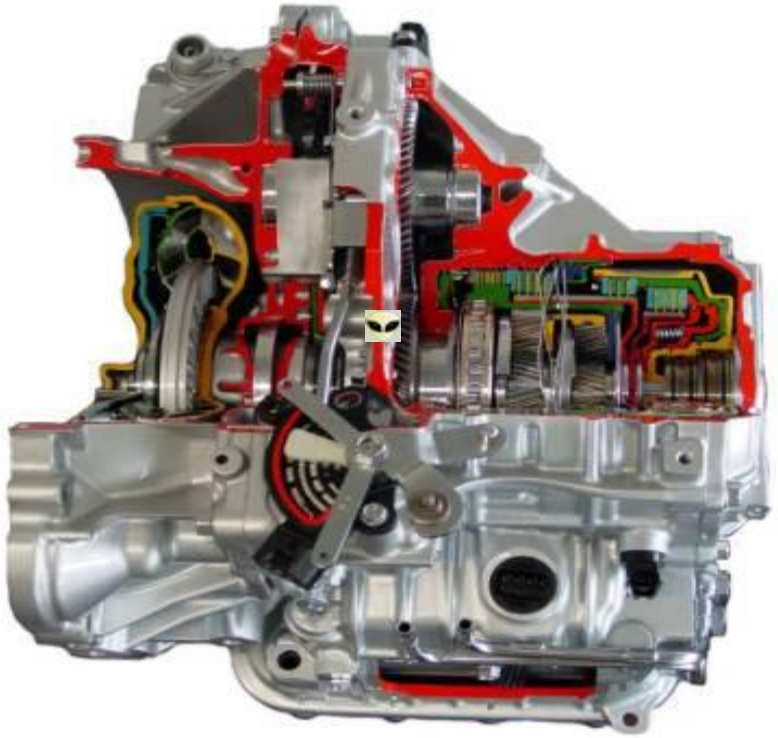
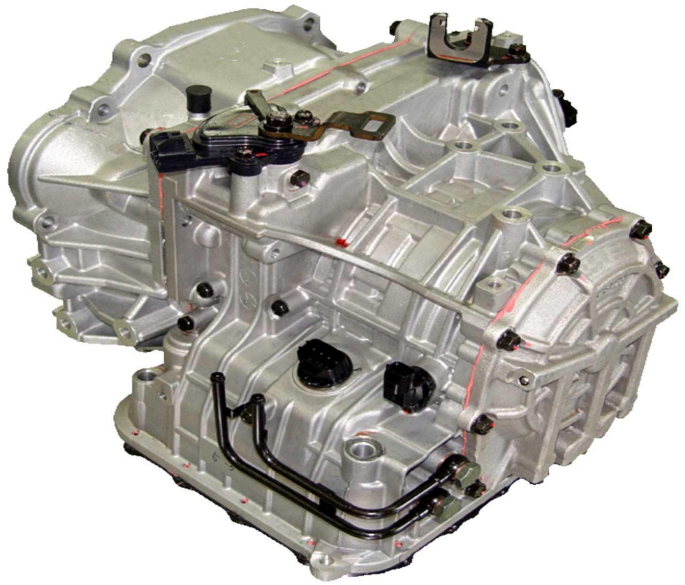
A4CFx – New Alpha



Power Train Variation

Engine	T/M		Area			
	M/T	A/T	Korea	NAS	GEN	AUS
Gamma-1.6 (Bosch)	M5CF1	A4CF1 (Bosch)	●	-	●	-
Beta II-2.0 (Siemens)	M5CF2	A4CF2 (Siemens)	●	●	●	●
U-1.6(CRDI) (Bosch)	M5CF3	A4CF2 (Bosch)	●	-	●	-

(M5CFx)



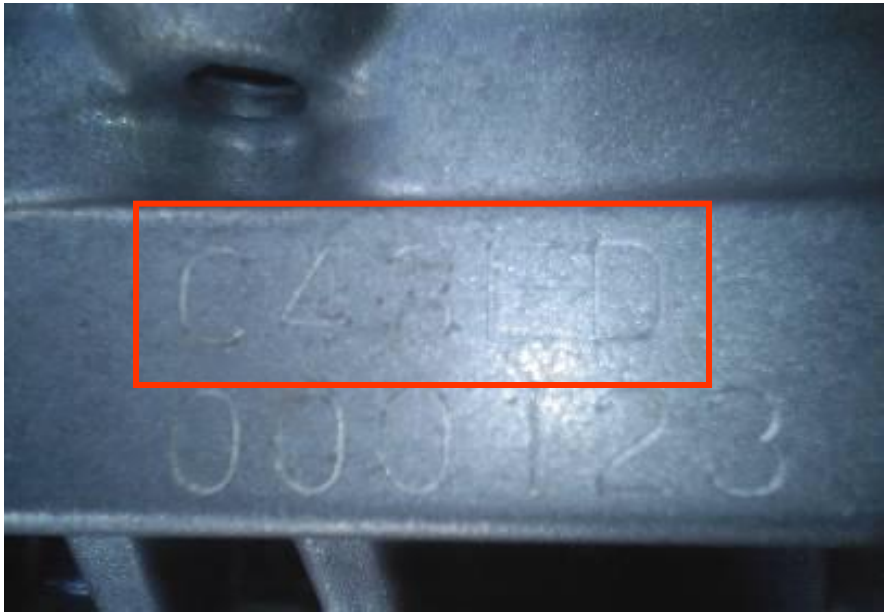
(A4CFx)

Power Train Variation

Manual/Auto	Vehicle	Engine	Type	Remarks
MT	FC	U-1.5	M5CF2	
	XD	U-1.5		
	MC	U-1.5		
		Alpha-II	M5CF1	
	TB	U1.5	M5CF2	
	HD	Gamma 1.6	M5CF1	
		Beta II 2.0	M5CF2	
		U1.6	M5CF3	
AT	HD	Gamma 1.6	A4CF1	PCM (Bosch)
		Beta II 2.0	A4CF2	PCM (Siemens)
		U1.6	A4CF2	TCM (Bosch)

*** In this material only New Alpha transmission will be introduced.**

Stamping Mark

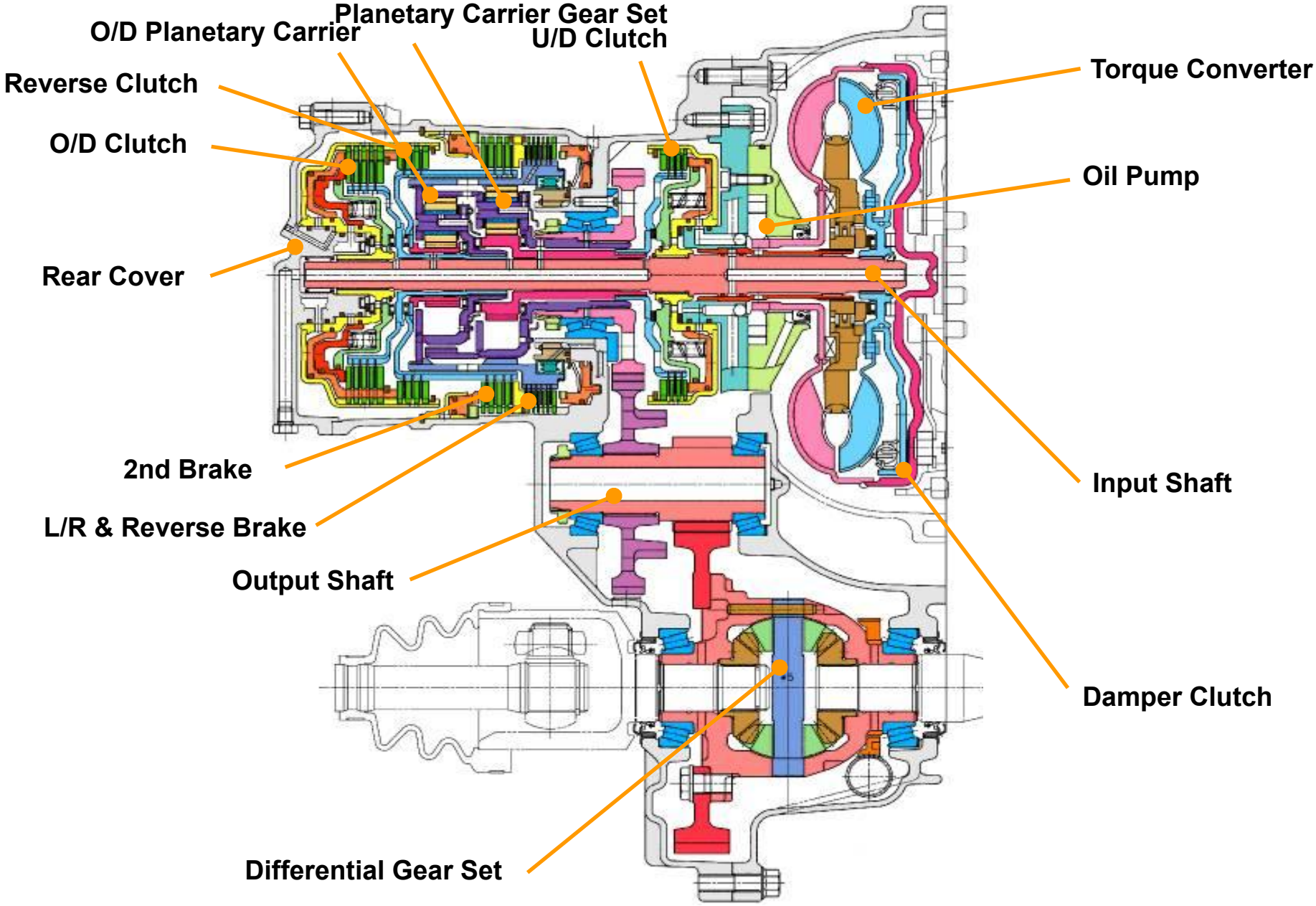


Vehicle	Engine	Type	FGR	Mark
HD	Gamma 1.6	A4CF1	4.375	A43AD
	Beta 2.0	A4CF2	3.849	B48CD
	U 1.6 CRDI		3.532	D45JD

Notice : FGR can be changeable without any notice.

*** To distinguish Transmission, you can use stamping mark on top of transmission. Even same type of transmission is used, FGR and some components can be possibly different. Choose correct one whenever you replace auto transmission.**

Main Components



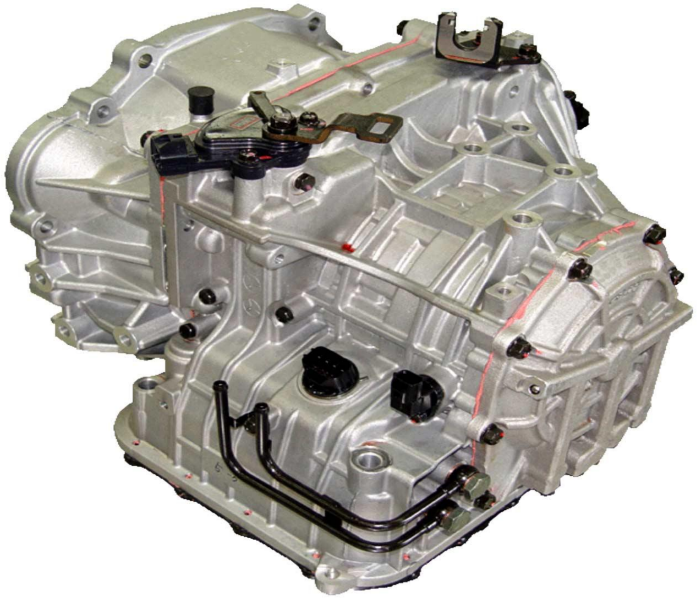
Specification

Items	A4CF1	A4CF2		A4AF3
Engine	Gamma	Beta II 2.0	U 1.6	Alpha II
Torque (kg · m)	15.5	24		14.6
Number of OWC	1	←	←	←
Number of Clutch	3	←	←	←
Number of Brake	2	←	←	←
Centrifugal Balance Chamber	3 (UD, OD, Reverse Clutch)			1 (Frt. Clutch)
Accumulator	4(UD,OD,2nd,RVS)			1
Solenoid valves	6 (PWM-5, VFS-1)			6 (On,Off-3, PWM-3)
Gear Shift Position	7 Range with 3th Position Switch			6 with O/D switch

Specification

Items	A4CF1	A4CF2	A4AF3
Overall Length	379mm		390.5mm
Weight	71.9kg		76kg
T/Con. Size (Φ)	236mm		230mm
1st Gear Ratio	2.919		2.846
2nd Gear Ratio	1.551		1.581
3rd Gear Ratio	1.000		1.000
4th Gear Ratio	0.713		0.685
Reverse Gear Ratio	2.480		2.176
Oil	Diamond SP III		←
Oil Capacity	6.2 L		6.7 L

Main Features



- Long travel damper clutch
- Flat & Long Travel type torque converter
- Full line pressure control (VFS)
- High capacity oil pump

  (Alloy Material)
- Flexible Printed circuit (FBC) used
- Hall type PG-A and PG-B
- Eliminating VSS

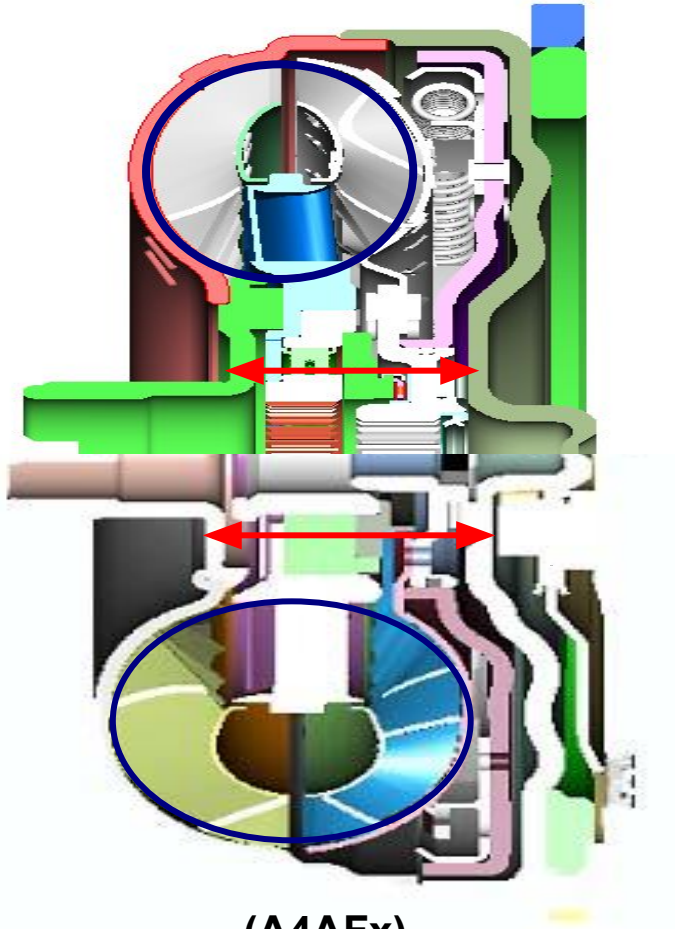
  (PGB is used alternatively)
- Grinding type gears (Reducing NVH)

Oil Pump

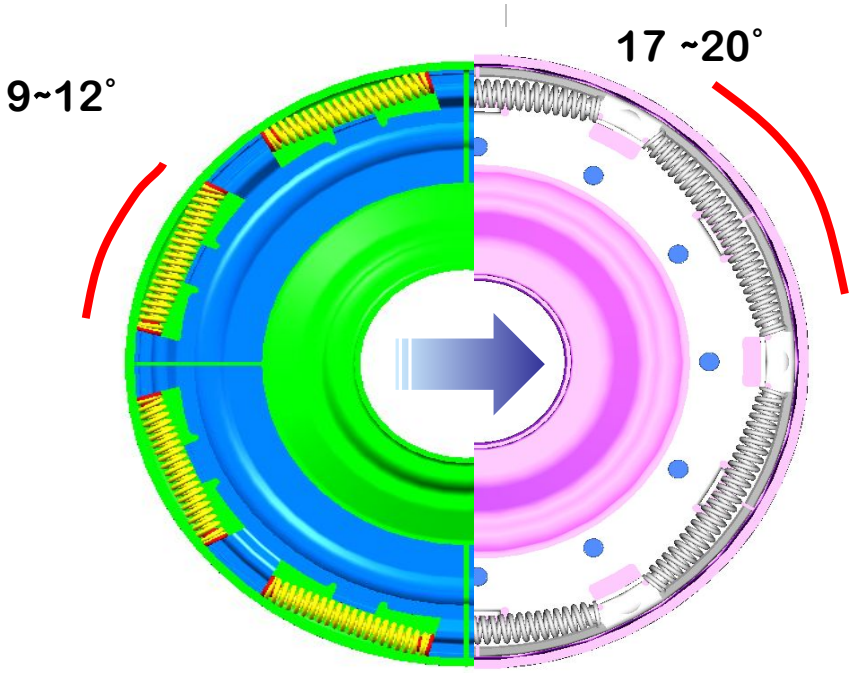
Item	A4CFx	A4AFx
Feature	- Parachoid Rotor - Material : Alloy	- Trochoid Centric Rotor - Material : Iron
Efficiency	- Volumetric Efficiency improved : 80 % (1000 RPM) - Weight, Driving Torque, Easy machining	- Volumetric Efficiency Lower : 60 % (1000 RPM)
Weight	1.9 Kg	4.7 Kg
Rotor Shape		

Torque Converter

(A4CFx)



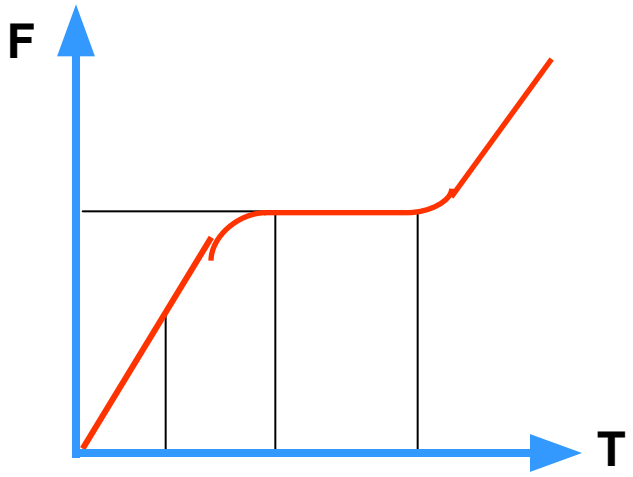
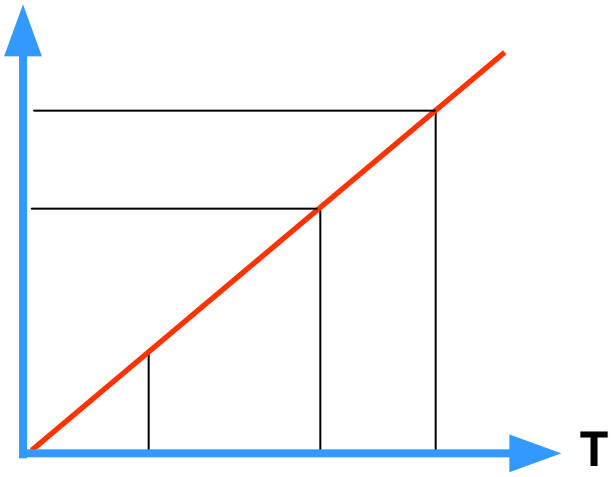
(A4AFx)



(A4AFx) (A4CFx)

- Reducing Thickness by 5mm
- Adapting long travel damper spring

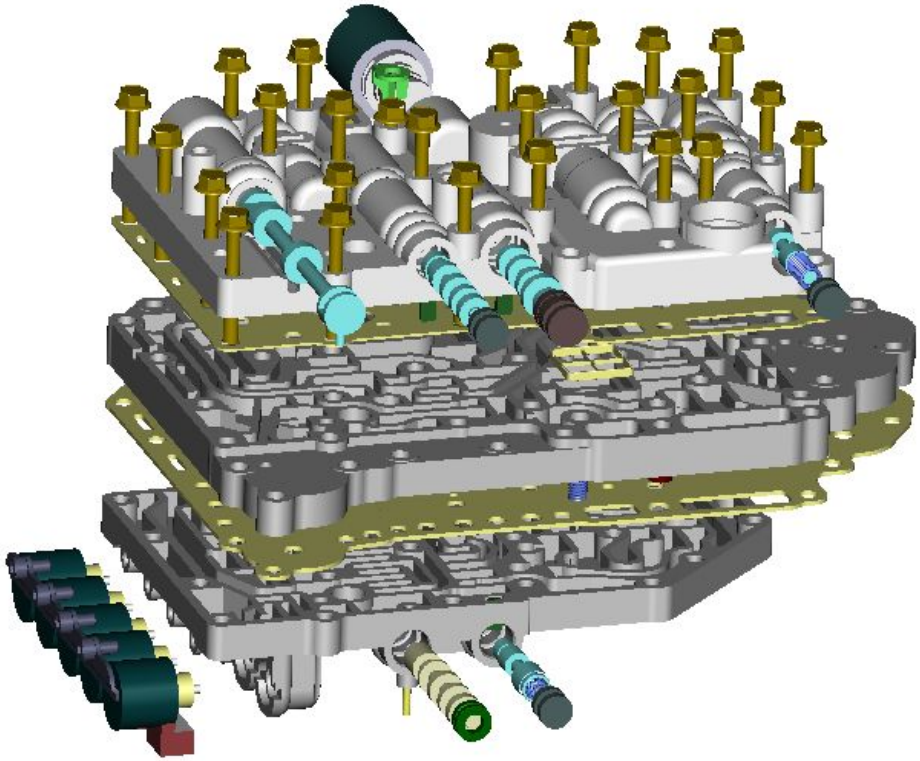
Disc Type Return Spring (L/R Brake)

Type	 **Disc**	 **Spring**
Performance Curve		
Advantage	Reaction Force is constantly held during lifetime.	Reaction Force is gradually decreased.

Oil Separator

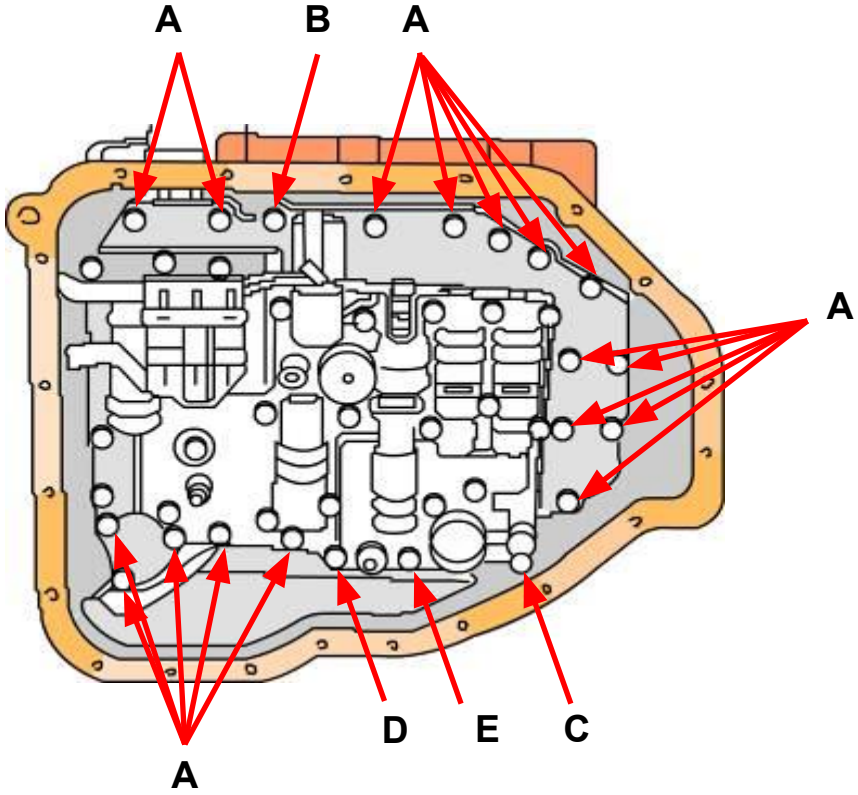
- Reducing the supplying oil for differential gear
- Reducing friction loss by differential gear rotation
- Increasing lubrication efficiency holding T/M oil in bottom side

Valve Body

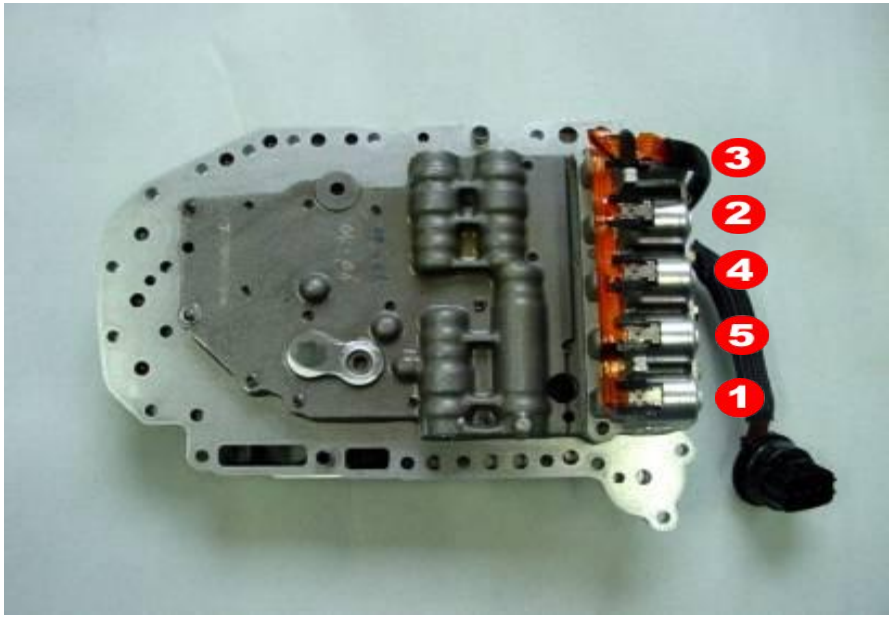


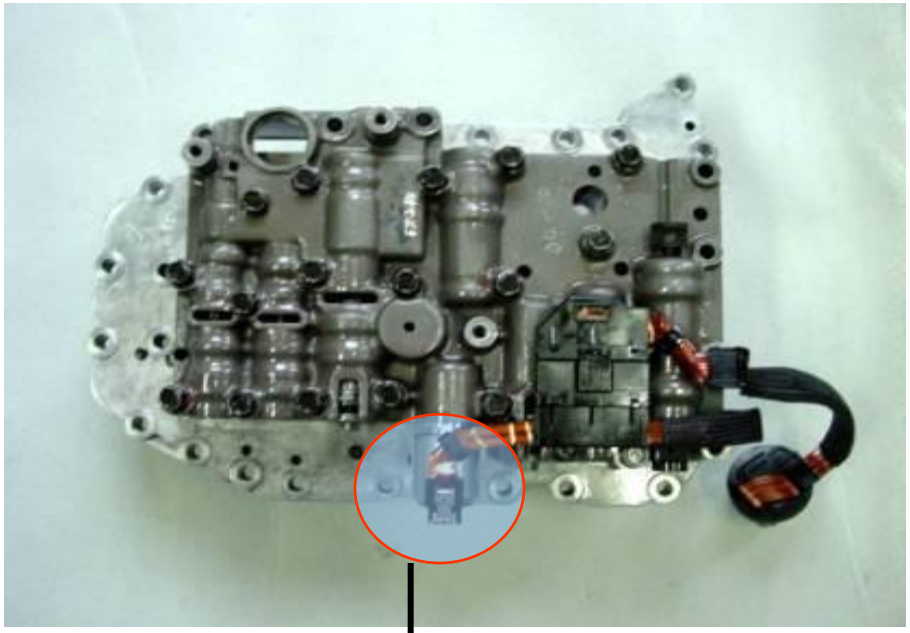
* To remove the valve body,
  - A type (6x30mm) : 17EA
  - B type (6x35mm) : 1EA
  - C type (6x40mm) : 1EA
  - D type (6x55mm) : 1EA
  - E type (6x60mm) : 1EA

- Valve body and spool valve are from Alloy
- Full line pressure control
- Individual Clutch to Clutch Control



Solenoid Valve

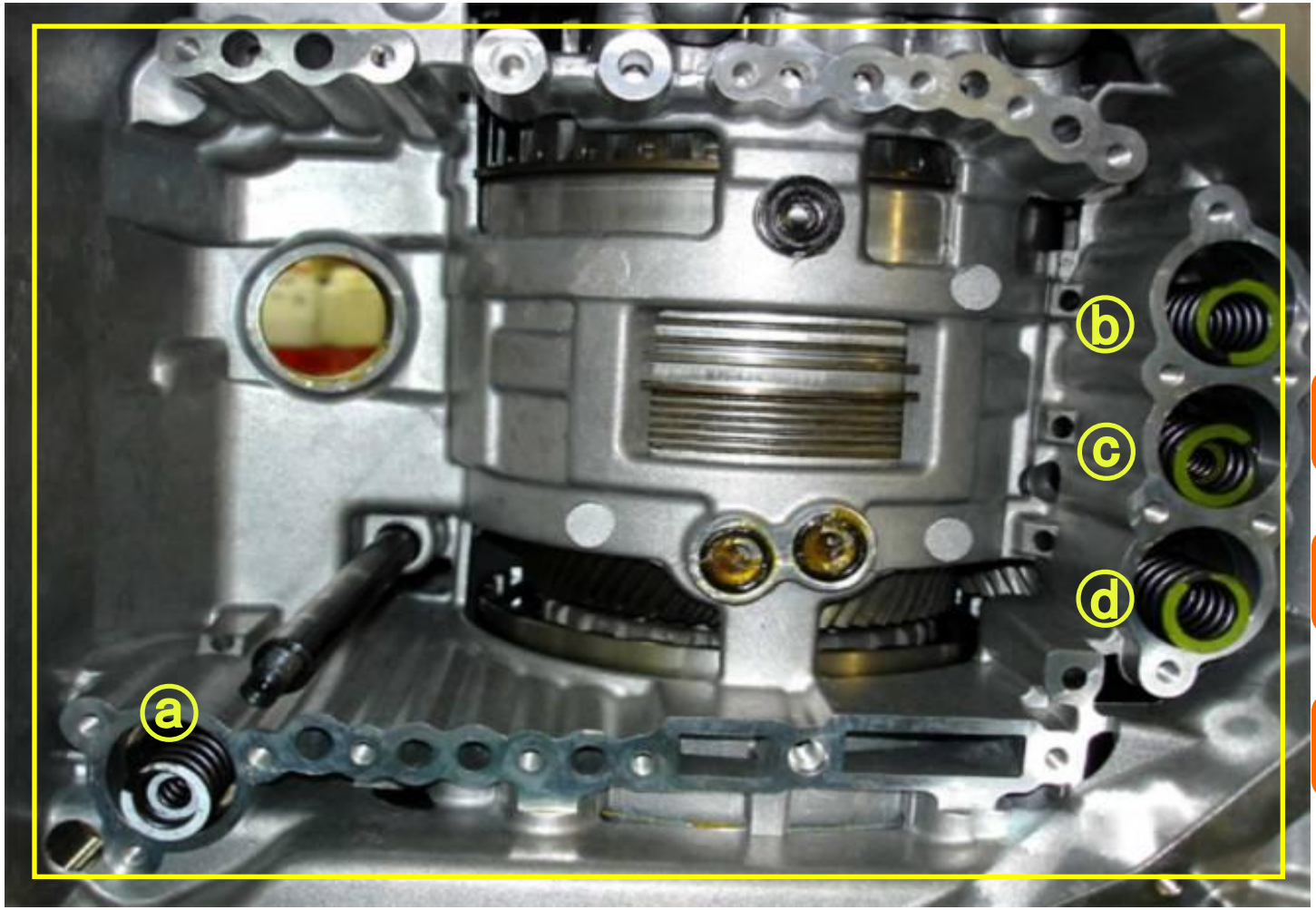




1. PCSV - A : O/D or LR Solenoid
2. PCSV - B : 2/4 or REV Solenoid
3. PCSV - C : UD Solenoid
4. PCSV - D : Damper Clutch Solenoid
5. On/Off Sol V/V : Switching PCSV – A from LR to O/D
   (Switch on – LR engaged, off- O/D engaged)

* Each solenoid can be interchangeable except VFS (Variable Force Solenoid)

Accumulator



- Each Spring can be interchangeable except white one

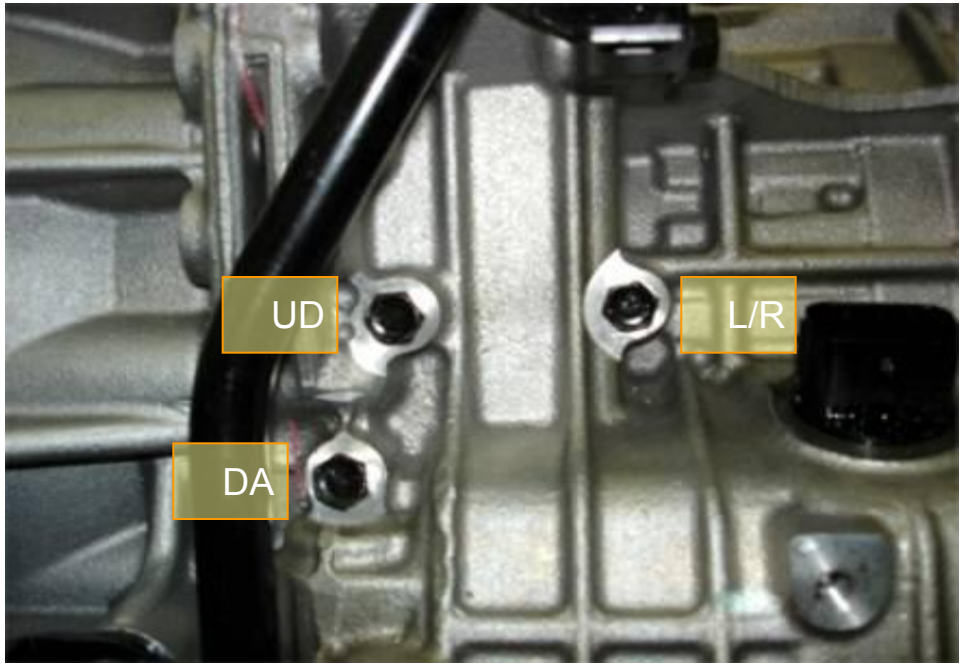
ⓑ OD (one spring with yellow color)

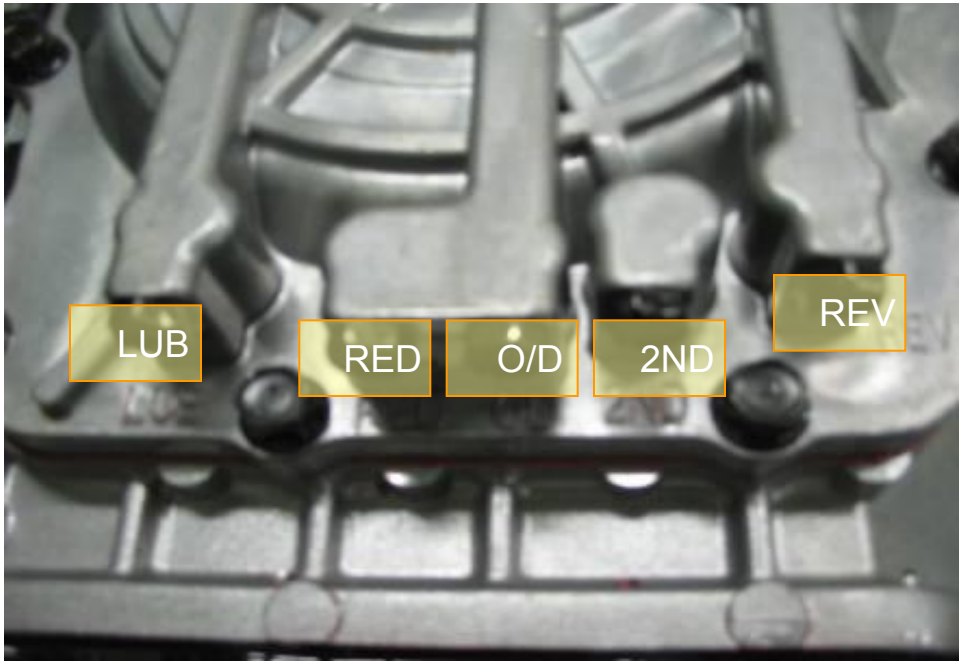
ⓒ 2nd (two springs with yellow color)

ⓓ L/R (one spring with yellow color)

ⓐ UD (two springs with white color)

Hydraulic Pressure Checking Port

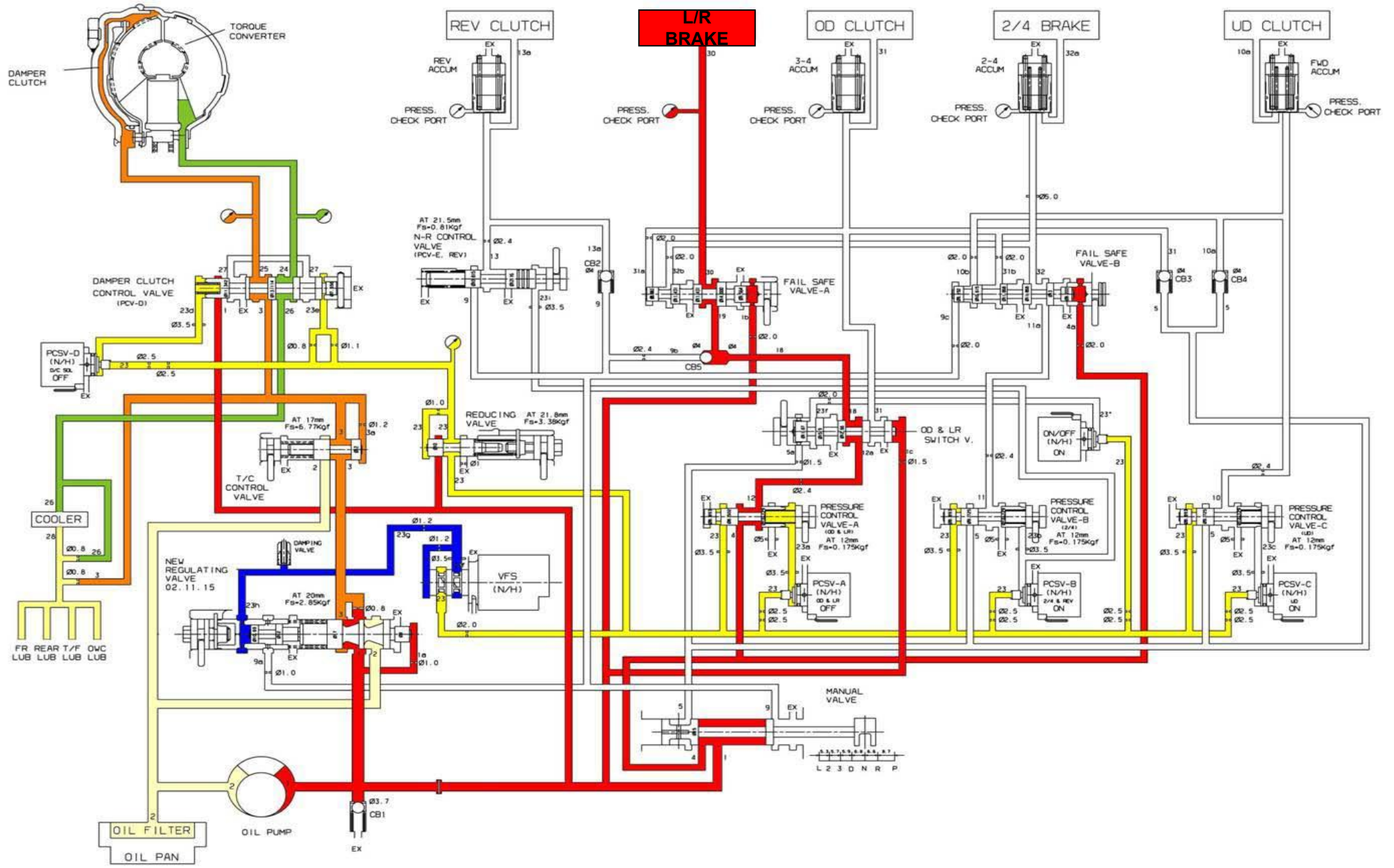




* **Totally 8 checking ports are used.**

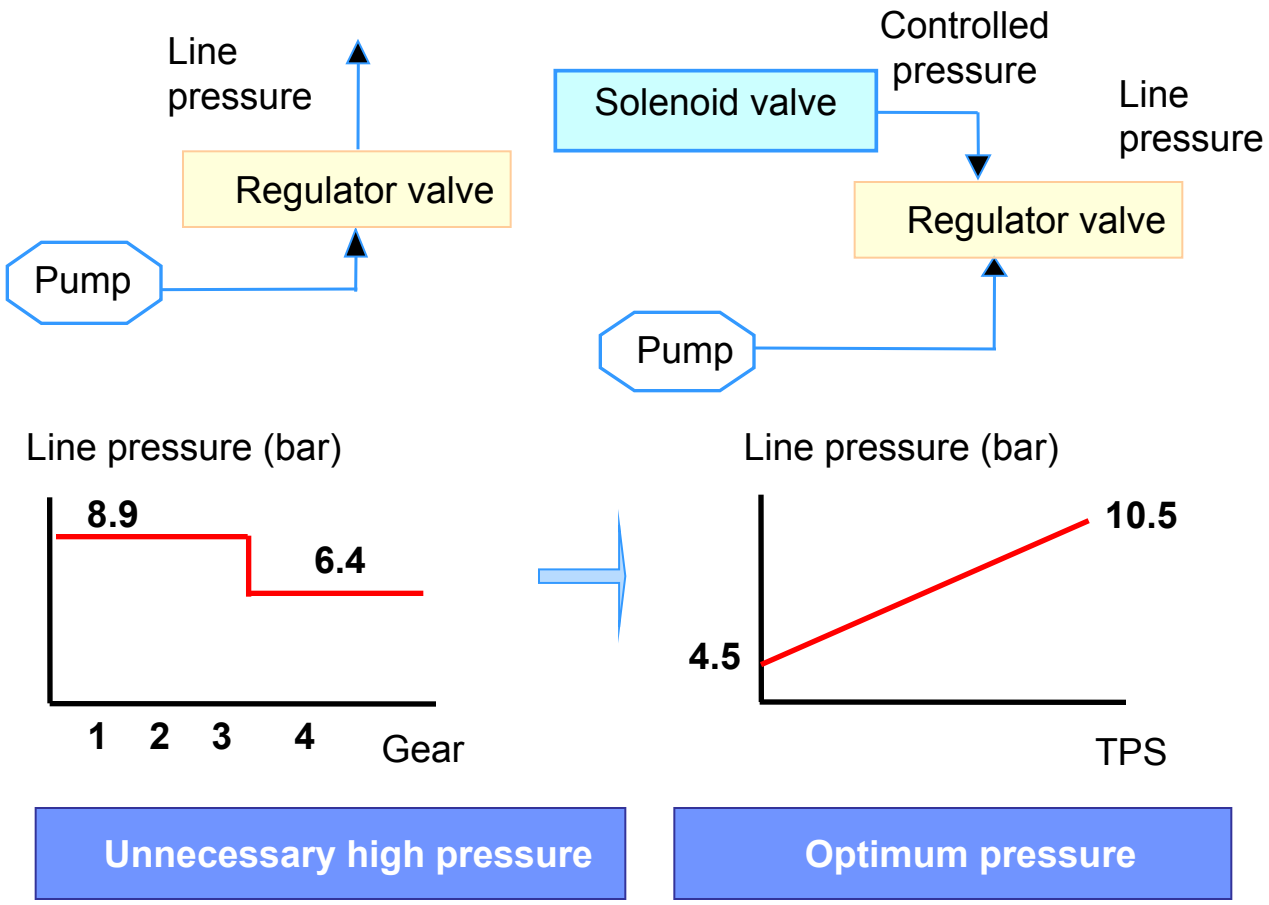
- **UD : UD Clutch**
- **L/R : L/R Brake**
- **DA : Damper Clutch**
- **LUB : Lubrication Pressure**
- **RED : Reducing Pressure**
- **O/D : O/D Clutch**
- **2^{nd} : 2^{nd} Brake**
- **REV : Reverse Clutch**

Pressure Circuit (P/N)

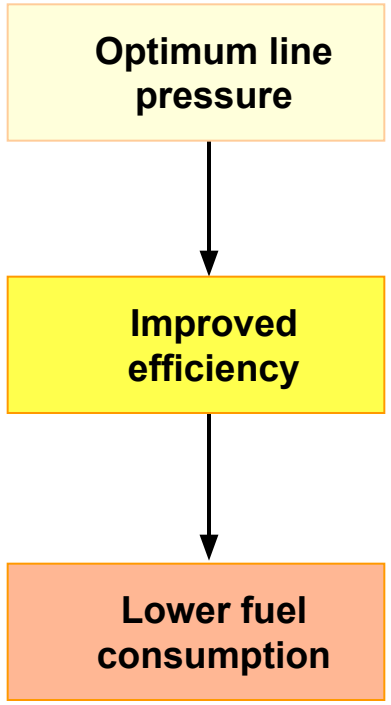


VFS (Variable Force Solenoid)

Comparison

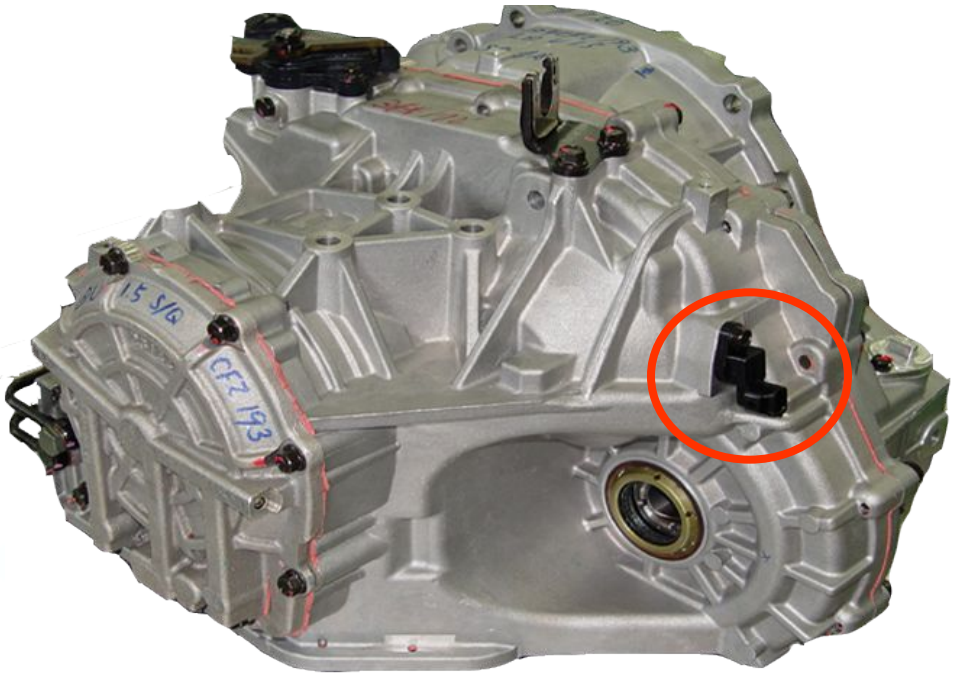


Purpose



* Advantage : To improve fuel consumption reducing unnecessary high pressure so as to decrease fuel consumption rate.

VSS (Vehicle Speed Sensor)



- VSS is eliminated in A4CFx. Instead of this, output speed sensor (PGB) is used for TCM. After filtering from output speed sensor, TCM send its speed information to cluster visa designated terminal.

  In case of engine management, frt. wheel speed sensor is used for vehicle speed acquisition like MC.

Shift Lever & 3rd Gear Position Switch

(A4CFx in HD)

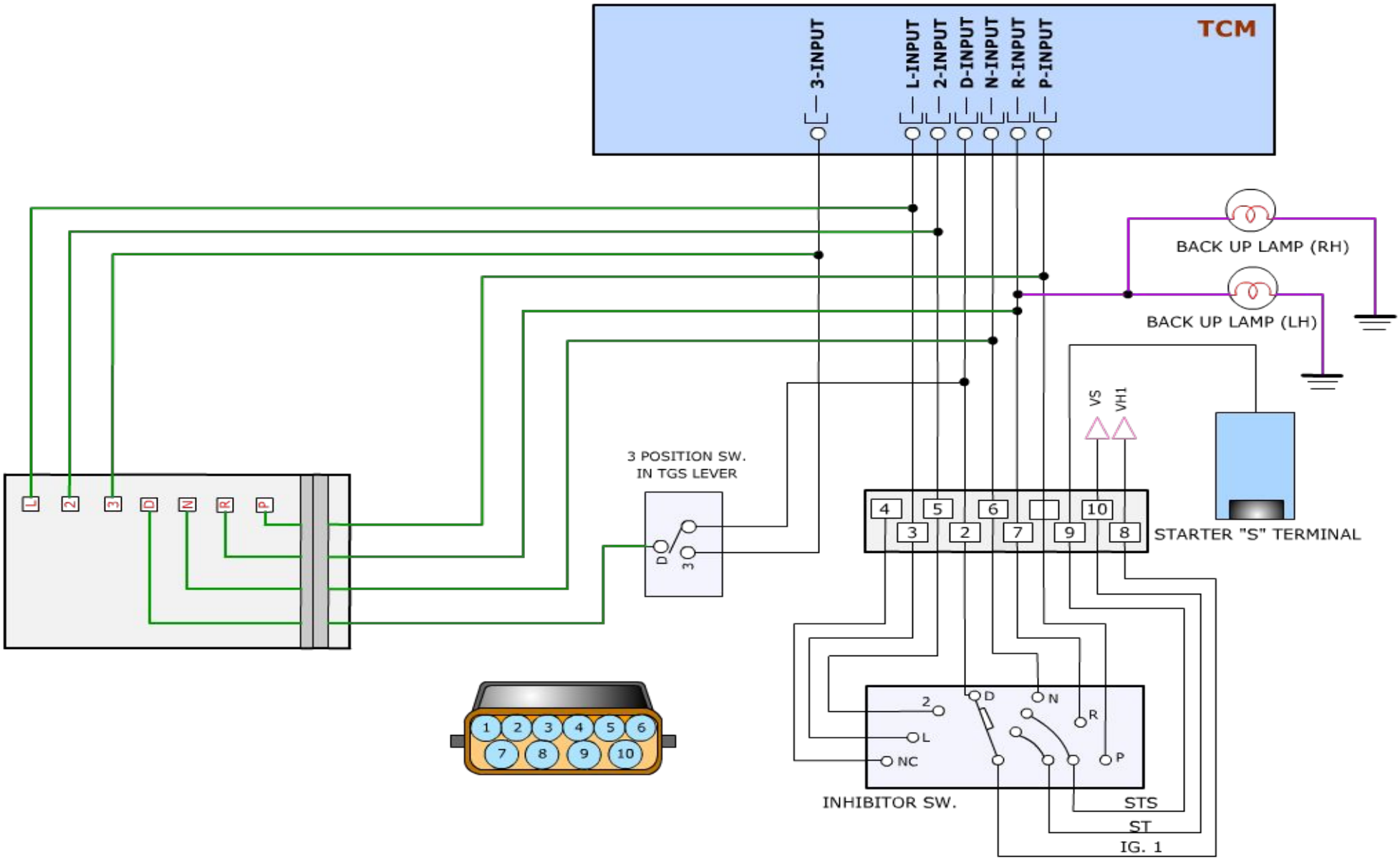
(A4AFx in MC)

- In case of MC, it has O/D on or off switch in shift lever. Unlike this, HD has 3 position sensor instead. When you push shift lever from “D” position to right side “3” position, shift down to 3rd gear happens from over driving (4th gear) and turn “3”position lamp in cluster.

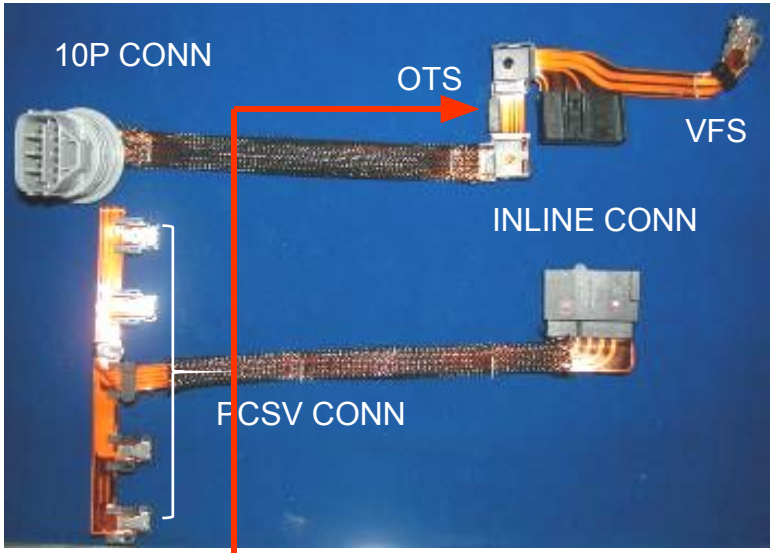
Shift Lever & 3rd Gear Position Switch

* To disassemble shift lever, first pushing chrome cover down with twisting, then release the screw.
* “3” gear position switch in installed just bottom side of the shift lever assembly. It has 3 terminals. One is for D input to TCM, another is for “3” input and the last is for cluster.

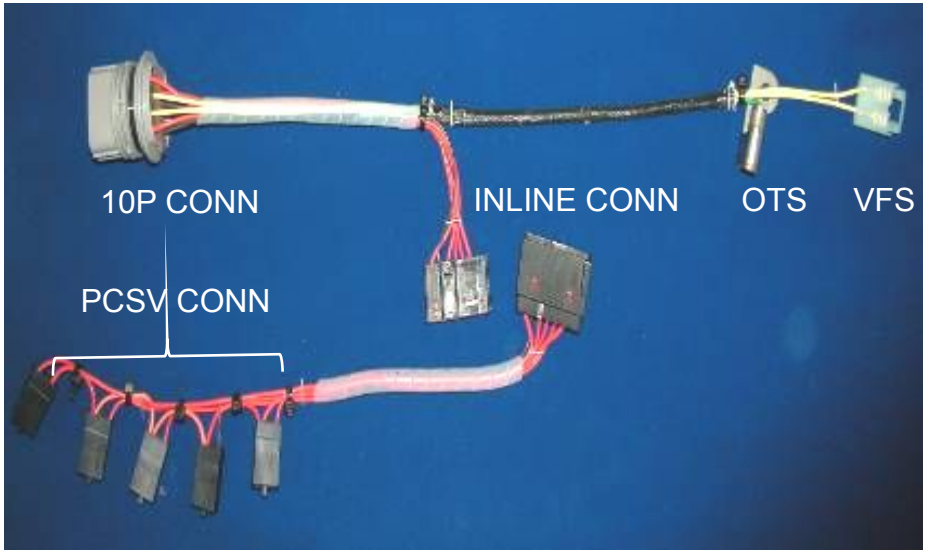
Inhibitor Switch



FPC (Flexible Printed Circuit) Harness



(F4CFx)



(F4AFx)

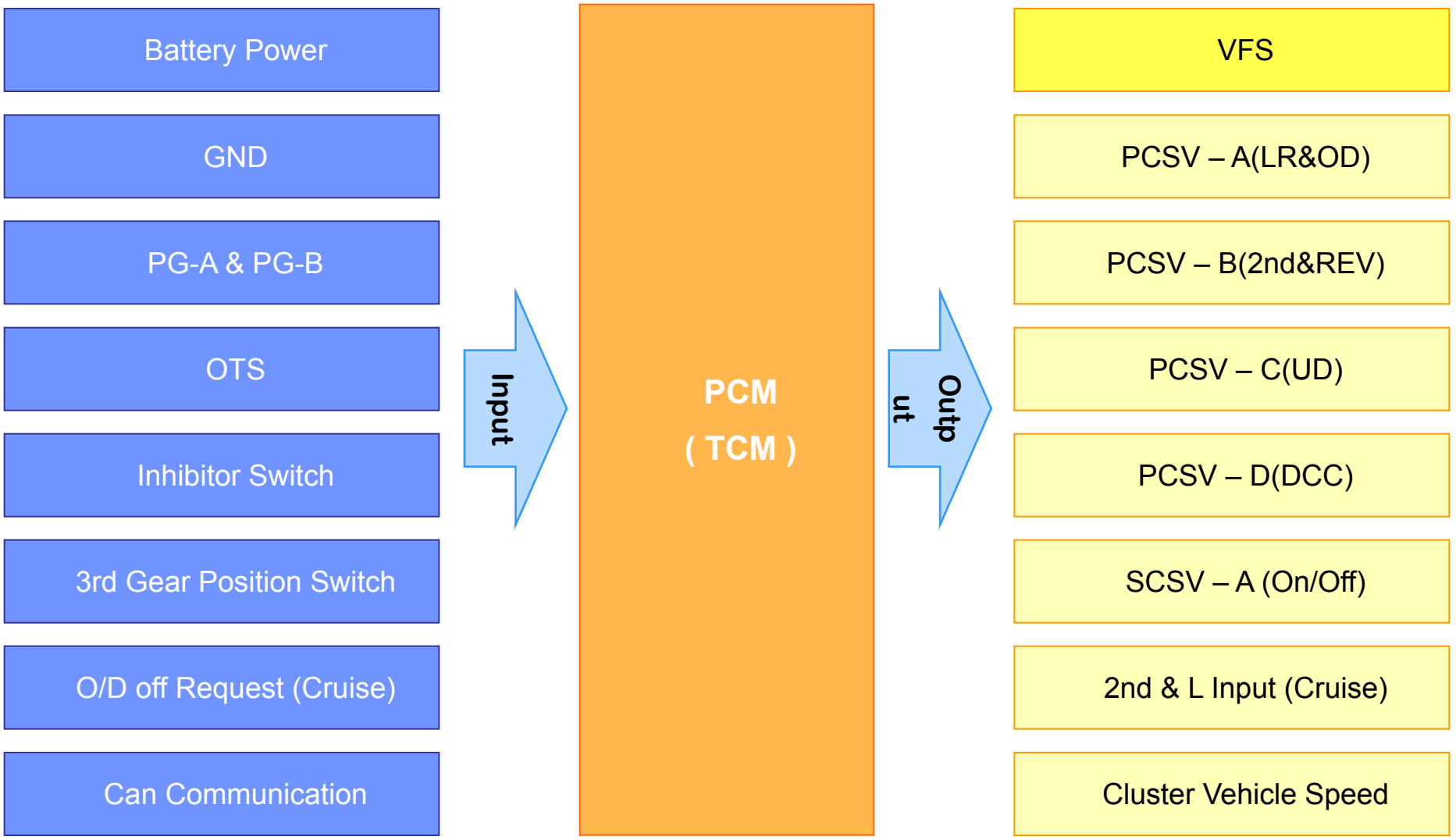
(OTS)

* To increase manufacturing efficiency and save space in solenoid valve, flexible printed circuit type harness is used.
(Reducing weight by 30%)

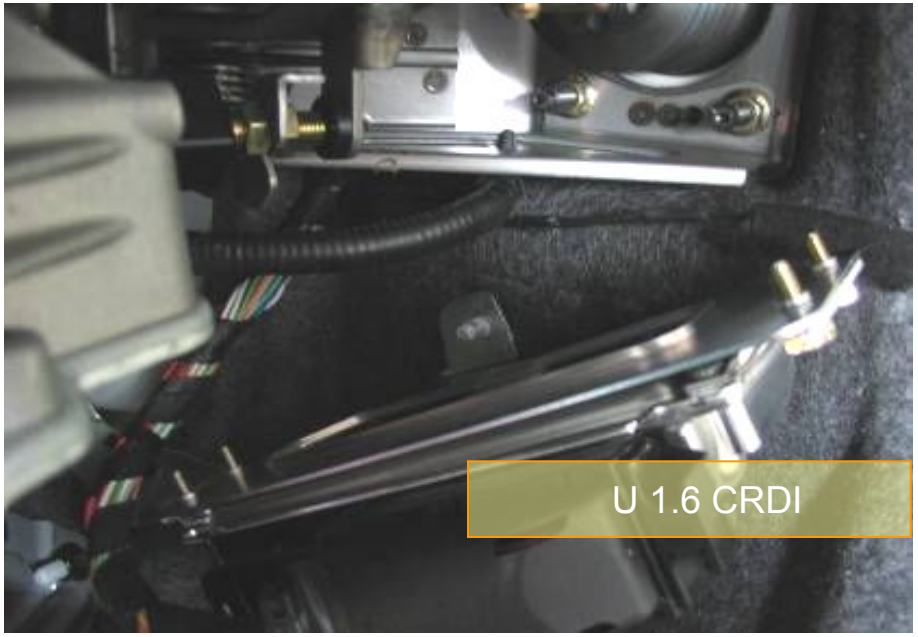
Operation Chart

Items		Solenoid Valve(0%:On, 100%:Off)				
Range	**Operation**	PCSV-A (OD&LR)	PCSV-B (2ND&RVS)	PCSV-C (UD)	PCSV-D (DCCSV)	ON/OFF SOL.
P, N	**LR**	OFF	ON	ON	OFF	ON
D-1	**UD**	ON	ON	OFF	OFF	OFF
D-2	**UD, 2ND**	ON	OFF	OFF	ON	OFF
D-3	**UD, OD**	OFF	ON	OFF	ON	OFF
D-4	**OD, 2ND**	OFF	OFF	ON	ON	OFF
REV	**LR, RVS**	OFF	OFF	ON	OFF	ON
2	**UD, 2ND**	ON	OFF	OFF	ON	OFF
LOW	**UD, LR**	OFF	ON	OFF	OFF	ON

Input & Output



PCM(TCM) Installation



* **Gamma & Beta engine's case, PCM type TCU controller is used and installed in engine room compartment.**

U1.6 CRDI's case, ECM and TCM are separated. Unlike ECM which is installed in engine compartment, TCM is position in passenger compartment near to in-panel junction box.

Pin Connection with Gamma Engine

Pin	Description	Pin	Description
1	GND (PCM)	68	Inhibitor L input
3	GND (Solenoid)	70	GND (VFS)
4	Voltage Supply for TCM	71	PCSV-A(LR & O/D)
5	Voltage Supply for TCM	72	PCSV-B (2nd & RVS)
26	On/Off Solenoid	80	GND (OTS)
27	PCSV-D (DCC)	82	GND (PG-B)
47	2 & L Position to Cruise	83	GND (PG-A)
48	Gear Information (Duty) to Cluster	86	Input Brake Switch (TCM)
49	Output Vehicle Speed to Cluster	88	Inhibitor R Input
57	OTS (Oil Temperature Sensor)	89	Inhibitor 2nd Input
60	Output Speed Sensor (PGB)	90	Inhibitor 3rd Input
61	Input Speed Sensor (PGA)	91	Inhibitor N Input
65	O/D off Request form Cruise	92	GND (TCM)
66	Inhibitor D input	93	VFS Control
67	Inhibitor P input	94	PCSV-C (UD)

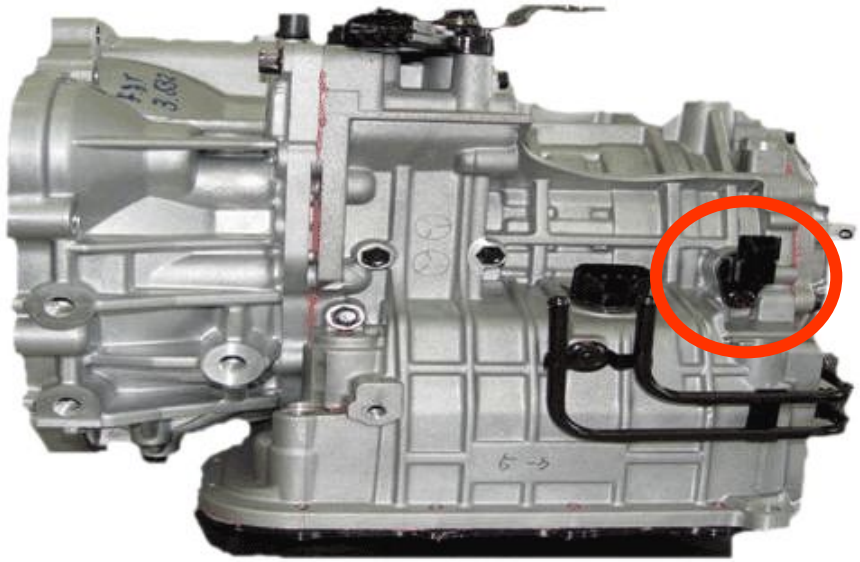
Pin Connection with Beta Engine

Pin	Description	Pin	Description
1	Power Supply (TCM)	20	GND (TCM)
2	Power Supply (TCM)	34	GND (TCM)
4	Power Supply (VFS)	35	GND (TCM)
6	Inhibitor P Input	38	Brake Switch
7	Inhibitor R Input	39	O/D Off Request from Cruise
8	Inhibitor N Input	46	PCSV-A (LR & O/D “-” Control)
9	Inhibitor D Input	48	PCSV-C (UD “-” Control)
10	Inhibitor 3 Input	49	Power Supply (Solenoid)
11	Inhibitor 2 Input	50	Power Supply (Solenoid)
12	Inhibitor L input	52	2 or L Gear Information to Cruise
14	Auto Cruise On/Off Input	53	Vehicle Speed Output to Cluster
15	GND (PG-A)	54	OTS (Oil Temperature Sensor)
16	On/Off Solenoid (“-” Control)	55	GND (OTS)
17	PCSV-B(2nd & RVS “–” Control)	56	Output Speed Sensor (PG-B)
18	PCSV-D(DCC “–” Control)	57	GND (PGB)
19	VFS (“-” Control)	58	Input Speed Sensor (PG-A)

Pin Connection with U 1.6 CRDI

Pin	Description	Pin	Description
1	Power Supply (TCM)	23	Inhibitor R Input
2	Power Supply (TCM)	24	Inhibitor P input
3	GND (TCM)	35	Shield for CAN
4	GND (TCM)	36	CAN High
5	GND (Solenoid Valve)	37	CAN Low
6	PCSV-A (LR & O/D)	38	K Line
7	PCSV-B (2^{nd} & RVS)	42	O/D Off Request from Cruise
8	PCSV-C (UD)	44	GND (VFS)
9	PCSV-D (DCC)	51	2 or L Gear Information to Cruise
10	On/Off Solenoid Valve	53	Vehicle Speed Out to Cluster
12	Power Supply (TCM)	58	OTS (Oil Temperature Sensor)
14	VFS Control (+)	59	GND (PG-B)
17	Brake Switch Input (TCM)	61	Output Speed Sensor (PG-B)
18	Inhibitor L Input	62	Input Speed Sensor (PG-A)
19	Inhibitor 2 Input	74	GND (OTS)
20	Inhibitor 3 Input	78	GND (PG-A)
21	Inhibitor D Input	80	Shield for PG-B
22	Inhibitor N input	81	Shield for PG-A

Input (PG-A) and Output Speed Sensor (PG-B)

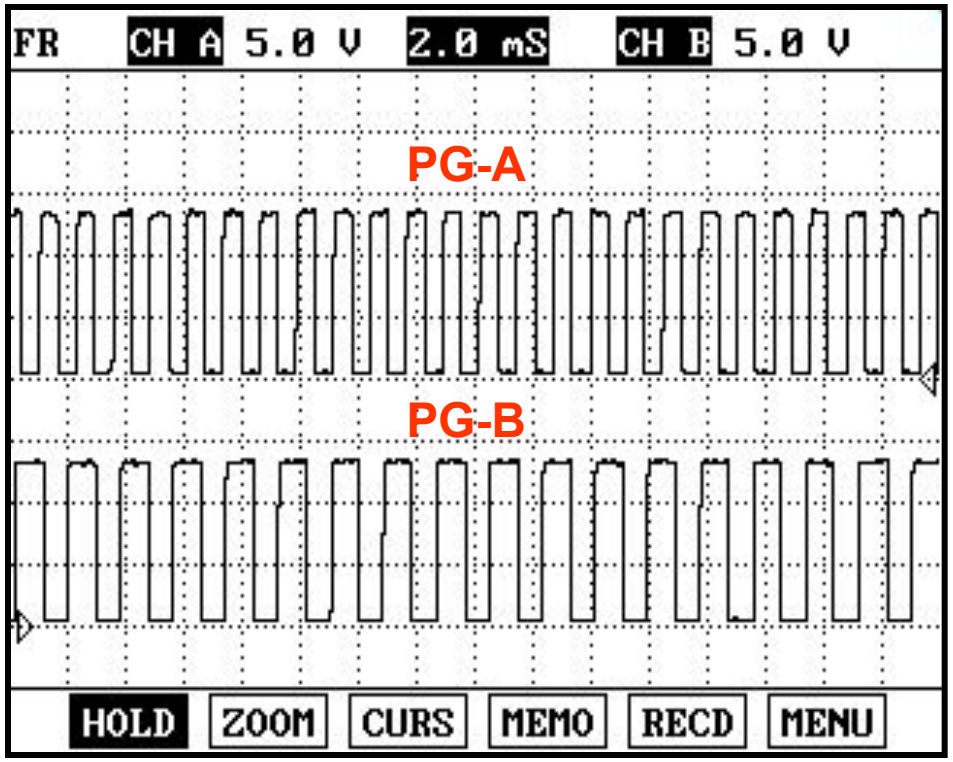


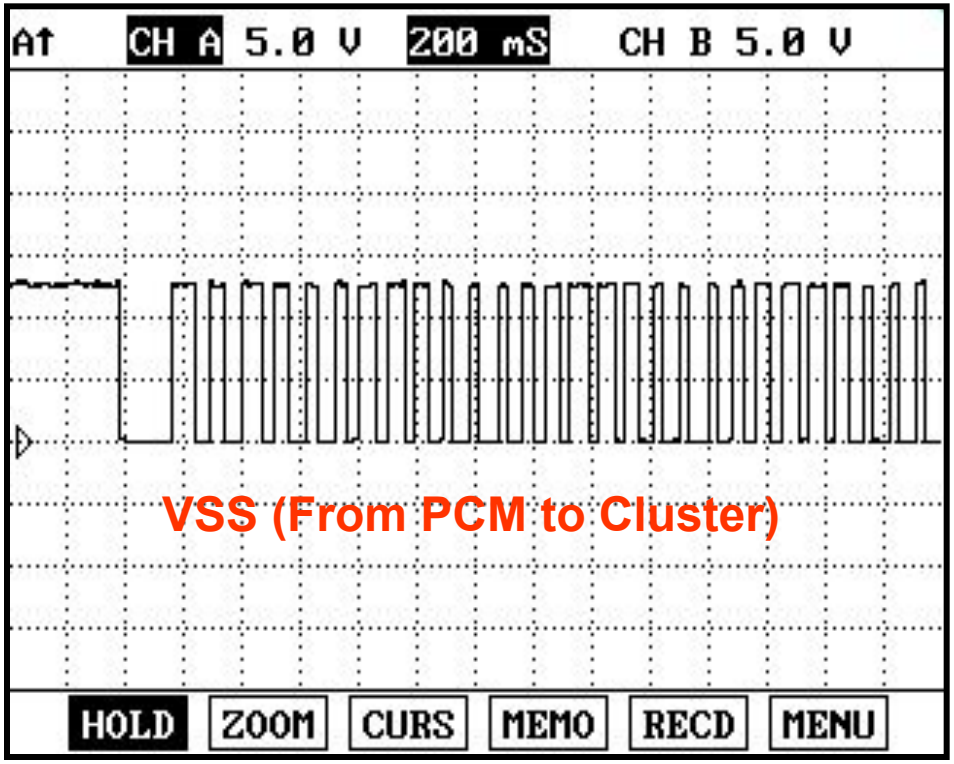
Input speed sensor is signaled from O/D clutch retainer. This is alternatively used for VSS information when output speed sensor has any failure.

Output speed sensor is captured from transfer driven gear. Both input and output speed sensor are from hall IC type which signals with digital wave.

When both sensors have failures, cluster speedometer doesn't work since main input for this is from these sensors (Main is output speed sensor)

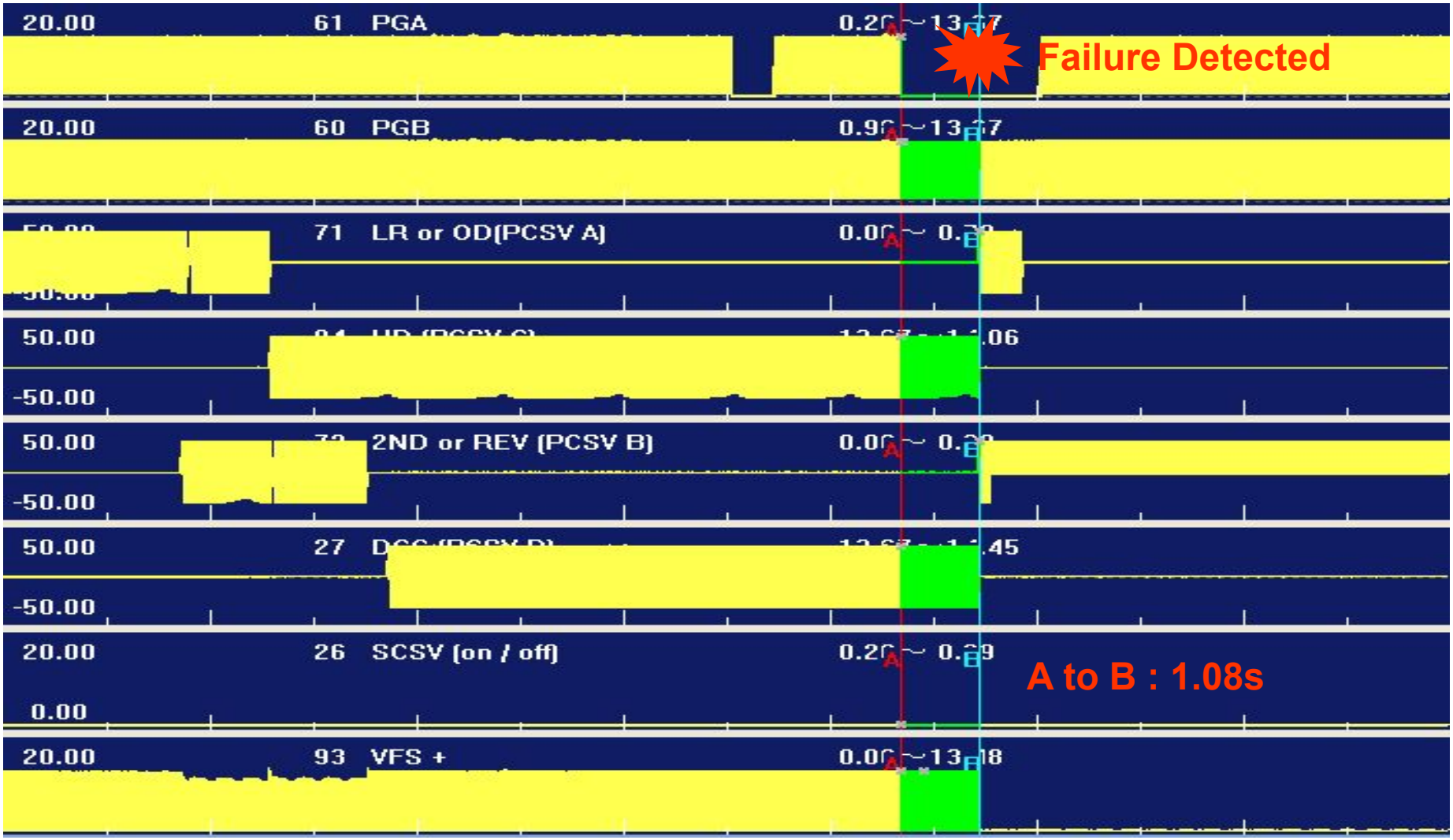
PG-A & PG-B Waveform





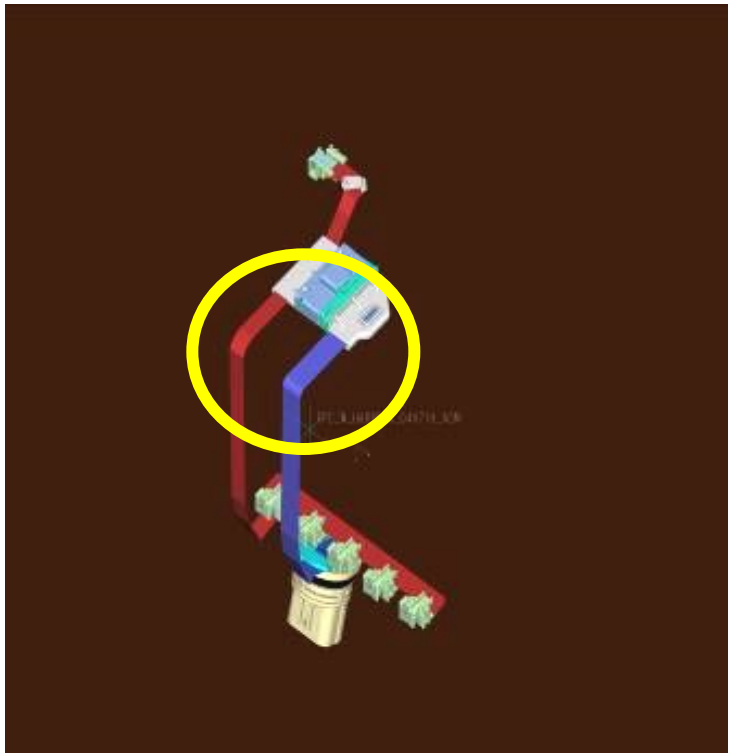
- PB-A & PG-B are from hall IC type. Checking methods are the same with Hivec's.
  You can check with current data or measure the waveform from the sensors.
  After receiving signal information, TCM sends VSS to cluster.

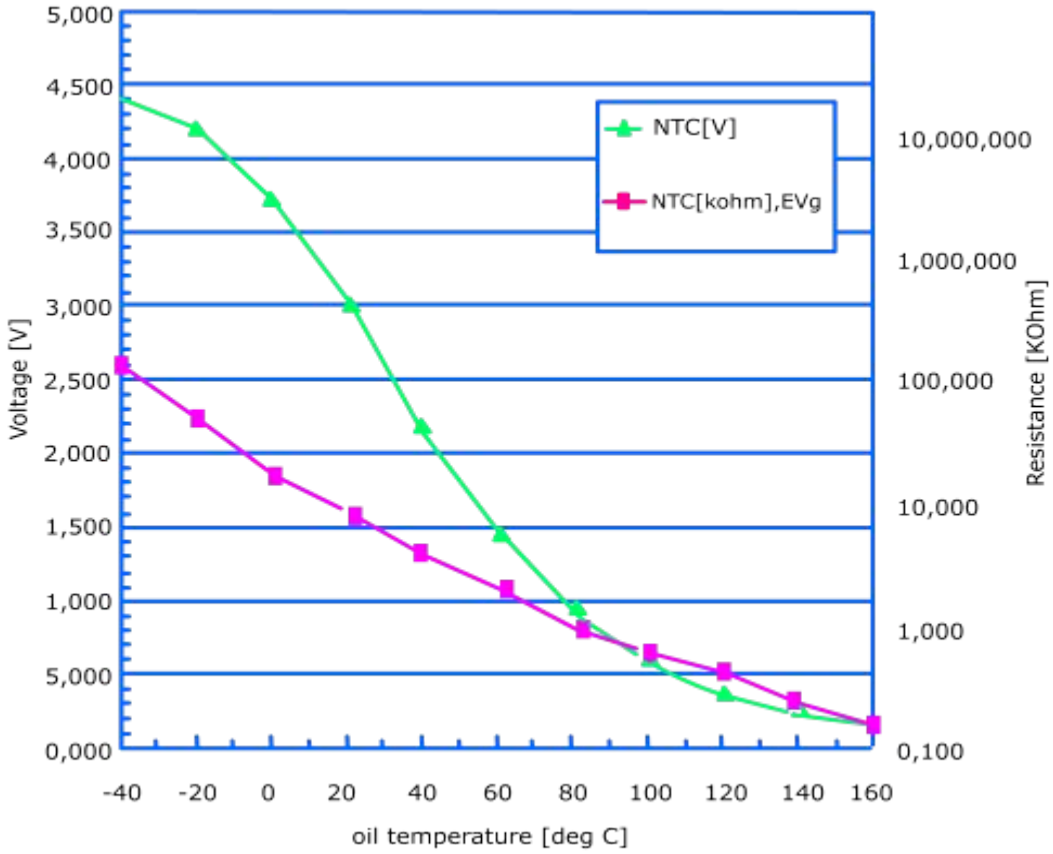
PG-A & PG-B Failure



* When PG-A or PG-B failure is detected, electrically gear shifting is held in 3rd range but possibly 3rd to 2nd shifting is allowed.

OTS (Oil Temperature Sensor)

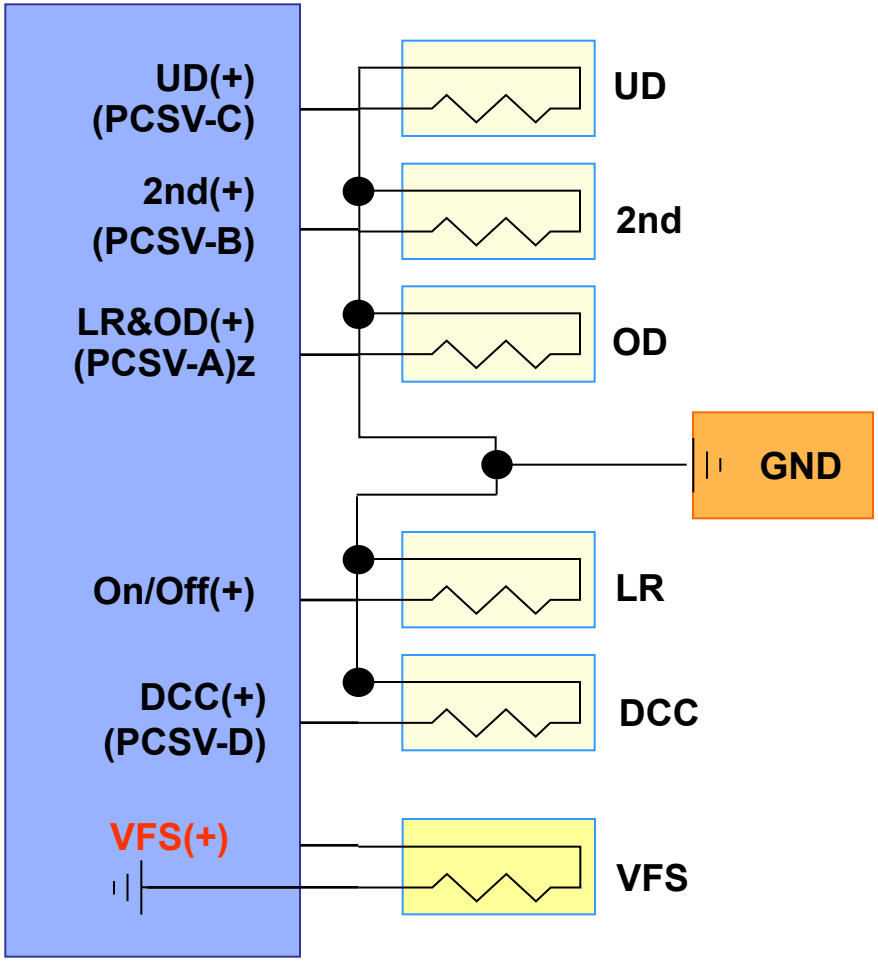




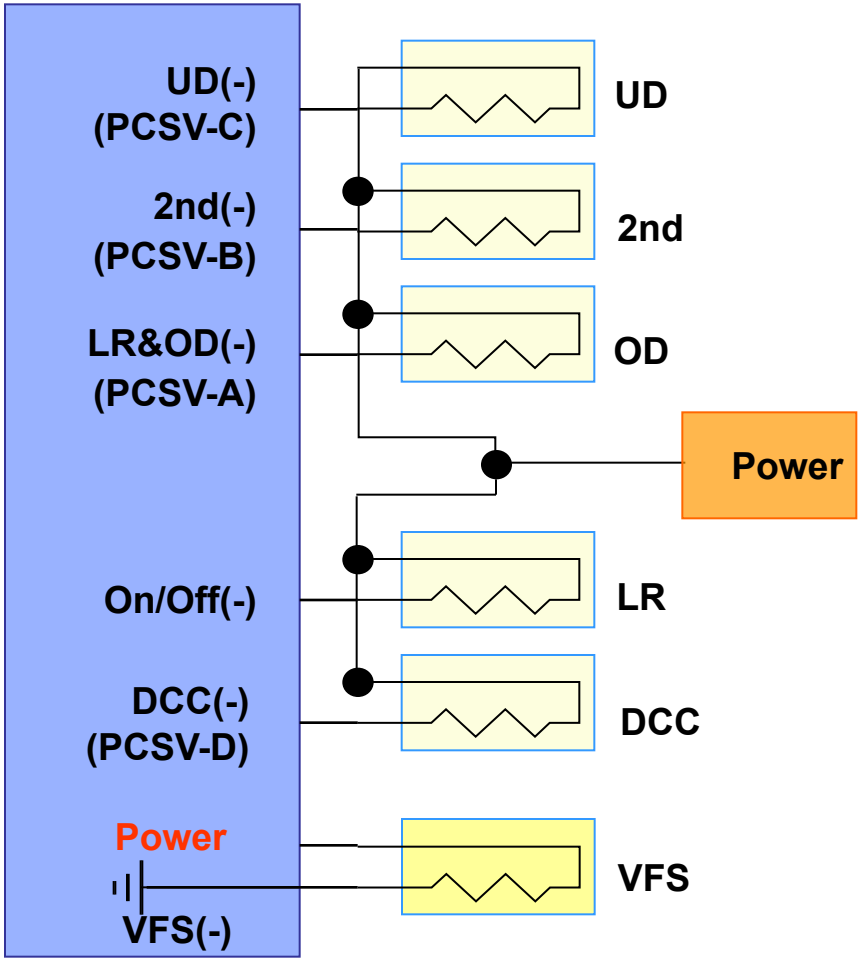
* When OTS failure is detected, OTS current data sets to 80℃.

Solenoid Valve (Bosch vs Siemens)

Bosch (Gamma & U1.6 CRDI)



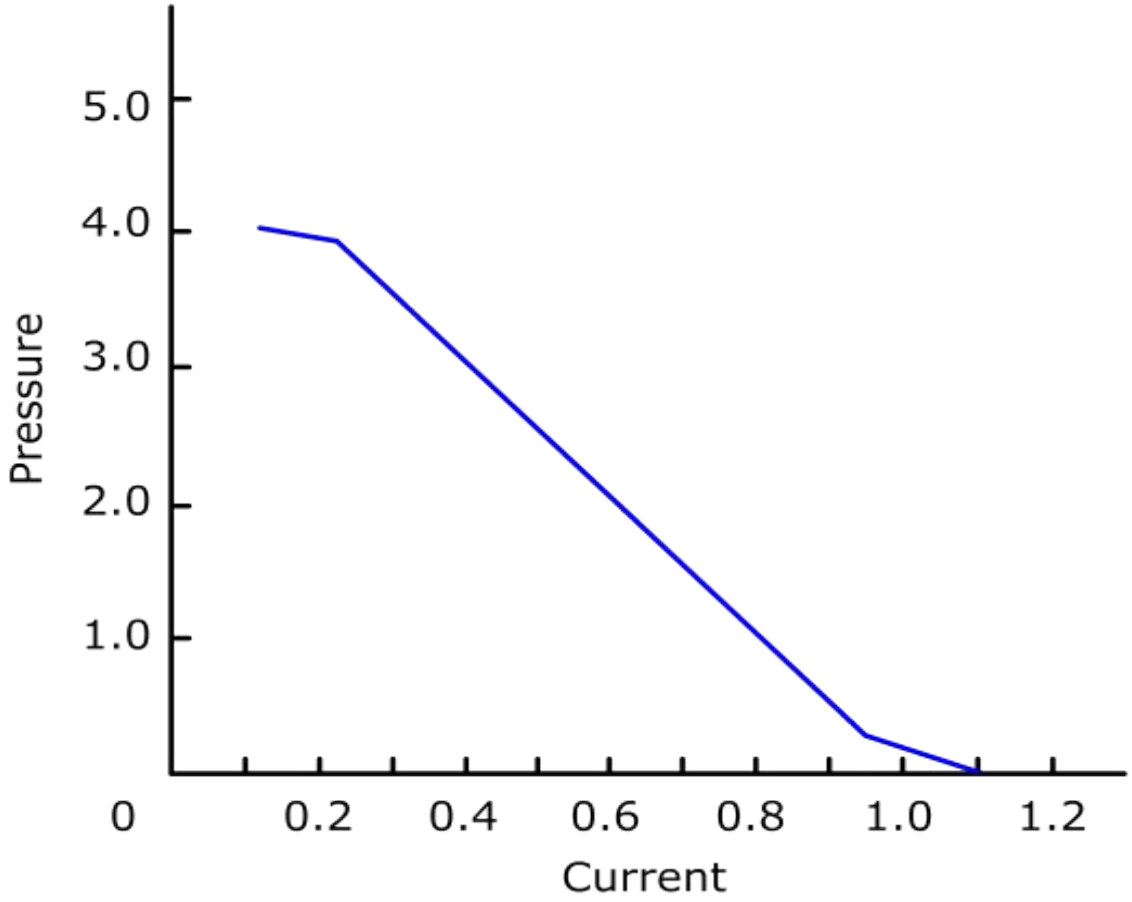
Siemens (Beta 2.0)



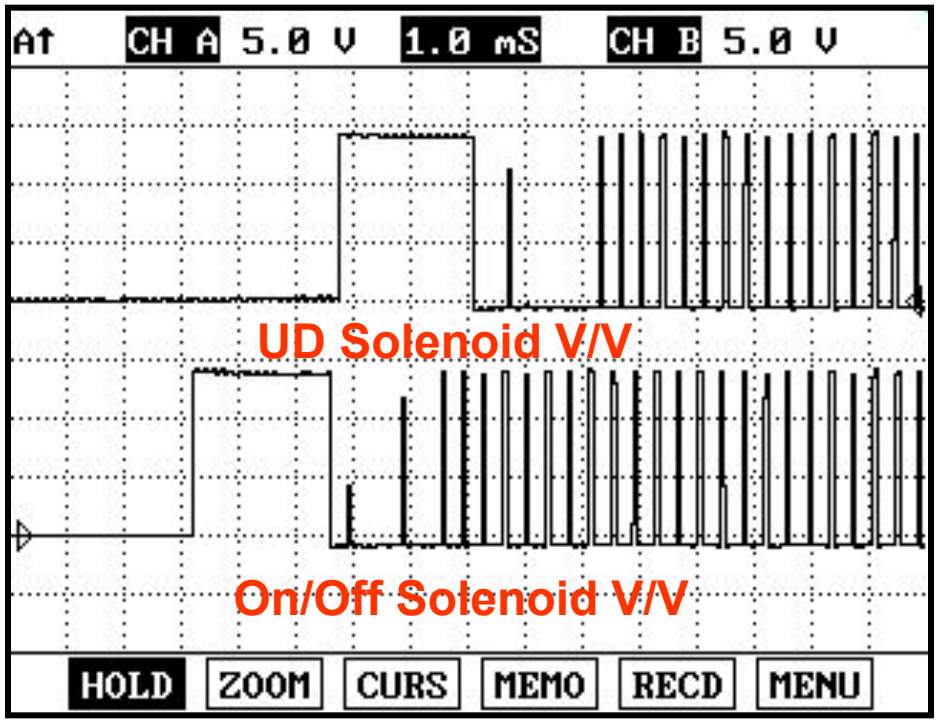
Solenoid Valve Current Control

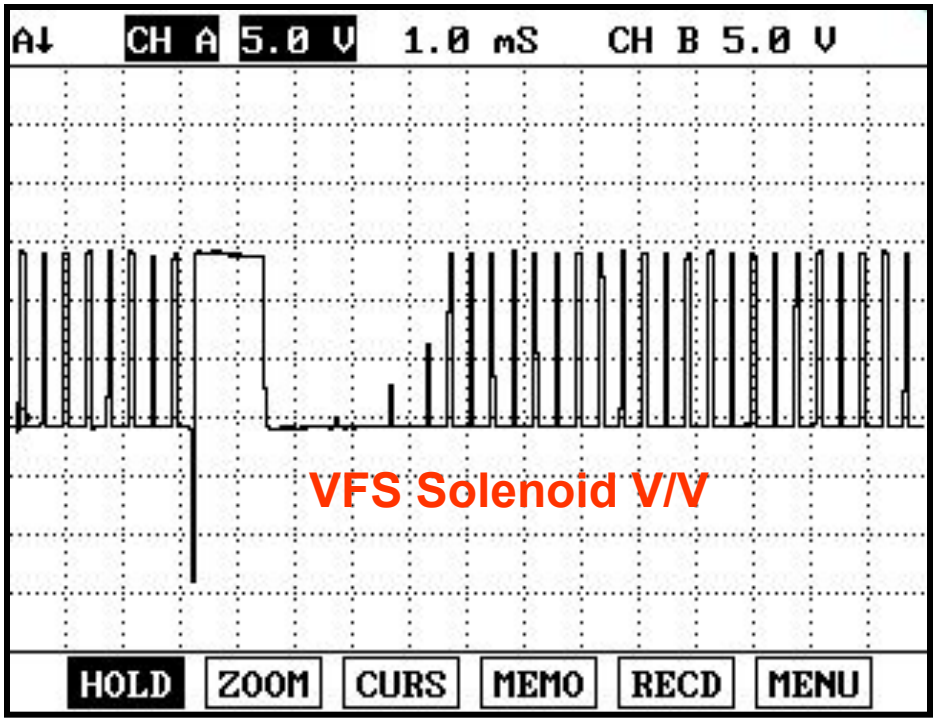
VFS

PCSV & SCSV



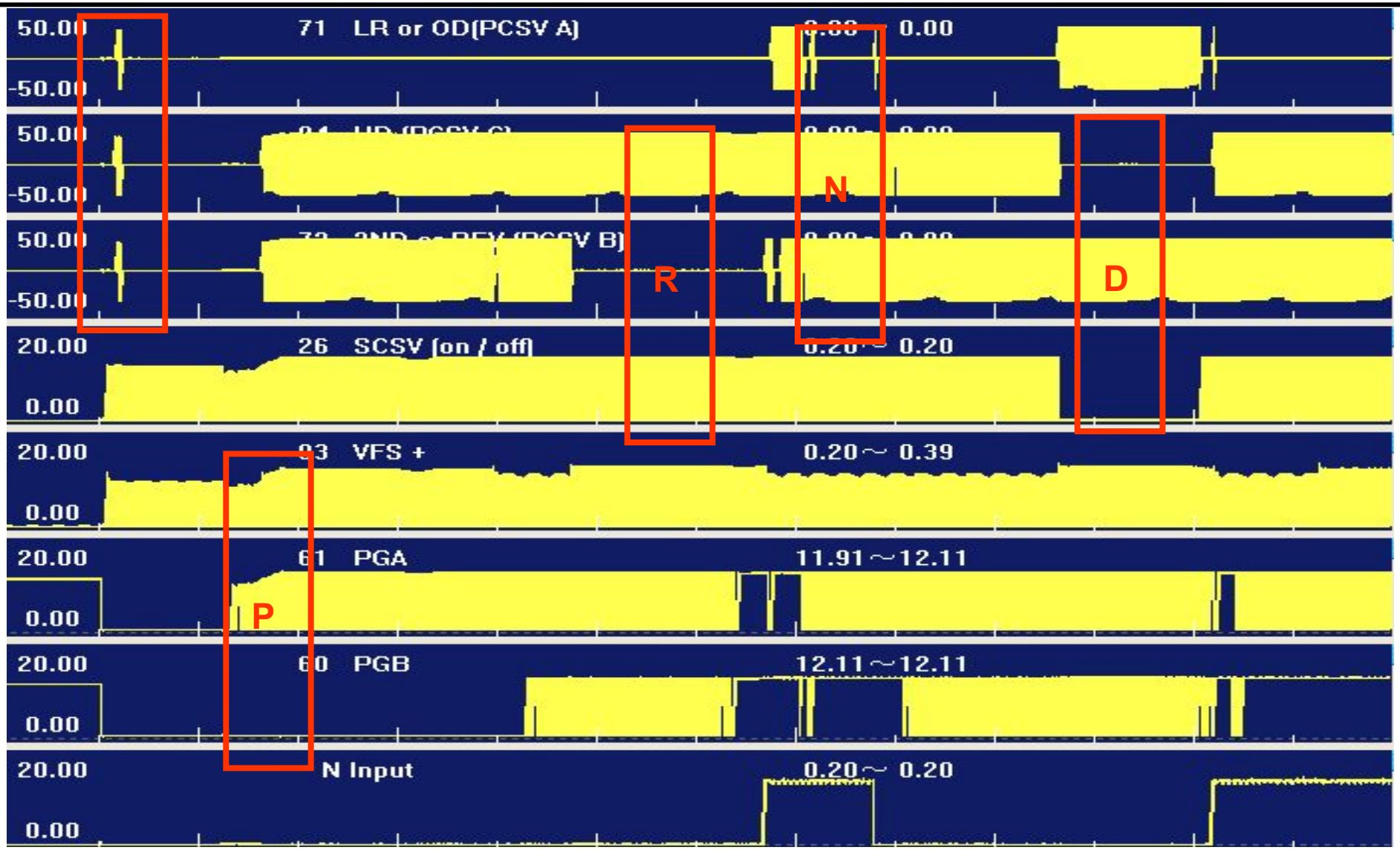
Solenoid Valve Waveform





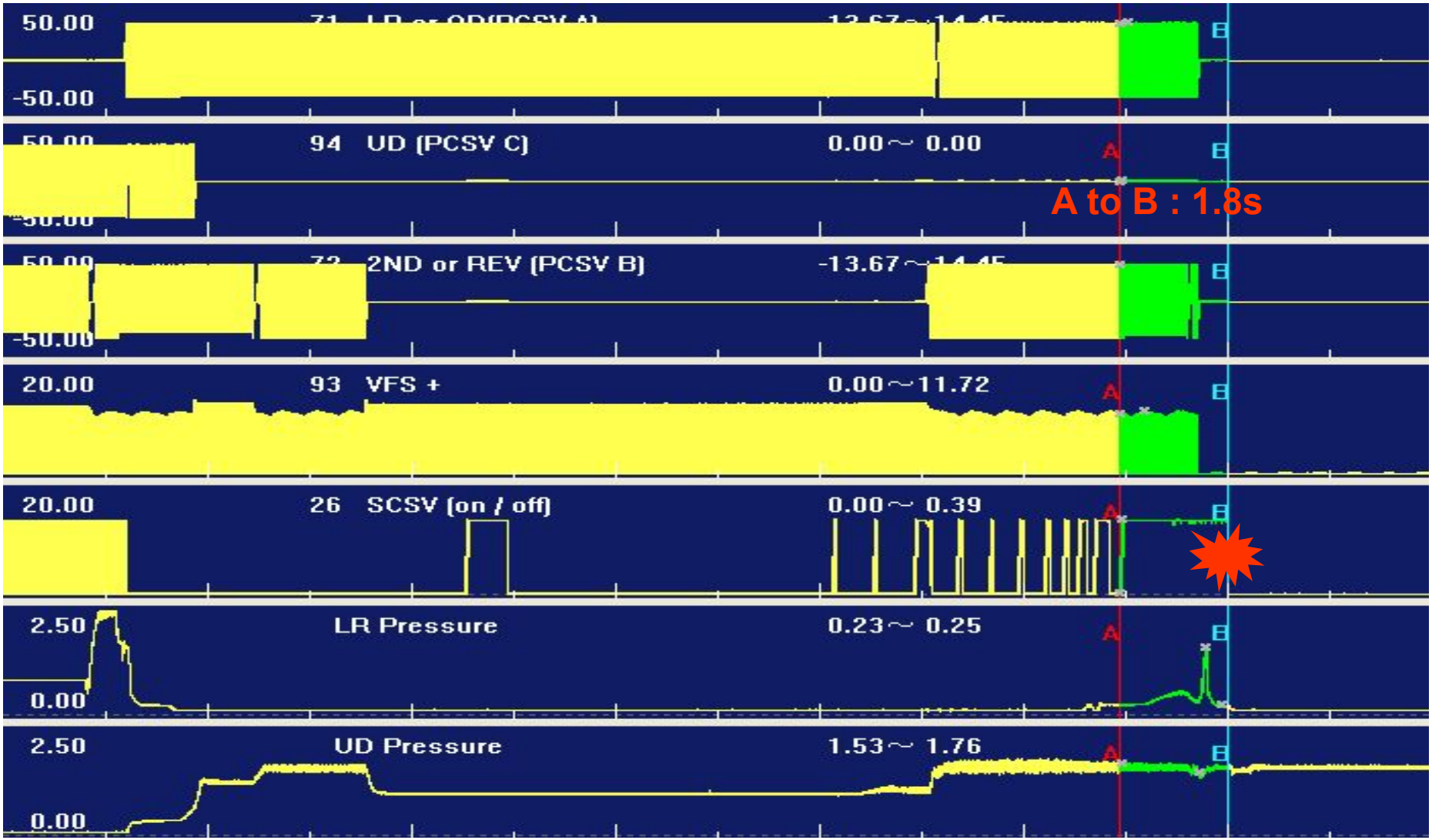
* In case of Bosch Control, all solenoid valve are controlled with “+”.
It means PCM(TCM) supplies solenoid operating voltage. Unlike Bosch,
Siemens PCM controls “-” which modulates ground line.
When Solenoid V/V doesn’t work (grounded), operating pressure is applied
and element is working.

P-R-N-D Shifting



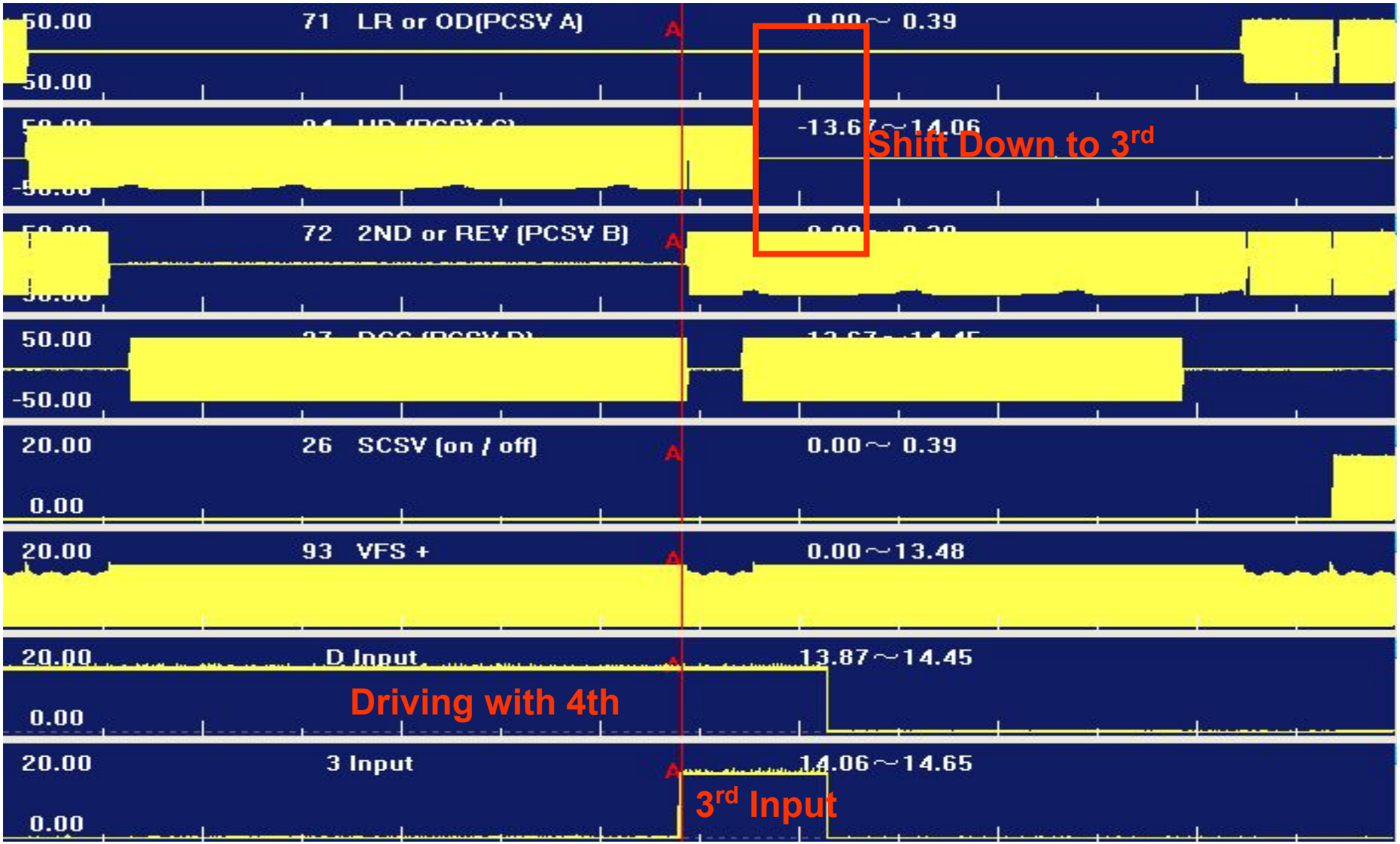
* After ignition, solenoid failure checking is done within 300ms for 80ms.
When solenoid related failure is detected, it goes to 3rd gear holding soon.

Solenoid Valve Fail (3rd Gear Fixed)



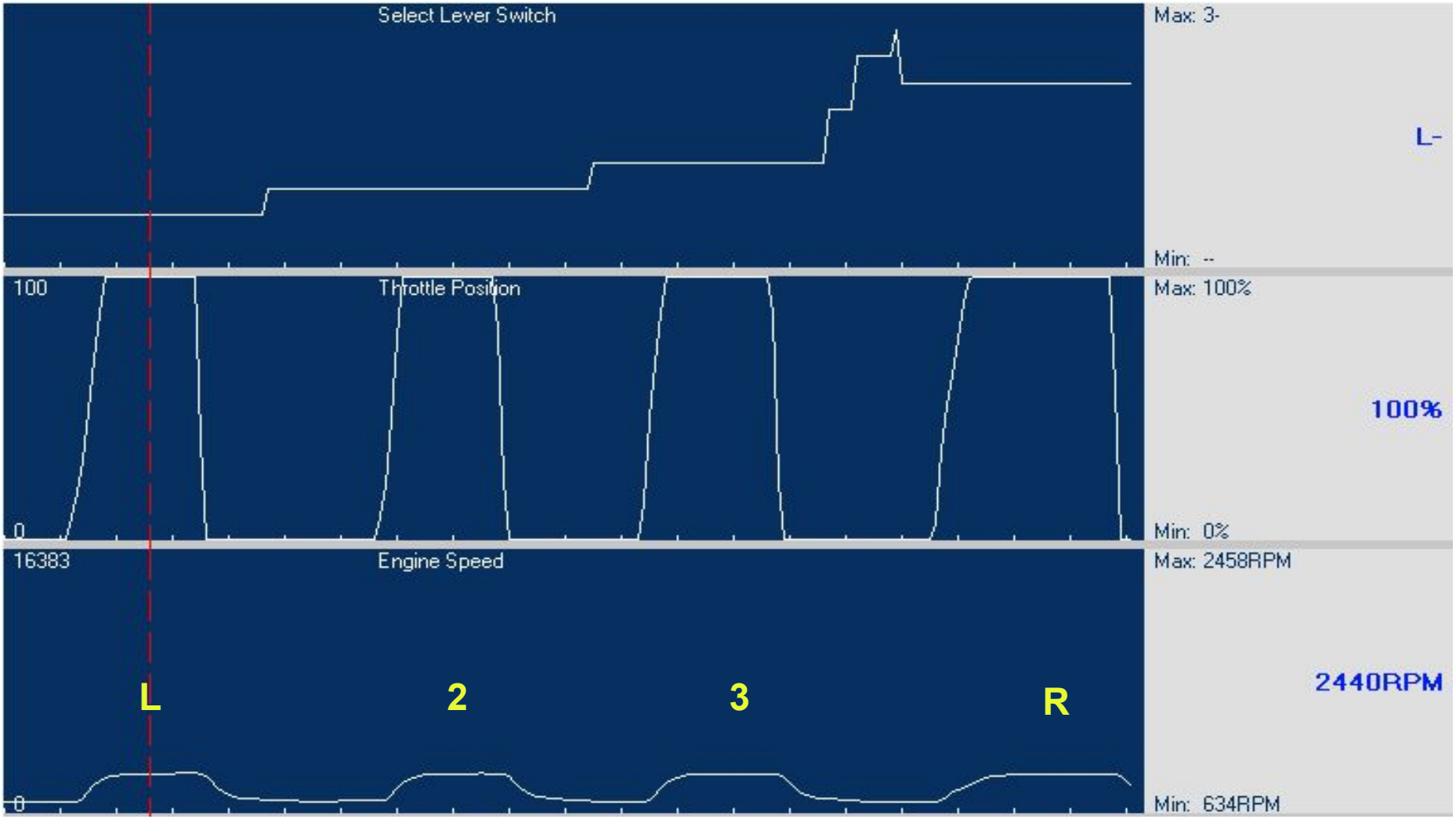
* SCSV solenoid valve shorts to ground during driving under 3rd gear resulting in mechanical 3rd gear fixed condition.

3rd Position Input (O/D Off)



* In stead of O/D off switch in MC (A4AFx), HD utilizes 3rd position. When this signal inputs to PCM(TCM), shift down is down from 4th to 3rd.

Stall Test


Select Lever Switch
Max: 3-
L-
Min: --
100
Throttle Position
Max: 100%
100%
0
Min: 0%
16383
Engine Speed
Max: 2458RPM
L
2
3
R
2440RPM
0
Min: 634RPM

Resetting Auto T/A Values

Resetting Auto T/A Values

[Resetting Auto T/A Values]

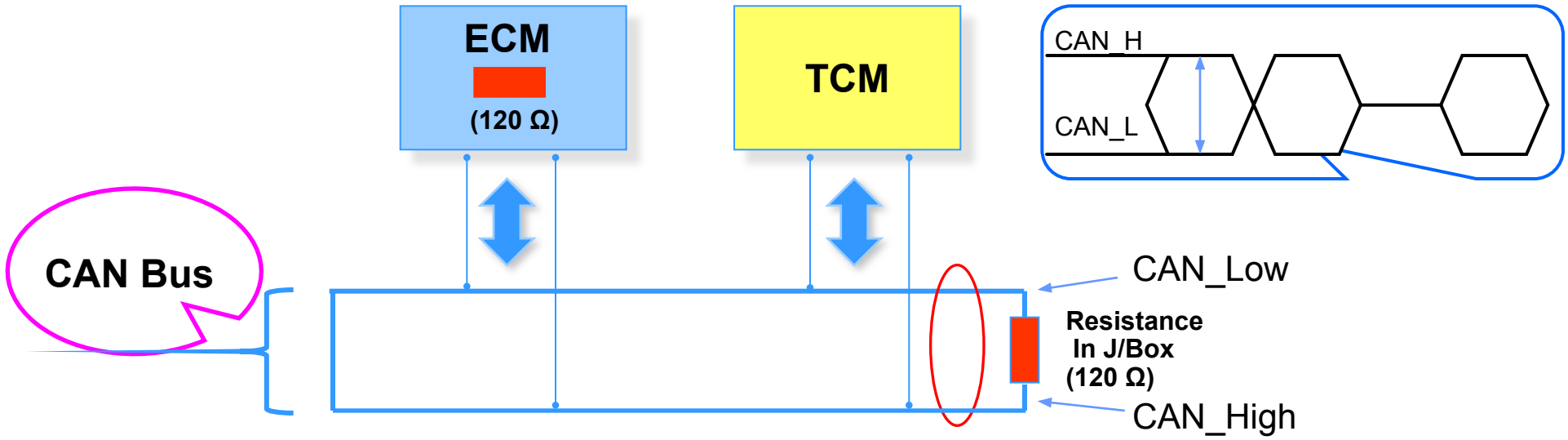
This function is for resetting the adaptive values from the used Auto T/A when replacing it.

<Condition>

1. IG. Key On
2. Transaxle Range : P
3. Vehicle Speed : 0 km/h
4. Engine Off

Reset Cancel

Can Communication

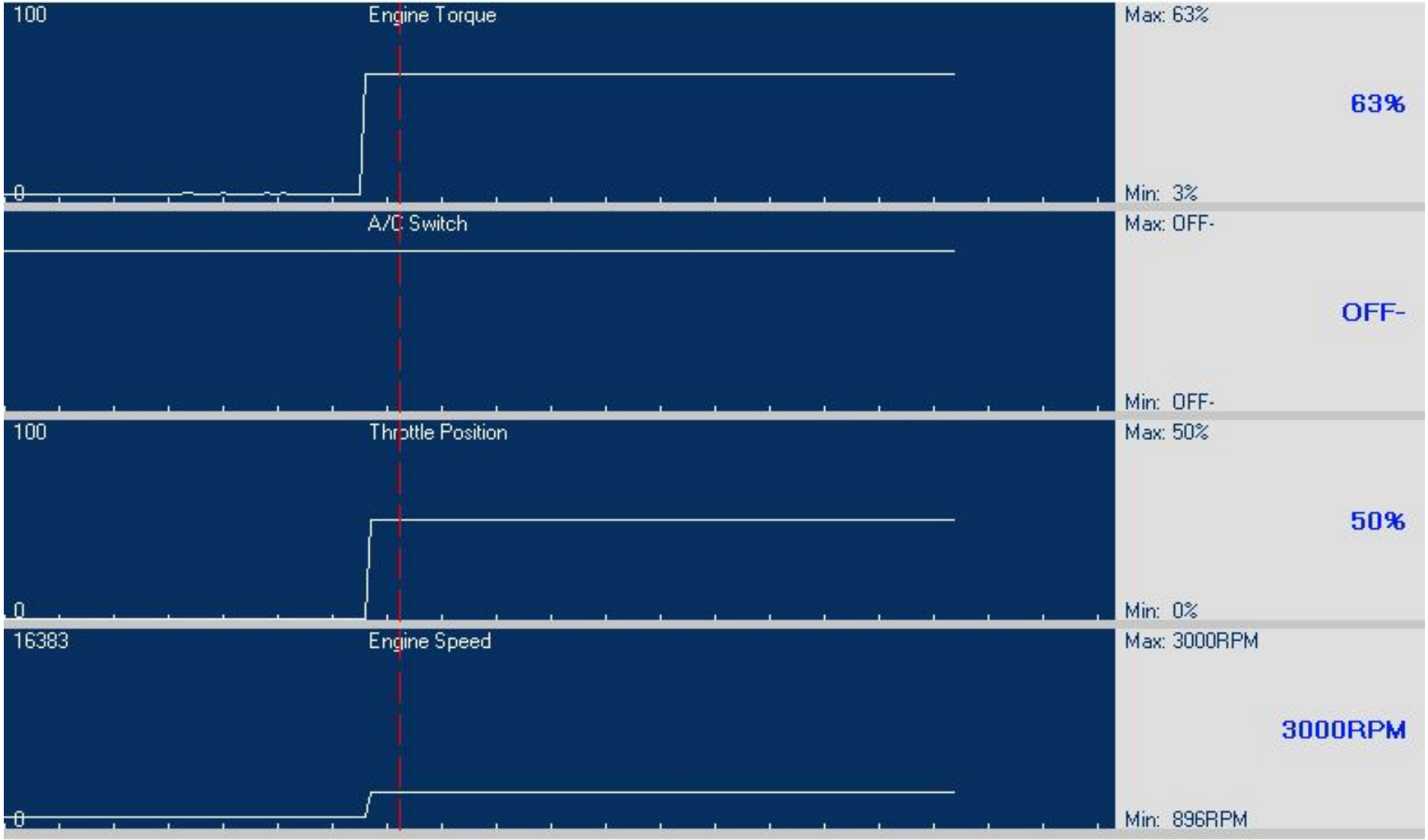


* **Between ECM and TCM especially in U 1.6 liter outside CAN communication is used. (Gamma and Beta II : Internal CAN)**

When CAN system error happens, following values go to fail safe like

- **Engine rpm : 3000**
- **Engine Torque : 63%**
- **A/Con. S/W : Off**
- **Throttle Position : 50%**

CAN Data in Failure



Current Data (P&N)

Engine Speed	651	RPM
Vehicle Speed Sensor	O	km/h
Throttle Position	0	%
Input Speed (PG-A)	627	RPM
Output Speed (PG-B)	0	RPM
DCC Solenoid Duty	0	%
Damper Clutch Slip	24	RPM
PCSV-A (LR & OD)	0	%
PCSV-B (2nd & RVS)	99	%
PCSV-C (UD)	99	%
PCSV-A (On/Off Solenoid)	ON	-
VFS Solenoid	0.0	%
Oil Temperature Sensor	73	℃
Gear Ratio	0.0	-
Shift Position	R,N,R	-
Select Lever Switch	P,N	-
A/C Switch	OFF	-
O/D Off Switch	OFF	-
Brake Switch	OFF	-
Overdrive Off Lamp	OFF	-
Engine Torque	0	%

Current Data (R)

☐ Engine Speed	706	RPM
☐ Vehicle Speed Sensor	2	km/h
☐ Throttle Position	0	%
☐ Input Speed (PG-A)	620	RPM
☐ Output Speed (PG-B)	249	RPM
☐ DCC Solenoid Duty	0	%
☐ Damper Clutch Slip	86	RPM
☐ PCSV-A(LR & OD)	0	%
☐ PCSV-B(2nd & RVS)	0	%
☐ PCSV-C (UD)	99	%
☐ PCSV-A (On/Off Solenoid)	ON	-
☐ VFS Solenoid	0.0	%
☐ Oil Temperature Sensor	70	℃
☐ Gear Ratio	2.5	-
☐ Shift Position	R,N,R	-
☐ Select Lever Switch	R	-
☐ A/C Switch	OFF	-
☐ O/D Off Switch	OFF	-
☐ Brake Switch	OFF	-
☐ Overdrive Off Lamp	OFF	-
☐ Engine Torque	2	%

Current Data (D-1)

☐ Engine Speed	718	RPM
☐ Vehicle Speed Sensor	5	km/h
☐ Throttle Position	0	%
☐ Input Speed (PG-A)	654	RPM
☐ Output Speed (PG-B)	241	RPM
☐ DCC Solenoid Duty	0	%
☐ Damper Clutch Slip	64	RPM
☐ PCSV-A (LR & OD)	99	%
☐ PCSV-B (2nd & RVS)	99	%
☐ PCSV-C (UD)	0	%
☐ PCSV-A (On/Off Solenoid)	OFF	-
☐ VFS Solenoid	0.0	%
☐ Oil Temperature Sensor	70	℃
☐ Gear Ratio	2.9	-
☐ Shift Position	1	-
☐ Select Lever Switch	D	-
☐ A/C Switch	OFF	-
☐ O/D Off Switch	OFF	-
☐ Brake Switch	OFF	-
☐ Overdrive Off Lamp	OFF	-
☐ Engine Torque	1	%

Current Data (D-2)

☐ Engine Speed	1684	RPM
☐ Vehicle Speed Sensor	27	km/h
☐ Throttle Position	3	%
☐ Input Speed (PG-A)	1647	RPM
☐ Output Speed (PG-B)	1063	RPM
☐ DCC Solenoid Duty	0	%
☐ Damper Clutch Slip	37	RPM
☐ PCSV-A(LR & OD)	99	%
☐ PCSV-B(2nd & RVS)	0	%
☐ PCSV-C(UD)	0	%
☐ PCSV-A(On/Off Solenoid)	OFF	-
☐ VFS Solenoid	0.0	%
☐ Oil Temperature Sensor	80	℃
☐ Gear Ratio	1.6	-
☐ Shift Position	2	-
☐ Select Lever Switch	D	-
☐ A/C Switch	OFF	-
☐ O/D Off Switch	OFF	-
☐ Brake Switch	OFF	-
☐ Overdrive Off Lamp	OFF	-
☐ Engine Torque	5	%

Current Data (D-3)

☐ Engine Speed	1343	RPM
☐ Vehicle Speed Sensor	30	km/h
☐ Throttle Position	3	%
☐ Input Speed (PG-A)	1319	RPM
☐ Output Speed (PG-B)	1319	RPM
☐ DCC Solenoid Duty	0	%
☐ Damper Clutch Slip	24	RPM
☐ PCSV-A (LR & OD)	0	%
☐ PCSV-B (2nd & RVS)	99	%
☐ PCSV-C (UD)	0	%
☐ PCSV-A (On/Off Solenoid)	OFF	-
☐ VFS Solenoid	0.0	%
☐ Oil Temperature Sensor	80	℃
☐ Gear Ratio	1.0	-
☐ Shift Position	3	-
☐ Select Lever Switch	D	-
☐ A/C Switch	OFF	-
☐ O/D Off Switch	OFF	-
☐ Brake Switch	OFF	-
☐ Overdrive Off Lamp	OFF	-
☐ Engine Torque	7	%

Current Data (D-4)

☐ Engine Speed	3363	RPM
☐ Vehicle Speed Sensor	118	km/h
☐ Throttle Position	10	%
☐ Input Speed (PG-A)	3360	RPM
☐ Output Speed (PG-B)	4717	RPM
☐ DCC Solenoid Duty	43	%
☐ Damper Clutch Slip	3	RPM
☐ PCSV-A (LR & OD)	0	%
☐ PCSV-B (2nd & RVS)	0	%
☐ PCSV-C (UD)	99	%
☐ PCSV-A (On/Off Solenoid)	OFF	-
☐ VFS Solenoid	0.0	%
☐ Oil Temperature Sensor	70	℃
☐ Gear Ratio	0.7	-
☐ Shift Position	4	-
☐ Select Lever Switch	D	-
☐ A/C Switch	OFF	-
☐ O/D Off Switch	OFF	-
☐ Brake Switch	OFF	-
☐ Overdrive Off Lamp	OFF	-
☐ Engine Torque	11	%

Field Case – Oil Leakage

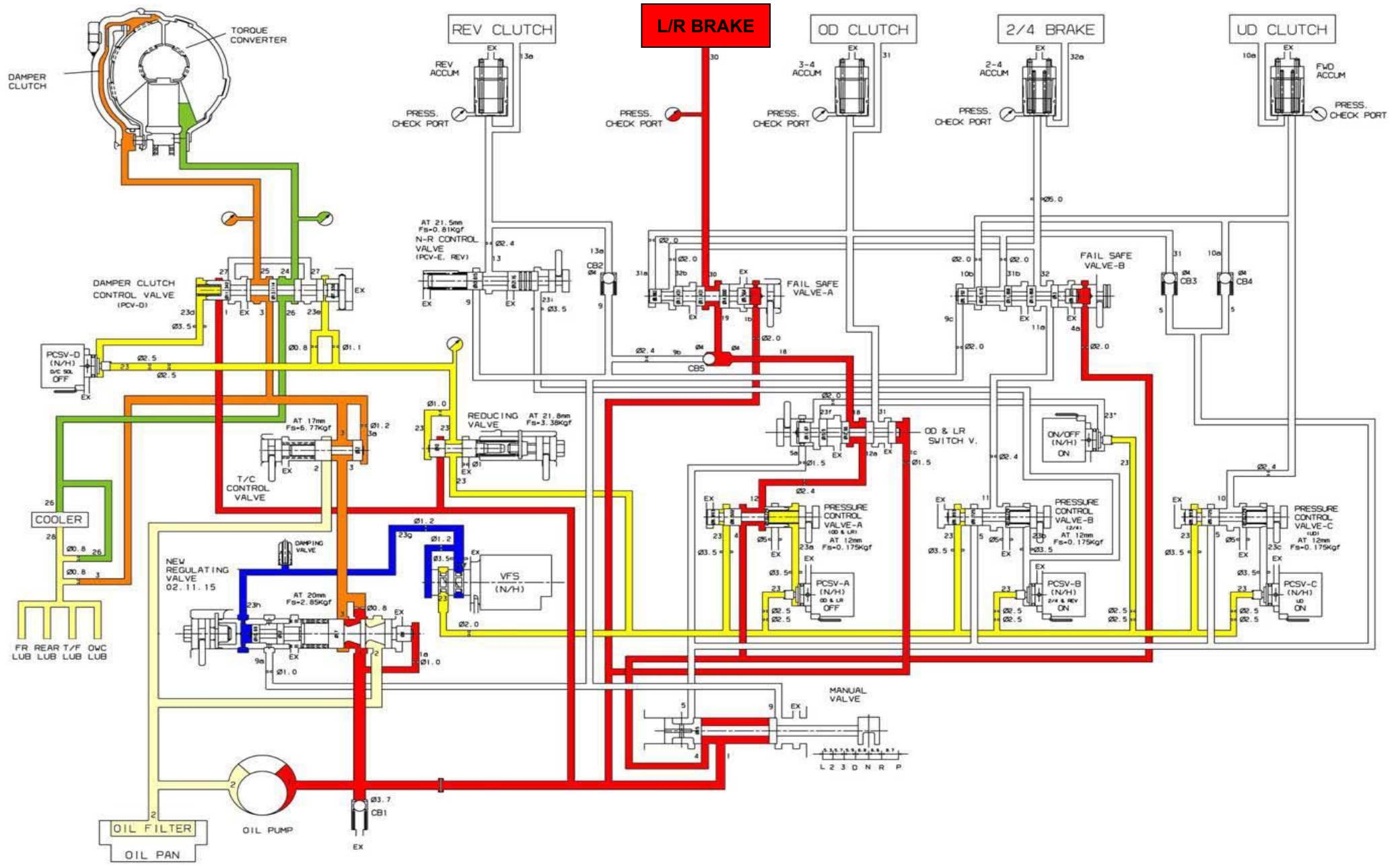
Air Bleeding Cap

Oil Level Gauge

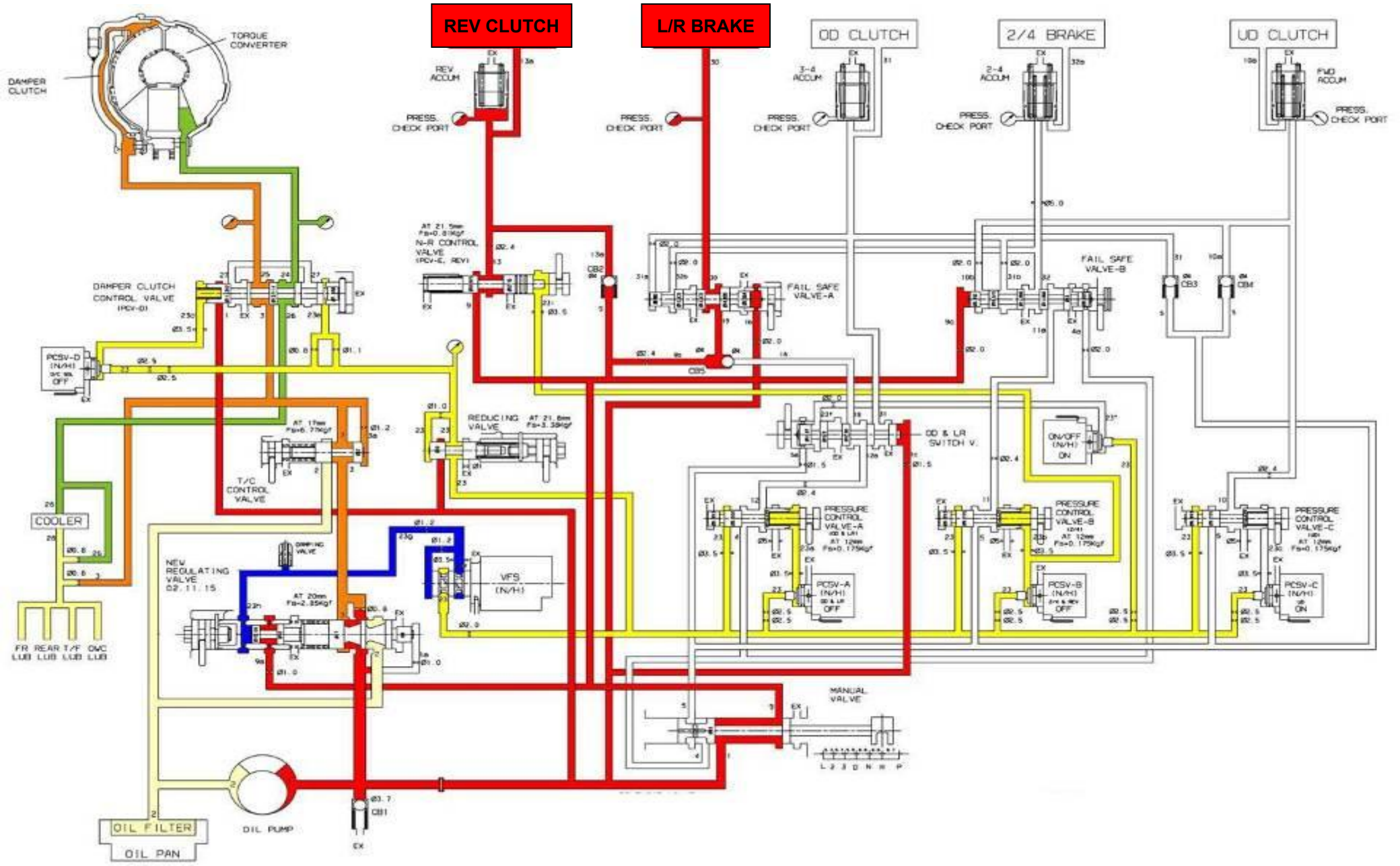
Taper Plug

Manual Shaft

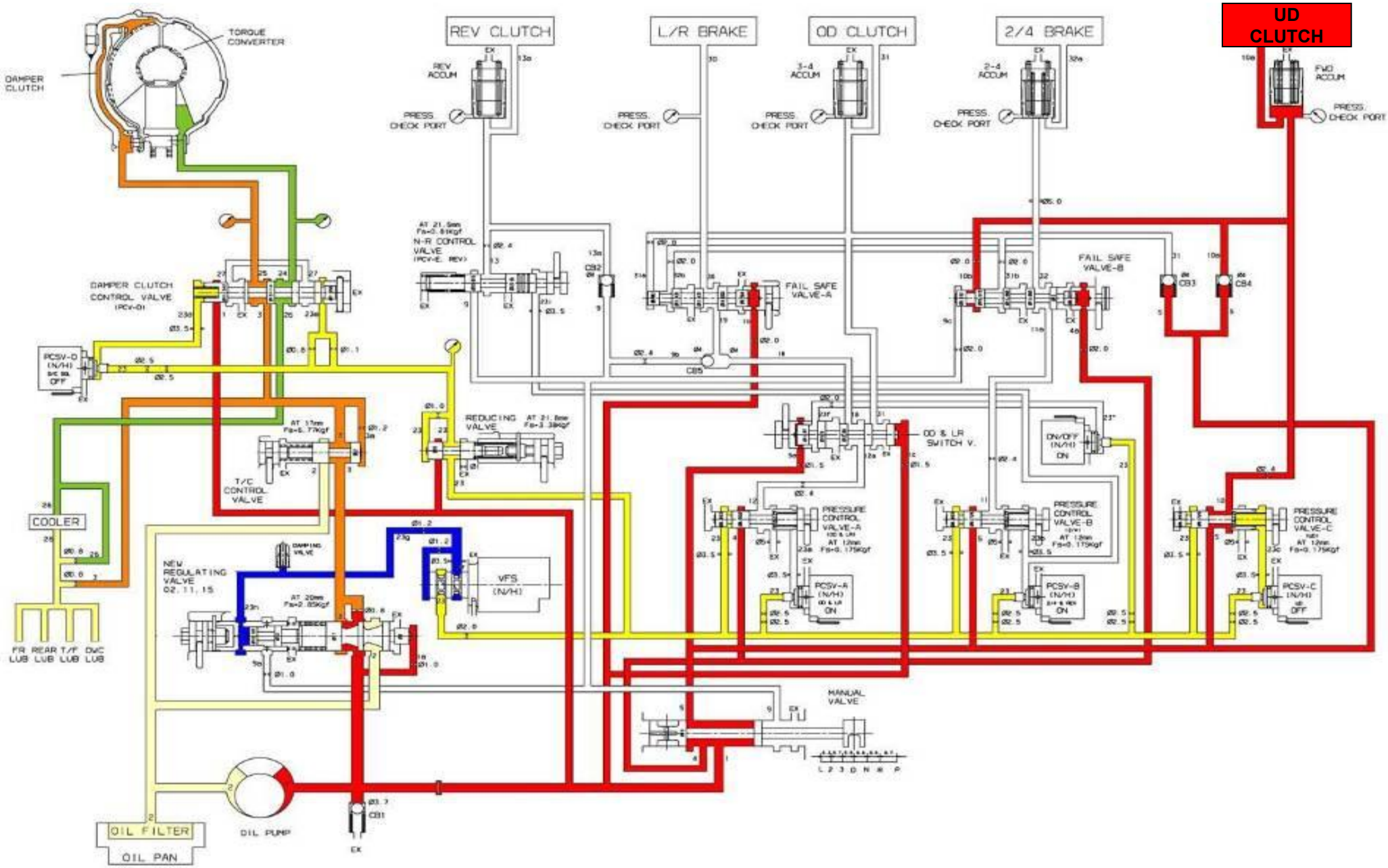
Appendix – Pressure Circuit (P/N)



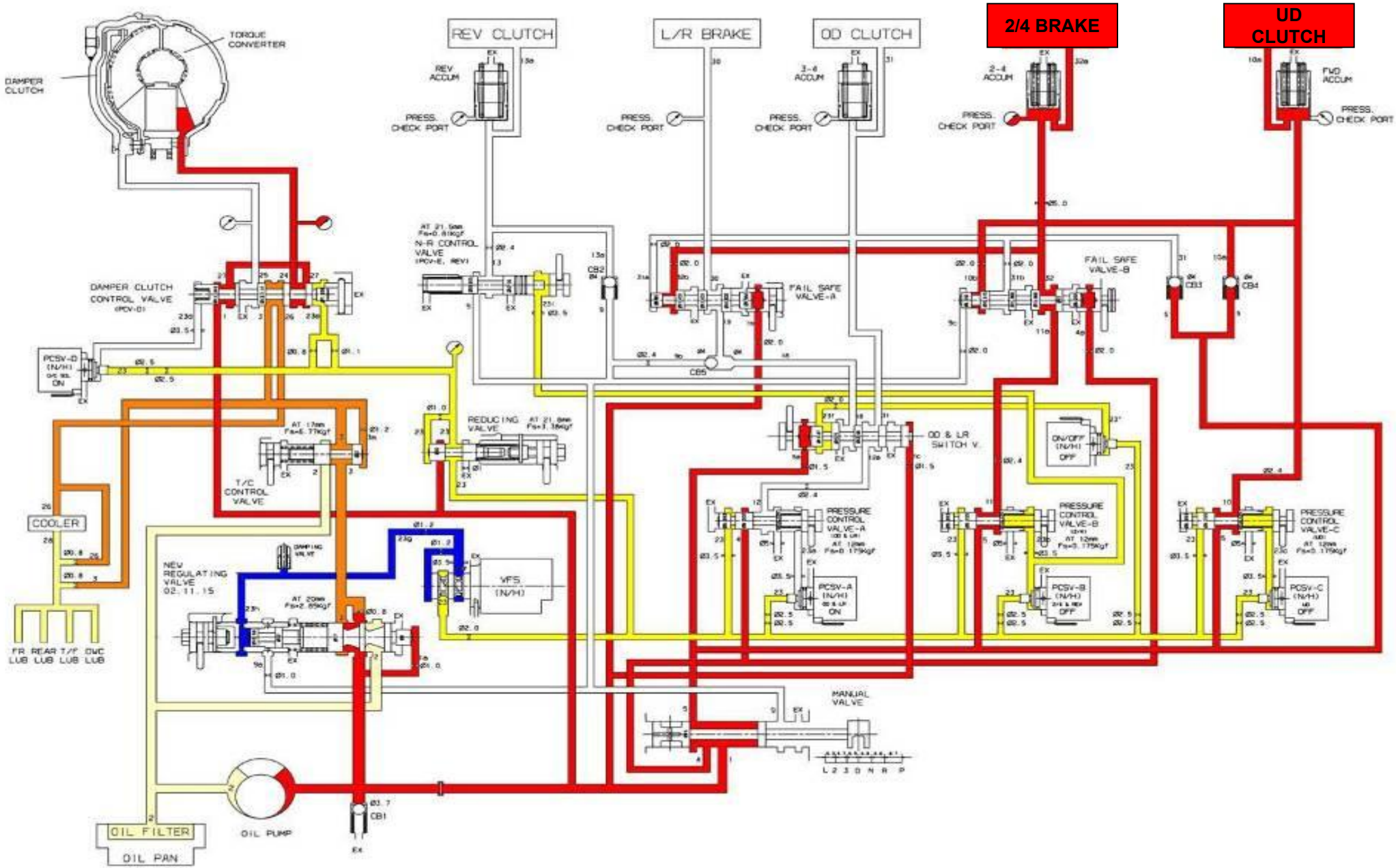
Appendix – Pressure Circuit (R)



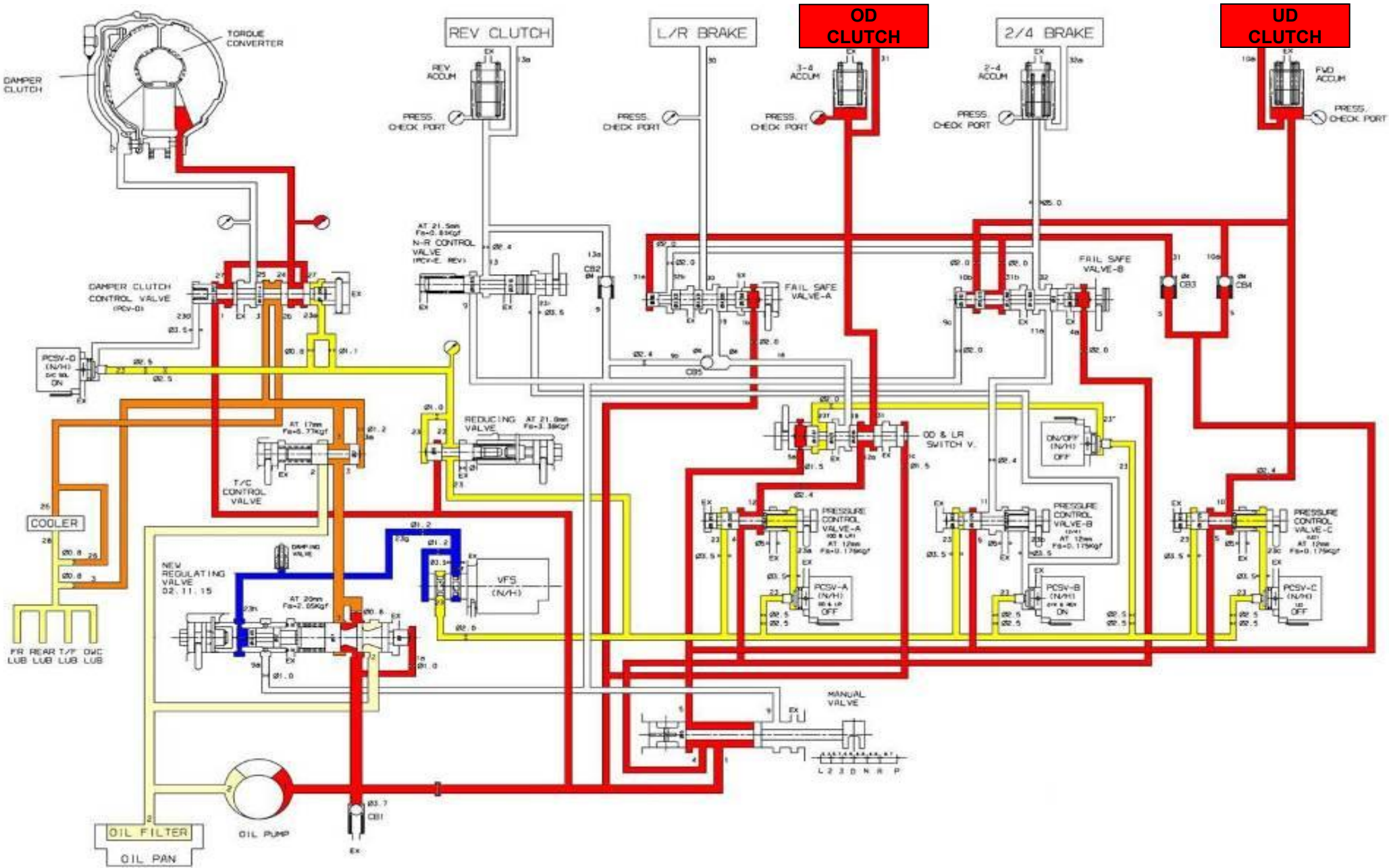
Appendix – Pressure Circuit (D1)



Appendix – Pressure Circuit (D2)



Appendix – Pressure Circuit (D3)



Appendix – Pressure Circuit (D4)