

DSI M78 6-SPEED A/T

3110-01/3650-01/3660-01/3680-01/3721-01/9210-01

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DSI M78 6-SPEED A/T

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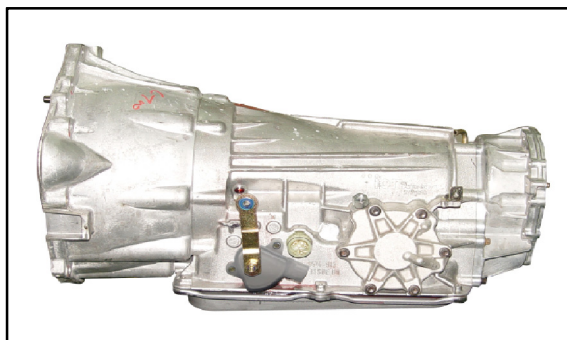
AUTOMATIC TRANSMISSION

3650-01

GENERALS

1. DSI M78 6-SPEED AUTOMATIC TRANSMISSION GENERAL

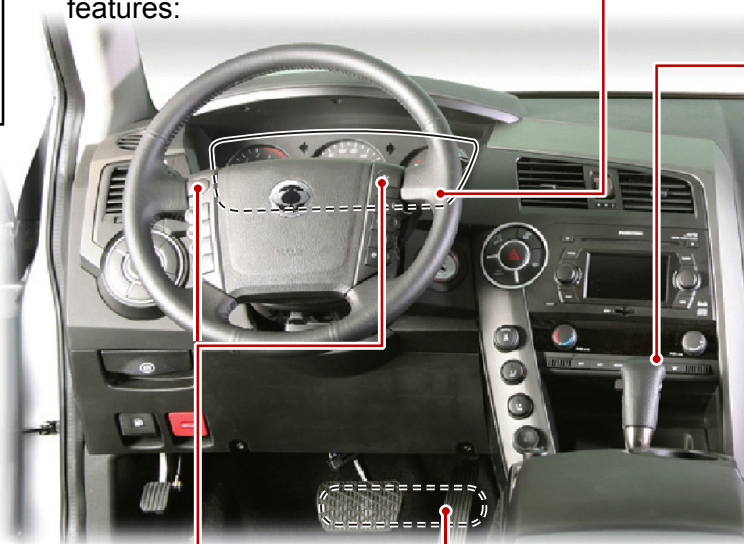
► Six Speed Automatic Transmission



- 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 six speed automatic (M78) transmission is available in two variants: four wheel drive and two wheel drive.

The transmission has the following features:



Tip Switch on Steering Wheel



Shift down

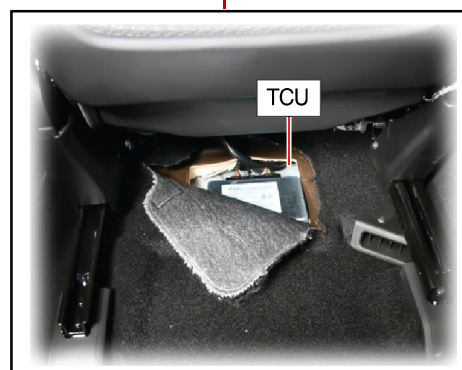


Shift up

► TCU (Installed under the driver's seat)

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.



Modification basis	
Application basis	
Affected VIN	

► Six Speed Automatic Transmission



Gear Position Indicator (for automatic transmission)



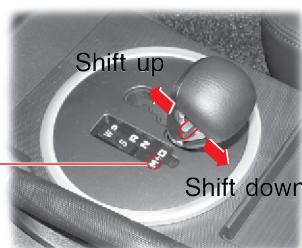
This indicator shows the current position of the gear.

- | | |
|--------------------------------|-------------------------------|
| P: Parking | 6: 1~6th Gear shifting |
| R: Reverse | 5: 1~5th Gear shifting |
| N: Neutral | 4: 1~4th Gear shifting |
| D: Driving | 3: 1~3rd Gear shifting |
| (1 ~ 6th gear shifting) - 6A/T | 2: 1~2nd Gear shifting |
| | 1: 1st Gear |

► TGS Lever



Tip Switch on Gear Selector Lever



Tip Switch (Manual Gear Adjustment)

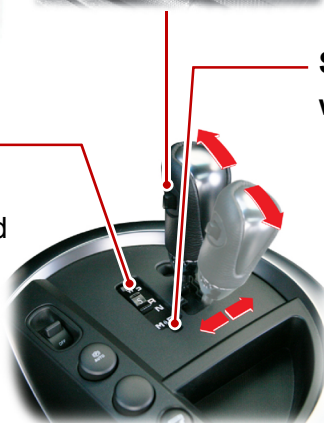
The shiftable gear can be adjusted by this switch when the gear selector lever is in "M" position.

Winter Mode

When winter mode is selected, starting in second gear is facilitated and the WINTER mode indicator light is switched ON. To prevent wheel spin on slippery surfaces, the transmission will not allow first gear unless manually overridden.

Standard Mode

Standard Mode is selected when the lever is in the D position with the mode switch in the standard (S) position and the transmission is within normal temperature ranges. Shift schedule points are optimised for fuel efficiency and general driving conditions.



Shift Lock Release Button Hole when Locked in the "P" Position

If you cannot move the selector 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.

Shift from the "P" Position

To shift into any other positions from the "P" position after stopping the vehicle, you have to depress the brake pedal with the ignition switch "ON".

Modification basis	
Application basis	
Affected VIN	

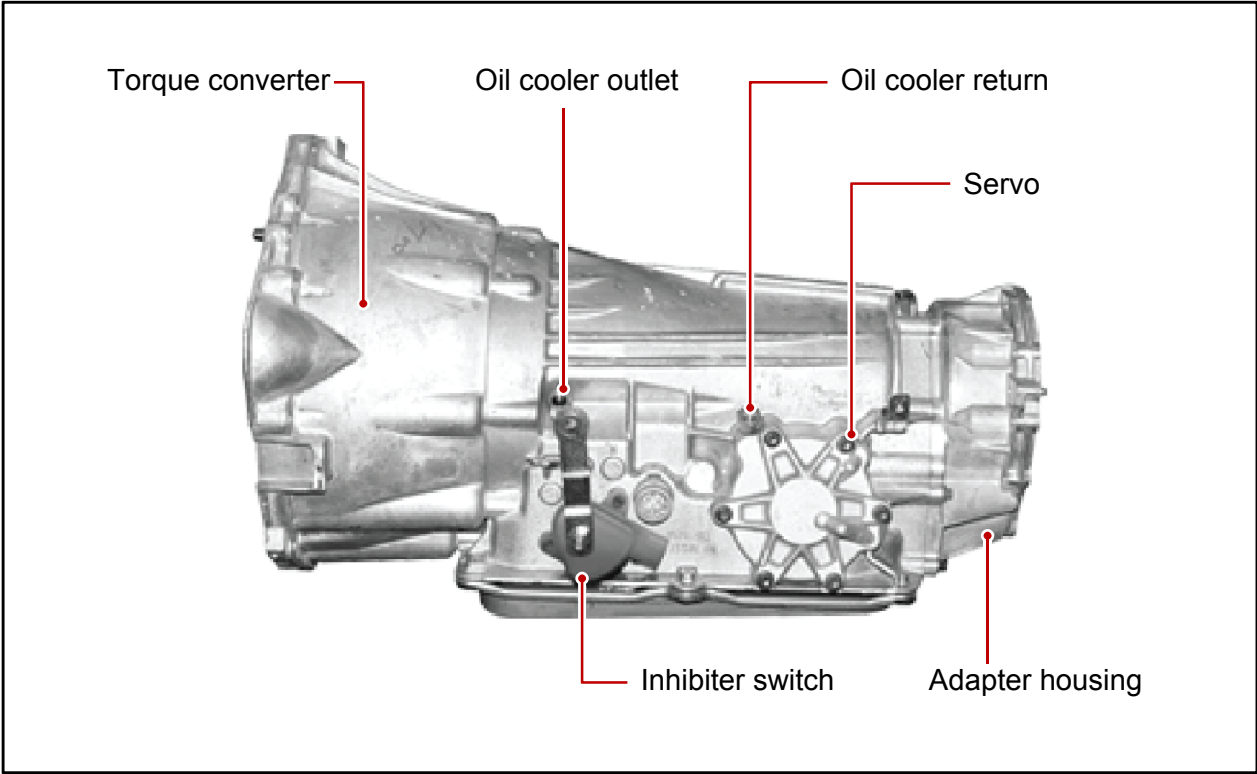
2. STRUCTURE CHARACTERISTICS AND SPECIFICATIONS

1) Specifications

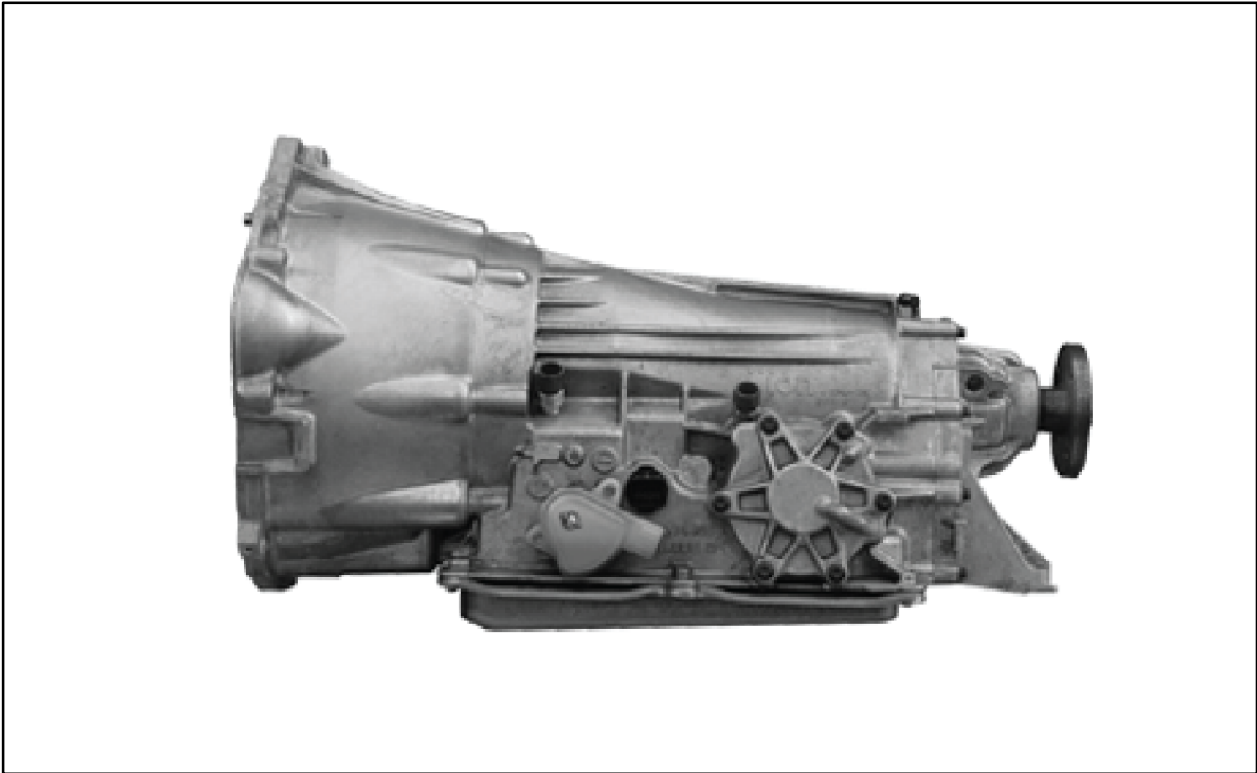
Description		DSI M78 6A/T	REMARK
Gear ratios	1st	3.536 : 1	
	2nd	2.143 : 1	
	3rd	1.478 : 1	
	4th	1.156 : 1	
	5th	0.866 : 1	
	6th	0.677 : 1	
	Reverse	3.094 : 1	
Torque converter	Diameter	260 (mm)	
	Number of element	3 EA	
	Number of Step	1 EA	
	Number of Phase	2 EA	
Transmission component	Planetary gear set	2 EA	
	One-way clutch	1 EA	
	Multi disc clutch	3 EA	
	Band brake	2 EA	
Weight	Including oil	79 kg	
Oil	Fluid specification	CALTEX PED 1712 ATF	
	Fluid capacity	Approx. 9.5 ℓ	
	Change interval	At every regular check-up (every 30,000 km or 1 year) Check fluid level, leakage and fluid condition. Change if necessary	
Resistance of oil temperature sensor	-20°C	430.7 ~ 533.9 Ω	
	0°C	146.8 ~ 175.7 Ω	
	20°C	56.74 ~ 65.86 Ω	
	100°C	3.201 ~ 3.399 Ω	
Resistance of gear position sensor	1	-	
	2	-	
	3	-	
	D gear position	2.686 kΩ ± 8%	
	N gear position	5.036 kΩ ± 8%	
	R gear position	8.953 kΩ ± 8%	
	P gear position	16.786 kΩ ± 8%	

2) Appearance

► 4WD Automatic Transmission



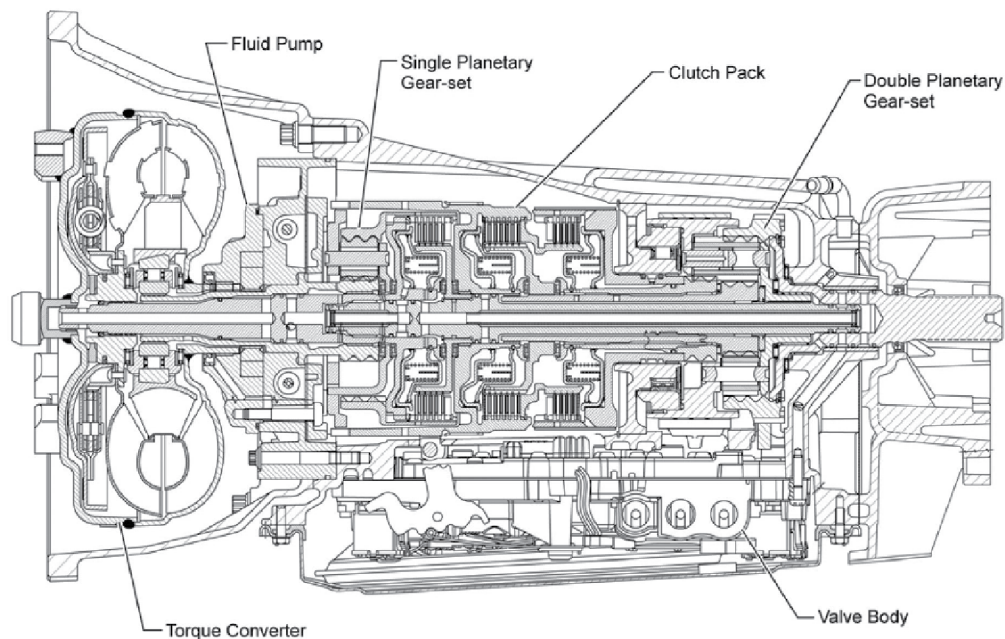
► 2WD Automatic Transmission



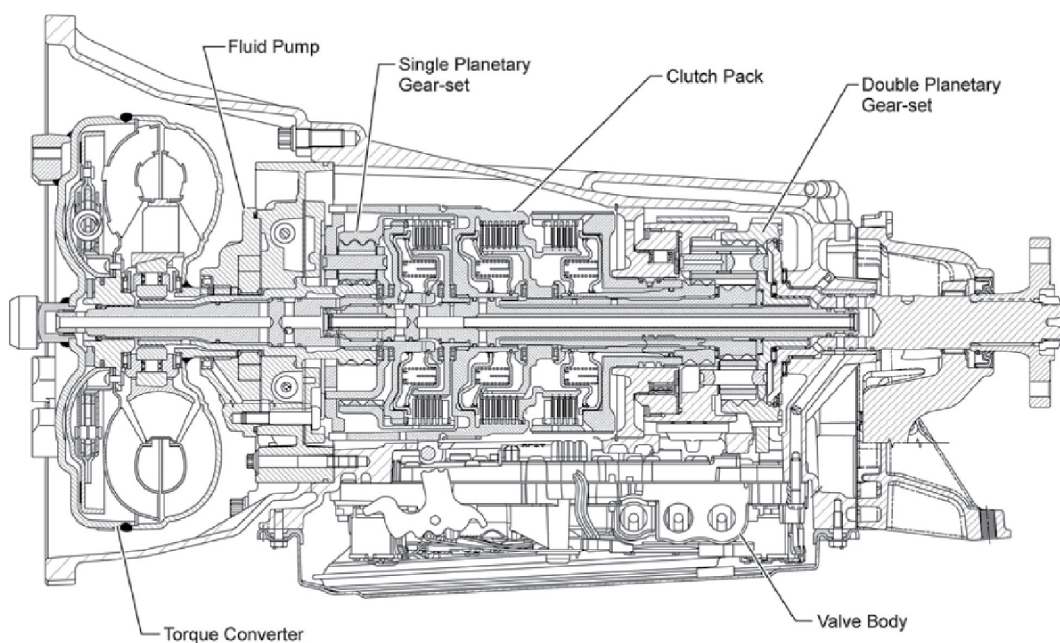
Modification basis	
Application basis	
Affected VIN	

3) Internal Assembly Figure

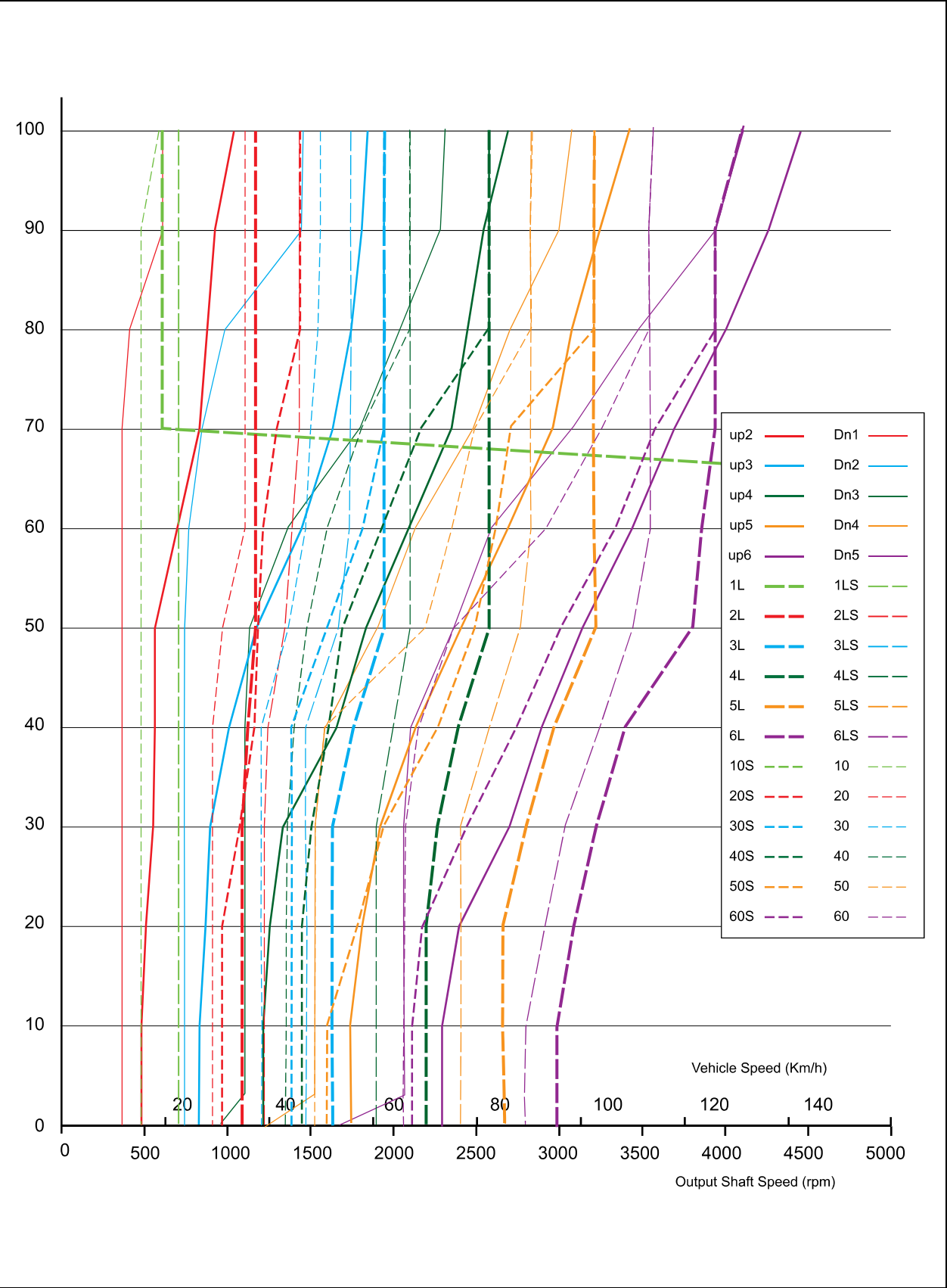
4WD



2WD



4) Shift Pattern



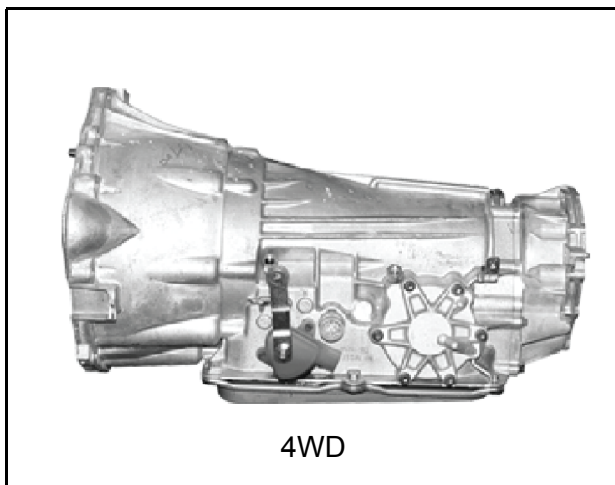
Modification basis	
Application basis	
Affected VIN	

3. TIGHTENING TORQUE

Component	Size	Torque (Nm)
TC housing	M12 x 32	54 ~ 68
Extension housing	M12 x 32	54 ~ 68
Oil pan	M6 x 16	4 ~ 6
Tightening valve body and transmission housing	M6 x 26	8 ~ 13
Tightening valve body and transmission housing	M6 x 45	8 ~ 13
Tightening center support and transmission housing	M10 x 34	20 ~ 27
Output shaft locking nut	M24 x 15	100 ~ 110
Tightening oil pump and pump cover	M8 x 55	24 ~ 27
Tightening pump cover and transmission housing	M8 x 40	24 ~ 34
Tightening pump cover and transmission housing	M8 x 58	24 ~ 34
Tightening upper valve body and lower valve body	M6 x 30	15 ~ 17
Fixing detent spring	M8 x 16	20 ~ 25
Fixing VBS & speed sensor	M4 x 12	2.8 ~ 3.2
Transmission oil level plug		30 ~ 35
Fixing front transmission cooler line and transmission cooler connector		25 ~ 35
Fixing rear transmission cooler line and transmission cooler connector		25 ~ 35
Fixing torque converter and drive plate		40 ~ 42
Tightening transmission selector lever and shaft rod		14 ~ 20

OVERVIEW AND OPERATION PROCESS

1. GENERAL DESCRIPTION



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

Modification basis	
Application basis	
Affected VIN	

2. ADVANCED SIX SPEED FEATURES

1) Characteristics

► 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 Going 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.

► Upshift Prevention with Fast-off Accelerator Pedal

Upshifts are prevented when the throttle is backed off very quickly to reduce busyness in sporty driving.

► Drive and Reverse Engagement

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. Drive and Reverse engagements from either Park or Neutral are performed in less than 2.2 seconds. There is no drive engagement prevention strategy implemented on the transmission system as there is sufficient engine strategy to protect the system. However, reverse 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.

► Converter Clutch Lock-Up In All Gears

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) Transmission Cooling

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 Hold Going Uphill/Downhill

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% pedal when the vehicle is coasting down to a stop.

► 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.

ION 4-
SPEEDDC 5-
SPEEDDSI M78
6-SPEEDTGS
LEVERT/M
LEVER

M/T

CLUTCH

AXLE

AXLE
(IOP)

T/C

PROPELL
ERSUSPENS
ION

ESP

STEERIN
G

Modification basis	
Application basis	
Affected VIN	

3. FUNCTION OF EACH MODE

1) Description

(1) Shift Lock Release Button Hole when Locked in the "P" Position

If you cannot move the selector 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.

Shift from the "P" Position

To shift into any other positions from the "P" position after stopping the vehicle, you have to depress the brake pedal with the ignition switch "ON".

(2) Selection of Manual / Automatic Shift Function

- **D** : Automatic shift according to the driving condition
- **M** : Manual shift

(3) Mode Switch

- **W** : Winter mode
- **S** : Standard mode

Use the standard mode in normal driving c

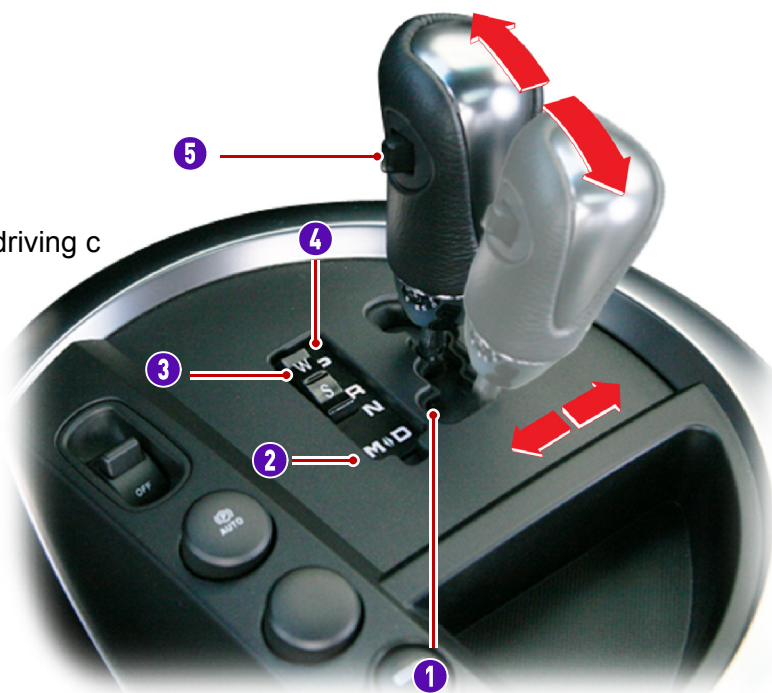
(4) Gear Position

- **P** : Parking
- **R** : Reverse
- **N** : Neutral
- **D** : Driving

(5) Tip Switch

(Manual Gear Adjustment)

The shiftable gear can be adjusted by this switch when the gear selector lever is in "M" position.



2) Range Mode (Manual 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 State

The 1st gear state will display on the instrument cluster. Unlike the normal 1st gear, engine braking will be available in this manual 1st state.

► 2st Gear State

The 2nd gear state will display on the instrument cluster. 2-1 automatic kick-down shifts are available. 2nd gear has engine braking available.

► 3st Gear State

The 3rd gear state will display on the instrument cluster. 3-2 and 3-1 automatic kick-down shifts are available. 3rd gear has engine braking available.

► 4st Gear State

The 4th gear state will display on the instrument cluster. 4-3, 4-2 and 4-1 automatic kick-down shifts are available. 4th gear has engine braking available.

► 5st Gear State

The 5th gear state will display on the instrument cluster. 5-4, 5-3 automatic kick-down shifts are available. 5th gear has engine braking available.

► 6st Gear State

The 6th gear state will display on the instrument cluster. 6-5, 6-4 automatic kick-down shifts are available. 6th gear has engine braking available.

Modification basis	
Application basis	
Affected VIN	

4. LIMP HOME MODE

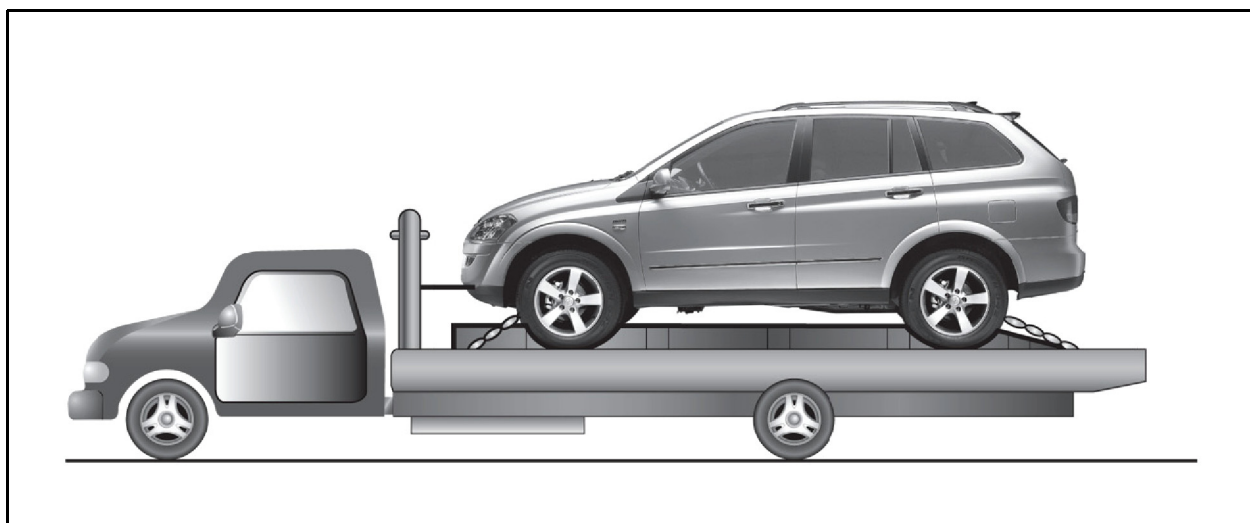
► In case of transmission malfunction

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 af

► 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 vehicle equipped with A/T



NOTE

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. TRANSMISSION ELECTRONIC CONTROL SYSTEM

1) General FATCS About TCU

The transmission control unit (TCU) and its input/output network control the following transmission operations:

- 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 transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

2) Transmission Control Unit

Caution: If the TCU requires reprogramming the handbrake must be firmly applied and the transmission placed in Park (P).

The transmission control unit (TCU) is mounted under the left-hand front seat and controls the operation of the transmission.

The TCU is activated and deactivated by the ignition power supply and is connected to the transmission link harness by a 26 pin connector.

The TCU processes information received from internal sensors and signals received across the CAN bus in analogue and digital forms such as:

- Transmission input speed
- Transmission output speed
- Accelerator pedal position
- Gear selector position
- Engine torque
- Engine speed
- Transmission fluid temperature
- Brake pedal status
- Engine oil temperature
- Engine coolant temperature
- Ambient air temperature
- Barometric pressure

This information is used by the TCU to decide which shift pattern to select and for shift energy management. Electro-hydraulic solenoid valves and variable bleed solenoids control the transmission gear changes.

Modification basis	
Application basis	
Affected VIN	

Six variable bleed solenoids and four on/off solenoids are used to direct transmission fluid flow to control the fluid pressure within the three clutches and two bands. Separate pressure regulators are used exclusively for torque converter clutch control and main transmission line pressure.

The TCU monitors all TCU inputs and outputs to confirm correct system operation. If a fault occurs the TCU is able to perform default action and inform the driver of the problem through the instrument cluster warning lights. Detailed information is available via trouble codes which can be read with the service tool.

3) Transmission Control Monitoring System

The TCU monitors all input and outputs to identify possible failures. If a fault is detected, the TCU takes the appropriate action to ensure the transmission maintains a safe mode of operation, without sacrificing transmission durability or driver safety.

► Supply Monitoring

If the battery voltage is either too great or too low, the TCU will detect a fault condition.

► Solenoid Supply Monitoring

While the solenoid operating transistors are being activated, checks are run for open circuits, shorts circuits to ground and short circuits to supply. The monitoring function evaluates the voltage characteristics during the switch ON process checking for the above faults.

► Gear Ratio Monitoring

The gear ratio diagnostic checks if each gear ratio is correctly engaged. Also, following a gear shift the diagnostic checks if the transmission has engaged the target gear within the allowed time.

► Torque Converter Monitoring

The TCU checks if the torque converter can be locked correctly. If torque converter lock-up does not occur correctly the TCU performs the appropriate fail-safe action of opening the torque converter clutch.

4) Shift Energy Management

This function involves reducing or increasing the engine output torque during shifting. The aim when upshifting is to reduce the energy which is dissipated in the friction elements of the transmission. This is done by reducing the engine torque during the ratio change without interrupting the tractive drive. This function is used for:

- Increasing the transmission service life by shortening the slipping time
- Improving the shift comfort by reducing the step change in torque caused by the gearshift

- Transferring a higher engine power, this is allowed by the mechanical in-gear strength of the transmission

Real-time control of engine torque is required to maintain maximum shift quality and transmission durability. The TCU has the ability to control the engine torque during the gearshift to synchronise with the operation of the transmission clutches.

► Pressure Modulation

To provide a high level of shift comfort and durability, the hydraulic pressure in the shift related friction elements of the transmission must be matched accurately to the transmission input torque. This hydraulic pressure is composed of a hydraulically pre-set basic pressure and a controlling 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 signals transmitted from the engine management ECU by CAN, and converter slip. Separate pressure characteristics for each gear change make it possible to adapt precisely to the particular shift operation.

High and Low range operation has different parameters to optimise shift quality.

4) Shift Map Selection

The driver can manually select between normal (S) and winter modes (W) via the mode switch. Depending on the transmission temperature, uphill and downhill grades and altitude, shift maps will be selected by the TCU to suit the driving conditions. The following maps are available.

► Normal Mode

Normal Mode is selected when the lever is in the D position with the mode switch in the normal (S) position and the transmission is within normal temperature ranges. Shift schedule points are optimised for fuel efficiency and general driving conditions.

► Uphill and Downhill Mode

In this mode, depending on the load of the vehicle, adaptive shift maps are selected to progressively adjust the shift points and torque converter lock points.

► Altitude Mode

Shift points are automatically adjusted at higher altitudes to compensate for changes in engine torque where the torque produced by the engine is greatly reduced by the effects of reduced barometric pressure and temperature.

► Winter Mode

When winter mode is selected, starting in second gear is facilitated and the WINTER mode indicator light is switched ON. To prevent wheel spin on slippery surfaces, the transmission will not allow first gear unless manually overridden.

Modification basis	
Application basis	
Affected VIN	

► Low Range Schedule

When the transfer case is in 4L position, the transmission uses a different shift map to optimise low range driving. Similar to winter mode, 1st gear is inhibited. The transmission may skip gears, e.g. 2-4, to optimise engine rpm.

► Warm up Schedule

Used typically when transmission fluid temperature is below 20°C.

The torque converter will not lock-up below 20°C to assist in transmission warm-up.

► Hot Mode

The hot mode is progressively applied between temperatures of 110°C– 145°C. The torque converter lock-up is increased to prevent heat generation by the torque converter.

As additional assistance to the hot mode, the following are activated:

- Above 110°C - the electrical radiator fans are switch ON
- Above 130°C - the engine torque will be reduced and the WINTER light on the instrument cluster will flash
- Above 145°C - the transmission will neutralise until the fluid temperature falls below 120°C as a final protection.

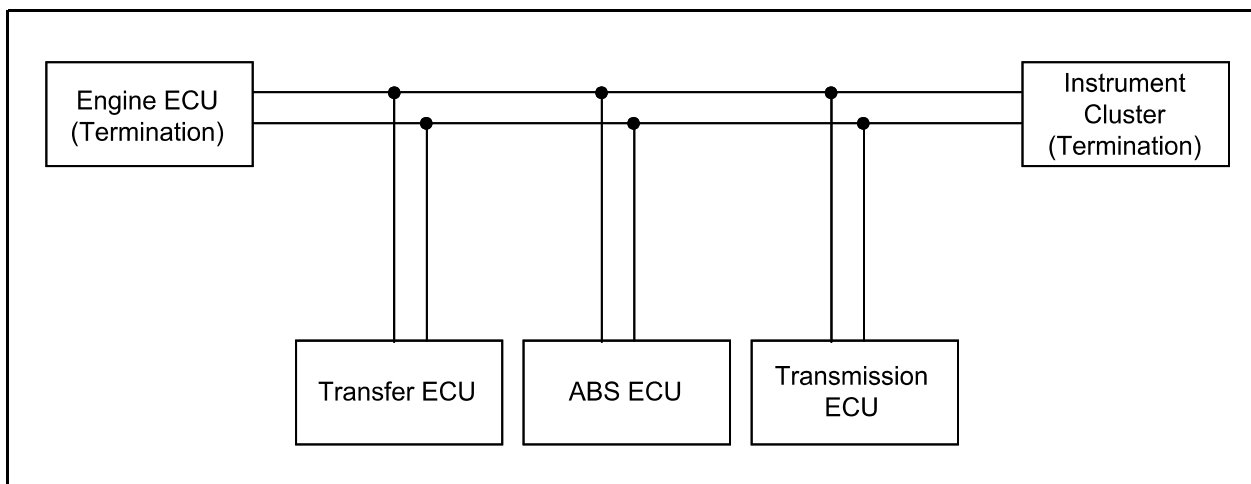
Activation of the hot mode inhibits other transmission performance features including uphill and downhill compensation and altitude compensation. Some degradation in shift feel may be experienced as the torque converter is not unlocked during shifting. The fluid temperature must be below 105℃ to exit all hot modes.

► Cruise

When cruise control is activated the engine ECU may request the transmission to downshift under trailing throttle conditions to increase engine braking.

6. CONFIGURATION OF CAN RELATED TO TCU

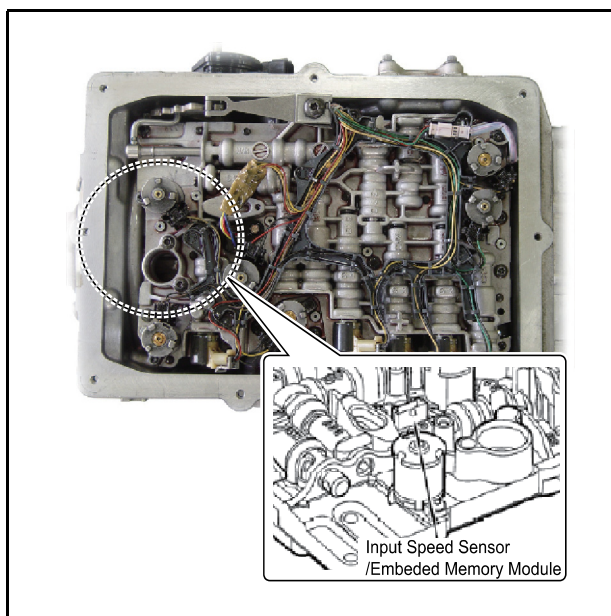
1) Communication Network



The TCU sends signals to be used by other vehicle systems via the CAN bus, such as:

- Selector lever position
- Selected gear state
- Manual mode activation
- Output torque
- Input speed
- Output speed
- Transmission fluid temperature
- Engine torque reduction requests

2) Embedded Memory Module



The embedded memory module (EMM) is matched to the transmission valve body during manufacture.

The EMM is integrated into the input speed sensor which is mounted on the valve body in the transmission.

The EMM data contains transmission specific characterisation information. Upon installation, the TCU will upload the data from the EMM and utilise this data in the operation of the transmission.

Modification basis	
Application basis	
Affected VIN	

7. POWER TRAIN

The various power train of the transmission is as follow:

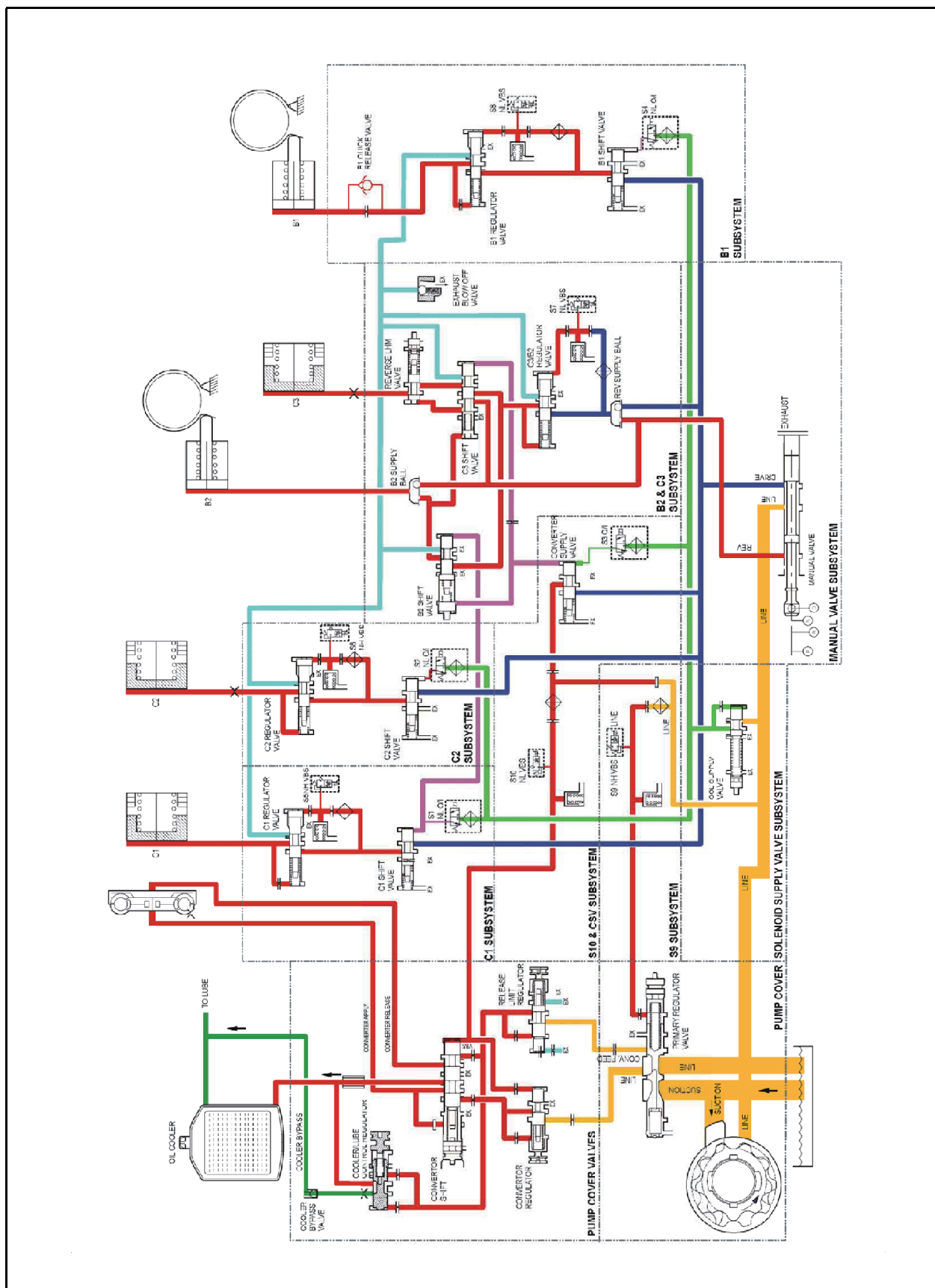
- Power train - M 1st gear
- Power train - D 1st gear
- Power train - D 2nd gear
- Power train - D 2nd gear - lockup
- Power train - D 3rd gear
- Power train - D 4th gear - D 4th gear - limp home mode
- Power train - D 5th gear
- Power train - D 6th gear

► Gear States Summary

Gear	Ratio	Engaged elements (clutches & bands)						Shift ON/OFF solenoids			
		C1	C2	C3	B1	B2	1-2OWC	S1	S2	S3	S4
M1	3.536		ON			ON		ON			
1st	3.536		ON				ON	ON			
2nd	2.143		ON		ON			ON			ON
3rd	1.478		ON	ON				ON		ON	
4th	1.156	ON	ON								
5th	0.866	ON		ON					ON		
6th	0.677	ON			ON				ON		ON
Reverse	-3.094			ON		ON		ON	ON	ON	

Gear	Ratio	Variable Pressure Solenoid Valve					
		S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
M1	3.536	1	0	1			
1st	3.536	1	0			0-1	
2nd	2.143	1	0		1	0-1	
3rd	1.478	1	0	1		0-1	
4th	1.156	0	0			0-1	
5th	0.866	0	1	1		0-1	
6th	0.677	0	1		1	0-1	
Reverse	-3.094	1	1	1		0-1	

► Overall Hydraulic Circuit



Modification basis	
Application basis	
Affected VIN	

DSI M78 6-SPEED A/T

KYRON 2010.01

ION 4-
SPEED

DC 5-SPEED

**DSI M78
6-SPEED**

TGS
LEVER

**T/M
EVER**

T

CH

CL

AXLE

AXLE
(IOP)

T/C

OPELL
ER

SPENS
ION

SP

ERIN
G

► Solenoids

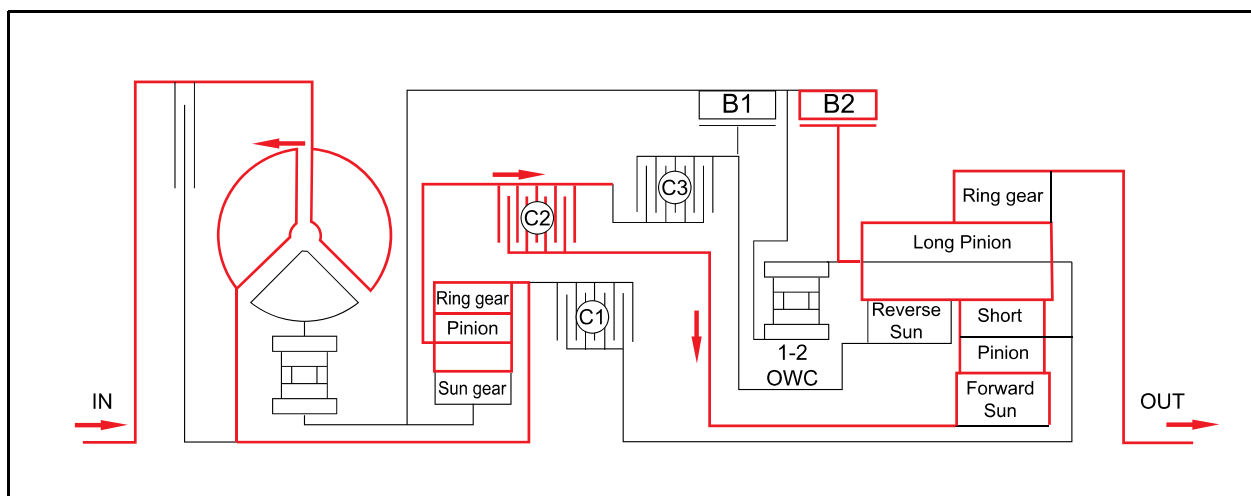
- There are in total 10 solenoids used to control the transmission. All solenoids are located in the Valve Body.
- Solenoids **S1, S2, S3 & S4** are ON/OFF solenoids. They determine the static gear position of the transmission by controlling the shift valves.
- Solenoids **S5, S6, S7 & S8** are Variable Bleeding Solenoids (VBS) which ramp pressure via a current change during gear shifting. They direct pressure to the regulator valves and are the primary means of controlling gear shift quality.
- Solenoids **S9** is also a variable bleeding solenoid. It controls Line Pressure.
- Solenoid **S10** is a variable bleeding solenoid as well and is used for controlling the application of the Torque Converter lock-up clutch.
- ON/OFF Solenoids:
 - **S1** controls apply/release of the C1 Clutch.
 - **S2** controls apply/release of the C2 Clutch
 - **S3** controls apply/release of the C3 Clutch & B2 Band
 - **S4** controls apply/release of the B1 Band
- VBS Solenoids are generally used for regulating and ramping pressure to different shift elements (clutch/band) :
 - **S5** regulates pressure supplied to the C1 Clutch
 - **S6** regulates pressure supplied to the C2 Clutch
 - **S7** regulates pressure supplied to the C3 Clutch & B2 Band
 - **S8** regulates pressure supplied to the B1 Band

► Gear States Summary

Gear	Ratio	Engaged elements (clutches & bands)						Shift ON/OFF solenoids			
		C1	C2	C3	B1	B2	1-2OWC	S1	S2	S3	S4
M1	3.536		ON			ON		ON			
1st	3.536		ON				ON	ON			
2nd	2.143		ON		ON			ON			ON
3rd	1.478		ON	ON				ON		ON	
4th	1.156	ON	ON								
5th	0.866	ON		ON					ON		
6th	0.677	ON			ON				ON		ON
Reverse	-3.094			ON		ON		ON	ON	ON	

1) Power Train - "M" (Manual) Position

► Power flow diagram



► Functioning elements

- C2 applied, drives FSG
- B2 applied to hold Rear Planet Carrier held stationary.
- This gear state provides engine braking.

► Control

- S1 is ON, S7 is ON
- S1 ON moves C1 Shift Valve to the left end not allowing an application of the C1 Clutch.
- S1 ON moves B2 Shift Valve to its left-end position allowing an application of the B2 Band. (S7 must be ON as well).
- C2 Shift Valve (S2 OFF) is open allowing drive oil to engage C2 Clutch.
- Drive oil that engages C2 Clutch is regulated by VBS S6.

► Connecting Components

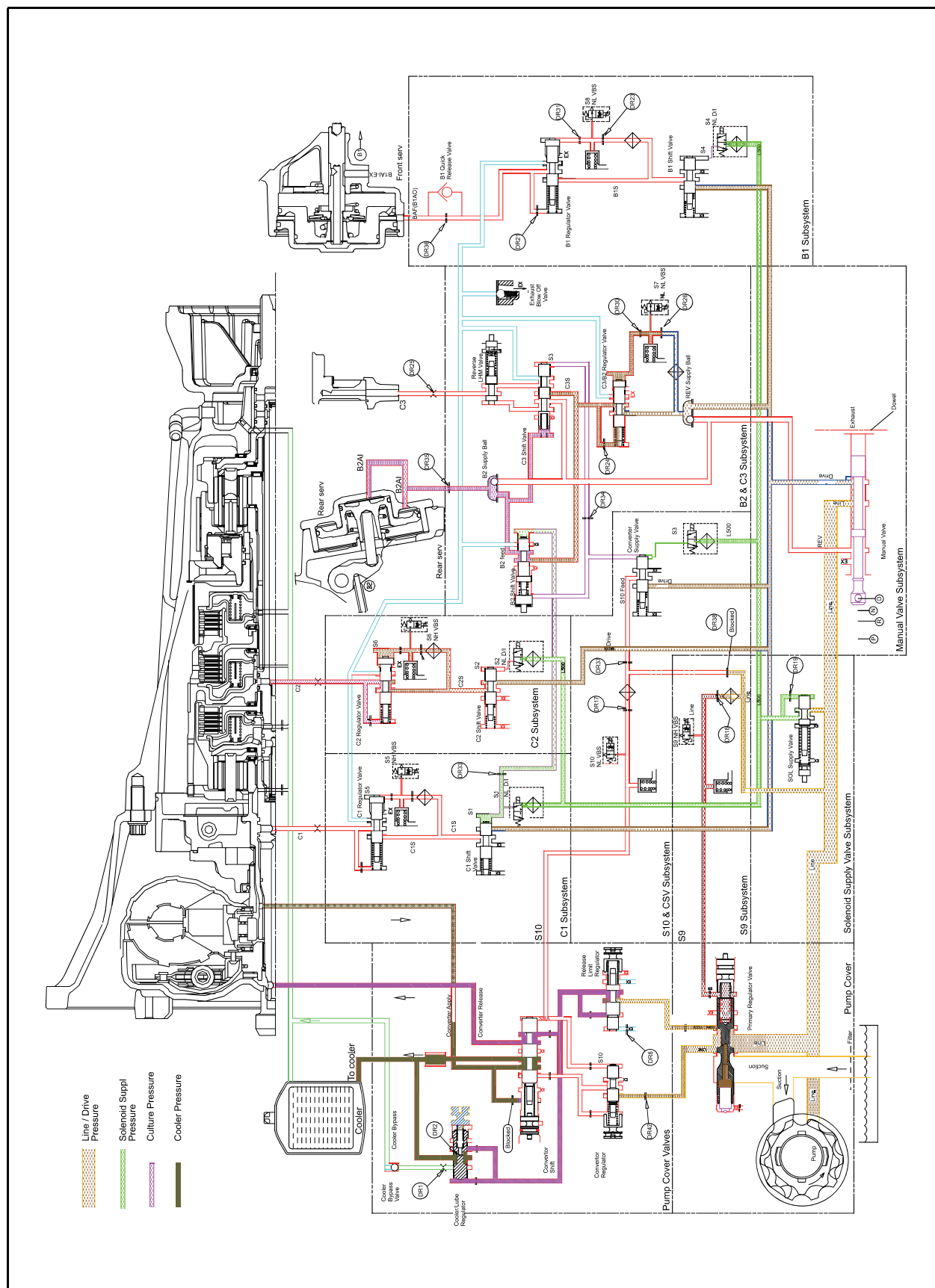
⚠ CAUTION

- Manual 1st is not achieved by moving the Manual Valve into a certain position. This gear state is obtained electronically by solenoids S1 & S7.

► Connecting Components

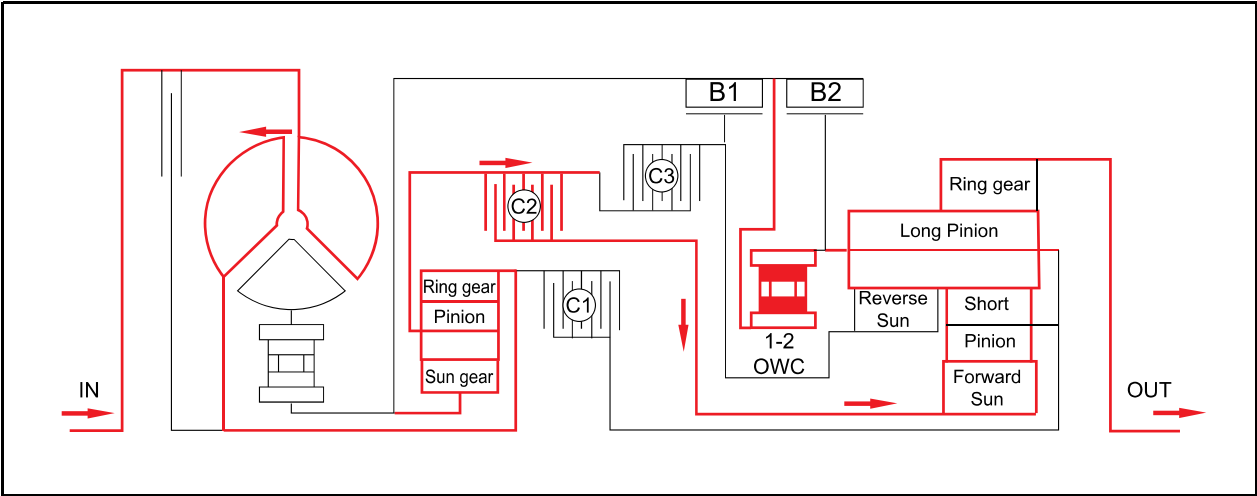
Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.536		ON					ON	ON			ON				1	0	1		0-1	

Modification basis	
Application basis	
Affected VIN	



2) Power Train - "D" (Drive) 1st (Auto)

► Power flow diagram



► Functioning elements

- C2 applied, drives FSG
- Rear Planet Carrier held via 1-2 OWC

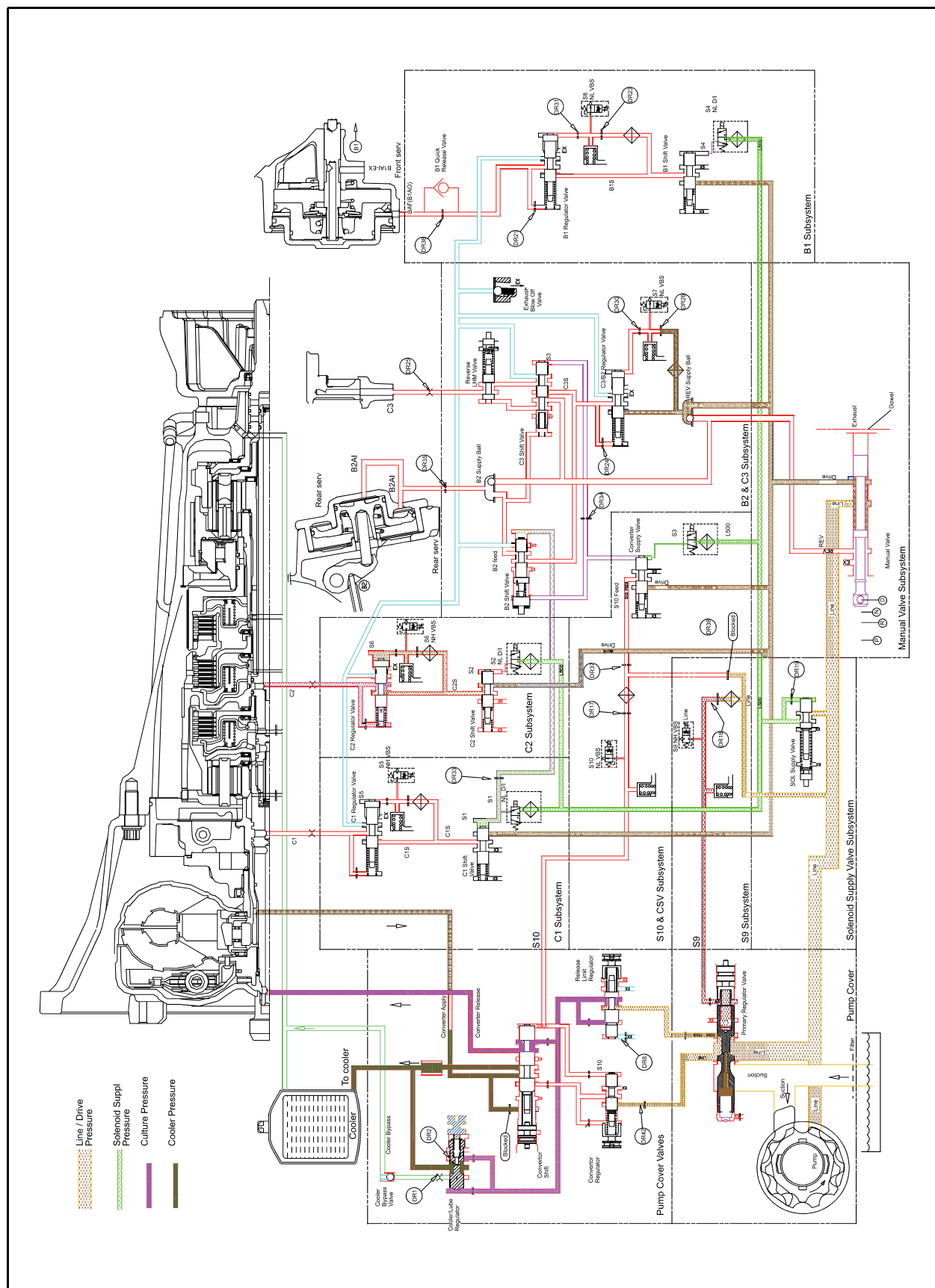
► Control

- S1 is ON, S2 is OFF
- S1 ON moves C1 Shift Valve to the left end not allowing an application of the C1 Clutch.
- C2 Shift Valve (S2 OFF) is open allowing drive oil to engage C2 Clutch.
- Drive oil that engages C2 Clutch is regulated by VBS S6.

► Connecting Components

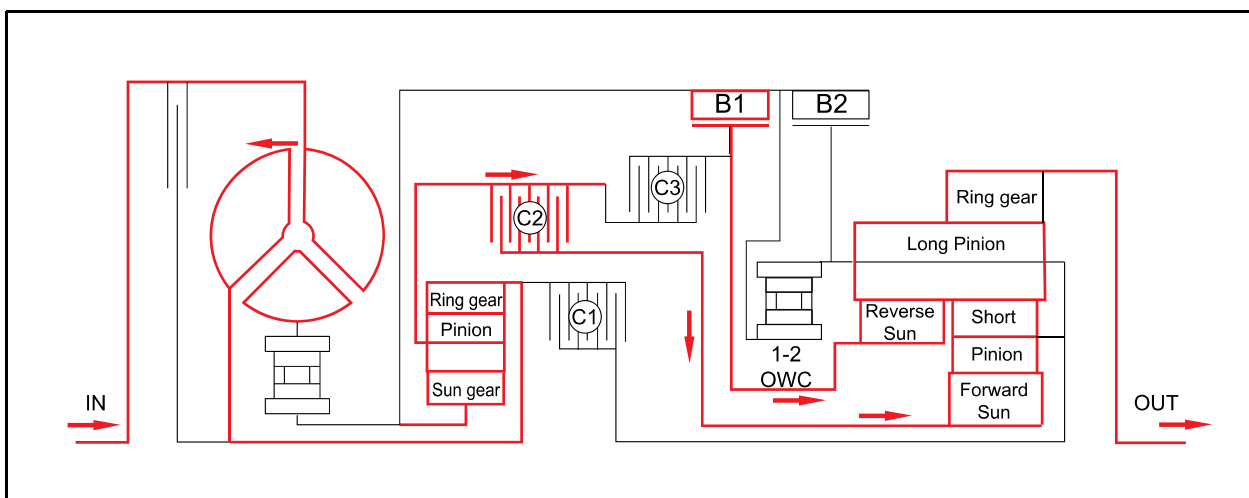
Gear ratio	Elements engaged									ON / OFF solenoids				Variable pressure sol. valve-VBS						
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.536		ON						ON		ON				1	0			0-1		

Modification basis	
Application basis	
Affected VIN	



3) Power Train - "D" (Drive) 2nd

► Power flow diagram



► Functioning elements

- C2 applied, drives FSG
- B1 applied to hold RSG stationary

► Control

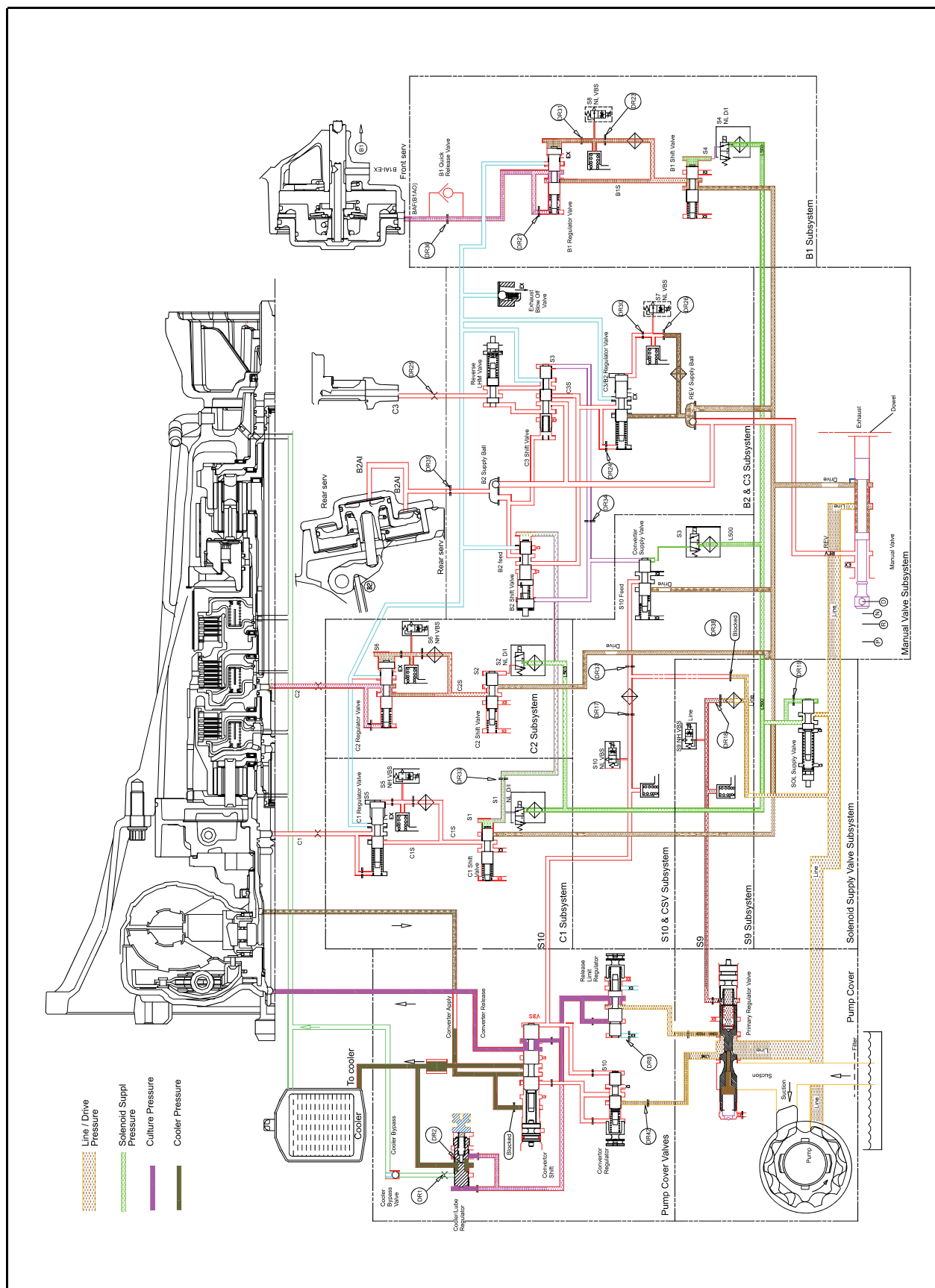
- S1 is ON, S2 is OFF & S4 is ON.
- S1 ON moves C1 Shift Valve to its left-end position not allowing the application of the C1 Clutch.
- C2 Shift Valve is OPEN (S2 OFF) allowing drive oil to engage C2 Clutch.
- Drive oil that engages C2 Clutch is regulated by VBS S6.
- S4 ON moves B1 Shift Valve to its left-end position allowing engagement of B1 Band.
- Drive oil that engages B1 Band is regulated by VBS S8.

► Connecting Components

Gear ratio	Elements engaged									ON / OFF solenoids				Variable pressure sol. valve-VBS						
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
2.143		ON		ON							ON			ON	1	0		1	0-1	

Modification basis	
Application basis	
Affected VIN	

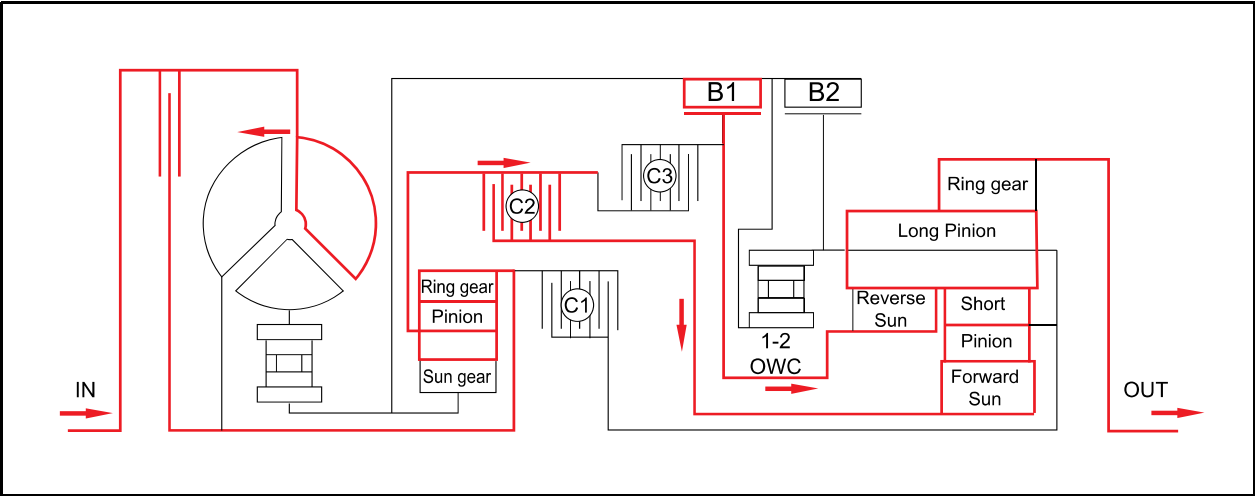
► Auto 2nd - C2 & B1 ON (2.143)



Modification basis	
Application basis	
Affected VIN	

4) Power Train - "D" (Drive) 2nd - Lockup

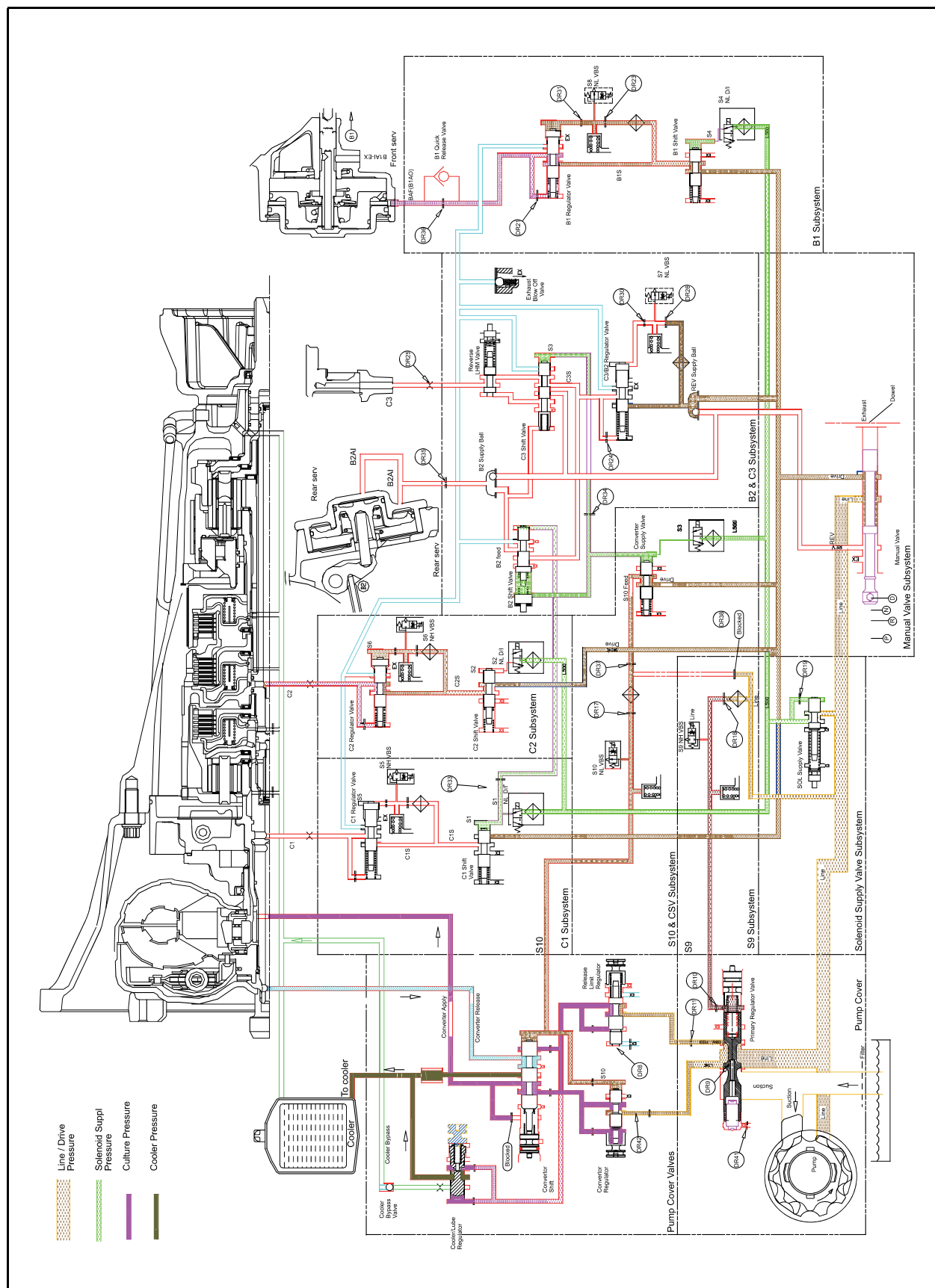
► Power flow diagram



► Connecting Components

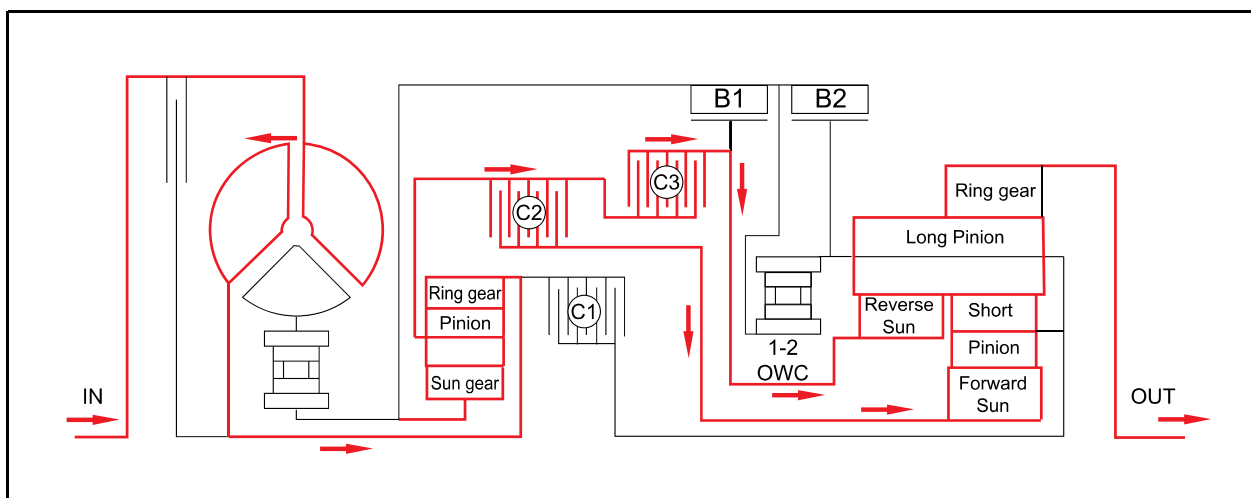
Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
2.143		ON		ON							ON		ON	ON	1	0	0	1	0-1	1

Modification basis	
Application basis	
Affected VIN	



5) Power Train - "D" (Drive) 3rd

► Power flow diagram



► Functioning elements

- C2 applied, drives FSG
- C3 applied, drives Rear Planet Carrier
- Rear Planetary Gear Set is locked and the output is equal to the ratio of the Front Gear Set.

► Control

- S1 ON moves C1 Shift Valve to the left end not allowing the application of the C1 Clutch.
- C2 Shift Valve is open allowing drive oil to engage C2 Clutch (S2 OFF).
- S3 & S7 ON moves C3 Shift Valve to the left end allowing the application of C3 Clutch.

► Connecting Components

⚠ CAUTION

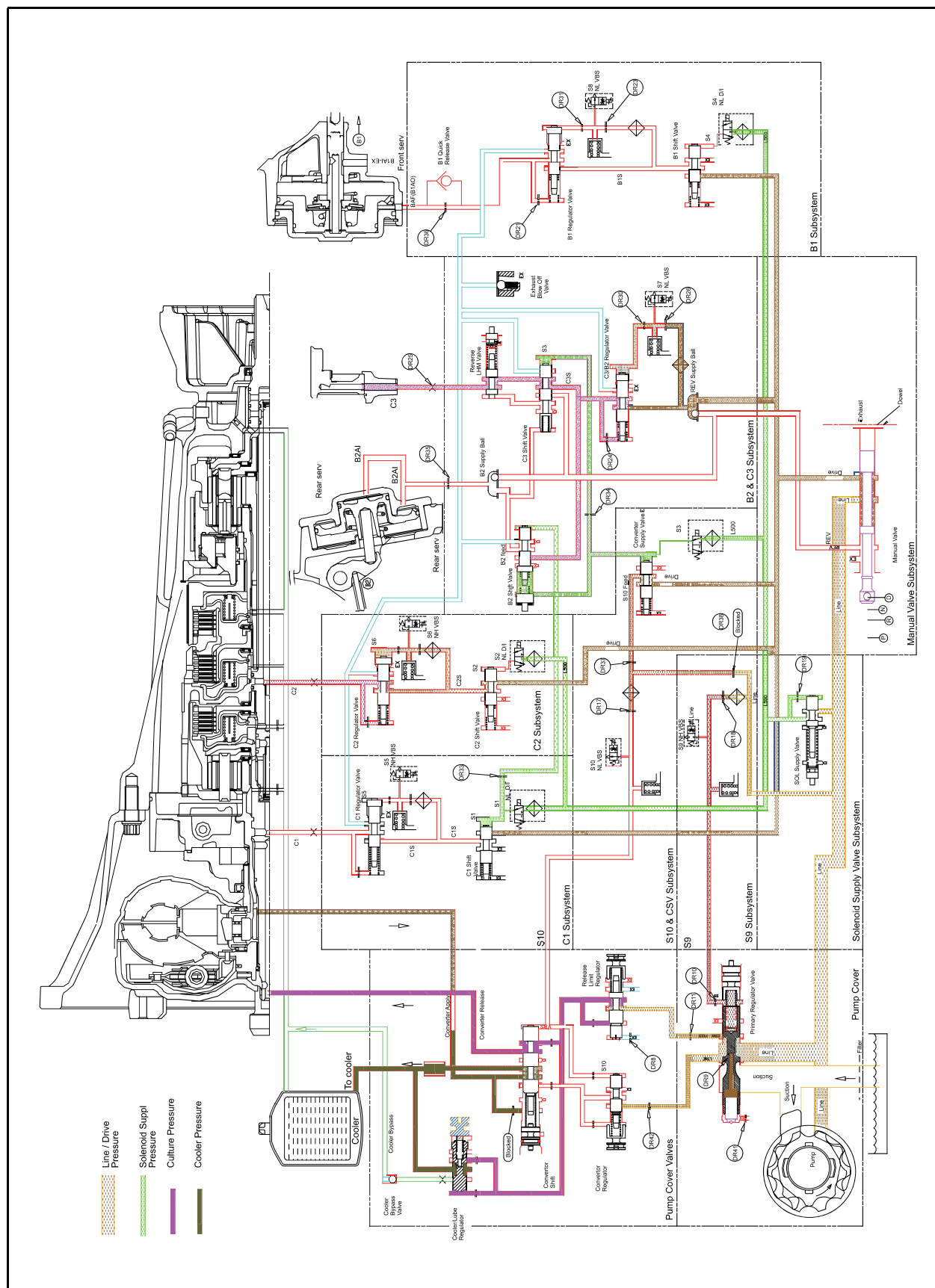
- C3 Clutch cannot be engaged without S7 being ON and supplying pressure to the C3 Regulator Valve.

► Connecting Components

Gear ratio	Elements engaged									ON / OFF solenoids				Variable pressure sol. valve-VBS						
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
1.478		ON	ON								ON		ON		1	0	1		0-1	

Modification basis	
Application basis	
Affected VIN	

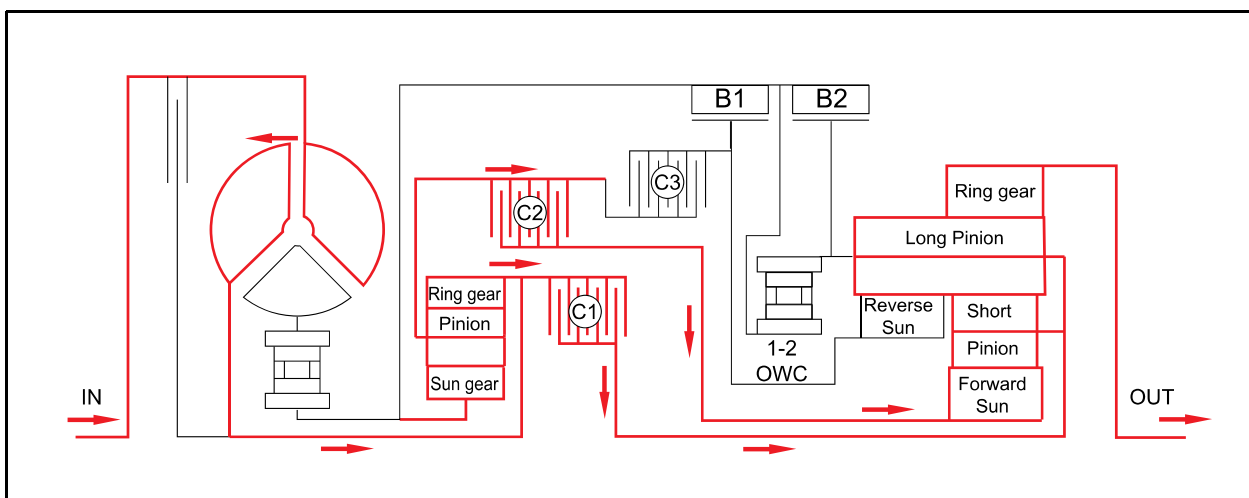
► 3rd Gear - C2 & C3 ON (1.478)



Modification basis	
Application basis	
Affected VIN	

6) Power Train - "D" (Drive) 4th - "D" (Drive) 4th Limp Home Mode

► Power flow diagram



► Functioning elements

- C2 applied, drives FSG
- C1 applied, drives Rear Planet Carrier

► Control

- S1 is OFF, S2 is OFF.
- C1 Shift Valve is OPEN (S1 OFF) allowing drive oil to engage C1 Clutch.
- C2 Shift Valve is OPEN (S2 OFF) allowing drive oil to engage C2 Clutch.
- Drive oil that engages C1 & C2 Clutches is regulated by S5 & S6 VBS, respectively for each clutch.

► Connecting Components



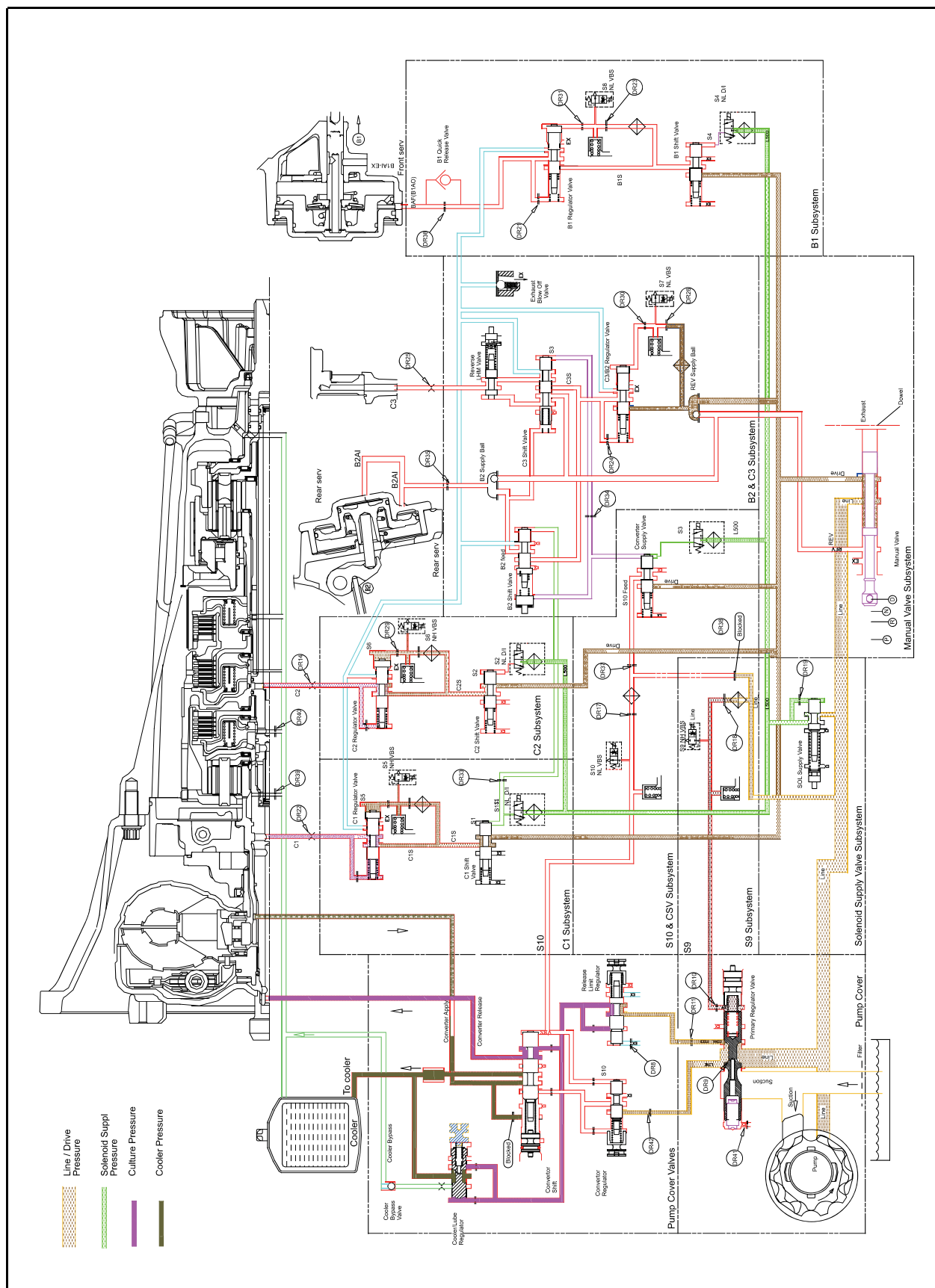
CAUTION

- 4th GEAR is used as a LHM state.

► Connecting Components

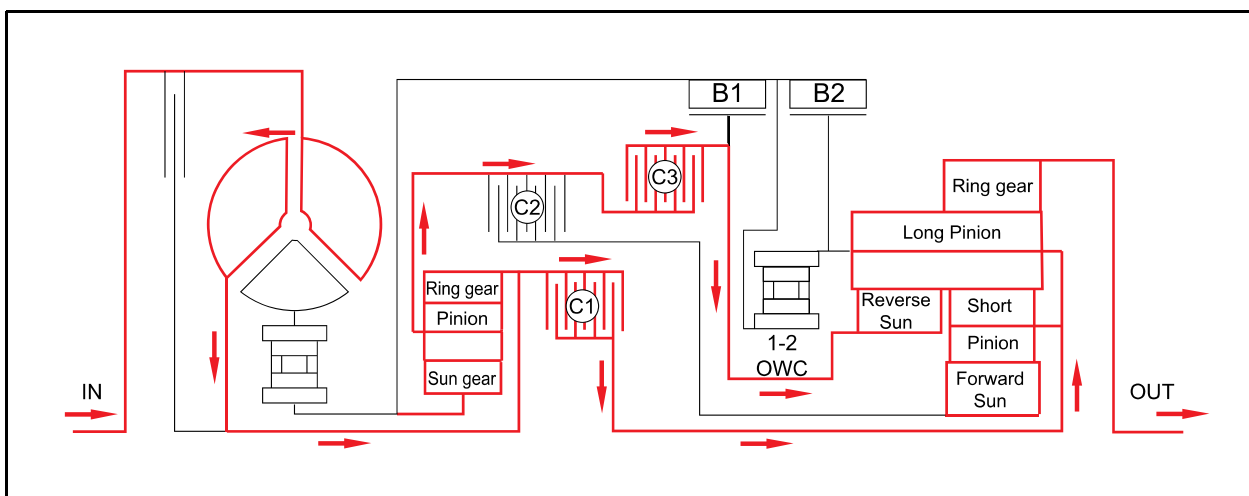
Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
1.156	ON	ON													0	0			0-1	

Modification basis	
Application basis	
Affected VIN	



7) Power Train - "D" (Drive) 5th

► Power flow diagram



► Functioning elements

- C1 applied, drives Rear Planet Carrier
- C3 applied, drives RSG

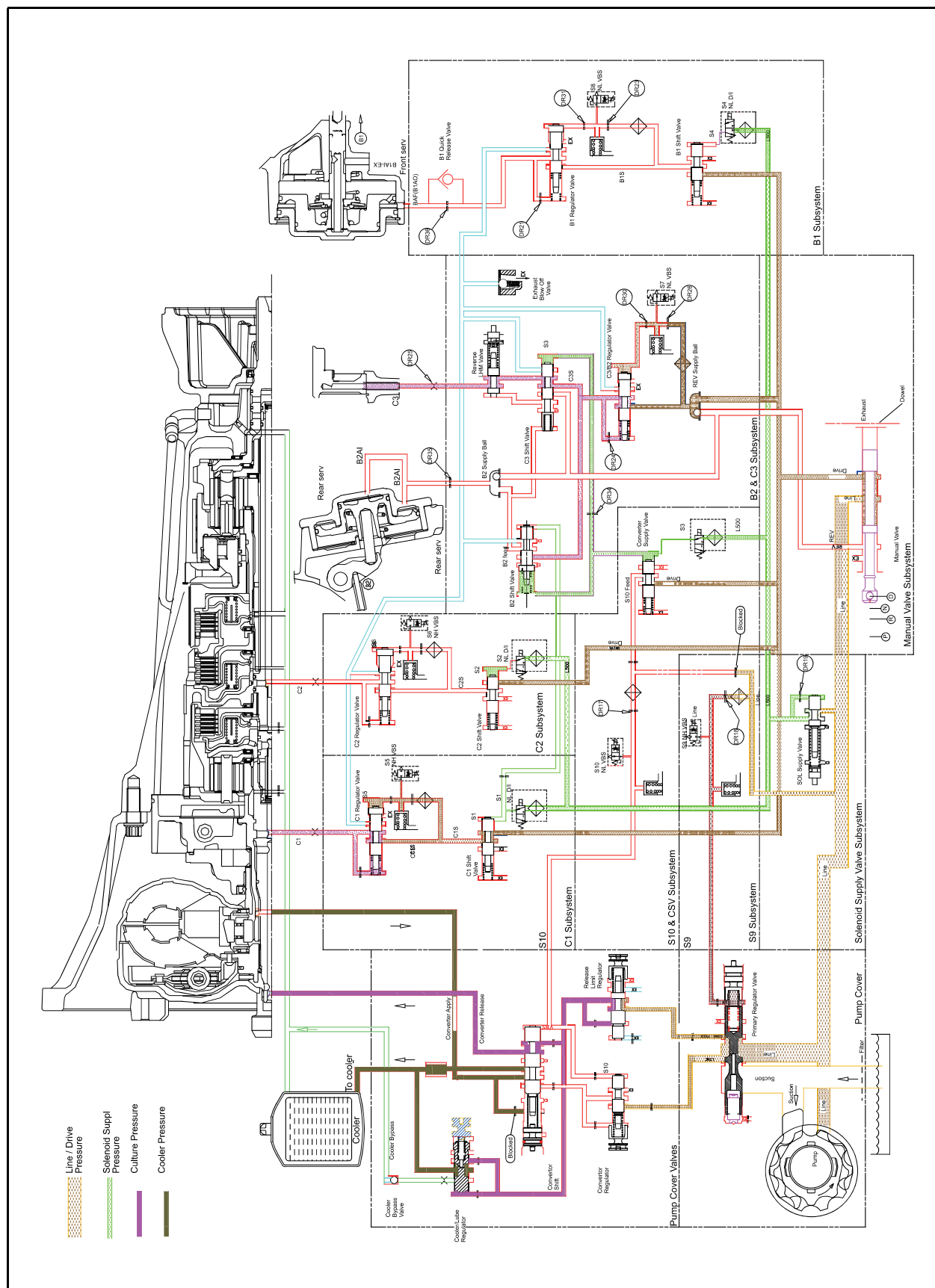
► Control

- S1 is OFF, S2 is ON, S3 is ON.
- S2 ON moves C2 Shift Valve to its left-end position not allowing the application of the C2 Clutch.
- C1 Shift Valve is OPEN (S1 OFF) allowing drive oil to engage C1 Clutch
- S3 ON and with S7 ON moves C3 Shift Valve to the left end allowing the application of C3 Clutch.

► Connecting Components

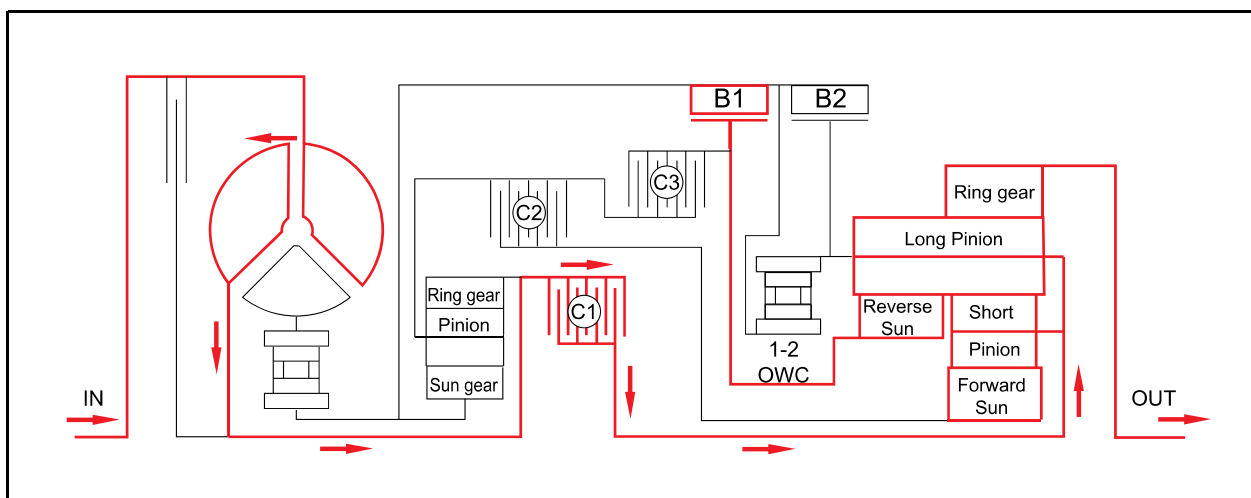
Gear ratio	Elements engaged										ON / OFF sole-				Variable pressure valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
0.866	ON		ON									ON	ON		0	1	1		0-1	

Modification basis	
Application basis	
Affected VIN	



8) Power Train - "D" (Drive) 6th

► Power flow diagram



► Functioning elements

- C1 applied, drives Rear Planet Carrier
- B1 applied to hold RSG

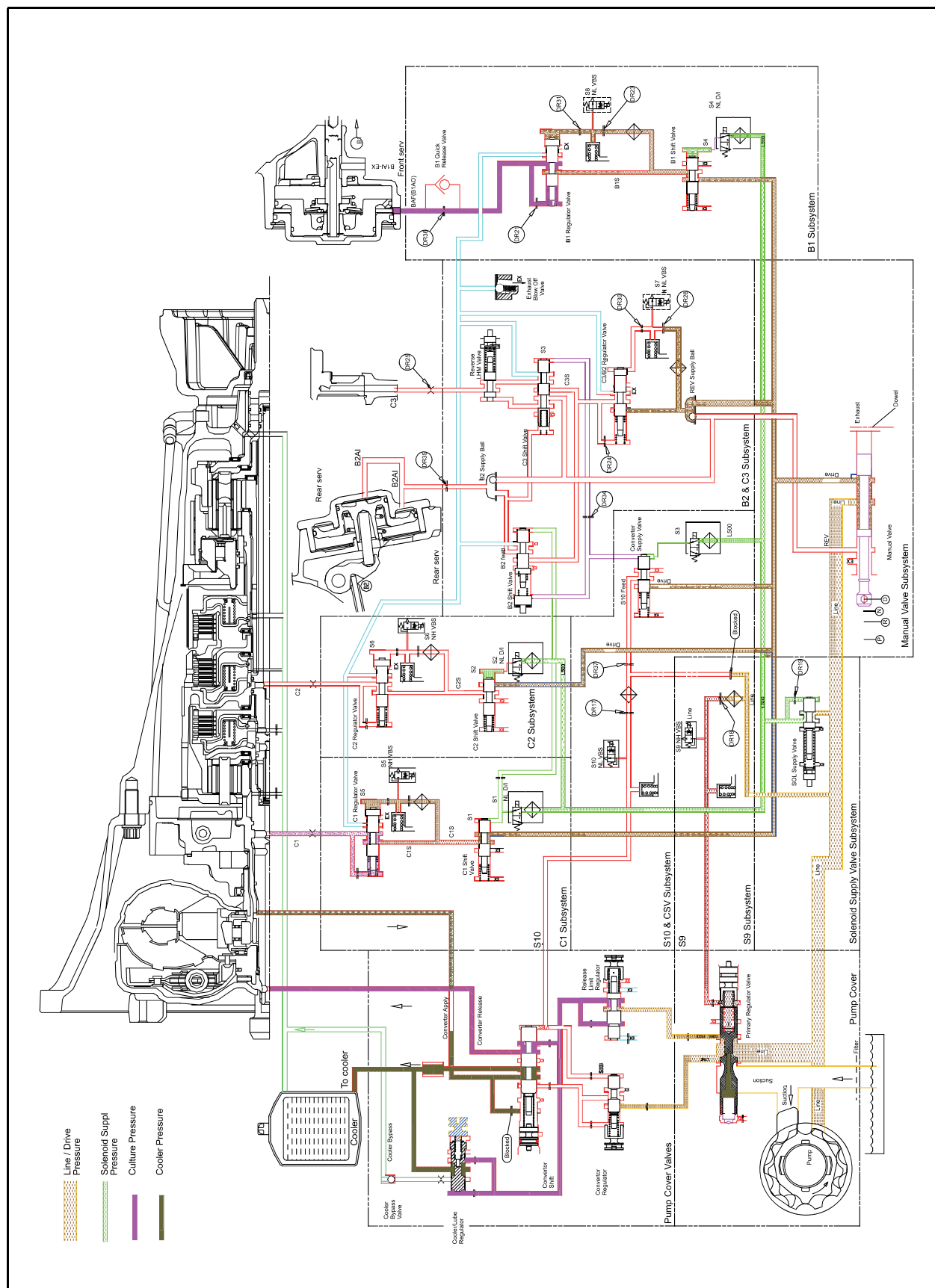
► Control

- S1 is OFF, S2 is ON, S4 is ON.
- S2 ON moves C2 Shift Valve to its left-end position not allowing the application of the C2 Clutch.
- C1 Shift Valve is OPEN (S1 OFF) allowing drive oil to engage C1 Clutch
- S4 ON moves B1 Shift Valve to its left-end position allowing the engagement of B1 Band.

► Connecting Components

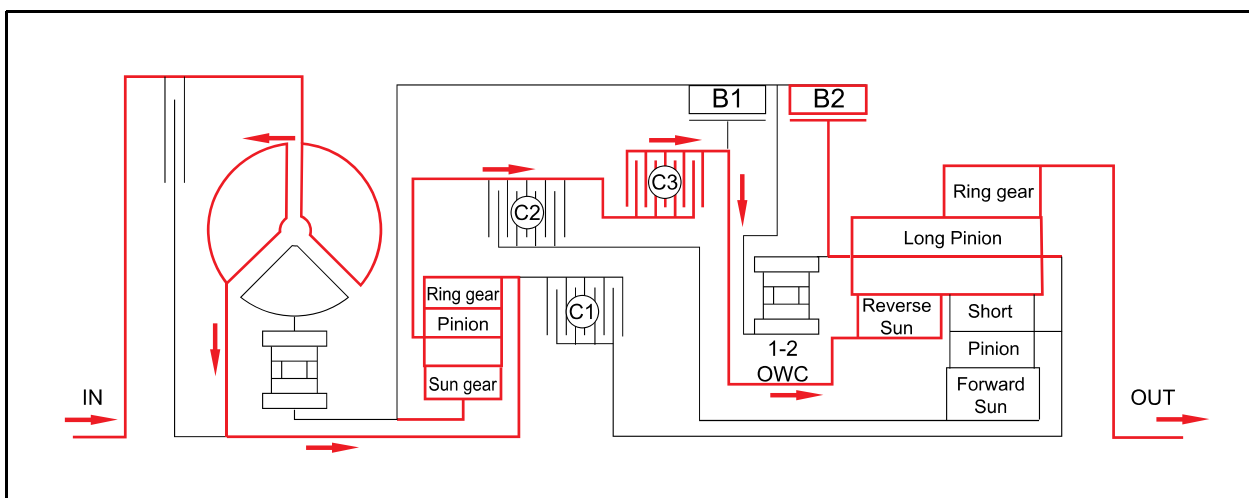
Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
0.677	ON			ON								ON		ON	0	1		1	0-1	

Modification basis	
Application basis	
Affected VIN	



9) Power Train - Reverse

► Power flow diagram



► Functioning elements

- C3 applied, drives RSG
- B2 applied, holds Rear Planet Carrier stationary

► Control

- S1 is ON, S2 is ON, S3 is ON.
- Line pressure is directed via Manual Valve to apply B2 Band directly.
- S3 ON allows ramping and regulating pressure supplied to the C3.
- S1 & S2 are ON not allowing engagement either C1 or C2 Clutch at any circumstances.

► Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.094			ON				ON	ON			ON	ON	ON		1	1	1		0-1	

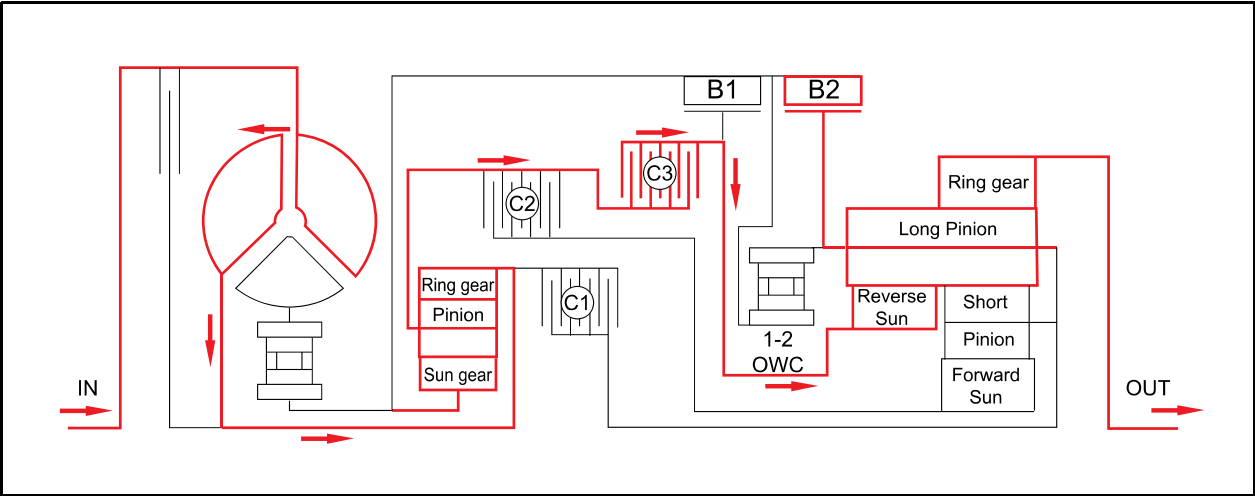
Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

10) Power Train - Reverse (Limp Home Mode)

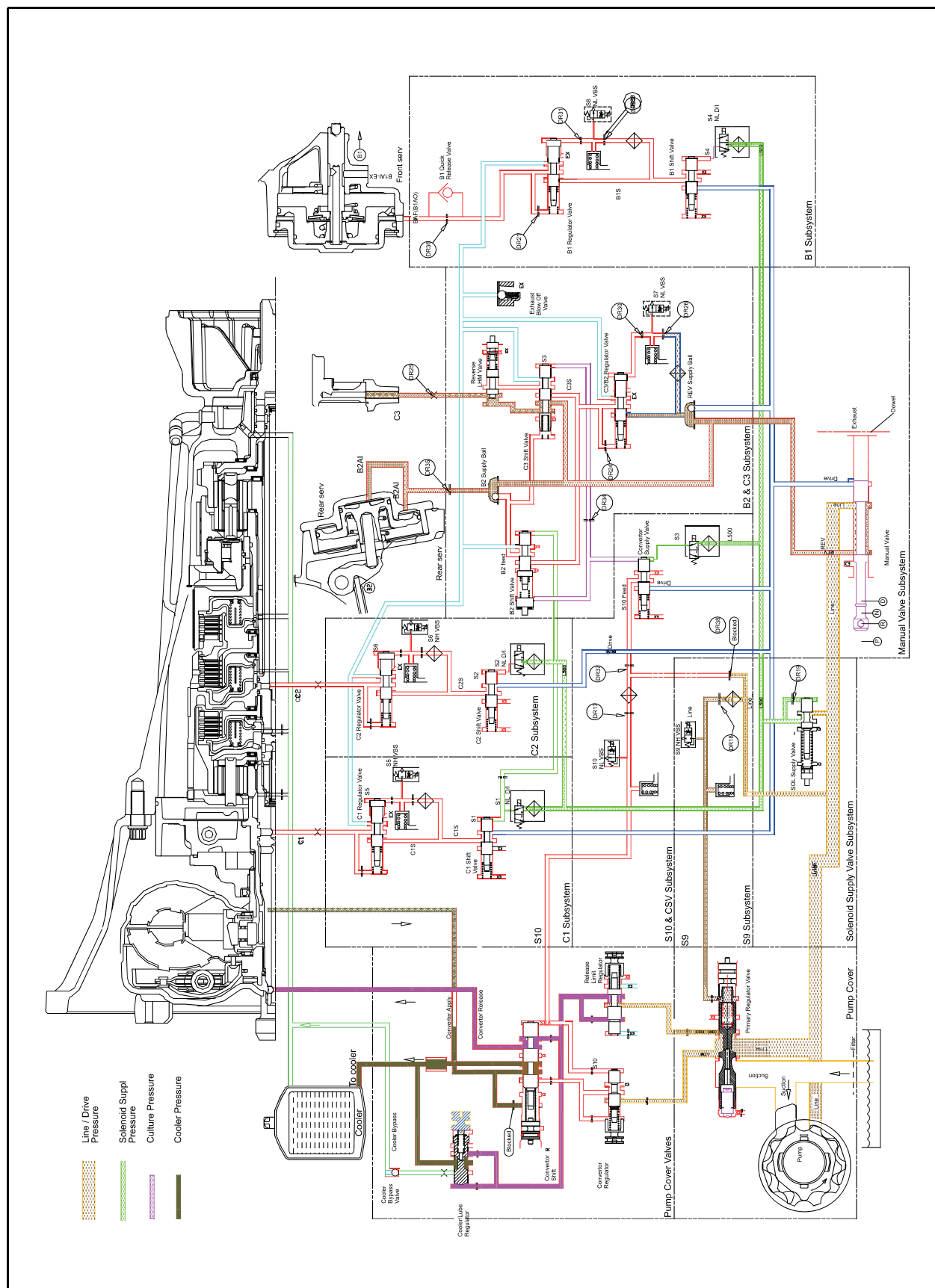
► Power flow diagram



► Connecting Components

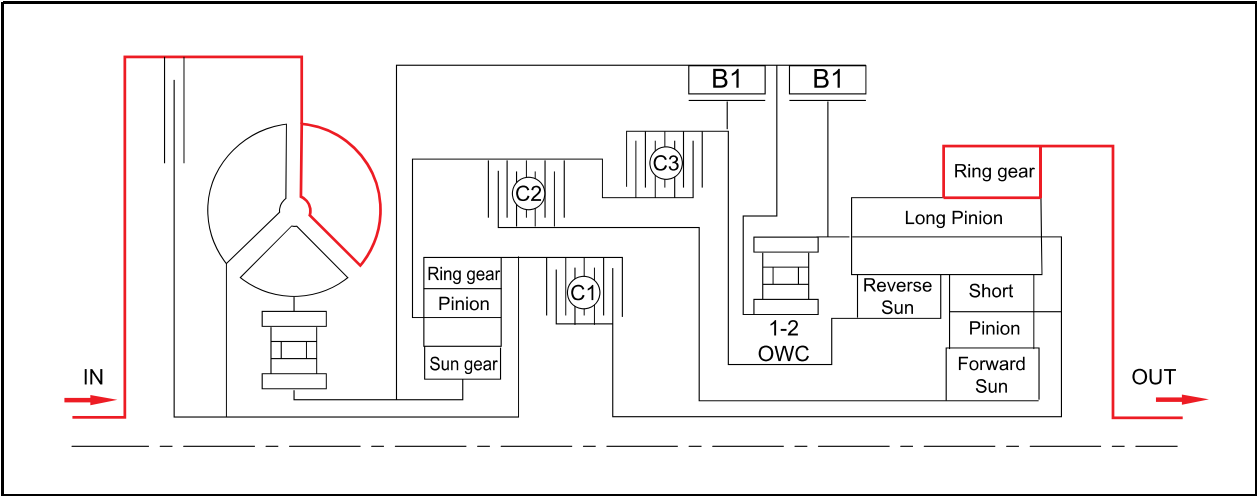
Gear ratio	Elements engaged									ON / OFF solenoids				Variable pressure sol. valve-VBS						
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.094			ON				ON	ON							0	0	0	0	0	0

Modification basis	
Application basis	
Affected VIN	



11) Power Train - Parking

► Power flow diagram

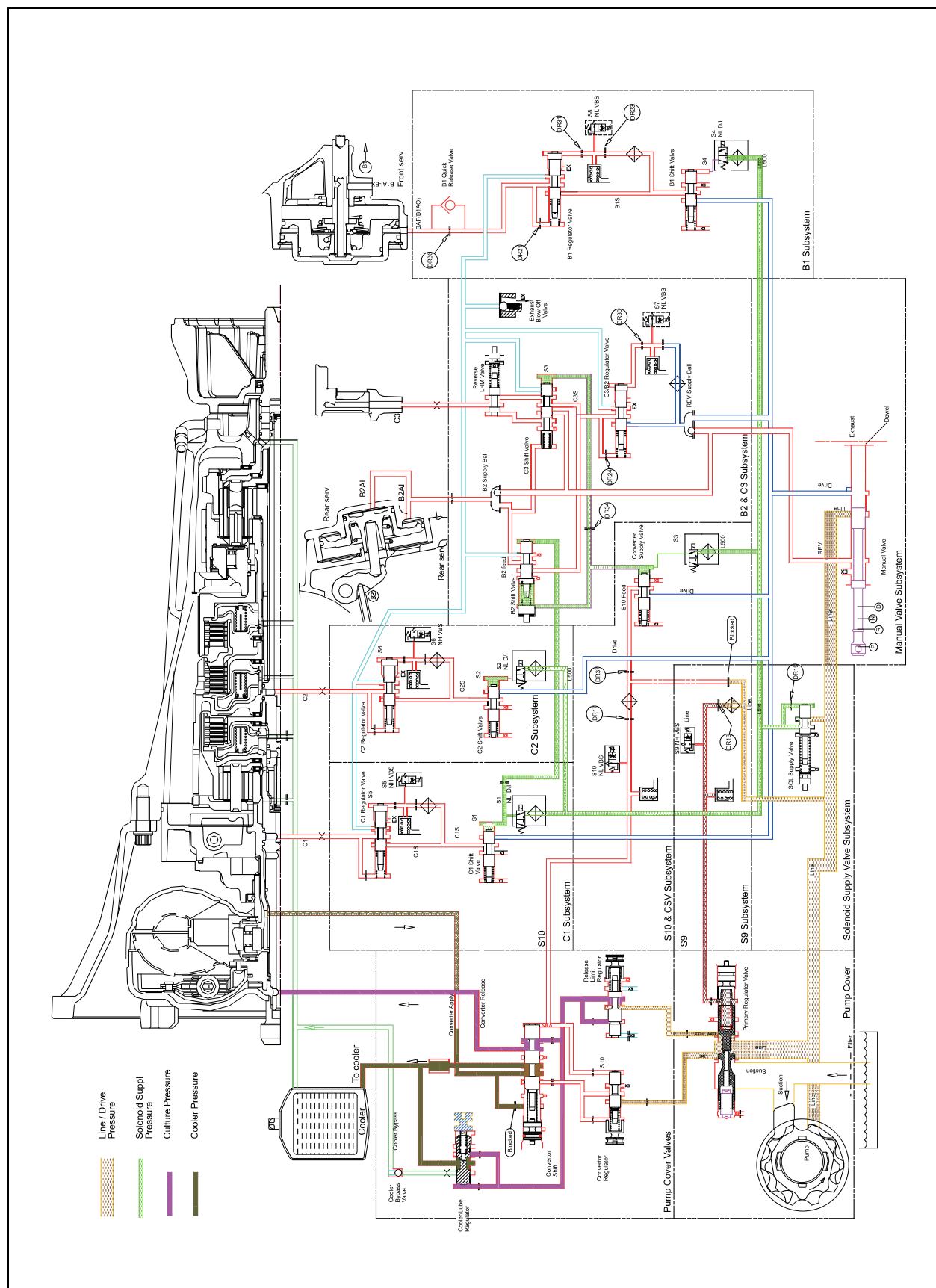


► Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
N/A											ON	ON	ON						1	

Modification basis	
Application basis	
Affected VIN	

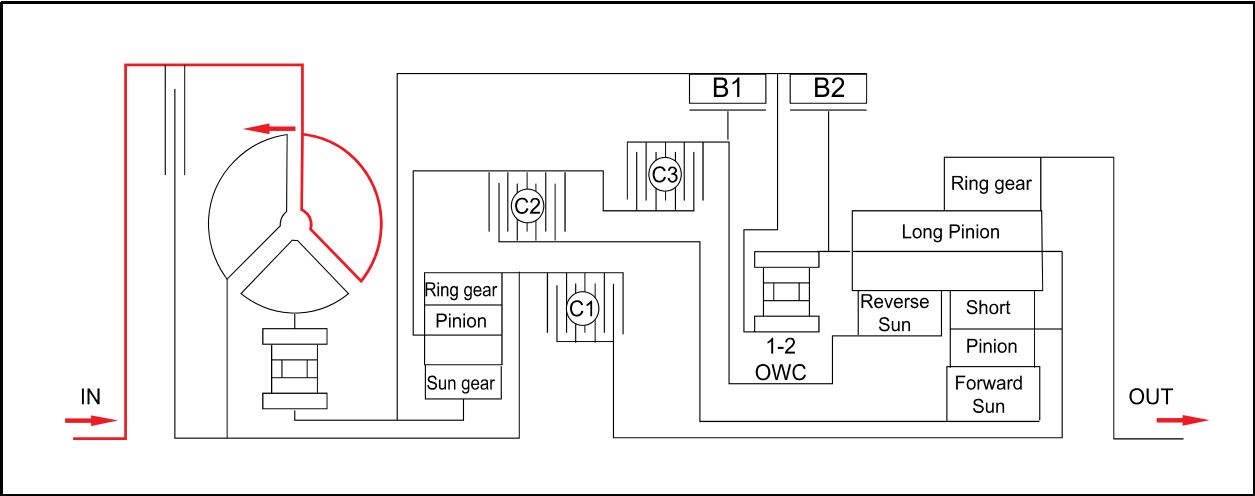
► Park



Modification basis	
Application basis	
Affected VIN	

12) Power Train - Neutral

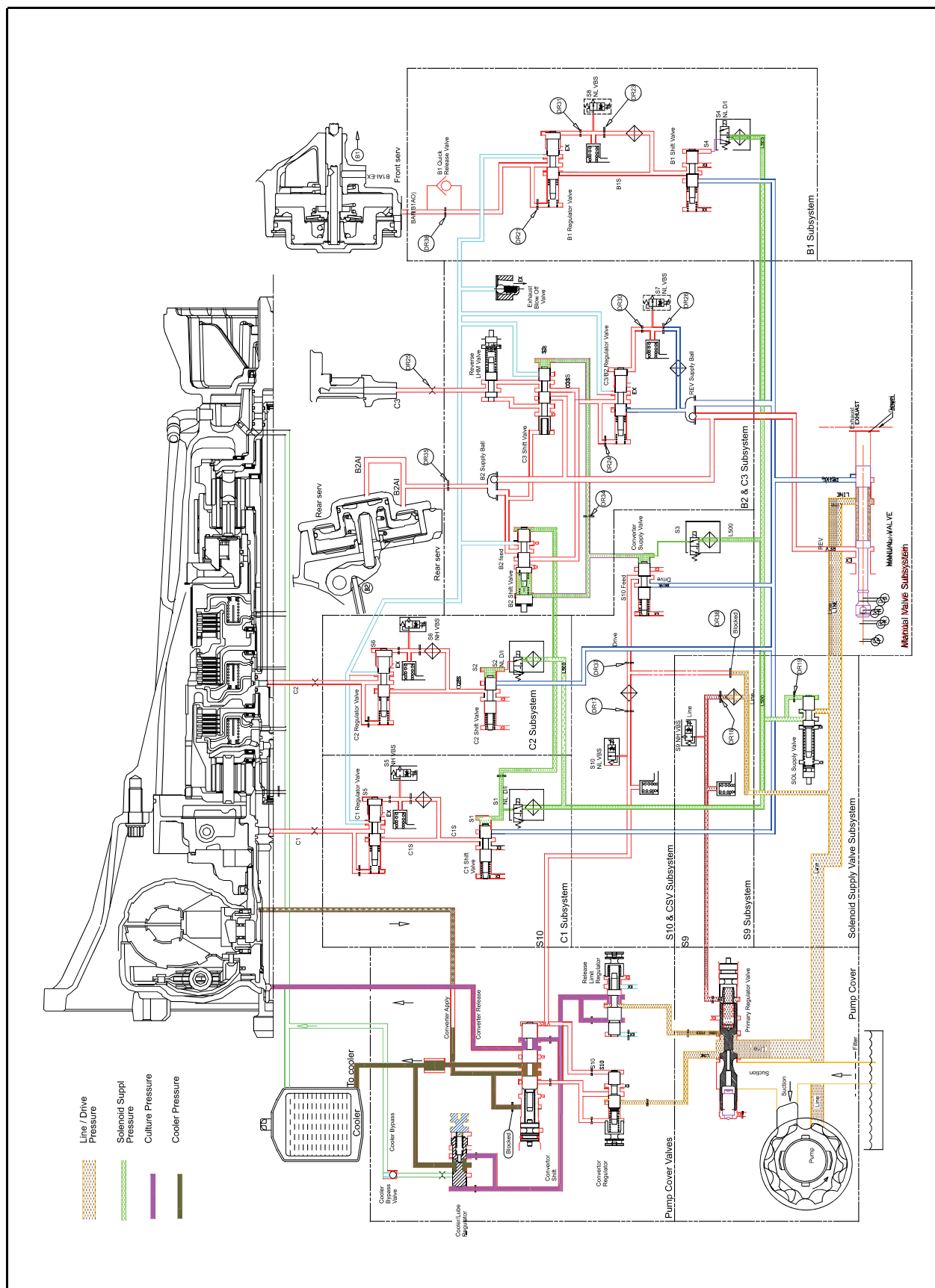
► Power flow diagram



► Connecting Components

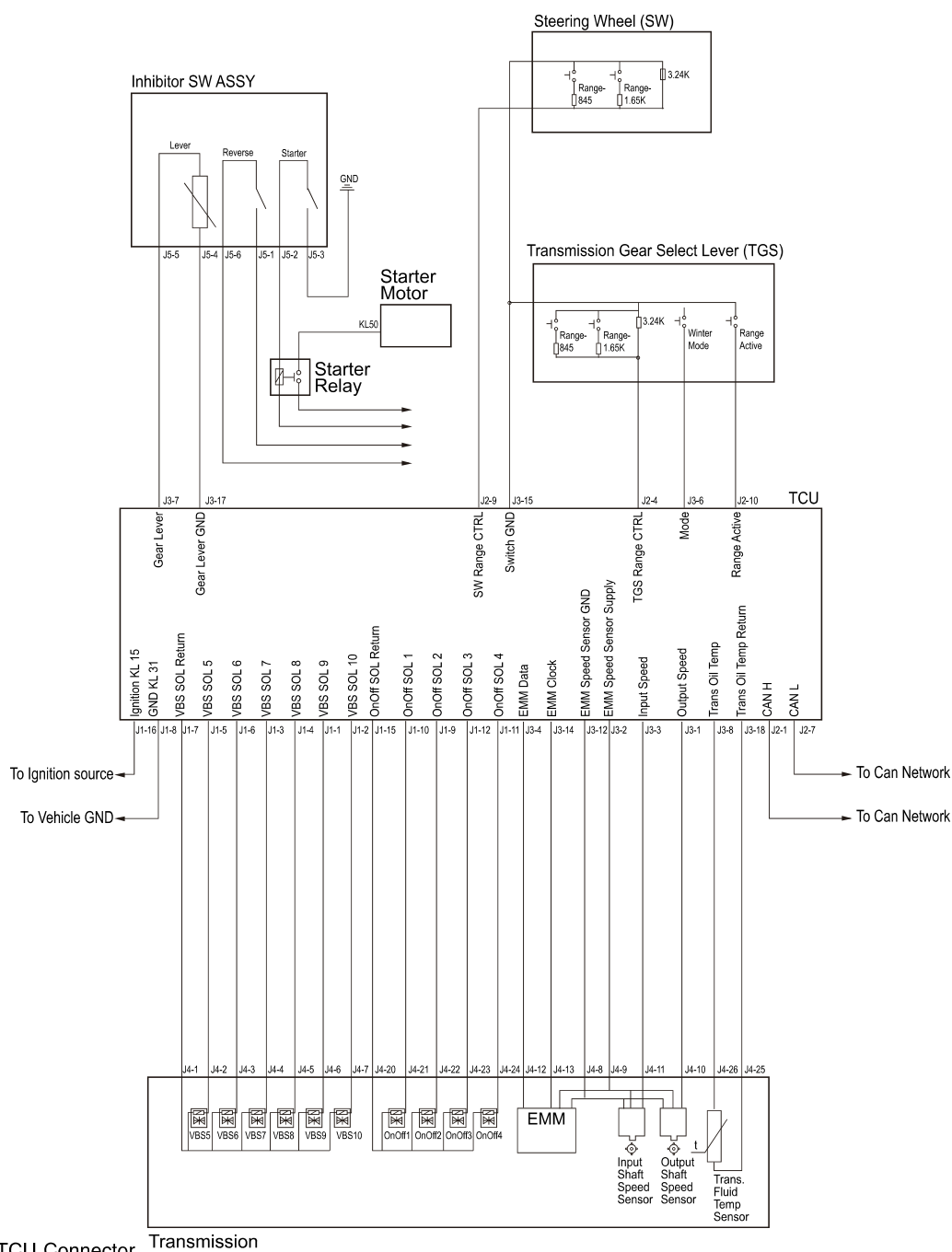
Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
N/A											ON	ON	ON						0-1	

Modification basis	
Application basis	
Affected VIN	



DIAGNOSIS AND TESTING

1. WIRING DIAGRAM



* TCU Connector

SM J1 = EWD A

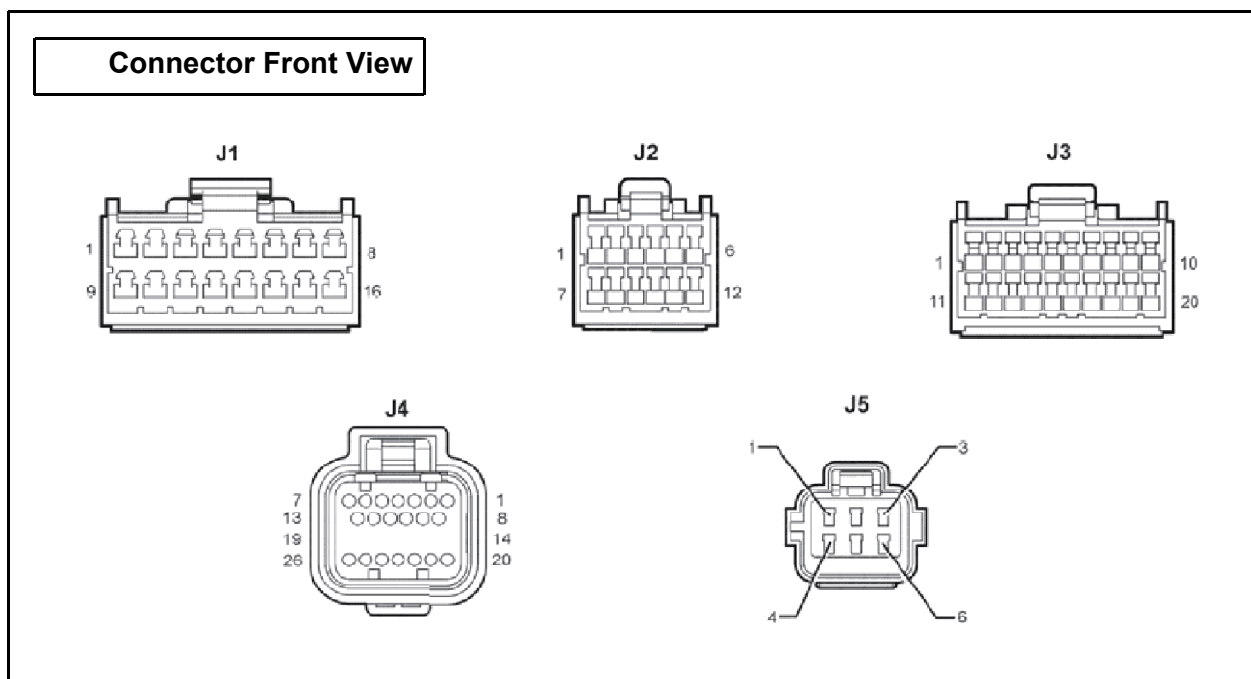
SM J2 = EWD B

SM J3 = EWD C

(SM: Service Manual, EWD: Electrical Wiring Diagram)

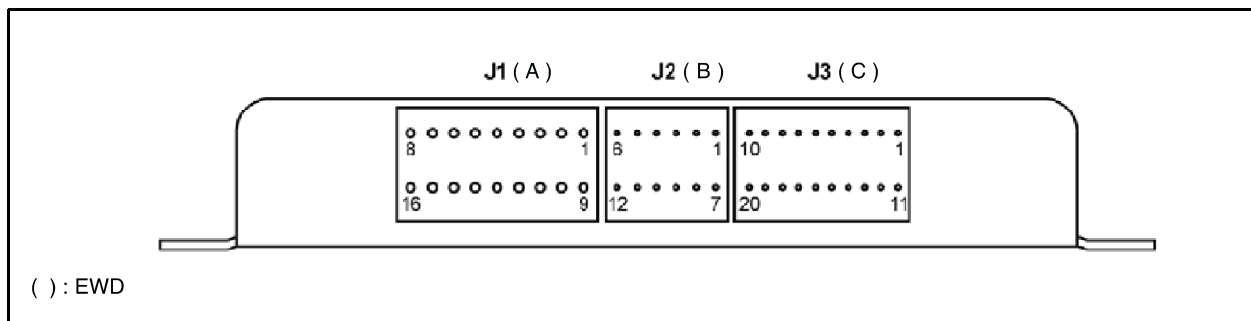
Modification basis	
Application basis	
Affected VIN	

2. WIRE HARNESS CONNECTOR CHART



3. UNIT CONNECTOR DESCRIPTION

1) Transmission Control Unit



► Connector J1 (A)

Terminal / Pin	Function	Terminal / Pin	Function
J1-1	VBS Solenoid 9	J1-9	On / Off Solenoid 2
J1-2	VBS Solenoid 10	J1-10	On / Off Solenoid 1
J1-3	VBS Solenoid 7	J1-11	On / Off Solenoid 4
J1-4	VBS Solenoid 8	J1-12	On / Off Solenoid 3
J1-5	VBS Solenoid 5	J1-13	-
J1-6	VBS Solenoid 6	J1-14	-
J1-7	VBS Solenoid Return	J1-15	On / Off Solenoid Return
J1-8	Ground	J1-16	Ignition Supply Voltage

Modification basis	
Application basis	
Affected VIN	

► Connector J2 (B)

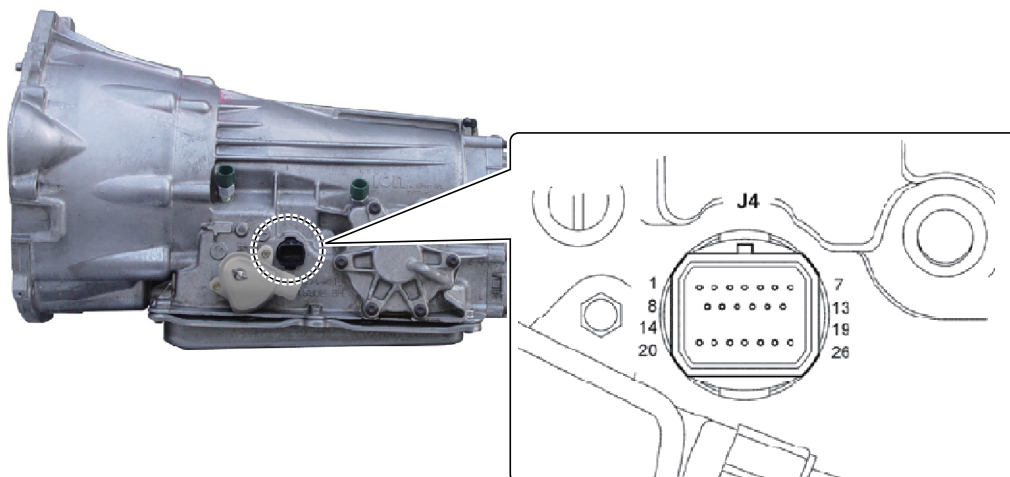
Terminal / Pin	Function	Terminal / Pin	Function
J2-1	CAN High	J2-7	CAN Low
J2-2	-	J2-8	-
J2-3	-	J2-9	Steering Wheel Range Control
J2-4	Transmission Gear Selector Range Control	J2-10	Range Active
J2-5	-	J2-11	-
J2-6	-	J2-12	-

► Connector J3 (C)

Terminal / Pin	Function	Terminal / Pin	Function
J3-1	Output Speed	J3-11	-
J3-2	EMM / Speed Sensor Supply Voltage	J3-12	EMM / Speed Sensor Ground
J3-3	Input Speed	J3-13	-
J3-4	Embedded Memory Module Data	J3-14	Embedded Memory Module Clock
J3-5	-	J3-15	Switch Ground
J3-6	Mode	J3-16	-
J3-7	Gear Lever	J3-17	Gear Lever Ground
J3-8	Transmission Fluid Temperature	J3-18	Transmission Fluid Temperature Return
J3-9	-	J3-19	-
J3-10	-	J3-20	-

2) Transmission

Connector Front View

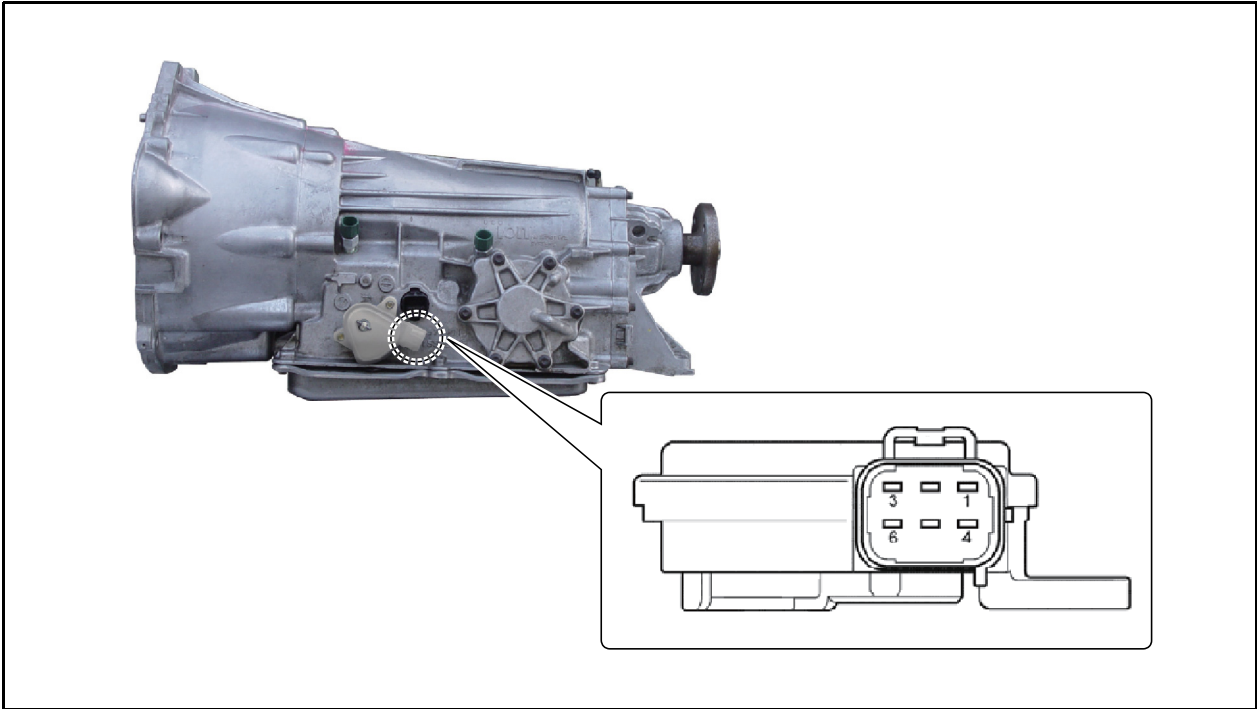


► Connector J4

Terminal / Pin	Function	Terminal / Pin	Function
J4-1	VBS Solenoid Return	J4-14	-
J4-2	VBS Solenoid 5	J4-15	-
J4-3	VBS Solenoid 6	J4-16	-
J4-4	VBS Solenoid 7	J4-17	-
J4-5	VBS Solenoid 8	J4-18	-
J4-6	VBS Solenoid 9	J4-19	-
J4-7	VBS Solenoid 10	J4-20	On/Off Solenoid Return
J4-8	EMM Data / Speed Sensor Ground	J4-21	On/Off Solenoid
J4-9	EMM / Speed Sensor Supply Voltage	J4-22	On/Off Solenoid
J4-10	Output Speed	J4-23	On/Off Solenoid
J4-11	Input Speed	J4-24	On/Off Solenoid
J4-12	Embedded Memory Module Data	J4-25	Transmission Fluid Temperature Return
J4-13	Embedded Memory Module Clock	J4-26	Transmission Fluid Temperature Input

Modification basis	
Application basis	
Affected VIN	

3) Inhibitor Switch



► Connector J5

Terminal / Pin	Function	Terminal / Pin	Function
J5-1	Reverse Circuit	J5-4	Gear Lever Ground
J5-2	Starter Circuit	J5-5	Gear Lever
J5-3	Starter Circuit	J5-6	Reverse Circuit

TROUBLE CODE DIAGNOSIS

1. DIAGNOSTIC TROUBLE CODE LIST

DTC	Description	Sub System
P0603	TCU Adaptive Data Memory Error	TCU (see page 68)
P0604	TCU Adaptive Data Limit Reached	
P0700	Transmission Control System (MIL Request)	
P0707	Gear Lever Position Sensor Error Low	
P0708	Gear Lever Position Sensor Error High	Inhibitor Switch Assembly (see page 71)
P0711	Transmission Oil Temp Over Temp	Transmission Cooling (see page 74)
P0712	Transmission Oil Temperature Sensor Error Low	
P0713	Transmission Oil Temperature Sensor Error High (Open Circuit)	Transmission Oil Temperature Sensor (see page 75)
P0716	Input Shaft/Turbine Speed Value	
P0717	Input Shaft/Turbine Speed Sensor Erratic	Input Speed Sensor (see page 78)
P071D	Manual Shift Control Up/Down (TGS) Switch Stuck	
P071E	Manual Shift Control Up/Down (TGS) Switch Signal Low	Transmission Gear Select (TGS) Lever (see page 82)
P071F	Manual Shift Control Up/Down (TGS) Switch Signal High	
P0721	Output Shaft Speed Sensor Value	Output Speed Sensor (see page 85)
P0722	Output Shaft Speed Sensor Erratic	
P0729	Gear 6 Incorrect Ratio	Gear Engagement (see page 87)
P0731	Gear 1 or M1 Incorrect Ratio	
P0732	Gear 2 Incorrect Ratio	
P0733	Gear 3 Incorrect Ratio	
P0734	Gear 4 Incorrect Ratio	
P0735	Gear 5 Incorrect Ratio	
P0736	Reverse Incorrect Ratio	
P0741	Torque converter clutch circuit stuck off	Torque Converter Control (see page 90)
P0742	Torque converter clutch circuit stuck on	
P0744	Torque converter clutch Slip Error	
P0826	Manual Shift Control Up/Down (Steering Wheel) Switch Stuck	Steering Wheel (see page 92)
P0827	Manual Shift Control Up/Down (Steering Wheel) Switch Signal Low	
P0828	Manual Shift Control Up/Down (Steering Wheel) Switch Signal High	
P0962	Solenoid S9 Over Current	Variable Bleed Solenoids (see page 95)
P0963	Solenoid S9 Low Current	
P0966	Solenoid S10 Over Current	
P0967	Solenoid S10 Low Current	

Modification basis	
Application basis	
Affected VIN	

DTC	Description	Sub System
P0973	Solenoid S1 Over Current	ON / OFF Solenoids (see page 101)
P0974	Solenoid S1 Low Current	
P0976	Solenoid S2 Over Current	
P0977	Solenoid S2 Low Current	
P0979	Solenoid S3 Over Current	
P0980	Solenoid S3 Low Current	
P0982	Solenoid S4 Over Current	
P0983	Solenoid S4 Low Current	
P0985	Solenoid S5 Over Current	Variable Bleed Solenoids (see page 95)
P0986	Solenoid S5 Low Current	
P0998	Solenoid S6 Over Current	
P0999	Solenoid S6 Low Current	
P099B	Solenoid S7 Over Current	
P099C	Solenoid S7 Low Current	
P099E	Solenoid S8 Over Current	
P099F	Solenoid S8 Low Current	
P1604	TCU EMM Data Error	TCU (see page 68)
P1605	EMM Data Mismatch	Input Speed Sensor (see page 82)
P1610	EMM Comms Error	
P1611	EMM Data Error	
P1701	TCU Supply Voltage Low	TCU (see page 68)
P1703	TCU Supply Voltage High	
U0100	Cyclic CAN messages from Engine Management ECU are unavailable	CAN Network (see page 106)
U0102	Cyclic CAN messages from Transfer Case ECU are unavailable	
U0103	Cyclic CAN messages from TGS ECU are unavailable	
U0121	Cyclic CAN messages from Brake System ECU (ABS/ESP/TCS) are unavailable	
U0401	CAN signals from EMS are out of range or Invalid	
U0403	CAN signals from Transfer Case are out of range or Invalid	
U0404	CAN signals from Gear Lever ECU are out of range or Invalid	
U0415	CAN signals from Brake System ECU (ABS/ESP/TCS) are out of range or Invalid	
U1600	ECU Application Software Missing	TCU Calibration (see page 109)
U1601	ECU Application Software Missing or Corrupted	
U1606	TCU Calibration Error - Platform	
U1607	TCU Calibration Error - Active Variant	
U1608	TCU VIN Coding Error	
U1609	TCU Hardware (pcb) Calibration Error	

2. SYSTEM DIAGNOSIS

1) TCU

The transmission control unit (TCU) controls transmission gear selection via variable bleed solenoids and On/Off solenoids. The TCU operating voltage is 8-16 V, with current draw typically being less than 4 amps but reaching as high as 10 amps during gear shifts.

As the mechanical components of the transmission change due to wear etc, the TCU adapts its shift data to accommodate these changes and maintain shift quality over the life of the vehicle. If a transmission component degrades to a point whereby the TCU is unable to adapt its shift data to maintain shift quality, the TCU will set a DTC.

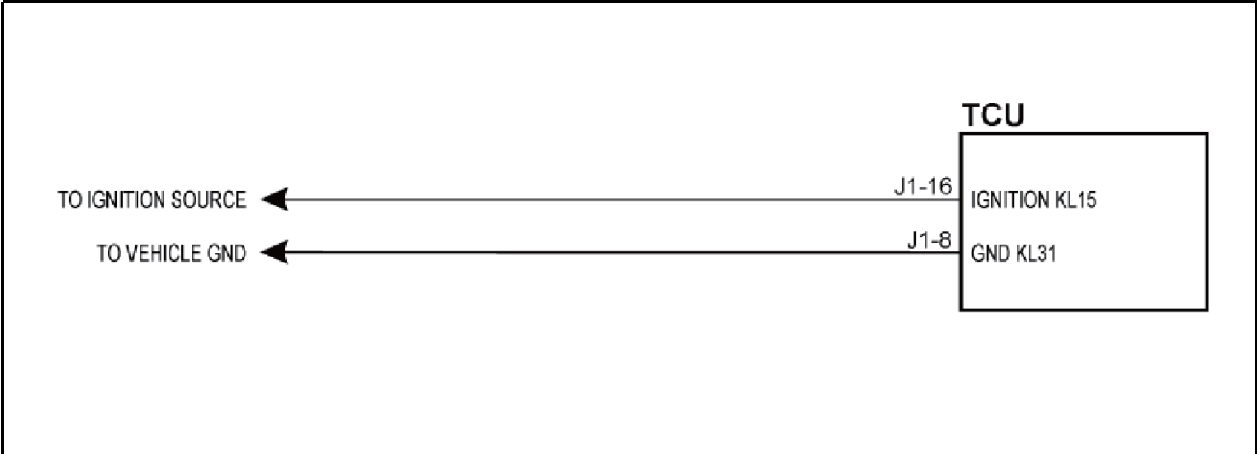
DTC	Title	System Action
P0603	TCU Adaptive Data Memory Error	<ul style="list-style-type: none"> MIL - OFF Normal transmission operation with degraded shift quality
P0604	TCU Adaptive Data Limit Reached	<ul style="list-style-type: none"> MIL - OFF Normal transmission operation with degraded shift quality
P0700	Transmission Control System (MIL Request)	<ul style="list-style-type: none"> MIL - ON
P1604	TCU EMM Data Error	<ul style="list-style-type: none"> MIL - ON Transmission in LHM
P1701	TCU Supply Voltage Low	<ul style="list-style-type: none"> MIL - ON Transmission in LHM
P1703	TCU Supply Voltage High	<ul style="list-style-type: none"> MIL - ON Transmission in LHM

► Connector J5

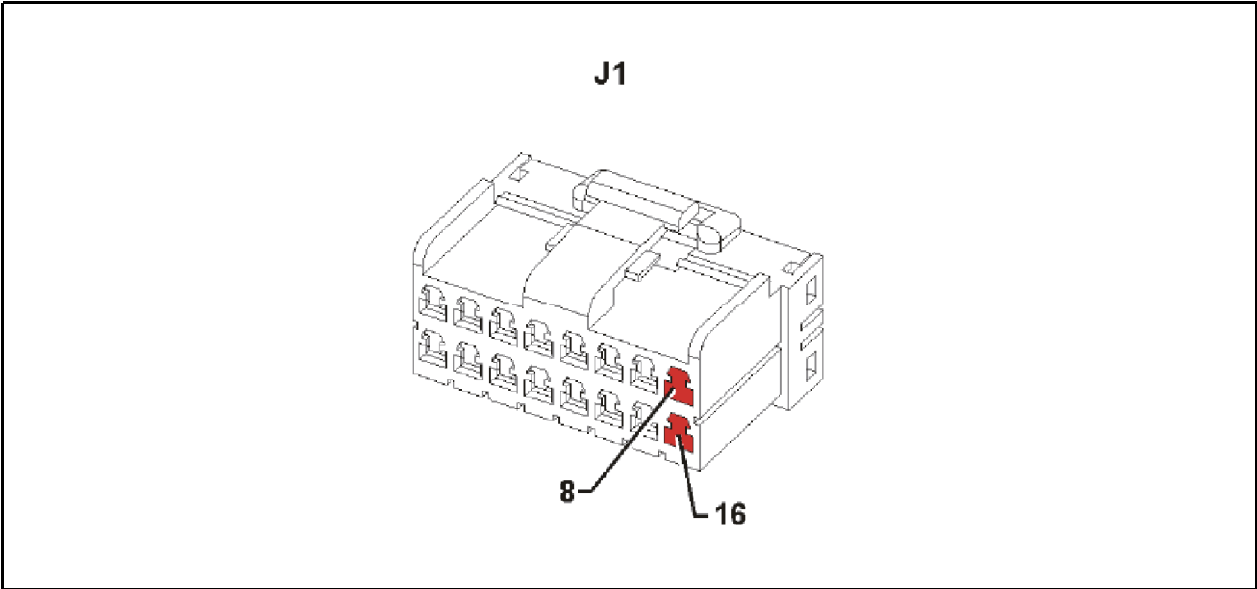
DTC	Description
P0603	TCU is not able to store adaptive (learning) data.
P0604	TCU shift adaptation is applying maximum effort. This may be because the transmission operation has degraded significantly.
P0700	The transmission control system has a sufficient number, and DTC type of faults to turn the MIL light ON.
P1604	The EMM Data image stored in the TCU is corrupted or missing.
P1701	The battery voltage sensor is reporting a value too low to operate the solenoids correctly.
P1703	The battery voltage sensor is reporting a value too high for continuous operation of solenoids. The solenoids will be disabled and the transmission in LHM during this condition.

Modification basis	
Application basis	
Affected VIN	

► Schematic



► Connector Details



Modification basis	
Application basis	
Affected VIN	

► DTC Details

DTC	Evaluation Condi-	Possible Causes	Actions
P0603 TCU Adaptive Data Memory Error	Ignition key in ON position	TCU	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Replace TCU
P0604 TCU Adaptive Data Limit Reached	Ignition key in ON position	Transmission	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Service transmission
P0700 TM Control System (MIL Request)	Ignition key in ON position	Other DTC's requiring the MIL to be turned ON are set.	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check if any DTC's requiring the MIL to be turned ON are set Replace TCU
P1604 TCU EMM Data Error	Ignition key in ON position	<ul style="list-style-type: none"> Embedded Memory Module (EMM). TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Replace TCU
P1701 TCU Supply Voltage Low	<ul style="list-style-type: none"> Ignition key in ON position Engine speed > 300 rpm TCU supply voltage <8 V for 0.5 seconds 	<ul style="list-style-type: none"> Vehicle charging system Vehicle battery TCU to Transmission harness and/or connector fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check vehicle charging system Check vehicle battery Check circuit between terminal J1-8 and vehicle ground Check circuit between terminal J1-16 and ignition source. Refer to vehicle electrical section for circuit specific information Check supply voltage at TCU Replace TCU
P1703 TCU Supply Voltage High	Ignition key in ON position TCU supply voltage >17 V for 60 seconds	<ul style="list-style-type: none"> Vehicle charging system Vehicle battery TCU to Transmission harness and/or connector fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check vehicle charging system Check vehicle battery Check circuit between terminal J1-8 and vehicle ground Check circuit between terminal J1-16 and ignition source. Refer to vehicle electrical section for circuit specific information Check supply voltage at TCU Replace TCU

► DTC Clearing

DTC	Conditions
P0603, P0604, P0700, P1604, P1701 & P1703	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

Modification basis	
Application basis	
Affected VIN	

2) Inhibitor Switch Assembly

The inhibitor switch assembly provides gear position data to the transmission control unit (TCU), inhibits starter motor operation when the transmission gear select (TGS) lever is not in the neutral or park position, and enables reverse light operation when the TGS lever is in the reverse position. The inhibitor switch has an individual circuit for each of these functions, with only the gear lever position circuit being connected directly to the TCU.

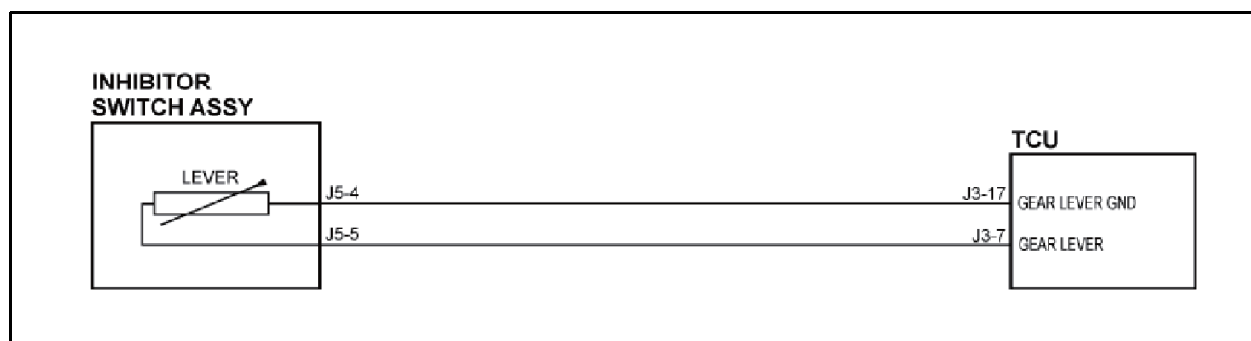
The TCU supplies a 5 V reference signal to the gear lever position circuit (inhibitor switch) and measures the voltage drop in the circuit to determine the gear lever position. There is a different resistance value for each position of the TGS lever.

DTC	Title	System Action
P0707	Gear Lever Position Sensor Error Low	<ul style="list-style-type: none"> MIL - ON Transmission in LHM
P0708	Gear Lever Position Sensor Error High	<ul style="list-style-type: none"> MIL - ON Transmission in LHM

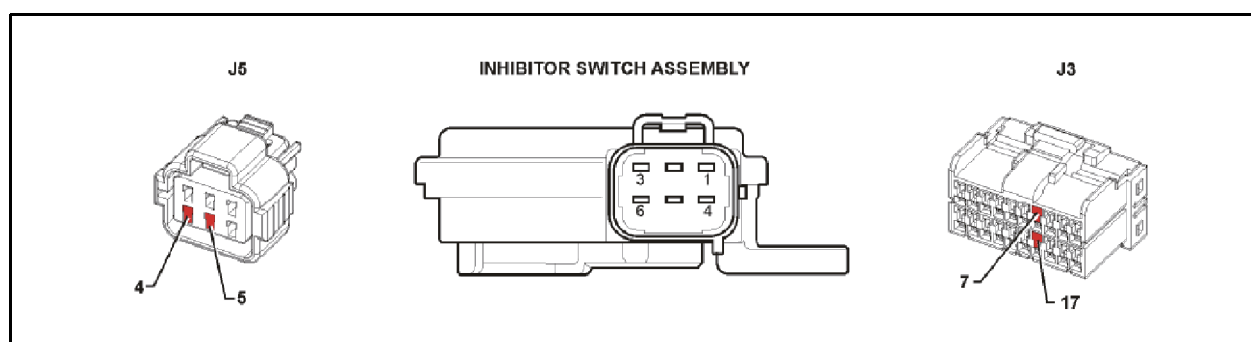
► DTC Description

DTC	Description
P0707	The Gear Lever Position sensor (Inhibitor Switch) is giving a value indicative of a short circuit to
P0708	ground

► Schematic



► Connector Details



► Resistance Values

Gear Lever Position Sensor Specifications

Gear Position	Value
P	16.786 kΩ ± 8%
R	8.953 kΩ ± 8%
N	5.036 kΩ ± 8%
D	2.686 kΩ ± 8%

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0707 Gear Lever Position Sensor Error Low	Ignition key in ON position	<ul style="list-style-type: none"> TCU to Inhibitor Switch Assy harness and/or connector fault Inhibitor Switch Assy TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Disconnect connector J5 from the inhibitor switch assembly. Check resistance of inhibitor switch assembly between terminals 4 and 5 for each position of TGS lever. Refer to the resistance table above for specifications. Replace transmission if the resistance values are outside of the specified range. Check circuit between terminals J5-4 and J3-17 for short or open condition Check circuit between terminals J5-5 and J3-7 for short or open condition Disconnect connector J5 from inhibitor switch assembly and measure voltage across J5-4 and J5-5 with the ignition key in the ON position. Voltage reading should be 5 V ± 0.1 V. If voltage reading is outside specifications, replace TCU

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Conditions	Possible Causes	Actions
P0708 Gear Lever Position Sensor Error High	Ignition key in ON position	<ul style="list-style-type: none"> TCU to Inhibitor Switch Assy harness and/or connector fault Inhibitor Switch Assy TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Disconnect connector J5 from the inhibitor switch assembly. Check resistance of inhibitor switch assembly between terminals 4 and 5 for each position of TGS. Refer to the resistance table above. Replace transmission assembly if the resistance values are outside of the specified range. Check circuit between terminals J5-4 and J3-17 for short or open condition Check circuit between terminals J5-5 and J3-7 for short or open condition Replace TCU

► DTC Clearing

DTC	Conditions
P0707 & P0708	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

3) Transmission Cooling

The transmission control unit (TCU) monitors the transmission oil temperature. If the vehicle cooling system is unable to maintain a satisfactory transmission oil temperature the TCU will take precautionary measures to prevent damage to the transmission and other vehicle components. The TCU also monitors the rate of temperature change according to current operating conditions (performance). If the temperature sensor performance is outside a pre-determined set of values, DTC P0711 will set.

DTC	Title	System Action
P0711	Transmission Oil Temp Over Temp	<ul style="list-style-type: none"> • MIL - ON • Normal transmission operation with degraded shift quality and "WINTER" indicator flashing when transmission oil temperature is >130°C. • When the transmission oil temperature is > 145°C the TCU will disable gear engagement until transmission oil temperature is <120°C

► DTC Description

DTC	Description
P0711	Transmission Oil Temperature is high enough to cause degraded transmission operation

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0711 Transmission Oil Temp Over Temp	<ul style="list-style-type: none"> • Ignition key in ON position • Transmission oil temperature is > 130°C 	<ul style="list-style-type: none"> • Transmission cooler blocked • Transmission cooler lines restricted • Engine cooling system fault 	<ul style="list-style-type: none"> • Clear DTC and check if DTC sets within the evaluation conditions • Inspect transmission oil level and oil quality • Inspect transmission cooling system • Inspect engine cooling system

► DTC Clearing

DTC	Conditions
P0711	<ul style="list-style-type: none"> • Ignition ON • Engine stopped • Scan tool

Modification basis	
Application basis	
Affected VIN	

4) Transmission Oil Temperature Sensor

The automatic transmission fluid temperature (TFT) sensor is mounted in the valve body harness tray. The TFT sensor is a negative coefficient thermistor.

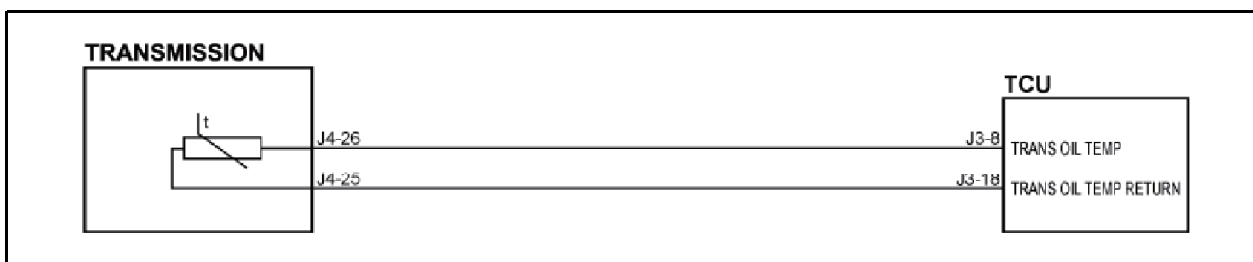
The transmission control unit (TCU) supplies a 5 V reference signal to the sensor and measures the voltage drop in the circuit. When the transmission fluid is cold, the sensor resistance is high, with the sensor resistance decreasing as the fluid temperature increases.

DTC	Title	System Action
P0712	Transmission Oil Temperature Sensor Error Low	• MIL - ON
P0713	Transmission Oil Temperature Sensor Error High	• MIL - ON

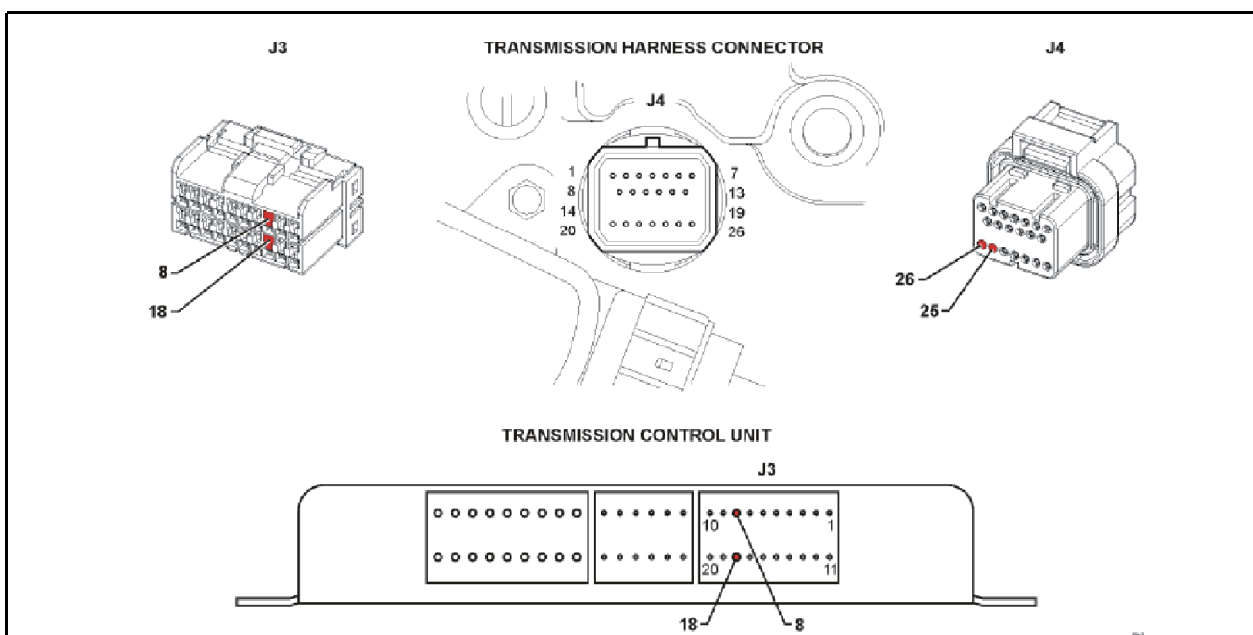
► DTC Description

DTC	Description
P0712	Transmission oil temperature sensor is giving a value indicative of a short circuit to ground.
P0713	Transmission oil temperature sensor is giving a value indicative of an open circuit.

► Schematic



► Connector Details



► Resistance Values

Temperature	Minimum Resistance Value	Maximum Resistance Value
-40°C	1.467 MΩ	1.896 MΩ
-30°C	778.4 kΩ	984.2 kΩ
-20°C	430.7 kΩ	533.9 kΩ
-10°C	247.3 kΩ	301.1 kΩ
0°C	146.8 kΩ	175.7 kΩ
10°C	89.95 kΩ	106 kΩ
20°C	56.74 kΩ	65.86 kΩ
30°C	36.76 kΩ	42.10 kΩ
40°C	24.43 kΩ	27.61 kΩ
50°C	16.60 kΩ	18.54 kΩ
60°C	11.53 kΩ	12.73 kΩ
70°C	8.161 kΩ	8.916 kΩ
80°C	5.880 kΩ	6.360 kΩ
90°C	4.306 kΩ	4.614 kΩ
100°C	3.210 kΩ	3.399 kΩ
110°C	2.392 kΩ	2.562 kΩ
120°C	1.811 kΩ	1.955 kΩ
130°C	1.388 kΩ	1.510 kΩ
140°C	1.075 kΩ	1.179 kΩ
150°C	0.843 kΩ	0.930 kΩ

Modification basis	
Application basis	
Affected VIN	

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0712 Transmission Oil Temperature Sensor Error Low	Ignition key in ON position	<ul style="list-style-type: none"> • TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Temperature sensor • TCU 	<ul style="list-style-type: none"> • Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminal's J3-8 and J4-26 for short condition • Check circuit between terminal's J3-18 and J4-25 for short condition • Disconnect transmission connector J4. Check resistance of transmission oil temp. sensor between terminals J4-25 and J4-26. Refer to the resistance table above for specifications. Replace transmission assembly if the resistance values are outside of the specified range • Disconnect connector J3 from the TCU and measure voltage across TCU terminals (TCU side) J3-8 and J3-18 with the ignition key in the ON position. Voltage reading should be $5\text{ V} \pm 0.1\text{ V}$. If voltage reading is outside specifications, replace TCU
P0713 Transmission Oil Temperature Sensor Error High	Ignition key in ON position	<ul style="list-style-type: none"> • TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Temperature sensor • TCU 	<ul style="list-style-type: none"> • Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminal's J3-8 and J4-26 for open condition • Check circuit between terminal's J3-18 and J4-25 for open condition • Disconnect transmission connector J4. Check resistance of transmission oil temp. sensor between terminals J4-25 and J4-26. Refer to the resistance table above for specifications. Replace transmission assembly if the resistance values are outside of the specified range • Disconnect connector J3 from the TCU and measure voltage across TCU terminals (TCU side) J3-8 and J3-18 with the ignition key in the ON position. Voltage reading should be $5\text{ V} \pm 0.1\text{ V}$. If voltage reading is outside specifications, replace TCU

► DTC Clearing

DTC	Conditions
P0712 & P0713	<ul style="list-style-type: none"> • Ignition ON • Engine stopped • Scan tool

5) Input Speed Sensor

The ISS sensor is a Hall Effect type sensor and is mounted on the valve body in the transmission. The EMM is matched to the transmission valve body during manufacture. The EMM is integrated into the input speed sensor.

The hall effect sensor drives the signal low. The TCU then pulls the signal up to 5 V via a resistor, 36 times per revolution of the C2 cylinder.

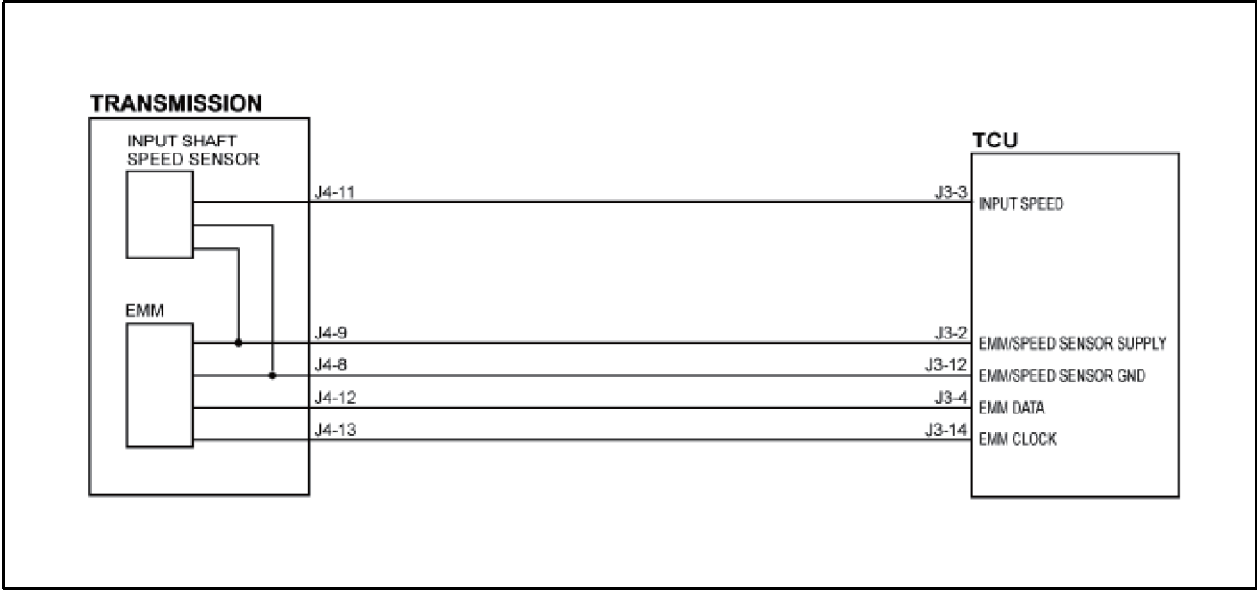
DTC	Title	System Action
P0716	Input Shaft/Turbine Speed Value	<ul style="list-style-type: none"> • MIL - ON • Closed loop torque converter clutch slip control is disabled • Adaptive learning is disabled • Engine speed is used to estimate input shaft speed for gear shifting
P0717	Input Shaft/Turbine Speed Sensor Erratic	<ul style="list-style-type: none"> • MIL - ON • Closed loop torque converter clutch slip control is disabled • Adaptive learning is disabled • Engine speed is used to estimate input shaft speed for gear shifting
P1605	EMM Data Mismatch	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
P1610	EMM Comms Error	<ul style="list-style-type: none"> • MIL - OFF
P1611	EMM Data Error	<ul style="list-style-type: none"> • MIL - ON • Last known valid EMM data in TCU used • Normal transmission operation

► DTC Description

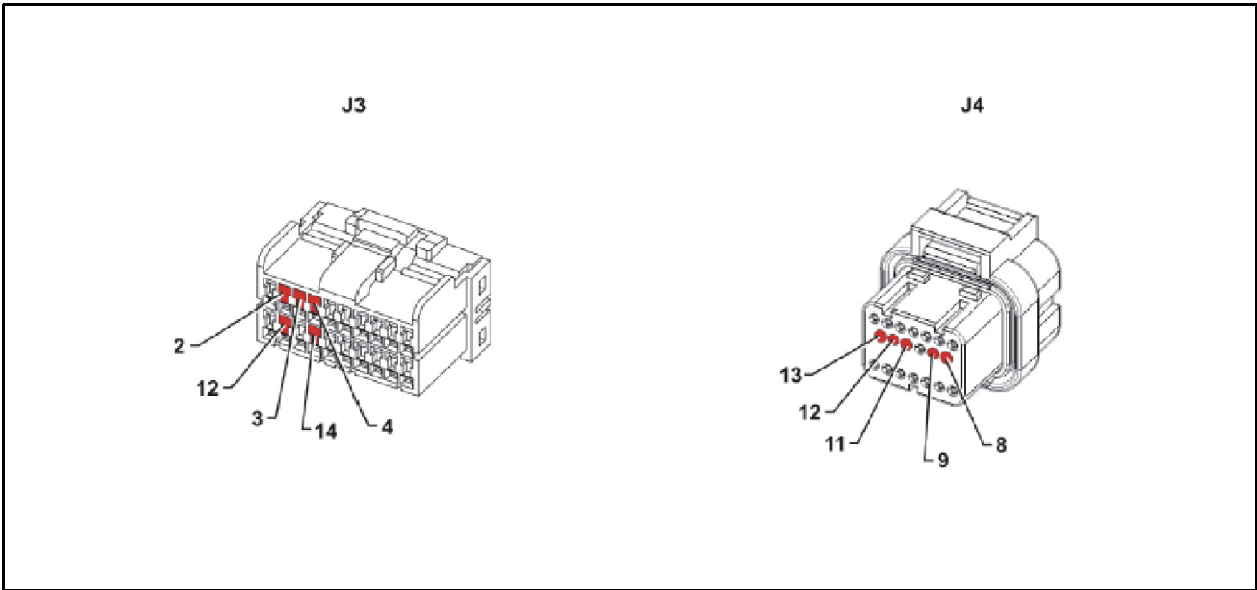
DTC	Description
P0716	The input shaft speed (ISS) is compared to engine speed and validated for plausibility
P0717	The input speed sensor is receiving intermittent or spurious pulses.
P1605	The Embedded Memory Module (EMM) data stored in the TCU does not match the EMM module in the transmission
P1610	The TCU was unable to communicate with EMM
P1611	The data stored in the EMM is corrupted or missing or invalid

Modification basis	
Application basis	
Affected VIN	

► Schematic



► Connector Details



Modification basis	
Application basis	
Affected VIN	

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0716 Input Shaft/ Turbine Speed Value	<ul style="list-style-type: none"> Ignition key in ON position Engine speed > 3000 rpm 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault Input speed sensor TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J3-3 and J4-11 for short or open condition Check circuit between terminals J3-2 and J4-9 for short or open condition Check circuit between terminals J3-12 and J4-8 for short or open Disconnect transmission connector J4. Measure the voltage across terminals J4-8 and J4-9 with ignition key in ON position. Voltage reading should be > 10 V. Replace the TCU if the reading is <10 V Measure the voltage across terminals J4-8 and J4-11 with ignition key in ON position. Voltage reading should be $5\text{ V} \pm 0.1\text{ V}$. Replace the TCU if the reading is not within specification Reconnect transmission connector J4. Connect an oscilloscope to J3-3 and J3-12 and start the engine. Increase engine rpm and observe the square wave pattern. If the pattern shows switching from 5 V to 0 V, replace the TCU. If the pattern does not show switching, replace the transmission
P0717 Input Shaft/ Turbine Speed Sensor Erratic	<ul style="list-style-type: none"> Ignition key in ON position Engine speed is >3000 rpm 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault Input speed sensor TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J3-3 and J4-11 for short or open condition Check circuit between terminals J3-2 and J4-9 for short or open condition Check circuit between terminals J3-12 and J4-8 for short or open Disconnect transmission connector J4. Measure the voltage across terminals J4-8 and J4-9 with ignition key in ON position. Voltage reading should be > 10 V. Replace the TCU if the reading is <10 V Measure the voltage across terminals J4-8 and J4-11 with ignition key in ON position. Voltage reading should be $5\text{ V} \pm 0.1\text{ V}$. Replace the TCU if the reading is not within specification Reconnect transmission connector J4. Connect an oscilloscope to J3-3 and J3-12 and start the engine. Increase engine rpm and observe the square wave pattern. If the pattern shows switching from 5 V to 0 V, replace the TCU. If the pattern does not show switching, replace the transmission

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Conditions	Possible Causes	Actions
P1605 EMM Data Mismatch	Ignition key in ON position	EMM data stored in the TCU does not match the EMM module in the transmission. This indicates that the transmission or TCU has been replaced.	<ul style="list-style-type: none"> • Clear DTC and check if DTC sets within the evaluation conditions • Replace the transmission
P1610 EMM Comms Error	Ignition key in ON position	<ul style="list-style-type: none"> • TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • EMM • TCU 	<ul style="list-style-type: none"> • Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J3-2 and J4-9 for short or open condition • Check circuit between terminals J3-12 and J4-8 for short or open • Check circuit between terminals J3-4 and J4-12 for short or open condition • Check circuit between terminals J3-14 and J4-13 for short or open condition • Replace the transmission
P1611 EMM Data Error	Ignition key in ON position	<ul style="list-style-type: none"> • EMM 	<ul style="list-style-type: none"> • Clear DTC and check if DTC sets within the evaluation conditions • Replace the transmission

► DTC Clearing

DTC	Conditions
P0716, P0717, P1605, P1610 & P1611	<ul style="list-style-type: none"> • Ignition ON • Engine stopped • Scan tool

6) Transmission Gear Select Lever

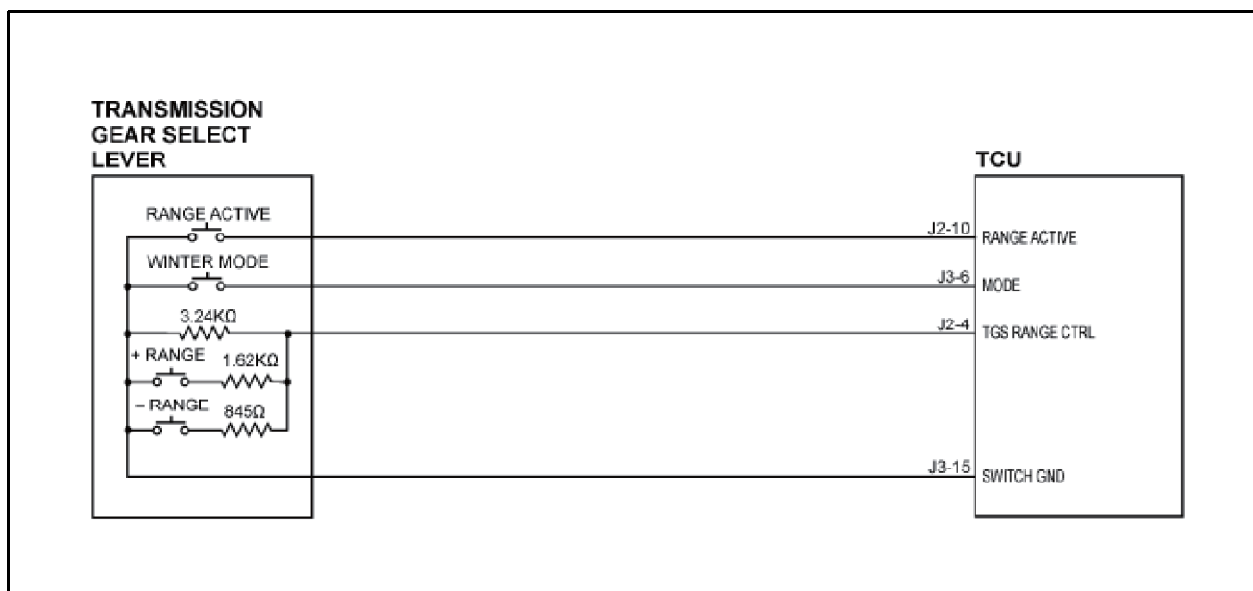
The transmission gear select lever contains the mode switch, manual mode active switch and up/down switches. These switches are connected directly to the TCU.

DTC	Title	System Action
P071D	Manual Shift Control Up/Down (TGS) Switch Stuck	<ul style="list-style-type: none"> MIL - OFF Manual shift control (TGS) switches disabled
P071E	Manual Shift Control Up/Down (TGS) Switch Signal Low	<ul style="list-style-type: none"> MIL - OFF Manual shift control (TGS) switches disabled
P071F	Manual Shift Control Up/Down (TGS) Switch Signal High	<ul style="list-style-type: none"> MIL - OFF Manual shift control (TGS) switches disabled

► DTC Description

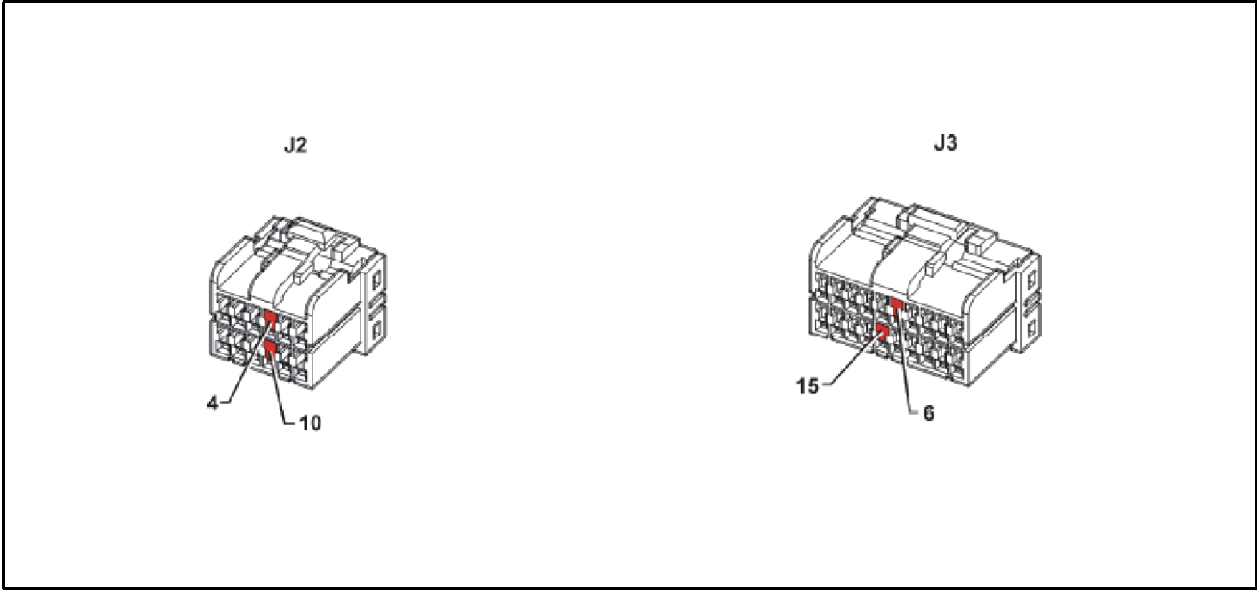
DTC	Description
DTC P071D	The Manual Shift Control Up/Down switch (TGS) has been depressed for more than 120 seconds continuously. This may indicate a faulty switch
DTC P071E	The Manual Shift Control Up/Down (TGS) switch signal is giving a value indicative of a short circuit
DTC P071F	The Manual Shift Control Up/Down (TGS) switch signal is giving a value indicative of an open circuit

► Schematic



Modification basis	
Application basis	
Affected VIN	

► Connector Details



► Resistance Values

Transmission Gear Select Lever

Switch	Value
Range up (press and hold)	1.08 kΩ ± 10%
Range down (press and hold)	555 kΩ ± 10%
Range up / down at rest position	3.24 kΩ ± 10%

► Resistance Values

DTC	Evaluation Conditions	Possible Causes	Actions
P071D Manual Shift Control Up/Down (TGS) Switch Stuck	Ignition key in ON position	<ul style="list-style-type: none"> Shift Control Up/Down switch (TGS) TCU to Shift Control Up/Down switch harness and/or connector fault TCU 	

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Condi-	Possible Causes	Actions
P071E Manual Shift Control Up/Down (TGS) Switch Signal Low	Ignition key in ON position	<ul style="list-style-type: none"> Shift Control Up/Down switch (TGS) TCU to Shift Control Up/Down switch harness and/or connector fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check up/down switch (TGS) mechanical operation Check circuit between terminal J2-4 and Shift Control Up/Down switch (TGS) for short or open condition Check circuit between terminals J3-15 and TGS Lever for short or open condition Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-4 and J3-15. Refer to the resistance table above for specifications. Replace TGS lever if the resistance values are outside of the specified range Replace TCU
P071F Manual Shift Control Up/Down (TGS) Switch Signal High	Ignition key in ON position	<ul style="list-style-type: none"> Shift Control Up/Down switch (TGS) TCU to Shift Control Up/Down switch harness and/or connector fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check up/down switch (TGS) mechanical operation Check circuit between terminal J2-4 and Shift Control Up/Down switch (TGS) for short or open condition Check circuit between terminals J3-15 and TGS Lever for short or open condition Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-4 and J3-15. Refer to the resistance table above for specifications. Replace TGS lever if the resistance values are outside of the specified range Replace TCU

► DTC Clearing

DTC	Conditions
P071D, P071E, P071F	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

Modification basis	
Application basis	
Affected VIN	

7) Output Speed Sensor

The OSS sensor is a Hall Effect type sensor and is mounted at the rear of the transmission main case.

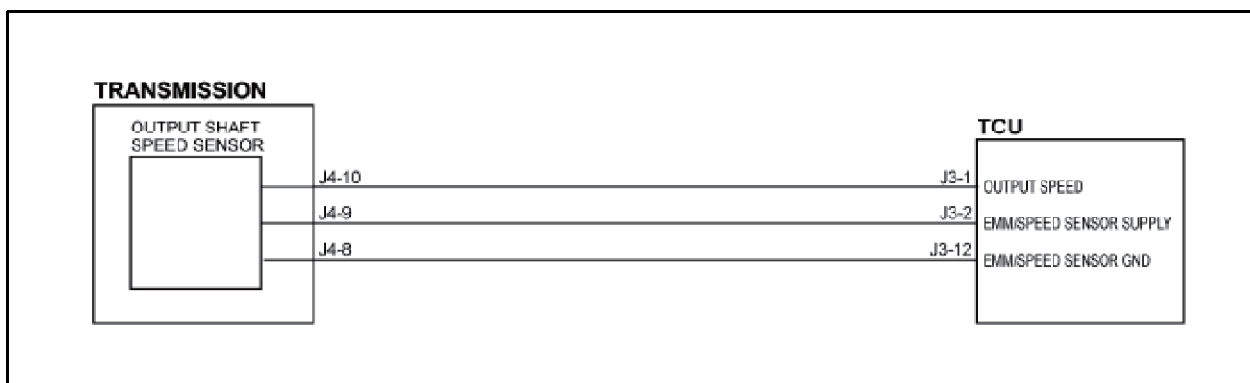
The hall effect sensor drives the signal low. The TCU then pulls the signal up to 5 V via a resistor, 22 times per revolution of the transmission output shaft.

DTC	Title	System Action
P0721	Output Shaft Speed Sensor Value	<ul style="list-style-type: none"> MIL - ON Transmission in LHM
P0722	Output Shaft Speed Sensor Erratic	<ul style="list-style-type: none"> MIL - ON Transmission in LHM

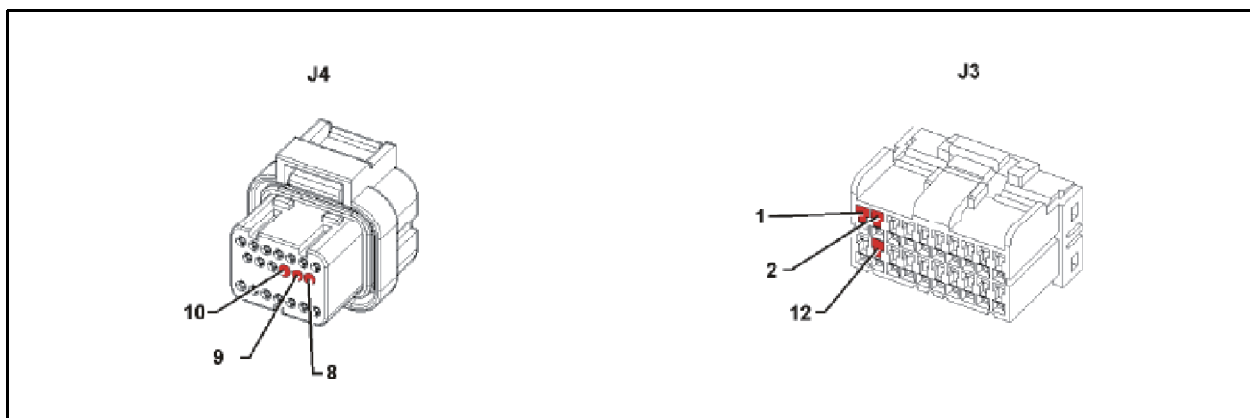
► DTC Description

DTC	Description
P0721	The output shaft speed (OSS) sensor is compared to external equivalent speed signals and validated for integrity
P0722	The output speed sensor is receiving intermittent or spurious pulses.

► Schematic



► Connector Details



► DTC Details

DTC	Evaluation Condi-	Possible Causes	Actions
P0721 Output Shaft Speed Sensor Value	Ignition key in ON position	<ul style="list-style-type: none"> TCU to Trans- mission harness and/or connector fault Transmission in- ternal harness and/or connector fault Output speed sensor TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J3-1 and J4-10 for short or open condition Check circuit between terminals J3-2 and J4-9 for short or open condition Check circuit between terminals J3-12 and J4-8 for short or open Disconnect connector J4 from transmis- sion and measure voltage across ter- minals J4-8 and J4-9. If reading is not > 10 V, replace TCU Measure voltage across terminals J4- 8 and J4-10. If reading is not $5\text{ V} \pm 0.1$ V, replace TCU Connect connector J4 to transmission, start engine, and connect oscilloscope to terminal J3-3. Shift TGS to Park position, increase engine speed and observe square wave switching from 5 V to 0 V. If correct, replace TCU. If not, replace transmission
P0722 Output Shaft Speed Sensor Erratic	Ignition key in ON position	<ul style="list-style-type: none"> TCU to Trans- mission harness and/or connector fault Transmission in- ternal harness and/or connector fault Output speed 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J3-1 and J4-10 for short or open condition Check circuit between terminals J3-2 and J4-9 for short or open condition Check circuit between terminals J3-12 and J4-8 for short or open Disconnect connector J4 from transmis- sion and measure voltage across ter- minals J4-8 and J4-9. If reading is not > 10 V, replace TCU Measure voltage across terminals J4- 8 and J4-10. If reading is not $5\text{ V} \pm 0.1$ V, replace TCU Connect connector J4 to transmission, start engine, and connect oscilloscope to terminal J3-3. Shift TGS to Park position, increase engine speed and observe square wave switching from 5 V to 0 V. If correct, replace TCU. If not,

► DTC Details

DTC	Conditions
P0721 & P0722	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

Modification basis	
Application basis	
Affected VIN	

8) Gear Engagement

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.

DTC	Title	System Action
P0729	Gear 6 Incorrect Ratio	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0731	Gear 1 or M1 Incorrect Ratio	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0732	Gear 2 Incorrect Ratio	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0733	Gear 3 Incorrect Ratio	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0734	Gear 4 Incorrect Ratio	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0735	Gear 5 Incorrect Ratio	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0736	Reverse Incorrect Ratio	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM

► DTC Description

DTC	Description
P0729	The observed gear ratio in GEAR 6 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0731	The observed gear ratio in GEAR 1 or GEAR MANUAL 1 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0732	The observed gear ratio in GEAR 2 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0733	The observed gear ratio in GEAR 3 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0734	The observed gear ratio in GEAR 4 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0735	The observed gear ratio in GEAR 5 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0736	The observed gear ratio in REVERSE when not shifting is outside nominal values +/-10% for more than 0.5 seconds.

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0729 The observed gear ratio in GEAR 6 is incorrect	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission output shaft speed >300 rpm Transmission gear select lever NOT in Neutral 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission
P0731 The observed gear ratio in GEAR 1 or GEAR MANUAL 1 is incorrect	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission output shaft speed >300 rpm Transmission gear select lever NOT in Neutral 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission
P0732 The observed gear ratio in GEAR 2 is incorrect	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission output shaft speed >300 rpm Transmission gear select lever NOT in Neutral 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission
P0733 The observed gear ratio in GEAR 3 is incorrect	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission output shaft speed >300 rpm Transmission gear select lever NOT in Neutral 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission
P0734 The observed gear ratio in GEAR 4 is incorrect	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission output shaft speed >300 rpm Transmission gear select lever NOT in Neutral 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Conditions	Possible Causes	Actions
P0735 The observed gear ratio in GEAR 5 is incorrect	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission output shaft speed >300 rpm Transmission gear select lever NOT in Neutral 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission
P0736 The observed gear ratio in REVERSE is incorrect	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission output shaft speed >300 rpm Transmission gear select lever NOT in Neutral 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission

► DTC Clearing

DTC	Conditions
P0729, P0731, P0732, P0733, P0734, P0735 & P0736	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

9) Torque Converter Control

The torque converter lock-up clutch is engaged and released via the hydraulic control system. Pressure at the torque converter lock-up clutch piston is determined by an electronic variable bleed solenoid (VBS). During operation, the TCU evaluates torque converter slip speed and compares this against what is expected. If torque converter slip is not within predefined parameters, a DTC will set to indicate a torque converter lock-up problem.

DTC	Title	System Action
P0741	Torque converter clutch circuit stuck OFF	<ul style="list-style-type: none"> MIL - ON Torque converter remains in open state
P0742	Torque converter clutch circuit stuck ON	<ul style="list-style-type: none"> MIL - ON Torque converter remains in open state with Solenoid S3 disabled
P0744	Torque converter clutch Slip Error	<ul style="list-style-type: none"> MIL - ON Torque converter remains in open state

► DTC Description

DTC	Description
P0741	Torque converter stuck open when requested to lock. Slip speed is greater than 50 rpm for more than 0.5 seconds while locked state requested.
P0742	Torque converter stuck locked when requested to open. Slip speed is less than 150 rpm and engine torque is greater than 150 Nm for more than 0.5 seconds while open state requested.
P0744	Torque converter slip speed cannot be controlled for more than 0.5 seconds.

Modification basis	
Application basis	
Affected VIN	

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0741 Torque converter clutch circuit stuck OFF	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission NOT shifting Transmission gear select lever in Drive 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission
P0742 Torque converter clutch circuit stuck ON	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission NOT shifting Transmission gear select lever in Drive 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission
P0744 Torque converter clutch Slip Error	<ul style="list-style-type: none"> Ignition key in ON position Engine speed >300 rpm Engine not in LHM Transmission oil temperature >0°C Transmission NOT shifting Transmission gear select lever in Drive 	<ul style="list-style-type: none"> Low oil level Contaminated oil Mechanical damage TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check oil level Check oil quality Check for mechanical damage Replace transmission

► DTC Clearing

DTC	Conditions
P0741, P0742 & P0744	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

10) Steering Wheel

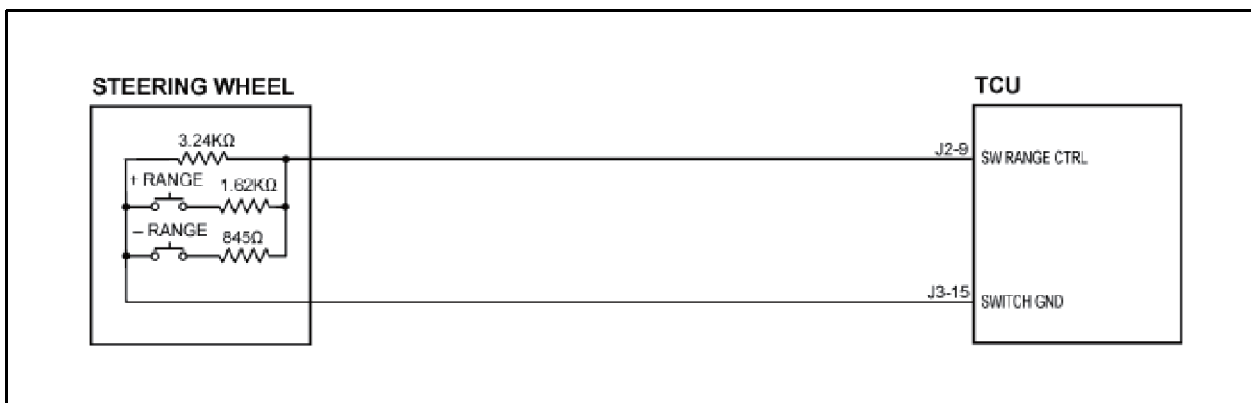
The steering wheel contains transmission gear select (TGS) up/down switches and are directly connected to the TCU. These switches operate in parallel with the TGS lever switches directly to the TCU.

DTC	Title	System Action
P0826	Manual Shift Control Up/Down (Steering Wheel) Switch Stuck	<ul style="list-style-type: none"> MIL - OFF Manual shift control (steering wheel) switches disabled
P0827	Manual Shift Control Up/Down (Steering Wheel) Switch Signal Low	<ul style="list-style-type: none"> MIL - OFF Manual shift control (steering wheel) switches disabled
P0828	Manual Shift Control Up/Down (Steering Wheel) Switch Signal High	<ul style="list-style-type: none"> MIL - OFF Manual shift control (steering wheel) switches disabled

► DTC Description

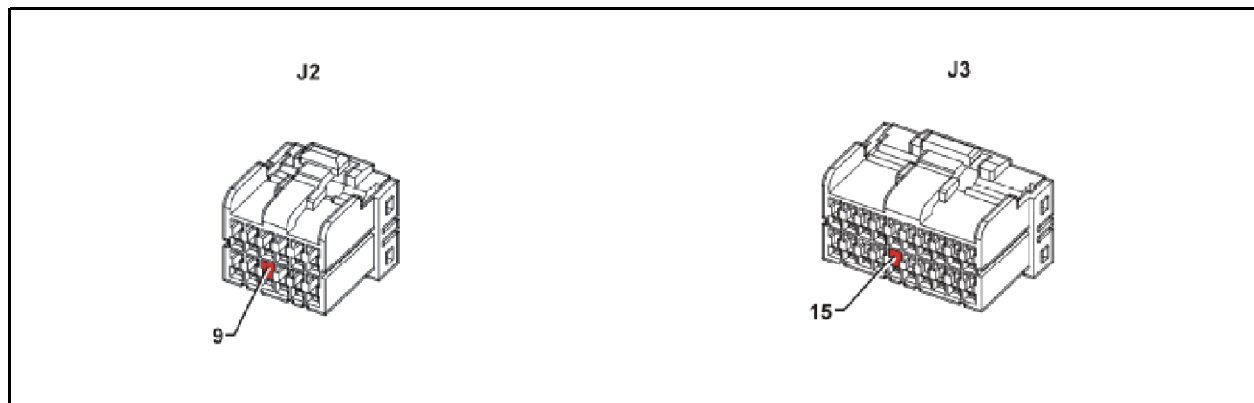
DTC	Description
P0826	The Manual Shift Control Up/Down (Steering Wheel) switch has been depressed for more than 120 seconds continuously. This may indicate a faulty switch
P0827	The Manual Shift Control Up/Down (Steering Wheel) switch signal is giving a value indicative of a short circuit
P0828	The Manual Shift Control Up/Down (Steering Wheel) switch signal is giving a value indicative of an open circuit

► Schematic



Modification basis	
Application basis	
Affected VIN	

► Connector Details



► Resistance Values

Switch	Value
Range up (press and hold)	1.08 k Ω \pm 10%
Range down (press and hold)	555 k Ω \pm 10%
Range up / down at rest position	3.24 k Ω \pm 10%

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0826 Manual Shift Control Up/Down (Steering Wheel) Switch Stuck	Ignition key in ON position	<ul style="list-style-type: none"> Shift Control Up/Down Switch (steering wheel) TCU to Shift Control Up/Down switch harness and/or connector fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check up/down switch (steering wheel) mechanical operation Check circuit between terminal J2-9 and Shift Control Up/Down switch (steering wheel) for short or open condition Check circuit between terminals J3-15 and steering wheel for short or open condition Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-9 and J3-15. Refer to the resistance table above for specifications. Replace range up/down switch (steering wheel) if the resistance values are outside of the specified range Replace TCU

DTC	Evaluation Conditions	Possible Causes	Actions
P0827 Manual Shift Control Up/Down (Steering Wheel) Switch Signal Low	Ignition key in ON position	<ul style="list-style-type: none"> Shift Control Up/Down Switch (steering wheel) TCU to Shift Control Up/Down switch harness and/or connector fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check up/down switch (steering wheel) mechanical operation Check circuit between terminal J2-9 and Shift Control Up/Down switch (steering wheel) for short or open condition Check circuit between terminals J3-15 and steering wheel for short or open condition Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-9 and J3-15. Refer to the resistance table above for specifications. Replace range up/down switch (steering wheel) if the resistance values are outside of the specified range Replace TCU
P0828 Manual Shift Control Up/Down (Steering Wheel) Switch Signal High	Ignition key in ON position	<ul style="list-style-type: none"> Shift Control Up/Down Switch (steering wheel) TCU to Shift Control Up/Down switch harness and/or connector fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check up/down switch (TGS) mechanical operation Check circuit between terminal J2-4 and Shift Control Up/Down switch (TGS) for short or open condition Check circuit between terminals J3-15 and TGS Lever for short or open condition Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-9 and J3-15. Refer to the resistance table above for specifications. Replace range up/down switch (steering wheel) if the resistance values are outside of the specified range Replace TCU

► DTC Clearing

DTC	Conditions
P0826, P0827 & P0828	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

Modification basis	
Application basis	
Affected VIN	

11) Variable Bleed Solenoids

The transmission control unit uses variable bleed solenoids to regulate hydraulic pressure. This hydraulic pressure controls torque flow through clutch elements within the transmission.

The TCU is able to vary the amount of torque applied to the clutch elements by controlling the current to the variable bleed solenoid windings. The clutch element torque transfer is directly related to the current applied to the solenoids.

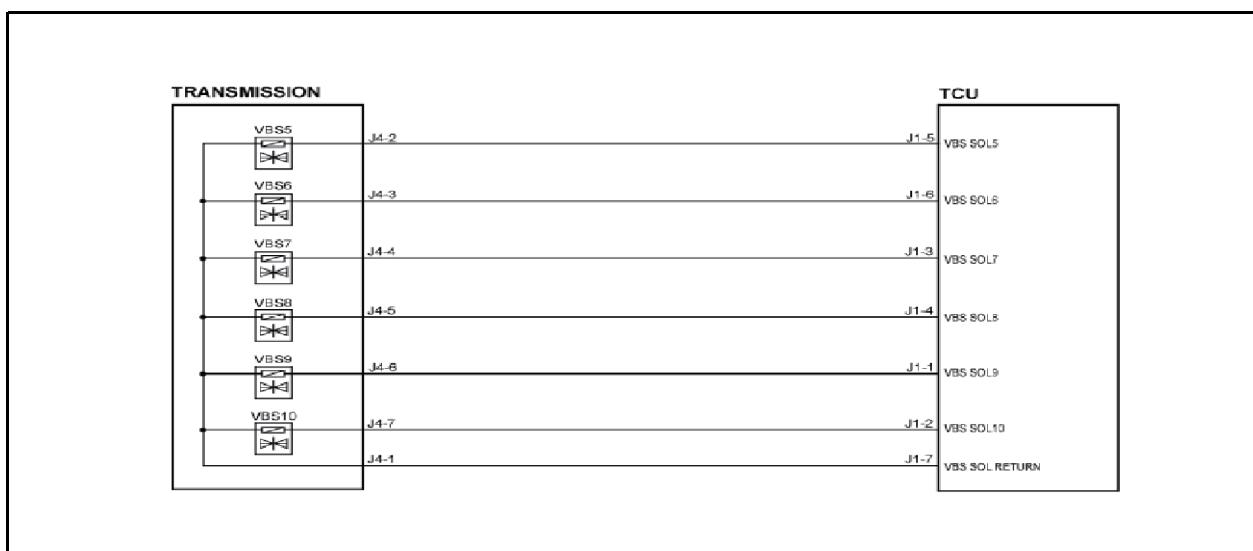
During operation, the TCU evaluates the actual current delivered to the solenoid and compares this against what is expected. If the current is not within predefined parameters, a DTC will be set to indicate the load on the TCU is abnormal.

DTC	Title	System Action
P0962	Solenoid S9 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0963	Solenoid S9 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0966	Solenoid S10 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0967	Solenoid S10 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0985	Solenoid S5 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0986	Solenoid S5 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0998	Solenoid S6 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0999	Solenoid S6 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P099B	Solenoid S7 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P099C	Solenoid S7 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P099E	Solenoid S8 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P099F	Solenoid S8 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM

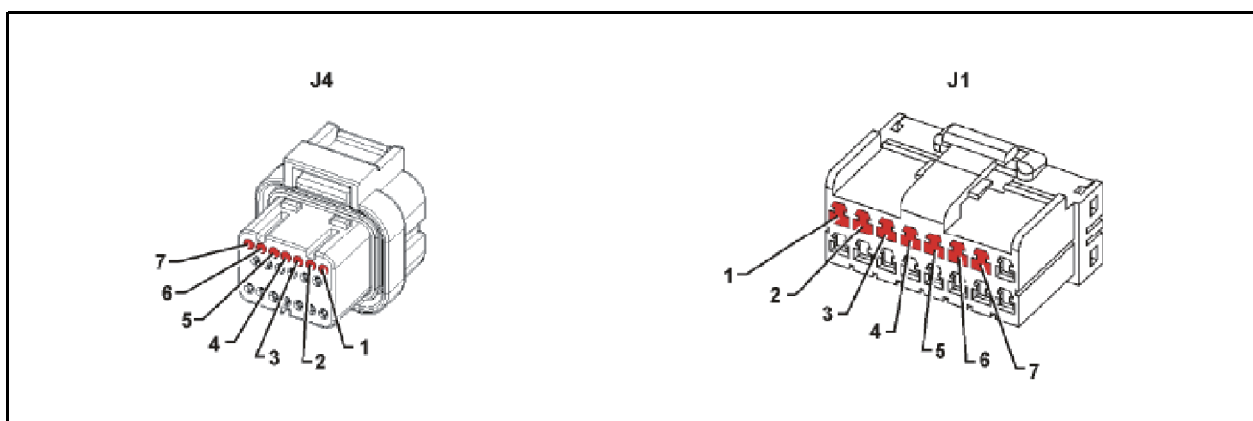
► DTC Description

DTC	Description
P0962	The Variable Bleed Solenoid S9 feedback indicates a short circuit.
P0963	The Variable Bleed Solenoid S9 feedback indicates an open circuit
P0966	The Variable Bleed Solenoid S10 feedback indicates a short circuit
P0967	The Variable Bleed Solenoid S10 feedback indicates an open circuit
P0985	The Variable Bleed Solenoid S5 feedback indicates a short circuit
P0986	The Variable Bleed Solenoid S5 feedback indicates an open circuit
P0998	The Variable Bleed Solenoid S6 feedback indicates a short circuit
P0999	The Variable Bleed Solenoid S6 feedback indicates an open circuit
P099B	The Variable Bleed Solenoid S7 feedback indicates a short circuit
P099C	The Variable Bleed Solenoid S7 feedback indicates an open circuit
P099E	The Variable Bleed Solenoid S8 feedback indicates a short circuit
P099F	The Variable Bleed Solenoid S8 feedback indicates an open circuit

► Schematic



► Connector Details



Modification basis	
Application basis	
Affected VIN	

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0962 Solenoid S9 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS9 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-6 and J1-1 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-6 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0963 Solenoid S9 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS9 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-6 and J1-1 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-6 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0966 Solenoid S10 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS10 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-7 and J1-2 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-7 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0967 Solenoid S10 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS10 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-7 and J1-2 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-7 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU

DTC	Evaluation Conditions	Possible Causes	Actions
P0985 Solenoid S5 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS5 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-2 and J1-5 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-2 for solenoid resistance of $4.14 \pm 0.3 \Omega$ Replace transmission if value is outside of this range. Replace TCU
P0986 Solenoid S5 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS5 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-2 and J1-5 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-2 for solenoid resistance of $4.14 \pm 0.3 \Omega$ Replace transmission if value is outside of this range. Replace TCU
P0998 Solenoid S6 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS6 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-3 and J1-6 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-3 for solenoid resistance of $4.14 \pm 0.3 \Omega$ Replace transmission if value is outside of this range. Replace TCU
P0999 Solenoid S6 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS6 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-3 and J1-6 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-3 for solenoid resistance of $4.14 \pm 0.3 \Omega$ Replace transmission if value is outside of this range. Replace TCU

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Conditions	Possible Causes	Actions
P099B Solenoid S7 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS7 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-4 and J1-3 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-4 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P099C Solenoid S7 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS7 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-4 and J1-3 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-4 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P099E Solenoid S8 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS8 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-5 and J1-4 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-5 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P099F Solenoid S8 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault VBS8 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-5 and J1-4 for short or open condition Check circuit between terminals J4-1 and J1-7 for short or open condition Check between terminals J4-1 and J4-5 for solenoid resistance of $4.14 \pm 0.3 \Omega$. Replace transmission if value is outside of this range. Replace TCU

► DTC Clearing

DTC	Conditions
P0962, P0963, P0966, P0967, P0985, P0986, P0998, P0999, P099B, P099C, P099E & P099F	<ul style="list-style-type: none">• Ignition ON• Engine stopped• Scan tool

Modification basis	
Application basis	
Affected VIN	

12) On/Off Solenoids

The TCU uses on/off solenoids to select between different clutch elements within the transmission.

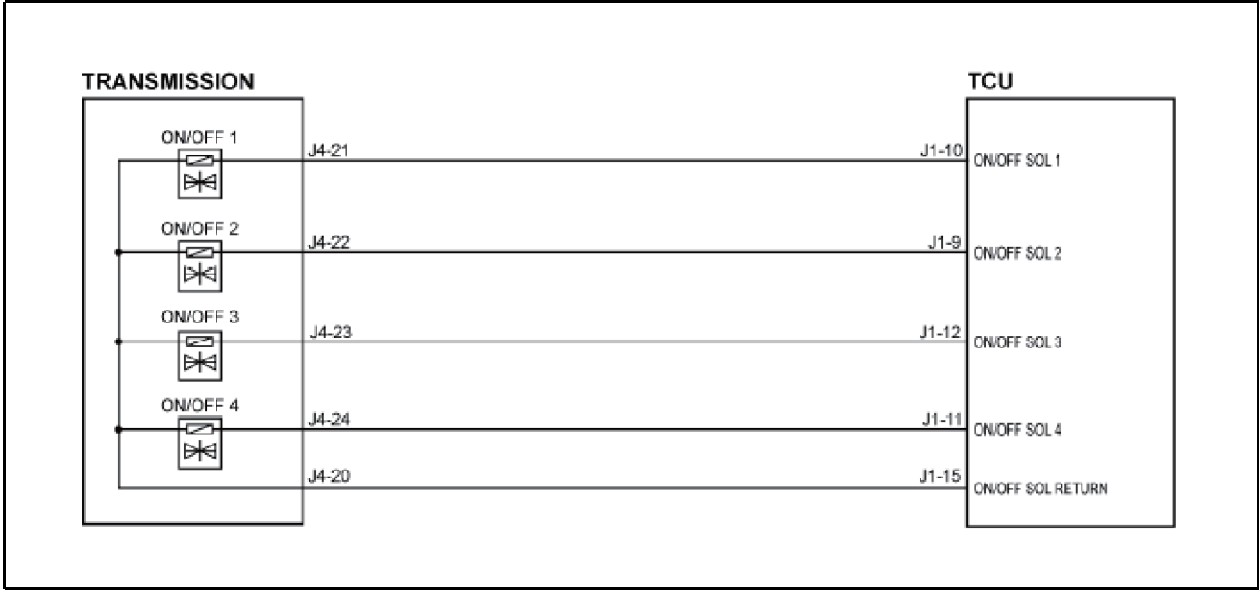
During operation, the TCU evaluates the actual current delivered to the on/off solenoid and compares this against what is expected. If the current is not within predefined parameters, a DTC will be set to indicate the load on the TCU is abnormal.

DTC	Title	System Action
P0973	Solenoid S1 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0974	Solenoid S1 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0976	Solenoid S2 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0977	Solenoid S2 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0979	Solenoid S3 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0980	Solenoid S3 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0982	Solenoid S4 Over Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
P0983	Solenoid S4 Low Current	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM

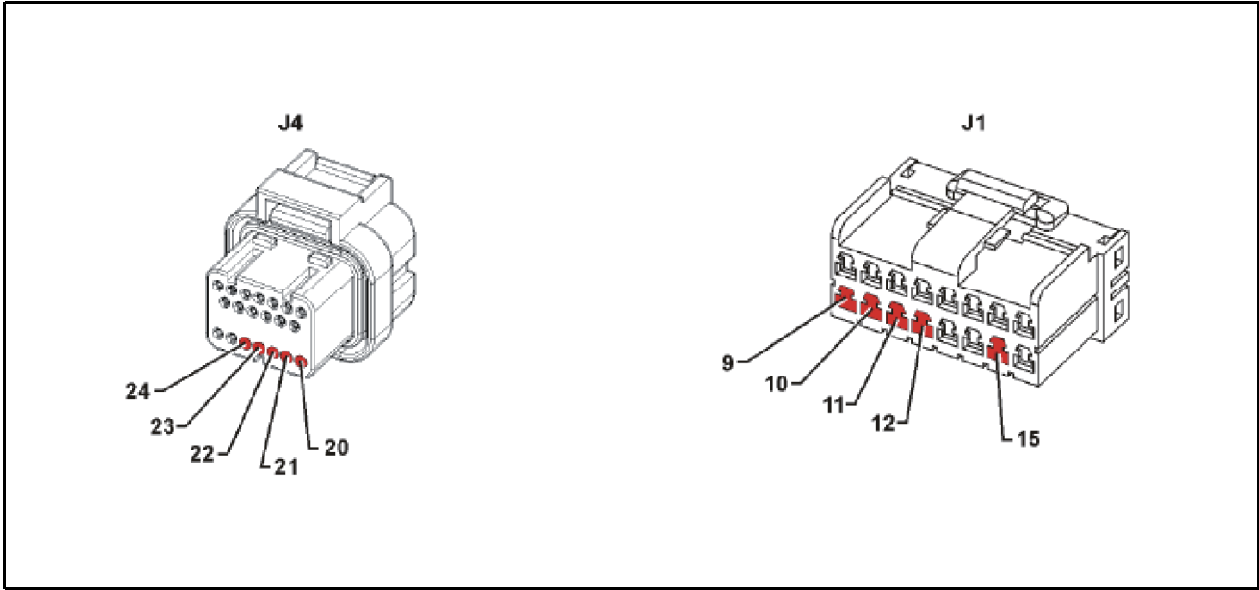
► DTC Description

DTC	Description
P0973	The On/Off Solenoid S1 feedback indicates a short circuit
P0974	The On/Off Solenoid S1 feedback indicates an open circuit
P0976	The On/Off Solenoid S2 feedback indicates a short circuit
P0977	The On/Off Solenoid S2 feedback indicates an open circuit
P0979	The On/Off Solenoid S3 feedback indicates a short circuit
P0980	The On/Off Solenoid S3 feedback indicates an open circuit
P0982	The On/Off Solenoid S4 feedback indicates a short circuit
P0983	The On/Off Solenoid S4 feedback indicates an open circuit

► Schematic



► Connector Details



Modification basis	
Application basis	
Affected VIN	

ION 4-
SPEED
DC 5-
SPEED
DSI M78
6-SPEED
TGS
LEVER
T/M
LEVER
M/T
CLUTCH
AXLE
AXLE
(IOP)
T/C
PROPELL
ER
SUSPENS
ION
ESP
STEERIN
G

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0973 Solenoid S1 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 1 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-21 and J1-10 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-21 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0974 Solenoid S1 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 1 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-21 and J1-10 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-21 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0976 Solenoid S2 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 2 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-22 and J1-9 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-22 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0977 Solenoid S2 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 2 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-22 and J1-9 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-22 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU

DTC	Evaluation Conditions	Possible Causes	Actions
P0979 Solenoid S3 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 3 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-23 and J1-12 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-23 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0980 Solenoid S3 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 3 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-23 and J1-12 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-23 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0982 Solenoid S4 Over Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 4 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-24 and J1-11 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-24 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU
P0983 Solenoid S4 Low Current	<ul style="list-style-type: none"> Ignition key in ON position Solenoid energised TCU supply voltage OK 	<ul style="list-style-type: none"> TCU to Transmission harness and/or connector fault Transmission internal harness and/or connector fault On/Off Solenoid 4 TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check circuit between terminals J4-24 and J1-11 for short or open condition Check circuit between terminals J4-20 and J1-15 for short or open condition Check between terminals J4-20 and J4-24 for solenoid resistance of $22.0 \pm 1.2 \Omega$. Replace transmission if value is outside of this range. Replace TCU

Modification basis	
Application basis	
Affected VIN	

► DTC Clearing

DTC	Conditions
P0973, P0974, P0976, P0977, P0979, P0980, P0982 & P0983	<ul style="list-style-type: none">• Ignition ON• Engine stopped• Scan tool

13) CAN Network

The Controller Area Network (CAN) bus is used to share vehicle system information between the control units connected to the bus. The TCU obtains the majority of its information via this network. If the TCU does not receive information at regular intervals from the electronic control units connected to the bus, the TCU will set a communication DTC.

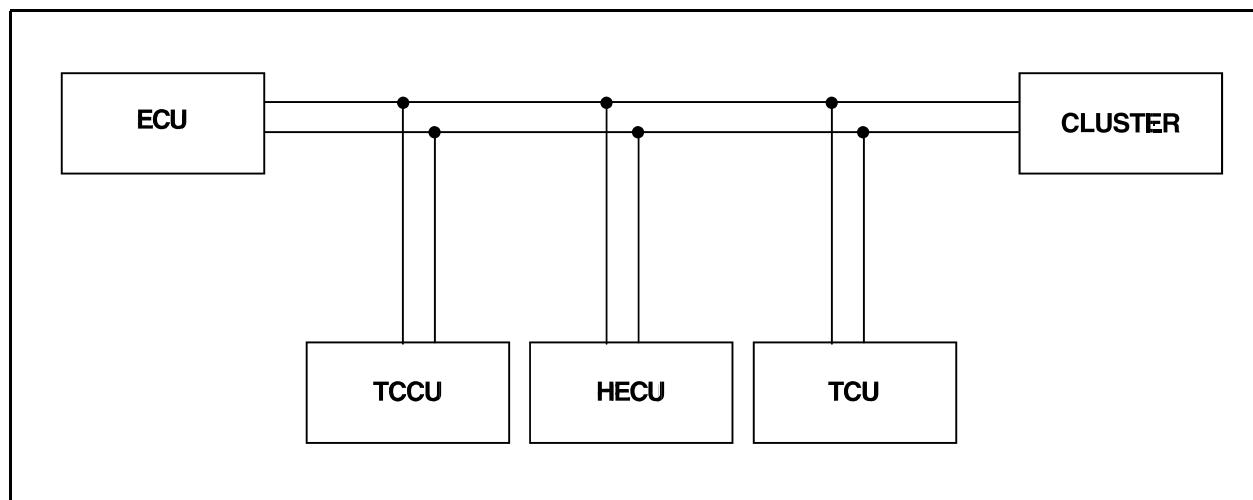
DTC	Title	System Action
U0100	Cyclic CAN messages from Engine ECU are unavailable	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U0102	Cyclic CAN messages from Transfer Case Control Unit are unavailable	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U0103	Cyclic CAN messages from TGS ECU are unavailable	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U0121	Cyclic CAN messages from Brake System Control Unit (ABS/ESP/TCS) are unavailable	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U0401	CAN signals from Engine ECU are out of range or Invalid	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U0403	CAN signals from Transfer Case Control Unit are out of range or Invalid	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U0404	CAN signals from Gear Lever ECU are out of range or Invalid	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U0415	CAN signals from Brake System Control Unit (ABS/ESP/TCS) are out of range or Invalid	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM

► DTC Description

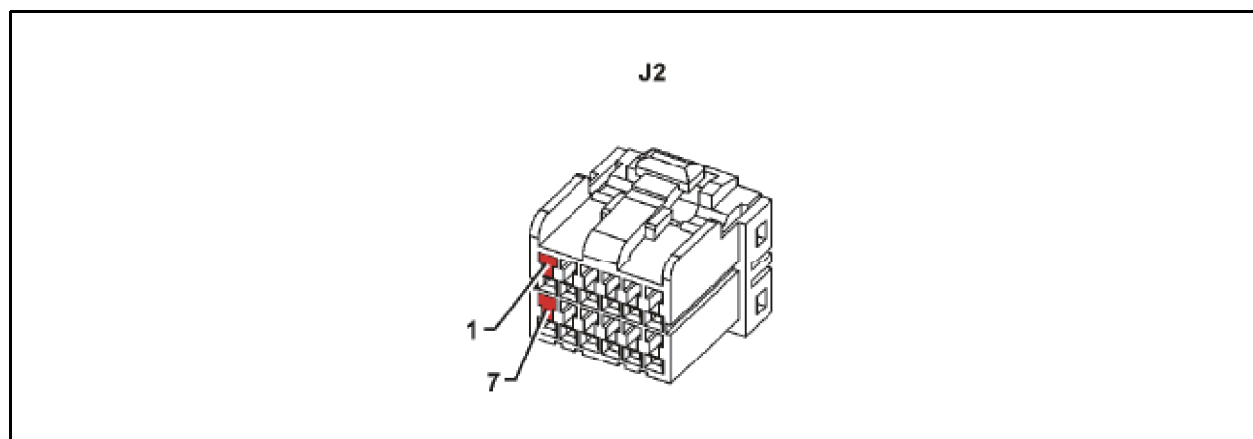
DTC	Description
U0100	CAN Message not available
U0102	CAN Message not available
U0103	CAN Message not available
U0121	CAN Message not available
U0403	CAN Message not available
U0404	CAN Message not available
U0415	CAN Message not available

Modification basis	
Application basis	
Affected VIN	

► Schematic



► Connector Details



► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
U0100 Cyclic CAN messages from Engine ECU are unavailable U0401 CAN signals from Engine ECU are out of range or Invalid	<ul style="list-style-type: none"> Ignition key in ON position for longer than 1 second CAN Message from Engine ECU not received for five message cycles 	<ul style="list-style-type: none"> Wiring harness and/or connector fault Engine ECU system fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check Engine ECU system Check circuit between terminal J2-1 and Engine ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information Check circuit between terminal J2-7 and Engine ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information Replace TCU

DTC	Evaluation Conditions	Possible Causes	Actions
U0102 Cyclic CAN messages from Transfer Case Control Unit are unavailable U0403 CAN signals from Transfer Case Control Unit are out of range or Invalid	<ul style="list-style-type: none"> Ignition key in ON position for longer than 1 second CAN Message from Transfer Case Control Unit not received for five message cycles 	<ul style="list-style-type: none"> Wiring harness and/or connector fault Transfer Case system fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check Transfer Case Control Unit Check circuit between terminal J2-1 and Transfer Case Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information Check circuit between terminal J2-7 and Transfer Case Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information Replace TCU
U0103 Cyclic CAN messages from TGS ECU are unavailable U0404 CAN signals from Gear Lever ECU are out of range or Invalid	<ul style="list-style-type: none"> Ignition key in ON position for longer than 1 second CAN Message from ECU not received for five message cycles 	<ul style="list-style-type: none"> Wiring harness and/or connector fault Brake system fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check engine management system Check circuit between terminal J2-1 and transmission gear select ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information Check circuit between terminal J2-7 and transmission gear select ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information Replace TCU
U0121 Cyclic CAN messages from Brake System Control Unit (ABS/ESP/TCS) are unavailable U0415 CAN signals from Brake System Control Unit (ABS/ESP/TCS) are out of range or Invalid	<ul style="list-style-type: none"> Ignition key in ON position for longer than 1 second CAN Message from Brake System Control Unit not received for five message cycles 	<ul style="list-style-type: none"> Wiring harness and/or connector fault Brake system fault TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Check Brake System Control Unit DTC's Check circuit between terminal J2-1 and Brake System Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information Check circuit between terminal J2-7 and Brake System Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information Replace TCU

► DTC Clearing

DTC	Conditions
U0100, U0102, U0121, U0401, U0403, & U0415	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

Modification basis	
Application basis	
Affected VIN	

14) TCU Calibration

TCU software or calibration may be upgraded at service. These DTC들 protect the TCU against corrupted files being loaded into the TCU. They also ensure only the correct calibration parameters are used with the software version currently loaded into the TCU.

DTC	Title	System Action
U1600	ECU Application Software Mismatch	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U1601	TCU Application Software Missing or Corrupted	<ul style="list-style-type: none"> • MIL - OFF • Transmission in LHM
U1606	TCU Calibration Error – Platform	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
U1607	TCU Calibration Error - Active Variant	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
U1608	TCU VIN Coding Error	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM
U1609	TCU Hardware (pcb) Calibration Error	<ul style="list-style-type: none"> • MIL - ON • Transmission in LHM

► DTC Description

DTC	Description
U1600	The TCU Software and Calibration are not compatible
U1601	During initialisation, the TCU software was found to be missing or corrupted. In this condition the TCU will not operate, and the transmission will be in LHM
U1606	Platform calibration data CRC check failed at initialisation of TCU. This is normal for a development TCU
U1607	Active Variant calibration data CRC check failed at initialisation of TCU. This is normal for a development TCU
U1608	VIN based variant could not be determined. TCU will use default VIN calibration
U1609	Calibration for TCU hardware (pcb) is missing or corrupted. TCU will use default calibration

► DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
U1600 ECU Application Software Mismatch U1601 TCU Calibration Error – Platform	<ul style="list-style-type: none"> Ignition key in ON position Message not received for 5 x cycle time 	<ul style="list-style-type: none"> TCU calibration 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Update TCU calibration software. Refer to vehicle scan tool documentation for further information Replace TCU
U1606 TCU Calibration Error – Platform U1607 TCU Calibration Error - Active Variant	<ul style="list-style-type: none"> Ignition key in ON position CRC not Valid 	<ul style="list-style-type: none"> TCU calibration 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Update TCU calibration software. Refer to vehicle scan tool documentation for further information Replace TCU
U1608 TCU VIN Coding Error	<ul style="list-style-type: none"> Ignition key in ON position VIN not compatible with calibration 	<ul style="list-style-type: none"> TCU calibration 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Update TCU calibration software. Refer to vehicle scan tool documentation for further information
U1609 TCU Hardware (pcb) Calibration Error	<ul style="list-style-type: none"> Ignition key in ON position TCU manufacturing information not present 	<ul style="list-style-type: none"> TCU 	<ul style="list-style-type: none"> Clear DTC and check if DTC sets within the evaluation conditions Replace TCU

► DTC Clearing

DTC	Conditions
U1600, U1601, U1606, U1607, U1608 & U1609	<ul style="list-style-type: none"> Ignition ON Engine stopped Scan tool

Modification basis	
Application basis	
Affected VIN	

MAINTENANCE OPERATIONS

3680-01

GENERALS

1. OIL TEST

1) Hydraulic System

If there is a problem in the hydraulic system, perform the following:

- Test transmission oil
- Inspect the manual linkage adjustment
- Check the engine's idling speed
- Perform the stall test
- Perform the driving test

2) Oil Test

► Check the Amount of Oil

This check must be performed when the engine is warm. If there is insufficient oil and the vehicle moves, shift loss or delay may happen.

First, check the transmission malfunction code. If there is a problem with the shaft speed, insufficient oil may cause the problem.

When there is an abnormal shift delay or loss of driving power during driving or reversing, perform the driving test. When the level of oil is low and this vehicle is moving on a corner, there will be a brief driving power loss.

When both oil temperature and level are low, there will be loss of driving power. Replenish oil if the engine is completely warmed up and there is no loss of driving power, but there is still a problem with the vehicle speed.

► Oil Check and Replenishment

When replenishing or changing transmission oil, a genuine recommended oil must be used.

If non-approved oil is used, it will have fatal impacts on the transmission's performance and life. Never use such oil. Wrong oil can damage the transmission.

When the transmission oil is hot, do not remove the filler plug. Wait for 2 hours to cool down the oil. Then, remove the plug.

1. When the engine is hot, wait for 2 hours before replenishing transmission oil. Then, the transmission's temperature also becomes cooled down to a proper range. When the filler plug is removed while the temperature of oil is hot, oil will flow out and its level in the transmission will go down.
2. Push the selection lever to the "P" position and shut off the engine.
3. Raise up the vehicle with a proper lift.
4. Clean up the surroundings of the filler plug before removing the plug. After removing the plug, clean up the plug thoroughly and inspect the O-ring for any damage.

Modification basis	
Application basis	
Affected VIN	

5. After attaching the filler pump to the transmission, lower the vehicle and replenish oil. Engage the parking brake, start the engine while the selection lever is engaged to "P" and press the foot brake. Then, start shifting the selection lever to all positions. Replenish oil until you can sense moving of the transmission gears.
6. Shut off the engine again and raise up the vehicle. Ensure that the vehicle maintains horizontal balance.
7. Shut off the engine, wait for at least 3 minutes (within 1 hour), and remove the filler pump. If oil reaches to just below the filler inlet, it is appropriate. If not, replenish oil until it reaches this level.
8. Replace the filler plug with a new one. Wipe off oil on the transmission or other parts of the vehicle.
9. Apply the specified torque to tighten up the filler plug (30 ~ 35 Nm).

► **Oil check/Replenishment when there is an insufficient amount of oil**

1. Engage the shift lever to the "P" position and shut off the engine.
2. Raise this vehicle with an appropriate lift.
3. Clean up the surroundings of the filler plug before removing the plug. After removing the plug, clean up the plug thoroughly and inspect the O-ring for any damage. Then, attach the filler pump to the oil inlet.
4. After attaching the filler pump to the transmission, lower this vehicle and replenish oil.
 - a. When the transmission torque converter has no oil: 9.5 ℓ
 - b. When the transmission torque converter is filled with oil: 4.5 ℓ
5. Engage the parking brake, start the engine while the selection lever is engaged to "P" and depress the foot brake. Then, start shifting the selection lever to all positions. Replenish oil until you can sense moving of the transmission gears.
6. Add a 0.5 ℓ of recommended oil.
7. Shut off the engine and raise this vehicle with an appropriate lifte. Detach the filler pump. Replace the filler plug with a new one (Tightening torque: 30 ~ 35 Nm).
8. When this vehicle travels 3.5 ~ 4.5 kilometers with the engine's RPM below 2500, the temperature of the transmission will reach to 50 ~ 60°C.
9. With the engine idling, press the brake pedal and shift the transmission selector lever to all positions several times.
10. Shut off the engine and raise the vehicle with an appropriate lift. Maintain horizontal balance of the vehicle if possible.
11. Remove the filler plug 3 minutes after shutting off the engine. If oil reaches just below the filler inlet, it is appropriate. If not, replenish oil until it reaches this level.
12. Replace the filler plug with a new one. Wipe off oil on the transmission or other parts of the vehicle. Apply the specified torque to tighten up the filler plug (30 ~ 35 Nm).

Modification basis	
Application basis	
Affected VIN	

2. STALL TEST

Stall testing can be performed on the Model 78 6 speed automatic transmission to determine whether the transmission clutches can hold the full engine torque without slipping.

Stall testing should be performed for a period no longer than 10 seconds.

- Apply Hand Brake
- Start Engine
- Press Brake Pedal
- Shift to "DRIVE"
- Press Accelerator Pedal to 100 % for 6 seconds
- Observe Engine speed
- Release Accelerator Pedal
- Shift To Reverse
- Press Accelerator Pedal to 100 % for 6 seconds
- Observe Engine speed

If engine speed is observed > 3000 rpm; transmission hardware failure

3. TRANSMISSION RESET PROCEDURE (REPLACEMENT TRANSMISSION)

It is necessary to reset the adaptive data stored within the transmission control unit (TCU) when the transmission and or TCU have been replaced.

► Green Offset Reset

Carried out when a replacement transmission has been installed in a vehicle.

► Adaptive Reset

Carried out when one of the following has occurred:

- Replace transmission
- Replace TCU

► Green Offset Reset Procedure

To perform a green offset reset procedure, proceed as follows:

1. Connect the vehicle's diagnostic scan tool to the vehicle's diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.
2. With the transmission gear select (TGS) lever in Park, turn the ignition key to the ON position (engine not running).
3. Using the scan tool, set the parameter **Set Km Travelled** to 0Km.
4. Run the task **Activate Adaptive Green Offset**.
5. Turn the ignition key to the OFF position.
6. Start the vehicle and check for normal operation.

► Adaptive Reset Procedure

To perform an adaptive reset procedure, proceed as follows:

1. Connect the vehicle's diagnostic scan tool to the vehicle's diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.
2. With the transmission gear select (TGS) lever in Park, turn the ignition key to the ON position (engine not running).
3. Set the parameter **Set Km Travelled** to 0 Km.
4. Run the task **Reset Adaptive Data**.
5. Turn the ignition key to the OFF position.
6. Start the vehicle and check for normal operation.

Modification basis	
Application basis	
Affected VIN	

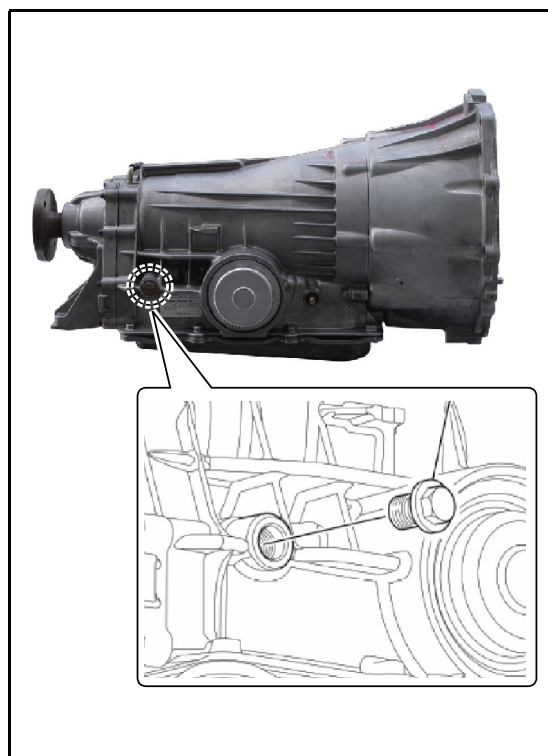
4. FLUID LEVEL INSPECTION



NOTE

- As the temperature of the transmission fluid greatly affects the fluid level, this procedure
 - must only be carried out with the transmission fluid temperature below 50°C). If the
 - transmission fluid temperature is greater than 50°C and the correct procedure is not followed, the result could be a false reading of the fluid level.
- Fluid level inspection must be carried out with the vehicle level.
Caltex PED 1712 ATF must be used.

1. Raise the vehicle on a certified hoist.
2. Place a drain container below the fluid level hole and remove the transmission fluid level plug (1).
3. If fluid starts to drain from the fluid level hole, reinstall the fluid level plug. If no fluid drains from the fluid level hole, fill the transmission until fluid starts to drain from the level hole and reinstall the plug.
4. Drive the vehicle for approximately five minutes.
5. Connect the vehicle's diagnostic scan tool to the vehicle's diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.
6. With the gear select lever in the Neutral position, start the engine and allow to run at idle until the transmission fluid temperature reaches 50°C.



NOTE

Use the scan tool to monitor the transmission fluid temperature.

7. Raise the vehicle on a certified hoist.
8. When the transmission fluid temperature reaches 50°C turn off the engine.
9. Place a drain container below the fluid level hole and remove the transmission fluid level plug.
Allow transmission fluid to drain from the fluid level hole for 50 seconds.
10. Reinstall the fluid level plug and tighten the plug to the correct torque specification.

Transmission fluid level plug torque specification	30 ~ 35 Nm
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11. Lower the vehicle to the ground and road test the vehicle to check vehicle operation and for fluid leaks.

Modification basis	
Application basis	
Affected VIN	

5. TRANSMISSION COOLER AND HYDRAULIC LINE FLUSHING PROCEDURE



NOTE

To prevent transmission damage due to contaminants being present in the transmission cooler and/or hydraulic lines, the cooler and lines must be flushed.

1. Raise the vehicle on a certified hoist.
2. Using compressed air, clear the cooler lines of any residual fluid.
3. Connect the front transmission cooler line to the transmission.

Front transmission cooler line to transmission fitting torque specification	25 ~ 35 Nm
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4. Connect one end of a rubber hose to the end of the rear cooler line and place the other end in a suitable container to collect the transmission fluid as it is pumped out.
5. Start the engine and run for approximately 30 seconds at idle. (With ATF at 50°C temperature, a minimum of 2.5litres oil flow after 30 seconds.)
6. Whilst the engine is running, have an assistant pump transmission fluid into the transmission fluid level hole.
7. Connect the rear transmission cooler line to the transmission.

Rear transmission cooler line to transmission fitting torque specification	25 ~ 35 Nm
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8. Check the transmission fluid level; refer to Fluid Level Inspection on page 69.

6. LUBRICATION

Automatic transmission fluid.....Caltex PED 1712 ATF

Modification basis	
Application basis	
Affected VIN	

7. TRANSMISSION COOLER AND HYDRAULIC LINE FLUSHING PROCEDURE(NEW TRANSMISSION)

Items	Size	Torque (Nm)
TC Housing	M12 x 32	54 ~ 68
Extension Housing	M12 x 32	54 ~ 68
Oil Pan	M6 x 16	4 ~ 6
Valve Body to Case	M6 x 26	8 ~ 13
Valve Body to Case	M6 x 45	8 ~ 13
Center Support to Case	M10 x 34	20 ~ 27
Output Shaft Locking Nut	M24 x 15	100 ~ 110
Pump to Pump Cover	M8 x 55	24 ~ 27
Pump Cover to Case	M8 x 40	24 ~ 34
Pump Cover to Case	M8 x 58	24 ~ 34
Upper Valve Body to Lower	M6 x 30	15 ~ 17
Detent Spring	M8 x 16	20 ~ 25
VBS & Speed Sensor	M4 x 12	2.8 ~ 3.2
Transmission Oil Level Plug		30 ~ 35
Front Transmission Cooler Line to Transmission Connector		25 ~ 35
Rear Transmission Cooler Line to Transmission Cooler Connector		25 ~ 35
Torque Converter to Drive Plate Bolt		40 ~ 42
Transmission Selector Lever to Cross Shaft Nut		14 ~ 20

Memo

[illegible]