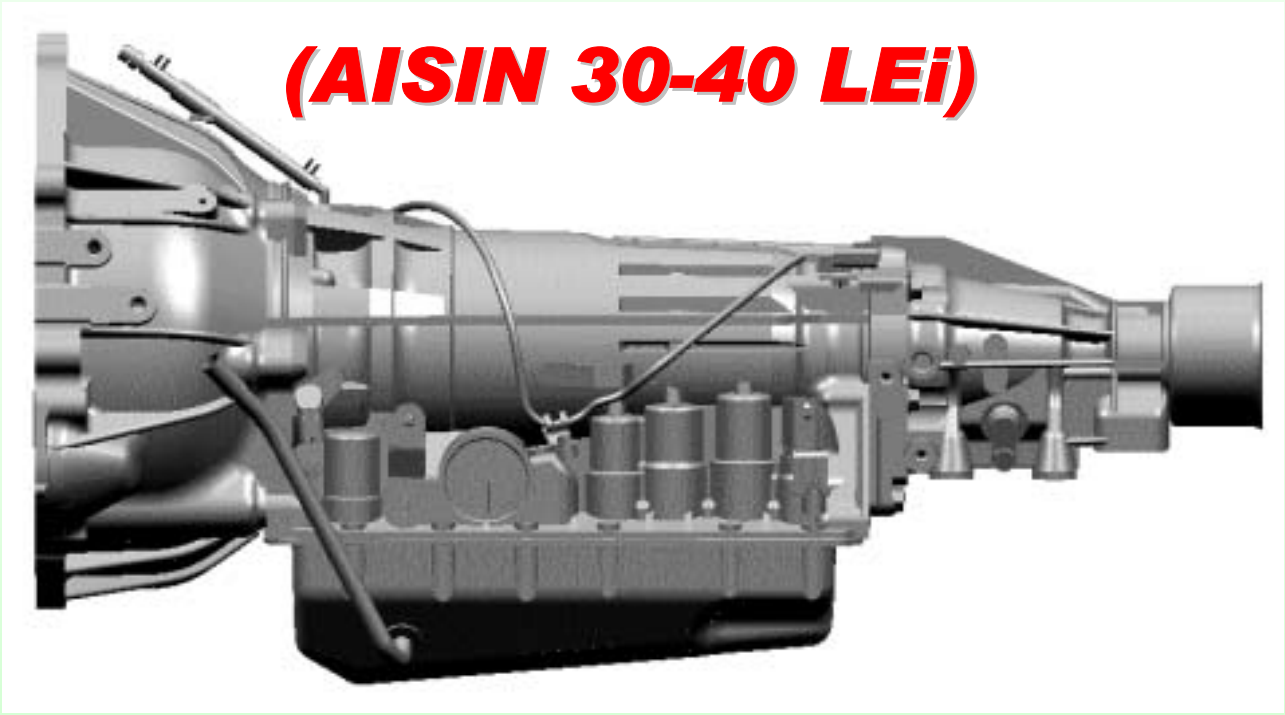
# BL AUTOMATIC TRANSMISSION

***(AISIN 30-40 LEi)***



# CONTENTS

# SPECIFICATION



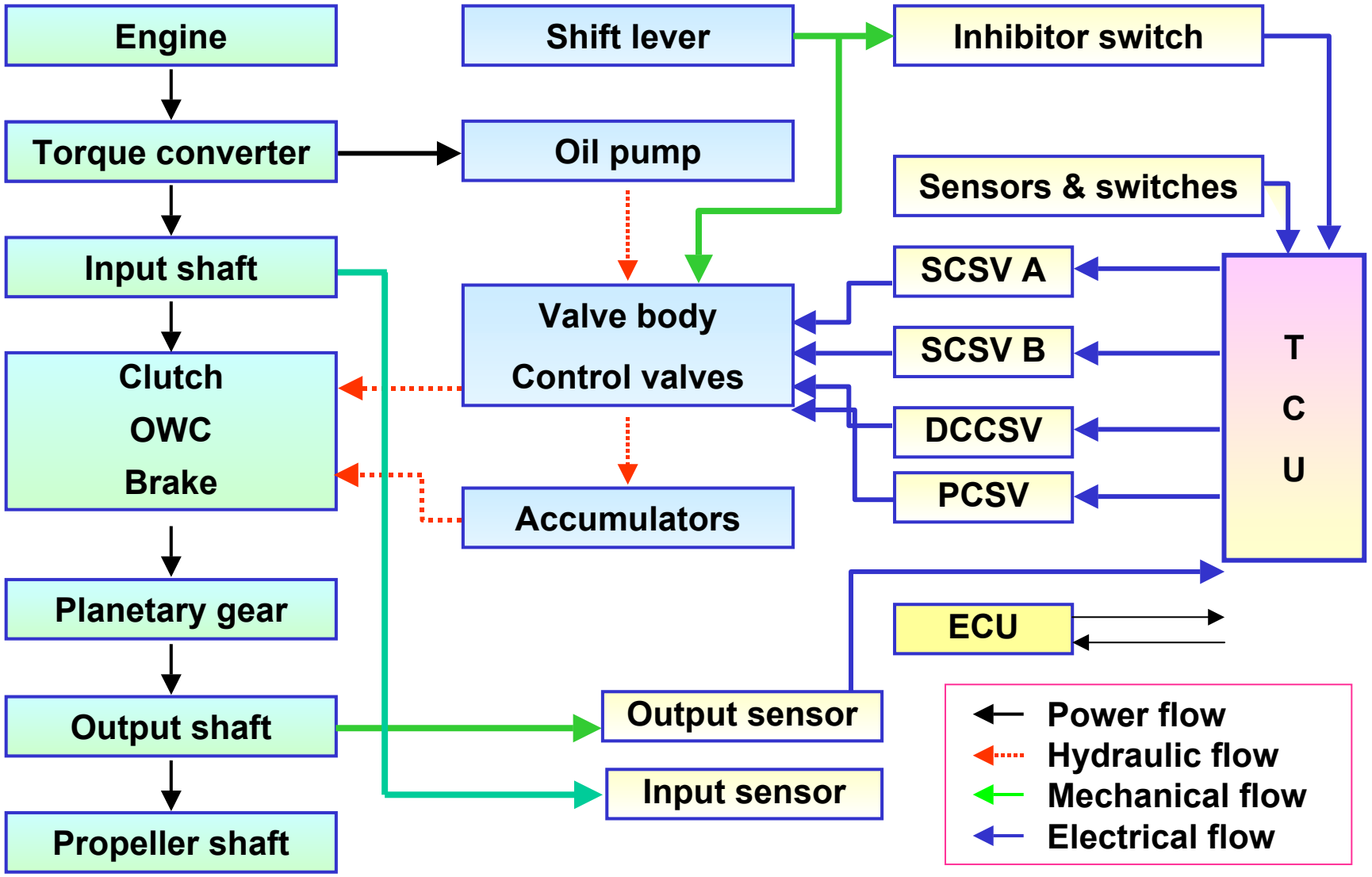
## General Specifications

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

# SYSTEM CONSTRUCTION

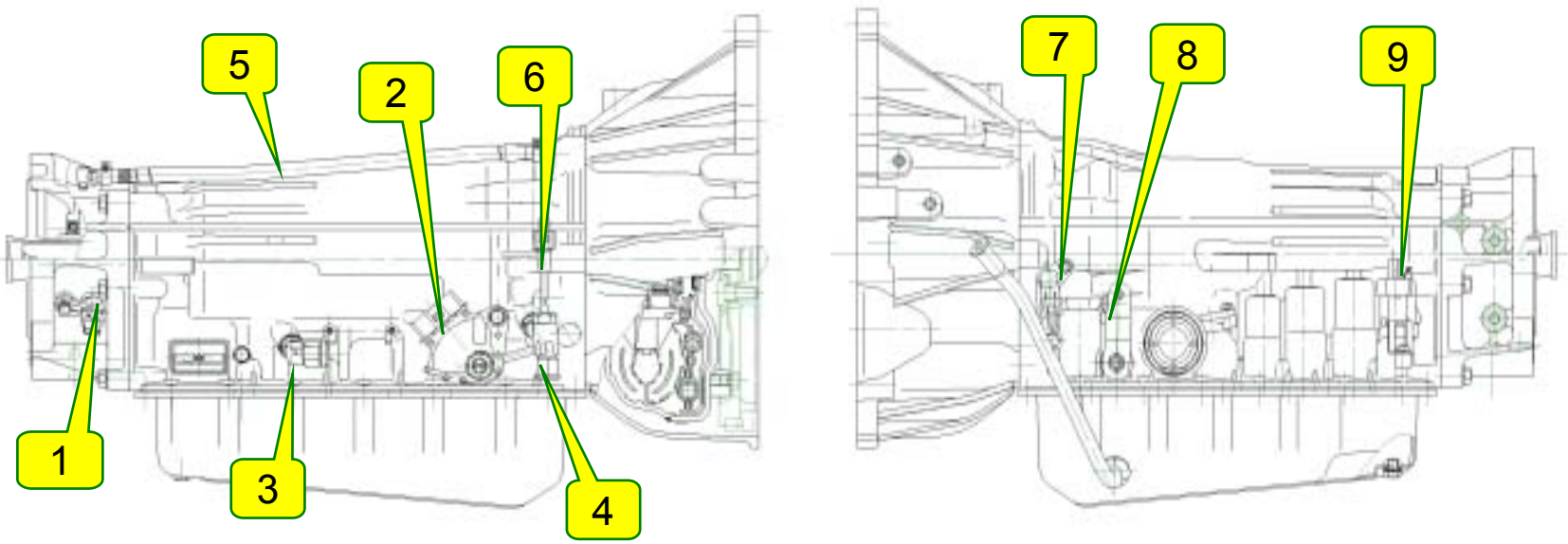


## Block Diagram



# SYSTEM LAYOUT

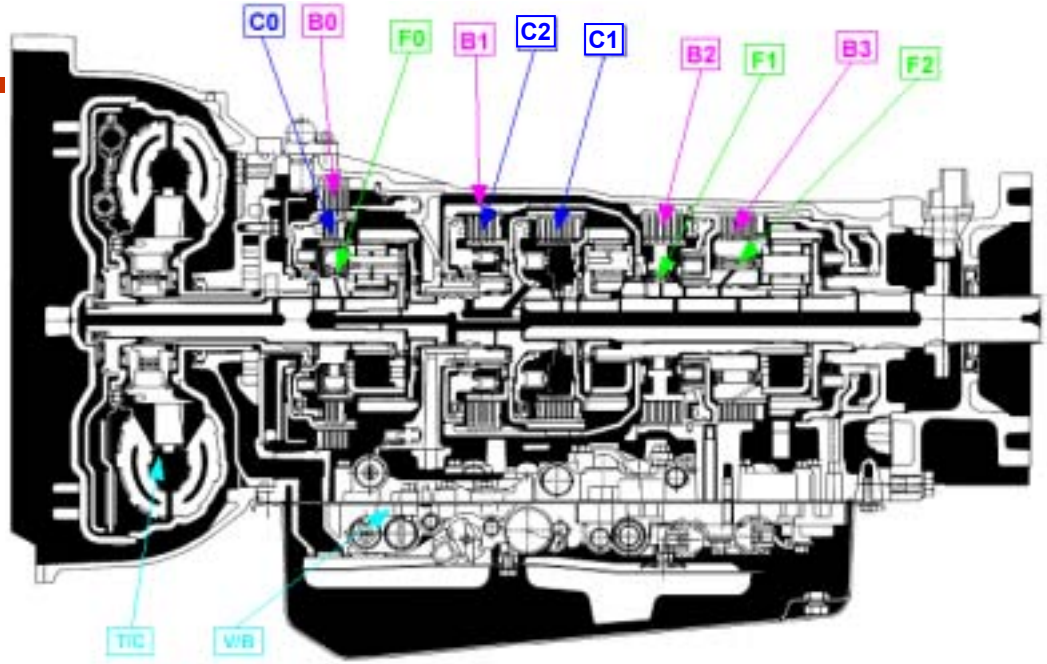





| | |
|---|---|
| **1. Output speed sensor** | To detect output shaft revolution |
| **2. Neutral switch** | To detect "N" range(A/T) or "Neutral" range(M/T) |
| **3. Elbow (cooler out)** | Way-out from a cooler hose to the A/T |
| **4. Elbow (cooler in)** | Way-in to the cooler hose from the torque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

# POWER FLOW

## Components and function

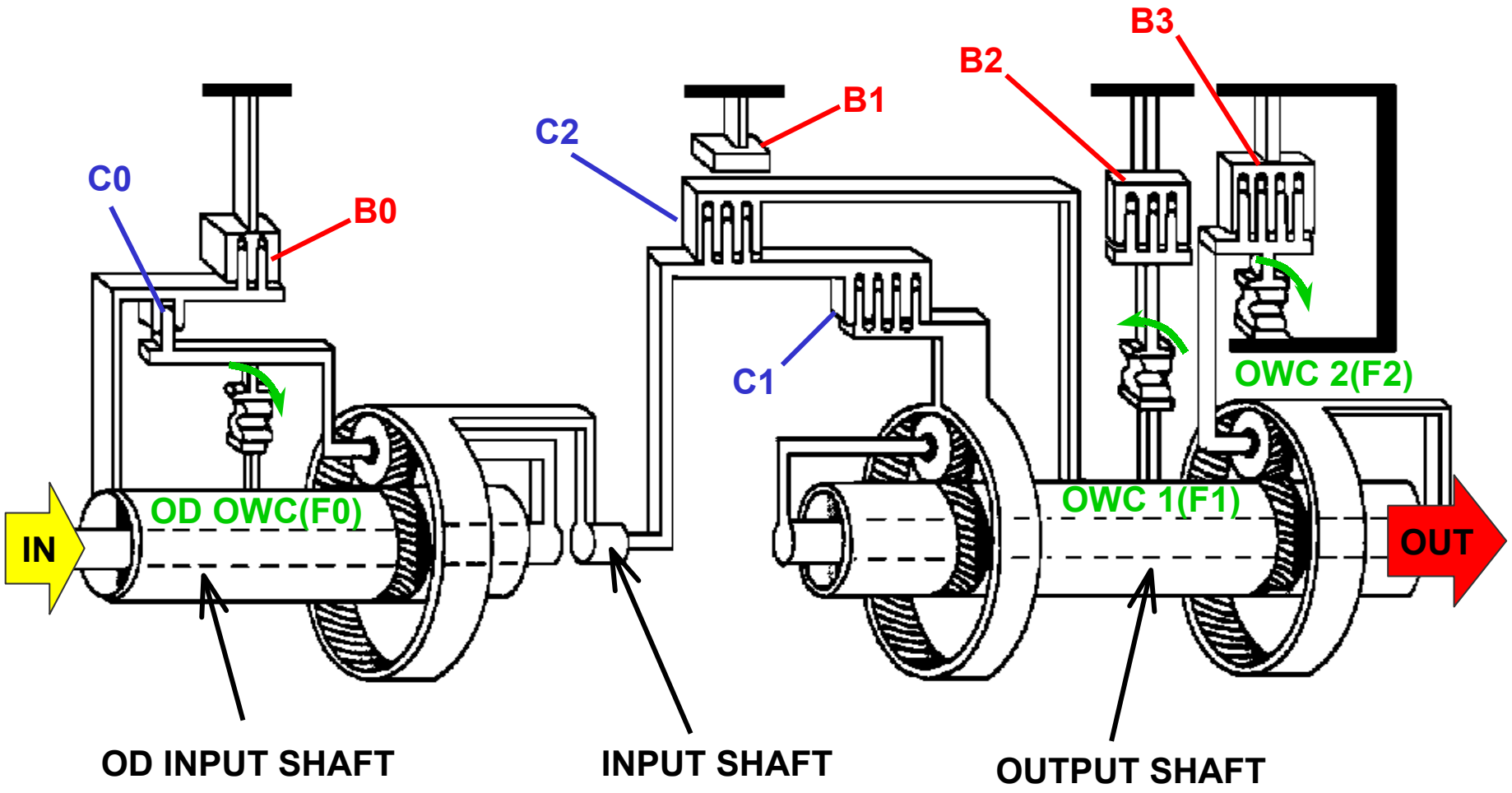



| COMPONENTS | | FUNCTION |
|---|---|---|
| C0 | O/D direct clutch | Connect O/D sun gear and O/D carrier |
| C1 | Forward clutch | Connect O/D input shaft and input shaft |
| C2 | Direct clutch | Connect input shaft and Fr/Rr planetary sun gear |
| B0 | O/D brake | Hold O/D sun gear |
| B1 | 2nd coast brake | Hold Fr/Rr planetary sun gear |
| B2 | 2nd brake | Hold counterclockwise rotation of Fr/Rr planetary sun gear (Hold outer race of F1) |
| B3 | 1st & reverse brake | Hold Fr planetary carrier |
| F0 | O/D OWC | Connect O/D sun gear and O/D carrier, when O/D sun gear rotates faster than O/D carrier |
| F1 | NO.1 OWC | Hold counterclockwise rotation of Fr/Rr planetary sun gear, when B2 operates. |
| F2 | NO.2 OWC | Hold counterclockwise rotation of Fr planetary carrier |

# POWER FLOW



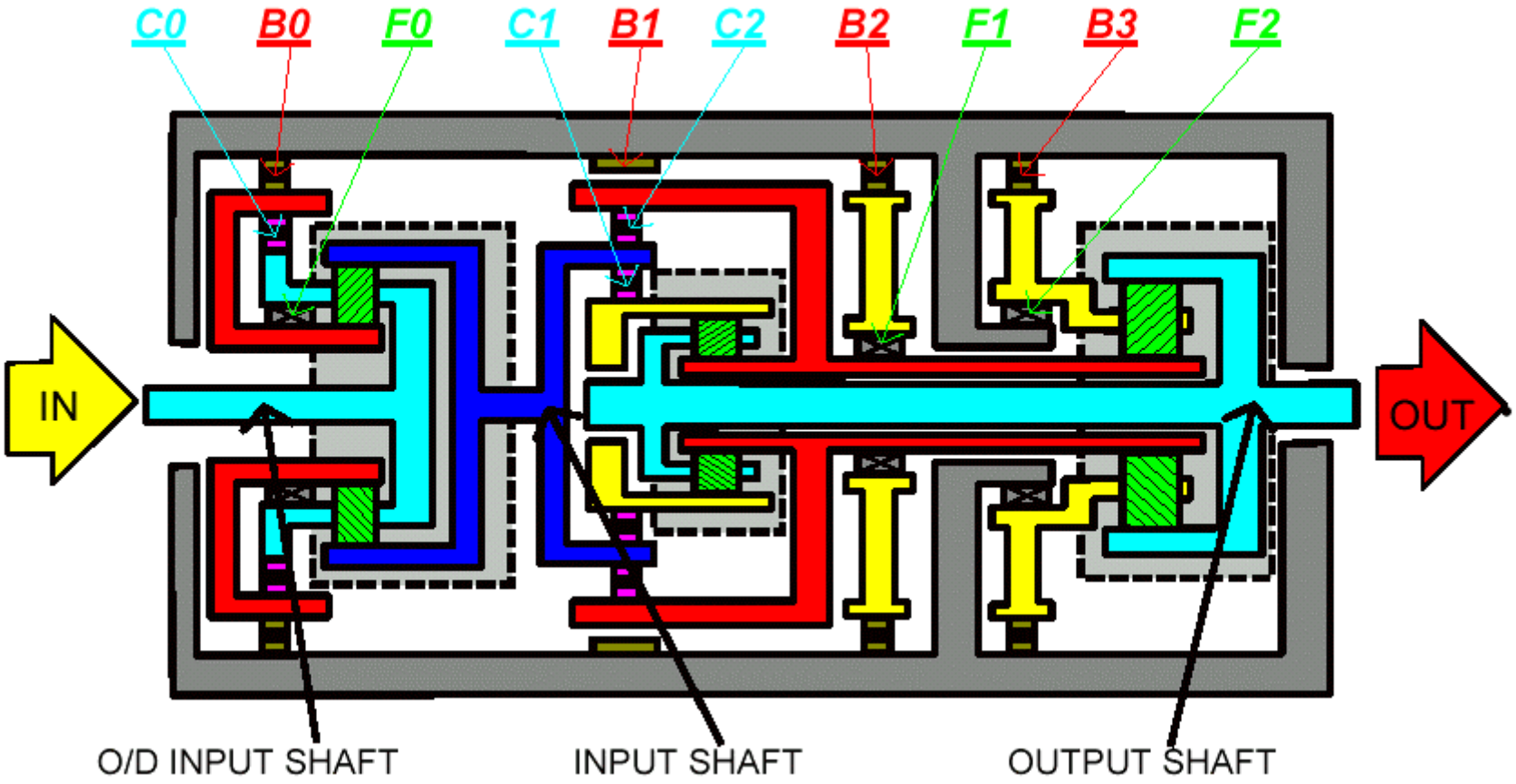
## Components and operation



# POWER FLOW

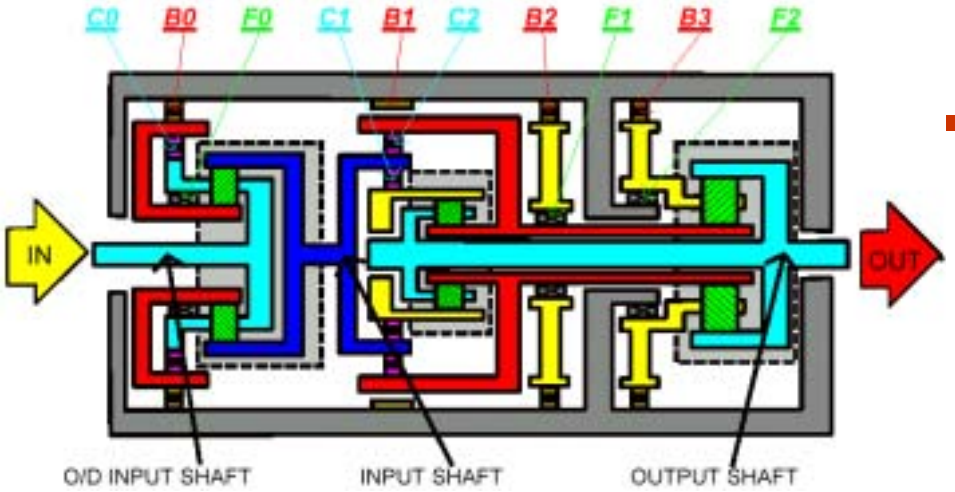


## Components and operation



# POWER FLOW

## Components and operation

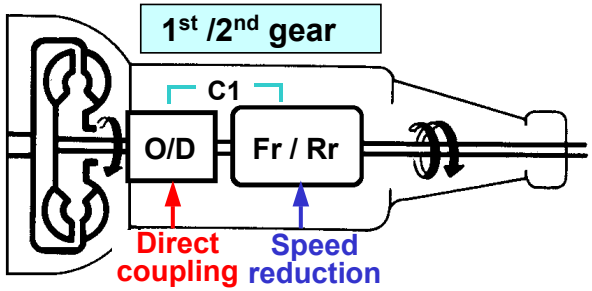



| POSITION | | SOLENOID | | | CLUTCH | | | BRAKE | | | | O.W.C. | | | GEAR RATIO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S1 | S2 | SL | C0 | C1 | C2 | B0 | B1 | B2 | B3 | F0 | F1 | F2 | |
| P | | ON | OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | - |
| R(V<7) | | ON | OFF | OFF | ON | OFF | ON | OFF | OFF | OFF | ON | ON | OFF | OFF | 2.393 |
| R(V>=7) | | ON | ON | OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF | OFF | - |
| N | | ON | OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | - |
| D | 1st | ON | OFF | OFF | ON | ON | OFF | OFF | OFF | OFF | OFF | ON | OFF | ON OFF | 2.804 |
| | 2nd | ON | ON | OFF | ON | ON | OFF | OFF | OFF | ON | OFF | ON | ON OFF | OFF | 1.531 |
| | 3rd | OFF | ON | ON | ON | ON | ON | OFF | OFF | ON | OFF | ON | OFF | OFF | 1.000 |
| | 4th | OFF | OFF | ON | OFF | ON | ON | ON | OFF | ON | OFF | OFF | OFF | OFF | 0.705 |
| 2 | 1st | ON | OFF | OFF | ON | ON | OFF | OFF | OFF | OFF | OFF | ON | OFF | ON OFF | 2.804 |
| | 2nd | ON | ON | OFF | ON | ON | OFF | OFF | ON | ON | OFF | ON | ON | OFF | 1.531 |
| | 3rd | OFF | ON | OFF | ON | ON | ON | OFF | OFF | ON | OFF | ON | OFF | OFF | 1.000 |
| L | 1st | ON | OFF | OFF | ON | ON | OFF | OFF | OFF | OFF | ON | ON | OFF | ON | 2.804 |
| | 2nd | ON | ON | OFF | ON | ON | OFF | OFF | ON | ON | OFF | ON | ON | OFF | 1.531 |

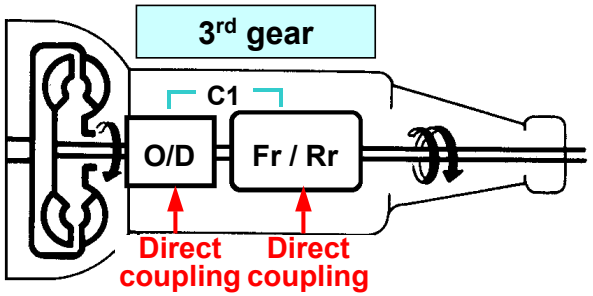
# POWER FLOW



## Principle of each range

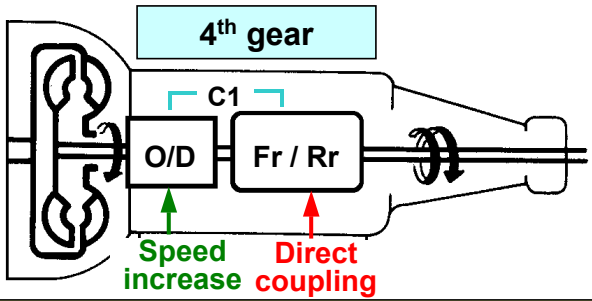



1. Power flow
 OD input shaft →OD gear set(coupling by C0) →Fr/Rr (speed reduction by F2(1st gear), by B2&F1(2nd gear))
2. Engine brake
 - D range 1st,2nd gear: non(F2,F1 free to clockwise)
 - 2 range: 1st gear(non), 2nd gear(operated by B1)
 - L range 1st,2nd gear: operated by B1, B3

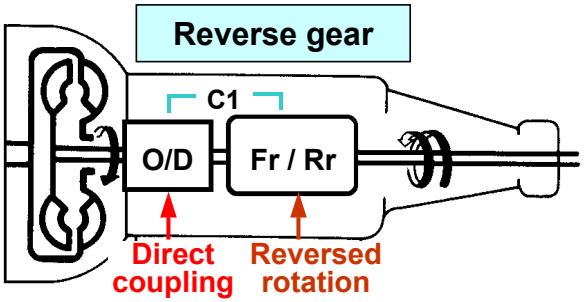



1. Power flow
 OD input shaft → OD gear set(coupling by C0) →Fr/Rr (coupling by C1 & C2)

2. Engine brake
 - D & 2 range: operates




1. Power flow
 OD input shaft → OD gear set (speed increase by B0) → Fr/Rr (coupling by C1&C2)
2. Engine brake
 - D range: operates



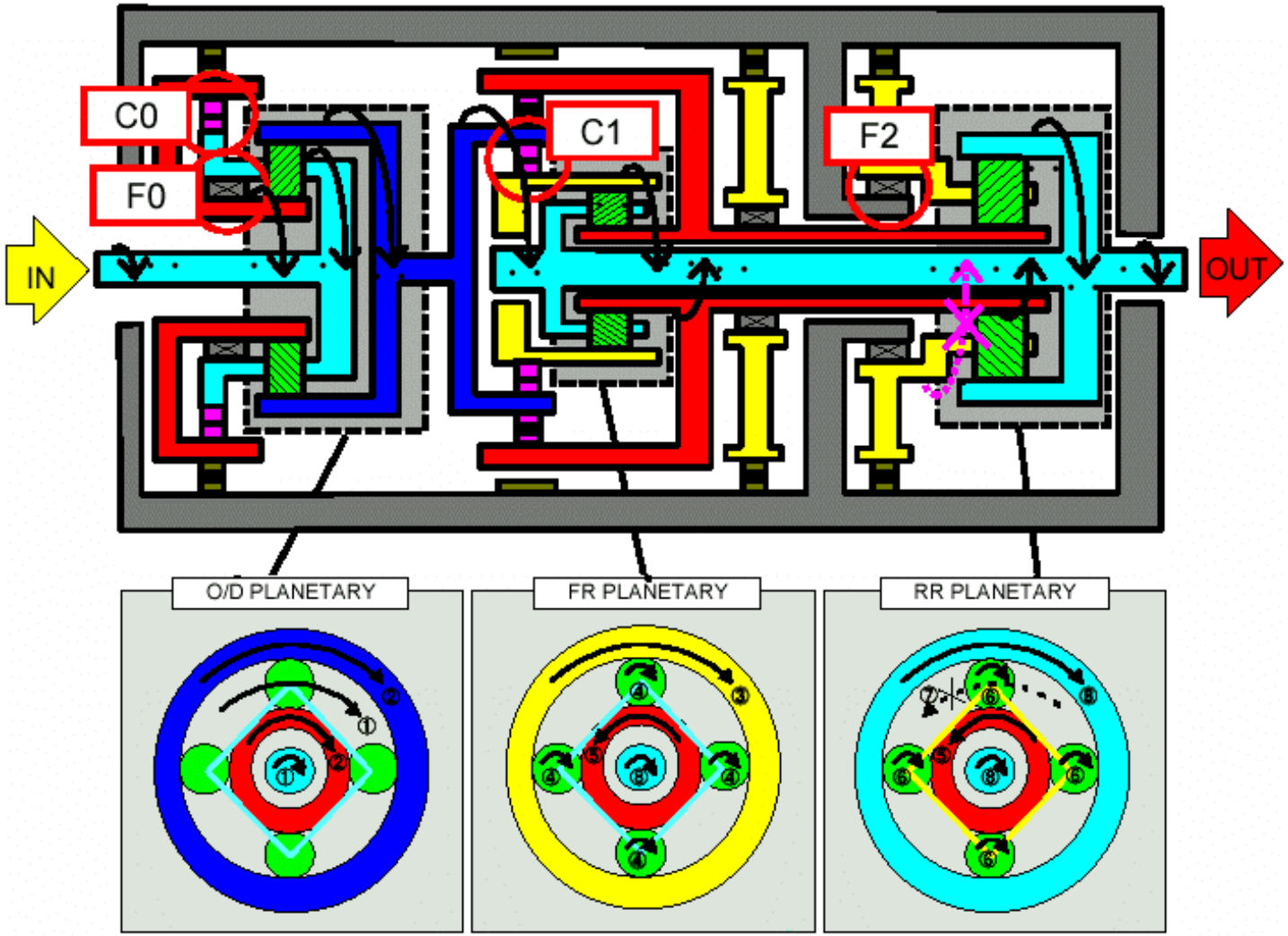

1. Power flow
 OD input shaft → OD gear set (coupling by C0) → Fr/Rr (reverse rotation by B3)
2. Reverse inhibition control: C2

# POWER FLOW



## D range – 1st gear

| POSITION | | S1 | S2 | SL | C0 | C1 | C2 | B0 | B1 | B2 | B3 | F0 | F1 | F2 | GEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | 1st | O | × | × | O | O | × | × | × | × | × | O | × | O× | 2.804 |

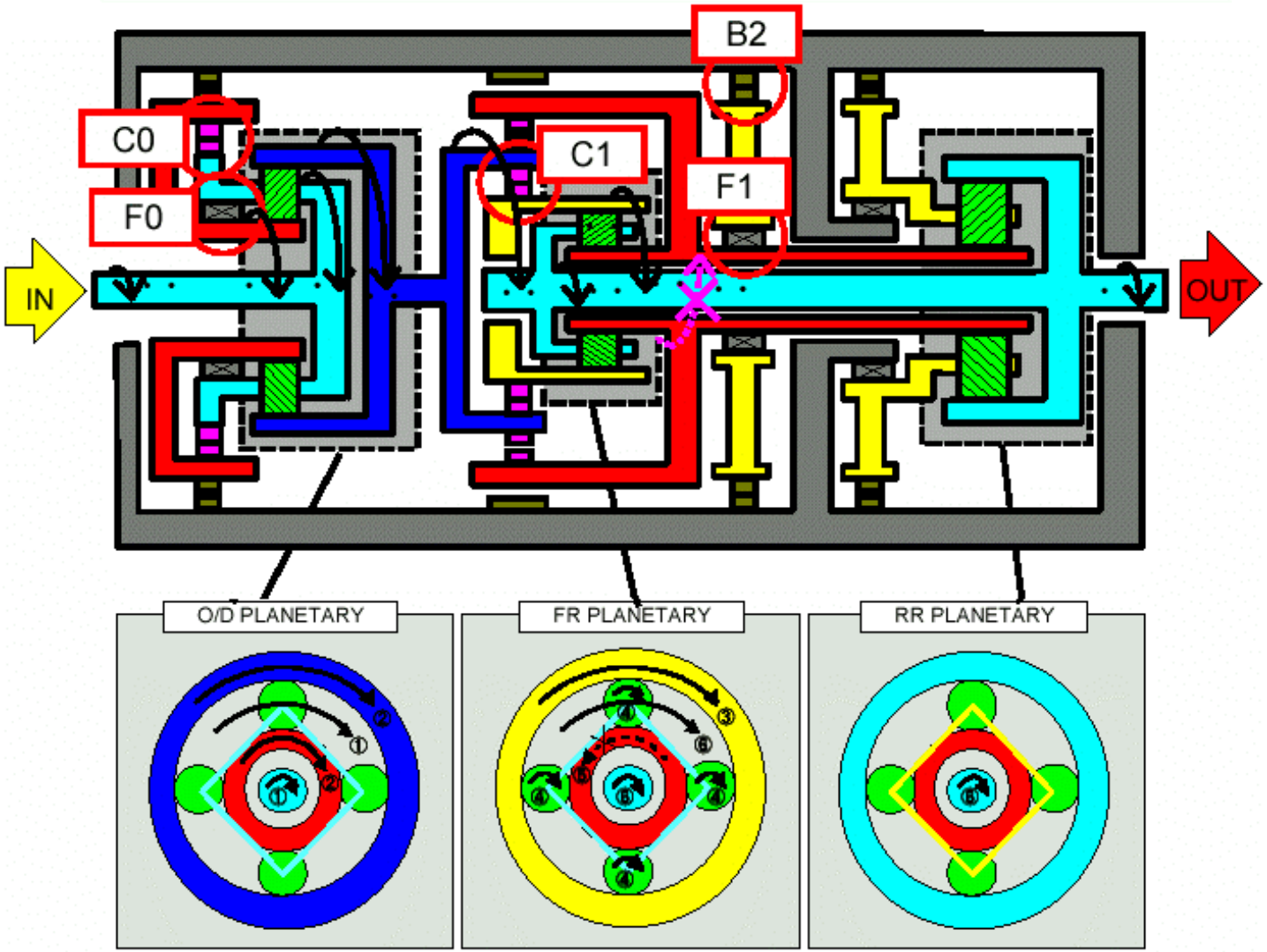


# POWER FLOW



## D range – 2nd gear

| POSITION | | S1 | S2 | SL | C0 | C1 | C2 | B0 | B1 | B2 | B3 | F0 | F1 | F2 | GEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | 2nd | O | O | × | O | O | × | × | × | O | × | O | O× | × | 1.531 |

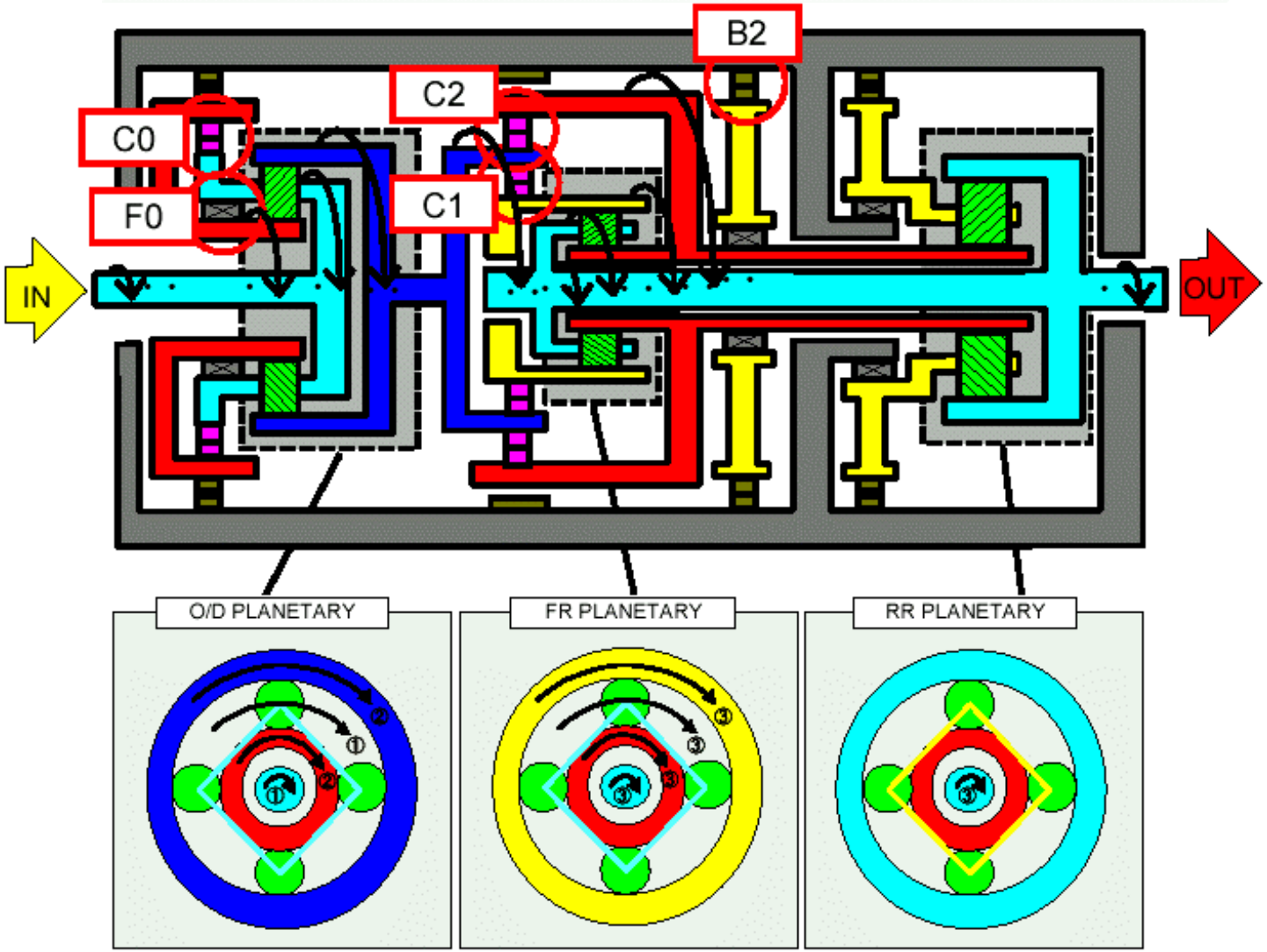


# POWER FLOW



## D range – 3rd gear

| POSITION | | S1 | S2 | SL | C0 | C1 | C2 | B0 | B1 | B2 | B3 | F0 | F1 | F2 | GEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | 3rd | × | ○ | ○ | ○ | ○ | ○ | × | × | ○ | × | ○ | × | × | 1.000 |

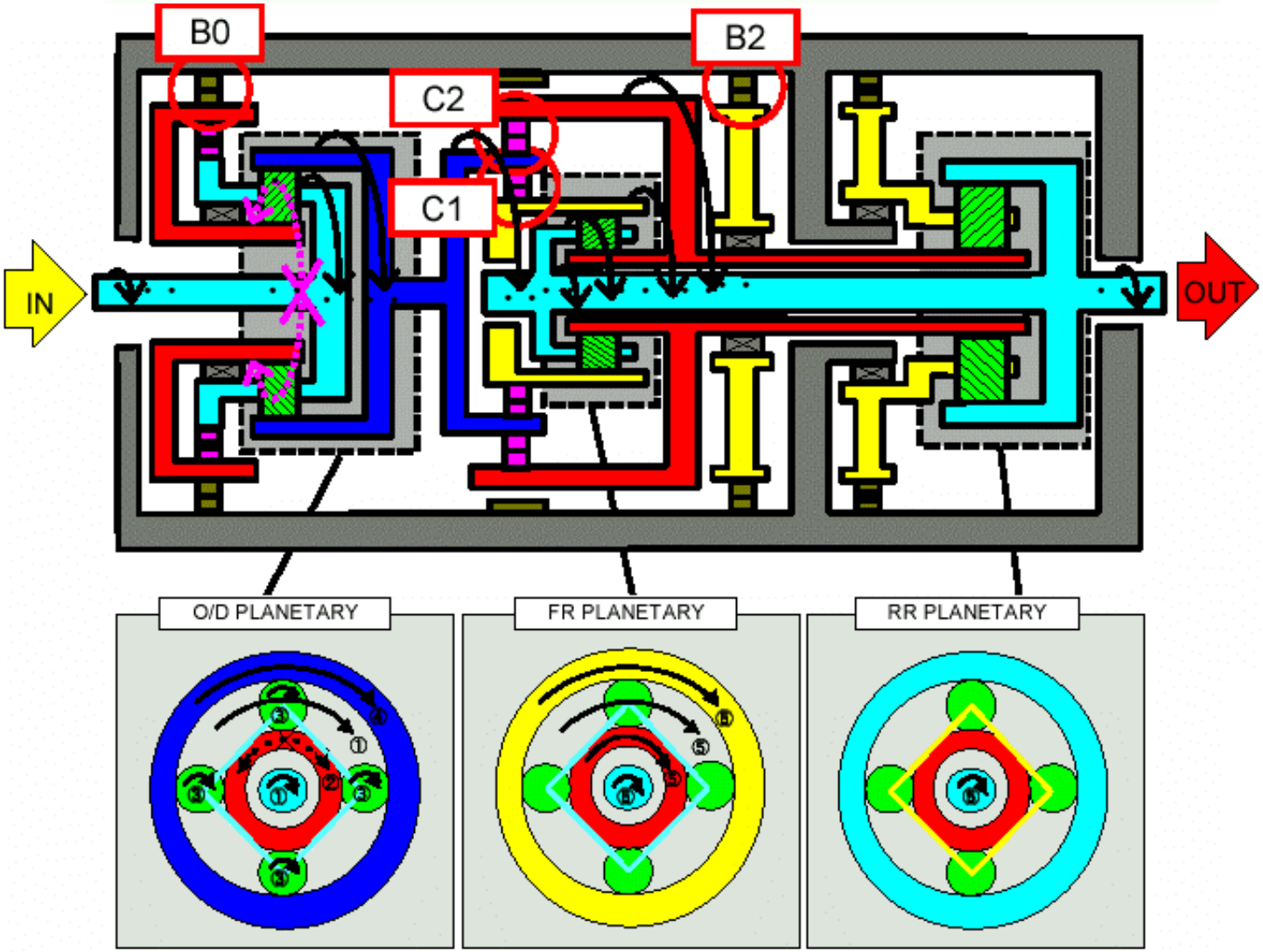


# POWER FLOW



## D range – 4th gear

| POSITION | | S1 | S2 | SL | C0 | C1 | C2 | B0 | B1 | B2 | B3 | F0 | F1 | F2 | GEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | 4th | × | × | ○ | × | ○ | ○ | ○ | × | ○ | × | × | × | × | 0.705 |

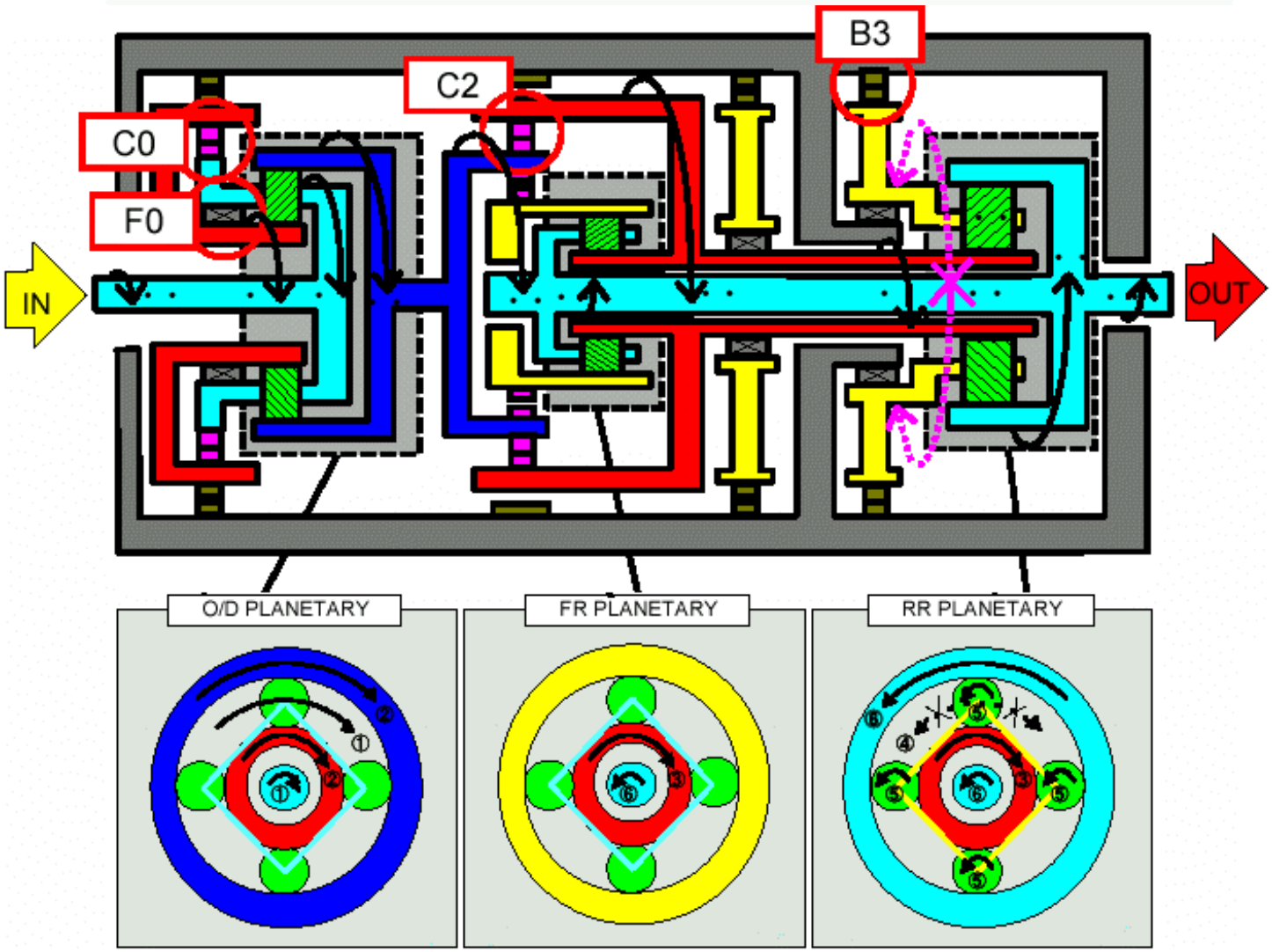


# POWER FLOW



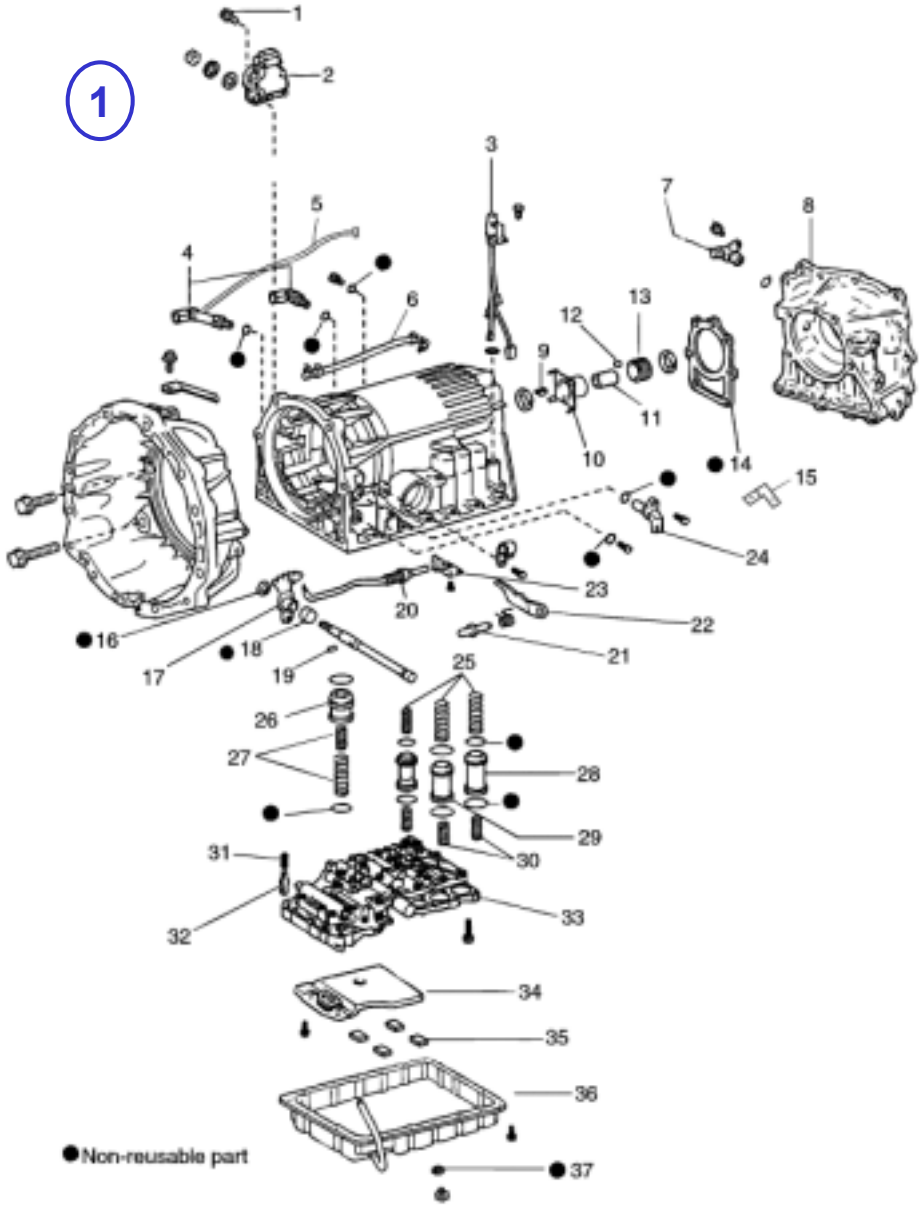
## R range

| POSITION | S1 | S2 | SL | C0 | C1 | C2 | B0 | B1 | B2 | B3 | F0 | F1 | F2 | GEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R(V<7) | O | × | × | O | × | O | × | × | × | O | O | × | × | 2.393 |



# COMPONENTS

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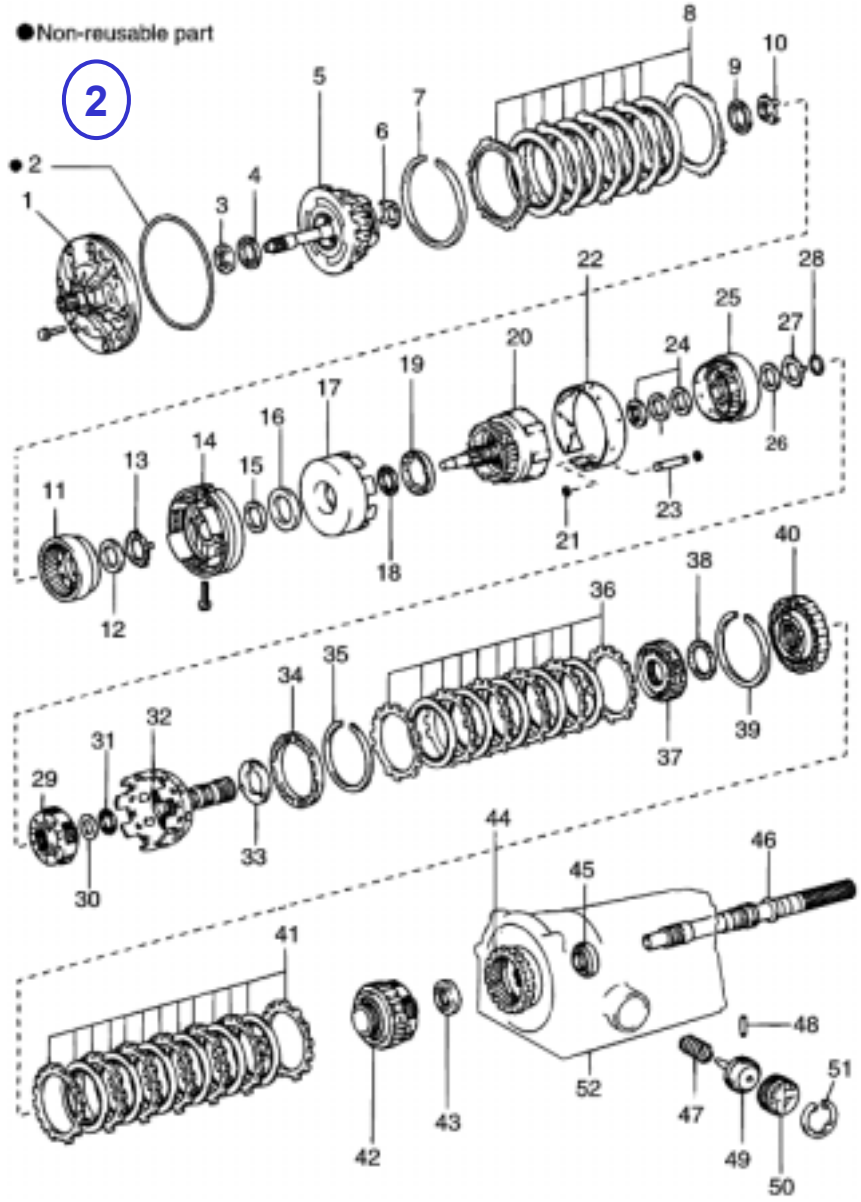
●Non-reusable part


●Non-reusable part
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# COMPONENTS



(1)

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



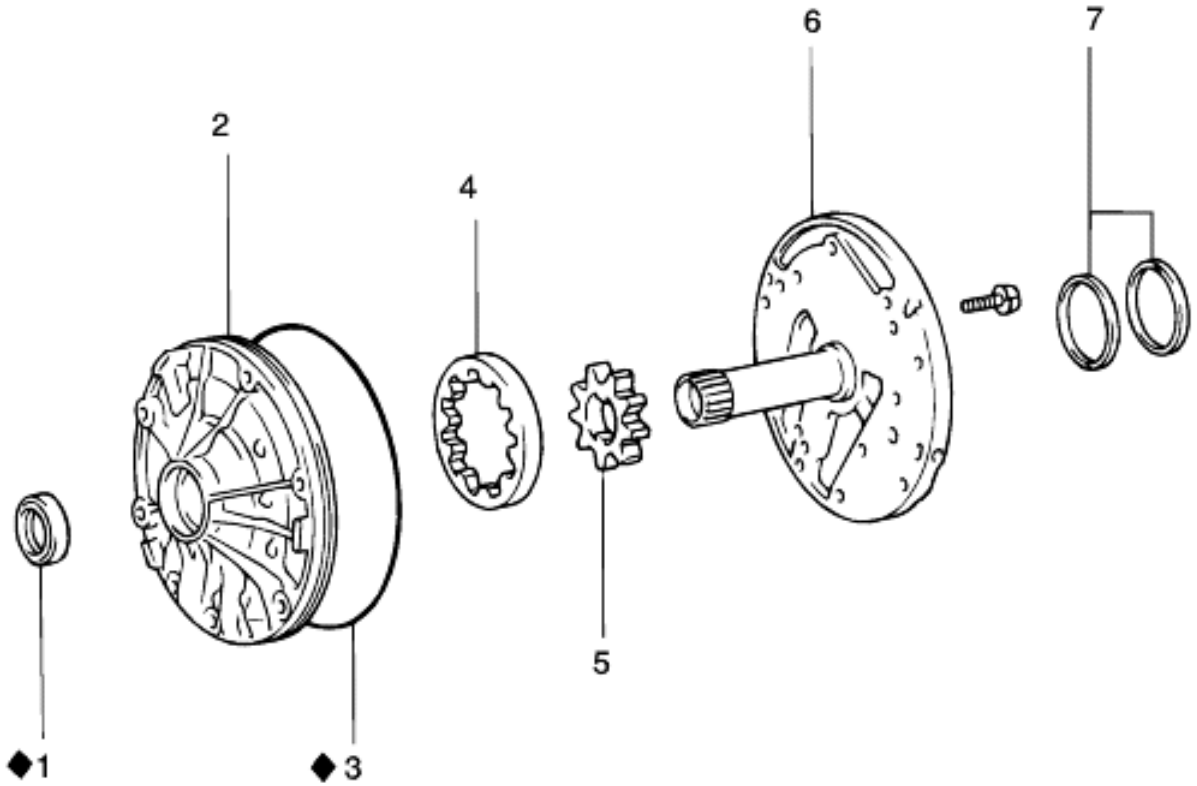
2

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

# COMPONENTS



## Oil pump



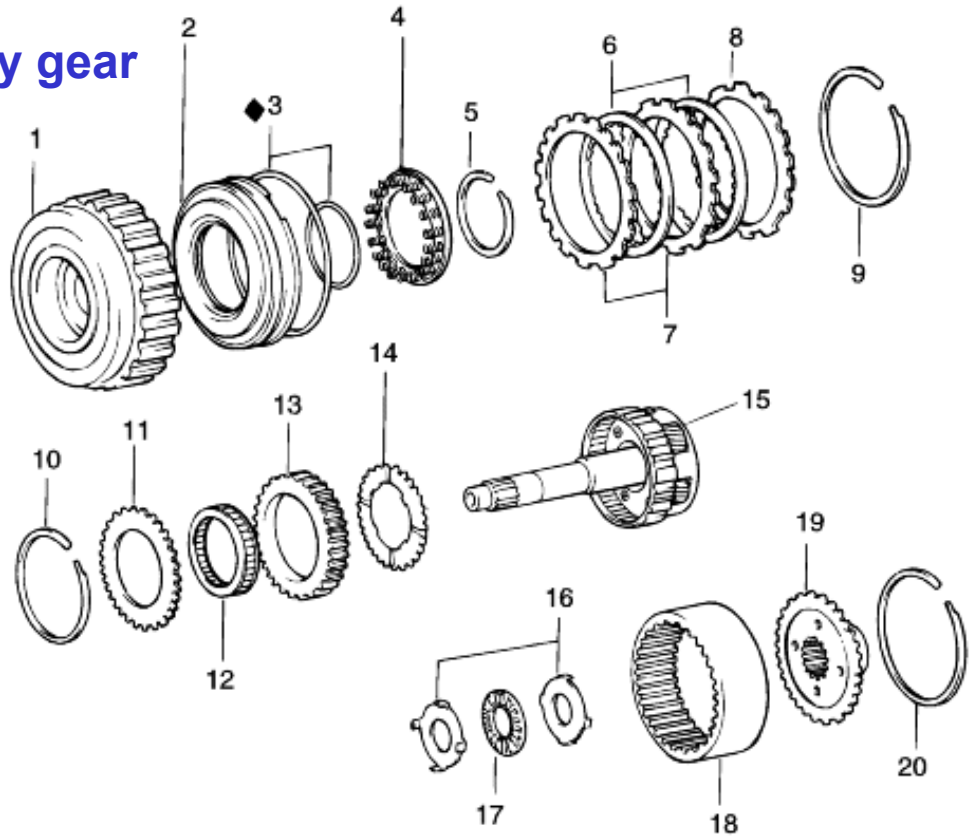

◆ Non-reusable part

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

# COMPONENTS



## OD clutch & OD planetary gear

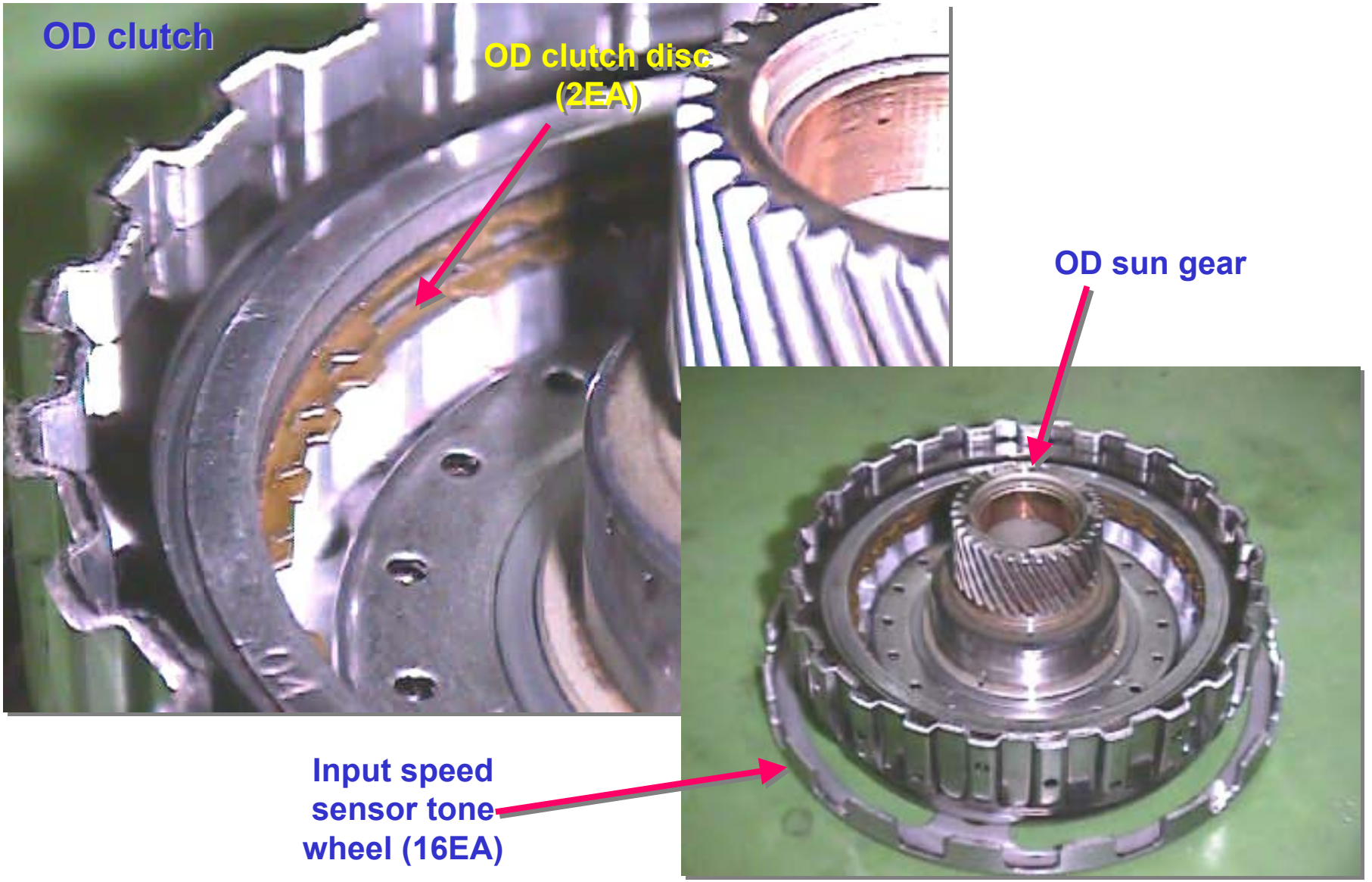



◆ Non-reusable part

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

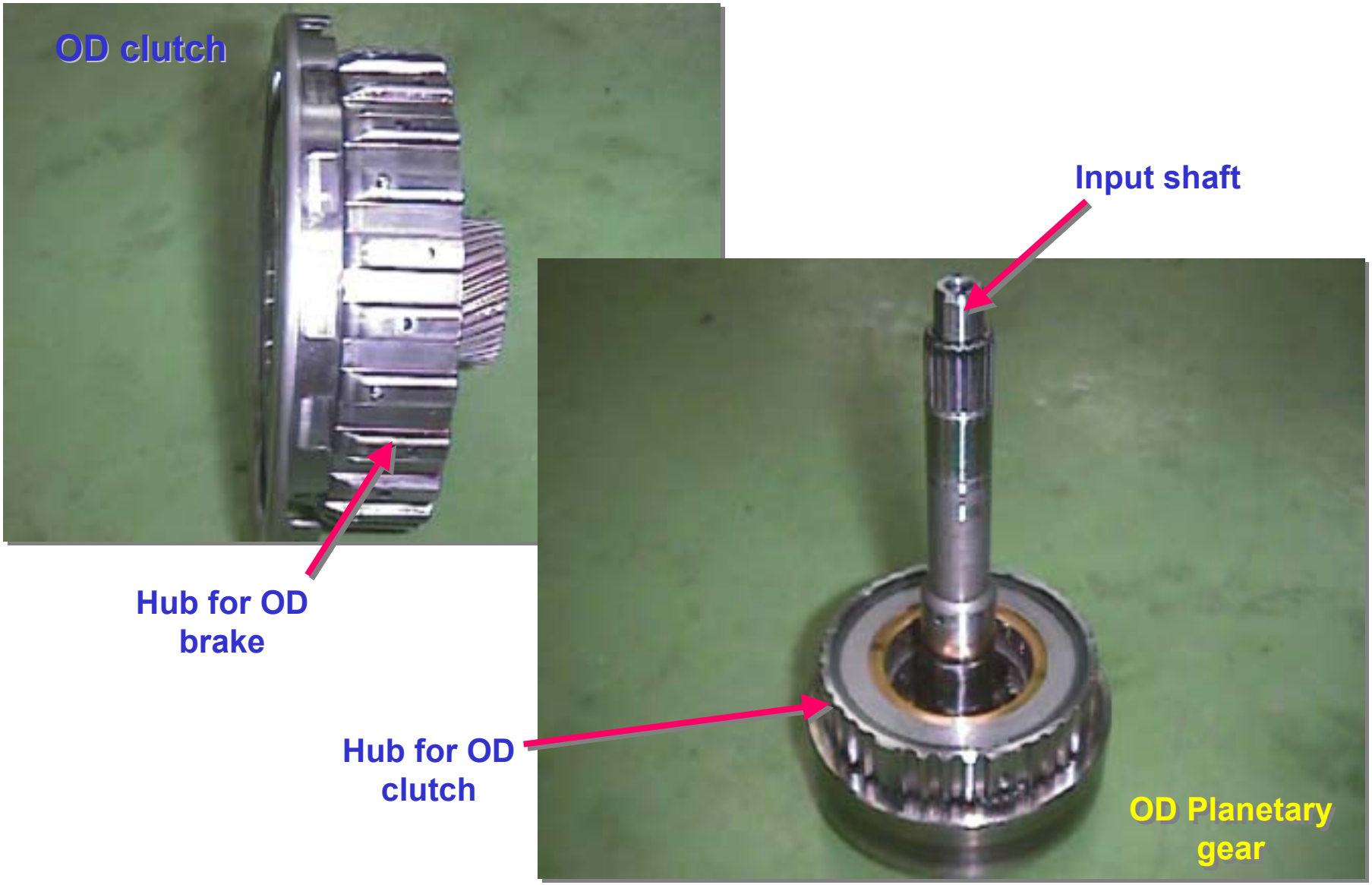
# COMPONENTS




OD clutch
OD clutch disc (2EA)
OD sun gear
Input speed sensor tone wheel (16EA)

# COMPONENTS

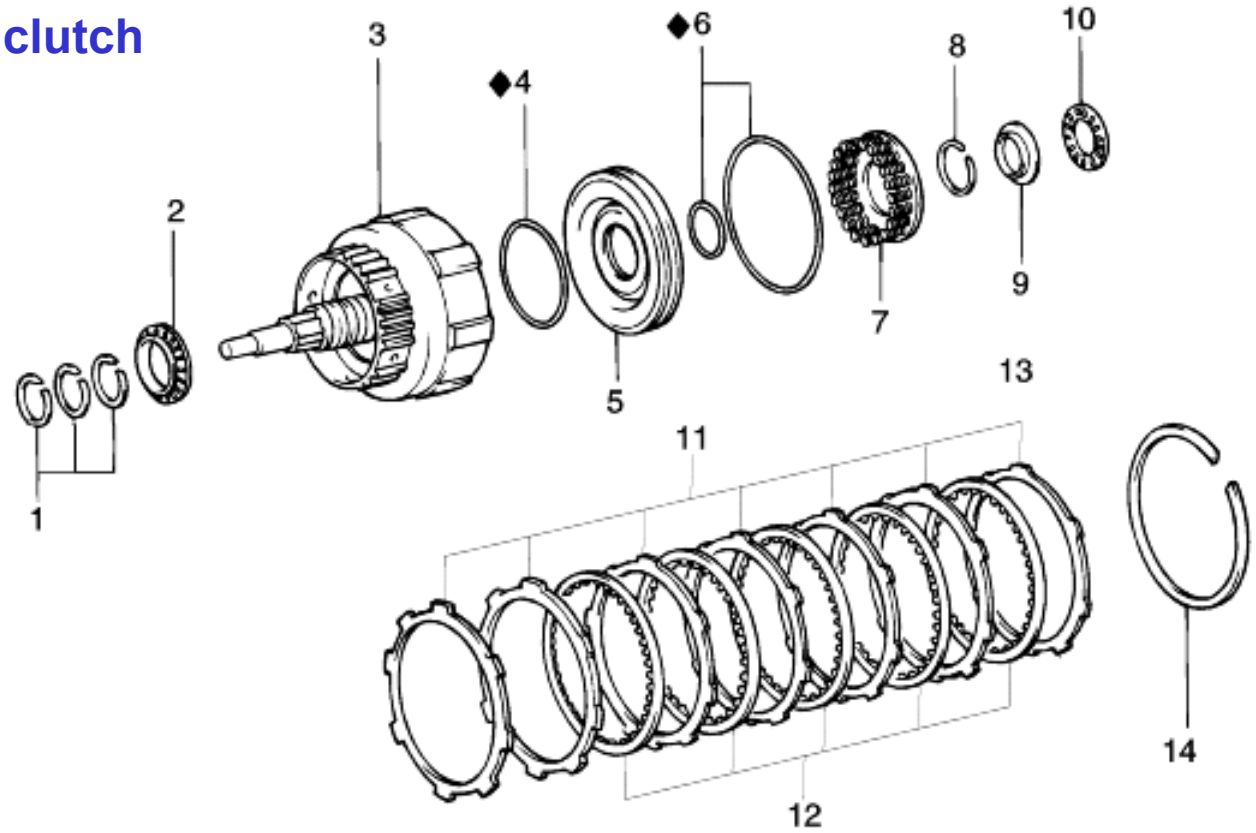



OD clutch
Input shaft
Hub for OD brake
Hub for OD clutch
OD Planetary gear

# COMPONENTS



## Forward clutch



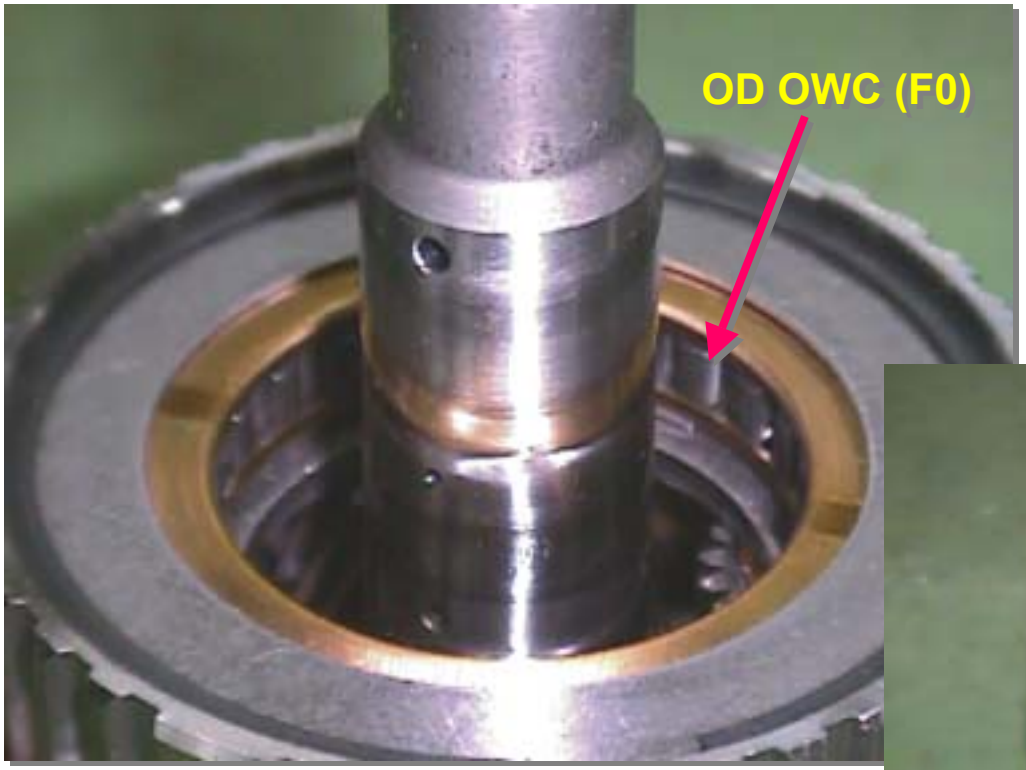

◆ Non-reusable part

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

# COMPONENTS



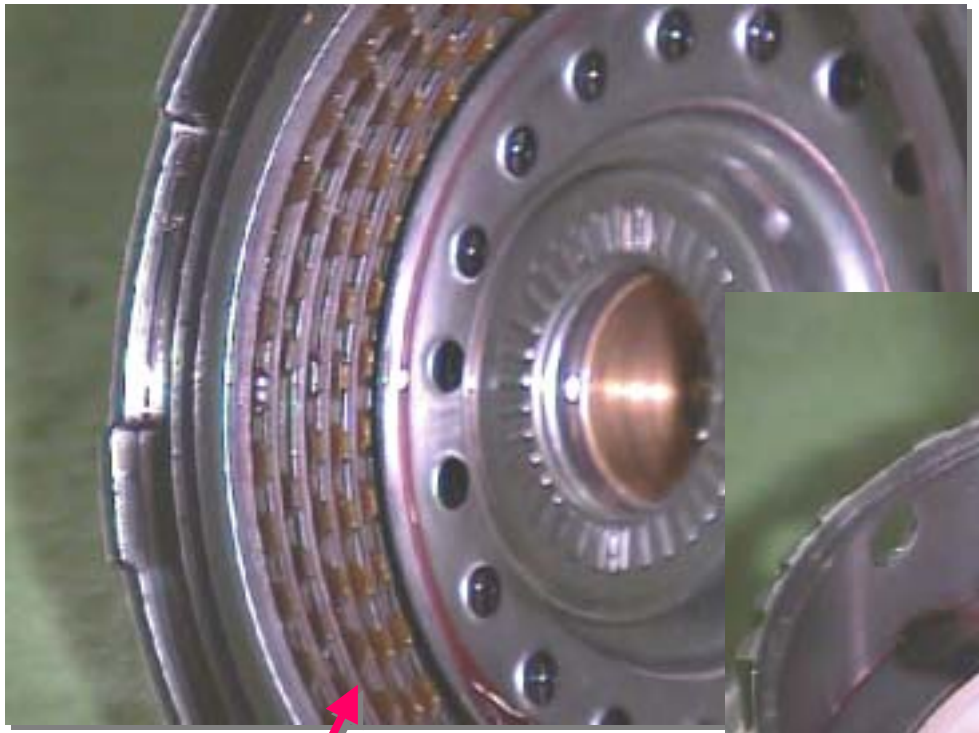
## OD OWC (F0) and Forward clutch



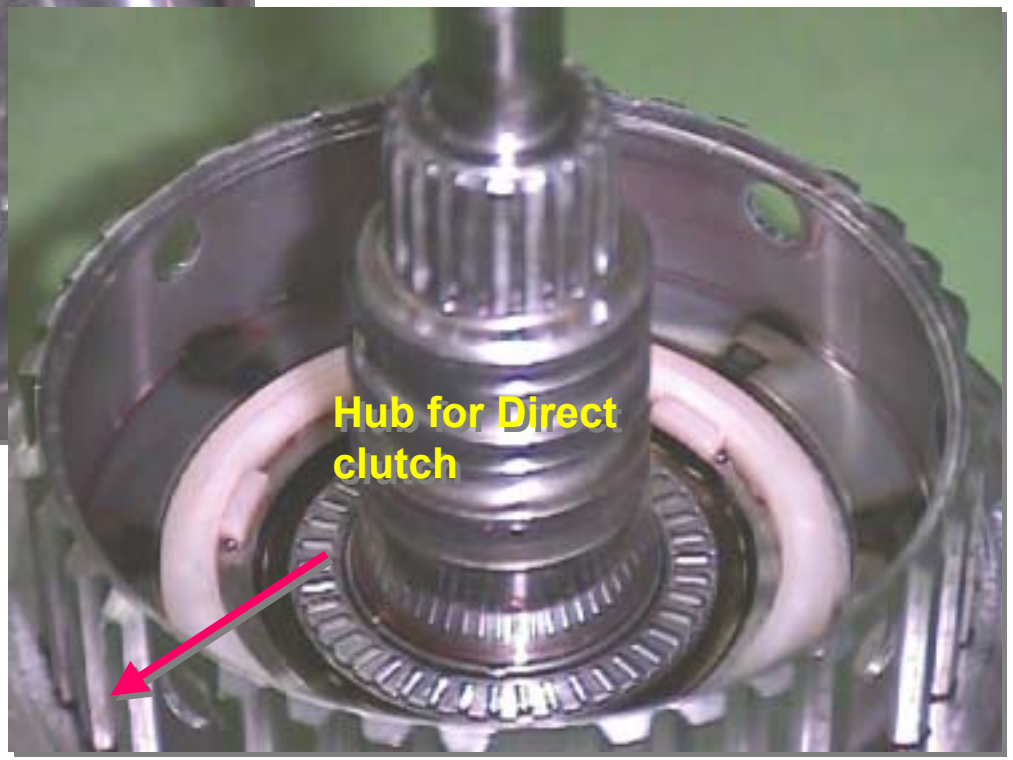

# COMPONENTS



## Forward clutch



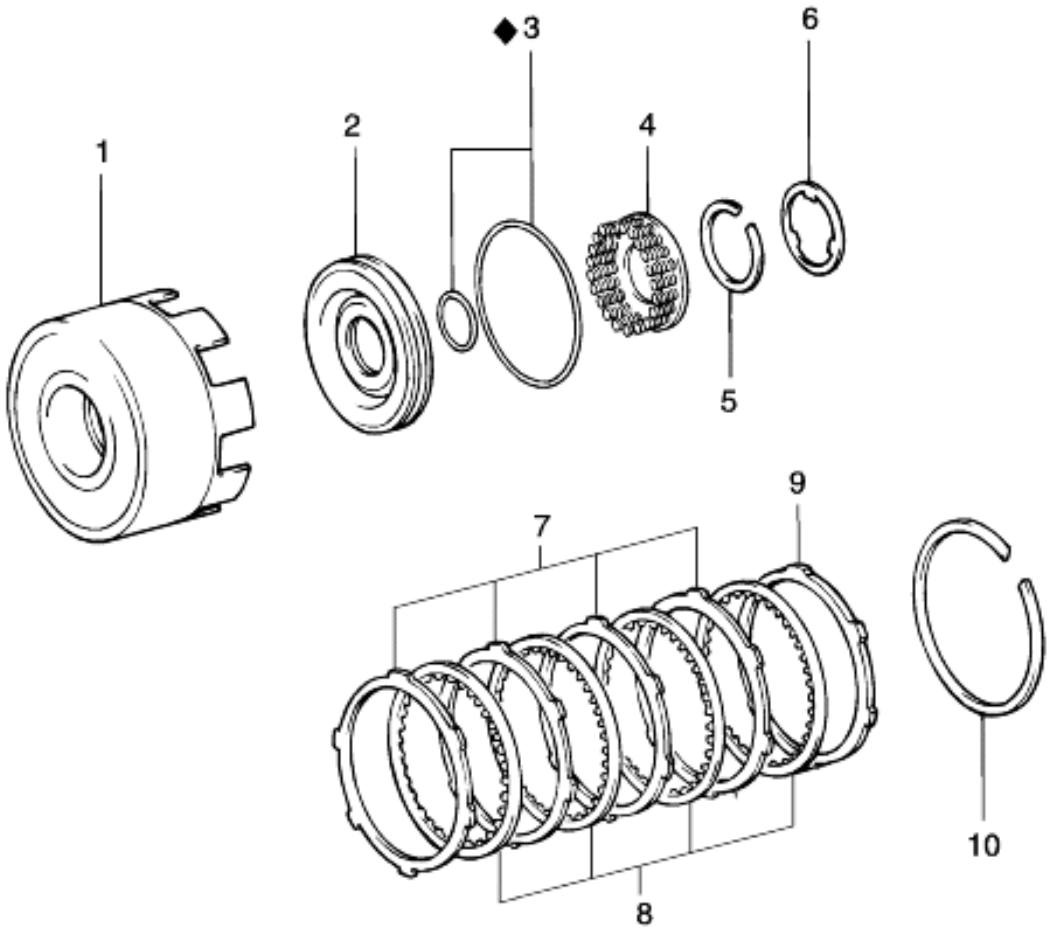
Forward clutch
(5EA)



# COMPONENTS



## Direct clutch



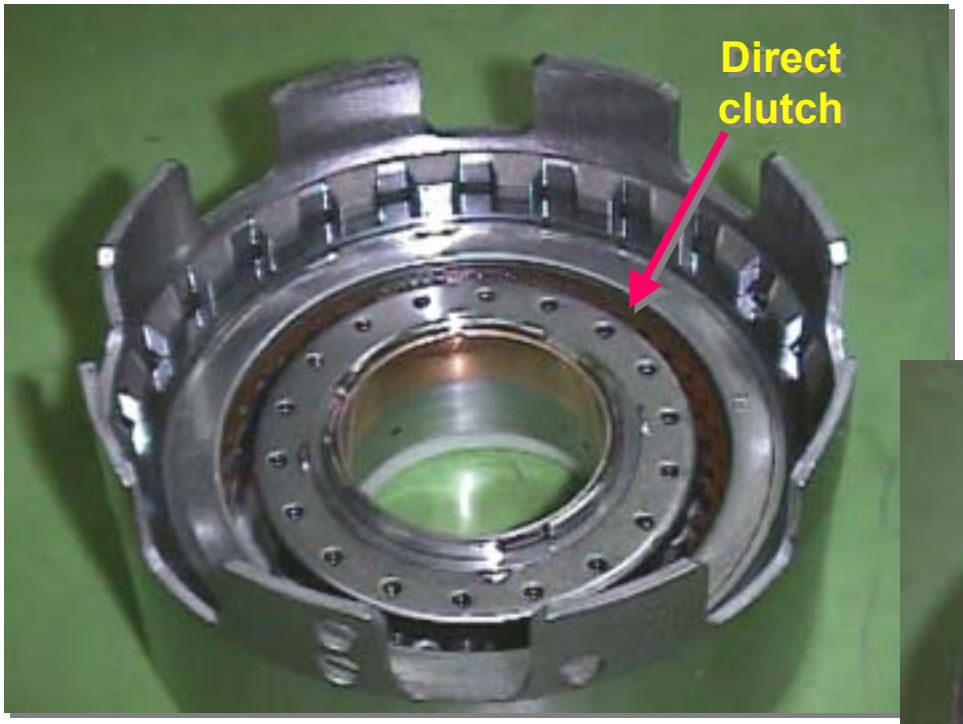

◆ Non-reusable part

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

# COMPONENTS



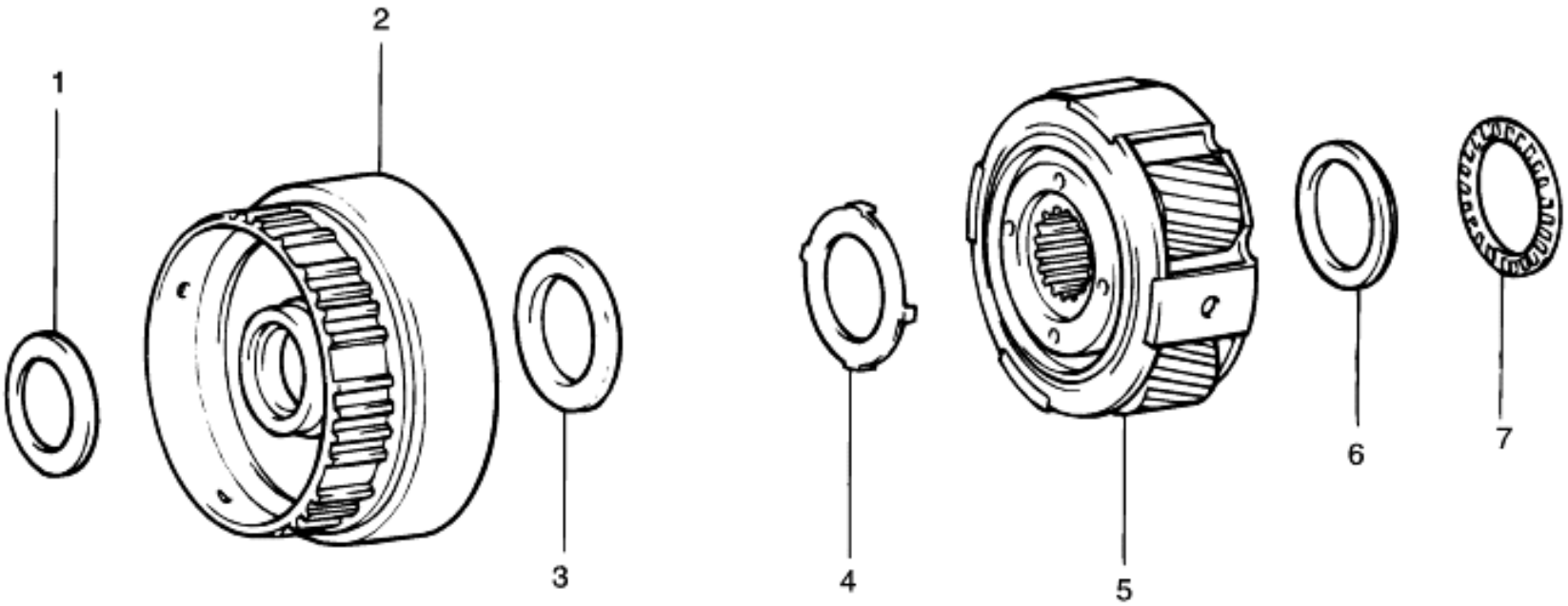
## Direct clutch




Plastic washer on Direct clutch and OD brake piston

# COMPONENTS

## Front planetary gear

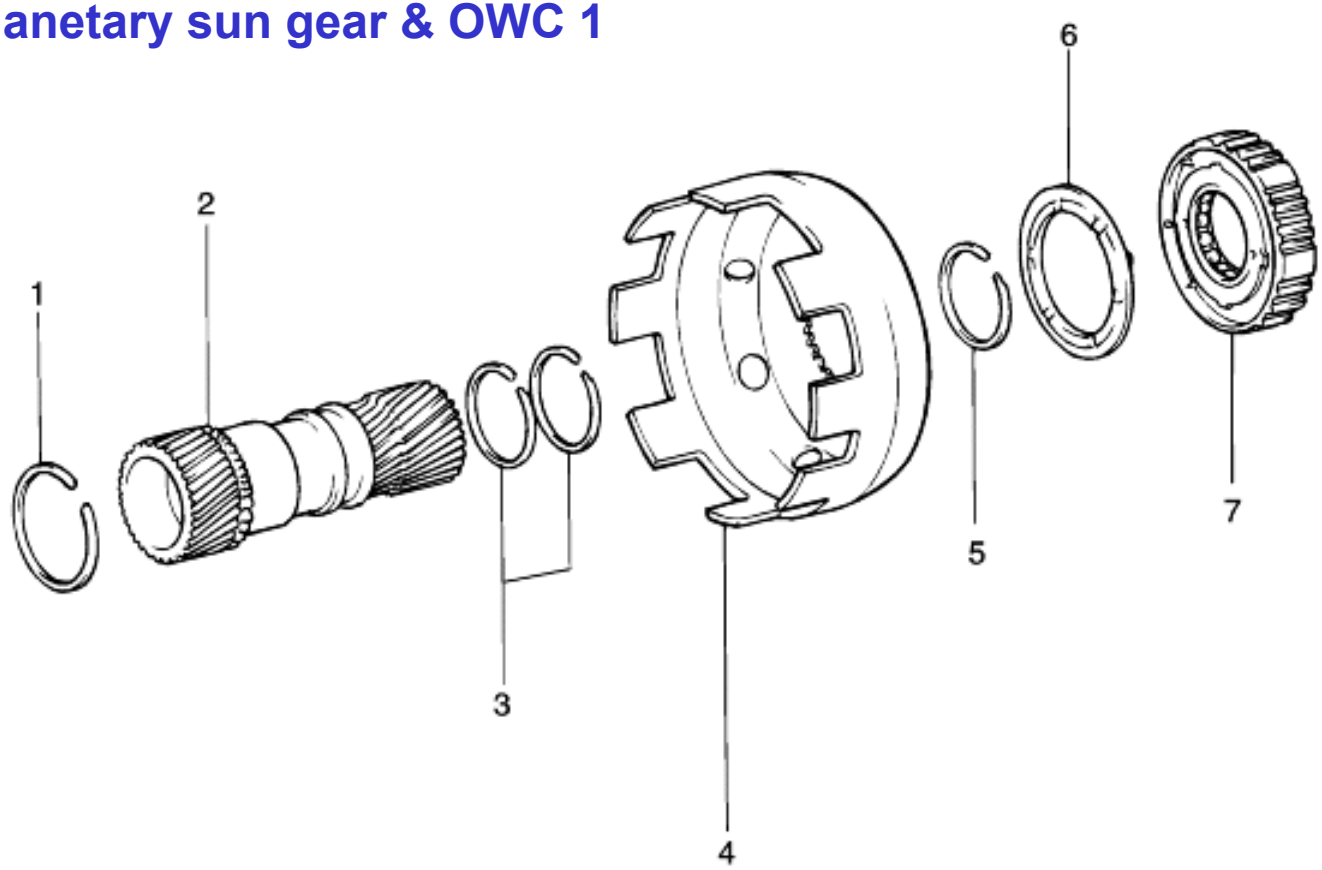



1. Race
2. Front planetary ring gear
3. Race
4. Race
5. Front planetary gear
6. Race
7. Bearing

# COMPONENTS



## Front planetary sun gear & OWC 1

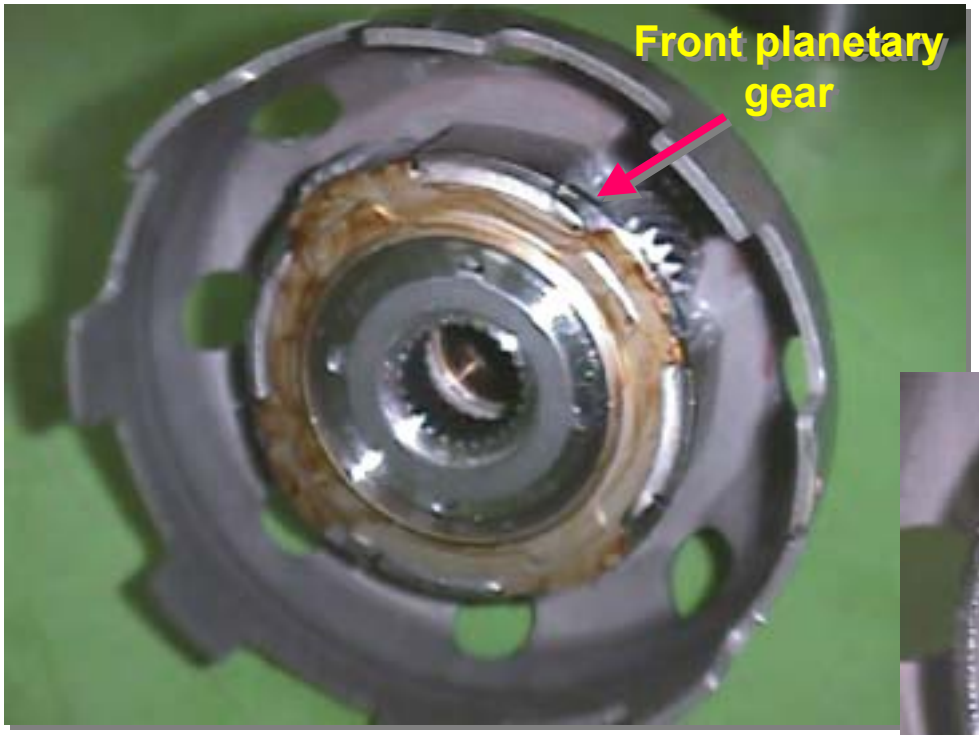


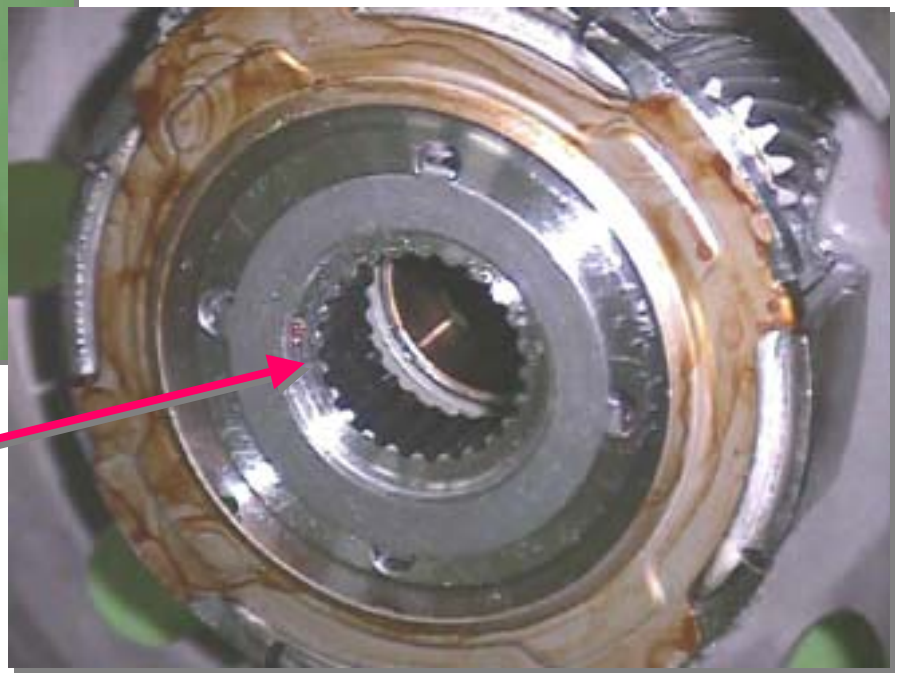

1. Snap ring
2. Planetary sun gear
3. Oil seal ring
4. Sun gear input drum
5. Snap ring
6. Thrust washer
7. One-way clutch & second brake hub

# COMPONENTS



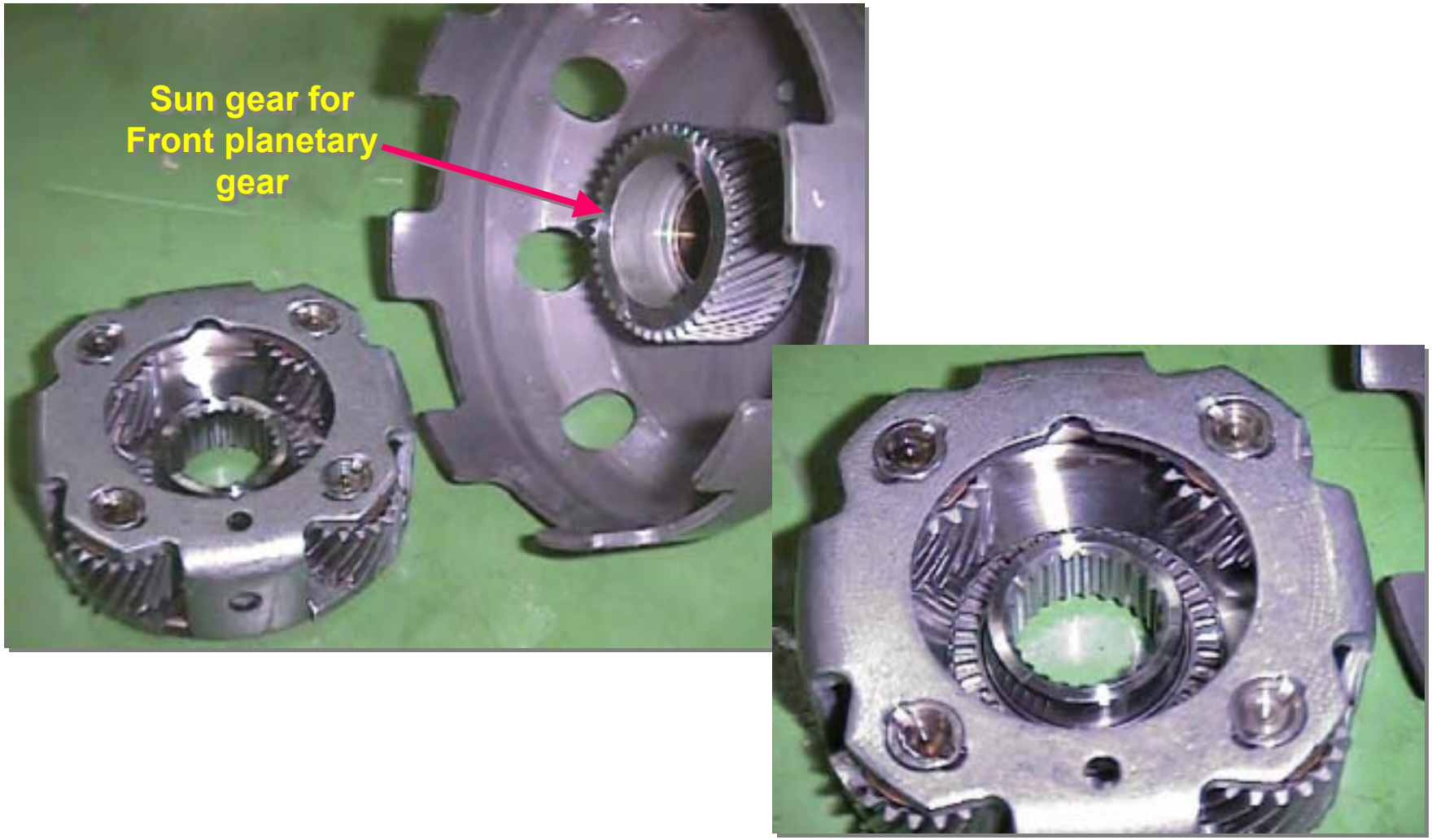
## Front planetary gear



Connected to output shaft

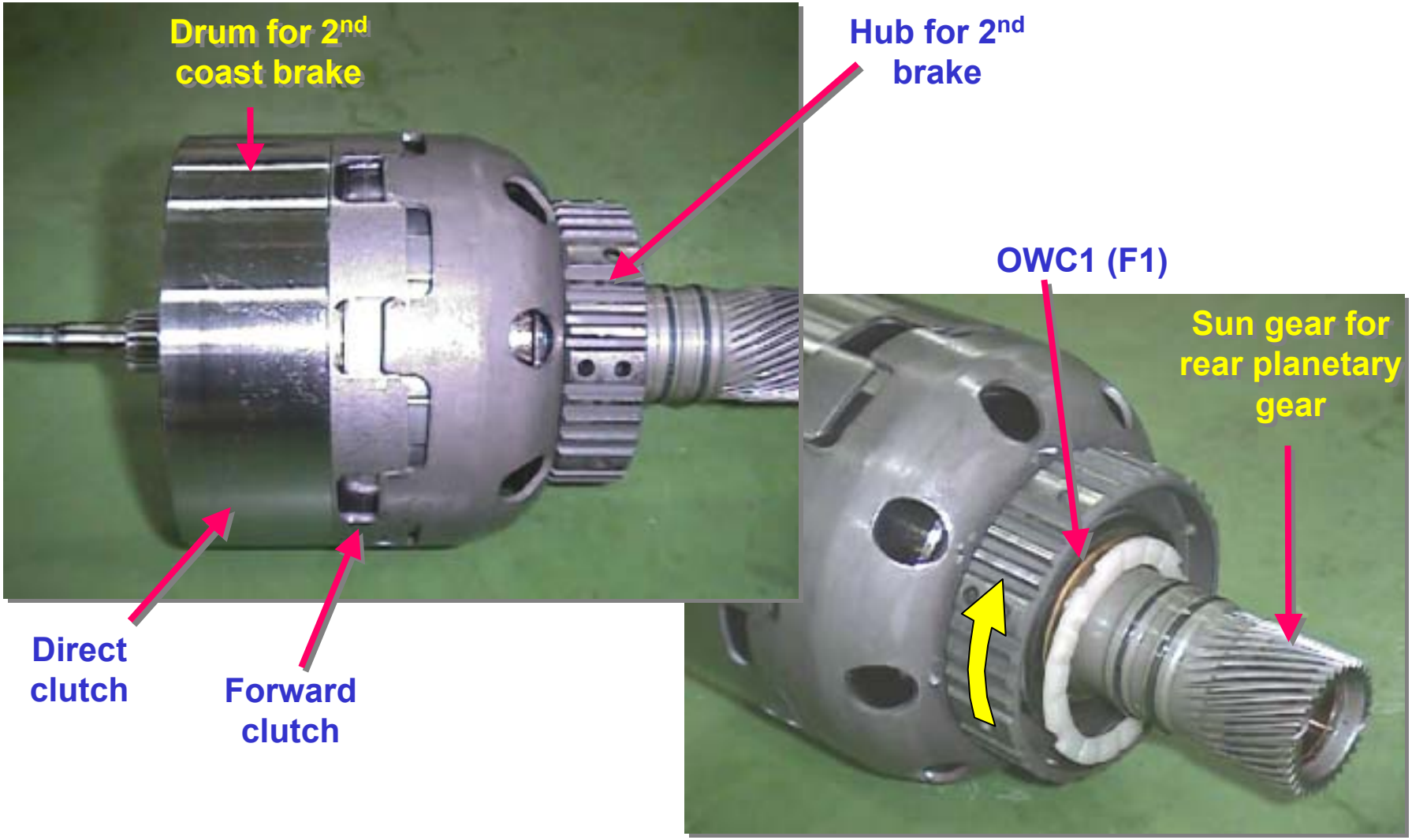
## Front planetary gear



# COMPONENTS



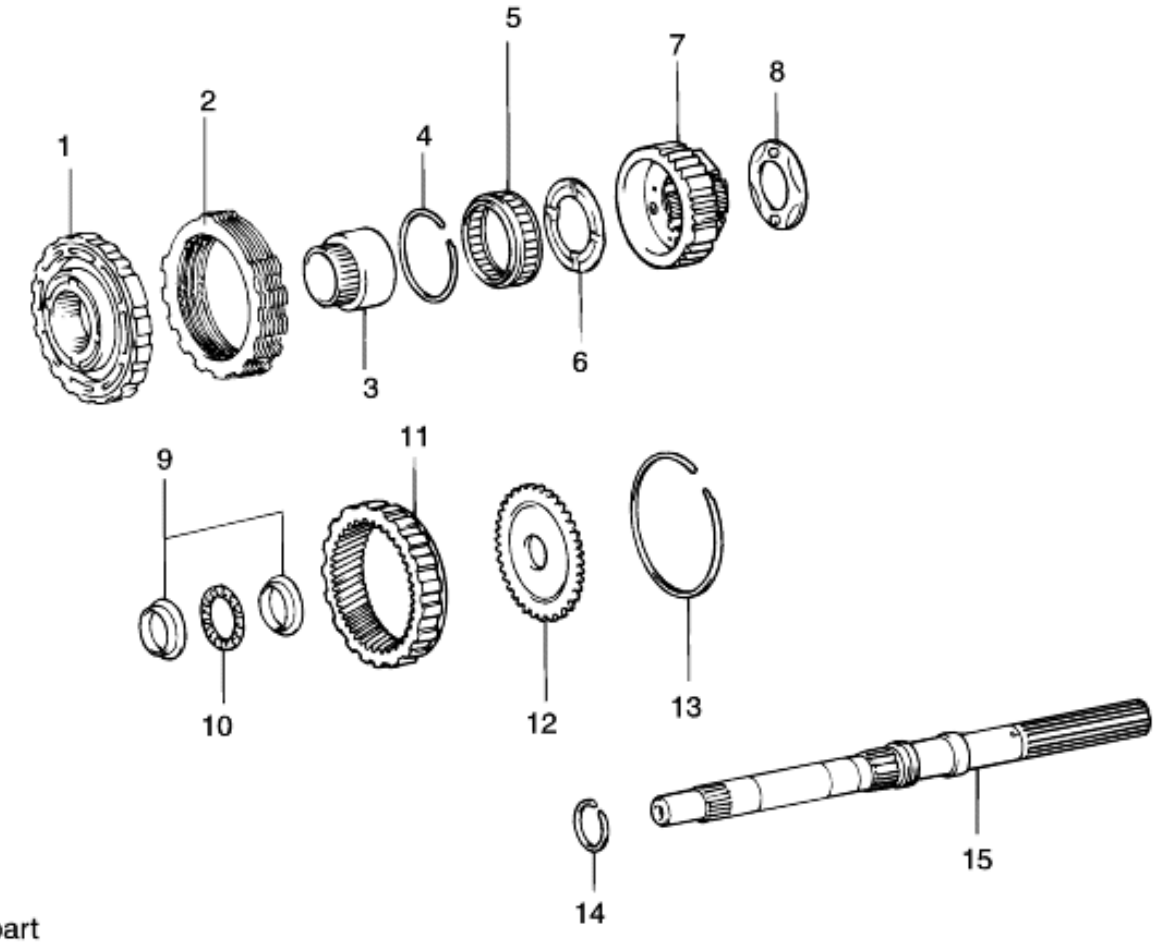
## Direct clutch & Forward clutch & OWC1



# COMPONENTS



## 2ND Brake



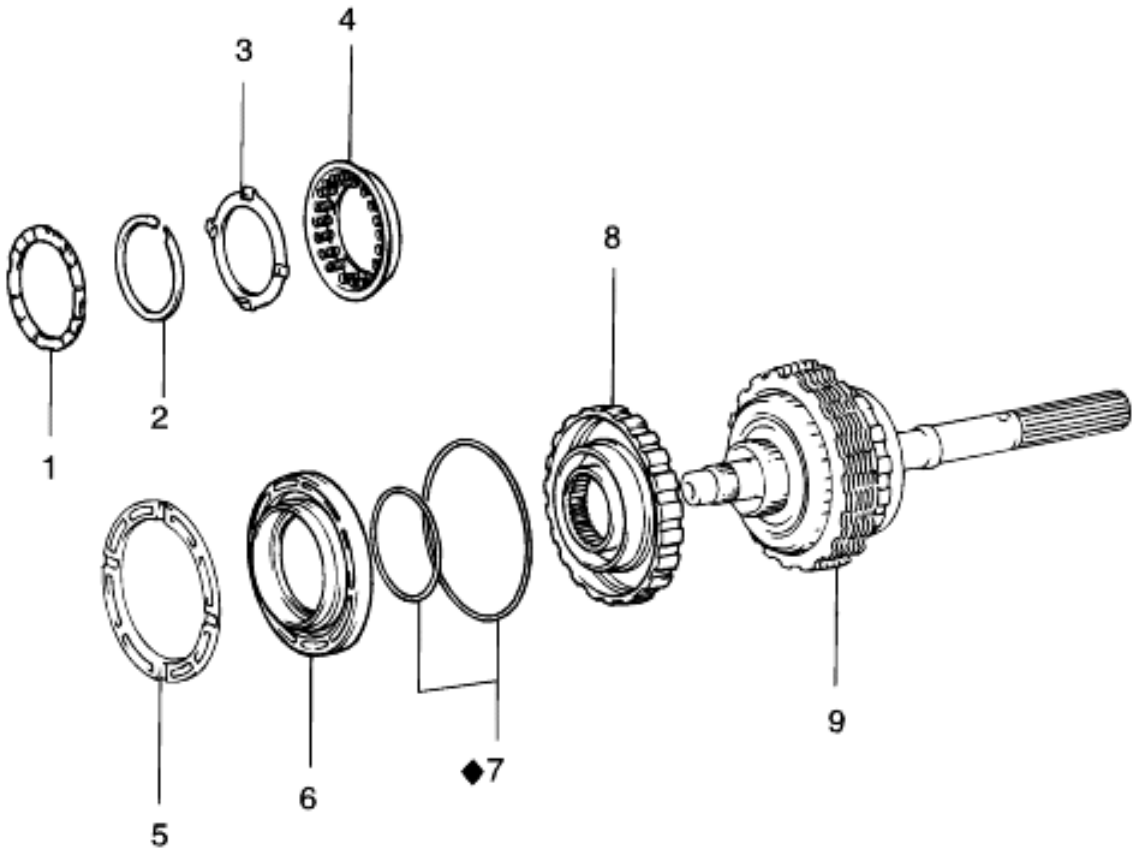

◆ Non-reusable part

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

# COMPONENTS



## 2ND Brake



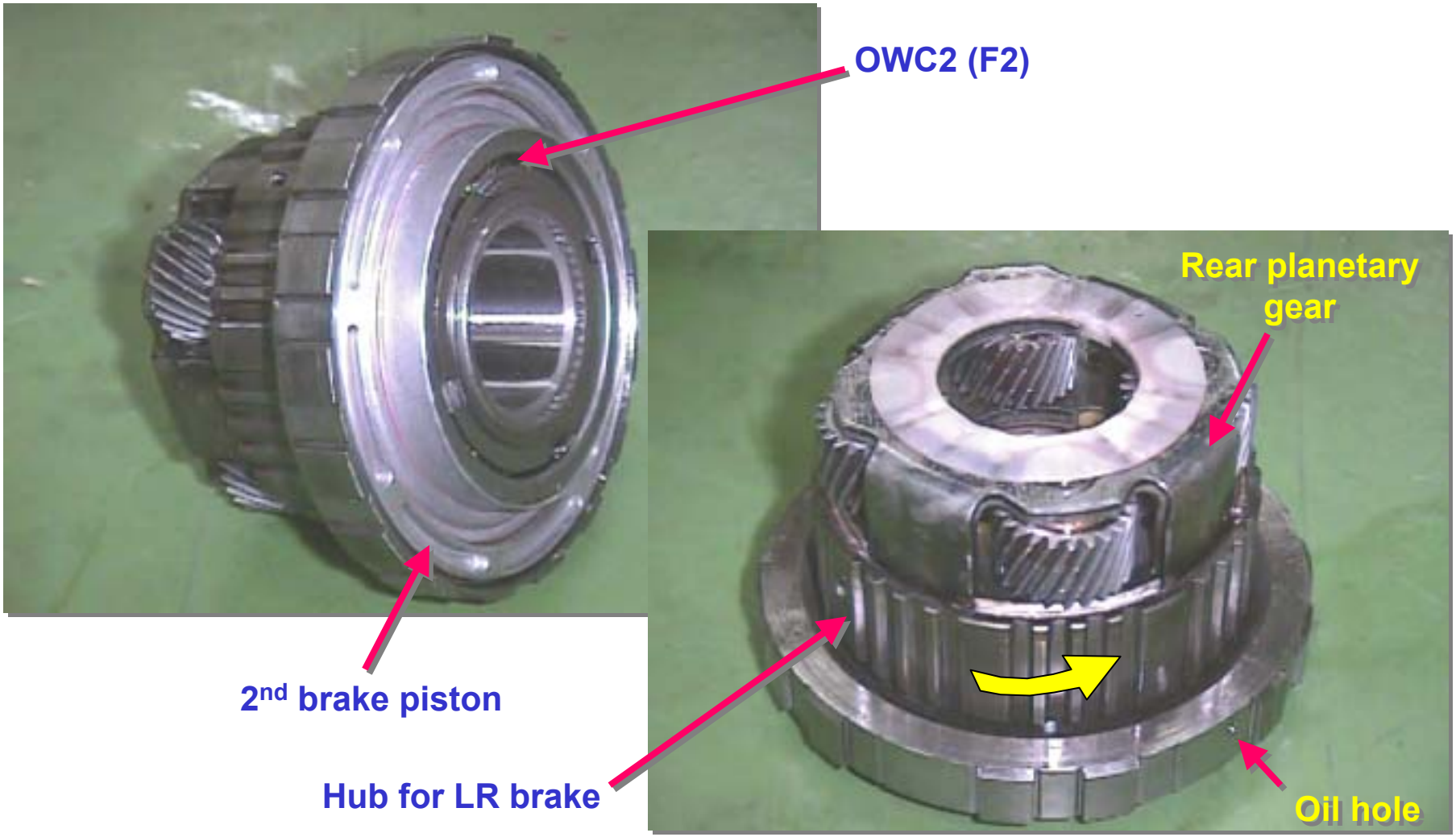

◆ Non-reusable part

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

# COMPONENTS



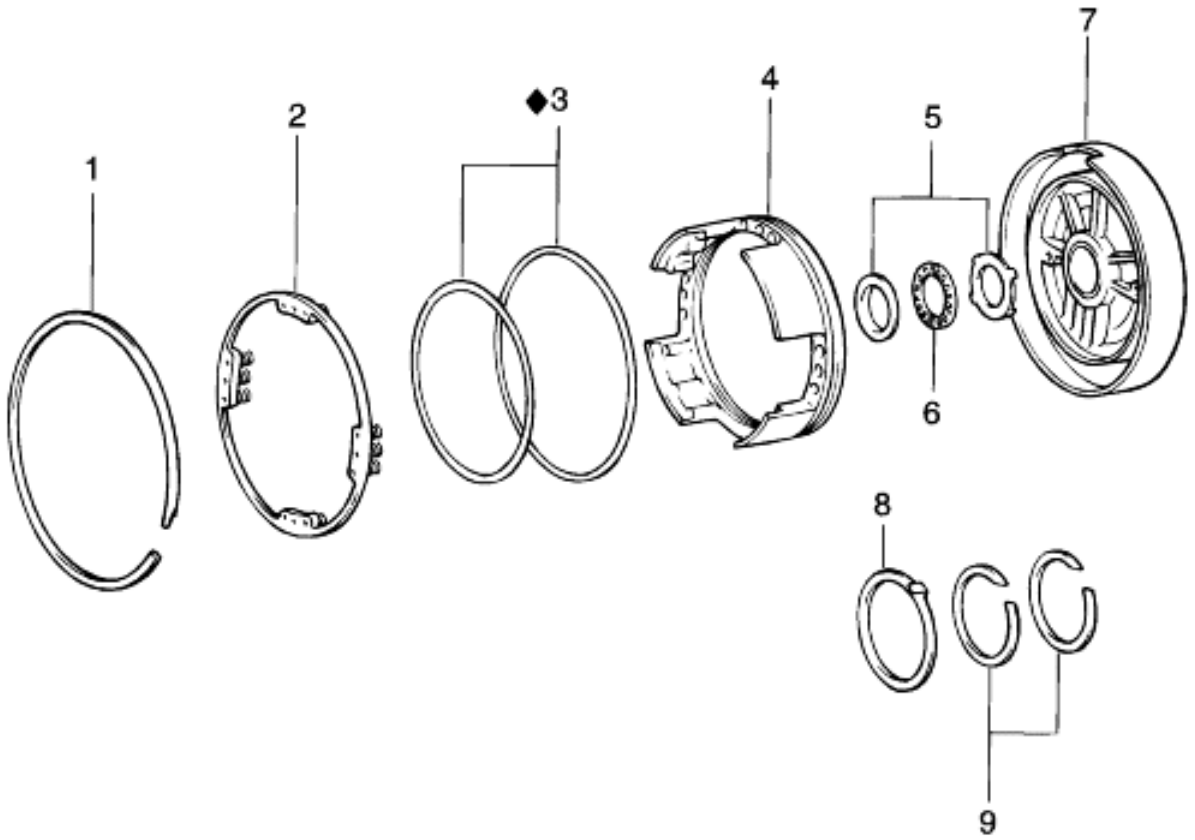
## Rear planetary gear & 2nd brake piston



# COMPONENTS



## OD brake




◆ Non-reusable part

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

# COMPONENTS

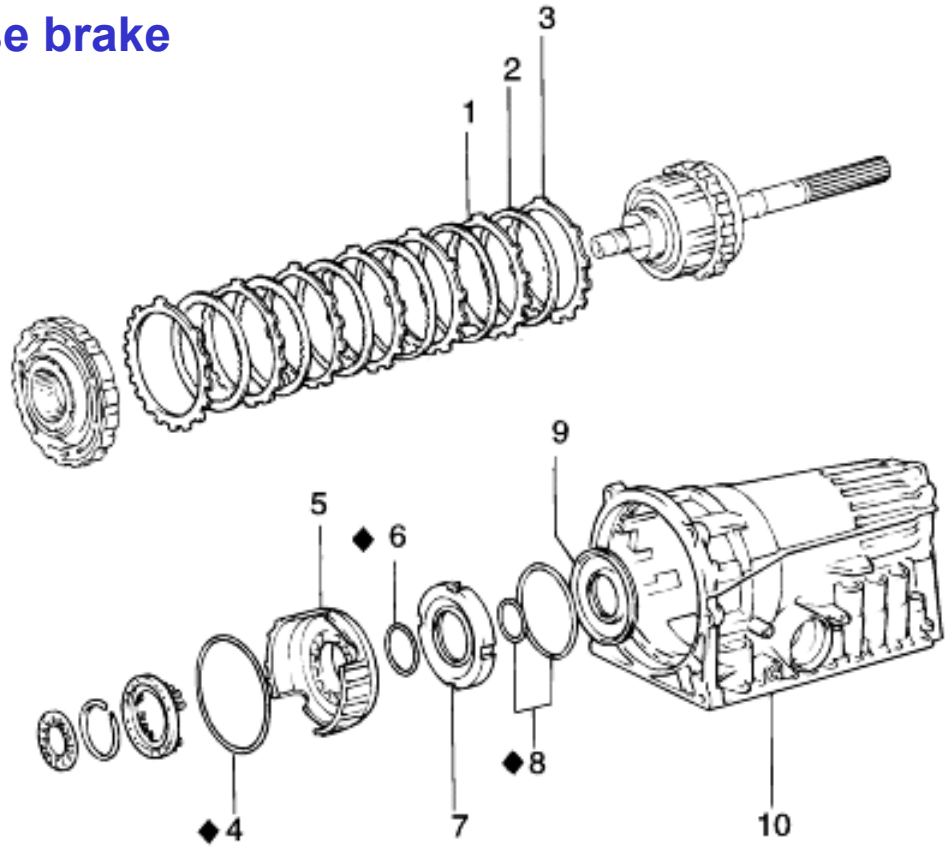


## OD brake


# COMPONENTS



## Low and reverse brake

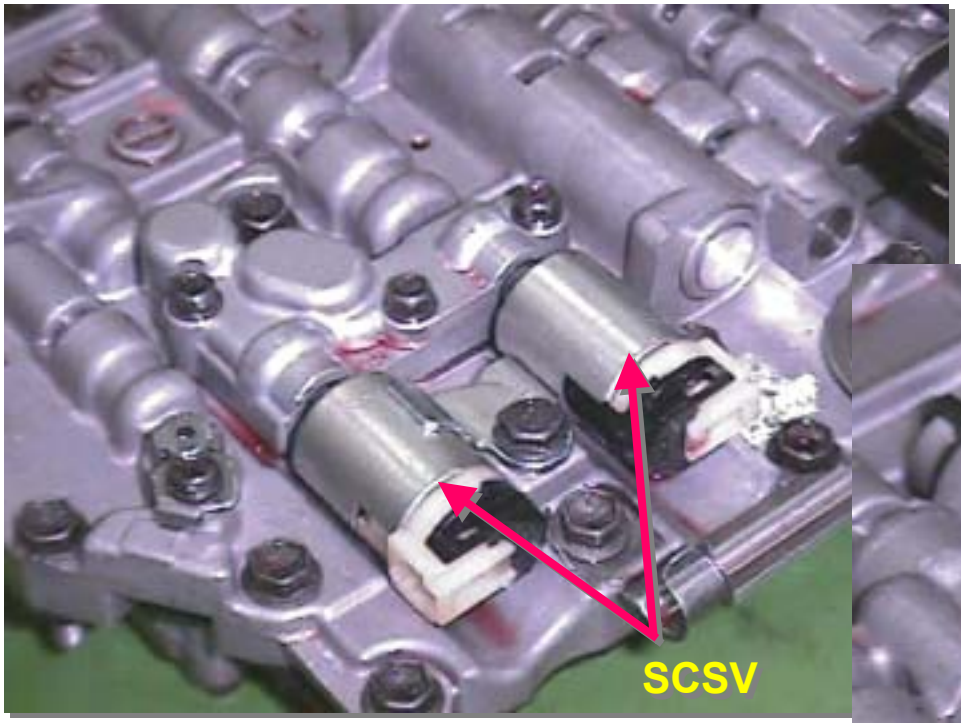


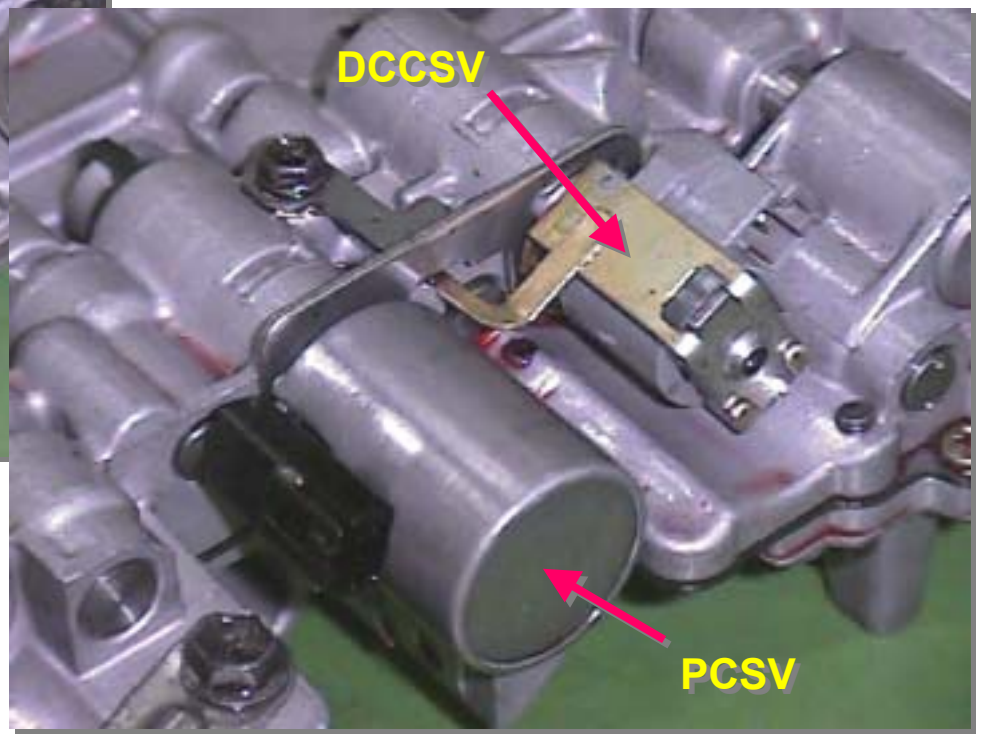

◆ Non- reusable part

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

# COMPONENTS

## Valve body

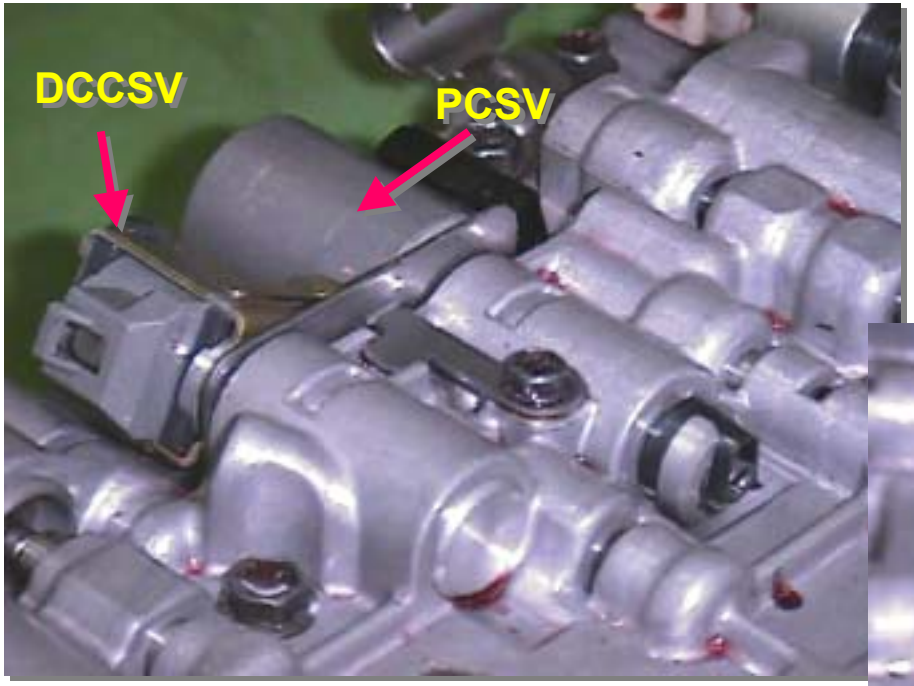


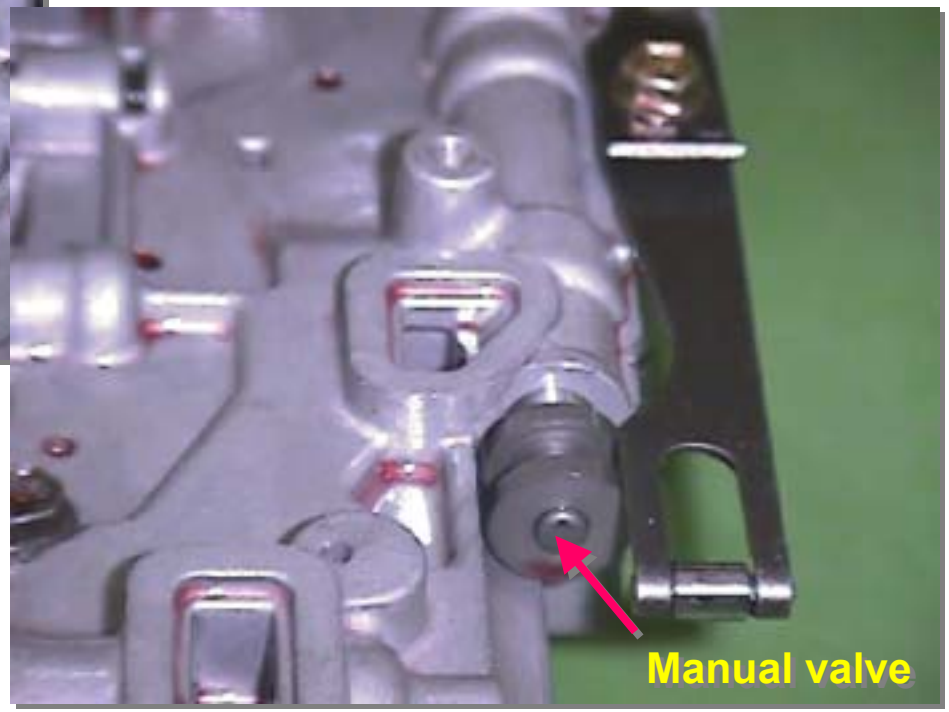



# COMPONENTS



## Valve body

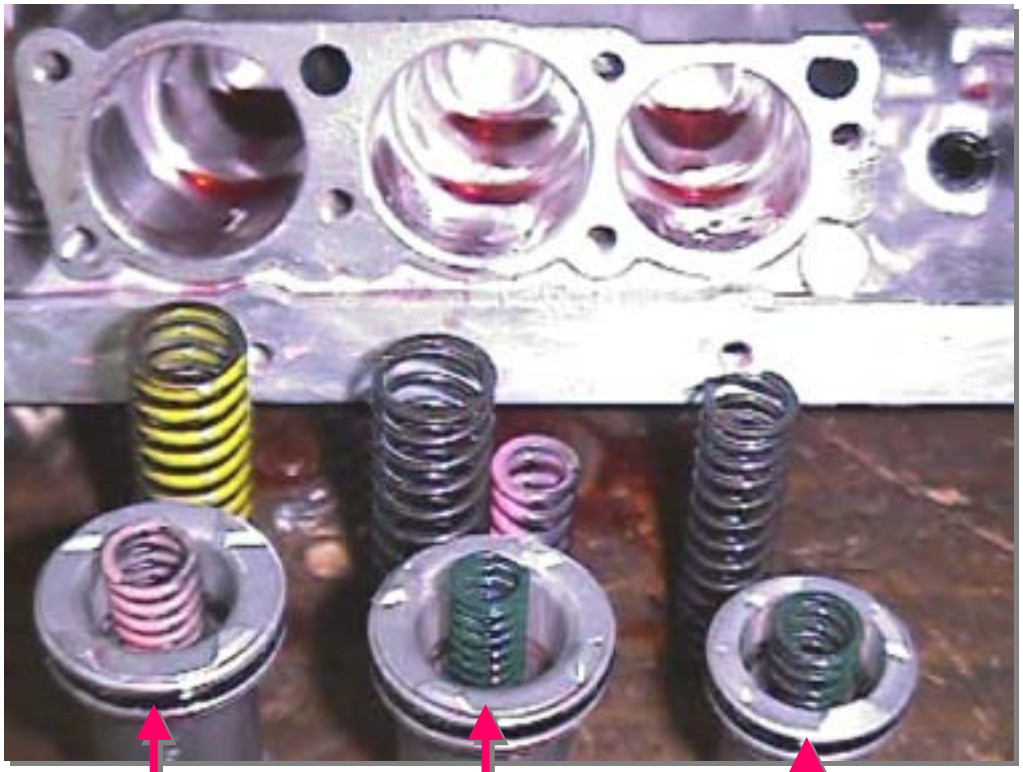


# COMPONENTS



## Accumulators



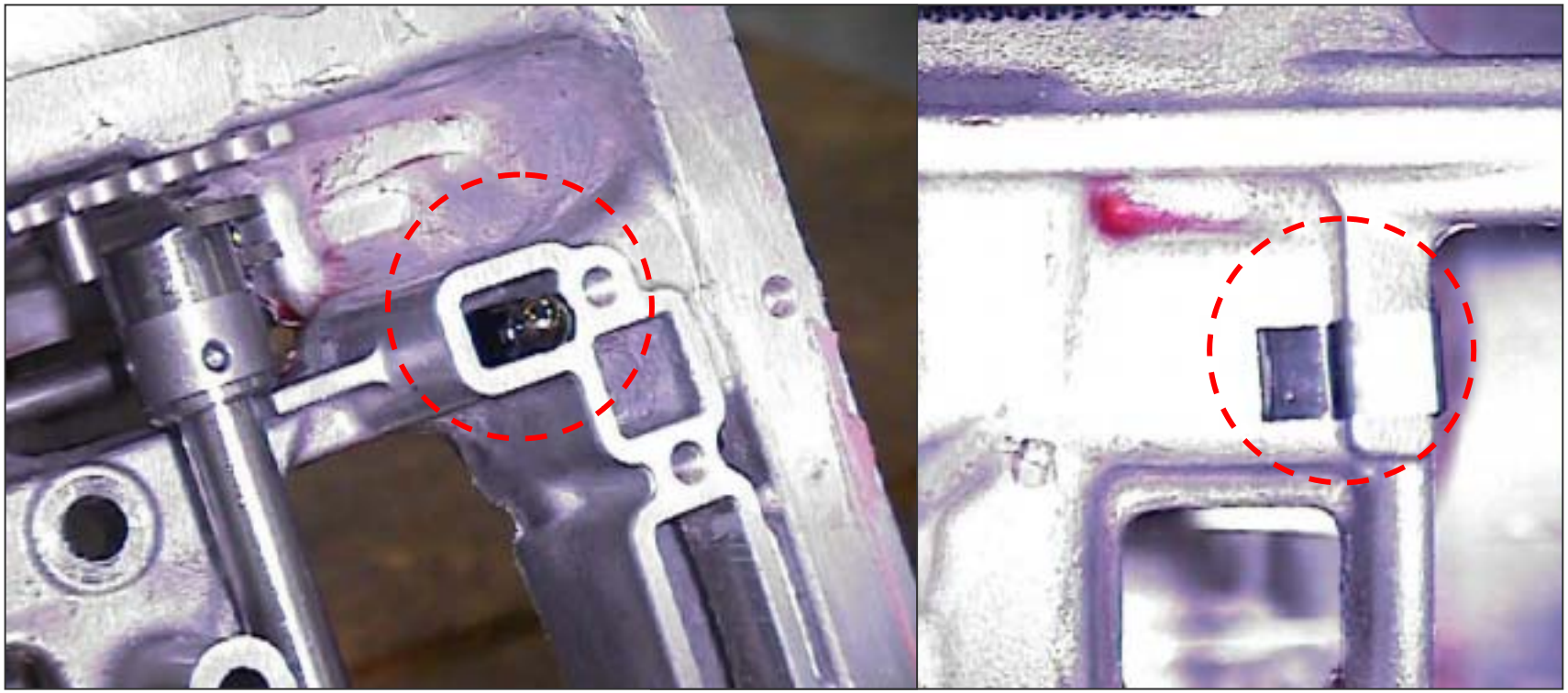
Second brake Accumulator

Direct clutch Accumulator

OD brake Accumulator

OD direct clutch Accumulator pistons

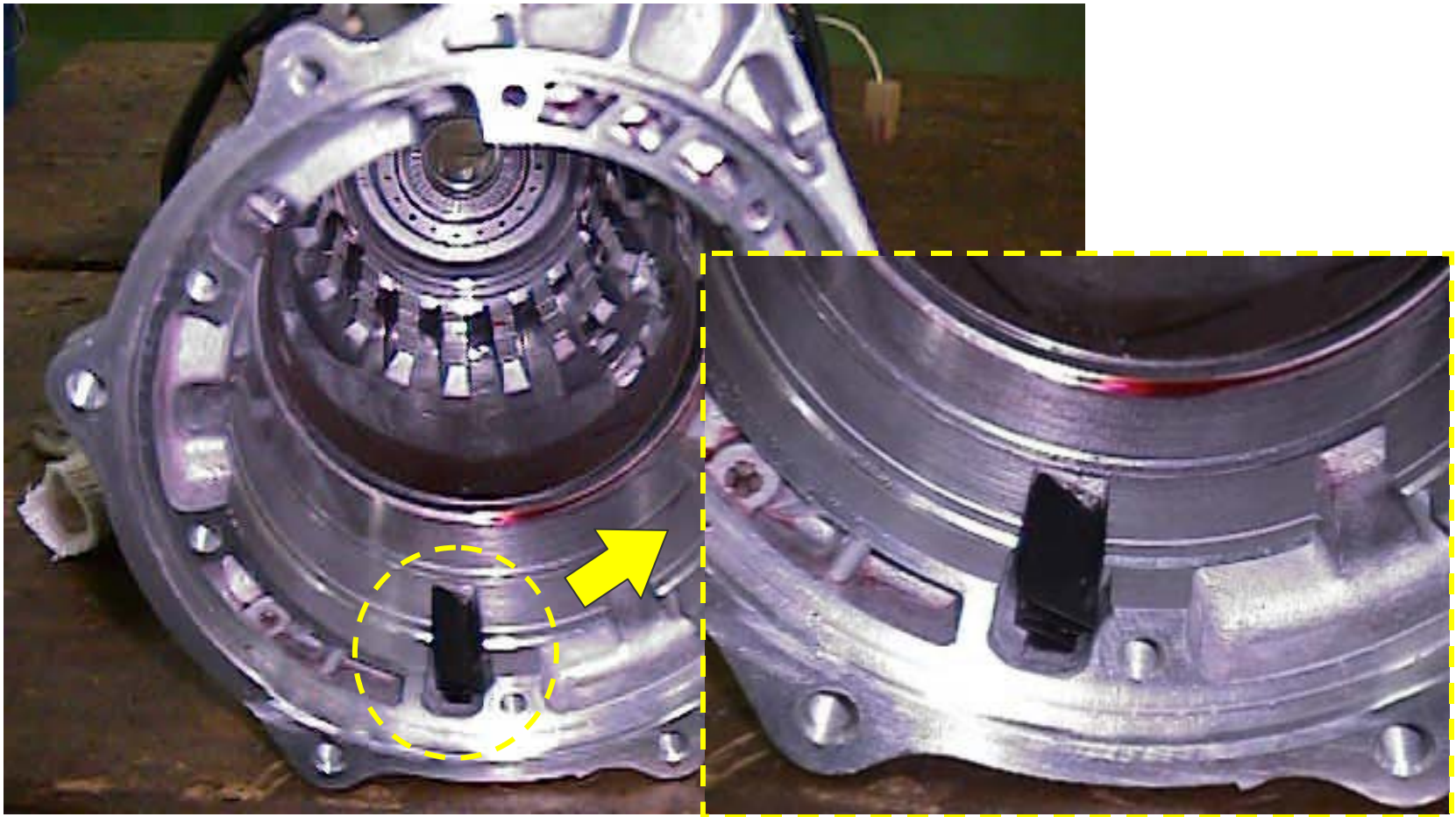
## Ball and clip



# COMPONENTS



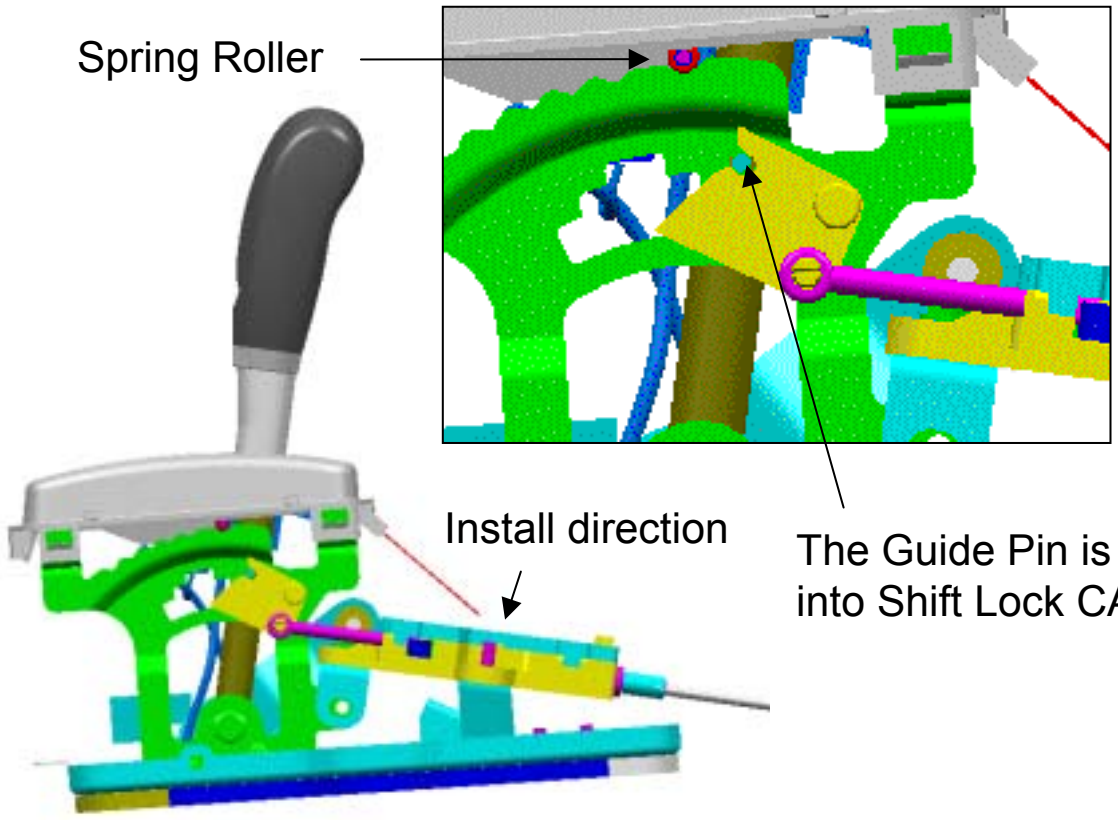
## Clip



## 2nd coast brake oil hole

# SHIFT LOCK DEVICE INSTALLATION





# SHIFT LOCK DEVICE INSTALLATION



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.

# SHIFT LOCK DEVICE INSTALLATION

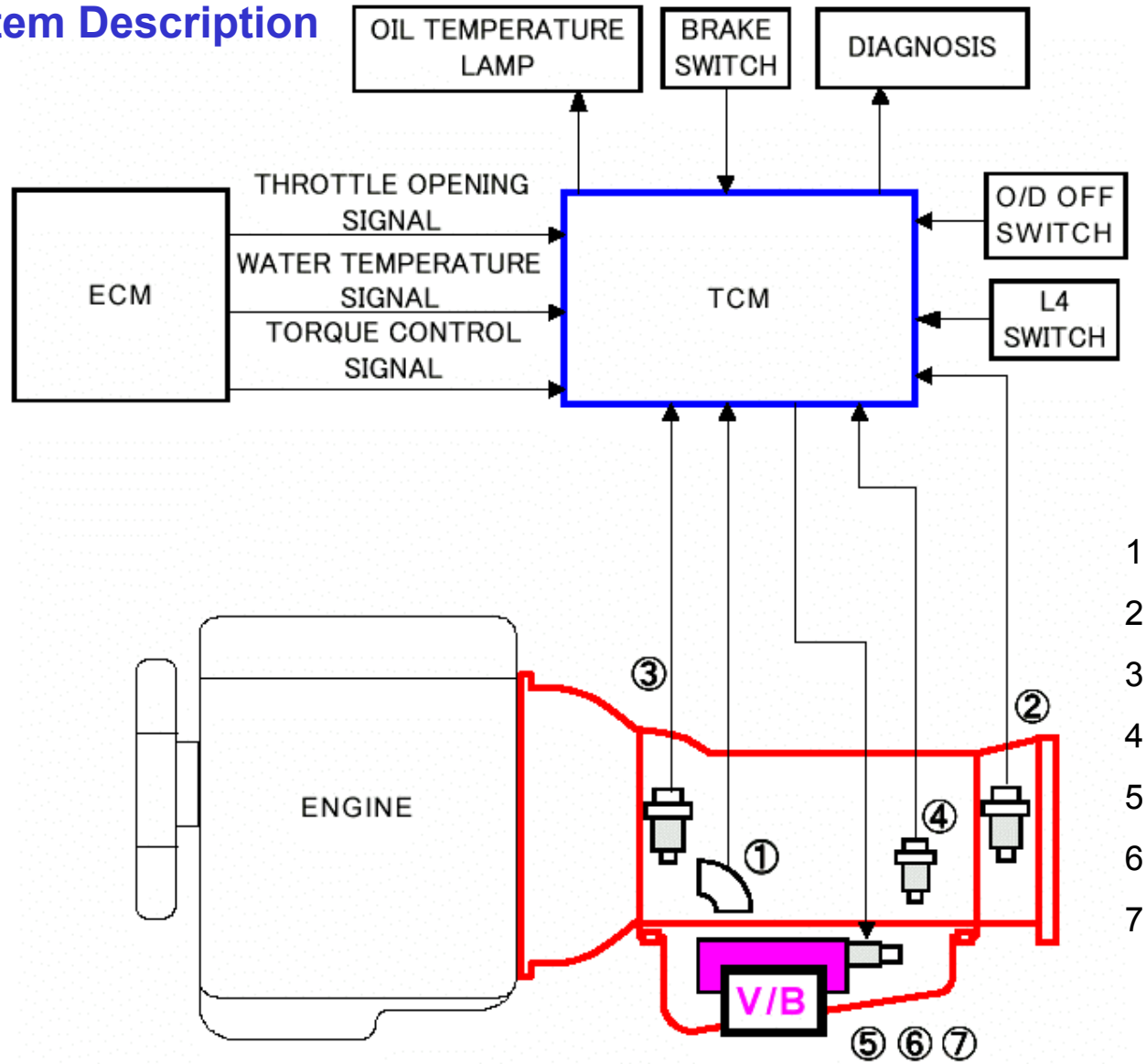


3. Checking that procedure for installing the shift lock is correct.
   - When the brake pedal is not depressed, push button of the shift lever at “P” position cannot be operated. (Shift lever cannot be shifted at the other positions from “P”).
     Push button can be operated at the other positions 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
6. Line pressure control sol.
7. Lock-up solenoid

# ELECTRICAL CONTROL PARTS



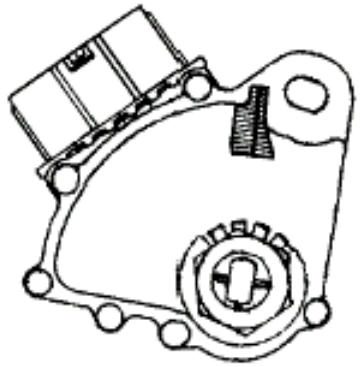
## Each electrical parts

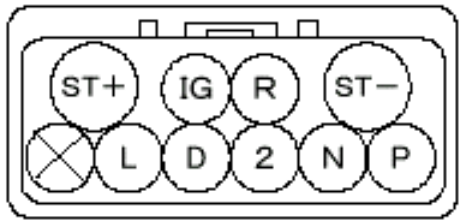
### ① NEUTRAL START SWITCH (NSW)

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.

| | STARTER | | POSITION | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| RANGE | ST+ | ST- | IG | P | R | N | D | 2 | L |
| P | ○ | ○ | ○ | ○ | | | | | |
| R | | | ○ | | ○ | | | | |
| N | ○ | ○ | ○ | | | ○ | | | |
| D | | | ○ | | | | ○ | | |
| 2 | | | ○ | | | | | ○ | |
| L | | | ○ | | | | | | ○ |
| POLARITY | + | – | + | – | – | – | – | – | – |



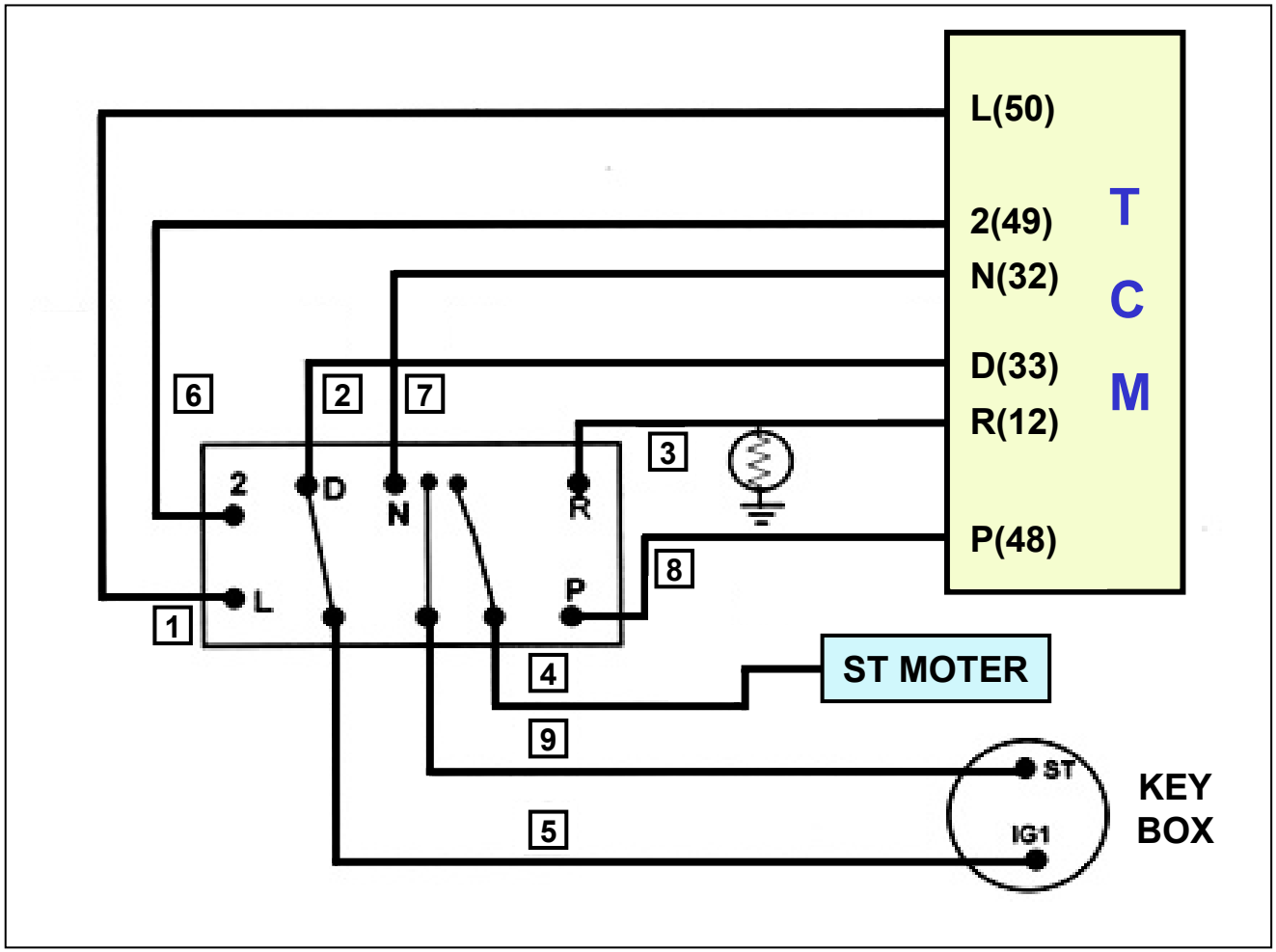


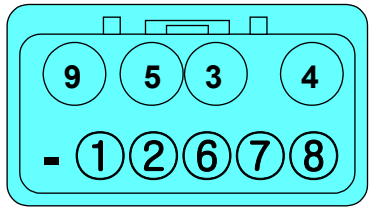

- ***No input signal: ‘D’ range control***
- ***Multi input signals: Priority of D-2-L-R-N-P***

# ELECTRICAL CONTROL PARTS



## Each electrical parts (Inhibitor switch)



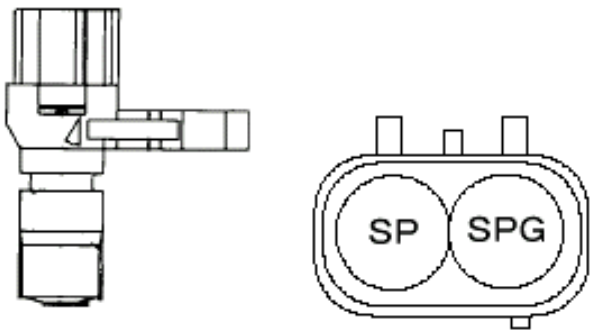

Connector

# ELECTRICAL CONTROL PARTS

## Each electrical parts

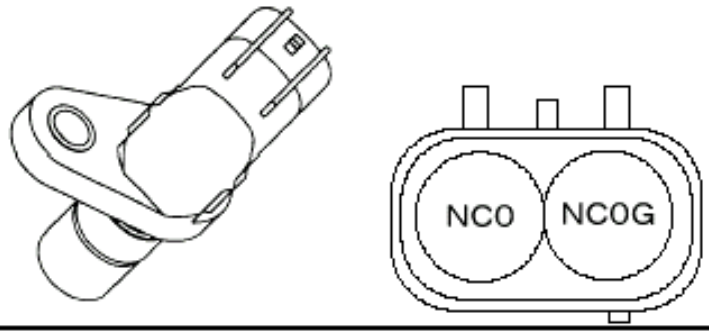
### ② OUTPUT SPEED SENSOR (SP)

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.

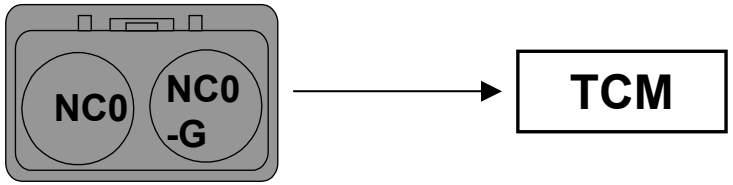


# ELECTRICAL CONTROL PARTS

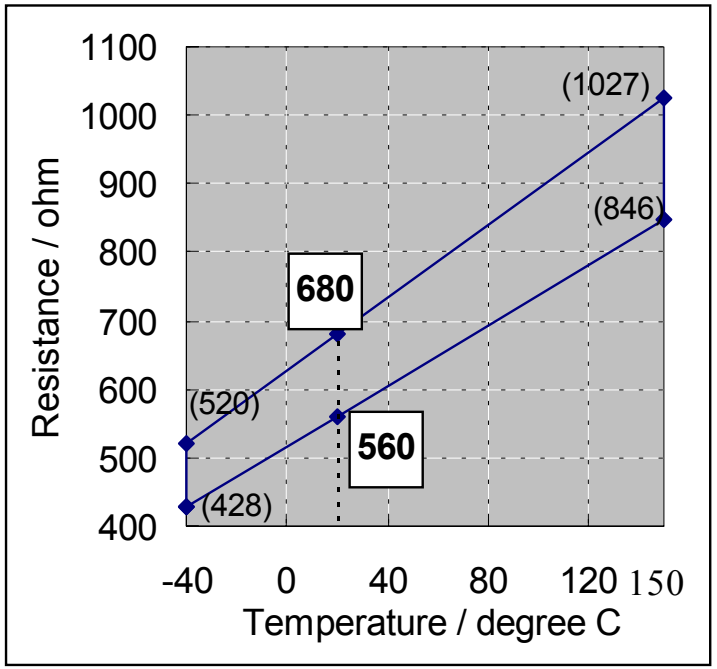


## Each electrical parts (Input speed sensor, C0)

- To detect input shaft speed
- Data for shift control
  *(Judge the beginning or the end of 4th gear shifting)*
- Detect if 4th gear is engaged or not
- 0 RPM at 4th gear → C0 (no operation)
  - → *C0 rev.>500 rpm: recognition to be shifted to 3rd gear*
  - → *C0 rev.<500 rpm: recognition to be shifted to 4th gear*




Connector



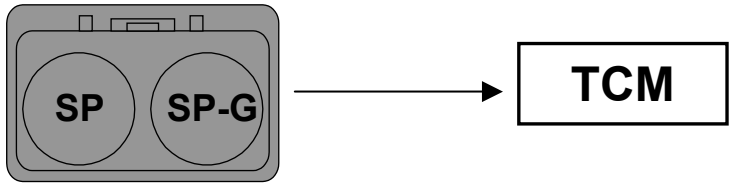

**560-680 ohm (20 degrees Celsius)**

# ELECTRICAL CONTROL PARTS



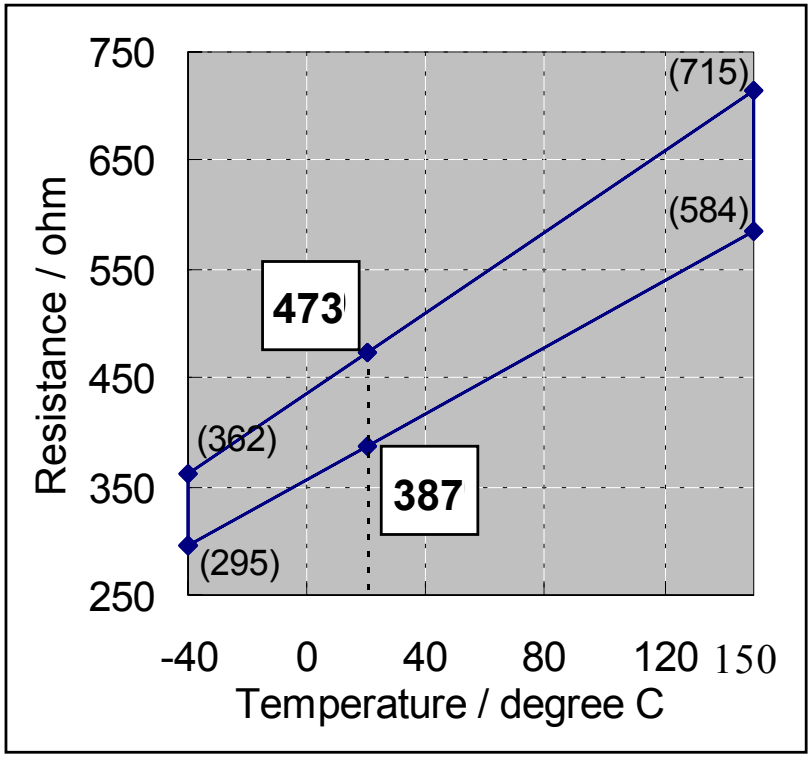
## Each electrical parts (Output speed sensor)

- To detect output shaft speed
- Data for shift control




Connector

**Output speed sensor**




**Resistance: 387 –473 ohm (20 degrees Celsius)**

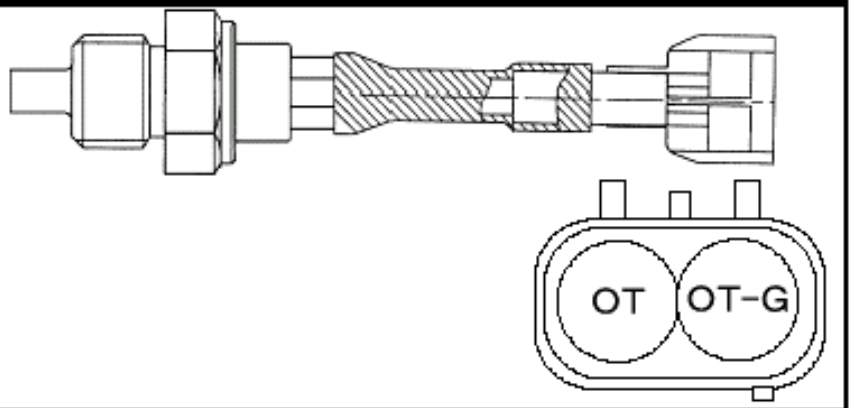
# ELECTRICAL CONTROL PARTS



## Each electrical parts

### ④ OIL TEMPERATURE SENSOR (OT)

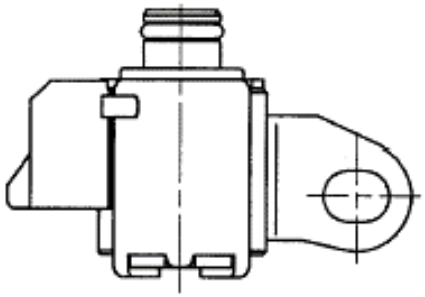
The Oil Temperature Sensor concerts ATF temperature variation into electronic signals to transmit to TCM. This information is necessary for shift control and L-up control, etc.




### 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.

NORMAL CLOSE TYPE

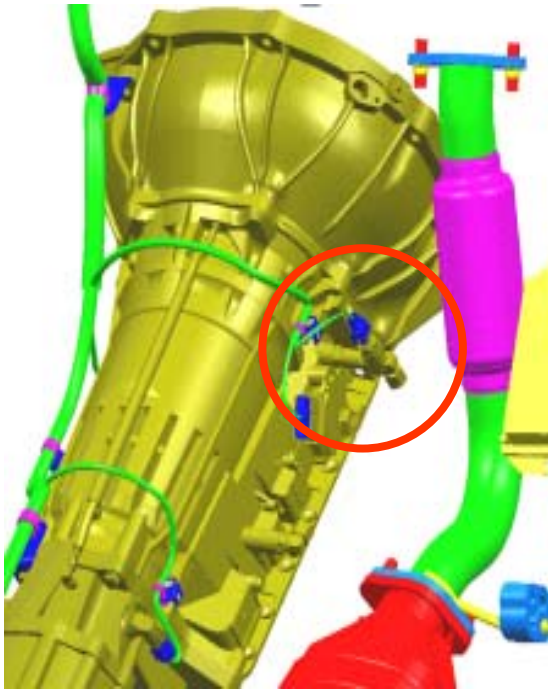


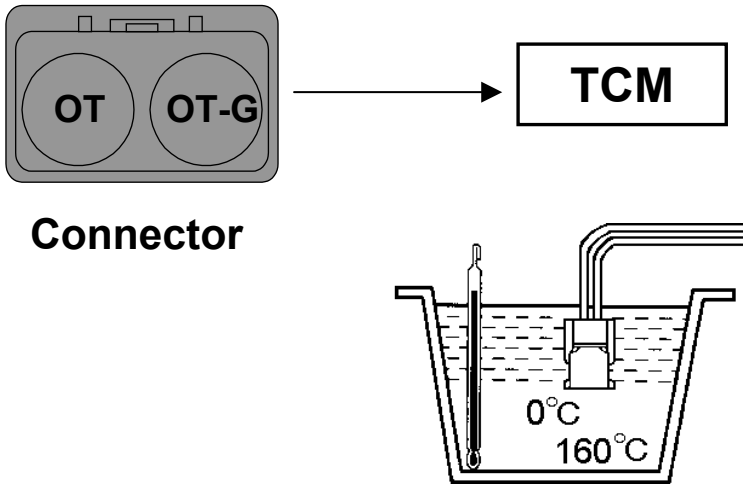
# ELECTRICAL CONTROL PARTS



## 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*



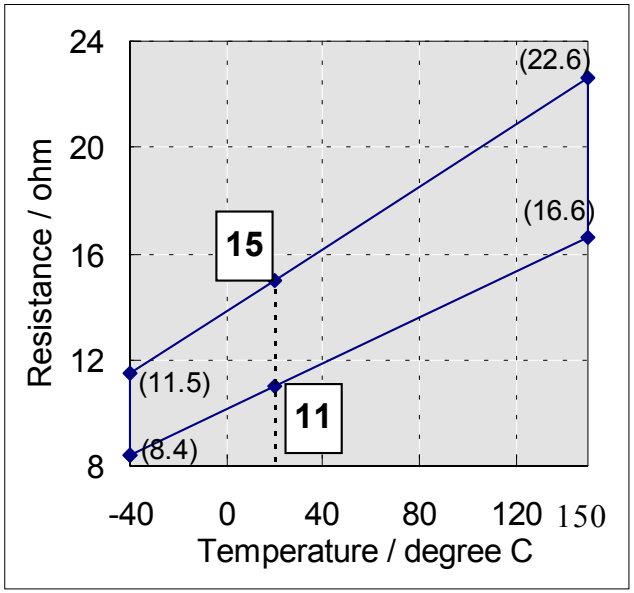



| | |
|---|---|
| 0 degree C | 1,884 - 2,290 ohm |
| 160 degree C | 19.2 - 22.2 ohm |

# ELECTRICAL CONTROL PARTS



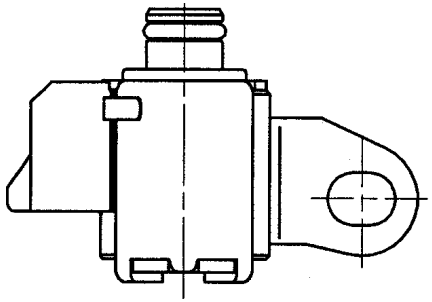
## Each electrical parts (Shift solenoid No 1 No.2)

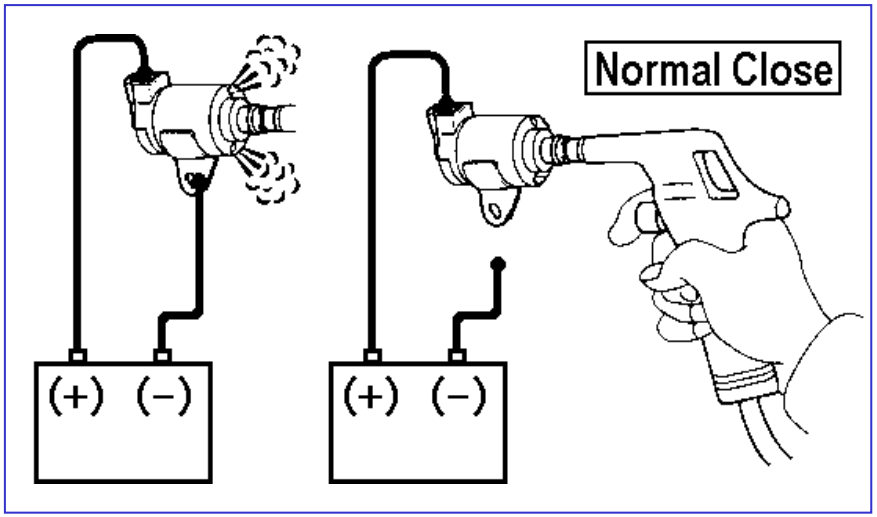



**11-15 ohm (20 degrees Celsius)**

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

*** Normal close type**






| | |
|---|---|
| **No battery connected** | **No air leakage** |
| **Battery connected** | **Air leakage** |

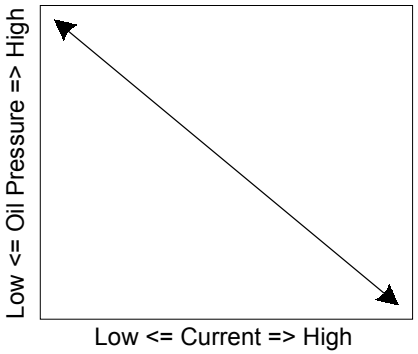
# ELECTRICAL CONTROL PARTS

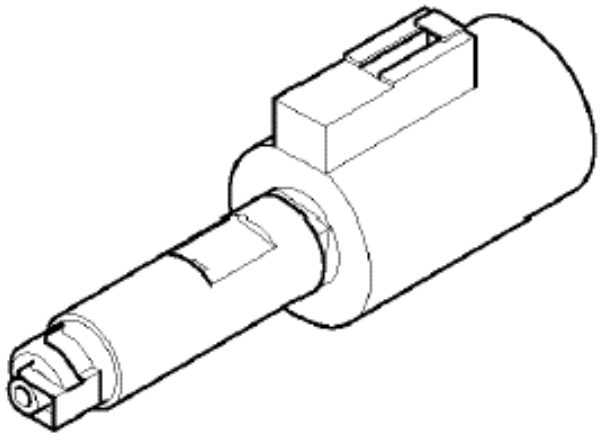


## Each electrical parts

### 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.

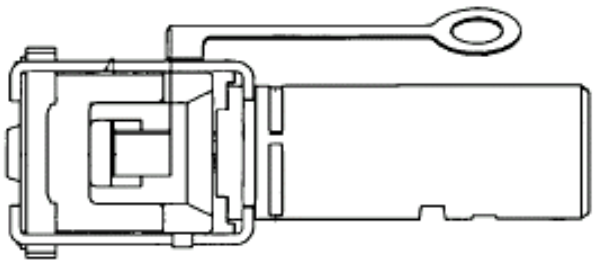


### ⑦ LOCK UP SOLENOID (SL)

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

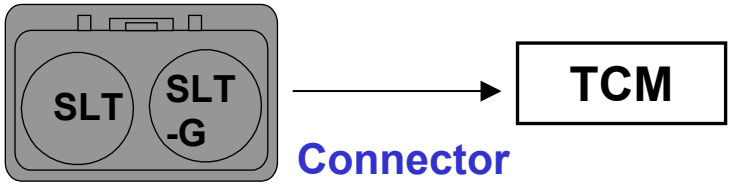
NORMAL OPEN

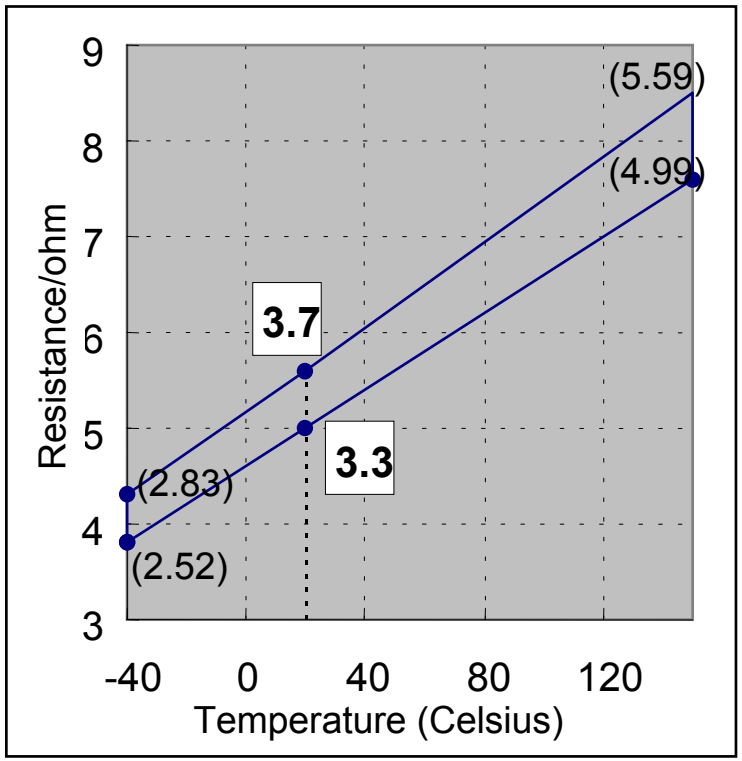


# ELECTRICAL CONTROL PARTS



## Each electrical parts (Line pressure control solenoid valve)




| SHIFT RANGE | LINE PRESSURE (kg/cm$^2$) | |
|---|---|---|
| | IDLE | STALL |
| D | 3.7 ~ 4.3 | 8.1 ~ 9.0 |
| R | 6.2 ~ 7.2 | 15.6 ~ 19.0 |

**Resistance: 3.3 - 3.7 ohm (20 degrees Celsius)**

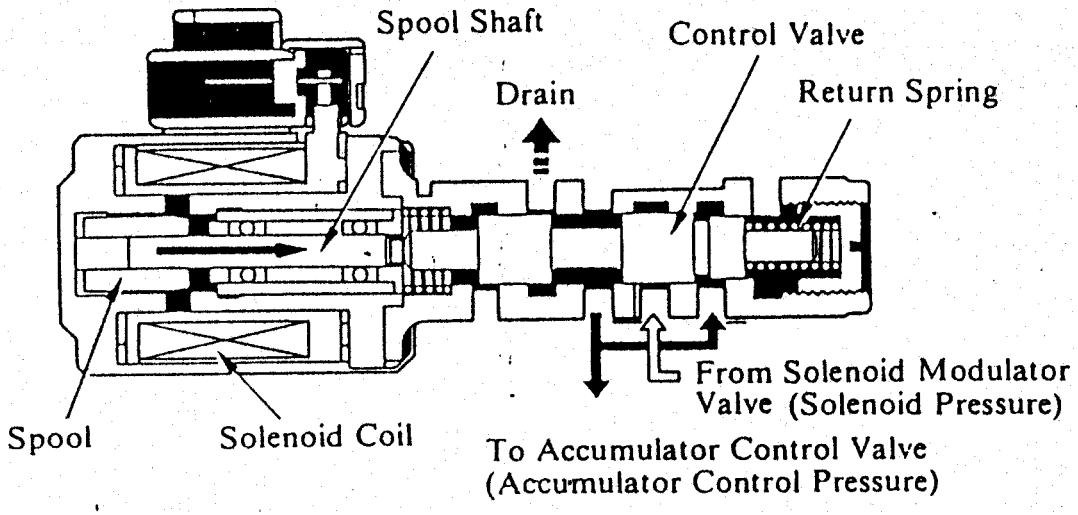
# ELECTRICAL CONTROL PARTS

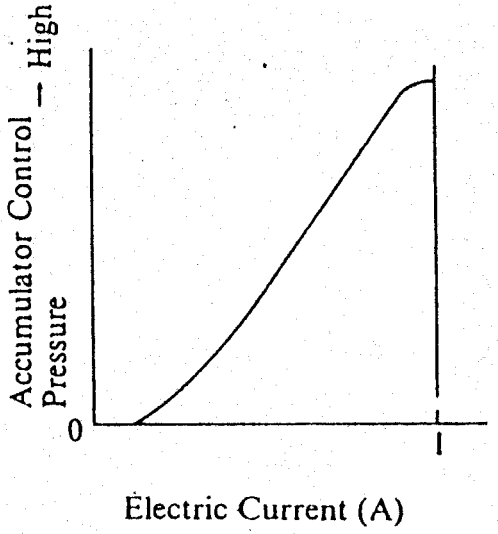
## Each electrical parts (Line pressure control solenoid valve)

**- 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.



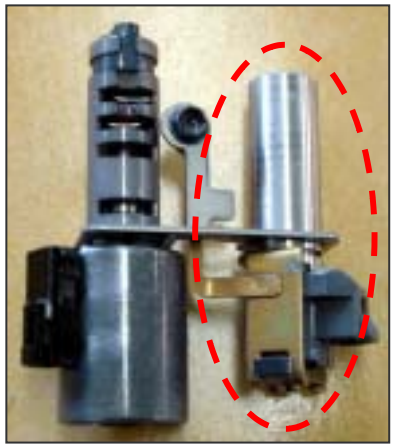



# ELECTRICAL CONTROL PARTS



## 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.

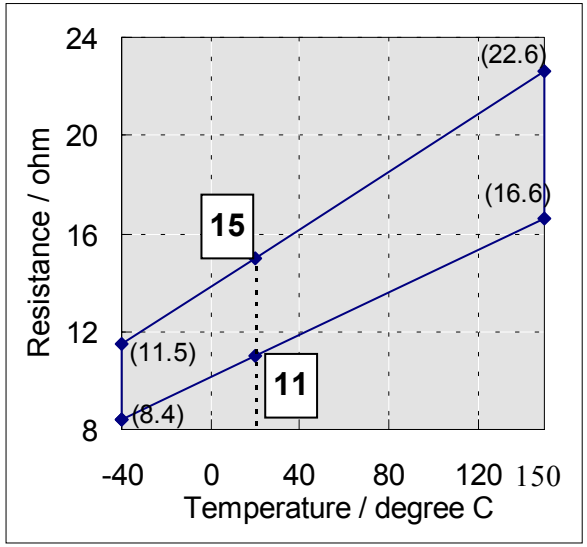


■ Solenoid Type: NO(Normal Open)

* HP/H1(HMC), BL → NO Type

Enterprise → Duty Type

03-Model → NC Type




**11-15 ohm (20 degrees Celsius)**

■ ***Hydraulic flow***

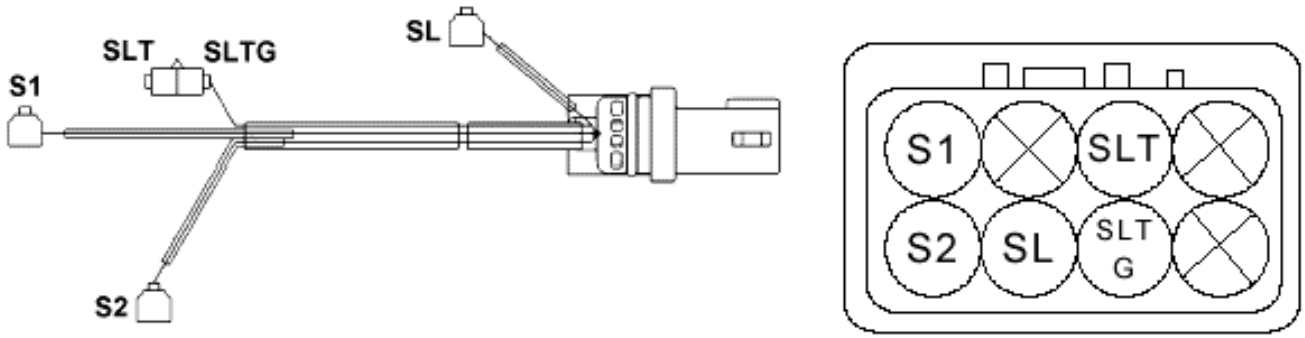
***Solenoid modulator valve → Lock-up solenoid → Solenoid relay valve → Lock-up relay valve → Lock-up control valve***

# ELECTRICAL CONTROL PARTS

## Each electrical parts

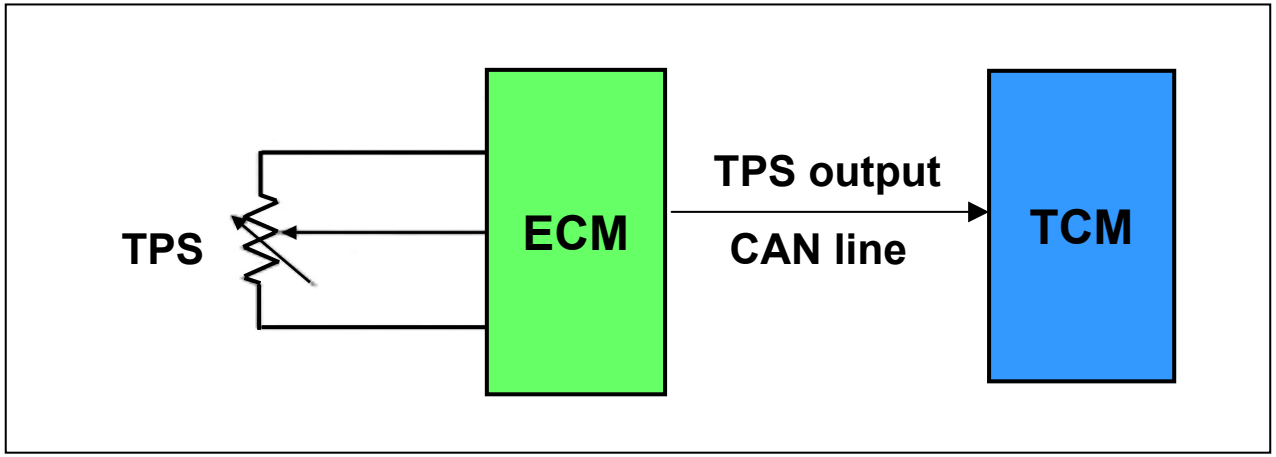
### WIRE TO SOLENOID

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.



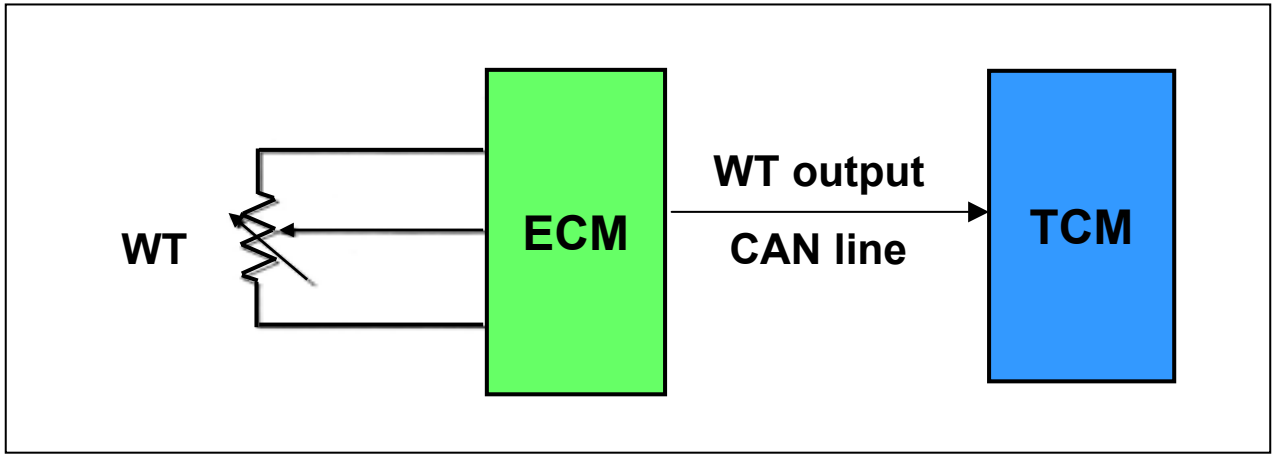
## TPS (Throttle Position Sensor) signal

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



## Water Temperature signal

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



# HYDRAULIC CONTROL SYSTEM

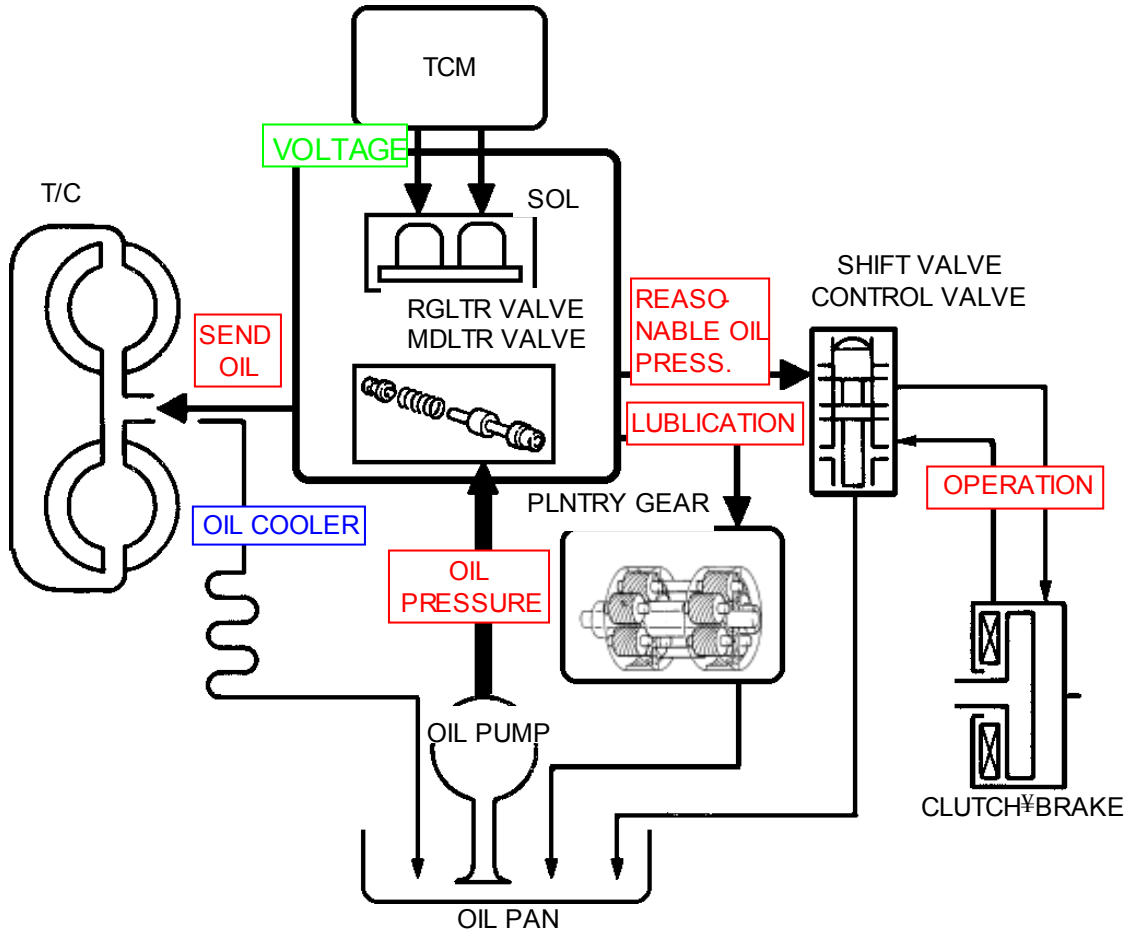


## Constructions

- **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 syste m governs the hydraulic pressure acting on the torque converter, plane-tary gear, clutches and brakes in accordance with the vehicle driving conditions.

**Hydraulic system block diagram**

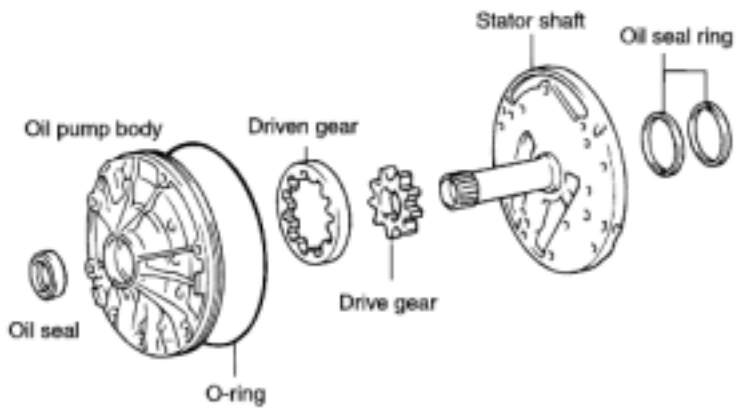


# HYDRAULIC CONTROL SYSTEM



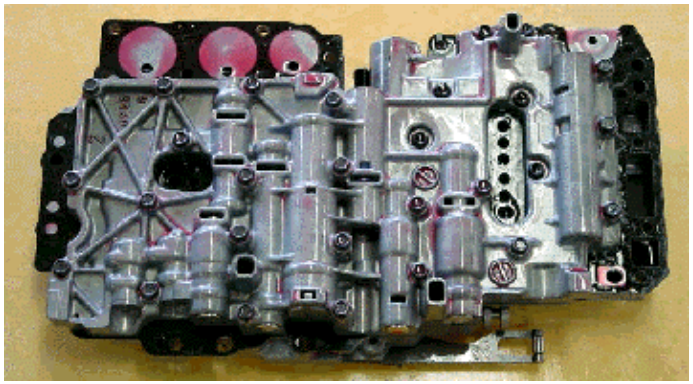
## Oil pump

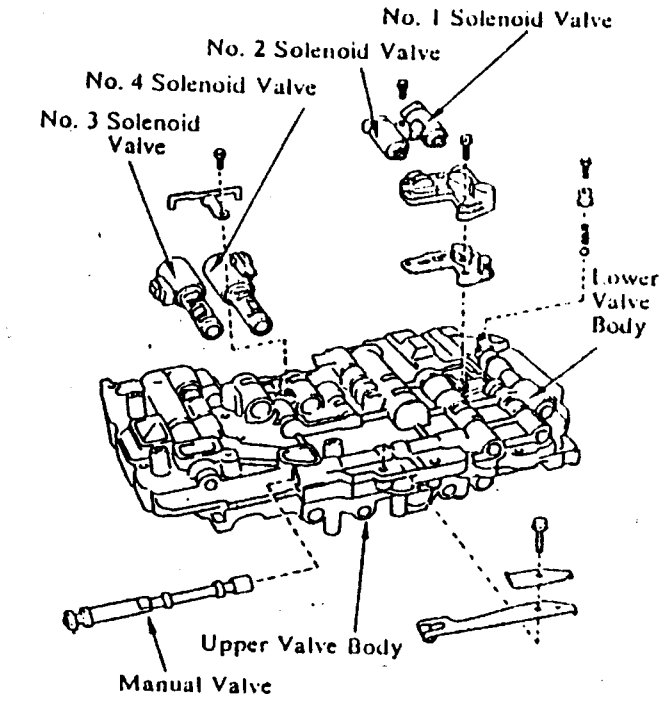
Operated by the impeller hub inside Torque converter, it generates oil pressure for operating components as well as lubricating planetary gear set.




## 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.



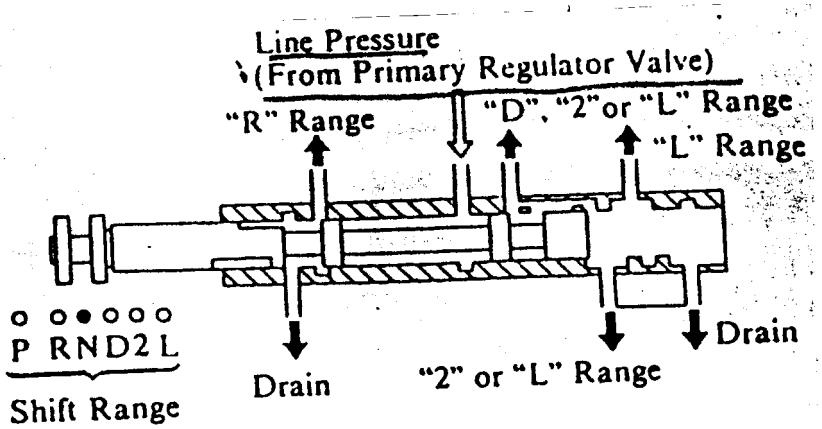


# HYDRAULIC CONTROL SYSTEM



## Manual valve

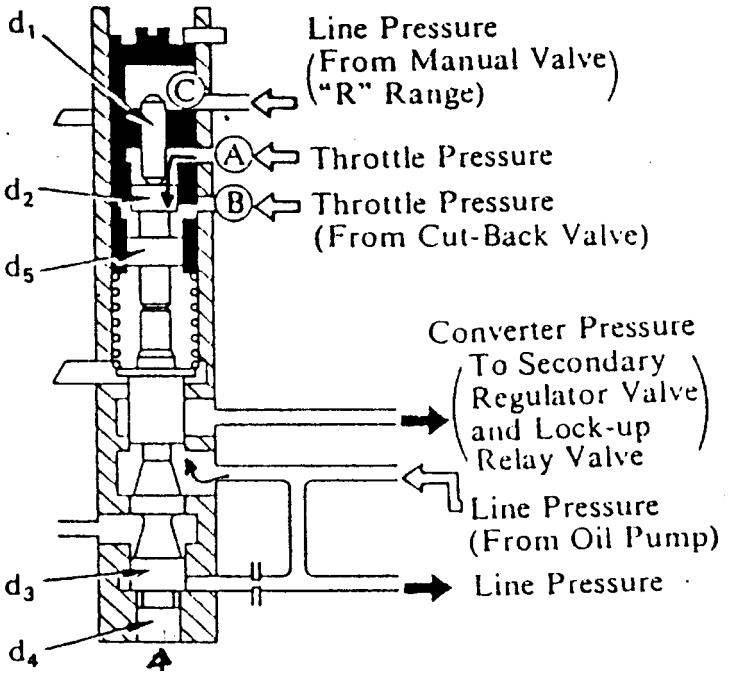
Connected to a shift lever, it changes oil path according to the shift lever position, P-R-N-D-2-L.




## 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.

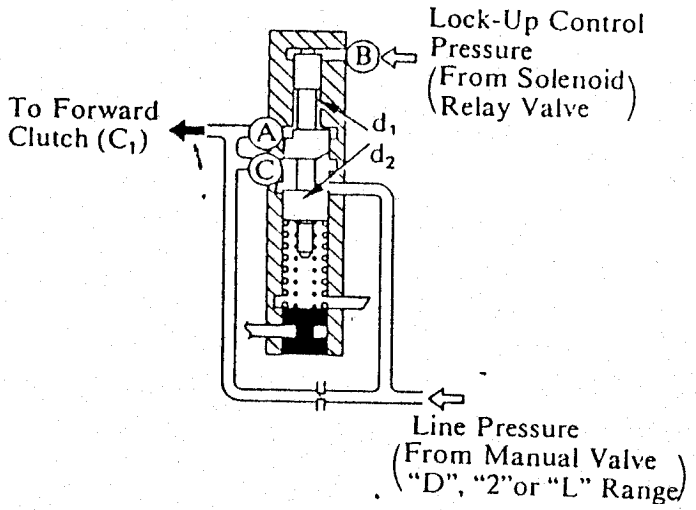


# HYDRAULIC CONTROL SYSTEM



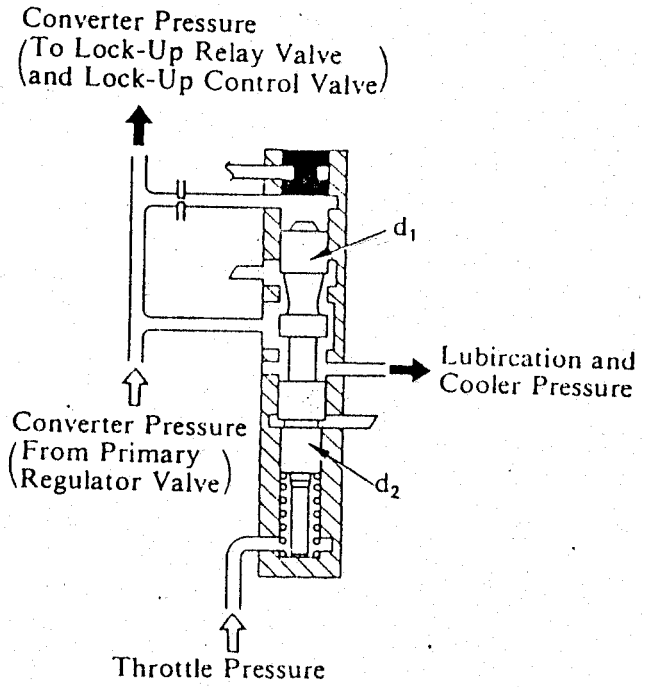
## C1 orifice control valve

Line pressure from manual valve applies to **$C_1$**. 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.



# HYDRAULIC CONTROL SYSTEM

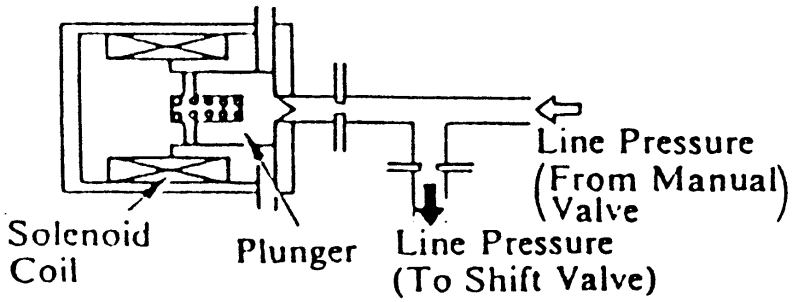


## SCSV-A, B

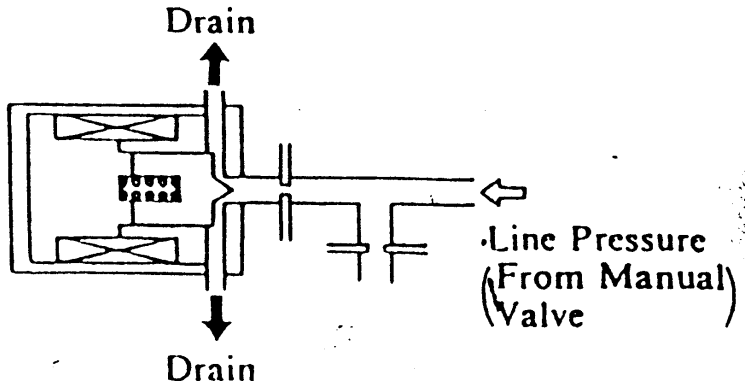
SCSC-A & B controls 1-2, 2-3, 3-4 shift valve by ON or OFF signal from TCM.
Line pressure applies to the SCSV-A at all the forward driving ranges(D,2,L) and to the SCSV-B at all ranges(P,R,N,D,2,L).

| SCSV-A / SCSV-B / Shift range | ON / OFF | ON / ON | OFF / ON | OFF / OFF |
|---|---|---|---|---|
| P | Parking | – | – | – |
| R | Reverse | – | – | – |
| N | Neutral | – | – | – |
| D | 1st | 2nd | 3rd | 4th |
| 2 | 1st | 2nd | 3rd | 3rd |
| L | 1st | 2nd | 2nd | 1st |

► When the solenoid valve is turned off ◄




► When the solenoid valve is tuned on ◄




**** 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

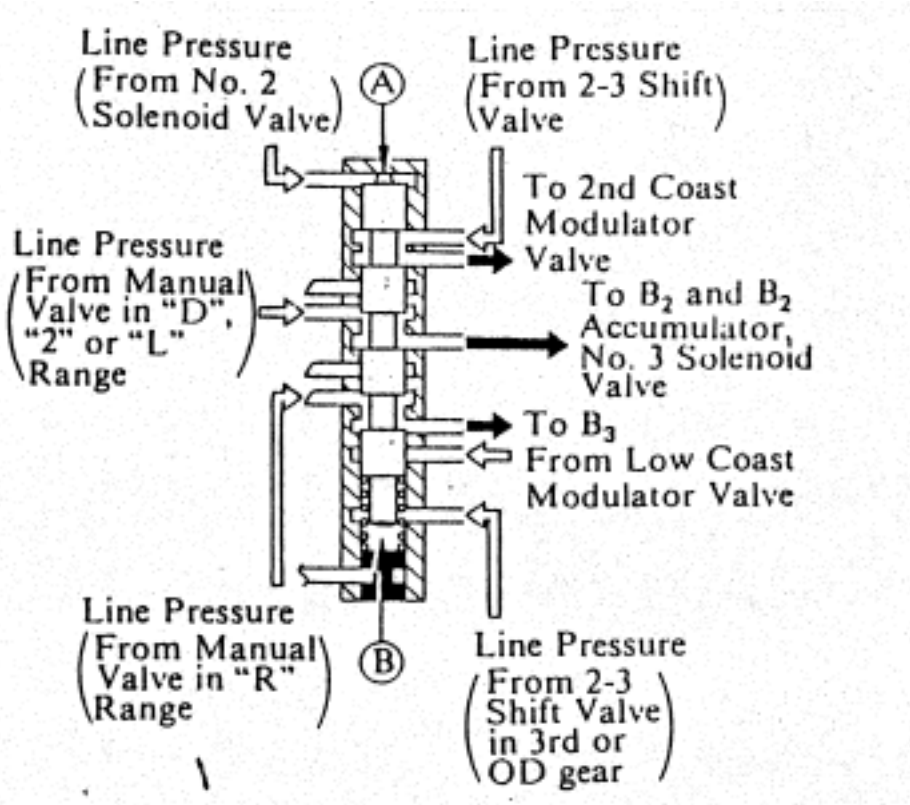
1-2 shift valve performs ***1st - 2nd gear shift by SCSV-B ON/OFF.***

*** SCSV-B ON:**

Pressure at 'A' releases → Spool moves upward → ***Pressure to $B_2$ is applied → 2nd gear***

*** SCSV-B OFF:**

Hydraulic pressure applied to 'A' → Spool moves downward → ***$B_2$ 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 $B_2$***

# HYDRAULIC CONTROL SYSTEM



## 2-3 Shift valve

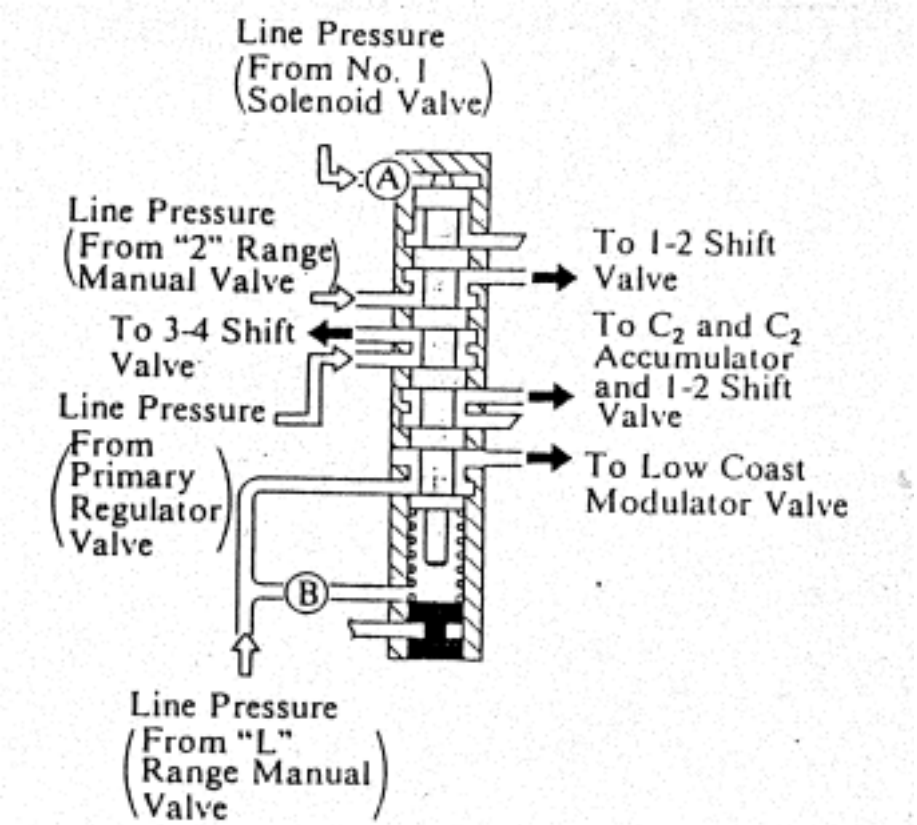
2-3 shift valve performs ***2nd - 3rd gear shift by SCSV-A ON/OFF.***

*** SCSV-A ON:**

Pressure at 'A' releases → Spool moves upward → ***$C_2$ pressure is cut → 2nd gear***

*** SCSV-A OFF:**

Hydraulic pressure applied to 'A' → Spool moves downward → ***Pressure to $C_2$ 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***

# HYDRAULIC CONTROL SYSTEM



## 3-4 Shift valve

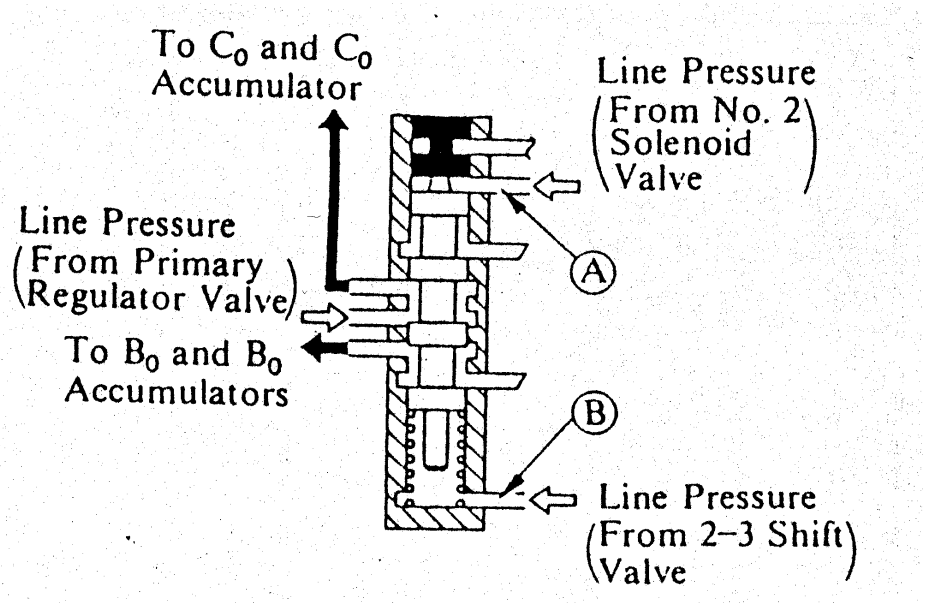
3-4 shift valve performs 3rd - 4th gear shift *by **SCSV-B ON/OFF.***

*** 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***



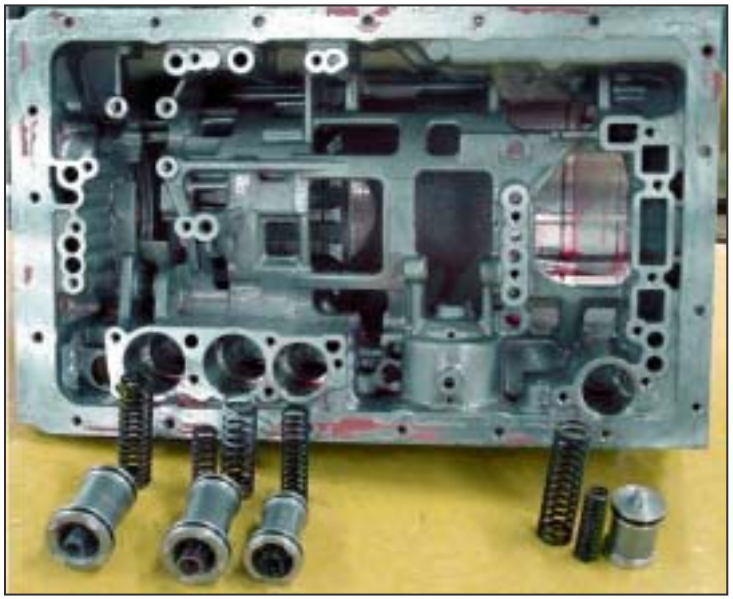

**** At '2', 'L' range, the spool moves upward** because the line pressure from a 2-3 shift valve applies to 'B': **4th gear is impossible***

# HYDRAULIC CONTROL SYSTEM



## 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.

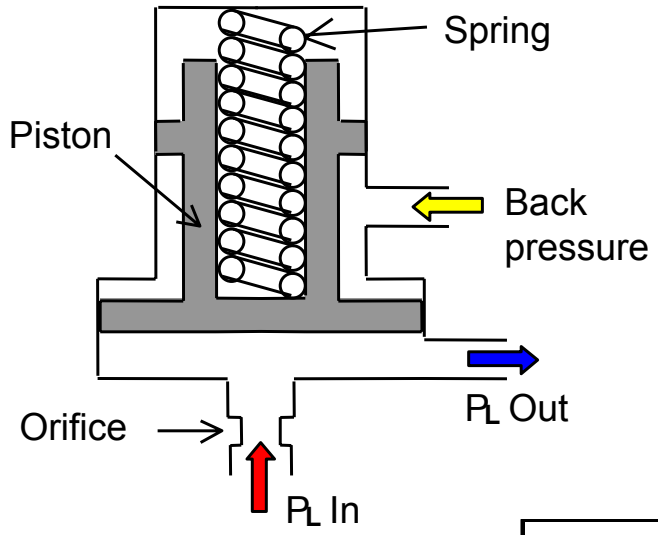


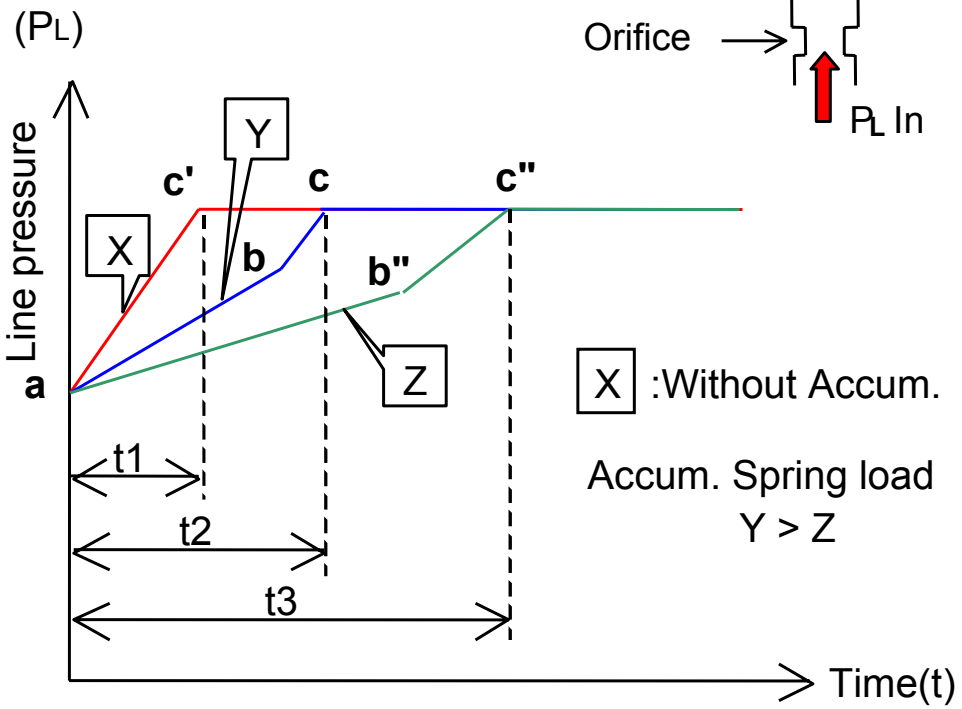
***That is,accumulator functions as a damper until the accumulator back pressure and spring force that applies on the back side of the piston reaches the line pressure of the other side.*** If the line pressure exceeds the accumulator back pressure and spring force, accumulator just functions as oil 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.***

# HYDRAULIC CONTROL SYSTEM

## Accumulators

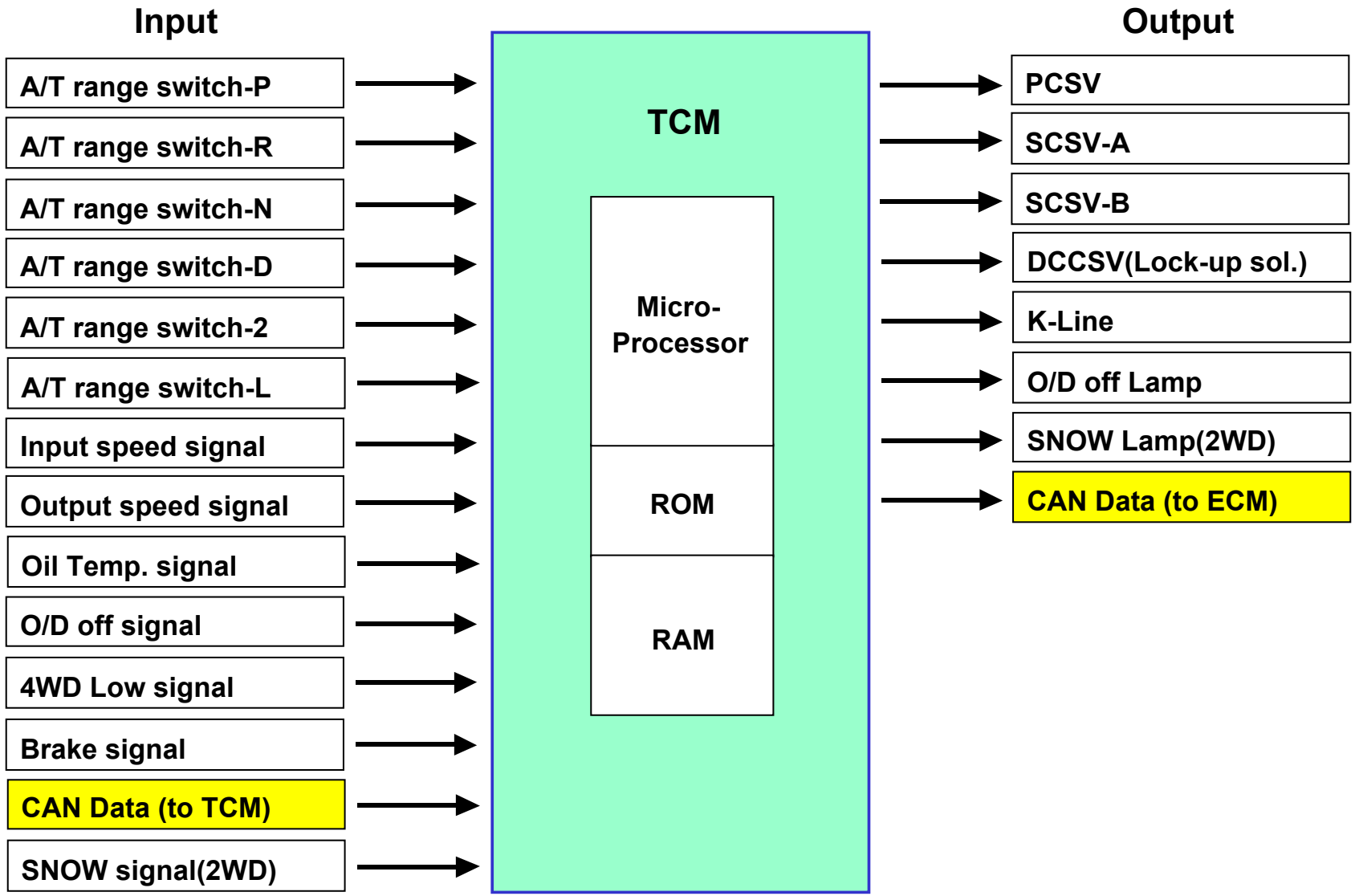



**Function**

| Accum. | Operating timing |
|---|---|
| C0 | 4 → 3 |
| C1 | N → D |
| C2 | 2 → 3 |
| B0 | 3 → 4 |
| B2 | 1 → 2 |

## Block Diagram



## 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

| Gear | SCSV No.1 | SCSV No.2 |
|---|---|---|
| 1st | ON | OFF |
| 2nd | ON | ON |
| 3rd | OFF | ON |
| 4th | OFF | OFF |

## 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℃ ↑

■ **Control inhibition**

- Brake Switch: ON
- Throttle opening: 9% ↓(2.5 DSL), 5% ↓(3.5 GSL)
- Low coolant temperature: -100℃↓
- 4WD LOW mode

## Engine torque reduction(ETR) and line pressure control (LPC)

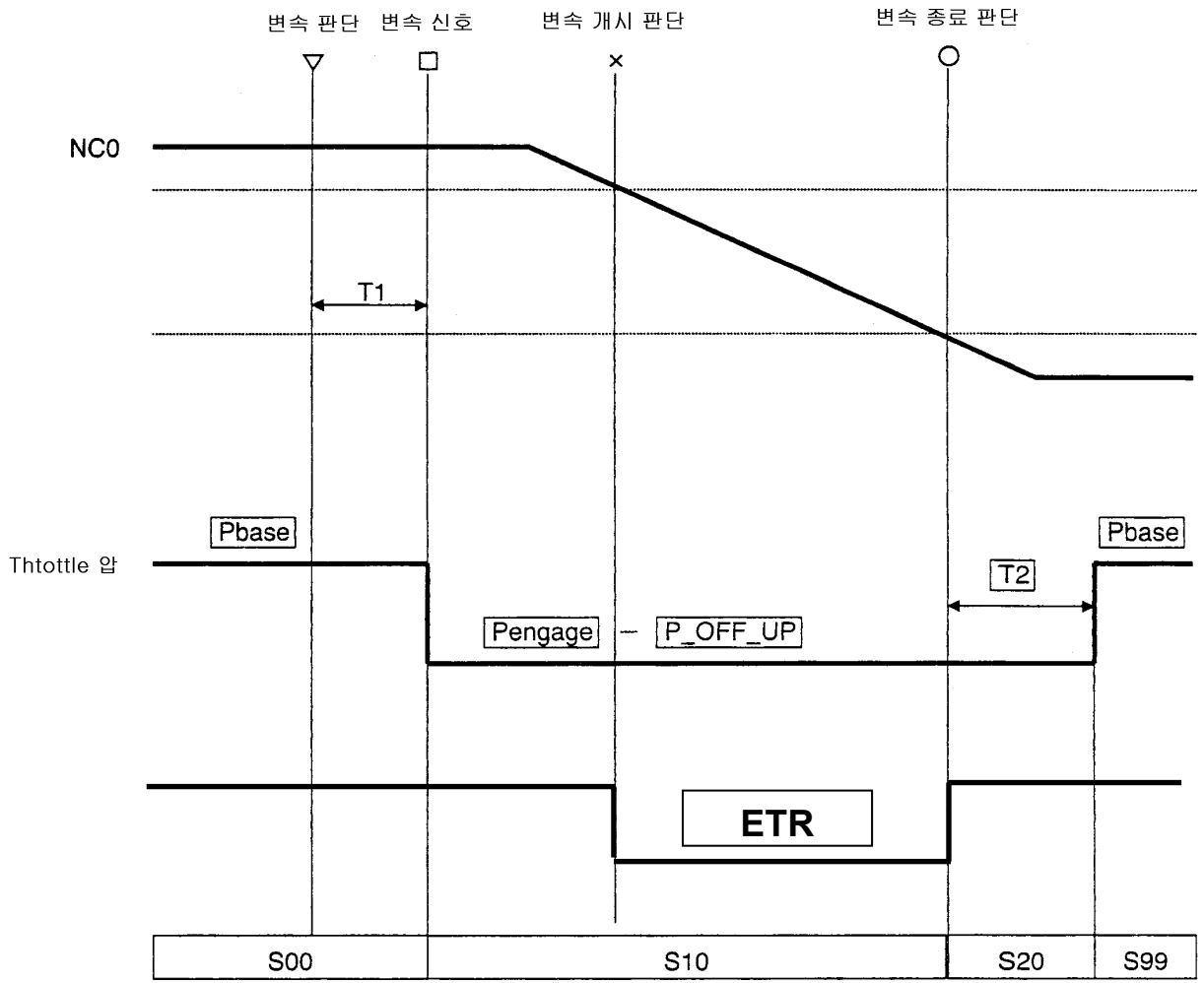
**Engine torque reduction control** improves shift quality due to sending torque reduction request signal from TCM to ECM and reducing engine torque while shifting “N” to “D”, “N” to ”R” as well as shifting 1←→2←→3←→4.

** 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

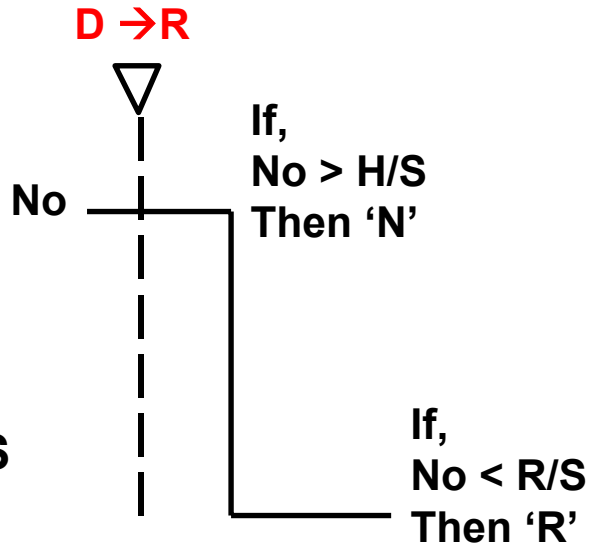
- To prevent engaging “Reverse” gear while D →R shift (Neutral by C2)

■ 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

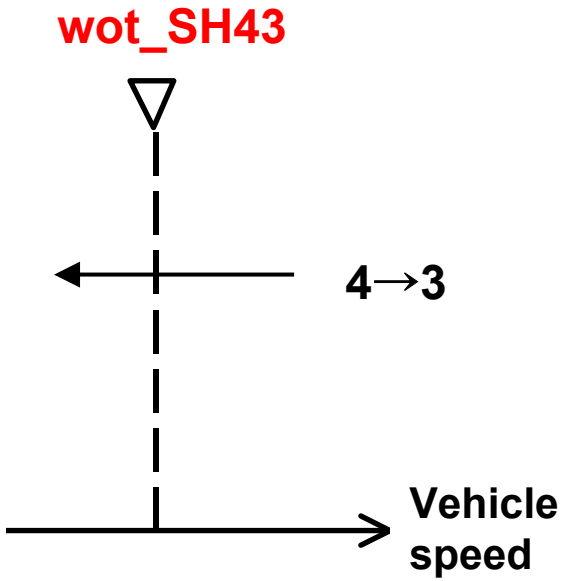
- To prevent engine over-run by turning the O/D OFF switch accidentally "ON" at high vehicle speed

■ 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)*

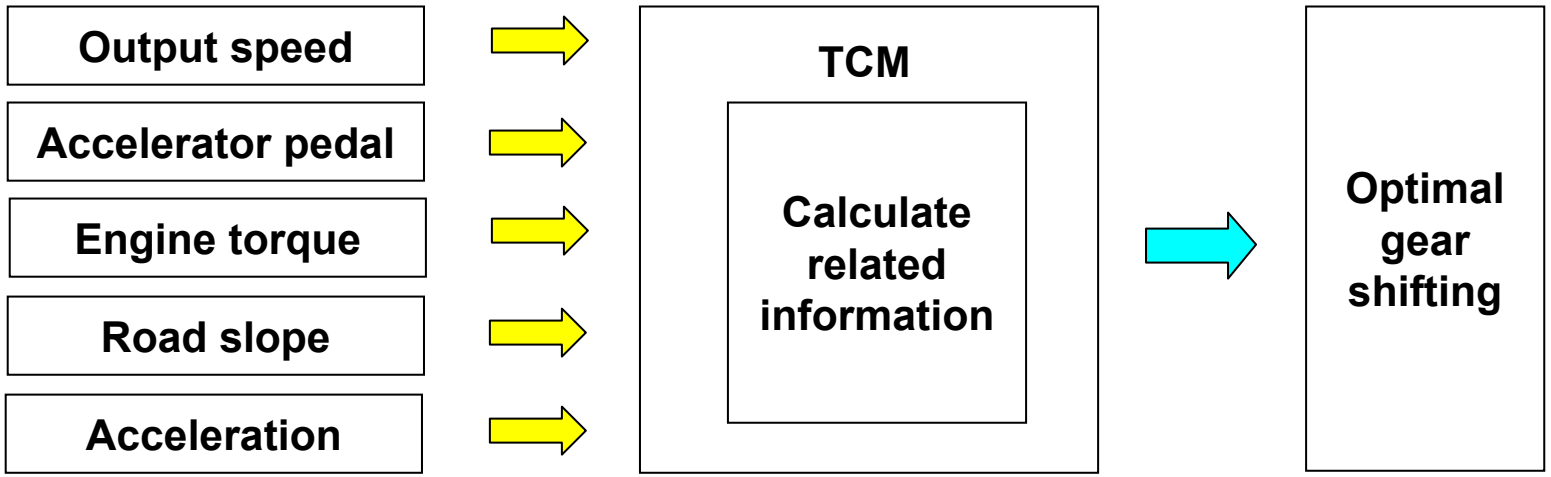
## Adaptive shift control

■ **Purpose**

- Optimal shift control according to the road and driving condition

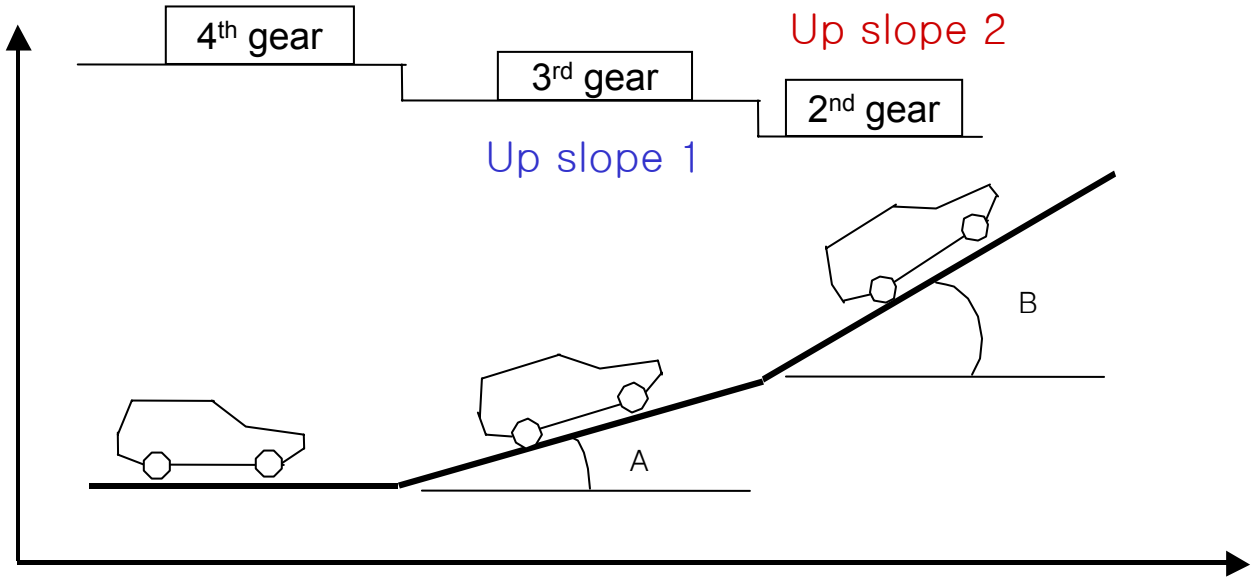
■ **Functions**

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



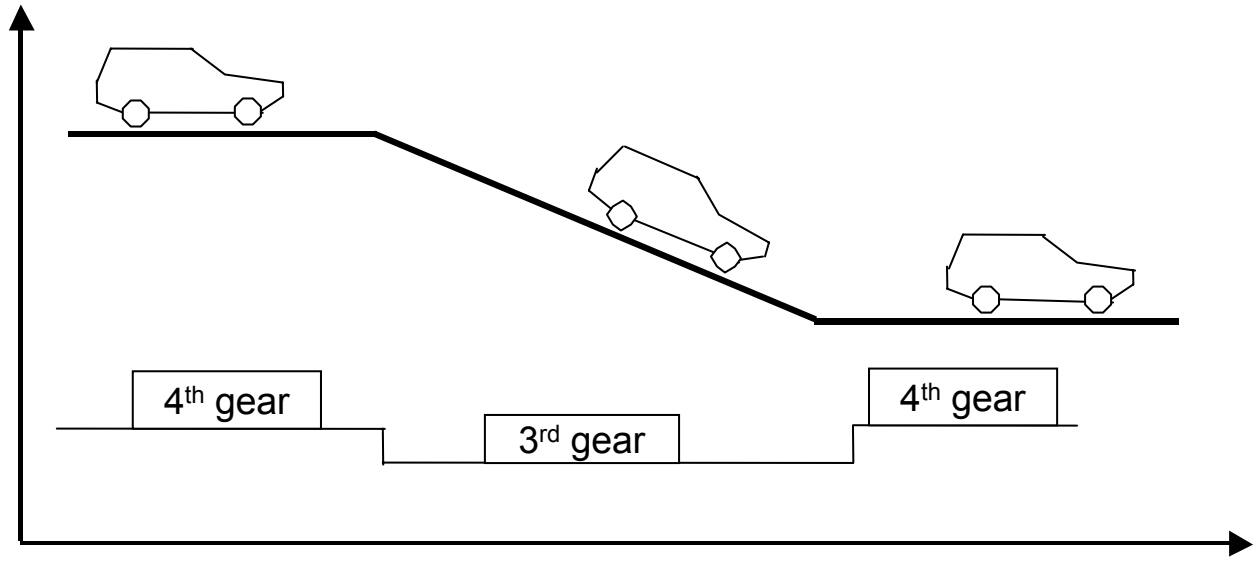
## Adaptive shift control (Up slope mode)

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.



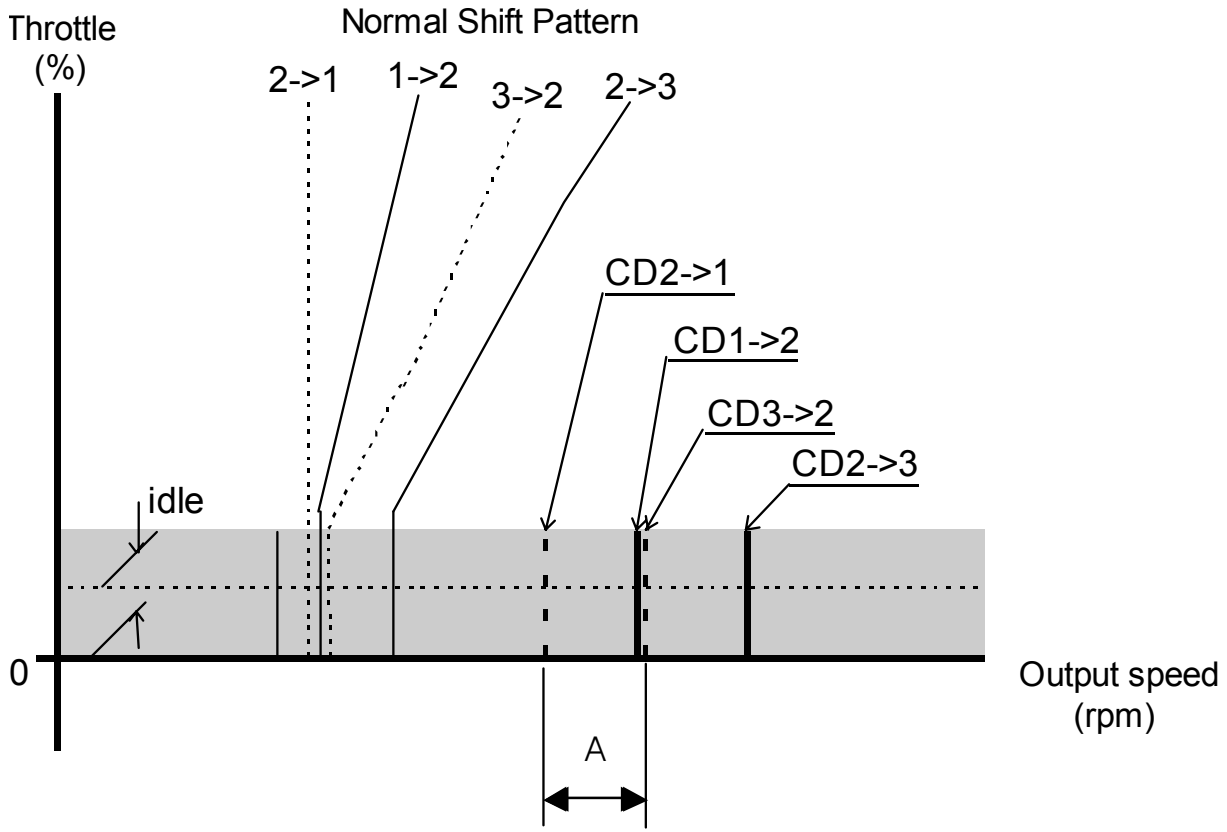
## Adaptive shift control (Down slope mode)

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 operating 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***

## 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

| Condition | | Possible cause |
|---|---|---|
| Above standard | In "D" and "R" range | Line pressure too low<br>OD clutch slipping<br>OD one-way clutch not operating properly |
| | In "D" range only | Forward clutch slipping<br>Rear one-way clutch not operating properly<br>Line pressure too low<br>OD clutch slipping<br>OD one-way clutch not operating properly |
| | In "R" range only | Direct clutch slipping<br>Low & reverse clutch slipping<br>Line pressure too low<br>OD clutch slipping<br>OD one-way clutch not operating properly |
| Below standard | | Engine out of tune<br>Slipping of one way clutch within torque converter |

## Line pressure test

| Shift position | Line Pressure (kg/cm$^2$) | |
|---|---|---|
| | Idle | Stall |
| D | 4.0 - 4.6 | 11.7 - 13.2 |
| R | 6.2 - 7.2 | 15.6 - 19.0 |

### ■ Test result

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

## 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

## 20 Pin DLC connector

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

## 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) un till IG off after engine starts.
And next IG off, ECM Rest (0)

| MUL_CODE | | MUL_INFO | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0 | OBD_FRF_ACK | | | | | |
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |

■ 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.*

| MUL_CODE | | MUL_INFO | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0 | OBD_FRF_ACK | | | | | |
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |

■ Message information

MUL_CODE:10 → OBD_FRF_ACK

Bit 0: 0 → W/C unsatisfied, Reset

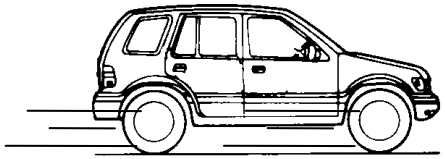
: 1 → W/C satisfied

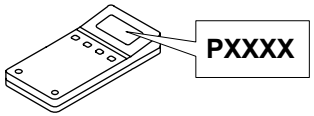
# DIAGNOSIS

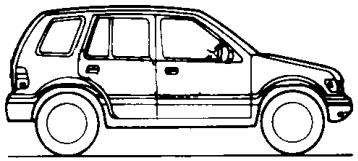
## 2 Consecutive Driving cycles

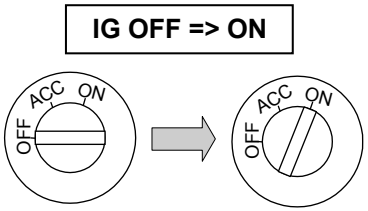
■ **2 Driving cycle detection:**

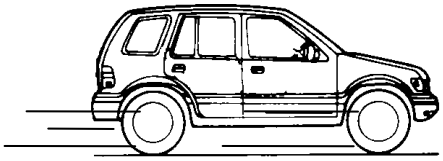
***DTC is duplicated in case same failure is detected at least 2 consecutive driving cycles.***







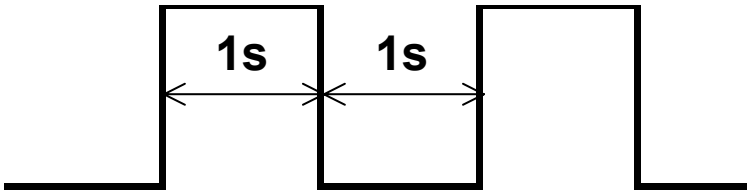



| | |
|---|---|
| 1 | Symptom simulation test |
| 2 | Tester detects one failure (one driving cycle) |
| 3 | IG OFF => ON |
| 4 | Perform the symptom simulation test again |
| 5 | Tester detects failure again (2 driving cycle) |

## 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

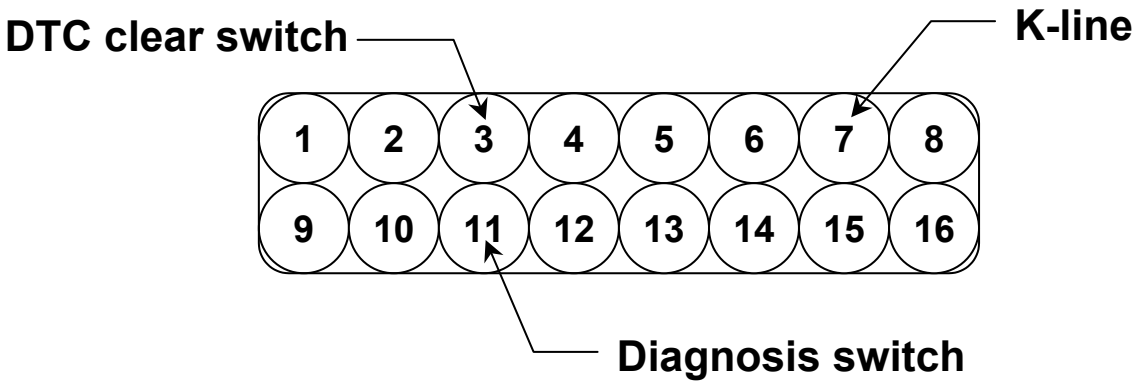
- Type A: 1D/C (DTC stored on the 1st driving cycle)
- Type B: 2D/C (DTC stored on the 2nd driving cycle)
- Type C: only failsafe (No memory)

■ 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

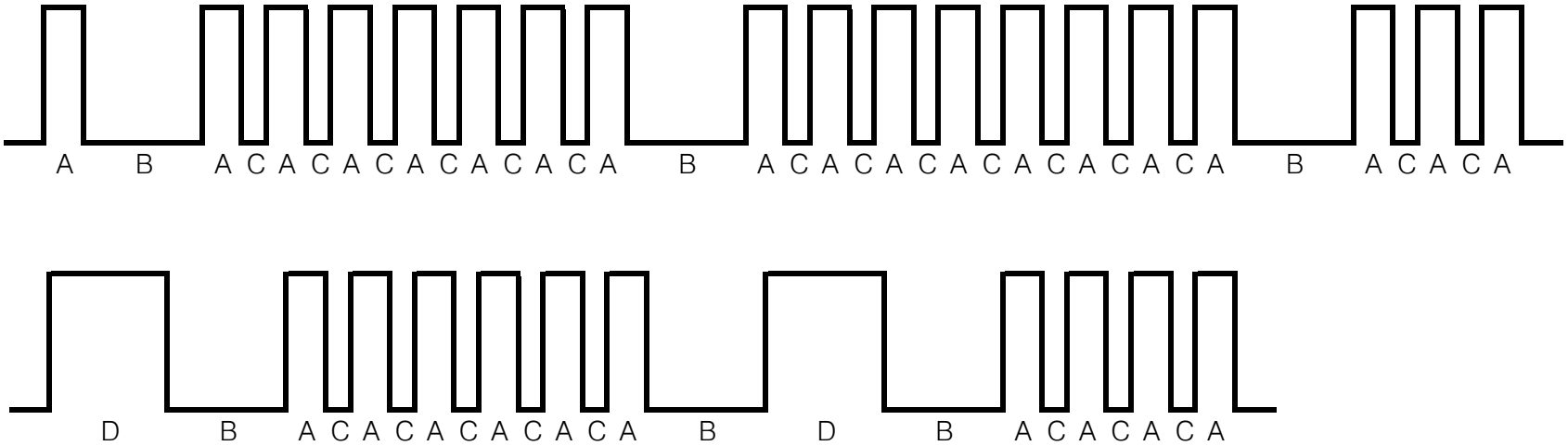
1) Let the PIN No. 11 of DLC ground.
2) O/D OFF lamp will be flashing several seconds after O/D OFF lamp turns on.
3) For the clear of Fail-code, let the PIN No. 3 of DLC ground over than 5 sec.




[Data Link Connector]

## 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

| Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|
| MIL blinking | MIL on | freeze frame | readiness |

■ 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

| CODE | DESCRIPTION | FAILSAFE |
|---|---|---|
| P0707 | Output speed >= 1130, Engine rpm>= 1500 | Judge 'D' range (system mechanically operates) |
| P0708 | 2 or more signals are dectected for more than 10 sec. | **D>2>L>R>N>P (operation priority)** |
| P0722 | (1st-3rd gear) No output while 45 input pulses detected<br>(4th gear) 1500 output rpm drop and 0 rpm detected | Gear shift by using input speed sensor signals<br>No lock-up/4th gear/ETR/LPC/Rverse/Squat control |
| P0743 | (Short to GND) 'OFF' detected for 300 msec after 'ON'<br>(Open/short to B+) 'ON' detected for 50 msec after 'OFF' | DCCSV OFF<br>1st gear hold if output rpm < 375 (Open/B+ short) |
| P0748 | (Open/short to GND) AD value =< 15 for 70 msec<br>(Short to B+) AD value >= 1000 for 500 msec | **4th gear hold** |
| P0753 | (Short to GND) 'OFF' detected for 300 msec after 'ON'<br>(Open/short to B+) 'ON' detected for 50 msec after 'OFF' | Lock-up inhibited<br>**Gear hold: D range-4th,2 range-3rd,L range-1st** |
| P0758 | (Short to GND) 'OFF' detected for 300 msec after 'ON'<br>(Open/short to B+) 'ON' detected for 50 msec after 'OFF' | Lock-up inhibited<br>**Gear hold: D range-4th,2 range-3rd,L range-1st** |
| P1121 | TPS message FF H is received for 0.2 sec | Judge TPS 0%, Max. line pressure, No ETR/LPC |
| P0710 | (Short) Abnormal sensor resistance detected for 5 min.<br>(Open) AD value is under 15 or over 1000 detected | Judge ATF temp. 200℃, No lock-up, ETR/LPC inhibited while shifting |
| P1115 | WT message FF H is received for 0.2 sec | Judge the Temperature normal |
| P0717 | No input while 12 pulses of output signal are detected | No lock-up, ETR/LPC inhibited while shifting |
| P0716 | Input speed >= 7000 rpm detected | - |
| P1630 | BUS OFF is detected 0.2 sec after IG on | No lock-up, maximum line pressure, No ETR/LPC |
| P1631 | No message received from ECM | No lock-up, maximum line pressure, No ETR/LPC |
| - | Output rpm >= 2260, TPS>=5%, Brake on >= 10sec | Ignore the brake signal, Lock-up available |

# DIAGNOSIS



| DTC | DESCRIPTION | 3.5 V6(EUR/US) | | 3.5 V6(DOM/GEN), A-2.5 | |
|---|---|---|---|---|---|
| | | Fault type | MIL | Fault type | W/L |
| P0707 | Transmission Range Sensor Circuit Low Input | B | O | B | - |
| P0708 | Transmission Range Sensor Circuit High Input | B | O | B | - |
| **P0722** | **Output Speed Sensor Circuit No Signal** | **B** | **O** | **B** | **O** |
| P0726 | Engine Speed Input Sensor Range/Performance | B | O | B | - |
| P0727 | Engine Speed signal invalid | B | O | B | - |
| P0740 | Torque Converter Clutch Circuit (SL) Malfunction | B | O | B | - |
| P0743 | Torque Converter Clutch Circuit (SL) Electrical | B | O | B | - |
| P0750 | Shift Solenoid A(S1) Malfunction | B | O | B | - |
| P0753 | Shift Solenoid A (S1 ) Electrical | A | O | A | - |
| P0755 | Shift Solenoid B (S2) Malfunction | B | O | B | - |
| P0758 | Shift Solenoid B (S2) Electrical | A | O | A | - |
| P0748 | Pressure Solenoid (SLT) Electrical | A | O | A | - |
| **P1121** | **Throttle Sensor Signal invalid** | **B** | **O** | **B** | **O** |
| P0710 | ATF Temp. Sensor Circuit Malfunction | B | O | B | - |
| P1115 | Water Temp. Signal Malfunction from ECU to TCU | B | O | B | - |
| **P0717** | **Input Speed Sensor Circuit No Signal** | **B** | **O** | **B** | **O** |
| P0716 | Input Speed Sensor Circuit Range / Performance | B | O | B | - |
| P1795 | Transfer High/Low(L4) Switch Malfunction | B | O | - | - |
| **P1630** | **CAN communication BUS OFF** | **B** | **O** | **B** | **O** |
| **P1631** | **No ID from ECU** | **B** | **O** | **B** | **O** |
| - | Vehicle Speed Signal From Meter Set | C | - | - | - |
| - | Brake SW malfunction | C | - | C | - |

*** 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

| | |
|---|---|
| P0753<br>P0758<br>P0743 | **Solenoid No.1 (S1) Open, Ground short**<br>**Solenoid No.2 (S2) Open, Ground short**<br>**L-up solenoid (SL) Open, Ground short** |

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

## Troubleshooting

| P0748 | Pressure control solenoid Open, Ground short |
|---|---|

| DTC detected condition | Cause of failure |
|---|---|
| **Open/short to GND:**<br>**20 mA** or less current has been detected for **12.5 seconds or more,** DTC is memorized.<br><br>**Short to B+:**<br>**1.36 A** or more output current is detected for **0.5 seconds or more,** DTC is memorized. | 1. Harness or connector between PCSV and TCM.<br>2. PCSV<br>3. TCM |

## Troubleshooting

| | |
|---|---|
| **P0716, P0717<br>P0722** | **Input speed sensor No signal<br>Output speed sensor No signal** |

| DTC detected condition | Cause of failure |
|---|---|
| **No C0 signal:**<br>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.<br><br>**No SP signal :**<br>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. | 1. Harness or connector between each speed sensor and TCM.<br>2. Each speed sensor<br>3. TCM |

## Troubleshooting

| P0707 | TR switch No signal, Open |
|---|---|

| DTC detected condition | Cause of failure |
|---|---|
| **No signal:**<br>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.<br><br>**Open:**<br>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. | 1. Harness or connector between TR switch and TCM.<br>2. TR switch<br>3. TCM |

## Troubleshooting

| P0710 | ATF temp. sensor open or short to Ground |
|---|---|

| DTC detected condition | Cause of failure |
|---|---|
| **Open:**<br>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.<br><br>**Ground short:**<br>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.<br>2. ATF temp. sensor<br>3. TCM |

## TCM input and output terminal voltage table

| No | PIN NAME | CONDITION | INPUT&OUTPUT SIGNAL | | REMARK |
|---|---|---|---|---|---|
| | | | TYPE | Level | |
| 13 | SCSV 1<br>(1st, 2nd speed operation) | DRIVING<br>(P,N/1st/2nd 3rd/4th speed) | Frequency | Vbatt - 0V<br>Io : 1.9A MAX | SCSV1:<br>Shift Control Solenoid Valve no.1 |
| 14 | SCSV 2<br>(2nd,3rd speed operation) | DRIVING<br>(P,N/1st/2nd 3rd/4th speed) | Frequency | Vbatt - 0V<br>Io : 1.9A MAX | SCSV2:<br>Shift Control Solenoid Valve no.2 |
| 9 | SNOW SW<br>(2WD VEHICLE) | SW OFF | Frequency | $V_{GND}$ -0.3 - 2V | |
| | | SW ON | DC | V(IG.1) | |
| 7 | C0 CYLINDER REV. SNSR<br>(Over drive clutch drum) | IDLE | Pusle | $V_{Hi}$ - $V_{Low}$<br>16 Pulse/Co cylinder rev. | <- Input speed sensor |
| 8 | VEHICLE SPEED SENSOR | DRIVING | Pulse | $V_{Hi}$ - $V_{Low}$<br>12Pulse/TM rev. | <- Output speed |
| 31 | O/D OFF SW | OFF SW OFF | DC | V(IG.1) | |
| | | OFF SW ON | DC | $V_{GND}$ -0.3 - 2V | |
| 48 | INHIBITOR SW(P) | P | DC | Vbatt | |
| | | R/N/D/2/L | DC | BELOW 0.8V | |
| 12 | INHIBITOR SW(R) | R | DC | Vbatt | |
| | | P/N/D/2/L | DC | BELOW 0.8V | |
| 34 | BATT | IGN OFF | DC | Vbatt | |
| | | IGN ON | DC | Vbatt | |
| 2 | LOCK-UP SOLENOID | DRIVING<br>(over 45km/h) | Frequency | Vbatt - 0V<br>Lo : 1.9A MAX | <- Torque conveter solenoid valve |
| 3 | PCSV | IDLE | | Current control<br>Lo : 1A MAX | Pressure control solenoid valve |

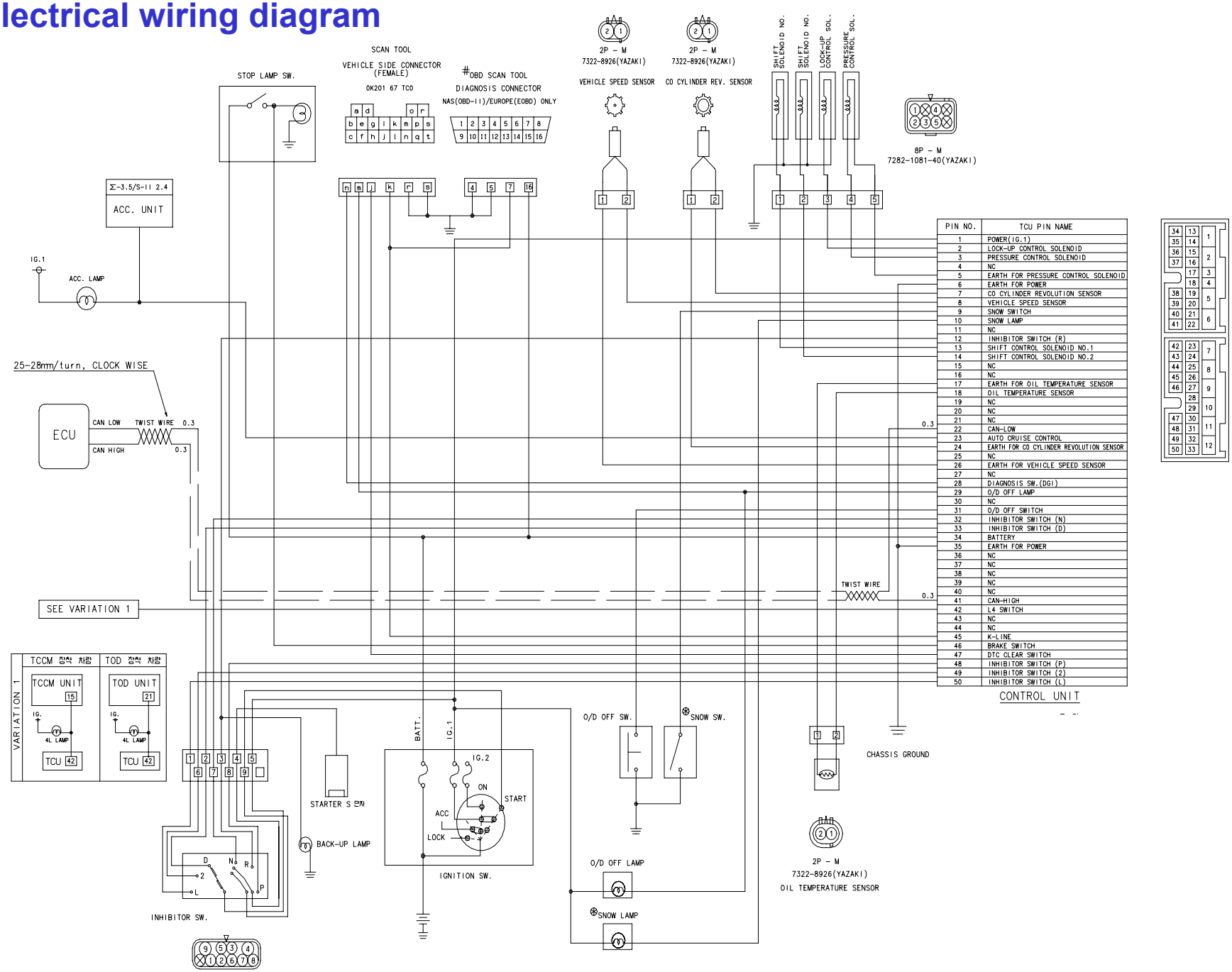
## TCM input and output terminal voltage table

| No | PIN NAME | CONDITION | INPUT&OUTPUT SIGNAL | | REMARK |
|---|---|---|---|---|---|
| | | | TYPE | Level | |
| 5 | EARTH FOR PCSV | | | | |
| 47 | DTC CLEAR SW | S/W OFF | DC | V(IG.1) | |
| | | S/W ON | DC | $V_{GND}$ -0.3 - 1.0V | |
| 18 | OIL TEMP SNSR | IGN OFF | DC | 0V | |
| | | IDLE | DC | 0 - 5V | |
| 24 | EARTH FOR C0 CYLINDER REV. SNSR | | | | |
| 26 | EARTH FOR VSS | | | | |
| 42 | L4 SW (4WD VEHICLE) | SW OFF | DC | V(IG.1) | |
| | | SW ON | DC | $V_{GND}$ -0.3 - 1.0V | |
| 10 | SNOW LAMP (2WD VEHICLE) | LAMP OFF | DC | Vbatt | |
| | | LAMP ON | DC | 1.5V MAX | |
| 29 | O/D OFF LAMP | LAMP OFF | DC | Vbatt | |
| | | LAMP ON | DC | 1.5V MAX | |
| 32 | INHIBITOR SW(N) | N | DC | Vbatt | |
| | | P/R/D/2/L | DC | BELOW 0.8V | |
| 33 | INHIBITOR SW(D) | D | DC | Vbatt | |
| | | P/R/N/2/L | DC | BELOW 0.8V | |
| 1 | POWER(IGN 1) | IGN OFF | DC | 0V | |
| | | IGN ON | DC | 9V - 16V | |
| 6 | EARTH FOR POWER | | | | |
| 46 | BRAKE SW | SW OFF | DC | $V_{GND}$ -0.3 - 2V | |
| | | SW ON | DC | Vbatt-2.0 - Vbatt | |
| 35 | EARTH FOR POWER | | | | |
| 17 | EARTH FOR OTS | | | | OTS:Oil Temp. Sensor |

## TCM input and output terminal voltage table

| No | PIN NAME | CONDITION | INPUT&OUTPUT SIGNAL | | REMARK |
|---|---|---|---|---|---|
| | | | TYPE | Level | |
| 45 | K-LINE | Continuity (10.4Kbps) | Pulse | Logic "0" : Vbatt 20% ↓<br>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 | | V(IG.1) | |
| | | ACC ON | | $V_{GND}$ -0.3 - 1.5V | |
| 41 | CAN(HIGH) | Continuity (500kbit/s) | | | |
| | | | | | |
| 22 | CAN(LOW) | Continuity (500kbit/s) | | | |
| | | | | | |

# Electrical wiring diagram

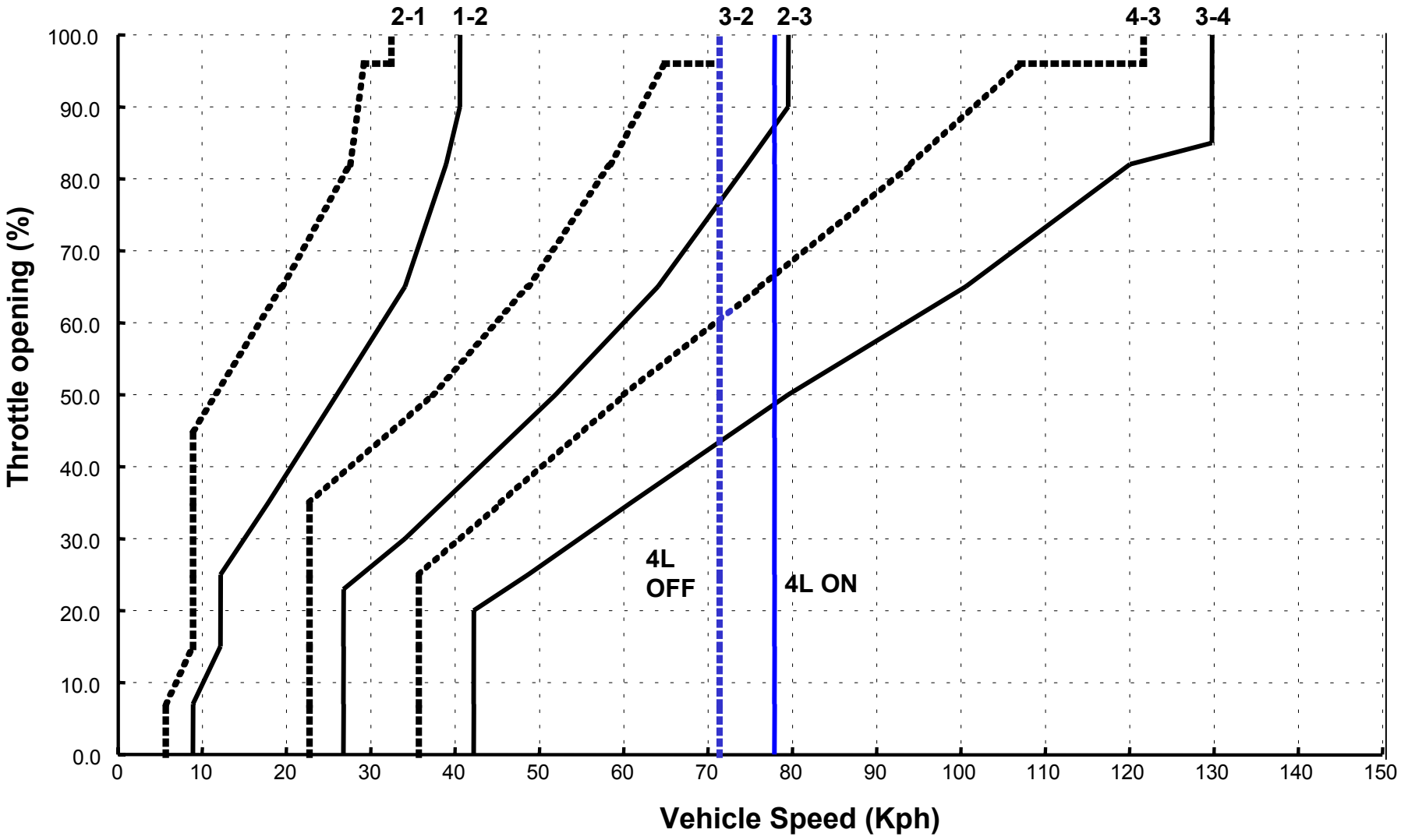



| PIN NO. | TCU PIN NAME |
|---|---|
| 1 | POWER(IG.1) |
| 2 | LOCK-UP CONTROL SOLENOID |
| 3 | PRESSURE CONTROL SOLENOID |
| 4 | NC |
| 5 | EARTH FOR PRESSURE CONTROL SOLENOID |
| 6 | EARTH FOR POWER |
| 7 | C0 CYLINDER REVOLUTION SENSOR |
| 8 | VEHICLE SPEED SENSOR |
| 9 | SNOW SWITCH |
| 10 | SNOW LAMP |
| 11 | NC |
| 12 | INHIBITOR SWITCH (R) |
| 13 | SHIFT CONTROL SOLENOID NO.1 |
| 14 | SHIFT CONTROL SOLENOID NO.2 |
| 15 | NC |
| 16 | NC |
| 17 | EARTH FOR OIL TEMPERATURE SENSOR |
| 18 | OIL TEMPERATURE SENSOR |
| 19 | NC |
| 20 | NC |
| 21 | NC |
| 22 | CAN-LOW |
| 23 | AUTO CRUISE CONTROL |
| 24 | EARTH FOR C0 CYLINDER REVOLUTION SENSOR |
| 25 | NC |
| 26 | EARTH FOR VEHICLE SPEED SENSOR |
| 27 | NC |
| 28 | DIAGNOSIS SW.(DGI) |
| 29 | O/D OFF LAMP |
| 30 | NC |
| 31 | O/D OFF SWITCH |
| 32 | INHIBITOR SWITCH (N) |
| 33 | INHIBITOR SWITCH (D) |
| 34 | BATTERY |
| 35 | EARTH FOR POWER |
| 36 | NC |
| 37 | NC |
| 38 | NC |
| 39 | NC |
| 40 | NC |
| 41 | CAN-HIGH |
| 42 | L4 SWITCH |
| 43 | NC |
| 44 | NC |
| 45 | K-LINE |
| 46 | BRAKE SWITCH |
| 47 | DTC CLEAR SWITCH |
| 48 | INHIBITOR SWITCH (P) |
| 49 | INHIBITOR SWITCH (2) |
| 50 | INHIBITOR SWITCH (L) |

# SHIFT PATTERN



## BL A-2.5 SHIFT PATTERN (Normal D range:FGR 4.181)



# SHIFT PATTERN



## BL Σ3.5 SHIFT PATTERN (Normal D range: FGR 4.666)