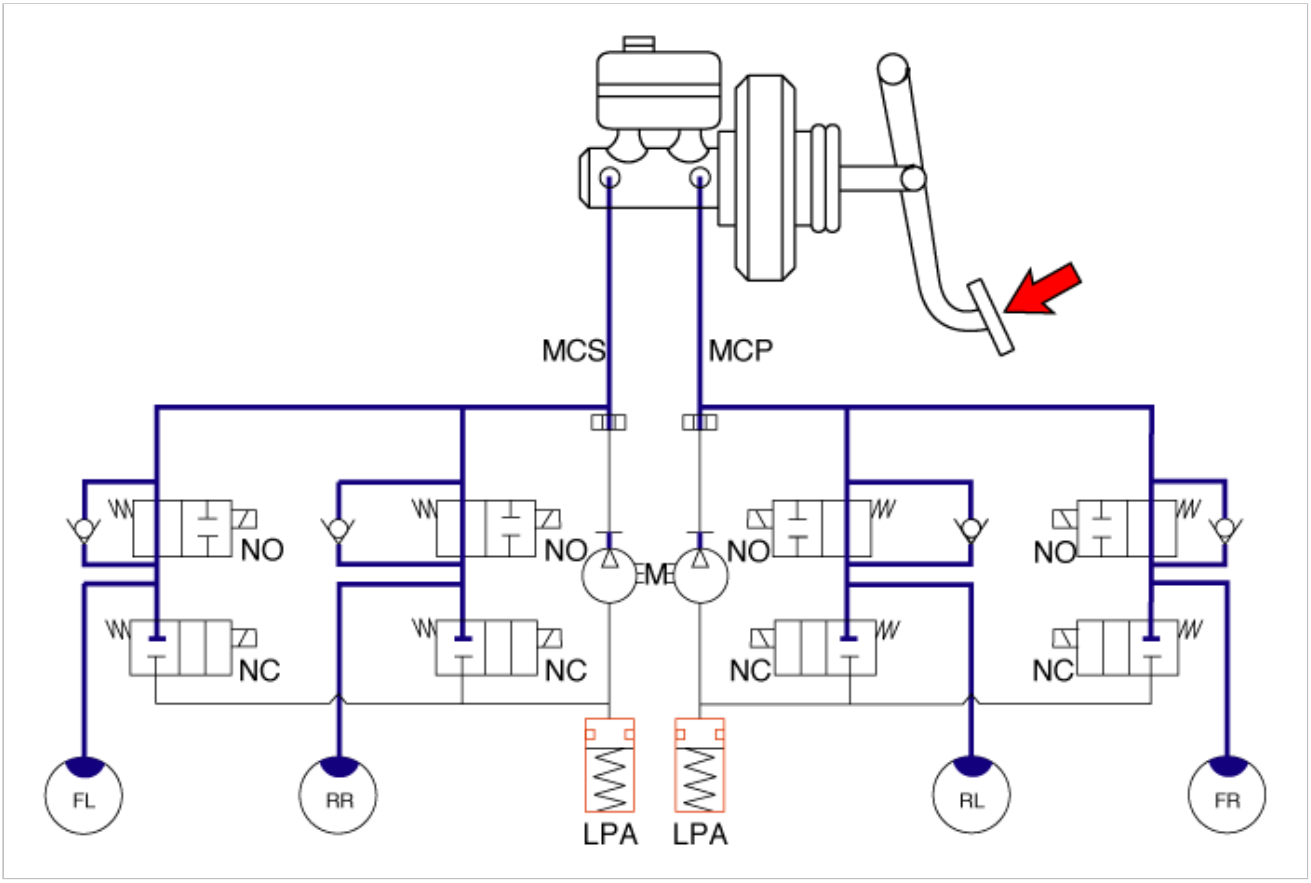


1. ABS Warning Lamp module
   The active ABS warning lamp module indicates the self-test and failure status of the ABS.
   The ABS warning lamp shall be on:
   A. During the initialization phase after IGN ON. (continuously 3 seconds).
   B. In the event of inhibition of ABS functions by failure.
   C. During diagnostic mode.
   D. When the ECU Connector is seperated from ECU.
2. PARKING/EBD warning lamp module
   The active EBD warning lamp module indicates the self-test and failure status of the EBD.
   However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions.
   The EBD warning lamp shall be on:
   A. During the initialization phase after IGN ON. (continuously 3 seconds).
   B. When the Parking Brake Switch is ON or brake fluid level is low.
   C. When the EBD function is out of order.
   D. During diagnostic mode.
   E. When the ECU Connector is seperated from ECU.

ABS Control

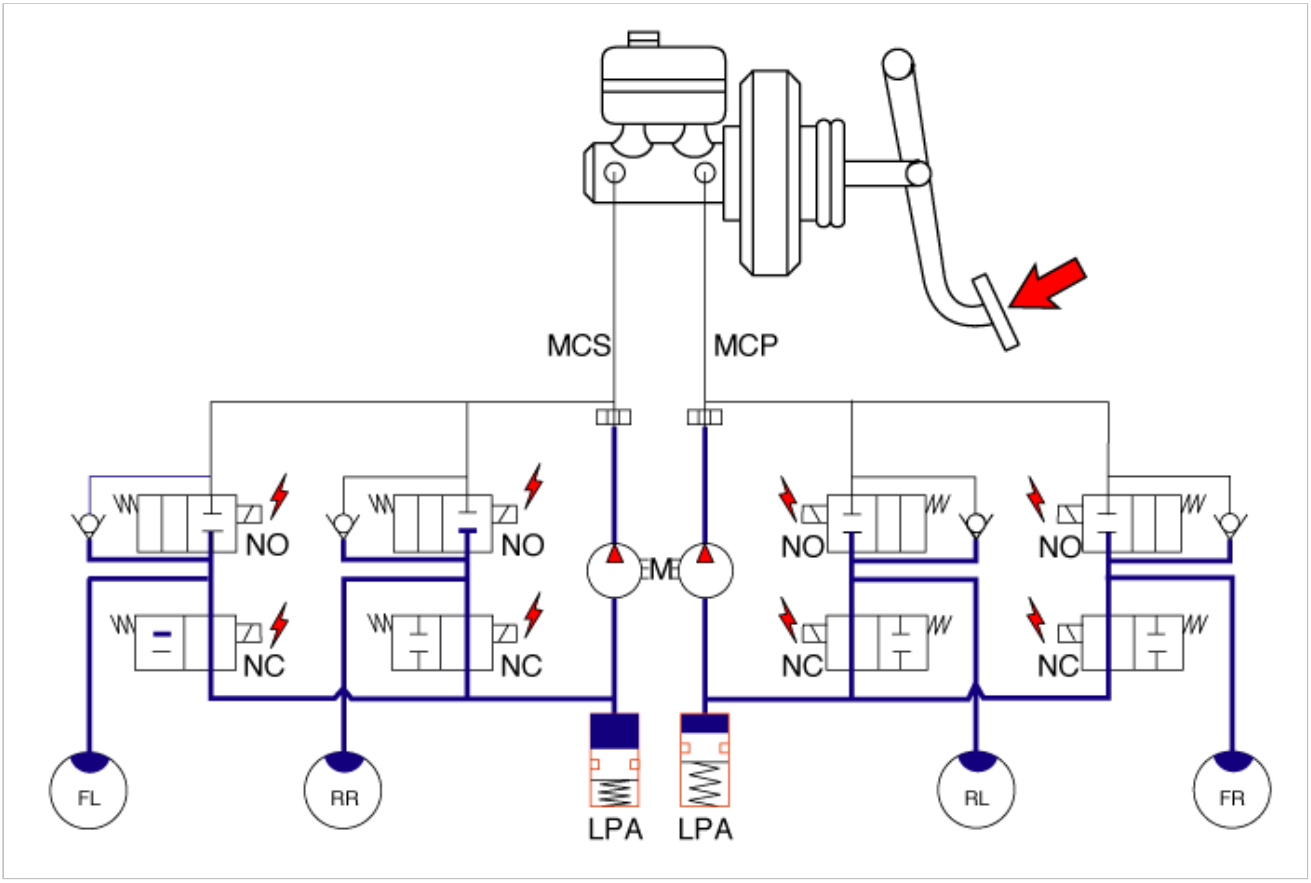
1. NORMAL BRAKING without ABS
   Under the normal braking, voltage is not supplied to solenoid valve, inlet valve is opened and outlet valve is closed.When the brake is depressed, brake fluid is supplied to the wheel cylinder via solenoid valve to activate the brake.When the brake is released, brake fluid is back to the master cylinder via inlet valve and check valve.

Solenoid valve	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	Open	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	



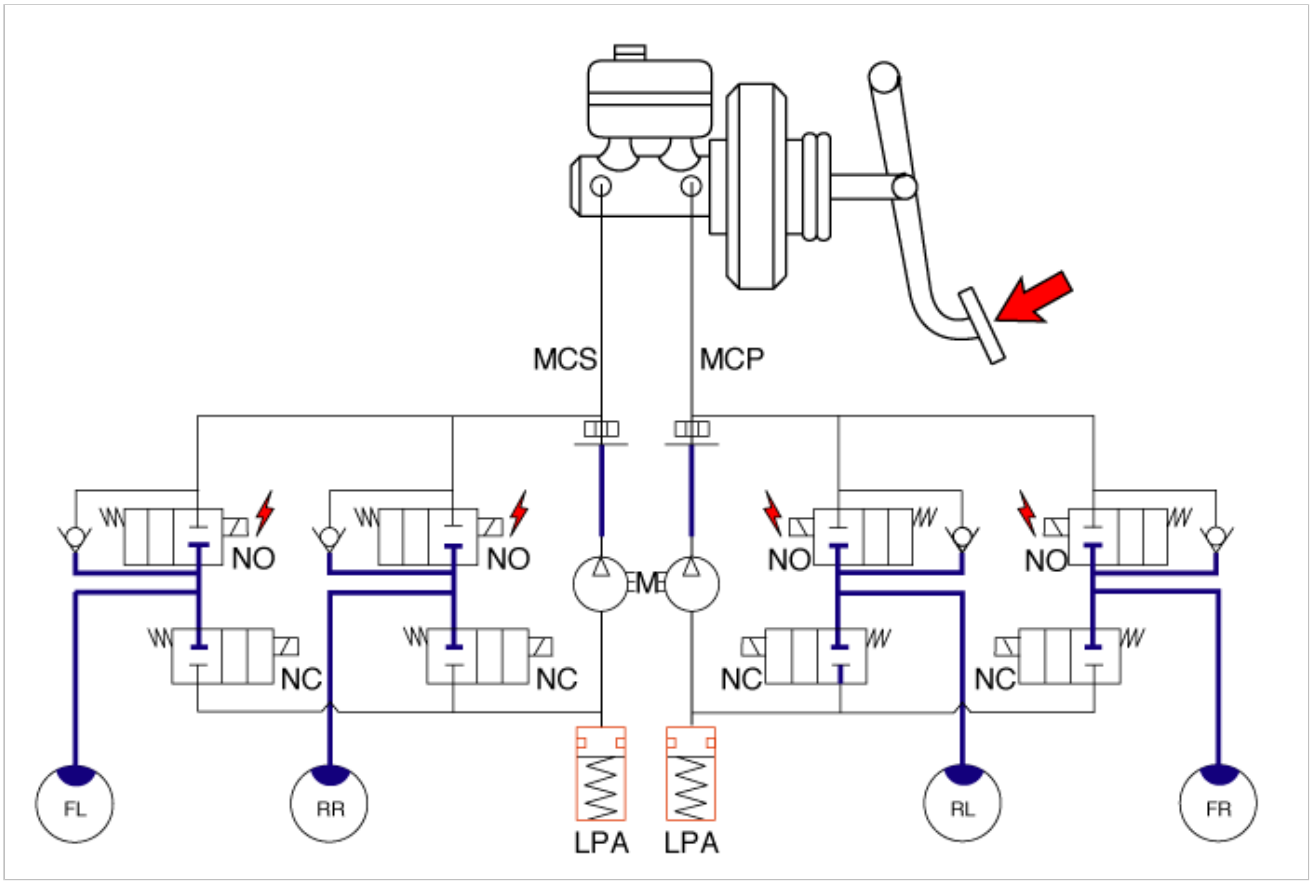
2. Dump Mode
   Under the emergency braking, if the wheels start to lock up, HECU sends a signal to the solenoid valve to decrease the brake fluid, then voltage is supplied to each solenoid. At this time inlet valve is closed and brake fluid is blocked from the master cylinder. Conversely outlet valve is opened and brake fluid passes through wheel cylinder to reservoir, resulting in pressure decrease.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	Close	Master cylinder ⇔ Wheel cylinder	ON
Outlet valve (NC)	ON	Open	Wheel cylinder ⇔ Reservoir	



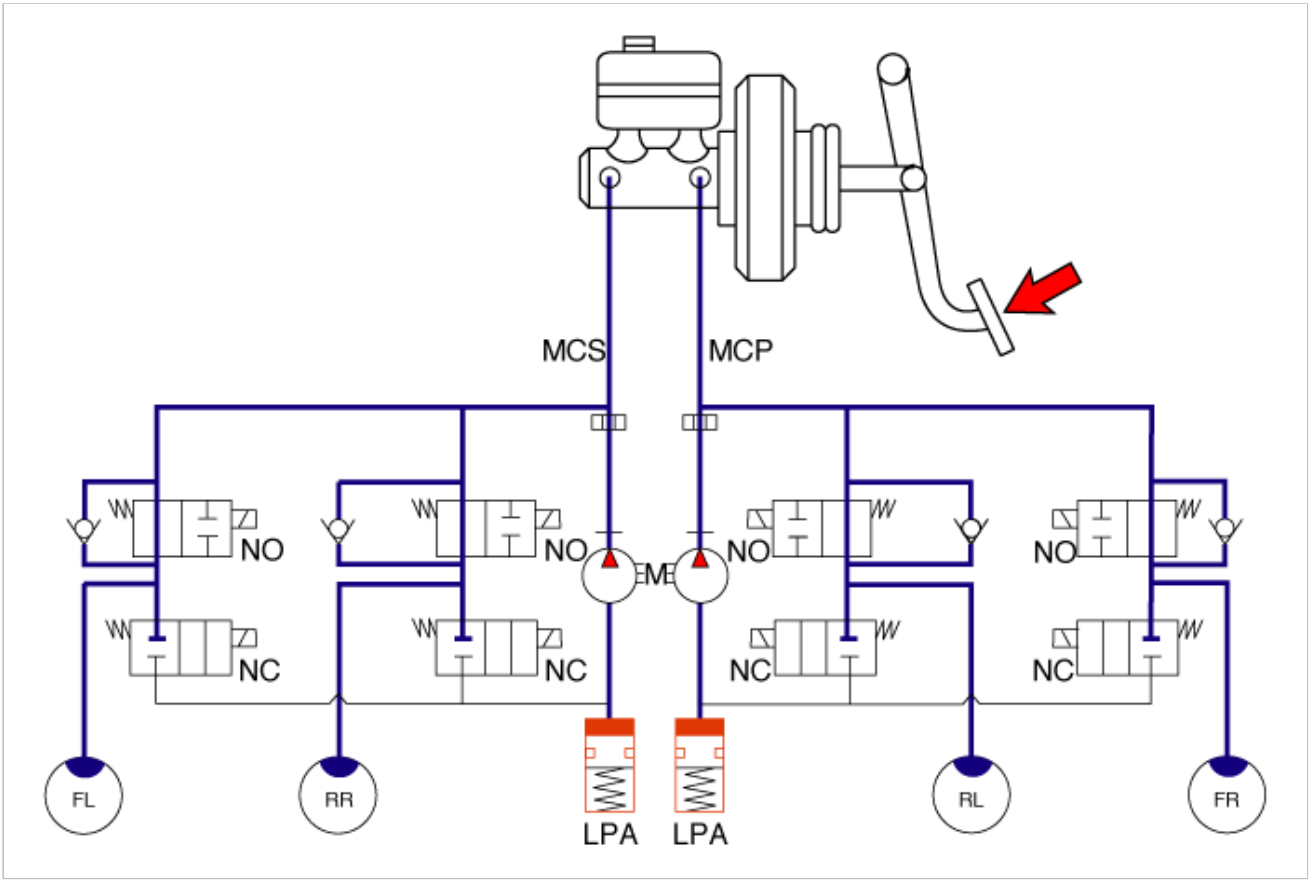
3. Hold Mode
   When the brake fluid pressure is maximally decreased in wheel cylinder, HECU sends a signal to solenoid valve to keep the fluid pressure, voltage is supplied to inlet valve but it is not supplied to outlet valve. At this time inlet and outlet valves are closed and brake fluid is kept in wheel cylinder.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	Close	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	

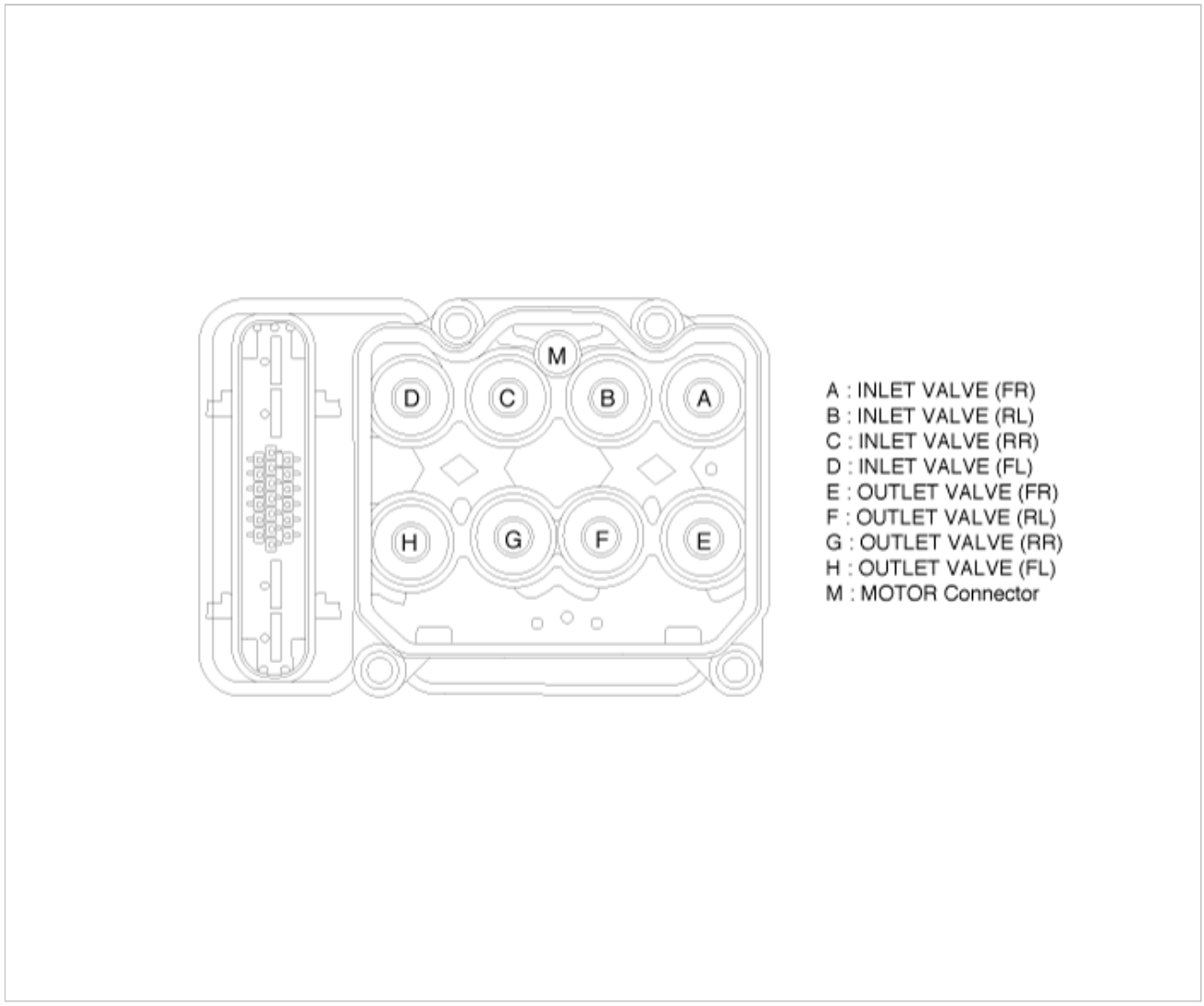


4. Increase Mode
   If HECU determines there's no lock-up in the wheel, HECU cuts voltage to solenoid valve. So voltage is not supplied to each solenoid valve, brake fluid passes through the inlet valve to wheel cylinder, resulting in pressure increase.

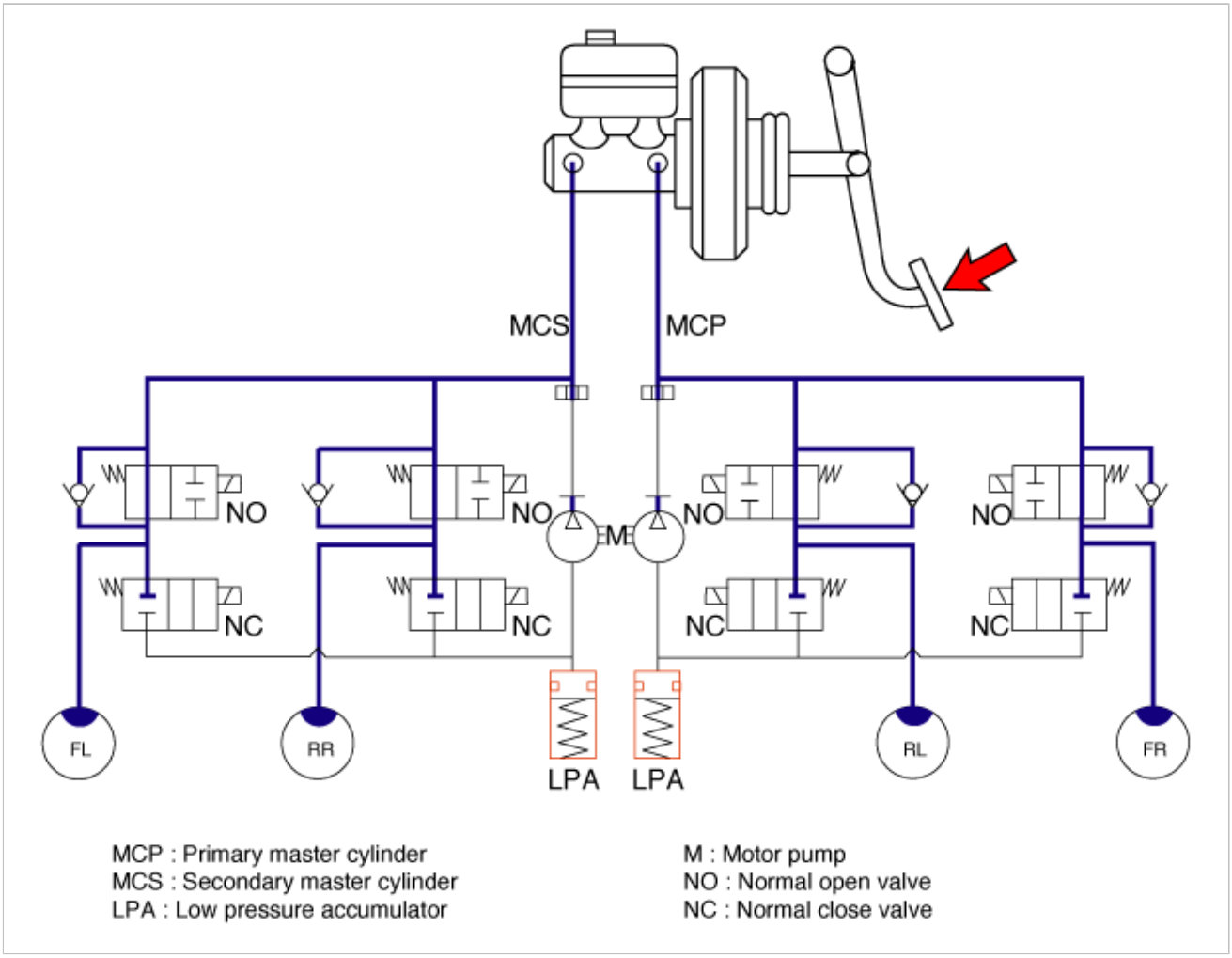
Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	Open	Master cylinder ⇔ Wheel cylinder	ON
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	



ABS HECU External Diagram



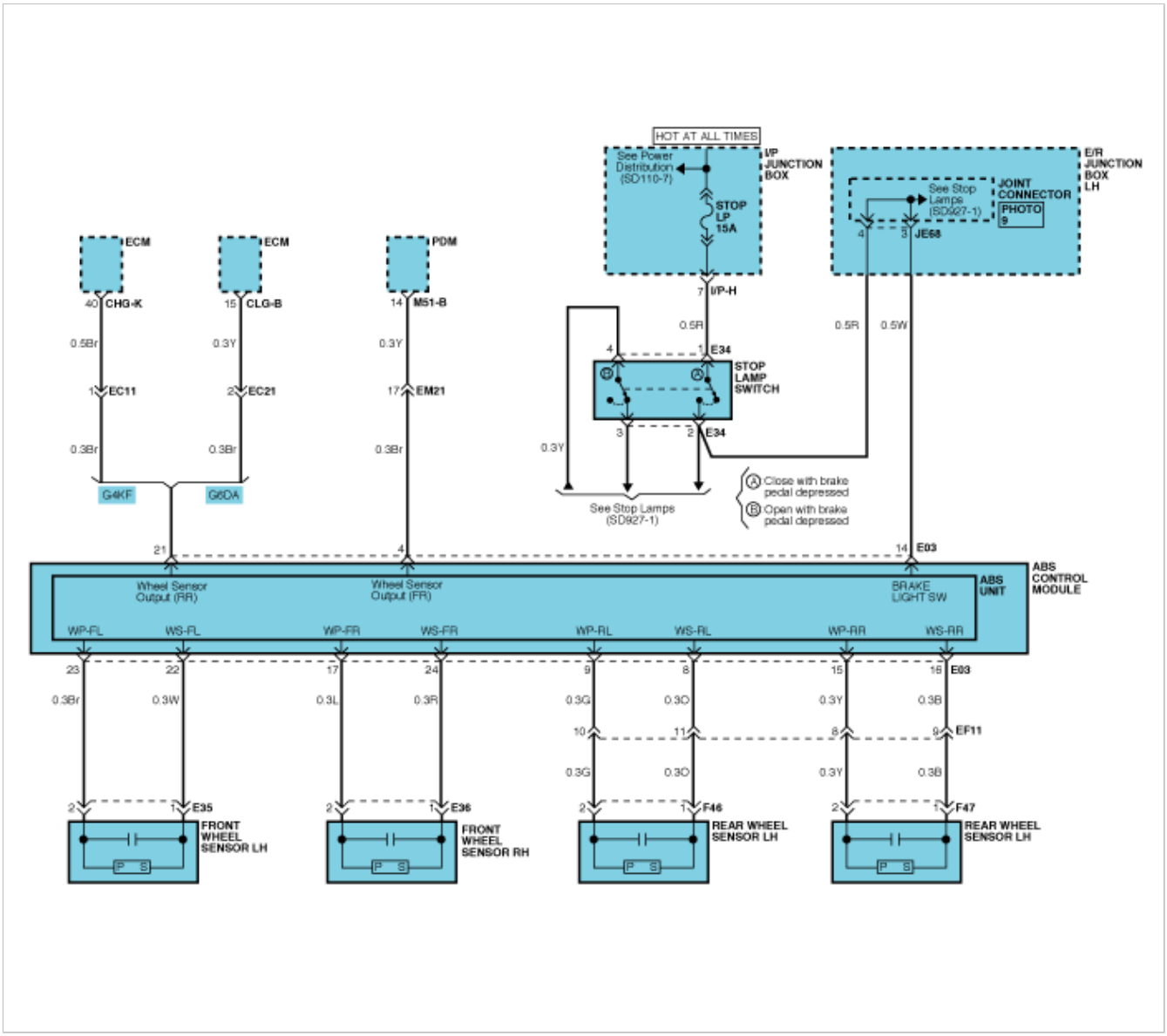
Hydraulic System Diagram



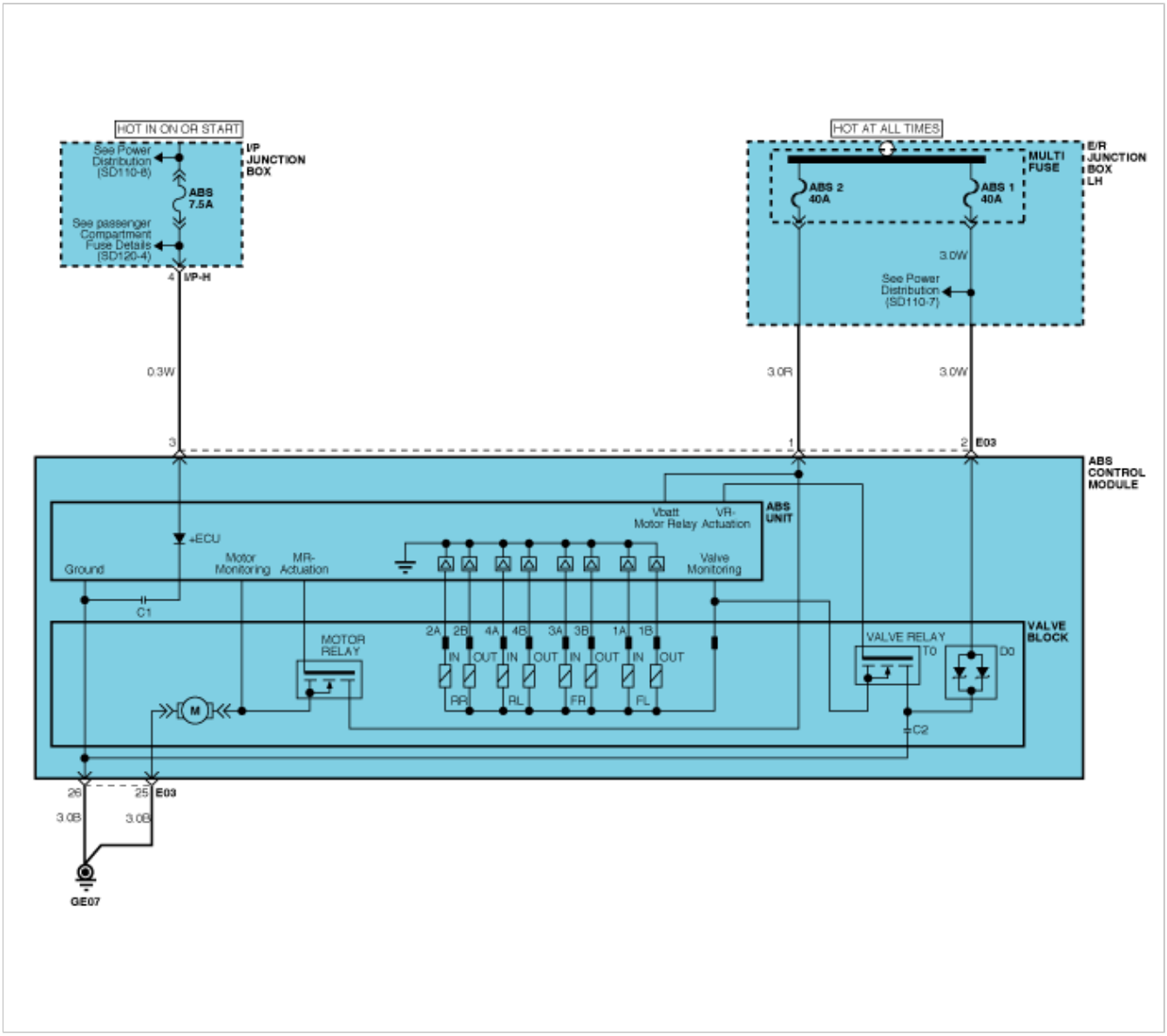
MCP : Primary master cylinder
MCS : Secondary master cylinder
LPA : Low pressure accumulator

M : Motor pump
NO : Normal open valve
NC : Normal close valve

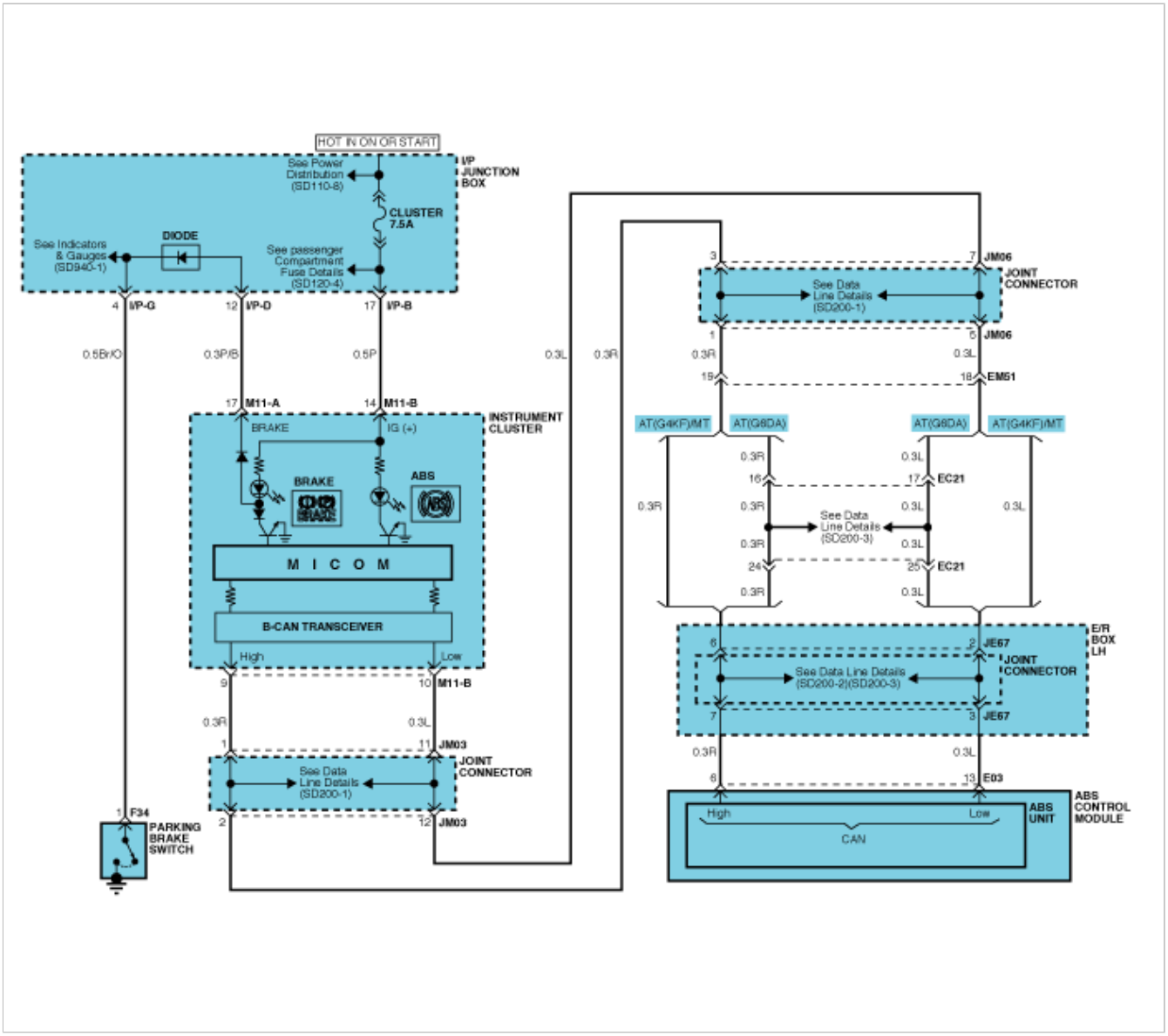
Circuit Diagram - ABS(1)



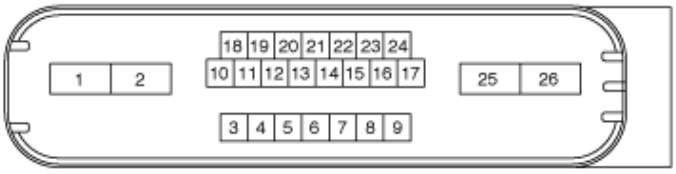
Circuit Diagram - ABS(2)



Circuit Diagram - ABS(3)



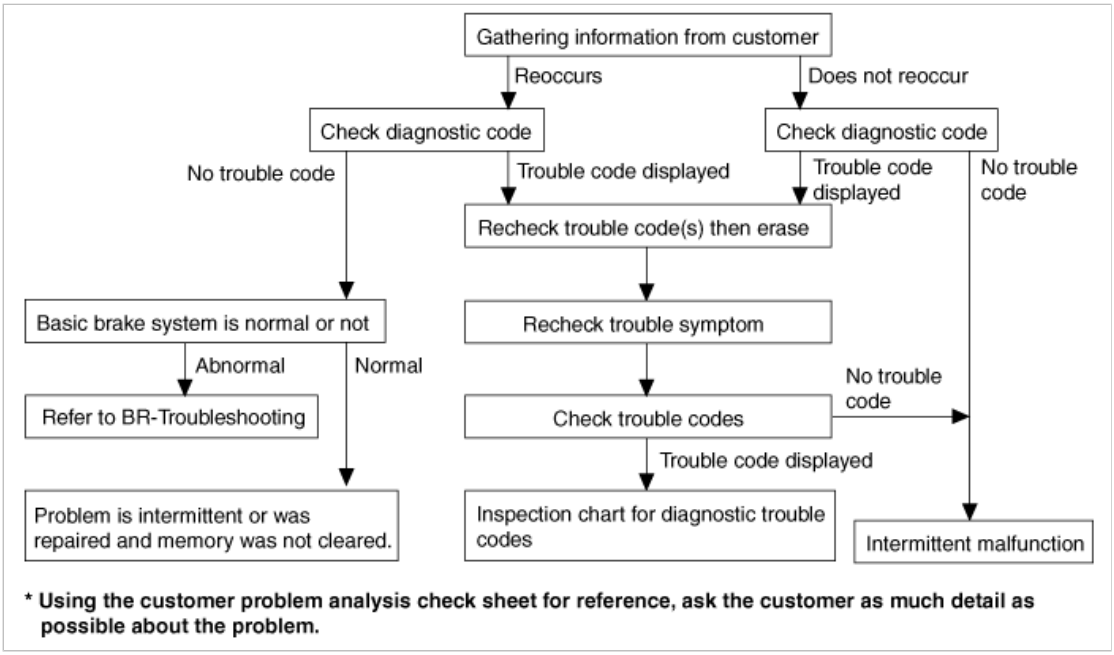
ABS Connector Input / Output



Connector Terminal		Specification	Remark
No	Description		
3	IGNITION1(+)	Over voltage range: 17 ± 0.5V Operating voltage range: 9.5 ± 0.5V < V < 17 ± 0.5V Low voltage range: 7.0 ± 0.5V < V < 9.5 ± 0.5V Max. current: I < 300mA Hardware shutdown voltage : V < 6.0V	
2	POS. BATTERY.(SOLENOID)	Max leakage current : I < 0.8mA Operating voltage range: 9.5 ± 0.5V < V < 17 ± 0.5V Max current : I < 40A	

1	POS, BATTERY.(MOTOR)	Operating voltage range: 9.5 ± 0.5V < V < 16.5 ± 0.5V Rush current : I < 100A Max current : I < 40A Max leakage current : I < 0.2mA	
26	GROUND	Rated current : I < 300mA Max. current: I < 40A	
25	PUMP MOTOR GROUND	Rush current : I < 100A Max current : I < 40A	
14	BRAKE LIGHT SWITCH	Input voltage low: 0V ≤ V ≤ 3.0V Input voltage High: 7.0V ≤ V ≤ 16.0V	
23	SENSOR FRONT LEFT POWER	Output voltage : IGN[V] ± 1V Output current : Max 30mA	
17	SENSOR FRONT RIGHT POWER		
9	SENSOR REAR LEFT POWER		
15	SENSOR REAR RIGHT POWER		
22	SENSOR FRONT LEFT SIGNAL	Input current LOW : 5.9 ~ 8.4mA Input current HIGH : 11.8 ~ 16.8mA Frequency range : 1 ~ 2500Hz Input duty : 50 ± 20%	
24	SENSOR FRONT RIGHT SIGNAL		
8	SENSOR REAR LEFT SIGNAL		
16	SENSOR REAR RIGHT SIGNAL		
13	CAN BUS LINE (LOW)	Max. current : I < 10mA	
6	CAN BUS LINE (HIGH)		
4	SENSOR FRONT RIGHT OUTPUT	Max. current : I < 16mA External pull up resister : 1kΩ < R Output duty : 50 ± 20%	
21	SENSOR REAR RIGHT OUTPUT		

Standard flow of diagnostic troubleshooting



*** Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.**

Notes with regard to diagnosis

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed.
Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.	

ABS Check sheet

ABS Check Sheet

Inspector's Name _____

Customer's Name		Registration No.	
		Registration Year	/ /
		VIN.	
Date Vehicle Brought In	/ /	Odometer	Km Miles

Date the Problem First Occurred	/ /
Frequency of Occurence of Problem	☐ Continuous ☐ Intermittent (times a day)

Symptoms	☐ ABS does not operate.	
	☐ ABS does not operate efficiently.	☐ Intermittent (times a day)
	ABS Warning Light Abnormal	☐ Remains ON ☐ Does not light up

Diagnostic Trouble Code Check	1st Time	☐ Normal Code	☐ Malfunction Code (Code)
	2nd Time	☐ Normal Code	☐ Malfunction Code (Code)

Problem symptoms table

Symptom	Suspect Area
ABS does not operate.	Only when 1.~4. are all normal and the problem is still occurring, replace the HECU. 1. Check the DTC reconfirming that the normal code is output. 2. Power source circuit. 3. Speed sensor circuit. 4. Check the hydraulic circuit for leakage.
ABS does not operate intermittently.	Only when 1.~4. are all normal and the problem is still occurring, replace the ABS actuator assembly. 1. Check the DTC reconfirming that the normal code is output. 2. Wheel speed sensor circuit. 3. Stop lamp switch circuit. 4. Check the hydraulic circuit for leakage.
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line
Communication with Hi-scan (pro) is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU
Even after the engine is started, the ABS	1. ABS warning lamp circuit

warning lamp remains ON.	2. HECU

CAUTION

During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

ABS Does Not Operate.

Detecting condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection procedures

DTC Inspection

1. Connect the scan tool with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

NO	▸ Check the power source circuit.
YES	▸ Erase the DTC and recheck using scan tool.

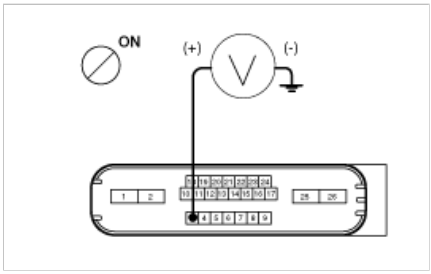
Check the power source circuit

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

Specification: approximately B+

3. Is the voltage within specification?

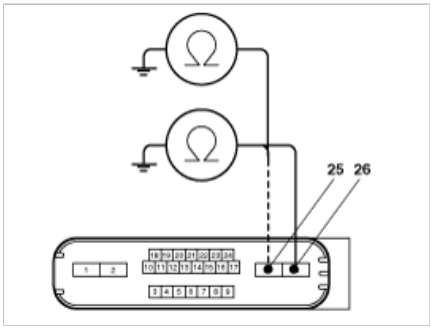
YES	▸ Check the ground circuit.
NO	▸ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module. Repair if necessary.



Check the ground circuit

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 25, 26 of the ABS control module harness side connector and ground point.
3. Is there continuity?

YES	▸ Check the wheel speed sensor circuit.
NO	▸ Repair an open in the wire and ground point.



Check the wheel speed sensor circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

YES	▸ Check the hydraulic circuit for leakage.
NO	▸ Repair or replace the wheel speed sensor.

Check the hydraulic circuit for leakage

1. Refer to the hydraulic lines.
2. Inspect leakage of the hydraulic lines.
3. Is it normal?

YES	▸ The problem is still occurring, replace the ABS control module.
NO	▸ Repair the hydraulic lines for leakage.

ABS Does Not Operate (Intermittently).

Detecting condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection procedures

DTC Inspection

1. Connect the scan tool with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

NO	▸ Check the wheel speed sensor circuit.
YES	▸ Erase the DTC and recheck using scan tool.

Check the wheel speed sensor circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

YES	▸ Check the stop lamp switch circuit.
NO	▸ Repair or replace the wheel speed sensor.

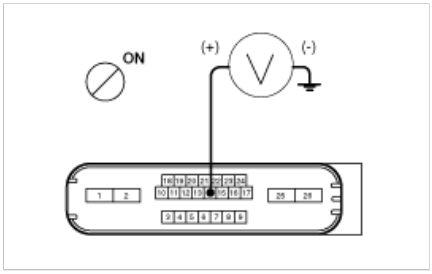
Check the stop lamp switch circuit

1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 14 of the ABS control module harness side connector and body ground when brake pedal is depressed.

Specification : approximately B+

3. Is the voltage within specification?

YES	▸ Check the hydraulic circuit for leakage.
NO	▸ Repair the stop lamp switch. Repair an open in the wire between the ABS control module and the stop lamp switch.



Check the hydraulic circuit for leakage

1. Refer to the hydraulic lines.
2. Inspection leakage of the hydraulic lines.
3. Is it normal?

YES	▸ The problem is still occurring, replace the ABS control module.
NO	▸ Repair the hydraulic lines for leakage.

Communication with Scan-Tool is not possible. (Communication with any system is not possible)

Detecting condition

Trouble Symptoms	Possible Cause
Possible defect in the power supply system (including ground) for the diagnosis line.	- An open in the wire - Poor ground - Faulty power source circuit

Inspection procedures

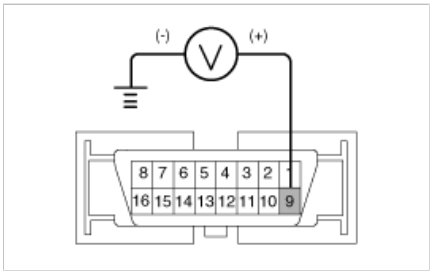
Check The Power Supply Circuit For The Diagnosis

1. Measure the voltage between terminal 9 of the data link connector and body ground.

Specification : approximately B+

2. Is voltage within specification?

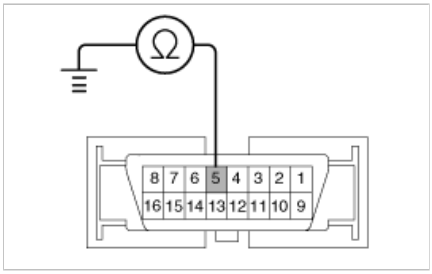
YES	▸ Check the ground circuit for the diagnosis.
NO	▸ Repair an open in the wire. Check and replace fuse (15A) from the engine compartment junction block.



Check the ground circuit for the diagnosis

1. Check for continuity between terminal 5 of the data link connector and body ground.
2. Is there continuity?

NO	▸ Repair an open in the wire between terminal 5 of the data link connector and ground point.



Communication with Scan Tool is not possible.
(Communication with ABS only is not possible)

Detecting condition

Trouble Symptoms	Possible Cause
When communication with Hi-Scan (pro) is not possible, the cause may be probably an open in the HECU power circuit or an open in the diagnosis output circuit.	- An open in the wire - Faulty HECU - Faulty power source circuit

Inspection procedures

Check for Continuity in the Diagnosis Line

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 7 of the ABS control module connector and 1 of the data link connector.
3. Is there continuity?

YES	▸ Check the power source of ABS control module.
NO	▸ Repair an open in the wire.

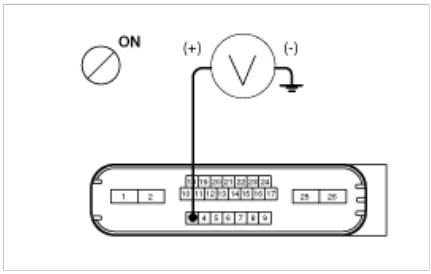
Check the power source of ABS control module

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

Specification : approximately B+

3. Is voltage within specification?

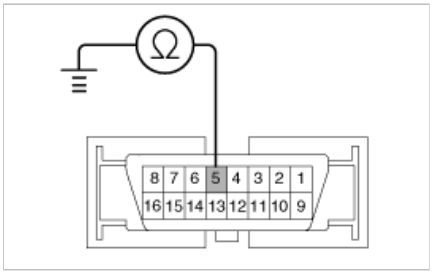
YES	▸ Check for poor ground.
NO	▸ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module.Repair if necessary.



Check for poor ground

1. Check for continuity between terminal 5 of the data link connector and ground point.

YES	▸ Replace the ABS control module and recheck.
NO	▸ Repair an open in the wire or poor ground



When Ignition Key Is Turned ON (engine OFF), The ABS Warning Lamp Does Not Light Up.

Detecting condition

Trouble Symptoms	Possible Cause
When current flows in the HECU the ABS warning lamp turns from ON to OFF as the initial check. Therefore if the lamp does not light up, the cause may be an open in the lamp power supply circuit, a blown bulb, an open in the both circuits between the ABS warning lamp and the HECU, and the faulty HECU.	- Faulty ABS warning lamp bulb - Blown fuse is related to ABS in the engine compartment junction block - Faulty ABS warning lamp module - Faulty HECU

Inspection procedures

Problem verification

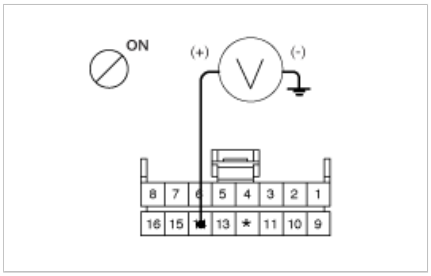
1. Disconnect the connector from the ABS control module and turn the ignition switch ON.
2. Does the ABS warning lamp light up?

YES	▸ Inspect again after replacing the ABS HECU.
NO	▸ Check the power source for the ABS warning lamp.

Check the power source for the ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch ON.
2. Measure the voltage between terminal (M11-B) 14 of the cluster harness side connector and body ground.

Specification : approximately B+



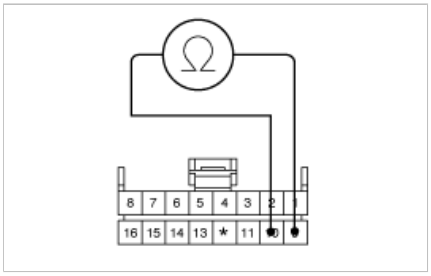
3. Is voltage within specification?

YES	▸ Check the CAN circuit resistance for ABS warning lamp.
NO	▸ Check for blown fuse.

Check the can circuit resistance for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M11-B) 9 and 10 of the cluster harness side connector.

Specification : 60Ω



3. Is resistance within specification?

YES	▸ Repair ABS warning lamp bulb or instrument cluster assembly.
NO	▸ Check the CAN circuit wiring for ABS warning lamp.

Check the can circuit wiring for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M11-B) 9 of the cluster harness side connector and terminal 6 of ABS HECU harness side.
   Check for continuity between terminal (M11-B) 10 of the cluster harness side connector and terminal 13 of ABS HECU harness side.

Specification : Below 1Ω

3. Is resistance within specification?

YES	▸ Repair short of wiring between terminal 6, 13 of ABS HECU harness connector and ABS warning lamp module.
NO	▸ Repair open of wiring between terminal 6, 13 of ABS HECU harness connector and ABS warning lamp module.

Even After The Engine Is Started, The ABS Warning Lamp Remains ON.

Detecting condition

Trouble Symptoms	Possible Cause
If the HECU detects trouble, it lights the ABS warning lamp while at the same time prohibiting ABS control. At this time, the HECU records a DTC in memory. Even though the normal code is output, the ABS warning lamp remains ON, then the cause may be probably an open or short in the ABS warning lamp circuit.	- An open in the wire - Faulty instrument cluster assembly - Faulty ABS warning lamp module - Faulty HECU

Inspection procedures

Check DTC Output

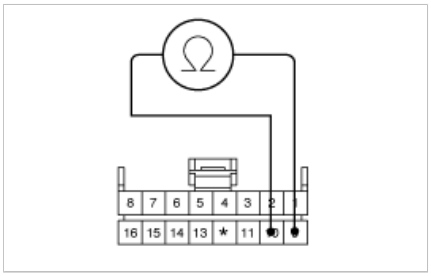
1. Connect the scan tool to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using scan tool.
3. Is DTC output?

YES	▸ Perform the DTC troubleshooting procedure (Refer to DTC troubleshooting).
NO	▸ Check the CAN circuit resistance for ABS warning lamp.

Check the can circuit resistance for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M11-B) 9 and 10 of the cluster harness side connector.

Specification : 60Ω



3. Is resistance within specification?

YES	▸ Repair ABS warning lamp bulb or instrument cluster assembly.
NO	▸ Check the CAN circuit wiring for ABS warning lamp.

Check the can circuit wiring for ABS warning lamp

1. Disconnect the instrument cluster connector (M11-B) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M11-B) 9 of the cluster harness side connector and terminal 6 of ABS HECU harness side.
   Check for continuity between terminal (M11-B) 10 of the cluster harness side connector and terminal 13 of ABS HECU harness side.

   Specification : Below 1Ω

3. Is there continuity?

YES	▸ Repair short of wiring between terminal 6, 13 of ABS HECU harness connector and ABS warning lamp module.If no trouble in wiring, inspect again after replacing the ABS HECU.
NO	▸ Repair short of wiring between terminal 6, 13 of ABS HECU harness connector and ABS warning lamp module.If no trouble in wiring, inspect again after replacing the ABS HECU.

Bleeding of Brake System

This procedure should be followed to ensure adequate bleeding of air and filling of the ABS unit, brake lines and master cylinder with brake fluid.

1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

   CAUTION

   If there is any brake fluid on any painted surface, wash it off immediately.

   NOTE

   When pressure bleeding, do not depress the brake pedal.
   Recommended fluid..... DOT3 or DOT4

2. Disconnect the vacuum switch connector.
   (2.0 AT & ESC Only)
3. Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.
4. Connect the scantool to the data link connector located underneath the dash panel.
5. Select and operate according to the instructions on the scantool screen.

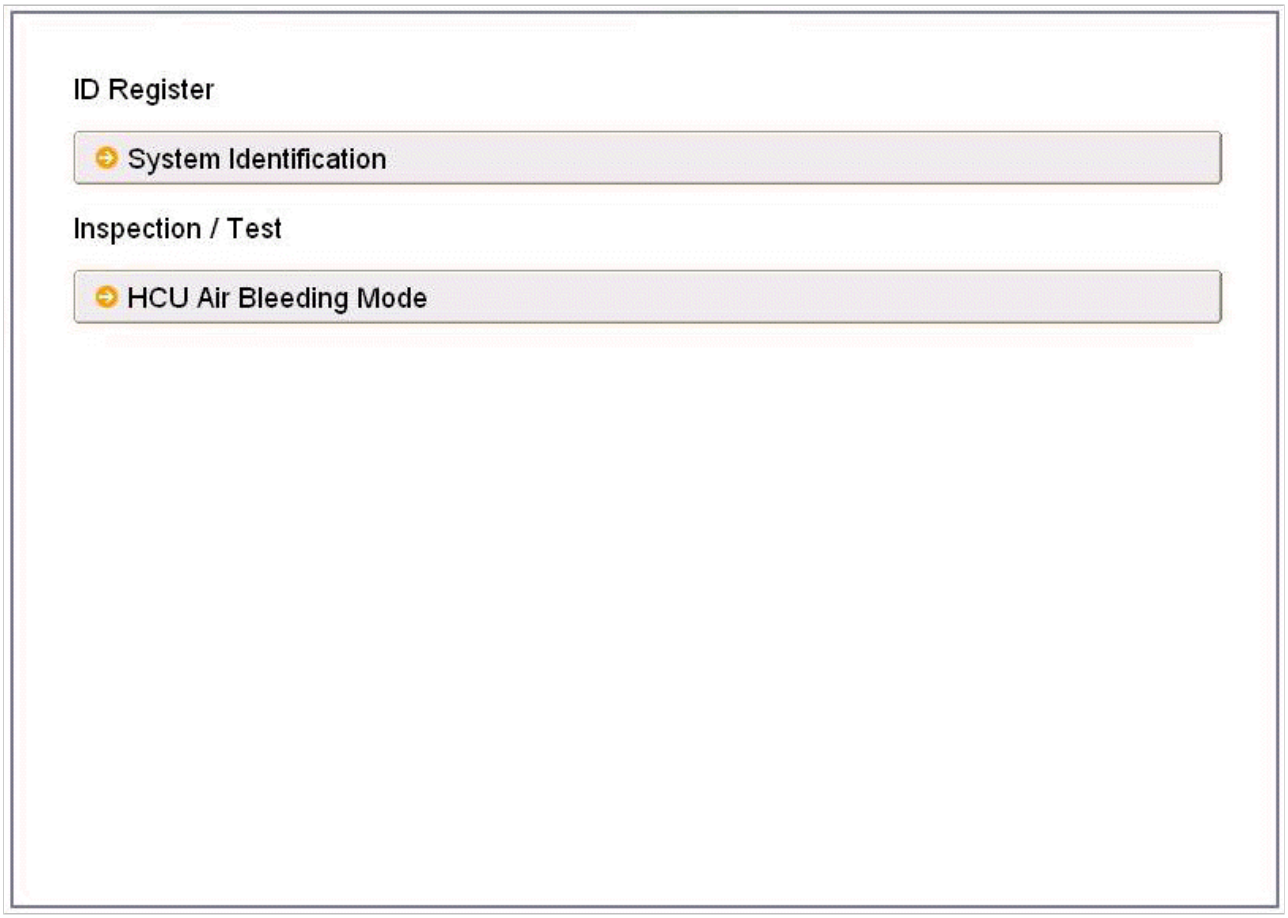
   CAUTION

   You must obey the maximum operating time of the ABS motor with the scantool to prevent the motor pump from burning.

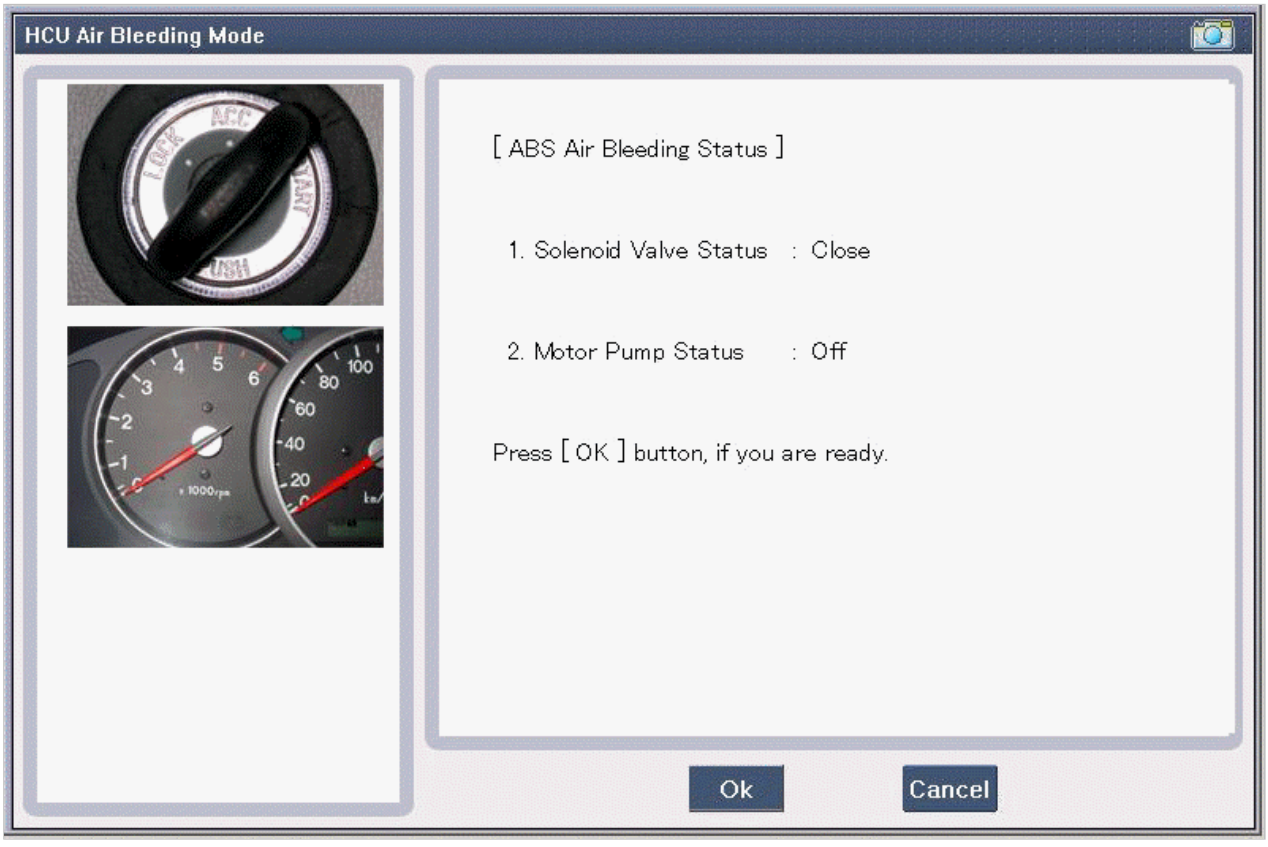
   (1) Select vehicle name.

   (2) Select Anti-Lock Brake system.

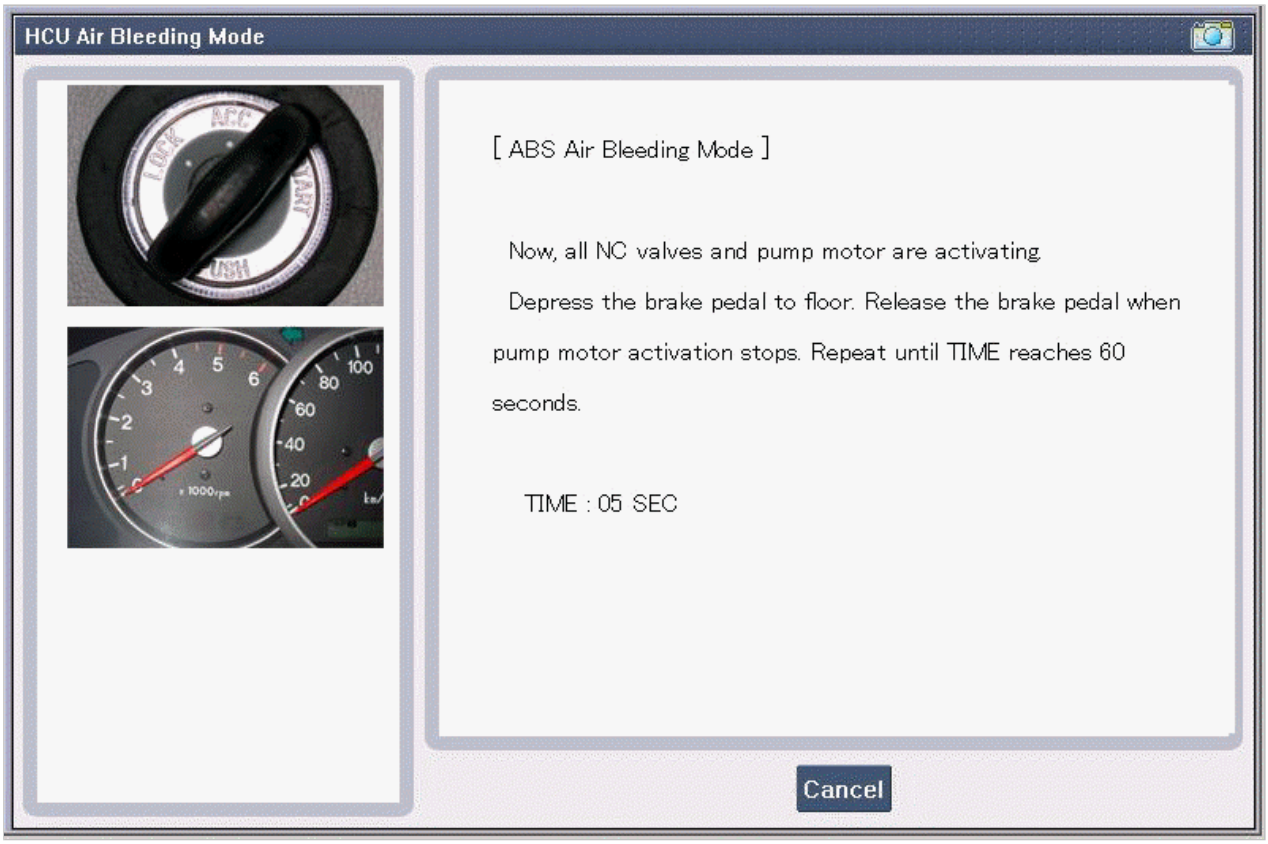
   (3) Select HCU air bleeding mode.



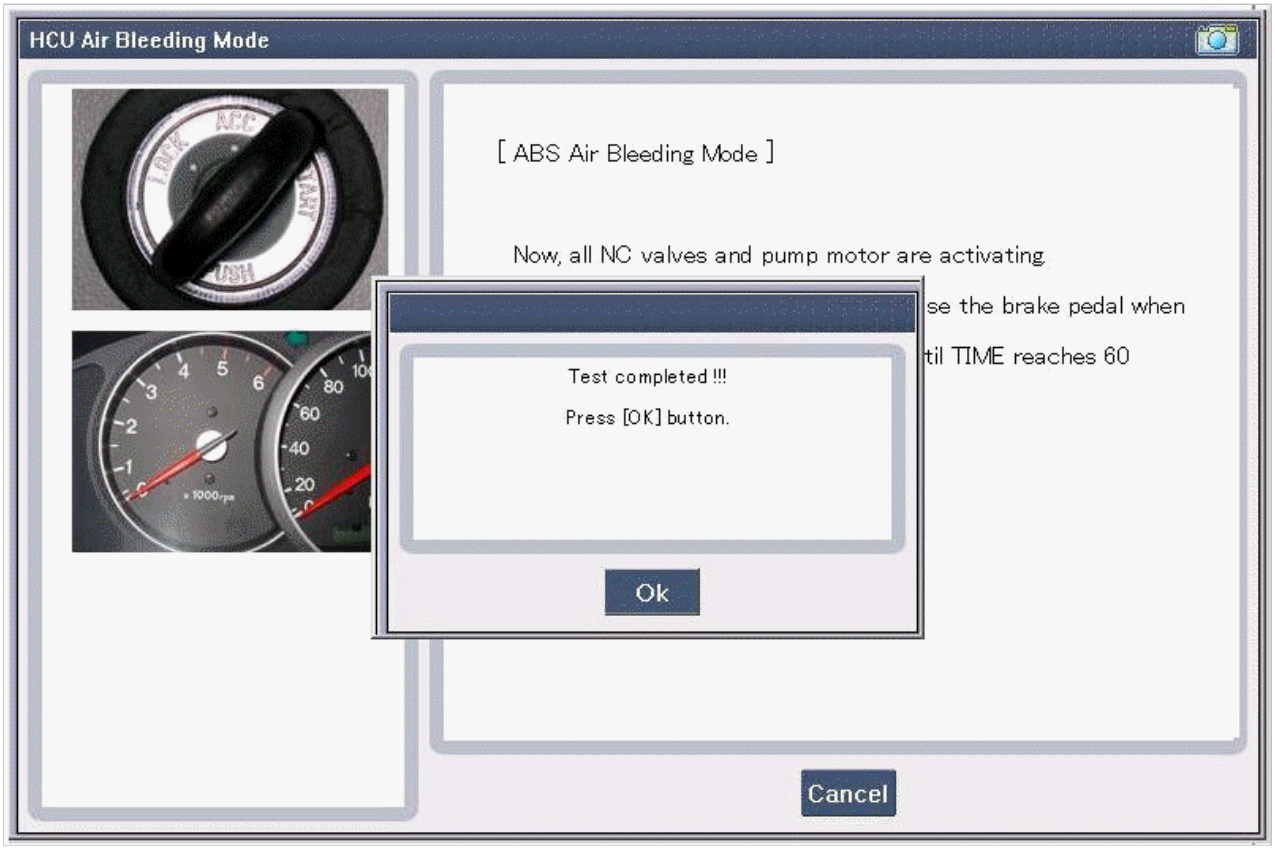
(4) Press "OK" to operate motor pump and solenoid valve.



(5) Wait 60 sec. before operating the air bleeding. (If not, you may damage the motor.)

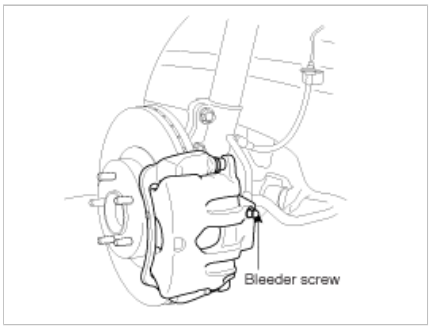


(6) Perform the air bleeding.

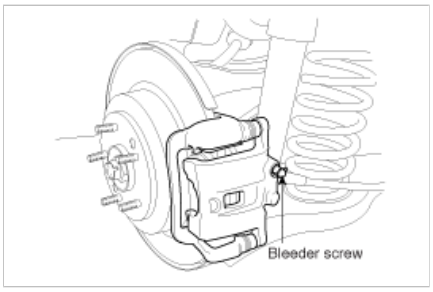


6. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.

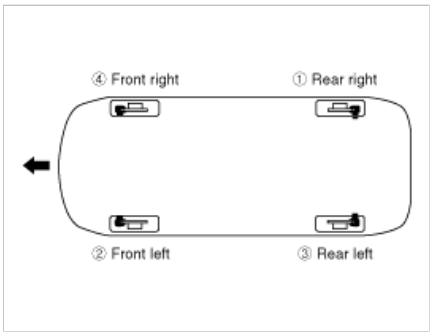
Front



Rear



7. Repeat step 5 until there are no more bubbles in the fluid for each wheel.



8. Tighten the bleeder screw.

Bleed screw tightening torque:
6.9 ~ 12.7N.m (0.7 ~ 2.0kgf.m, 5.1 ~ 9.5lb-ft)

9. Connect the vacuum switch connector.
(2.0 AT & ESC Only)

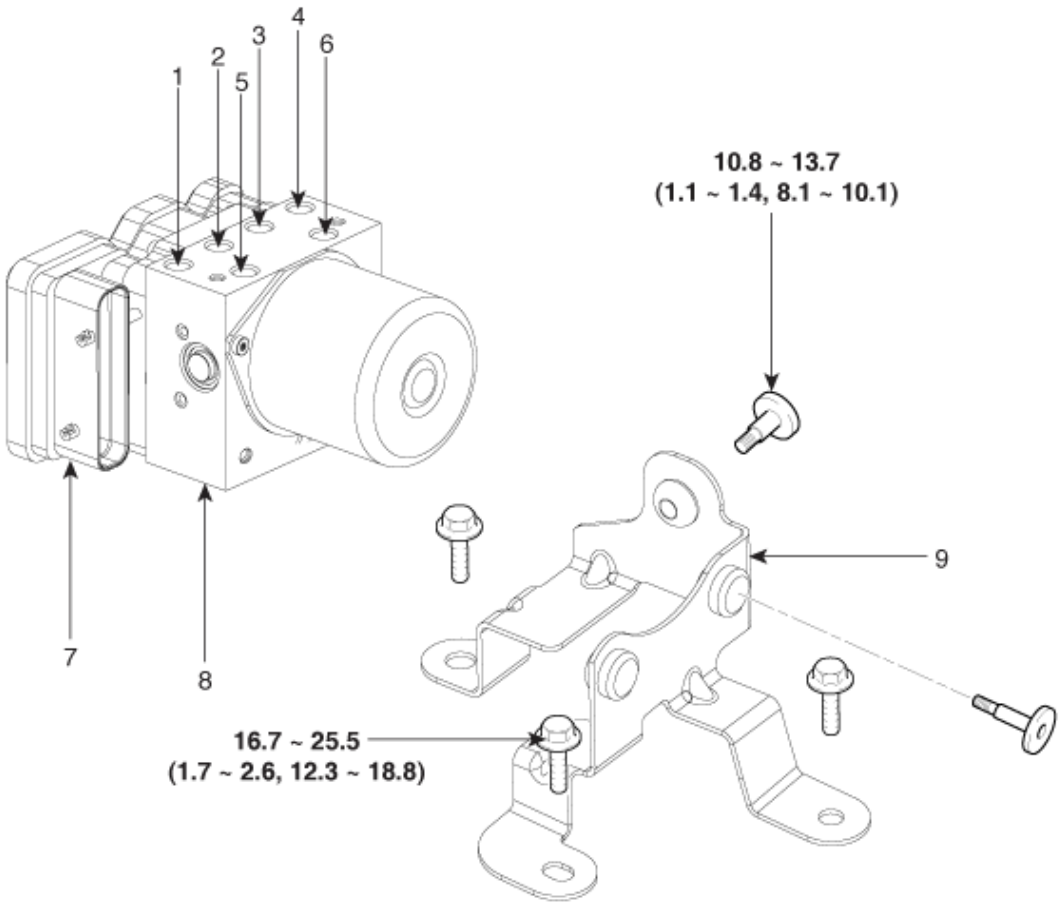
ABS Diagnostic Trouble Code(DTC) chart

● : MIL ON ○ : MIL OFF

DTC CODE	Trouble description	Warning lamp condition		Remark
		EBD	ABS	
C1101	Battery Voltage High	●	●	
C1102	Battery Voltage Low	○/●	●	
C1200	Wheel Speed Sensor Front-LH Open/Short	○/●	●	
C1201	Wheel Speed Sensor Front-LH Range / Performance / Intermittent	○/●	●	
C1202	Wheel Speed Sensor Front-LH Invalid/no Signal	○/●	●	
C1203	Wheel Speed Sensor Front-RH Open/Short	○/●	●	
C1204	Wheel Speed Sensor Front-RH Range / Performance / Intermittent	○/●	●	
C1205	Wheel Speed Sensor Front-RH Invalid/no Signal	○/●	●	
C1206	Wheel Speed Sensor Rear-LH Open/Short	○/●	●	
C1207	Wheel Speed Sensor Rear-LH Range / Performance / Intermittent	○/●	●	
C1208	Wheel Speed Sensor Rear-LH Invalid/no Signal	○/●	●	
C1209	Wheel Speed Sensor Rear-RH Open/Short	○/●	●	

C1210	Wheel Speed Sensor Rear-RH Range / Performance / Intermittent	○/●	●	
C1211	Wheel Speed Sensor Rear-RH Invalid/no Signal	○/●	●	
C1604	ECU Hardware Error	●	●	
C2112	Valve Relay Error	●	●	
C2380	ABS/TCS/ESC valve error	●	●	
C2402	Motor Failure	○	●	

Components

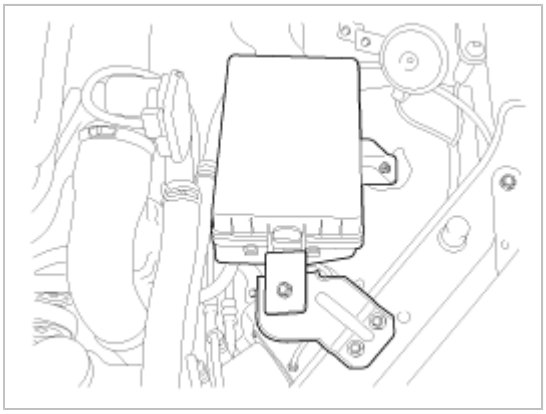


Torque : N.m (kgf.m, lb-ft)

1. Front-left tube	6. MC1
2. Rear -right tube	7. ABS control module connector (B)
3. Rear-left tube	8. ABS control module (HECU)
4. Front-right tube	9. Bracket
5. MC2	

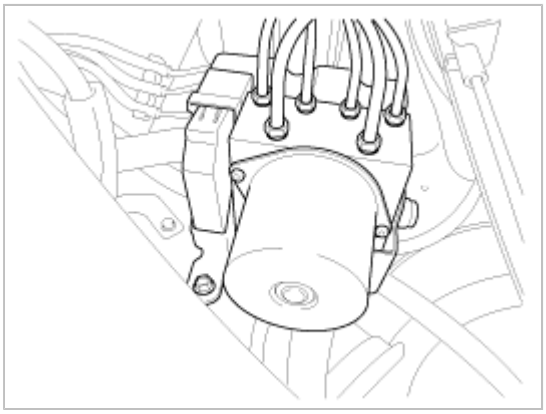
Removal

1. Turn the ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the engine room junction box and bracket.



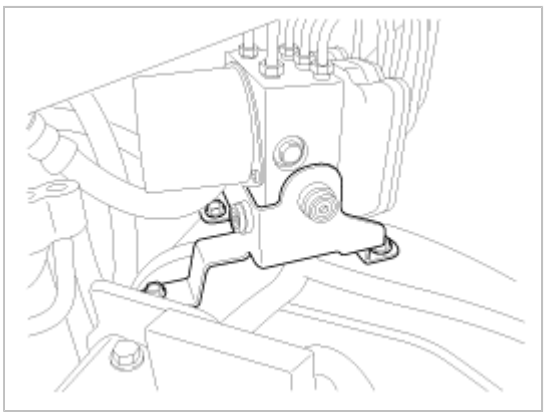
3. Disconnect the brake tubes from the HECU by unlocking the nuts counterclockwise with a spanner.

Tightening torque:
ABS : 12.7 ~ 16.7N.m(1.3 ~ 1.7kgf.m, 9.4 ~ 12.3lb-ft)
ESC : 18.6 ~ 22.6N.m(1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)



4. Pull up the lock of the ABS control unit connector, then disconnect the connector.
5. Loosen the ABS HECU bracket bolt(3EA), then remove HECU and bracket.

Tightening torque:
16.7 ~ 25.5N.m (1.7 ~ 2.6kgf.m, 12.3 ~ 18.8lb-ft)



CAUTION

1. Never attempt to disassemble the HECU.
2. The HECU must be transported and stored in.
3. Never shock to the HECU.

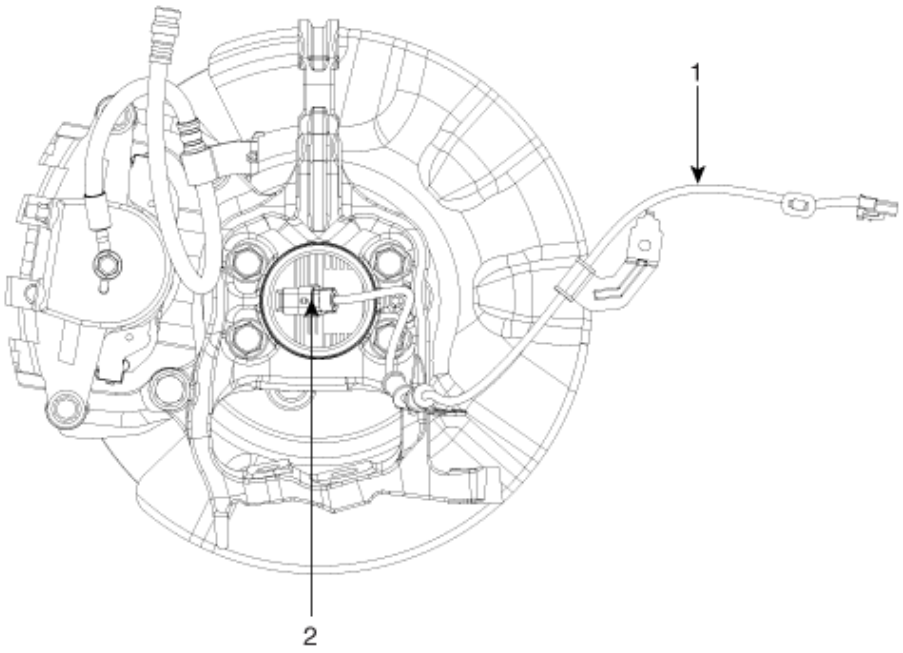
6. Remove the 3 bolts, then remove the bracket from HECU.

Tightening torque:
10.8 ~ 13.7N.m (1.1 ~ 1.4kgf.m, 8.0 ~ 10.1lb-ft)

Installation

1. Installation is the reverse of removal.
2. Tighten the HECU mounting bolts and nuts to the specified torque.

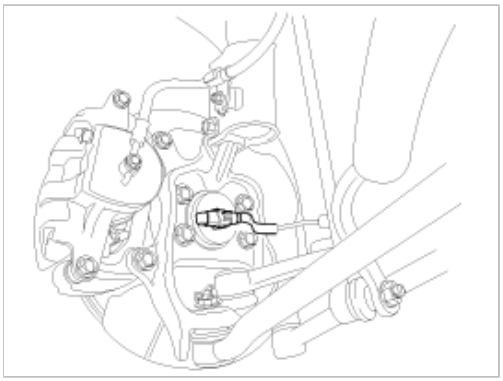
Components



1. Front wheel speed sensor cable
2. Front wheel speed sensor

Removal

1. Remove the connector after removing the front wheel speed sensor clip.

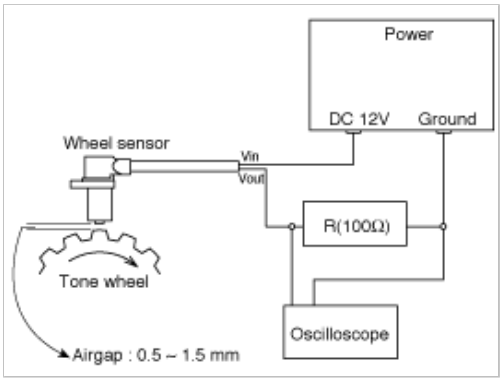


2. Remove the front wheel speed sensor. (Refer to Driveshaft and axle group - Front axle assembly)
3. Installation is the reverse of removal.

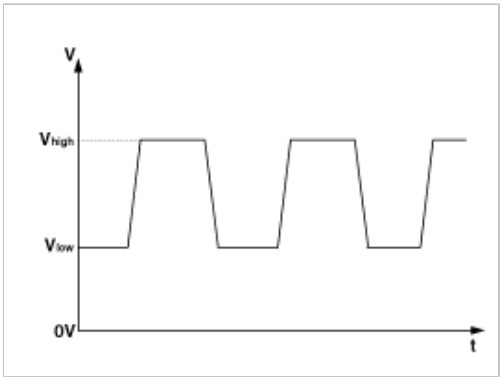
Inspection

1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

> **CAUTION**
>
> In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resister must be used as shown.

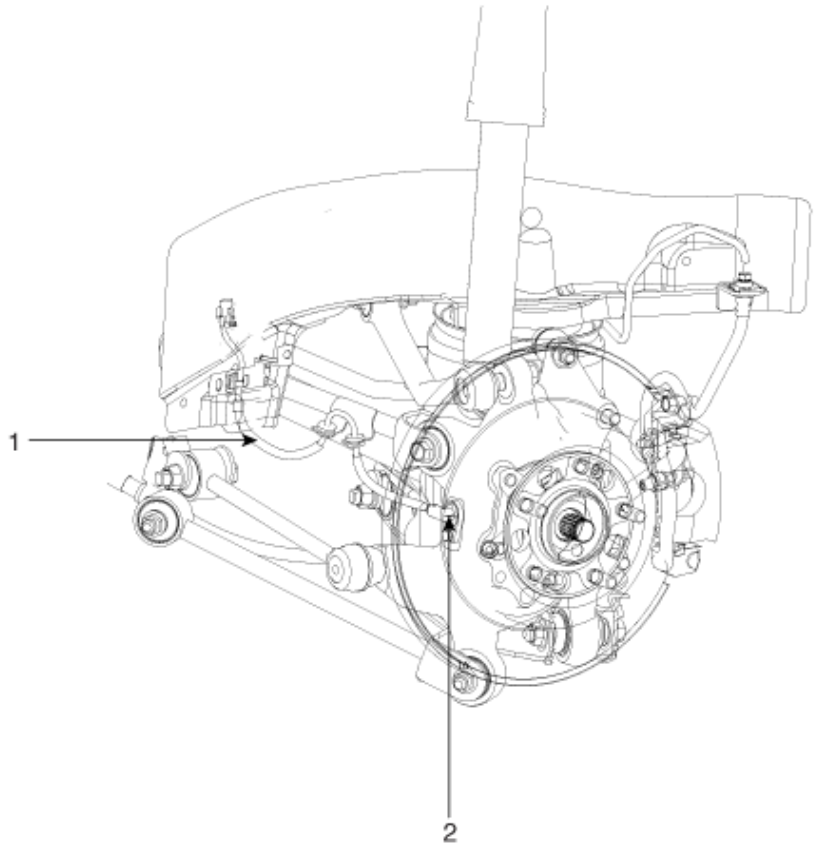


2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



V_low : 0.59V ~ 0.84V
V_high : 1.18V ~ 1.68V
Frequency range : 1 ~ 2,500Hz

Components

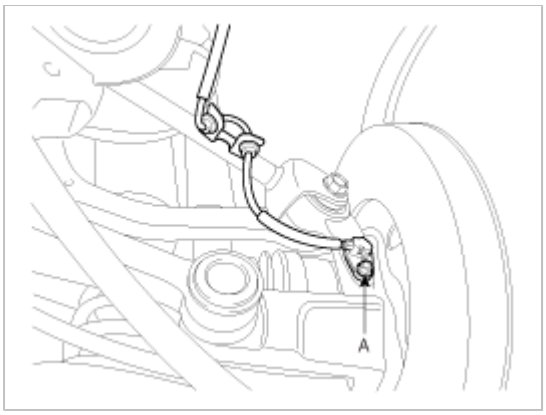


1. Rear wheel speed sensor cable
2. Rear wheel speed sensor

Removal

1. Remove the rear wheel speed sensor mounting bolt (A).

Tightening torque:
8.8 ~ 11.8 N.m (0.9 ~ 1.2 kgf.m, 6.5 ~ 8.7 lb-ft)

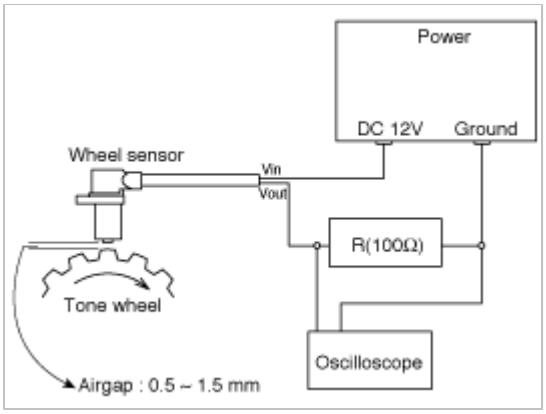


2. Remove the rear wheel guard.
3. Disconnect the rear wheel speed sensor connector (A). And remove the rear wheel speed sensor.
4. Installation is the reverse of removal.

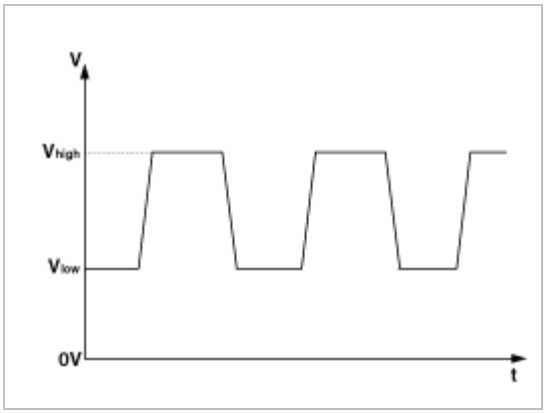
Inspection

1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

> **CAUTION**
>
> In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resister must be used as shown.



2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



Low :
High :
Frequency range :

EBD(Electronic brake-force distribution) Operation

The EBD system (Electronic Brake force Distribution) as a sub-system of the ABS system is to control the effective adhesion utilization by the rear wheels.
It further utilizes the efficiency of highly developed ABS equipment by controlling the slip of the rear wheels in the partial braking range.
The brake force is moved even closer to the optimum and controlled electronically, thus dispensing with the need for the proportioning valve.
The proportioning valve, because of a mechanical device, has limitations to achieve an ideal brake force distribution tothe rear wheels as well as to carry out the flexible brake force distribution proportioning to the vehicle load or weight increasing. And in the event of malfunctioning, driver cannot notice whether it fails or not.
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.
If the EBD fails, the EBD warning lamp (Parking brake lamp) lights up.

Advantages

- Function improvement of the base-brake system.
- Compensation for the different friction coefficients.
- Elimination of the proportioning valve.
- Failure recognition by the warning lamp.

Comparison between proportioning valve and EBD