

# Brake System (BOSCH ABS)

## ABS(Anti-Lock Brake System)

Specifications .....	BRA -2
Components .....	BRA -3
Generals .....	BRA -4
Oil Pressure Circuit Diagram .....	BRA -6
Electric Circuit Diagram .....	BRA -7
Connector ID Diagram .....	BRA -9
Troubleshooting .....	BRA -10
Diagnostic Troubleshooting Codes .....	BRA -12
ABS Modulator	
Components .....	BRA -19
Removal .....	BRA -20
Installation .....	BRA -20
ABS Control Module	
Removal .....	BRA -21
Wheel Speed Sensor	
Components .....	BRA -22
Removal .....	BRA -23
Inspection .....	BRA -23



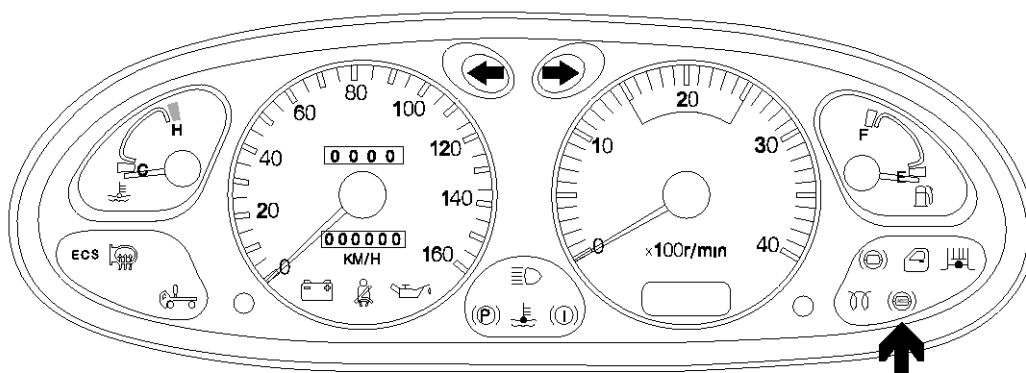
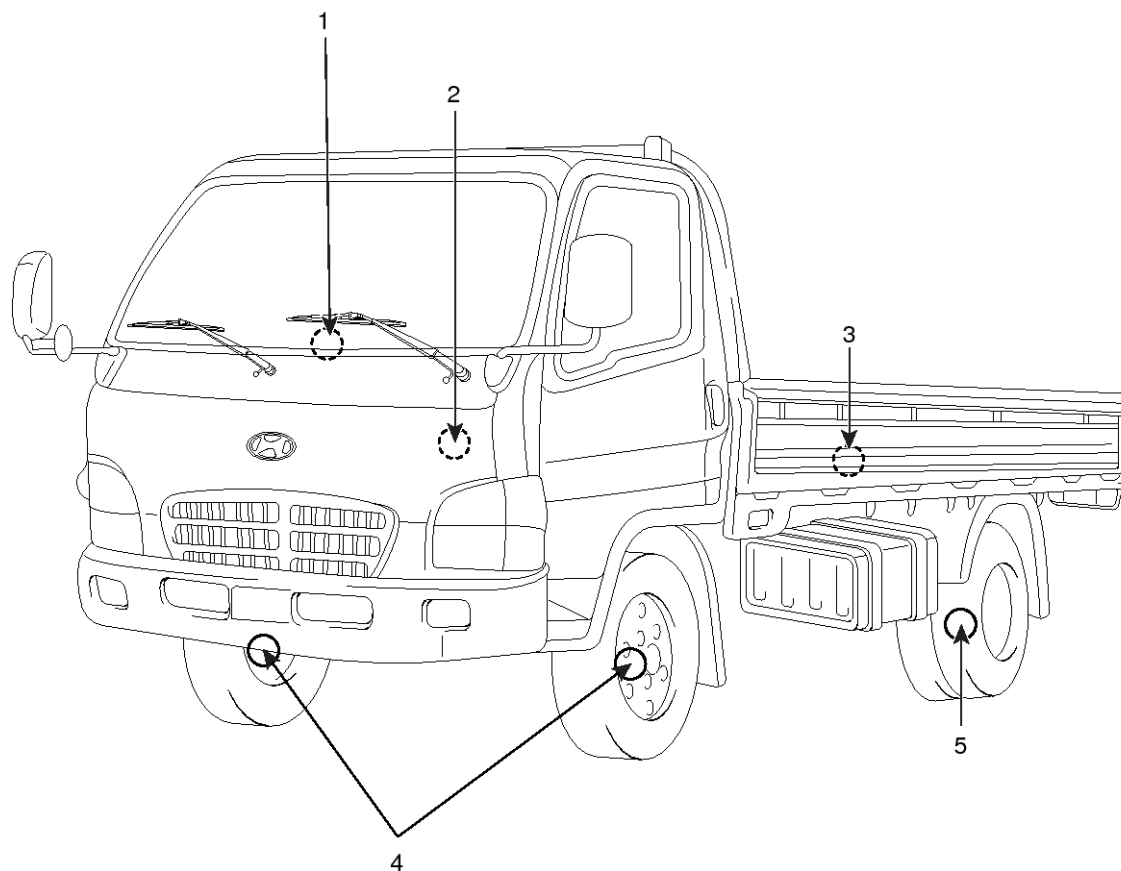
## ABS(Anti-lock Brake System)

### Specifications

#### ABS specification

Item	12V	24V
ABSCM(ABS Control Module)		
Operating voltage	8 ~ 16V	16~35V
Power consumption		
Inoperation	12W or below	12W or below
Operation	15W or below	18W or below
Operating temperature range	-40 ~ 65°C	-40 ~ 65°C
Modulator		
Operating voltage range	8.8 ~ 17.0 V	18.9 ~ 32.8 V
On-board voltage	12V	24V
Operating temperature range	-40°~ 120°C	-40°~ 120°C
Motor relay		
On-board voltage	DC12V	DC24V
Operation voltage	10~16V	17~32V
On-board current	35A	20A
Valve relay		
On-board voltage	DC12V	DC24V
Operating voltage	10~16V	19~32V

## Components



Warning lamp

1. ABS control module
2. Master cylinder and brake booster
3. Modulate assembly
4. Front wheel speed sensor
5. Rear wheel speed sensor

## Generals

### ABS System

The Anti-Lock Brake System (ABS) protects the locking of the wheel by controlling the oil pressure of the 4 wheels when the driver brakes the car suddenly or on the slide road.

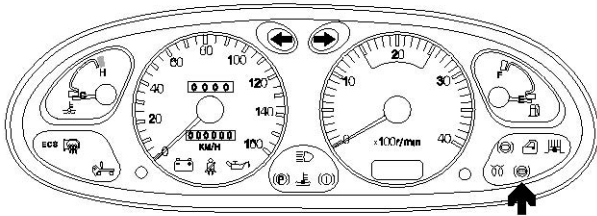
The ABS suggests the following advantages.

1. When the car is turn around an object suddenly or when the car is stopped suddenly, it is possible to control the car.
2. During sudden braking time, or even running in curved way, it is possible to drive in safe and to ensure the excellent controlling so as to stop the car safely.

In order to ensure the good service when it has a problem, the ABS system includes the self diagnosis and the fail safe device.

### Checking the system Diagnosis Indicator.

When turning the ignition switch ON, check that the ABS warning lamp turns on for 2 seconds. If the warning lamp does not turn on immediately when the ignition switch is ON, the ABS fail safe may be damaged.



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### Method for diagnosing the System

The ABS control module continuously checks the failure of the electric state of the ABS.

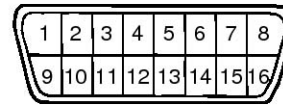
If it detects any problem, the ABS warning lamp will be blinking to indicate an error code.

## Checking the ABS Error Code

### Method for diagnosing the ABS Error Code

The Nippon ABS system can save the error code. When the L terminal of the data link connector is connected to the ground, it is possible to check the self-diagnosis code number.

1. Connect the L terminal (pin No.6) of the self-diagnosis data link connector to the GND.



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#### NOTICE

*If the L terminal is not connected to GND, it is not possible to read the error code.*

2. Turn ON the ignition switch.
3. The error code is stored in EEPROM. At most, the 3 error codes can be saved and output.

#### NOTICE

*If the error codes more than 3 are occurred, the only 3 codes recently occurred are memorized and the old ones are erased.*

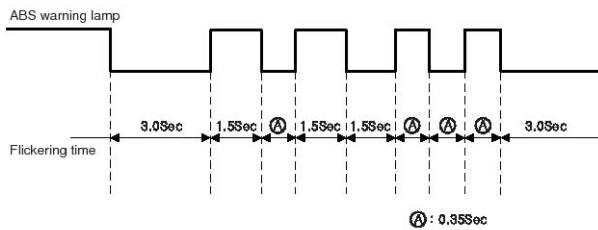
4. When the IG switch is ON or the L terminal is grounded, it enters into the self-diagnosis mode. (In this case, the speed of vehicle should be less than 10km and the brake lamp switch should be in OFF state.)

#### NOTICE

*In the self-diagnosis mode, the serial communication with the ABS controller is prohibited.*

## Indicating the ABS Error Code

1. The error code will be shown at 3 seconds later after the self diagnosis mode starts.
2. The first digit of the self-diagnosis is blinking for 1.5 seconds. After 0.35 seconds, the second digit is blinking for 1.5 seconds.
3. From 10s digit, the error code is indicated by the number of blinking. When there is no error code, the lamp will be on continually.



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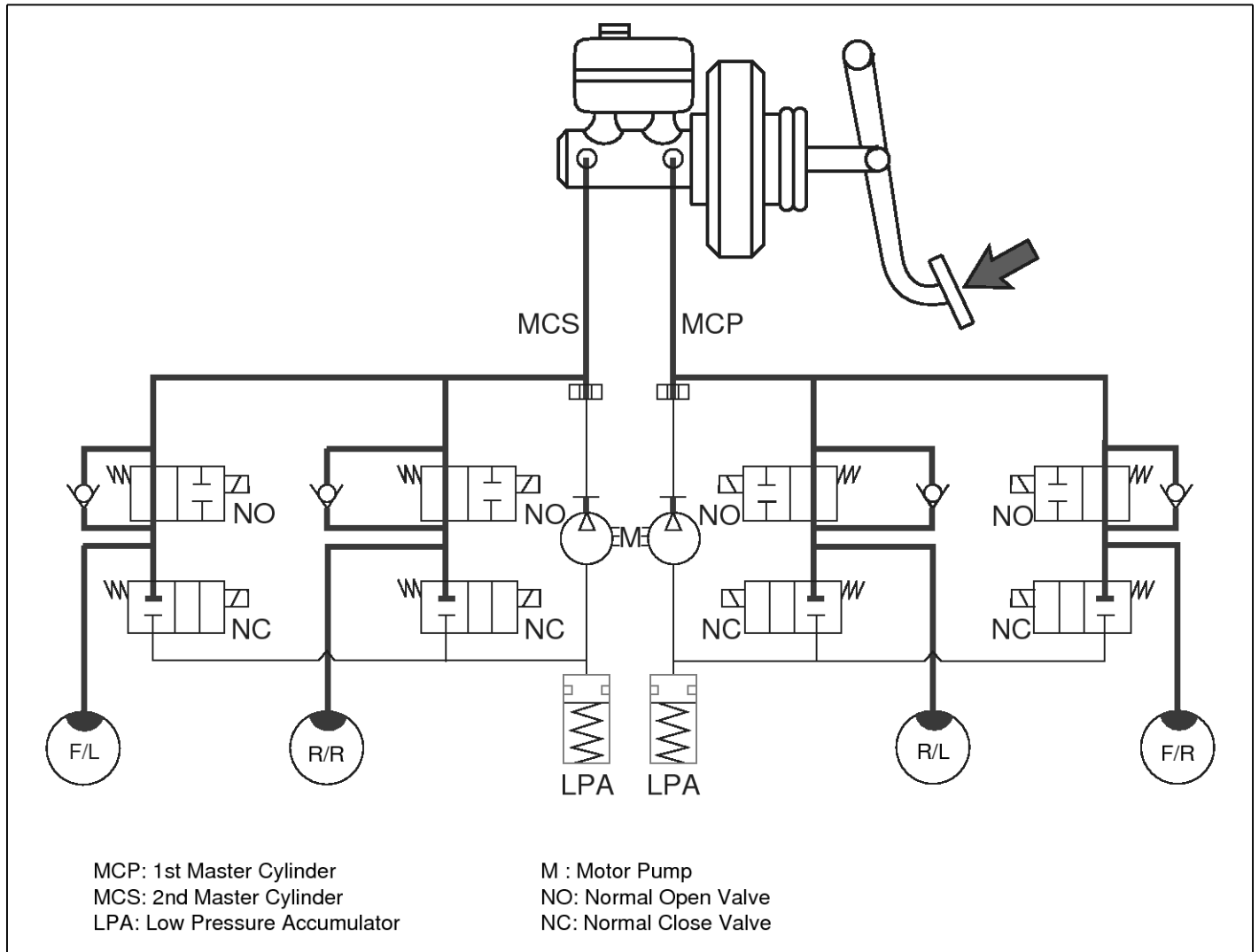
## Inspection on Connector

1. Remove the battery (-) terminal.
2. Remove the connectors. Check the terminals in accordance with the following diagnosis sequence.

### **CAUTION**

**When checking the terminals, use a small pin to protect the terminal from being damaged.**

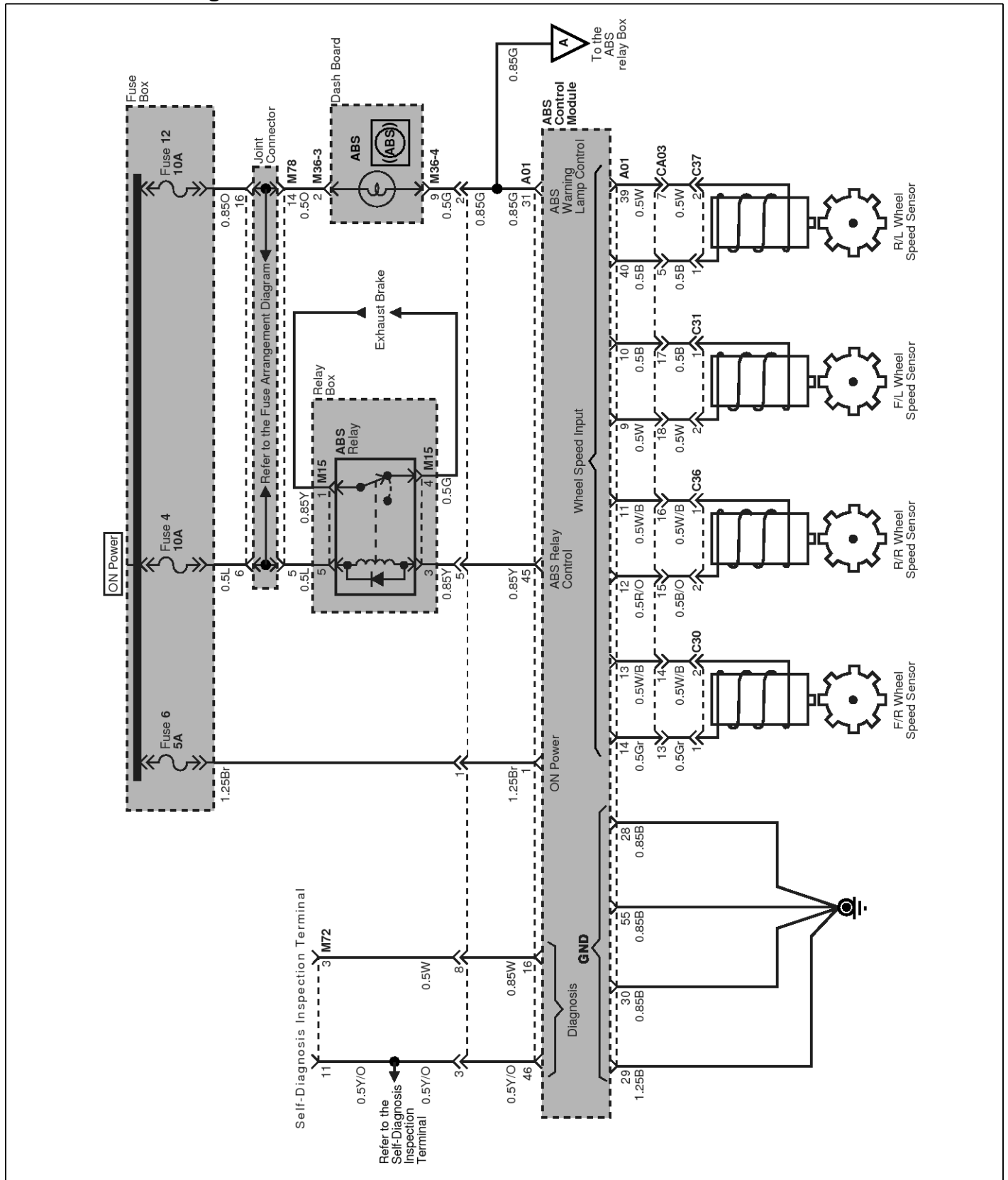
## Oil Pressure Circuit Diagram



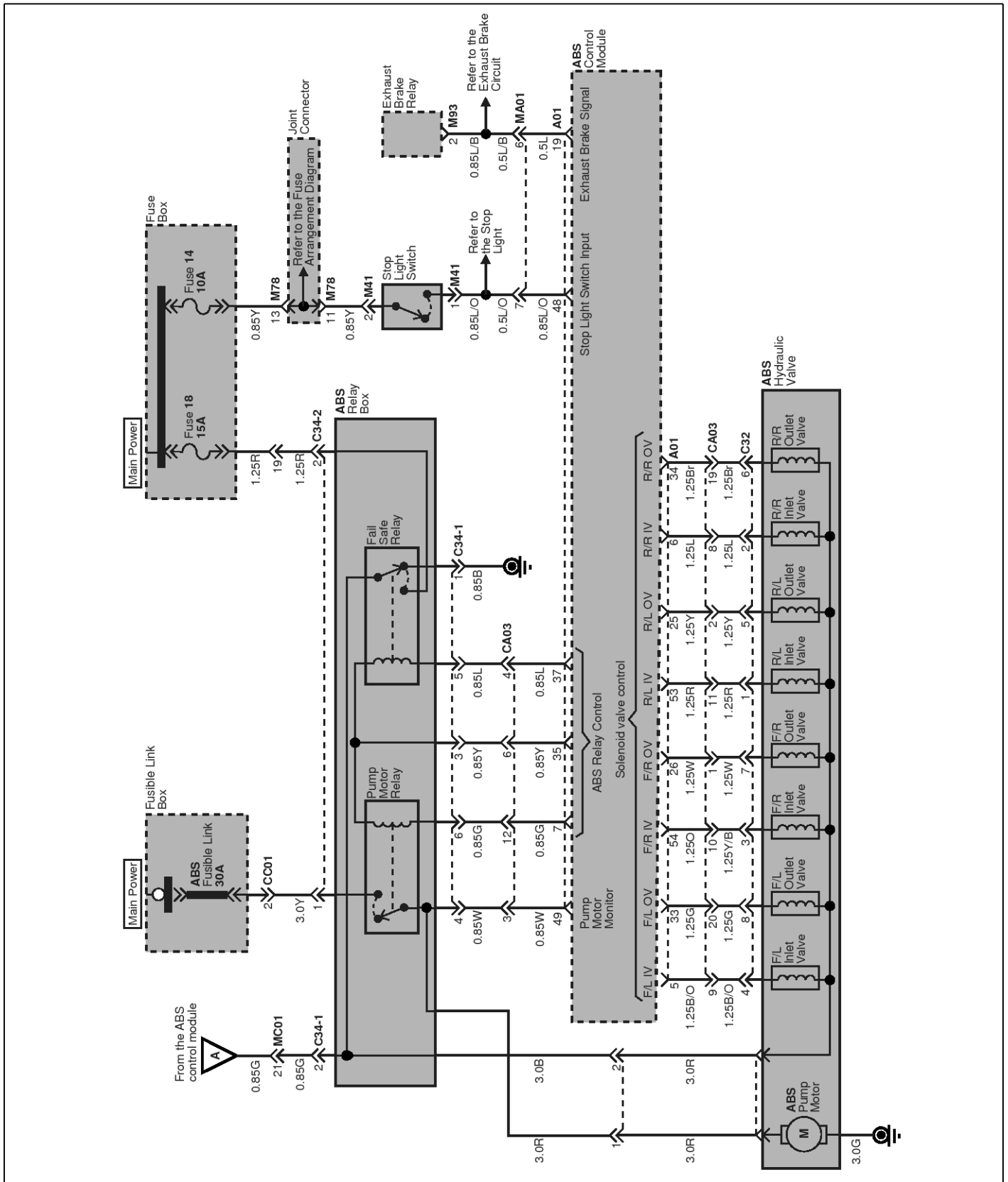
# ABS(Anti-lock Brake System)

# BRA-7

## Electric Circuit Diagram

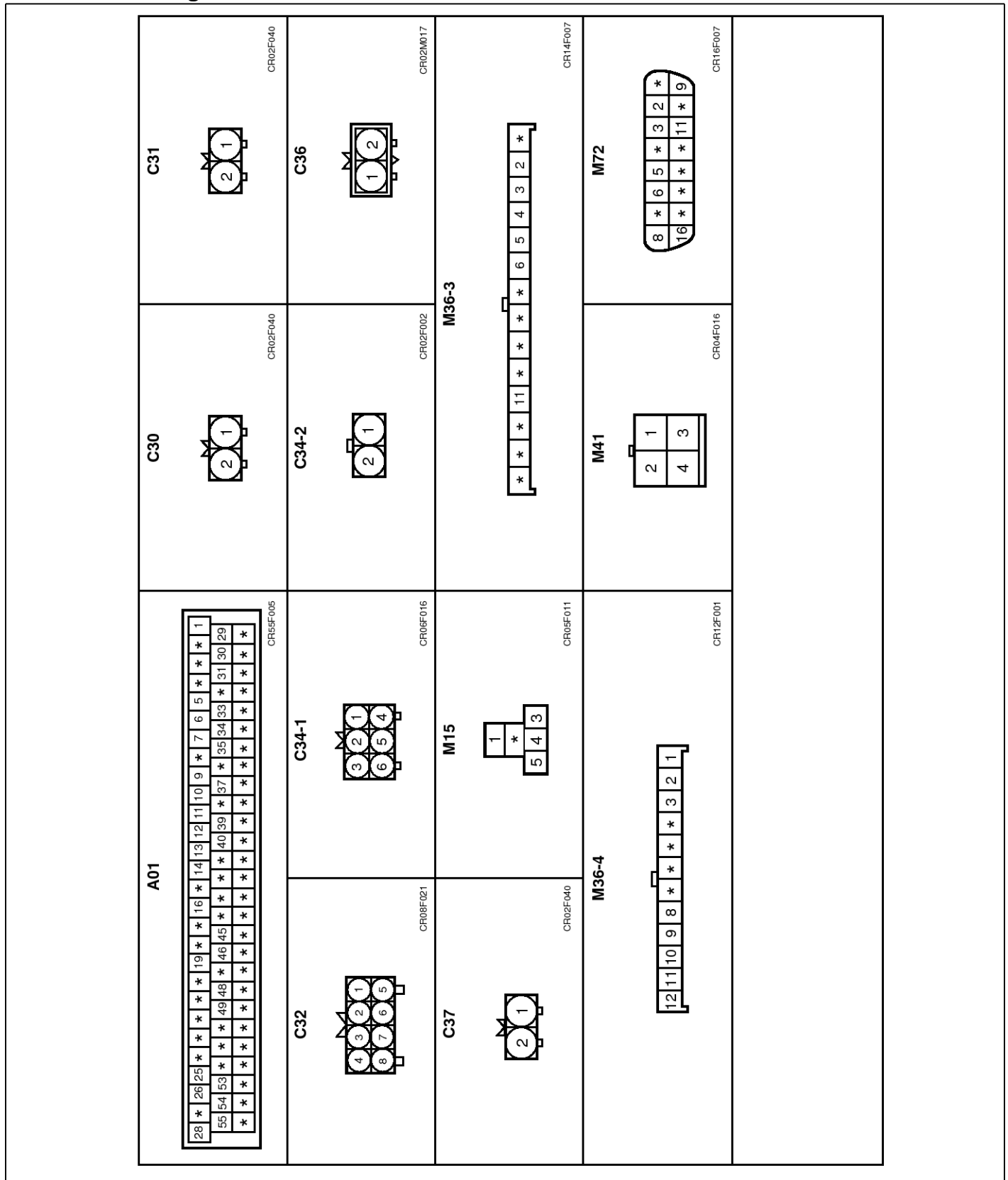


## Electric Circuit Diagram (2)



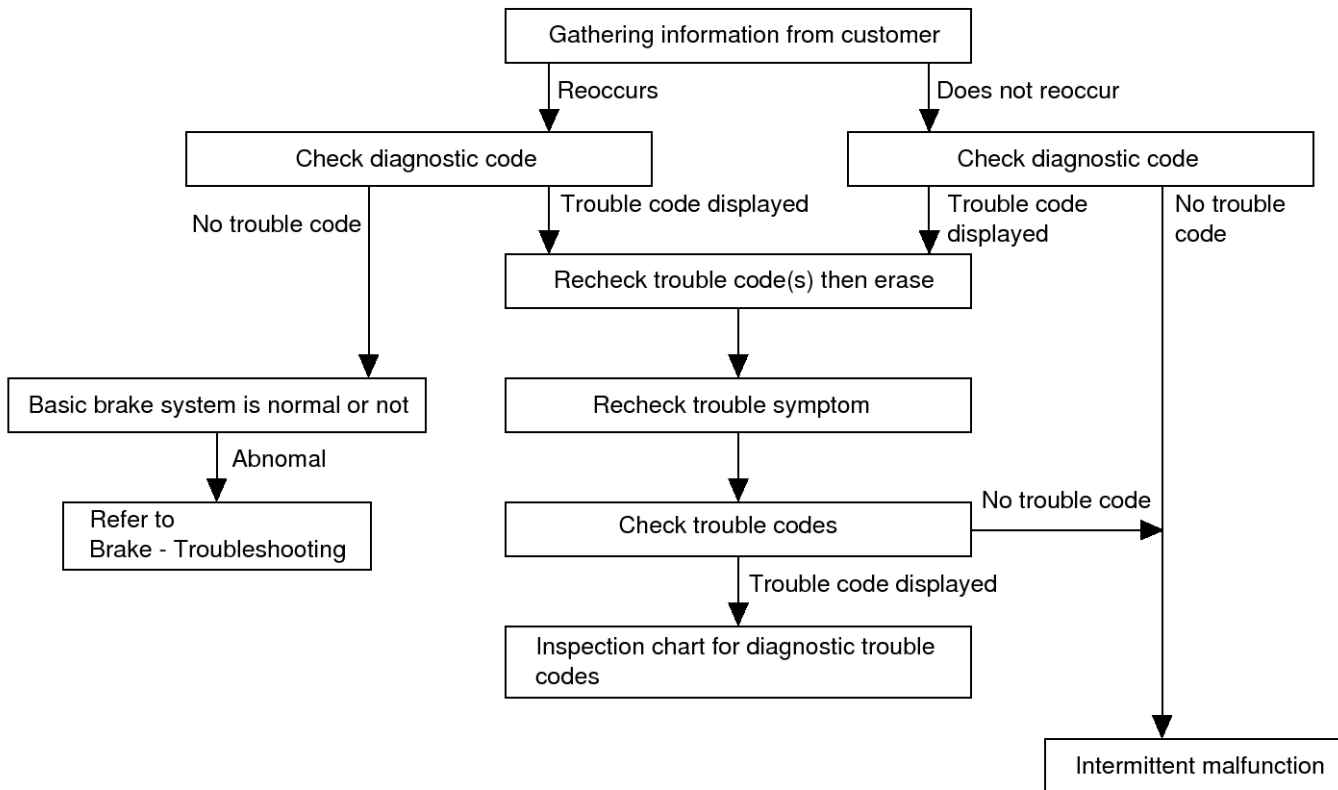


## Connector ID diagram



## TROUBLESHOOTING

### Standard Flow of Diagnostic Troubleshooting



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

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### Notes with regard to Diagnosis

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation of phenomenon
ABS operation sound	<ol style="list-style-type: none"> <li>1. Sound is generated along with vibration of the brake pedal (scraping).</li> <li>2. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release. (Thump : suspension; squeak: tires)</li> </ol>
ABS operation (Long braking distance )	For road surfaces such as snow-covered roads and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicle. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed and not being too overconfident.

Diagnosis detection condition can vary depending on the diagnosis code.

Make sure that checking requirements listed in the "Comment" are satisfied when checking the trouble symptom again after the diagnosis code has been erased.

## ABS Check Sheet

Inspector's  
Name \_\_\_\_\_

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

Data Problem First Occurred	/ /
Frequency Problem Occurs	<input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent (    times a day)

Symptoms	<input type="checkbox"/> ABS does not operate.		
	<input type="checkbox"/> ABS does not operate efficiently.		<input type="checkbox"/> Intermittent (    times a day)
	ABS Warning Light Abnormal	<input type="checkbox"/> Remains ON	<input type="checkbox"/> Does not Light UP

Diagnostic Trouble Code Check	1st Time	<input type="checkbox"/> Normal Code	<input type="checkbox"/> Malfunction Code (Code    )
	2nd Time	<input type="checkbox"/> Normal Code	<input type="checkbox"/> Malfunction Code (Code    )

**Inspection Chart For Diagnostic Trouble Codes**

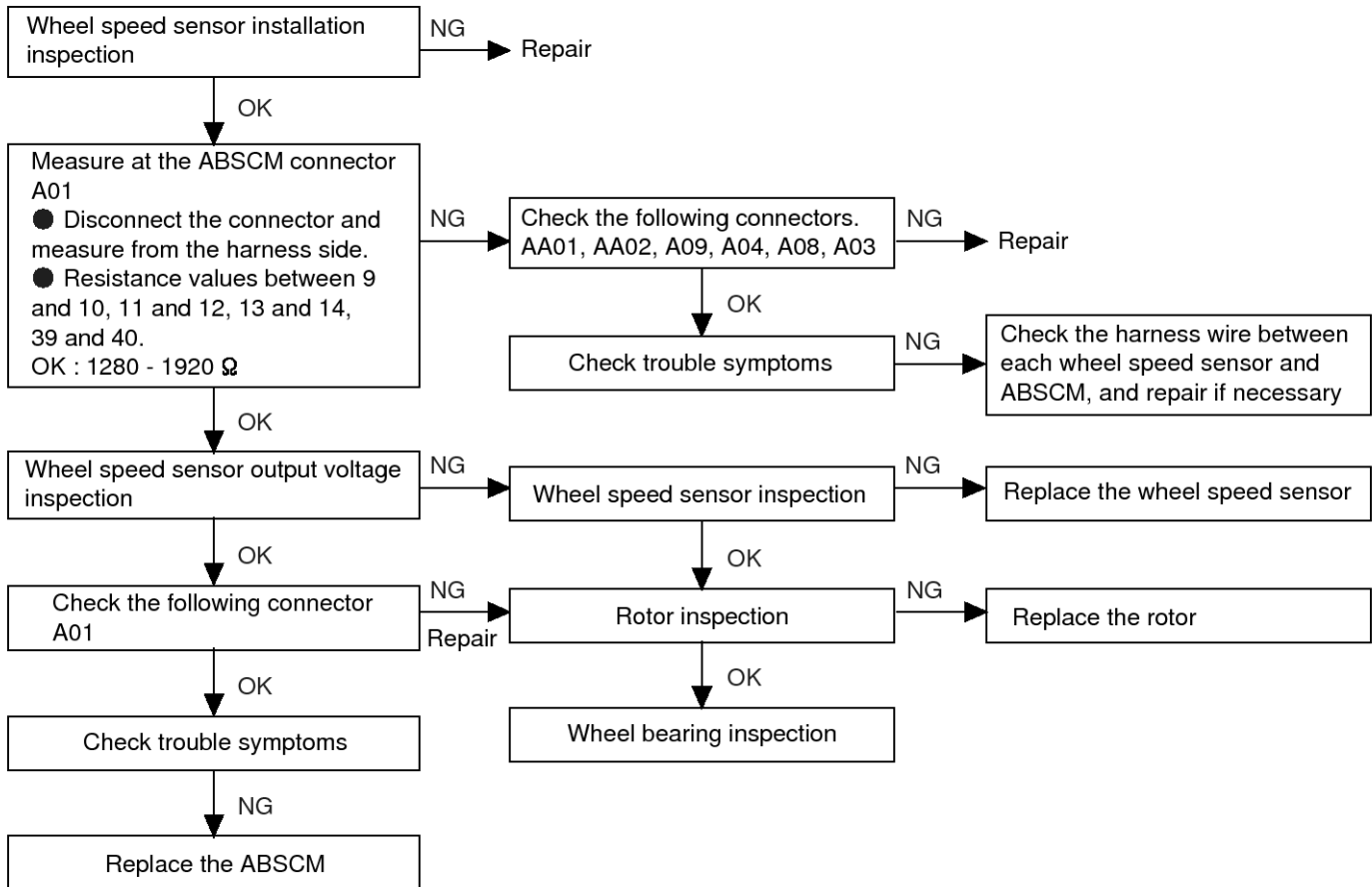
Inspect according to the inspection chart that is appropriate for the malfunction code.

<b>Dtc No.</b>	<b>Description</b>	<b>Mil*</b>	<b>Memory</b>
11	FR sensor open	○	○
12	FL sensor open	○	○
13	RR sensor open	○	○
14	RL sensor open	○	○
15	Speed sensor series malfunction (Teeth number malfunction)	○	○
16	Voltage out of range	○	○
21	FR sensor short	○	○
22	FL sensor short	○	○
23	RR sensor short	○	○
24	RL sensor short	○	○
38	BLS (Brake Lamp Switch) malfunction	○	○
41	FR - Inlet valve malfunction	○	○
42	FL - Inlet valve malfunction	○	○
43	RR - Inlet valve malfunction	○	○
44	RL - Inlet valve malfunction	○	○
45	FR - Outlet valve malfunction	○	○
46	FL - Outlet valve malfunction	○	○
47	RR - Outlet valve malfunction	○	○
48	RL - Outlet valve malfunction	○	○
51	Valve relay malfunction	○	○
53	Pump motor malfunction	○	○
63	ECU error	○	○

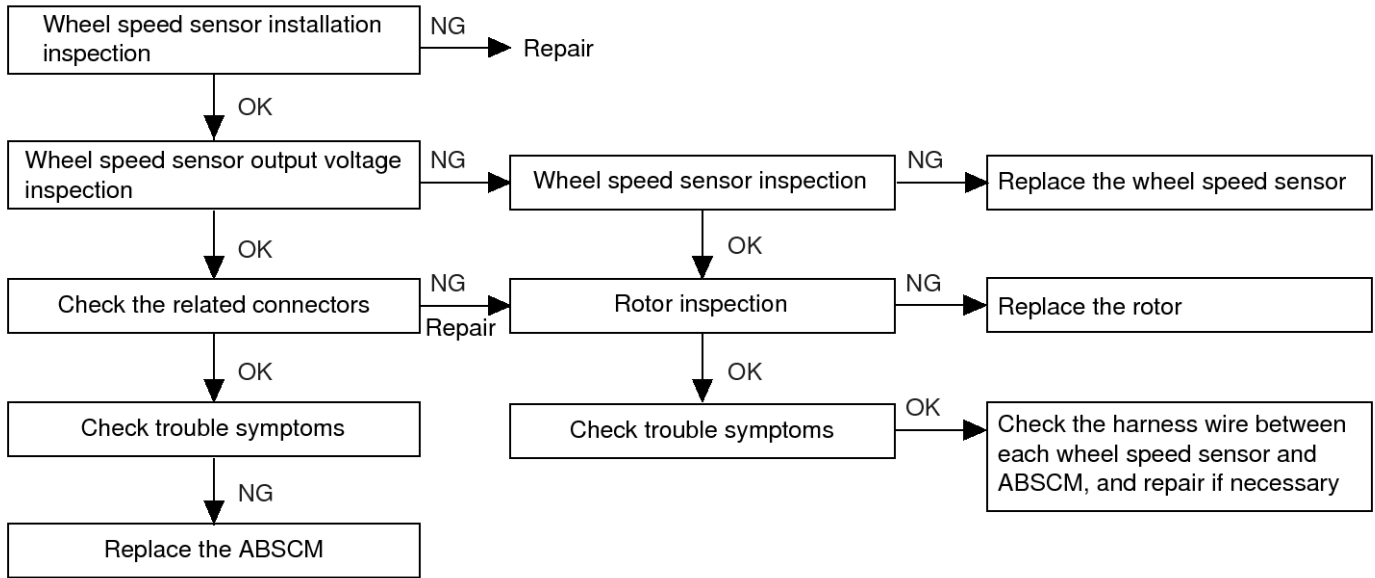
\* MIL : Malfunction Indication Lamp

## Inspection Procedure for Diagnostic Trouble Codes

DTC No. 11, 12, 13, 14, 21, 22, 23, 24 Wheel speed sensor open or s-short	Probable cause
[Comment] The ABSCM determines that an open or short circuit occurs in more than one line of wheel speed sensors.	Malfunction of wheel speed sensor Malfunction of wiring harness or connector Malfunction of ABSCM

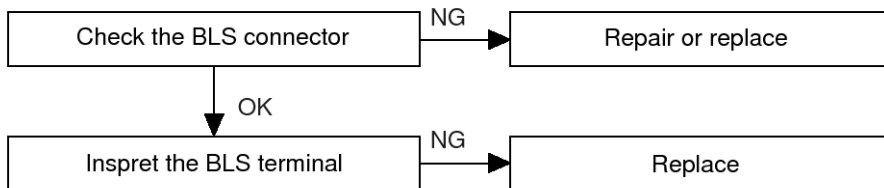


DTC No. 15 (Speed sensor series malfunction)	Probable cause
[Comment] A wheel speed sensor outputs an abnormal signal or no signal	Improper installation of wheel speed sensor Malfunction of wheel speed sensor Malfunction of rotor Malfunction of wiring harness or connector Malfunction of ABSCM



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DTC No. 38 BLS Malfunction	Probable cause
[Comment] BLS (Brake Lamp Switch) outputs an abnormal signal	Improper installation of the connectors

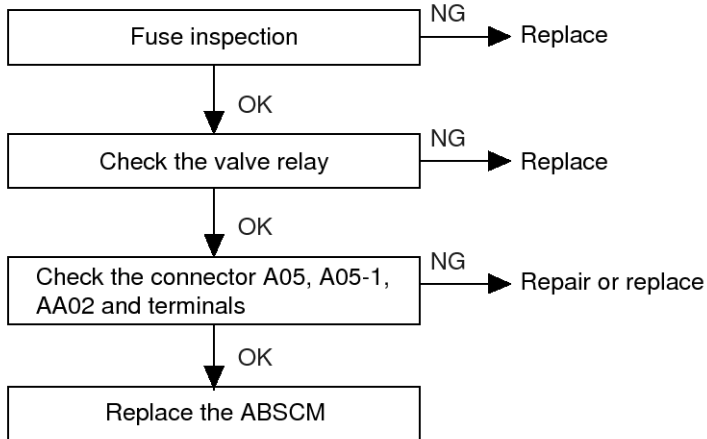


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# ABS(Anti-lock Brake System)

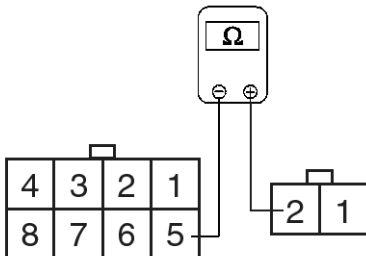
# BRA-15

DTC No. 41, 42, 43, 44, 45, 46, 47, 48(Inlet/outlet solenoid valve malfunction)	Probable cause
[Comment]Inlet or outlet solenoid valve outputs no signal	Malfunction of valve inner coil Improper installation of wiring harness or connector Malfunction of valve relay Malfunction of fuse (15A)



EMTBR5051A

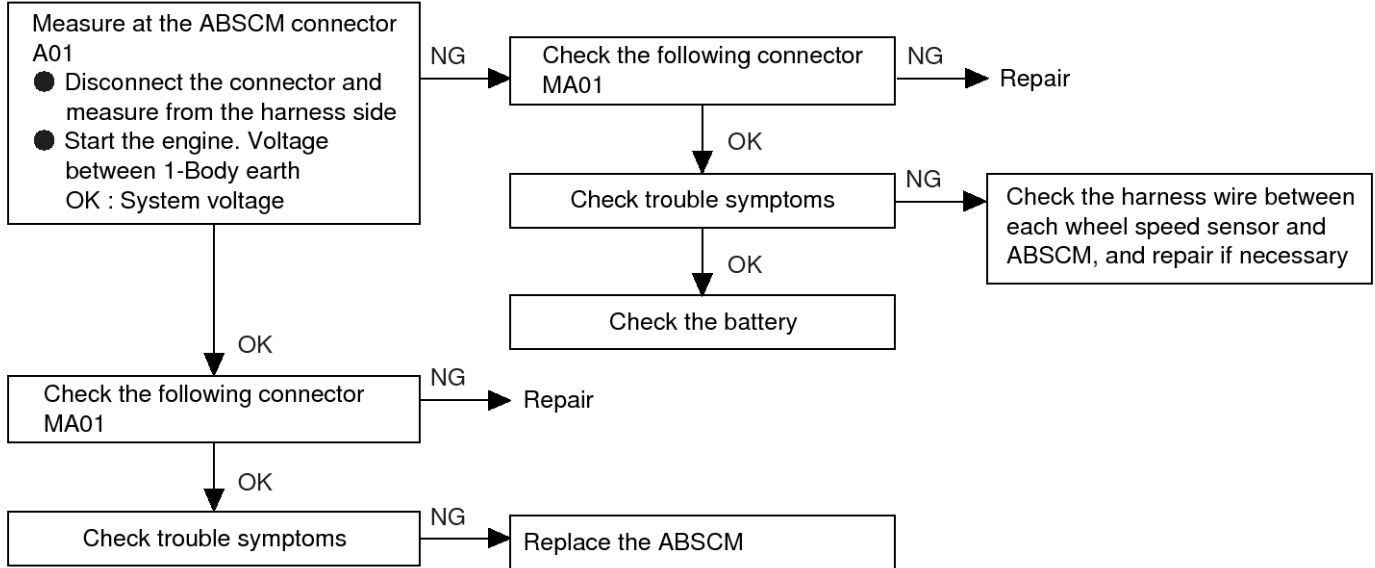
Check the connectors of hydraulic unit side a each valve.  
(At ambient temperature  $23 \pm 5^{\circ}\text{C}$ )



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Connector name	Terminal	Terminal name	Check terminals	Basic value	
				24V	12V
Modulator connector	2	FR - Inlet valve	2 + 2	$24.66 \pm 0.5$	$8.54 \pm 0.5$
	1	FL - Inlet valve	1 + 2	$24.66 \pm 0.5$	$8.54 \pm 0.5$
	3	RR - Inlet valve	3 + 2	$24.66 \pm 0.5$	$8.54 \pm 0.5$
	4	RL - Inlet valve	4 + 2	$24.66 \pm 0.5$	$8.54 \pm 0.5$
	6	FR - Outlet valve	6 + 2	$18.3 \pm 0.5$	$4.29 \pm 0.5$
	5	FL -Outlet valve	5 + 2	$18.3 \pm 0.5$	$4.29 \pm 0.5$
	7	RR -Outlet valve	7 + 2	$18.3 \pm 0.5$	$4.29 \pm 0.5$
	8	RL -Outlet valve	8 + 2	$18.3 \pm 0.5$	$4.29 \pm 0.5$

DTC No. 16 Voltage out of range (Under and over voltage)	Probable cause
<p>[Comment] The voltage of the ABSCM power supply drops lower or rises higher than a specified value. If the voltage returns to the specified value, this code is no longer output.</p>	<p>Malfunction of wiring harness or connector Malfunction of ABSCM</p>



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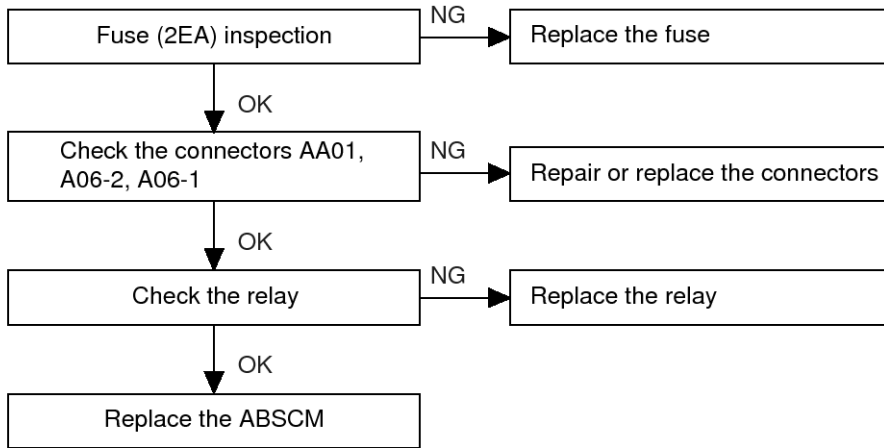
DTC No. 63 ECU (ABSCM) error	Probable cause
<p>[Comment] The ABSCM always monitors the solenoid valve drive circuit. It determines that there is an open or short-circuit in the solenoid coil or in a harness : When no current flows in the solenoid even though the ABSCM turns on it, and vice versa.</p>	<p>Malfunction of ABSCM → Replace the ABSCM</p>



DTC No. 51 Valve relay malfunction	Probable cause
<p>[Comment] When the ignition switch is turned to ON, the ABSCM switches the valve relay off and on during the initial check. In that way, the ABSCM compares the signals sent to the valve relay with the voltage in the valve power monitor line. That is how to check if the valve relay is operating normally. The ABSCM always checks if current flows in the valve power monitor line, too. It determines that there is an open circuit when no current flows. If no current flows in the valve power monitor line, this diagnosis code is output.</p>	<p>Malfunction of valve relay Malfunction of wiring harness or connector Malfunction of ABSCM Malfunction of hydraulic unit</p>

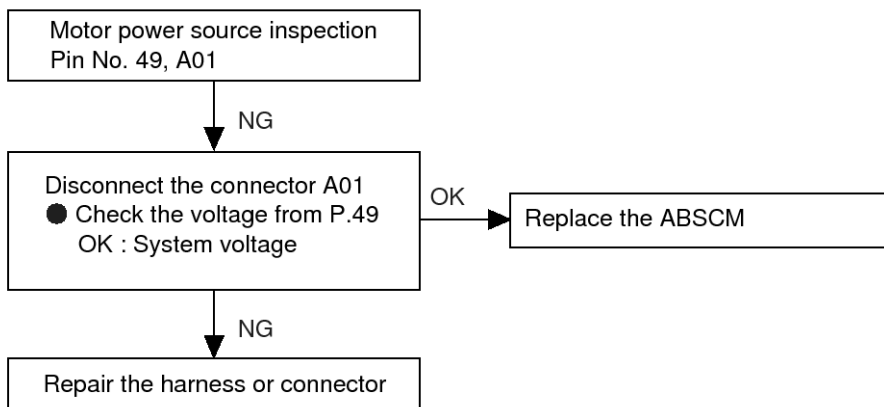
## NOTICE

Whenever reading the diagnosis codes using the ABS warning lamp, this diagnosis code will be output.



EMTBR5054A

DTC No. 53 Motor pump malfunction	Probable cause
<p>[Comment] When the motor power line is normal but no signal is input to the motor monitor line when the motor power line is faulty.</p>	<p>Malfunction of wiring harness or connector Malfunction of hydraulic unit Malfunction of ABSCM</p>



EMTBR5055A

## ABS Operation Check

### Wheel Speed Sensor Output Voltage Check

1. Lift up the vehicle and release the parking brake
2. Disconnect the ABSCM harness connector and measure from the harness side connector.

**⚠CAUTION**

**Be sure to remove the connector lock and insert the probe into the harness side. Inserting it into the terminal side will result in a bad connection.**

3. Rotate the wheel to be measured at approximately 1/2-1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal No.	5	54	53	6
	33	26	25	34

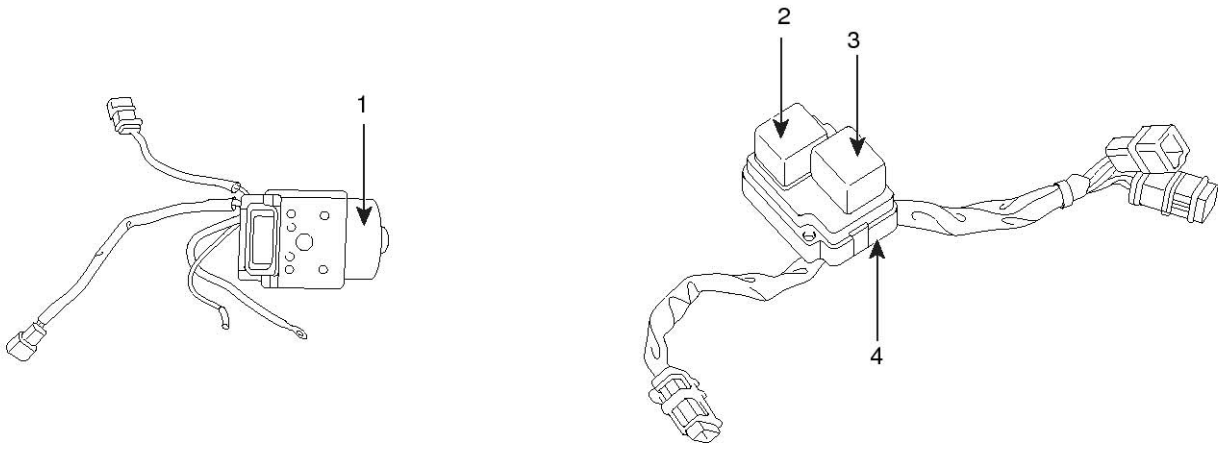
Output voltage

When measuring with an oscilloscope :

120 mV p-p or more

## ABS Modulator

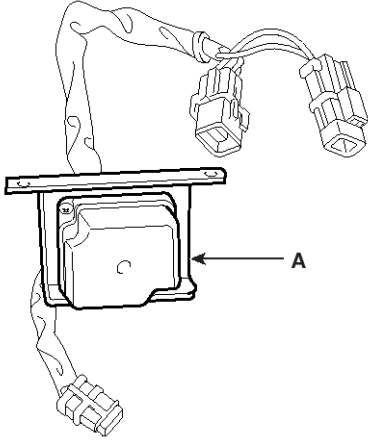
### COMPONENTS



1. Modulator
2. Valve relay
3. Pump motor relay(4P)
4. Relay box

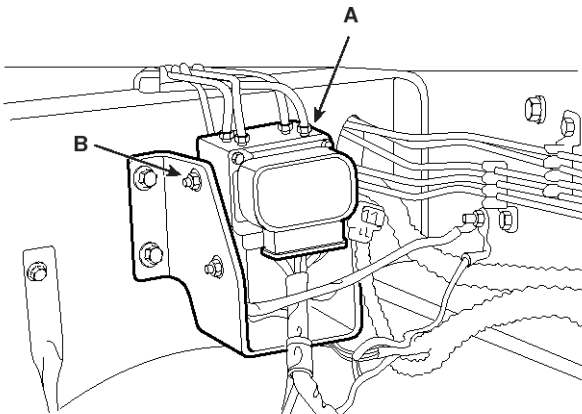
## Removal

1. Disconnect motor pump and relay box harness and remove the ABS relay box mounting nuts.
2. Remove the relay box(A) from relay box mounting bracket.



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3. Disconnect the brake tubes(A) from the ABS modulator.
4. Remove the ABS modulator mounting bolts(B).



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### **CAUTION**

1. Never attempt to disassemble the ABS modulator.
2. The modulator must be transported and stored in upright position and with sealed ports.  
The modulator must not be drained.

## Installation

1. Follow the reverse order of Removal.
2. Tighten the modulator mounting bolts and brake tube nuts to the specified torque.

### Tightening torque

#### Modulator mounting nut

..... 17-26 Nm (1.7~2.6kgf.m, 12-19 lb.ft)

#### Brake tube nut

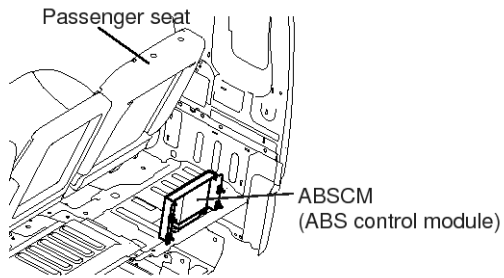
..... 13-17 Nm (1.3~1.7kgf.m, 9-12 lb.ft)

3. Bleed the brake system.

## ABS Control Module

### Removal

1. Fold the seat of passenger side.
2. Remove the ABSCM mounting bolts and ABSCM.

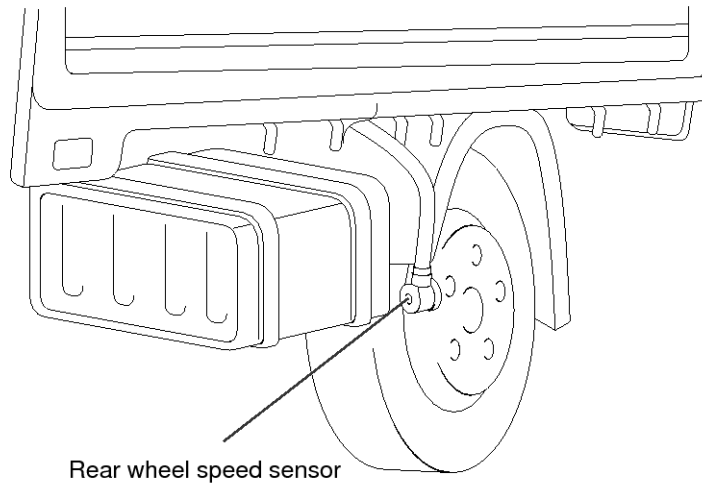
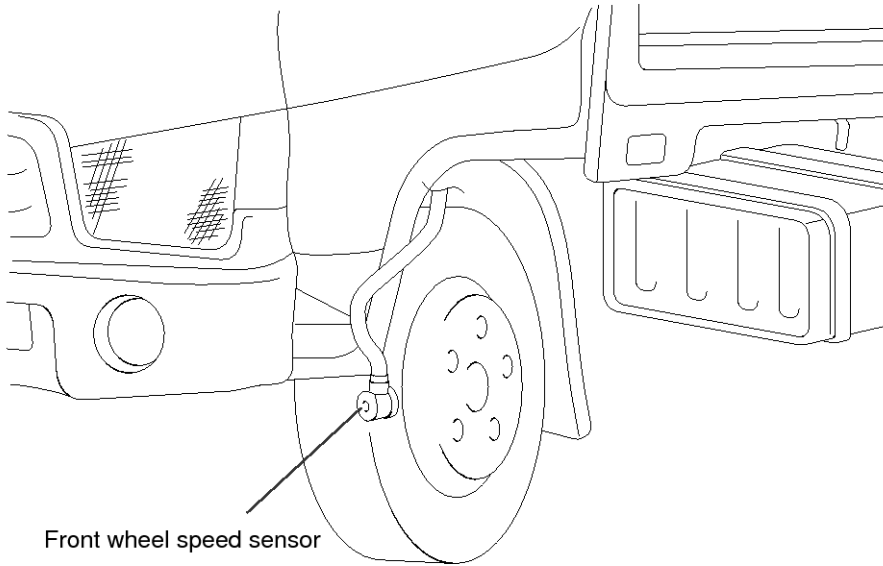


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3. Installation is the reverse of removal.

## Wheel Speed Sensor

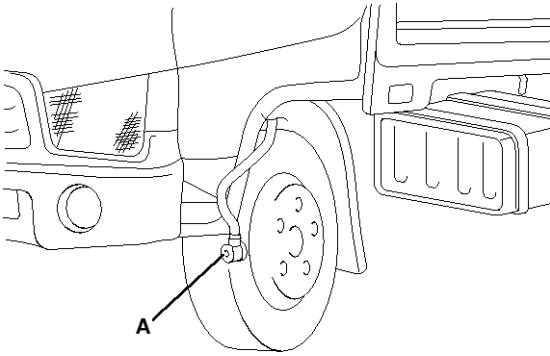
### COMPONENTS



## Removal

### Front Wheel Speed Sensor

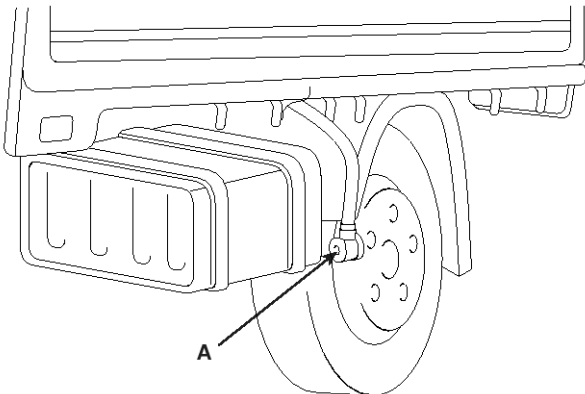
1. Remove the front wheel speed sensor mounting bolt.
2. Disconnect the wheel speed sensor connector(A).



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### Rear Wheel Speed Sensor

Remove the rear wheel speed sensor after disconnection the wheel speed sensor connector(A).

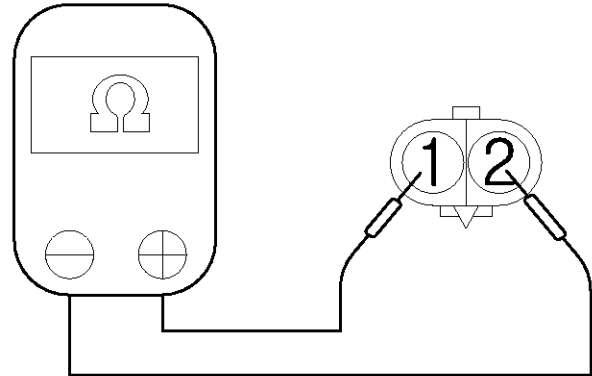


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## Inspection

1. Connect an ohmmeter between the wheel speed sensor terminals and measure the resistance.

Service standard : 1280 - 1920  $\Omega$



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2. Connect a voltmeter between the wheel speed sensor terminals, and measure the voltage by turning the wheel.

### **NOTICE**

*Set the voltmeter to measure AC voltage.*

*Service standard : AC voltage detected.*

Output voltage

Measurement by oscilloscope : 12mV P-P over.