BL AUTOMATIC TRANSMISSION

(AISIN 30-40 LEi)
## SPECIFICATION

### General Specifications

<table>
<thead>
<tr>
<th></th>
<th>A-2.5 TCI</th>
<th>3.5 V6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGINE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A/T Model</td>
<td>30-40LEi (AISIN AW)</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>4 speed transmission (Full line pressure control)</td>
<td></td>
</tr>
<tr>
<td>Maximum input torque (kg.m)</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td></td>
<td>79.8</td>
</tr>
<tr>
<td>Torque converter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>3 Elements 1 Stage 2 Phases</td>
<td></td>
</tr>
<tr>
<td>Dia. (mm)</td>
<td>254</td>
<td></td>
</tr>
<tr>
<td>Components</td>
<td></td>
<td>3 Clutches, 4 Brakes, 3 OWCs</td>
</tr>
<tr>
<td>Planetary gear</td>
<td></td>
<td>3 Planetary gear sets (Simple type)</td>
</tr>
<tr>
<td>Gear ratio</td>
<td>1,2,3,4/R</td>
<td>2.804, 1.531, 1.000, 0.705 / 2.393</td>
</tr>
<tr>
<td>Shift mode</td>
<td></td>
<td>P-R-N-D-2-L / SNOW(2WD only)</td>
</tr>
<tr>
<td>ATF oil</td>
<td>CASTLE AUTO FLUID D - II</td>
<td></td>
</tr>
<tr>
<td>ATF capacity (liter)</td>
<td></td>
<td>9.2</td>
</tr>
<tr>
<td>Adapted vehicle</td>
<td>TERRACAN(HMC), CROWN(TOYOTA), VOLVO 960</td>
<td></td>
</tr>
</tbody>
</table>
## SYSTEM LAYOUT

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Output speed sensor</td>
<td>To detect output shaft revolution</td>
</tr>
<tr>
<td>2. Neutral switch</td>
<td>To detect &quot;N&quot; range(A/T) or &quot;Neutral&quot; range(M/T)</td>
</tr>
<tr>
<td>3. Elbow (cooler out)</td>
<td>Way-out from a cooler hose to the A/T</td>
</tr>
<tr>
<td>4. Elbow (cooler in)</td>
<td>Way-in to the cooler hose from the torque converter</td>
</tr>
<tr>
<td>5. Air Breather hose</td>
<td>For air ventilation inside transmission</td>
</tr>
<tr>
<td>6. Oil temp. sensor</td>
<td>To detect the oil temperature</td>
</tr>
<tr>
<td>7. Input speed sensor</td>
<td>To detect input shaft revolution</td>
</tr>
<tr>
<td>8. Outer lever</td>
<td>Connected to the control cable to change driving range</td>
</tr>
<tr>
<td>9. T/M wire</td>
<td>Solenoid valves and sensors connection</td>
</tr>
</tbody>
</table>
### POWER FLOW

Components and function

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C0 O/D direct clutch</td>
<td>Connect O/D sun gear and O/D carrier</td>
</tr>
<tr>
<td>C1 Forward clutch</td>
<td>Connect O/D input shaft and input shaft</td>
</tr>
<tr>
<td>C2 Direct clutch</td>
<td>Connect input shaft and Fr/Rr planetary sun gear</td>
</tr>
<tr>
<td>B0 O/D brake</td>
<td>Hold O/D sun gear</td>
</tr>
<tr>
<td>B1 2nd coast brake</td>
<td>Hold Fr/Rr planetary sun gear</td>
</tr>
<tr>
<td>B2 2nd brake</td>
<td>Hold counterclockwise rotation of Fr/Rr planetary sun gear (Hold outer race of F1)</td>
</tr>
<tr>
<td>B3 1st &amp; reverse brake</td>
<td>Hold Fr planetary carrier</td>
</tr>
<tr>
<td>F0 O/D OWC</td>
<td>Connect O/D sun gear and O/D carrier, when O/D sun gear rotates faster than O/D carrier</td>
</tr>
<tr>
<td>F1 NO.1 OWC</td>
<td>Hold counterclockwise rotation of Fr/Rr planetary sun gear, when B2 operates.</td>
</tr>
<tr>
<td>F2 NO.2 OWC</td>
<td>Hold counterclockwise rotation of Fr planetary carrier</td>
</tr>
</tbody>
</table>
POWER FLOW

Components and operation
POWER FLOW

Components and operation
<table>
<thead>
<tr>
<th>POSITION</th>
<th>SOLENOID</th>
<th>CLUTCH</th>
<th>BRAKE</th>
<th>O.W.C.</th>
<th>GEAR RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S1</td>
<td>S2</td>
<td>SL</td>
<td>C0</td>
<td>C1</td>
</tr>
<tr>
<td>P</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>R(V&lt;7)</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>R(V&gt;=7)</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>N</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>D</td>
<td>1st</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>4th</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>1st</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>L</td>
<td>1st</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>
**POWER FLOW**

**Principle of each range**

### 1st / 2nd gear

- **1. Power flow**
  - OD input shaft → OD gear set (coupling by C0) → Fr/Rr (speed reduction by F2(1st gear), by B2&F1(2nd gear))

- **2. Engine brake**
  - D range 1st, 2nd gear: non (F2, F1 free to clockwise)
  - 2 range: 1st gear (non), 2nd gear (operated by B1)
  - L range 1st, 2nd gear: operated by B1, B3

### 3rd gear

- **1. Power flow**
  - OD input shaft → OD gear set (coupling by C0) → Fr/Rr (coupling by C1 & C2)

### 4th gear

- **1. Power flow**
  - OD input shaft → OD gear set (speed increase by B0) → Fr/Rr (coupling by C1&C2)

### Reverse gear

- **1. Power flow**
  - OD input shaft → OD gear set (coupling by C0) → Fr/Rr (reverse rotation by B3)

- **2. Reverse inhibition control**: C2
D range – 1st gear

<table>
<thead>
<tr>
<th>POSITION</th>
<th>S1</th>
<th>S2</th>
<th>SL</th>
<th>C0</th>
<th>C1</th>
<th>C2</th>
<th>B0</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>F0</th>
<th>F1</th>
<th>F2</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>1st</td>
<td>O</td>
<td>X</td>
<td>O</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O</td>
<td>X</td>
<td>O</td>
<td>2.804</td>
</tr>
</tbody>
</table>

IN

OUT

OD PLANETARY

FR PLANETARY

RR PLANETARY

KIA KIA MOTORS
POWER FLOW

D range – 2nd gear

<table>
<thead>
<tr>
<th>POSITION</th>
<th>S1</th>
<th>S2</th>
<th>SL</th>
<th>C0</th>
<th>C1</th>
<th>C2</th>
<th>B0</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>F0</th>
<th>F1</th>
<th>F2</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>O</td>
<td>O</td>
<td>×</td>
<td>O</td>
<td>O</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>O</td>
<td>×</td>
<td>O</td>
<td>O</td>
<td>×</td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.531</td>
</tr>
</tbody>
</table>

IN

OUT

O/D PLANETARY

FR PLANETARY

RR PLANETARY
POWER FLOW

D range – 3rd gear

<table>
<thead>
<tr>
<th>POSITION</th>
<th>S1</th>
<th>S2</th>
<th>SL</th>
<th>C0</th>
<th>C1</th>
<th>C2</th>
<th>B0</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>F0</th>
<th>F1</th>
<th>F2</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>3rd</td>
<td>×</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>×</td>
<td>×</td>
<td>O</td>
<td>×</td>
<td>O</td>
<td>×</td>
<td>O</td>
<td>×</td>
</tr>
</tbody>
</table>

IN

OUT

O/D PLANETARY

FR PLANETARY

RR PLANETARY
POWER FLOW

D range – 4th gear

<table>
<thead>
<tr>
<th>POSITION</th>
<th>S1</th>
<th>S2</th>
<th>SL</th>
<th>C0</th>
<th>C1</th>
<th>C2</th>
<th>B0</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>F0</th>
<th>F1</th>
<th>F2</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>✓</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>×</td>
<td>O</td>
<td>O</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

IN

OUT

O/D PLANETARY

FR PLANETARY

RR PLANETARY

KIA KIA MOTORS
POWER FLOW

R range

<table>
<thead>
<tr>
<th>POSITION</th>
<th>S1</th>
<th>S2</th>
<th>SL</th>
<th>C0</th>
<th>C1</th>
<th>C2</th>
<th>B0</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>F0</th>
<th>F1</th>
<th>F2</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>R(V&lt;7)</td>
<td>O</td>
<td>×</td>
<td>×</td>
<td>O</td>
<td>×</td>
<td>O</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>×</td>
<td>2.393</td>
</tr>
</tbody>
</table>

O.D PLANETARY

FR PLANETARY

RR PLANETARY

IN

OUT
1. Adjusting Bolt
2. Selector Position Switch
3. Solenoid Wiring
4. Elbow
5. Oil temperature Sensor(OTS) Wire
6. Breather hose
7. Output Speed Sensor
8. Adapter
9. Key
10. Sensor Rotor
11. Spacer
12. Ball
13. Speedometer Drive Gear
14. Gasket
15. Oil temperature Sensor Bracket
16. Oil Seal
17. Manual Valve Lever
18. Spacer
19. Pin
20. Parking Lock Rod
21. Parking Lock Pawl Shaft
22. Parking Lock Pawl
23. Parking Lock Pawl Bracket
24. Input Speed Sensor
25. Spring
26. C0 Accumulator Piston
27. Spring
28. B2 Accumulator Piston
29. C2 Accumulator Piston
30. Spring
31. Spring
32. Check Ball Body
33. Valve Body
34. Oil Strainer
35. Magnet
36. Oil Pan
37. Drain plug
COMPONENTS

1. Oil Pump
2. O-Ring
3. Race
4. Bearing
5. O/D Planetary Gear, Direct Clutch and One-Way Clutch
6. Race
7. Snap Ring
8. O/D Brake Pack
9. Bearing
10. Race
11. O/D Planetary Ring Gear
12. Race
13. Bearing
14. O/D Support
15. Race
16. Thrust Washer
17. Direct Clutch
18. Bearing
19. Thrust Washer
20. Forward Clutch
21. E-Ring
22. Second Coast Brake Band
23. Pin
24. Race
25. Front Planetary Ring Gear
26. Bearing
27. Race
28. Snap Ring
29. Front Planetary Ring Gear
30. Race
31. Bearing
32. Planetary Sun Gear
33. Thrust Washer
34. Piston Sleeve
35. Snap Ring
36. Second Brake Pack
37. NO.1 One-Way Clutch
38. Thrust Washer
39. Snap Ring
40. Second Brake Drum
41. First and Reverse Brake Pack
42. Rear Planetary Gear and NO.2 One-Way Clutch
43. Bearing and Race
44. Rear Planetary Ring Gear
45. Assembled Bearing and Race
46. Output Shaft
47. Spring
48. Second Brake Drum Gasket
49. Second Coast Brake Piston
50. Second Coast Brake Cover
51. Snap Ring
52. Transmission Case
Oil pump

1. Oil seal
2. Oil pump body
3. O-ring
4. Driven gear
5. Drive gear
6. Stator shaft
7. Oil seal ring

◆ Non-reusable part
COMPONENTS

OD clutch & OD planetary gear

1. O/D direct clutch drum
2. O/D direct clutch piston
3. O-ring
4. Piston return spring
5. Snap ring
6. Disc
7. Plate
8. Flange
9. Snap ring
10. Snap ring
11. Retaining plate
12. O/D one-way clutch
13. One-way clutch outer race
14. Thrust washer
15. O/D Planetary gear
16. Race
17. Bearing
18. O/D planetary ring gear
19. Ring gear flange
20. Snap ring

◆ Non-reusable part
COMPONENTS

OD clutch disc (2EA)

OD sun gear

Input speed sensor tone wheel (16EA)
COMPONENTS

OD clutch

Hub for OD brake

Input shaft

Hub for OD clutch

OD Planetary gear
COMPONENTS

Forward clutch

1. Seal ring
2. Bearing
3. Forward clutch drum
4. O-ring
5. Forward clutch piston
6. O-ring
7. Return spring
8. Snap ring
9. Race
10. Bearing
11. Plate
12. Disc
13. Flange
14. Snap ring

◆ Non-reusable part
COMPONENTS

OD OWC (F0) and Forward clutch
COMPONENTS

Forward clutch

Hub for Direct clutch

Forward clutch (5EA)
COMPONENTS

Direct clutch

1. Direct clutch drum
2. Piston
3. O-ring
4. Return spring
5. Snap ring
6. Thrust washer
7. Plate
8. Disc
9. Flange
10. Snap ring

◆ Non-reusable part
COMPONENTS

Direct clutch

Plastic washer on Direct clutch and OD brake piston
COMPONENTS

Front planetary gear

1. Race
2. Front planetary ring gear
3. Race
4. Race
5. Front planetary gear
6. Race
7. Bearing
COMPONENTS

Front planetary sun gear & OWC 1

1. Snap ring
2. Planetary sun gear
3. Oil seal ring
4. Sun gear input drum
5. Snap ring
6. Thrust washer
7. One-way clutch & second brake hub
COMPONENTS

Front planetary gear

Connected to output shaft
COMPONENTS

Front planetary gear

Sun gear for Front planetary gear
COMPONENTS

Direct clutch & Forward clutch & OWC1

- Drum for 2\textsuperscript{nd} coast brake
- Hub for 2\textsuperscript{nd} brake
- OWC1 (F1)
- Sun gear for rear planetary gear

Direct clutch
Forward clutch
COMPONENTS

2ND Brake

1. Second Brake Assembly
2. 1st & Reverse Brake Pack
3. One-Way Clutch Inner Race
4. Snap Ring
5. NO.2 One-Way Clutch
6. NO.2 Thrust Washer
7. Rear Planetary Gear
8. NO.1 Thrust Washer
9. Race
10. Bearing
11. Rear Planetary Ring Gear
12. Ring Gear Flange
13. Snap Ring
14. Oil Seal Ring
15. Output Shaft

◆ Non-reusable part
COMPONENTS

2ND Brake

1. Thrust washer
2. Snap ring
3. Spring retainer
4. Piston return spring
5. Piston sleeve
6. Second piston
7. O-ring
8. Second brake drum
9. Rear planetary gear and output shaft

◆ Non-reusable part
COMPONENTS

Rear planetary gear & 2nd brake piston

- OWC2 (F2)
- 2nd brake piston
- Hub for LR brake
- Rear planetary gear
- Oil hole
COMPONENTS

OD brake

1. Snap ring
2. Piston return spring
3. O-ring
4. OD brake piston
5. Race
6. Bearing
7. OD support
8. Thrust washer
9. Seal ring

◆ Non-reusable part
COMPONENTS

OD brake

OD brake piston
Low and reverse brake

1. Plate
2. Disc
3. Flange
4. O-ring
5. NO.2 First & reverse brake piston
6. O-ring
7. Reaction sleeve
8. O-ring
9. NO.1 First & reverse brake piston
10. Case

◆ Non-reusable part
COMPONENTS

Valve body

- SCSV
- DCCSV
- PCSV
COMPONENTS

Valve body

DCCSV

PCSV

Manual valve
COMPONENTS

Accumulators

- Second brake Accumulator
- Direct clutch Accumulator
- OD brake Accumulator
- OD direct clutch Accumulator pistons
COMPONENTS

Ball and clip
COMPONENTS

Clip
COMPONENTS

2nd coast brake oil hole
The Guide Pin is inserted into Shift Lock CAM.

Spring Roller

Install direction
1. Procedure to install the lock cam.
   - Make sure to move shift lever to position “P” and install lock cam as figure.

2. Procedure for adjusting shift lock cable.
   - Check that lock cam is located in position.
   - Install shift lock cable in position as figure.
   - Temporarily install shift lock cable to A/T lever assembly as shown in figure.
     Securely insert cable end into fixing pin of cam.
   - After checking that a portion of cable end touches cable fixing pin of P-lock cam, fix shift lock cable to A/T lever.
3. Checking that procedure for installing the shift lock is correct.

- When the brake pedal is not depressed, push button of the shift lever at “P”
  position cannot be operated. (Shift lever cannot be shifted at the other positions
  from “P”).
  Push button can be operated at the other positions except “P”.
- When brake pedal stroke is 30 mm (with shift lever at “P” position), push button
  should be operated without catching and shift lever can be shifted smoothly to
  other from “P”.
- When brake pedal is not depressed, shift lever should be shifted smoothly to “P”
  position from other positions.
- Brake pedal must be operated smoothly without catching at all positions.
- If shift lever is shifted to “P” position, ignition key must be turned to “LOCK”
  position smoothly.
ELECTRICAL CONTROL PARTS

System Description

1. Neutral start switch
2. Output speed sensor
3. Input speed sensor (C0)
4. Oil temperature sensor
5. SCSV 1, SCSV 2
7. Lock-up solenoid
Each electrical parts

**NEUTRAL START SWITCH (NSW)**

NSW transmission the information which range includes shift lever of A/T to TCM by combination of a position circuit terminal.

1) It is possible for NSW to start an engine in only “P” and “N”. (Prevention of reckless driving)
2) It is used for NSW to shift control.

- **No input signal:** ‘D’ range control
- **Multi input signals:** Priority of D-2-L-R-N-P
ELECTRICAL CONTROL PARTS

Each electrical parts (Inhibitor switch)

- Connector

TCM

L(50)
2(49)
N(32)
D(33)
R(12)
P(48)

ST MOTEER

KEY BOX

ST

IG1
ELECTRICAL CONTROL PARTS

Each electrical parts

② OUTPUT SPEED SENSOR (SP)
Output Speed Sensor detects a turn number of magnet of rotor sensor installed in output shaft, and communicates to TCM as a signal.

③ INPUT SPEED SENSOR (C0)
Input Speed Sensor detects A/T input speed from rotation number of C0 drum, and they transmit to TCM as a signal.
Each electrical parts (Input speed sensor, C0)

- To detect input shaft speed

- Data for shift control
  \( \text{(Judge the beginning or the end of 4}^{\text{th}} \text{ gear shifting)} \)

- Detect if 4\(^{\text{th}}\) gear is engaged or not

- 0 RPM at 4\(^{\text{th}}\) gear \( \rightarrow \) C0 (no operation)
  - C0 rev. > 500 rpm: recognition to be shifted to 3\(^{\text{rd}}\) gear
  - C0 rev. < 500 rpm: recognition to be shifted to 4\(^{\text{th}}\) gear

![Connector diagram] (KIA MOTORS)
Each electrical parts (Output speed sensor)

- To detect output shaft speed
- Data for shift control

Resistance: 387 – 473 ohm (20 degrees Celsius)
Each electrical parts

**4 OIL TEMPERATURE SENSOR (OT)**

The Oil Temperature Sensor converts ATF temperature variation into electronic signals to transmit to TCM. This information is necessary for shift control and L-up control, etc.

**5 SHIFT SOLENOID NO.1 NO.2 (S1, S2)**

Shift Solenoid No.1/2 is each, and it is installed VALVE BODY of A/T directly. And Shift Solenoid No.1/2 does the operation of ON / OFF by the control signal from TCM, and changes a position of shift valve by a combination with Shift Solenoid No.1/2, and changes gear.
ELECTRICAL CONTROL PARTS

Each electrical parts (Oil temperature sensor)

- To detect oil temperature
- Data for high or low oil temperature shift control
- 200 degrees Celsius when short or open → No lock-up control

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Resistance Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 degree C</td>
<td>1,884 - 2,290 ohm</td>
</tr>
<tr>
<td>160 degree C</td>
<td>19.2 - 22.2 ohm</td>
</tr>
</tbody>
</table>
ELECTRICAL CONTROL PARTS

Each electrical parts (Shift solenoid No 1 No.2)

* Normal close type

11-15 ohm (20 degrees Celsius)

* S1, S2 (NC type) & DCCSV (NO type)

<table>
<thead>
<tr>
<th>Temperature / degree C</th>
<th>Resistance / ohm</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40</td>
<td>8</td>
</tr>
<tr>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>80</td>
<td>16</td>
</tr>
<tr>
<td>120</td>
<td>12</td>
</tr>
<tr>
<td>150</td>
<td>11</td>
</tr>
</tbody>
</table>

No battery connected
No air leakage

Battery connected
Air leakage
Each electrical parts

**6. LINE PRESSURE CONTROL SOLENOID (SLT)**

SLT controls linear throttle pressure by control signal from TCM and line pressure for clutched and brakes to reduce shift shock.

**7. LOCK UP SOLENOID (SL)**

SL operates of ON/OFF by the control signal from TCM and L-up clutch inside T/C.
ELECTRICAL CONTROL PARTS

Each electrical parts (Line pressure control solenoid valve)

<table>
<thead>
<tr>
<th>SHIFT RANGE</th>
<th>LINE PRESSURE (kg/cm²)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IDLE</td>
<td>STALL</td>
</tr>
<tr>
<td>D</td>
<td>3.7 ~ 4.3</td>
<td>8.1 ~ 9.0</td>
</tr>
<tr>
<td>R</td>
<td>6.2 ~ 7.2</td>
<td>15.6 ~ 19.0</td>
</tr>
</tbody>
</table>

Resistance: 3.3 - 3.7 ohm (20 degrees Celsius)
ELECTRICAL CONTROL PARTS

Each electrical parts (Line pressure control solenoid valve)

- **Linear control of applied oil pressure**

According to the amount of applying current from the TCM to the line pressure control solenoid coil, accumulator control pressure is managed resulting in smooth engagement of clutches and brakes.

According to the TPS opening angle, it controls the applying oil pressure to the primary regulator valve and generates proper line pressure which matches engine load.
Each electrical parts (Lock-up solenoid valve or DCCSV)

According to each L-up shift schedule, TCM sends signals to the Lock-up solenoid valve which operates ON/OFF control “L-up control” on the basis of the vehicle speed and the throttle opening.

- Solenoid Type: NO(Normal Open)

  * HP/H1(HMC), BL → NO Type

  Enterprise → Duty Type

  03-Model → NC Type

- Hydraulic flow

  Solenoid modulator valve → Lock-up solenoid → Solenoid relay valve → Lock-up relay valve → Lock-up control valve

11-15 ohm (20 degrees Celsius)
Each electrical parts

<table>
<thead>
<tr>
<th>WIRE TO SOLENOID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire To Solenoid puts wiring of Shift Solenoid No.1, No.2, L-up Solenoid and SLT together in one connector, and it is installed to A/T case.</td>
</tr>
</tbody>
</table>

![Wiring Diagram](image)
TPS (Throttle Position Sensor) signal

- Throttle opening (%) signal
- ECM → TCM as CAN data
Water Temperature signal

- Water Temperature (Celsius) signal
- ECM → TCM as CAN data
Constructions

• Oil pump
• Valve body assembly
• Sol. Valve
• Accumulator
• Oil path

Based on the hydraulic pressure created by the oil pump, TCM sends signals to solenoid and hydraulic control system governs the hydraulic pressure acting on the torque converter, planetary gear, clutches and brakes in accordance with the vehicle driving conditions.
HYDRAULIC CONTROL SYSTEM

Oil pump
Operated by the impeller hub inside Torque converter, it generates oil pressure for operating components as well as lubricating planetary gear set.

Valve body
Consists of an upper body and a lower body. It controls hydraulic pressure that applies to operating components as well as changes oil paths inside valve body.
Manual valve

Connected to a shift lever, it changes oil path according to the shift lever position, P-R-N-D-2-L.

Primary regulator valve

Using the throttle pressure, Primary regulator valve processes the pressure from the oil pump and generates proper line pressure in accordance with engine load. If the primary regulator valve is abnormal, shift shock or disc slip occurs.

* Line pressure: Basic operating pressure to engage all the clutches and brakes.
C1 orifice control valve

Line pressure from manual valve applies to C₁. At the same time lock-up control pressure also applies to the other side of the spool valve inside it. Therefore the output pressure to forward clutch via this valve changes.

Secondary regulator valve

It keeps converter pressure, lubrication and cooler pressure steady. If the converter pressure increases, it drains, if the converter pressure decreases, then it stops the drain. Therefore the converter pressure can be controlled stably.
SCSV-A, B

SCSC-A & B controls 1-2, 2-3, 3-4 shift valve by ON or OFF signal from TCM. Line pressure applies to the SCSV-A at all the forward driving ranges (D, 2, L) and to the SCSV-B at all ranges (P, R, N, D, 2, L).

<table>
<thead>
<tr>
<th>Shift range</th>
<th>SCSV-A</th>
<th>SCSV-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>P Parking</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>R Reverse</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>N Neutral</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>D 1st</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td>3rd</td>
</tr>
<tr>
<td>L</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>1st</td>
</tr>
</tbody>
</table>

*Sol. Type: NC (Normal close)*

*When ON, it is open → line pressure to shift valve drains*

*Resistance: 11~15 ohm (20 degrees Cels.)*
HYDRAULIC CONTROL SYSTEM

1-2 Shift valve

1-2 shift valve performs **1st - 2nd gear shift** by **SCSV-B ON/OFF**.

* SCSV-B ON:
  Pressure at ‘A’ releases → Spool moves upward → **Pressure to B₂ is applied → 2nd gear**

* SCSV-B OFF:
  Hydraulic pressure applied to ‘A’ → Spool moves downward → **B₂ pressure is cut → 1st gear**

* **At 4th gear, even the SCSV-B is OFF, the spool moves upward because of the 2-3 shift valve line pressure: Pressure is applied to B₂**
2-3 Shift valve

2-3 shift valve performs **2nd - 3rd gear shift** by **SCSV-A ON/OFF**.

* **SCSV-A ON:**
  Pressure at ‘A’ releases → Spool moves upward → **C₂ pressure is cut → 2nd gear**

* **SCSV-A OFF:**
  Hydraulic pressure applied to ‘A’ → Spool moves downward → **Pressure to C₂ is applied → 3rd gear**

* At ‘L’ range, the spool moves upward because the line pressure from a manual valve applies to ‘B’: **3rd gear is impossible**
3-4 Shift valve

3-4 shift valve performs 3rd - 4th gear shift by SCSV-B ON/OFF.

* SCSV-B ON:
Pressure at ‘A’ releases → Spool moves upward → $B_0$ pressure is cut → 3rd gear

* SCSV-B OFF:
Hydraulic pressure applied to ‘A’ → Spool moves downward → Pressure to $B_0$ is applied → 4th gear

* At ‘2’, ‘L’ range, the spool moves upward because the line pressure from a 2-3 shift valve applies to ‘B’: 4th gear is impossible
Accumulators

Hydraulic circuit of accumulator, of which one side is installed in the TM case and the other side faces the valve body, is connected with hydraulic circuit to Clutches, Brakes in parallel. It functions as a damper to lessen the engaging shock of Clutches and Brakes. *That is, accumulator functions as a damper until the accumulator back pressure and spring force that applies on the back side of the piston reaches the line pressure of the other side.* If the line pressure exceeds the accumulator back pressure and spring force, accumulator just functions as oil path.

*30-Model has 5 accumulators (C0, C1, C2, B0, B2), one of them is installed inside a valve body and the others are located in the TM case.*
Accumulators

Function

<table>
<thead>
<tr>
<th>Accum.</th>
<th>Operating timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>C0</td>
<td>4 → 3</td>
</tr>
<tr>
<td>C1</td>
<td>N → D</td>
</tr>
<tr>
<td>C2</td>
<td>2 → 3</td>
</tr>
<tr>
<td>B0</td>
<td>3 → 4</td>
</tr>
<tr>
<td>B2</td>
<td>1 → 2</td>
</tr>
</tbody>
</table>

Accum. Operating timing

X: Without Accum.

Accum. Spring load

Y > Z

Line pressure

Time (t)

Spring

Piston

Back pressure

Orifice

PL In

PL Out

Function
## ELECTRONIC CONTROL

### Shift control

- **Shift decision factors**
  - TPS(CAN data), Output + Input speed(serial data)

- **Driving control** (↔: Up/Down Shift, ←: Only Down Shift)
  - Normal & Hot Mode
    - D: 1↔2↔3↔4  2: 1↔2↔3  L: 1←2
  - L4 Mode
    - D: 1↔2↔3  2: 1↔2↔3  L: 1←2
  - Snow Mode
    - D: 2↔3↔4  2: 1↔2↔3  L: 1←2

<table>
<thead>
<tr>
<th>Gear</th>
<th>SCSV No.1</th>
<th>SCSV No.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>2nd</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>3rd</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>4th</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>
Damper clutch control

■ Purpose
- Low fuel consumption, NVH, (Emission) improvement

■ Operating condition
- Brake switch: Off
- Throttle opening: 12% (2.5 DSL), 6.5% (3.5 GSL)
- Coolant temperature: -100 °C

■ Control inhibition
- Brake Switch: ON
- Throttle opening: 9% (2.5 DSL), 5% (3.5 GSL)
- Low coolant temperature: -100 °C
- 4WD LOW mode
Engine torque reduction (ETR) and line pressure control (LPC)

**Engine torque reduction control** improves shift quality due to sending torque reduction request signal from TCM to ECM and reducing engine torque while shifting “N” to “D”, “N” to ”R” as well as shifting 1→2→3→4.

* TCM have no information of real (current) engine torque, but through the calibration work at each condition in the actual vehicle for up- and down-shifts, the TCM determines the value by how much the engine torque has to be reduced.

**Line pressure control** improves shift quality due to controllable line pressure while shifting “N” to “D”, “N” to ”R” as well as shifting 1→2→3→4.

* Controlled line pressure is a mapping data which changes according to the current gear position, TPS value, oil temperature.
Engine torque reduction (ETR) and line pressure control (LPC)
Reverse inhibition control

■ Purpose
- To prevent engaging “Reverse” gear while D → R shift (Neutral by C2)

■ Operating condition
- D → R shift
- Output speed >= H/S

■ Control
- C2 pressure drains, when output speed >= H/S

■ Control inhibition
- Output speed < R/S

* High Speed(H/S): 2.5 DSL: 350 rpm(11km/h), 3.5GSL: 400 rpm(11km/h)
* Reset Speed(R/S): 2.5 DSL: 300 rpm(9km/h), 3.5GSL: 325 rpm(9km/h)
Engine over-run inhibition control

■ Purpose
- To prevent engine over-run by turning the O/D OFF switch accidentally “ON” at high vehicle speed

■ Operating condition
- Driving at 4th speed
- O/D OFF switch: ON
- Vehicle speed ≥ wot_SH43

■ Control inhibition
- O/D OFF switch: OFF
- Vehicle speed < wot_SH43
- Below 4→3 shift point

* wot_43SH
- 2.5 DSL: 4200 rpm (136 km/h), 3.5GSL: 5000 rpm (145 km/h)
Adaptive shift control

■ Purpose
- Optimal shift control according to the road and driving condition

■ Functions
- Up slope mode: Prevent a frequent gear shifting → improved performance and fuel consumption
- Down slope mode: Use engine brake → improved driving stability

Output speed
Accelerator pedal
Engine torque
Road slope
Acceleration

TCM
Calculate related information

Optimal gear shifting
Adaptive shift control (Up slope mode)

Accelerator pedal is off while sloping upward, gear shifts up resulting in poor acceleration. Up slope mode prevents up-shifting at the moment to maintain the driving force during acceleration or escaping corner.

According to the slope angle, there are two modes, Up slope1 and Up slope 2.
Adaptive shift control (Down slope mode)

While driving down hill, engine brake operates automatically according to accelerator position and braking condition at a certain slope degree.
Coast down control

To prevent the frequent gear shift during short time in the condition of low TPS opening ratio and to improve the shift quality such as 2->1, 3->2 at the coast down road, a special shift pattern was adopted to be operated in case of specified vehicle condition.
Coast down control

- Coast down control start condition
  - Brake switch is N (When the foot brake is depressed)
  - Engine is idle (When the accelerator pedal is not depressed)
  - D or 2 range

- Coast down control cancellation condition
  - After 1 second since the brake switch is OFF (To prevent hysteresis)
  - TPS > 0% (When the accelerator pedal is depressed)
High ATF temperature control

When ATF temperature abnormally rises (more than 135 degrees Celsius), TCM changes shift pattern automatically to avoid ATF temperature increase. This kind of Hot mode situation can happen when the vehicle is moving up on a steep slope. TCM changes the shift pattern as a high ATF shift pattern extending a low gear range but it does not operate damper clutch. Engaging damper clutch engagement can rapidly drop down ATF temperature but it reveals inferior drivability.

* In case of Terracan(HMC) which uses same AT model, damper clutch can operate from 2nd gear.

- ATF Temp. >= 135 degrees Celsius → High ATF Temp. shift pattern
- ATF Temp. <= 120 degrees Celsius → Normal shift pattern
DIAGNOSIS

Stall test

■ Purpose
- To check the slip of components and overall performance of the transmission

■ Caution
- Never longer than 5 seconds at a time
- Take at least one minute idle time in neutral before one more test

■ Stall RPM
- 2.5 TCI: 2420 +- 150 RPM
- 3.5 GSL: 2520 RPM

■ Test result
- Over the normal RPM: Slip of components, less line pressure
- Below the normal RPM: ATF oversupply, lack of engine power
## Stall test

### Test result

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above standard</td>
<td></td>
</tr>
<tr>
<td>In &quot;D&quot; and &quot;R&quot; range</td>
<td>Line pressure too low</td>
</tr>
<tr>
<td></td>
<td>OD clutch slipping</td>
</tr>
<tr>
<td></td>
<td>OD one-way clutch not operating properly</td>
</tr>
<tr>
<td>In &quot;D&quot; range only</td>
<td>Forward clutch slipping</td>
</tr>
<tr>
<td></td>
<td>Rear one-way clutch not operating properly</td>
</tr>
<tr>
<td></td>
<td>Line pressure too low</td>
</tr>
<tr>
<td></td>
<td>OD clutch slipping</td>
</tr>
<tr>
<td></td>
<td>OD one-way clutch not operating properly</td>
</tr>
<tr>
<td>Below standard</td>
<td>Engine out of tune</td>
</tr>
<tr>
<td></td>
<td>Slipping of one way clutch within torque converter</td>
</tr>
<tr>
<td>In &quot;R&quot; range only</td>
<td>Direct clutch slipping</td>
</tr>
<tr>
<td></td>
<td>Low &amp; reverse clutch slipping</td>
</tr>
<tr>
<td></td>
<td>Line pressure too low</td>
</tr>
<tr>
<td></td>
<td>OD clutch slipping</td>
</tr>
<tr>
<td></td>
<td>OD one-way clutch not operating properly</td>
</tr>
</tbody>
</table>
## DIAGNOSIS

### Line pressure test

#### Test result

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible cause</th>
</tr>
</thead>
</table>
| Below standard In "D" and "R" ranges | Defective or stuck the throttle valve  
Defective or stuck the regulator valve  
Defective the oil pump  
OD clutch slipping |
| In "D" range only | Fluid leakage in the "D" range line pressure  
hydraulic circuit  
Forward clutch slipping  
OD clutch slipping |
| In "R" range only | Fluid leakage in the "R" range line pressure  
hydraulic circuit  
Direct clutch slipping  
Defective low & reverse brake |
| Excessive line pressure at idle | Defective or stuck the throttle valve  
Defective or stuck the regulator valve |

<table>
<thead>
<tr>
<th>Shift position</th>
<th>Line Pressure (kg/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle</td>
<td>Stall</td>
</tr>
<tr>
<td>D</td>
<td>4.0 - 4.6</td>
</tr>
<tr>
<td>R</td>
<td>6.2 - 7.2</td>
</tr>
</tbody>
</table>
Warning lamp & Data Link Connector (DLC)

- Trouble codes and service data display on a HI-SCAN (PRO)
- Failure warning: O/D OFF lamp, MIL (OBD area)
- 2 DLCs are supplied

Waning lamp: DOM/GEN Only
※ OBD area: MIL Lamp

DLC (20 PIN): Engine compartment
DLC (16PIN): Inside Cabin
### DIAGNOSIS

#### 20 Pin DLC connector

<table>
<thead>
<tr>
<th>PIN</th>
<th>NAME</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Fuel pump</td>
<td>Fuel pump is operated under IG ON</td>
</tr>
<tr>
<td>B</td>
<td>IG1</td>
<td>Key switch IG1 power</td>
</tr>
<tr>
<td>C</td>
<td>Discretionary</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>Condenser fan</td>
<td>Condenser fan is operated in case of ground</td>
</tr>
<tr>
<td>E</td>
<td>RKE coding</td>
<td>Data send and receiving</td>
</tr>
<tr>
<td>F</td>
<td>Air bag</td>
<td>Data send and receiving</td>
</tr>
<tr>
<td>G</td>
<td>Flash power</td>
<td>Data re-write</td>
</tr>
<tr>
<td>H</td>
<td>ABS</td>
<td>Data send and receiving</td>
</tr>
<tr>
<td>I</td>
<td>Discretionary</td>
<td>-</td>
</tr>
<tr>
<td>J</td>
<td>Spark plug adjustment</td>
<td>-</td>
</tr>
<tr>
<td>K</td>
<td>K-line</td>
<td>Data send and receiving</td>
</tr>
<tr>
<td>L</td>
<td>Discretionary</td>
<td>-</td>
</tr>
<tr>
<td>M</td>
<td>EAT fail</td>
<td>Display of TCM fail code</td>
</tr>
<tr>
<td>N</td>
<td>EAT test</td>
<td>TCM check in case of ground</td>
</tr>
<tr>
<td>O</td>
<td>IG-</td>
<td>For RPM check</td>
</tr>
<tr>
<td>P</td>
<td>Engine fail</td>
<td>Display of Engine fail code</td>
</tr>
<tr>
<td>Q</td>
<td>engine test</td>
<td>ECM check in case of ground</td>
</tr>
<tr>
<td>R</td>
<td>GND</td>
<td>-</td>
</tr>
<tr>
<td>S</td>
<td>GND</td>
<td>-</td>
</tr>
<tr>
<td>T</td>
<td>B+</td>
<td>Battery power</td>
</tr>
</tbody>
</table>
Definition of D/C & W/C

Driving Cycle (D/C): Driving condition for Diagnosis, Memory, Erase

Definition

When the OBD_FRF_ACK bit2 among ECM CAN Messages turns 0 → 1,

1D/C

ECM keeps ‘1’ (1D/C) until IG off after engine starts.
And next IG off, ECM Rest (0)

<table>
<thead>
<tr>
<th>MUL_CODE</th>
<th>MUL_INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 OBD_FRF_ACK</td>
</tr>
</tbody>
</table>

Message information

MUL_CODE: 10 → OBD_FRF_ACK

Bit 2: 0 → D/C unsatisfied, Reset

: 1 → D/C satisfied
Definition of D/C & W/C

■ Warm-up Cycle (W/C): Driving condition for OBD
■ Definition

*When the OBD_FRF_ACK bit0 among ECM CAN Messages turns 0 → 1, 1W/C*

; ECM keeps ‘1’ (1D/C) if all the conditions below are satisfied until IG off after engine starts.
- *Coolant temperature ≥ 71 degrees Celsius, and it should be 4 degree Celsius higher than the previous temperature.*

<table>
<thead>
<tr>
<th>MUL_CODE</th>
<th>MUL_INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>OBD_FRF_ACK</td>
</tr>
</tbody>
</table>

■ Message information
- MUL_CODE: 10 → OBD_FRF_ACK
- Bit 0: 0 → W/C unsatisfied, Reset
  - : 1 → W/C satisfied
2 Consecutive Driving cycles

2 Driving cycle detection:

*DTC is duplicated in case same failure is detected at least 2 consecutive driving cycles.*

1. Symptom simulation test

2. Tester detects one failure (one driving cycle)

3. IG OFF => ON

4. Perform the symptom simulation test again

5. Tester detects failure again (2 driving cycle)
Warning lamp ON/OFF condition

■ Warning lamp ‘Flashing’ condition
- DTC is memorized, O/D OFF lamp illuminates
- Type A: 1D/C (DTC stored on the 1st driving cycle)
- Type B: 2D/C (DTC stored on the 2nd driving cycle)
- Type C: only failsafe (No DTC stored, W/L not flashing)

■ Warning lamp ‘OFF’ condition
- After no failure detected, the D/C condition below should be satisfied.
  → US/EUR: 3 consecutive D/C, DOM/GEN: 1D/C
- When DTC is erased by a Hi-Scan (Pro) or by means of DGC
DTC memory and erase

Memory condition
- Type A: 1D/C (DTC stored on the 1st driving cycle)
- Type B: 2D/C (DTC stored on the 2nd driving cycle)
- Type C: only failsafe (No memory)

Erase condition
- After no failure detected, the consecutive W/C condition below should be satisfied.
  - US/EUR: 40 W/C, DOM/GEN: 40 W/C
- When DTC is erased by a Hi-Scan (Pro) or by means of DGC
How to check the Fail-code by means of DGI/DGC

1) Let the PIN No. 11 of DLC ground.
2) O/D OFF lamp will be flashing several seconds after O/D OFF lamp turns on.
3) For the clear of Fail-code, let the PIN No. 3 of DLC ground over than 5 sec.
How to count the O/D OFF lamp flashing

For example: P1783 / P0604

A : 0.5sec.  B : 1.5sec.  C : 0.3sec.  D : 1.5sec.
MIL Request

■ MIL: On-board warning lamp for OBD-II, EOBD Emission regulation

■ MIL ON condition
- When DTC is memorized in TCM,
  ; TCU CAN Message, TCU_OBD Bit 2 sets 0 → 1

<table>
<thead>
<tr>
<th>Bit 3</th>
<th>Bit 2</th>
<th>Bit 1</th>
<th>Bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL blinking</td>
<td>MIL on</td>
<td>freeze frame</td>
<td>readiness</td>
</tr>
</tbody>
</table>

■ MIL OFF condition
- After no failure detected, the D/C condition below should be satisfied.
  → US/EUR: 3 consecutive D/C
- When DTC is erased by a Hi-Scan (Pro) or by means of DGC
### DTC detected condition and failsafe

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
<th>FAILSAFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0707</td>
<td>Output speed &gt;= 1130, Engine rpm&gt;= 1500</td>
<td>Judge 'D' range (system mechanically operates)</td>
</tr>
<tr>
<td>P0708</td>
<td>2 or more signals are detected for more than 10 sec.</td>
<td>D&gt;2&gt;L&gt;R&gt;N&gt;P (operation priority)</td>
</tr>
<tr>
<td>P0722</td>
<td>(1st-3rd gear) No output while 45 input pulses detected</td>
<td>Gear shift by using input speed sensor signals</td>
</tr>
<tr>
<td></td>
<td>(4th gear) 1500 output rpm drop and 0 rpm detected</td>
<td>No lock-up/4th gear/ETR/LPC/Rverse/Squat control</td>
</tr>
<tr>
<td>P0743</td>
<td>(Short to GND) 'OFF' detected for 300 msec after 'ON'</td>
<td>DCCSV OFF</td>
</tr>
<tr>
<td></td>
<td>(Open/short to B+) 'ON' detected for 50 msec after 'OFF'</td>
<td>1st gear hold if output rpm &lt; 375 (Open/B+ short)</td>
</tr>
<tr>
<td>P0748</td>
<td>(Open/short to GND) AD value &lt;= 15 for 70 msec</td>
<td>4th gear hold</td>
</tr>
<tr>
<td></td>
<td>(Short to B+) AD value &gt;= 1000 for 500 msec</td>
<td></td>
</tr>
<tr>
<td>P0753</td>
<td>(Short to GND) 'OFF' detected for 300 msec after 'ON'</td>
<td>Lock-up inhibited</td>
</tr>
<tr>
<td></td>
<td>(Open/short to B+) 'ON' detected for 50 msec after 'OFF'</td>
<td>Gear hold: D range-4th,2 range-3rd,L range-1st</td>
</tr>
<tr>
<td>P0758</td>
<td>(Short to GND) 'OFF' detected for 300 msec after 'ON'</td>
<td>Lock-up inhibited</td>
</tr>
<tr>
<td></td>
<td>(Open/short to B+) 'ON' detected for 50 msec after 'OFF'</td>
<td>Gear hold: D range-4th,2 range-3rd,L range-1st</td>
</tr>
<tr>
<td>P1121</td>
<td>TPS message FF H is received for 0.2 sec</td>
<td>Judge TPS 0%, Max. line pressure, No ETR/LPC</td>
</tr>
<tr>
<td>P0710</td>
<td>(Short) Abnormal sensor resistance detected for 5 min.</td>
<td>Judge ATF temp. 200°C, No lock-up, ETR/LPC inhibited while shifting</td>
</tr>
<tr>
<td></td>
<td>(Open) AD value is under 15 or over 1000 detected</td>
<td></td>
</tr>
<tr>
<td>P1115</td>
<td>WT message FF H is received for 0.2 sec</td>
<td>Judge the Temperature normal</td>
</tr>
<tr>
<td>P0717</td>
<td>No input while 12 pulses of output signal are detected</td>
<td>No lock-up, ETR/LPC inhibited while shifting</td>
</tr>
<tr>
<td>P0716</td>
<td>Input speed &gt;= 7000 rpm detected</td>
<td></td>
</tr>
<tr>
<td>P1630</td>
<td>BUS OFF is detected 0.2 sec after IG on</td>
<td>No lock-up, maximum line pressure, No ETR/LPC</td>
</tr>
<tr>
<td>P1631</td>
<td>No message received from ECM</td>
<td>No lock-up, maximum line pressure, No ETR/LPC</td>
</tr>
<tr>
<td>-</td>
<td>Output rpm &gt;= 2260, TPS&gt;=5%, Brake on &gt;= 10sec</td>
<td>Ignore the brake signal, Lock-up available</td>
</tr>
<tr>
<td>DTC</td>
<td>DESCRIPTION</td>
<td>3.5 V6(EUR/US)</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fault type</td>
</tr>
<tr>
<td>P0707</td>
<td>Transmission Range Sensor Circuit Low Input</td>
<td>B</td>
</tr>
<tr>
<td>P0708</td>
<td>Transmission Range Sensor Circuit High Input</td>
<td>B</td>
</tr>
<tr>
<td>P0722</td>
<td>Output Speed Sensor Circuit No Signal</td>
<td>B</td>
</tr>
<tr>
<td>P0726</td>
<td>Engine Speed Input Sensor Range/Performance</td>
<td>B</td>
</tr>
<tr>
<td>P0727</td>
<td>Engine Speed signal invalid</td>
<td>B</td>
</tr>
<tr>
<td>P0740</td>
<td>Torque Converter Clutch Circuit (SL) Malfunction</td>
<td>B</td>
</tr>
<tr>
<td>P0743</td>
<td>Torque Converter Clutch Circuit (SL) Electrical</td>
<td>B</td>
</tr>
<tr>
<td>P0750</td>
<td>Shift Solenoid A(S1) Malfunction</td>
<td>B</td>
</tr>
<tr>
<td>P0753</td>
<td>Shift Solenoid A (S1 ) Electrical</td>
<td>A</td>
</tr>
<tr>
<td>P0755</td>
<td>Shift Solenoid B (S2) Malfunction</td>
<td>B</td>
</tr>
<tr>
<td>P0758</td>
<td>Shift Solenoid B (S2) Electrical</td>
<td>A</td>
</tr>
<tr>
<td>P0748</td>
<td>Pressure Solenoid (SLT) Electrical</td>
<td>A</td>
</tr>
<tr>
<td>P1121</td>
<td>Throttle Sensor Signal invalid</td>
<td>B</td>
</tr>
<tr>
<td>P0710</td>
<td>ATF Temp. Sensor Circuit Malfunction</td>
<td>B</td>
</tr>
<tr>
<td>P1115</td>
<td>Water Temp. Signal Malfunction from ECU to TCU</td>
<td>B</td>
</tr>
<tr>
<td>P0717</td>
<td>Input Speed Sensor Circuit No Signal</td>
<td>B</td>
</tr>
<tr>
<td>P0716</td>
<td>Input Speed Sensor Circuit Range / Performance</td>
<td>B</td>
</tr>
<tr>
<td>P1795</td>
<td>Transfer High/Low(L4) Switch Malfunction</td>
<td>B</td>
</tr>
<tr>
<td>P1630</td>
<td>CAN communication BUS OFF</td>
<td>B</td>
</tr>
<tr>
<td>P1631</td>
<td>No ID from ECU</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Vehicle Speed Signal From Meter Set</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Brake SW malfunction</td>
<td>C</td>
</tr>
</tbody>
</table>

* Fault type - Type A: DTC stored on the 1st driving, Type B: DTC stored on the 2nd driving, Type C: only failsafe (Not DTC stored)
* Warning lamp: O/D OFF lamp
## Troubleshooting

<table>
<thead>
<tr>
<th>DTC detected condition</th>
<th>Cause of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ground short:</strong></td>
<td>1. Harness or connector between each shift solenoid and TCM</td>
</tr>
<tr>
<td>A failure will be displayed in case any trouble is detected at any other gears <strong>8 times</strong> after a trouble is detected at one gear for <strong>0.3 sec.</strong>.</td>
<td></td>
</tr>
<tr>
<td><strong>Open:</strong></td>
<td>2. Each shift solenoid</td>
</tr>
<tr>
<td>A failure will be displayed in case any trouble is detected at any other gears <strong>8 times</strong> after a trouble is detected at one gear for <strong>0.5 sec.</strong>.</td>
<td>3. TCM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DTC detected condition</th>
<th>Cause of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0753</td>
<td>Solenoid No.1 (S1) Open, Ground short</td>
</tr>
<tr>
<td>P0758</td>
<td>Solenoid No.2 (S2) Open, Ground short</td>
</tr>
<tr>
<td>P0743</td>
<td>L-up solenoid (SL) Open, Ground short</td>
</tr>
</tbody>
</table>
### Troubleshooting

<table>
<thead>
<tr>
<th>P0748</th>
<th>Pressure control solenoid Open, Ground short</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DTC detected condition</strong></td>
<td><strong>Cause of failure</strong></td>
</tr>
</tbody>
</table>
| Open/short to GND:  
20 mA or less current has been detected for **12.5 seconds or more**, DTC is memorized. | 1. Harness or connector between PCSV and TCM. |
| Short to B+:  
1.36 A or more output current is detected for **0.5 seconds or more**, DTC is memorized. | 2. PCSV  
3. TCM |
Troubleshooting

<table>
<thead>
<tr>
<th>P0716, P0717</th>
<th>Input speed sensor No signal</th>
<th>Output speed sensor No signal</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DTC detected condition</th>
<th>Cause of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No C0 signal:</strong></td>
<td></td>
</tr>
<tr>
<td>No pulse from C0 is detected while 12 pulses of SP signal detected, failure is 1 time. More than 1000 times continuously detected, it is judged a temporary failure. When it is detected again after IG OFF to ON, total failure become 2 times. DTC is displayed.</td>
<td>1. Harness or connector between each speed sensor and TCM.</td>
</tr>
<tr>
<td><strong>No SP signal:</strong></td>
<td></td>
</tr>
<tr>
<td>No pulses from SP is detected while 45 pulses of C0 signal detected, failure is 1 time. More than 500 times continuously detected, a temporary failure is memorized. When it is detected again after IG OFF to ON, total failure become 2 times. DTC is displayed.</td>
<td>2. Each speed sensor 3. TCM</td>
</tr>
</tbody>
</table>
## Troubleshooting

<table>
<thead>
<tr>
<th>P0707</th>
<th>TR switch No signal, Open</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DTC detected condition</th>
<th>Cause of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No signal:</strong> DTC decides a temporary failure in case no signal is transmitted more than 30 seconds at 1130 rpm. When any trouble is detected again after IG OFF to ON, the number of problems total 2 and DTC decides a failure.</td>
<td>1. Harness or connector between TR switch and TCM.</td>
</tr>
</tbody>
</table>
| **Open:** DTC decides a temporary failure in case detected 2 or more signals for more than 10 sec. When any trouble is detected again after IG OFF to ON, the number of problems total 2 and DTC decides a failure. | 2. TR switch  
3. TCM |
Troubleshooting

<table>
<thead>
<tr>
<th>P0710</th>
<th>ATF temp. sensor open or short to Ground</th>
</tr>
</thead>
</table>

DTC detected condition | Cause of failure
---|---
**Open:**  
When detected detection condition that the abnormal condition of oil temperature after **15 minutes** has passed since IG ON, a temporary failure is decided. When it is detected again after IG OFF => ON, the total of failures become **2 times** and DTC is decided.

**Ground short:**  
When detected detection condition that the abnormal condition for **5 minutes** since IG ON, a temporary failure is decided. When it is detected again after IG is OFF => ON, the total of failures become **2 times** and DTC is decided.

1. Harness or connector between ATF temp. sensor and TCM.
2. ATF temp. sensor
3. TCM
## TCM input and output terminal voltage table

<table>
<thead>
<tr>
<th>No</th>
<th>PIN NAME</th>
<th>CONDITION</th>
<th>INPUT&amp;OUTPUT SIGNAL</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>TYPE</td>
<td>Level</td>
</tr>
<tr>
<td>13</td>
<td>SCSV 1 (1st, 2nd speed operation)</td>
<td>DRIVING (P,N/1st/2nd 3rd/4th speed)</td>
<td>Frequency</td>
<td>V\text{batt} - 0V  \text{Lo} : 1.9A MAX</td>
</tr>
<tr>
<td>14</td>
<td>SCSV 2 (2nd,3rd speed operation)</td>
<td>DRIVING (P,N/1st/2nd 3rd/4th speed)</td>
<td>Frequency</td>
<td>V\text{batt} - 0V  \text{Lo} : 1.9A MAX</td>
</tr>
<tr>
<td>9</td>
<td>SNOW SW (2WD VEHICLE)</td>
<td>SW OFF</td>
<td>Frequency</td>
<td>V_{\text{GND}} -0.3 - 2V</td>
</tr>
<tr>
<td>7</td>
<td>C0 CYLINDER REV. SNSR (Over drive clutch drum)</td>
<td>IDLE</td>
<td>Pulse</td>
<td>V_{\text{Hi}} - V_{\text{Low}}  \text{16 Pulse/Co cylinder rev.}</td>
</tr>
<tr>
<td>8</td>
<td>VEHICLE SPEED SENSOR</td>
<td>DRIVING</td>
<td>Pulse</td>
<td>V_{\text{Hi}} - V_{\text{Low}}  \text{12Pulse/TM rev.}</td>
</tr>
<tr>
<td>31</td>
<td>O/D OFF SW</td>
<td>OFF SW OFF</td>
<td>DC</td>
<td>V(IG.1)</td>
</tr>
<tr>
<td>48</td>
<td>INHIBITOR SW(P)</td>
<td>P</td>
<td>DC</td>
<td>V_{\text{batt}}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R/N/D/2/L</td>
<td>DC</td>
<td>\text{BELOW 0.8V}</td>
</tr>
<tr>
<td>12</td>
<td>INHIBITOR SW(R)</td>
<td>R</td>
<td>DC</td>
<td>V_{\text{batt}}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P/N/D/2/L</td>
<td>DC</td>
<td>\text{BELOW 0.8V}</td>
</tr>
<tr>
<td>34</td>
<td>BATT</td>
<td>IGN OFF</td>
<td>DC</td>
<td>V_{\text{batt}}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IGN ON</td>
<td>DC</td>
<td>V_{\text{batt}}</td>
</tr>
<tr>
<td>2</td>
<td>LOCK-UP SOLENOID</td>
<td>DRIVING (over 45km/h)</td>
<td>Frequency</td>
<td>V\text{batt} - 0V  \text{Lo} : 1.9A MAX</td>
</tr>
<tr>
<td>3</td>
<td>PCSV</td>
<td>IDLE</td>
<td>Current control</td>
<td>Lo : 1A MAX</td>
</tr>
</tbody>
</table>
## TCM input and output terminal voltage table

<table>
<thead>
<tr>
<th>No</th>
<th>PIN NAME</th>
<th>CONDITION</th>
<th>INPUT&amp;OUTPUT SIGNAL</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>EARTH FOR PCSV</td>
<td>S/W OFF</td>
<td>DC</td>
<td>V(IG.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S/W ON</td>
<td>DC</td>
<td>V&lt;sub&gt;GND&lt;/sub&gt; -0.3 - 1.0V</td>
</tr>
<tr>
<td>18</td>
<td>OIL TEMP SNSR</td>
<td>IGN OFF</td>
<td>DC</td>
<td>0V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IDLE</td>
<td>DC</td>
<td>0 - 5V</td>
</tr>
<tr>
<td>24</td>
<td>EARTH FOR C0 CYLINDER REV. SNSR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>EARTH FOR VSS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>L4 SW (4WD VEHICLE)</td>
<td>SW OFF</td>
<td>DC</td>
<td>V(IG.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SW ON</td>
<td>DC</td>
<td>V&lt;sub&gt;GND&lt;/sub&gt; -0.3 - 1.0V</td>
</tr>
<tr>
<td>10</td>
<td>SNOW LAMP (2WD VEHICLE)</td>
<td>LAMP OFF</td>
<td>DC</td>
<td>V&lt;sub&gt;batt&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LAMP ON</td>
<td>DC</td>
<td>1.5V MAX</td>
</tr>
<tr>
<td>29</td>
<td>O/D OFF LAMP</td>
<td>LAMP OFF</td>
<td>DC</td>
<td>V&lt;sub&gt;batt&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LAMP ON</td>
<td>DC</td>
<td>1.5V MAX</td>
</tr>
<tr>
<td>32</td>
<td>INHIBITOR SW(N)</td>
<td>N</td>
<td>DC</td>
<td>V&lt;sub&gt;batt&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P/R/D/2/L</td>
<td>DC</td>
<td>BELOW 0.8V</td>
</tr>
<tr>
<td>33</td>
<td>INHIBITOR SW(D)</td>
<td>D</td>
<td>DC</td>
<td>V&lt;sub&gt;batt&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P/R/N/2/L</td>
<td>DC</td>
<td>BELOW 0.8V</td>
</tr>
<tr>
<td>1</td>
<td>POWER(IGN 1)</td>
<td>IGN OFF</td>
<td>DC</td>
<td>0V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IGN ON</td>
<td>DC</td>
<td>9V - 16V</td>
</tr>
<tr>
<td>6</td>
<td>EARTH FOR POWER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>BRAKE SW</td>
<td>SW OFF</td>
<td>DC</td>
<td>V&lt;sub&gt;GND&lt;/sub&gt; -0.3 - 2V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SW ON</td>
<td>DC</td>
<td>V&lt;sub&gt;batt&lt;/sub&gt;-2.0 - V&lt;sub&gt;batt&lt;/sub&gt;</td>
</tr>
<tr>
<td>35</td>
<td>EARTH FOR POWER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>EARTH FOR OTS</td>
<td></td>
<td></td>
<td>OTS: Oil Temp. Sensor</td>
</tr>
</tbody>
</table>

**Remark**: V<sub>batt</sub> indicates the battery voltage.
## TCM input and output terminal voltage table

<table>
<thead>
<tr>
<th>No</th>
<th>PIN NAME</th>
<th>CONDITION</th>
<th>INPUT&amp;OUTPUT SIGNAL</th>
<th>REMARK</th>
</tr>
</thead>
</table>
| 45 | K-LINE         | Continuity (10.4Kbps)             | Pulse              | Logic "0": Vbatt 20% ↓  
|    |                |                                   |                     | Logic "1": Vbatt 80% ↑ |
| 28 | DIAG. SW       | S/W OFF DC                        | V(IG.1)            |                      |
|    |                | S/W ON DC                         | V_GND -0.3 - 1.0V   |                      |
| 49 | INHIBITOR SW(2)| 2 DC                             | Vbatt              |                      |
|    |                | P/R/N/D/L DC                      | Below 0.8V         |                      |
| 50 | INHIBITOR SW(L)| L DC                             | Vbatt              |                      |
|    |                | P/R/N/D/2 DC                     | Below 0.8V         |                      |
| 23 | CRUISE CONTROL (Σ3.5/S-II 2.4)| ACC OFF DC                      | V(IG.1)            |                      |
|    |                | ACC ON DC                        | V_GND -0.3 - 1.5V  |                      |
| 41 | CAN(HIGH)      | Continuity (500kbit/s)            |                     |                      |
| 22 | CAN(LOW)       | Continuity (500kbit/s)            |                     |                      |
Electrical wiring diagram
BL A-2.5 SHIFT PATTERN (Normal D range: FGR 4.181)
SHIFT PATTERN

BL Σ 3.5 SHIFT PATTERN (Normal D range: FGR 4.666)

Vehicle Speed (Kph) vs Throttle opening (%)

- 2-1
- 1-2
- 3-2
- 2-3
- 4-3
- 3-4

4L OFF
4L ON

SHIFT PATTERN (Normal D range: FGR 4.666)