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# SECTION 5D2

## TRANSFER CASE - TOD

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## GENERAL INFORMATION AND OPERATION

TOD system means the full time 4WD system and the registered trade mark of Borg Warner. TOD is an abbreviation of Torque On Demand.

TOD control unit automatically tailors torque distribution to road, offering full time four wheel drive. TOD distributes electronically-controlled power into front and rear wheels whose ratio change from 0 : 100 to 50 : 50 complying with wheel speed differences.

Also TOD control unit analyzes data from wheel speed sensor and engine output then changes pressure of electromagnetic clutch. This pressure controls front propeller shaft and power to front wheel. Power to front wheel depends on degree of pressure corresponding clutch slip.

TOD is designed to distribute the power to front and rear axle by operation of 4H/4L switch and shift motor. Shifting 4WD high (4H) to 4WD low (4L) is performed towards reducing high-low collar by means for connection high-low shift fork with output shaft in order to join with planetary gear. Torque transmits input shaft then sun gear rotating front planetary gear. Front planetary gear joins with output shaft and drives at low position.

The TOD system has 2 selectable mode, 4H and 4L. 4H is the normal operating mode when drive of which gear ratio is 1:1 and 4L mode distributes power to front and rear wheels 50 : 50 of which gear ratio is 2.48:1.

## TOD SYSTEM FUNCTION

### 4H Mode

The TOD system transfer case controls the clutch mechanism to comply with rotation in front and rear propeller shaft and if its difference exceeds the permissible range, corresponding power is distributed into front wheel through electromagnetic clutch (EMC).

Hall effect speed sensors are located front and rear propeller shafts, send signals to TOD transfer case control unit (TCCU). The EMC coil is activated by variable current on exceeding difference of speed in front and rear propeller shafts.

### 4L Mode

When select 4L mode, EMC is locked to apply maximum torque into front and rear propeller shafts. Shift motor rotates also 4L position by rotation of cam thus propeller shaft torque changes from 1:1 to 2.48:1 by planetary gear set.

### Transfer Case Control Unit (TCCU)

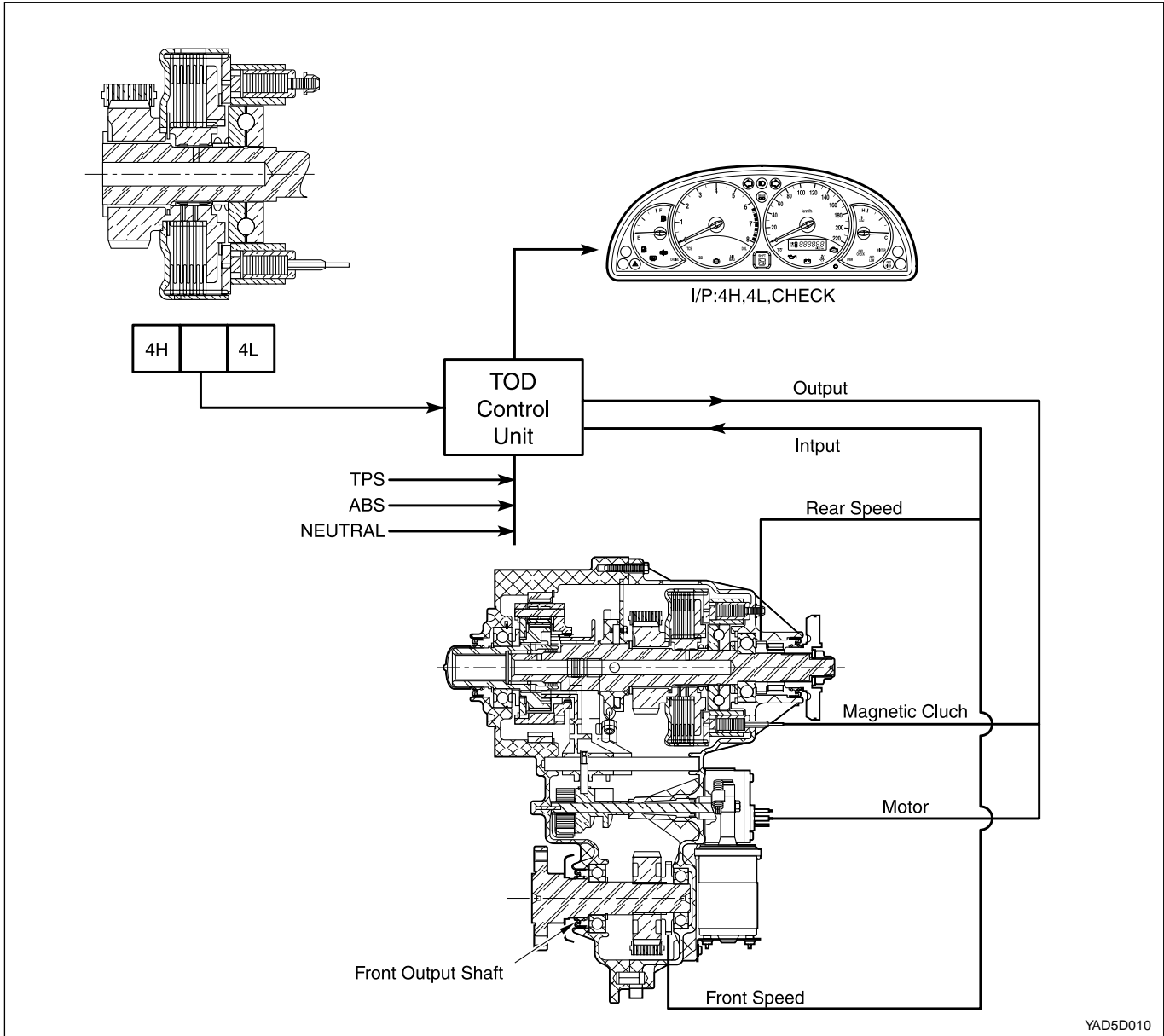
Transfer case control unit (TCCU) receives, front and rear propeller shaft speed, shift motor position and 4H/4L switch signals and controls electromagnetic clutch (EMC), shift motor. TCCU communicates with scan tool with K-line for diagnosis. It located under the front LH seat.

## 4WD OPERATION OVERVIEW

Application	Mode Position		Operation Condition
Driving Type	4H	4WD Drive(High Speed)	Normal Driving on the normal road or highway, or high speed driving Slipped road such as snow, rainy, sand, mud etc.
	4L	4WD Drive(Low Speed)	Max driving force requiring condition such as towing, rough road. Same function as part time transfer case 4L.
Transferring	4H ↔ 4L	4WD Drive High Speed ↔ Low Speed	A vehicle should stop for transfer. Manual Transmission <ul style="list-style-type: none"> <li>• Transfer starts after the vehicle stops and the clutch is applied</li> </ul> Automatic Transmission <ul style="list-style-type: none"> <li>• Transfer starts after the vehicle stops and the shift lever is shifted [N] position.</li> </ul>

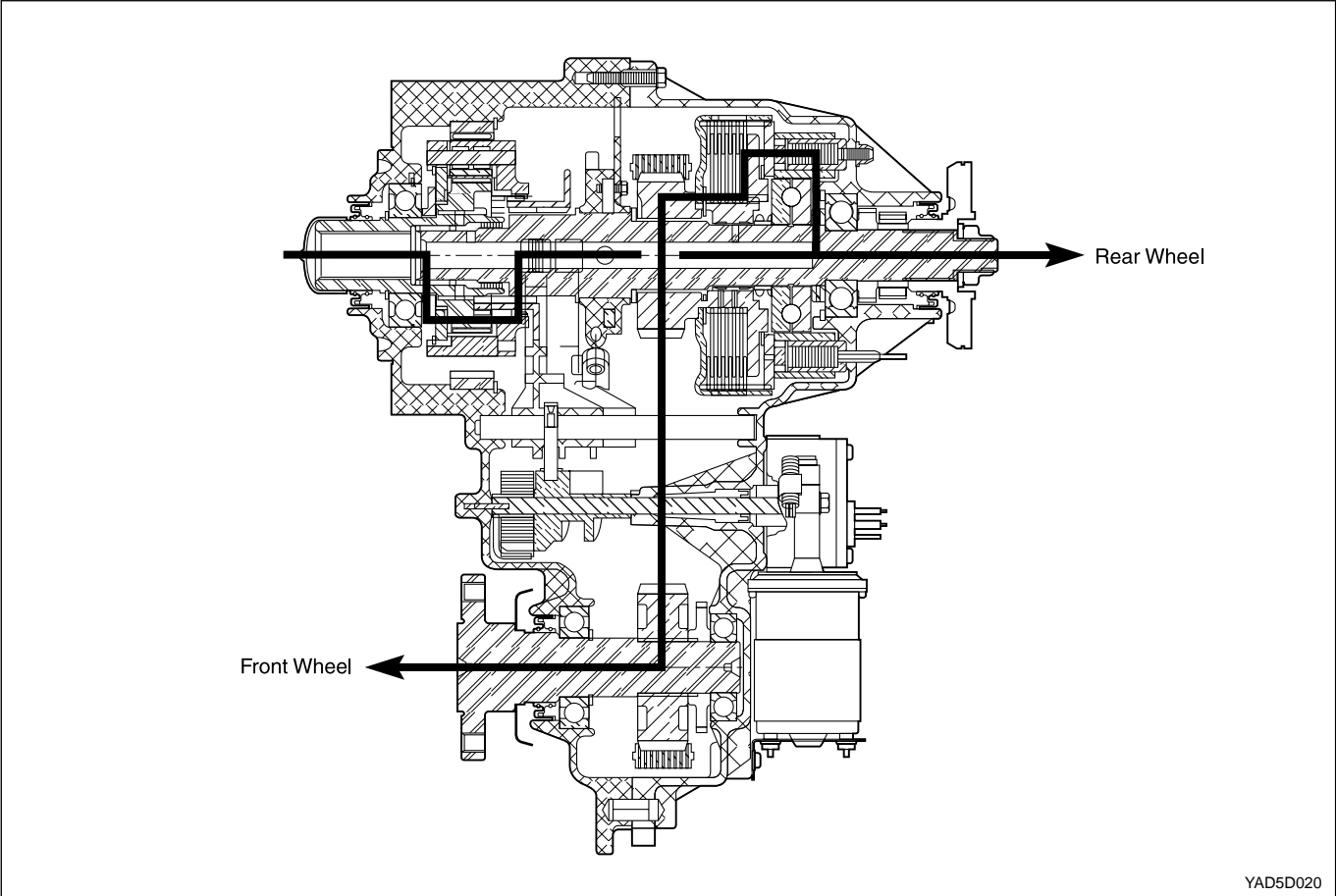
**Notice:** After the vehicle stops and the mode switch is selected with applying the brake pedal, shifting [N-R-N] makes the mode transfer easier.

# SYSTEM STRUCTURE



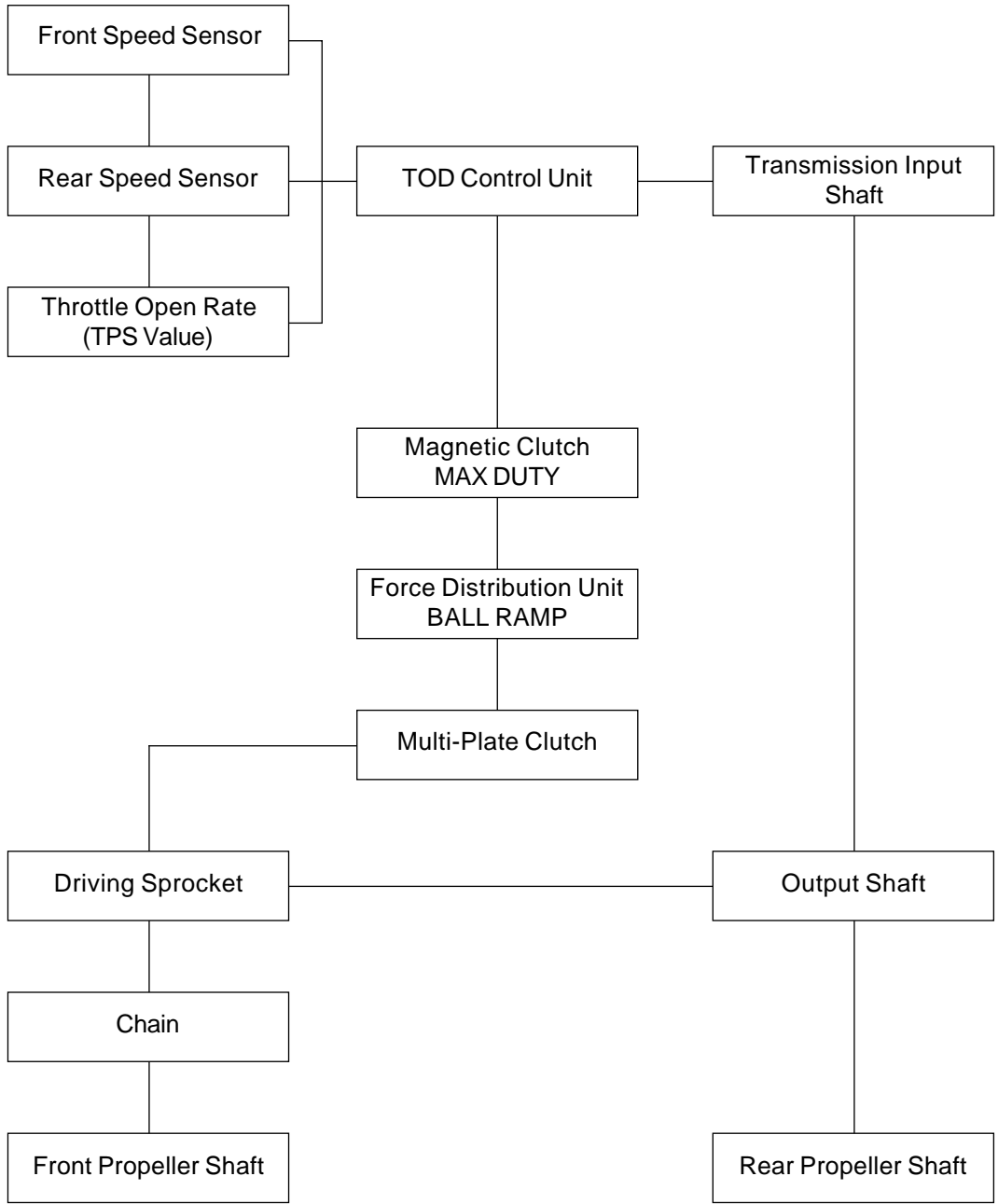
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**4H MODE (4WD DRIVE - HIGH SPEED)**

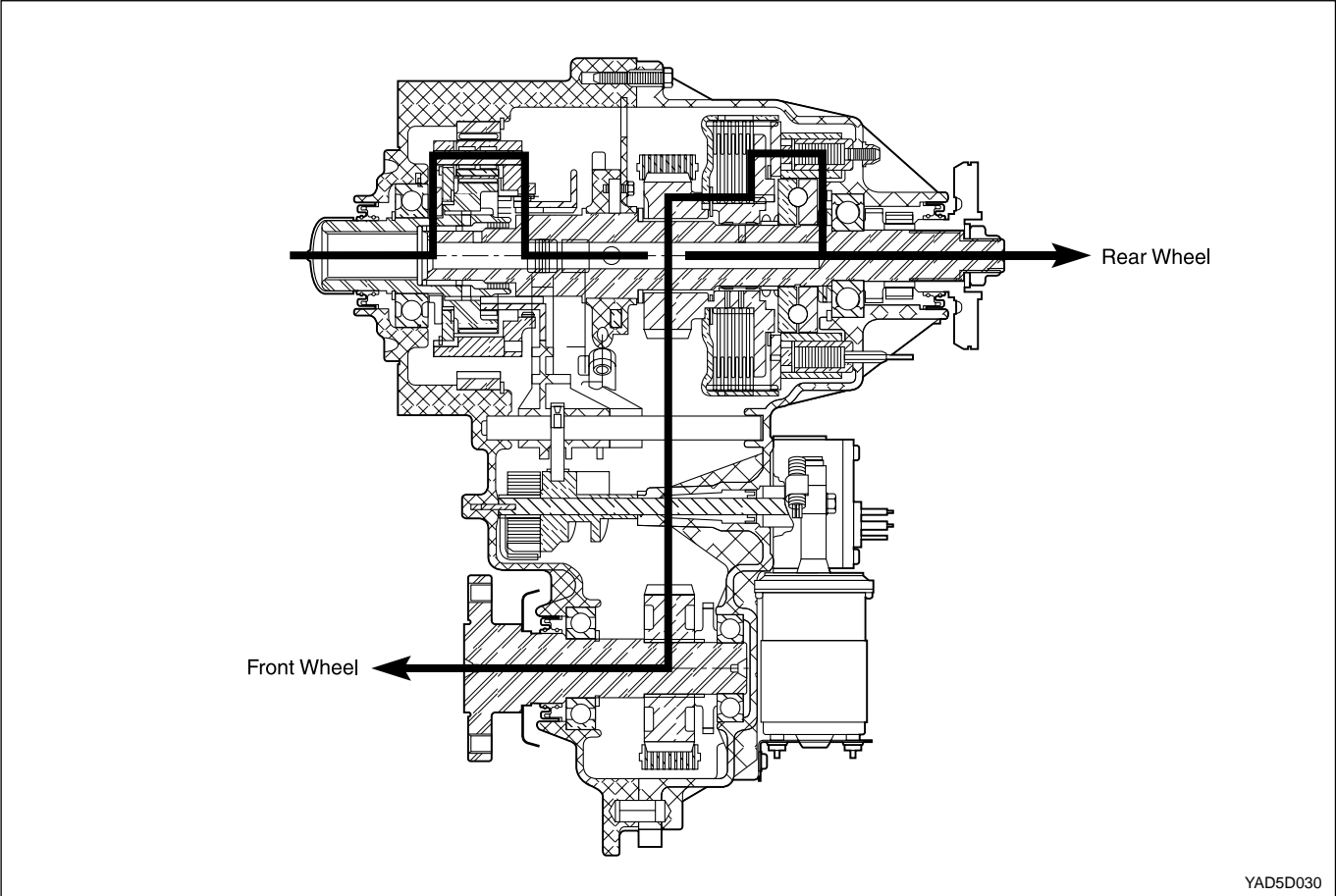


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### Power Flow

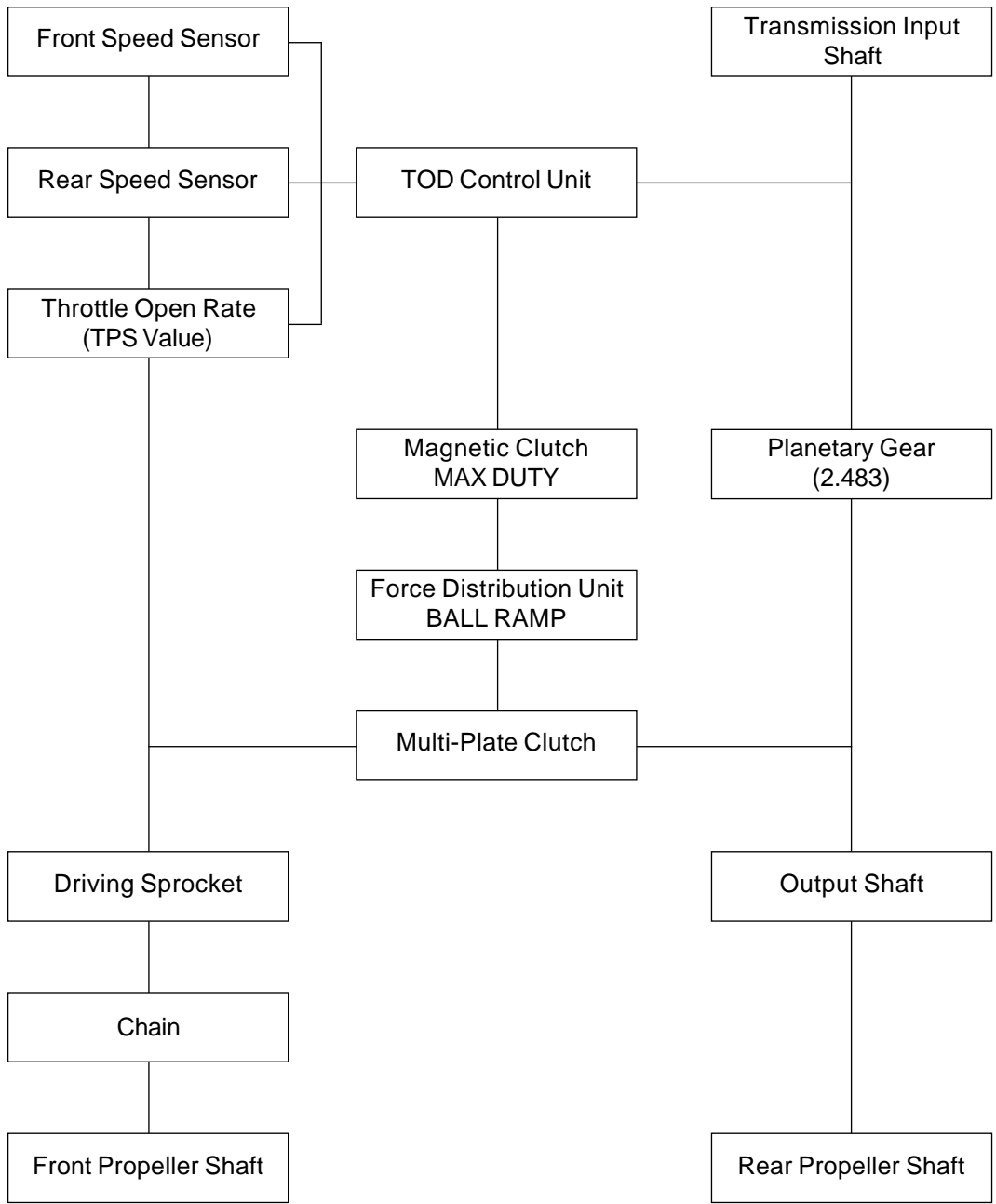


**4L MODE (4WD DRIVE - LOW SPEED)**



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### Power Flow





## SPECIFICATIONS

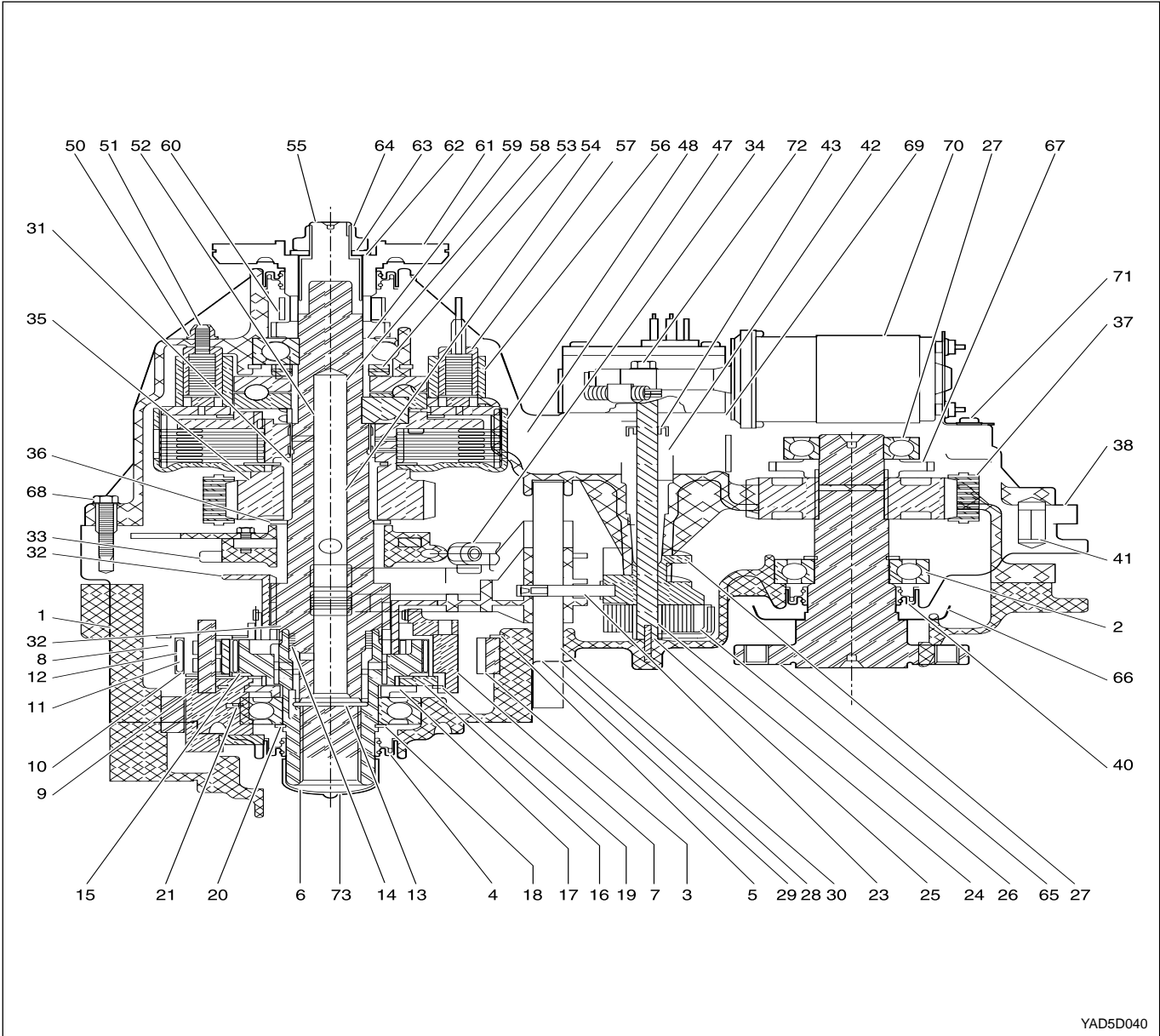
Check		Action	
TOD	Model		TOD (Torque On Demand) Transfer Case (4423E)
	Length		343.0 mm
	Weight (w/oil)		37.9 kg
	Shift Mode		4H and 4L
	Gear Ratio	High	1 : 1
		Low	2.48 : 1
	Oil	Specification	ATF S-3, S-4 or Dexron II, III
		Capacity	1.4 L
		Interval	Inspect Every 15,000km, Replace Every 50,000km
	Max. Torque		550 lb ft (76kg cm)
TOD Control Unit	Voltage	Normal Range	9-16 V
		CAN Comm.	6-16 V
	Current(Below Max. Operation Voltage)	Ignition Switch OFF	2 mA
		Ignition Switch ON	1 A
	Max. Operation Current	Motor OFF	7 A
		Motor ON	20 A

## TIGHTENING SPECIFICATIONS

Application	N•m	Kgf.m
Clutch Coil Retaining Bolt	10	1.0
Drain Plug	25	2.5
Filter Plug	25	2.5
Front Case - Rear Case Mounting Bolt	31	3.1
Front Propeller Shaft - Front Output Shaft/Flange Mounting Bolt	85	8.6
Planner Damper - Transfer Case Mounting Bolt	35	3.6
Rear Output Shaft Flange Mounting Nut	167	17.0
Rear Propeller Shaft - Rear Output Shaft/Flange Mounting Bolt	85	8.7
Shift Motor Adjusting Nut	5	0.5
Shift Motor Bracket Bolt	10	1.0
Shift Motor Mounting Bolt	10	1.0
Speed Sensor Retaining Bolt	5	0.5
Transfer Case Control Unit (TCCU) Retaining Bolts	10	1.0
Transfer Case - Transmission Adapter Housing Mounting Bolt	48	4.9

# COMPONENT LOCATOR

## TRANSFER CASE CROSS SECTIONAL VIEW



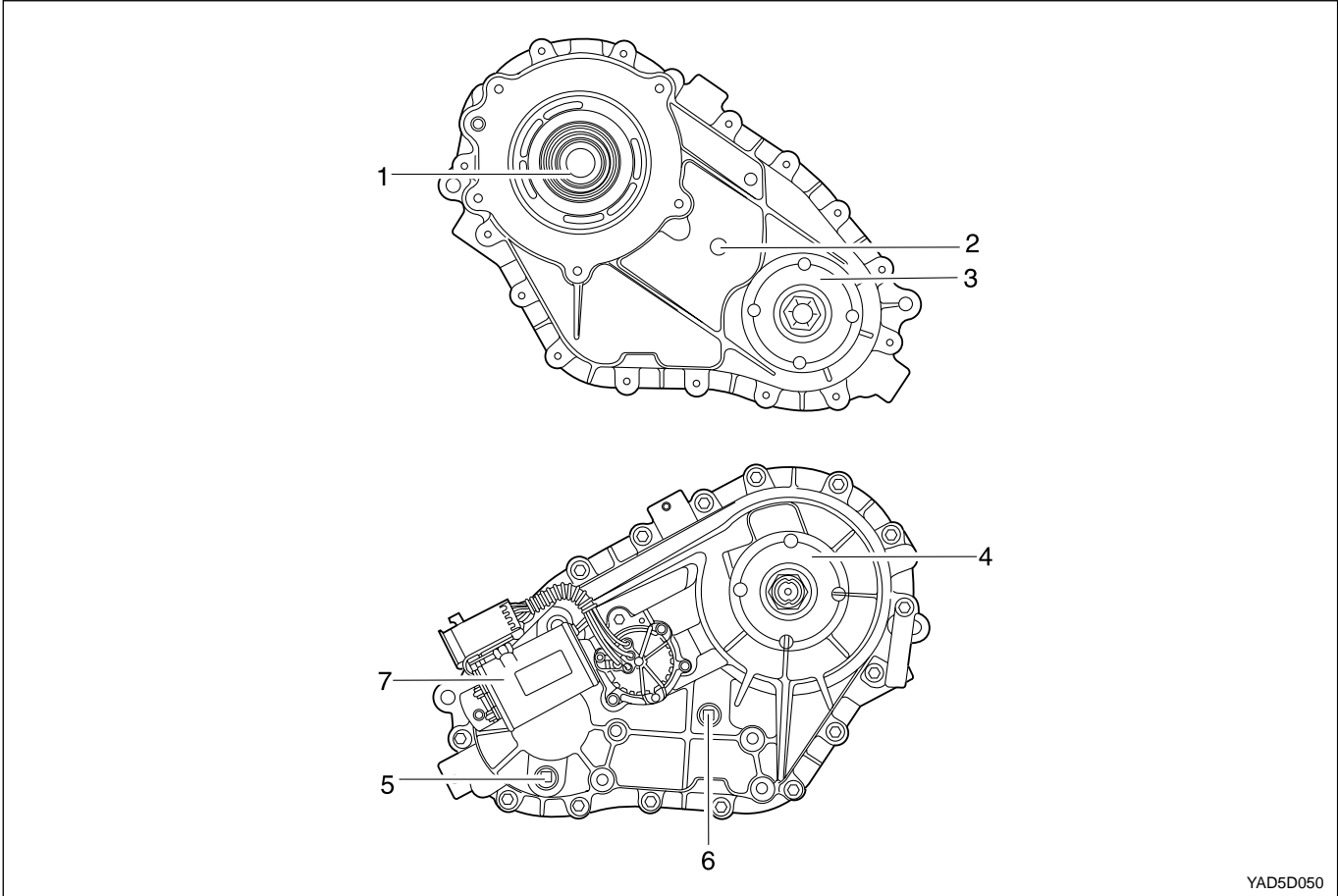
## 5D2-12 TRANSFER CASE - TOD

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1 Case	37 Chain
2 Bearing	38 Cover
3 Ring Gear	39 Bearing
4 Oil Seal	40 Oil Seal
5 Retaining Ring	41 Dowel Pin
6 Input Shaft	42 Bearing Sleeve
7 Carrier	43 Seal
8 Pinion Gear	44 Snap Ring
9 Pinion Shaft	45 Center Bearing Support
10 Thrust Washer	46 Ball Bearing
11 Needle Roller	47 Dowel Pin
12 Spacer	48 Viscous Coupling
13 Bearing	49 Pinion Gear
14 Bushing	50 Thrust Washer
15 Sun Gear	51 Pinion Shaft
16 Thrust Plate	52 Thrust Washer
17 Hub	53 Thrust Washer
18 Bearing	54 Bushing
19 Snap Ring	55 Output Shaft
20 Snap Ring	56 Ring Gear
21 Snap Ring	57 Retaining Ring
22 Hub Reduction	58 Needle Bearing
23 Shift Fork	59 Ball Bearing
24 Spacer	60 Speed Gear
25 Shaft Shift	61 Flange
26 Spring	62 Oil Seal
27 Cam	63 Washer
28 Breather Hose	64 Nut
29 Breather Plug	65 Flange
30 Shift Rail	66 Dust Deflector
31 Intermediate Shaft	67 Tone Wheel
32 Thrust Washer	68 Bolt
33 Pump	69 Motor
34 Clamp Hose	70 Bolt
35 Upper Sprocket	71 Cap Screw
36 Thrust Washer	

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# TRANSFER CASE ASSEMBLY



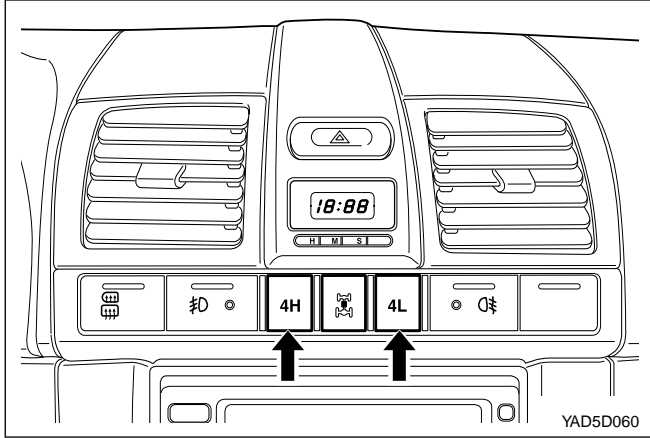
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- 1 Input Shaft
- 2 Air Control Cap
- 3 Front Companion Flange
- 4 Rear Companion Flange
- 5 Drain Plug
- 6 Filler Plug
- 7 Shift Cam Driving Motor

# FUNCTION DESCRIPTION

## TOD SYSTEM SELECT MODE

4H is the mode when drive normally of which gear ratio is 1 : 1 and 4L mode distributes power to front and rear wheels 50 : 50 of which gear ratio is 2.48 : 1.



TOD system controls clutch mechanism to comply with rotation in front and rear propeller shaft and if its difference exceeds the permissible range, corresponding power is distributed into front wheel through EMC (Electro-Magnetic Clutch). Hall effect sensor signals speed on front and rear propeller shafts going through with TOD control unit.

Transfer case clutch coil is activated by variable current on exceeding difference of speed in front and rear propeller shafts.

### Select 4L Mode

When select 4L mode, EMC is locked to apply maximum torque into front and rear propeller shafts. Shift motor rotates also 4L position by rotation of cam thus propeller shaft torque changes from 1 : 1 to 2.48 : 1 by planetary gear set.

### Deselect 4L Mode

When select 4H mode, the 4WD mode is deselected and returns the 4WD - high speed mode.

- “4H” switch : Slef-return Type
- “4L” switch : Push Lock Type

## COMPONENT FUNCTION

### Shift Motor

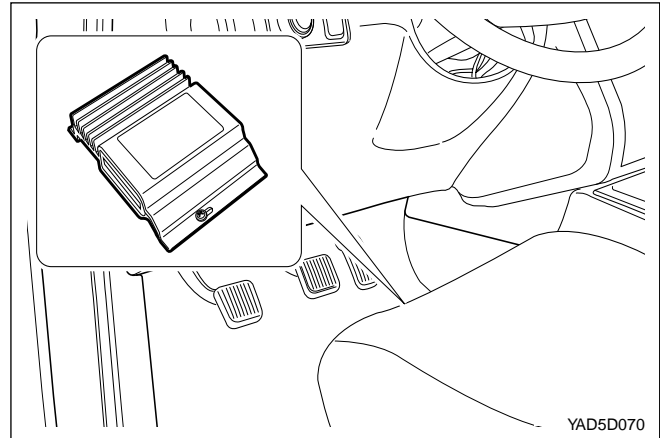
It locates backside transfer case, which drives rotary helical cam. When mode select switch changes to 4L, shift fork is on position for 2.48:1 by rotation of helical cam.

### Transfer Case

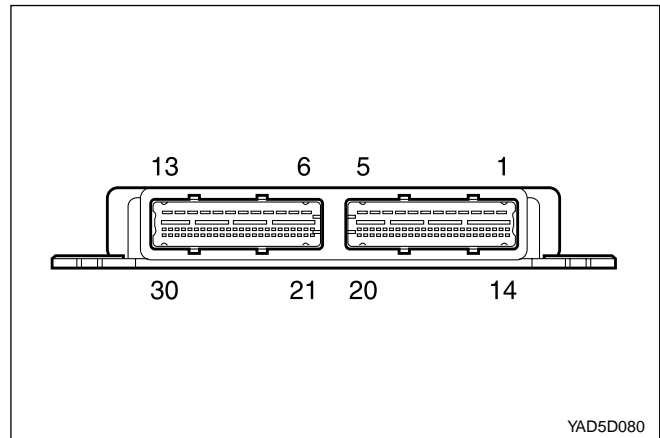
TOD transfer case distributes power into front and rear axle by operation of 4H/4L switch and shift motor. Shifting 4H to 4L, is performed towards reducing HI-LO collar by means for connection HI-LO shift fork with output shaft in order to join with planetary gear. Torque transmits input shaft then sun gear rotating front planetary gear. Front planetary gear join with output shaft and drives LO position.

### TOD Control Unit

TOD control unit is located on the floor under the driver seat.



### Shape and function of TOD Control Unit

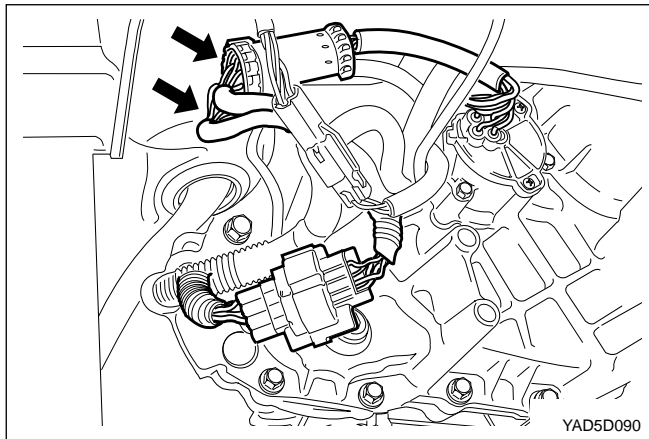


Pin	Function	Pin	Function
1	Motor HI-LO	16	Speed Reference
2	Motor LO-HI	17	Ground
3	EMC	18	Ground
4	Battery (+)	19	Battery (+)
5	Ignition	20	K-LINE
6	Position Return	21	4L Illumination
7	Diagnosis Display	22	CAN-H
8	-	23	CAN-L
9	HI / LO Switch	24	Auto T/M, Neutral
10	Position 2	25	ABS Input
11	Front Speed	26	Brake Switch
12	TPS Supply (Diesel)	27	Position 1
13	Speed/TPS Return	28	Position 3
14	Motor HI-LO	29	Rear Speed
15	Motor LO-HI	30	Position 4

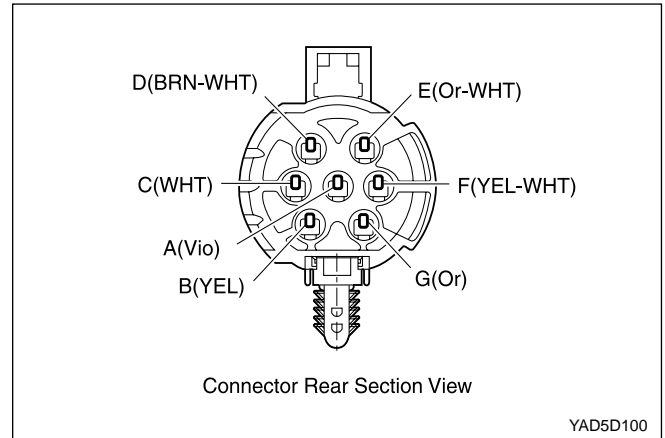
### Speed Sensor, Clutch Coil, Motor Connector

Speed Sensor, Clutch Coil and Motor Connector are located at the upper & rear side of the transfer case (upper shift motor) as shown.

- Shift Motor Connector : Black (upper arrow as shown)
- Speed Sensor and Clutch Coil Connector : White (lower arrow as shown)

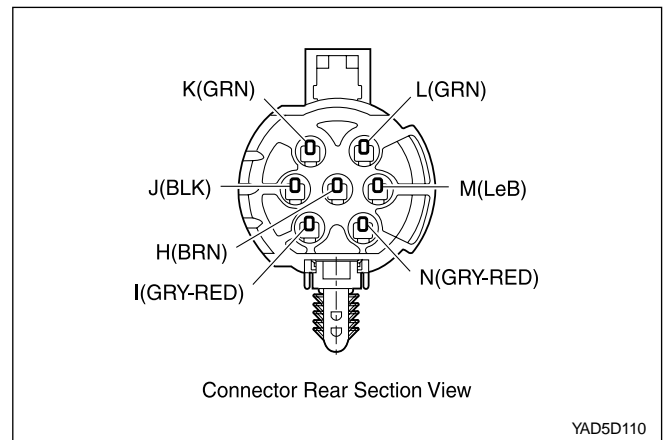


### Shift Motor Connector



Pin	Function
A	Motor HI-LO (clockwise)
B	Motor HI-LO (counter-clockwise)
C	Position Return
D	Position 1
E	Position 2
F	Position 3
G	Position 4

### Speed sensor, clutch coil connector



Pin	Function
H	Clutch Coil
I	Front Speed Return
J	Front Speed
K	Front Speed Sensor Voltage Supply
L	Rear Speed Sensor Voltage Supply
M	Rear Speed
N	Rear Speed Return

## DEFINITION OF TERMINOLOGY

Definitions	Description
Rear Speed Sensor	<p>A Hall Effect speed sensor which produces a square wave. 0-5Vdc signal in response to a rotating 30 tooth wheel coupled to the rear propeller shaft inside the Transfer Case.</p> <p>Each rotation of the rear propeller shaft will result in 30 speed sensor pulse.</p> <div style="text-align: center;"> <p style="text-align: right; margin-right: 50px;">YAD5D120</p> </div>
Front Speed Sensor	A Hall Effect speed sensor which produces a square wave. 0-5Vdc signal in response to a rotating 30 tooth wheel coupled to the front propeller shaft inside the Transfer Case.
EMC (Electromagnetic Clutch)	Each rotation of the front propeller shaft will result in 30 speed sensor pulse. An Electromagnetic clutch used to control the amount of torque applied to the front propeller shaft.
TOD	TOD is an abbreviation of Torque On Demand and means that the torque is transferred according to the operating condition.
TPS (Throttle Position Sensor)	TPS is an abbreviation of Throttle Position Sensor. For MSE engine, the potentiometer in the throttle actuator acts as TPS.
PWM	PWM is an abbreviation of Pulse Width Modulation and is a type of output value control by adjusting pulse width.
Duty Cycle	Duty Cycle is the time the EMC is on divided by the period in which it is being modulated.
Touch-off	A minimum amount of duty cycle applied to the EMC.
Front Overrun	A condition where the front propeller shaft is turning at a rate which is faster than the rear propeller shaft.
Rear Overrun	A condition where the rear propeller shaft is turning at a rate which is faster than the front propeller shaft.
High Range	The highest (numerically lowest = 1 : 1) gear ratio between the input and outputs of the Transfer Case.
Low Range	The lowest (numerically highest = 2.48 : 1) gear ratio between the input and outputs of the Transfer Case.

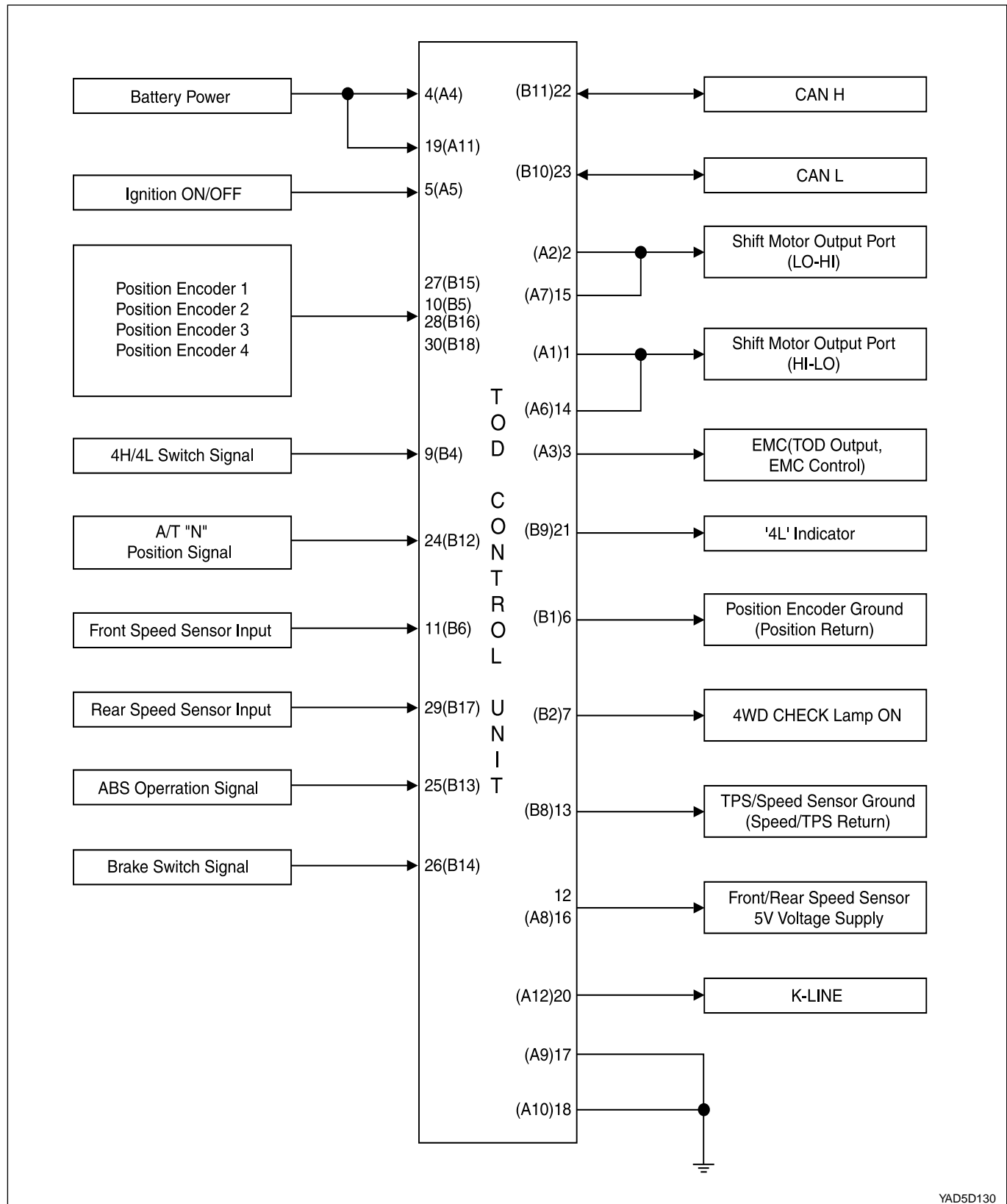


<b>Definitions</b>	<b>Description</b>
4H/4L Switch	A switch which selects the desired gear ratio. Electric motor which changes the Transfer Case range.
Shift Motor	A set of 4 Gray code switches which provide feedback to the TOD indicating the position of the Shift Motor.
Position Encoder	A switch on vehicles equipped with a manual transmission which indicates that the clutch pedal is depressed.
Neutral Safety Switch	A switch on vehicles equipped with an automatic transmission which indicates that the transmission is in neutral.
Shift Inhibit Speed	The vehicle speed above which Transfer Case shifts are disallowed. Vehicle speed is indicated by propeller shaft speed measurement.

# CONTROL UNIT

## Input/Output diagram

TOD control unit and main wiring harness is linked by 30 pin connector. Each pin joins with switch and actuator whose details refer to the below diagram.



Classification	Pin No.	Pin Name	Description
Power Supply	17,18	Ground	TOD control unit ground
	4,19	Input	TOD control unit battery supply : (Fuse No 13,20A)
Signal Input	5	Ignition	Ignition ON / OFF
	27	Position 1	Position encoder 1 : check of shift motor position
	10	Position 2	Position encoder 2 : check of shift motor position
	28	Position 3	Position encoder 3 : check of shift motor position
	30	Position 4	Position encoder 4 : check of shift motor position
	9	4H/4L Switch	Transfer case mode input
	24	Auto T/M Neutral	Check of neutral gear position in Auto T/M
	12, 16	Speed Voltage Supply	5V supply (TPS / speed sensor)
	11	Front Speed	Front speed sensor signal input
	29	Rear Speed	Rear speed sensor signal input
	25	ABS Operation	ABS ON / OFF
	26	Brake Switch	Brake Switch ON/OFF Signal Input
	22	CAN-L	CAN bus low line
	23	CAN-H	CAN bus high line
	20	K-LINE (1)	Connect to Diagnostic Connector No. 15
Signal Output		Motor LO-HI	Motor output port - LO to HI : join with battery - HI to LO (or motor brake) : join with ground
		Motor HI-LO	Motor output port - HI to LO : join with battery - LO to HI (or motor brake) : join with ground
	3	EMC	TOD Output
	21	4L Illumination	When the transfer case is in "4L" mode, illuminates "4L" indicator.
	6	Position Return	Position encoder ground
	7	Self Diagnosis Display	Illuminates "4L" indicator "4WD check lamp" turns ON Upon defect ; Ground circuit
	13	Speed	Ground for speed sensor / TPS

**(1) K-LINE : It means that Communication line for coding and diagnosis with diagnostic scanning tool.**

## SYSTEM OPERATION

### Initial Operation of TOD Control Unit

When ignition "ON", "4L" and "4WD check" lamps illuminates for 0.6 second to check bulb in instrument panel, then perform diagnosis of system (See 3F-19 Self-Diagnosis Condition).

### Position Encoder

The Position Encoder is used by the TOD to determine the position of the Shift Motor. Each motor position is identified by a position code below.

#### Notice:

- All other position codes are invalid
- Position  
Input Open Circuit (> 4.5V) = 1
- Position Input shorted to Speed/Position Return (< 0.5V) = 0

Position Code 1/2/3/4	Motor Position	Position Code 1/2/3/4	Motor Position
1110	Left Stop	1001	Neutral
1010	Left of High	0001	Zone 2
0010	High	0101	Low
0000	Right of High	0100	Right Stop
1110	Zone 1	-	-

**Position Sensor Interpretation**

When the module powers up, it will read the position sensor and the 4H/4L switch input and respond to the possible codes as follows.

<b>4H/4L Switch Input</b>	<b>Motor Position</b>	<b>System Response (Action)</b>
4H	Left Stop	No action required. 4L bulb off.
4H	Left of High	No action required. 4L bulb off.
4H	High	No action required. 4L bulb off.
4H	Right of High	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4H under conditions of below 87 rpm in front and rear propeller shaft and "Neutral" position. After successfully shifting into 4H, stop blinking 4L bulb.
4H	Zone 1	Same as above
4H	Neutral	Same as above
4H	Zone 2	Same as above
4H	Low	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4L. After successfully shifting into 4L, stop blinking 4L bulb.
4H	Right Stop	Same as above
4L	Left Stop	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4L. After successfully shifting into 4L, stop blinking 4L bulb.
4L	Left of High	Same as above
4L	High	Same as above
4L	Right of High	Same as above
4L	Zone 1	Same as above
4L	Neutral	Same as above
4L	Zone 2	Same as above
4L	Low	No action required. 4L bulb on.
4L	Right Stop	No action required. 4L bulb on.

A command to shift will only be acted upon if the TOD is reading a valid code at the time the command to shift is made.

After a shift has started, the TOD will power the shift motor until the code for the requested position is read. If an invalid code is read, the TOD will go into a default mode.

During a shift attempt, the shift motor will be energized for a maximum of 5 seconds.

### Electric Shift System Operation

The Electric Shift System is responsible for changing the Transfer Case gear ratio by controlling the electric shift motor. The TOD monitors the 4H/4L switch, neutral switch, speed sensors, position encoder, and ignition switch.

A range change is initiated when ;

1. The 4H/4L Switch is changed from 4H to 4L or from 4L to 4H.
2. The motor position (as indicated by the position encoder) does not match the 4H/4L Switch immediately after the ignition is turned on.

### Shift criteria

When a range change is initiated a Diagnostic Test will be completed on the motor, speed sensors, and position encoder. If the Diagnostic Test fails, the shift will not be attempted. If all components are operating properly, the TOD will attempt a range change after the following shift criteria are met:

1. The transmission is in neutral for 2 seconds after the shift is requested.
2. Both propeller shaft speeds are below 87 rpm (2580 pulses/minute).

If the transmission is taken out of neutral before 2 seconds has elapsed, or either propeller shaft speed increases above the limit, the shift will be suspended and the 4L Indicator will continue to blink until the criteria are met again or the 4H/4L Switch is returned to the original position.

### Range change

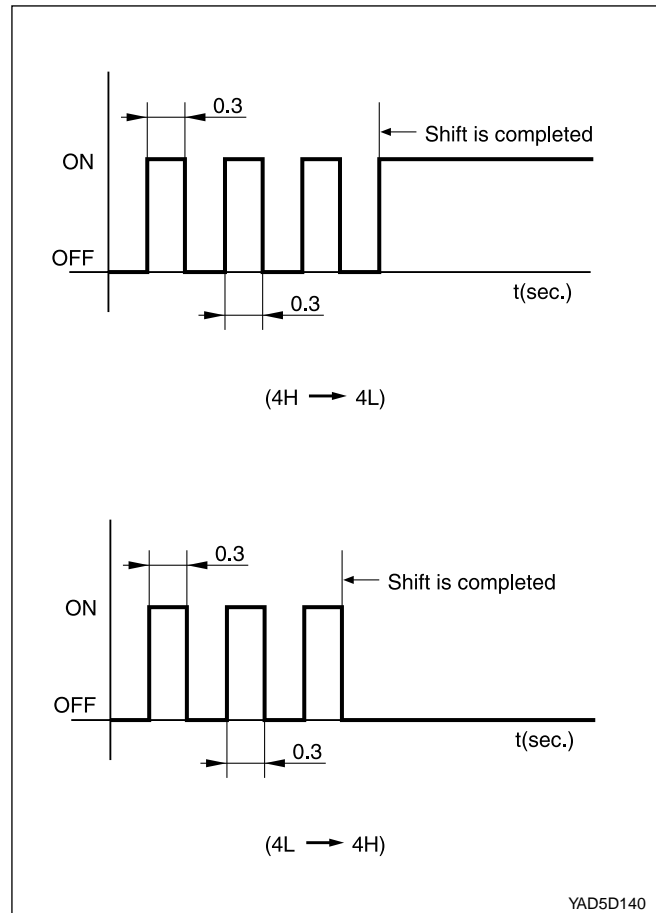
When the shift criteria are met, the motor is rotated in the appropriate direction (as determined by the selector switch) until one of the following occurs:

1. The motor reaches its destination.
2. The motor is on for 5 seconds without reaching its destination. The shift has failed and the TOD will respond as default mode.
3. A fault occurs with either the motor or position encoder. Refer to the diagnosis requirement.

When the motor is energized, the Ignition, 4H/4L Switch, propeller shaft speeds, and transmission neutral inputs are ignored.

### Indicator function on shifting

Once a range change has been initiated the 4L Indicator will begin to blink at a rate of 0.3 seconds on, 0.3 seconds off until the shift is completed or canceled.



If a successful shift has been completed, the 4L Indicator will be illuminated if the motor is in Low and it will be turned off if the motor is in High.

4L Indicator illuminates as below figure.

### Electric shift default mode

If the motor fails to reach its destination, the TOD will attempt the following (in order):

1. The TOD will wait 3 seconds then attempt the shift again.
2. If the second attempt to reach the destination fails the TOD will wait 3 seconds then attempt to rotate the motor back to the original position. If successful, all future shifts will be inhibited until the Ignition is cycled.
3. If the attempt to return to the original position fails, the TOD will wait 3 seconds then attempt to rotate the motor to the original position again. If the second attempt to return to the original position is successful, the 4WD CHECK lamp will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.

4. If the second attempt to return to the original position fails the motor will be turned off, the "4WD CHECK" lamp will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.

### **TOD TM System operation**

The TODTM System is responsible for distributing torque between the front and rear axles. The TOD monitors the propeller shaft speeds, operating range (High/Low), and ABS activity and then applies a calculated amount of torque to the front axle by Pulse Width Modulating the current applied to the EMC.

1. Touch-off Torque

The minimum EMC Duty Cycle is based on the vehicle speed and throttle position.

The TOD receives the TPS signal from the following sources:

On vehicles equipped with CAN, the TOD receives the TPS signal from the CAN bus.

2. When Slip Detection

The TOD continuously monitors the front and rear propeller shaft speeds to detect wheel slip.

3. Wheel Slip Control

When wheel slip is detected the TOD controls the EMC duty cycle as necessary until the wheel slip is reduced below the allowable limit. The EMC Duty Cycle will then be reduced to the Touch-Off value.

4. Brake/ABS Strategy

When the ABS System is active, the EMC Duty Cycle is set to a fixed duty cycle (30 %) to aid in braking without counteracting the ABS System.

5. 4L Strategy

When the system is operating in 4L, the TOD continues TODTM (operation provided that the propeller shaft speed is below 175 rpm (5220 pulses/minute)). When the speed increases above 175 rpm, the EMC Duty Cycle is set to the maximum value (88 %) which applies the maximum available torque to the front axle.

## DIAGNOSIS

While the TOD is active it periodically monitors its inputs and outputs. If a fault is detected the “4WD CHECK” lamp is illuminated and a fault code is stored in the TOD memory.

When requested, fault codes are downloaded to a diagnostic connector (K-line) serial communications using SCAN-100.

### DIAGNOSTIC TESTS

#### TOD Internal Function

When the Ignition is turned on the TOD tests its ROM and RAM. If there is a fault, the TOD immediately resets itself and re-tests the ROM and RAM. If the fault persists the TOD continues to reset and re-test until the fault is corrected or the ignition is turned off. All TOD functions are inhibited until the fault is corrected. The 4WD CHECK lamp is not illuminated if there is a ROM or RAM fault.

If the ROM/RAM passes the EEPROM memory is tested. If there is a fault the 4WD CHECK lamp is illuminated and the TOD continues to operate using the default calibration data stored in ROM. Fault codes are not stored when there is an EEPROM fault.

An EEPROM fault can only be cleared by cycling ignition off-on.

#### Shift Motor Assembly Test

If the TOD detects a shift motor or position encoder fault continuously for one second the “4WD CHECK” lamp is turned on and the appropriate fault code is stored in memory.

1. A shift motor fault when the motor is off is defined as follows:
  - Motor H-L shorted to Ground
  - Motor L-H shorted to Ground
  - Motor open circuit
2. A shift motor fault when the motor is energized is defined as follows:
  - Motor H-L shorted to Ground
  - Motor L-H shorted to Ground
  - Motor H-L shorted to Motor L-H
  - Motor open circuit
3. A position encoder fault is defined as follows:
  - Any position code which does not correspond to the valid 9 codes.
  - A short to ground on any of the encoder lines.
4. If no shifts are in progress when a failure occurs the TOD will not respond to any shift commands.

5. If a shift command has been received, but not acted upon when a failure occurs the TOD will cancel the command and not respond to any subsequent shift commands.
6. If a shift command is in progress when an invalid position code is confirmed it will be halted and the TOD will turn the motor toward the high position. Afterwards the TOD will not respond to any shift commands.
7. If the shift motor/position encoder assembly failure (other than a motor failure which occurs when the motor is energized) recovers continuously for one second the TOD will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.
8. A motor failure (i.e. open or short circuit) which occurs when the motor is energized can only be cleared by cycling the ignition off-on.

#### Front Speed Sensor Test

If a Front Speed Sensor fault is detected continuously for 0.5 second the 4WD CHECK lamp is illuminated. The TOD then responds as follows:

1. If the system is in High Range the TOD uses the Rear Speed Sensor to determine the EMC Touch Off level and wheel slip control is suspended.
2. If the system is in Low Range, the EMC Duty Cycle is set to maximum (independent of vehicle speed) until the system is shifted out of 4L.
3. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If the Front Speed Sensor recovers continuously for 0.5 second the TOD will function normally. The 4WD CHECK lamp is turned off but the fault code will remain in memory.

#### Rear Speed Sensor Test

If a Rear Speed Sensor fault is detected continuously for 0.5 second the 4WD CHECK lamp is illuminated. The TOD then responds as follows:

1. If the system is in High Range the TOD uses the Front Speed Sensor to determine the EMC Touch Off level and wheel slip control is suspended.
2. If the system is in Low Range, the EMC Duty Cycle is set to maximum (independent of vehicle speed) until the system is shifted out of 4L.
3. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If the Rear Speed Sensor recovers continuously for 0.5 second the TOD will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.



### Both Speed Sensor Faulty

If both the Front and Rear Speed Sensors are faulty continuously for 0.5 seconds the "4WD CHECK" lamp is illuminated. The TOD then responds as follows:

1. If the system is in High Range the TOD sets the EMC Touch off level based on a vehicle speed of 0 and wheel slip control is suspended.
2. If the system is in Low Range, the EMC Duty Cycle is set to maximum until the system is shifted out of 4L.
3. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If both Speed Sensors recover continuously for 0.5 second the TOD will function normally. The "4WD CHECK" lamp is turned off but the fault code will remain in memory.

### EMC Test

The EMC is tested for open circuit or short circuit to ground. If a fault is detected continuously for 0.8 second the "4WD CHECK" lamp is turned on and all TODTM activity is halted.

If the EMC recovers continuously for 0.8 second the TOD will function normally. The "4WD CHECK" lamp is turned off but the fault code will remain in memory.

## CODING ON TOD

### Connection of Coding Tool

Construct SCANNER into diagnosis connector (20 pins) near fuse box in engine room as below figure.

1. Diagnosis Connector
2. SCANNER

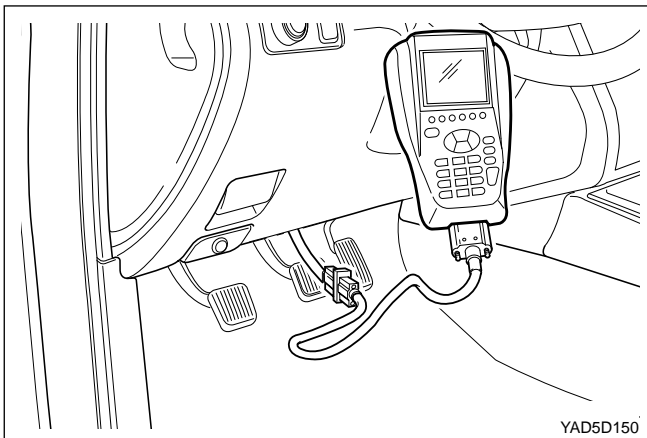
**Notice:** Coding ; An input activity of data for the proper performance by matching specification, devices and system with control unit.

### Coding required

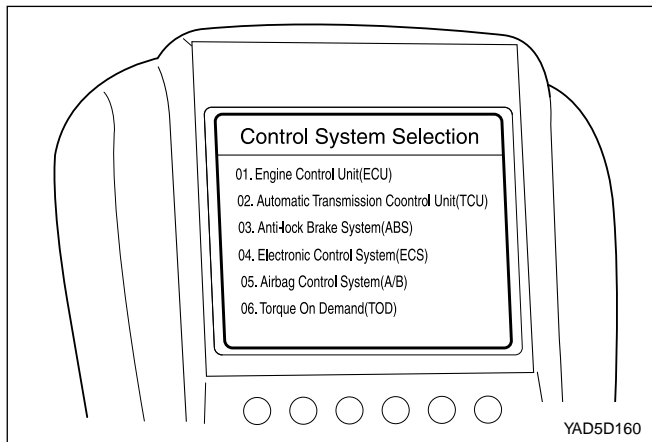
1. Replacement of TOD control unit.
2. Adjustment by input error.
3. Change of tire specification.

### Coding method

1. Check and record engine type, axle ratio and tire size.
2. Ignition "OFF".
3. Connect SCANNER with diagnosis connector in engine room.
4. Ignition "ON".
5. Read the current memorized specification in TOD control unit.



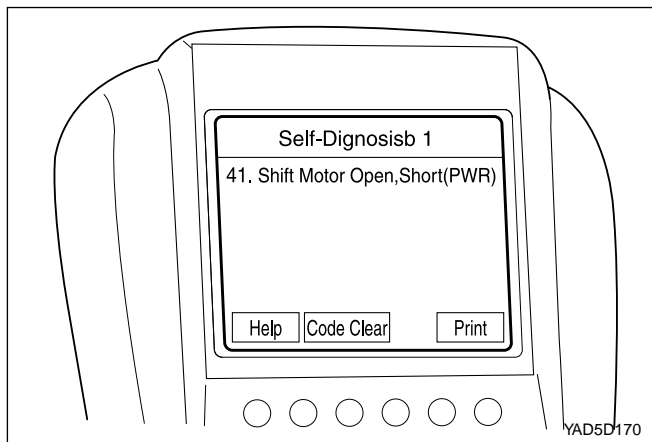
6. Compare memorized specification with the checked record. If not matched, perform a coding.
7. Read again memorized coding specification in TOD control unit for confirmation of coding.
8. Check coding specification whether it matches with vehicle or not. If not, perform a coding again.



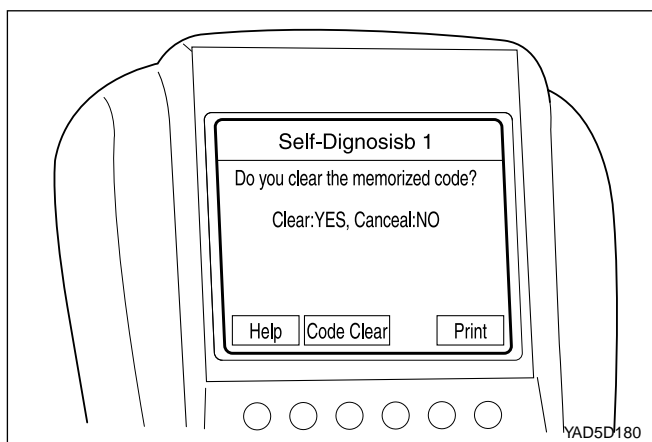
### Eliminate the Memorized Fault Code

When diagnose by SCANNER, it is required that you make adequate service on defects against all fault codes. And then you should delete the memorized fault codes in TOD control unit using SCANNER as follows;

1. Connect SCANNER with diagnosis connector.
2. Ignition turns "ON".
3. Select "Vehicle Type" and press "ENTER" key.
4. Select "Model Type" and press "ENTER" key.
5. Select "Control System" and then select "06 Transfer Case (TOD)". Press "ENTER" key.

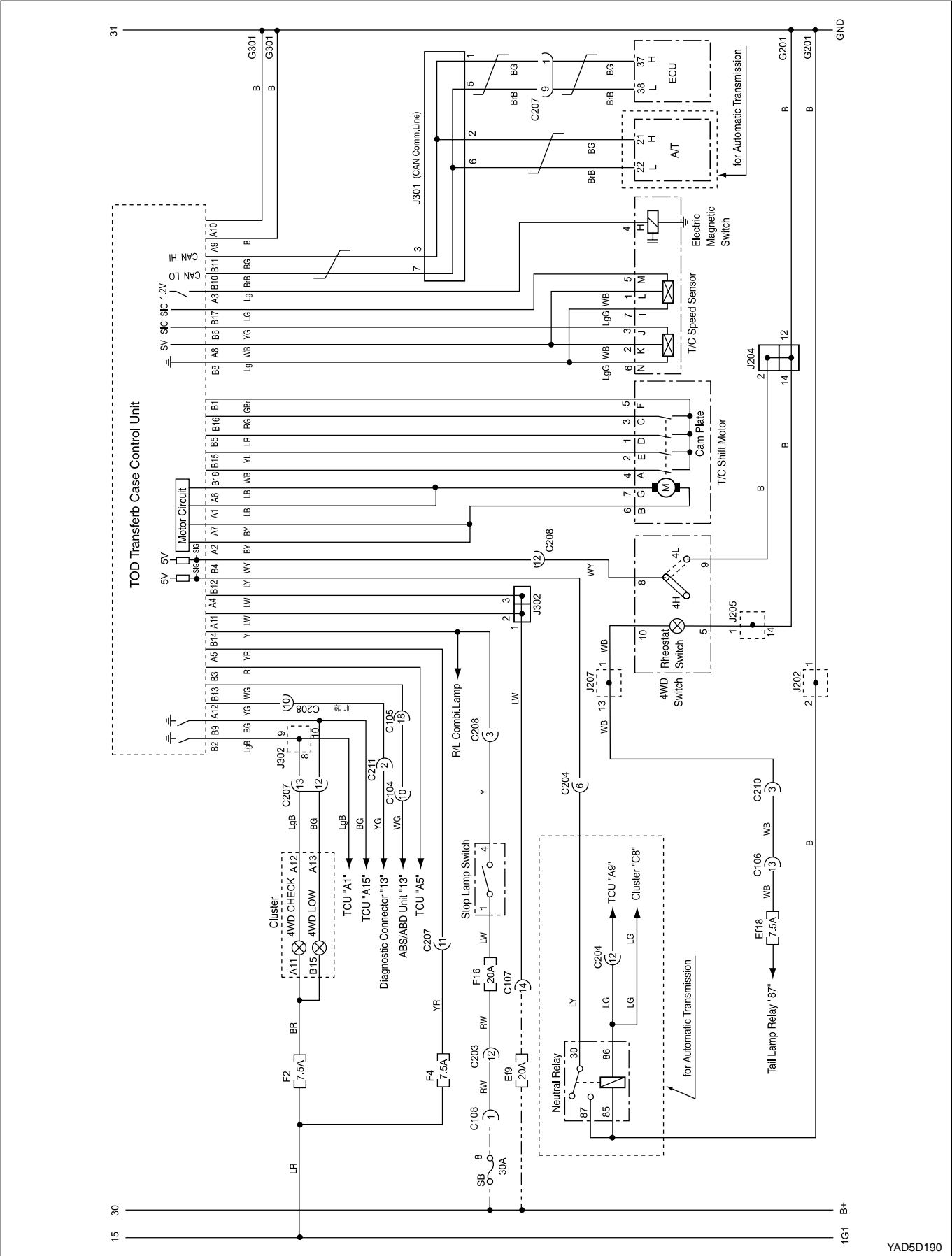


6. When system confirmation screen displays, press "ENTER" key.
7. If there is any fault in the system, it displays as shown.



8. Press the function key "F2".
9. Press "Yes".
10. If the memorized fault code is cleared successfully, it appears on the screen as following; "Self Diagnosis Result is Normal".

# SCHEMATIC WIRING DIAGRAM



## TOD CONTROL UNIT DIAGNOSTIC SYSTEM CHECK

### Circuit Description

The diagnostic system check is an organized approach to identifying a problem created by a transfer case control unit (TOD) malfunction. It must be starting point for any derivability complaint diagnosis because it directs the technician to the next logical step in diagnosing the complaint. Understanding the table and using it correctly will reduce diagnostic time and prevent the unnecessary replacement of parts.

Step	Action	Value	Yes	NO
1	Verify the customer's complaint. Does it verify the customer's complaint?	-	Go To Step 2	-
2	Turn the ignition ON. Does "4WD CHECK" lamp turns on continuously?	-	Go To Step 4	Go To Step 3
3	Jump between the terminal A2 of the TOD and ground. Does "4WD CHECK" lamp turns on? 1. Turn the ignition OFF.	-	Go To Step 4	Repair the bulb and circuit
4	2. Connect the data diagnosis connector to scan tool and follow the manual instruction. 3. Turn the ignition ON. Does the scan tool communicate with TOD?	-	Go To Step 9	Go To Step 5
5	Check whether the scan tool communicates with other control units. Does the scan tool communicate with other control units?	-	Go To Step 6	Go To Step 7
6	Repair the diagnostic line between the TOD terminal A12 and DLC connector 13. Is the repair complete?	-	Go To Step 4	-
7	Change the scan tool. Does the scan tool communicate with other control units?	-	Go To Step 4	Go To Step 8
8	1. Replace the TOD. 2. Connect the data diagnosis connector to scan tool. 3. Request the DTC. Does any DTC display?	-	Go To Step 11	Go To Step 10
9	Request the DTC with the scan tool. Does any DTC display?	-	Go To Step 11	Go To Step 10
10	1. Perform the road test. 2. Recheck any DTC. Does any DTC display?	-	Go To Step 11	System OK
11	Refer to applicable DTC table. Start the lowest DTC and move another DTC. Does the DTC identify as a valid DTC?	-	Go To the applicable DTC table	-

## DIAGNOSTIC TROUBLE CODES (DTC's)

### Diagnostic Trouble Code Retention

The first time a fault is detected a DTC is stored in the TOD's Non-Volatile memory. This DTC will remain in memory until the TOD is instructed to erase DTC's by SCAN-100. DTC's will not be erased by disconnecting power to the TOD.

### Diagnostic Trouble Code Assignments

Classification	Fault Code	Description
TOD	1714	EEPROM Checksum Fault
	1715	TPS Loss of Signal
	1716	TPS Out of Range
EMC	1721	EMC Open / Short to Battery
	1722	EMC Short to ground
Speed Sensor	1731	Front Speed Sensor Voltage Low
	1732	Front Speed Sensor Voltage High
	1733	Rear Speed Sensor Voltage Low
	1734	Rear Speed Sensor Voltage High
	1735	Speed Sensor Reference Voltage Low
	1736	Speed Sensor Reference Voltage High
Shift Motor	1741	Motor Open / Shorted to Battery
	1742	Motor Output Shorted to Ground
	1743	Shift System Timeout
Position Encoder	1750	General Position Encoder Fault (Invalid Code)
	1751	Position 1 Shorted to Ground
	1752	Position 2 Shorted to Ground
	1753	Position 3 Shorted to Ground
	1754	Position 4 Shorted to Ground

## 4WD CHECK INDICATOR STAYS ON WITH IGNITION SWITCH ON

### Circuit Description

When the ignition switch turns to ON the transfer case control unit (TOD) illuminates 4WD CHECK and 4WD LOW indicator to check bulb operation and turns off after 0.6 seconds. Then TOD starts self-diagnosis and illuminate 4WD CHECK indicator when TOD detects any fault.

### Diagnostic Aids

- If the 4WD CHECK indicator illuminates steadily the TOD may detect some fault. TOD should be checked by scan tool to solve the problem.
- The 4WD CHECK indicator also illuminates steadily if the terminal B2 of TOD connector is shorted to ground. The shorted wire or terminals should be repaired.

### Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step, along with step 4, checks the short to ground condition of the wire or terminals.

Step	Action	Value	Yes	No
1	1. Turn the ignition switch to OFF. 2. Connect the scan tool to the data link connector (DLC). 3. Turn the ignition switch to ON and request the DTC. Does the scan tool display any DTC?	-	Go to the specific DTC diagnostic table	Go to Step 2
2	1. Turn the ignition switch to OFF. 2. Disconnect the 18-pin connector from transfer case control unit (TOD). 3. Turn the ignition switch to ON and check the 4WD CHECK bulb operation. Does the 4WD CHECK indicator come on steadily?	-	Go to Step 3	Go to Step 4
3	Repair any short to ground circuit between terminal A2 of TOD connector and terminal 31 of cluster. Is the repair complete?	-	System OK	-
4	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Does the 4WD CHECK indicator come on steadily?	-	Go to Step 5	System OK
5	Replace the TOD. Is the repair complete?	-	System OK	-

## 4WD LOW INDICATOR STAYS ON WITH IGNITION SWITCH ON

### Circuit Description

When the ignition switch turns to ON the transfer case control unit (TOD) illuminates 4WD CHECK and 4WD LOW indicator to check bulb operation and turns off after 0.6 seconds. Then TOD starts self-diagnosis and illuminate 4WD CHECK indicator when TOD detects any fault.

### Diagnostic Aids

- If the 4WD LOW indicator illuminates steadily the transfer case in 4WD low range and 4H/4L switch set to 4L. It is normal condition.
- The 4WD LOW indicator also illuminates steadily if the terminal B9 of TOD connector is shorted to ground. The shorted wire or terminals should be repaired.

### Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for the normal bulb operation.

Step	Action	Value	Yes	No
1	Check the position of 4H/4L switch. Does the 4H/4L switch set on 4L?	-	Go to Step 2	Go to Step 3
2	1. Turn the ignition switch to ON. 2. Set the shift lever to N (neutral). 3. Turn the 4H/4L switch to 4H. Does the 4WD LOW indicator go off?	-	System OK	-
3	1. Turn the ignition switch to ON. 2. Set the shift lever to N (neutral). 3. Turn the 4H/4L switch to 4L. Does the 4WD LOW indicator go off?	-	Go to Step 4	Go to Step 5
4	The wiring of 4H/4L switch is reversed. Repair the wiring. Is the repair complete?	-	System OK	-
5	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Does the 4WD LOW indicator come on steadily?	-	Go to Step 6	System OK
6	Repair any short to ground circuit between terminal B9 of TOD connector and terminal A13 of cluster. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-

## NO 4WD CHECK OR 4WD LOW INDICATOR WITH IGNITION SWITCH ON

### Circuit Description

When the ignition switch turns to ON the transfer case control unit (TOD) illuminates 4WD CHECK and 4WD LOW indicator to check bulb operation and turns off after 0.6 seconds. Then TOD starts self-diagnosis and illuminate 4WD CHECK indicator when TOD detects any fault.

### Diagnostic Aids

If the both of the 4WD CHECK and 4WD LOW indicator were not illuminating there would be some problems with fuse, power supply line, improper connection of connector or transfer case control unit (TOD).

If one of the indicators illuminates, the fuse and power supply line is good and the connector or TOD may be the cause of problems.

### Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step checks for the normal bulb operation.
5. This step checks voltage supply condition.

Step	Action	Value	Yes	No
1	Check the bulb operation when the ignition switch turns to ON. Does the only 4WD LOW indicator come on and goes after 0.6 seconds?	-	Go to Step 2	Go to Step 5
2	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connector from the transfer case control unit (TOD). 3. Using test lamp check the continuity between terminal B2 of TOD and ground. Does the test lamp come on?	-	Go to Step 3	Go to Step 4
3	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Do the two indicators come on go after 0.6 seconds?	-	System OK	Go to Step 7
4	Repair or replace of following components: <ul style="list-style-type: none"> <li>• 4WD CHECK indicator bulb.</li> <li>• Open circuit between terminal A12 of cluster and terminal B2 of TOD connector.</li> </ul> Is the repair complete?	-	System OK	Go to Step 7
5	1. Check the fuse F2 and indicator bulbs. 2. Check the continuity for following terminals: <ul style="list-style-type: none"> <li>• Fuse F2 to B2 (TOD)</li> <li>• A2 (Cluster) to B2 (TOD)</li> <li>• B15 (Cluster) to B9 (TOD)</li> </ul> Are there any problems?	-	Go to Step 6	Go to Step 7
6	Repair open circuit or replace damaged parts. Is the repair complete?	-	System OK	Go to Step 7
7	Replace the TOD. Is the repair complete?	-	System OK	-



## 4WD LOW INDICATOR BLINK STEADILY

**Circuit Description**

When the 4H/4L switch turned from 4H (4L) to 4L (4H) electric shift starts and 4WD LOW indicator begin to blink until the shifting is completed or canceled. If 4H to 4L shifting is completed the 4WD LOW indicator will illuminated and 4L to 4H shifting is completed it will be turned off.

If shifting fails the 4WD LOW indicator will blink steadily until the shifting is completed or canceled.

**Diagnostic Aids**

The 4WD LOW indicator shows that the transfer case is operating in low range. And the indicator will blink while shifting from low to high range or high to low range. If the indicator blinks steadily it warns the shifting command and real position of the shift motor or position encoder are not matched.

Step	Action	Value	Yes	No
1	1. Stop the vehicle. 2. Turn the 4H/4L switch to original position. Does the 4WD LOW indicator stop blinking?	-	Go to Step 2	Go to Step 3
2	1. Make sure the vehicle stopped completely. 2. Set the shift lever to N (neutral) and wait more than 2 seconds. 3. Turn the 4H/4L switch. Does the 4WD LOW indicator blink and stop after complete shifting? <ul style="list-style-type: none"> <li>• 4H → 4L: 4WD LOW indicator illuminates.</li> <li>• 4L → 4H: 4WD LOW Indicator turns off.</li> </ul>	-	System OK	Go to Step 3
3	1. Starts TOD Diagnostic System Check. 2. If there were no trouble code, replace TOD. Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1714

### EEPROM Checksum Fault

#### Circuit Description

When the ignition is turned on the transfer case control unit (TOD) receives battery voltage and ignition voltage and illuminates the 4WD CHECK and 4WD LOW indicators for 0.6 seconds. Then it starts self diagnosis to check itself.

#### Conditions for Setting the DTC

DTC 1714 is an indication of a potential internal transfer case control unit (TOD) malfunction. It will set if any of following conditions is detected.

- The calculated checksum for internal memory does not match the stored value.
- The permanent memory storage area is malfunctioning.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

#### Diagnostic Aids

- Check for poor connections, fuse and power supply wiring.
- Check for ground condition.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the battery supply voltage.
4. This step checks the ground condition.
6. This step checks the connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go To "TOD Control Unit Diagnostic System Check"
2	1. Turn the ignition switch OFF. 2. Disconnect the 12-pin connector from transfer case control unit (TOD). 3. Turn the ignition switch to ON. 4. Connect a digital voltmeter between each of the following TOD connector terminal and ground. <ul style="list-style-type: none"> <li>• A4 (Battery supply)</li> <li>• A11 (Battery supply)</li> <li>• A5 (Battery supply)</li> </ul> Does the voltage of the all circuits measure within the value specified?	11 ~ 14 V	Go to Step 4	Go to Step 3
3	1. Check the fuse EF9 and voltage supply circuit. 2. Repair or replace any open or damaged circuit or fuse. Is the repair complete?	-	Go to Step 4	-
4	Connect a digital ohmmeter between each of the following TOD connector terminal and ground. <ul style="list-style-type: none"> <li>• B9 (Ground).</li> <li>• B2 (Ground).</li> </ul> Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 6	Go to Step 5
5	Repair or replace any open or damaged circuit. Is the repair complete?	-	Go to Step 6	-

Step	Action	Value	Yes	No
6	1. Check the terminals for damages and loose connection. 2. Replace or repair the faulty connector, wire, or terminals. 3. Connect the TOD connector. 4. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 5. Turn the ignition switch to ON. 6. Delete and request DTC with scan tool. Is DTC 1714 still present?	-	Go to Step 7	System OK
7	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete DTC with scan tool. Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1715

### TP Sensor Loss of Signal

#### Circuit Description

The transfer case control unit (TOD) receives throttle position (TP) sensor signals from engine control module (ECM) through CAN bus line.

#### Conditions for Setting the DTC

The transfer case control unit (TOD) can not receive throttle position (TP) sensor signal from engine control module (ECM). There is a bad communication between TOD and ECM.

- TOD is malfunction.
- ECM is malfunction.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

#### Diagnostic Aids

- Check for poor connections of CAN bus line.
- Check for ECM and TP sensor.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step decides the causal parts of the problem.
4. This step checks the ground condition.
6. This step checks the connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON and request engine DTC. Are there any engine DTC related throttle position (TP) sensor?	-	Go to "TOD Diagnostic System Check" Refer to Section Engine	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect the 18-pin connector from the transfer case control unit (TOD). 3. Disconnect the gray connector from engine control module (ECM). 4. Connect a digital ohmmeter between the following TOD connector terminal and gray ECM connector terminal. <ul style="list-style-type: none"> <li>• B11 (TOD) and 37 (ECM)</li> <li>• B10 (TOD) and 38 (ECM)</li> <li>• B11 (TOD) and 24 (ECM)</li> <li>• B10 (TOD) and 23 (ECM)</li> </ul> Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 5	Go to Step 4
4	Repair or replace any open wires, faulty connector, or terminal. Is the repair complete?	-	System OK	-

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
5	1. Replace the TOD. 2. Connect all connectors. 3. Request DTC with scan tool. Is the repair complete?	-	System OK	Go to Step 6
6	Replace the ECU. Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1716

### TP Sensor Out of Range

#### Circuit Description

The transfer case control unit (TOD) receives throttle position (TP) sensor signals from engine control module (ECM) through CAN bus line.

#### Conditions for Setting the DTC

The transfer case control unit (TOD) receives throttle position (TP) sensor signal from engine control module (ECM), but the signal is out of the range.

There is a bad communication between TOD and ECU.

- TOD is malfunction.
- ECU is malfunction.

#### Action taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

#### Diagnostic Aids

Check for poor connections of CAN bus line.

Check for ECU and TP sensor.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step decides the causal parts of the problem.
4. This step checks the ground condition.
6. This step checks the connection status.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-		Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON and request engine DTC. Are there any engine DTC related throttle position (TP) sensor?	-	Go to Step 2 Go to "TOD Diagnostic System Check" Go to specific engine DTC diagnosis.	Go to Step 2
3	1. Turn the ignition switch to OFF. 2. Disconnect the 18-pin connector from the transfer case control unit (TOD). 3. Disconnect the gray connector from engine control module (ECU). 4. Connect a digital ohmmeter between the following TOD connector terminal and gray ECU connector terminal. <ul style="list-style-type: none"> <li>• B11 (TOD) and 38 (ECU)</li> <li>• B10 (TOD) and 37 (ECU)</li> <li>• B11 (TOD) and A24</li> <li>• B10 (TOD) and A23</li> <li>• B11 (TOD) and ground</li> <li>• B10 (TOD) and ground</li> </ul> Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 4	Go to Step 5
4	Repair or replace any short wires, faulty connector, or terminal. Is the repair complete?	-	System OK	-

<b>Step</b>	<b>Action</b>	<b>Value</b>	<b>Yes</b>	<b>No</b>
5	1. Replace the TOD. 2. Connect all connectors. 3. Request DTC with scan tool. Is the repair complete?	-	System OK	Go to Step 6
6	Replace the ECU. Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1721

### Electromagnetic Clutch Open / Short to Battery

#### Circuit Description

To control the distribution of the torque to front propeller shaft, the transfer case control unit (TOD) sends a signal to the electromagnetic clutch (EMC). Then the clutch disc is compressed or released by the EMC.

#### Conditions for Setting the DTC

Even the TOD send signal for controlling the EMC, it receives uncontrolled propeller shaft speed signal.

- The wiring circuit to EMC opened.
- The wiring circuit is shorted to battery.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

#### Diagnostic Aids

- Check for poor connections of the circuit.
- Check for EMC.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks poor connection or damage on the pin.
3. This step, along with step 4, checks the voltage supply condition.
5. This step checks the ground condition.
7. This step checks the continuity of the wire and short to battery condition.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Inspect the terminals for damage or improper connection. 4. Repair any damaged pins or terminals on the wiring harness and TOD. 5. Reconnect the connectors and make sure it is seated properly. 6. Connect a scan tool to the data link connector (DLC). 7. Turn the ignition ON. 8. Request the DTC with scan tool. Is the DTC still current?	-	Go to Step 3	System OK
3	1. Turn the ignition switch to OFF. 2. Disconnect the 12-pin connector from transfer case control unit (TOD). 3. Turn the ignition switch to ON. 4. Connect a digital voltmeter between each of the following TOD connector terminal and ground. <ul style="list-style-type: none"> <li>• A4 (Battery supply).</li> <li>• A11 (Battery supply).</li> </ul> Does the voltage of the all circuits measure within the value specified?	11 ~ 14 V	Go to Step 5	Go to Step 4



Step	Action	Value	Yes	No
4	1. Check the fuse EF9, F10 and voltage supply circuit. 2. Repair or replace any open or damaged circuit or fuse. Is the repair complete?	-	Go to Step 5	-
5	Connect a digital ohmmeter between each of the following TOD connector terminal and ground. <ul style="list-style-type: none"> <li>• A9 (Ground)</li> <li>• A10 (Ground)</li> </ul> Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 7	Go to Step 6
6	Repair or replace any open or damaged circuit. Is the repair complete?	-	Go to Step 7	-
7	1. Disconnect the 7-pin connector under the body. 2. Measure the voltage between terminal 4 and ground. Is the resistance within the value specified?	12	Go to Step 9	Go to Step 8
8	Repair open or short to battery circuit. Is the repair complete?	-	System OK	-
9	Measure the resistance between the clutch coil terminal H and ground. Is the measurement within the value specified?	2.2 ~ 2.8 Ω	Go to Step 11	Go to Step 10
10	1. Replace EMC (Electronic Magnetic Clutch). 2. Connect all the connectors. 3. Connect a scan tool to the DLC. 4. Turn the ignition switch to ON. 5. Delete and request DTC. Is the repair complete?	-	System OK	-
11	Replace TOD. Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1722

### Electromagnetic Clutch Short to Ground

#### Circuit Description

To control the distribution of the torque to front propeller shaft, the transfer case control unit (TOD) sends a signal to the electromagnetic clutch (EMC). Then the clutch disc is compressed or released by the EMC.

#### Conditions for Setting the DTC

Even the TOD send signal for controlling the EMC, it receives uncontrolled propeller shaft speed signal.

- The wiring circuit to EMC is shorted to ground.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

#### Diagnostic Aids

- Check for poor connections of the circuit.
- Check for EMC.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

- This step checks poor connection or damage on the pin.
- This step, along with step 4, checks the voltage supply condition.
- This step checks the ground condition.
- This step checks the continuity of the wire and short to battery condition.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	<ol style="list-style-type: none"> <li>Turn the ignition switch to OFF.</li> <li>Disconnect two connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body.</li> <li>Inspect the terminals for damage or improper connection.</li> <li>Repair any damaged pins or terminals on the wiring harness and TOD.</li> <li>Reconnect the connectors and make sure it is seated properly.</li> <li>Connect a scan tool to the data link connector (DLC).</li> <li>Turn the ignition ON.</li> <li>Request the DTC with scan tool.</li> </ol> Is the DTC still current?	-	Go to Step 3	System OK
3	<ol style="list-style-type: none"> <li>Turn the ignition switch to OFF.</li> <li>Disconnect the 12-pin connector from transfer case control unit (TOD).</li> <li>Turn the ignition switch to ON.</li> <li>Connect a digital voltmeter between each of the following TOD connector terminal and ground.               <ul style="list-style-type: none"> <li>A4 (Battery supply).</li> <li>A11 (Battery supply).</li> </ul> </li> </ol> Does the voltage of the all circuits measure within the value specified?	11 ~ 14 V	Go to Step 5	Go to Step 4
4	<ol style="list-style-type: none"> <li>Check the fuse EF9, F10 and voltage supply circuit.</li> <li>Repair or replace any open or damaged circuit or fuse.</li> </ol> Is the repair complete?	-	Go to Step 5	-

Step	Action	Value	Yes	No
5	Connect a digital ohmmeter between each of the following TOD connector terminal and ground. <ul style="list-style-type: none"> <li>• A9 (Ground)</li> <li>• A10 (Ground)</li> </ul> Does the resistance of the all circuits measure within the value specified?	0 Ω	Go to Step 7	Go to Step 6
6	Repair or replace any open or damaged circuit. Is the repair complete?	-	Go to Step 7	-
7	1. Disconnect the 7-pin connector under the body. 2. Measure the voltage between terminal 4 and ground. Is the resistance within the value specified?	0 Ω	Go to Step 9	Go to Step 8
8	Repair open or short to battery circuit. Is the repair complete?	-	System OK	-
9	Measure the resistance between the clutch coil terminal H and ground. Is the measurement within the value specified?	2.2 ~ 2.8 Ω	Go to Step 11	Go to Step 10
10	1. Replace EMC (Electronic Magnetic Clutch). 2. Connect all the connectors. 3. Connect a scan tool to the DLC. 4. Turn the ignition switch to ON. 5. Delete and request DTC. Is the repair complete?	-	System OK	-
11	Replace TOD. Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1731

### Front Speed Sensor Voltage Low

#### Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front speed sensor and receives speed signals generated by Hall effect speed sensor.

#### Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to ground or opened.
- The reference voltage circuit is shorted to ground or opened.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the rear speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum, independent of vehicle speed, until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

#### Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1735 also shown?	-	Go to "DTC 1735 – Speed Sensor Reference Voltage Low"	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the resistance between terminals B6 and terminals of the 7-pin connector. 4. Measure the resistance between terminals B6 and ground. Is measured value equal to specified range?	0 Ω	Go to Step 5	Go to Step 4
		∞		

Step	Action	Value	Yes	No
4	<ol style="list-style-type: none"> <li>1. Repair any damaged pins, terminals, open or short to ground circuit.</li> <li>2. Reconnect the connectors and make sure it is seated properly.</li> <li>3. Connect a scan tool to the data link connector (DLC).</li> <li>4. Turn the ignition ON.</li> <li>5. Request the DTC with scan tool.</li> </ol> Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? <ul style="list-style-type: none"> <li>• Terminal 6 and terminal 3</li> <li>• Terminal 6 and terminal 2</li> <li>• Terminal 3 and terminal 2</li> </ul>	5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 MΩ	Go to Step 7	Go to Step 6
6	Replace front propeller shaft speed sensor. Is the repair complete?	-	System OK	-
7	<ol style="list-style-type: none"> <li>1. Replace the TOD.</li> <li>2. Turn the ignition switch to OFF.</li> <li>3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual.</li> <li>4. Turn the ignition switch to ON.</li> <li>5. Delete and request DTC with scan tool.</li> </ol> Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1732

### Front Speed Sensor Voltage High

#### Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front speed sensor and receives speed signals generated by Hall effect speed sensor.

#### Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to voltage.
- The reference voltage circuit is shorted to voltage.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the rear speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum, independent of vehicle speed, until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

#### Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1736 also shown?	-	Go to "DTC 1736 – Speed Sensor Reference Voltage High"	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the voltage between terminals B6 and ground. Is measured value below the specified value?	0 Ω	Go to Step 5	Go to Step 4

Step	Action	Value	Yes	No
4	<ol style="list-style-type: none"> <li>1. Repair any damaged pins, terminals, short to battery circuit.</li> <li>2. Reconnect the connectors and make sure it is seated properly.</li> <li>3. Connect a scan tool to the data link connector (DLC).</li> <li>4. Turn the ignition ON.</li> <li>5. Request the DTC with scan tool.</li> </ol> Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? <ul style="list-style-type: none"> <li>• Terminal B and terminal C</li> <li>• Terminal B and terminal D</li> <li>• Terminal C and terminal D</li> </ul>	5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	Go to Step 7	Go to Step 6
6	Replace front propeller shaft speed sensor. Is the repair complete?	-	System OK	-
7	<ol style="list-style-type: none"> <li>1. Replace the TOD.</li> <li>2. Turn the ignition switch to OFF.</li> <li>3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual.</li> <li>4. Turn the ignition switch to ON.</li> <li>5. Delete and request DTC with scan tool.</li> </ol> Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1733

### Rear Speed Sensor Voltage Low

#### Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front and rear speed sensor and receives speed signals generated by Hall effect speed sensor.

#### Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to ground or opened.
- The reference voltage circuit is shorted to ground or opened.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the front speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum independent of vehicle speed until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

#### Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1736 also shown?	-	Go to "DTC 1735 – Speed Sensor Reference Voltage Low"	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the resistance between terminals 17 of TOD and terminals in female white 7-pin connector. Is measured value equal to specified range? 4. Measure the resistance between terminals B17 of TOD and ground. Is measured value equal to specified range?	0 Ω  ∞	Go to Step 5	Go to Step 4



Step	Action	Value	Yes	No
4	<ol style="list-style-type: none"> <li>1. Repair any damaged pins, terminals, open or short to ground circuit.</li> <li>2. Reconnect the connectors and make sure it is seated properly.</li> <li>3. Connect a scan tool to the data link connector (DLC).</li> <li>4. Turn the ignition ON.</li> <li>5. Request the DTC with scan tool.</li> </ol> Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? <ul style="list-style-type: none"> <li>• Terminal 7 and terminal 5</li> <li>• Terminal 7 and terminal 1</li> <li>• Terminal 5 and terminal 1</li> </ul>	5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	Go to Step 7	Go to Step 6
6	Replace rear propeller shaft speed sensor. Is the repair complete?	-	System OK	-
7	<ol style="list-style-type: none"> <li>1. Replace the TOD.</li> <li>2. Turn the ignition switch to OFF.</li> <li>3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual.</li> <li>4. Turn the ignition switch to ON.</li> <li>5. Delete and request DTC with scan tool.</li> </ol> Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1734

### Rear Speed Sensor Voltage High

#### Circuit Description

The transfer case control unit (TOD) supplies 5 volts reference voltage to the front speed sensor and receives speed signals generated by Hall effect speed sensor.

#### Conditions for Setting the DTC

- The wiring circuit for speed sensor shorted to voltage.
- The reference voltage circuit is shorted to voltage.

#### Action Taken When the DTC Sets

The TOD will illuminate 4WD CHECK indicator and DTC is stored in TOD.

The TOD then responds as follows:

- If the system is in high range the TOD uses the front speed sensor to determine the EMC touch off level and wheel slip control is suspended.
- If the system is in low range, the EMC duty cycle is set to maximum independent of vehicle speed until the system is shifted out of low range.
- All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

#### Diagnostic Aids

- Check for short to ground or open circuit.
- Check for front propeller speed sensor.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks the continuity.
5. This step checks the speed sensor.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Turn the ignition switch to OFF. 2. Connect a scan tool to the data link connector (DLC) and follow the directions given in the scan tool manual. 3. Turn the ignition switch to ON. 4. Request DTC with scan tool. Is the DTC 1736 also shown?	-	Go to "DTC 1736 - Speed Sensor Reference Voltage High"	Go to Step 3
3	1. Turn the ignition switch to OFF. 2. Disconnect 18-pin connectors of the transfer case control unit (TOD) and white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 3. Measure the voltage between terminals B17 of TOD and ground. Is measured value below the specified value?	0 Ω	Go to Step 5	Go to Step 4

Step	Action	Value	Yes	No
4	<ol style="list-style-type: none"> <li>1. Repair any damaged pins, terminals, open or short to ground circuit.</li> <li>2. Reconnect the connectors and make sure it is seated properly.</li> <li>3. Connect a scan tool to the data link connector (DLC).</li> <li>4. Turn the ignition ON.</li> <li>5. Request the DTC with scan tool.</li> </ol> Is the DTC still current?	-	Go to Step 5	System OK
5	Measure the resistance between terminals of the male white 7-pin connector. Is the measurement within specified range? <ul style="list-style-type: none"> <li>• Terminal 7 and terminal 5</li> <li>• Terminal 7 and terminal 1</li> <li>• Terminal 5 and terminal 1</li> </ul>	5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	Go to Step 7	Go to Step 6
6	Replace rear propeller shaft speed sensor. Is the repair complete?	-	System OK	
7	<ol style="list-style-type: none"> <li>1. Replace the TOD.</li> <li>2. Turn the ignition switch to OFF.</li> <li>3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual.</li> <li>4. Turn the ignition switch to ON.</li> <li>5. Delete and request DTC with scan tool.</li> </ol> Is the repair complete?	-	System OK	-

## DIAGNOSTIC TROUBLE CODE (DTC) 1735

### Speed Sensor Reference Voltage Low

#### Circuit Description

The transfer case control unit (TOD) provides reference voltage to front and rear propeller-shaft speed sensor.

#### Conditions for Setting the DTC

If the system is in high range the TOD sets the EMC touch off level based on a vehicle speed of 0 and wheel slip control is suspended.

- If the system is in low range, the EMC duty cycle is set to maximum until the system is shifted out of low range.

#### Diagnostic Aids

- Check for short to ground or open circuit.

#### Test Description

The number(s) below refer to step(s) on the diagnostic table.

- This step, along with step 3, checks the voltage supply condition.
- This step checks the continuity of ground line.
- This step checks the speed sensors.

Step	Action	Value	Yes	No
1	Was the TOD Diagnostic System Check performed?	-	Go to Step 2	Go to "TOD Diagnostic System Check"
2	1. Disconnect white 7-pin connector, for propeller shaft speed sensor and clutch coil, located under the body. 2. Turn the ignition switch to ON. 3. Measure the voltage between following terminals of male white 7-pin connector: Terminal D/E and terminal B/G Is measured value within the specified range?	4.5 ~ 5.5 V	Go to Step 7	Go to Step 3
3	Measure the resistance between terminal A8 and terminals B8 of transfer case control unit (TOD). Is measured value within the specified range?	4.5 ~ 5.5 V	Go to Step 5	Go to Step 4
4	1. Turn the ignition switch to OFF. 2. Check two connectors of the TOD and white 7-pin connector. 3. Repair any damaged pins, connector or wires. 4. Reconnect all the connectors and make sure it is seated properly. 5. Connect a scan tool to the data link connector (DLC). 6. Turn the ignition switch to ON. 7. Request DTC Is the DTC still current?	-	Go to Step 5	System OK
5	1. Turn the ignition switch to OFF. 2. Disconnect two connectors of the TOD and white 7-pin connector under the body. 3. Measure the resistance between following terminals: <ul style="list-style-type: none"> <li>A8 (TOD) and 1/2 (7-pin connector)</li> <li>B8 (TOD) and 6/7 (7-pin connector)</li> </ul> Is the resistance equal to specified value?           4. Measure the resistance between A8 and B8 of TOD connector and ground Is the resistance equal to specified value?	0 Ω	Go to Step 7	Go to Step 6
6	Repair any open or short to ground circuit. Is the repair complete?	-	System OK	Go to Step 7

Step	Action	Value	Yes	No
7	Measure the resistance between terminals of the male white 7-pin connector. <ul style="list-style-type: none"> <li>• Terminal 6 and terminal 3</li> <li>• Terminal 6 and terminal 2</li> <li>• Terminal 3 and terminal 2</li> <li>• Terminal 7 and terminal 5</li> <li>• Terminal 7 and terminal 1</li> <li>• Terminal 5 and terminal 1</li> </ul> Is the measurement within specified range?	5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ 5 ~ 6 MΩ 5 ~ 6 MΩ 9 ~ 10 kΩ	Go to Step 9	Go to Step 8
8	Replace front or rear propeller shaft speed sensor. Is the repair complete?	-	System OK	-
9	1. Replace the TOD. 2. Turn the ignition switch to OFF. 3. Connect the scan tool to data link connector (DLC) and follow the directions given in the scan tool manual. 4. Turn the ignition switch to ON. 5. Delete and request DTC with scan tool. Is the repair complete?	-	System OK	-