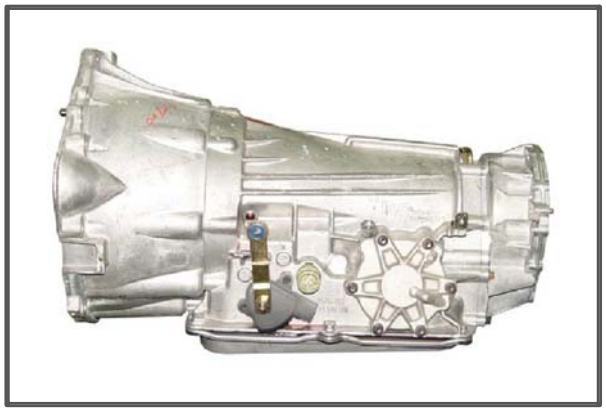
DSI 6 A/T

3680-01

GENERAL

1. GENERAL INFORMATION

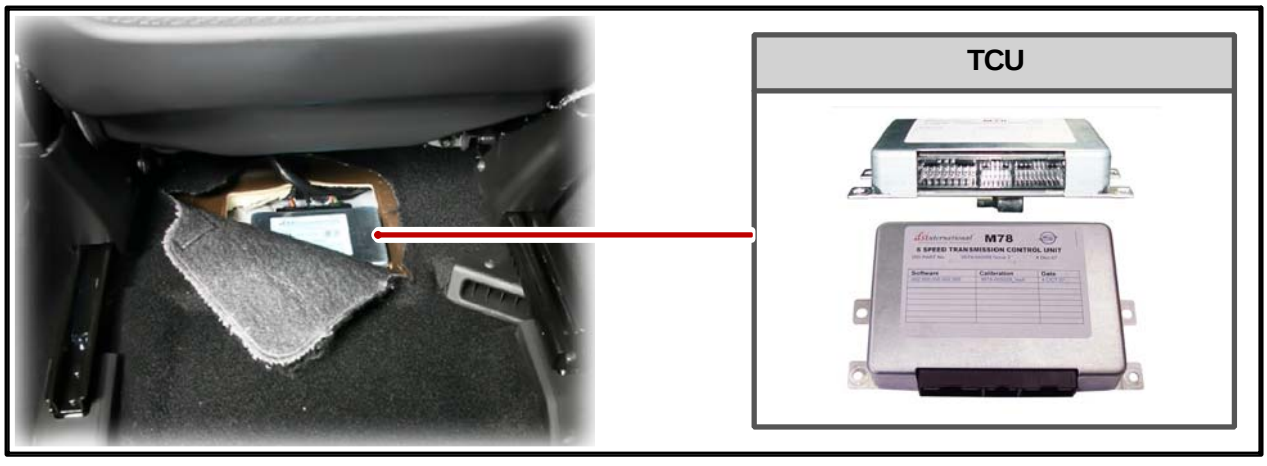
▶ **Automatic transaxle (DSI M78)**



- Six forward speeds
- One reverse gear
- A toruqe converter with an integral converter lock-up clutch
- Electronic shift and pressure controls
- A single planetary gear-set
- A double planetary gear-set
- Two hydraulically controlled brake bands
- Three multi-plate clutches
- All hydraulic functions are directed by electronic solenoids to control

▶ **TCU**

TCU is located under the driver's seat and controls the operations of transmission.
TCU receives the ignition voltage and has three connectors (16-pin, 12-pin, 20-pin).
TCU receives input signals from certain transmission-related sensors, gear select lever and inhibitor switch. TCU also uses these signals when determining transmission operating strategy. TCU uses PCAN to communicate with other units. And, TCU communicates with engine ECU, ESP unit, TCCU and instrument cluster through CAN lines to control the gear shifting and to recognize the current gear position.



Modification basis	
Application basis	
Affected VIN	

▶ Tip switch on steering wheel

Driving gear can be adjusted by operating the tip switch after moving the gear select lever in "M" position.

Shift down | Shift up

▶ Gear position display on instrument cluster

This indicator shows the current position of the gear.
In normal mode: P, R, N, D
Gear indication in "M" mode: 1, 2, 3, 4, 5, 6

Positions of gear select lever
P : Parking
R : Reverse
N : Neutral
D : Drive

▶ Gear select lever

Tip Switch in "M" Position (Manual Gear Shift)
The shiftable gear can be adjusted by moving this switch to forward and rearward when the gear select lever is in "M" position.

Mode Switch
W : Winter mode
S : Standard mode (Use the standard mode in normal driving conditions.)

Selection of Manual/ Automatic Shift Function
D : Automatic shift according to the driving condition
M : Manual shift

Shift Lock Release Button Hole when Locked in the "P" Position
If you cannot move the gear select lever from the "P" position, try to move the lever while pushing down here with a sharp object such as a ballpoint pen. For your safety, turn off the engine and depress the brake pedal before the attempt.

Modification basis	
Application basis	
Affected VIN	

2. FEATURES AND SPECIFICATIONS

1) Specifications

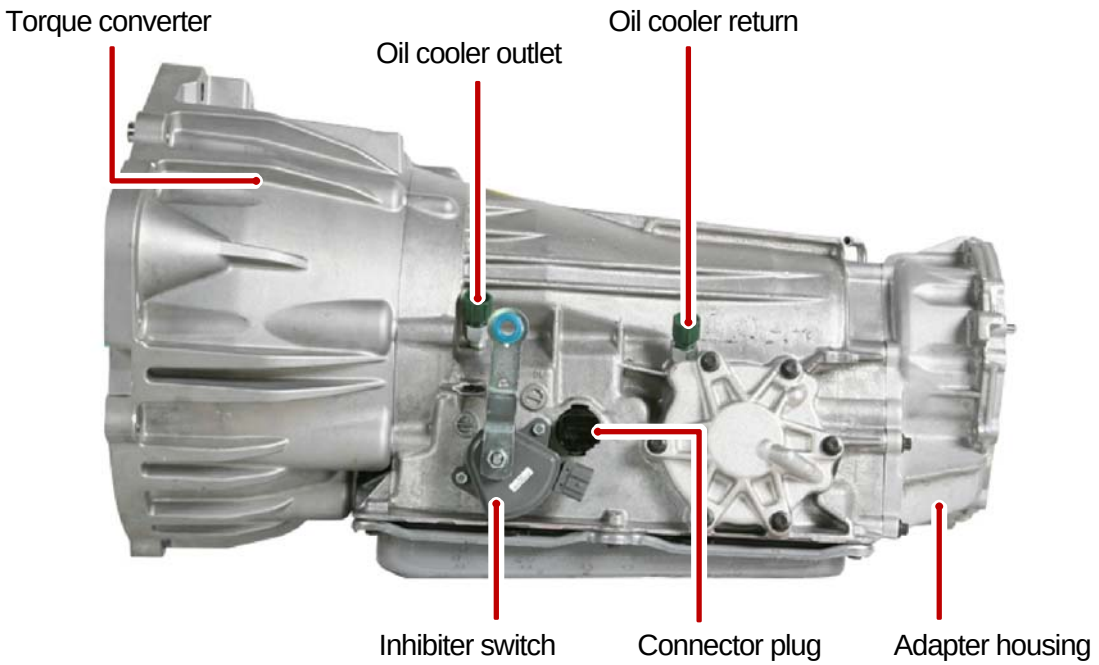
Description		DSI M78 (6-speed)	Remarks
Gear ratio	1st	3.53:1	
	2nd	2.14:1	
	3rd	1.48:1	
	4th	1.16:1	
	5th	0.87:1	
	6th	0.68:1	
	Reverse	3.09:1	
Transmission fluid	Fluid	Fuchs ATF 3292	
	Capacity	Approx. 9.5 L	
	Change interval	Check the fluid at every 30,000 km or 1 year, and change it if necessary.	Under the severe driving conditions, change the fluid at every 60,000 km.
Resistance of oil temperature sensor	-20	430.7 ~ 533.9 kΩ	
	0	146.8 ~ 175.7 kΩ	
	20	56.74 ~ 65.86 kΩ	
	100	3.201 ~ 3.399 kΩ	
Gear position sensor	1	-	
	2	-	
	3	-	
	D	2.686 kΩ ± 8%	
	N	5.036 kΩ ± 8%	
	R	8.953 kΩ ± 8%	
	P	16.786 kΩ ± 8%	

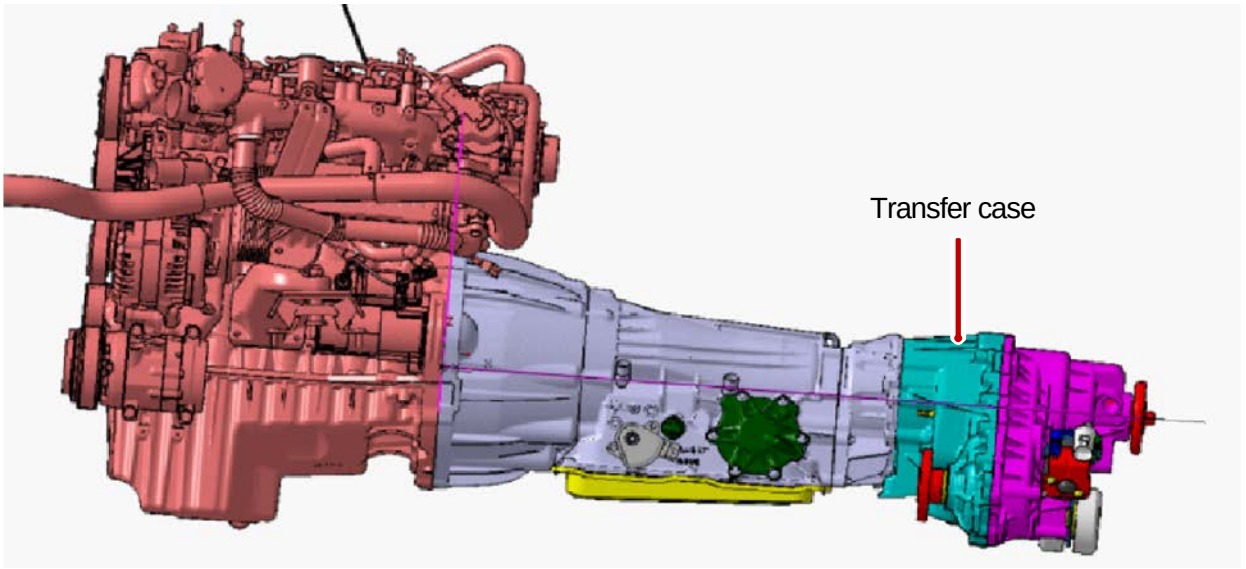
* **Severe driving conditions?**

- Towing a trailer or off-road driving (Inspect the leak of fl uid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed) Frequent stop-and-go traffi c, extended idling,
- short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffi c under the ambient temperature above 32°C

2) Appearance

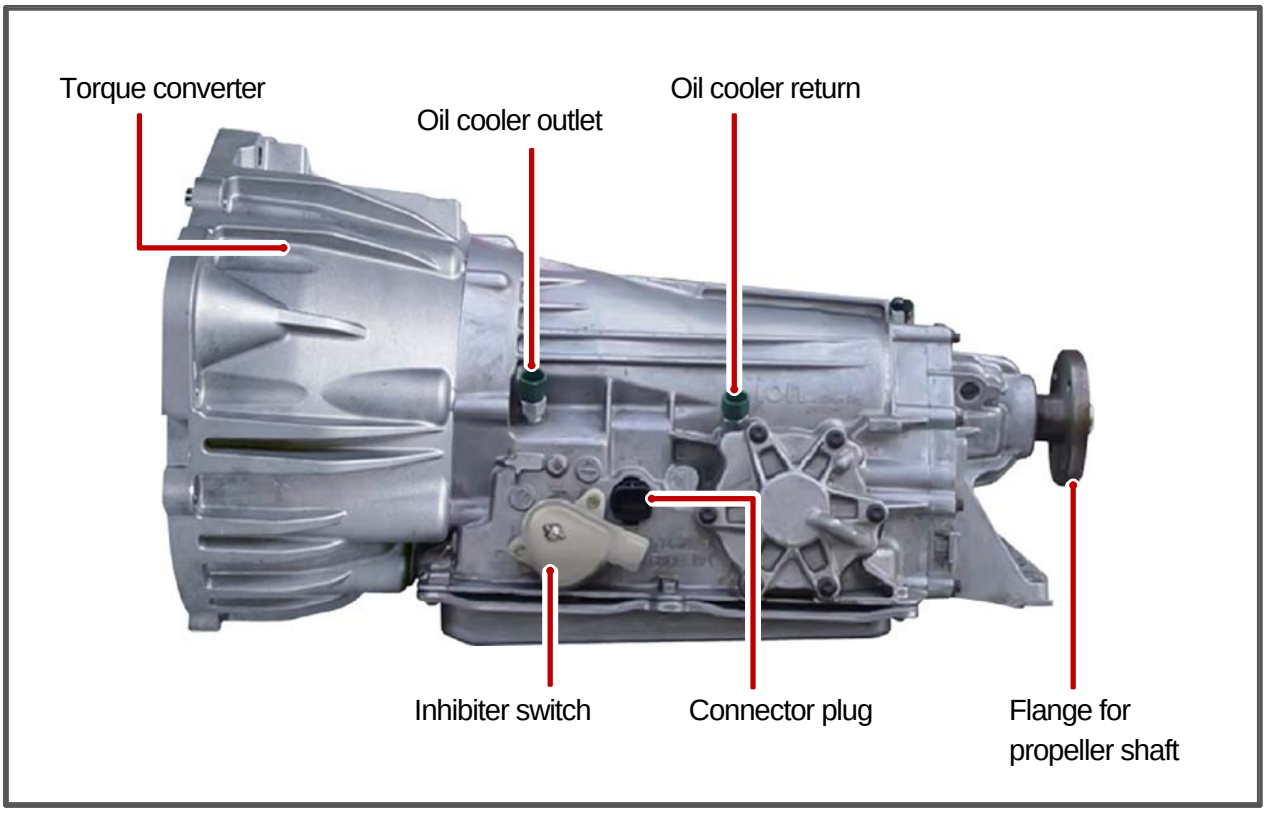
▶ **4WD Automatic Transmission**

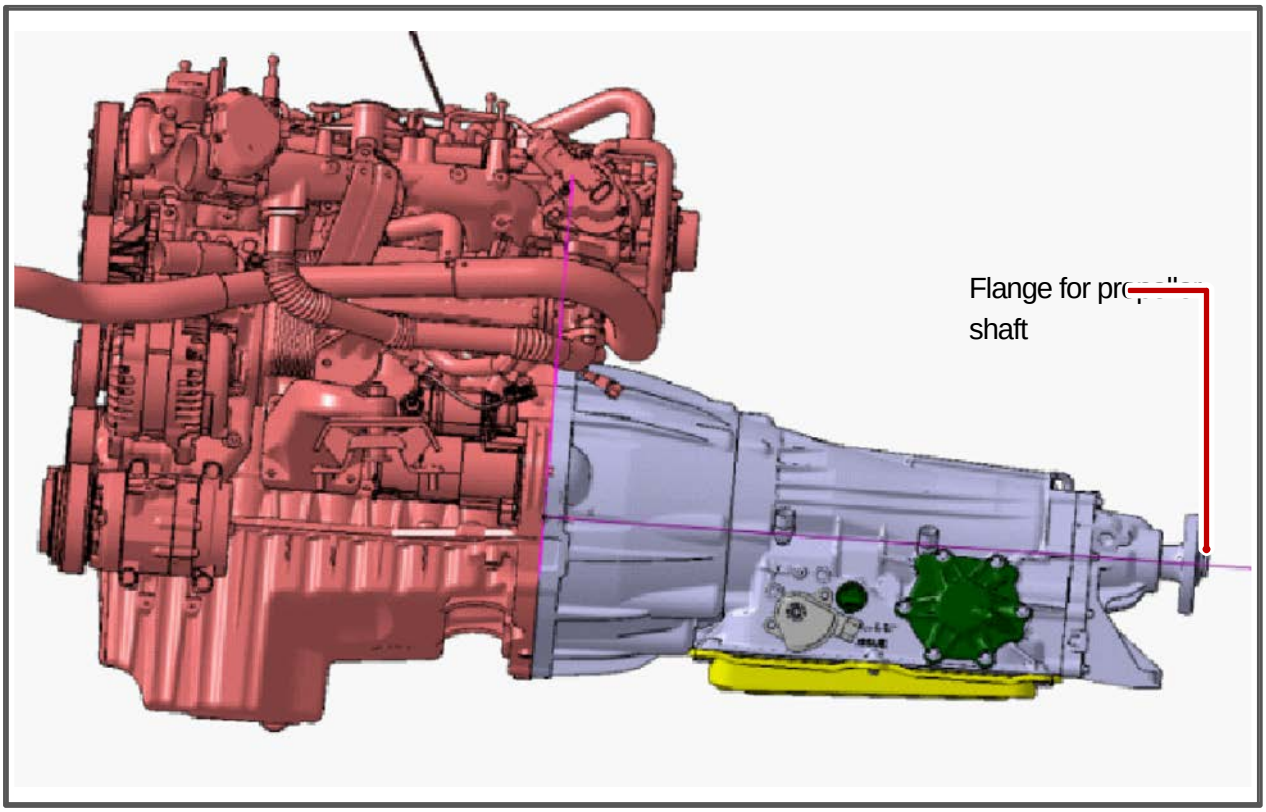




Modification basis	
Application basis	
Affected VIN	

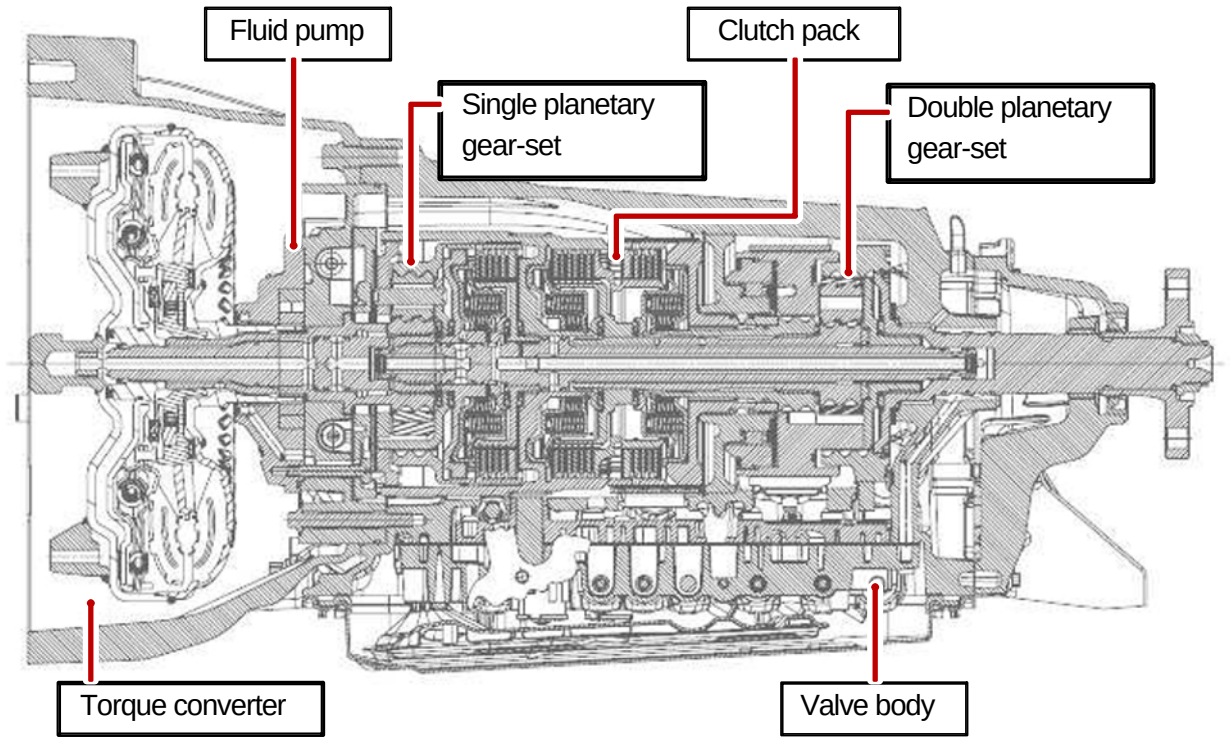
▶ 2WD Automatic Transmission



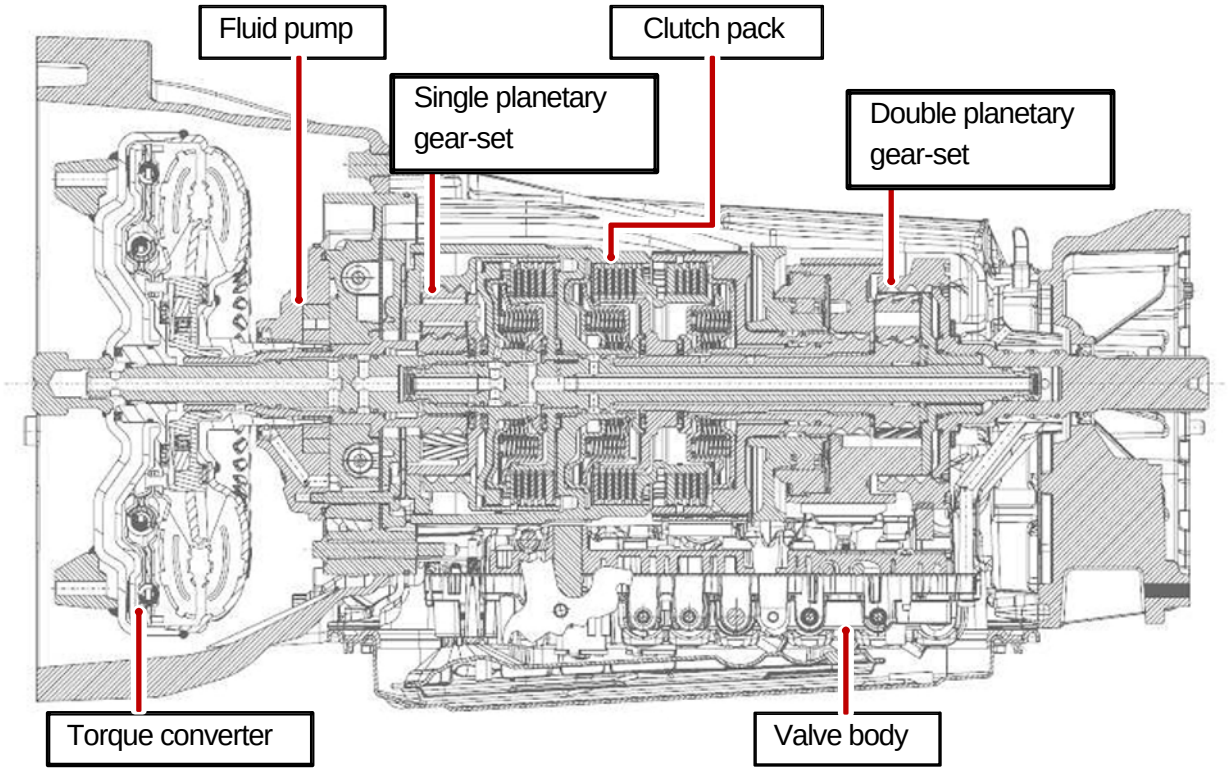


3) Sectional Diagram

4WD



2WD

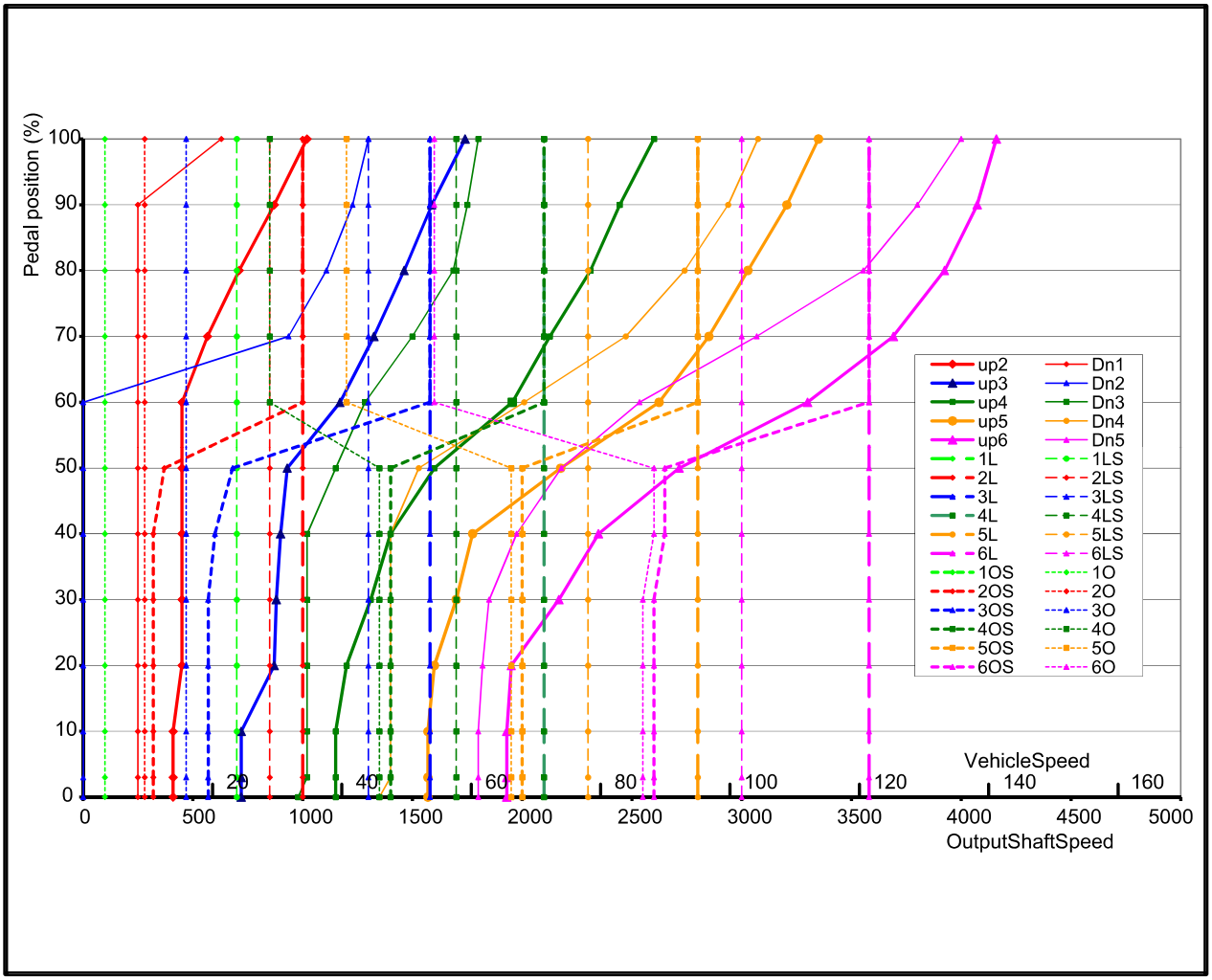


Modification basis	
Application basis	
Affected VIN	

3. TIGHTENING TORQUE

Description	Size x Numbers	Tightening torque
Transfer case housing	M12 x 32	54 ~ 68
Etension housing	M12 x 32	54 ~ 68
Oil pan	M6 x 16	4 ~ 6
Valve body to transmission housing	M6 x 26	8 ~ 13
Valve body to transmission housing	M6 x 45	8 ~ 13
Center support to transmission housing	M10 x 34	20 ~ 27
Output shaft locking nut	M24 x 15	100 ~ 110
Pump cover to oil pump	M8 x 55	24 ~ 27
Pump cover to transmission housing	M8 x 40	24 ~ 34
Pump cover to transmission housing	M8 x 58	24 ~ 34
Upper valve body to lower valve body	M6 x 30	15 ~ 17
Detent spring	M8 x 16	20 ~ 25
Variable bleed solenoid and speed sensor	M4 x 12	2.8 ~ 3.2
Transmission oil level plug		30 ~ 35
Front cooling lines to transmission cooler		25 ~ 35
Rear cooling lines to transmission cooler		25 ~ 35
Drive plate to torque converter		40 ~ 42
Gear select lever to shaft rod		14 ~ 20

4. SHIFT PATTERN DIAGRAM



Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The six speed automatic (M78) transmission is available in two variants: four wheel drive and two wheel drive.
The transmission has the following features:

- Six Forward Speeds
- One reverse gear
- A torque converter with an integral converter lock-up clutch
- Electronic shift and pressure controls
- A single planetary gear-set
- A double planetary gear-set
- Two hydraulically controlled brake bands
- Three multi-plate clutches
- All hydraulic functions are directed by electronic solenoids to control:
  - Engagement feel
  - Shift feel
  - Shift scheduling
  - Modulated torque converter clutch applications

The transmission contains fully synthetic automatic transmission fluid (ATF) and is filled for life; therefore it does not require periodic servicing.
Engine power reaches the transmission via a torque converter with integral converter lock-up clutch. The six forward gears and one reverse gear are obtained from a single planetary set, followed by a double planetary set. This type of gear-set arrangement is commonly known as Lepelletier type gear-set.
The automatic transmission is electronically controlled. The control system is comprised of the following elements:

- External transmission control unit (TCU)
- Internal embedded memory module (EMM)
- Input and output speed sensors
- Valve body unit comprised of four on/off solenoid valves and six variable bleed solenoids
- Torque converter

2. FEATURES

1) Features

▶ Early Downshifts with Hard Braking and Skip Shifts

When heavy braking is detected, the transmission downshifts early and skips gears to provide increased engine braking to provide gear selection for tip-in.

▶ Gear Hold on Uphill/Downhill

If the accelerator pedal is released when travelling uphill, upshifts are prevented to reduce busyness on grades. If the accelerator pedal is released when travelling downhill, upshifts are prevented to enhance engine braking.

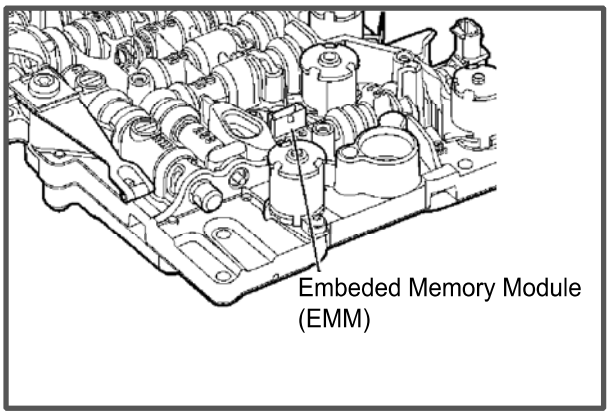
▶ Soft Engagement when Shifting to "D" and "R" Position

A soft engagement feature avoids harsh take up of drive when selecting Drive or Reverse. This is achieved by limiting engine speed and engine torque which results in a rapid, but progressive engagement of either Drive or Reverse when moving from the Park or Neutral positions. There is no drive engagement prevention strategy implemented on the transmission system as there is sufficient engine strategy to protect the system. However, reverse gear engagement is prevented until engine speed is less than 1400 rpm and the accelerator pedal position is less than 12% and vehicle speed is less than 10 km/h.

▶ Converter Clutch Lock-Up In All Gears

The transmission features converter clutch lock-up in all gears. This feature provides improved fuel economy and vehicle performance. It also improves transmission cooling efficiency when towing heavy loads at low speeds, e.g. in city driving or hill terrain.

▶ Embeded Memory Module (EMM)



The embedded memory module (EMM) is matched to the transmission's valve bodies during transmission assembly to ensure refined shift quality. The EMM is integrated into the input speed sensor which is mounted on the valve body in the transmission. The EMM is used to store data such as valve body calibration data and valve body serial number. Upon installation, the TCU will download the data from the EMM and utilise this data in the operation of the transmission.

Modification basis	
Application basis	
Affected VIN	

2) Cooling System

The transmission cooling system ensures rapid warm-up and constant operating temperature resulting in reduced fuel consumption and refined shift quality.
It also includes a cooler by-pass within the hydraulic system to allow sufficient cooling and lubrication to the transmission drivetrain in the event of a blockage in the transmission cooler.

3) Shift Strategy

▶ Gear Shift

Transmission gear change is controlled by the TCU. The TCU receives inputs from various engine and vehicle sensors to select shift schedules and to control the shift feel and torque converter clutch (TCC) operation at each gear change

▶ Coastdown

Coastdown downshifts occur at 0% accelerator pedal when the vehicle is coasting down to a stop. To reduce the shift shock and to improve the shift feeling during downshift, TCU electronically controls the transmission.

▶ Torque Demand

Torque demand downshifts occur (automatically) when the driver demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

3. MODE DESCRIPTIONS

1) Functions

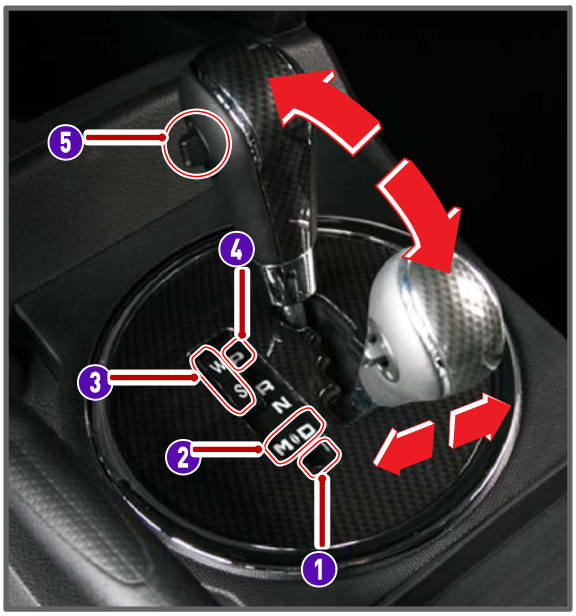
1. **Shift Lock Release Button Hole when Locked in the "P" Position (1)**
   If you cannot move the gear select lever from the "P" position, try to move the lever while pushing down here with a sharp object such as a ballpoint pen. For your safety, turn off the engine and depress the brake pedal before the attempt.

2. Selection of Manual/Automatic Shift Function (M↔D) (2)
   D : Automatic shift according to the driving condition
   M : Manual shift

3. **Mode Switch (3)**
   W : Winter mode (Start off the vehicle in 2nd gear)
   S : Standard mode (Use the standard mode in normal driving conditions.)

4. **Gear Position (4)**
   P : Park
   R : Reverse
   N : Neutral
   D : Drive

5. Tip Switch in "M" Position (Manual Gear Shift) (5)
   The shiftable gear can be adjusted by moving this switch to forward and rearward when the gear select lever is in "M" position.



Modification basis	
Application basis	
Affected VIN	

2) Mode “M” (Manual Shift Mode)

This allows the driver to define the highest possible gear by selecting "+" or "-" on the gear selector when the lever is in the "M" position. When the lever is first moved to the manual "M" position the transmission will select the lowest possible gear.
When maximum engine rpm is reached the transmission will upshift automatically regardless of the driver selected limit. 4WD models with low range will not automatically upshift when low range is selected.

NOTE

Kickdown Function

If you need to accelerate rapidly, depress the accelerator pedal completely to the floor.
Then, a one- or two-lever gear will automatically be engaged. This is called the Kickdown function.

▶ **1st gear position**

- Use on a rugged road, mountain path and steep hill. Engine braking effect on steep hill is available.

▶ **2nd gear position**

- Use on a long and gentle slope. 2-1 automatic kickdown shift is available. Engine braking effect is available.

▶ **3st gear position**

- Use on a long and gentle slope. 3-2 and 2-1 automatic kickdown shift is available. Engine braking effect is available.

▶ **4th gear position**

- Use on a long and gentle slope. 4-3, 4-2 and 4-1 automatic kickdown shift is available.

▶ **5th gear position**

- 5-4 and 5-3 automatic kickdown shift is available.

▶ **6th gear position**

- 6-5 and 6-4 automatic kickdown shift is available.

4. LIMP HOME MODE

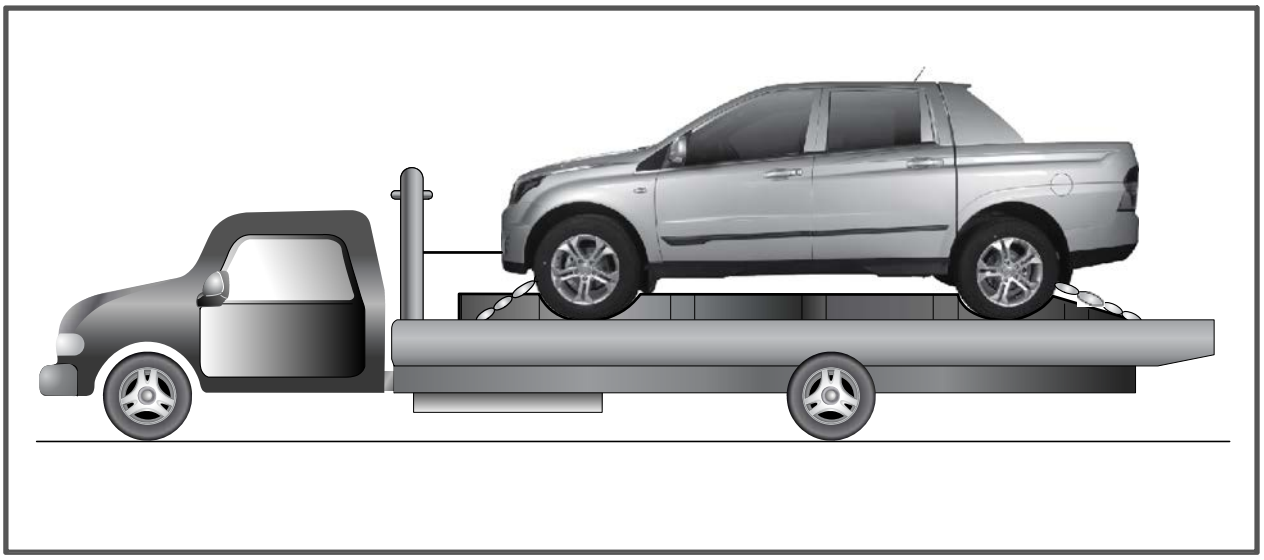
▶ In case of transmission malfunction

1. If a serious fault occurs in the automatic transmission, the TCU enters the limp home mode to secure safe driving and protect the automatic transmission.
2. As power is no longer supplied to the solenoid, the current basic function (P, R, N, D) is maintained and the 4th gear can be maintained only by the operation of the hydraulic system without electrical operation.
3. The ECU communicates with other electric modules with CAN. If a serious fault occurs, the transmission automatically enters the limp home mode for service.
4. The TCU monitors all factors which can affect to the performance of the transmission and diagnose the system according to OBD II regulation.

▶ In case of overheated transmission

1. The TCU enters the limp home mode when the batter voltage drops below 8 V.
2. If the transmission is overheated, the shift pattern is changed to the hot mode to cool the transmission more efficiently.
3. While the transmission is overheated, the selector lever symbol and engine temperature warning lamp on the instrument cluster blink until the transmission is cooled down to the normal operation temperature. If the transmission is excessively overheated, the gear cannot be shifted but remains in the neutral position.

▶ Towing the vehicle with A/T



CAUTION

The best way to transport the vehicle is to load it to a truck and transport it, especially if the vehicle is 4WD.

- If towing the vehicle with the propeller shaft connected, the transmission or oil pump of transfer case may malfunction, resulting in internal damage due to poor lubrication.

Modification basis	
Application basis	
Affected VIN	

5. ELECTRONIC CONTROL SYSTEM

1) Overview

The transmission control unit (TCU) and its input/output networks control the operations of transmission:

- Shift timing
- Line pressure
- Clutch pressure (shift feel)
- Torque converter clutch

In addition, the TCU receives input signals from certain transmission-related sensors and switches. The TCU also uses these signals when determining transmission operating strategy. Using all of these input signals, the TCU can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the pressure needed to optimise shift feel. To accomplish this, the TCU operates six variable bleed control solenoids and four ON/OFF solenoids to control the operations of transmission.

2) Transmission Control Unit (TCU)

The transmission control unit (TCU) is mounted under the driver's seat and controls the operation of the transmission.
TCU processes the analog information from the internal sensors and the digital information through CAN communication lines. TCU monitors all the input and output signals. If there is any failure, TCU changes the system to "Limp Home Mode" and alerts to the driver through the warning lamp on the instrument cluster.

(1) Hard-wired (Analog) Input/Output

▶ **Input/Output Data between TGS Lever and TCU**

- Position and conditions of gear select lever
- Driving moded (Winter or Standard)

▶ **Input/Output Data between Inhibitor and TCU**

- Position of inhibitor switch

▶ **Input/Output Data between Automatic Transmission and TCU**

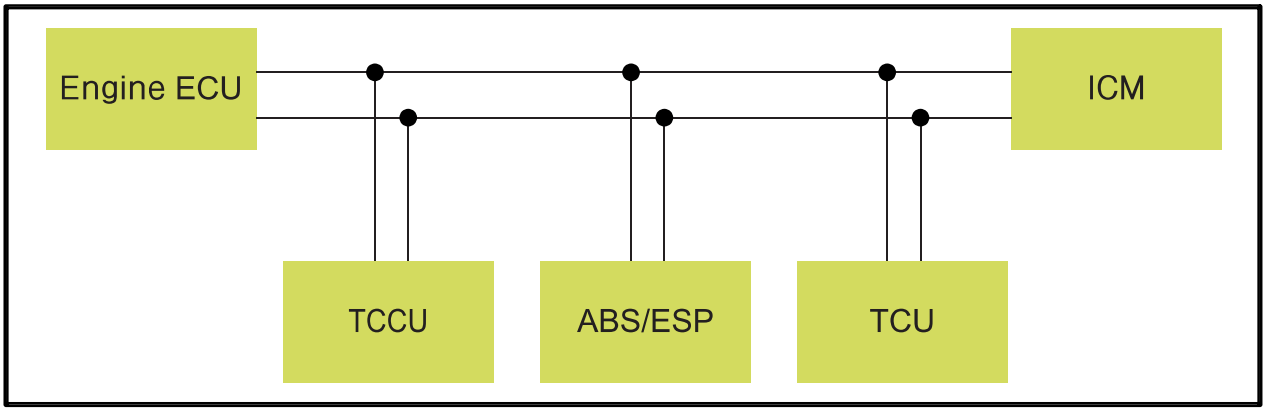
- 6 control signals for variable bleed solenoid
- 4 control signals for ON/OFF solenoid
- Transmission input speed
- Transmission output speed
- Transmission oil temperature
- EMM (Embeded Memory Module)

▶ **Input/Output Data between Self Diagnostic Connector and TCU**

- Various DTC codes and TCU information

(2) CAN Input/Output

TCU receives and sends the data among the units through P-CAN communication.

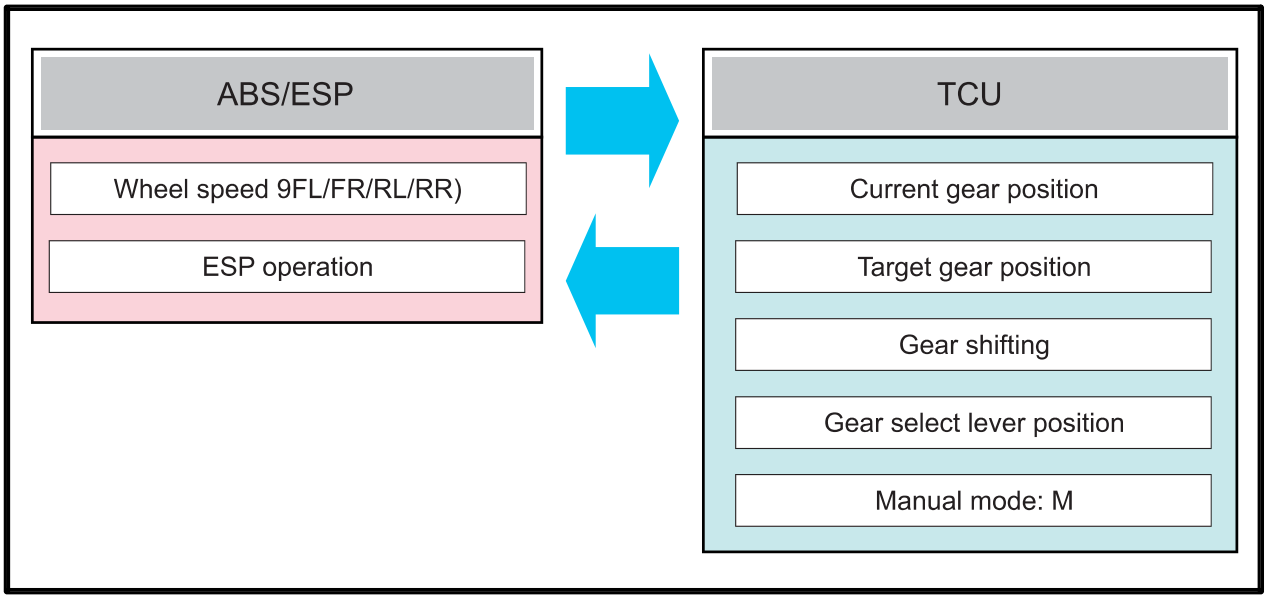


▶ **CAN Input/Output Data between Engine ECU and TCU**

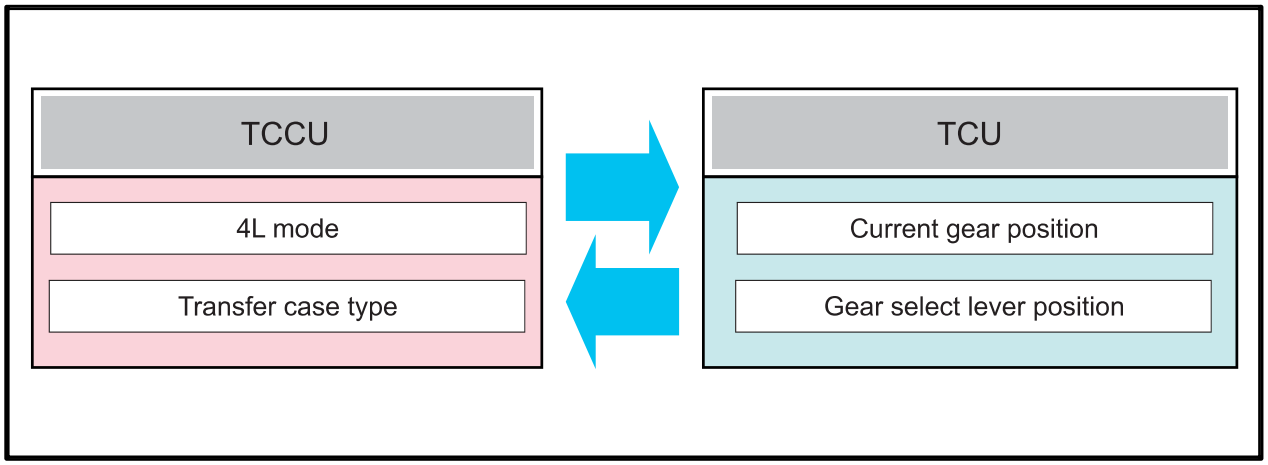
Engine ECU	TCU
Accelerator pedal position	Engine torque (including max/min)
Shift level request	Current gear position
Engine limp home mode	Target gear position
Accelerator pedal sensor error	Torque converter lock up
Cruise control ON	Gear shifting
Requested torque from ESP	Torque request in safety mode
Engine rpm	Engine torque control
Engine torque (including max/min)	Software calibration ID and gear select lever position
Vehicle speed	Failure and error
Stop lamp ON/OFF	Turbine speed of torque converter
Engine coolant temperature	Drive position
Intake air temperature	Driving mode program (Winter or Standatd)
	Transmission oil temperature

Modification basis	
Application basis	
Affected VIN	

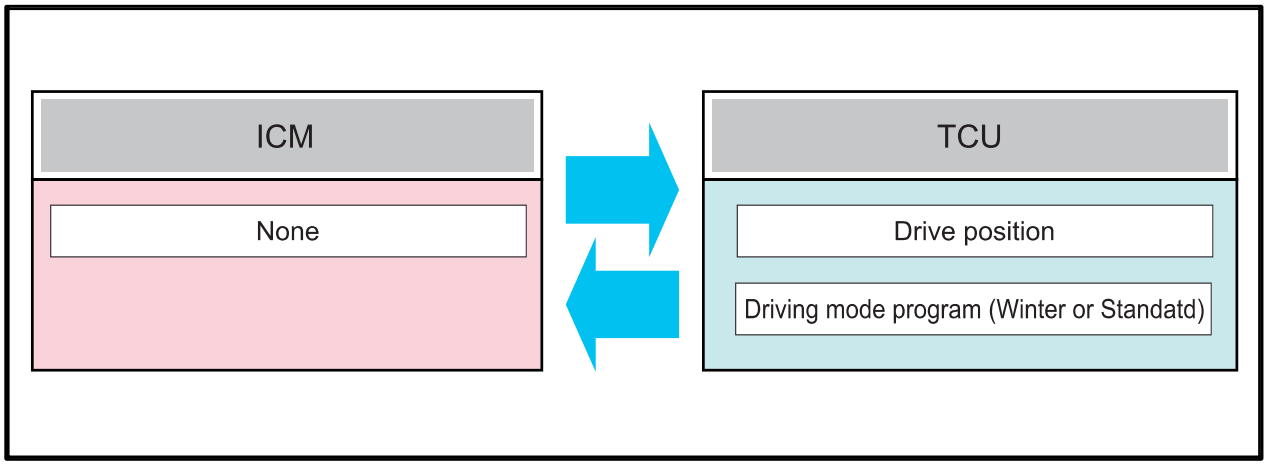
▶ CAN Input/Output Data between ABS/ESP and TCU



▶ CAN Input/Output Data between TCCU and TCU



▶ CAN Input/Output Data between ICM and TCU



3) Transmission Control Monitoring System

TCU monitors all input and output signals to identify possible failures. If a fault is detected, TCU activates the safety mode to keep the driver's safety and the life span of transmission.

▶ Monitoring the Supply Voltage

If the battery voltage is too high or too low, the TCU sets the DTC.

▶ Monitoring the Supply Voltage to Solenoid

TCU monitors the circuits for open or short to ground or supply. The monitoring function evaluates the voltage characteristics while the switch is ON.

▶ Monitoring the Gear Ratio

TCU monitors the gear is engaged properly in the allowed time.

▶ Monitoring the Torque Converter

TCU checks if the torque converter can be locked up properly. If it is failed, TCU releases the torque converter clutch to activate the fail-safe operation.

4) Shift Energy Management

This function involves reducing or increasing the engine output torque during shifting. This reduces the energy which is dissipated in the friction elements of the transmission during up-shift. This is done by reducing the engine torque during the gear ratio change without interrupting the tractive drive.
This function is used for:

- Increasing the life span of transmission by shortening the slipping time
- Improving the shift comfort by reducing the step changes due to gearshift
- Transferring a higher engine power

Real-time control of engine torque is required to maintain the proper shift operations and the durability of transmission. TCU controls the engine torque during the gearshift by synchronizing the operation of transmission clutches.

▶ **Pressure Modulation**

To provide a higher level of shift comfort and durability, the hydraulic pressure in the shift related friction elements of the transmission must be matched accurately to the input torque to transmission. This hydraulic pressure is composed of a hydraulically pre-set basic pressure and a control pressure which is set by one of the variable bleed solenoids.

The transmission input torque can be directly calculated from the following operating parameters:

- engine torque signals
- engine speed or any signal transmitted from ECU through CAN lines
- converter slip

Separate pressure characteristics for each gear change make it possible to adapt precisely to the particular shift operation.

5) Shift Mode Selection by TCU

The driver can select Standard (S) or Winter mode (W) with the mode switch. TCU automatically changes the shift mode according to the transmission oil temperature, uphill or downhill gradient, and altitude to keep the good driving conditions.

▶ **Standard Mode (S)**

Standard Mode is selected when setting the mode switch in Standard (S) position with the gear select lever in "D" and the transmission oil temperature in normal operating range. Proper shift timing provides the optimized fuel economy and good driving conditions.

▶ **Uphii and Downhill Mode**

In this mode, the operating points of torque converter lock-up clutch and the shifting points are adjusted according to the vehicle weight.

▶ **Altitude Mode**

In this mode, the shifting points are automatically adjusted according to the altitude to compensate the engine torque changes due to barometric pressure and temperature.

▶ Winter Mode (W)

When the Winter mode is selected, the second gear is engaged to start off the vehicle easily to prevent wheel spin on slippery surfaces and WINTER mode indicator comes ON. The first gear is not available in this mode.

▶ Low Range Driving Mode

When the vehicle is in 4L driving mode, the transmission uses a different shift mode to optimize the low range driving. Similar to Winter mode, the first gear is not available.

▶ Warm Up Mode

This mode is normally used when the transmission oil temperature is below 20°C.
The torque converter cannot be locked-up below 20°C to provide the warming up process of transmission.

▶ Hot Mode

If the transmission oil temperature is between 110°C and 145°C, the system provides the cooling and reduces the load to the transmission. This is called Hot Mode.

- Above 110°C: PWM fan ON
- Above 130°C: the engine torque is reduced and WINTER indicator is blinking
- Above 145°C: the transmission is held in Neutral (N) gear until the oil temperature falls below 120°C (Final protection)

In Hot Mode, any of shift mode is not available.

▶ Cruise Control

When the cruise control is activated, the engine ECU requests the downshift to increase the engine brake effect.

6. POWER FLOW

Power flows in gears:

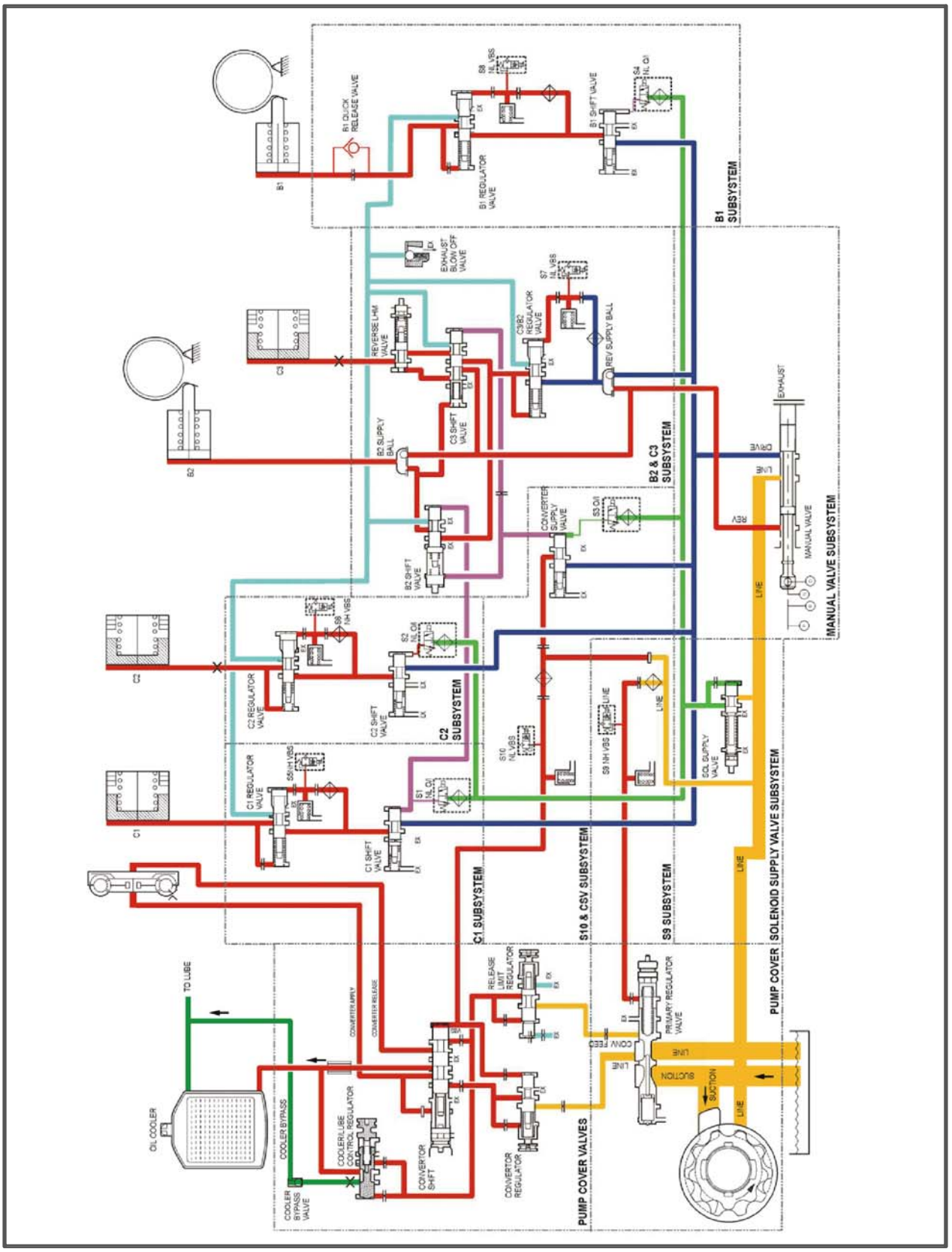
- Power flow - 1st gear (M)
- Power flow - 1st gear (D)
- Power flow - 2nd gear (D)
- Power flow - 2nd gear (D) ? lockup (D)
- Power flow - 3rd gear (D)
- Power flow - 4th gear (D) - 4th gear (D) in Limp home mode
- Power flow - 5th gear (D)
- Power flow - 6th gear (D)

▶ **Gear Selection and Engaged Element**

Gear	Gear ratio	Engaged element (clutch & band)					
		C1	C2	C3	B1	B2	1-2OWC
M1	3.53		ON			ON	
1st	3.53		ON				ON
2nd	2.14		ON		ON		
3rd	1.48		ON	ON			
4th	1.16	ON	ON				
5th	0.87	ON		ON			
6th	0.68	ON			ON		
Reverse	-3.09			ON		ON	

Gear	ON/OFF solenoid valve				Variable bleed solenoid valve - VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
M1	ON				1	0	1			
1st	ON				1	0			0-1	
2nd	ON			ON	1	0		1	0-1	
3rd	ON		ON		1	0	1		0-1	
4th					0	0			0-1	
5th		ON			0	1	1		0-1	
6th		ON		ON	0	1		1	0-1	
Reverse	ON	ON	ON		1	1	1		0-1	

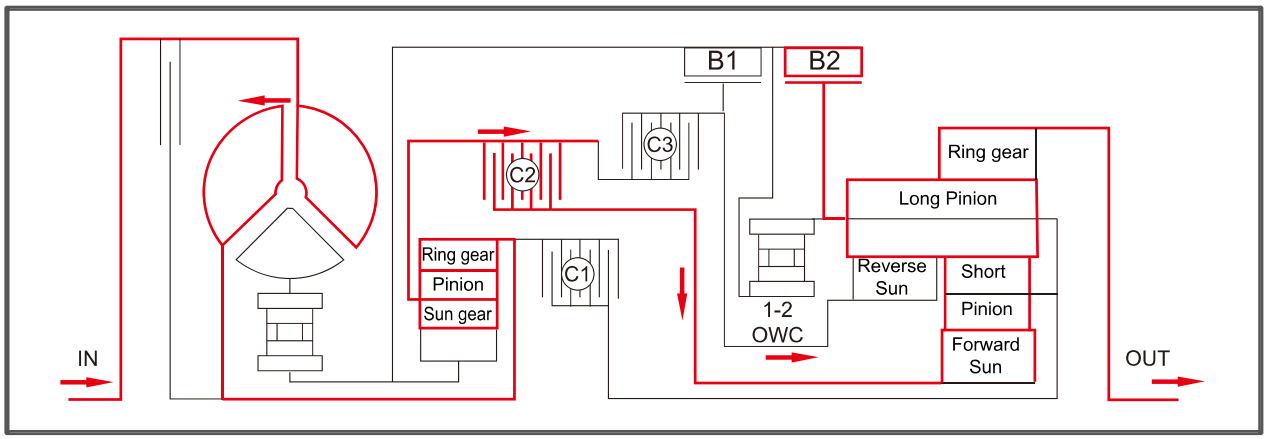
▶ Hydraulic Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

1) Power Flow - Manual (M Position)

▶ Power Flow Diagram



▶ Functioning elements

- C2 applied, FSG (Forward Sun Gear) driven
- B2 applied to hold Rear Planet Carrier stationary
- Provides engine breake effect

CAUTION

Manual 1st gear is not engaged even when moving the manual valve to a certain position. This gear state is obtained electronically by solenoids S1 and S7.

▶ Control

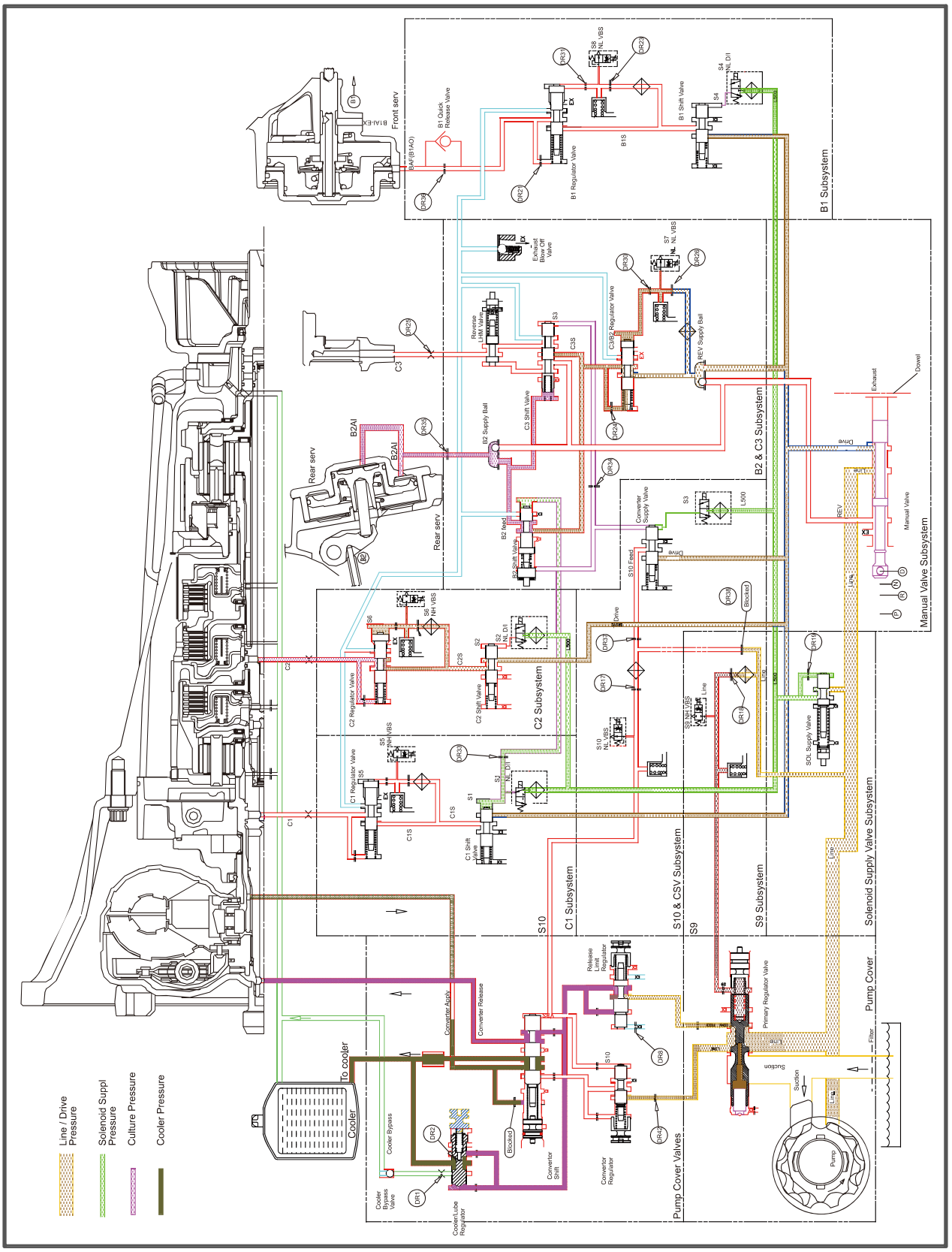
- S1 ON, C1 shift valve moved to the left end, C1 clutch not engaged
- S1 ON, B2 shift valve moved to the left end, B2 band operated (S7 should be ON)
- C2 shift valve open (S2 OFF), C2 clutch engaged by drive oil
- Drive oil (for C2 clutch engagement) is regulated by VBS S6

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
3.53	ON						ON	ON		

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
3.53	ON				1	0	1		0-1	

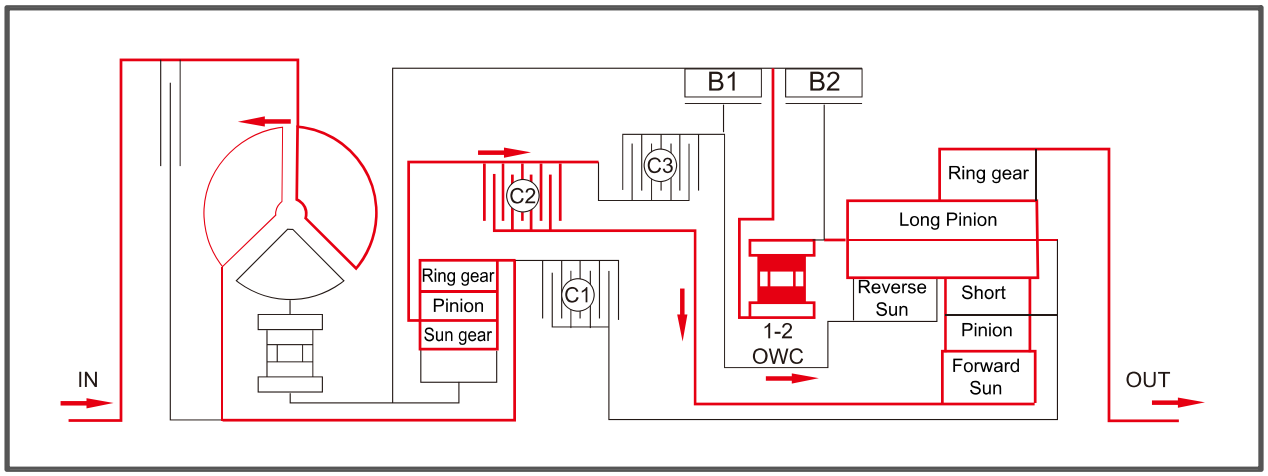
▶ 1st Gear (M) (3.53:1)



Modification basis	
Application basis	
Affected VIN	

2) Power Flow - 1st Gear (D)

▶ Power Flow Diagram



▶ Functioning elements

- C2 applied, FSG (Forward Sun Gear) driven
- 1-2 OWC (One-Way Clutch) operated to hold Rear Planet Carrier stationary

▶ Control

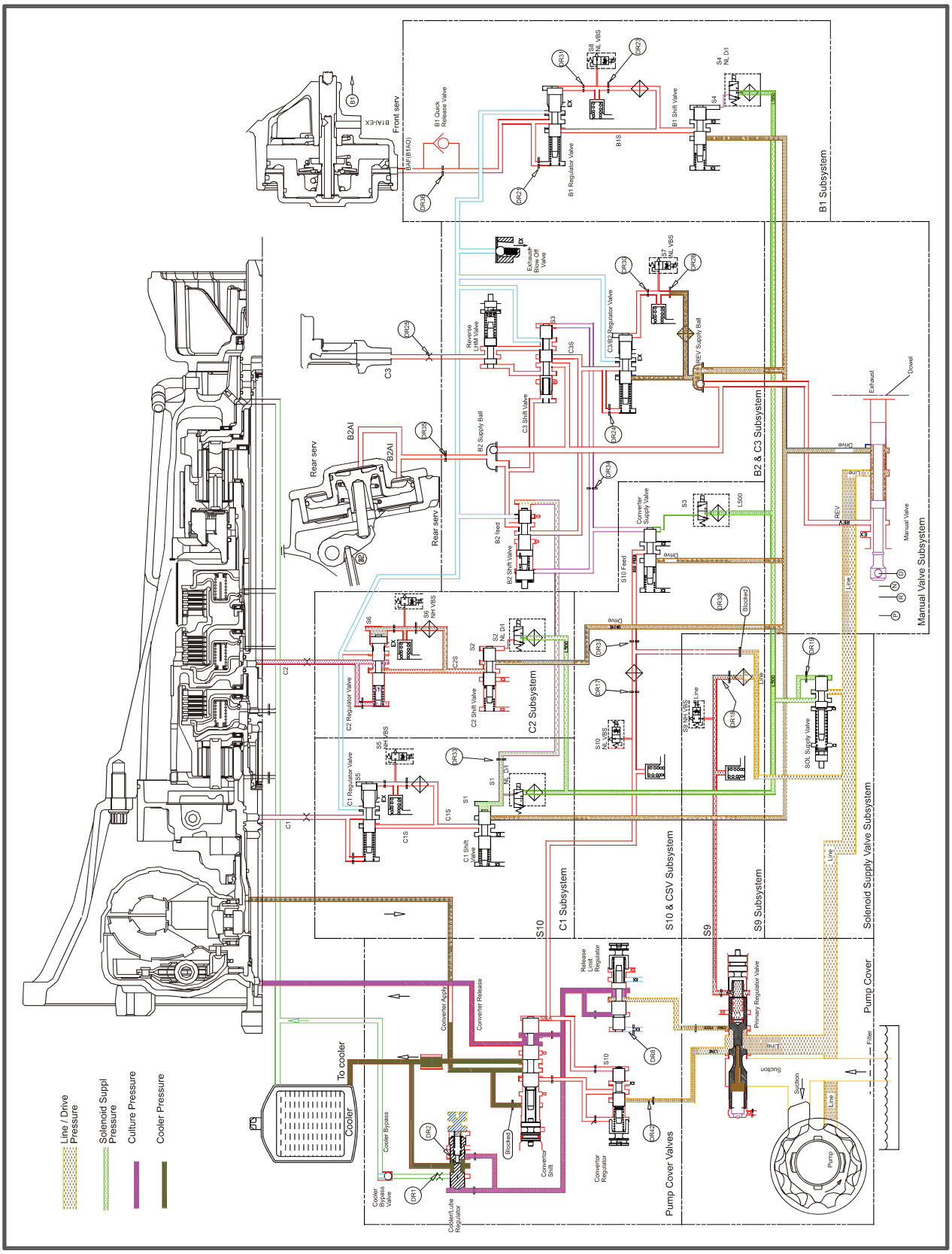
- S1 ON, S2 OFF
- S1 ON, C1 shift valve moved to the left end, C1 clutch not engaged
- C2 shift valve open (S2 OFF), C2 clutch engaged by drive oil
- Drive oil (for C2 clutch engagement) is regulated by VBS S6

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
3.53		ON							ON	

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
3.53	ON				1	0			0-1	

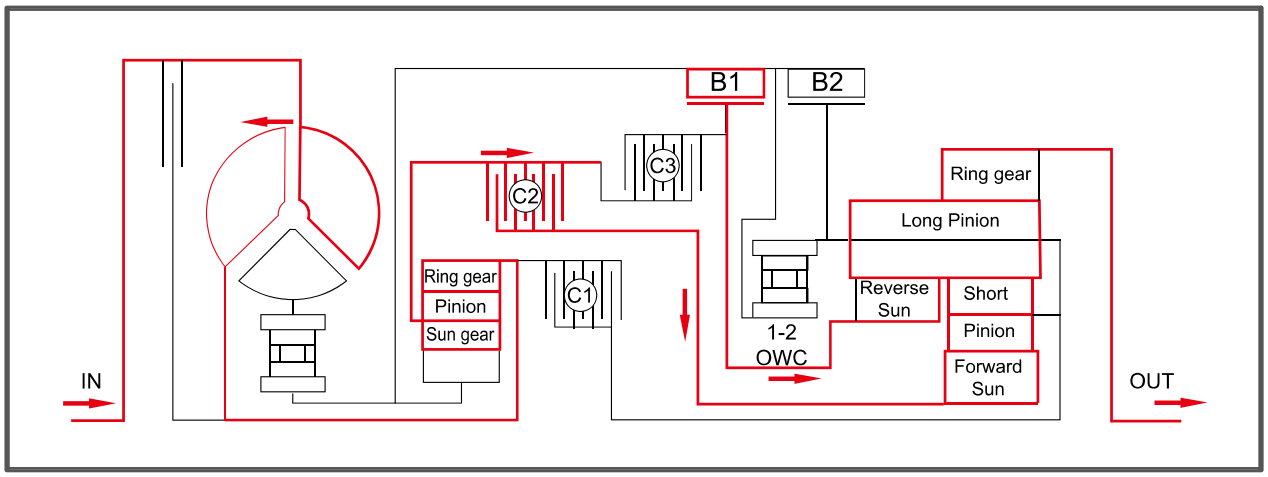
▶ 1st Gear (D) (3.53:1)



Modification basis	
Application basis	
Affected VIN	

3) Power Flow - 2nd Gear (D)

▶ Power Flow Diagram



▶ Functioning elements

- C2 applied, FSG (Forward Sun Gear) driven
- B1 applied to hold Rear Planet Carrier stationary

▶ Control

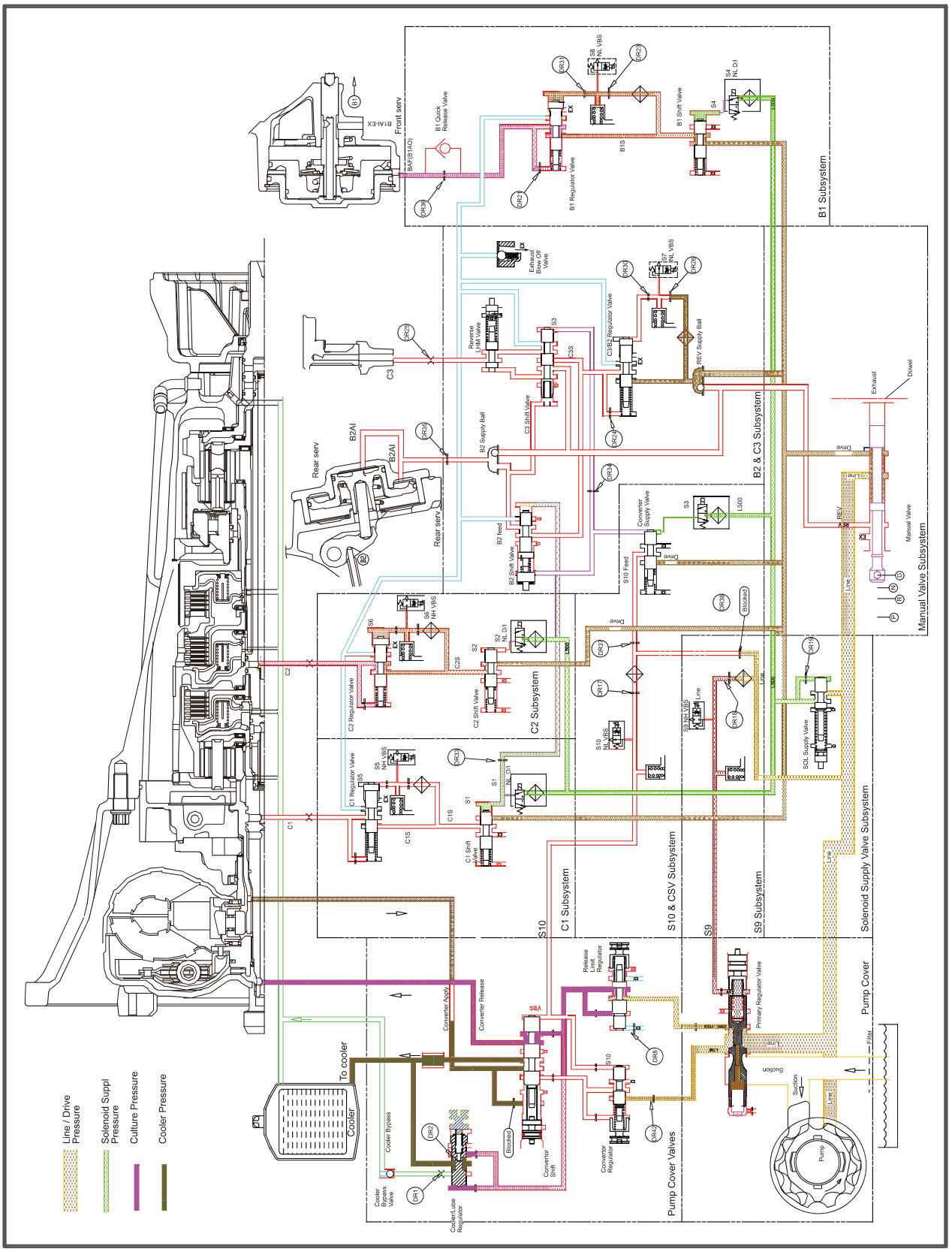
- S1 ON, S4 ON, S2 OFF
- S1 ON, C1 shift valve moved to the left end, C1 clutch not engaged
- C2 shift valve open (S2 OFF), C2 clutch engaged by drive oil
- Drive oil (for C2 clutch engagement) is regulated by VBS S6
- S4 ON, B1 shift valve moved to the left end, B1 band operated
- Drive oil (for B1 band engagement) is regulated by VBS S6

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
2.14		ON		ON						

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
2.14	ON			ON	1	0		1	0-1	

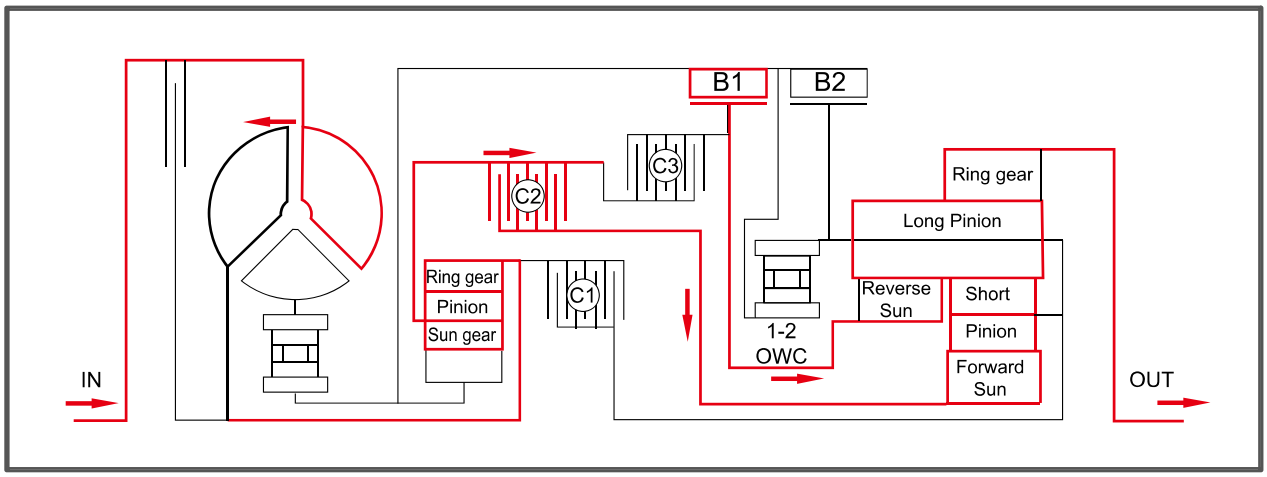
▶ 2nd Gear (D) (2.14:1)



Modification basis	
Application basis	
Affected VIN	

4) Power Flow - 2nd Gear (D) Lock-Up

▶ Power Flow Diagram

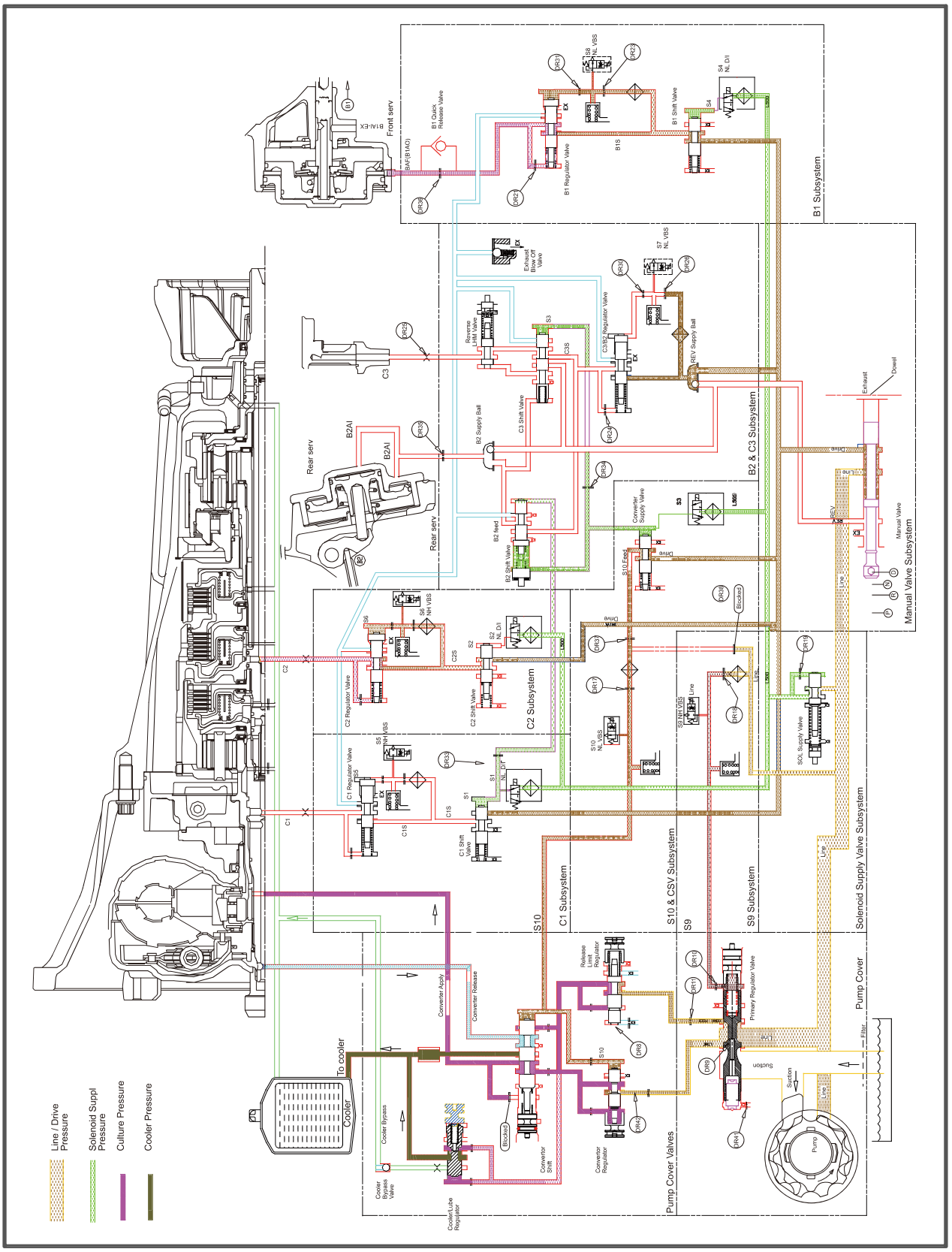


▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
2.14		ON		ON						

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
2.14	ON		ON	ON	1	0	0	1	0-1	1

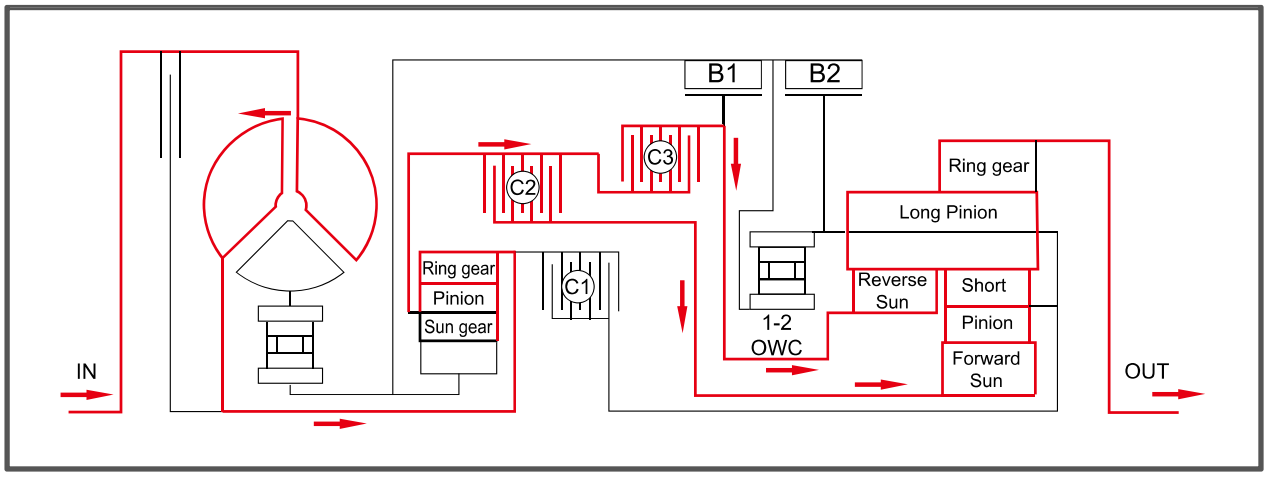
▶ 2nd Gear (D) Lock-Up



Modification basis	
Application basis	
Affected VIN	

5) Power Flow - 3rd Gear (D)

▶ Power Flow Diagram



▶ Functioning elements

- C2 applied, FSG (Forward Sun Gear) driven
- C3 applied, Rear Planet Carrier driven
- Rear Planet Gear Set is locked and its output has the same gear ratio with Front Gear Set.

CAUTION

C3 clutch cannot be engaged if S7 is OFF and the oil pressure is not supplied to C3 regulator valve.

▶ Control

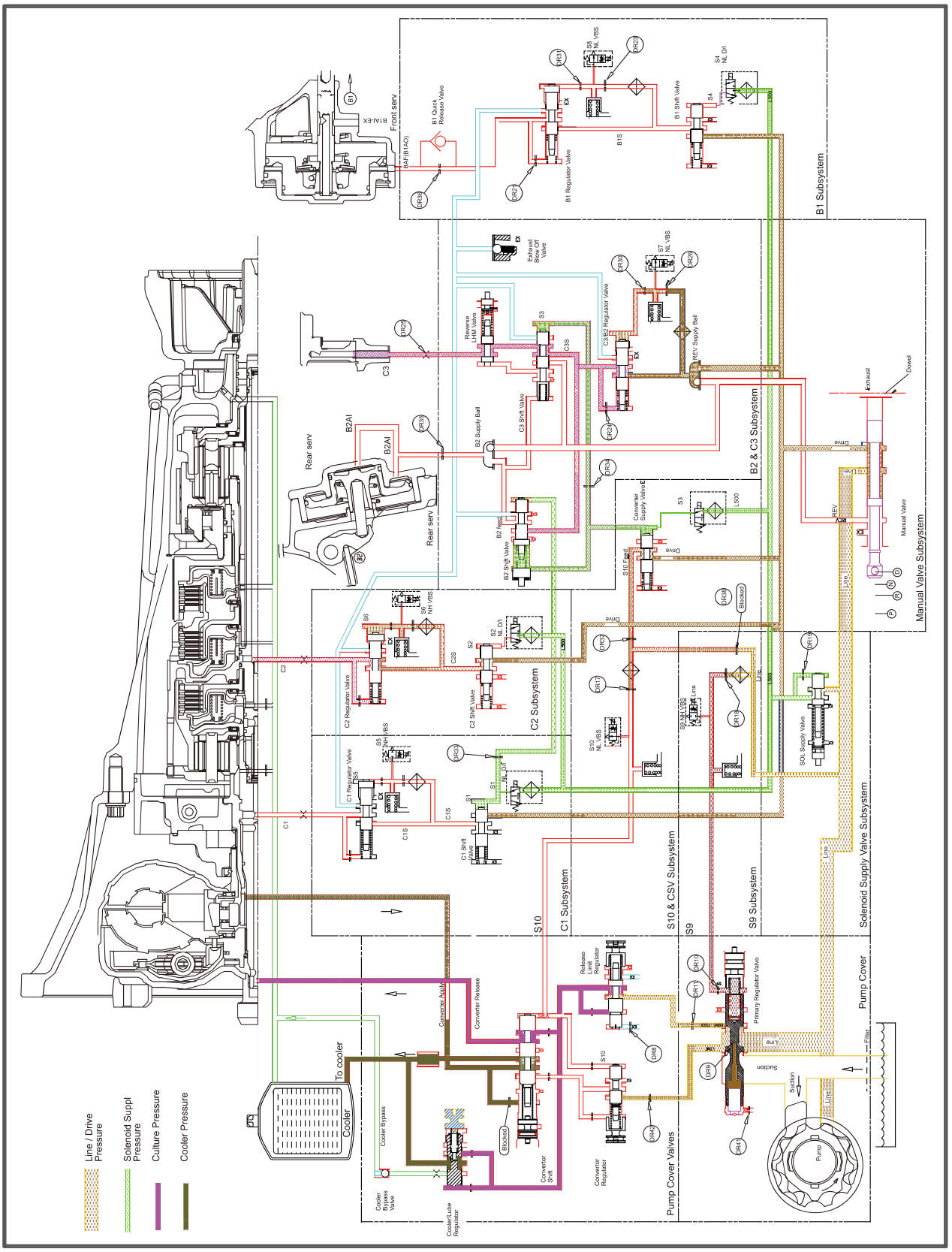
- S1 ON, C1 shift valve moved to the left end, C1 clutch not engaged
- C2 shift valve open (S2 OFF), C2 clutch engaged by drive oil
- S3 and S7 ON, C3 shift valve moved to the left end, C3 clutch engaged

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
1.48		ON	ON							

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
1.48	ON		ON		1	0	1		0-1	

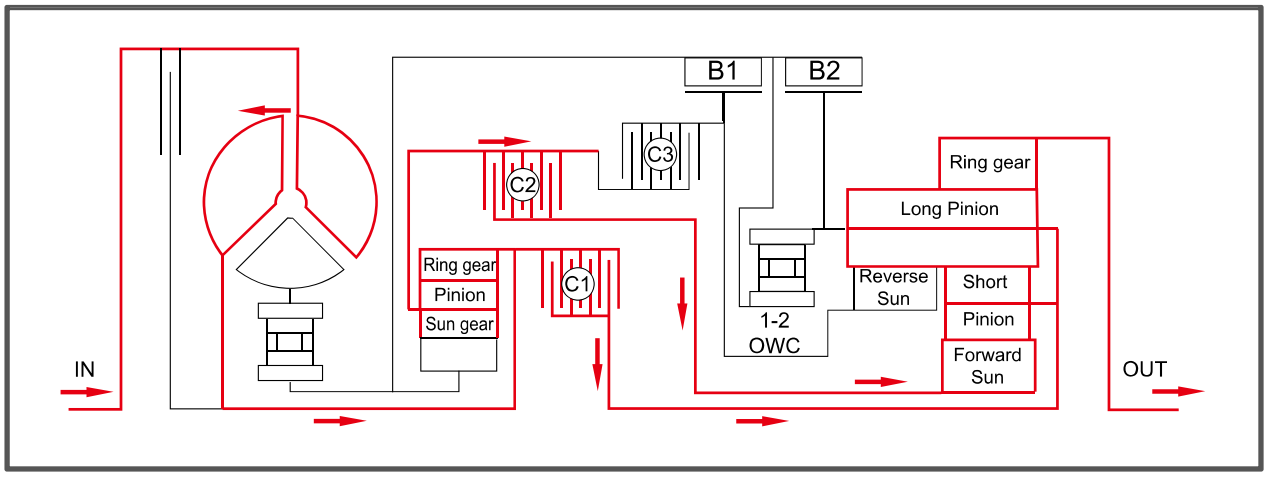
▶ 3rd Gear (D) (1.48:1)



Modification basis	
Application basis	
Affected VIN	

6) Power Flow - 4th Gear (D) & 4th Gear (D) in Limp Home Mode

▶ Power Flow Diagram



▶ Functioning elements

- C2 applied, FSG (Forward Sun Gear) driven
- C1 applied, Rear Planet Carrier driven

CAUTION
4th gear is used as Limp Home Mode.

▶ Control

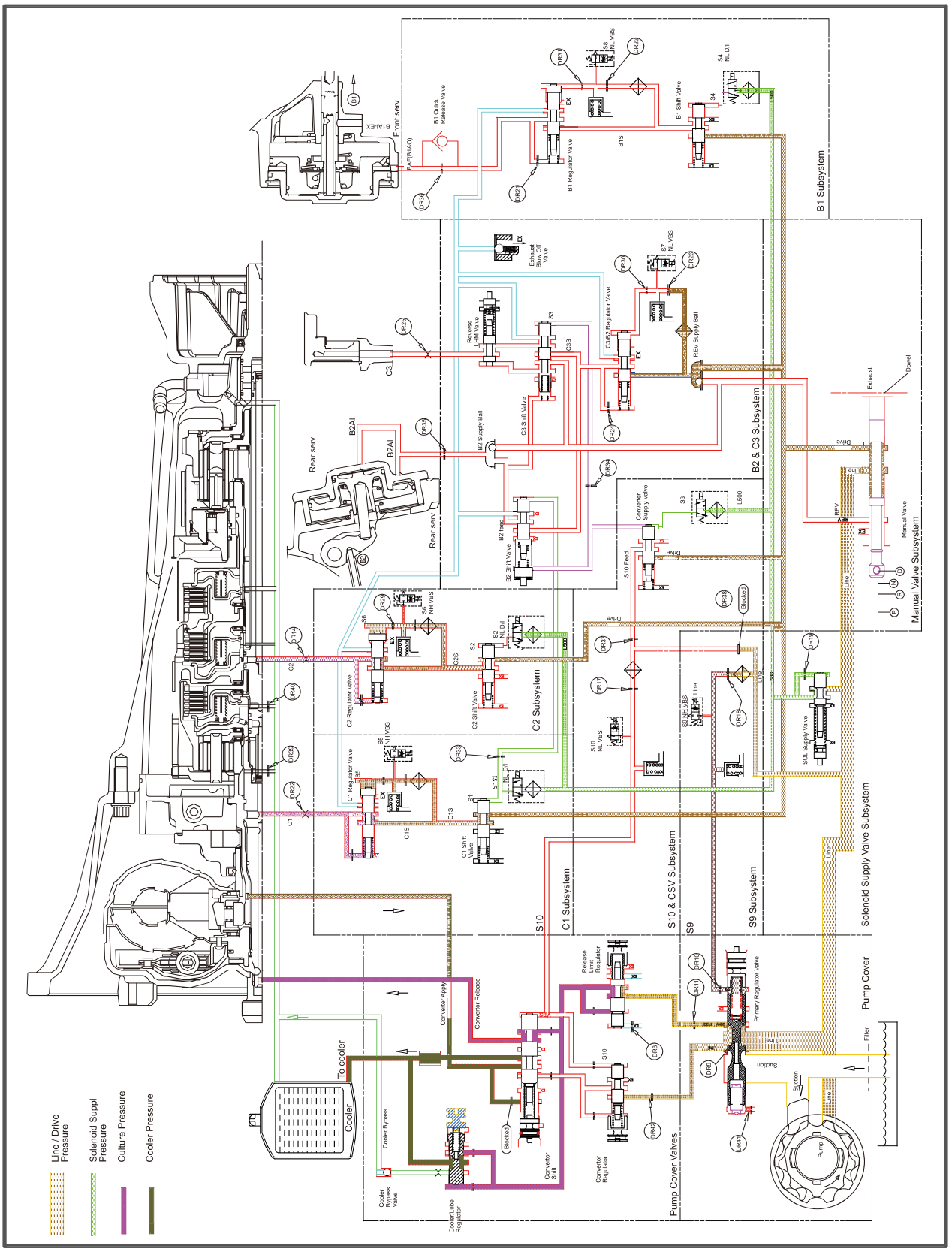
- S1 and S2 ON
- C1 shift valve open (S1 OFF), C1 clutch engaged by drive oil
- C2 shift valve open (S2 OFF), C2 clutch engaged by drive oil
- Drive oil (for C1 and C2 engagement) is regulated by VBS S6 and S6

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
1.16	ON	ON								

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
1.16					0	0			0-1	

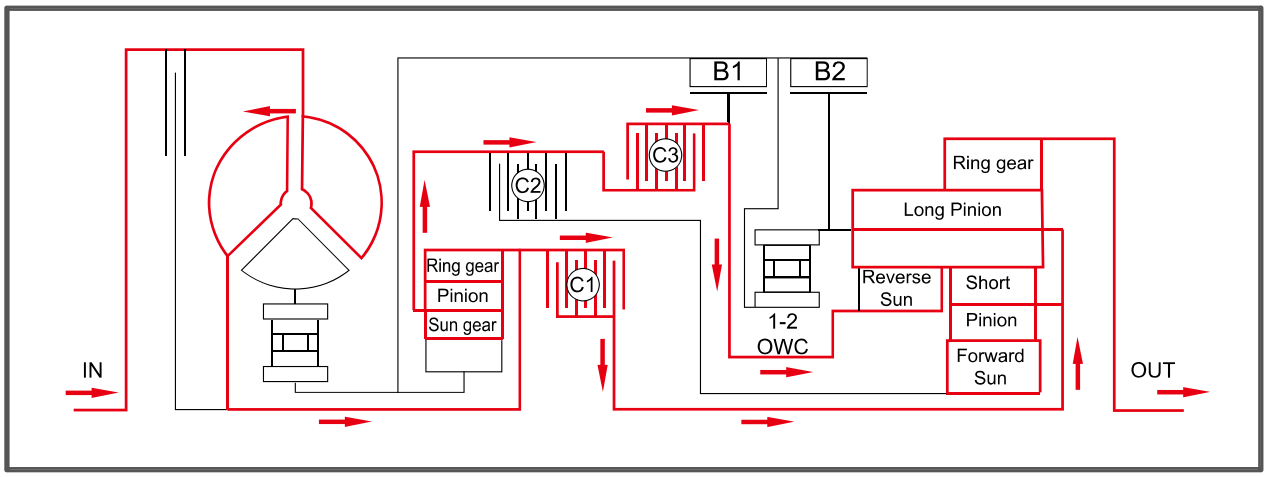
▶ 4th gear (D) & 4th gear (D) in Limp home mode (1.16:1)



Modification basis	
Application basis	
Affected VIN	

7) Power Flow - 5th Gear (D)

▶ Power Flow Diagram



▶ Functioning elements

- C1 applied, Rear Planet Carrier driven
- C3 applied, RSG (Rear Sun Gera) driven

▶ Control

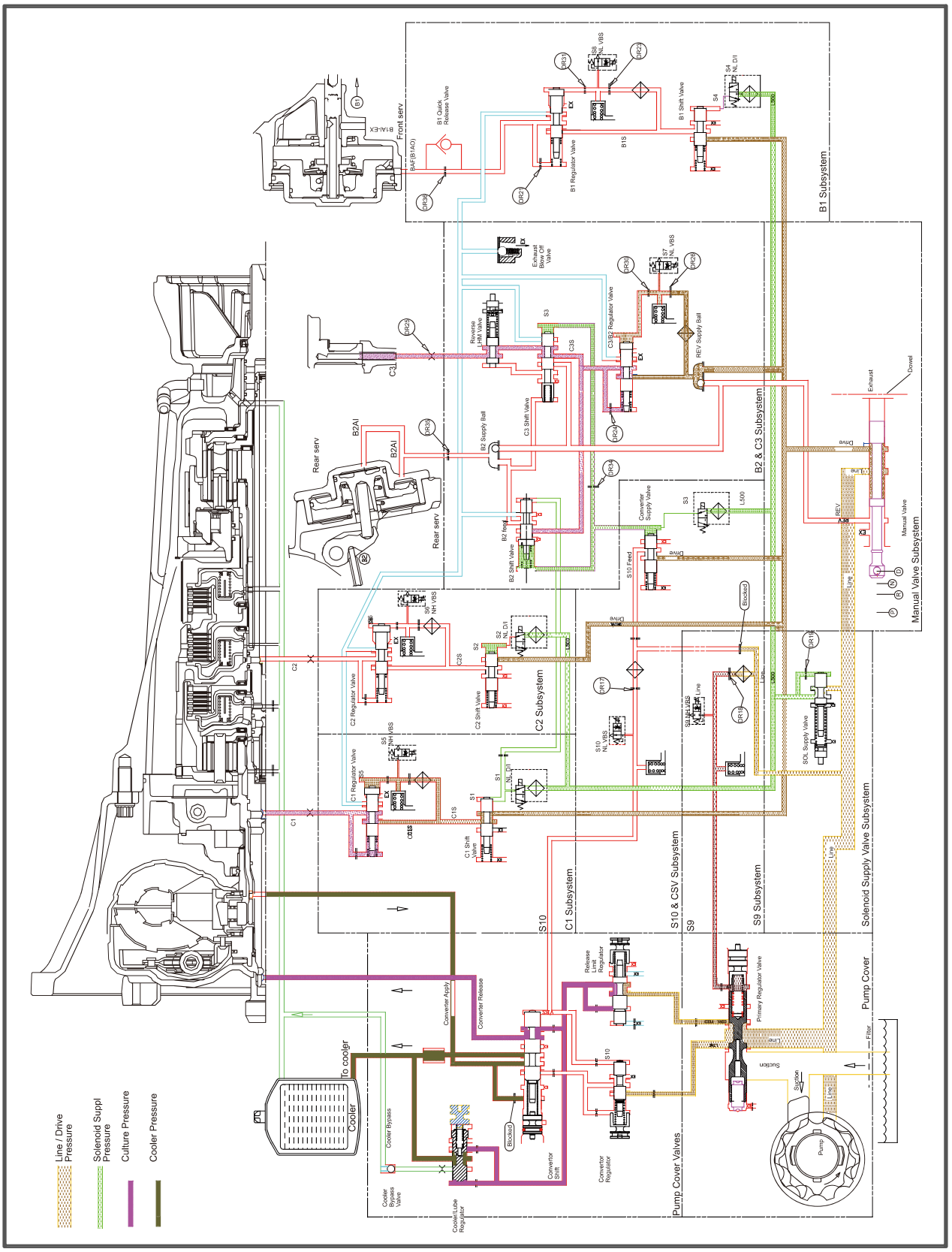
- S1 OFF, S2 and S3 ON
- S2 ON, C2 shift valve moved to the left end, C2 clutch not engaged
- C1 shift valve open (S1 OFF), C1 clutch engaged by drive oil
- S3 and S7 ON, C3 shift valve moved to the left end, C3 clutch engaged

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
0.87	ON		ON							

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
0.87		ON	ON		0	1	1		0-1	

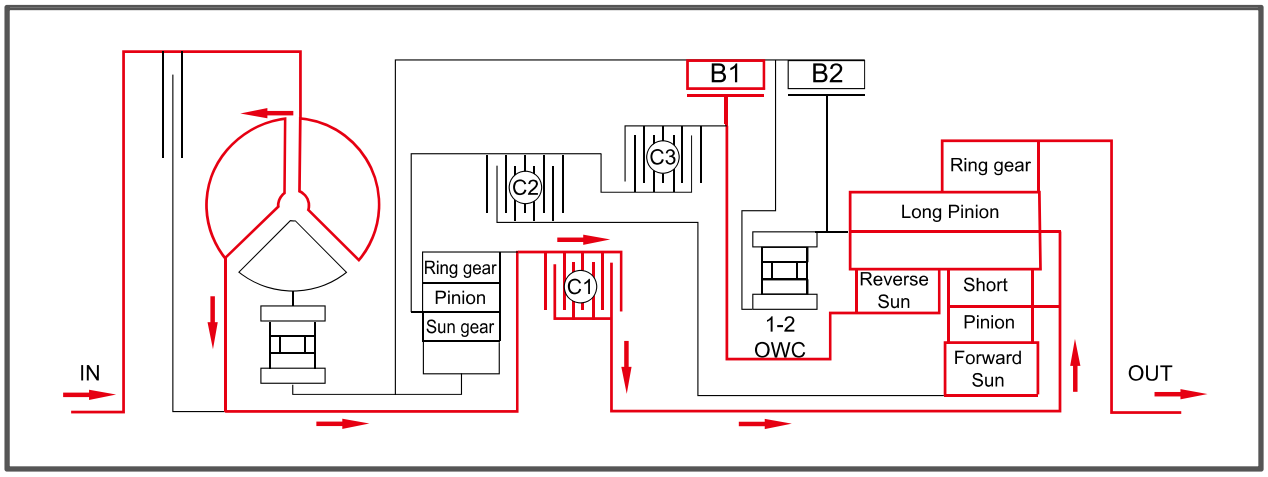
▶ 5th gear (D) (0.87:1)



Modification basis	
Application basis	
Affected VIN	

8) Power flow - 6th gear (D)

▶ Power Flow Diagram



▶ Functioning elements

- C1 applied, Rear Planet Carrier driven
- B1 applied, RSG (Rear Sun Gera) locked

▶ Control

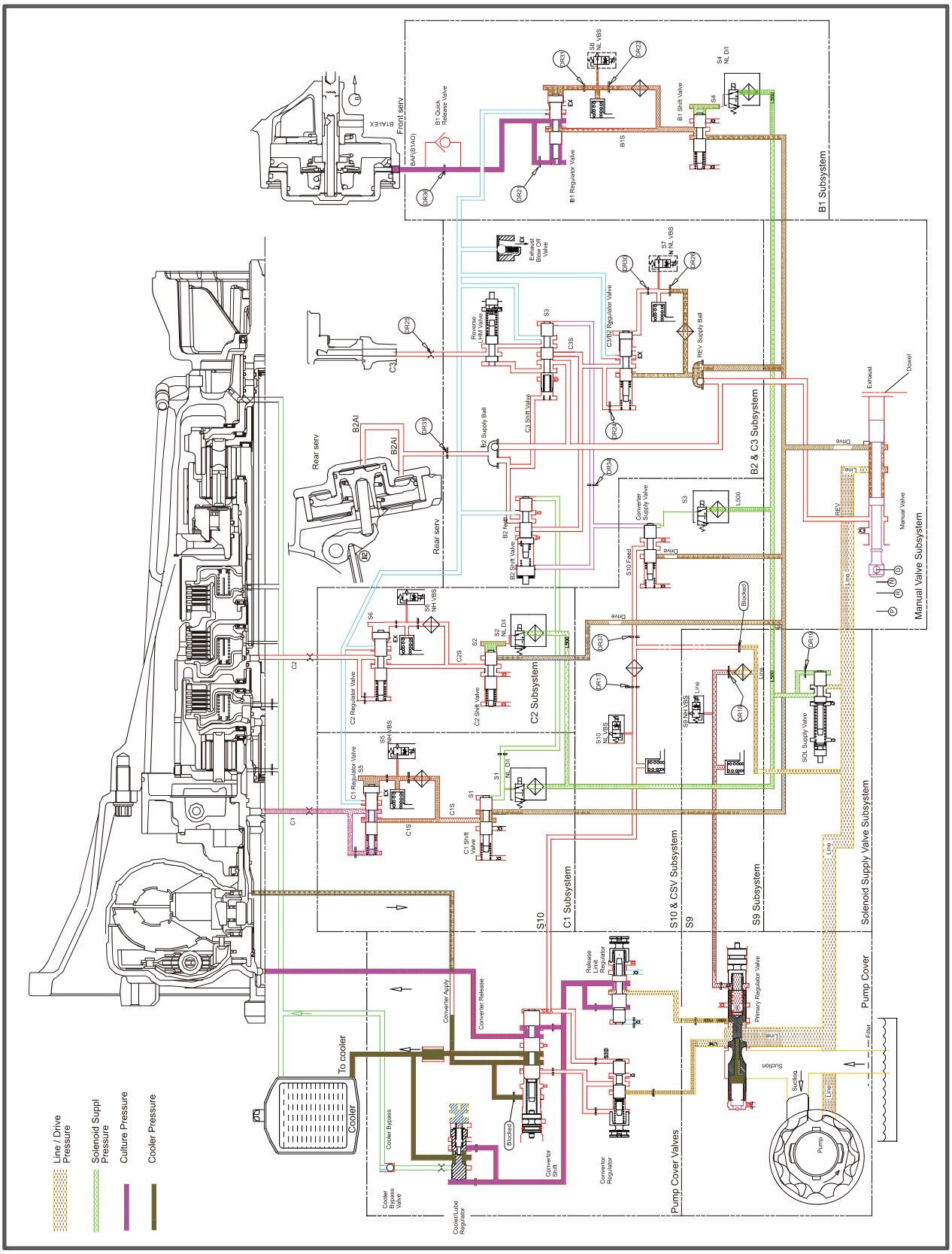
- S1 OFF, S2 and S4 ON
- S3 ON, C2 shift valve moved to the left end, C2 clutch not engaged
- C1 shift valve open (S1 OFF), C1 clutch engaged by drive oil
- S4 ON, B1 shift valve moved to the left end, B1 Band engaged

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
0.68	ON			ON						

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
0.68		ON		ON	0	1		1	0-1	

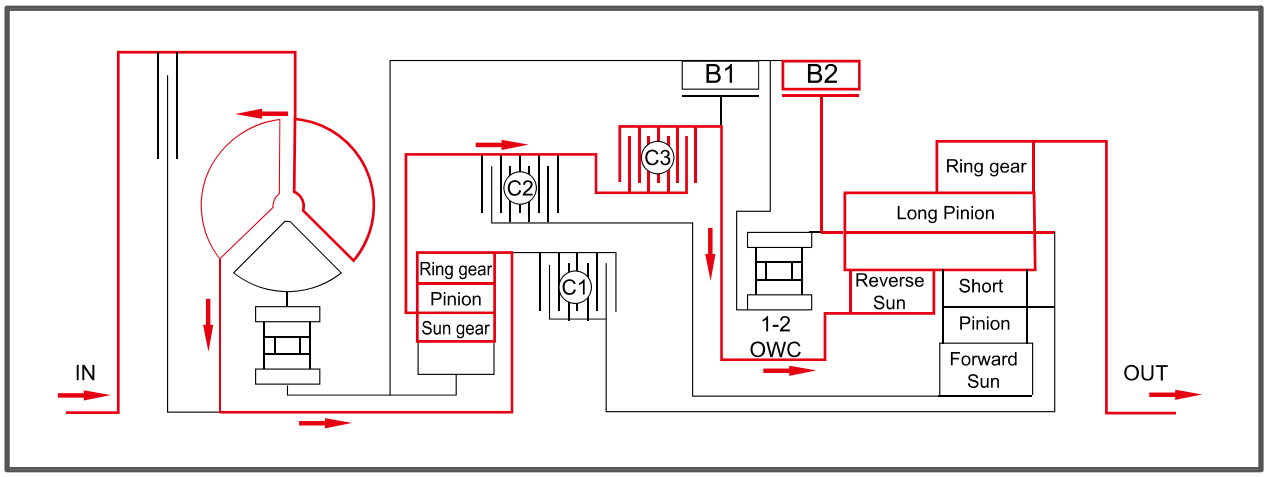
▶ 6th gear (D) (0.68:1)



Modification basis	
Application basis	
Affected VIN	

9) Power flow - Reverse (R)

▶ Power Flow Diagram



▶ Functioning elements

- C3 applied, RSG (Rear Sun Gera) locked
- B2 applied, Rear Planet Carrier locked

▶ Control

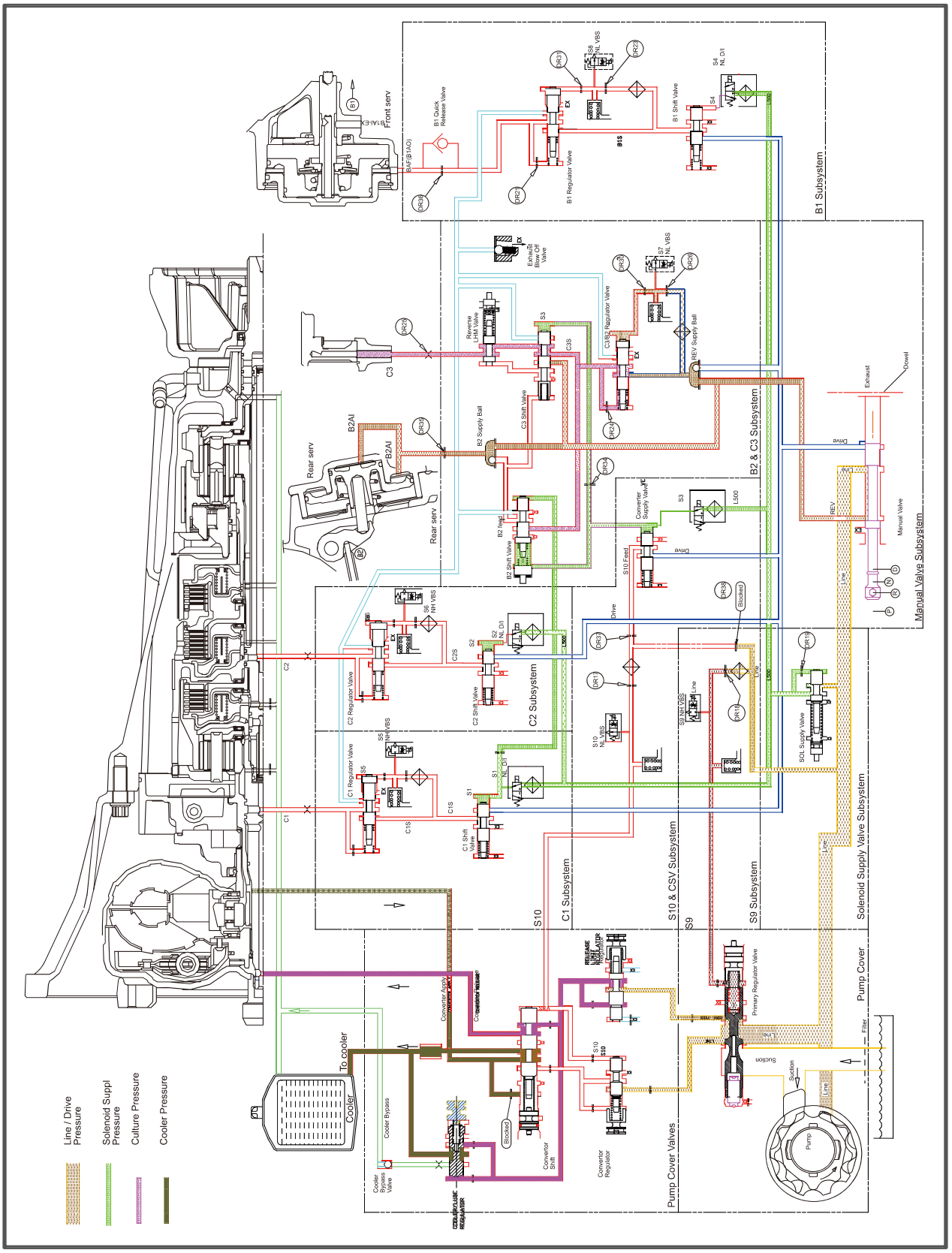
- S1, S2 and S3 ON
- Line pressure applied to B2 Band directly through manual valve
- S3 ON, Pressure to C3 increased or regulated
- S1 and S2 ON, C1 not engaged in any case

▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
3.09			ON				ON	ON		

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
3.09	ON	ON	ON		1	1	1		0-1	

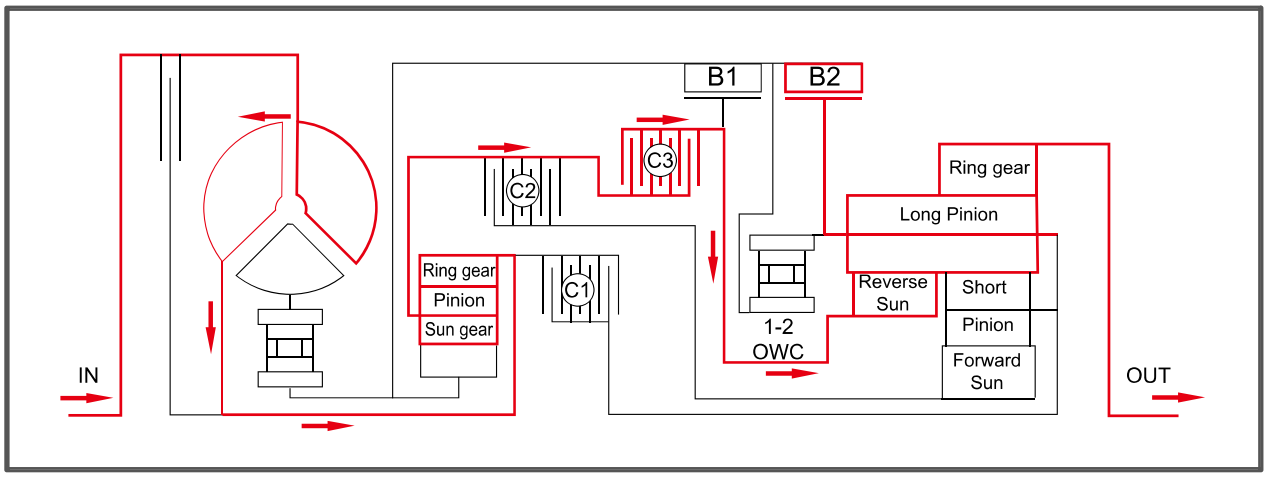
▶ Reverse gear (R) (3.09:1)



Modification basis	
Application basis	
Affected VIN	

10) Power Flow - Reverse (R) Limp Home Mode

▶ Power Flow Diagram

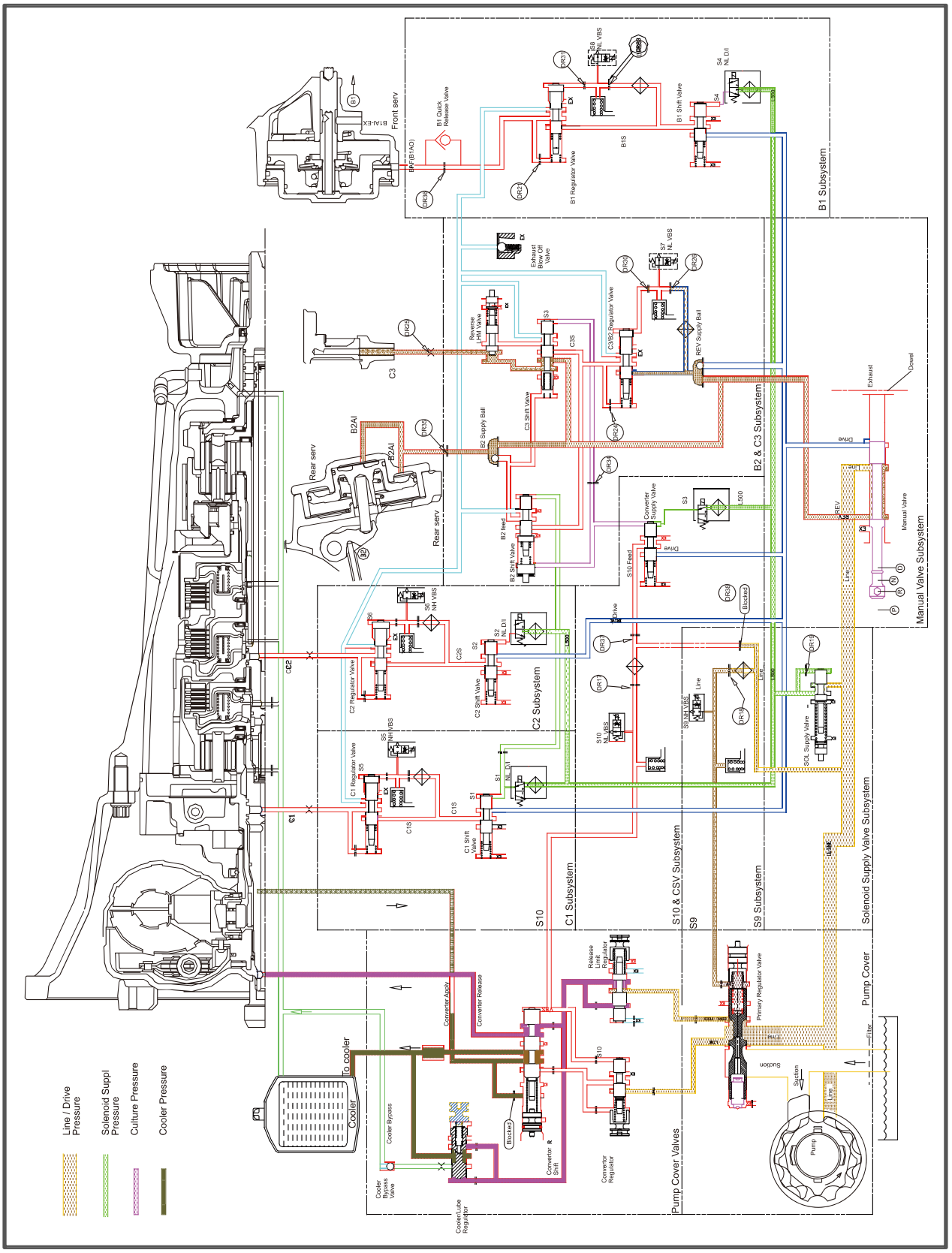


▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
3.09			ON				ON	ON		

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
3.09					0	0	0	0	0	0

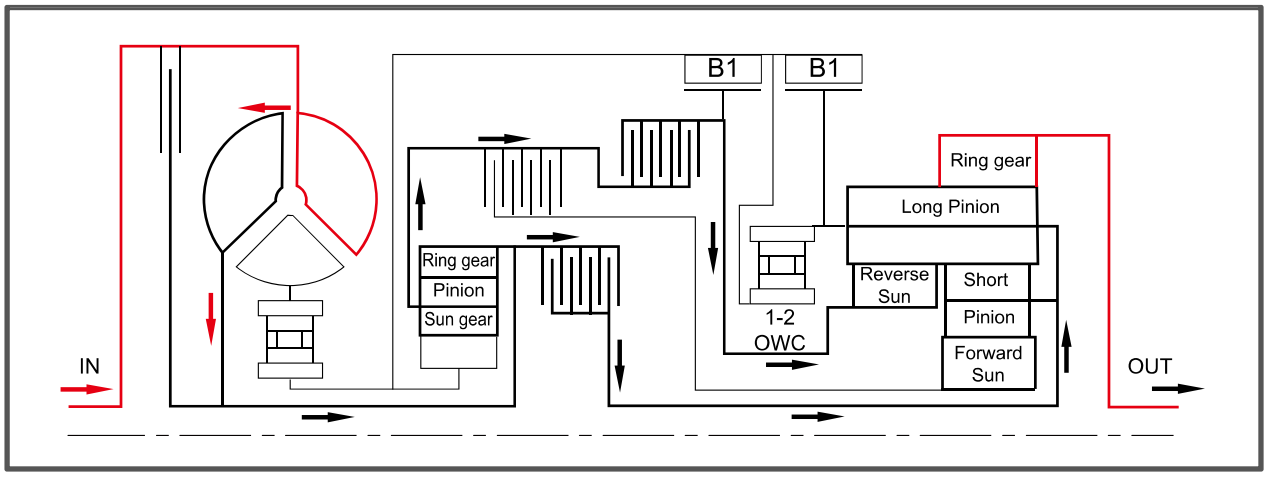
▶ Reverse (R) Limp Home Mode



Modification basis	
Application basis	
Affected VIN	

11) Power flow - Park (P)

▶ Power Flow Diagram

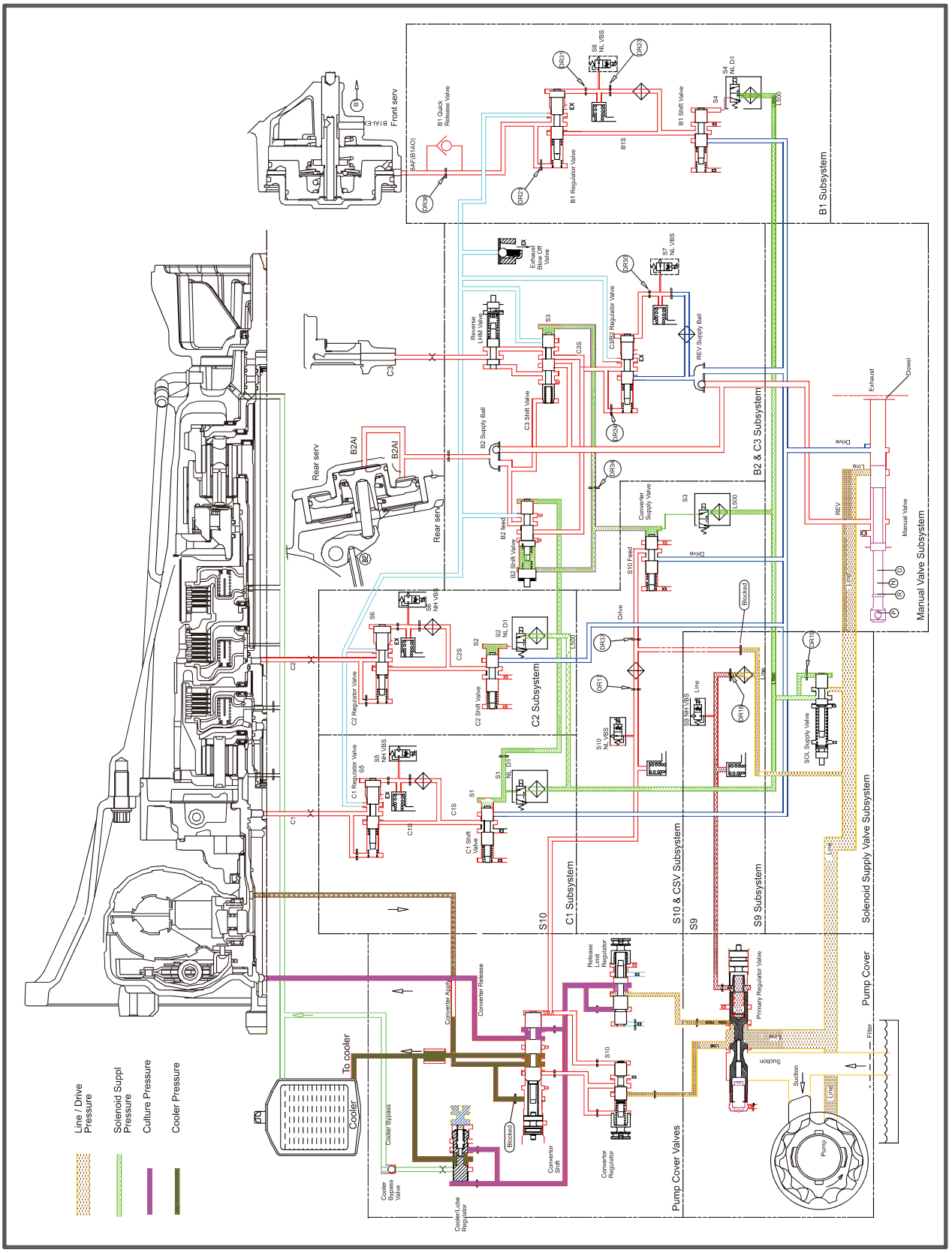


▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
N/A										

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
N/A	ON	ON	ON							

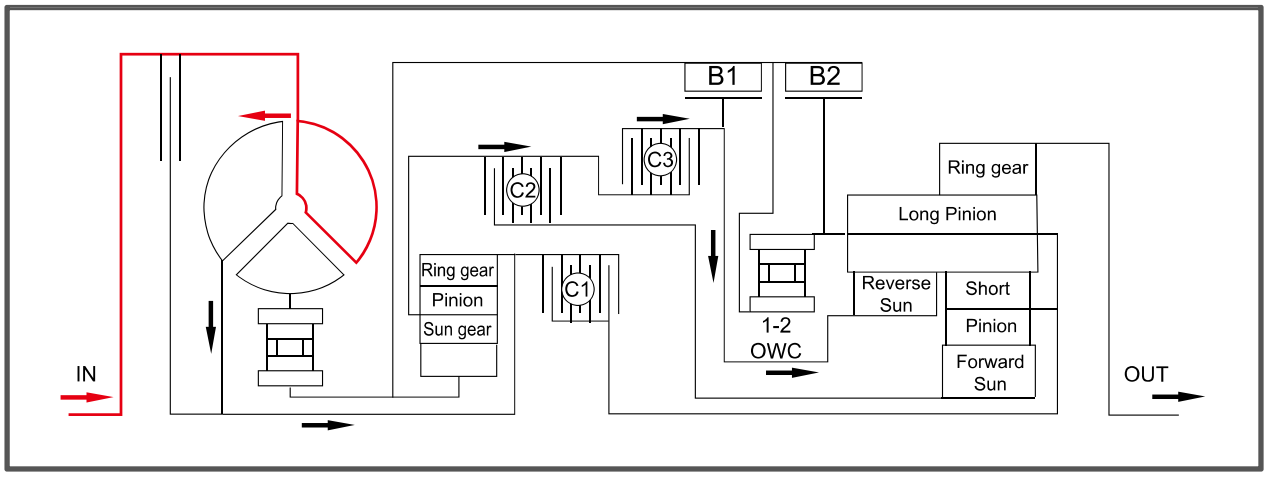
▶ Park



Modification basis	
Application basis	
Affected VIN	

12) Neutral (N)

▶ Power Flow Diagram

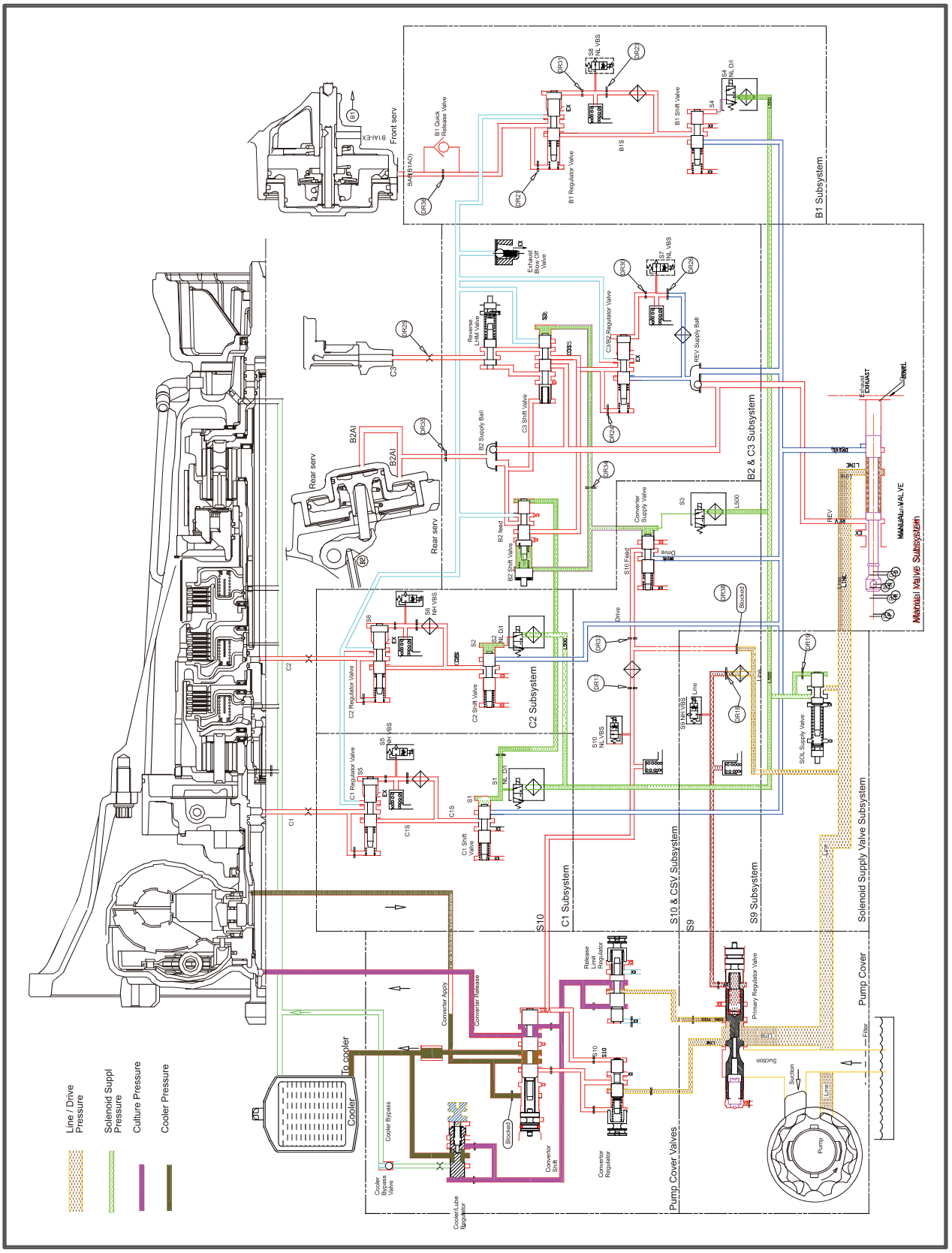


▶ Connecting Components

Gear ratio	Engaged element									
	C1	C2	C3	B1			B2		OWC	Lock-up clutch
				AO	AI	R	AO	AI		
N/A										

Gear ratio	ON / OFF solenoids				Variable pressure sol. valve-VBS					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
N/A	ON	ON	ON						0-1	

▶ Neutral



Modification basis	
Application basis	
Affected VIN	