General Information

Specifications

Type			A5SR2
Driving system			2WD/ 4WD
T/CON	Type		3 elements, 1 stage, 2 phase
	Identification inscription [Nominal diameter (mm)]		8 (Φ260)
	Stall torque ratio		1.84
Transmission	Shift position	P	Fix output axle (Engine start allowed)
		R	Reverse
		N	Neutral (Engine start allowed)
		D	1↔2↔3↔4↔5
	Gear ratio	1st	3.827
		2nd	2.368
		3rd	1.52
		4th	1
		5th	0.834
		Reverse	2.613
		Final gear ratio	3.333
	Oil pump	Type	Trochoid oil pump
		Driving system	Engine drive
	ATF oil	The recommended	APOLLOIL ATF RED-1
		Quantity	10ℓ(10.57 US qt, 8.8 Imp.qt)

Automatic Transaxle System

Description

We have employed A5SR2, the 5th speed automatic transmission with full range electronic control and sports mode that provides smooth driving with lesser transmission shock as well as pleasant driving from manual transmission.

A/t electronic control system is the system where an optimized transmission has been realized from taking a grasp of driving status, A/T internal status at A/T control unit that has integrated with control valve assembly.

This paper describes apparatus cross-sectional view, major controls and control circuit diagram, major components and their functions, and etc.

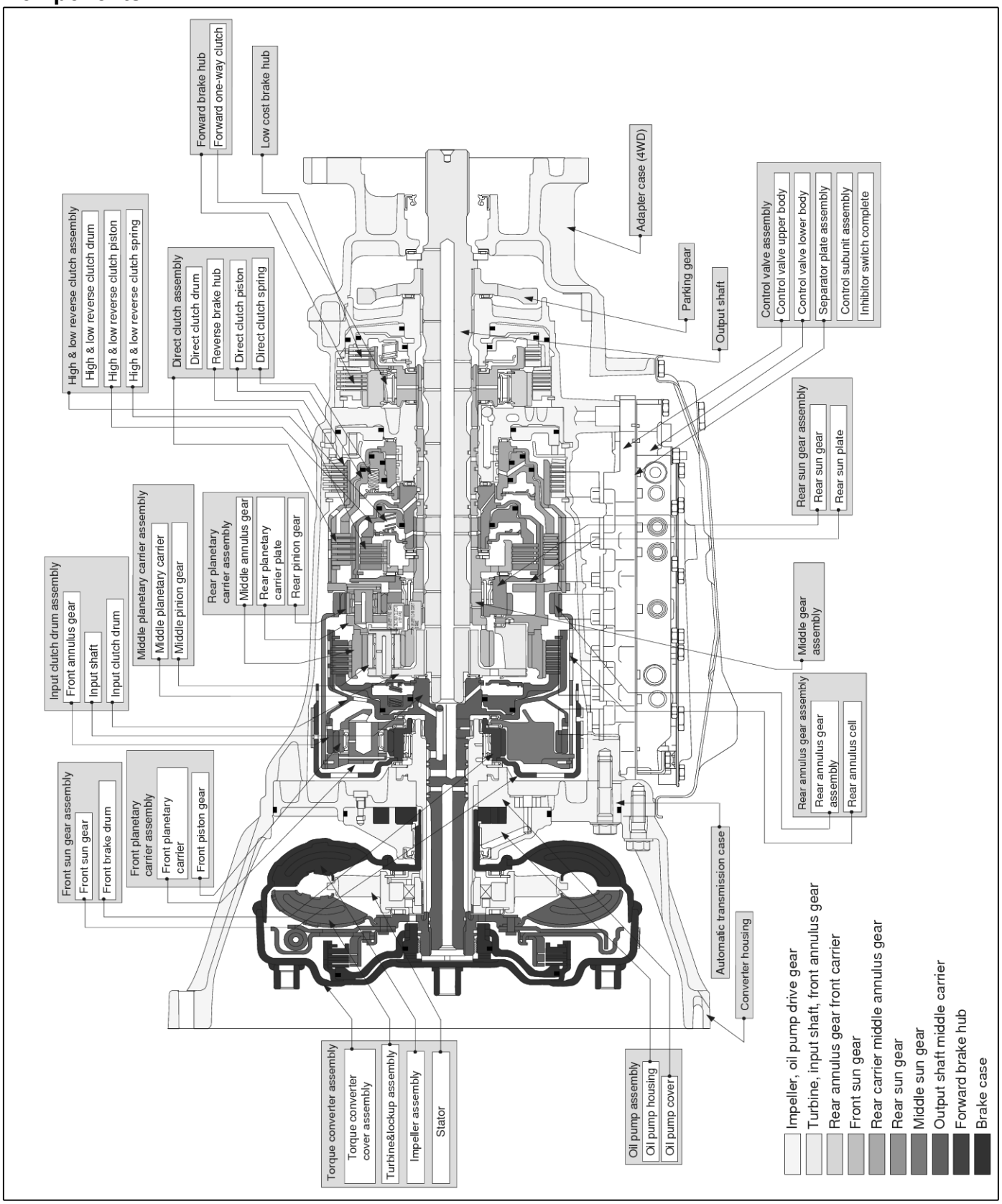
A5SR 2

Item	Contents
Improved transmission feel	- Integrated control over engine and A/T (CAN communication control) system employed - Turbine sensor 1.2 employed - Real time feedback control at all phases applied
Improved driving	- Sports mode function employed - Snow mode function employed (2WD applied) - Gear ratio extension
Improved fuel consum-ption	- Slip lock-up employed - Full range lock-up employed (Larger lock-up zone) - E-flow torque converter employed (Improved driving efficiency) - Small transmission power train employed
Improved safety	- Transmission lock apparatus (P range maintenance apparatus affixed) employed
Improved maintenance	- Electronic system diagnosis tester (hi-scan) counterpart

Major Components And Their Functions

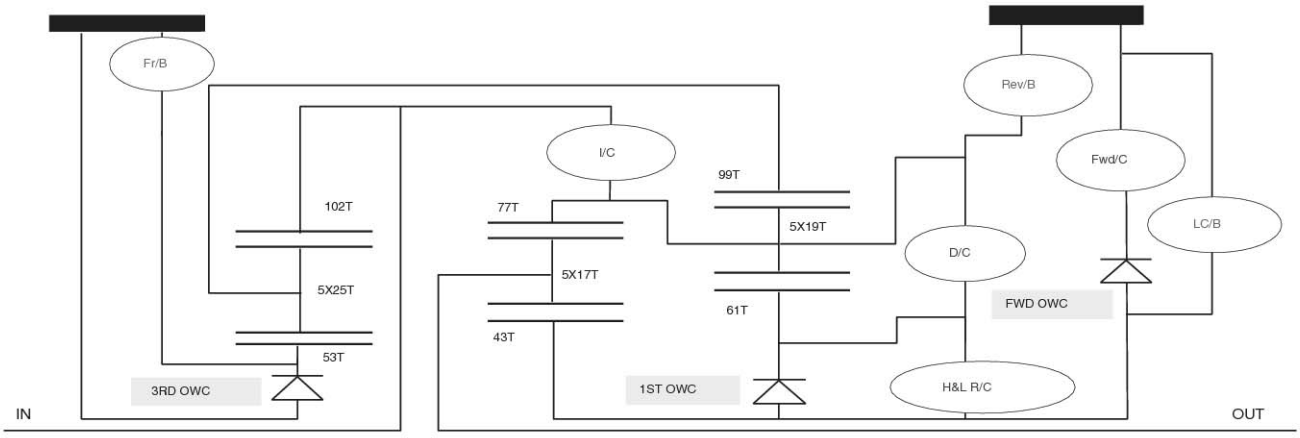
Part name	Acronyms	Function
Front brake	F/B	Fastens the front sun gear
Input clutch	I/ C	Engages the input shaft, with the middle annulus gear and the fr-ont annulus gear
Direct clutch	D/C	Engages the rear planetary carrier with a rear sun gear
High & low reverse clutch	H&L R/C	Engages the middle sun gear with the rear sun gear
Reverse brake	R/B	Fastens the rear planetary carrier
Forward brake	FWD/B	Fastens the middle sun gear
Low cost brake	LC/B	Fastens the middle sun gear
1st one-way clutch	1st OWC	Allows the rear sun gear to turn freely forward relative to the mid sun gear but fastens it for reverse rotation
Forward one-way clutch	FWD OWC	Allows the mid sun gear to turn freely in the forward direction but fastens it for reverse rotation
3rd one-way clutch	3rd OWC	Allows the front sun gear to turn freely in the forward direction b-ut fastens it for reverse rotation

Components



LLAE001A

Operation



Shift Position		I/C	H&L R/C	D/C	Rev/B	Fr/B	LC/B	Fwd/B	Ratio1 OWC	Forword OWC	Ratio 2 OWC	Remarks
P			△			△						Parking position
R			0		0	0			◎		◎	Reverse position
N			△			△	△""					Neutral position
D	1st		△"			△		0	◎	◎	◎	Automatic shift 1↔2↔3 ↔4↔5
	2nd			0		△		0		◎	◎	
	3rd		0	0		0		△	◇		◎	
	4th	0	0	0				△	◇			
	5th	0	0			0		△	◇		◇	
5M	5th	0	0			0		△	◇		◇	Fix to the 5th speed
4M	4th	0	0	0				△	◇			Fix to the 4th speed
3M	3rd		0	0		0		△	◇		◎	Fix to the 3rd speed
2M	2nd			0		0	0	0		◎	◎	Fix to the 2nd speed
1M	1st		0			0	0	0	◎	◎	◎	Fix to the 1st speed

0 : Operates.
◎ : Operates during progressive acceleration.
◇ : Operates and effects power transmission while coasting.
△ : Line pressure is applied but does not affect power transmission.
△" : Operates under conditions shown in the high & low reverse clutch operating condition.
△"" : Operates under conditions shown in the LC/B operating condition.
Note) Delay control is applied during D(4,3,2,1)⇒N shift.

LLAE001B

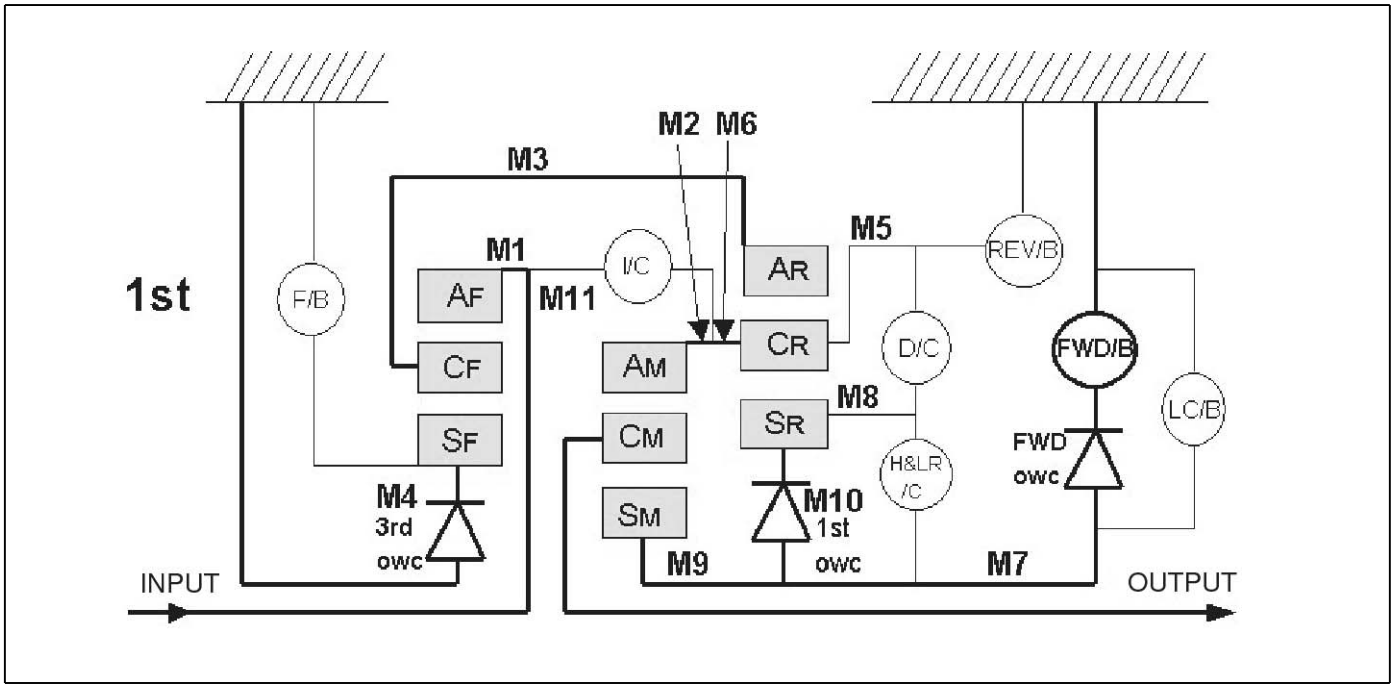
Operating Principles Of Each Range

1. N range

   Since the forward and reverse brakes are released, driving force of input shaft is not transmitted to output shaft.

2. P range
   - Since the forward and reverse brakes are released, as those in the N range, driving force of input shaft is not transmitted to output shaft.
   - Parking pawl that is linked with select lever parking gear meshes with and fastens output shaft mechanically.

3. D, M2, M3, M4, M5 range 1st speed
   - Fastens the front brake.
   - The front brake and the forward one-way clutch regulate reverse rotation of the mid sun gear.
   - The 1st one-way clutch regulates reverse rotation of the rear sun gear.
   - The 3rd one-way clutch regulates reverse rotation of the front sun gear.

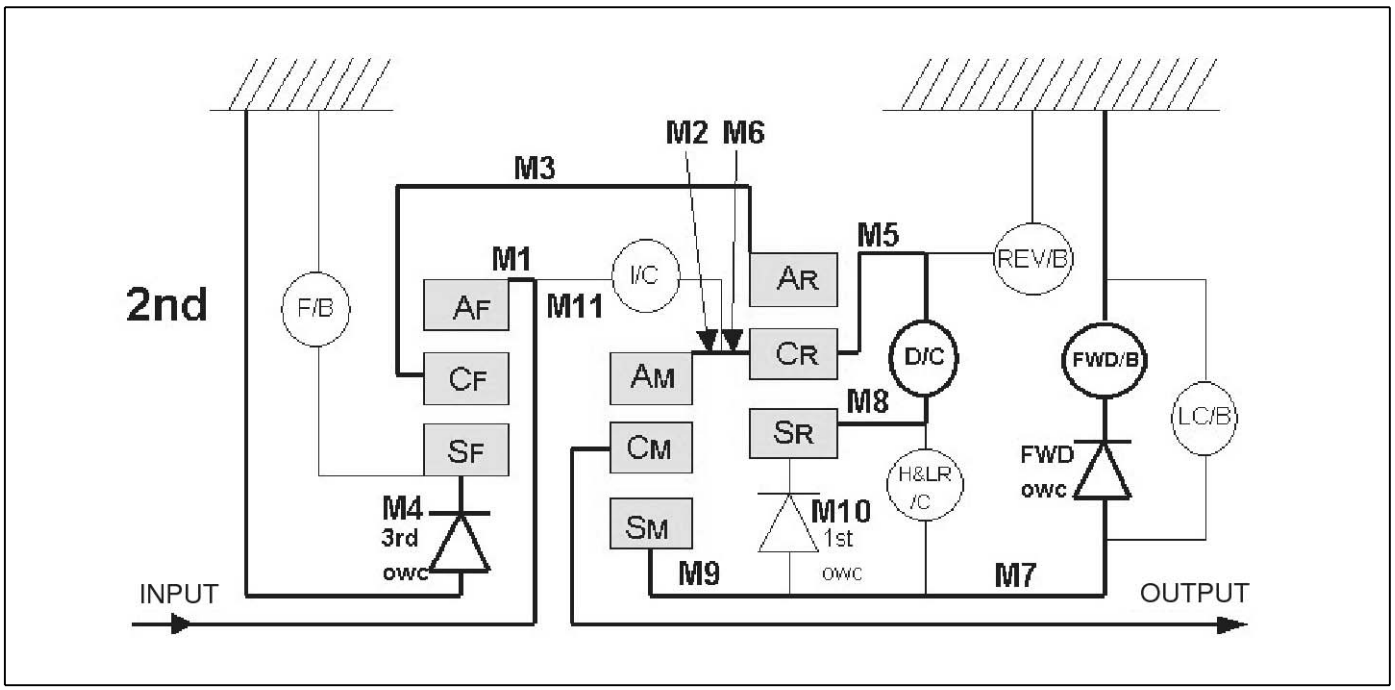


LLAE002A

*** Power Flow**

Input shaft ⇒ Front internal gear ⇒ Front carrier ⇒ Rear internal gear ⇒ Rear carrier ⇒ Middle internal gear ⇒ Middle carrier ⇒ Output shaft

4. D, M3, M4, M5 range ratio 2nd
   - Fasten the front brake.
   - The front brake and the forward one-way clutch regulate reverse rotation of the mid sun gear.
   - The 3rd one-way clutch regulates reverse rotation of the front sun gear.



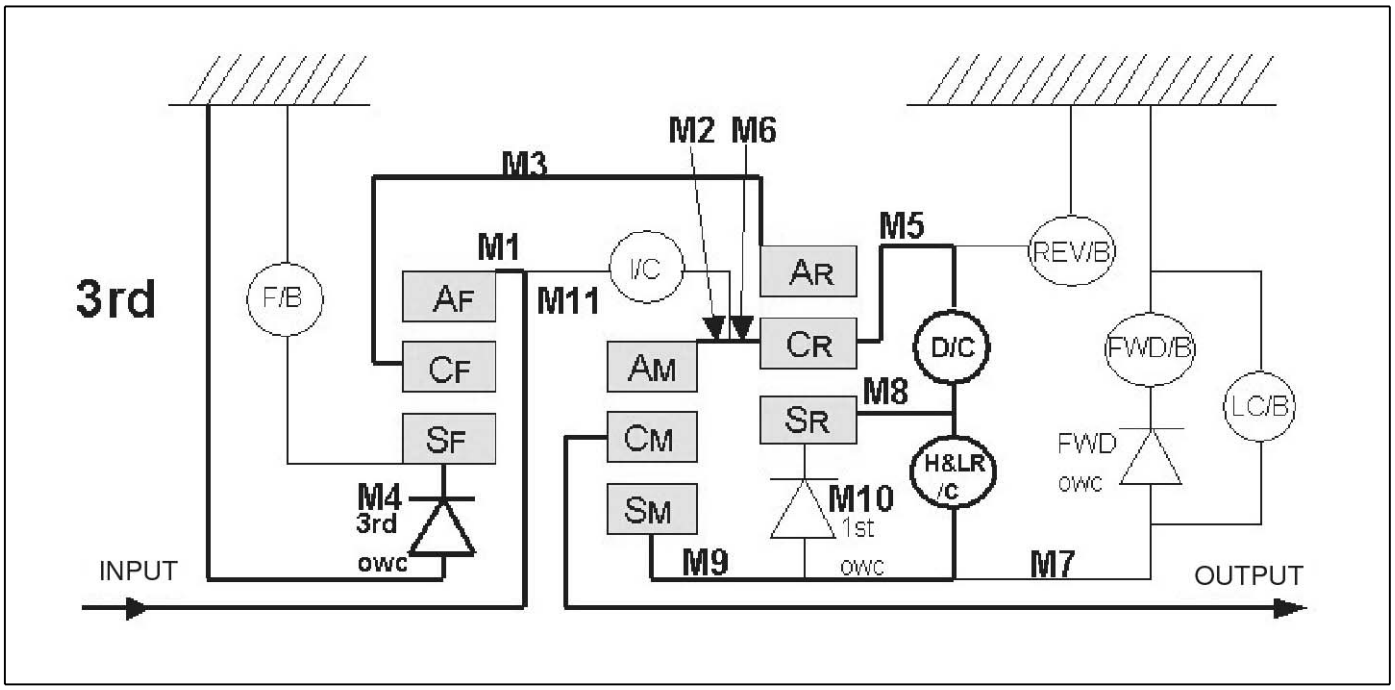
LLAE002B

The direct clutch is coupled and the rear carrier and the rear sun gear are connected.

*** Power Flow**

Input shaft ⇒Front internal gear ⇒Front carrier ⇒Rear internal gear ⇒Rear carrier ⇒Rear carrier ⇒Middle internal gear ⇒Middle carrier ⇒Output shaft

5. D, M3, M4, M5 range 3rd speed
   - Fastens the front brake.
   - The 3rd one-way clutch regulates reverse rotation of the front sun gear.



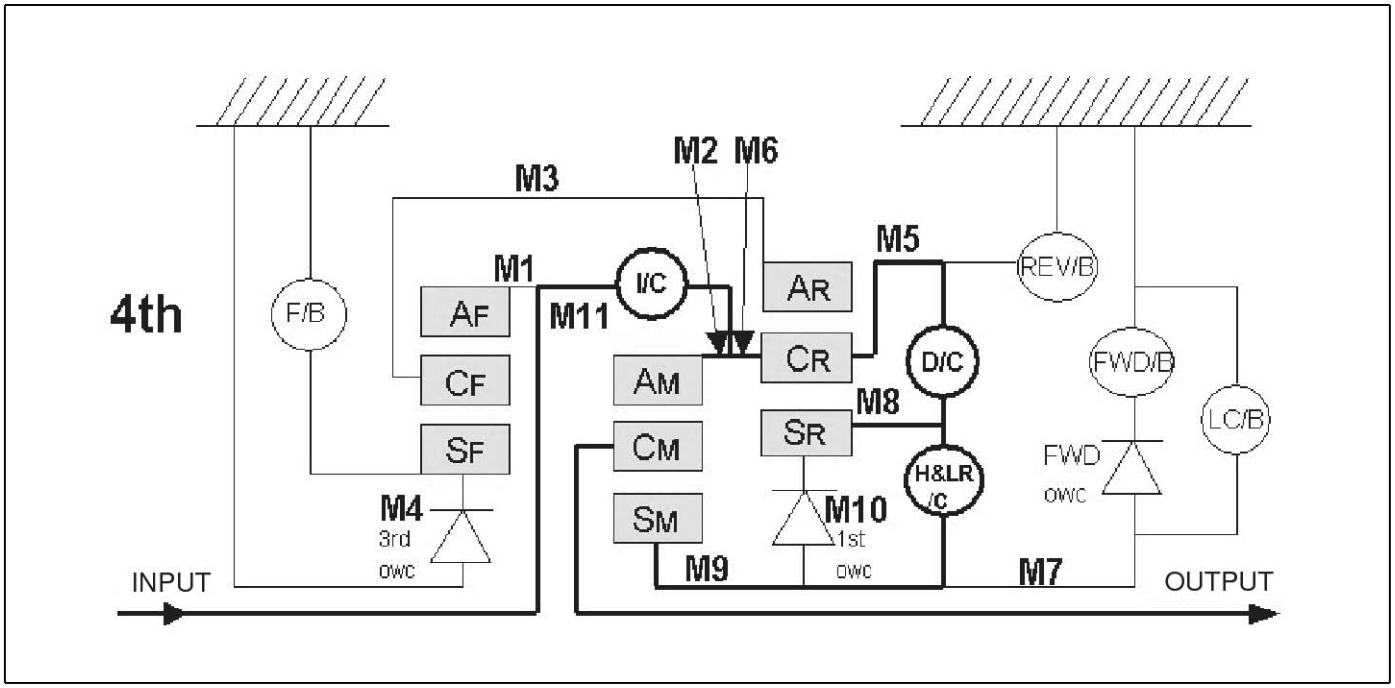
LLAE002C

   - The high & low reverse clutch is coupled and the middle and rear sun gears are connected.

*** Power Flow**

Input shaft ⇒Front internal gear ⇒Front carrier ⇒Rear internal gear ⇒Rear carrier ⇒Rear carrier ⇒Middle internal gear ⇒Middle carrier ⇒Output shaft

6. D, M4, M5 range 4th speed
   - The front brake is released and sun gear turns freely forward.
   - The input clutch is coupled and the front and middle internal gears are connected.



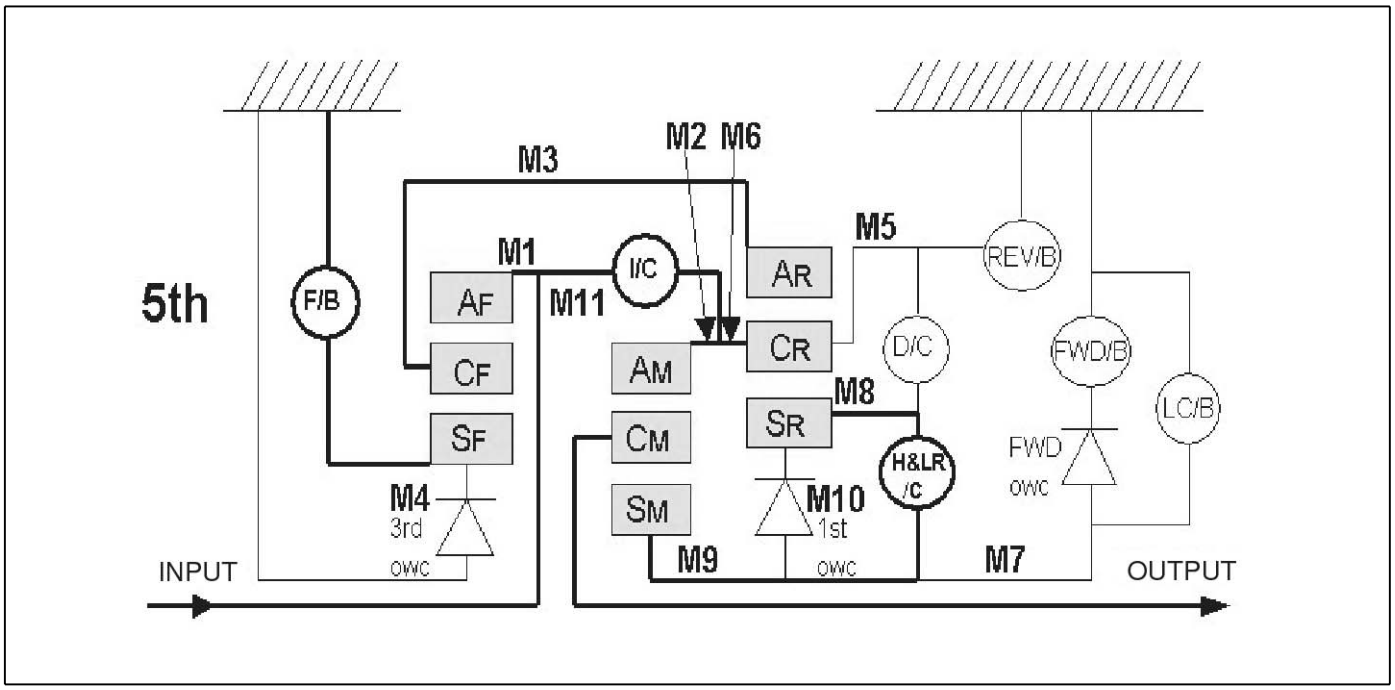
LLAE002D

   - Driving force is conveyed to the front internal gear, the middle internal gear, and the rear carrier and the three planetary gears rotate forward as a unit.

*** Power Flow**

Input shaft ⇒Front internal gear ⇒Front carrier ⇒Rear internal gear ⇒Rear carrier ⇒Middle internal carrier ⇒Middle carrier ⇒Output shaft

7. D, M5 range 5th speed
   - The front brake fastens the front sun gear.
   - The direct clutch is released and the rear carrier and rear sun gear are disconnected.

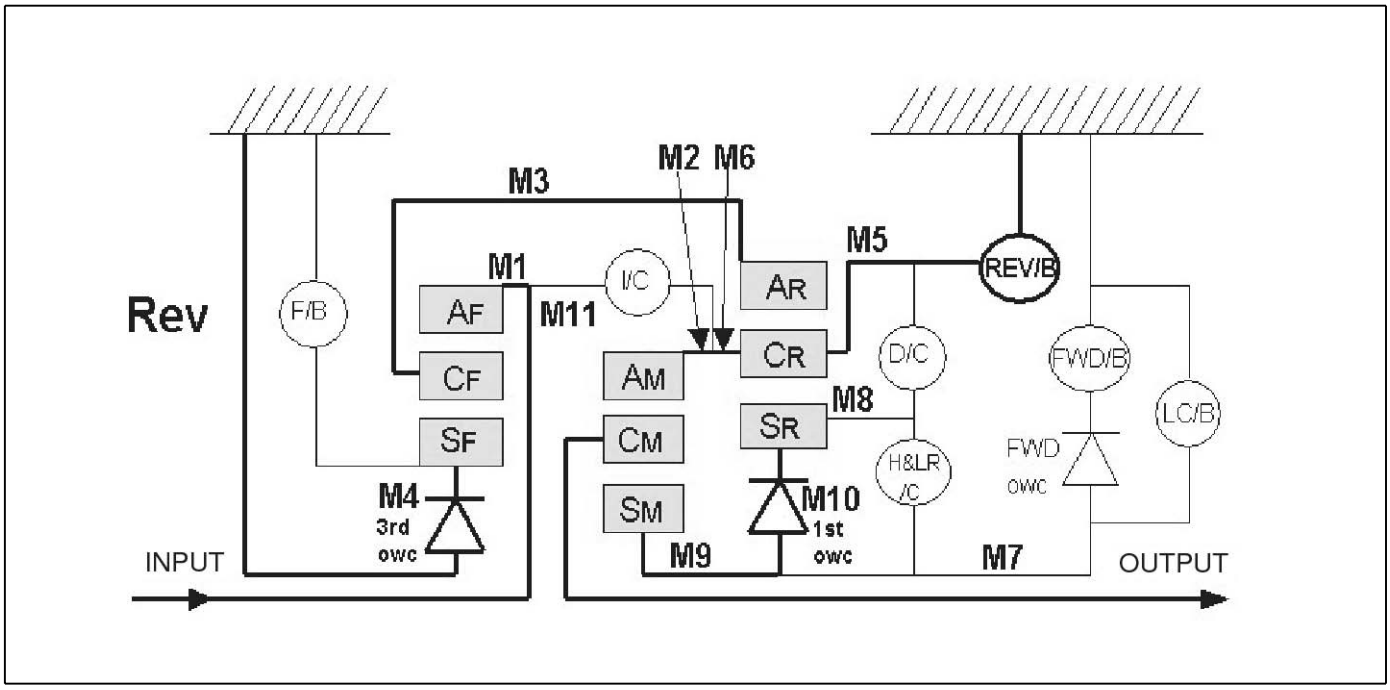


LLAE002E

*** Power Flow**

Input shaft ⇒ Front internal ⇒ Front carrier ⇒ Rear internal input shaft ⇒ Middle internal ⇒ Rear carrier ⇒ Rear sun gear ⇒ Middle sun carrier ⇒ Middle carrier ⇒ Output shaft

8. R range
   - The front brake fastens the front sun gear.
   - The high & low reverse clutch is coupled and the middle and rear sun gears are connected.
   - The reverse brake fastens the rear carrier.

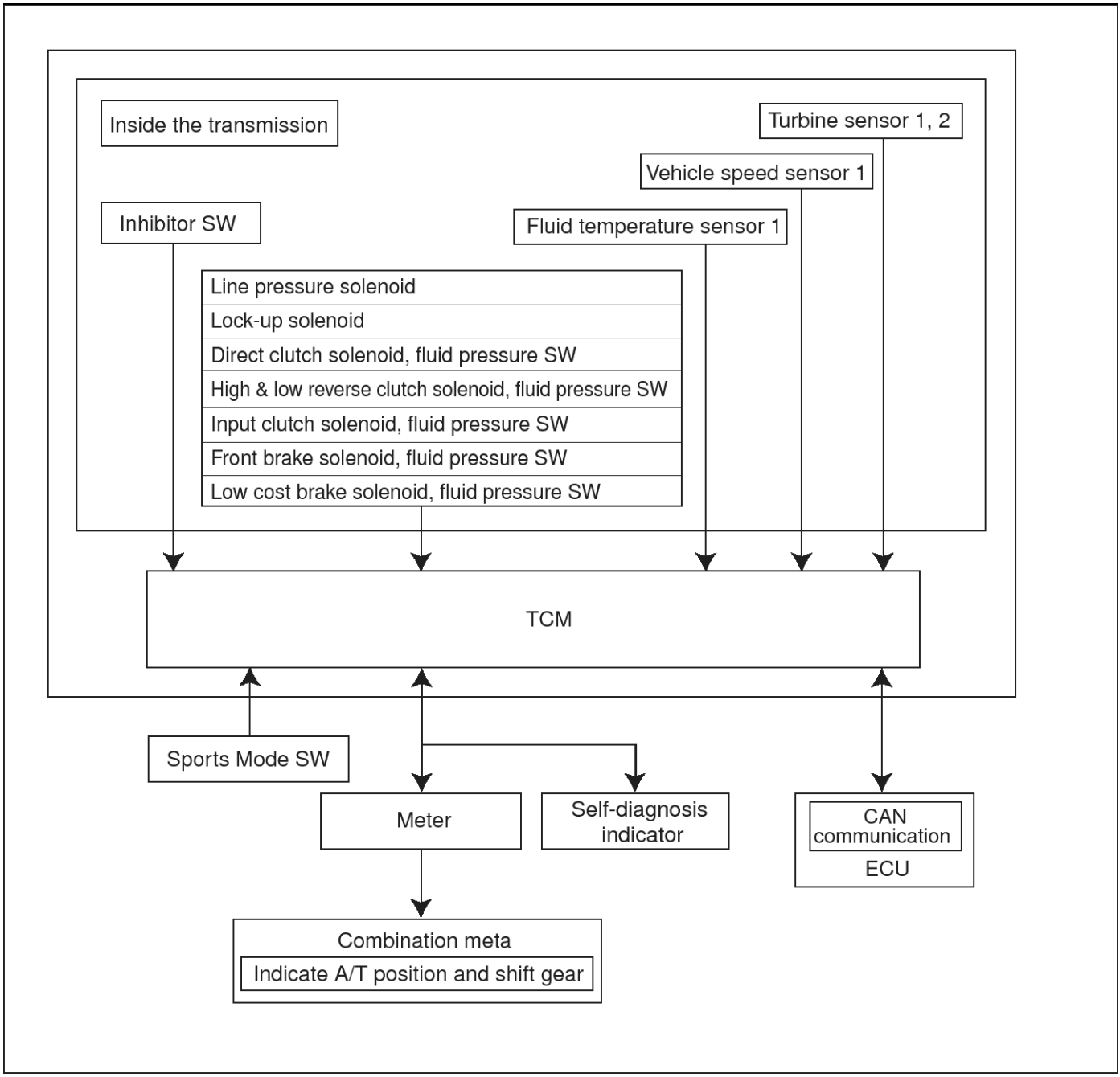


LLAE002F

*** Power Flow**

Input shaft ⇒ Front internal ⇒ Front carrier ⇒ Rear internal ⇒ Rear sun gear ⇒ Middle sun gear ⇒ Middle carrier ⇒ Output shaft

Control System Diagram



LLAE002G

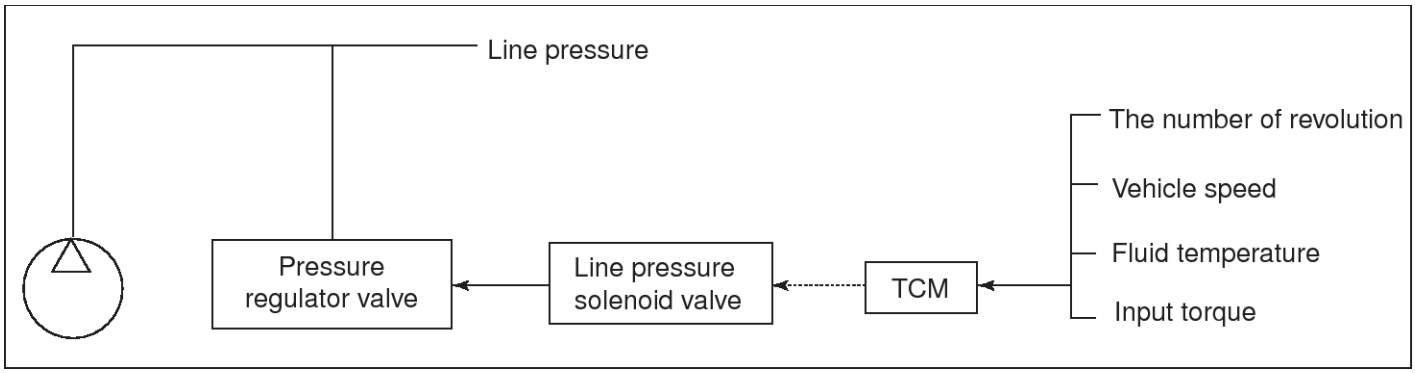
Main Communication Signal

Input to ECM(CAN)	Output to ECM(CAN)	Input from external sys.	Output to external sys.
-	-	A/T driving mode SW	Self-diagnosis indicator
Engine torque signal	Output revolution signal	Sports mode SW	Range signal (P, R, N, D)
Engine revolution signal	Turbine sensor signal	Up SW	Range signal
-	Torque reduction request signal	Down SW	Reverse lamp signal
Accelerator opening signal		Stop lamp SW	N position signal
Power		4 x 4 Low signal	

Line Pressure Control

- If the engine control unit sends the input torque signal equivalent to the engine driving force to the A/T control unit (TCM), the A/T control unit (TCM) controls line pressure solenoid.
- This line pressure solenoid controls the pressure regulator valve as the signal pressure and adjusts the pressure of theoperating oil discharged from the oil pump to the line pressure most appropriate to the driving plate.

Line Pressure System Diagram

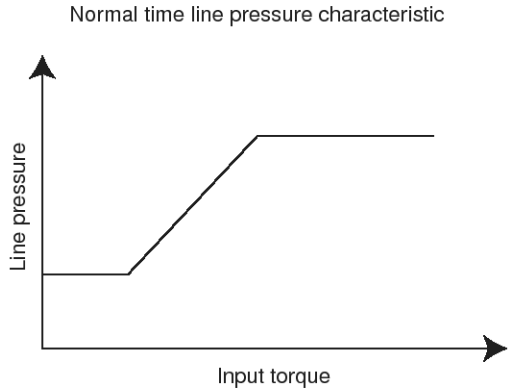


LLAE002H

Line pressure control based on line pressure characteristic pattern of A/T control unit (TCM)

- A/T control unit (TCM) has stored in memory a number of patterns for the optimum line pressure characteristics according to driving conditions.
- In order to obtain the most appropriate line pressure characteristic to meet the current driving state, the TCM controlsthe line pressure solenoid current valve and thus controls the line pressure.
  - Normal line pressure control.

    Each clutch is adjusted to the necessary pressure to match the engine drive force.

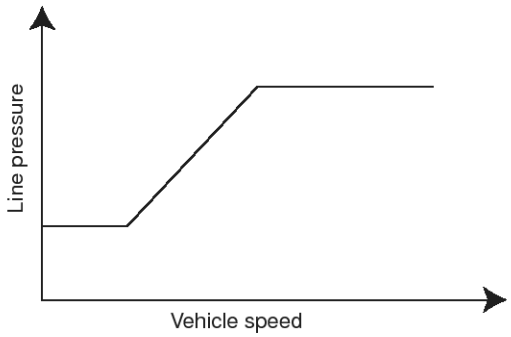


LLAE002I

- Back-up control (Engine brake)

  Line pressure according to speed is set during shift down by select operation while driving.

Line pressure characteristic for backup control

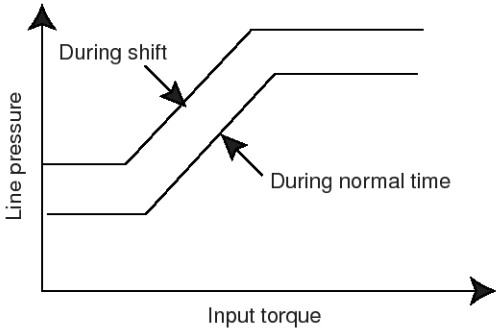


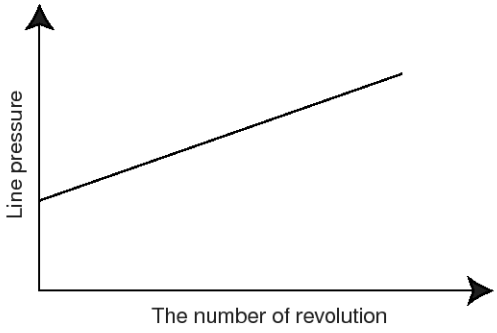
LLAE002J

- During shift change

  Set to line pressure that is necessary for shift change. Therefore, line pressure characteristic is set according to input torque and shift types.

Line pressure characteristic during shift



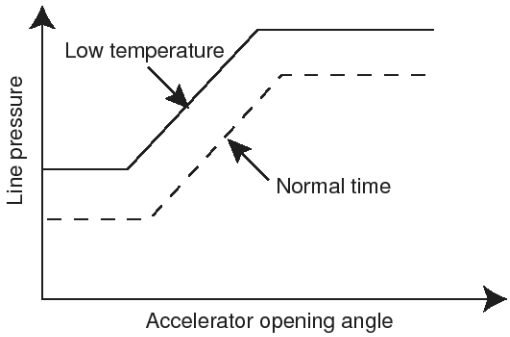


LLAE002K

- At low fluid temperature

  When the A/T fluid temperature drops below the prescribed temperature, in order to speed up the action of each friction element, the line pressure is set higher than the normal line pressure characteristic.

Line pressure character during low temperature

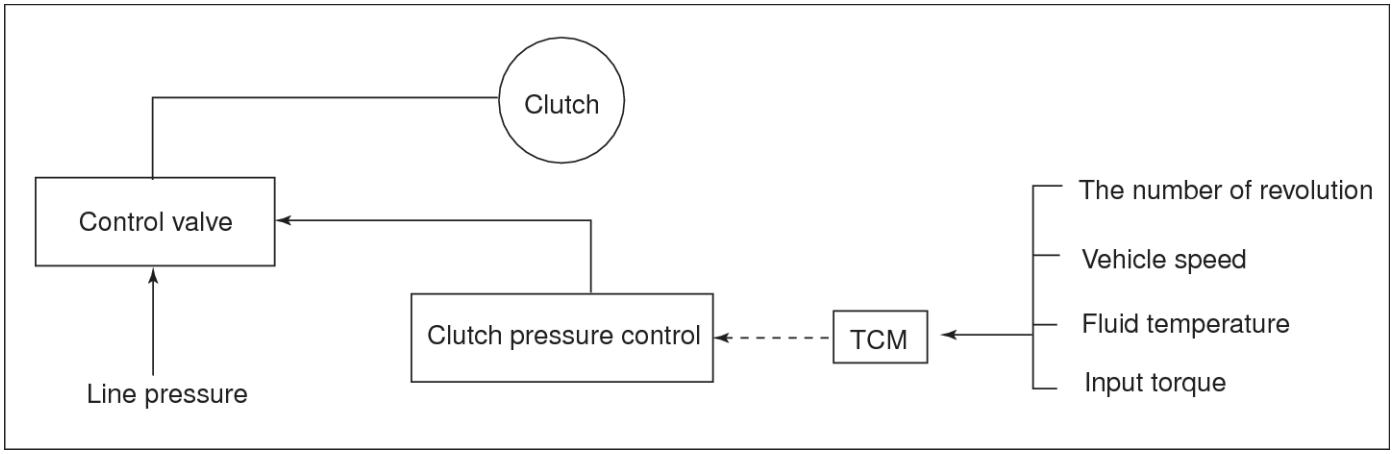


LLAE002L

Shift control

- The clutch pressure control solenoid is controlled by the signals from the switches and sensors. Thus the clutch pressure is adjusted to be appropriate to the engine load state and vehicle driving state. It becomes possible to finely control the clutch hydraulic pressure with high precision and a smoother shift change characteristic is attained.

Shift Control System Diagram



LLAE002M

Shift description

Controls clutches with optimum timing and fluid pressure in response to engine speed, engine torque information, and etc.

Lock-up Control

Lock-up control is to enhance delivery efficiency by preventing the torque converter from slipping, engaging the lock-up piston into the torque converter.

It operates lock-up solenoid control in response to a signal from A/T control unit (TCM) and lock-up control valve behavior control, engages or releases the lock up piston of the torque converter.

Lock-up Operating Condition Table

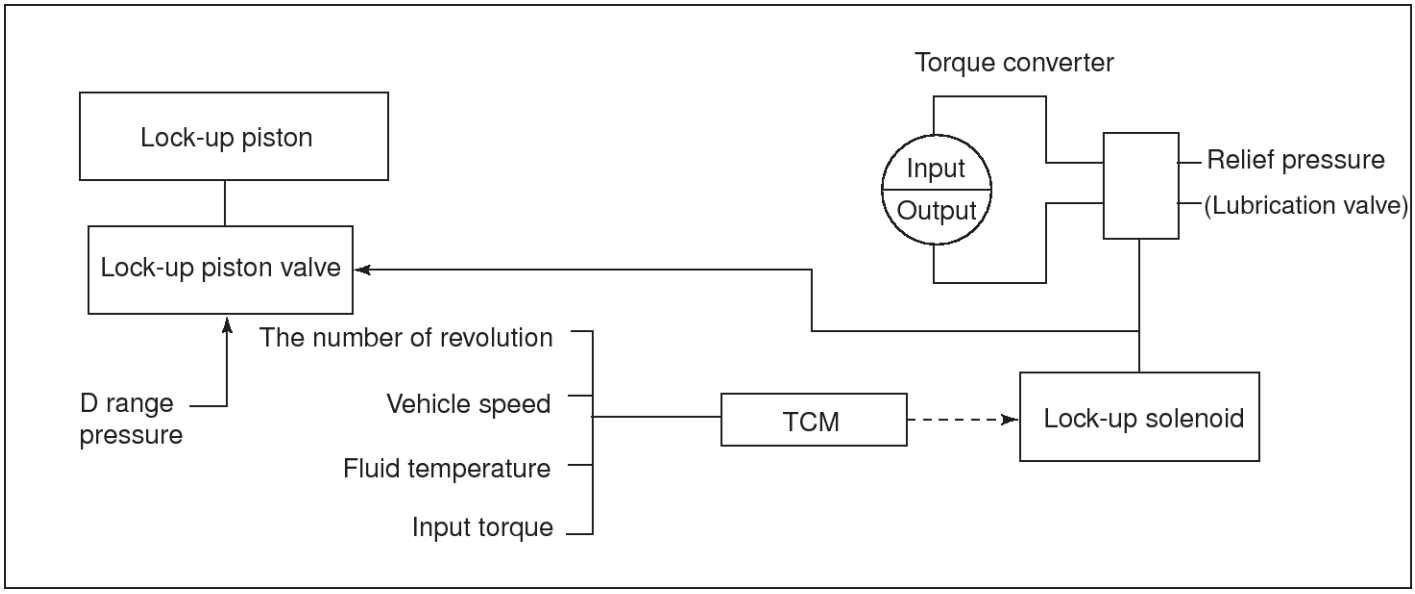
Select lever	D range			Sports mode	
Gear position	5	4	3	5	4
Lock-up	○	-	-	○	○
Slip lock-up	○	○	-	-	-

LLAE002N

Lock-up control valve control

- In the lock-up control valve, there is operating fluid pressure circuit linked into the lock-up piston and lock-up solenoid operates valve shift in response to a signal from the A/T control unit.
- Operating fluid pressure circuit that is applied to the lock-up piston chamber is controlled with the release or apply sides.

Lock-up Control System Diagram



LLAE002O

Lock-up released

- In the lock-up control valve, there is operating fluid pressure circuit connected into the lock-up piston and lock-up solenoid operates valve shift in response to a signal from the A/T control unit.

  Therefore, the lock-up piston is not coupled.

Lock-up applied

- During the lock-up applied status, lock-up apply pressure is generated having the lock-up control valve to L/U by the lock-up solenoid.

  Therefore, press the lock-up piston to be coupled.

Smooth lock-up control

- A/T control unit (TCM) controls current value that is output to the lock-up solenoid when shifting lock-up applied state from lock-up released state.

  Therefore the lock-up clutch is temporarily set to half-clutched state when shifting the lock-up applied state to reduce the shock.

Half-clutched state

- Changes current value that is output to the lock-up solenoid from A/T control unit (TCM) to gradually increase lock-up solenoid pressure.

  In this way, the lock up apply pressure gradually rises and while the lock-up piston is put into half-clutched status, the lock-up piston operating pressure is increased and the coupling is completed smoothly.

Slip lock-up control

- In the slip region, A/T control unit controls current value of the lock-up solenoid to half-clutched status. Therefore lock-up operates from low speed absorbing torque fluctuation of engine.

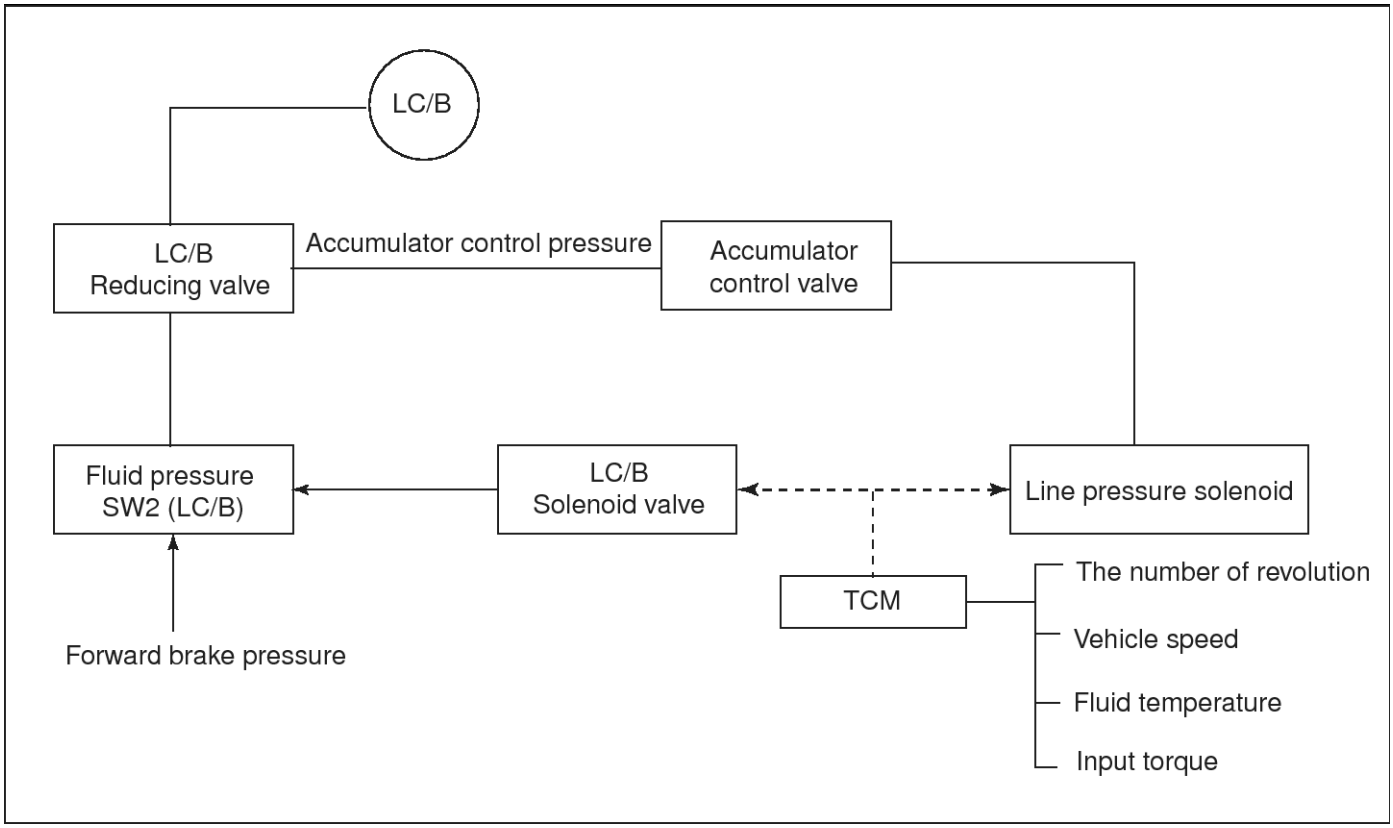
  Thereby fuel consumption was increased during low accelerator opening with 4th, and 5th gears at low speed.

Engine Brake Control

- The forward one-way clutch delivers driving force from the engine to the rear wheel but reverse driving from the wheel drive is not delivered since the one-way clutch is idling.

  Therefore low coast brake solenoid is operated to prevent the forward one-way clutch from idling so that the engine brake is operated in the same as before.

Engine Brake Control System Diagram



LLAE002P

- The operation of the low coast brake solenoid switches the low coast brake switch valve and controls the coupling and releasing of the low coast brake.

  The low coast brake reducing valve controls the low coast brake coupling force.

Control Valve

Control Valve Functions

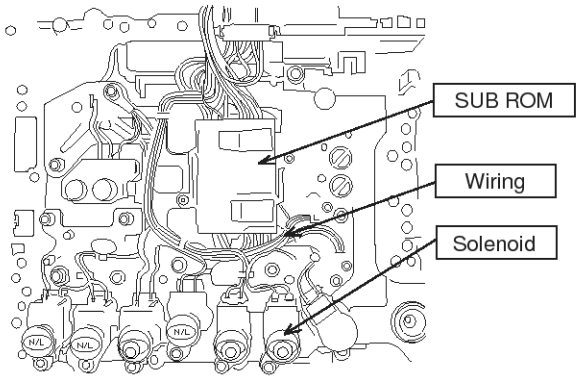
Valve name	Function
Torque converter regulator valve	Regulates line pressure to the optimum pressure (torque converter operating pressure) to prevent pressure applied to the torque converter from being excessive.
Pressure regulator valve Pressure regulator plug Pressure regulator sleeve	Regulates oil pump discharge pressure to the optimum pressure (line pressure) in response to the driving conditions.
Front brake control valve	Regulates line pressure to the optimum pressure (front brake pressure) to be applied to the front brake during the front brake apply.
Accumulator control valve	Regulates pressure applied to the accumulator piston, and the low coast reducing valve (accumulator control pressure) inresponse to the driving conditions (regulates clutch pressure at 1st, 2nd, 3rd, 5th gears).
Pilot valve A	Regulates line pressure to the regular pressure required by line pressure control, shift control, and lock-up control (pilot pressure).
Pilot valve B	Regulates line pressure to the regular pressure required by shift control (pilot pressure).
Low coast brake switching valve	Provides the low coast brake reducing valve with line pressure during engine brake operation.
Low coast brake reducing valve	Regulates line pressure to the optimum pressure to be applied to the low coast brake when the low coast brake is coupled.
N-R accumulator	Produces the stabilizing pressure for when N-R is selected.
Direct clutch piston switching valve	Operates in 4th gear and switches the direct clutch coupling capacity.
High & low reverse clutch control valve	Regulates line pressure to the optimum pressure (high & low reverse clutch pressure) to be applied to the high & low reverse clutch when the high & low reverse clutch is coupled (regulates clutch pressure in 1st, 3rd, 4th, 5th gears).
Input clutch control valve	Regulates line pressure to the optimum pressure (input clutch pressure) to be applied to the input clutch when the inputclutch is coupled (regulates clutch pressure in 4th, 5th gears).
Direct clutch control valve	Regulates line pressure to the optimum pressure (direct clutch pressure) to be applied to the direct clutch when the direct clutch is coupled (regulates clutch pressure in 2nd, 3rd, 4th gears).
Lock-up control valve Lock-up control plug Lock-up control sleeve	Switches lock-up to operating or released. Also, by performing the lock-up operation transiently, lock-up smoothly.
Torque converter lubrication valve	Operates to switch torque converter, cooling, and oil path of lubrication system during lock-up.
Cool bypass valve	Allows excess oil to by pass cooler circuit without being fed into it.
Line pressure relief valve	Discharges excess oil from line pressure circuit.
N-D accumulator	Produces the stabilizing pressure for when N-D is selected.
Manual valve	Delivers line pressure to each circuit in response to each select position. Circuit to which line pressure is not sent drain.

Function Of Pressure Switch

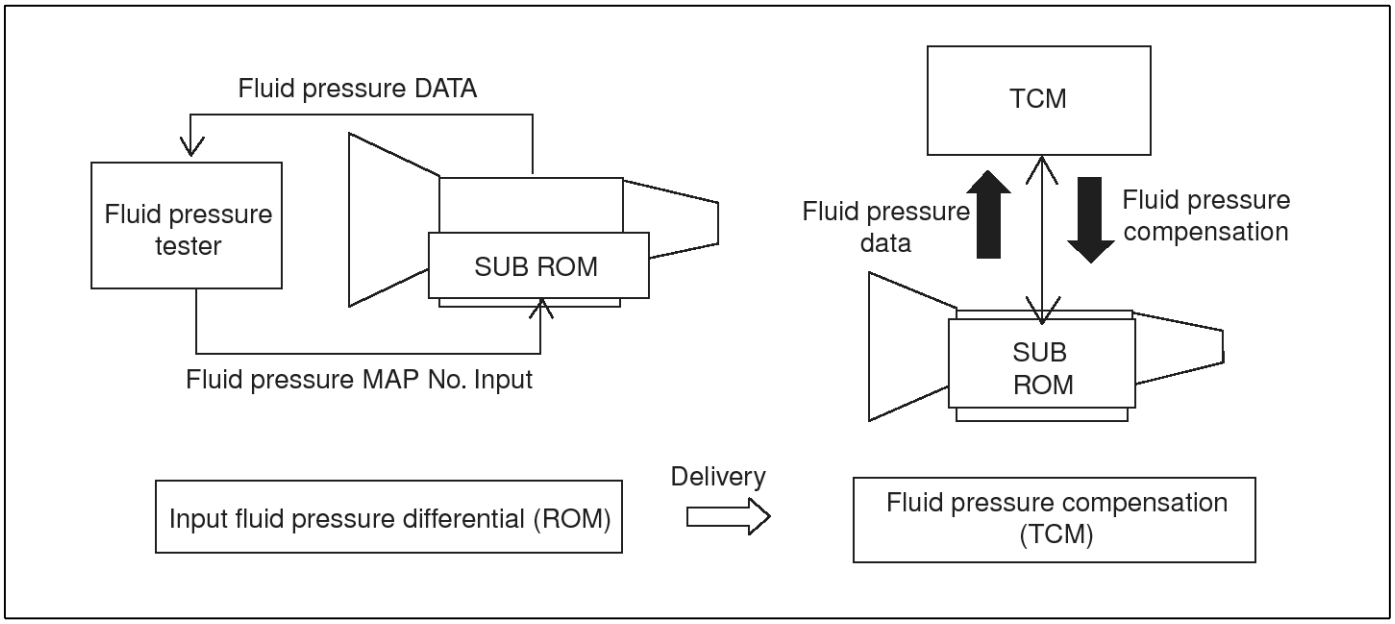
Name	Function
Fluid pressure switch 1 (FR/B)	Detects abnormal fluid pressure of the front brake. When it detects any malfunction, it puts the system into fail-safe mode.
Fluid pressure switch 2(LC/B)	Detects abnormal fluid pressure of the low coast brake. When it detects any malfunction, it puts the system into fail-safe mode.
Fluid pressure switch 3(I/C)	Detects abnormal fluid pressure of the input clutch. When it detects any malfunction , it puts the system into fail-safe mode.
Fluid pressure switch 5(D/C)	Detects abnormal fluid pressure of the direct clutch. When it detects any malfunction, it puts the system into fail-safe mode.
Fluid pressure switch 6 (H＆LR/C)	Detects abnormal fluid pressure of the high＆low reverse clutch. When it detects any malfunction, it puts the system into fail-safe mode.

SUB ROM unit

1. Installing location: The valve body upper part
2. Function: To obtain A/T fluid pressure stability by compensating for solenoid & valve body unit fluid pressure differential.
3. Principle: Install additional ROM onto valve body of automatic transmission and input fluid pressure differential of solenoid & valve body so that TCM reads the input data to perform fluid pressure compensation.



LLAE117A

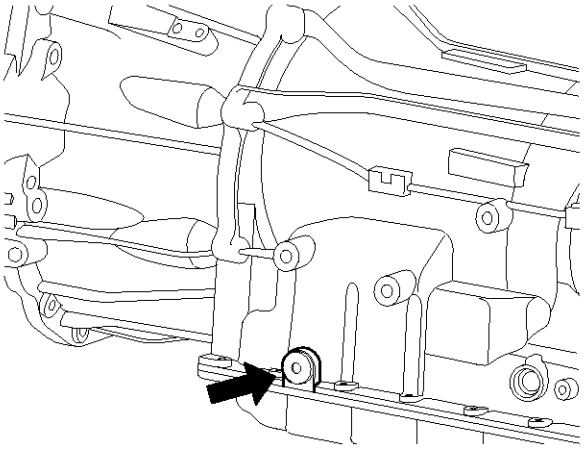


LLAE117B

4. Maintenance
   1) When replacing with a new TCM in the vehicle
      - TCM automatically reads SUB ROM DATA during I.G ON. At this time, shift range valve is off for about 2.5 second.
   2) When replacing A/T (regardless of new or old ones) in the vehicle
      - Must erase SUB ROM DATA stored in TCM.
      - Erase SUB ROM DATA in SCAN TOOL delete mode during shift stage in R-range + accelerator opening angle maintains 50% + I.G ON.
      - TCM reads SUB ROM DATA from a new A/T upon I.G ON again after I.G OFF.
   3) Moving TCM from vehicle A to another vehicle B
      - Perform the same way as in 2) above.

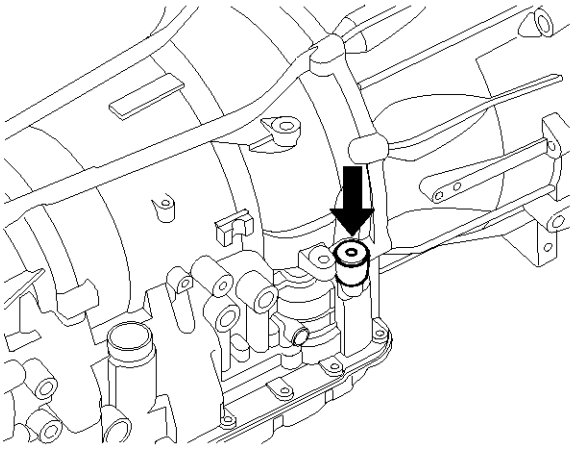
Procedure of ATF level adjusting

1. Park the vehicle on a flat road and lock the tires.
2. Shift the shift lever to the "P" range.
3. Remove the overflow plug by using a torx wrench.



STQAA8033L

4. Remove the filler plug by using a torx wrench.



STQAA8034L

5. Check if ATF drops from the overflow hole. If ATF does not drop, add ATF until it drops.
6. Fix the overflow plug by using Torx wrench.
7. Add 1400cc(A5SR1),1200cc(A5SR2) of ATF from the oil filling hole.
8. Install it to the filler plug with a new gasket.
9. Tighten the filler plug by using Torx wrench with the specified torque.

Tightening torque :
24-56 Nm(2.4-5.6 kgf.m, 17.4-40.5 lb-ft)

10. Start the engine.
11. Raise ATF temperatirue on CAN signal up to 50~60˚C at stabilized idle speed condition.
12. Shift from "P" to "D", then from "D" to "P", keeping each shift position "N","R" more than 2 seconds with foot braking.
13. Repeat 2 times above procedure "3".
14. Remove the overflow plug and the O-ring by using Torx wrench.
15. Check If the thin oil stream becomes drop by drop when ATF temperatirue on CAN signal is at 58~64˚C (A5SR1), 54~60˚C (A5SR2).
16. Install it to the overflow plug with a new gasket.
17. Tighten the overflow plug by using Torx wrench with the specified torque.

Tightening torque :
6-9 Nm(0.6-0.9 kgf.m, 4.3-6.5 lb-ft)

NOTICE
Be sure to wipe off spilled ATF completely after tightening the overflow plug.

Troubleshooting

Diagnostic Trouble Codes (Inspection Procedure)

Check the Diagnostic Trouble Codes

1. Turn the ignition switch to OFF.
2. Connect the Hi-scan tool to the DLC connector for diagnosis.
3. Turn the ignition switch to ON.
4. Check the diagnostic trouble codes using the Hi-scan tool.
5. Read the output diagnostic trouble codes. Then follow the remedy procedures according to the "DIAGNOSTIC TROUBLE CODE DESCRIPTION" on the following pages.

   NOTICE
   - *A maximum of 10 diagnostic trouble codes (in the sequence of occurrence) can be stored in the Random Access Memory (RAM) incorporated within the control module.*
   - *The same diagnostic trouble code can be stored one time only.*
   - *If the number of stored diagnostic trouble codes or diagnostic trouble patterns exceeds 10, already stored diagnostic trouble codes will be erased in sequence, beginning with the oldest.*
   - *Do not disconnect the battery until all diagnostic trouble codes or diagnostic trouble patterns have been read out, because all stored diagnostic trouble codes or diagnostic trouble patterns will be cancelled when the battery is disconnected.*
   - *All diagnostic trouble codes are deleted from memory the 200th time the ATF temperature reaches 50˚C(122˚F) after memorization of the most recent diagnostic code.*
6. Delete the diagnostic trouble code.
7. Disconnect the Hi-scan tool.

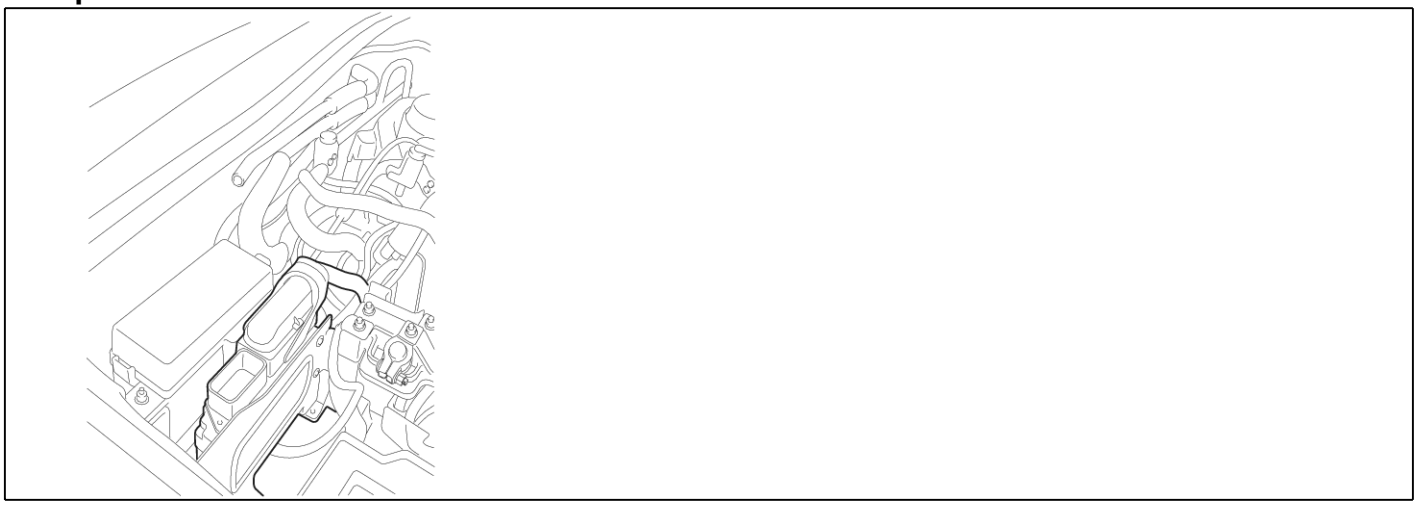
   NOTICE
   DTC cleaning should only be done with the scan tool.

Diagnostic Trouble Code Table

No.	Code	Description	MIL	Remark
1	P0601	Internal Control Module Memory Check Sum Error	●	
2	P0641	Sensor Reference Voltage “A” Circuit/Open	●	
3	P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	●	
4	P0711	Transmission Fluid Temperature Sensor “A” Circuit Range/Performance	●	
5	P0712	Transmission Fluid Temperature Sensor “A” Circuit Low Input	●	
6	P0713	Transmission Fluid Temperature Sensor “A” Circuit High Input	●	
7	P0716	Input/Turbine Speed Sensor "A" Circuit Range/Performance	●	
8	P0717	Input/Turbine Speed Sensor "A" Circuit No Signal	●	
9	P0721	Output Speed Sensor Circuit Range/Performance	●	
10	P0731	Gear 1 Incorrect Ratio	●	
11	P0732	Gear 2 Incorrect Ratio	●	
12	P0733	Gear 3 Incorrect Ratio	●	
13	P0734	Gear 4 Incorrect Ratio	●	
14	P0735	Gear 5 Incorrect Ratio	●	
15	P0741	Torque Converter Clutch Circuit Performance or Stuck Off	●	
16	P0743	Torque Converter Clutch Circuit Electrical	●	
17	P0748	Pressure Control Solenoid "A" Electrical	●	
18	P0753	Shift Solenoid "A" Electrical	●	
19	P0758	Shift Solenoid "B" Electrical	●	
20	P0763	Shift Solenoid "C" Electrical	●	
21	P0768	Shift Solenoid "D" Electrical	●	
22	P0773	Shift Solenoid "E" Electrical	●	
23	P0819	Up and Down Shift Switch to Transmission Range Correlation	X	
24	U0001	High Speed CAN Communication Bus	●	
25	U0100	Lost Communication With ECM/PCM “A”	●	

P0601 Internal Control Module Memory Check Sum Error

Component Location



SHMAT9497L

General Description

A malfunction is detected by using a checksum technique for verifying data. The digital data is composed of zeros and ones. A checksum is the total of all ones in a string of data. By comparing the checksum value with a stored value, a malfunction can be detected.

DTC Description

By comparing the checksum value with a stored value, if the both data are not equal , TCM sets DTC P0601 .

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Rationalityt	• TCM
Enable Conditions	• IG "on"	
Threshold Value	• Internal Control Module Check Not tested : S/W modification is required	
Diagnostic Time	• More than 1sec	
Fail Safe	• Locked in 4th gear.	

Component Inspection

1. Ignition "ON" & Engine "OFF".
2. Connect scantool and erase the DTC P0601 with scantool.
3. Turn IG OFF ↔ IG ON 2 or 3 times then, check that DTC P0601 is set again.
4. Is the DTC P0601set again ?

YES ▶ Replace a known-good PCM/TCM as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

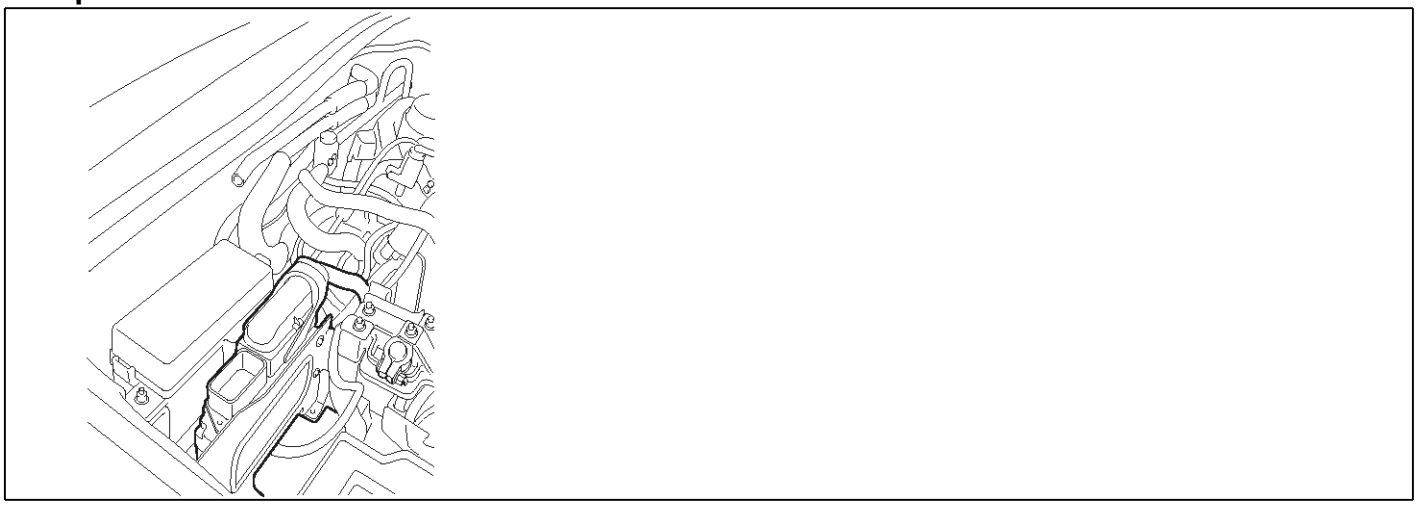
1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0641 Sensor Reference Voltage "A" Circuit/Open

Component Location



SHMAT9497L

General Description

The TCM monitors voltage supply to solenoid valve.

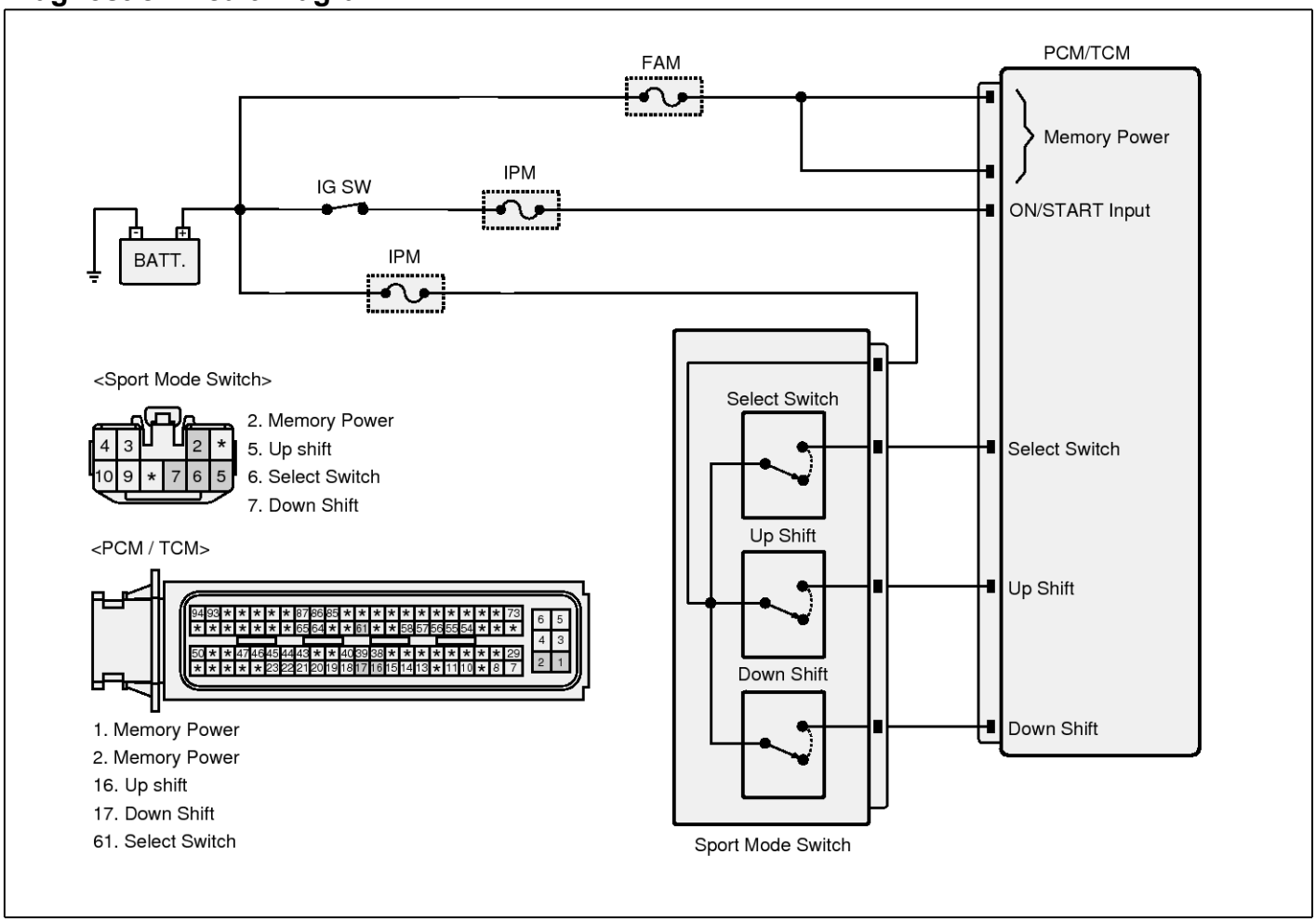
DTC Description

The TCM sets this code when suppling voltage to TCM is lower or higher than specification.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• UnderVoltage or OverVoltage	• Open or shrot in harness • TCM
Enable Conditions	• Battery voltage > 10V	
Threshold Value	• 8.7 V < Sensor Supply Voltage or Sensor Supply Voltage > 16 V	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• Prevention of pressure adaptation • Output speed from vehicle speed • D/C Off	

Diagnostic Circuit Diagram



SHMAT9701L

Monitor Scantool Data

1. Connect scantool to data link connector(DLC).
2. Ignition "ON" & Engine "OFF".
3. Monitor the "BATTERY VOLTAGE and A/T MAIN RELAY VOLTAGE" parameter on the scantool.

Specification : Approx. 12V

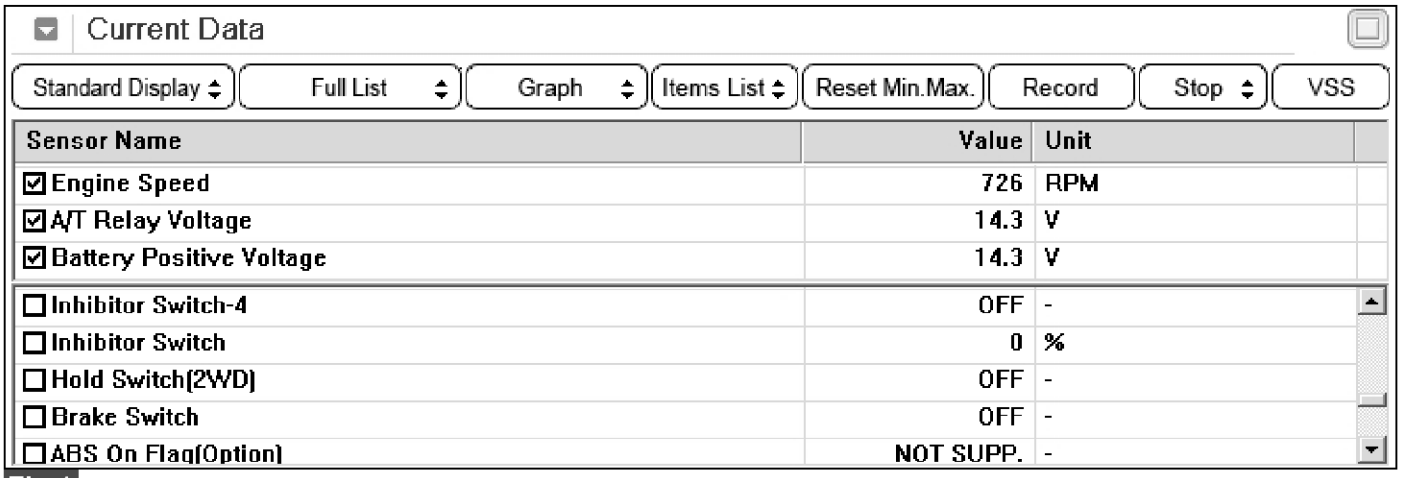


Fig.1

SHMAT9501L

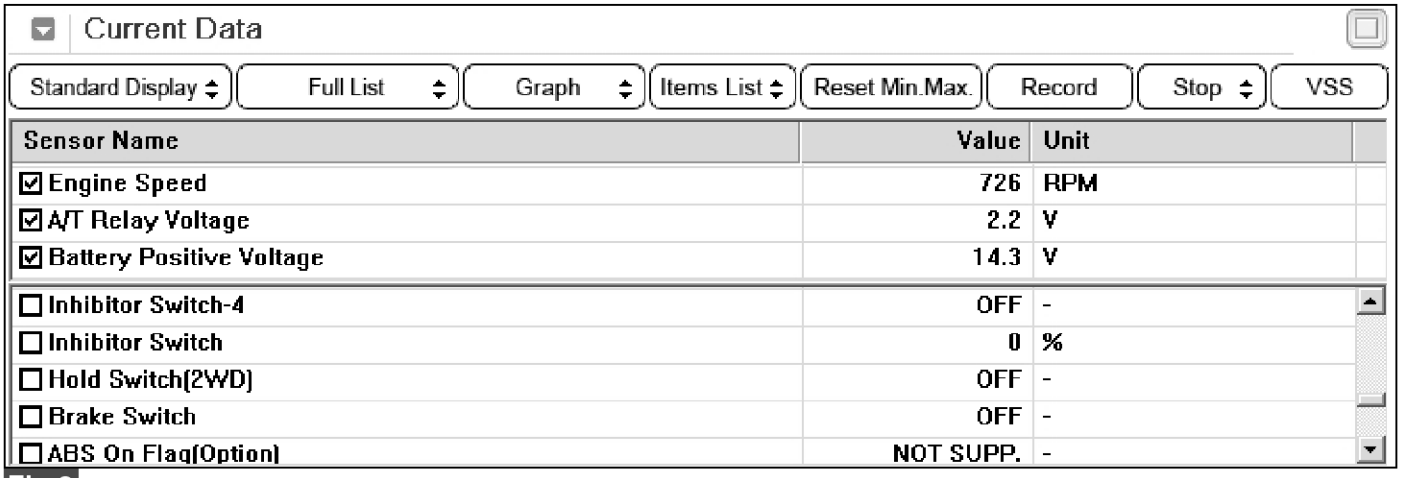


Fig.2

SHMAT9502L

Fig 1) Power Supply - Normal

Fig 2) Power Supply - Open

4. Does "BATTERY VOLTAGE and A/T MAIN RELAY VOLTAGE" follow the reference data?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Power circuit inspection" procedure.

Power Circuit Inspection

1. Connect the "PCM/TCM" connector.
2. IG "ON" & Engine "OFF" .
3. Measure the voltage between "Solenoid Supply" terminal of solenoid valve connector and chassis ground.

Specification : Battery Voltage

4. Is the measured voltage within specifications?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Check open or short in harness. Repair as necessary and then, go to "Verification of Vehicle" procedure.

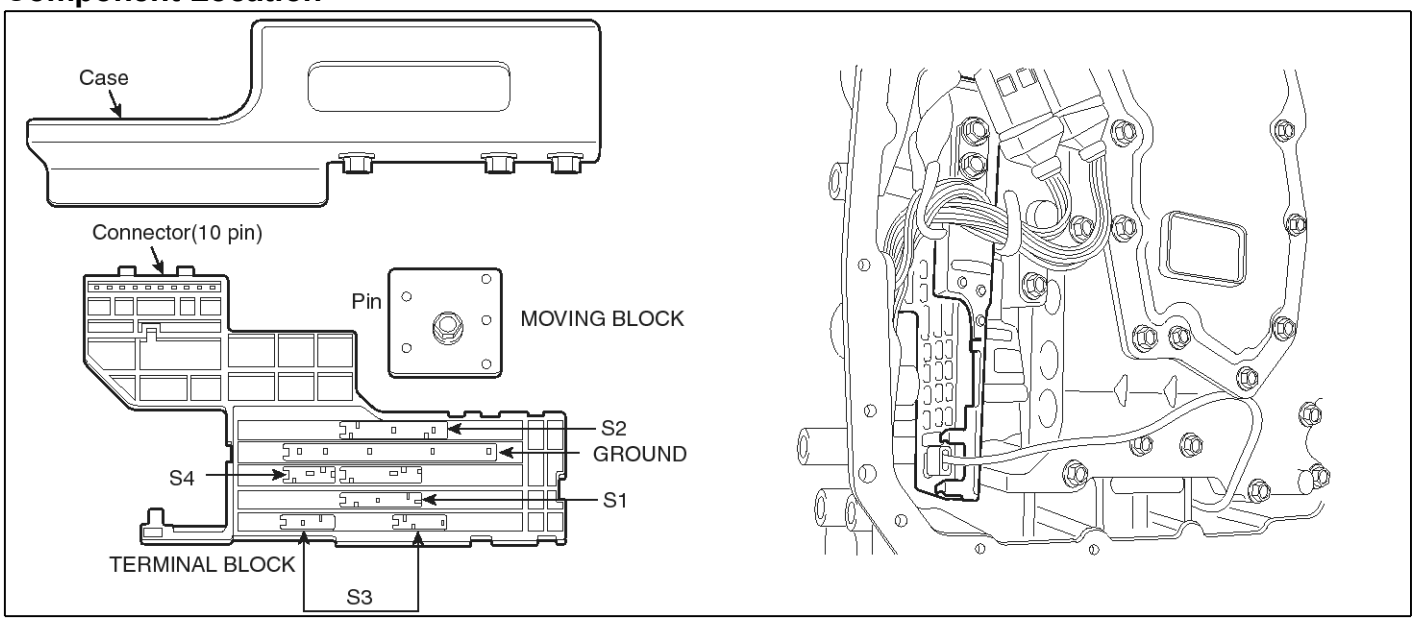
▶ If there is no problem in harness, substitute with know-good PCM/TCM and check for proper operation. If the problem is corrected, replace PCM/TCM as necessary and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error.

P0705 Transmission Range Sensor Circuit Malfunction (PRNDL Input)

Component Location



SBLAT6100L

General Description

When the shift lever is in the D (Drive) position the output signal of Tansaxle Range Switch is 12V and in all other positions the voltage is 0V. The TCM judges the shift lever position by reading all signals, for the TRANSMISSION Range Switch, simultaneously.

DTC Description

The TCM sets this code when patterns are out of specification based on the table shown below. the TRANSMISSION Range Switch has no output signal for an extended period of time.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Rationality	• OPEN OR SHORT IN CIRCUIT • Faulty TRANSMISSION RANGE SWITCH • Faulty TCM
Enable Conditions	• Sensor supply voltage in valid range OK	
Threshold Value	• Intermediate position pattern or Undefined pattern Inhibitor switch pattern check • Jump pattern Jump more than 5 steps	
Diagnostic Time	• More than 2 sec	
Fail Safe	• SELECT POSITION IS REGARDED AS "D"	

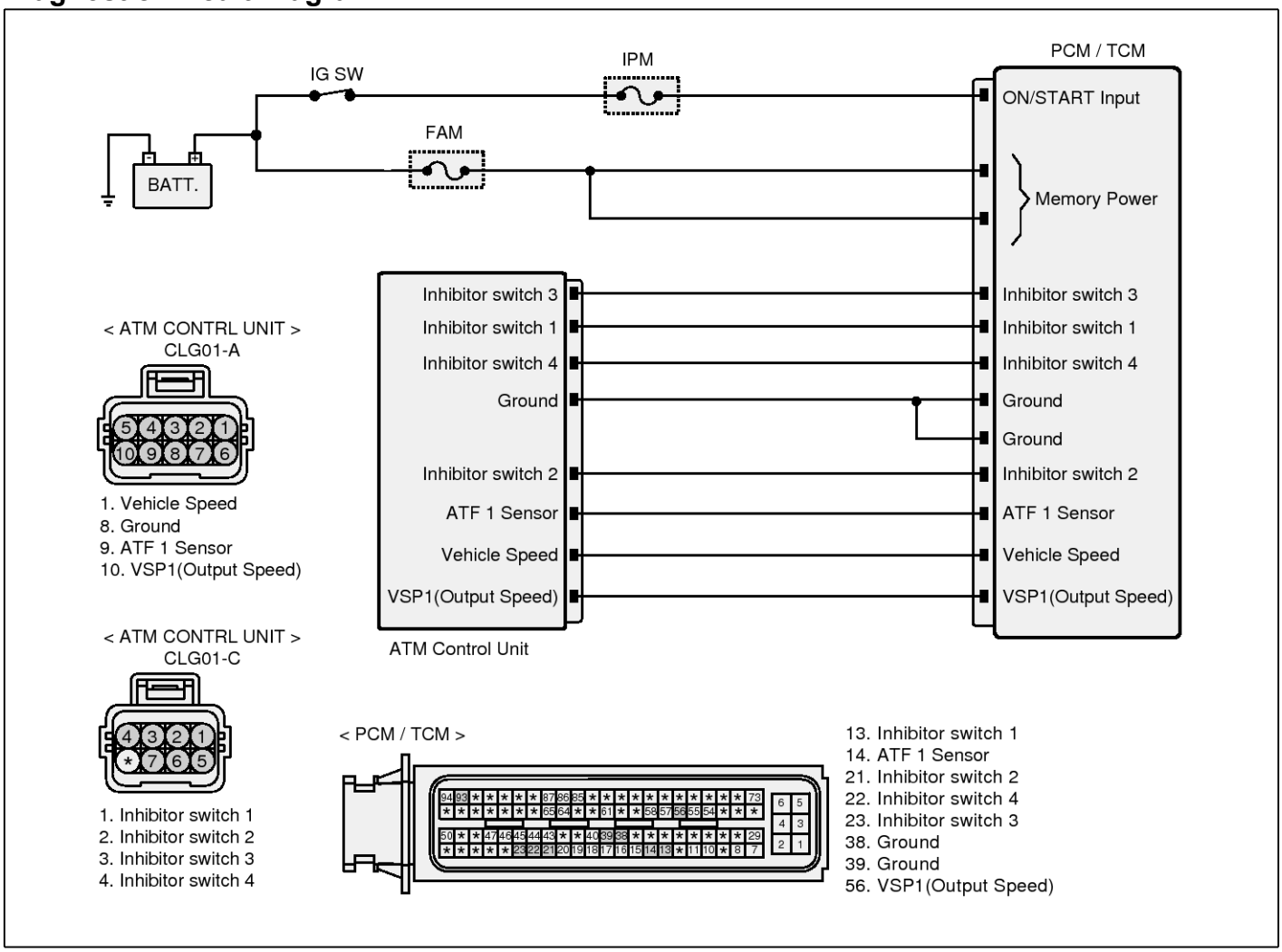
Specification

Figure 1) A/T range pattern

A/T Range Switch				Range Decision	Remarks
SW 1	SW 2	SW 3	SW 4		
OFF	OFF	OFF	OFF	Pst	P start
OFF	OFF	ON	OFF	P	P
OFF	OFF	ON	ON	P-R	Intermediate
ON	OFF	ON	ON	R	R
ON	OFF	ON	OFF	N-R	Intermediate
ON	OFF	OFF	OFF	Nst	N start
ON	OFF	OFF	ON	N-D	Intermediate
ON	ON	OFF	ON	D	D
OFF	ON	OFF	ON	3	3
OFF	ON	ON	ON	2	2
OFF	ON	ON	OFF	1	1
Irregular Pattern				Other	

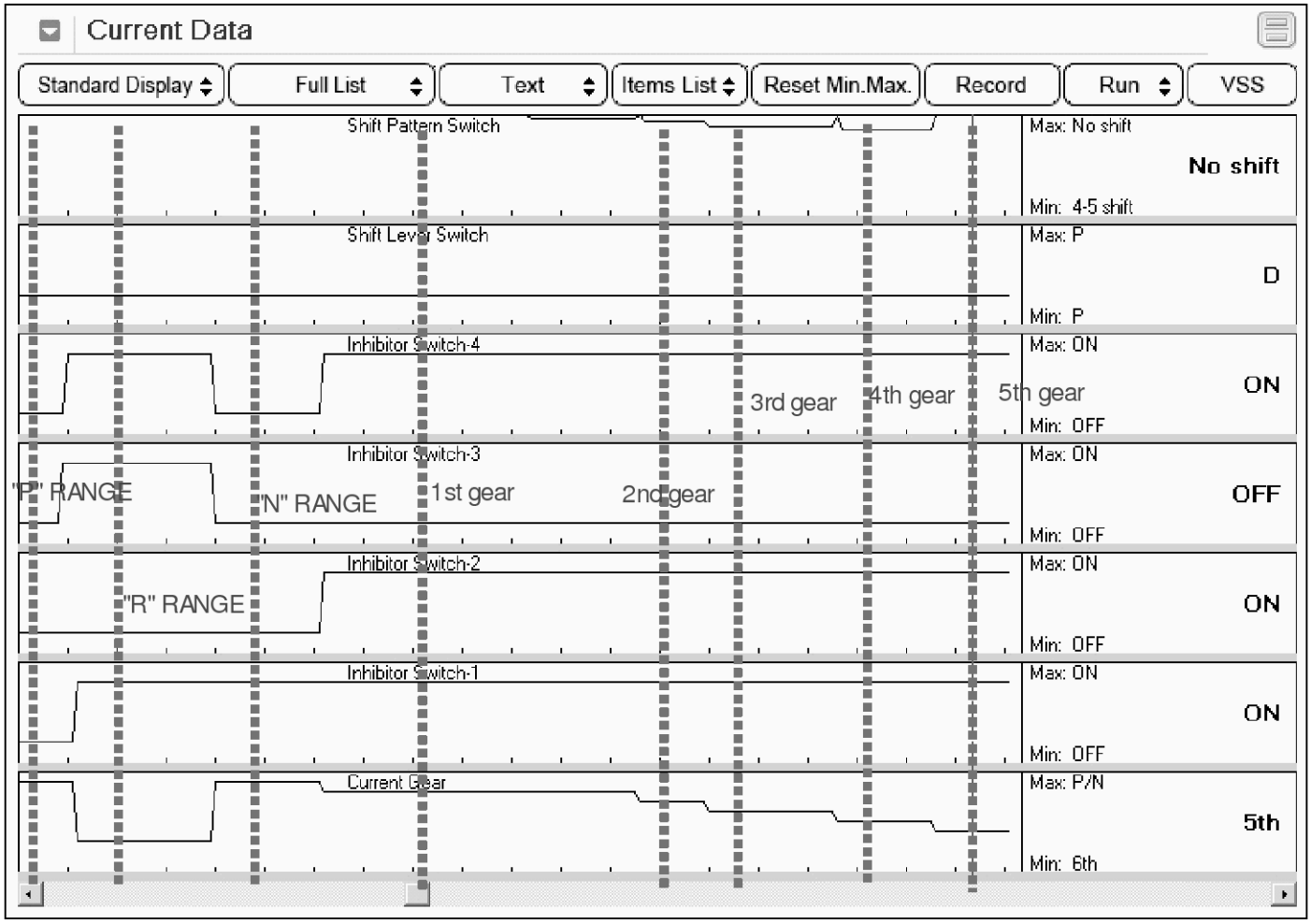
[OFF= 5V, ON = 0V]

Diagnostic Circuit Diagram



SHMAT9702L

Signal Waveform & Data



SHMAT9503L

Monitor Scantool Data

1. Connect scantool to data link connector(DLC).
2. Ignition "ON" & Engine "OFF".
3. Monitor the "TRANSMISSION RANGE SWITCH" parameter on the scantool.
4. Move selector lever from "P" range to "D" range.

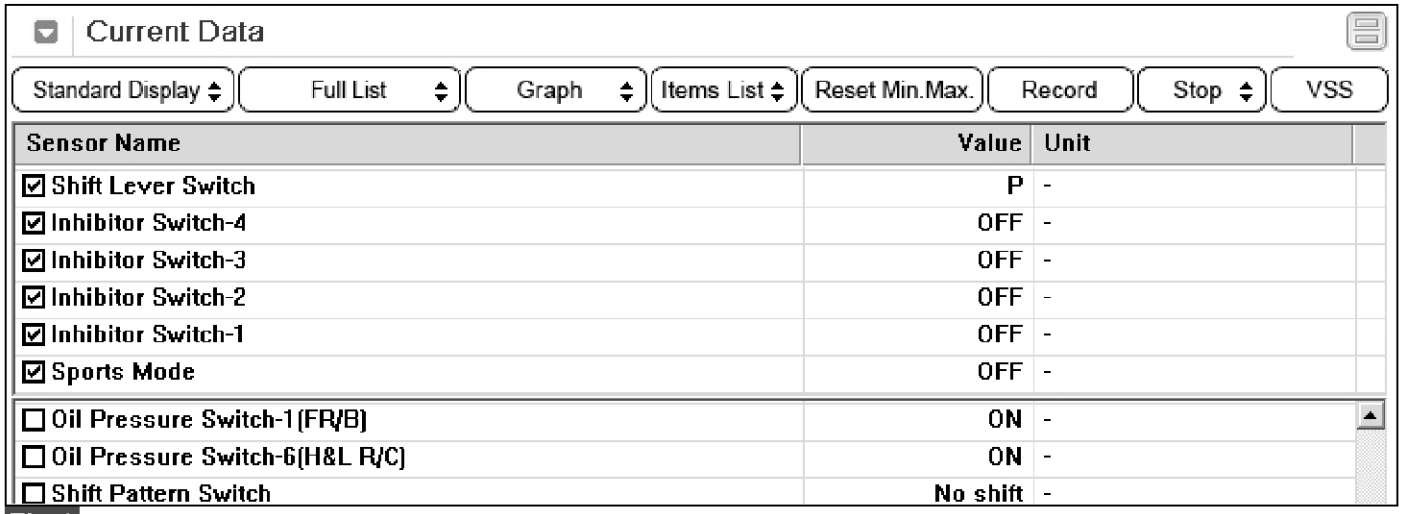


Fig.1

SHMAT9504L

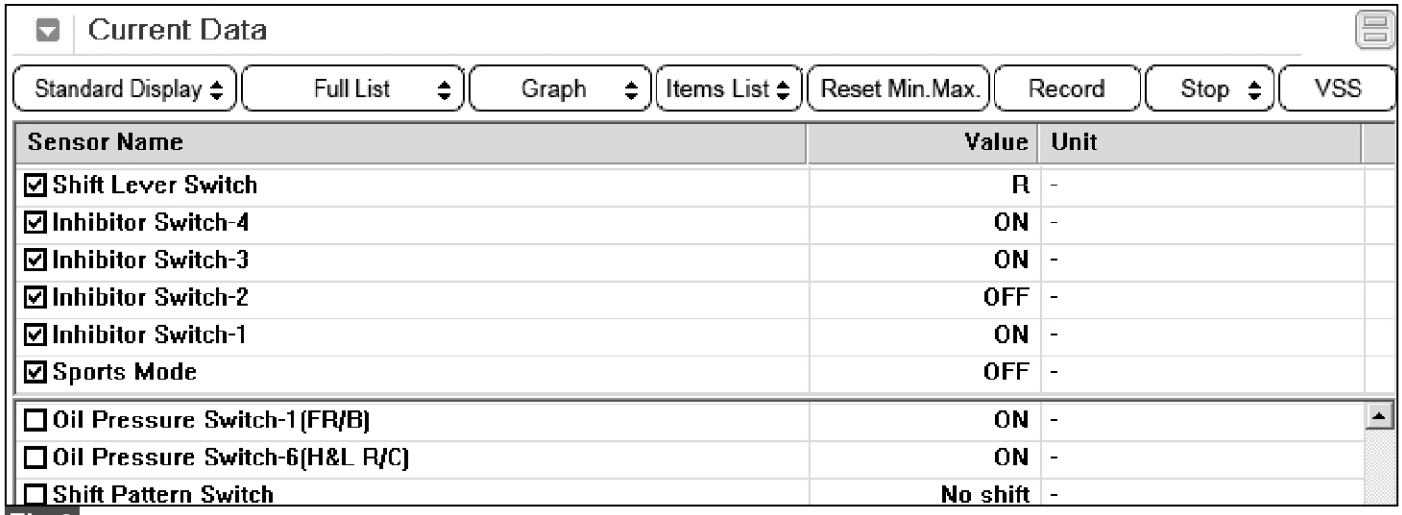


Fig.2

SHMAT9505L

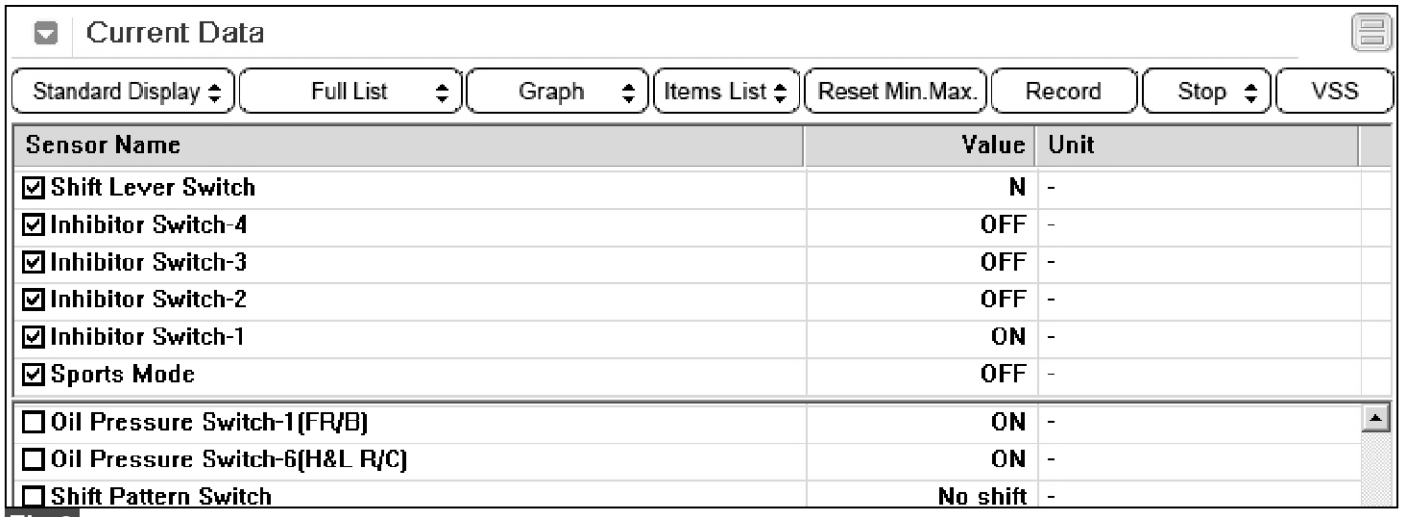


Fig.3

SHMAT9506L

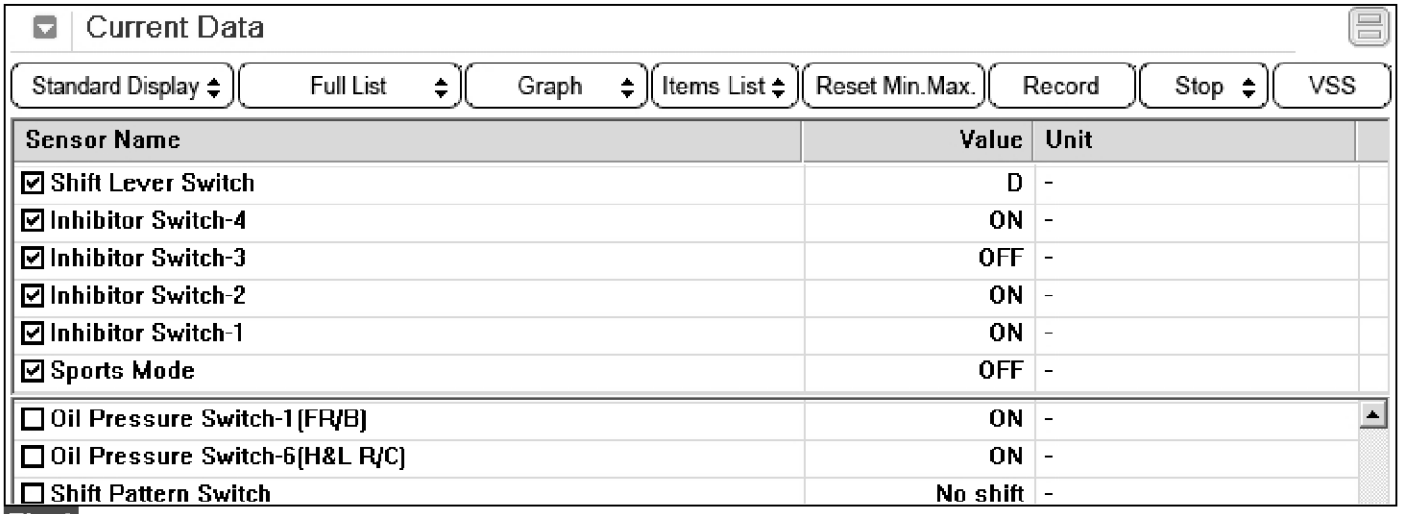


Fig.4

SHMAT9507L

Fig 1) P range

Fig 2) R range

Fig 3) N range

Fig 4) D range

5. Does "TRANSMISSION RANGE SWITCH" follow the reference data?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure

Signal Circuit Inspection

1. Disconnect ATM control Unit(CLG01-C) connector.
2. Ignition "ON" & Engine "OFF".
3. Measure voltage between each range terminal of ATM control Unit connector and chassis ground with shifting from P to D range one by one.

Specification : Battery Voltage

4. Is the measured voltage within specifications?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Check for open or short in harness. Repair as necessary and Go to "verification of vehicle repair" procedure.
▶ If signal circuit in harness is OK, Substitute with a known-good PCM/TCM and check for proper operation. If the problem is corrected, replace PCM/TCM as necessary and go to "verification of vehicle repair" procedure.

Component Inspection

1. IG "OFF" & Engine "OFF"
2. Disconnect ATM control Unit(CLG01-C & CLG01-A) connector.
3. Measure resistance between signal and ground terminal of range switch connector. (Component Side)

Specification : Refer to below table

Normal Condition(Any other conditions are treated as failure)

[Inspection table for Transmission Range Switch Table]

PIN No(C106-3)	GND	Transmission Range Switch1(S1)	Transmission Range Switch1(S2)	Transmission Range Switch1(S3)	Transmission Range Switch1(S4)	IND
P-R(Middle)	●				●	-
R	●	●		●	●	R
N-R(Middle)	●	●	●		●	-
N-D(Middle)	●	●	●	●		-
D	●	●	●		●	R

● : SWITCH IS ON(GND LEVER)

– : RANGE INDICATER LAMP "OFF" AND MAINTAIN PREVIOUS RANGE

4. Is the measured resistance within specifications ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for open or short in harness. Repair as necessary and Go to "verification of vehicle repair" procedure.
▶ If signal circuit in harness is OK, Substitute with a known-good "TRANSMISSION RANGE SWITCH" and check for proper operation. If the problem is corrected, replace "TRANSMISSION RANGE SWITCH" as necessary and go to "verification of vehicle repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

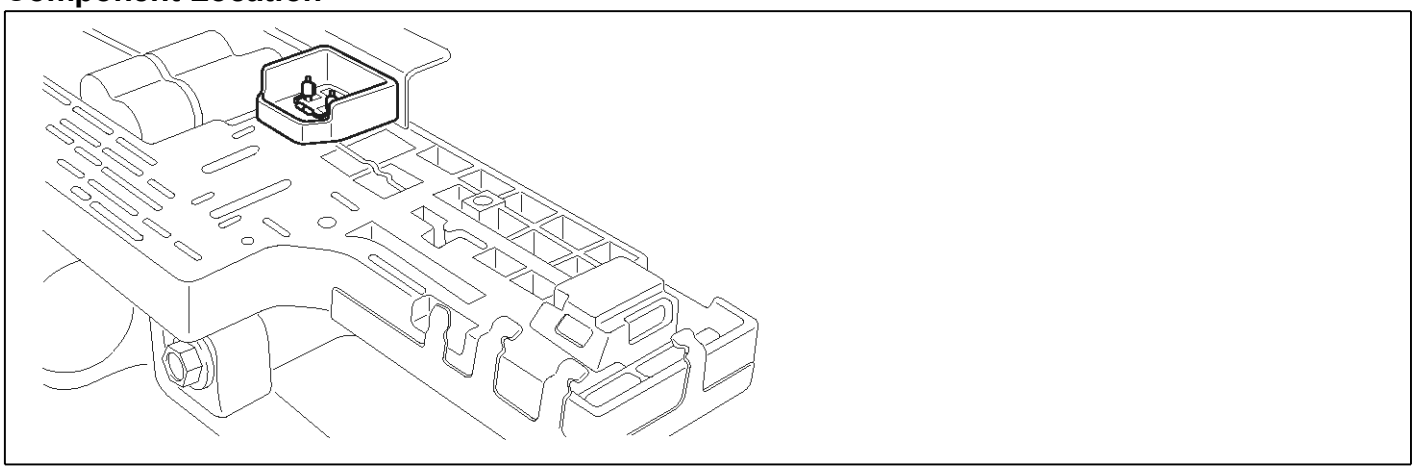
1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0711 Transmission Fluid Temperature Sensor "A" Circuit Range/Performance

Component Location



SBLAT6110L

General Description

The automatic transmission fluid(ATF) temperature sensor A is installed in the Transmission Range Switch and fluid(ATF) temperature sensor B is installed in the valve body. The TCM supplies a 5V reference voltage to the sensor, and the output voltage of the sensor changes when the ATF temperature varies.

DTC Description

This DTC code is set when the ATF temperature output voltage is lower than a value generated by thermistor resistance, in a normal operating range, for approximately 1 second or longer. The TCM regards the ATF temperature as fixed at a value of 80 ℃.

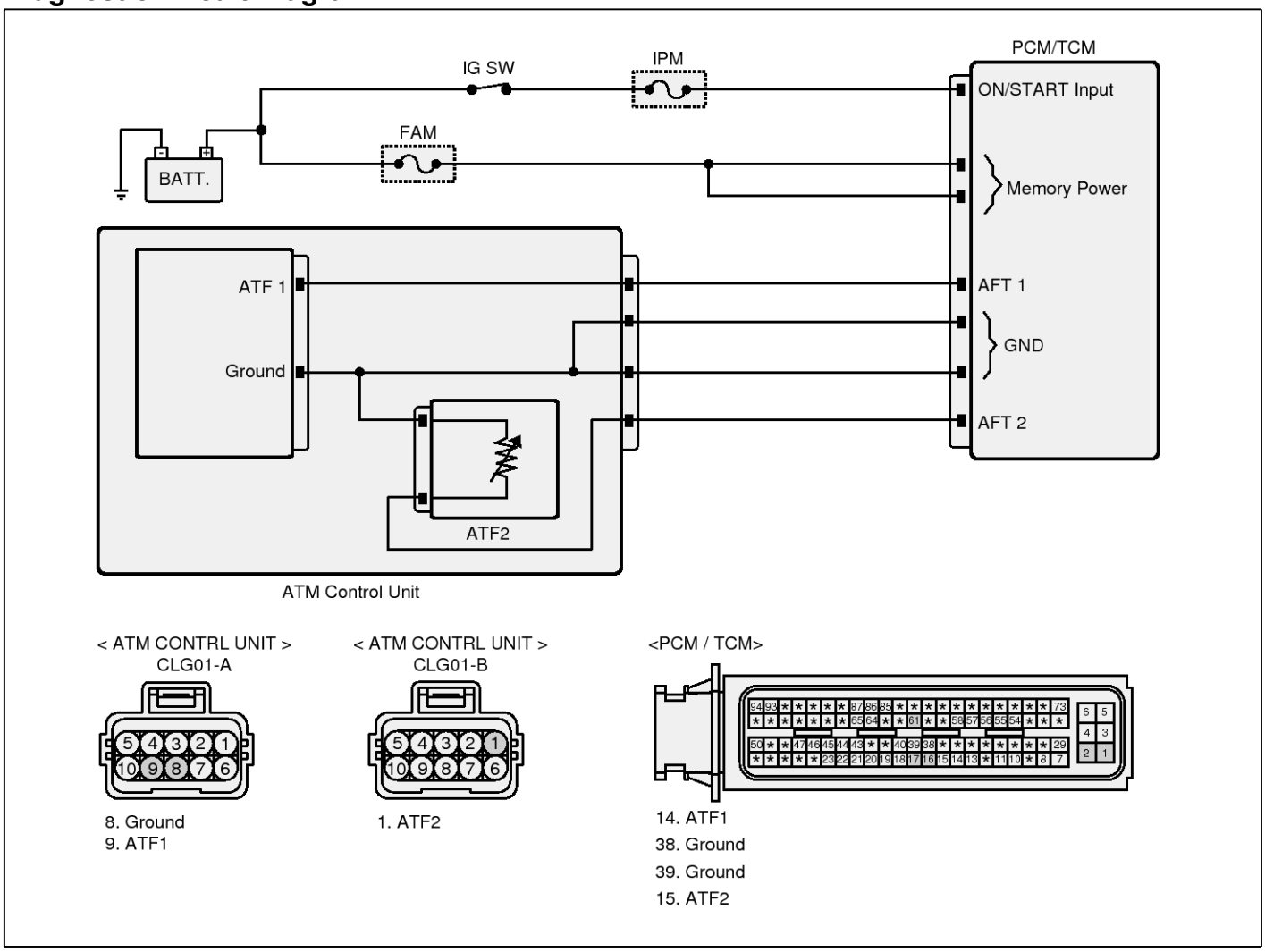
DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality(Low stuck error)	※ ATF T/S :Automatic Transmission Fluid Temperature Sensor • OPEN OR SHORT IN CIRCUIT • Faulty ATF T/S 1 • TCM
	Enable Conditions	• Output speed > 400 RPM • Engine speed > 600 RPM • Throttle opening > 3% • Oil temperature < 20 ℃	
	Threshold Value	• Oil temperature (Present Oil Temp.-Oil Temp. when the time starts)<2'C within 500 sec	
Case 2	DTC Strategy	• Rationality(High stuck error)	
	Enable Conditions	• Oil Temperature. at IG on > 18℃ • Coolant Temp at IG off - Coolant Temp. at IG on > = 50℃ • Soaking Time from ECU > 15000[sec] • Time elasped after engine coolant increase 50℃ 500 sec	
	Threshold Value	• Oil temperature Oil Temp. at IG on - Coolant Temp. at IG on > 10℃	
Case 3	DTC Strategy	• Rationality(Cold stuck error)	
	Enable Conditions	• Input speed or Engine speed > 600 RPM • Position Lever D, B, L • Oil Temperature at IG on < -10℃	
	Threshold Value	• Oil temperature Accumulated time to reach target temperature after start. * Table.1	
Diagnostic Time		• More than 2sec.	
Fail Safe		• Fluid temperature is regarded as 80℃	

Specification

	Temperature(℃)	Resistance(KΩ)	Voltage(V)
ATF T/S 1	0℃	Approx. 15KΩ	Approx. 3.3V
	20℃	Approx. 6.5KΩ	Approx. 2.7V
	80℃	Approx. 0.9KΩ	Approx. 0.9V
ATF T/S 2	0℃	Approx. 10.5KΩ	Approx. 3.3V
	20℃	Approx. 4.3KΩ	Approx. 2.5V
	80℃	Approx. 0.5KΩ	Approx. 0.7V

Diagnostic Circuit Diagram



SHMAT9703L

Monitor Scantool Data

1. Connect scantool to data link connector(DLC).
2. Engine "ON" .
3. Monitor the "TRANSAXLE FLUID TEMPERATURE SENSOR "1" parameter on the scantool .

Specification : Increasing Gradually

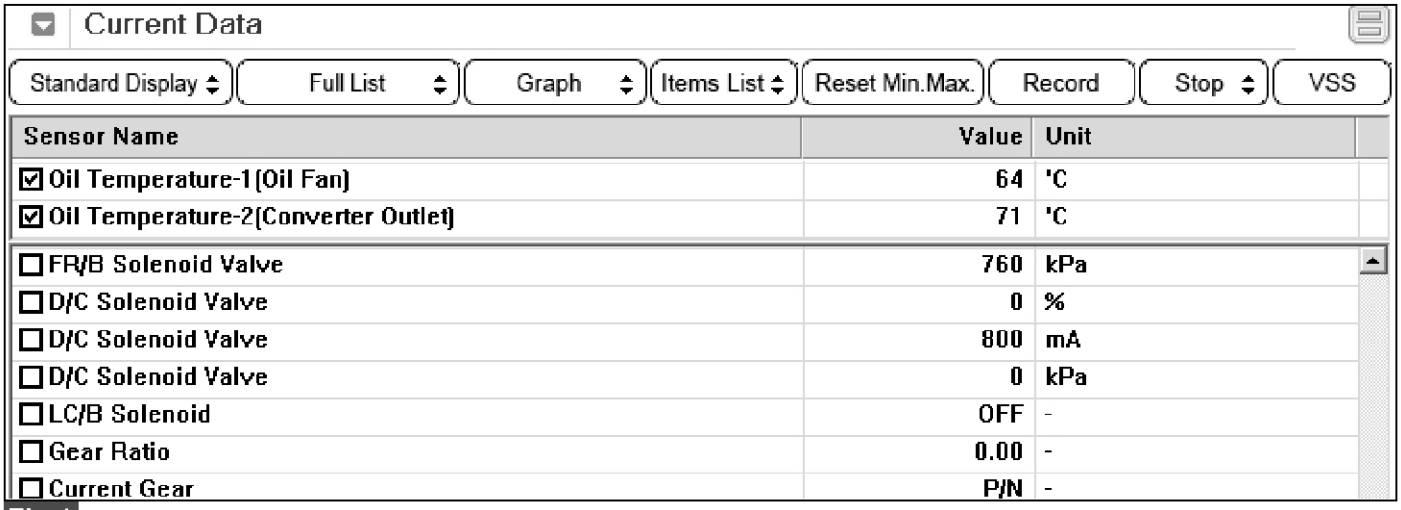


Fig.1

SHMAT9508L

Fig 1) Normal Data

4. Does "TRANSMISSION FLUID TEMPERATURE SENSOR " follow the reference data?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure.

Signal Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Disconnect ATM Control Unit(CLG01-A & CLG01-C) connector.
3. Measure voltage between signal terminal of AFT at the ATM Control Unit harness connector and chassis ground.

Specification : Refer to bleow table

[Inspection Table]

	Temperature(℃)	Resistance(KΩ)	Voltage(V)
ATF T/S 1	0℃	Approx. 15KΩ	Approx. 3.3V
	20℃	Approx. 6.5KΩ	Approx. 2.7V
	80℃	Approx. 0.9KΩ	Approx. 0.9V
ATF T/S 2	0℃	Approx. 10.5KΩ	Approx. 3.3V
	20℃	Approx. 4.3KΩ	Approx. 2.5V
	80℃	Approx. 0.5KΩ	Approx. 0.7V

4. Is the measured voltage within specifications ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check for open or short in harness. And repair as necessary and then, go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check TCM

1. Ignition "ON" & Engine "OFF".
2. Disconnect the "ATM Control Unit(CLG01-A) " connector.
3. Install scantool and slect a SIMU-SCAN,
4. Simulate voltage (0→5V) to "TRANSMISSION FLUID TEMPERATURE SENSOR 1, 2" signal circuit.

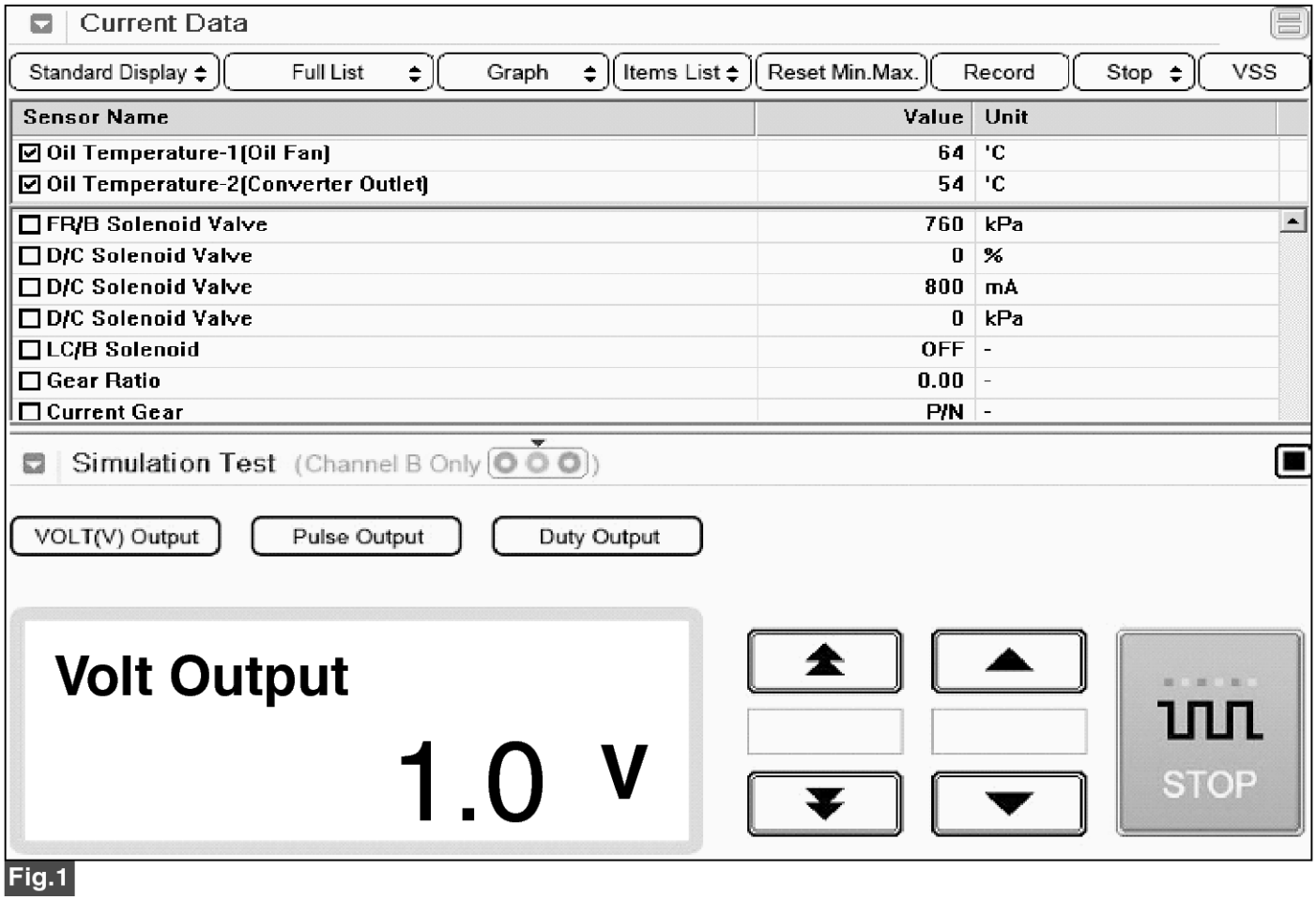


Fig.1

SHMAT9509L

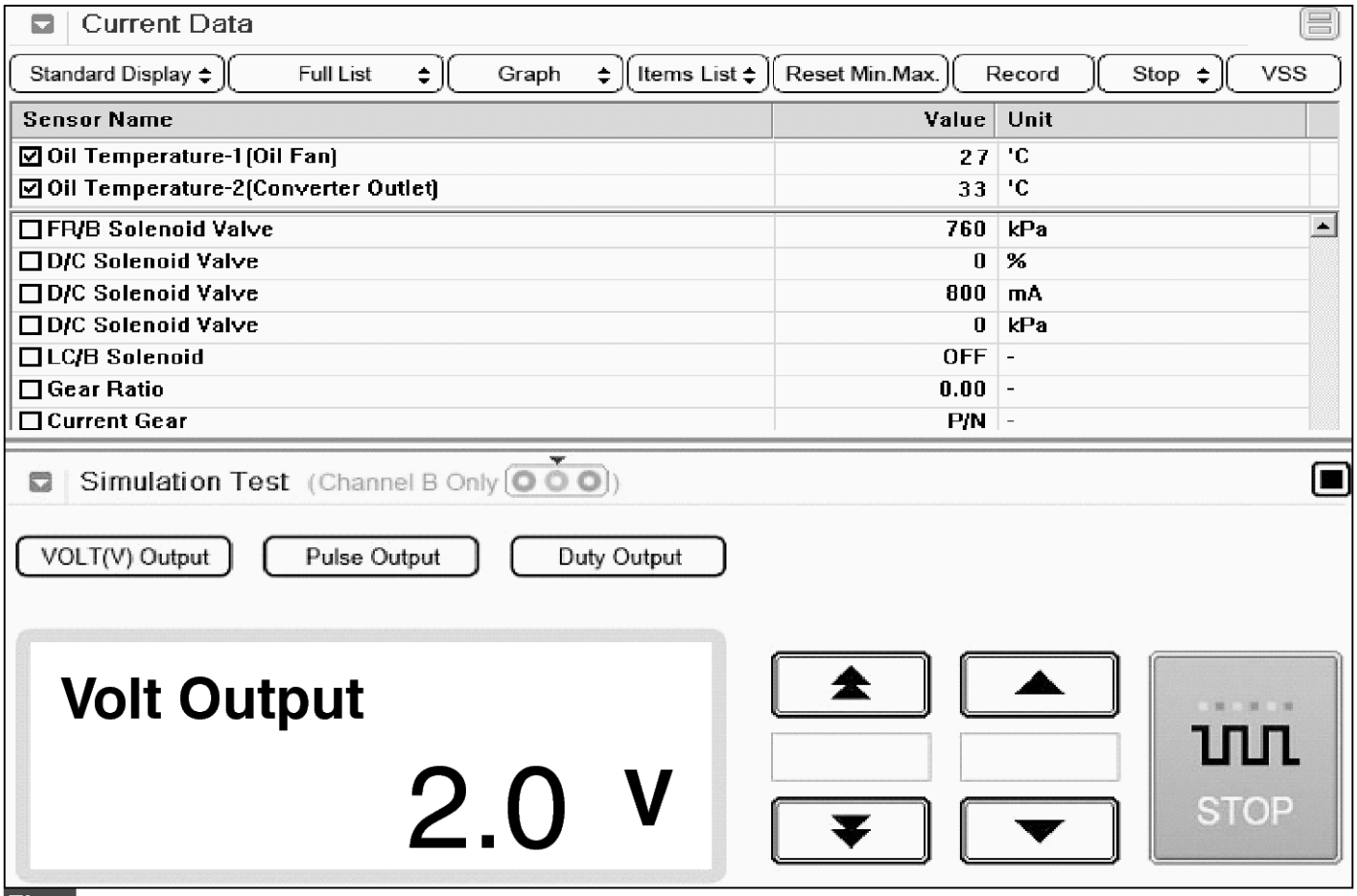


Fig.2

SHMAT9510L

Fig 1) Simulation Output 1.00V → 63℃

Fig 2) Simulation Output 2.00V → 33℃

※ It is subject to change vehicle condition.

5. Is FLUID TEMP. SENSOR signal value changed according to simulation voltage?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0712 Transmission Fluid Temperature Sensor "A" Circuit Low Input

Component Location

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

General Description

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

DTC Description

This DTC is for checking sensor failure. This code is set if the temperture data from Oil Temperture sensor is fixed between -20℃ and 0℃ or 0℃ and 20℃ for 10min. after driving a vehicle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Circuit continuty-ground	※ ATF T/S :Automatic Transmissi-on Fluid Temperature Sensor • Short to ground in circuit • Faulty ATF T/S 1 • TCM
Enable Conditions	• Battery voltage > 10V	
Threshold Value	• Input voltage < 0.05V	
Diagnostic Time	• More than 2 sec	
Fail Safe	• OTS2 temperature(If OTS2 is error, 80['C] is fixed) • Shift prevention over 4th gear • Prevention of manual shift • Prevention of pressure adaptation	

Specification

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Diagnostic Circuit Diagram

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Monitor Scantool Data

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Terminal & Connector Inspection

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Signal Circuit Inspection

■ Check Voltage

1. Ignition "ON" & Engine "OFF".
2. Disconnect ATM Control Unit(CLG01-A & CLG01-C) connector.
3. Measure voltage between signal terminal of AFT at the ATM Control Unit harness connector and chassis ground.

Specification : Refer to bleow table

[Inspection Table]

	Temperature(℃)	Resistance(KΩ)	Voltage(V)
ATF T/S 1	0℃	Approx. 15KΩ	Approx. 3.3V
	20℃	Approx. 6.5KΩ	Approx. 2.7V
	80℃	Approx. 0.9KΩ	Approx. 0.9V
ATF T/S 2	0℃	Approx. 10.5KΩ	Approx. 3.3V
	20℃	Approx. 4.3KΩ	Approx. 2.5V
	80℃	Approx. 0.5KΩ	Approx. 0.7V

4. Is the measured voltage within specifications ?

YES ▶ Go to "Check short to ground in circuit" procedure.

NO ▶ Check for open or short in harness. And repair as necessary and then, go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in circuit

1. Ignition "OFF" & Engine "OFF".
2. Disconnect ATM Control Unit(CLG01-A & CLG01-C) connector.
3. Measure continuity between signal terminal of AFT1 harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specifications?

YES ▶ Go to "CHECK PCM/TCM " as below.

NO ▶ Check for short to ground in harness. Repair as necessary and Go to "verification of vehicle repair" procedure.
▶ Replace "TRANSMISSION FLUID TEMPERATURE SENSOR 1" as necessary and Go to " verification of vehicle repair" procedure.

Component Inspection

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Verification of Vehicle Repair

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

P0713 Transmission Fluid Temperature Sensor "A" Circuit High Input

Component Location

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

General Description

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

DTC Description

Refer to DTC P0712 : Transmission Fluid Temperature Sensor “A” Circuit Low Input.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Battery short(After IG On)	※ ATF T/S :Automatic Transmission Fluid Temperature Sensor • Open or shrot to battery in circuit • Faulty ATF T/S 1 • Faulty TCM
	Enable Conditions	• Battery Voltage > 10V • Oil temperature at IG On >= -38℃	
	Threshold Value	• Oil temperature sensor voltage Sensor voltage > 4.8V	
Case 2	DTC Strategy	• Battery Short(Before IG On)	
	Enable Conditions	• Oil temperature at IG On <= -39℃ • Engine speed > 1000 RPM • Output speed >= 500 RPM • Engine coolant temperature >= 70℃ • Delay time 160 sec	
	Threshold Value	• Oil temperature sensor voltage Sensor voltage > 4.8V	
Case 3	DTC Strategy	• Open(After IG On)	
	Enable Conditions	• Battery Voltage > 10V • Oil temperature at IG On >= -38℃	
	Threshold Value	• Oil temperature sensor voltage Sensor 3.95V < Sensor voltage < 4.8V	
Case 4	DTC Strategy	• Open(Before IG On)	
	Enable Conditions	• Oil temperature at IG On <= -39℃ • Engine speed > 1000 RPM • Output speed >= 500 RPM • Engine coolant temperature >= 70℃ • Delay time 160 sec	
	Threshold Value	• Oil temperature sensor voltage Sensor 3.95V < Sensor voltage < 4.8V	
Diagnostic Time		• More than 2sec.	
Fail Safe		• OTS2 temperature(If OTS2 is error, 80['C] is fixed) • Shift prevention over 4th gear • Prevention of manual shift • Prevention of pressure adaptation	

Specification

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Diagnostic Circuit Diagram

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Monitor Scantool Data

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Terminal & Connector Inspection

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Signal Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Disconnect ATM Control Unit(CLG01-A & CLG01-C) connector.
3. Measure voltage between signal terminal of AFT at the ATM Control Unit harness connector and chassis ground.

Specification : Refer to bleow table

[Inspection Table]

	Temperature(℃)	Resistance(KΩ)	Voltage(V)
ATF T/S 1	0℃	Approx. 15KΩ	Approx. 3.3V
	20℃	Approx. 6.5KΩ	Approx. 2.7V
	80℃	Approx. 0.9KΩ	Approx. 0.9V
ATF T/S 2	0℃	Approx. 10.5KΩ	Approx. 3.3V
	20℃	Approx. 4.3KΩ	Approx. 2.5V
	80℃	Approx. 0.5KΩ	Approx. 0.7V

4. Is the measured voltage within specifications ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or short in harness. And repair as necessary and then, go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

1. Ignition "OFF" & Engine "OFF".
2. Disconnect ATM Control Unit(CLG01-A & CLG01-C) connector.
3. Measure continuity between signal terminal of AFT1 harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specifications?

YES ▶ Go to "CHECK PCM/TCM " as below.

NO ▶ Check for open in harness. Repair as necessary and Go to "verification of vehicle repair" procedure.
▶ Replace "TRANSMISSION FLUID TEMPERATURE SENSOR 1" as necessary and Go to " verification of vehicle repair" procedure.

Component Inspection

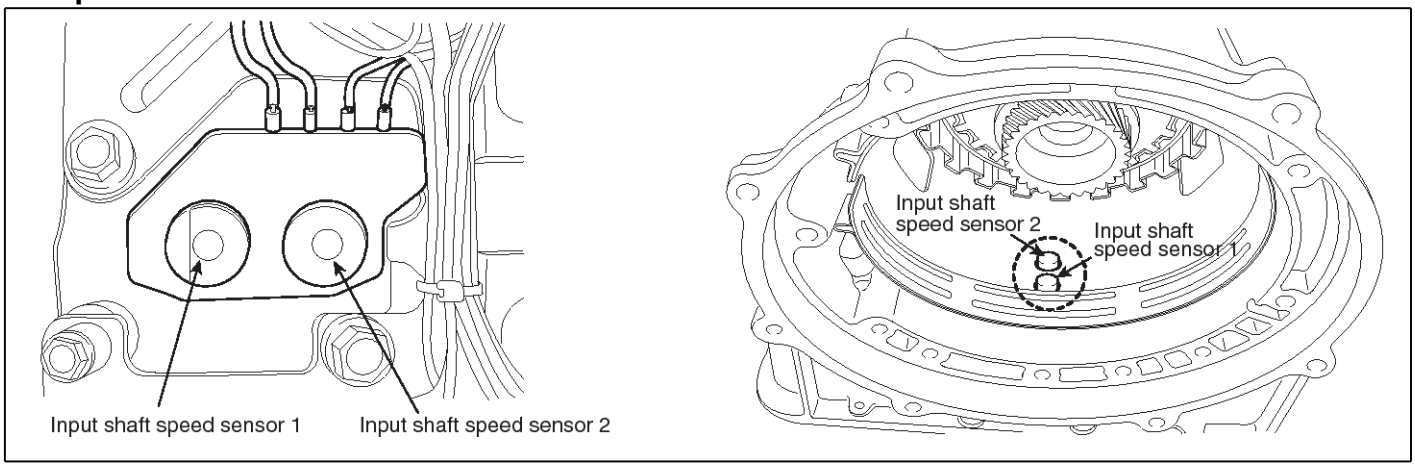
Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

Verification of Vehicle Repair

Refer to DTC P0711 : Transmission Fluid Temperature Sensor “A” Circuit Range/Performance.

P0716 Input/Turbine Speed Sensor "A" Circuit Range/Performance

Component Location



SBLAT6120L

General Description

The Input Sensor of RXC Auto transmission is composed of S1(Sensor1) and S2(Sensor2). S1 inputs signal to TCM only at 4th gear and S2 does at 1st, 2nd, 3rd, 4th and 5th gear. Therefore, sensing pulse frequency outputted from sensor 2, TCM calculates Inputshaft speed and compute Turbine rotation. This value is mainly used to control the optimum fluid pressure during shifting.

DTC Description

The TCM sets this code if an output pulse-signal is not detected, from the INPUT SPEED SENSOR 1 or 2, when the vehicle is running faster than 24.85MPH(40km/h). The Fail-Safe function will be set by the TCM if this code is detected.

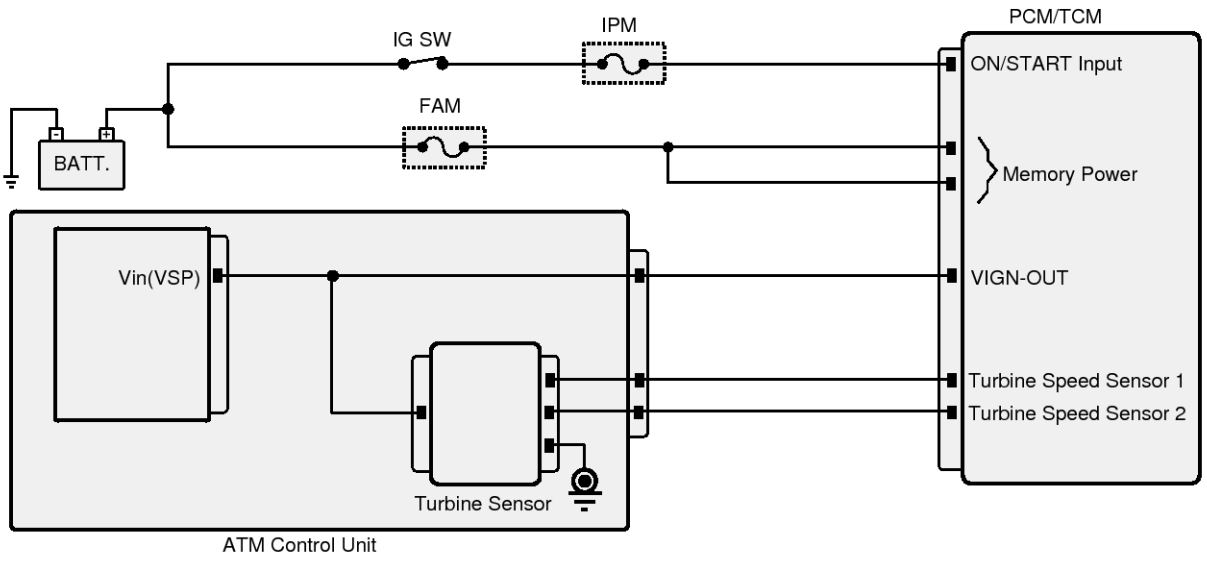
DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality(NTU Too high)	• Open or short in signal circuit • Open in power circuit • Open in ground ircuit • Faulty input speed sensor 1or 2 • Faulty TCM
	Enable Conditions	• Battery Voltage > 10V	
	Threshold Value	• Input speed1, Input speed2 Input speed1 >= 10000RPM or Input speed2 >= 10000RPM	
Case 2	DTC Strategy	• Rationality	
	Enable Conditions	• Battery Voltage > 10V • The time after the last shift was finished 500 msec • State of the tranmission Static • Output speed > 200RPM • Engine speed > 700RPM	
	Threshold Value	• Input speed1(1, 2, 3, 5 Gear) Input speed1 > 100[rpm]	
Diagnostic Time		• More than 2sec.	
Fail Safe		• Input Speed = 600RPM • Shift prevention over 4th gear • Prevention of manual shift • Prevention of pressure adaptation • Damper clutch off	

Specification

NAME	T01-3 PIN No.	Measurement Condition	Spec.
Turbine Sensor 1	6	• 1st gear • 20km/h • IDLE S/W OFF	Approx. 1.1K(Hz)
Turbine Sensor 2	7	• 4th gear • 50km/h • IDLE S/W OFF	

Diagnostic Circuit Diagram



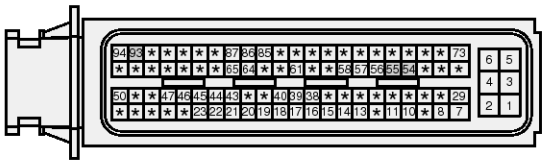
< ATM CONTRL UNIT > CLG01-A

1. VIGN-OUT

< ATM CONTRL UNIT > CLG01-C

6. Turbine Speed Sensor 1
7. Turbine Speed Sensor 2

<PCM / TCM>



54. Turbine Speed Sensor 2
55. Turbine Speed Sensor 1
93. VIGN-OUT

SHMAT9704L

Signal Waveform & Data

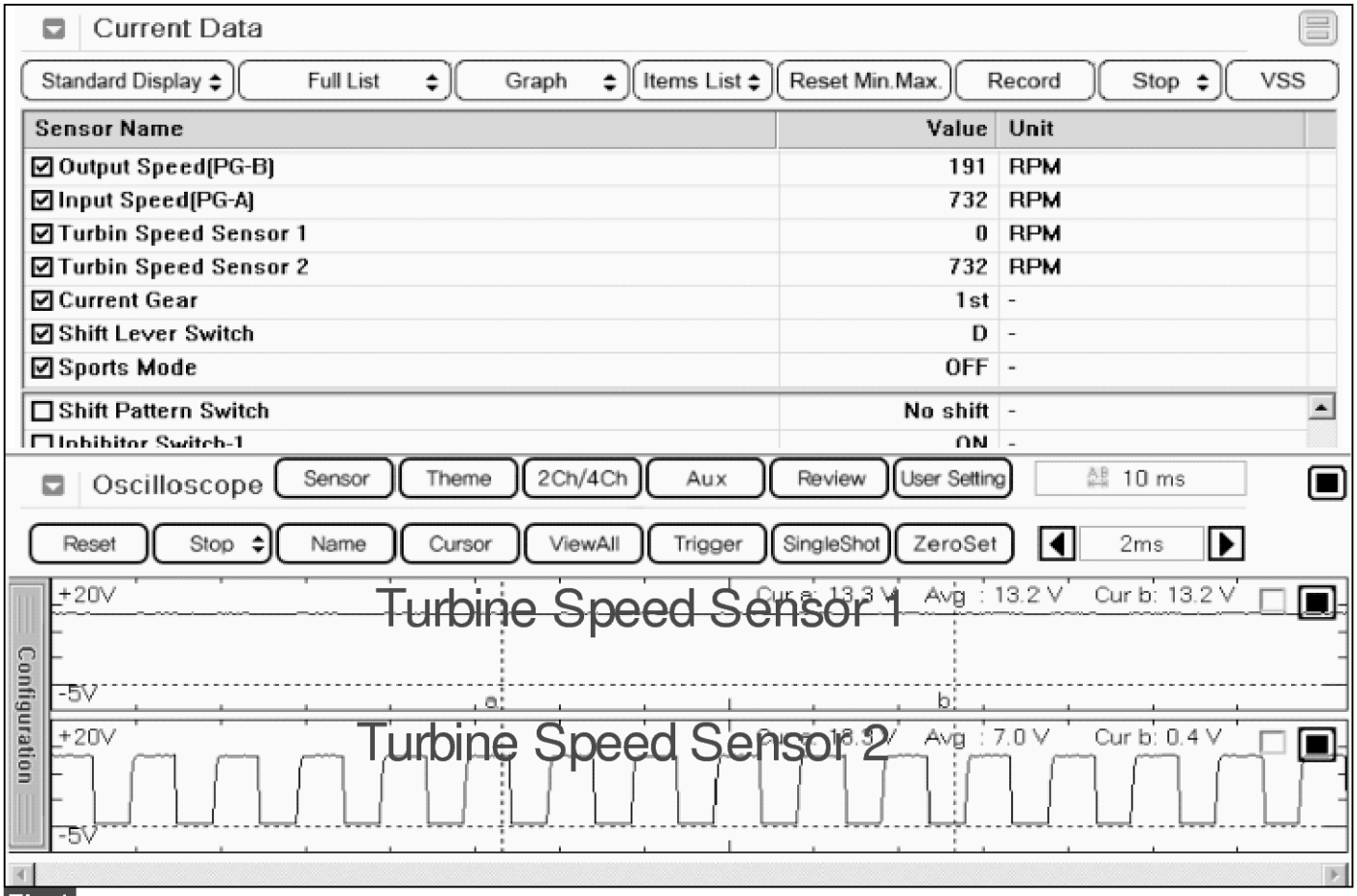


Fig.1

SHMAT9511L

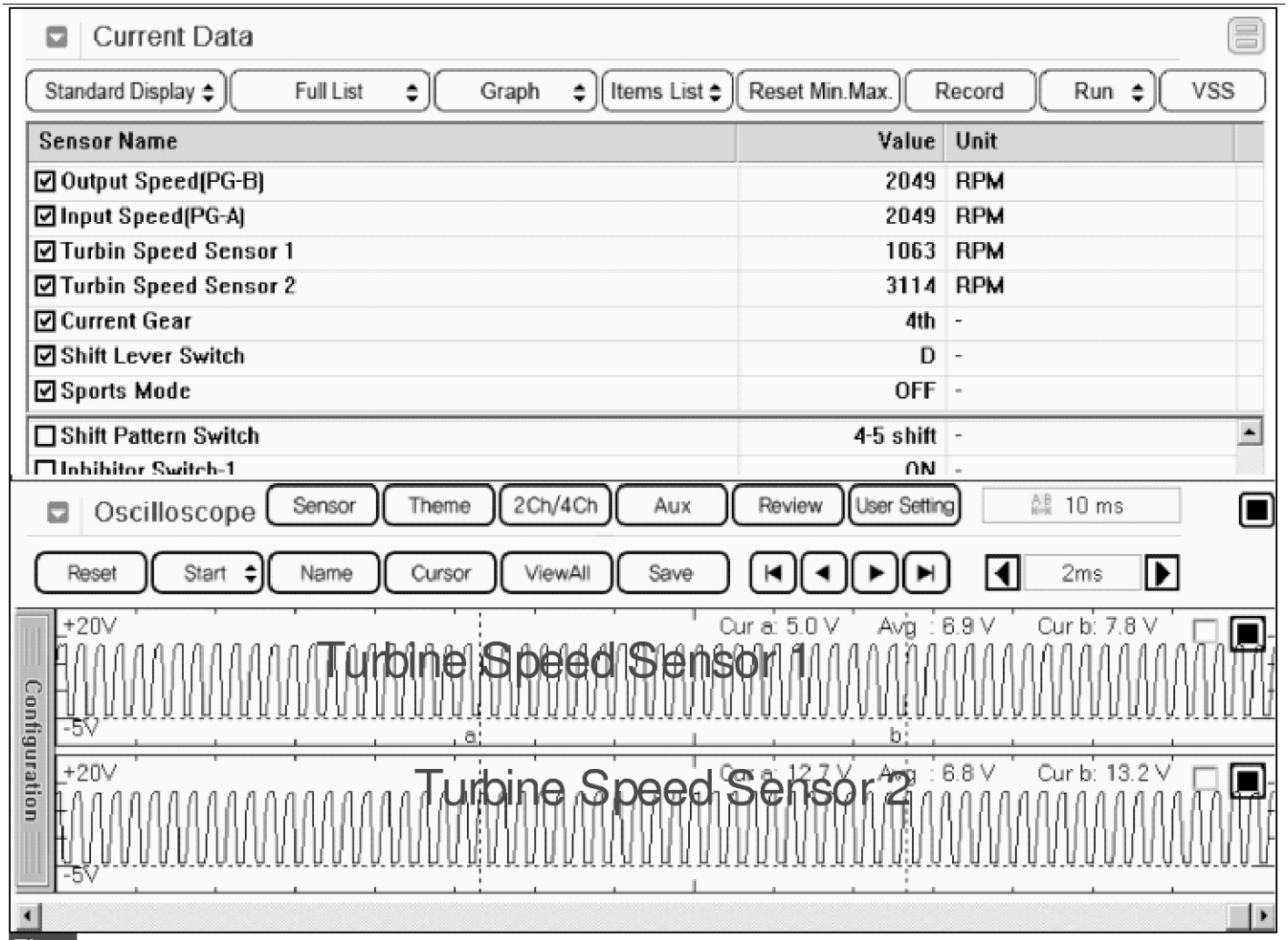


Fig.2

SHMAT9512L

Fig 1) 1st gear in D range

Fig 2) 4th gear in D range

⚠CAUTION

Singal waveform shows that voltage for Tubine Speed Sensor 1 & 2 is 0.5V or 13V when brake is ON

Monitor Scantool Data

1. Connect scantool to data link connector(DLC).
2. Engine "ON" .
3. Monitor the "INPUT SPEED SENSOR 1" parameter on the scantool.
4. Drive the vehicle over 40 Km/h.

Specification : Increasing Gradually

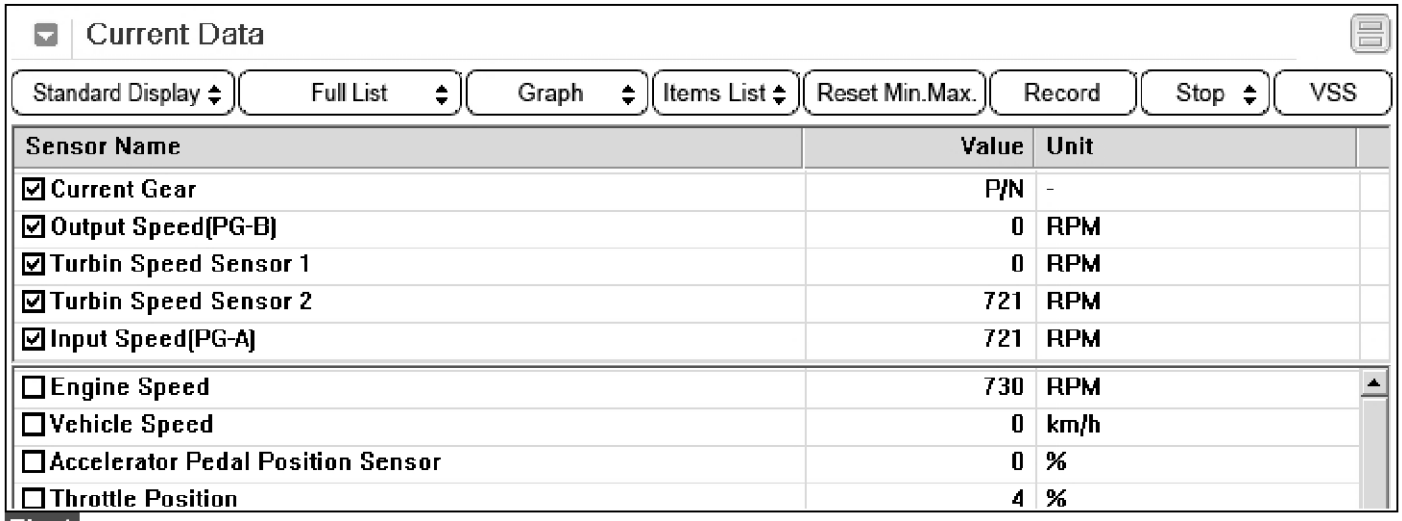


Fig.1

SHMAT9513L

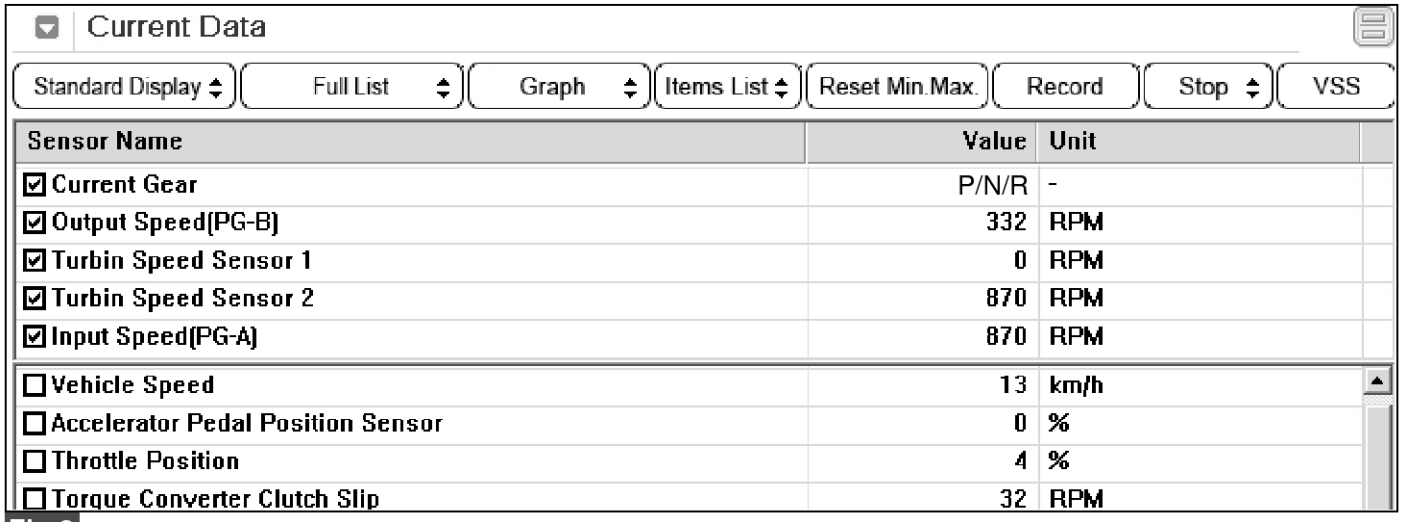


Fig.2

SHMAT9514L

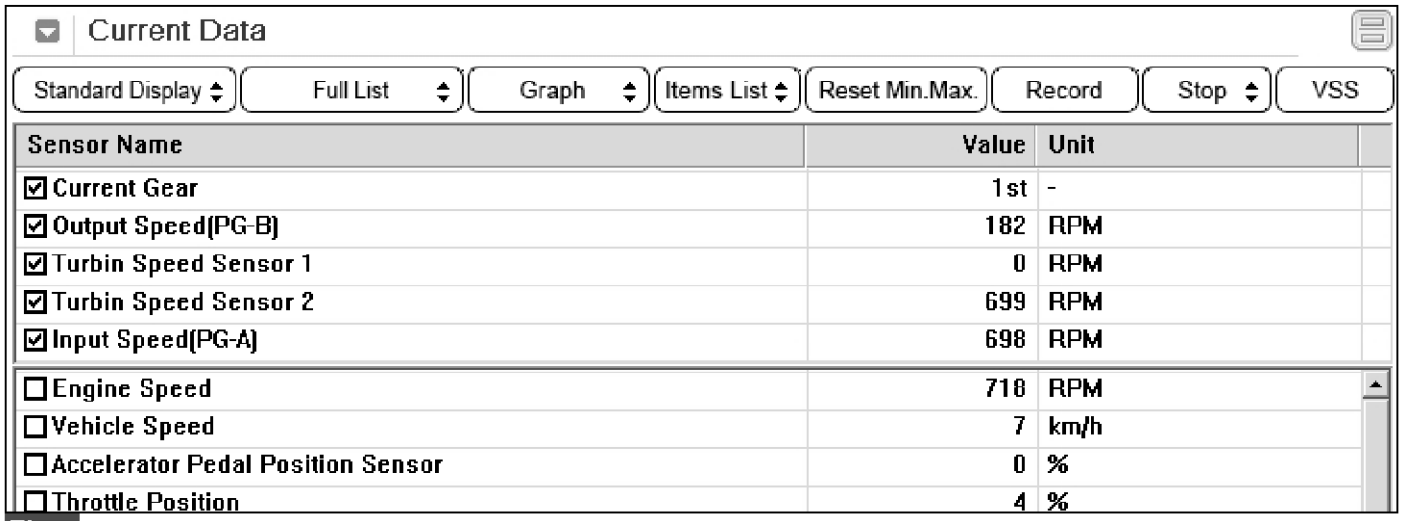


Fig.3

SHMAT9515L

Current Data

Standard Display | Full List | Graph | Items List | Reset Min.Max. | Record | Stop | VSS

Sensor Name	Value	Unit
☑ Current Gear	2nd	-
☑ Output Speed(PG-B)	469	RPM
☑ Turbin Speed Sensor 1	0	RPM
☑ Turbin Speed Sensor 2	1110	RPM
☑ Input Speed(PG-A)	1110	RPM
☐ Engine Speed	1133	RPM
☐ Vehicle Speed	19	km/h
☐ Accelerator Pedal Position Sensor	2	%
☐ Throttle Position	6	%

Fig.4

SHMAT9516L

Current Data

Standard Display | Full List | Graph | Items List | Reset Min.Max. | Record | Stop | VSS

Sensor Name	Value	Unit
☑ Current Gear	3rd	-
☑ Output Speed(PG-B)	779	RPM
☑ Turbin Speed Sensor 1	0	RPM
☑ Turbin Speed Sensor 2	1182	RPM
☑ Input Speed(PG-A)	1182	RPM
☐ Engine Speed	1223	RPM
☐ Vehicle Speed	32	km/h
☐ Accelerator Pedal Position Sensor	2	%
☐ Throttle Position	6	%

Fig.5

SHMAT9517L

Current Data

Standard Display | Full List | Graph | Items List | Reset Min.Max. | Record | Stop | VSS

Sensor Name	Value	Unit
☑ Current Gear	4th	-
☑ Output Speed(PG-B)	897	RPM
☑ Turbin Speed Sensor 1	465	RPM
☑ Turbin Speed Sensor 2	1355	RPM
☑ Input Speed(PG-A)	897	RPM
☐ Engine Speed	693	RPM
☐ Vehicle Speed	40	km/h
☐ Accelerator Pedal Position Sensor	0	%
☐ Throttle Position	5	%

Fig.6

SHMAT9518L

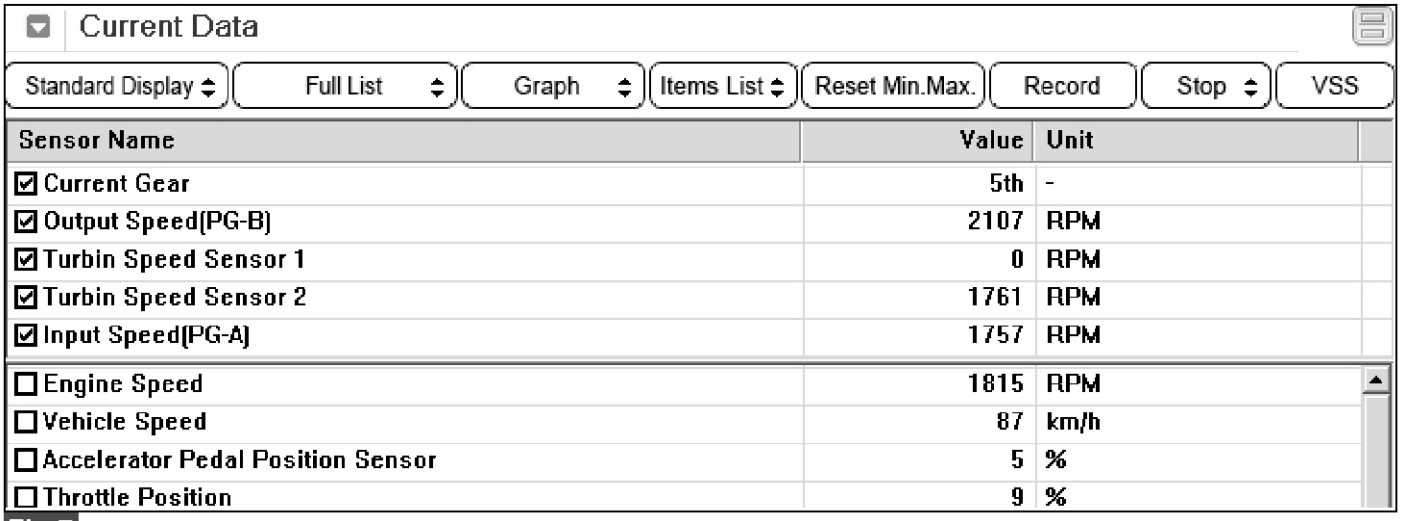


Fig.7

SHMAT9519L

Fig 1) "P,N" range

Fig 2) "R" range

Fig 3) "D" range 1st gear

Fig 4) "D" range 2nd gear

Fig 5) "D" range 3rd gear

Fig 6) "D" range 4th gear

Fig 7) "D" range 5th gear

5. Does "INPUT SPEED SENSOR " follow the reference data?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure.

Signal Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Disconnect "ATM Control Unit(CLG01-C)" connector.
3. Measure voltage between signal terminal of TCM harness connector and chassis ground.

Specification : Approx. 12V

4. Is the measured voltage within specifications?

YES ▶ Go to "Ground circuit Inspection" procedure .

NO ▶ Check for open or short in harness. Repair as necessary and Go to "verification of vehicle repair" procedure.
▶ If signal circuit in harness is OK, Go to "Check TCM" of the "Component Inspection" procedure.

Ground Circuit Inspection

1. Ignition "OFF".
2. Disconnect ATM Control Unit(CLG01-C) connector.
3. Remove the "OIL PAN" from the vehicle.
4. Measure continuity between ground terminal of Turbine sensor and chassis ground.

Specification : Continuity

5. Is the measured resistance within specifications ?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Check for open in harness. Repair as necessary and Go to "verification of vehicle repair" procedure.

Component Inspection

1. Ignition "ON" & Engine "OFF".
2. Disconnect "ATM Control Unit(CLG01-C)" connector.
3. Connect scantool and select 'Simulation Function"on the scanner.
4. Simulate duty pulse on signal terminal of "Input Speed Sensor 1 & 2" with scanner.

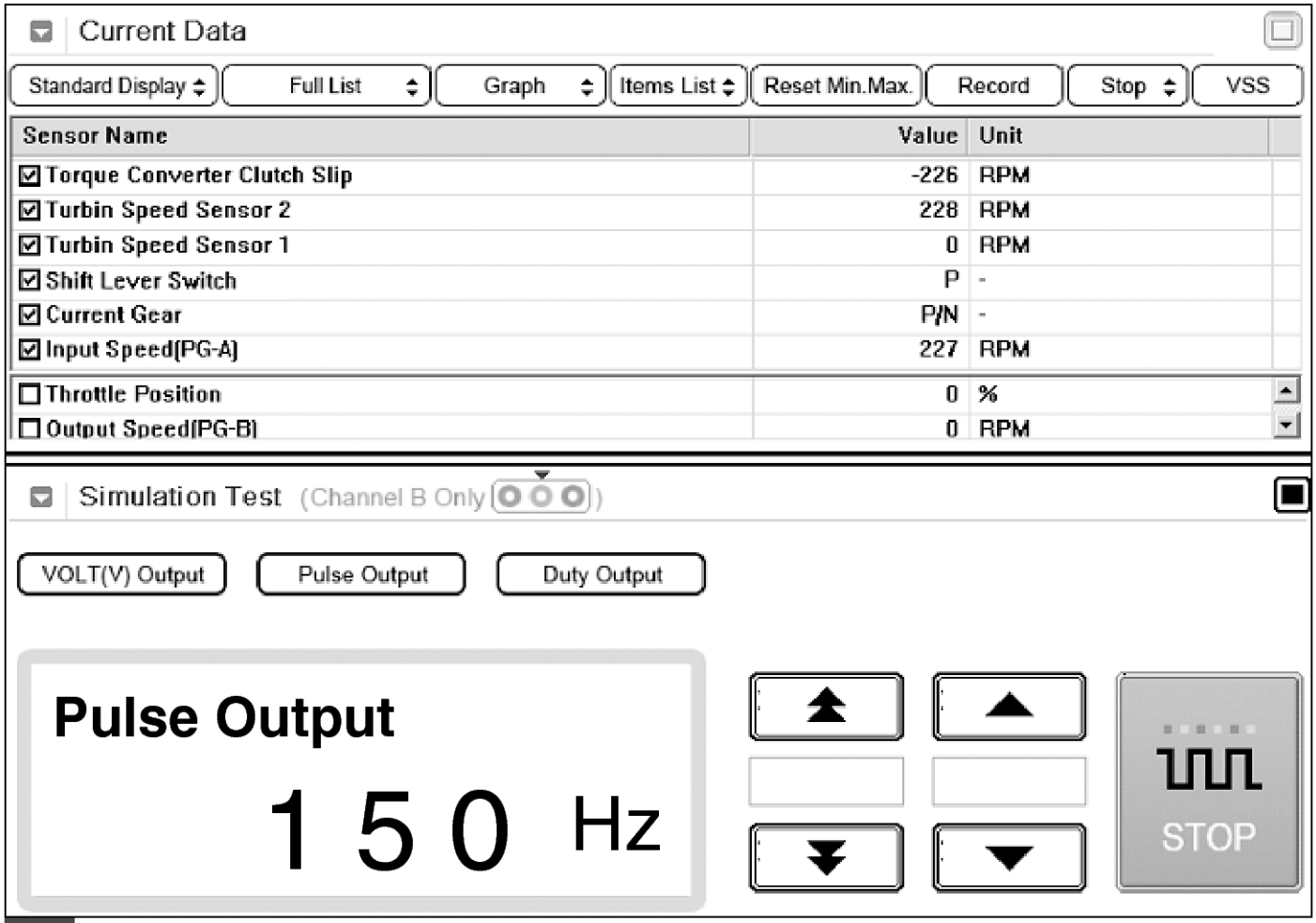


Fig.1

SHMAT9520L

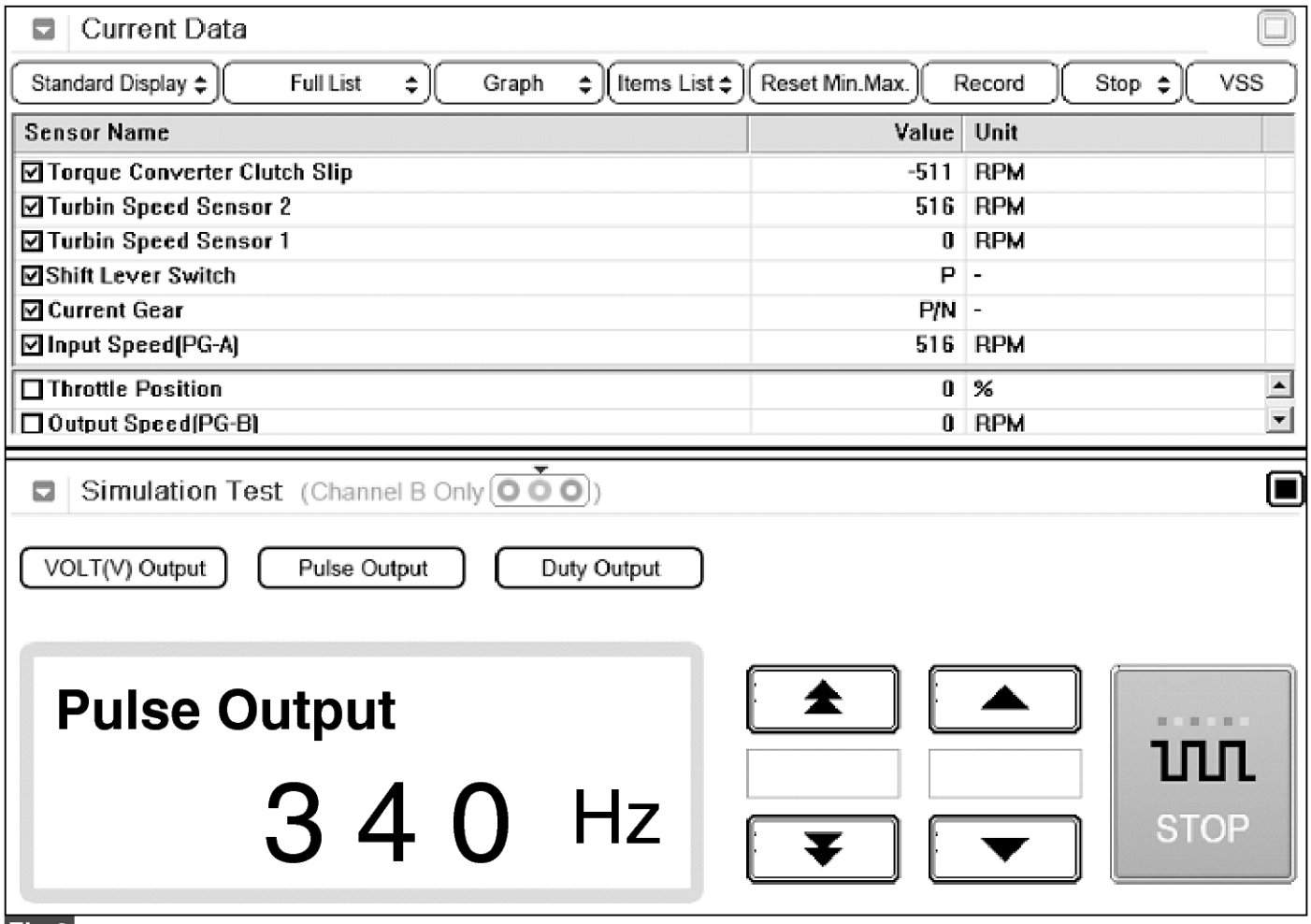


Fig.2

SHMAT9521L

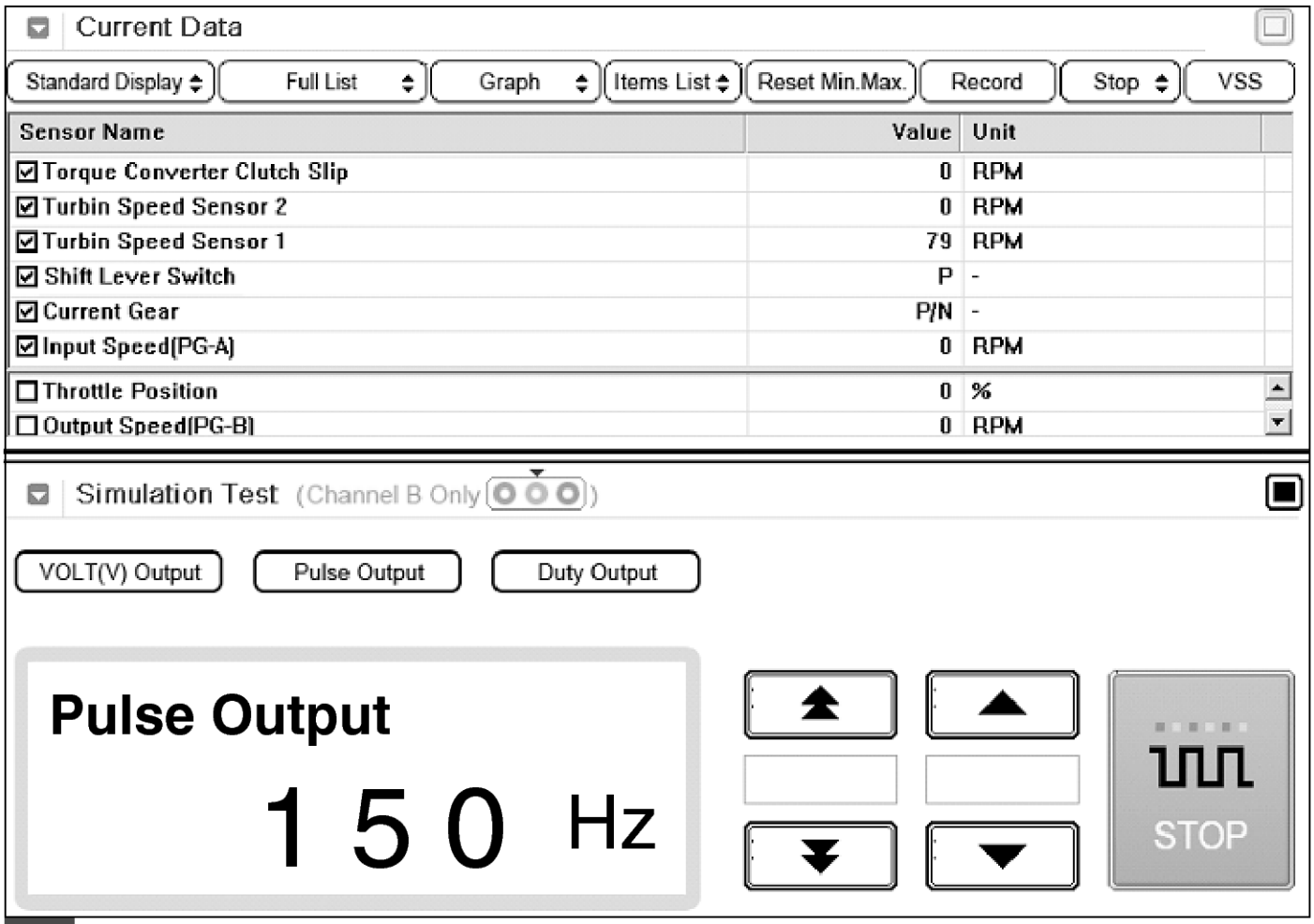


Fig.3

SHMAT9522L

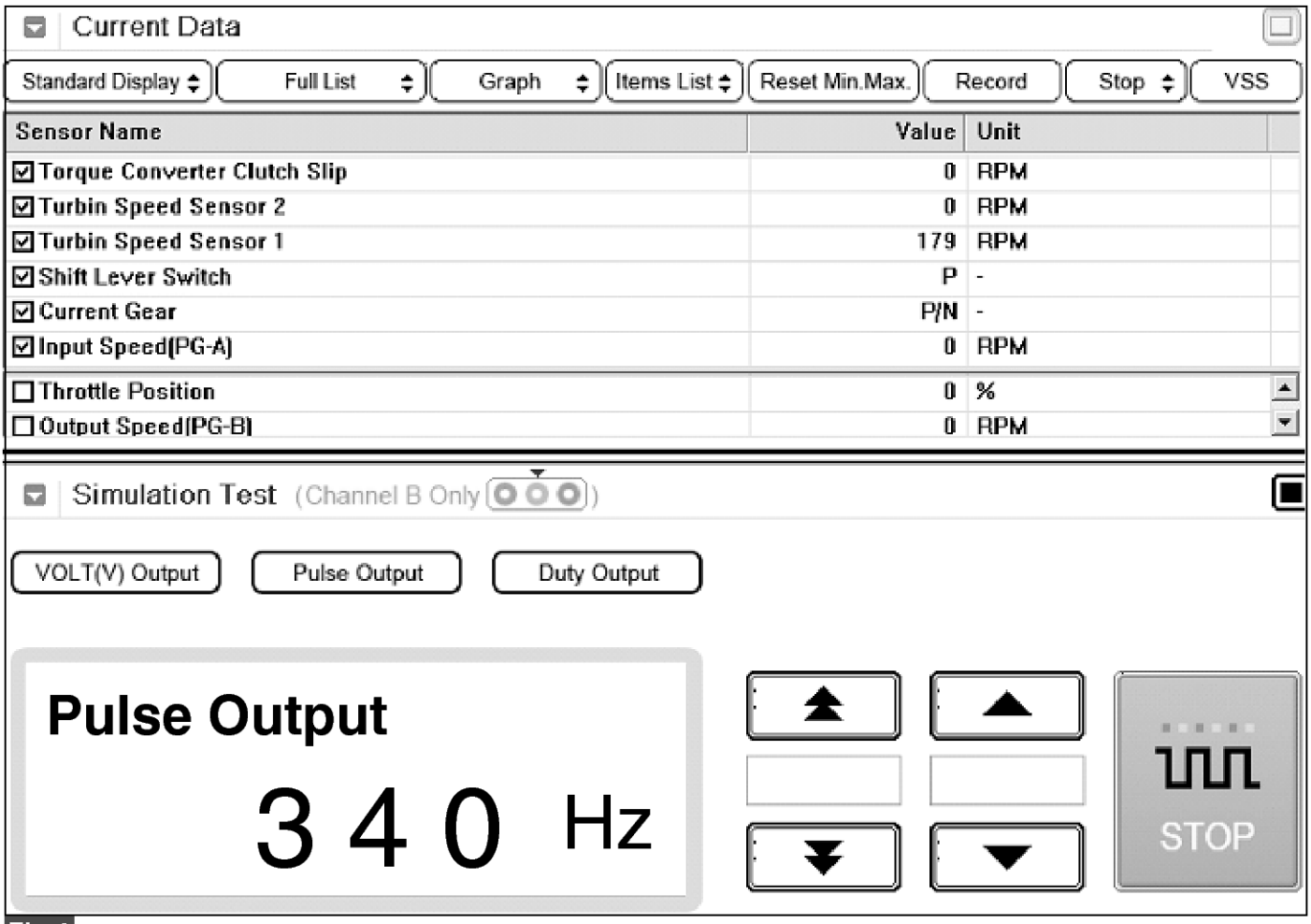


Fig.4

SHMAT9523L

Fig 1) Turbin Speed Sensor 2 : 150Hz → 227rpm

Fig 2) Turbin Speed Sensor 2 : 340Hz → 5160rpm

Fig 3) Turbin Speed Sensor 1 : 150Hz → 79rpm

Fig 4) Turbin Speed Sensor 1 : 340Hz → 179rpm

※ The values are subject to change according to vehicle model or conditions

5. Is "Input Speed Sensor 1& 2" signal value changed according to simulation frequency?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0717 Input/Turbine Speed Sensor "A" Circuit No Signal

Component Location

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

General Description

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

DTC Description

The TCM sets this code if an output pulse-signal is not detected, from the INPUT SPEED SENSOR 1 or 2, when the vehicle is running faster than 40km/h. The Fail-Safe function will be set by the TCM if this code is detected.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Lack of circuit Continuity	• Open or shrot in signal circuit • Open in power circuit • Open in ground circuit • Faulty Input speed sensor 1. 2 • Faulty TCM
Enable Conditions	• Battery Voltage > 10V • Output Speed Sensor > 1000rpm • Engine RPM(1st gear) > 3000 rpm • Engine RPM (2.3.4.5th gear) > 700 rpm • Shift Lever = "D"	
Threshold Value	• Input speed2(1, 2, 3, 4, 5Gear) Input speed1(4th Gear)Input Speed 1 ≤ 100rpm	
Diagnostic Time	• More than 2 sec.	
Fail Safe	• Input Speed = 600RPM • Shift prevention over 4th gear • Prevention of manual shift • Prevention of pressure adaptation • Damper clutch off	

Specification

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

Diagnostic Circuit Diagram

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

Signal Waveform & Data

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

Monitor Scantool Data

1. Connect scantool to data link connector(DLC).
2. Engine "ON" .
3. Monitor the "INPUT SPEED SENSOR" parameter on the scantool
4. Drive the vehicle over 40 Km/h.

Specification : Increasing Gradually

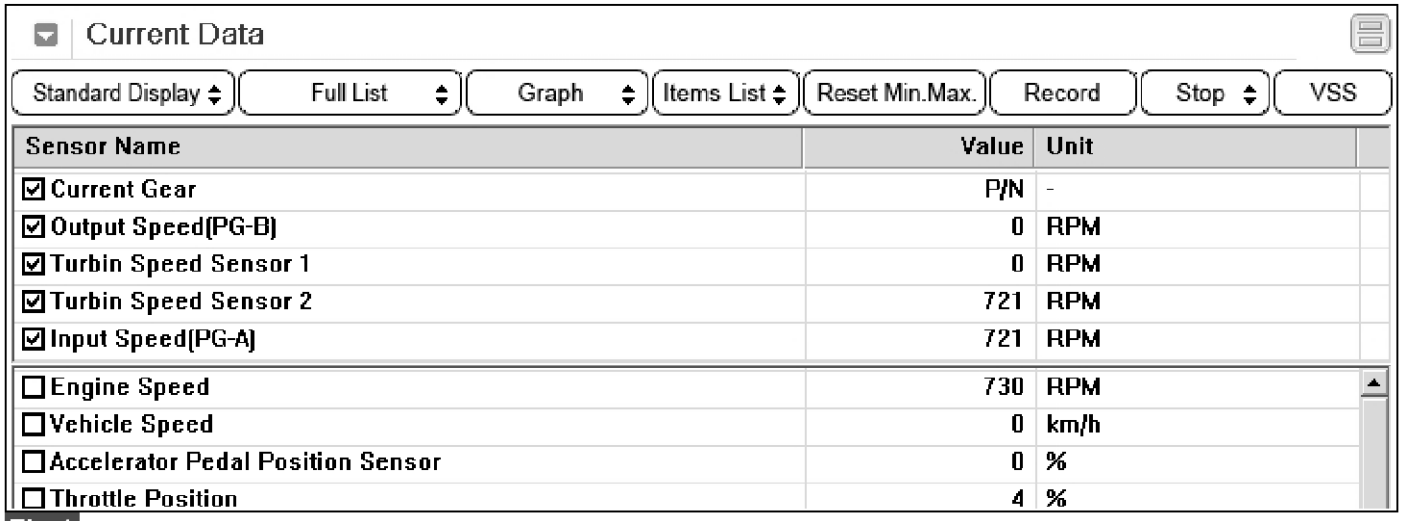


Fig.1

SHMAT9513L

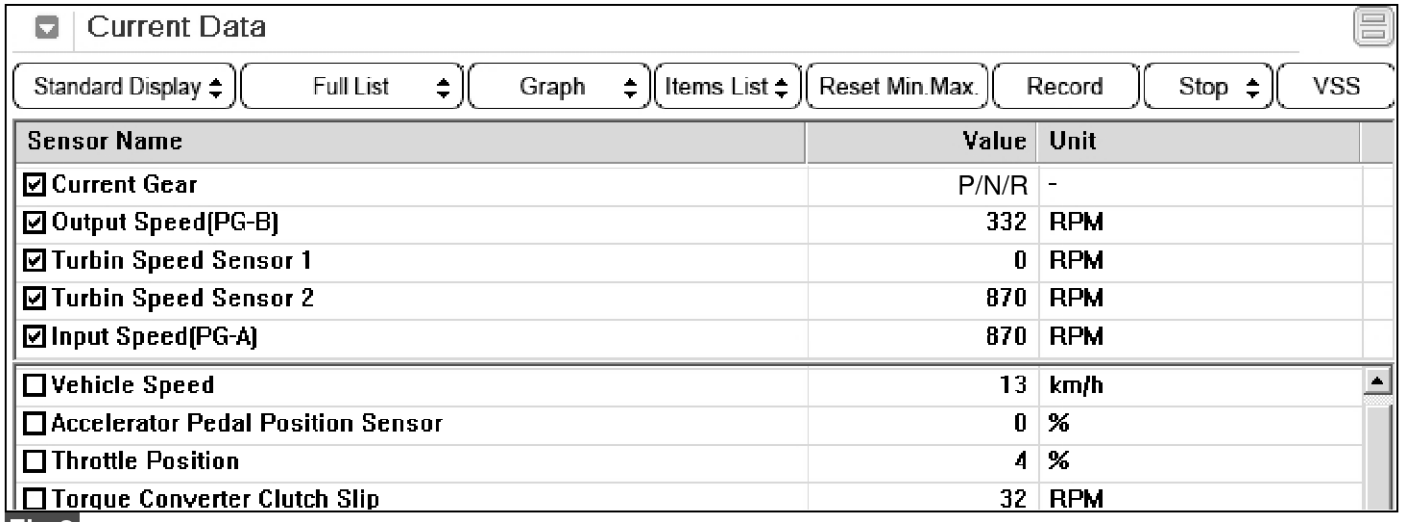


Fig.2

SHMAT9514L

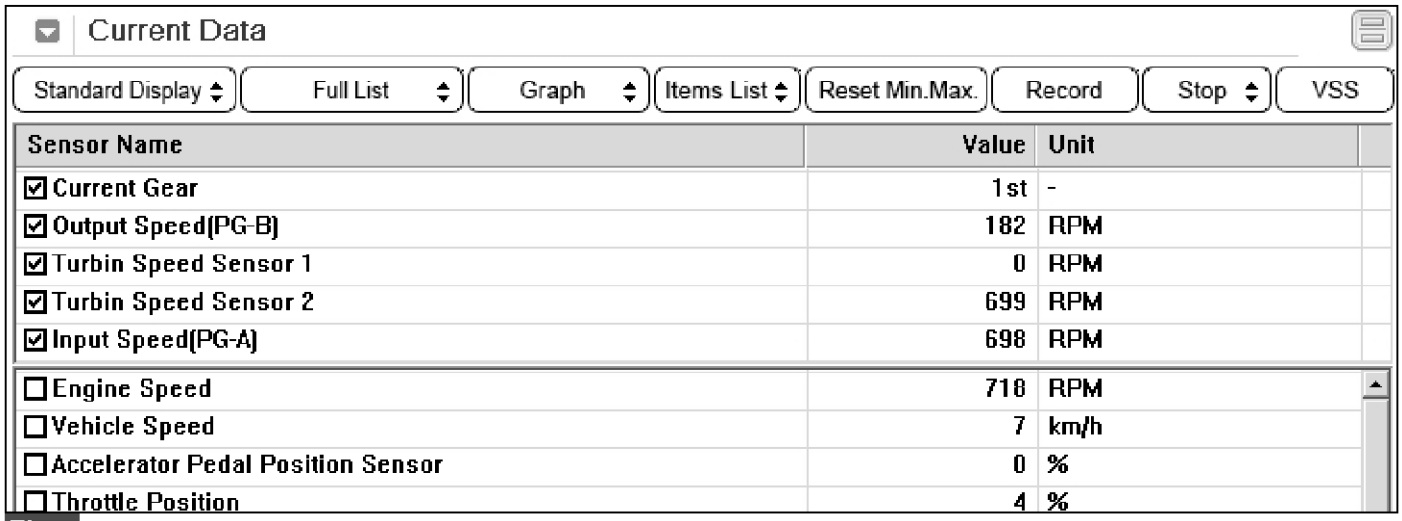


Fig.3

SHMAT9515L

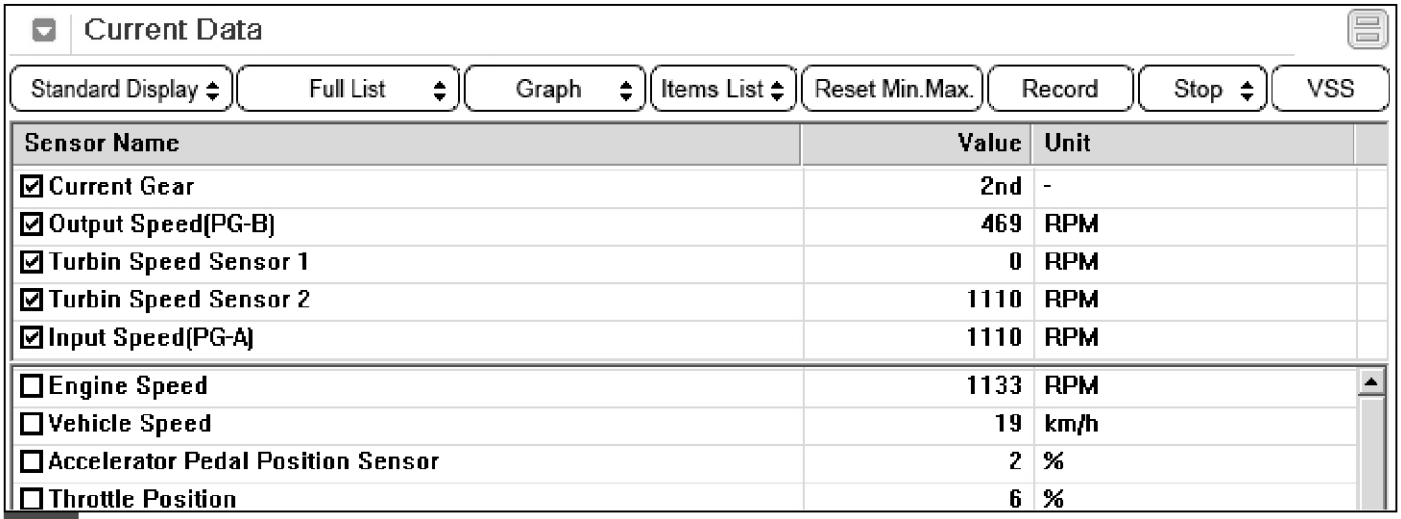


Fig.4

SHMAT9516L

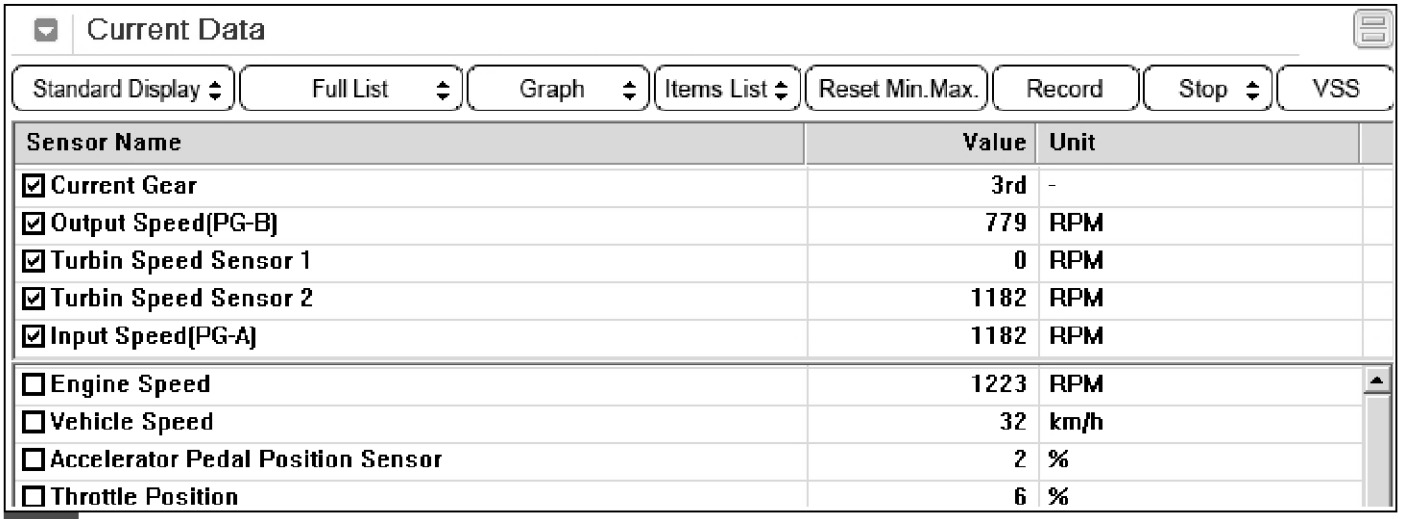


Fig.5

SHMAT9517L

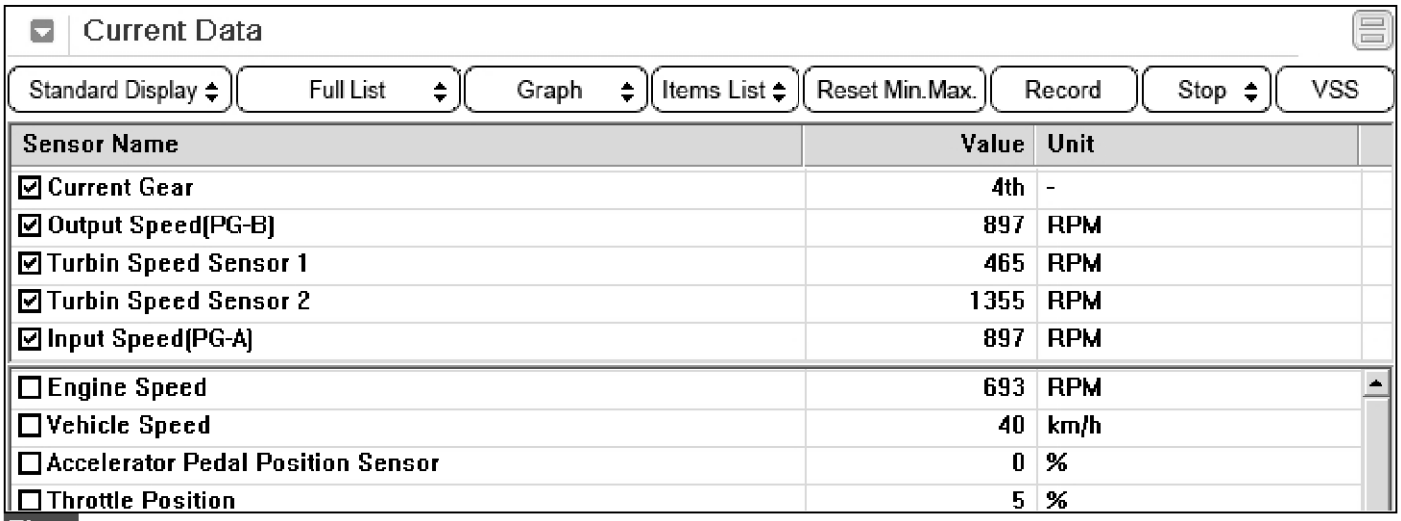


Fig.6

SHMAT9518L

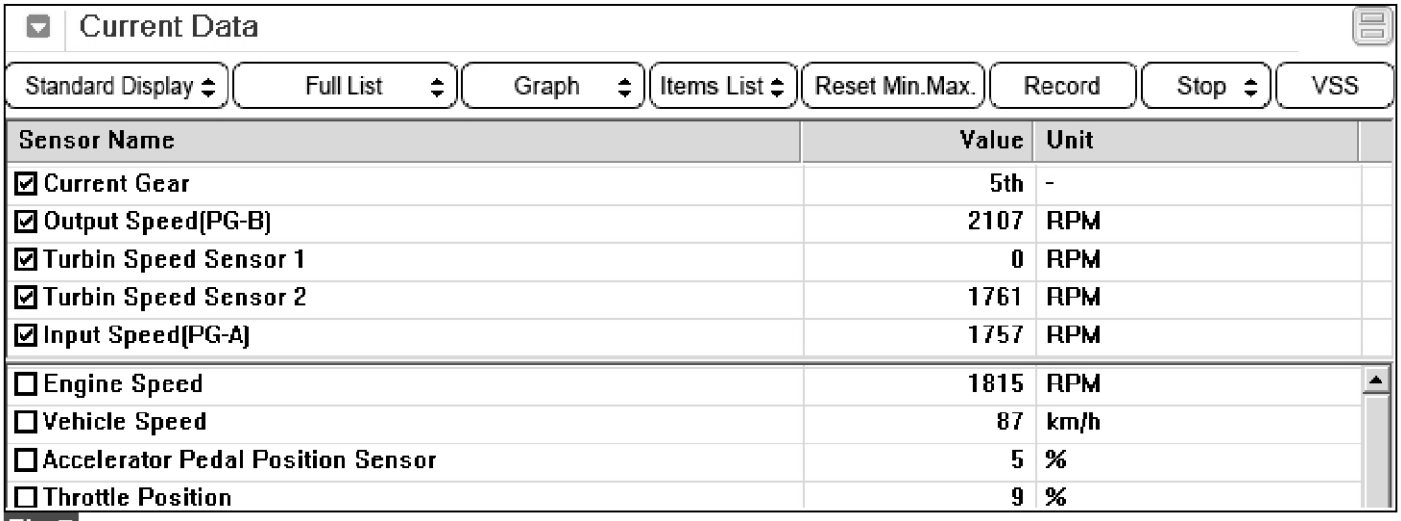


Fig.7

SHMAT9519L

Fig 1) "P,N" range

Fig 2) "R" range

Fig 3) "D" range 1st gear

Fig 4) "D" range 2nd gear

Fig 5) "D" range 3rd gear

Fig 6) "D" range 4th gear

Fig 7) "D" range 5th gear

5. Does "INPUT SPEED SENSOR " follow the reference data?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

Signal Circuit Inspection

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

Ground Circuit Inspection

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

Component Inspection

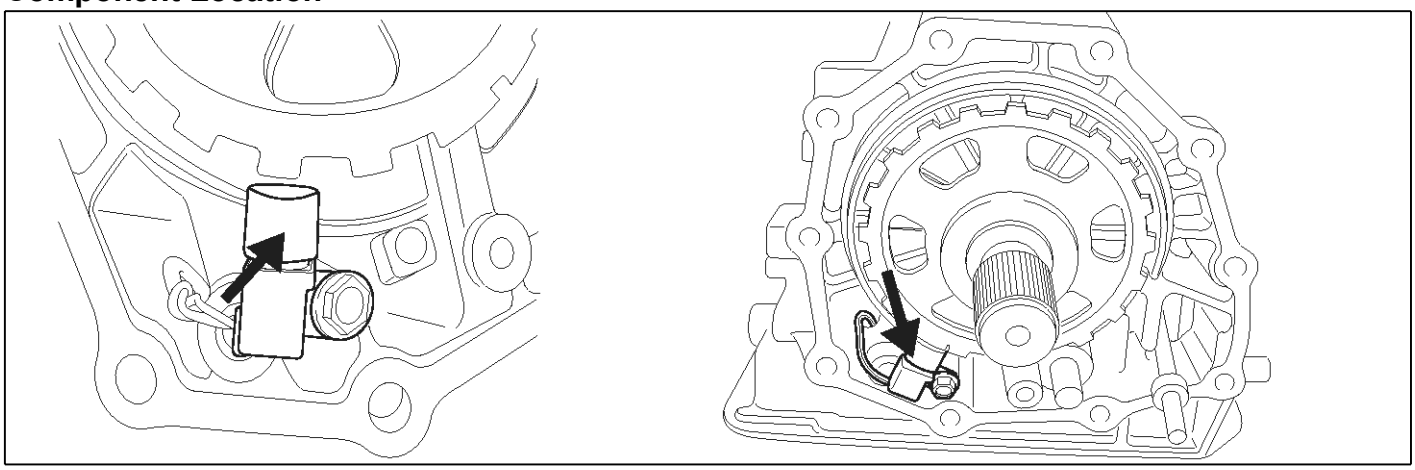
Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

Verification of Vehicle Repair

Refer to DTC P0716 : Input/Turbine Speed Sensor "A" Circuit Range/Performance.

P0721 Output Speed Sensor Circuit Range/Performance

Component Location



SBLAT6130L

General Description

The OUTPUT SPEED SENSOR outputs waveform signals according to the revolutions of the output shaft of the transmission. The Output Speed Sensor is installed in front of the Parking Gear to determine the Parking Gear rpms by counting the frequency of the pulses. This value, together with the throttle position data, is mainly used to decide the optimum gear position.

DTC Description

The TCM sets this code if the calculated value of the signals is noticeably different from the value calculated, using the Vehicle Speed Sensor output, when the vehicle is running faster than 18.6MPH(30km/h). The TCM will initiate the fail safe function if this code is detected.

DTC Detecting Condition

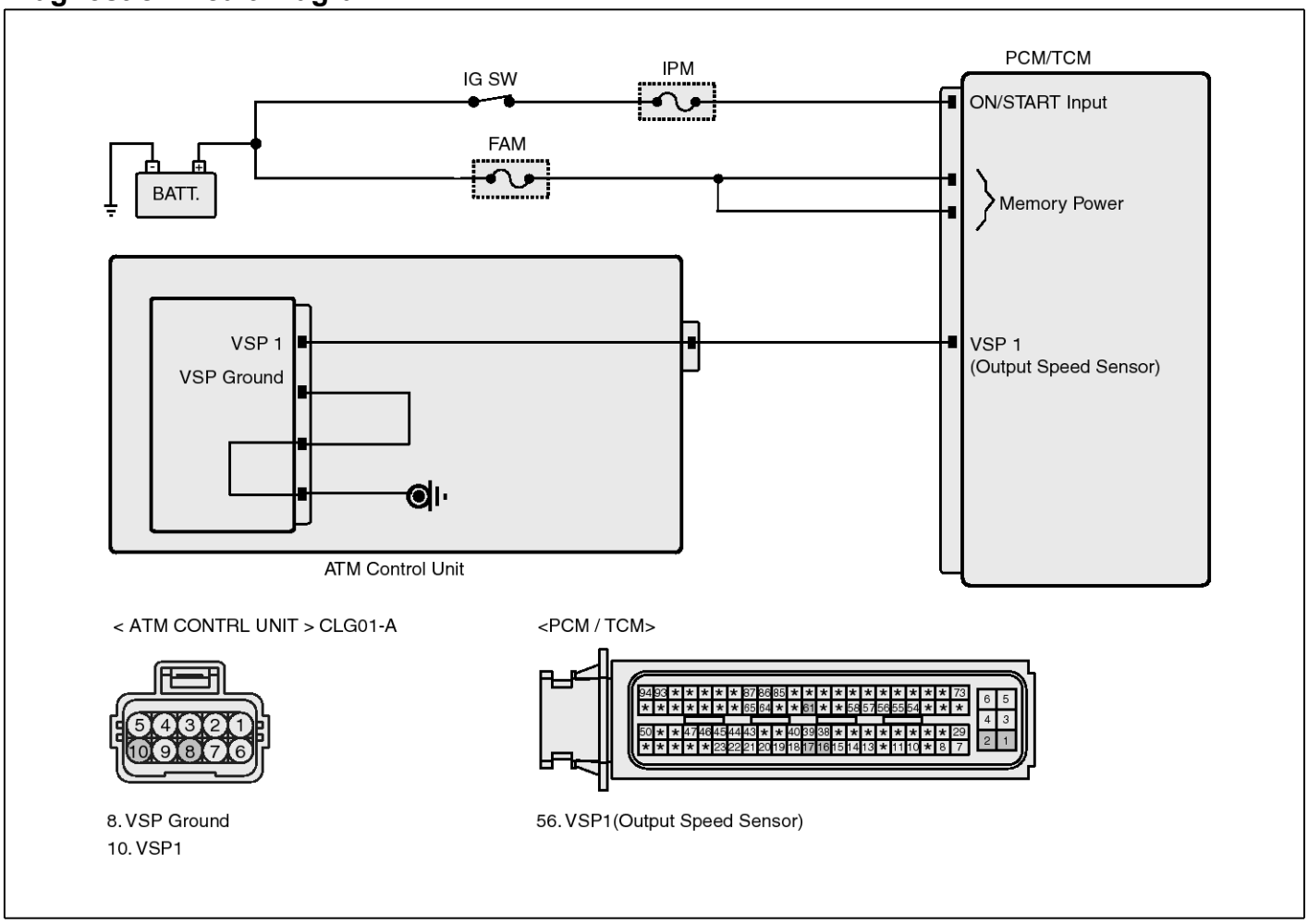
Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality(Too high)	• Open or shrot in signal circuit • Open in power circuit • Open in ground circuit • Faulty Output speed sensor • Faulty TCM
	Enable Conditions	• Battery Voltage > 10V	
	Threshold Value	• Output speed (NAB) Output speed >= 6000RPM	
Case 2	DTC Strategy	• Rationality	
	Enable Conditions(1)	• Battery Voltage > 10V • Position Lever D, B, L • State of the brake Off • Vehicle Speed > 25km/h • Throttle opening > 15% • Engine speed > 3000RPM • Pre-Filtering 1 sec	
	Threshold Value(1)	• Output speed (NAB) Output speed = 0 & Current gear = 1, L, B	
	Enable Conditions(2)	• Battery Voltage > 10V • Position Lever D, B • State of the brake Off • Input speed > 1800RPM • Engine speed > 3000RPM • Pre-Filtering 1 sec	
	Threshold Value(2)	• Output speed (NAB) Output speed = 0 & Current gear = 2	
	Enable Conditions(3)	• Battery Voltage > 10V • Position Lever D • State of the brake Off • Input speed > 1200RPM • Engine speed > 3000RPM • Pre-Filtering 1 sec	
	Threshold Value(3)	• Output speed (NAB) Output speed = 0 & Current gear = 3	
	Enable Conditions(4)	• Battery Voltage > 10V • Position Lever D • State of the brake Off • Input speed > 700RPM • Engine speed > 3000RPM • Pre-Filtering 1 sec	
	Threshold Value(4)	• Output speed (NAB) Output speed = 0 & Current gear = 4	

Item		Detecting Condition	Possible Cause
	Enable Conditions(5)	• Battery Voltage > 10V • Position Lever D • State of the brake Off • Input speed > 800RPM • Engine speed > 3000RPM • Pre-Filtering 1 sec	
	Threshold Value(5)	• Output speed (NAB) Output speed = 0 & Current gear = 5	
	Enable Conditions(6)	• Battery Voltage > 10V • Position Lever D, B, L • Output speed before dropping > 1200RPM • Input speed > 1000RPM • Pre-Filtering 1 sec	
	Threshold Value(6)	• Output speed gradient (nabg) Output speed gradient (during 20msec) > 600RPM	
Diagnostic Time		• More than 4.0 sec.	
Fail Safe		• Output speed from vehicle speed • Shift prevention over 4th gear • Prevention of manual shift • Prevention of pressure adaptation • Damper clutch off	

Specification

Item	Condition	Specification	Spec.
Output Speed Sensor	• 20km/h	Approx. 149[Hz]	Approx. 1.1K(Hz)

Diagnostic Circuit Diagram



SHMAT9705L

Signal Waveform & Data

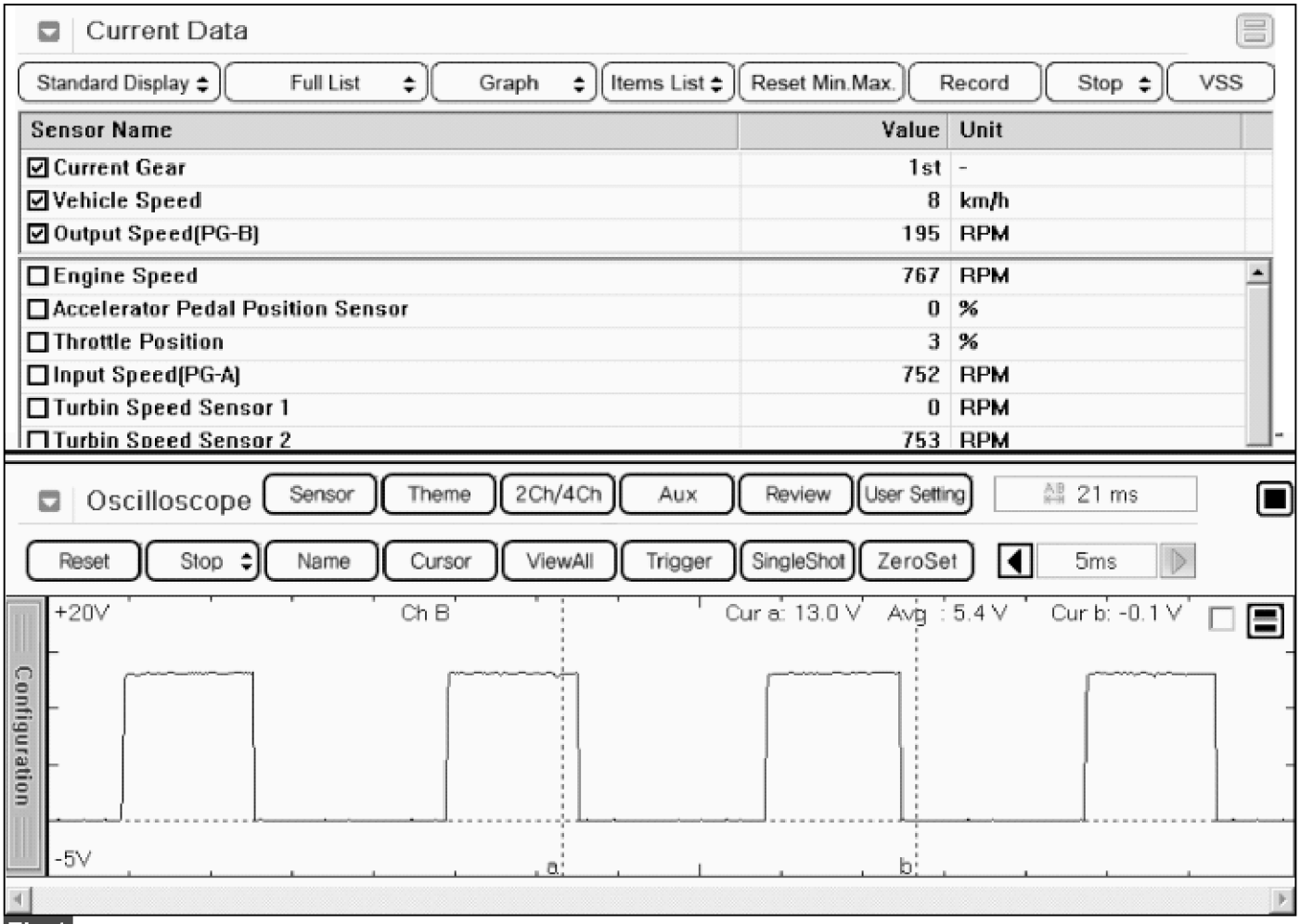


Fig.1

SHMAT9524L

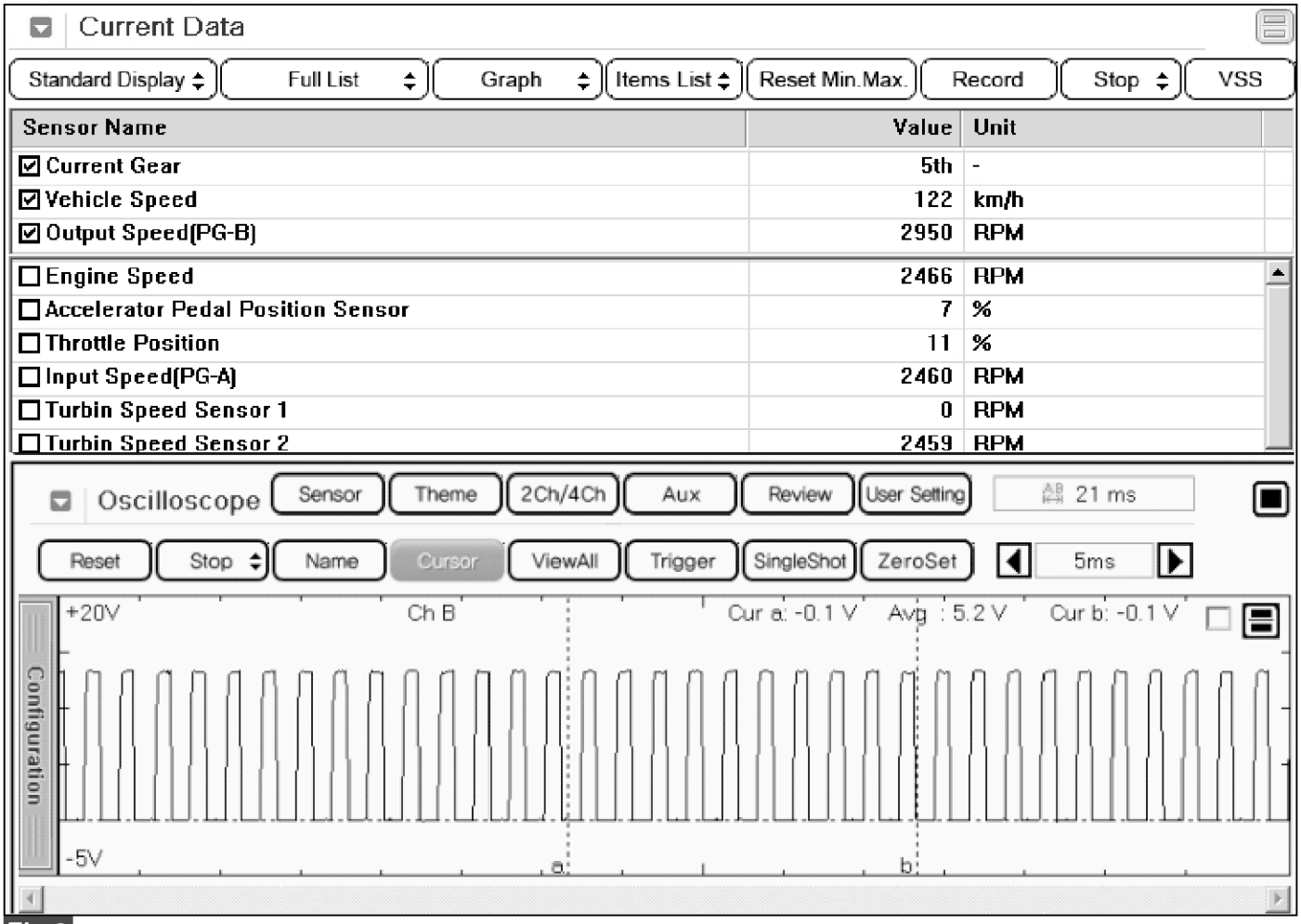


Fig.2

SHMAT9525L

Fig 1) Low Speed
Fig 2) High Speed

Monitor Scantool Data

1. Connect scantool to data link connector(DLC).
2. Engine "ON" .
3. Monitor the "OUTPUT SPEED SENSOR" parameter on the scantool
4. Drive the vehicle more than 5km/h.

Specification : Increasing Gradually

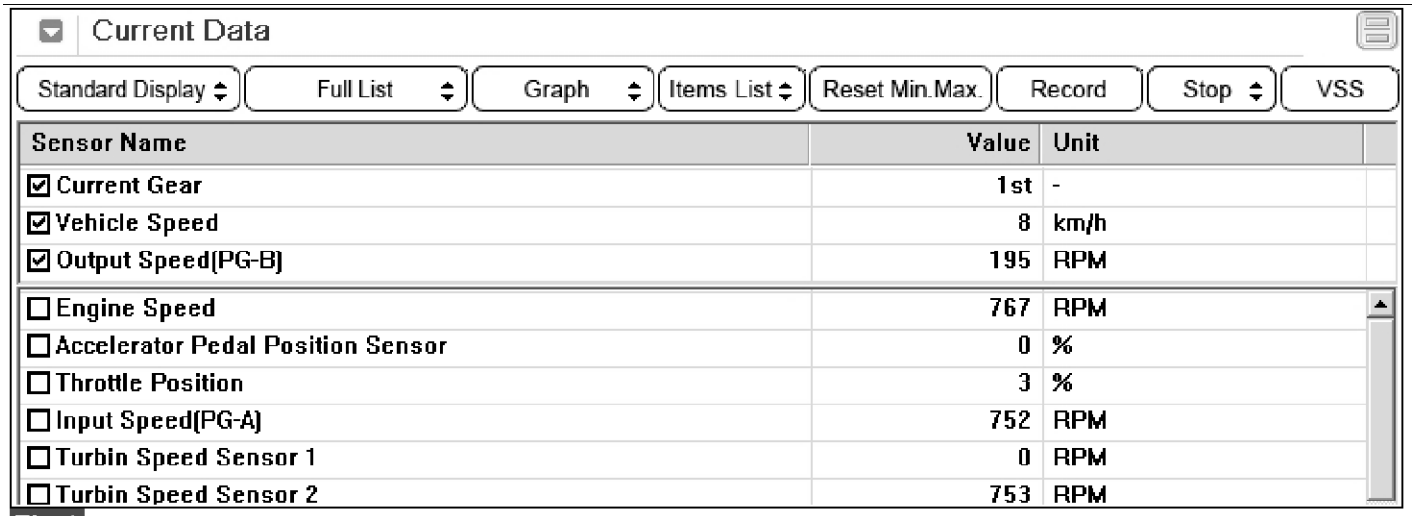


Fig.1

SHMAT9526L

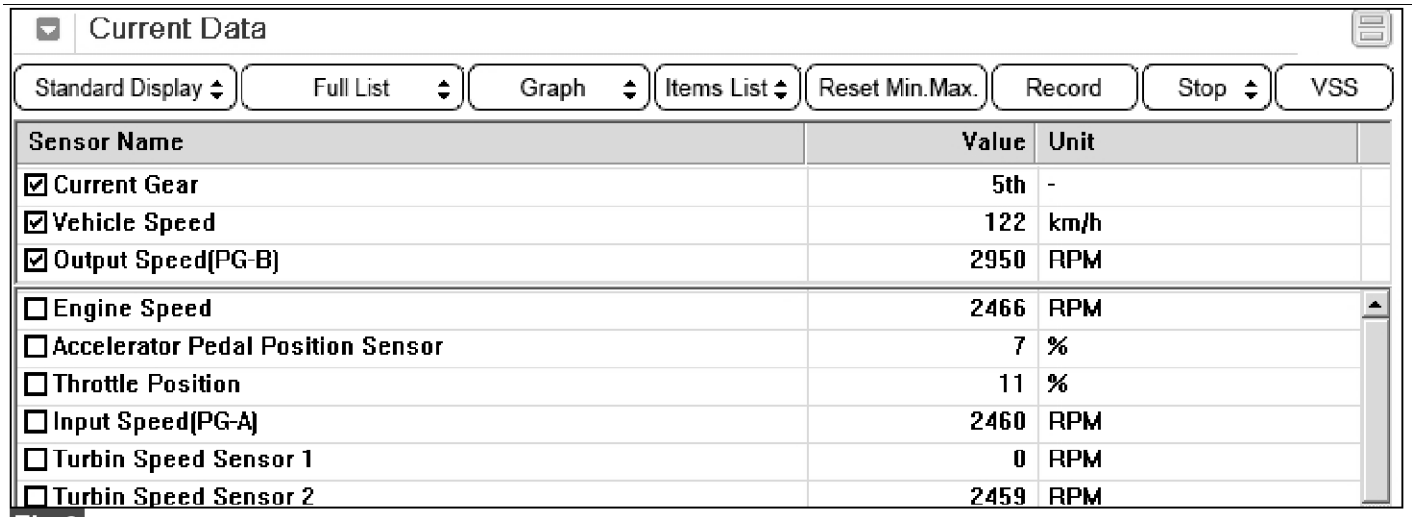


Fig.2

SHMAT9527L

Fig 1) Low Speed

Fig 2) High Speed

5. Does "OUTPUT SPEED SENSOR" follow the reference data?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure.

Signal Circuit Inspection

■ Check Output Speed Sensor(External Inspection)

1. Ignition "ON" & Engine "OFF".
2. Disconnect "ATM Control Unit(CLG01-A)" connector.
3. Measure voltage between signal terminal of TCM harness connector and chassis ground.

Specification : Approx. 12V

4. Is the measured voltage within specifications?

YES ▶ Go to "Ground circuit Inspection" procedure .

NO ▶ Check for open or short in harness. Repair as necessary and Go to "verification of vehicle repair" procedure.

Ground Circuit Inspection

1. Ignition "OFF" & Engine "OFF".
2. Disconnect "ATM Control Unit(CLG01-A)" connector.
3. Measure continuity between ground terminal of TCM harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specifications ?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Check open in harenss and repair as necessary an then, go to 'Verification of Vehicle Repair procedure.

Component Inspection

1. Ignition "ON" & Engine "OFF".
2. Disconnect "ATM Control Unit CLG01-A connector.
3. Connect scantool and select simulation function.
4. Simulate pulse out to output speed sensor (VSP1) terminal of TCM harness connector.

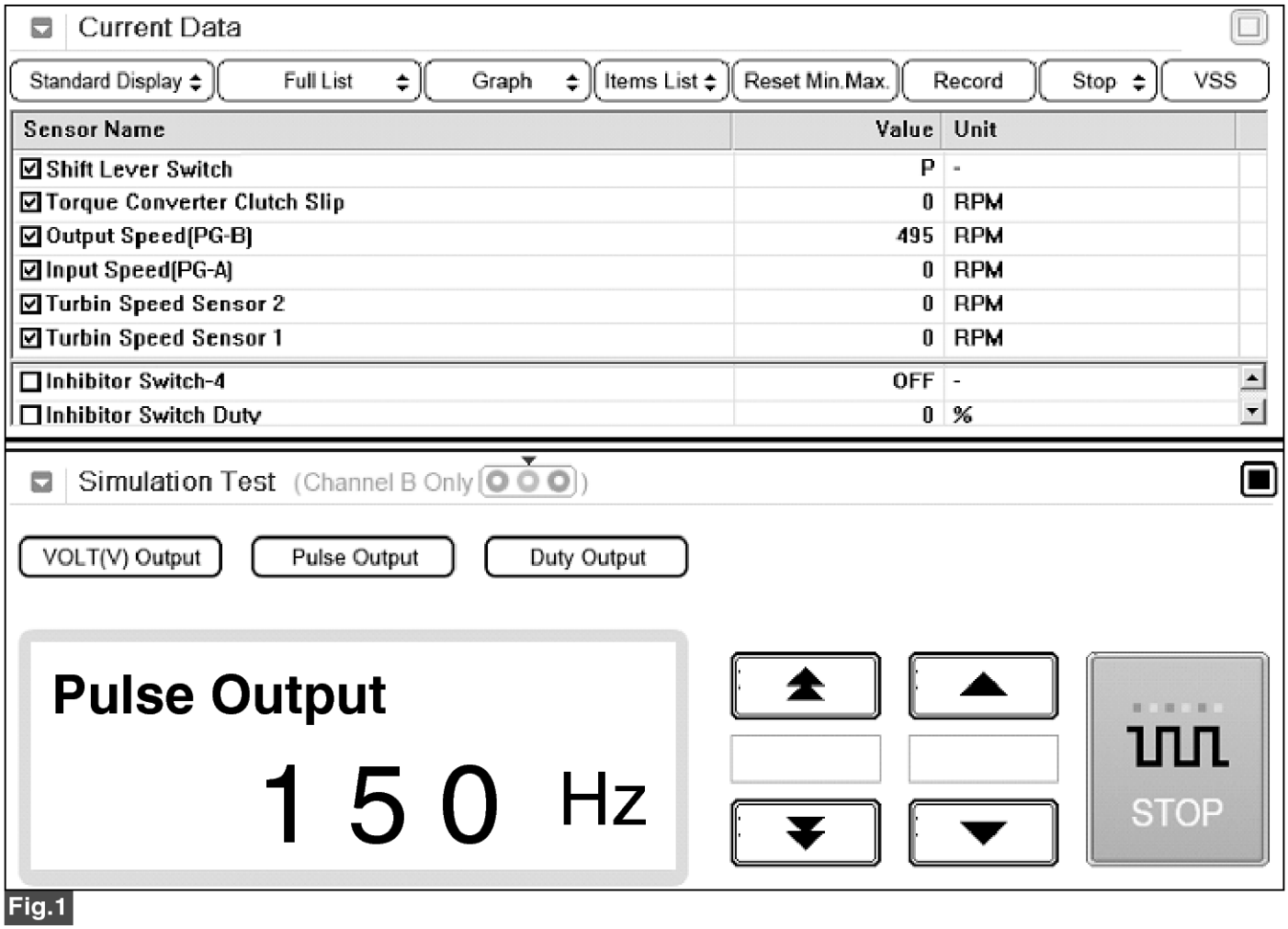


Fig.1

SHMAT9528L

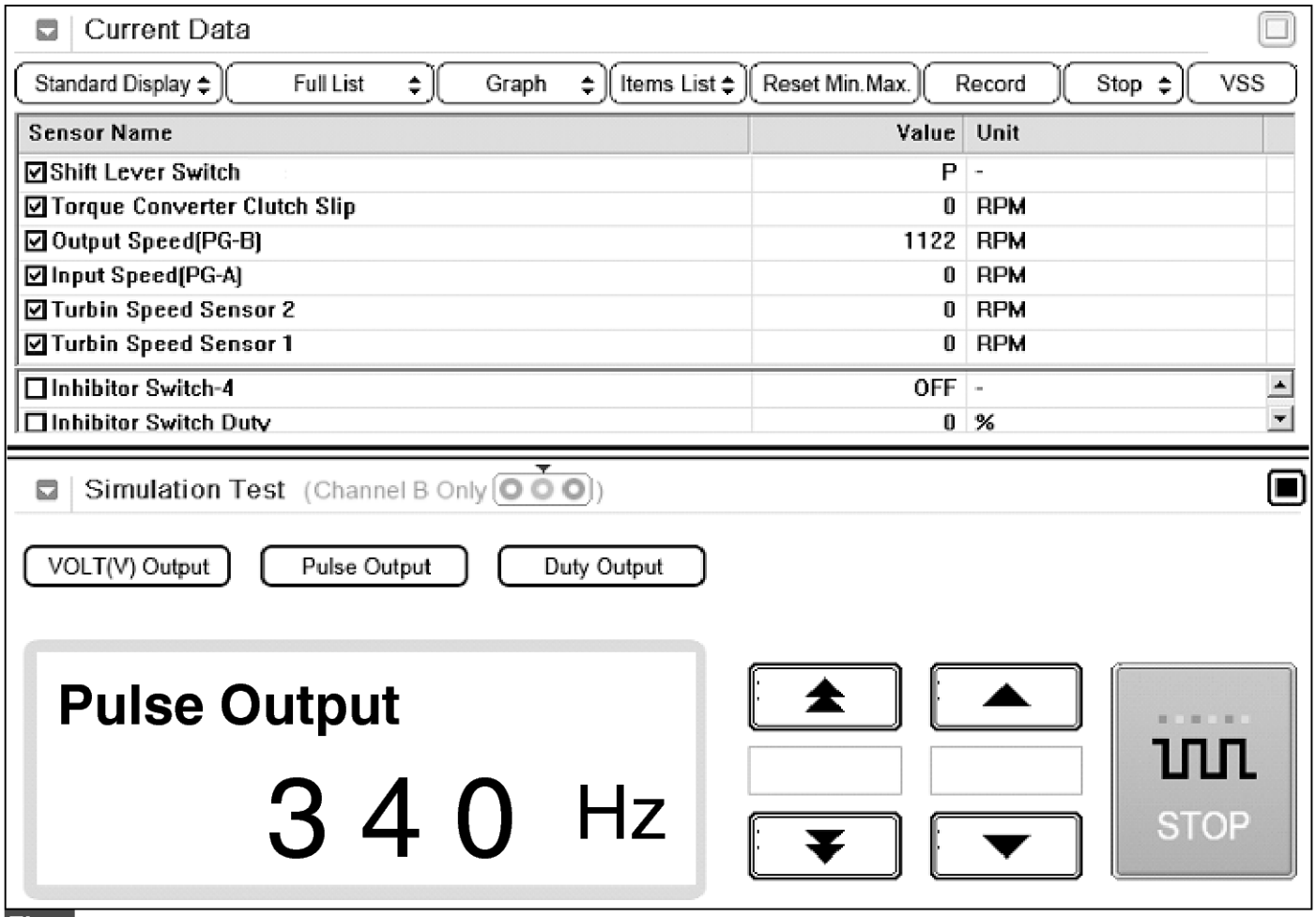


Fig.2

SHMAT9529L

Fig 1) 150Hz → 495rpm

Fig 2) 340Hz → 1122rpm

※ The values are subject to change according to vehicle model or conditions

5. Does the value of output speed sensor change according to the simulation frequence ?

YES ▶ Substitute with a known-good output speed sensor and check for proper operation. If the problem is corrected, replace output speed sensor as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good TCM/PCM and check for proper operation. If the problem is corrected, replace TCM/PCM as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

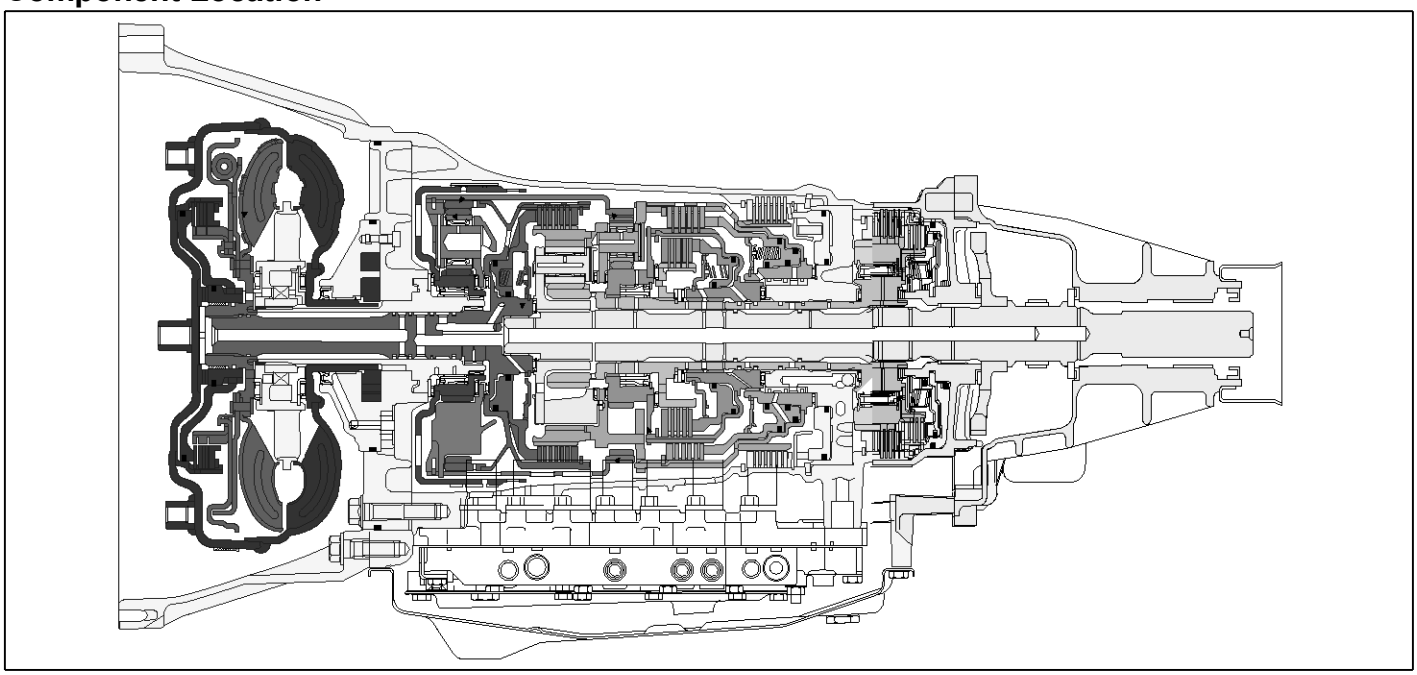
1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0731 Gear 1 Incorrect Ratio

Component Location



STQAT8100D

General Description

The value of the input shaft speed should be equal to the value of the output shaft speed, when multiplied by the 1st gear ratio, while the transaxle is engaged in the 1st gear. For example, if the output speed is 1000 rpm and the 1st gear ratio is 3.73, then the input speed is 3730 rpm.

DTC Description

This code is set if the value of input shaft speed is not equal to the value of the output shaft, when multiplied by the 1st gear ratio, while the transaxle is engaged in 1st gear. This malfunction is mainly caused by mechanical troubles such as control valve sticking or solenoid valve malfuctioning rather than an electrical issue.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality-high	• Faulty Input Speed Sensor • Faulty Output Speed Sensor • Faulty internal parts in transmission
	Threshold Value	• Proportionality check between input speed and Output speed at 1st gear Input speed > (Output speed *1st Gear Ratio)+200RPM	
Case 2	DTC Strategy	• Rationality-low	
	Threshold Value	• Proportionality check between input speed and Output speed at 1st gear Input speed < (Output speed *1st Gear Ratio)-200RPM	
Enable Conditions		• IThe time after the last shift was finished > 1 sec • Oil temperature > -10℃ • Engine speed > 600RPM • Position Lever D, B, L • Input speed > 300 RPM • Output speed(NAB) >150RPM & < 6000RPM • Throttle opening > 15%(Too Low Only) • Pre-Filtering 1 sec	
Diagnostic Time		• More than 1sec	
Fail Safe		• Locked as 4th gear	

Signal Waveform & Data

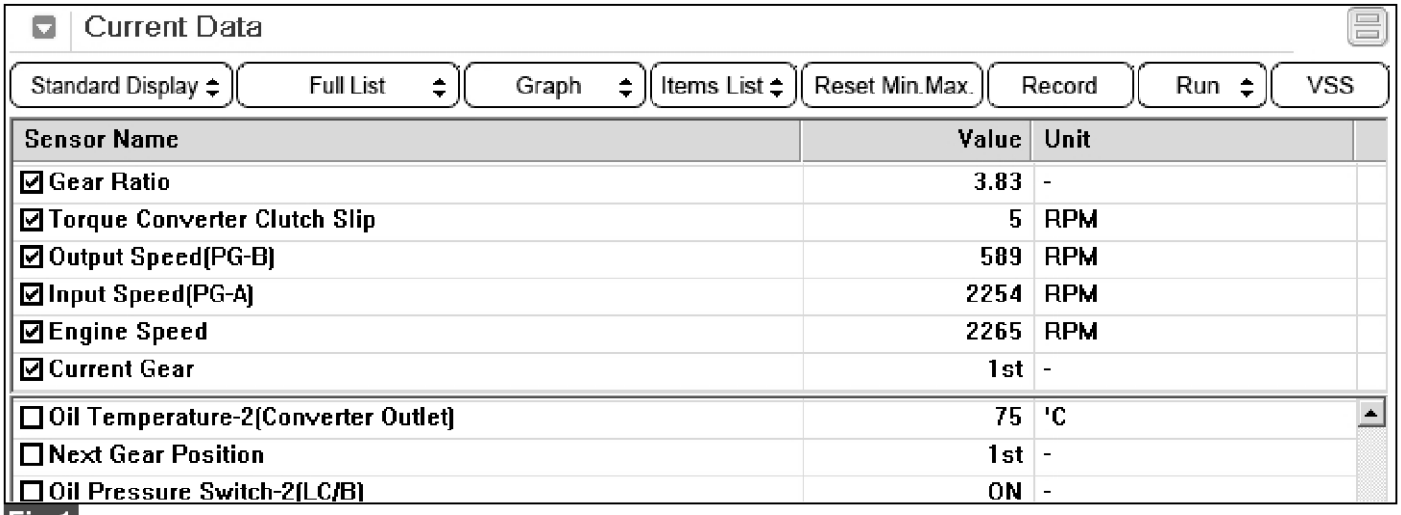


Fig.1

SHMAT9530L

Fig 1) 1st gear in D range

Monitor Scantool Data

■ Stall Test

1. Connect scantool to data link connector(DLC).
2. Engine "ON" .
3. Monitor the "ENGINE SPEED, INPUT SPEED SENSOR, OUTPUT SPEED SENSOR, GEAR POSITION" parameter on the scantool.
4. Perform the "STALL TEST" with gear position "1".

Specification : 2300 ± 200 engine rpm

Current Data

Standard Display | Full List | Graph | Items List | Reset Min.Max. | Record | Run | VSS

Sensor Name	Value	Unit
☑ Current Gear	1st	-
☑ Engine Speed	2456	RPM
☑ Input Speed(PG-A)	0	RPM
☑ Turbin Speed Sensor 1	0	RPM
☑ Turbin Speed Sensor 2	0	RPM
☑ Output Speed(PG-B)	0	RPM
☐ Vehicle Speed	0	km/h
☐ Accelerator Pedal Position Sensor	99	%
☐ Throttle Position	100	%

SHMAT9531L

Operating Element Of Each Shifting Range

Shifting Position		Input clutch	High&Low Reverse Clutch	Direct Clutch	Reverse Brake	Front Brake	Low Coast Brake	Forward Brake	1st OwnWay Clutch	Forward OwnWay Clutch	3rd OwnWay Clutch
P			▲			▲					
R			●		●	●			●		●
N			▲			▲					
D	1st gear		★			▲	★	●	●	●	●
	2nd gear			●		▲		●		●	●
	3rd gear		●	●		●		▲	◆		●
	4th gear	●	●	●				▲	◆		
	5th gear	●	●			●		▲	◆		◆

● : WORKING.

◆ : PARTICIPATE IN DELIVERY TORQUE WHEN COAST DRIVING.

▲ : SUPPLING OIL PRESSURE TO ELEMENT, BUT NOT EFFECT ON OUTPUT.

★ : TEMPORARY WORKING.

NOTICE

Stall test procedure in D1 and reason

Procedure

1. Warm up the engine

2. After positioning the select lever in "D" ,depress the foot brake pedal fully after that, depress the accelerator pedal to the maximum

** The slippage of 1st gear operating parts can be detected by stall test in D*

Reason for stall test

1. If there is no mechanical defaults in A/T, every slippage occur in torque converter.

2. Therfore, engine revolution is output, but input and output speed revolution must be "zero" due to wheel's lock.

3. If 1st gear operating parts have faults, input speed revolution will be out.

4. If ouppput speed revolution is output. It means that the foot brake force is not applied fully. Remeasuring is required.

5. Is the meausred "STALL TEST " within specifications?

YES ▶ Go to "signal check" as follow

NO ▶ Go to "Component inspection" procedure.

⚠CAUTION

1. Do not let anybody stand in front of or behind the vehicle while this test is being carried out.

2. Check the A/T fluid level and temperature and the engine coolant temperature.

- **Fluid level : At the hot mark on the oil level gauge.**
- **Fluid temperature : 176 °F~ 212 °F (80~100 ℃).**
- **Engine coolant temperature : 176 °F~ 212 °F (80~100 ℃).**

3. Chock both rear wheel(left and right).

4. Pull the parking brake lever on with the brake pedal fully depressed.

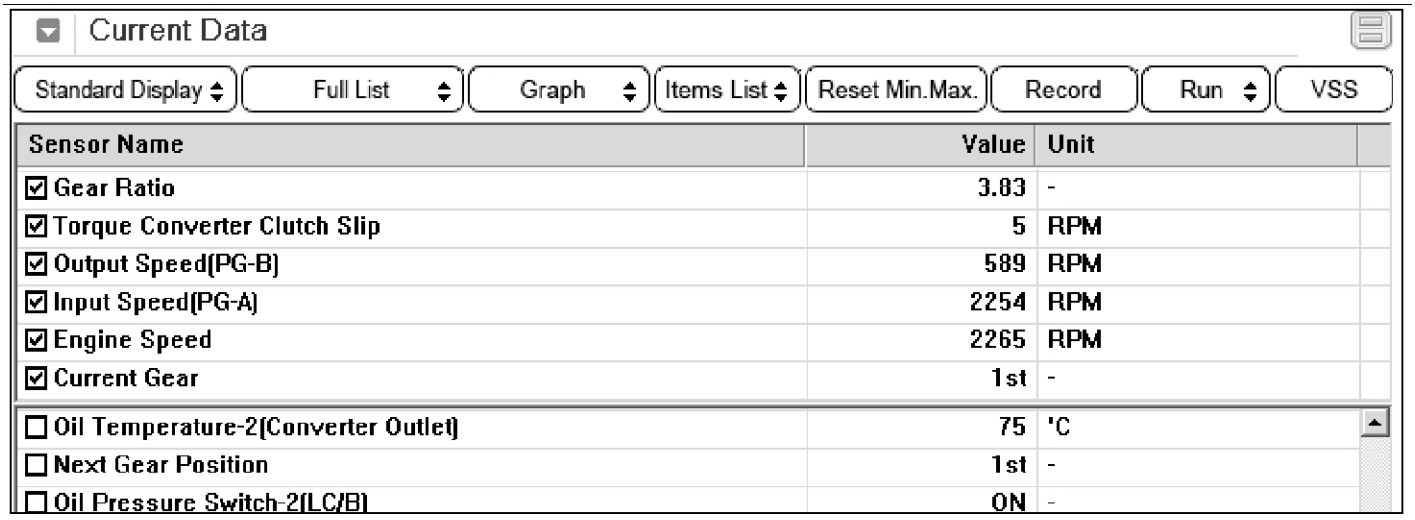
5. The throttle should not be left fully open for more than eight second.

6. If carrying out the stall test two or more time, move the select lever to the "N" position and run the engine at 1,000 rpm to let the A/T fluid cool down before carrying out subsequent.

■ Signal Check

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "INPUT & OUTPUT SPEED SENSOR" parameter on the scantool.
4. Accelerate the Engine speed until about 2000 rpm in the 1st gear.

Specification : INPUT SPEED - (OUTPUT SPEED × 1st GEAR RATIO) ≥ 200 RPM



SHMAT9532L

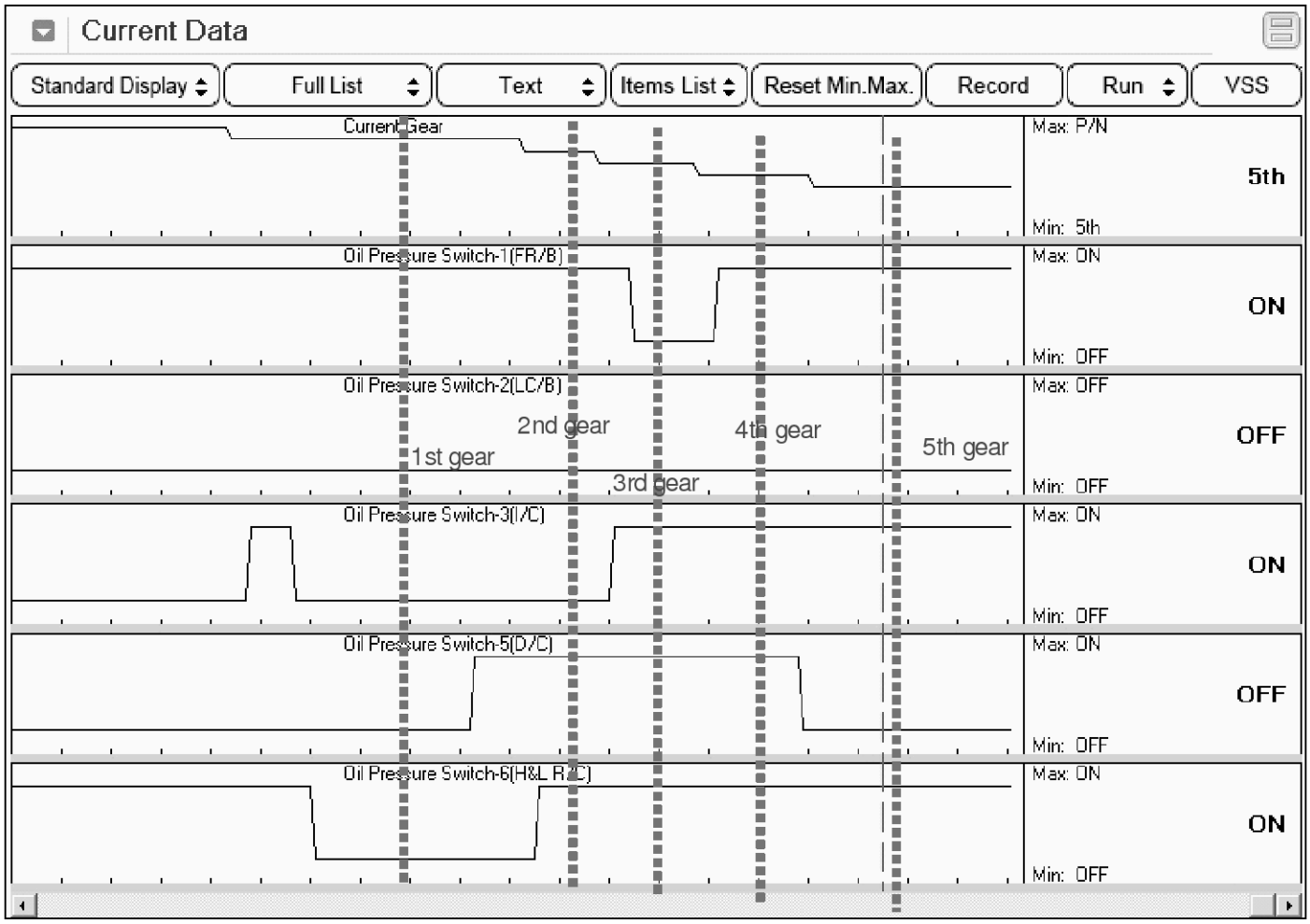
5. Does "INPUT & OUTPUT SPEED SENSOR" within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check for electrical niose of circuit in INPUT & OUTPUT SPEED SENSOR or Replace INPUT & OUTPUT SPEED SENSOR. Repair as necessary and Go to "verification of vehicle repair" procedure.

Component Inspection

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "OIL PRESSURE. S/W 1,2,3,5,6" parameter on the scantool.
4. Move select lever to "D" range and operate vehicle within 1st gear condition.



SHMAT9533L

5. Does "OIL PRESSURE. S/W 1,2,3,5,6 " follow the reference data?

YES ▶ Repair AUTO TRANSAXLE(Clutch or Brake) as necessary and Go to "verification of vehicle repair" Repair " procedure.

NO ▶ Replace AUTO TRANSAXLE (BODY CONTROL VALVE faulty) as necessary and Go to " verification of vehicle repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0732 Gear 2 Incorrect Ratio

Component Location

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

General Description

The value of the input shaft speed should be equal to the value of the output shaft speed, when multiplied by the 2nd gear ratio, while the transaxle is engaged in the 2nd gear. For example, if the output speed is 1000 rpm and the 2nd gear ratio is 2.308, then the input speed is 2308 rpm.

DTC Description

This code is set if the value of input shaft speed is not equal to the value of the output shaft, when multiplied by the 2nd gear ratio, while the transaxle is engaged in 2nd gear. This malfunction is mainly caused by mechanical troubles such as control valve sticking or solenoid valve malfuctioning rather than an electrical issue.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality-high	• Faulty Input Speed Sensor • Faulty Output Speed Sensor • Faulty internal parts in transmission
	Threshold Value	• Proportionality check between input speed and Output speed at 2st gear Input speed > (Output speed *2st Gear Ratio)+200RPM	
Case 2	DTC Strategy	• Rationality-low	
	Threshold Value	• Proportionality check between input speed and Output speed at 2st gear Input speed < (Output speed *2st Gear Ratio)-200RPM	
Enable Conditions		• IThe time after the last shift was finished > 1 sec • Oil temperature > -10℃ • Engine speed > 600RPM • Position Lever D, B • Input speed > 300 RPM • Output speed(NAB) >300RPM & < 6000RPM • Throttle opening > 15%(Too Low Only) • Pre-Filtering 1 sec	
Diagnostic Time		• More than 1sec	
Fail Safe		• 4th gear Limp-Home mode.	

Signal Waveform & Data

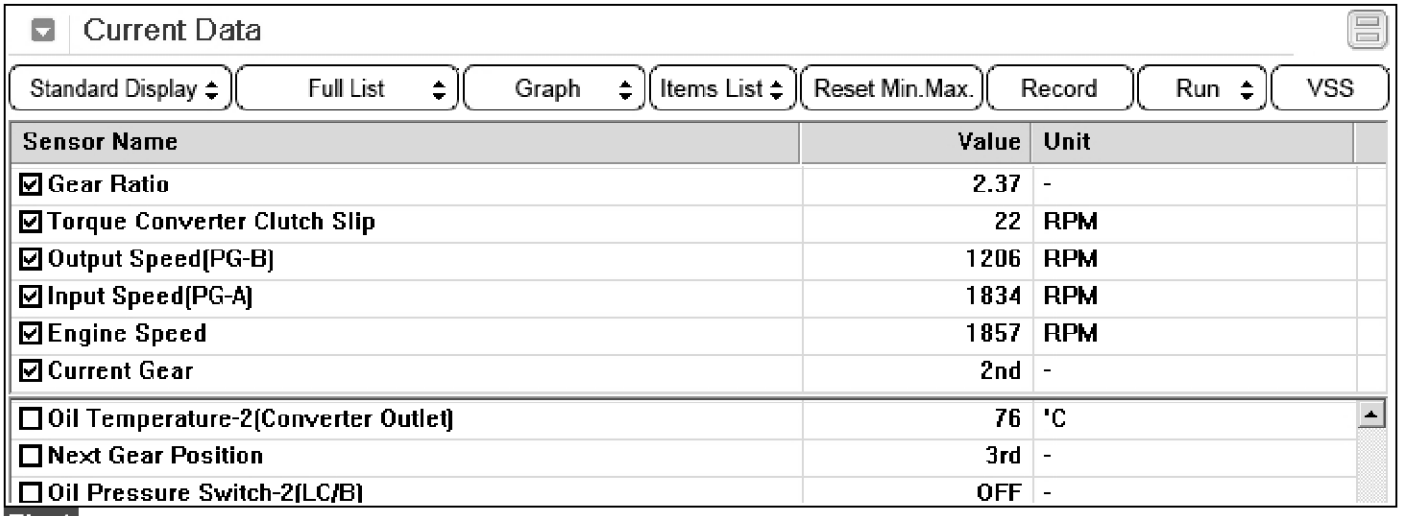


Fig.1

SHMAT9534L

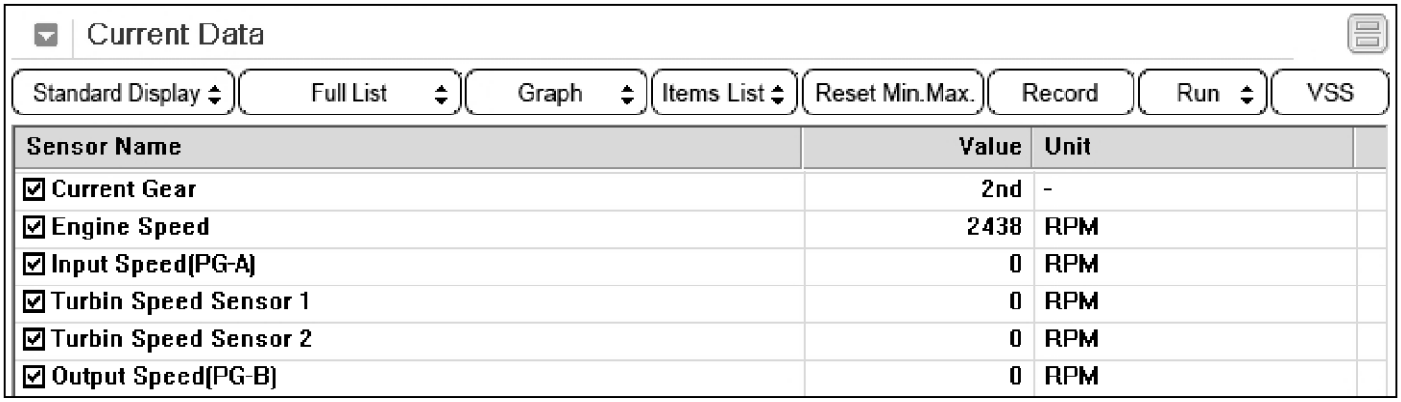
Fig 1) 2st gear in D range

Monitor Scantool Data

■ Stall Test

1. Connect scantool to data link connector(DLC).
2. Engine "ON" .
3. Monitor the "ENGINE SPEED, INPUT SPEED SENSOR, OUTPUT SPEED SENSOR, GEAR POSITION" parameter on the scantool.
4. Perform the "STALL TEST" with gear position "2".

Specification : 2300 ± 200 engine rpm



SHMAT9535L

Operating Element Of Each Shifting Range

Shifting Position		Input clutch	High&Low Reverse Clutch	Direct Clutch	Reverse Brake	Front Brake	Low Coast Brake	Forward Brake	1st OwnWay Clutch	Forward OwnWay Clutch	3rd OwnWay Clutch
P			▲			▲					
R			●		●	●			●		●
N			▲			▲					
D	1st gear		★			▲	★	●	●	●	●
	2nd gear			●		▲		●		●	●
	3rd gear		●	●		●		▲	◆		●
	4th gear	●	●	●				▲	◆		
	5th gear	●	●			●		▲	◆		◆

● : WORKING.

◆ : PARTICIPATE IN DELIVERY TORQUE WHEN COAST DRIVING.

▲ : SUPPLING OIL PRESSURE TO ELEMENT, BUT NOT EFFECT ON OUTPUT.

★ : TEMPORARY WORKING.

NOTICE

Stall test procedure in D2 and reason

Procedure

1. Warm up the engine

2. After positioning the select lever in "D" or "ON" of the HOLD SW (Operate UP SHIFT in case of "SPORTS MODE"),depress the foot brake pedal fully after that, depress the accelerator pedal to the maximum

** The slippage of 2nd gear operating parts can be detected by stall test in D2*

Reason for stall test

1. If there is no mechanical defaults in A/T, every slippage occur in torque converter.

2. Therfore, engine revolution is output, but input and output speed revolution must be "zero" due to wheel's lock.

3. If 2nd gear operating parts have faults, input speed revolution will be out.

4. If oupput speed revolution is output. It means that the foot brake force is not applied fully. Remeasuring is required.

5. Is the meausred "STALL TEST " within specifications?

YES ▶ Go to "signal check" as follow

NO ▶ Go to "Component inspection" procedure.

CAUTION

1. Do not let anybody stand in front of or behind the vehicle while this test is being carried out.

2. Check the A/T fluid level and temperature and the engine coolant temperature.

- **Fluid level : At the hot mark on the oil level gauge.**
- **Fluid temperature : 176 ˚F~ 212 ˚F (80~100 ℃).**
- **Engine coolant temperature : 176 ˚F~ 212 ˚F (80~100 ℃).**

3. Chock both rear wheel(left and right).

4. Pull the parking brake lever on with the brake pedal fully depressed.

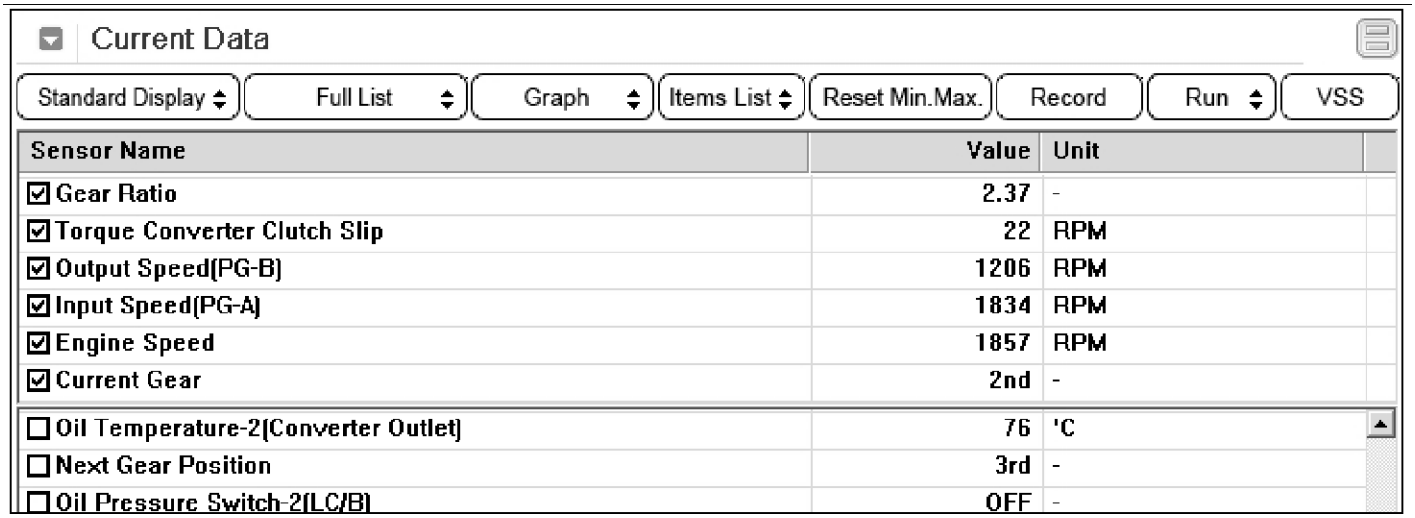
5. The throttle should not be left fully open for more than eight second.

6. If carrying out the stall test two or more time, move the select lever to the "N" position and run the engine at 1,000 rpm to let the A/T fluid cool down before carrying out subsequent.

■ Signal Check

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "INPUT & OUTPUT SPEED SENSOR" parameter on the scantool.
4. Accelerate the Engine speed until about 2000 rpm in the 2nd gear.

Specification : INPUT SPEED - (OUTPUT SPEED × 2nd GEAR RATIO) ≤ 200 RPM



Sensor Name	Value	Unit
☑ Gear Ratio	2.37	-
☑ Torque Converter Clutch Slip	22	RPM
☑ Output Speed(PG-B)	1206	RPM
☑ Input Speed(PG-A)	1834	RPM
☑ Engine Speed	1857	RPM
☑ Current Gear	2nd	-
☐ Oil Temperature-2(Converter Outlet)	76	'C
☐ Next Gear Position	3rd	-
☐ Oil Pressure Switch-2(LC/B)	OFF	-

SHMAT9536L

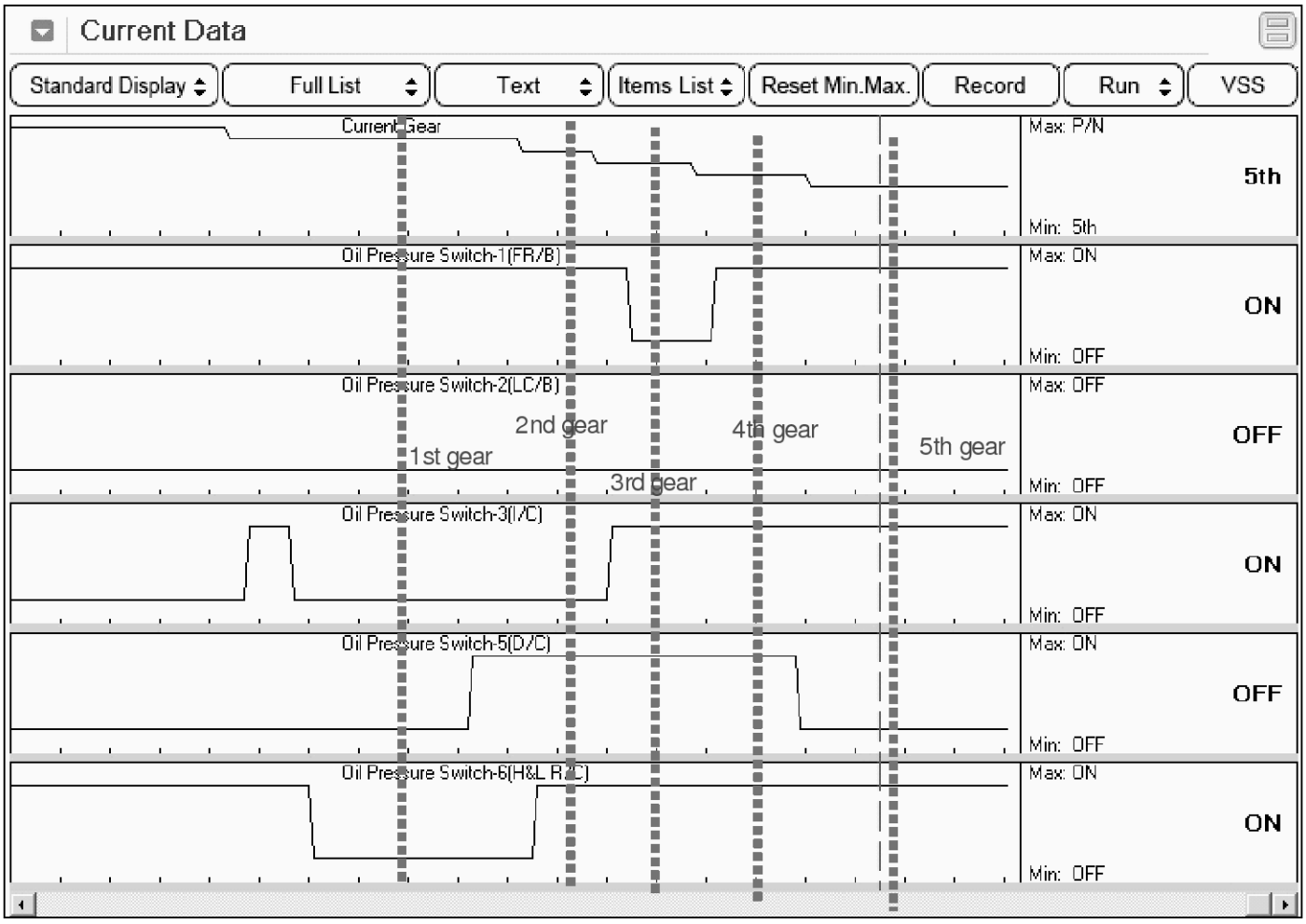
5. Does "INPUT & OUTPUT SPEED SENSOR" within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check for electrical niose of circuit in INPUT & OUTPUT SPEED SENSOR or Replace INPUT & OUTPUT SPEED SENSOR. Repair as necessary and Go to "verification of vehicle repair" procedure.

Component Inspection

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "OIL PRESSURE. S/W 1,2,3,5,6" parameter on the scantool.
4. Move select lever to "D" range and operate vehicle within 2nd gear condition.



SHMAT9533L

5. Does "OIL PRESSURE. S/W 1,2,3,5,6 " follow the reference data?

YES ▶ Repair AUTO TRANSAXLE(Clutch or Brake) as necessary and Go to "verification of vehicle repair" Repair " procedure.

NO ▶ Replace AUTO TRANSAXLE (BODY CONTROL VALVE faulty) as necessary and Go to " verification of vehicle repair " procedure.

Verification of Vehicle Repair

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

P0733 Gear 3 Incorrect Ratio

Component Location

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

General Description

The value of the input shaft speed should be equal to the value of the output shaft speed, when multiplied by the 3rd gear ratio, while the transaxle is engaged in the 3rd gear. For example, if the output speed is 1,000 rpm and the 3rd gear ratio is 1.519, then the input speed is 1519 rpm.

DTC Description

This code is set if the value of input shaft speed is not equal to the value of the output shaft, when multiplied by the 3rd gear ratio, while the transaxle is engaged in 3rd gear. This malfunction is mainly caused by mechanical troubles such as control valve sticking or solenoid valve malfuctioning rather than an electrical issue.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality-high	• Faulty Input Speed Sensor • Faulty Output Speed Sensor • Faulty internal parts in transmission
	Threshold Value	• Proportionality check between input speed and Output speed at 3st gear Input speed > (Output speed *3st Gear Ratio)+200RPM	
Case 2	DTC Strategy	• Rationality-low	
	Threshold Value	• Proportionality check between input speed and Output speed at 3st gear Input speed < (Output speed *3st Gear Ratio)-200RPM	
Enable Conditions		• IThe time after the last shift was finished > 1 sec • Oil temperature > -10℃ • Engine speed > 600RPM • Position Lever D • Input speed > 300 RPM • Output speed(NAB) >500RPM & < 6000RPM • Pre-Filtering 1 sec	
Diagnostic Time		• More than 1sec	
Fail Safe		• 4th gear Limp-Home mode.	

Signal Waveform & Data

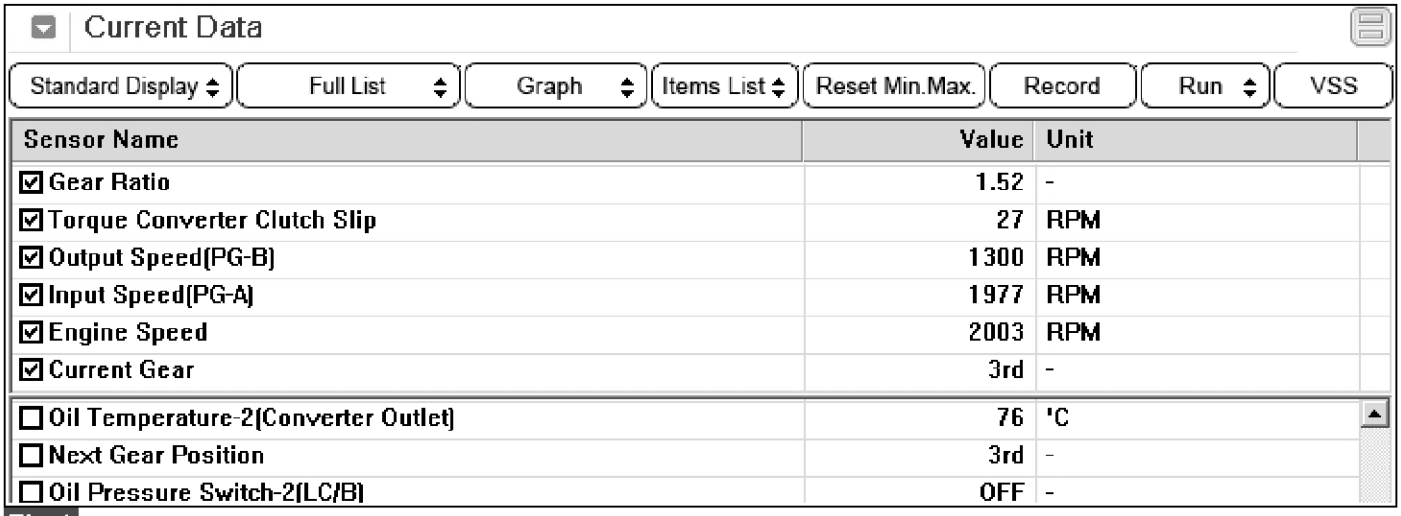


Fig.1

SHMAT9537L

Fig 1) 3st gear in D range

Monitor Scantool Data

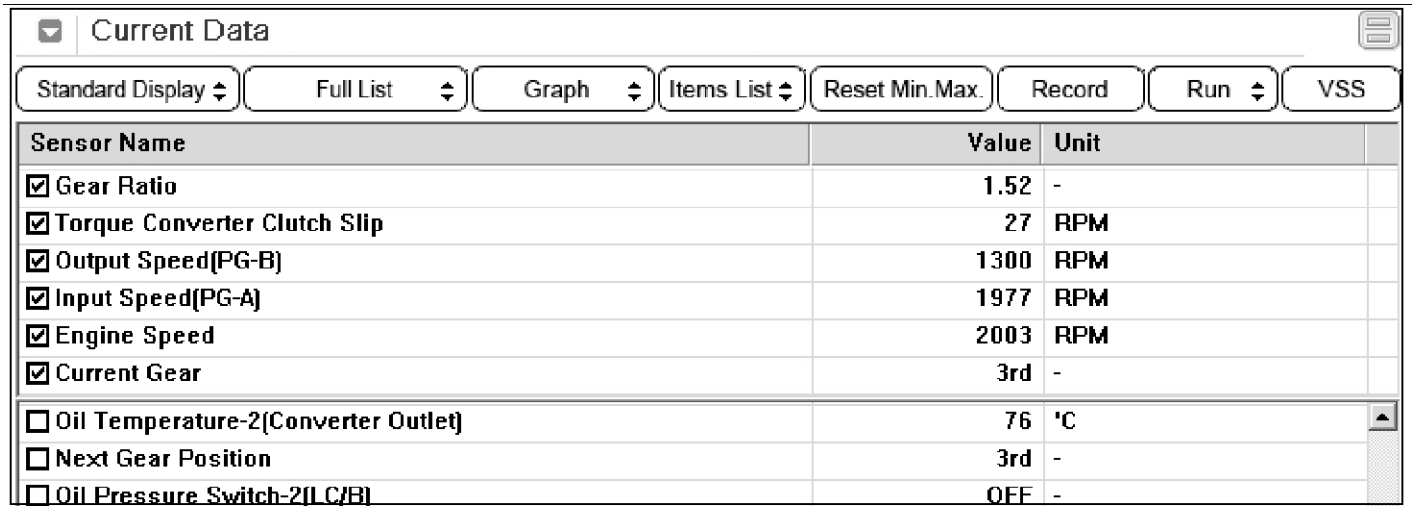
■ Stall Test

※ It is difficult to do "STALL TEST" in 3rd gear, therefore Go to "Signal Check" as follow

■ Signal Check

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "INPUT & OUTPUT SPEED SENSOR" parameter on the scantool.
4. Accelerate the Engine speed until about 2000 rpm in the 3rd gear.

Specification : INPUT SPEED - (OUTPUT SPEED × 3rd GEAR RATIO) ≥ 200 RPM



SHMAT9538L

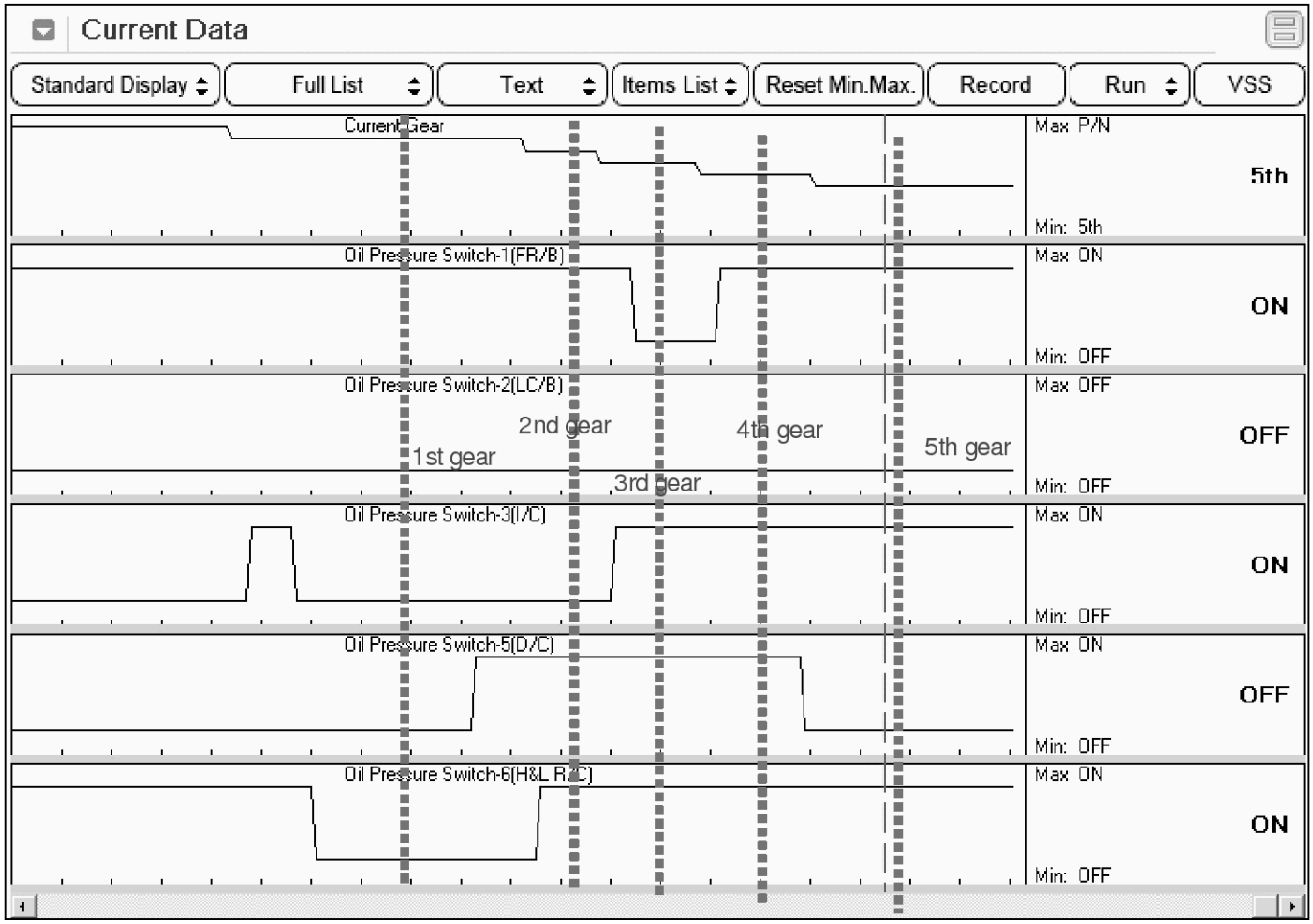
5. Does "INPUT & OUTPUT SPEED SENSOR" within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check for electrical niose of circuit in INPUT & OUTPUT SPEED SENSOR or Replace INPUT & OUTPUT SPEED SENSOR. Repair as necessary and Go to "verification of vehicle repair" procedure.

Component Inspection

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "OIL PRESSURE. S/W 1,2,3,5,6" parameter on the scantool.
4. Move select lever to "D" range and operate vehicle within 3rd gear condition.



SHMAT9533L

5. Does "OIL PRESSURE. S/W 1,2,3,5,6 " follow the reference data?

YES ▶ Repair AUTO TRANSAXLE(Clutch or Brake) as necessary and Go to "verification of vehicle repair" Repair " procedure.

NO ▶ Replace AUTO TRANSAXLE (BODY CONTROL VALVE faulty) as necessary and Go to " verification of vehicle repair " procedure.

Verification of Vehicle Repair

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

P0734 Gear 4 Incorrect Ratio

Component Location

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

General Description

The value of the input shaft speed should be equal to the value of the output shaft speed, when multiplied by the 4th gear ratio, while the transaxle is engaged in the 4th gear. For example, if the output speed is 1,000 rpm and the 4th gear ratio is 1.000, then the input speed is 1000 rpm.

DTC Description

This code is set if the value of input shaft speed is not equal to the value of the output shaft, when multiplied by the 4th gear ratio, while the transaxle is engaged in 4th gear. This malfunction is mainly caused by mechanical troubles such as control valve sticking or solenoid valve malfuctioning rather than an electrical issue.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality-high	• Faulty Input Speed Sensor • Faulty Output Speed Sensor • Faulty internal parts in transmission
	Threshold Value	• Proportionality check between input speed and Output speed at 4st gear Input speed > (Output speed *4st Gear Ratio)+200RPM	
Case 2	DTC Strategy	• Rationality-low	
	Threshold Value	• Proportionality check between input speed and Output speed at 4st gear Input speed < (Output speed *4st Gear Ratio)-200RPM	
Enable Conditions		• IThe time after the last shift was finished > 1 sec • Oil temperature > -10℃ • Engine speed > 600RPM • Position Lever D • Input speed > 300 RPM • Output speed(NAB) >750RPM & < 6000RPM • Pre-Filtering 1 sec	
Diagnostic Time		• More than 1sec	
Fail Safe		• 4th gear Limp-Home mode.	

Signal Waveform & Data

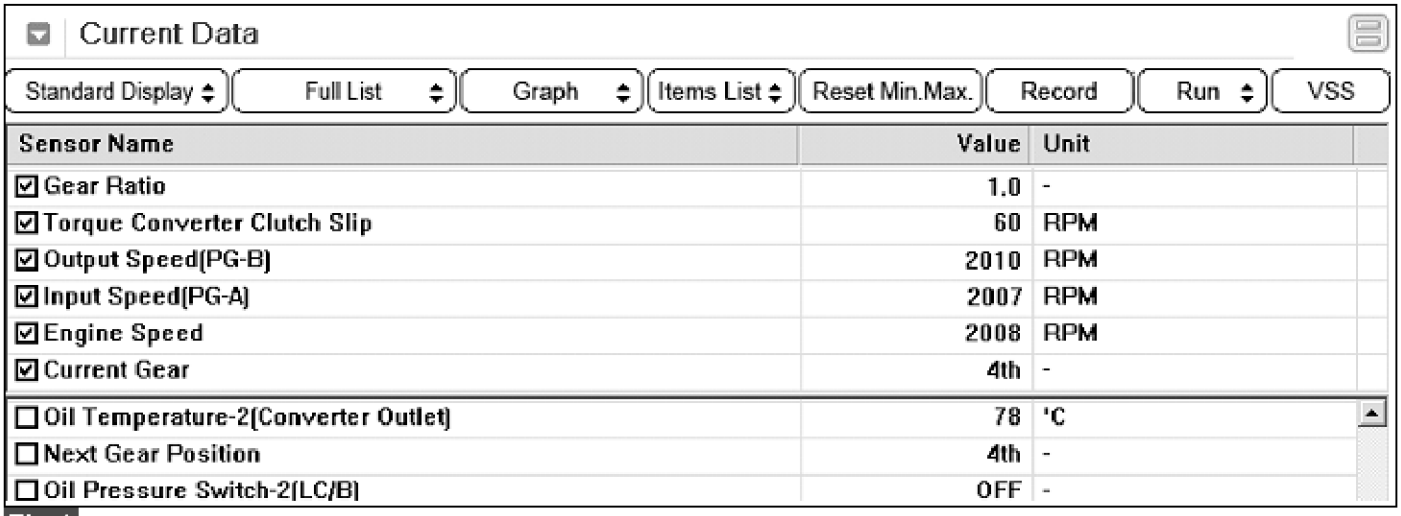


Fig.1

SHMAT9539L

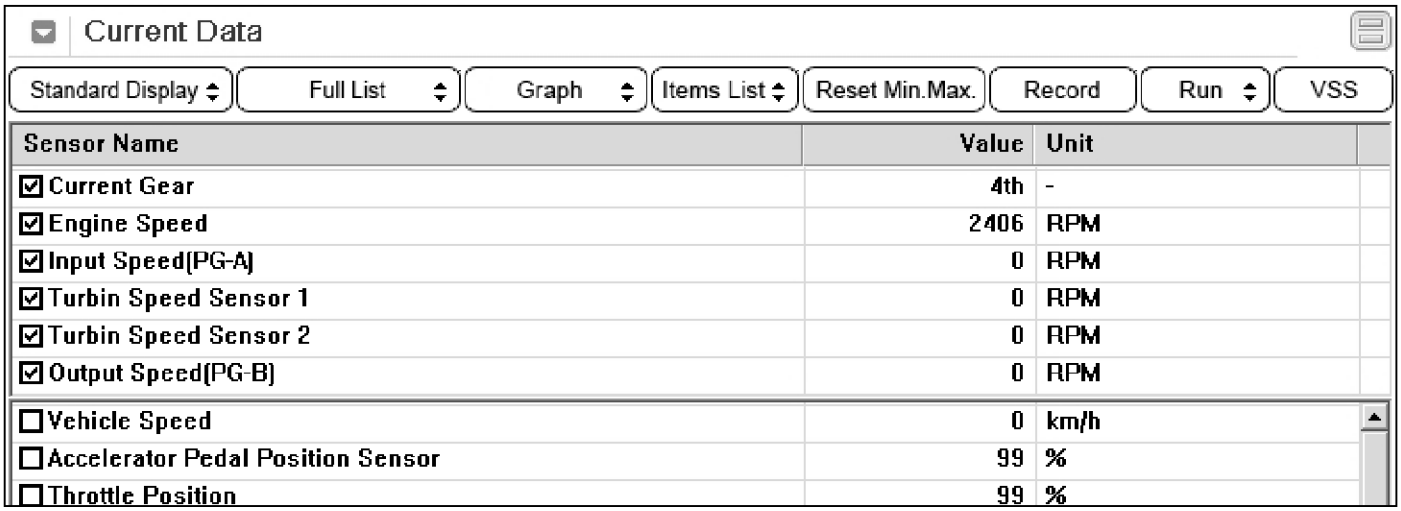
Fig 1) 4st gear in D range

Monitor Scantool Data

■ Stall Test

1. Connect scantool to data link connector(DLC).
2. Engine "ON" .
3. Fix the 4th gear by disconneting solenoid valve connector(CLG01-C).
4. Monitor the "ENGINE SPEED, INPUT SPEED SENSOR, OUTPUT SPEED SENSOR, GEAR POSITION" parameter on the scantool.
5. Perform the "STALL TEST" with gear position "4".

Specification : 2300 ± 200 engine rpm



SHMAT9540L

Operating Element Of Each Shifting Range

Shifting Position		Input clutch	High&Low Reverse Clutch	Direct Clutch	Reverse Brake	Front Brake	Low Coast Brake	Forward Brake	1st OwnWay Clutch	Forward OwnWay Clutch	3rd OwnWay Clutch
P			▲			▲					
R			●		●	●			●		●
N			▲			▲					
D	1st gear		★			▲	★	●	●	●	●
	2nd gear			●		▲		●		●	●
	3rd gear		●	●		●		▲	◆		●
	4th gear	●	●	●				▲	◆		
	5th gear	●	●			●		▲	◆		◆

● : WORKING.

◆ : PARTICIPATE IN DELIVERY TORQUE WHEN COAST DRIVING.

▲ : SUPPLING OIL PRESSURE TO ELEMENT, BUT NOT EFFECT ON OUTPUT.

★ : TEMPORARY WORKING.

NOTICE

Stall test procedure in D4 and reason

Procedure

1. Warm up the engine

2. After positioning the select lever in "D" or "ON" of the HOLD SW (Operate UP SHIFT in case of "SPORTS MODE"),depress the foot brake pedal fully after that, depress the accelerator pedal to the maximum

** The slippage of 4th gear operating parts can be detected by stall test in D2*

Reason for stall test

1. If there is no mechanical defaults in A/T, every slippage occur in torque converter.

2. Therfore, engine revolution is output, but input and output speed revolution must be "zero" due to wheel's lock.

3. If 4th gear operating parts have faults, input speed revolution will be out.

4. If oupput speed revolution is output. It means that the foot brake force is not applied fully. Remeasuring is required.

6. Is the meausred "STALL TEST " within specifications?

YES ▶ Go to "signal check" as follow

NO ▶ Go to "Component inspection" procedure.

CAUTION

1. Do not let anybody stand in front of or behind the vehicle while this test is being carried out.

2. Check the A/T fluid level and temperature and the engine coolant temperature.

- **Fluid level : At the hot mark on the oil level gauge.**
- **Fluid temperature : 176 ˚F~ 212 ˚F (80~100 ℃).**
- **Engine coolant temperature : 176 ˚F~ 212 ˚F (80~100 ℃).**

3. Chock both rear wheel(left and right).

4. Pull the parking brake lever on with the brake pedal fully depressed.

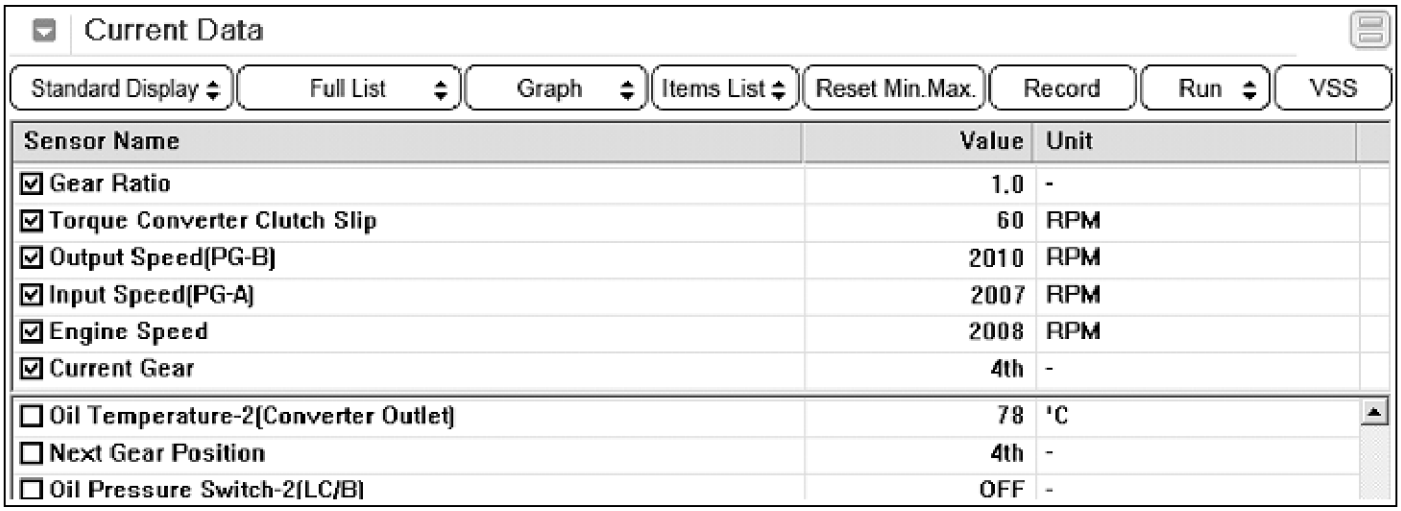
5. The throttle should not be left fully open for more than eight second.

6. If carrying out the stall test two or more time, move the select lever to the "N" position and run the engine at 1,000 rpm to let the A/T fluid cool down before carrying out subsequent.

■ Signal Check

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "INPUT & OUTPUT SPEED SENSOR" parameter on the scantool.
4. Accelerate the Engine speed until about 2000 rpm in the 4th gear

Specification : Input Speed /4th gear ratio - Output Speed ≥ 200rpm



SHMAT9541L

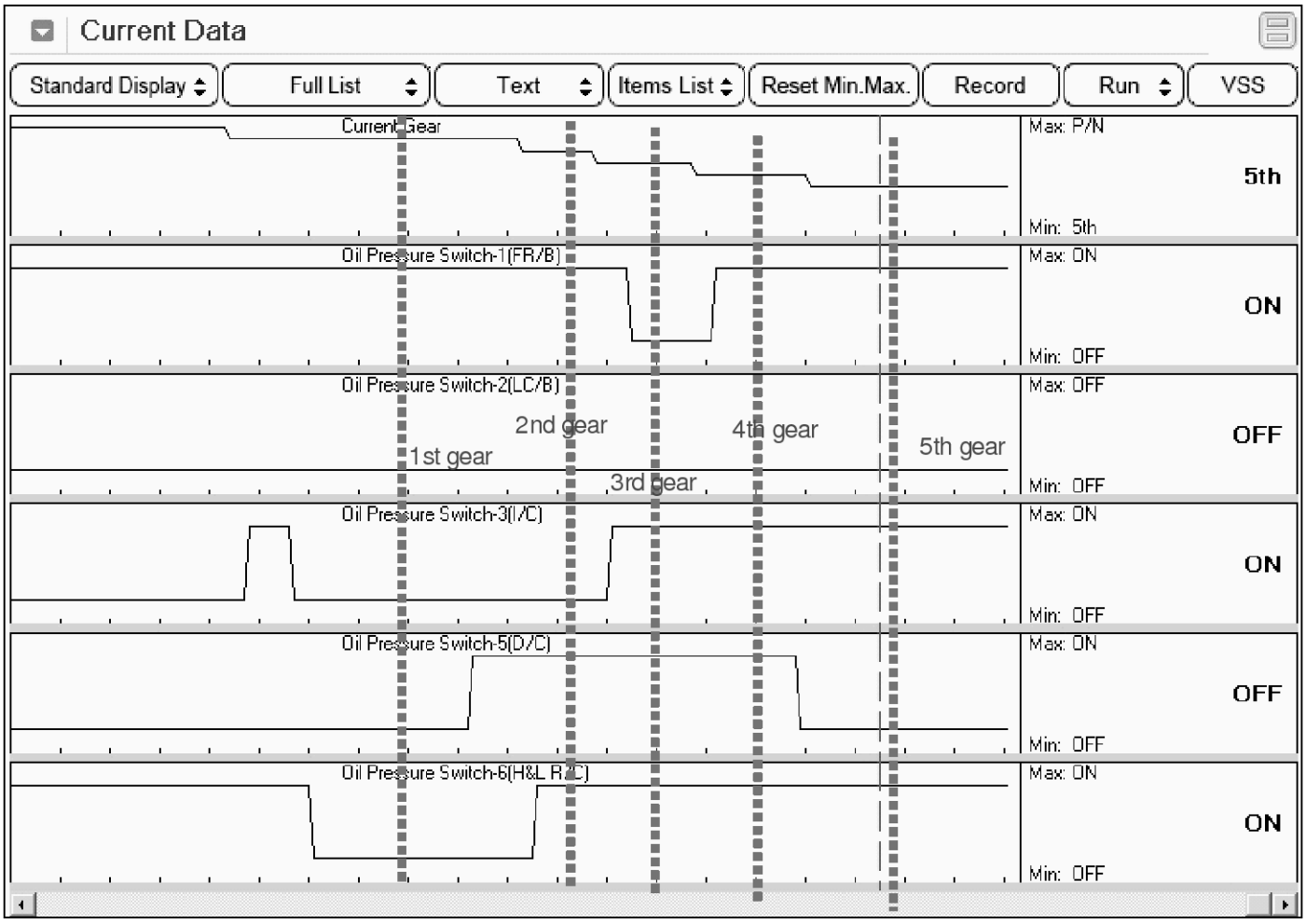
5. Does "INPUT & OUTPUT SPEED SENSOR" within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check for electrical niose of circuit in INPUT & OUTPUT SPEED SENSOR or Replace INPUT & OUTPUT SPEED SENSOR. Repair as necessary and Go to "verification of vehicle repair" procedure.

Component Inspection

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "OIL PRESSURE. S/W 1,2,3,5,6" parameter on the scantool.
4. Move select lever to "D" range and operate vehicle within 4th gear condition.



SHMAT9533L

5. Does "OIL PRESSURE. S/W 1,2,3,5,6 " follow the reference data?

YES ▶ Repair AUTO TRANSAXLE(Clutch or Brake) as necessary and Go to "verification of vehicle repair" Repair " procedure.

NO ▶ Replace AUTO TRANSAXLE (BODY CONTROL VALVE faulty) as necessary and Go to " verification of vehicle repair " procedure.

Verification of Vehicle Repair

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

P0735 Gear 5 Incorrect Ratio

Component Location

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

General Description

The value of the input shaft speed should be equal to the value of the output shaft speed, when multiplied by the 4th gear ratio, while the transaxle is engaged in the 5th gear. For example, if the output speed is 1,000 rpm and the 5th gear ratio is 0.840, then the input speed is 840 rpm.

DTC Description

This code is set if the value of input shaft speed is not equal to the value of the output shaft, when multiplied by the 5th gear ratio, while the transaxle is engaged in 5th gear. This malfunction is mainly caused by mechanical troubles such as control valve sticking or solenoid valve malfuctioning rather than an electrical issue.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Rationality-high	• Faulty Input Speed Sensor • Faulty Output Speed Sensor • Faulty internal parts in transmission
	Threshold Value	• Proportionality check between input speed and Output speed at 5st gear Input speed > (Output speed *5st Gear Ratio)+200RPM	
Case 2	DTC Strategy	• Rationality-low	
	Threshold Value	• Proportionality check between input speed and Output speed at 5st gear Input speed < (Output speed *5st Gear Ratio)-200RPM	
Enable Conditions		• IThe time after the last shift was finished > 1 sec • Oil temperature > -10℃ • Engine speed > 600RPM • Position Lever D • Input speed > 300 RPM • Output speed(NAB) >1100RPM & < 6000RPM • Pre-Filtering 1 sec	
Diagnostic Time		• More than 1sec	
Fail Safe		• 4th gear Limp-Home mode.	

Signal Waveform & Data

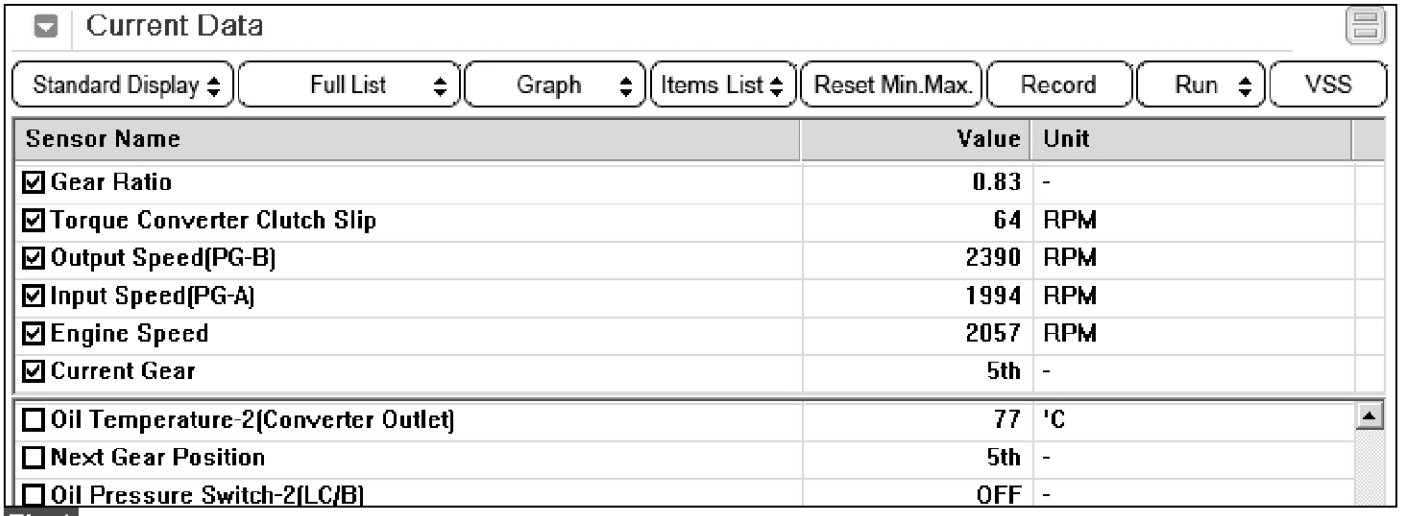


Fig.1

SHMAT9542L

Fig 1) 5st gear in D range

Monitor Scantool Data

■ Stall Test

※ It is difficult to do "STALL TEST" in 5th gear, so that Go to "signal check" procedure.

Operating Element Of Each Shifting Range

Shifting Position		Input clutch	High&Low Reverse Clutch	Direct Clutch	Reverse Brake	Front Brake	Low Coast Brake	Forward Brake	1st OwnWay Clutch	Forward OwnWay Clutch	3rd OwnWay Clutch
P			▲			▲					
R			●		●	●			●		●
N			▲			▲					
D	1st gear		★			▲	★	●	●	●	●
	2nd gear			●		▲		●		●	●
	3rd gear		●	●		●		▲	◆		●
	4th gear	●	●	●				▲	◆		
	5th gear	●	●			●		▲	◆		◆

● : WORKING.

◆ : PARTICIPATE IN DELIVERY TORQUE WHEN COAST DRIVING.

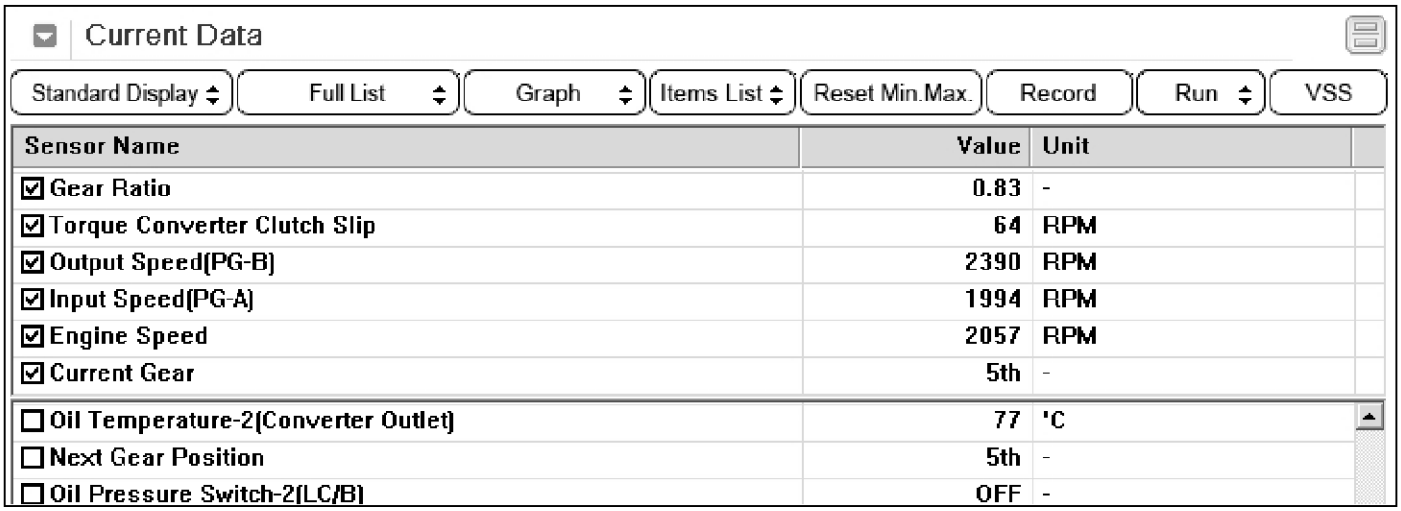
▲ : SUPPLING OIL PRESSURE TO ELEMENT, BUT NOT EFFECT ON OUTPUT.

★ : TEMPORARY WORKING.

■ Signal Check

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "INPUT & OUTPUT SPEED SENSOR" parameter on the scantool.
4. Accelerate the Engine speed until about 2000 rpm in the 5th gear

Specification : INPUT SPEED - (OUTPUT SPEED × 5th GEAR RATIO) ≥ 200 RPM



SHMAT9543L

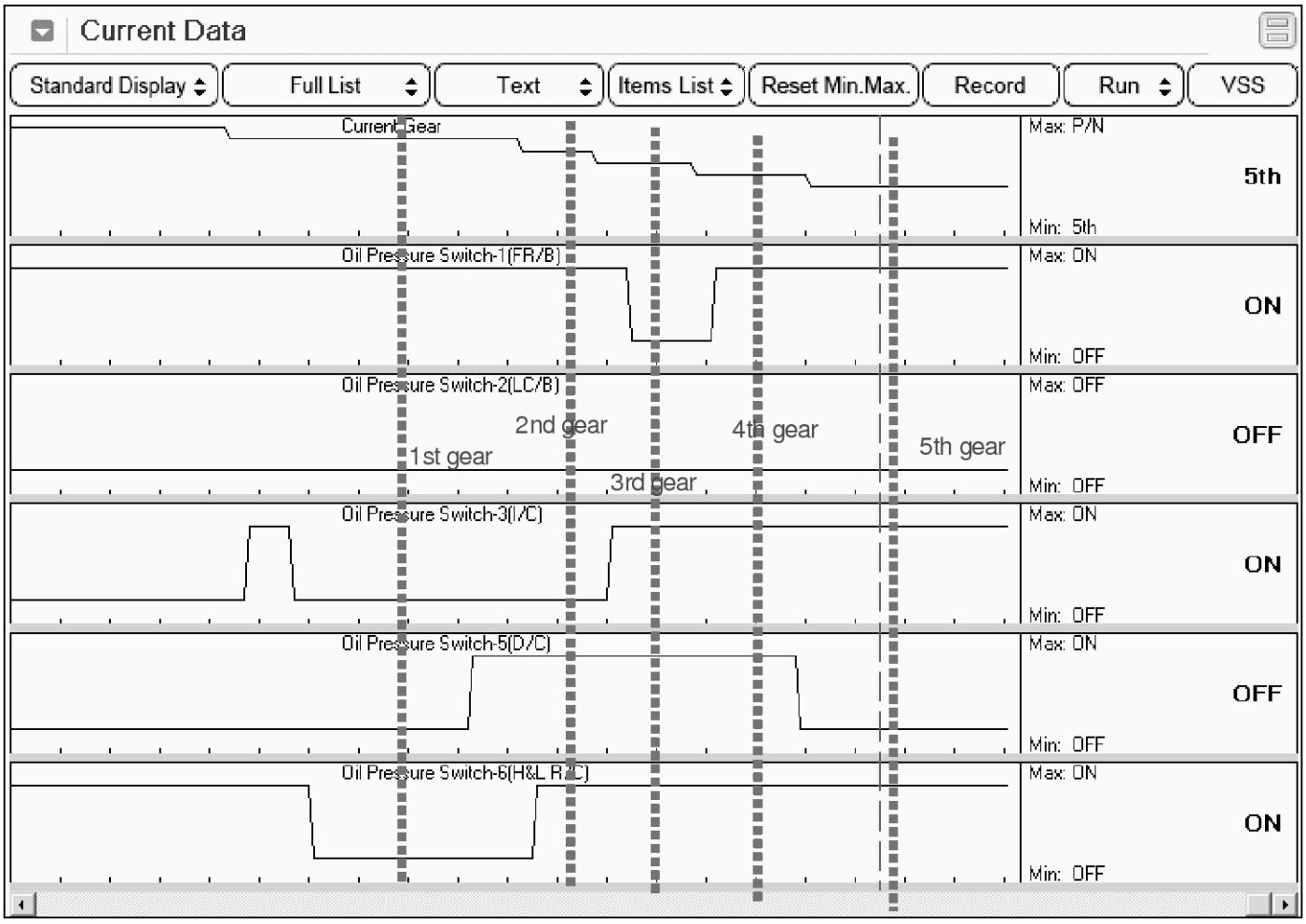
5. Does "INPUT & OUTPUT SPEED SENSOR" within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check for electrical niose of circuit in INPUT & OUTPUT SPEED SENSOR or Replace INPUT & OUTPUT SPEED SENSOR. Repair as necessary and Go to "verification of vehicle repair" procedure.

Component Inspection

1. Connect Scantool.
2. Engine "ON" .
3. Monitor the "OIL PRESSURE. S/W 1,2,3,5,6" parameter on the scantool.
4. Move select lever to "D" range and operate vehicle within 5th gear condition.



SHMAT9533L

5. Does "OIL PRESSURE. S/W 1,2,3,5,6 " follow the reference data?

YES ▶ Repair AUTO TRANSAXLE(Clutch or Brake) as necessary and Go to "verification of vehicle repair" Repair " procedure.

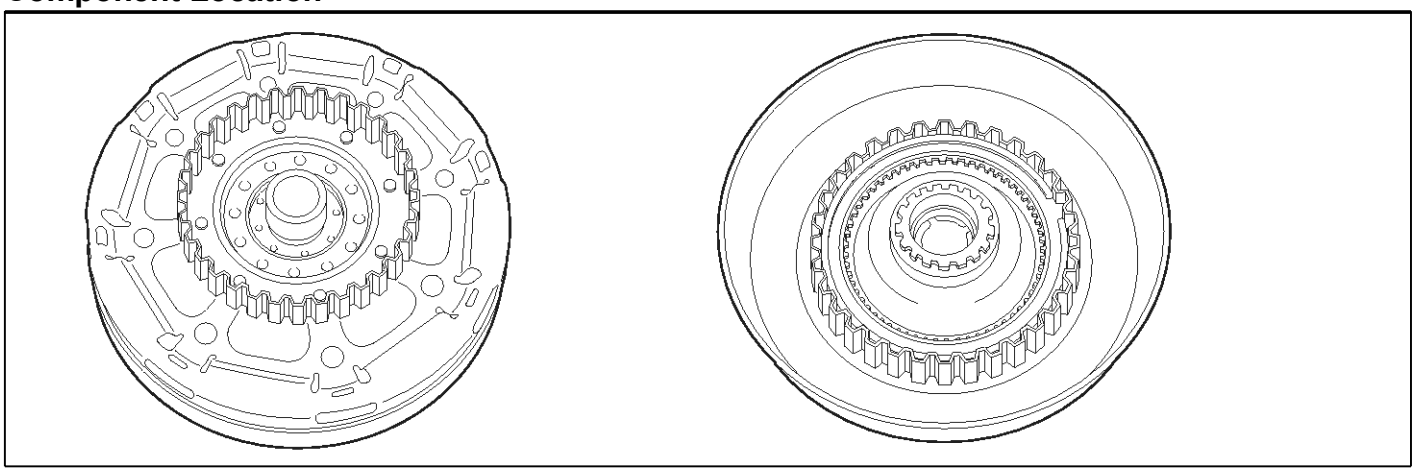
NO ▶ Replace AUTO TRANSAXLE (BODY CONTROL VALVE faulty) as necessary and Go to " verification of vehicle repair " procedure.

Verification of Vehicle Repair

Refer to DTC P0731 : Gear 1 Incorrect Ratio.

P0741 Torque Converter Clutch Circuit Stuck Off(SOL6)

Component Location



SBLAT6140L

General Description

The PCM/TCM controls the locking and unlocking of the Torque Converter Clutch (or Damper Clutch), to the input shaft of the transmission, by appling hydraulic pressure. The main purpose of T/C clutch control is to save fuel by decreasing the hydraulic load inside the T/C. The TCM outputs duty pulses to control the Damper Clutch Control Solenoid Valve(DCCSV) and hydraulic pressure is applied to DC according to the DCC duty ratio value. When the duty ratio is high, high pressure is applied and the Damper Clutch is locked. The normal operating range of the Damper Clutch Control current is from 0.05A(unlocked) to 0.75A(locked).

DTC Description

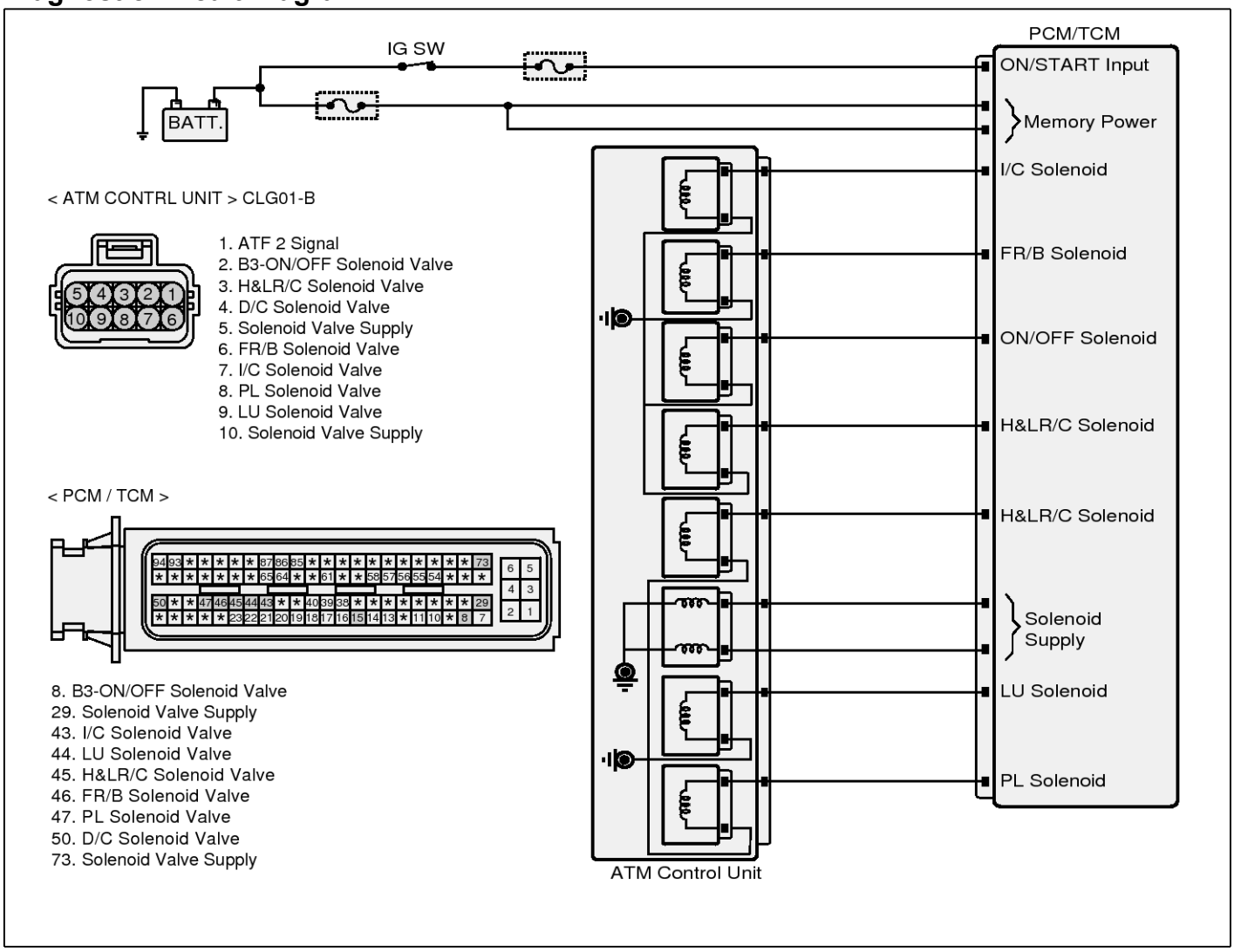
The PCM/TCM increases the duty ratio to engage the Damper Clutch by monitoring slip rpms (difference vlaue beteween engine speed and turbine speed).

To decrease the slip of the Damper Clutch, the TCM increases the duty ratio by appling more hyraulic pressure. When slip rpm does not drop under some value with 100% duty ratio, the PCM/TCM determines that the Torque Converter Clutch is stuck OFF and sets this code.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Rationality(Damper clutch open stuck)	※ Torque Converter Clutch = Damper Clutch • Faulty Torque Conveter Clutch • Faulty Torque Conveter Clutch Solenoid Valve • Faulty Valve Body • Fautly PCM/TCM
Enable Conditions	• Duty of "Damper clutch solenoid valve" = 100% • Input speed > 0rpm	
Threshold Value	• Calculated slip (engine speed-input speed) > 100rpm	
Diagnostic Time	• More than 5sec	
Fail Safe	• Damper clutch "OFF"	

Diagnostic Circuit Diagram



SHMAT9706L

Signal Waveform & Data

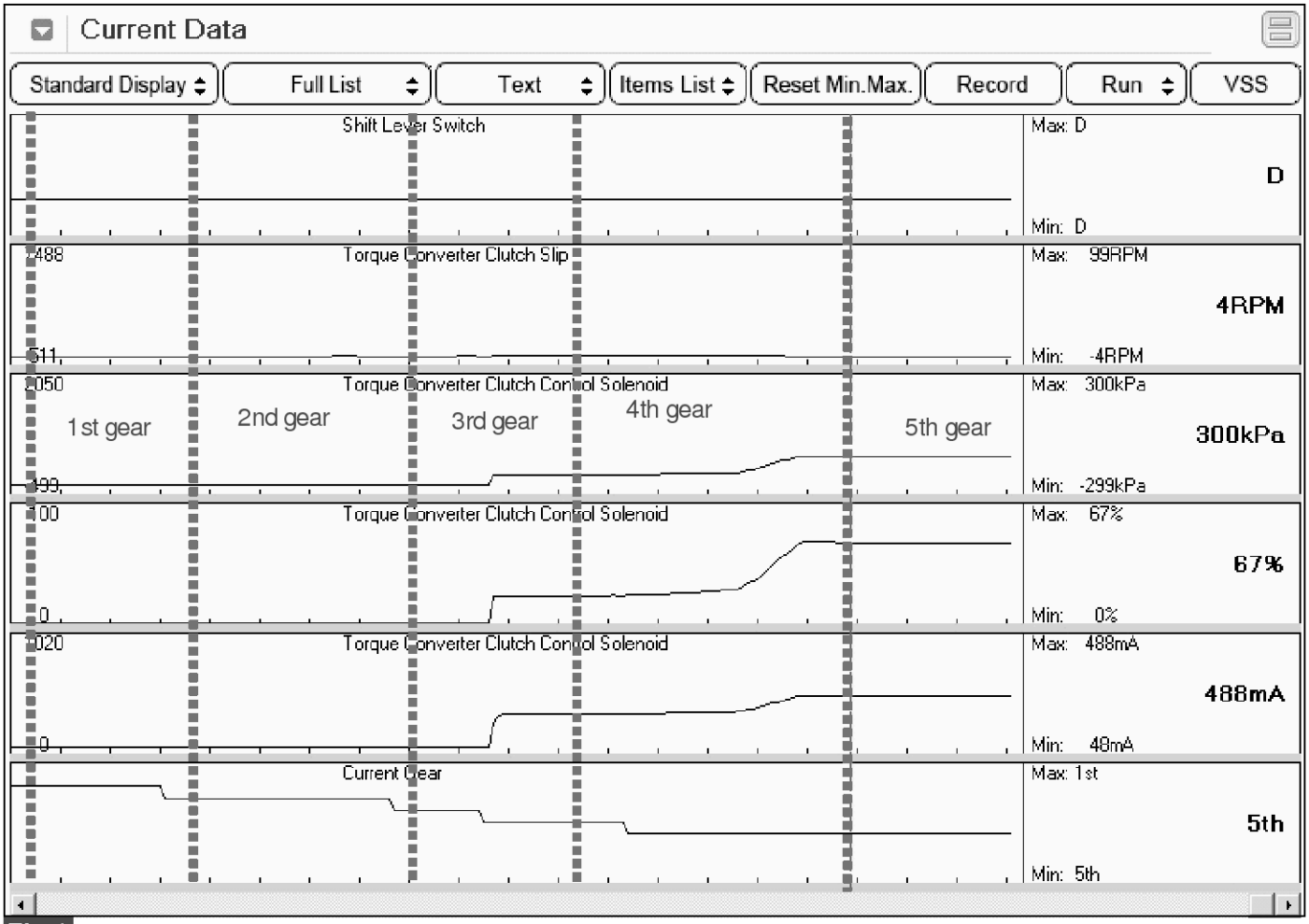


Fig.1

SHMAT9544L

Fig 1) Torque Converter Operation

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Select "D RANGE" and drive vehicle from 1st gear to 5th gear.
4. Monitor the "TORQUE CONVERTER(DAMPER) CLUTCH" parameter on the scantool.

Specification : TCC SLIP<40RPM+ Vsp1/2 (TCCSV Current > 6.5A)

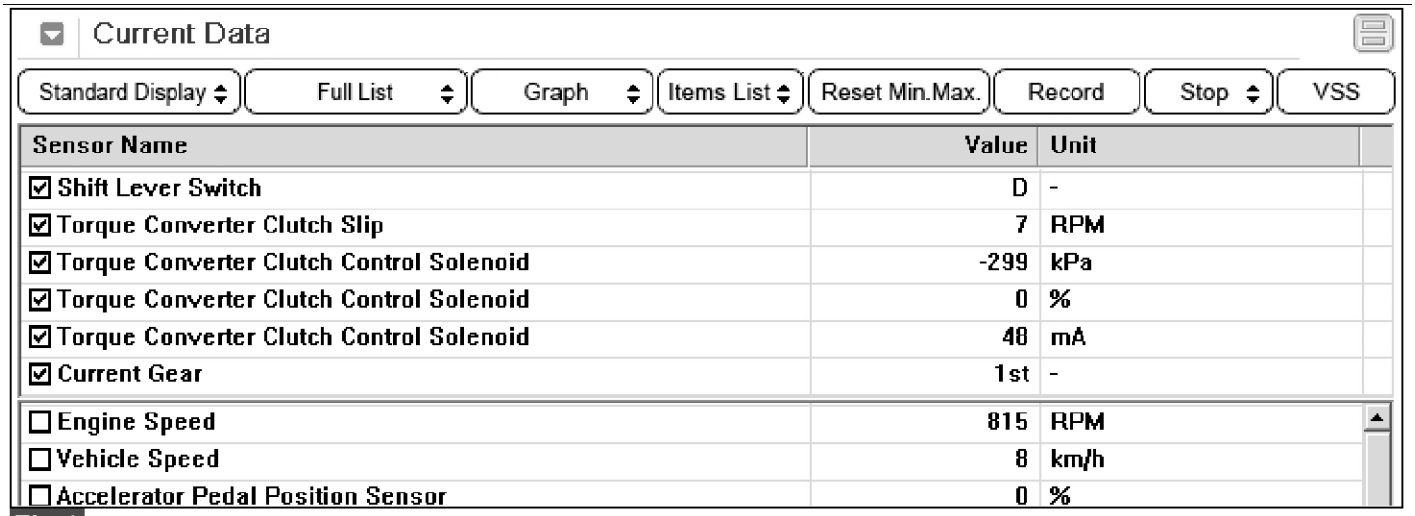


Fig.1

SHMAT9545L

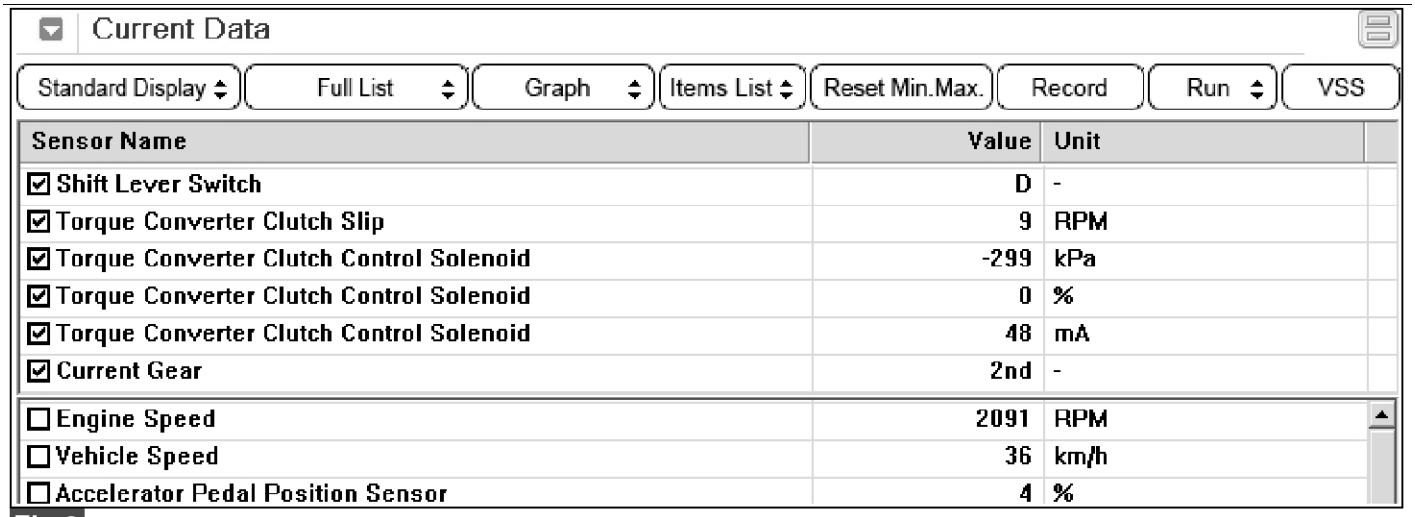


Fig.2

SHMAT9546L

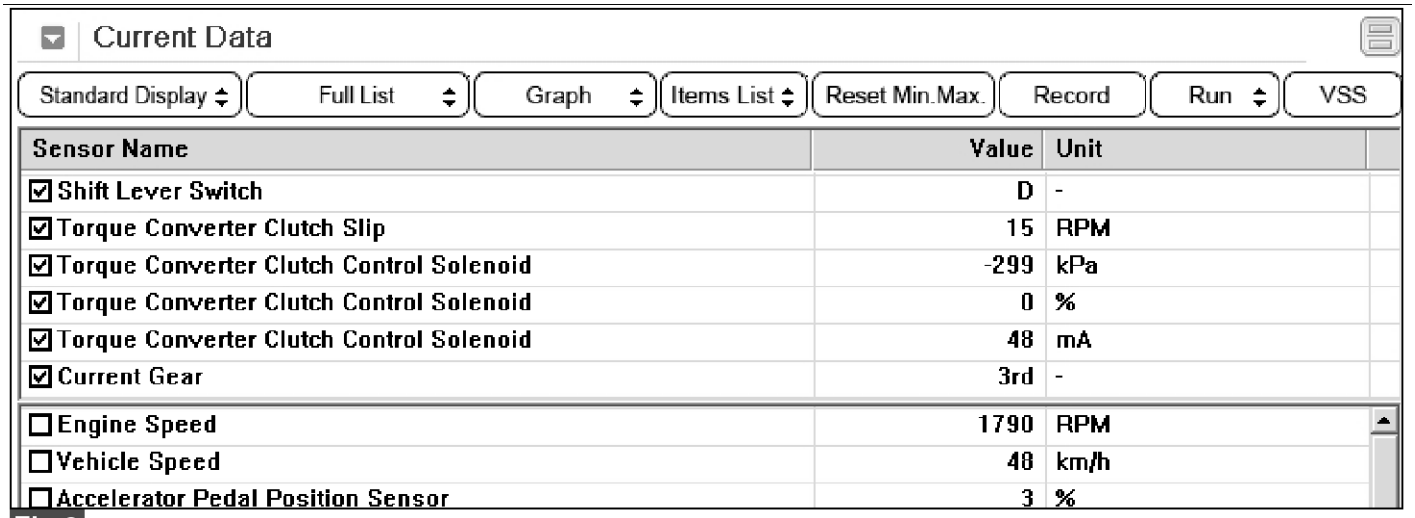


Fig.3

SHMAT9547L

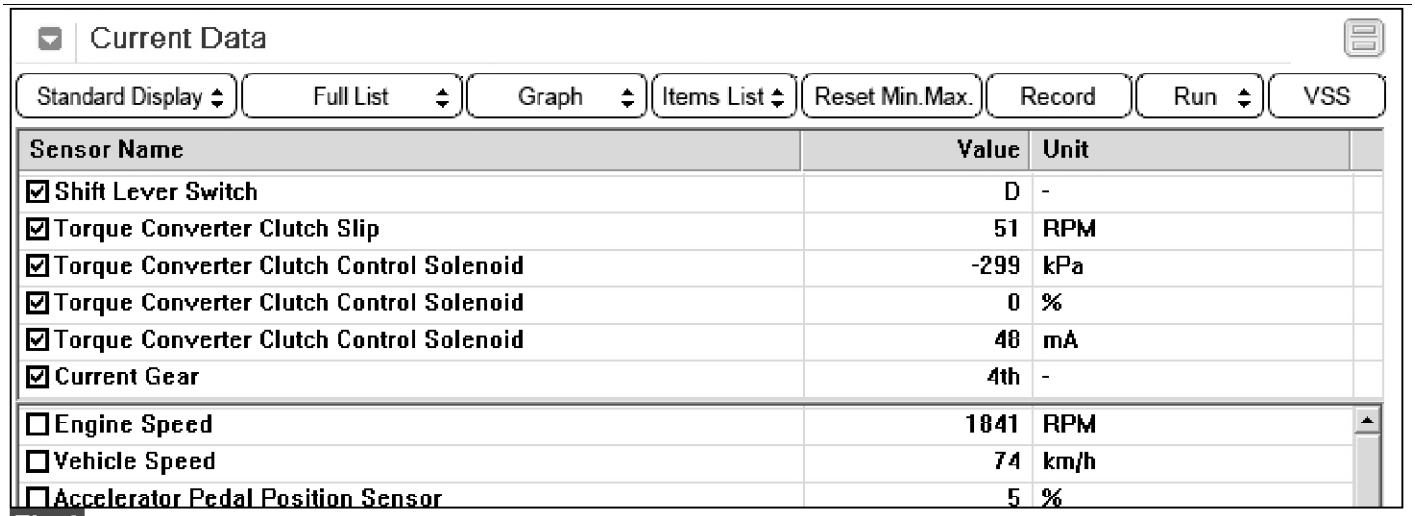


Fig.4

SHMAT9548L

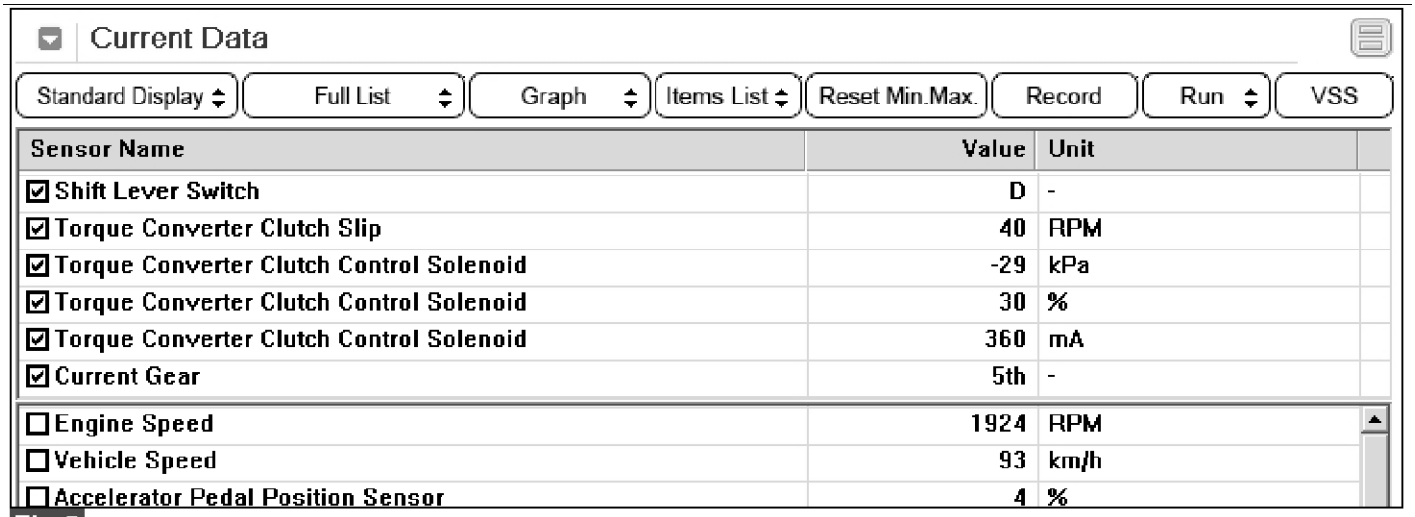


Fig.5

SHMAT9549L

Fig 1) 1st gear in "D" range - No Torque Converter Clutch operation

Fig 2) 2nd gear in "D" range - No Torque Converter Clutch operation

Fig 3) 3rd gear in "D" range - No Torque Converter Clutch operation

Fig 4) 4th gear in "D" range - No Torque Converter Clutch operation

Fig 5) 5th gear in "D" range - Torque Converter Clutch operation

5. Is the measured "TCC SLIP(DAMPER CLUTCH SL.RPM)" within specifications ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for loose-ness, poor connection, bending, corrosion, co-ntamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

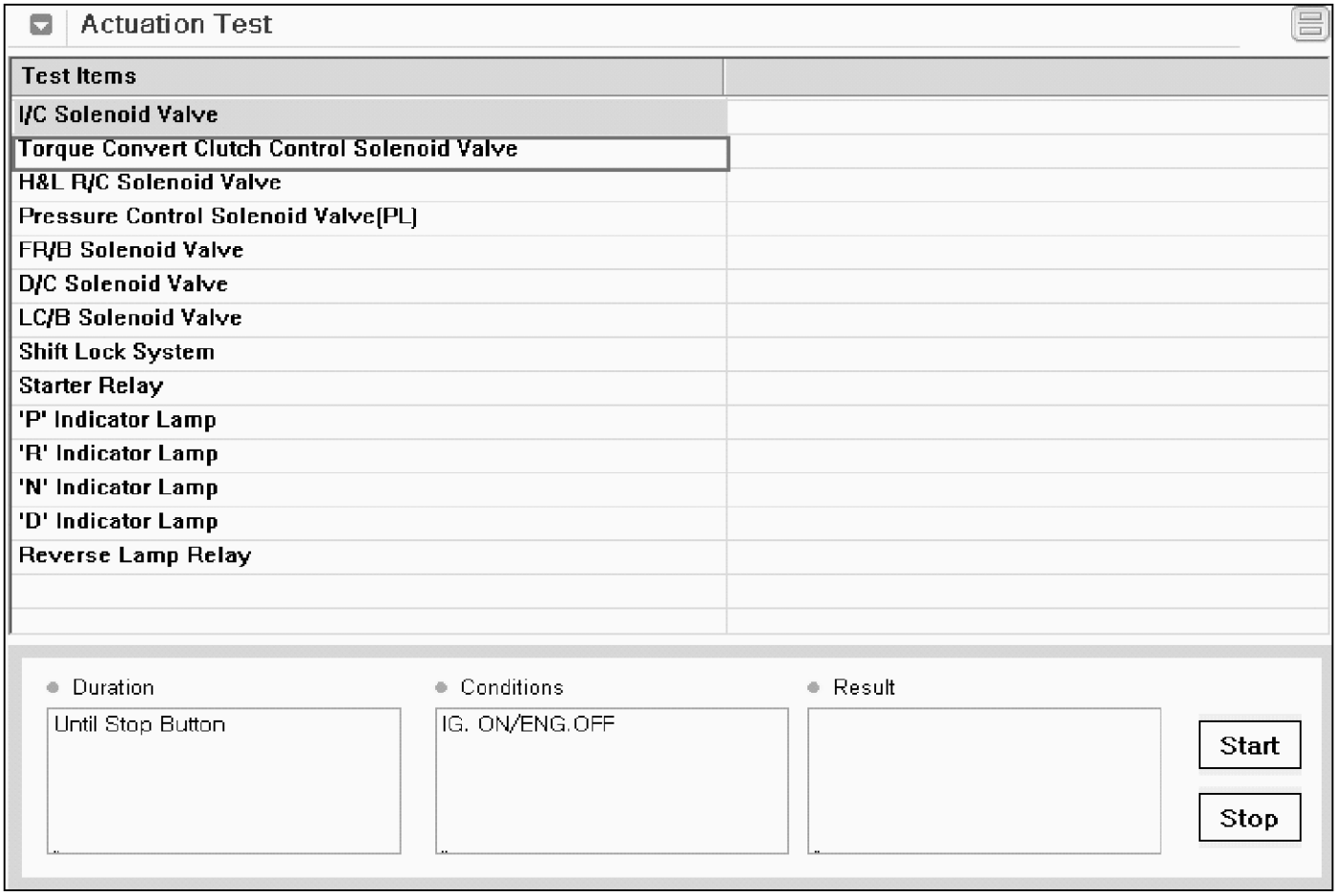
NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check TCC Solenoid Valve

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select Torque Converter Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9550L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Torque Converter Solenoid Valve and check for proper operation. If the problem is corrected, replace Torque Converter Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

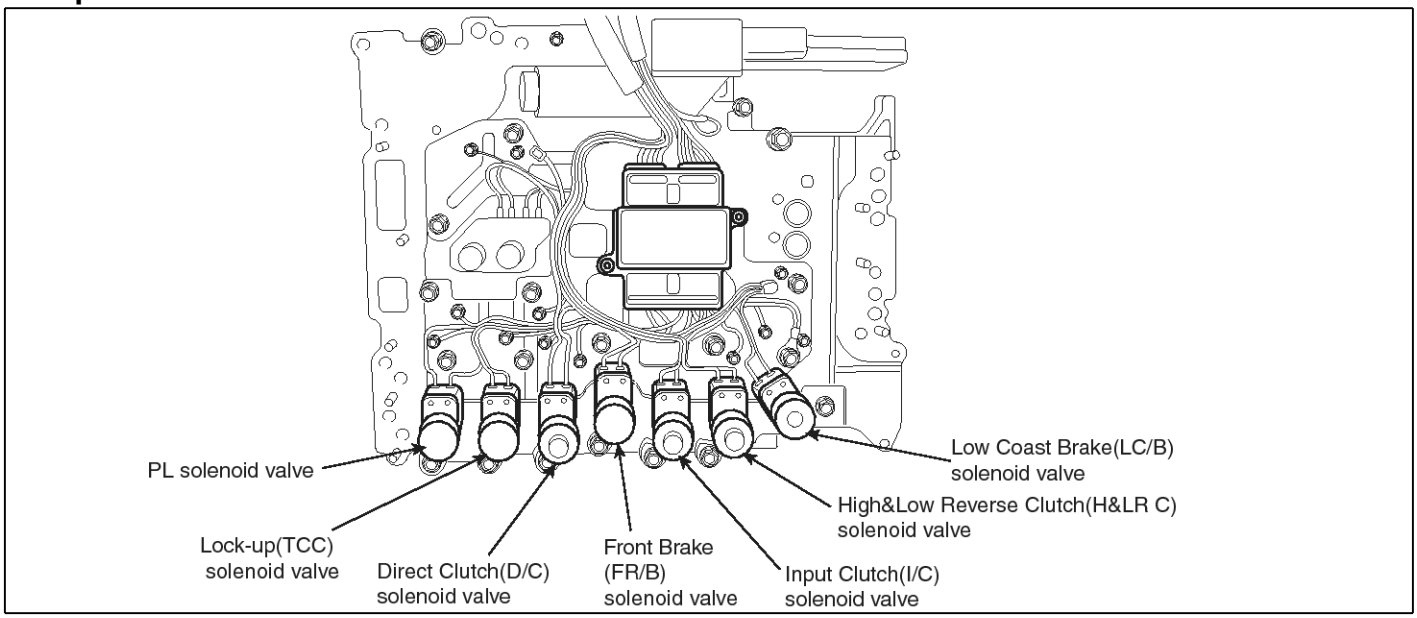
1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0743 Torque Converter Clutch Circuit - Short to battery (SOL6)

Component Location



SBLAT6150L

General Description

The PCM/TCM controls the locking and unlocking of the Torque Converter Clutch (or Damper Clutch), to the input shaft of the transmission, by appling hydraulic pressure. The main purpose of T/C clutch control is to save fuel by decreasing the hydraulic load inside the T/C. The TCM outputs duty pulses to control the Damper Clutch Control Solenoid Valve(DCCSV) and hydraulic pressure is applied to DC according to the DCC duty ratio value. When the duty ratio is high, high pressure is applied and the Damper Clutch is locked. The normal operating range of the Damper Clutch Control current is from 0.05A(unlocked) to 0.75A(locked).

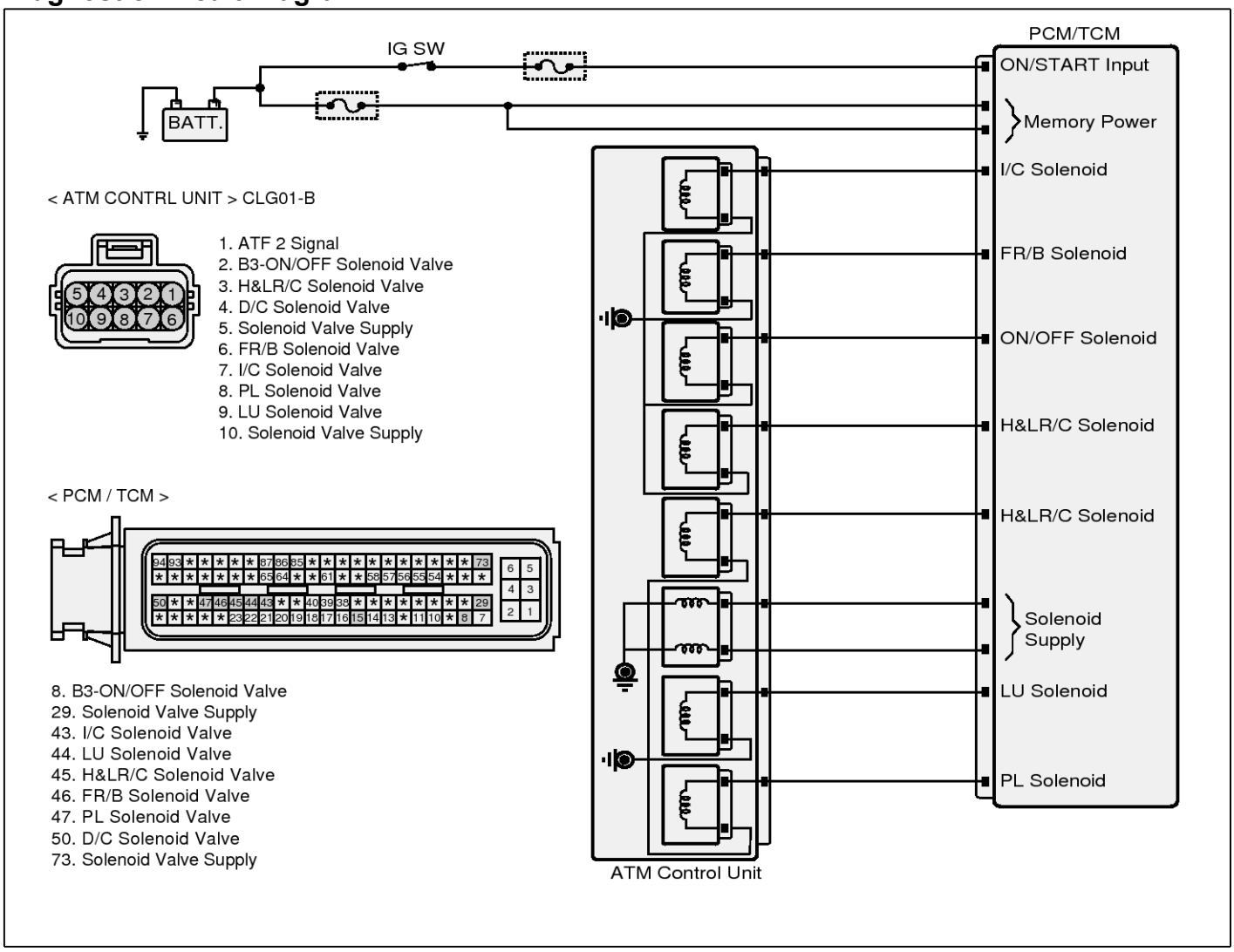
DTC Description

The TCM checks the Damper Clutch Control Signal by monitoring the feedback signal from the solenoid valve drive circuit. If an unexpected signal is monitored, (For example, high voltage is detected when low voltage is expected, or low voltage is detected when high voltage is expected) the TCM judges that the DCCSV circuit is malfunctioning and sets this code.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check voltage range(Open, Shrot)	※ Torque Converter Clutch = Damper Clutch • Faulty Torque Conveter Clutch • Faulty Torque Conveter Clutch Solenoid Valve • Faulty Valve Body • Fautly PCM/TCM
Enable Conditions	• 10V < Actuator Supply Voltage < 16V	
Threshold Value	• Hardware IC check	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• Torque Converter Clutch "OFF" • Locked as 4th gear	

Diagnostic Circuit Diagram



SHMAT9706L

Signal Waveform & Data

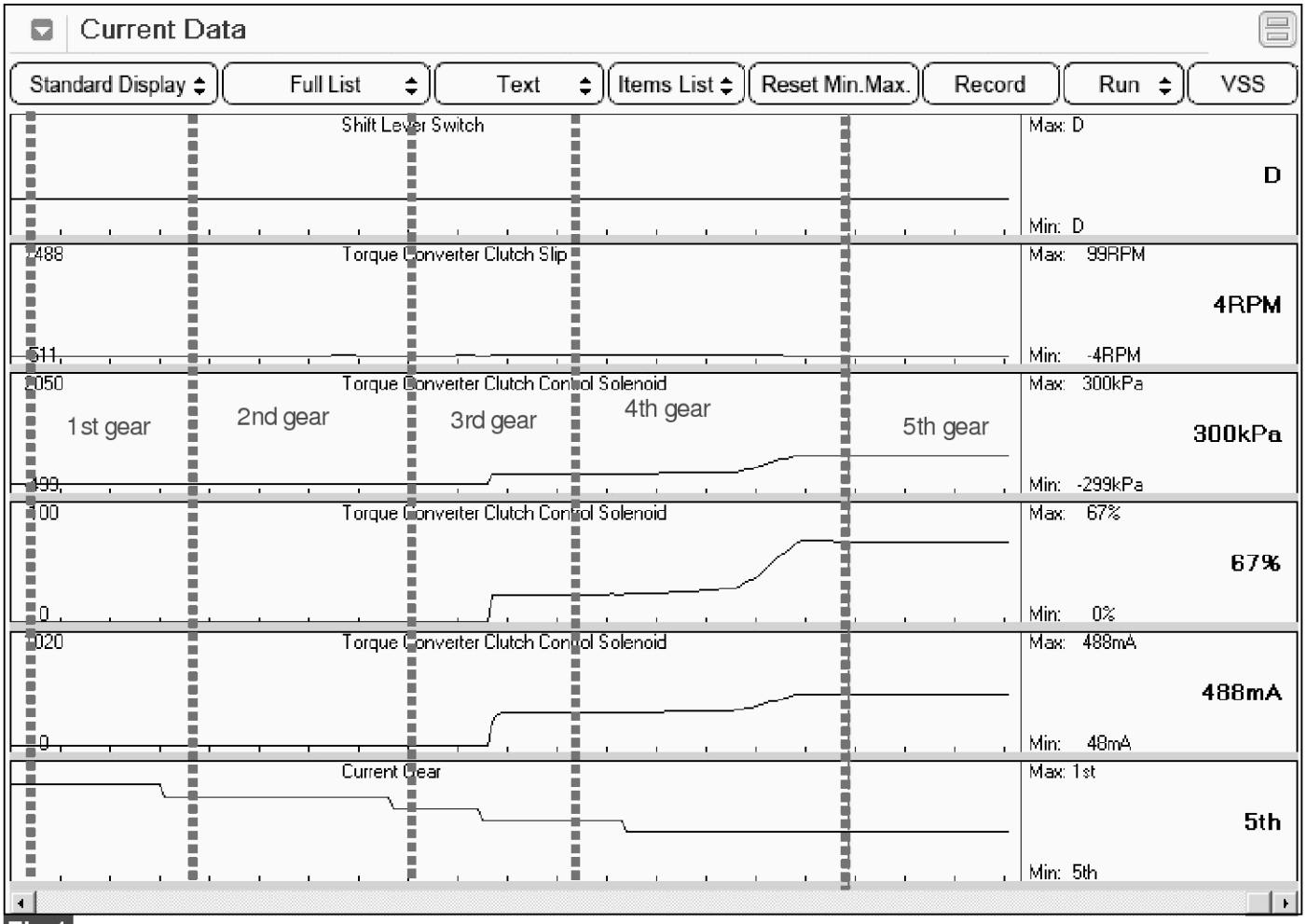


Fig.1

SHMAT9544L

Fig 1) Torque Converter Operation

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Monitor the "TCC SOL. VALVE" parameter on the scantool.
4. Select "D RANGE" and Operate the vehicle in 5th gear.
5. Check "TCC SOL. VALVE" parameter value changes while driving.

Specification : TCC SLIP<40RPM+ Vsp1/2 (TCCSV current > 6.5A)

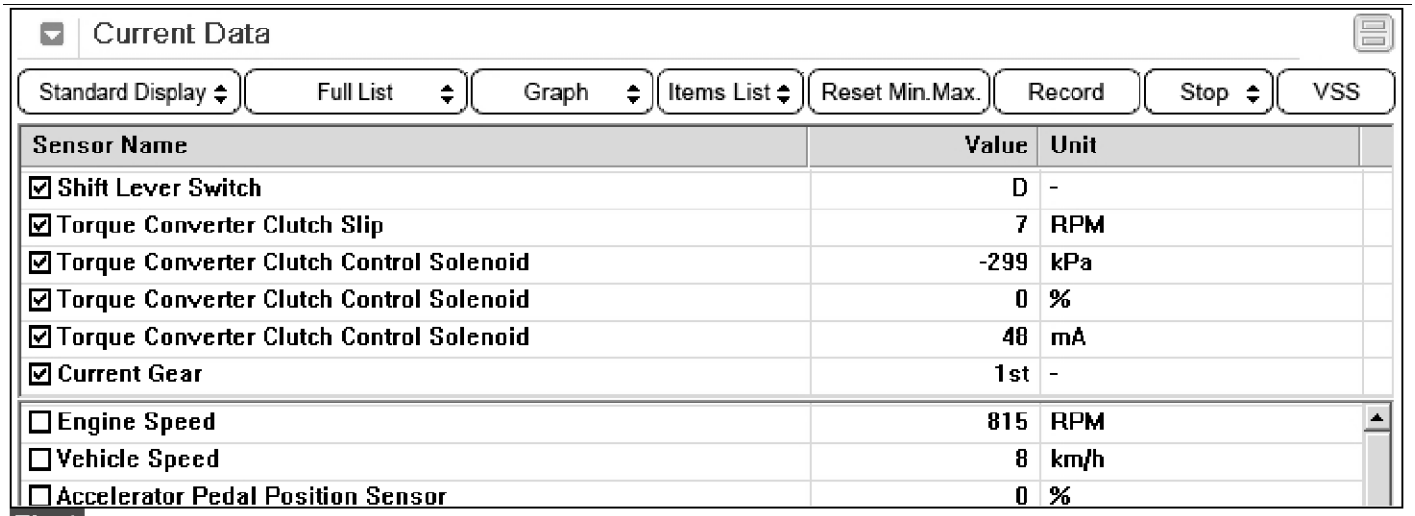


Fig.1

SHMAT9545L

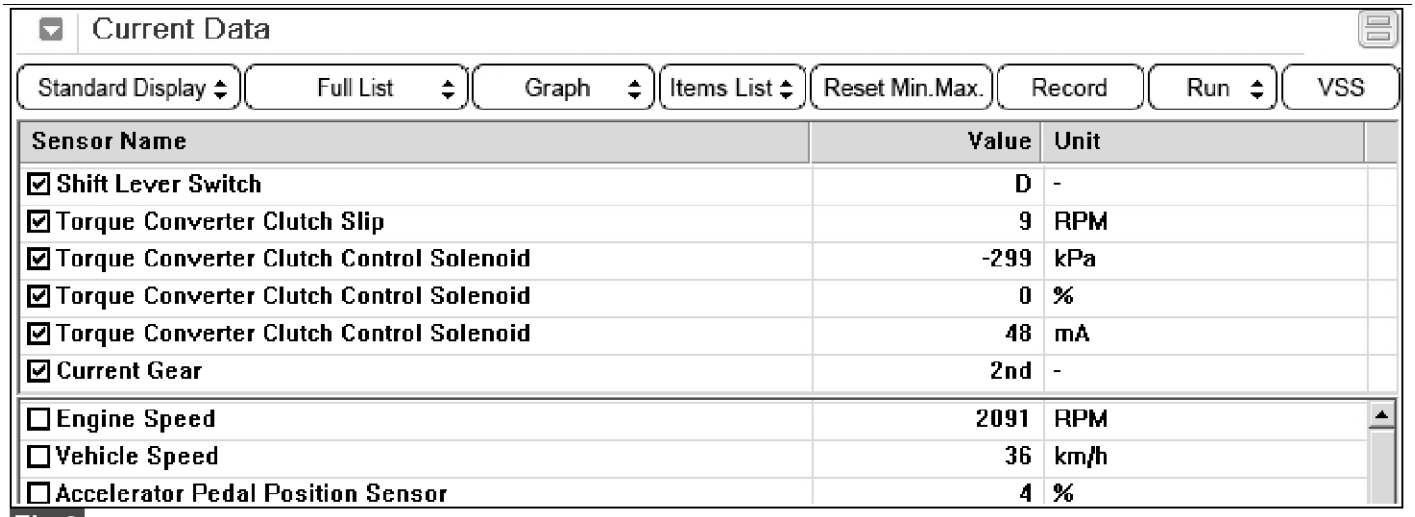


Fig.2

SHMAT9546L

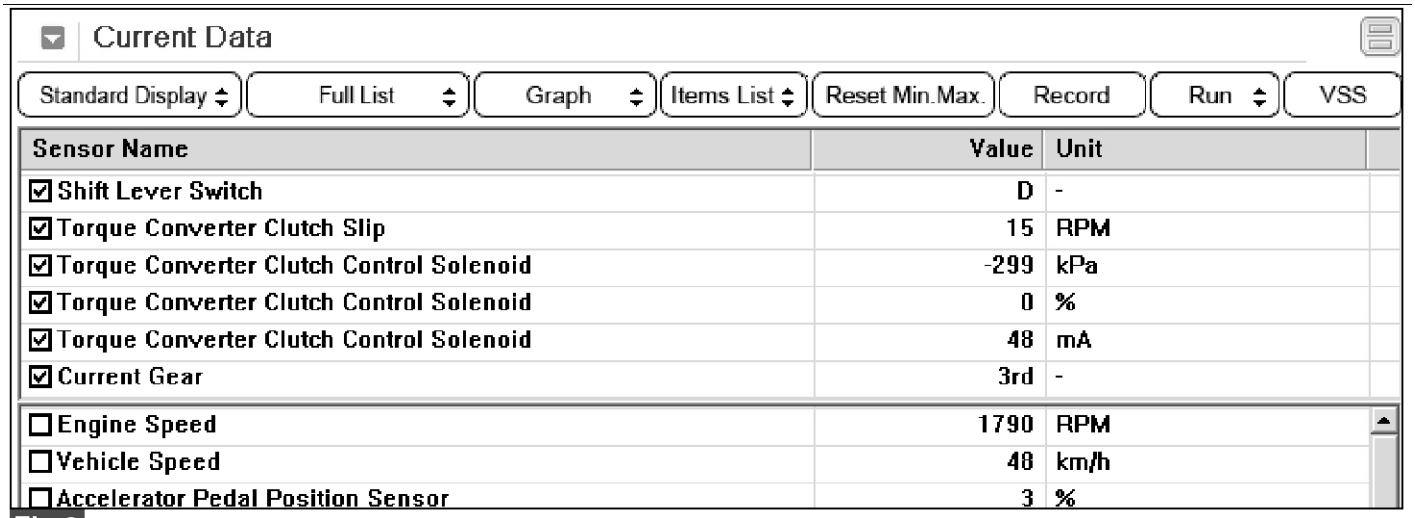


Fig.3

SHMAT9547L

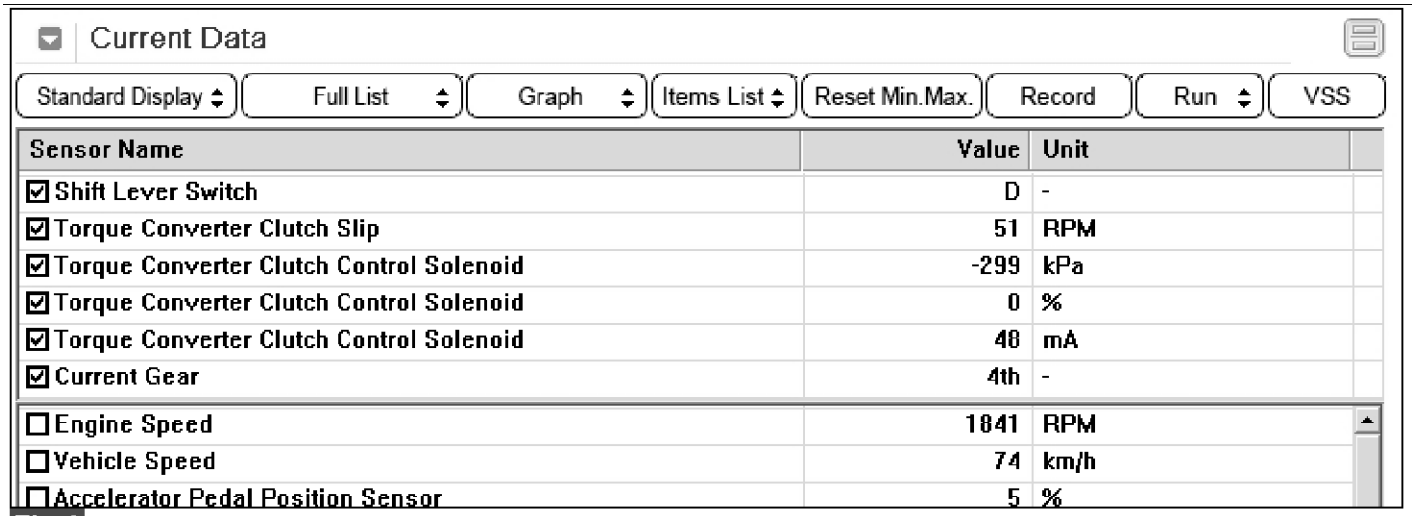


Fig.4

SHMAT9548L

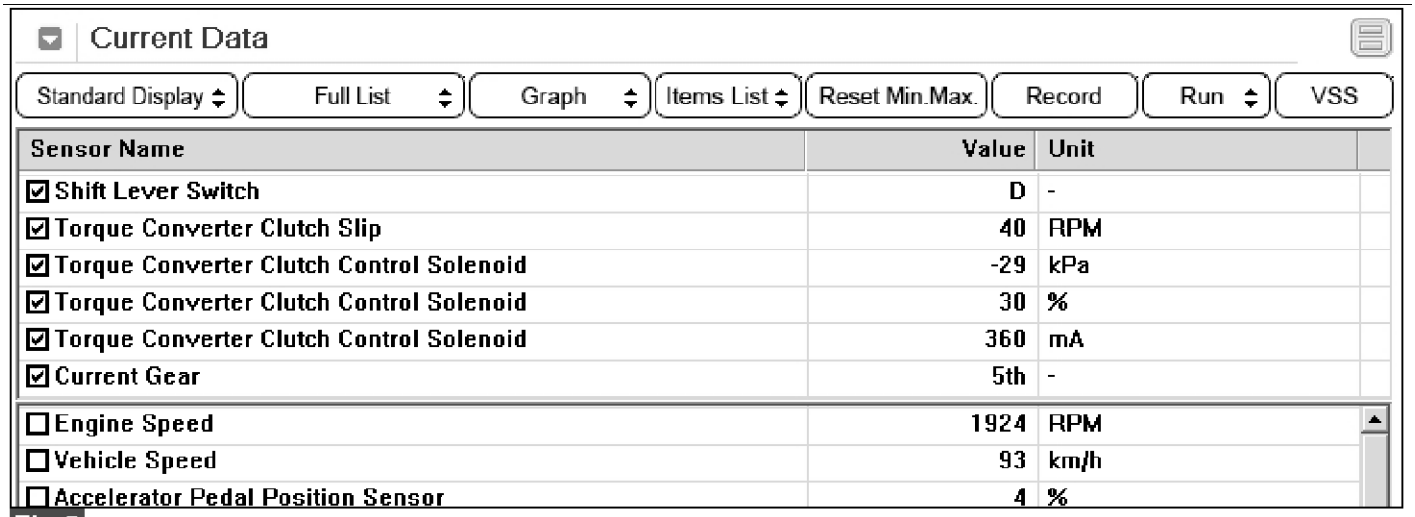


Fig.5

SHMAT9549L

Fig 1) 1st gear in "D" range - No Torque Converter Clutch operation

Fig 2) 2nd gear in "D" range - No Torque Converter Clutch operation

Fig 3) 3rd gear in "D" range - No Torque Converter Clutch operation

Fig 4) 4th gear in "D" range - No Torque Converter Clutch operation

Fig 5) 5th gear in "D" range - Torque Converter Clutch operation

6. Is the measured "TCC SLIP(DAMPER CLUTCH SL.RPM)" within specifications ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

1. Connect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "ON", ENGINE "OFF"
3. Measure voltage between power terminal of LU solenoid valve and chassis ground.

Specification : Approx. Battery Voltage

4. Is the measured voltage within specifications ?

YES ▶ "Go to Ground Circuit" Inspection Procedure .

NO ▶ Check for open or short in harness. Repair as necessary and then, go to "Verification of Vehicle Repair" procedure.
▶ If the power circuit is O.K, Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "verification of vehicle repair" procedure.

Ground Circuit Inspection

1. Disconnect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "OFF", ENGINE "OFF".
3. Measure continuity between ground terminal of LU solenoid Valve and chassis ground.

Specification : Continuity

4. Is the measured resistance within specificatins ?

YES ▶ Go to "Component Inspection" procedure.

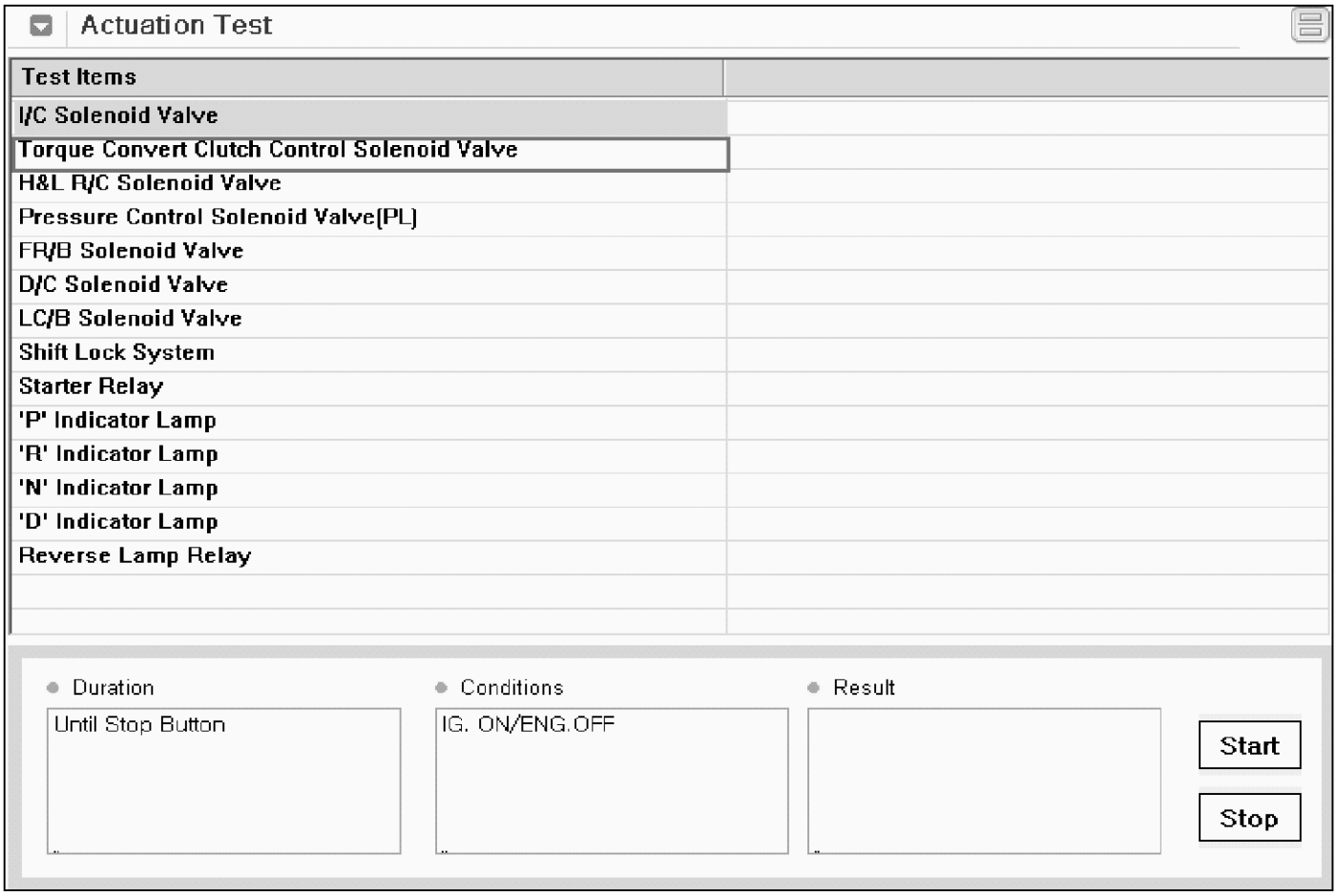
NO ▶ Check open in harness. Repair as necessary and then, go to " Verification of Vehicle Repari" procedure.

Component Inspection

■ Check TCC Solenoid Valve

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select Torque Converter Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9550L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Torque Converter Solenoid Valve and check for proper operation. If the problem is corrected, replace Torque Converter Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0748 Pressure Control Solenoid Valve "A" - Short to Battery(SOL5 - Normal / High)

Component Location

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

General Description

The line pressure solenoid valve regulates the oil pump discharge pressure to suit the driving condition in response to a signal sent from the TCM. The line pressure duty cycle valve is not consistent when the closedthrottle position signal is "ON".

DTC Description

To confirm the line pressure duty cycle at low pressure, the accelerator (throttle) should be open until the closed throttle position signal is "OFF".

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check voltage range(Open , Short)	※ Pressure Control Solenoid Valve: PCSV(PL. SOL) • Open or short in circuit • Faulty PCSV • Fautly PCM/TCM
Enable Conditions	• 10V < Actuator Supply Voltage < 16V	
Threshold Value	• Hardware IC check	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• Torque Converter Clutch "OFF" • Prevention of manual shift • Locked as 4th gear	

Diagnostic Circuit Diagram

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Signal Waveform & Data

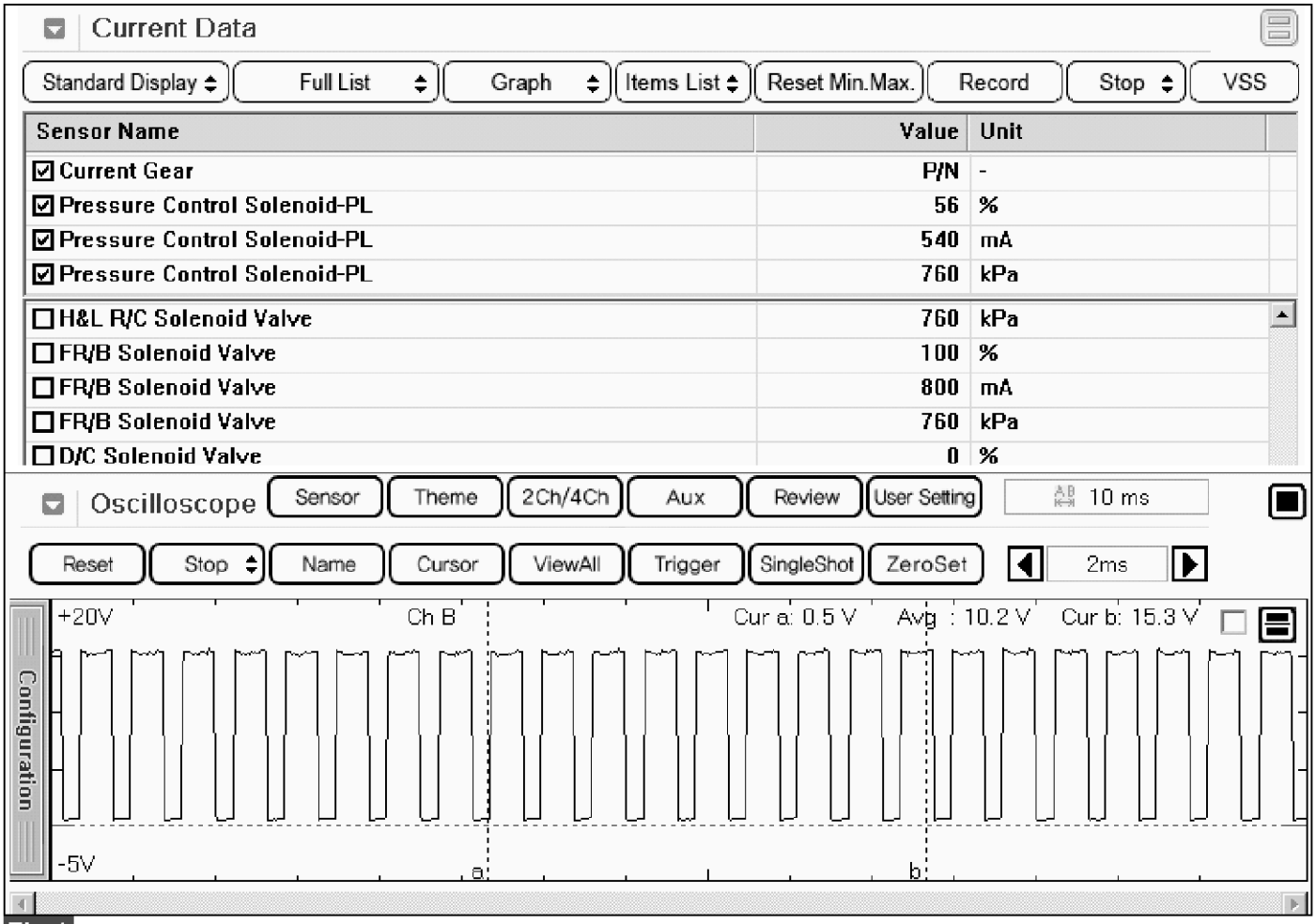


Fig.1

SHMAT9551L

Fig 1) Signal waveform at P range

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Monitor the "PCSV" parameter on the scantool.
4. Select "D RANGE" and Operate the vehicle in 5th gear.
5. Check "PCSV" parameter value changes while driving.

Specification : Changeable correspondence with each gear postion

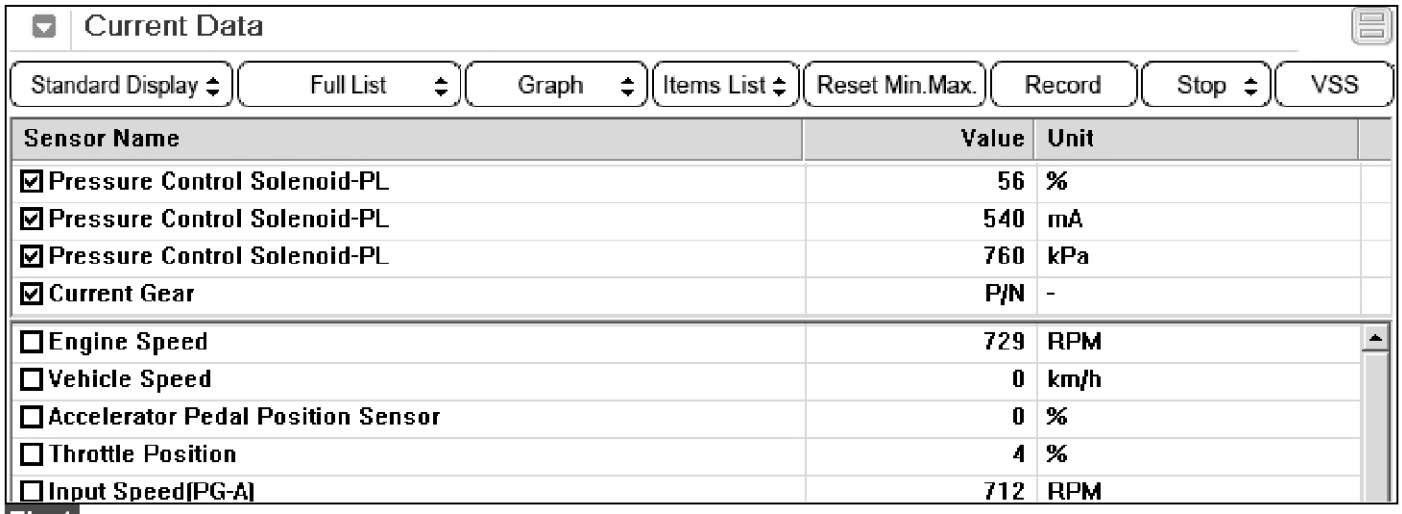


Fig.1

SHMAT9552L

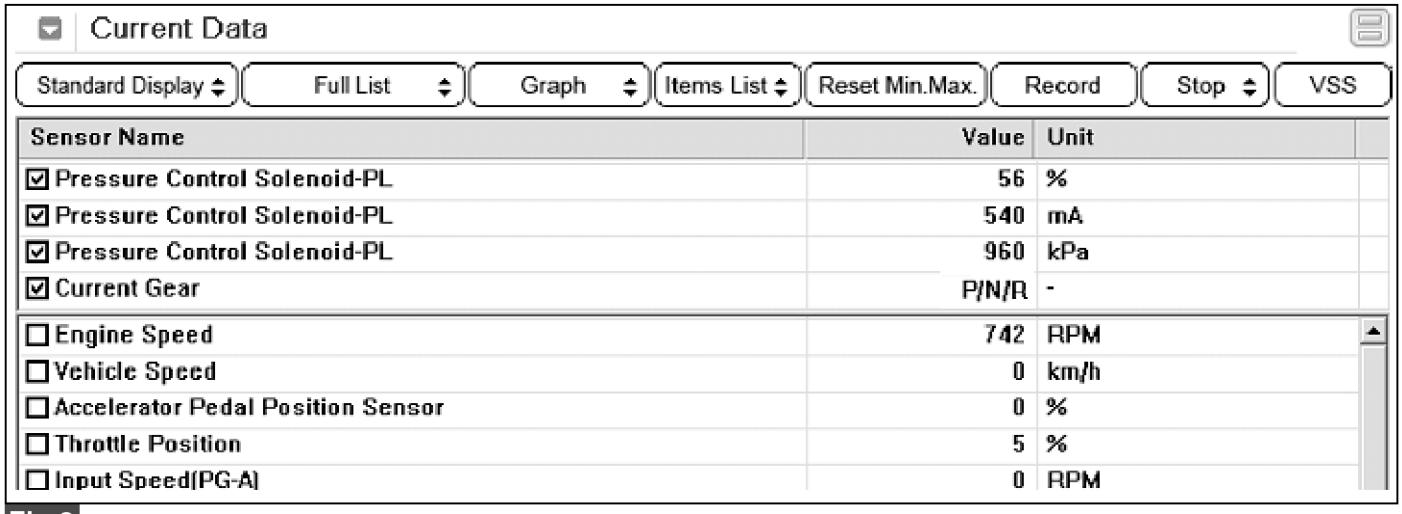


Fig.2

SHMAT9553L

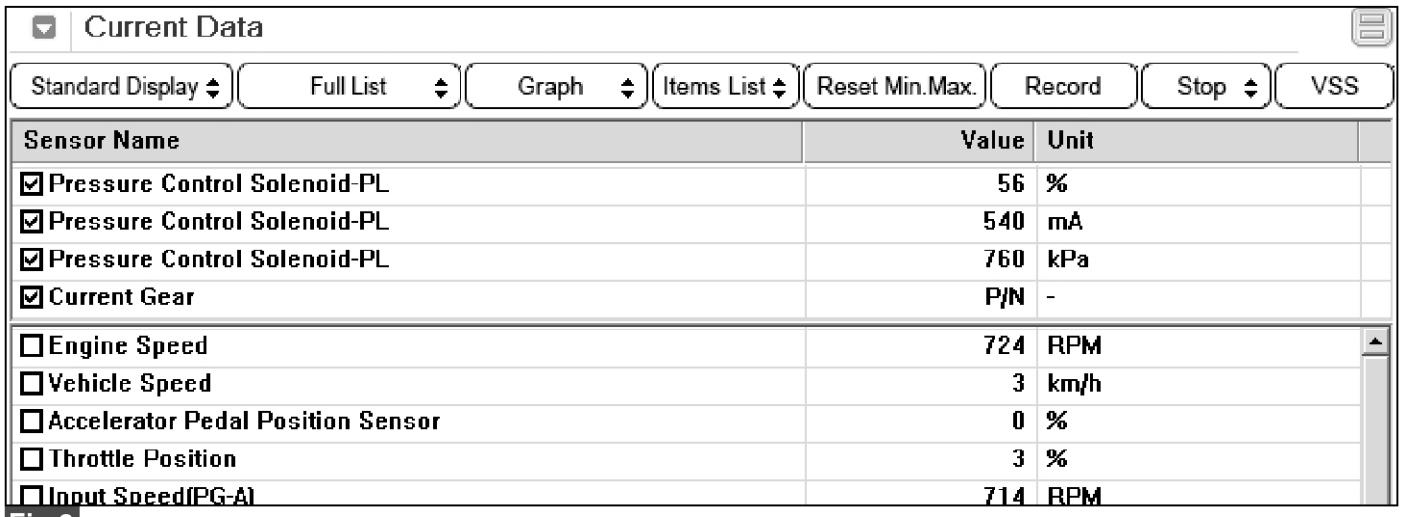


Fig.3

SHMAT9554L

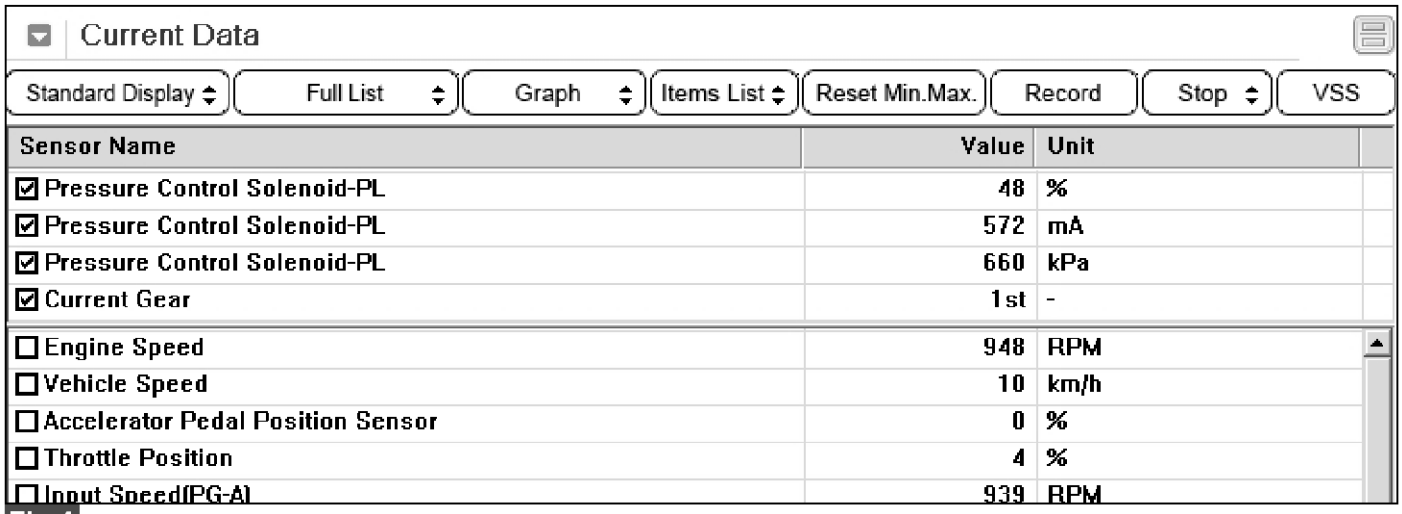


Fig.4

SHMAT9555L

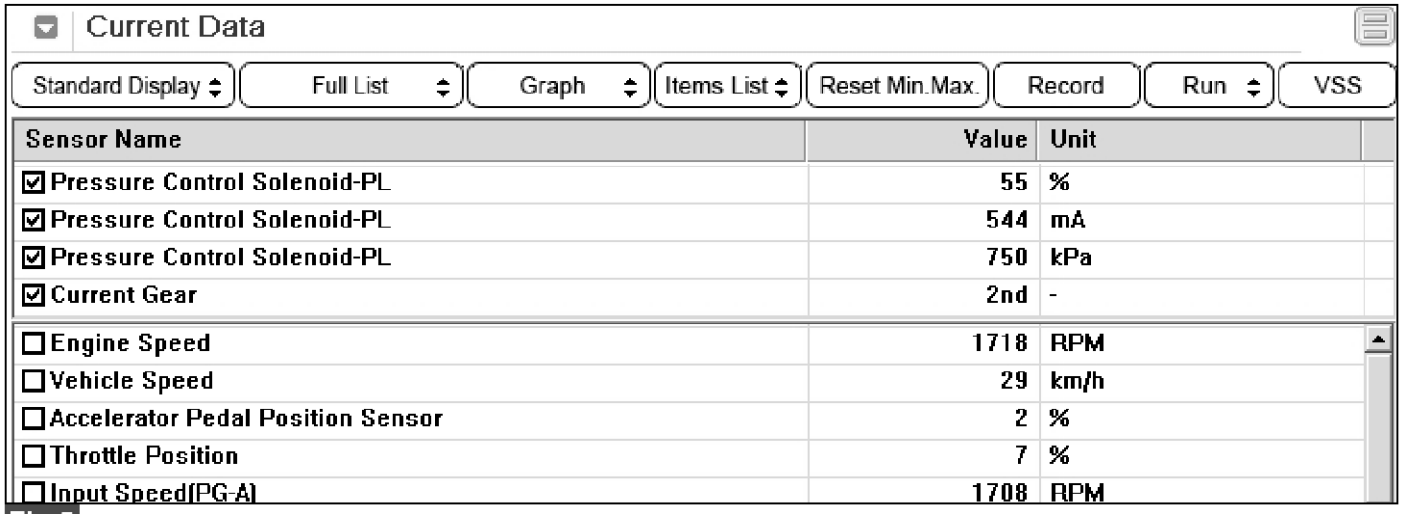


Fig.5

SHMAT9556L

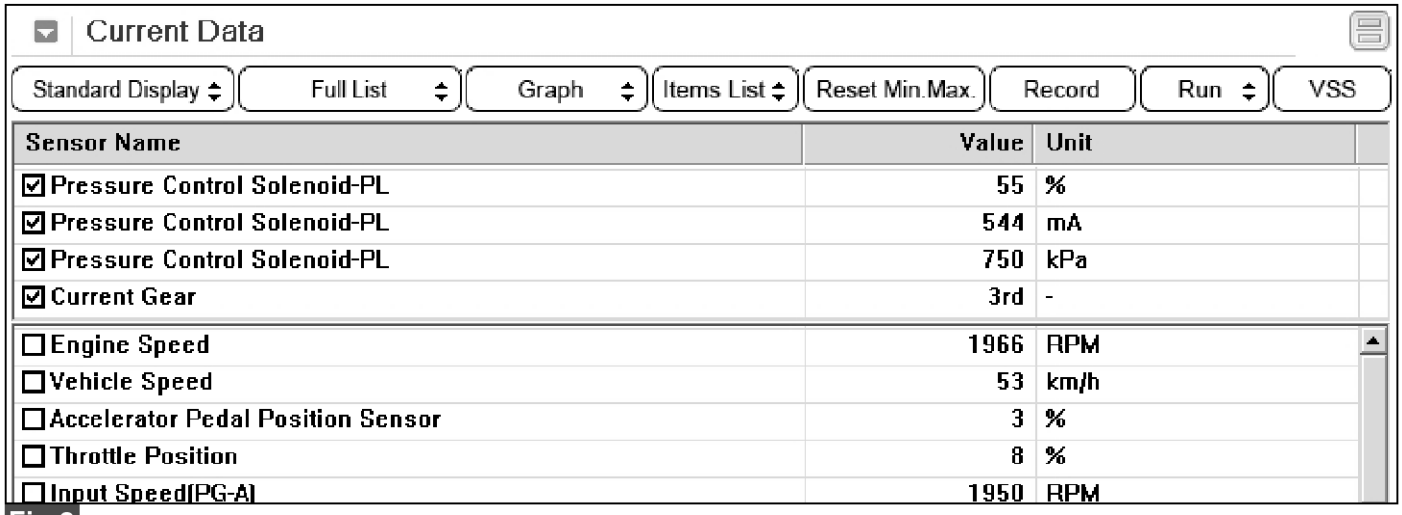


Fig.6

SHMAT9557L

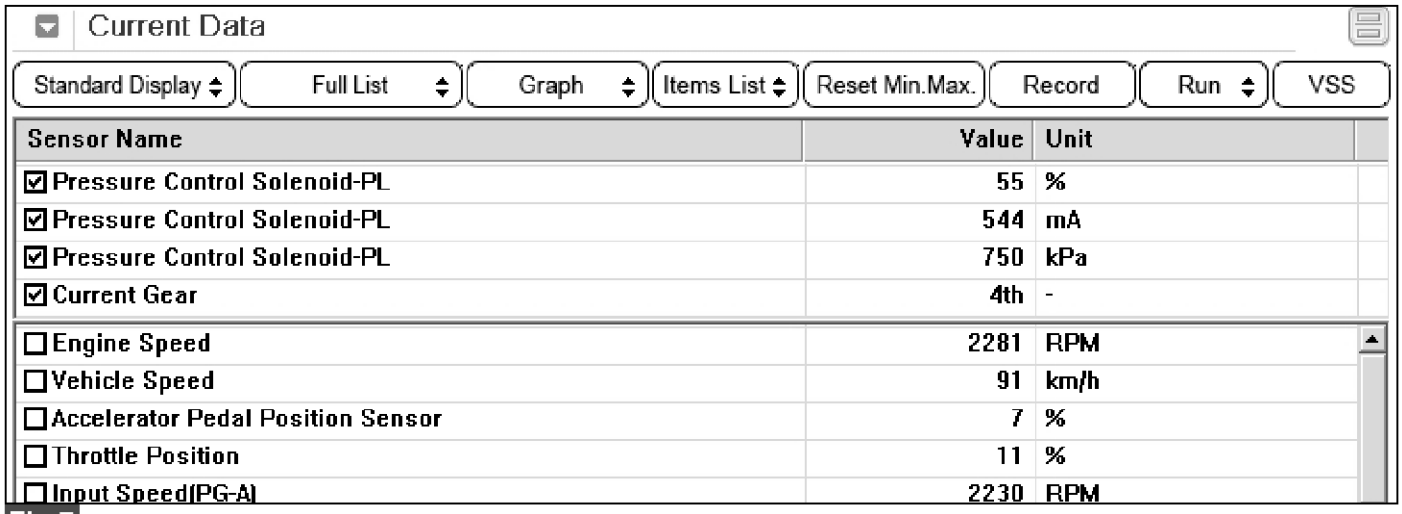


Fig.7

SHMAT9558L

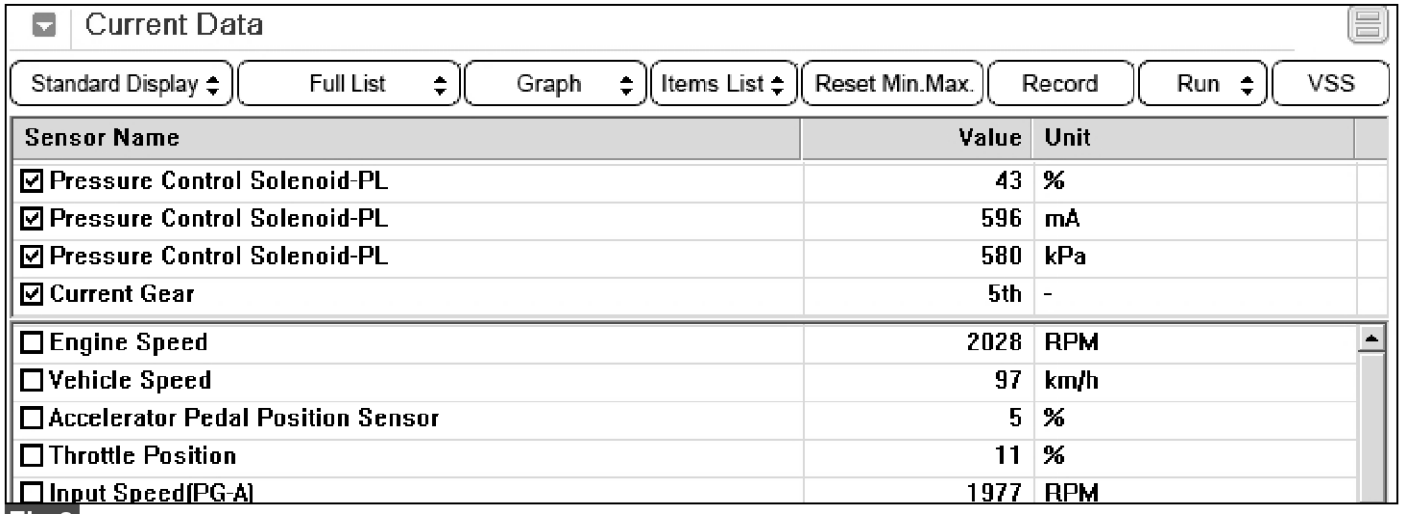


Fig.8

SHMAT9559L

Fig 1) "P" range
Fig 2) "R" range
Fig 3) "N" range
Fig 4) 1st gear in "D" range
Fig 5) 2nd gear in "D" range
Fig 6) 3rd gear in "D" range
Fig 7) 4th gear in "D" range
Fig 8) 5th gear in "D" range

6. Does the "Pressure Control Solenoid Valve" follow the reference data ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Power Circuit Inspection

1. Connect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "ON", ENGINE "OFF"
3. Measure voltage between power terminal of Pressure control Solenoid Valve harness connector and chassis ground.

Specification : Approx. Battery Voltage

4. Is the measured voltage within specifications ?

YES ▶ "Go to Ground Circuit" Inspection Procedure .

NO ▶ Check open or short in harness. Repair as necessary and then, go to "Verifcation of Vehicle Repair" procedure.
▶ If Power circuit is O.K, Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "verification of vehicle repair " procedure.

Ground Circuit Inspection

1. Disconnect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "OFF", ENGINE "OFF".
3. Measure continuity between ground terminal of Pressure control solenoid Valve harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specificatins ?

YES ▶ Go to "Component Inspection" procedure.

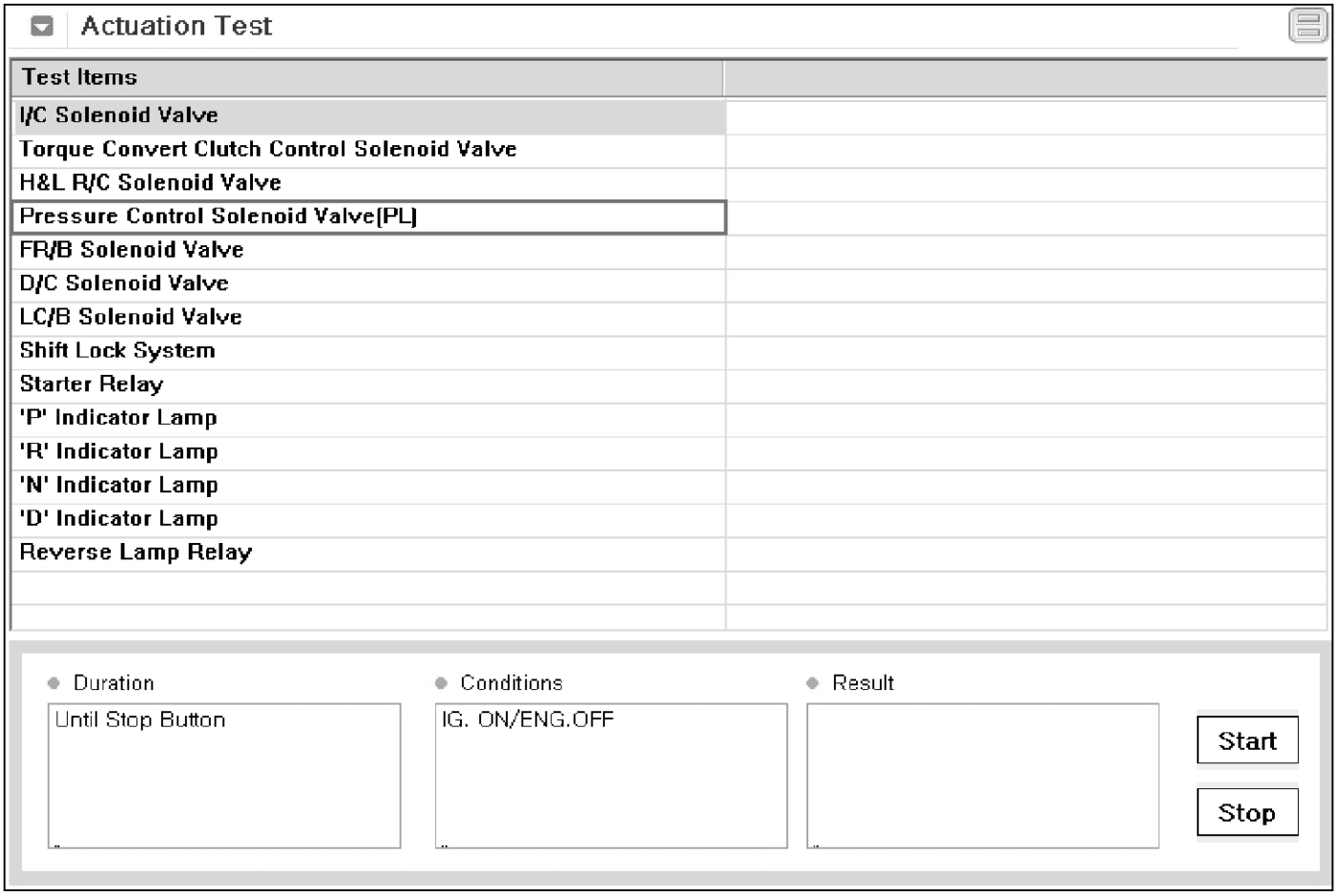
NO ▶ Check open in harness. Repair as necessary and then, go to " Verification of Vehicle Repari" procedure.

Component Inspection

■ Check Pressure Control Valve

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select Torque Converter Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9560L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Pressure Control Solenoid Valve and check for proper operation. If the problem is corrected, replace Pressure Control Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure .

Verification of Vehicle Repair

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

P0753 Shift Control Solenoid Valve "A" -Short to battery (SOL1- Clutch "A' : Normal / Low)

Component Location

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

General Description

The Automatic Transmission changes the gear position of the transmission utilizing a combination of Clutches and Brakes, which are controlled by solenoid valves. Input clutch solenoid valve is controlled by the TCM in response to signals sent from the inhibitor switch, vehicle speed sensor and accelerator pedal position sensor (throttle position sensor). Gears will then be shifted to the optimum position.

DTC Description

This is not only caused by electrical malfunction (circuits open or shorted) but also by mechanical malfunction such as control valve sticking, improper solenoid valve operation.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Voltage range Check (Open, Short)	• Open or short in circuit • Faulty pressure switch 3 • Faulty I/C solenoid valve • Faulty TCM
Enable Conditions	• 10V < Actuator Supply Voltage < 16V	
Threshold Value	• Hardware IC check	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• Locked as 4th gear	

Diagnostic Circuit Diagram

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Signal Waveform & Data

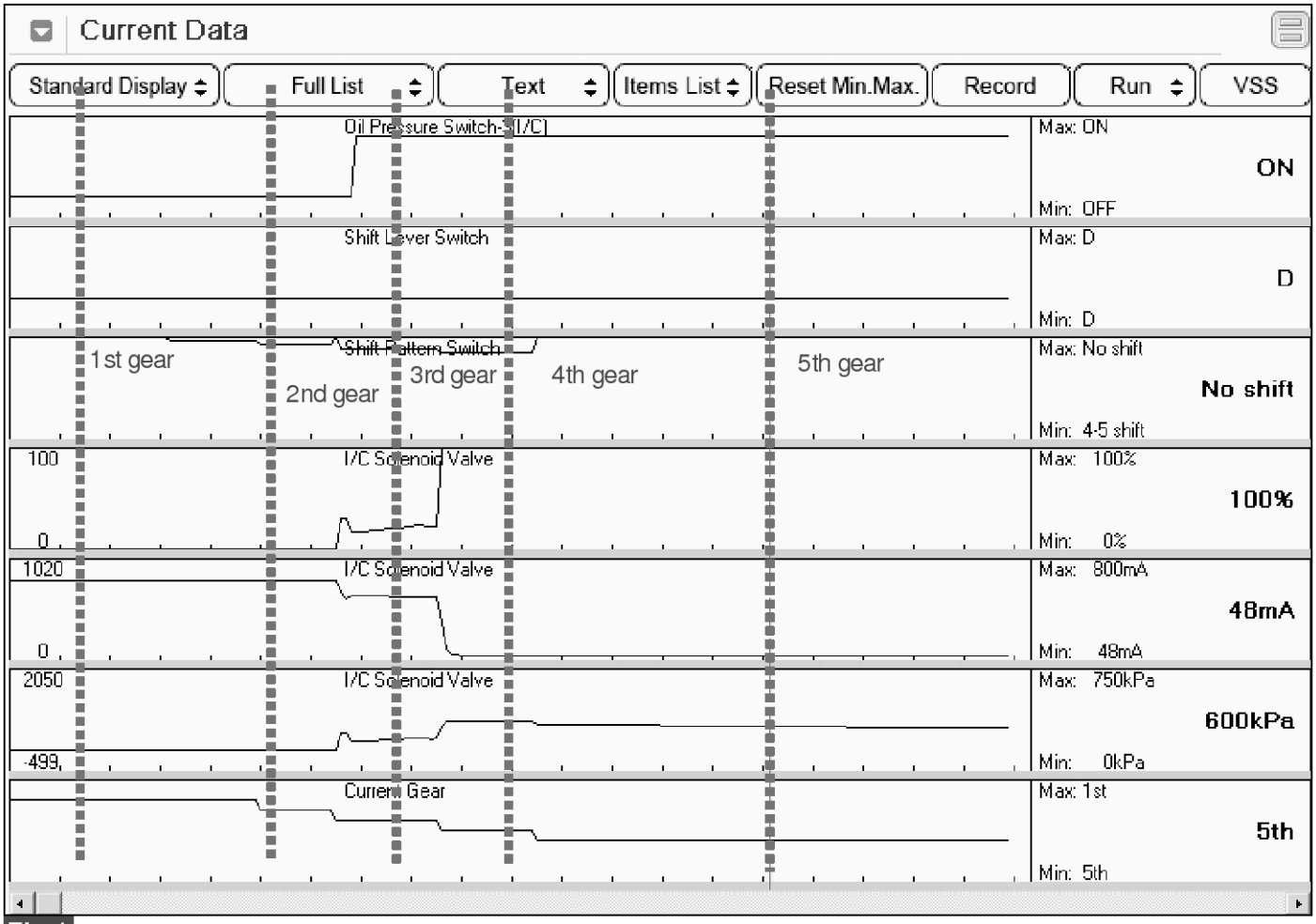


Fig.1

SHMAT9561L

Fig 1) I/C Solenoid Operation

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Monitor the "I/C SOLENOID" parameter on the scantool.
4. Select "D RANGE" and Operate the vehicle.
5. Check "I/C SOLENOID" parameter value changes while driving.

Specification : Changeable correspondence with each gear postion

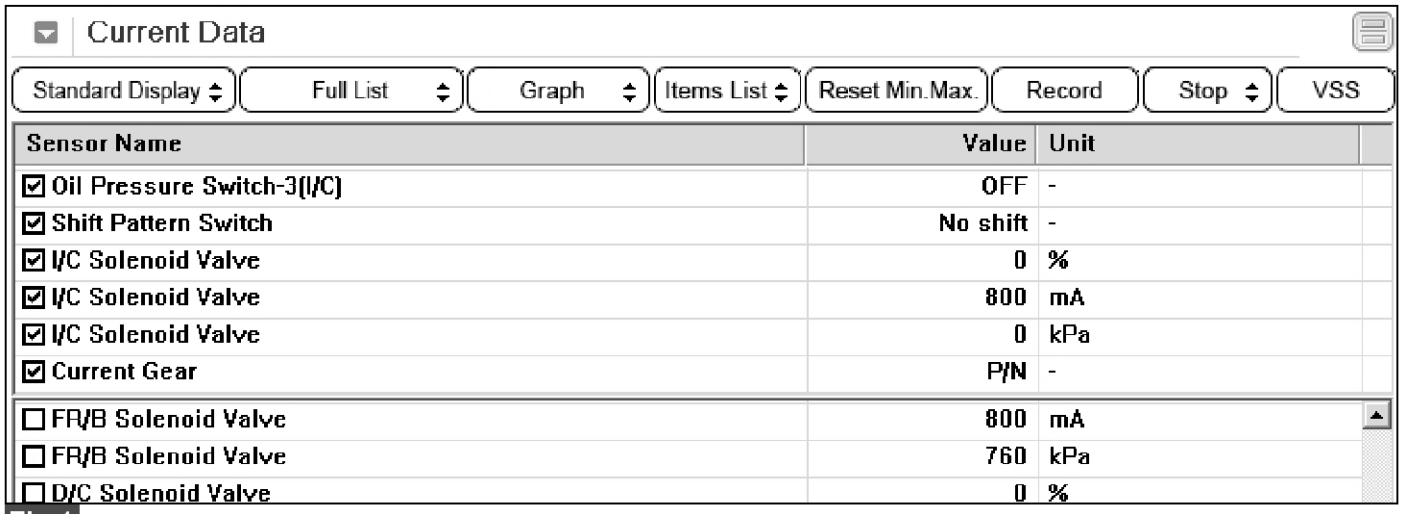


Fig.1

SHMAT9562L

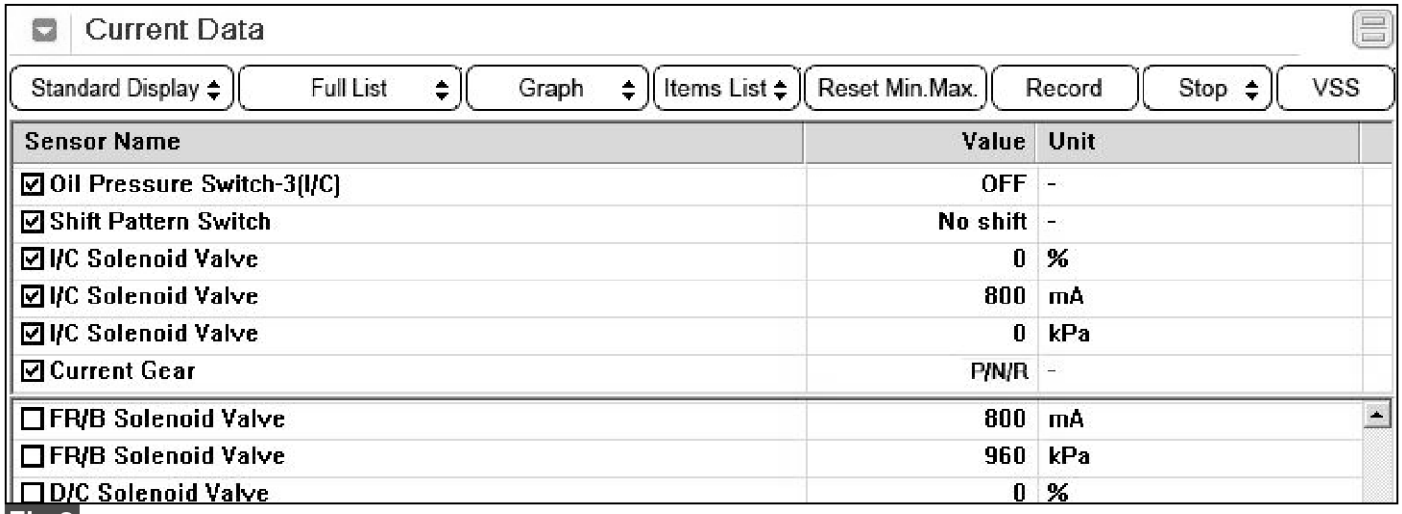


Fig.2

SHMAT9563L

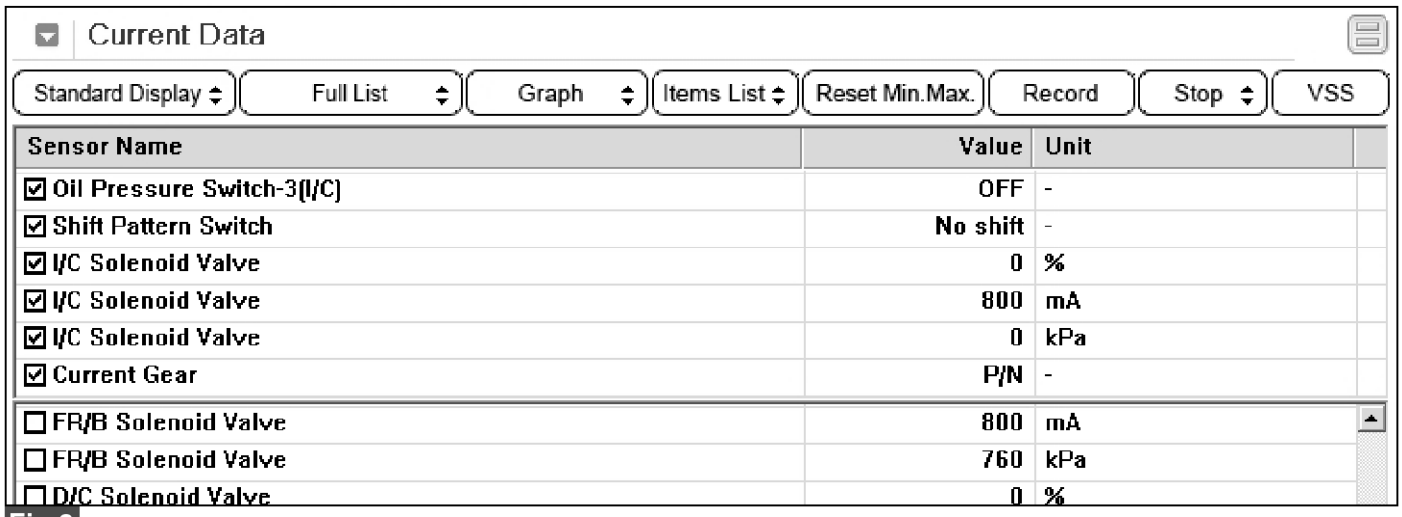


Fig.3

SHMAT9564L

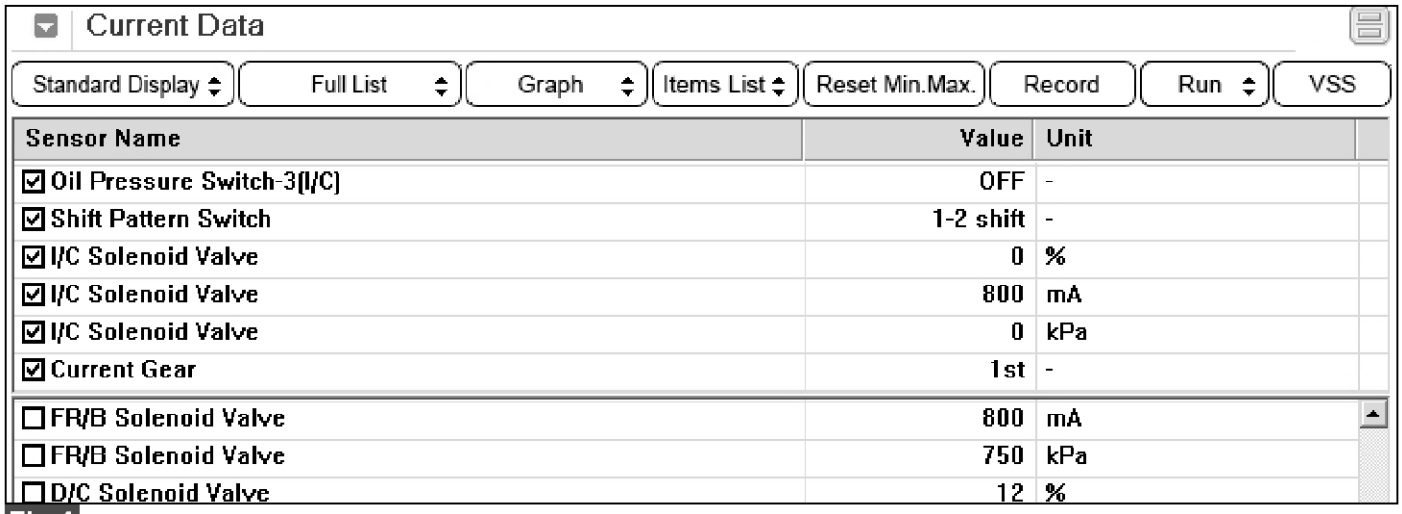


Fig.4

SHMAT9565L

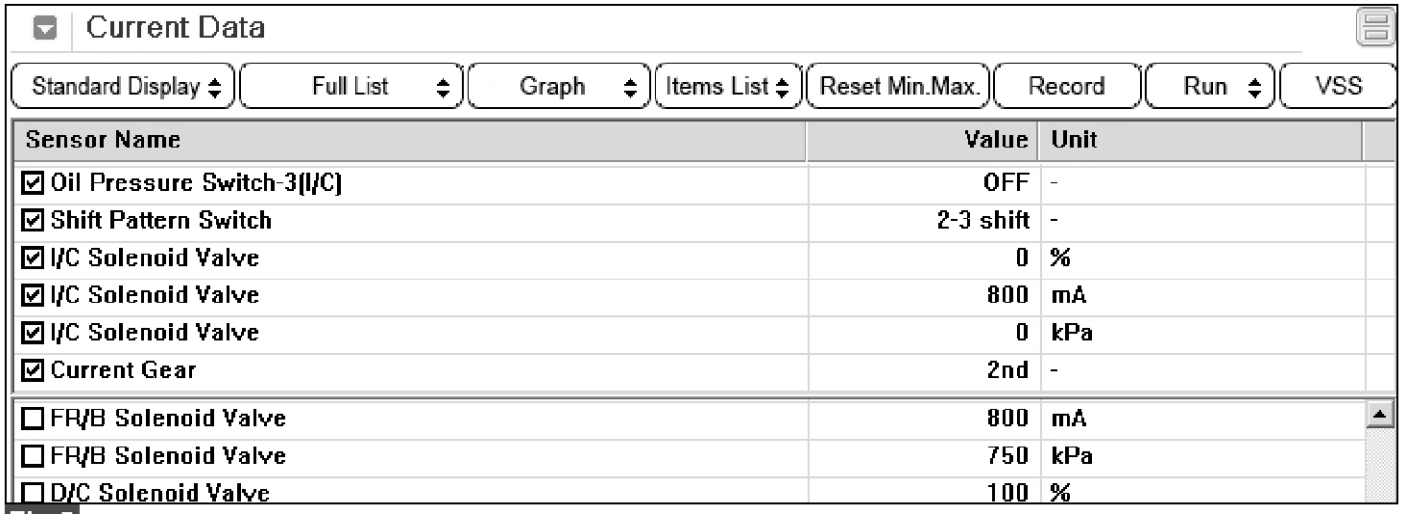


Fig.5

SHMAT9566L

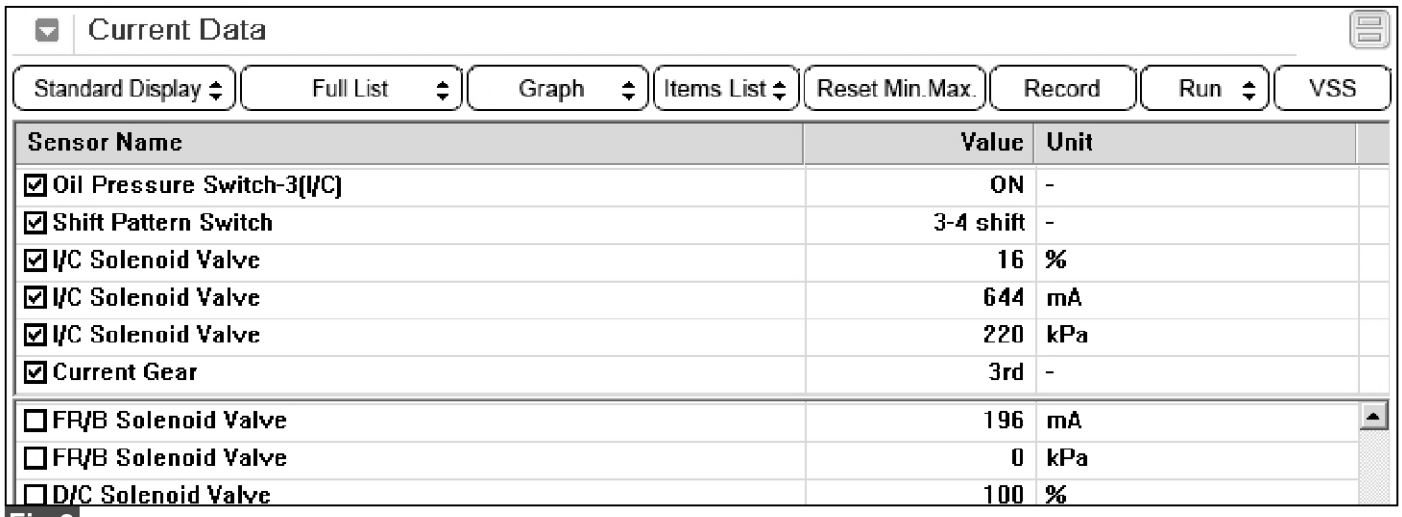


Fig.6

SHMAT9567L

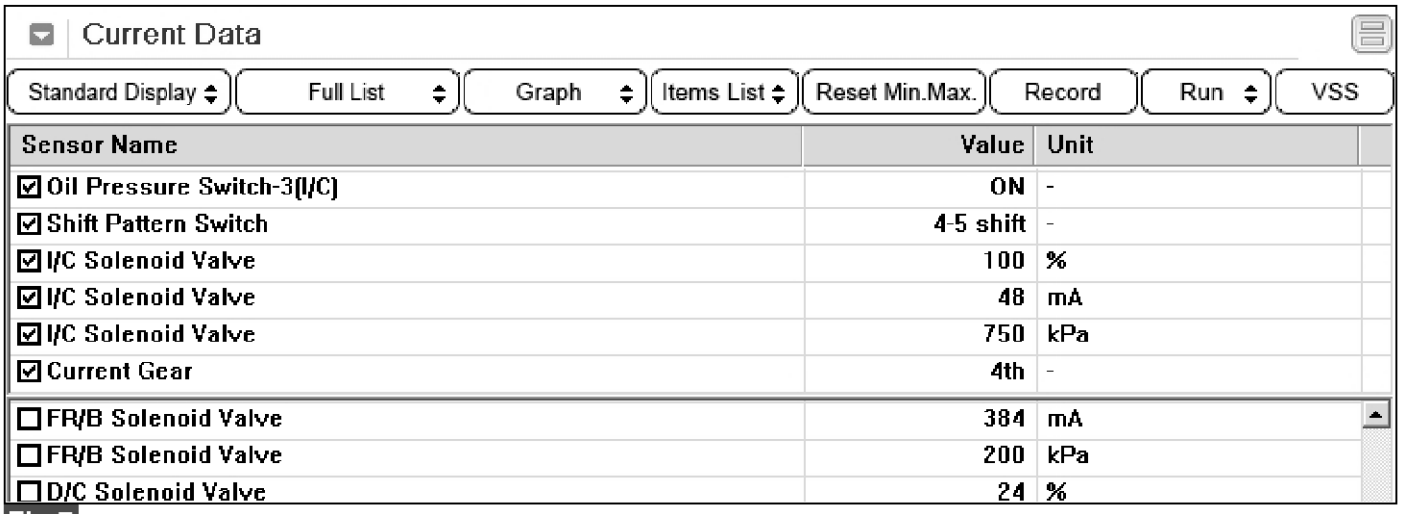


Fig.7

SHMAT9568L

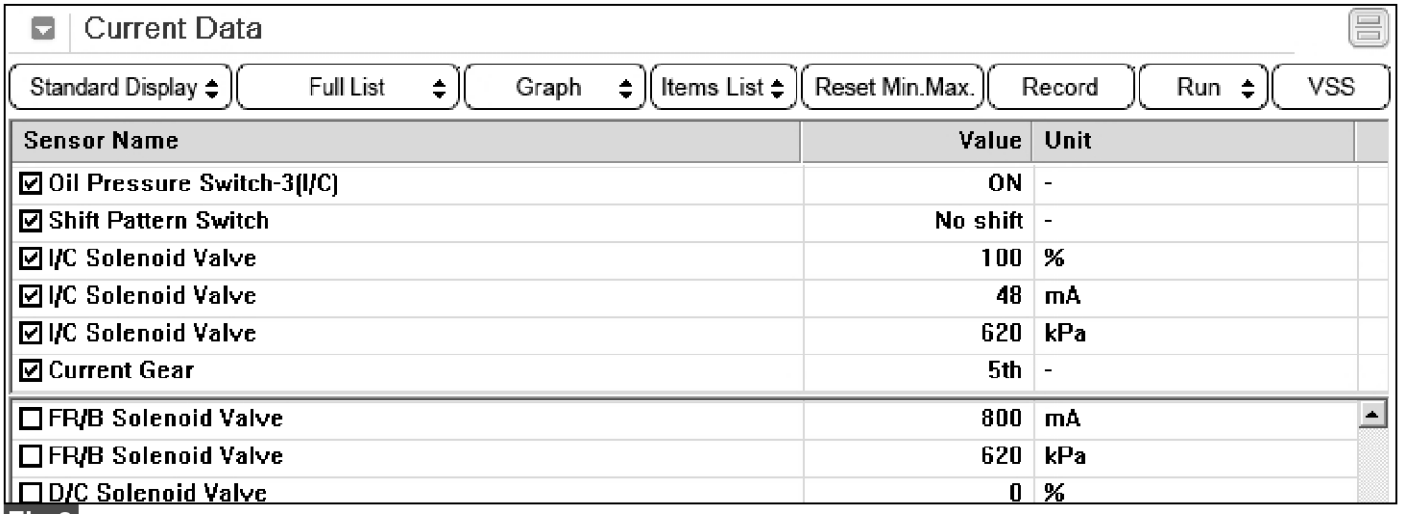


Fig.8

SHMAT9569L

Fig 1) "P" range
Fig 2) "R" range
Fig 3) "N" range
Fig 4) 1st gear in "D" range
Fig 5) 2nd gear in "D" range
Fig 6) 3rd gear in "D" range
Fig 7) 4th gear in "D" range
Fig 8) 5th gear in "D" range

6. Does the "Shift Control Solenoid Valve" follow the reference data ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for loose-ness, poor connection, bending, corrosion, co-ntamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Power Circuit Inspection

1. Connect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "ON", ENGINE "OFF"
3. Measure voltage between power terminal of I/C solenoid valve harness connector and chassis ground.

Specification : Approx. Battery Voltage

4. Is the measured voltage within specifications ?

YES ▶ "Go to Ground Circuit" Inspection Procedure .

NO ▶ Check open or short in harness. Repair as necessary and then, go to "Verifcation of Vehicle Repair" procedure.
▶ If Power circuit is O.K, Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "verification of vehicle repair " procedure.

Ground Circuit Inspection

1. Disconnect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "OFF", ENGINE "OFF".
3. Measure continuity between ground terminal of I/C control solenoid Valve harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specificatins ?

YES ▶ Go to "Component Inspection" procedure.

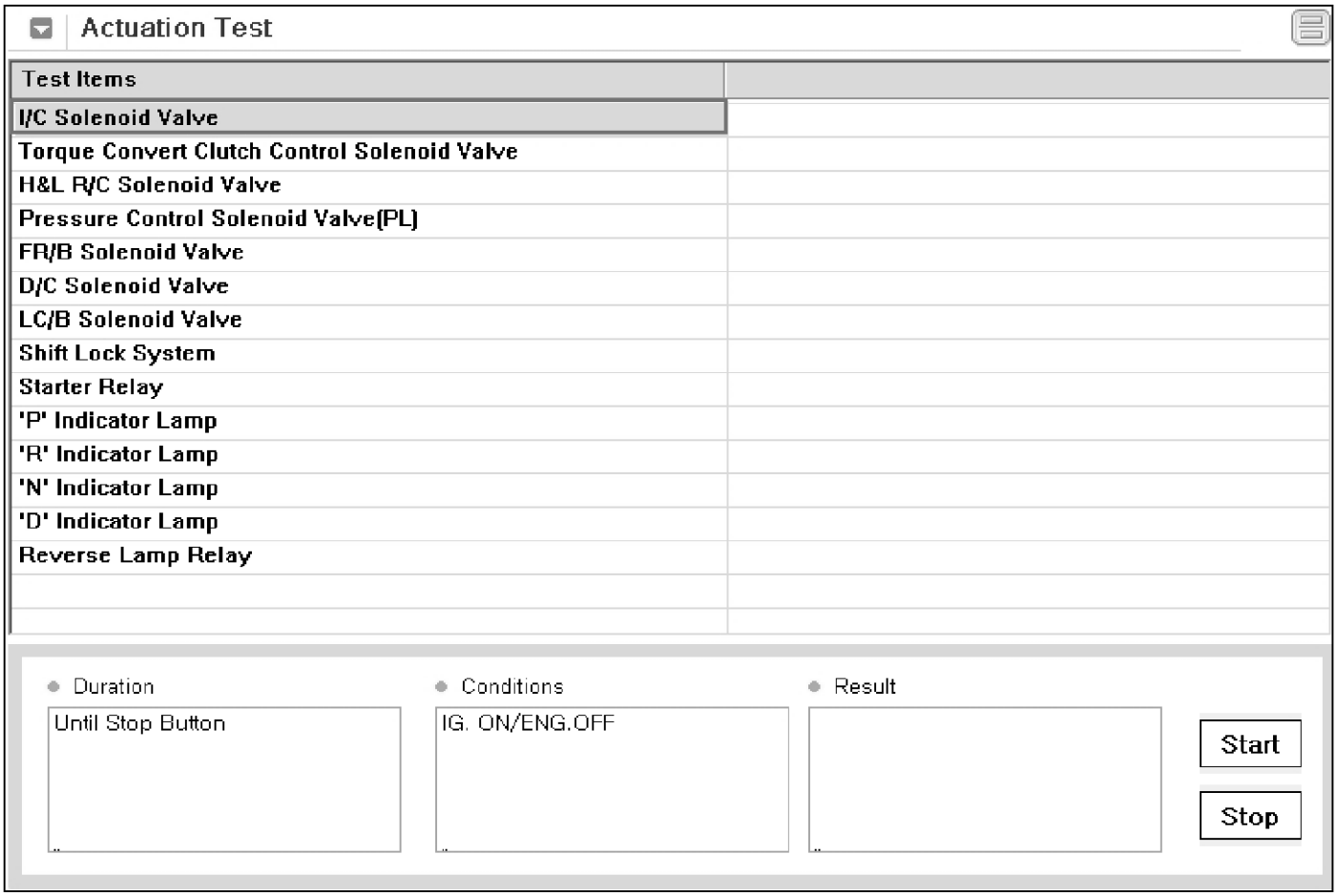
NO ▶ Check open in harness. Repair as necessary and then, go to " Verification of Vehicle Repari" procedure.

Component Inspection

■ Check shift solenoid Valve "I/C"

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select I/C Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9570L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Shift Control Solenoid Valve and check for proper operation. If the problem is corrected, replace Shift Control Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

P0758 Shift Control Solenoid Valve "B" - Short to battery (SOL2-Clutch B : Normal / High)

Component Location

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

General Description

Refer to DTC P0753 : Shift Solenoid "A" Electrical.

DTC Description

Refer to DTC P0753 : Shift Solenoid "A" Electrical.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check voltage range(Open, Short)	• Open or short in circuit • Faulty pressure switch 1 • Faulty Fr/B solenoid valve • Faulty TCM
Enable Conditions	• 10V < Actuator Supply Voltage < 16V	
Threshold Value	• Hardware IC check	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• Locked as 4th gear	

Diagnostic Circuit Diagram

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Signal Waveform & Data

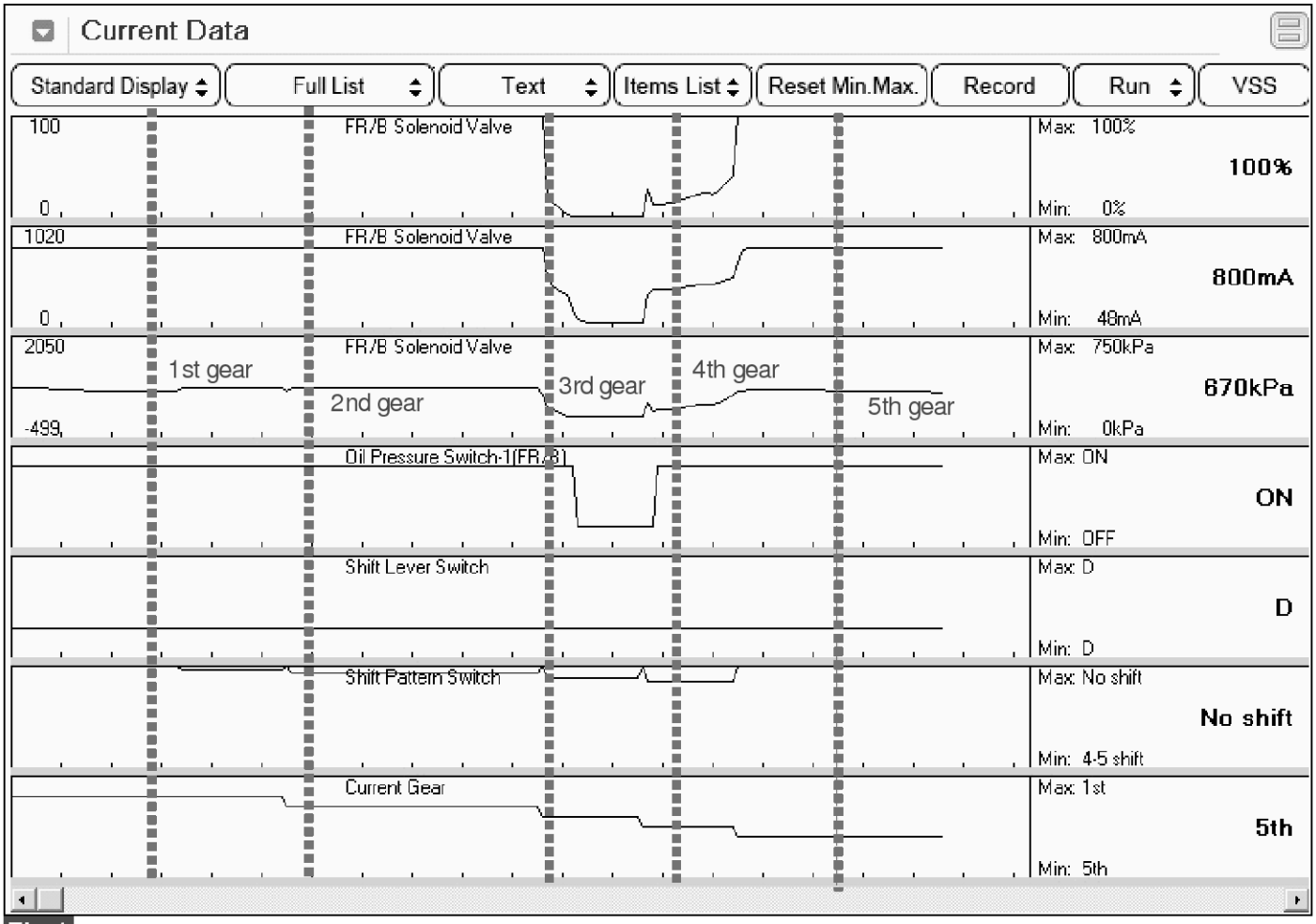


Fig.1

SHMAT9571L

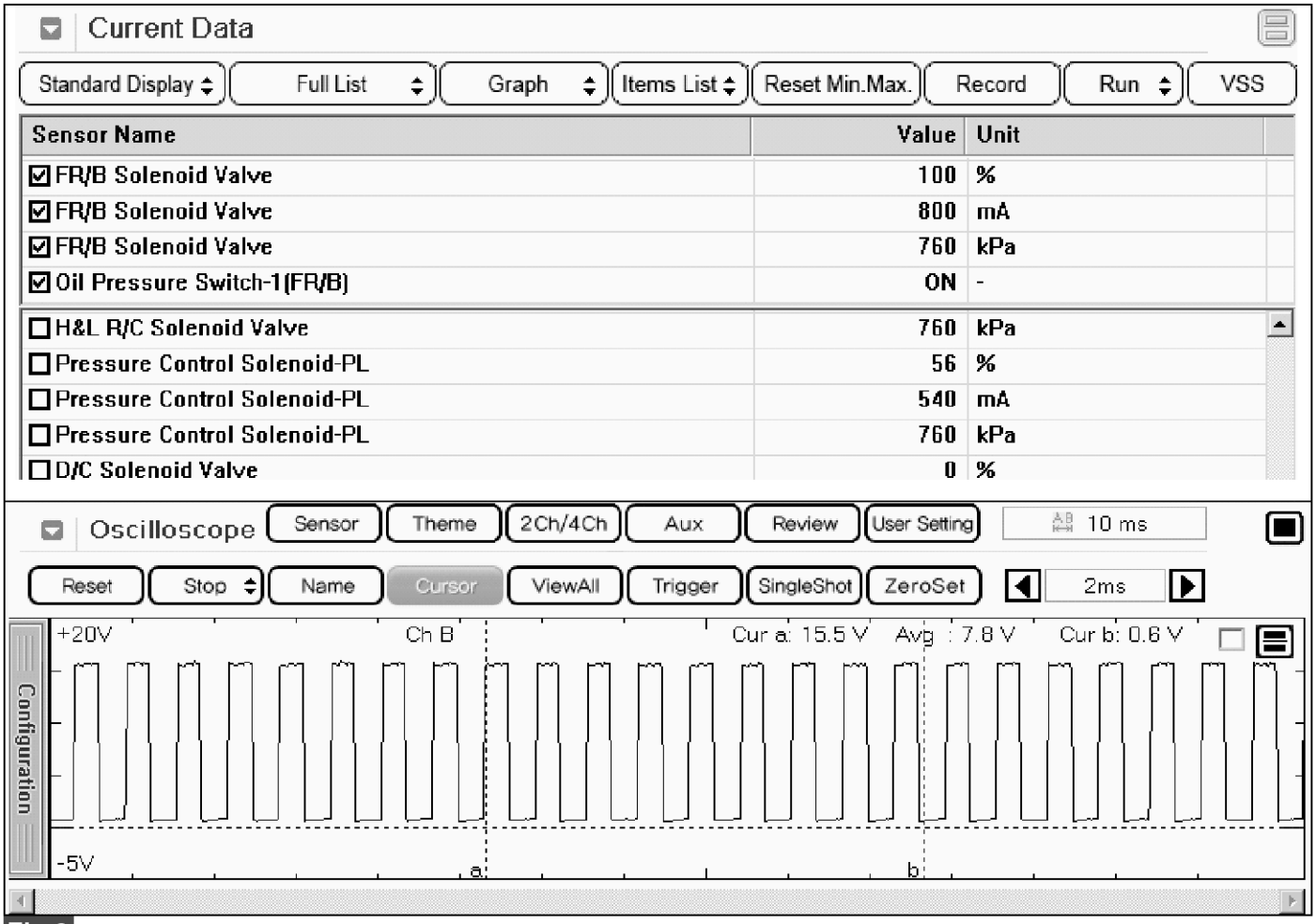


Fig.2

SHMAT9572L

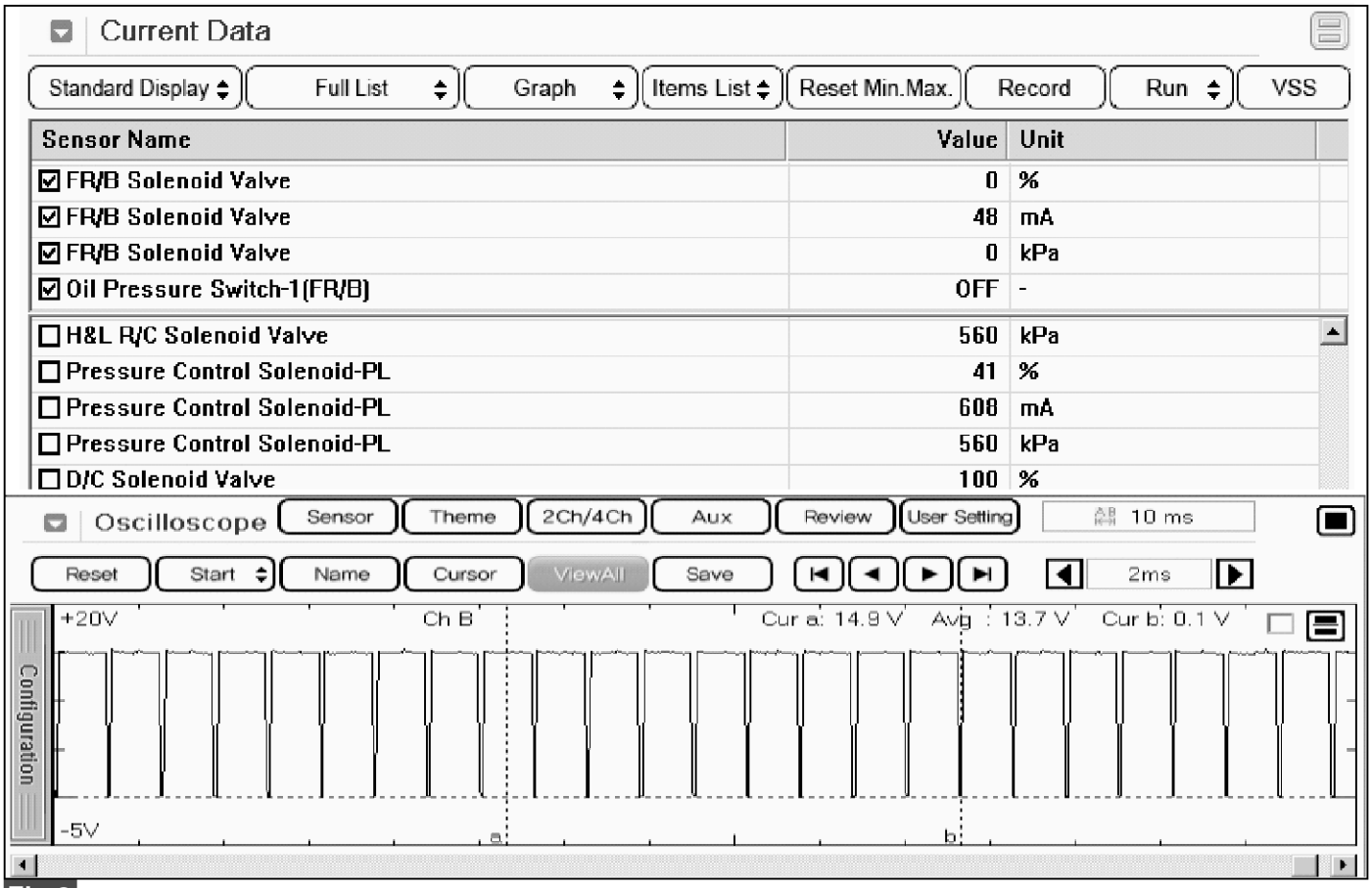


Fig.3

SHMAT9573L

Fig 1) Fr/B Solenoid Valve Operation

Fig 2) Signal Waveform at IDLE

Fig 3) Signal Waveform at accelleration

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Monitor the Fr/B SOLENOID" parameter on the scantool.
4. Select "D RANGE" and Operate the vehicle.
5. Check "FR/B SOLENOID" parameter value changes while driving.

Specification : Changeable correspondence with each gear postion

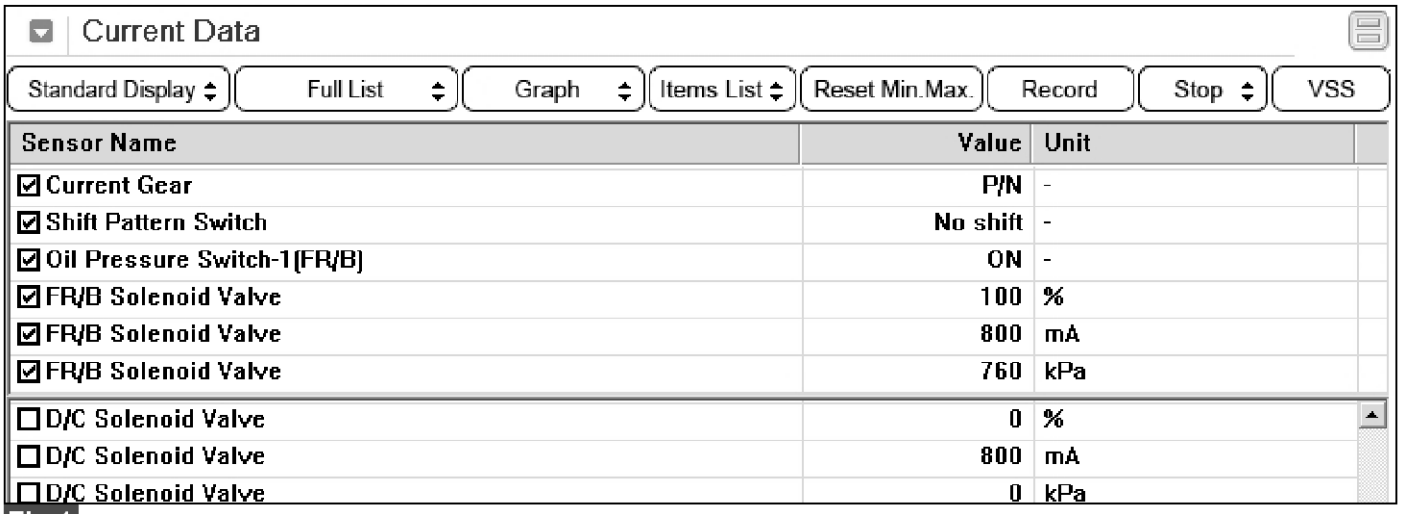


Fig.1

SHMAT9574L

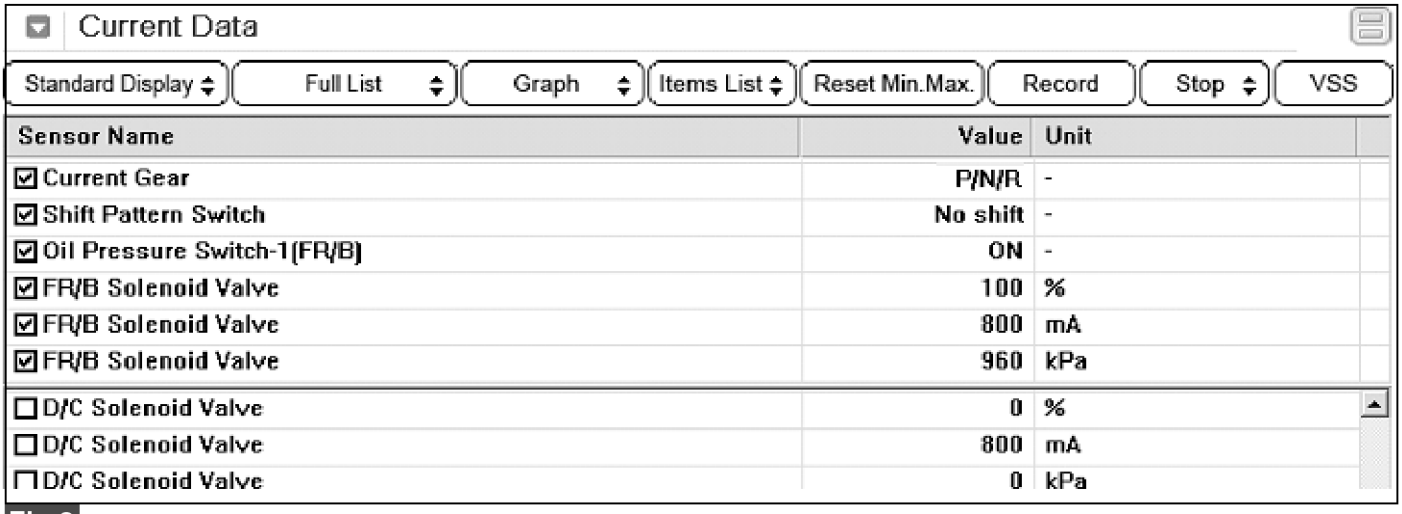


Fig.2

SHMAT9575L

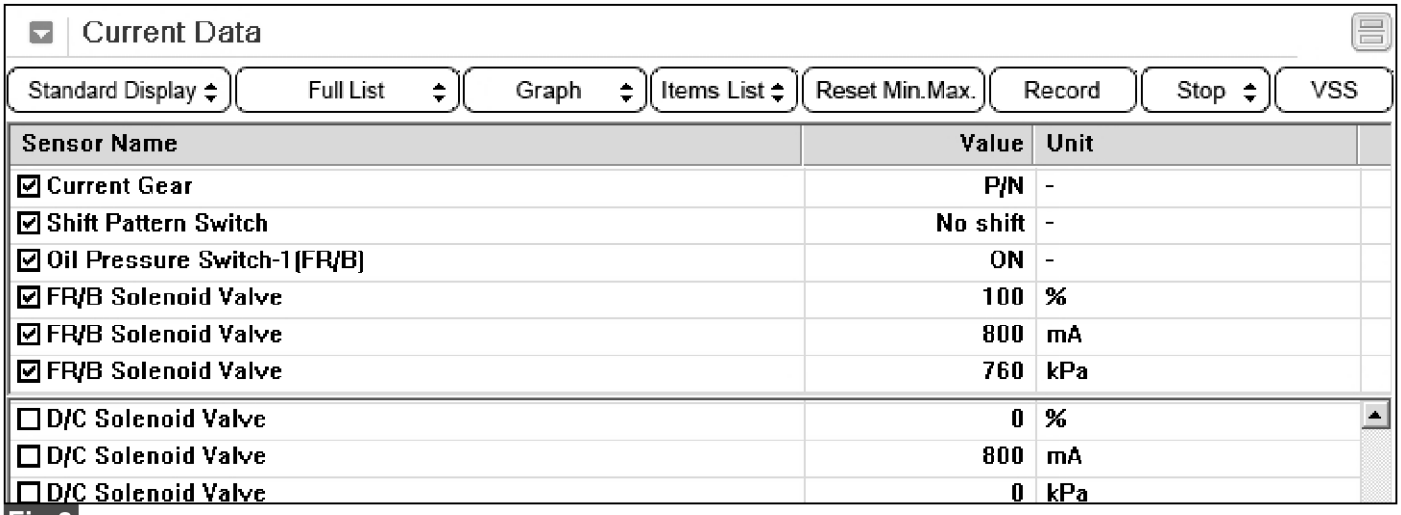


Fig.3

SHMAT9576L

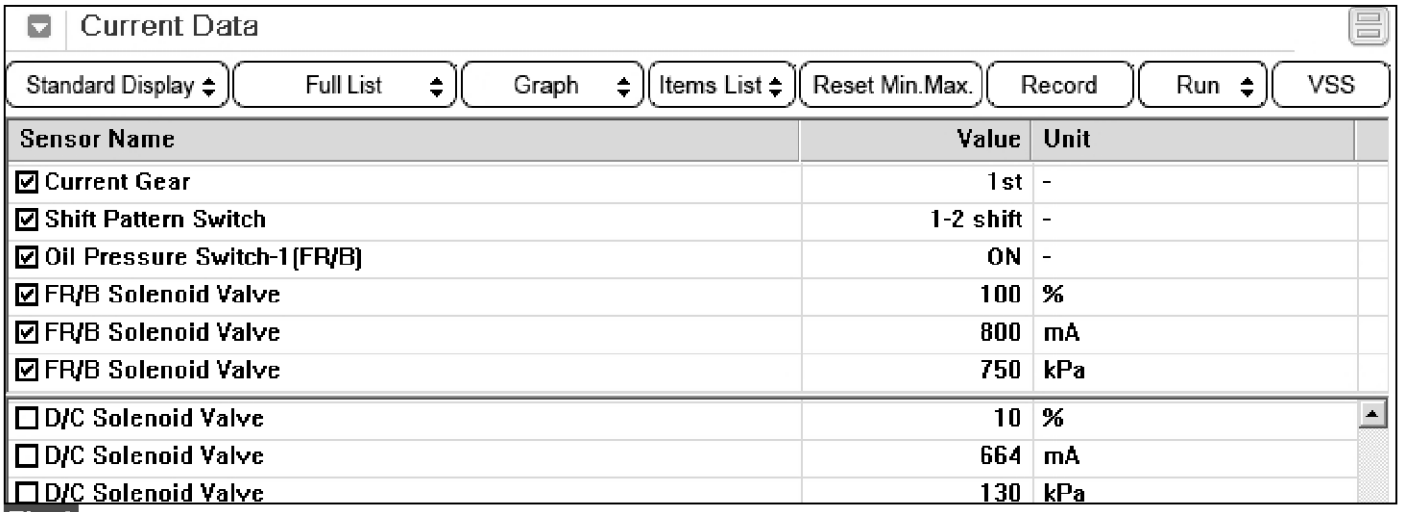


Fig.4

SHMAT9577L

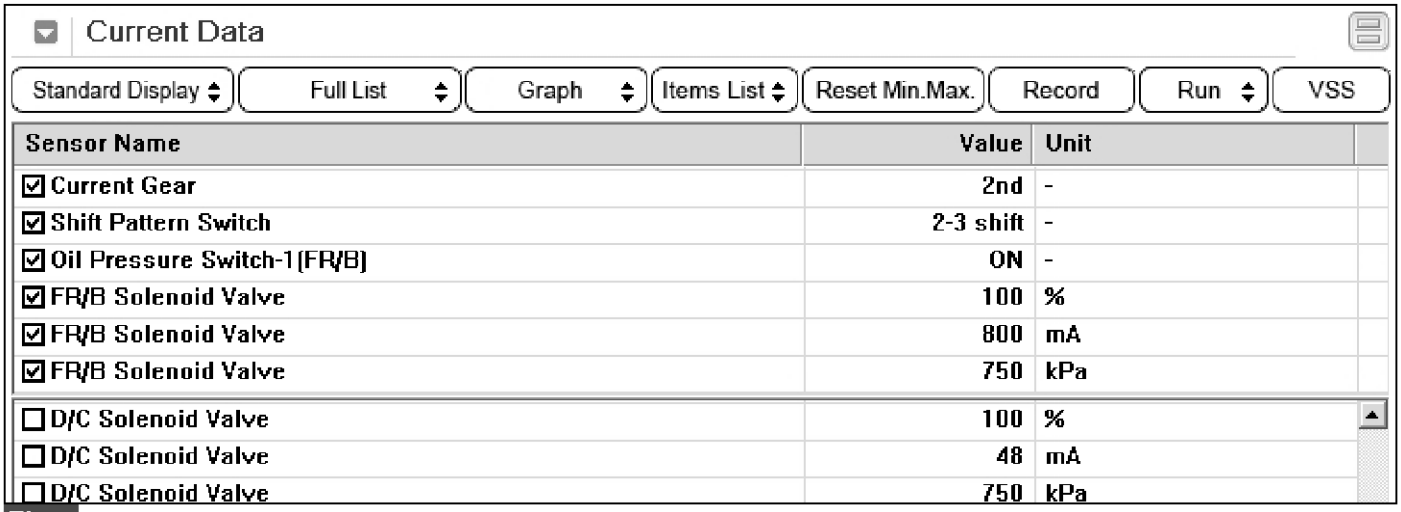


Fig.5

SHMAT9578L

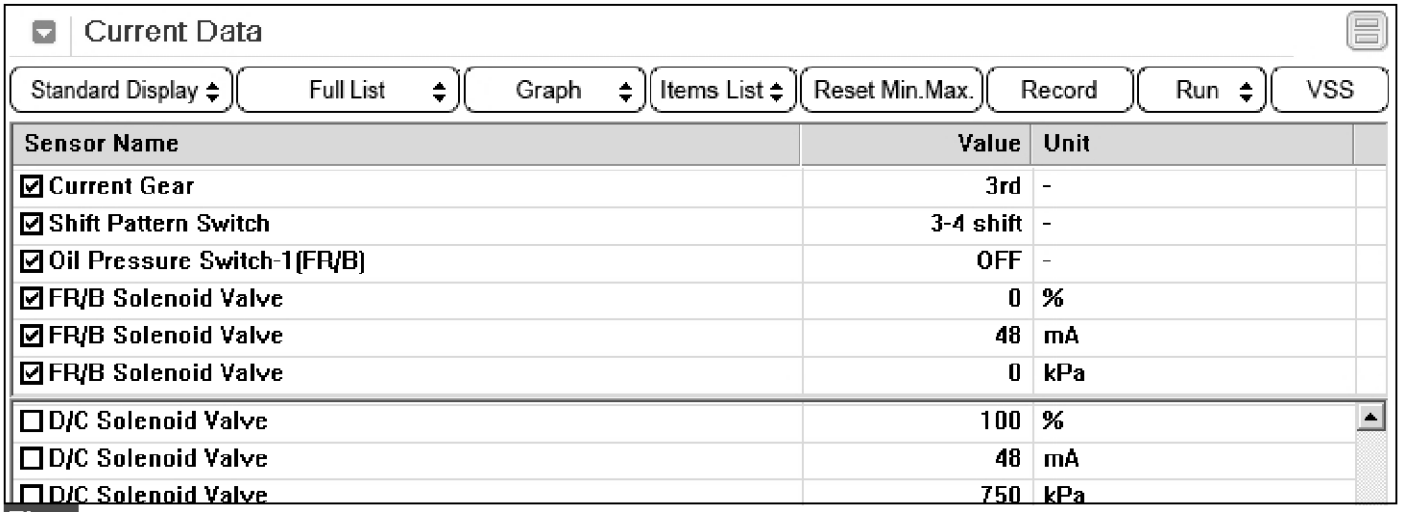


Fig.6

SHMAT9579L

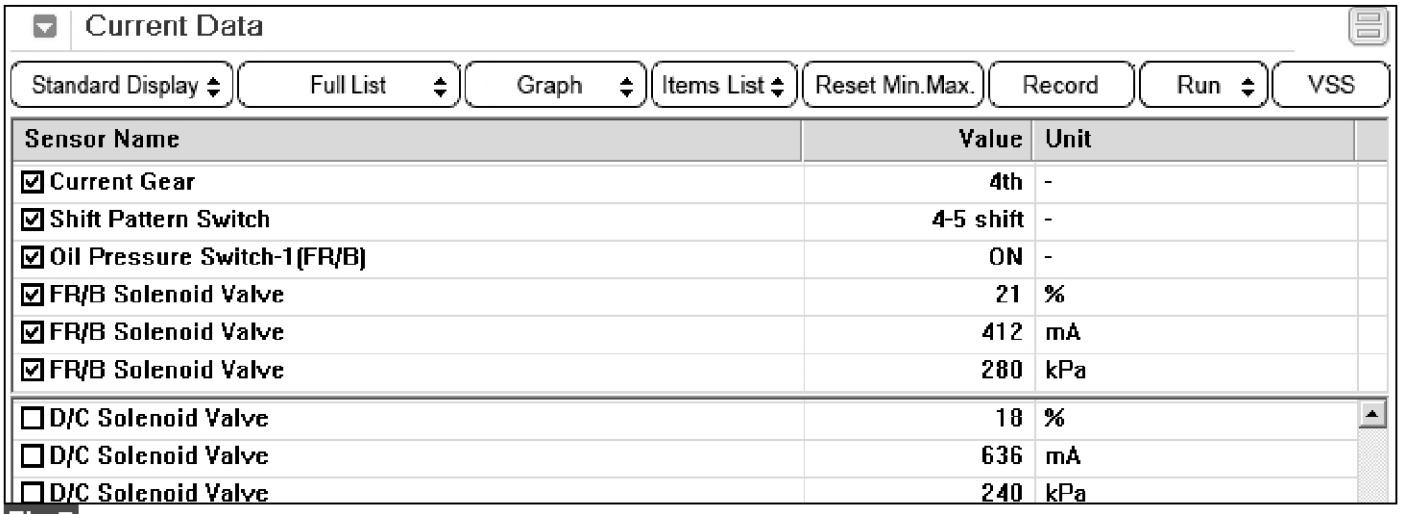


Fig.7

SHMAT9580L

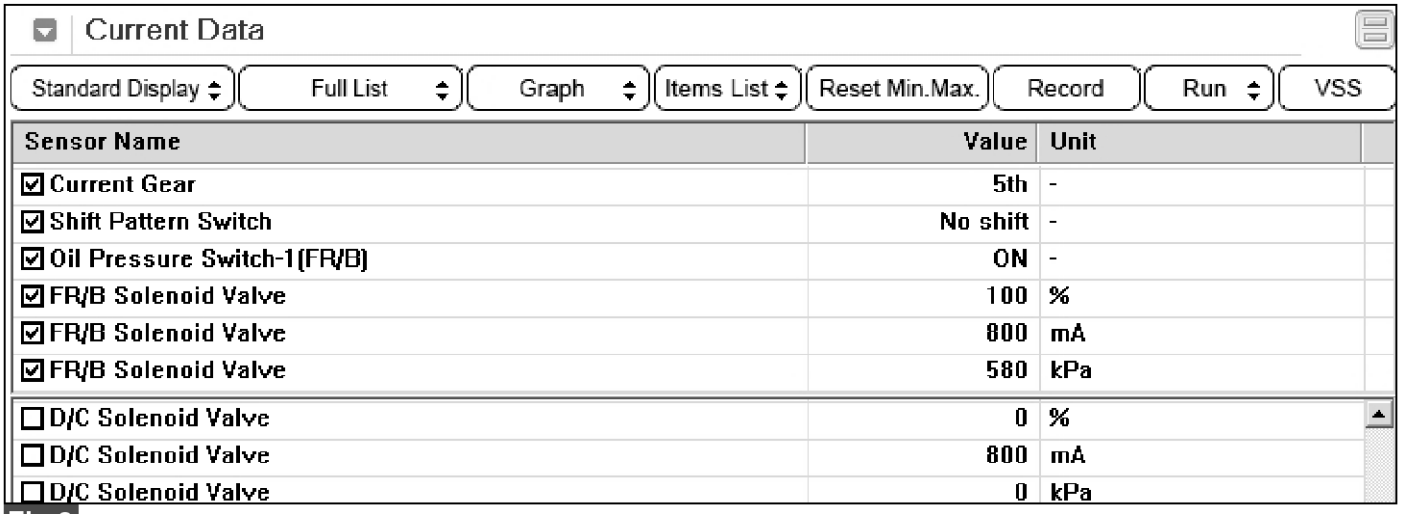


Fig.8

SHMAT9581L

Fig 1) "P" range
Fig 2) "R" range
Fig 3) "N" range
Fig 4) 1st gear in "D" range
Fig 5) 2nd gear in "D" range
Fig 6) 3rd gear in "D" range
Fig 7) 4th gear in "D" range
Fig 8) 5th gear in "D" range

6. Does the "Shift Control Solenoid Valve" follow the reference data ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Power Circuit Inspection

1. Connect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "ON", ENGINE "OFF"
3. Measure voltage between power terminal of FR/B solenoid valve harness connector and chassis ground.

Specification : Approx. Battery Voltage

4. Is the measured voltage within specifications ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check open or short in harness. Repair as necessary and then, go to "Verifcation of Vehicle Repair" procedure.
▶ If Power circuit is O.K, Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "verification of vehicle repair " procedure.

Ground Circuit Inspection

1. Disconnect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "OFF", ENGINE "OFF".
3. Measure resistance between ground terminal of FR/B control solenoid Valve harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specificatins ?

YES ▶ Go to "Component Inspection" procedure.

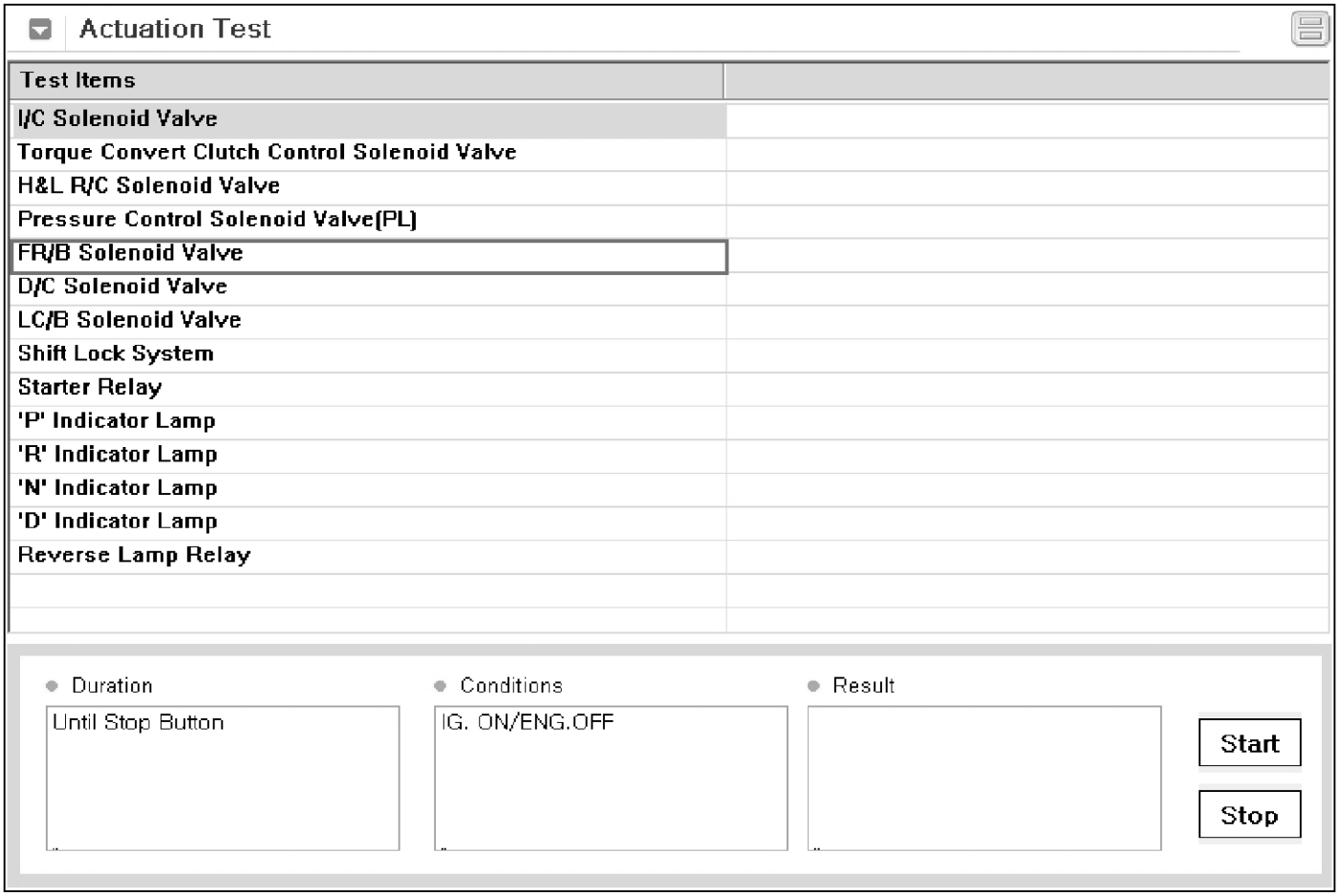
NO ▶ Check open in harness. Repair as necessary and then, go to " Verification of Vehicle Repari" procedure.

Component Inspection

■ Check shift solenoid valve "FR/B"

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select FR/B Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9582L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Shift Control Solenoid Valve and check for proper operation. If the problem is corrected, replace Shift Control Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

P0763 Shift Control Solenoid Valve "C" - Short to battery (SOL3 - Brake "C" : Normal / Low)

Component Location

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

General Description

Refer to DTC P0753 : Shift Solenoid "A" Electrical.

DTC Description

Refer to DTC P0753 : Shift Solenoid "A" Electrical.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check voltage range(Open, Short)	• Open or short in circuit • Faulty pressure switch 5 • Faulty DC solenoid valve • Faulty TCM
Enable Conditions	• 10V < Actuator Supply Voltage < 16V	
Threshold Value	• Hardware IC check	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• Locked as 4th gear	

Diagnostic Circuit Diagram

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Signal Waveform & Data

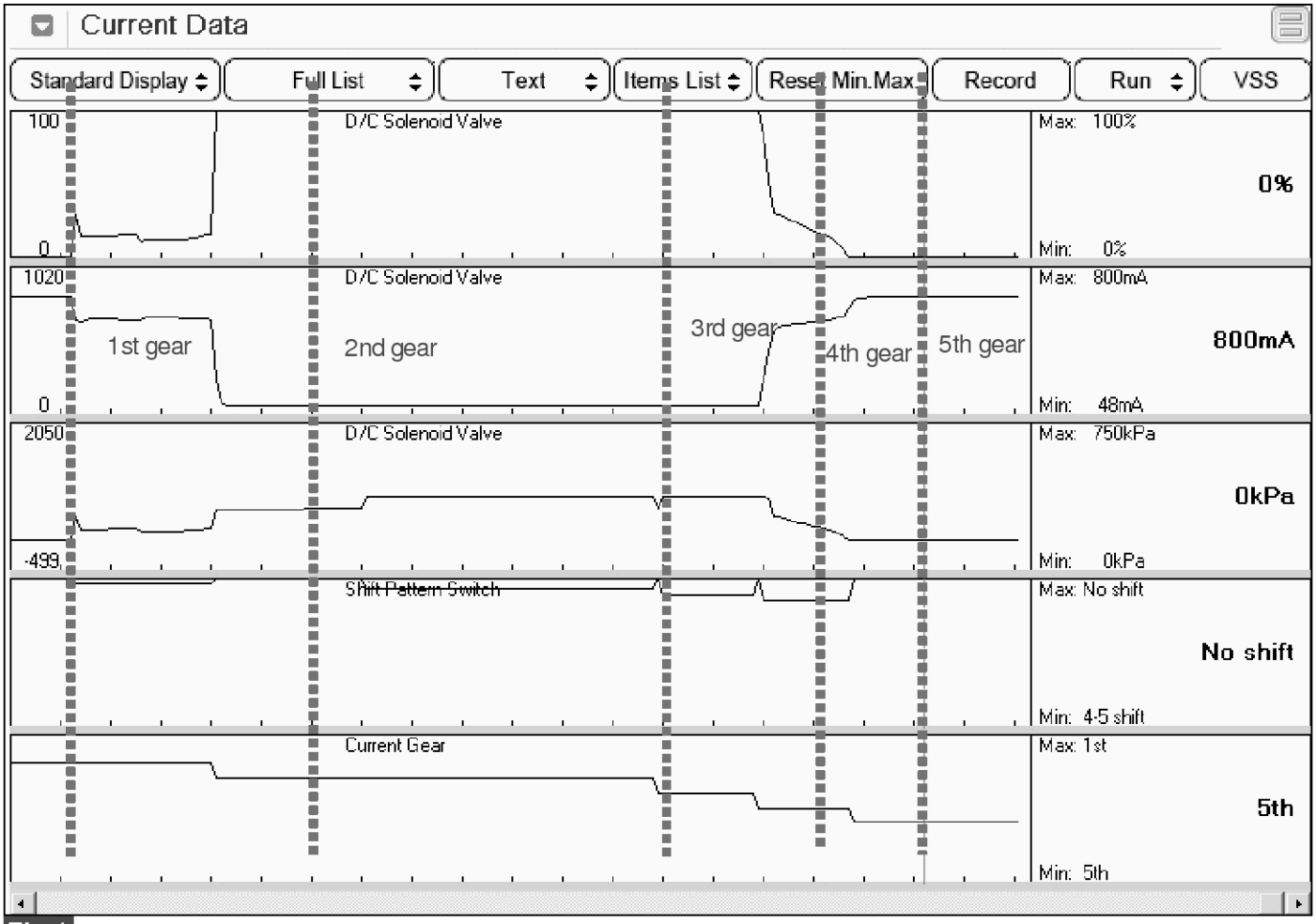


Fig.1

SHMAT9583L

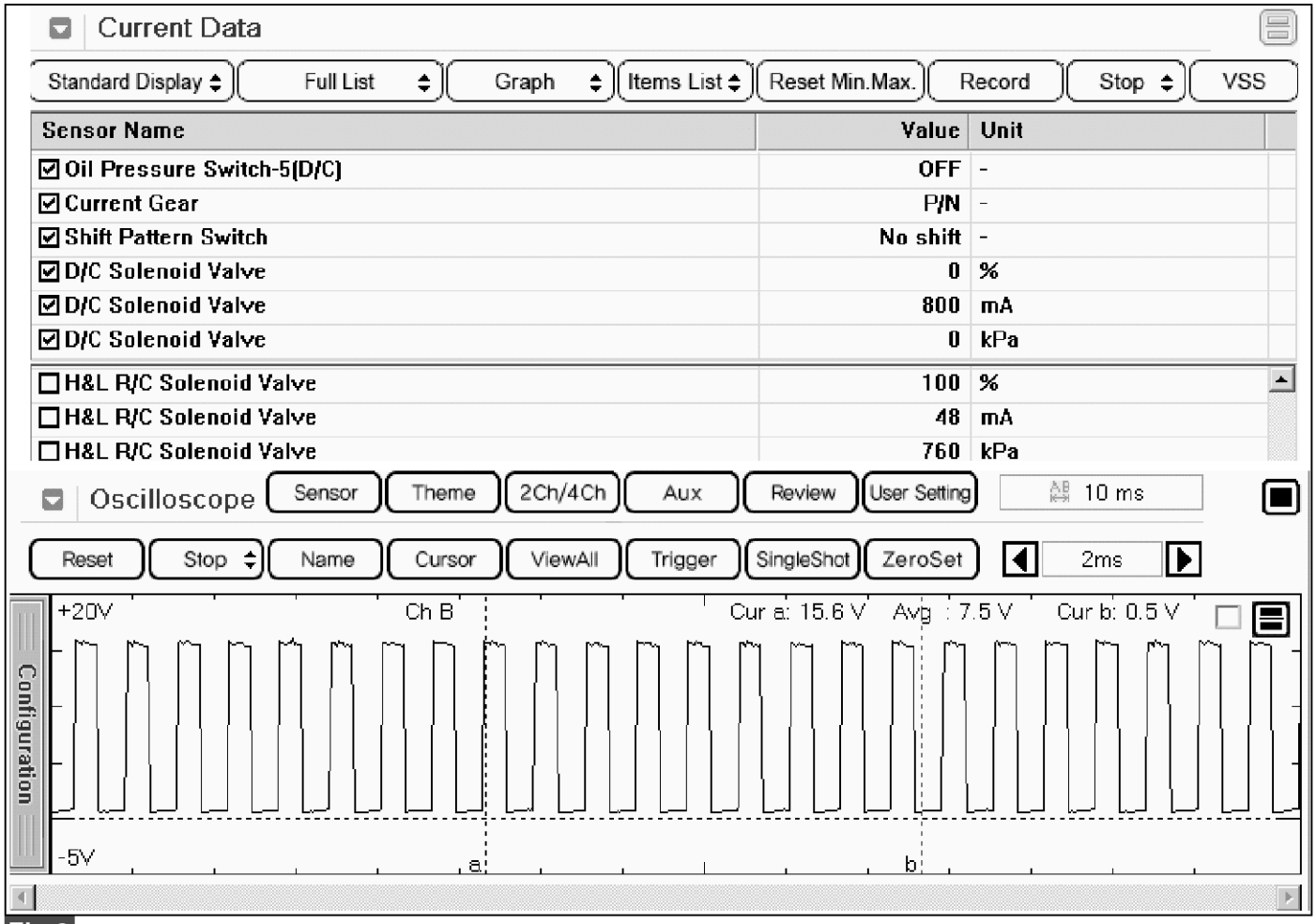


Fig.2

SHMAT9584L

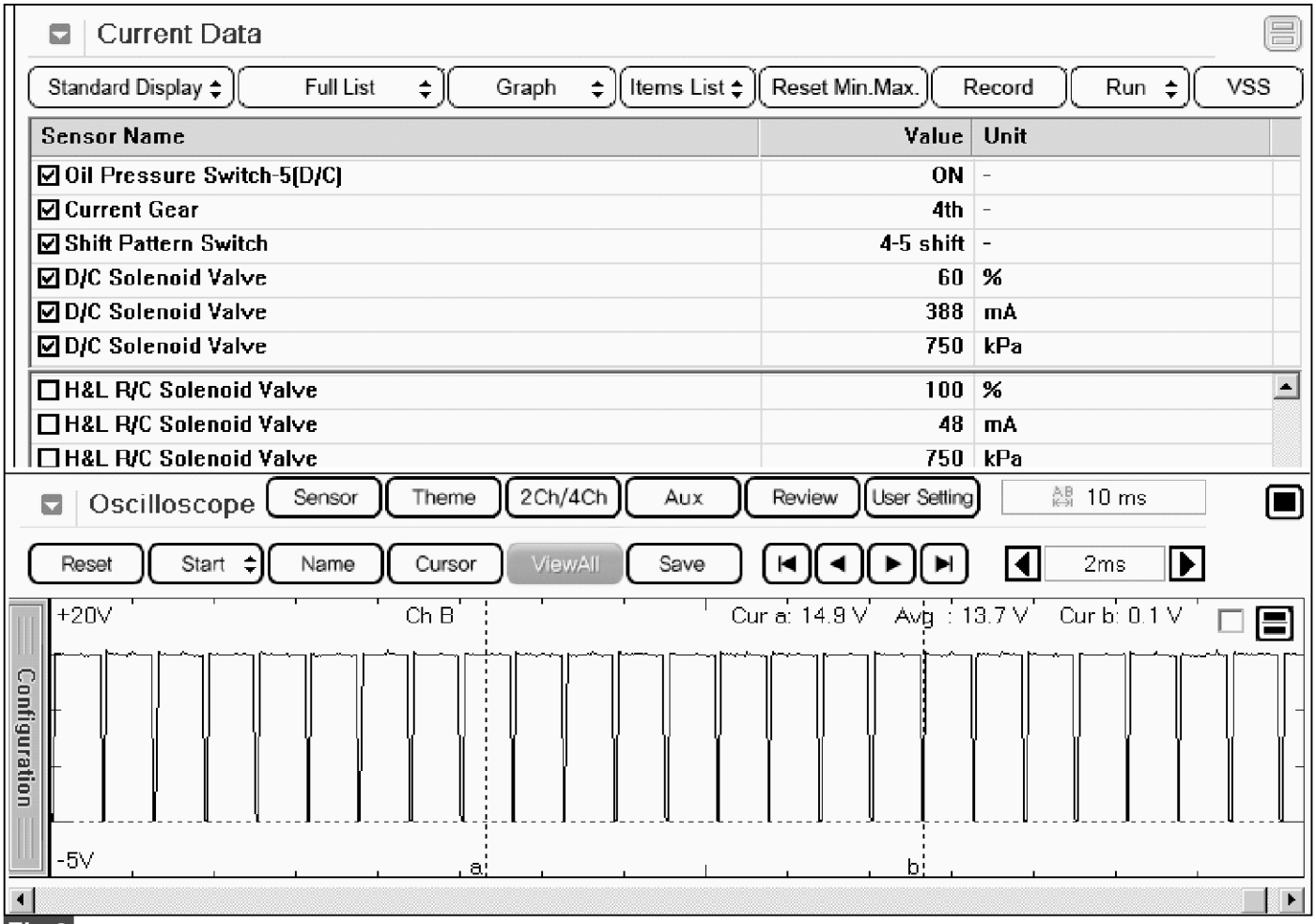


Fig.3

SHMAT9585L

Fig 1) D/C Solenoid Valve Operation

Fig 2) Signal Waveform at IDLE

Fig 3) Signal Waveform at accelleration

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Monitor the "D/C SOLENOID" parameter on the scantool.
4. Select "D RANGE" and Operate the vehicle.
5. Check "D/C SOLENOID" parameter value changes while driving.

Specification : Changeable correspondence with each gear postion

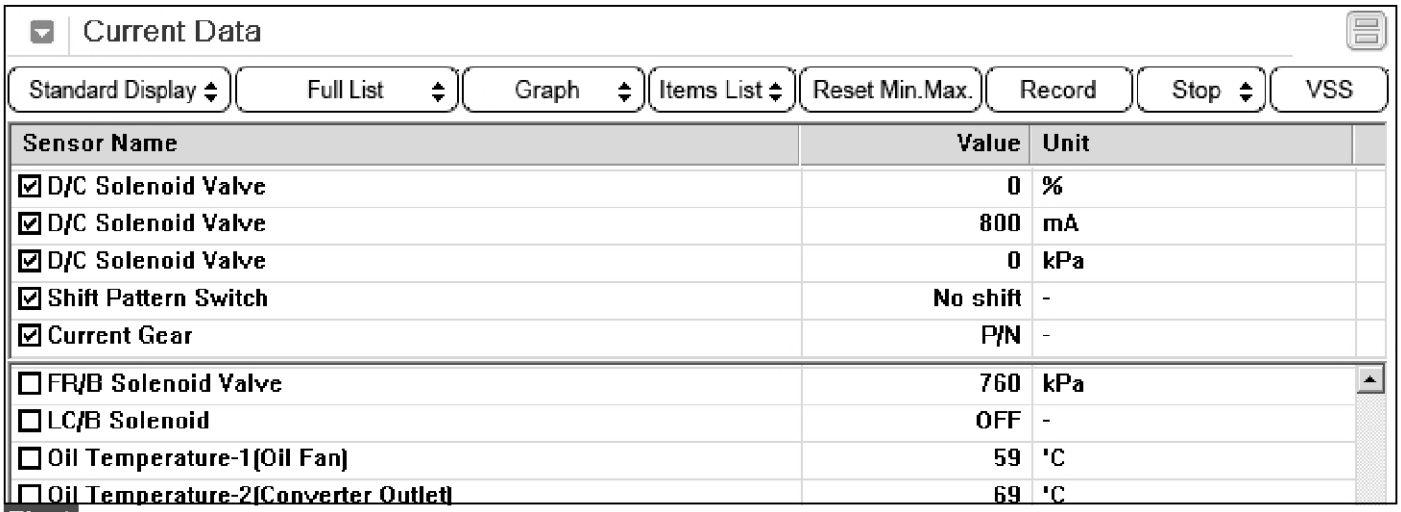


Fig.1

SHMAT9586L

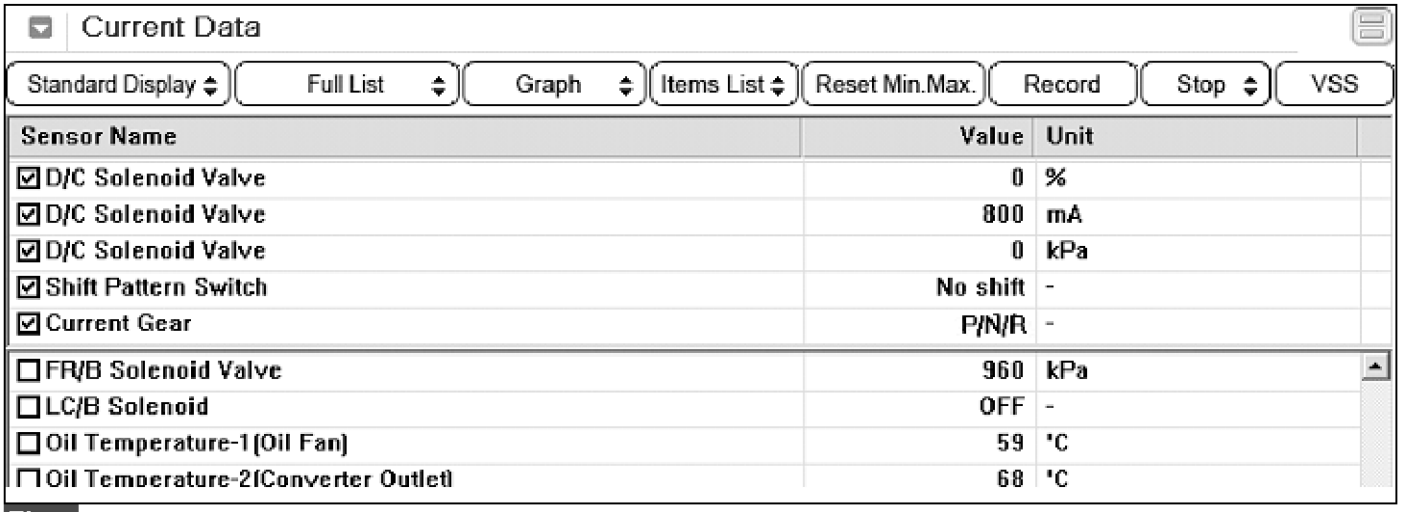


Fig.2

SHMAT9587L

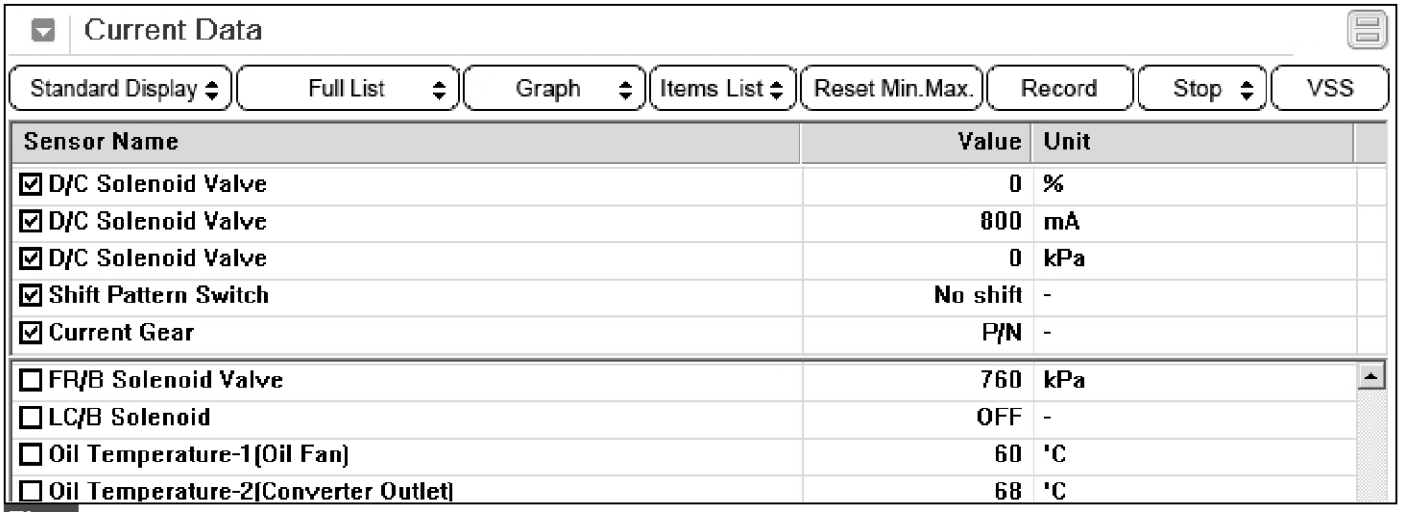


Fig.3

SHMAT9588L

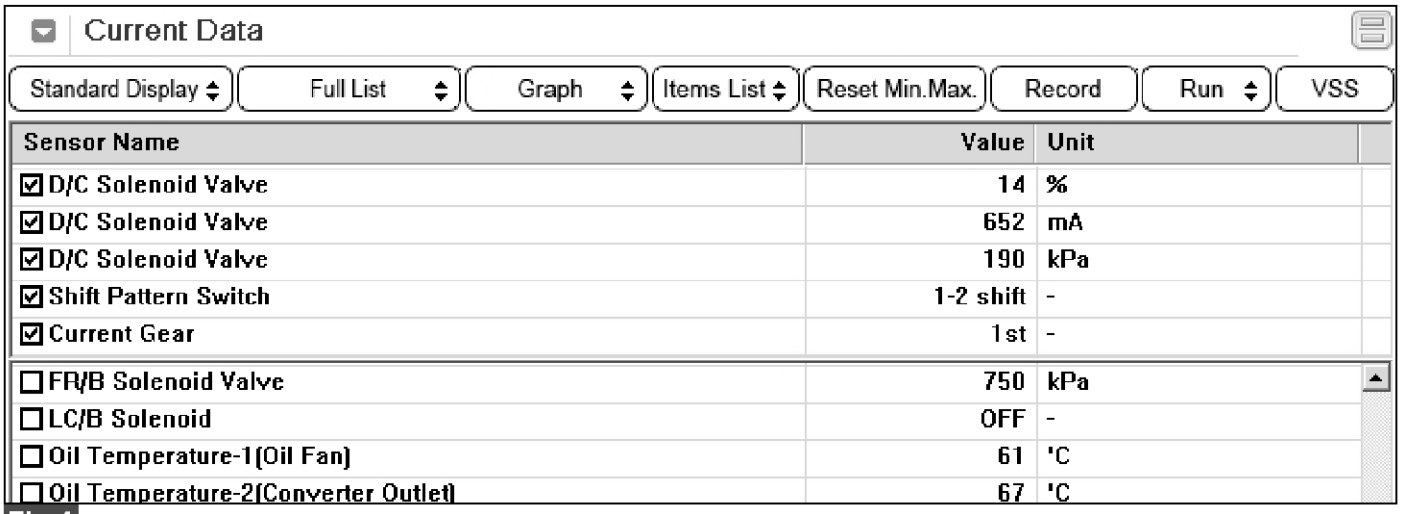


Fig.4

SHMAT9589L

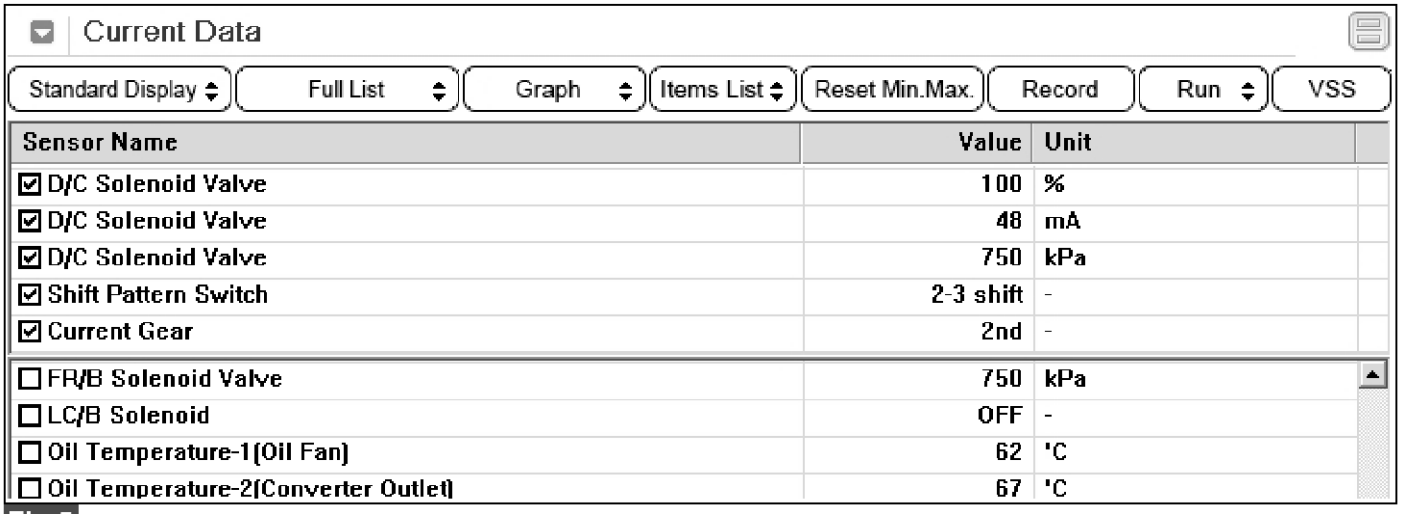


Fig.5

SHMAT9590L

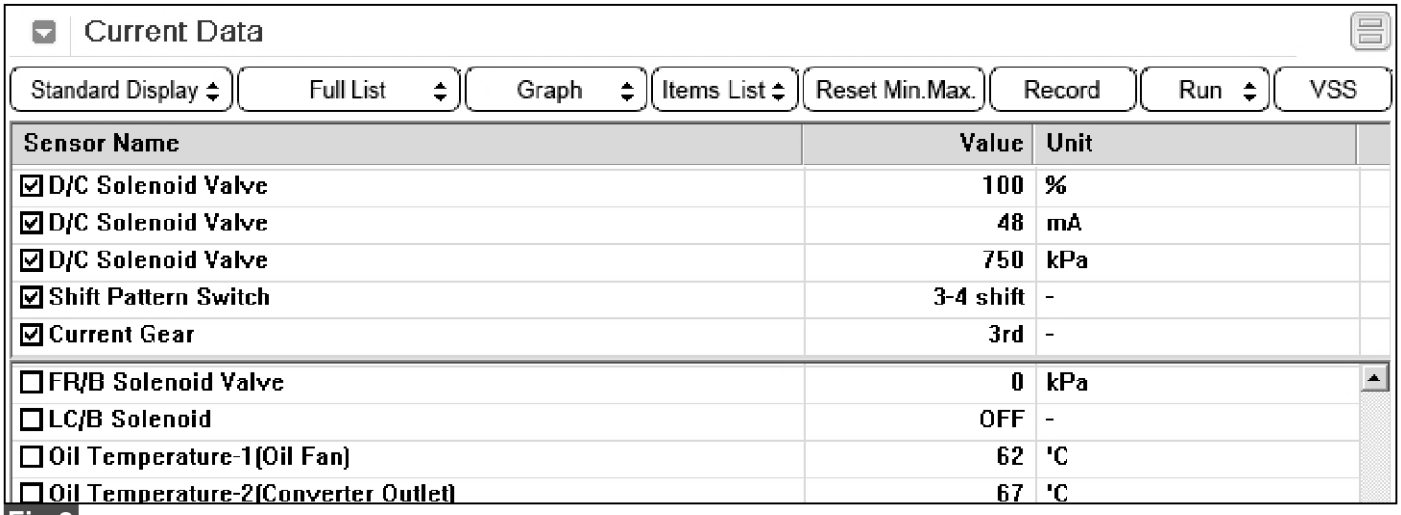


Fig.6

SHMAT9591L

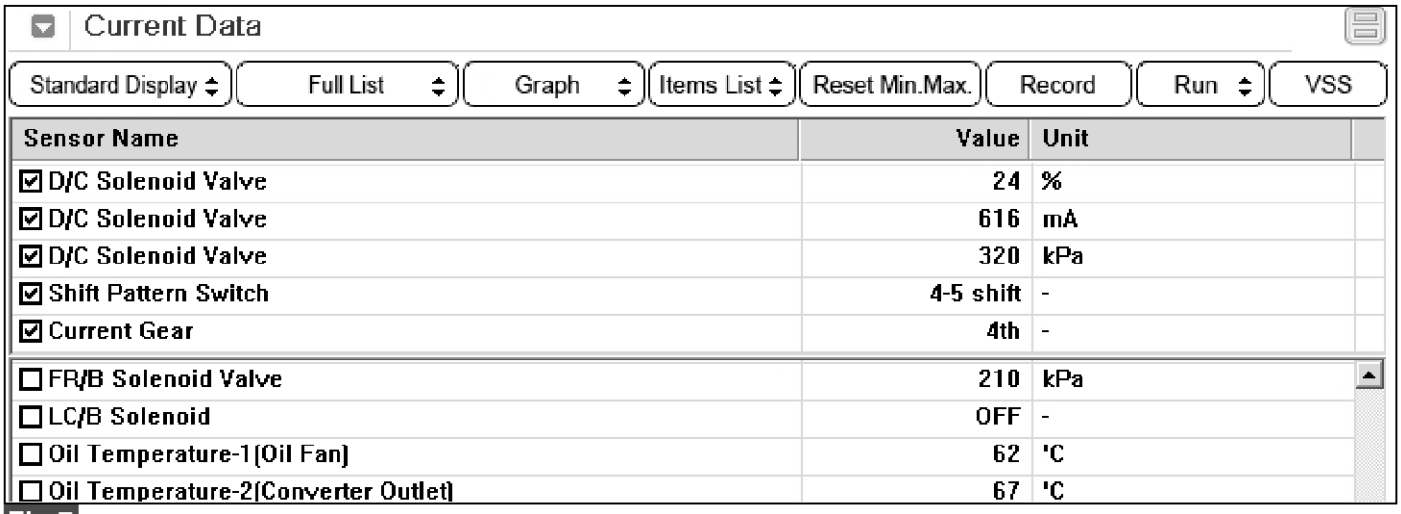


Fig.7

SHMAT9592L

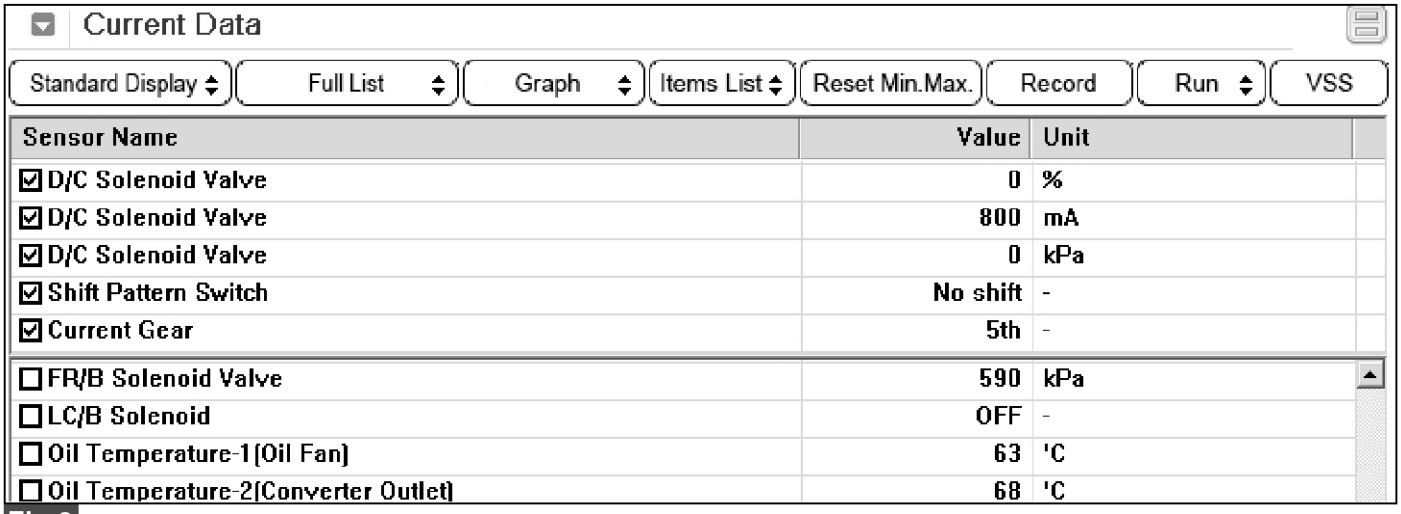


Fig.8

SHMAT9593L

Fig 1) "P" range
Fig 2) "R" range
Fig 3) "N" range
Fig 4) 1st gear in "D" range
Fig 5) 2nd gear in "D" range
Fig 6) 3rd gear in "D" range
Fig 7) 4th gear in "D" range
Fig 8) 5th gear in "D" range

6. Does the "Shift Control Solenoid Valve" follow the reference data ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for loose-ness, poor connection, bending, corrosion, co-ntamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Power Circuit Inspection

1. Connect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "ON", ENGINE "OFF"
3. Measure voltage between power terminal of DC solenoid valve harness connector and chassis ground.

Specification : Approx. Battery Voltage

4. Is the measured voltage within specifications ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check open or short in harness. Repair as necessary and then, go to "Verifcation of Vehicle Repair" procedure.
▶ If Power circuit is O.K, Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "verification of vehicle repair " procedure.

Ground Circuit Inspection

1. Disconnect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "OFF", ENGINE "OFF".
3. Measure resistance between ground terminal of DC control solenoid Valve harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specificatins ?

YES ▶ Go to "Component Inspection" procedure.

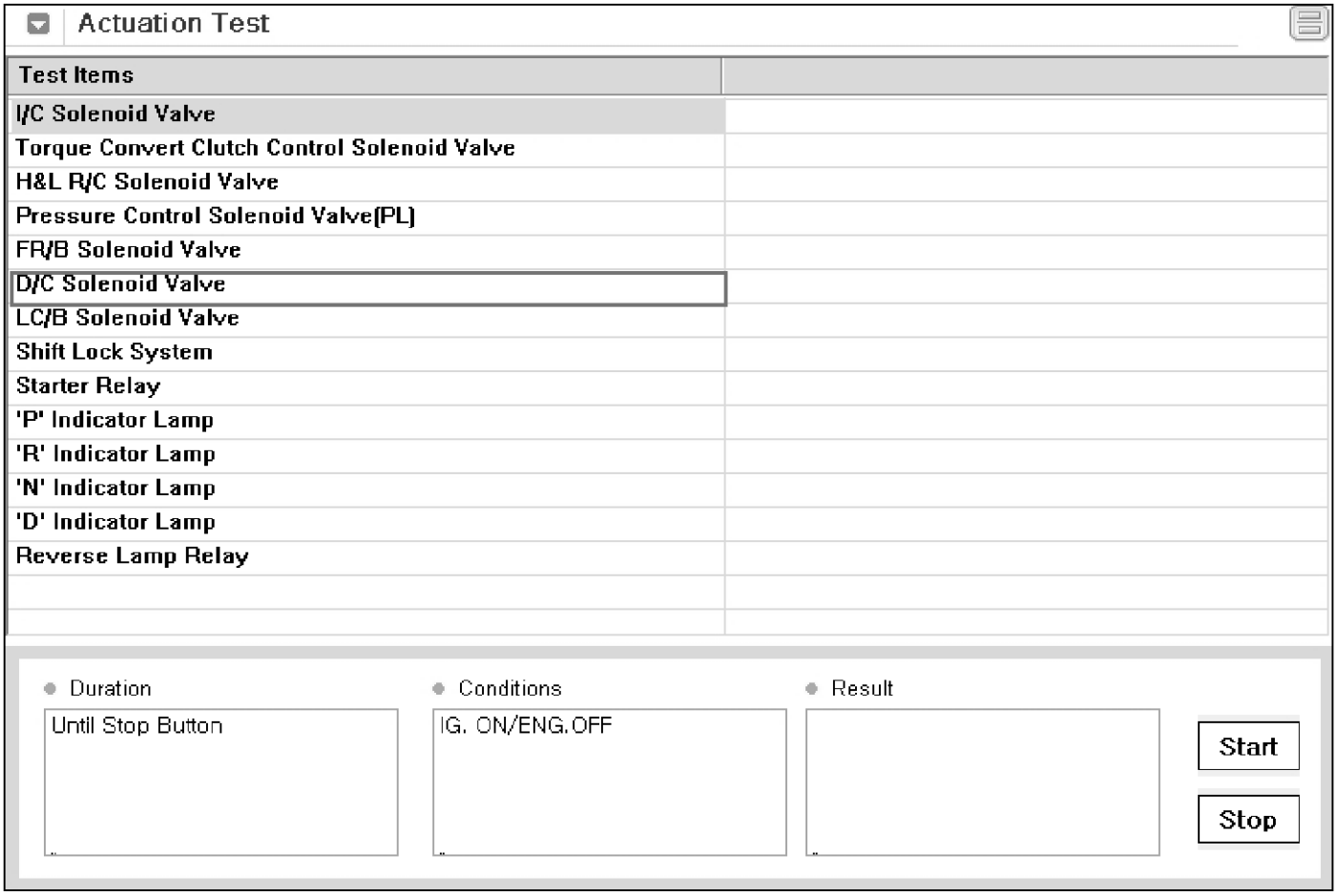
NO ▶ Check open in harness. Repair as necessary and then, go to " Verification of Vehicle Repari" procedure.

Component Inspection

■ Check shift solenoid valve "DC"

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select DC Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9594L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Shift Control Solenoid Valve and check for proper operation. If the problem is corrected, replace Shift Control Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

P0768 Shift Control Solenoid Valve "D" - Short to battery (SOL4- Brake "D", Clutch "E" - Normal / High)

Component Location

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

General Description

Refer to DTC P0753 : Shift Solenoid "A" Electrical.

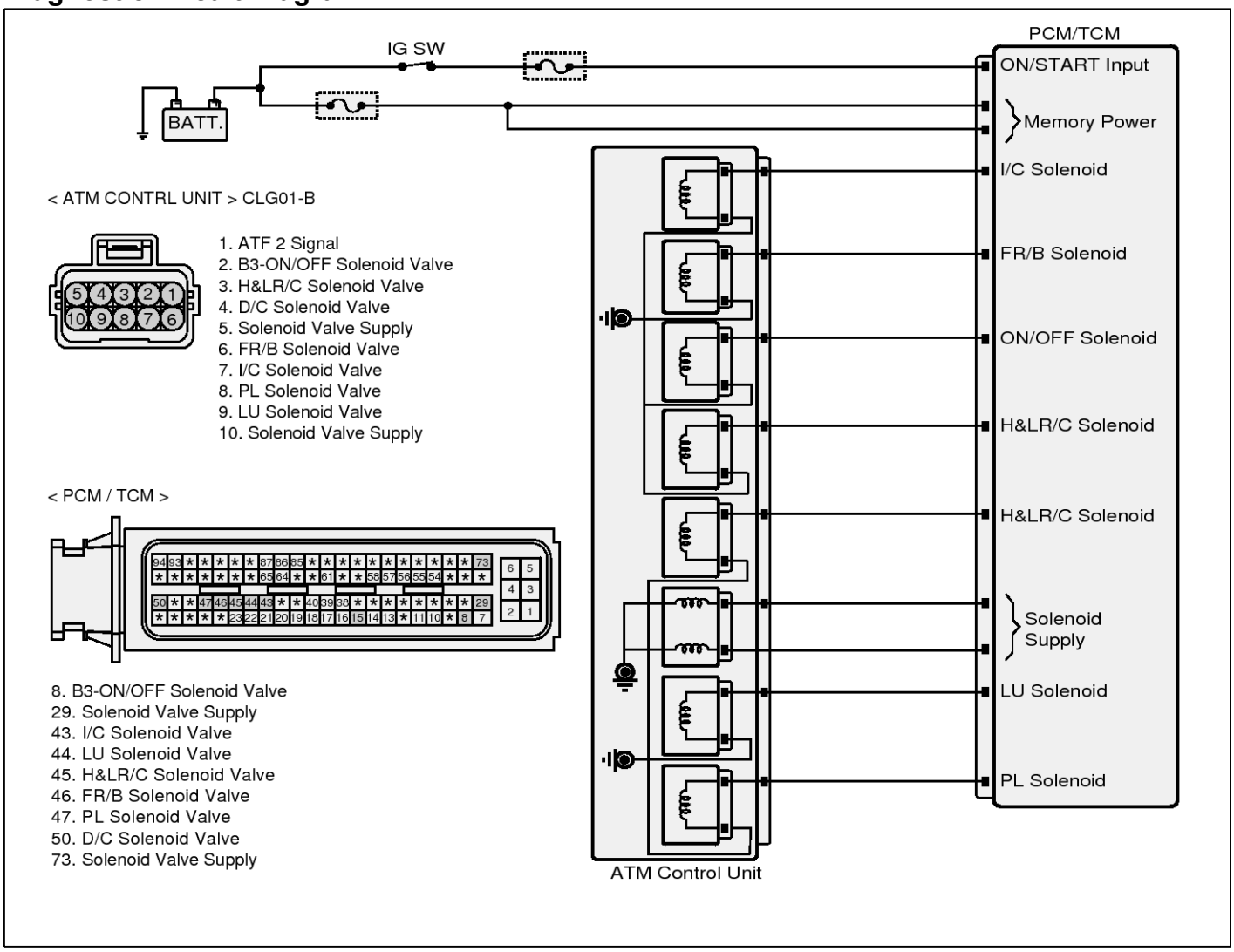
DTC Description

Refer to DTC P0753 : Shift Solenoid "A" Electrical.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check voltage range(Open, Short)	• Open or short in circuit • Faulty pressure switch 6 • Faulty H&L R/C solenoid valve • Faulty TCM
Enable Conditions	• 10V < Actuator Supply Voltage < 16V	
Threshold Value	• Hardware IC check	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• Locked as 4th gear	

Diagnostic Circuit Diagram



SHMAT9706L

Signal Waveform & Data

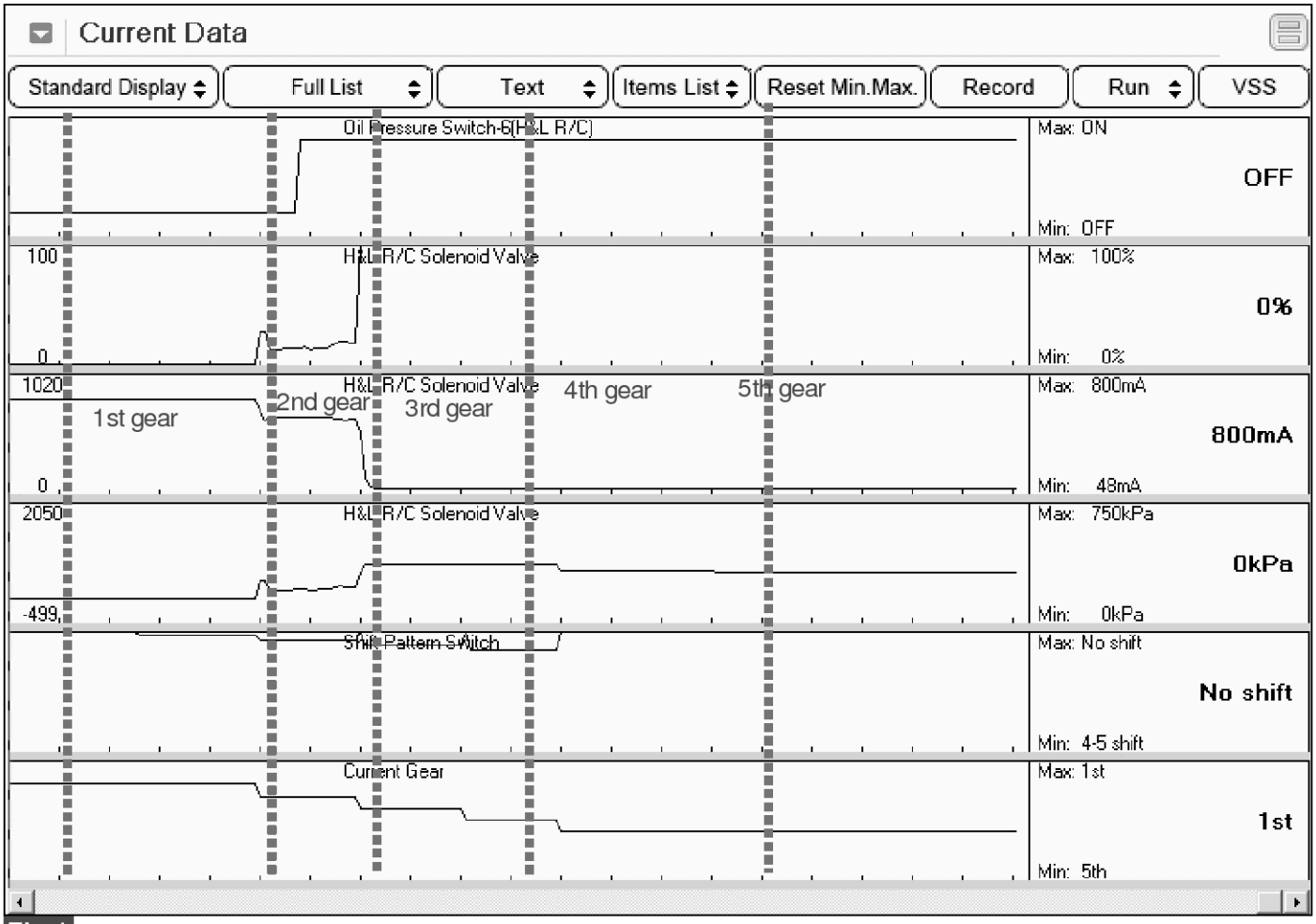


Fig.1

SHMAT9595L

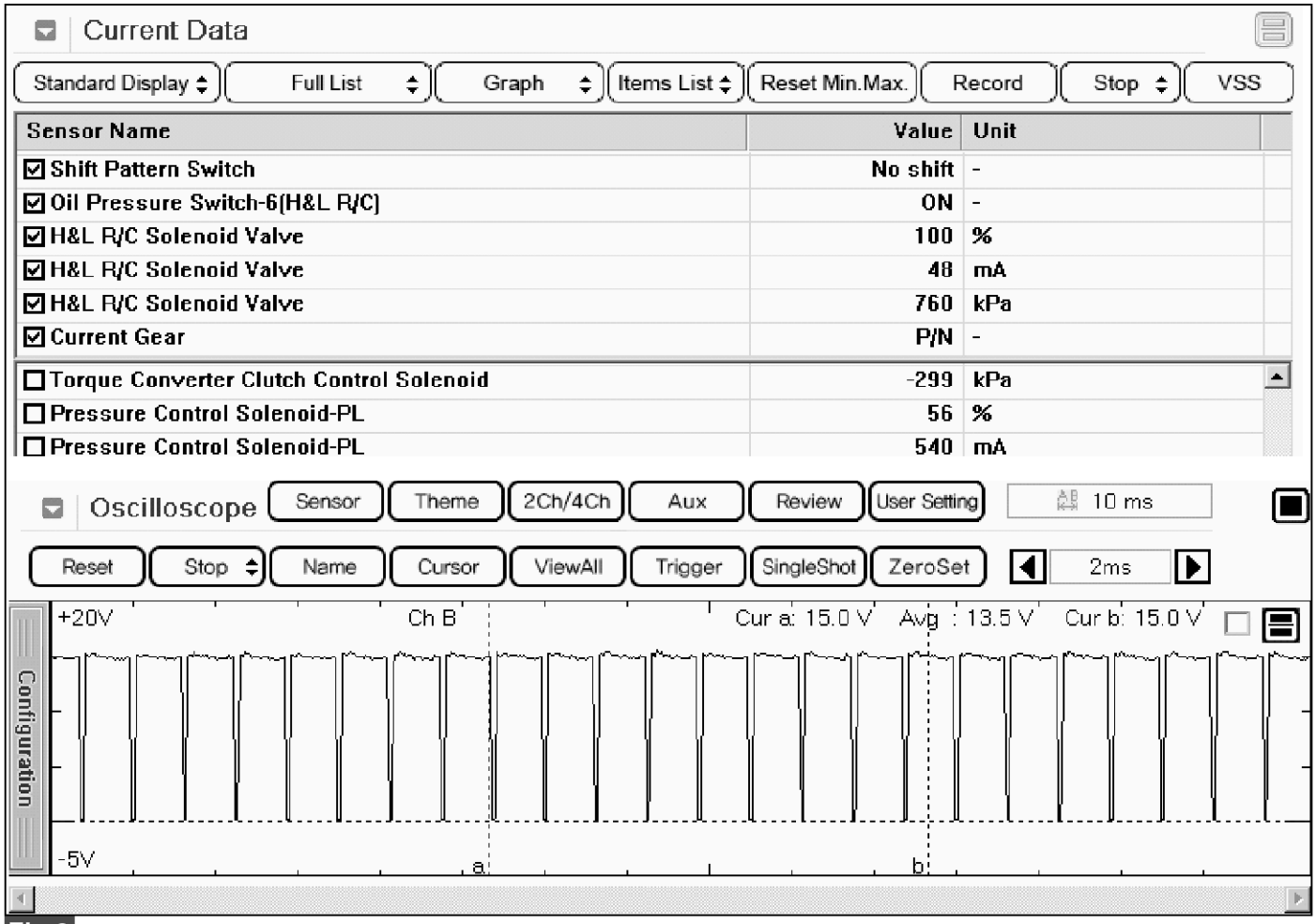


Fig.2

SHMAT9596L

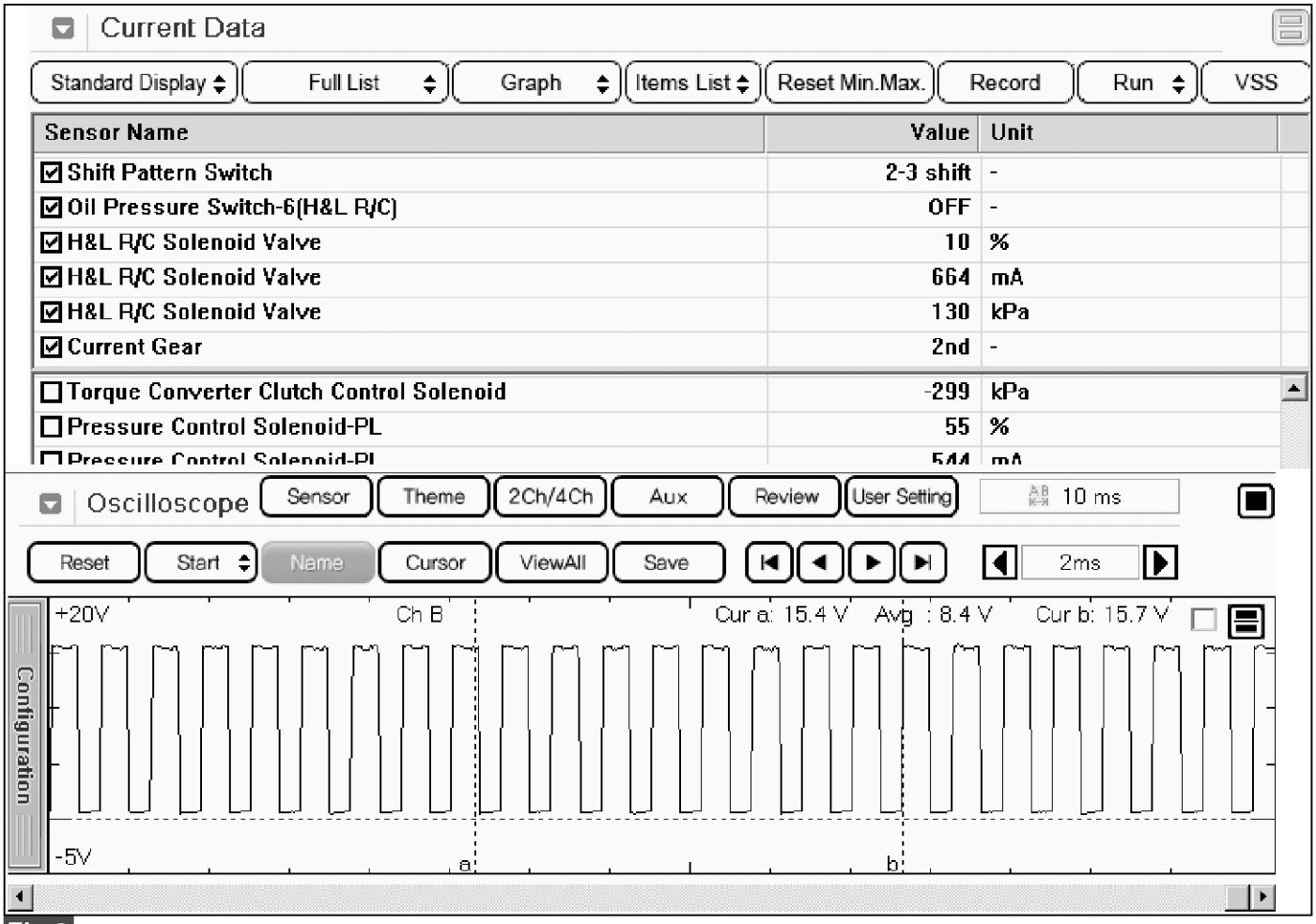


Fig.3

SHMAT9597L

Fig 1) H&L R/C Solenoid Valve Operation

Fig 2) Signal Waveform at IDLE

Fig 3) Signal Waveform at accelleration

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Monitor the "H& LR/C SOLENOID" parameter on the scantool.
4. Select "D RANGE" and Operate the vehicle.
5. Check "H& LR/C SOLENOID" parameter value changes while driving.

Specification : Changeable correspondence with each gear postion

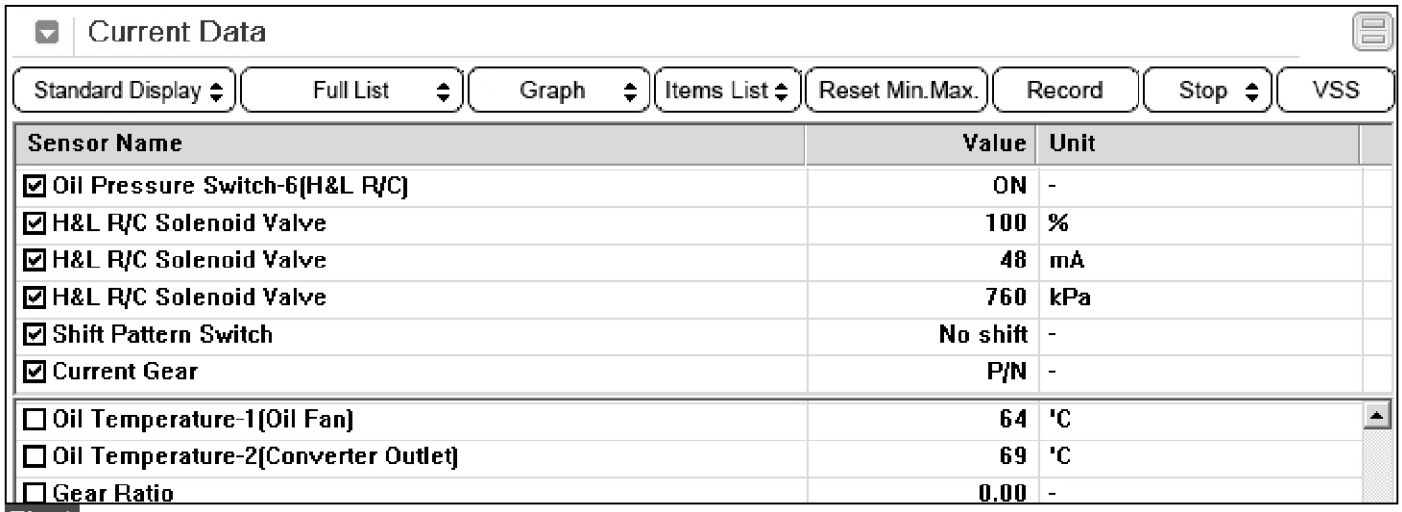


Fig.1

SHMAT9598L

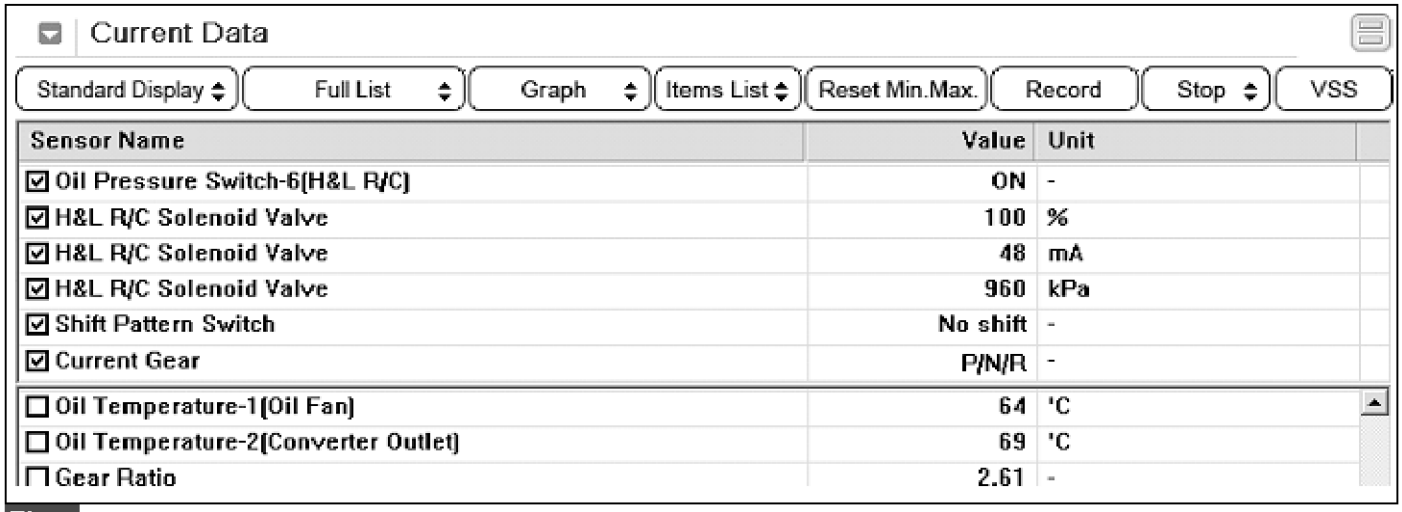


Fig.2

SHMAT9599L

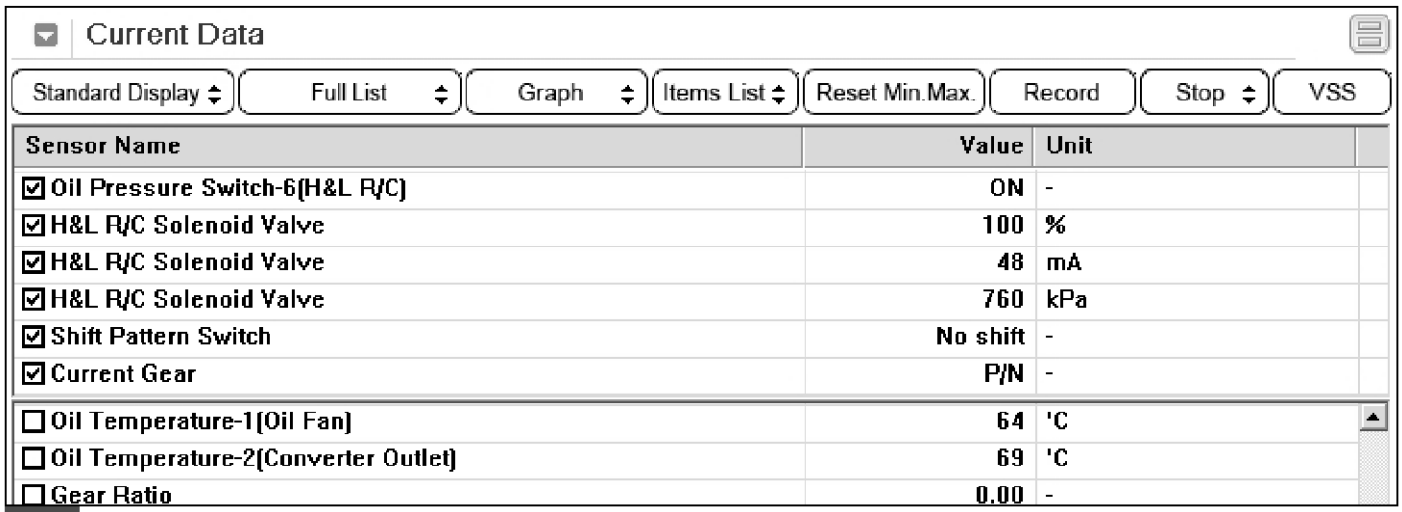


Fig.3

SHMAT9600L

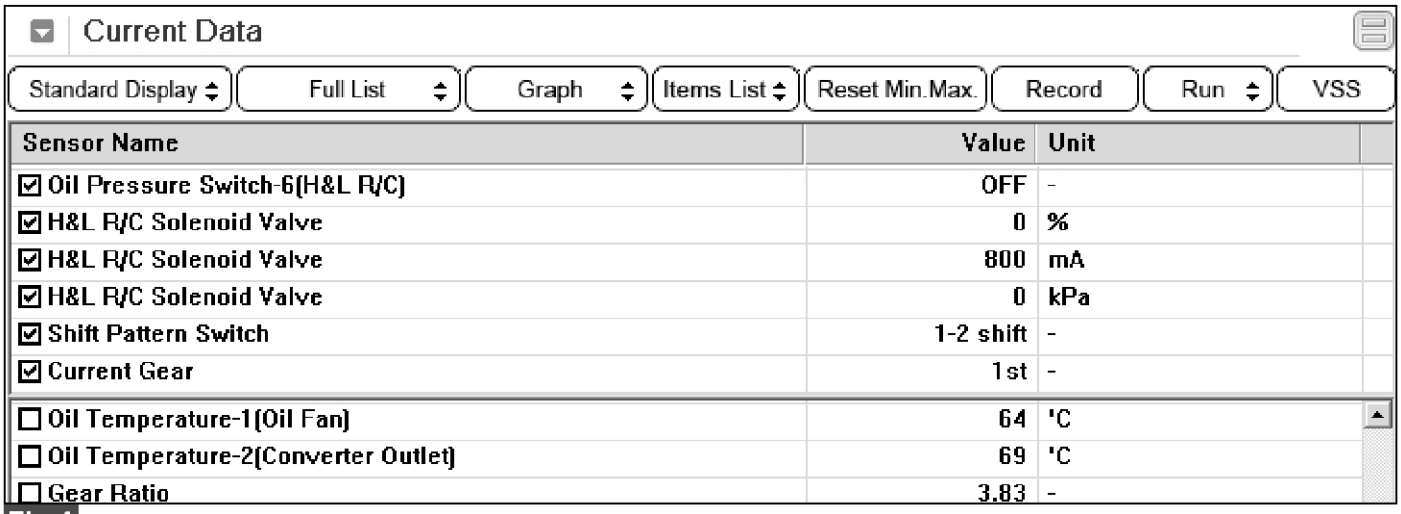


Fig.4

SHMAT9601L

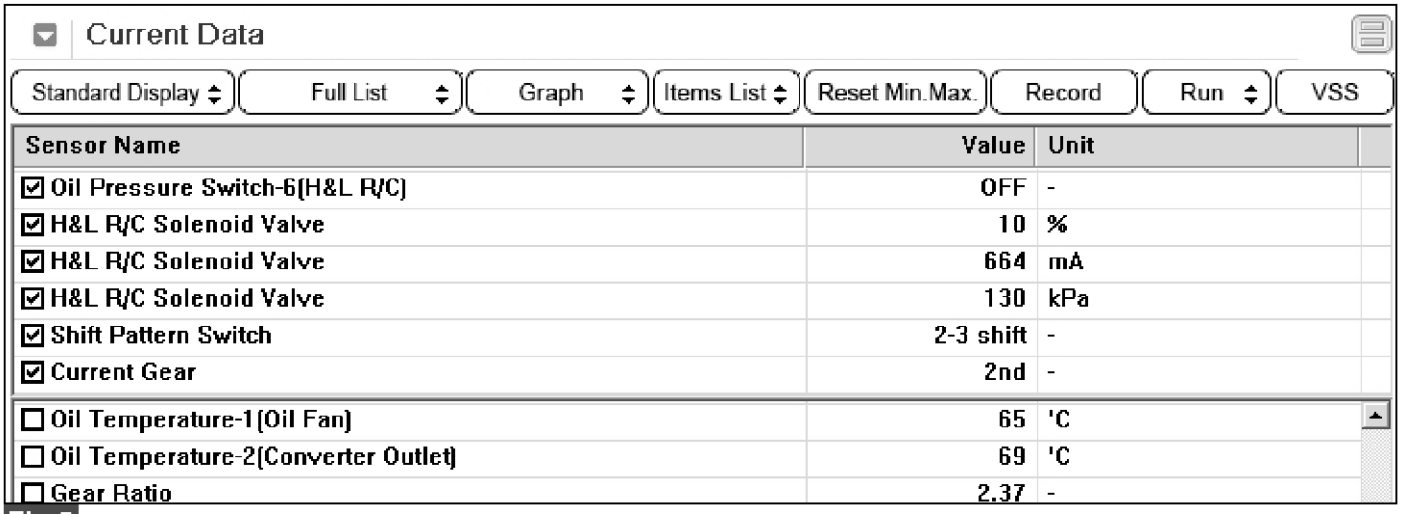


Fig.5

SHMAT9602L

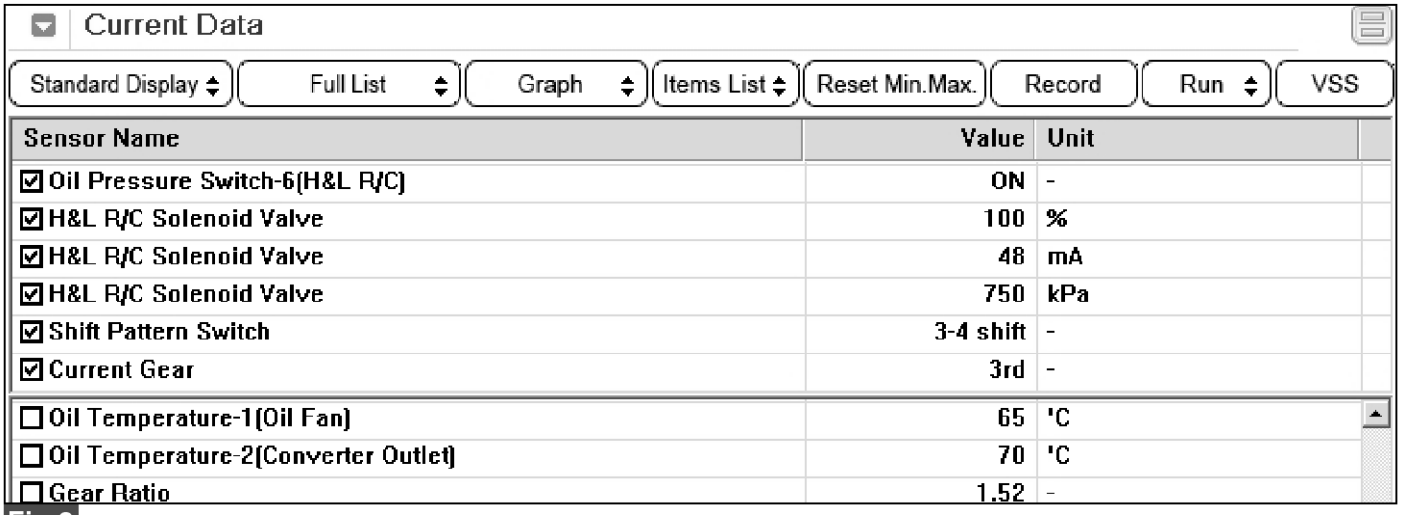


Fig.6

SHMAT9603L

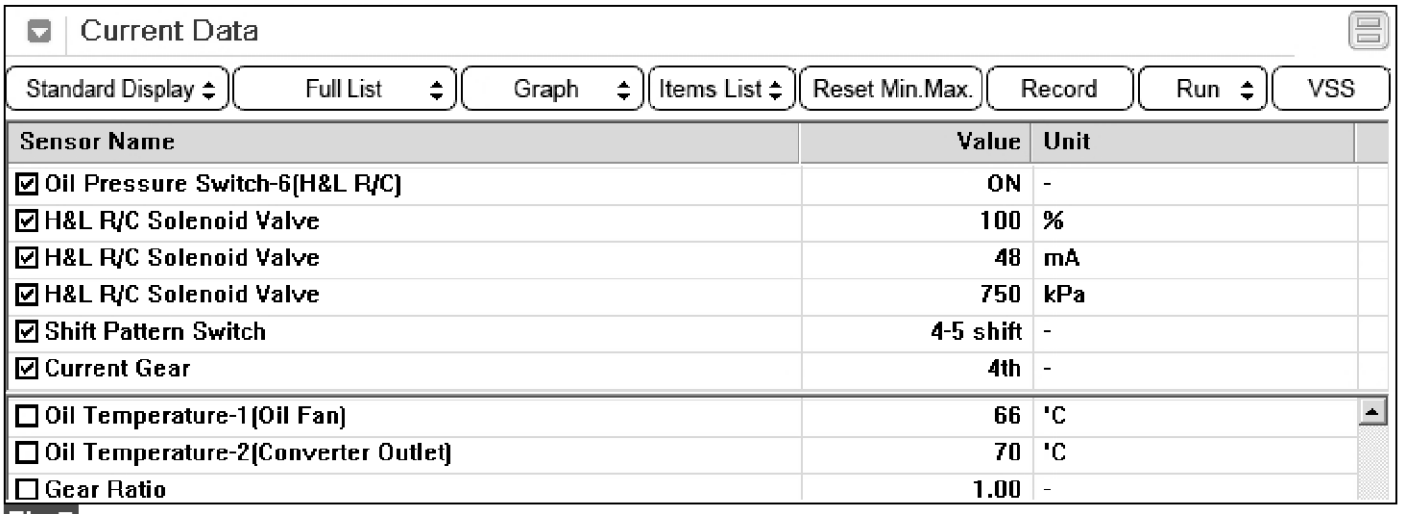


Fig.7

SHMAT9604L

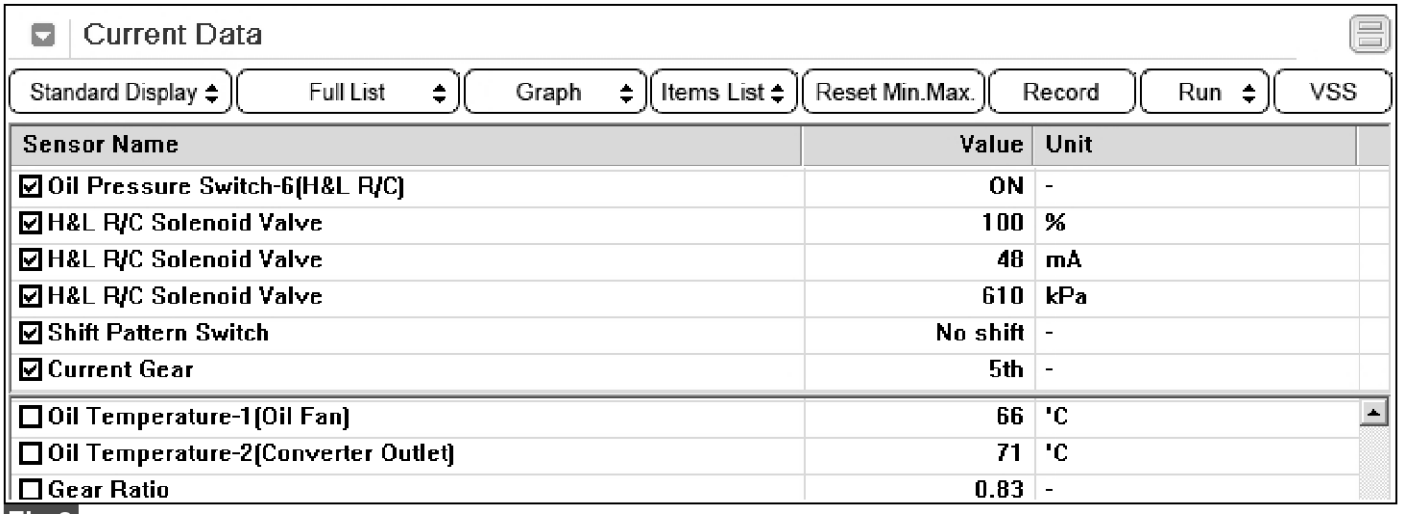


Fig.8

SHMAT9605L

Fig 1) "P" range
Fig 2) "R" range
Fig 3) "N" range
Fig 4) 1st gear in "D" range
Fig 5) 2nd gear in "D" range
Fig 6) 3rd gear in "D" range
Fig 7) 4th gear in "D" range
Fig 8) 5th gear in "D" range

6. Does the "Shift Control Solenoid Valve" follow the reference data ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Power Circuit Inspection

1. Connect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "ON", ENGINE "OFF"
3. Measure voltage between power terminal of H& LR/C solenoid valve harness connector and chassis ground.

Specification : Approx. Battery Voltage

4. Is the measured voltage within specifications ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check open or short in harness. Repair as necessary and then, go to "Verifcation of Vehicle Repair" procedure.
▶ If Power circuit is O.K, Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "verification of vehicle repair " procedure.

Ground Circuit Inspection

1. Disconnect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "OFF", ENGINE "OFF".
3. Measure continuity between ground terminal of H& LR/C control solenoid Valve harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specificatins ?

YES ▶ Go to "Component Inspection" procedure.

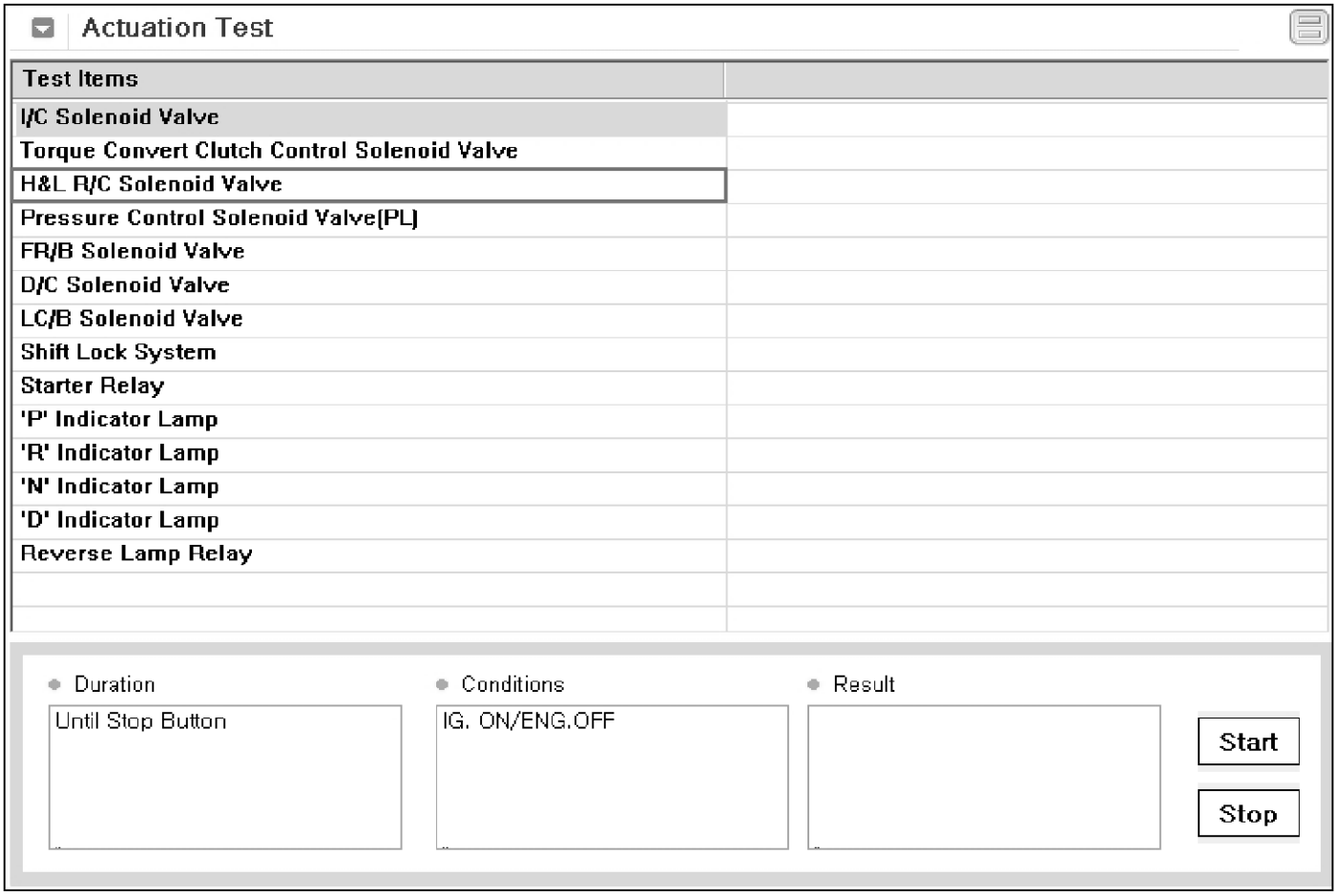
NO ▶ Check open in harness. Repair as necessary and then, go to " Verification of Vehicle Repari" procedure.

Component Inspection

■ Check shift solenoid valve "H&LR/C"

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select H&LR/C Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9606L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Shift Control Solenoid Valve and check for proper operation. If the problem is corrected, replace Shift Control Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

P0773 Shift Control Solenoid Valve "E" - Short to battery (SOL 7 - ON/OFF : Normal / Close)

Component Location

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

General Description

Refer to DTC P0753 : Shift Solenoid "A" Electrical.

DTC Description

The PCM/TCM checks the Shift Control Solenoin Valve E control signal by monitoring the feedback signal from the solenoid valve drive circuit. If an unexpected signal is monitored, (For example, high voltage is detected when low voltage is expected, or low votage detected when high voltage is expected)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check voltage range(Open, Short)	• Open or short in circuit • Faulty pressure switch 2 • Faulty LC/B solenoid valve • Faulty TCM
Enable Conditions	• 10V < Actuator Supply Voltage < 16V	
Threshold Value	• Hardware IC check	
Diagnostic Time	• More than 0.2sec	
Fail Safe	• OFF fail : Only LC/B OFF, The others are controlled as usual • ON fail : Lock as 4th gear	

Diagnostic Circuit Diagram

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Signal Waveform & Data

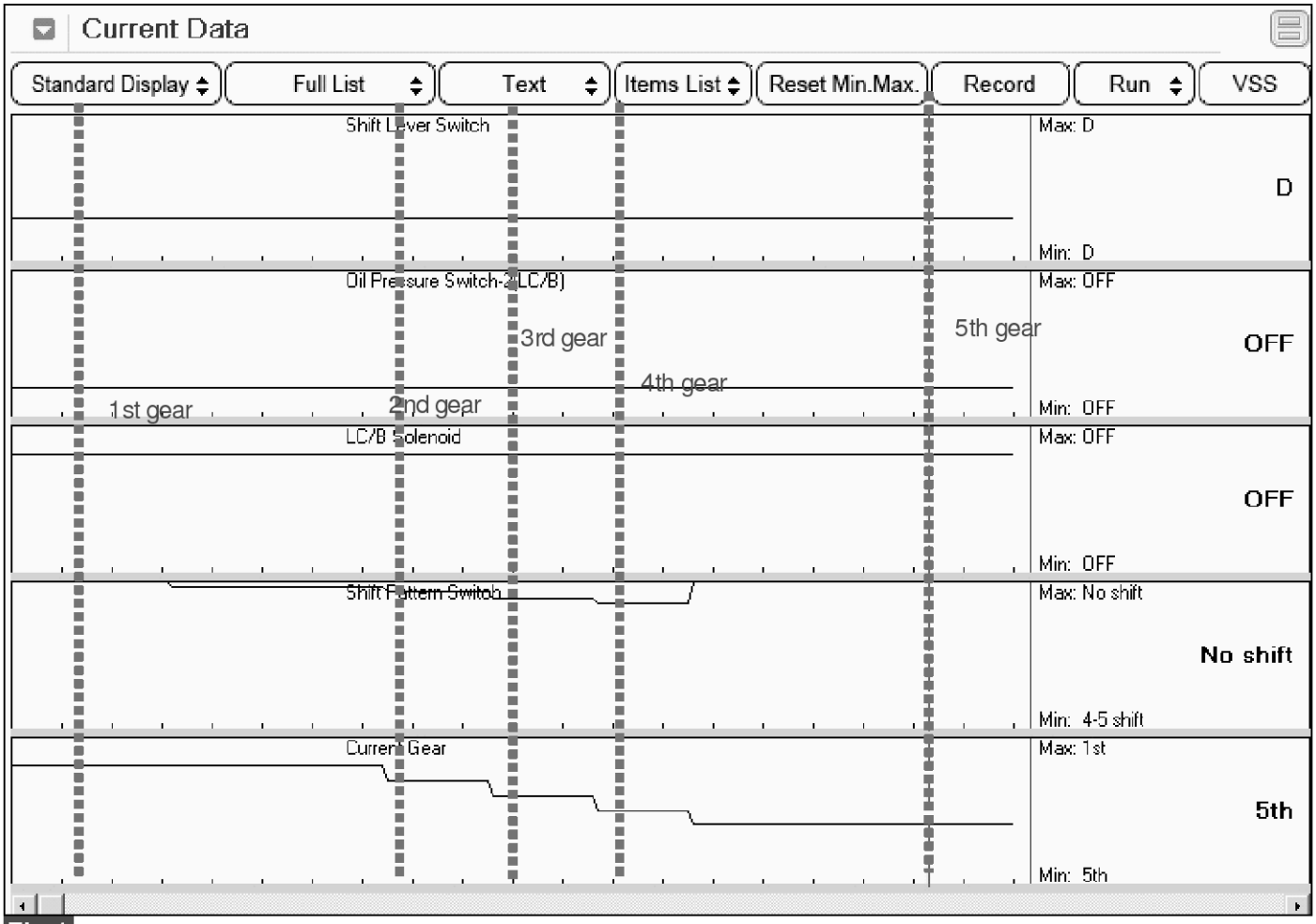


Fig.1

SHMAT9607L

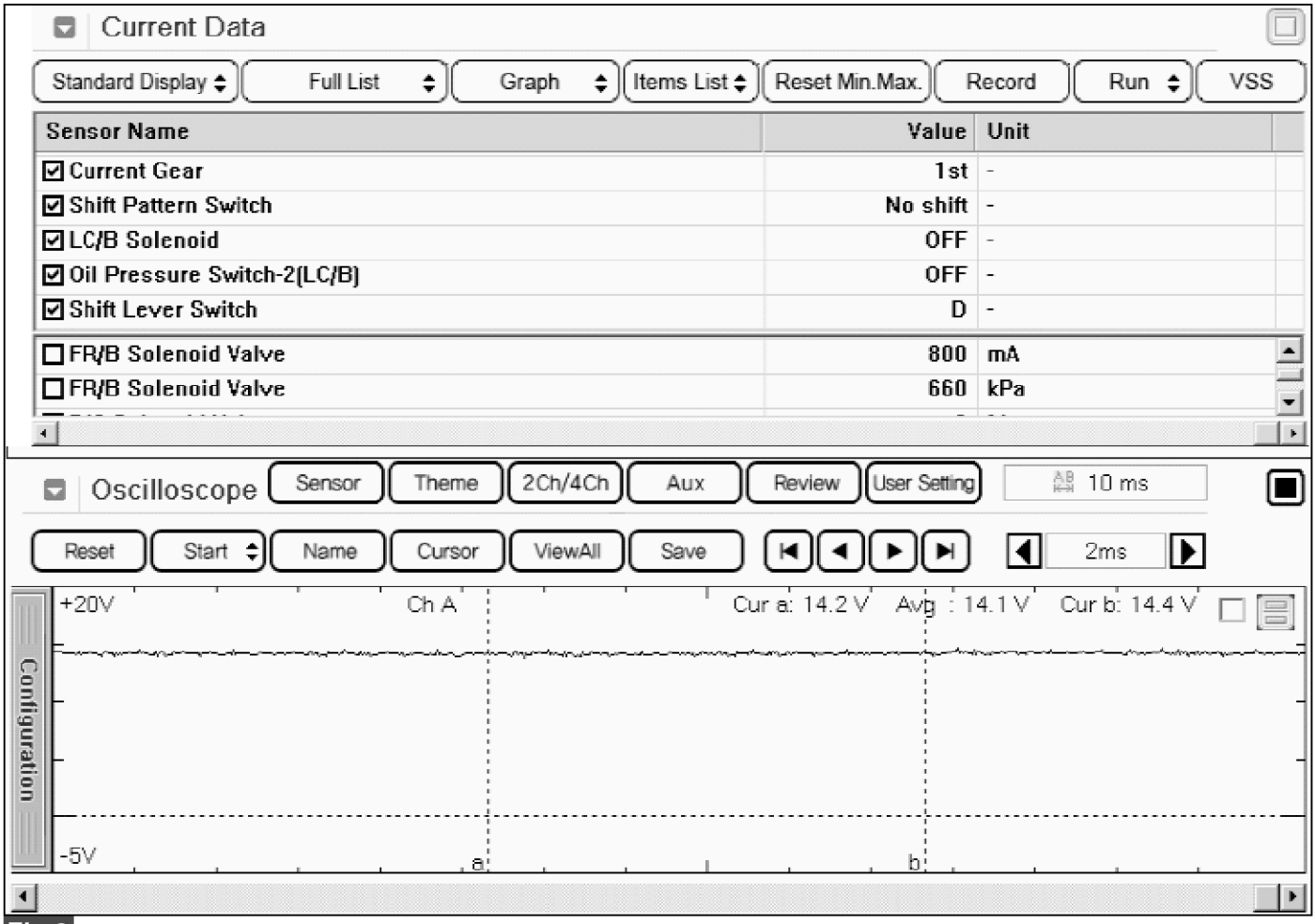


Fig.2

SHMAT9608L

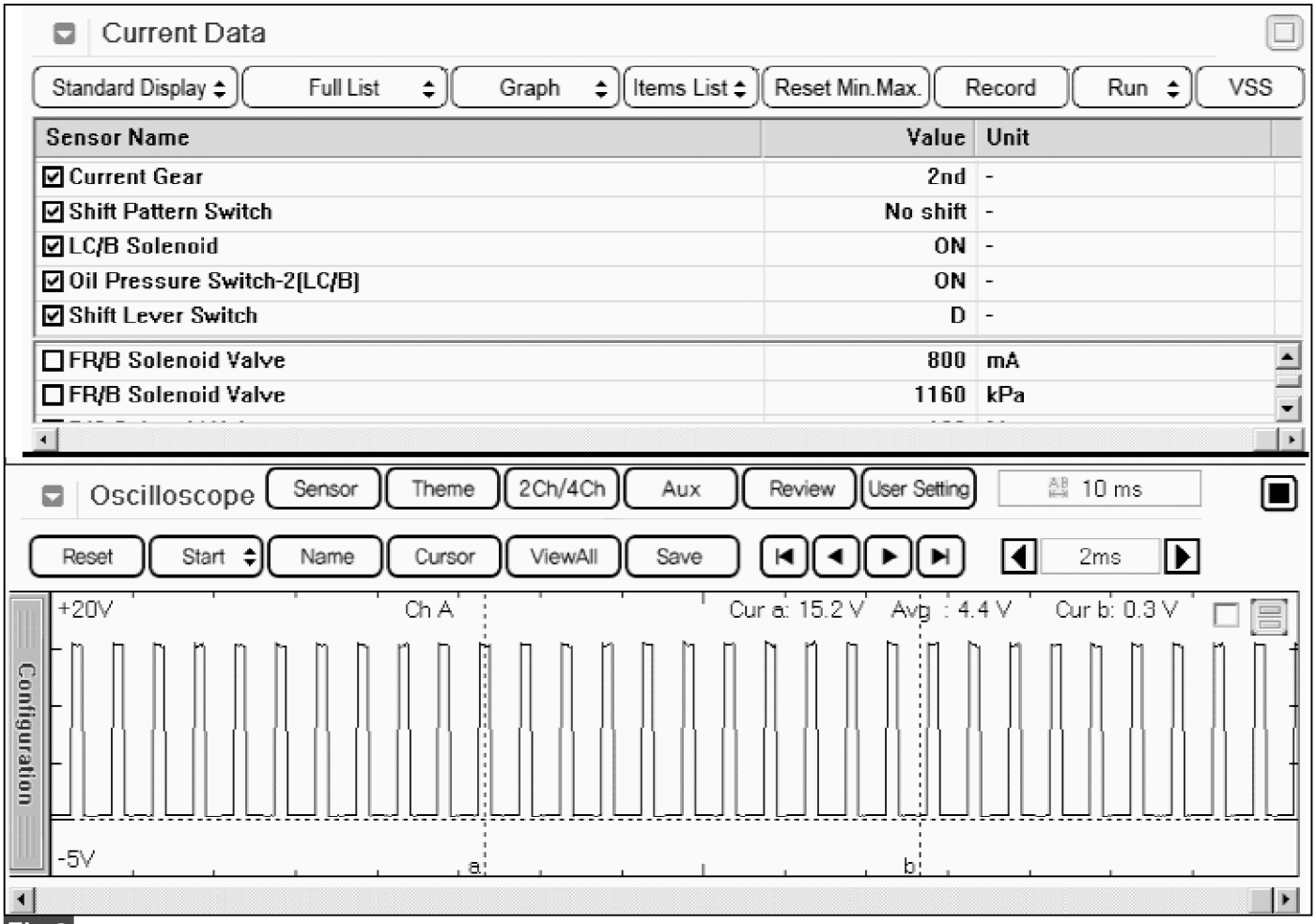


Fig.3

SHMAT9609L

Fig 1) LC/B solenoid operation
Fig 2) Signal Waveform at IDLE
Fig 3) Signal Waveform at accelleration

Monitor Scantool Data

1. Connect scantool to data link connector(DLC)
2. Engine "ON" .
3. Monitor the "LC/B SOLENOID" parameter on the scantool.
4. Select "D RANGE" and Operate the vehicle.
5. Check "LC/B SOLENOID" parameter value changes while driving.

Specification : Changeable correspondence with each gear postion

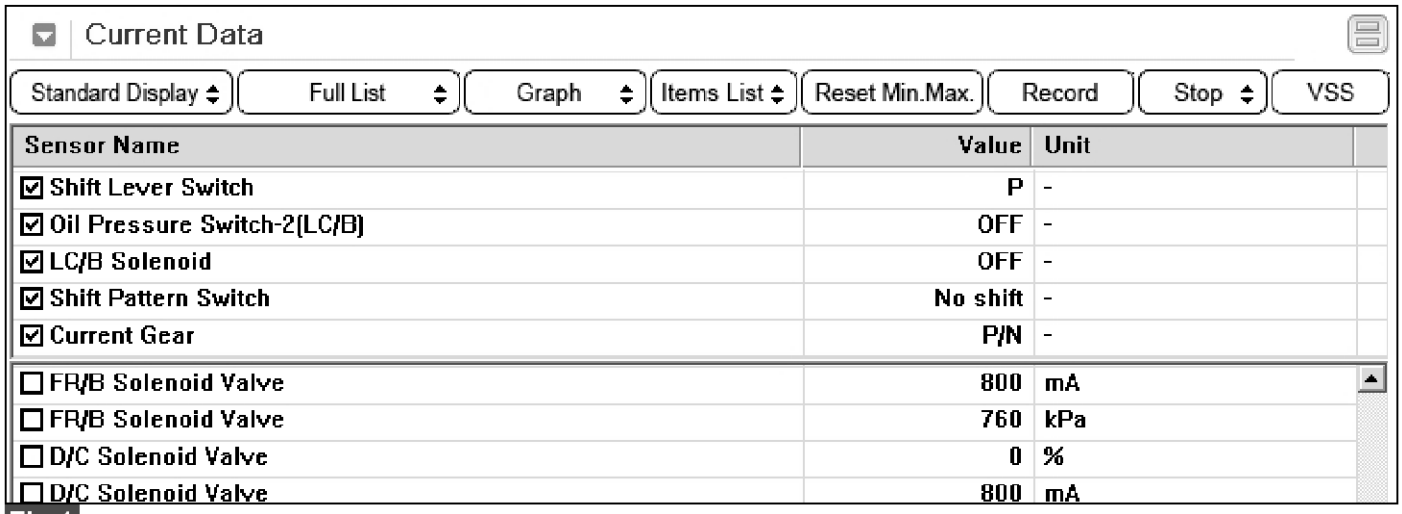


Fig.1

SHMAT9610L

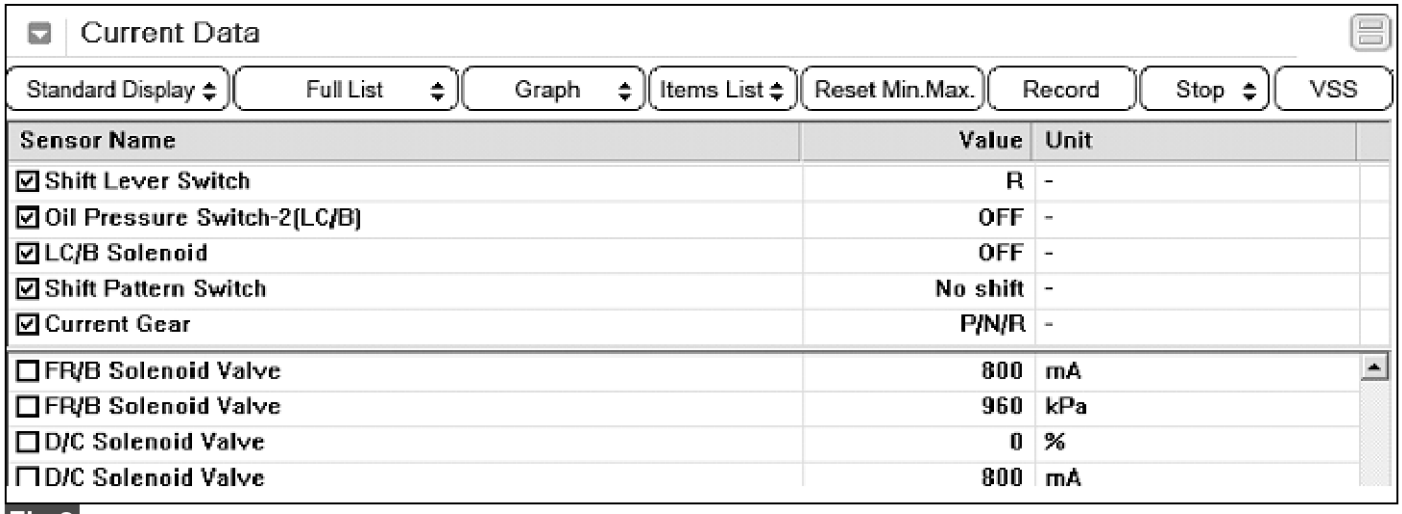


Fig.2

SHMAT9611L

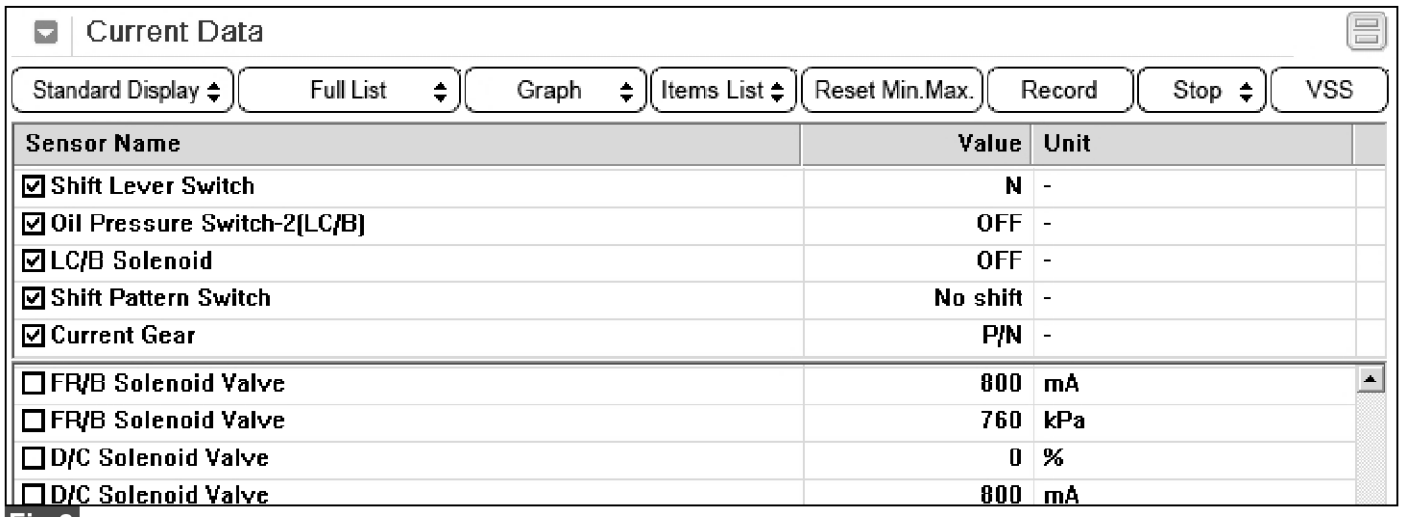


Fig.3

SHMAT9612L

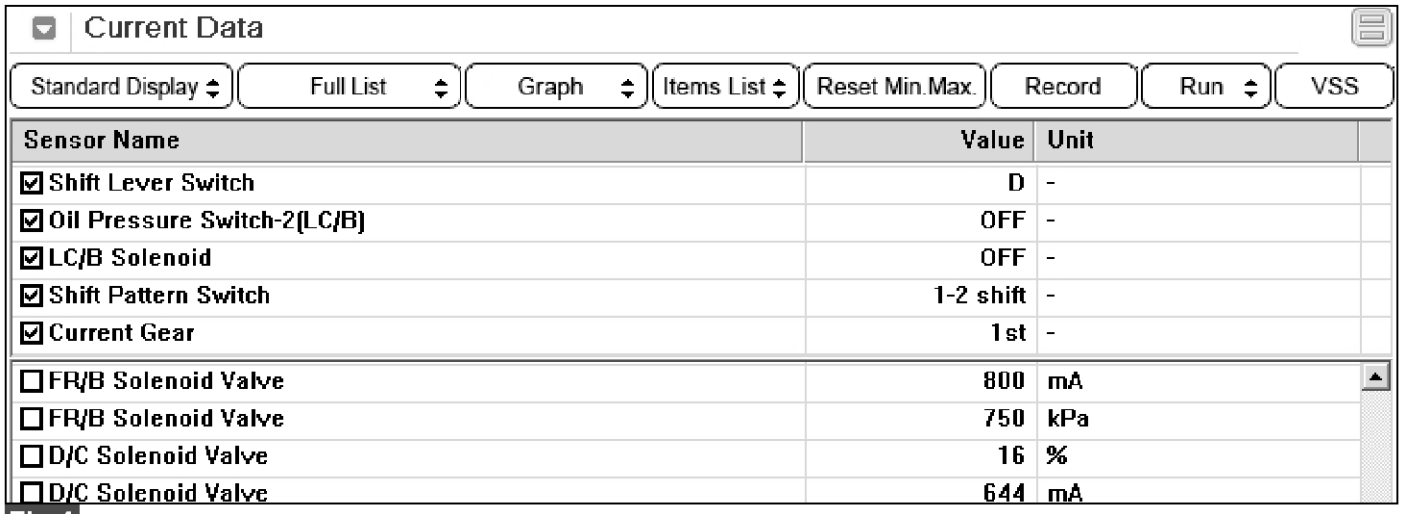


Fig.4

SHMAT9613L

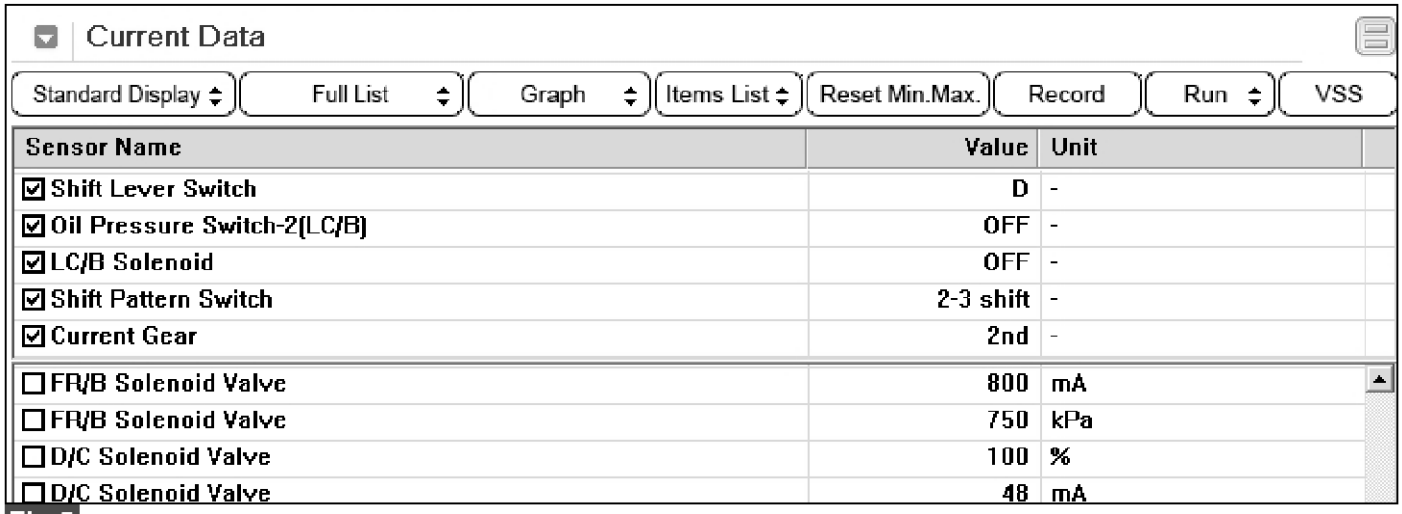


Fig.5

SHMAT9614L

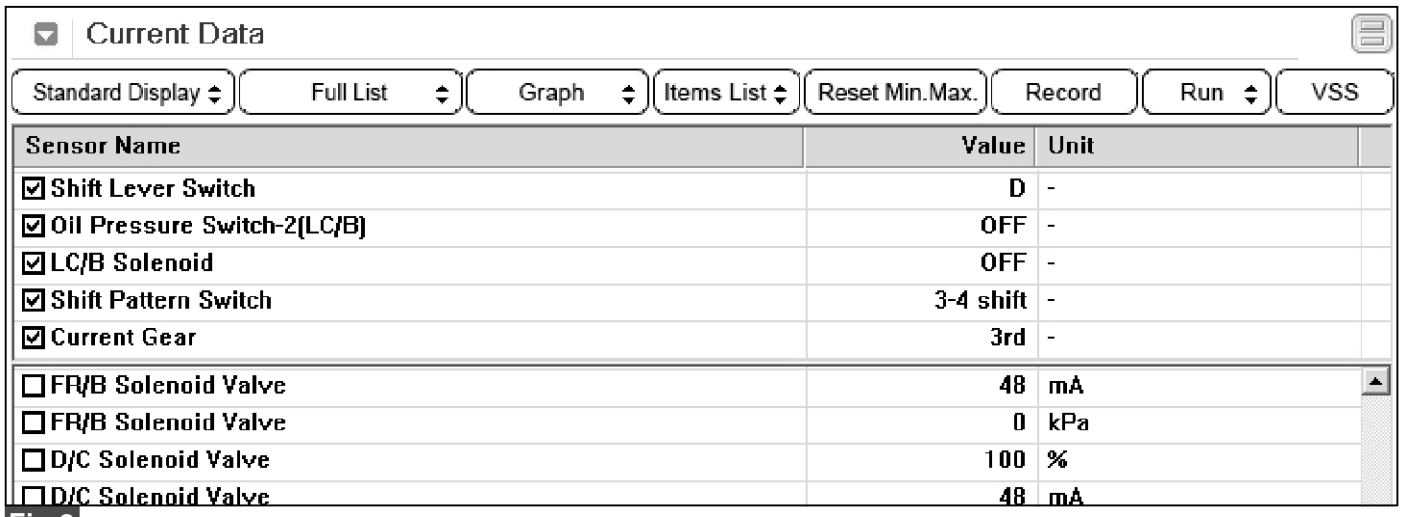


Fig.6

SHMAT9615L

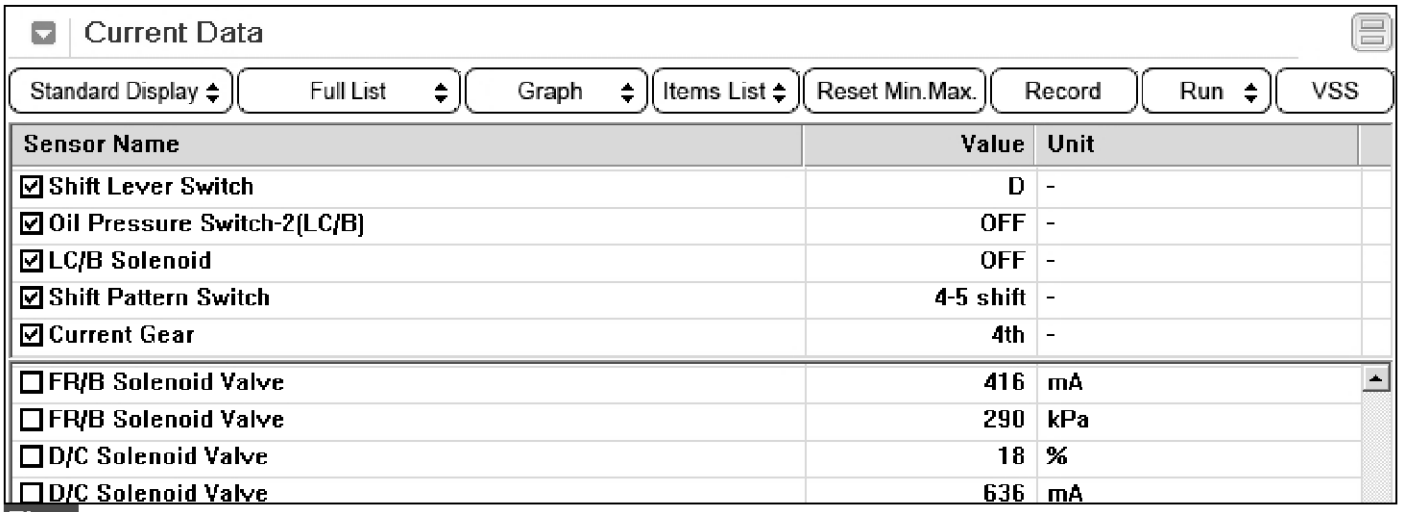


Fig.7

SHMAT9616L

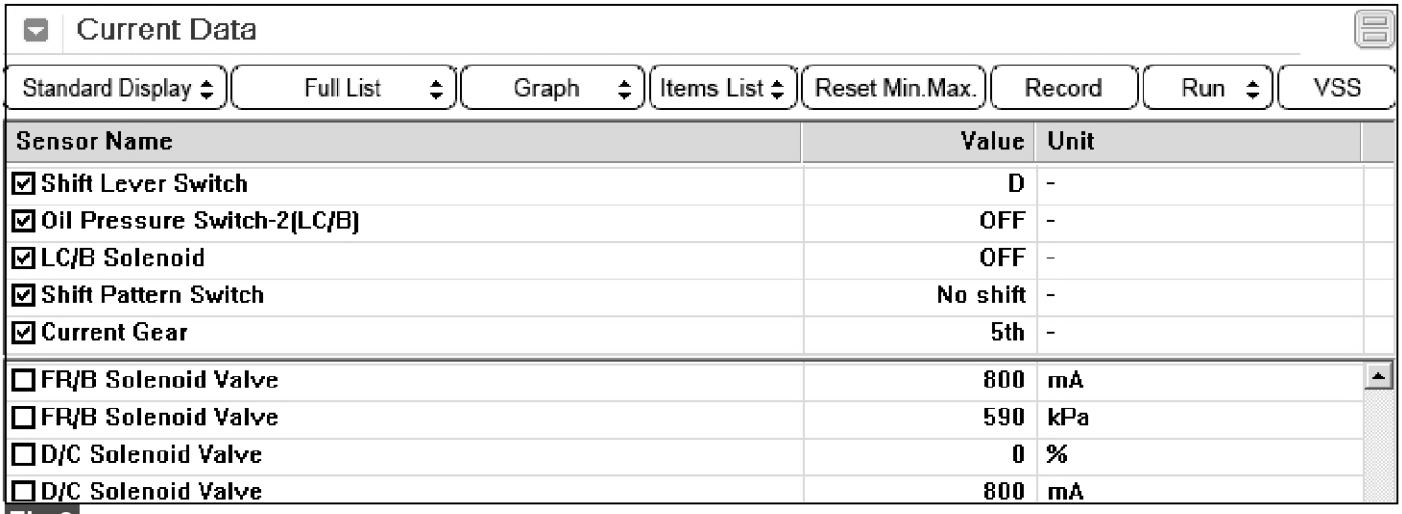


Fig.8

SHMAT9617L

Fig 1) "P" range
Fig 2) "R" range
Fig 3) "N" range
Fig 4) 1st gear in "D" range
Fig 5) 2nd gear in "D" range
Fig 6) 3rd gear in "D" range
Fig 7) 4th gear in "D" range
Fig 8) 5th gear in "D" range

6. Does the "Shift Control Solenoid Valve" follow the reference data ?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for loose-ness, poor connection, bending, corrosion, co-ntamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

Refer to DTC P0743 : Torque Converter Clutch Circuit Electrical.

Power Circuit Inspection

1. Connect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "ON", ENGINE "OFF"
3. Measure voltage between power terminal of LC/B solenoid valve harness connector and chassis ground.

Specification : Approx. Battery Voltage

4. Is the measured voltage within specifications ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check open or short in harness. Repair as necessary and then, go to "Verifcation of Vehicle Repair" procedure.
▶ If Power circuit is O.K, Substitute with a known-good TCM and check for proper operation. If the problem is corrected, replace TCM as necessary and go to "verification of vehicle repair " procedure.

Ground Circuit Inspection

1. Disconnect "ATM Control Unit(CLG01-B)" connector.
2. IGNITION "OFF", ENGINE "OFF".
3. Measure continuity between ground terminal of LC/B control solenoid Valve harness connector and chassis ground.

Specification : Continuity

4. Is the measured resistance within specificatins ?

YES ▶ Go to "Component Inspection" procedure.

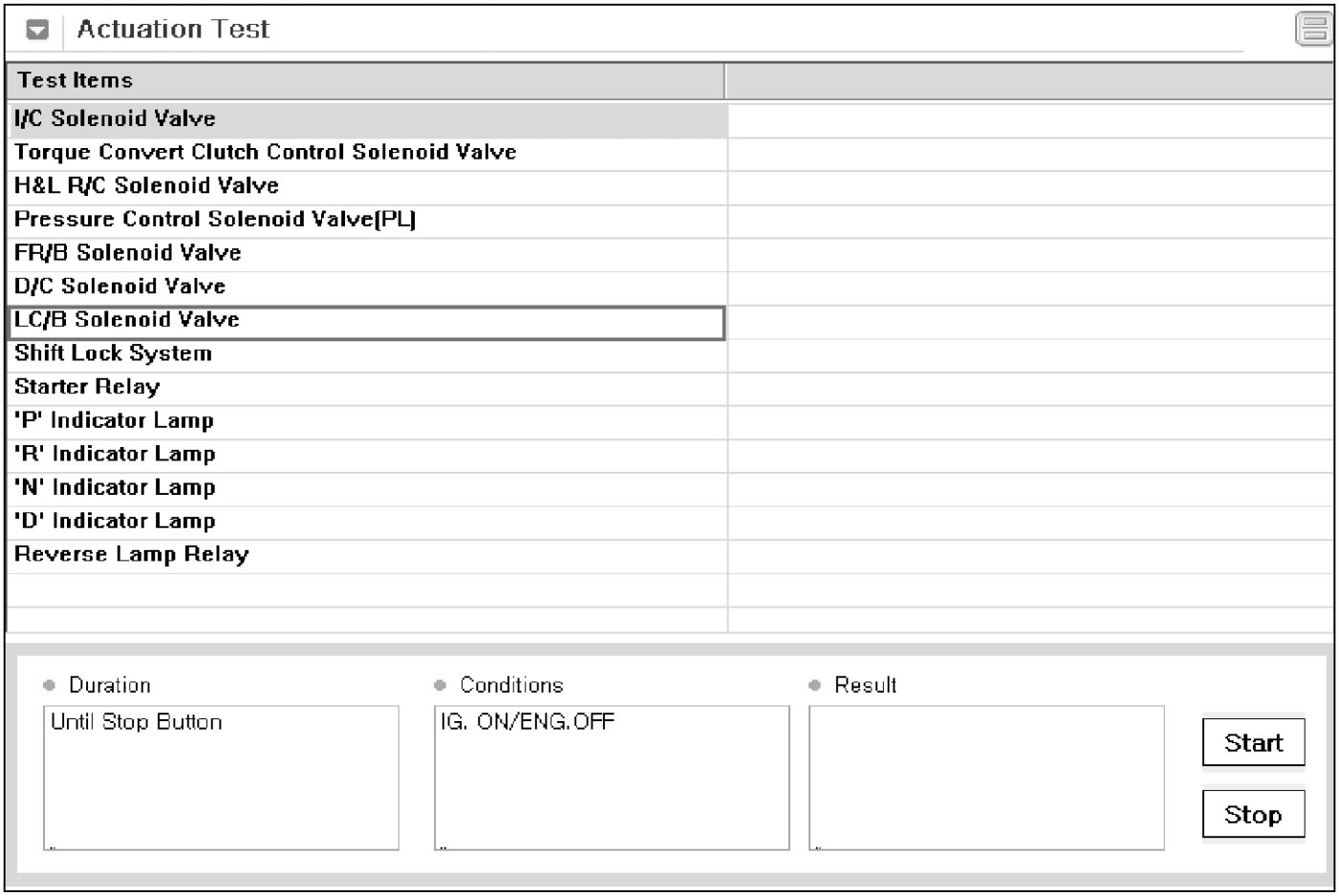
NO ▶ Check open in harness. Repair as necessary and then, go to " Verification of Vehicle Repari" procedure.

Component Inspection

■ Check shift solenoid valve "H&LR/C"

1. Connect Scantool.
2. IGNITION "ON", ENGINE "OFF".
3. Select LC/B Solenoid Valve in Actuation Test and Perform Actuation Test.

Specification : Operation



SHMAT9618L

4. Does the solenoid valve operates when actuation test ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Shift Control Solenoid Valve and check for proper operation. If the problem is corrected, replace Shift Control Solenoid Valve as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

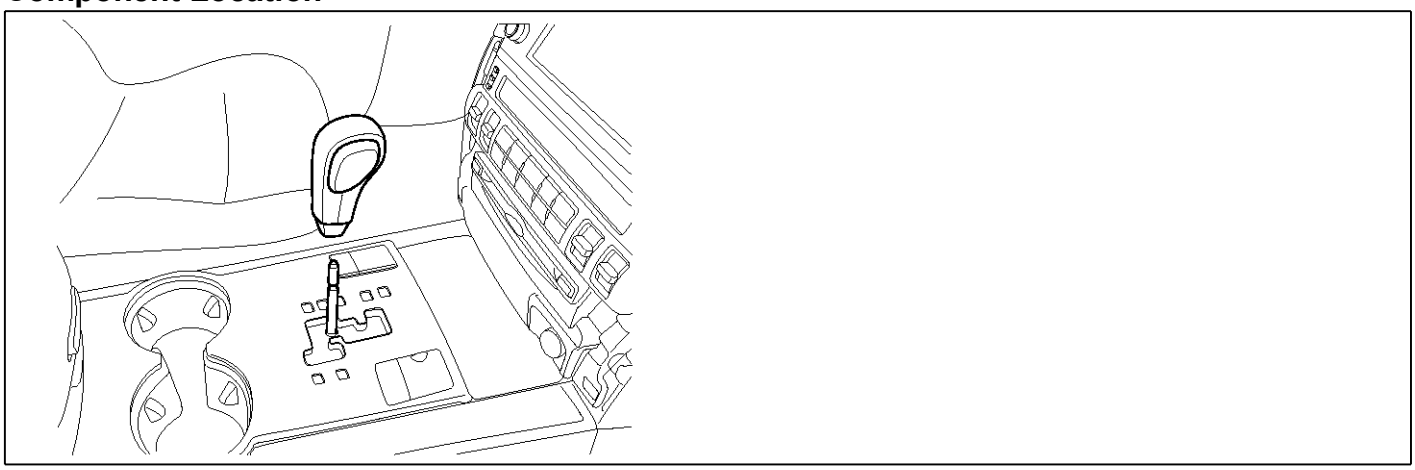
1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

P0819 Up and Down Shift Switch to Transmission Range Correlation

Component Location



SHMAT9496L

General Description

When the shift lever is in the D (Drive) position the output signal of Tansaxle Range Switch is 12V and in all other positions the voltage is 0V. The TCM judges the shift lever position by reading all signals, for the TRANSMISSION Range Switch, simultaneously.

DTC Description

The TCM sets this code when patterns are out of specification based on the table shown below. the TRANSMISSION Range Switch has no output signal for an extended period of time.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Rationality	• Open or short in harness • Faulty Shift Range switch • Faulty TCM
Enable Conditions	• Battery voltage > 10	
Threshold Value	• Abnormal input signal is detected	
Diagnostic Time	• More than 5sec	
Fail Safe	• Prevention of Manual Shift	

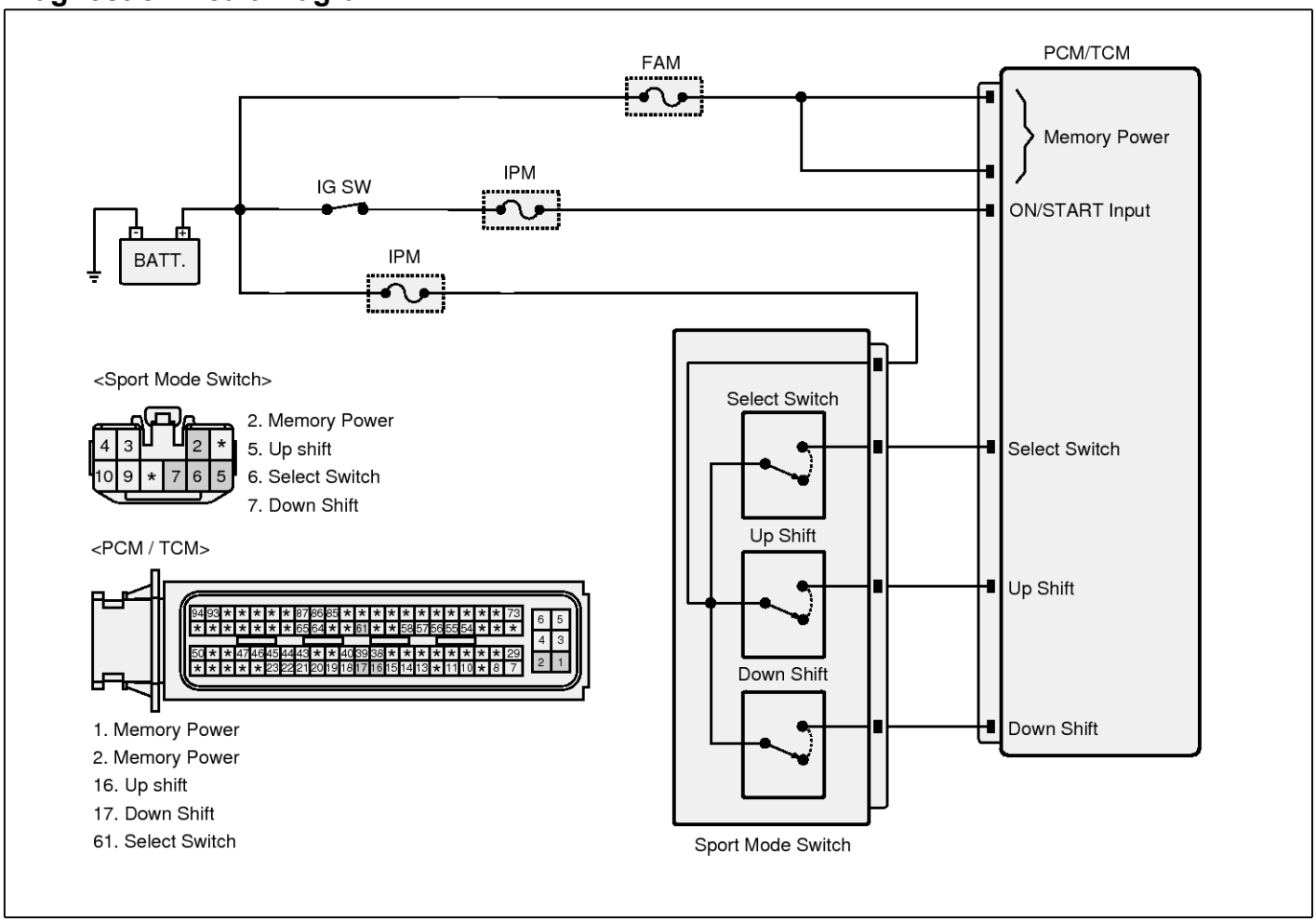
Specification

Figure 1) A/T range pattern

A/T Range Switch				Range Decision	Remarks
SW 1	SW 2	SW 3	SW 4		
OFF	OFF	OFF	OFF	Pst	P start
OFF	OFF	ON	OFF	P	P
OFF	OFF	ON	ON	P-R	Intermediate
ON	OFF	ON	ON	R	R
ON	OFF	ON	OFF	N-R	Intermediate
ON	OFF	OFF	OFF	Nst	N start
ON	OFF	OFF	ON	N-D	Intermediate
ON	ON	OFF	ON	D	D
OFF	ON	OFF	ON	3	3
OFF	ON	ON	ON	2	2
OFF	ON	ON	OFF	1	1
Irregular Pattern				Other	

[OFF= 5V, ON = 0V]

Diagnostic Circuit Diagram



SHMAT9701L

Monitor Scantool Data

1. Connect scantool to data link connector(DLC).
2. Ignition "ON" & Engine "OFF".
3. Monitor the "SPORTS MODE SELECT S/W, SPORTS MODE UP S/W, SPORTS MODE DOWN S/W " parameter on the scantool.
4. Move selector lever to "SPORTS MODE".

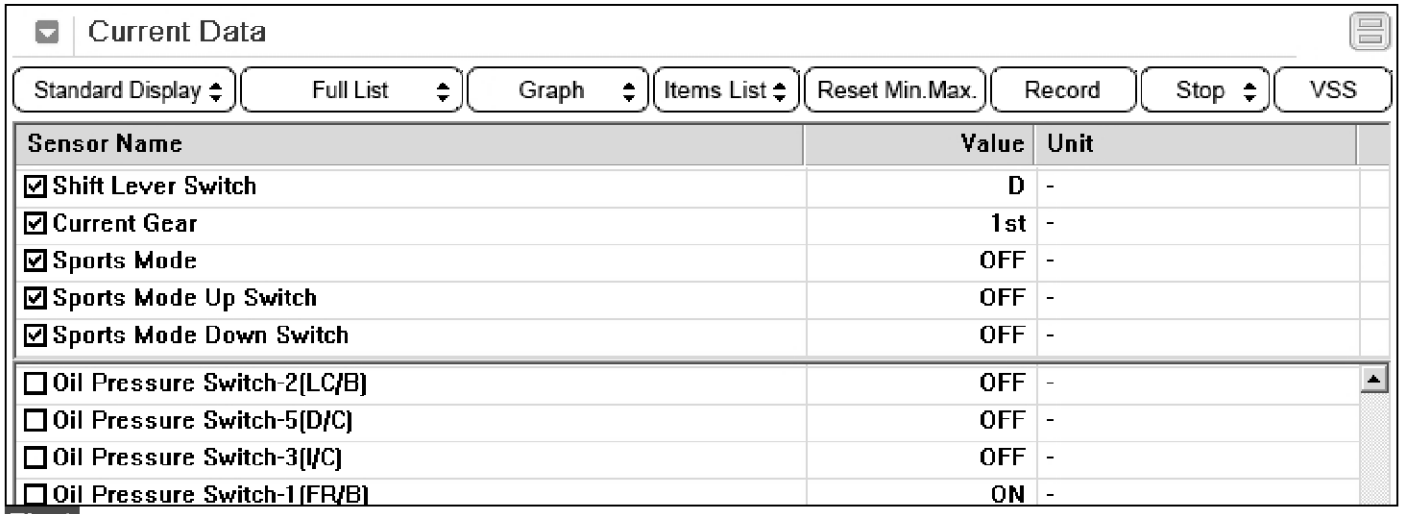


Fig.1

SHMAT9619L

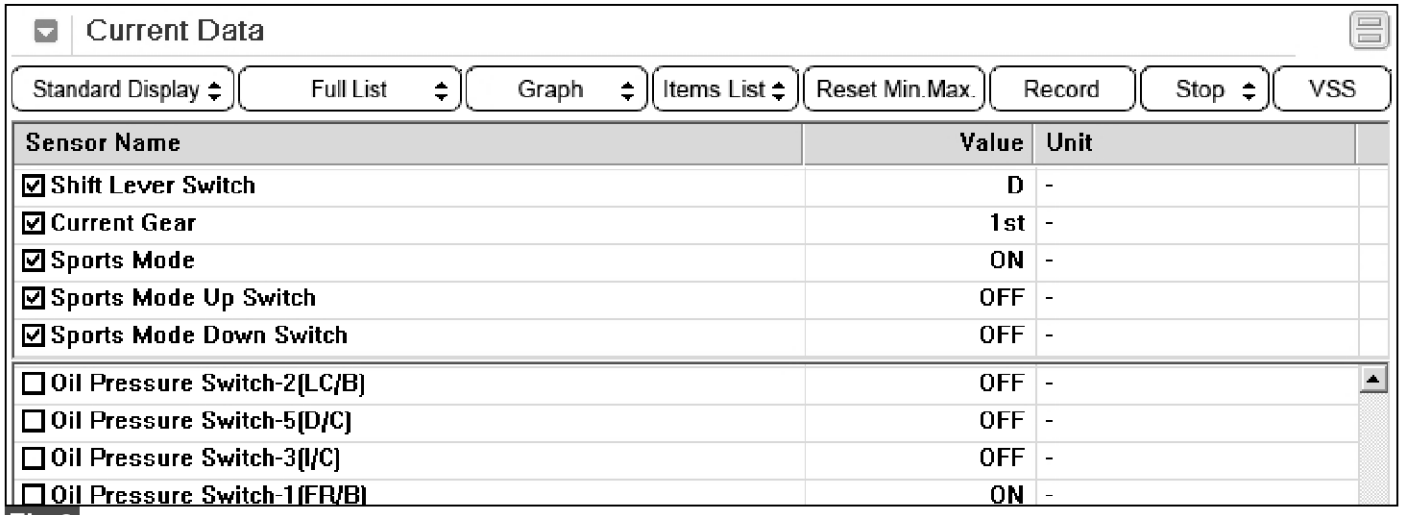


Fig.2

SHMAT9620L

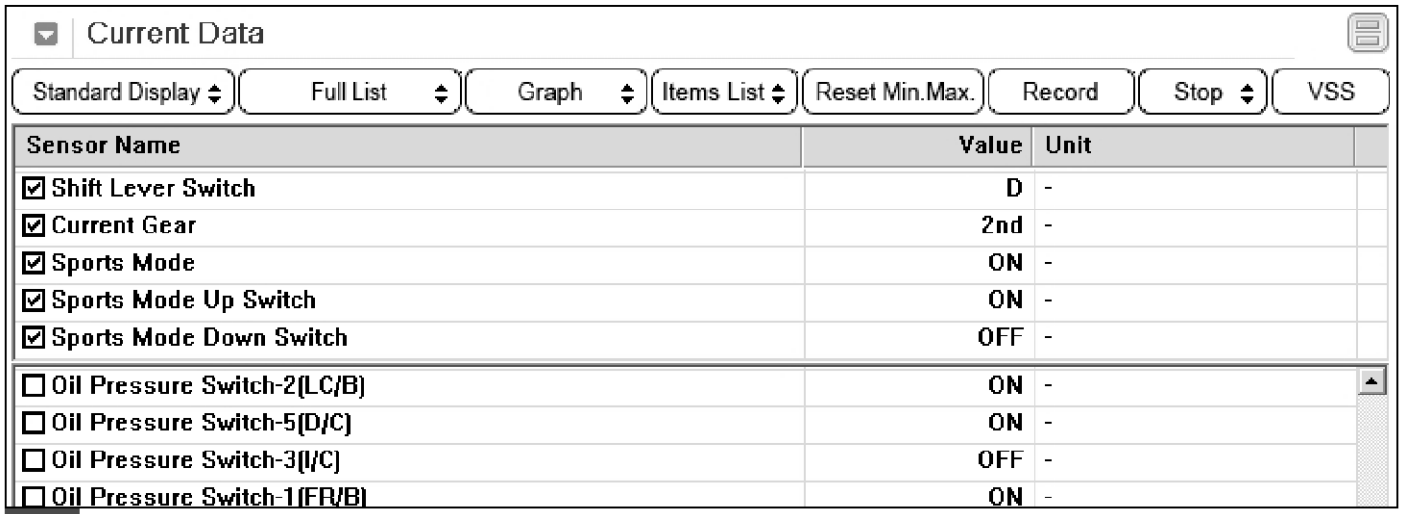


Fig.3

SHMAT9621L

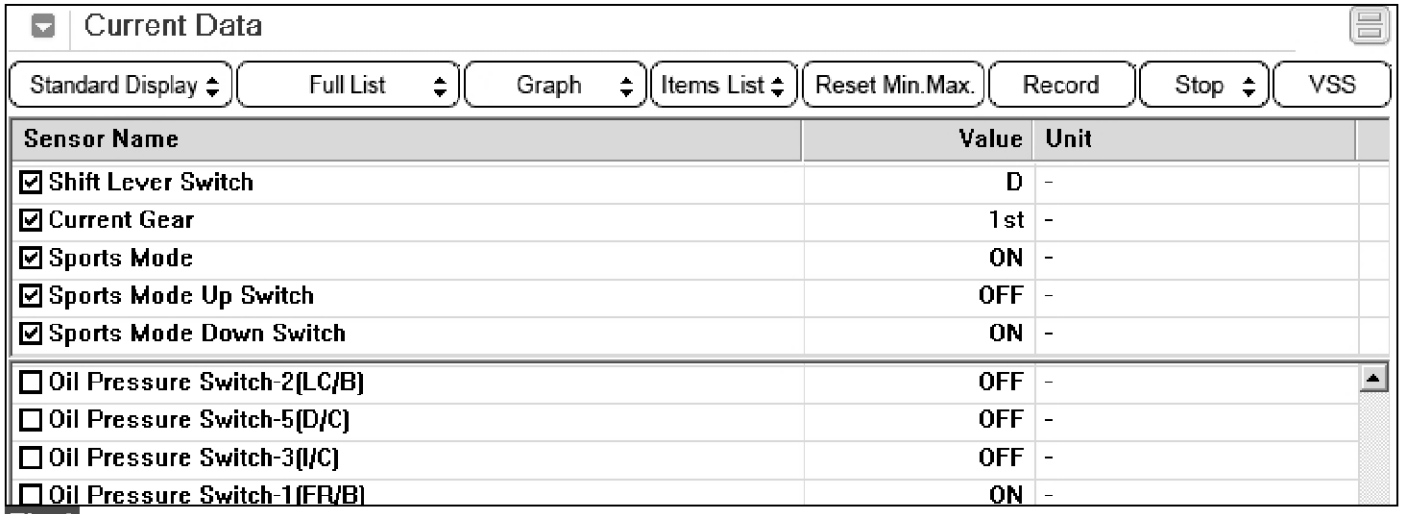


Fig.4

SHMAT9622L

Fig 1) "D" range

Fig 2) "Sports Mode ON"

Fig 3) "Up switch ON"

Fig 4) "Down switch ON"

5. Does "SPORTS MODE SELECT S/W" follow the reference data?

YES ▶ Fault is intermittent caused by poor contact in the sensor's and/or PCM/TCM's connector or was repaired and PCM/TCM memory was not cleared. Throughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.Repair or replace as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

1. Disconnect "Sports Mode Switch" connector.
2. Ignition "ON" & Engine "OFF".
3. Measure voltage between ON/START input terminal of PCM/TCM harness connector and chasssis ground.

Specification : Approx. 12V

4. Is the meausred voltage within specifications ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Check fuse is blown off or open or short in harness. Repair as necessary and then, go to " Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

1. Disconnect "TCM" connector.
2. Ignition "ON" & Engine "OFF".
3. Shift to sports mode position and select shift up and down.
4. Measure voltage between up and down terminal of TCM harness connector and chassis ground.

Specification : Approx. 12V

5. Is the measured voltage within specifications ?

YES ▶ Substitute with a known-good "PCM/TCM" and check for proper operation. If the problem i s corrected, replace "PCM/TCM" and Go to "v-erification of vehicle repair" procedure.

NO ▶ Check open or short in harness. Substitute with a known-good "Sports Mode Switch" and check for proper operation. If the problem is co-rrected, replace "Sports Mode Switch" and Go to "verification of vehicle repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

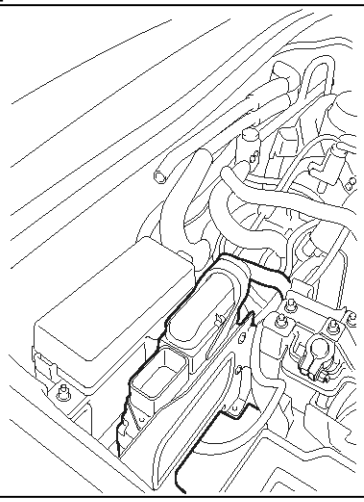
1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting proced-ure.

NO ▶ System performing to specification at this ti-me.

U0001 High Speed CAN Communication Bus off

Component Location



SHMAT9497L

General Description

The TCM can either receive data from the Engine Control Module or ABS control module, or it can send data to the ECM and ABSCM by using CAN communication. The CAN communicaton is one of the vehicle communications method, which is now widely used to transfer the vehicle data.

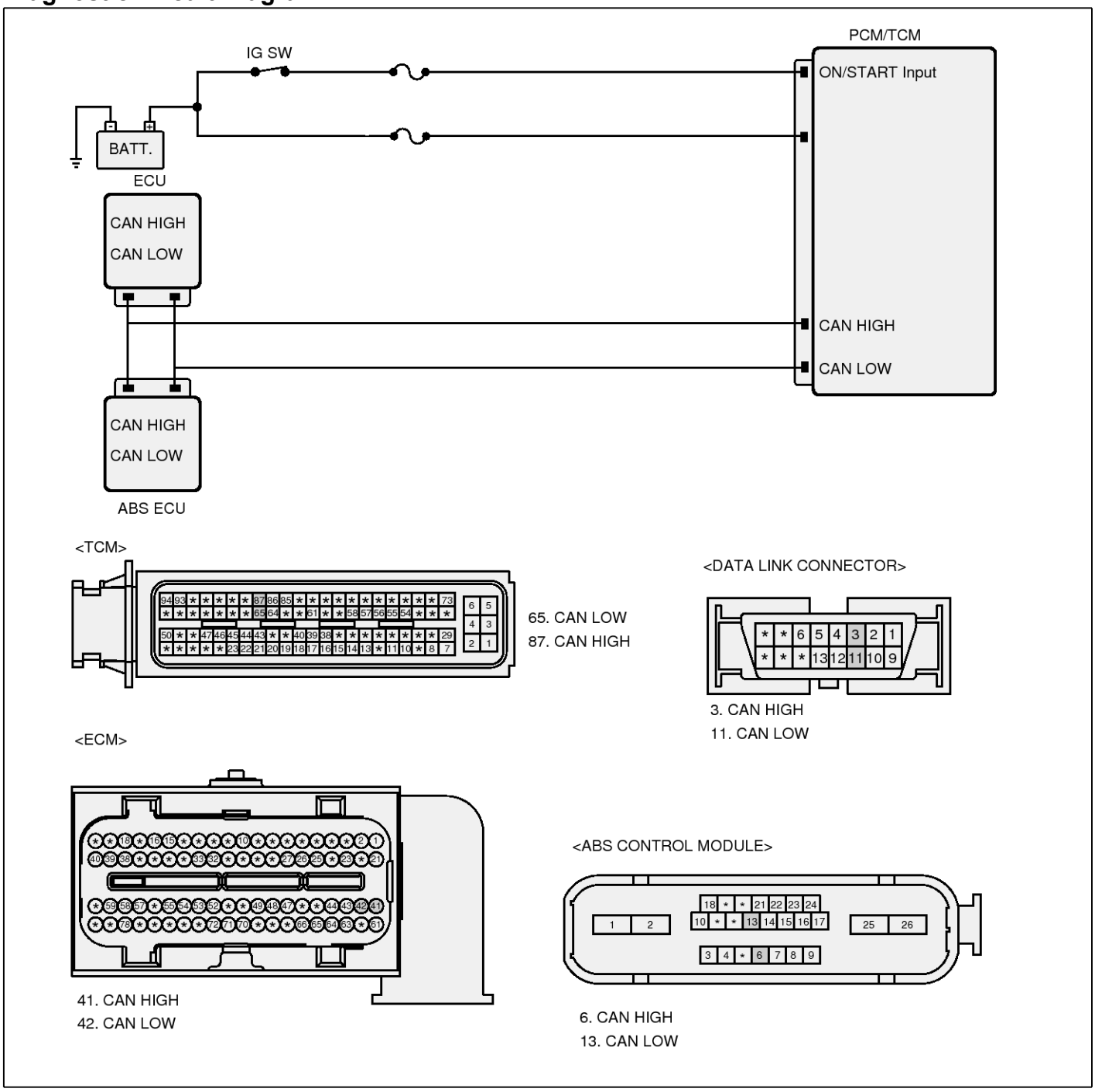
DTC Description

The TCM reads data on the CAN-BUS line and checks whether the data is equal to the data which the TCM sentbefore. If the data is not the same the TCM decides that either the CAN-BUS line or TCM are malfuncting and sets this code.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Message Check	• Open or short in CAN line • Faulty ECM • Faulty TCM
Enable Conditions	• IG "ON" • Battery Voltage > 10V • Input Speed > 300rpm	
Threshold Value	• BUS OFF	
Diagnostic Time	• More than 2sec.	
Fail Safe	• Default value	

Diagnostic Circuit Diagram



SHMAT9707L

Signal Waveform & Data

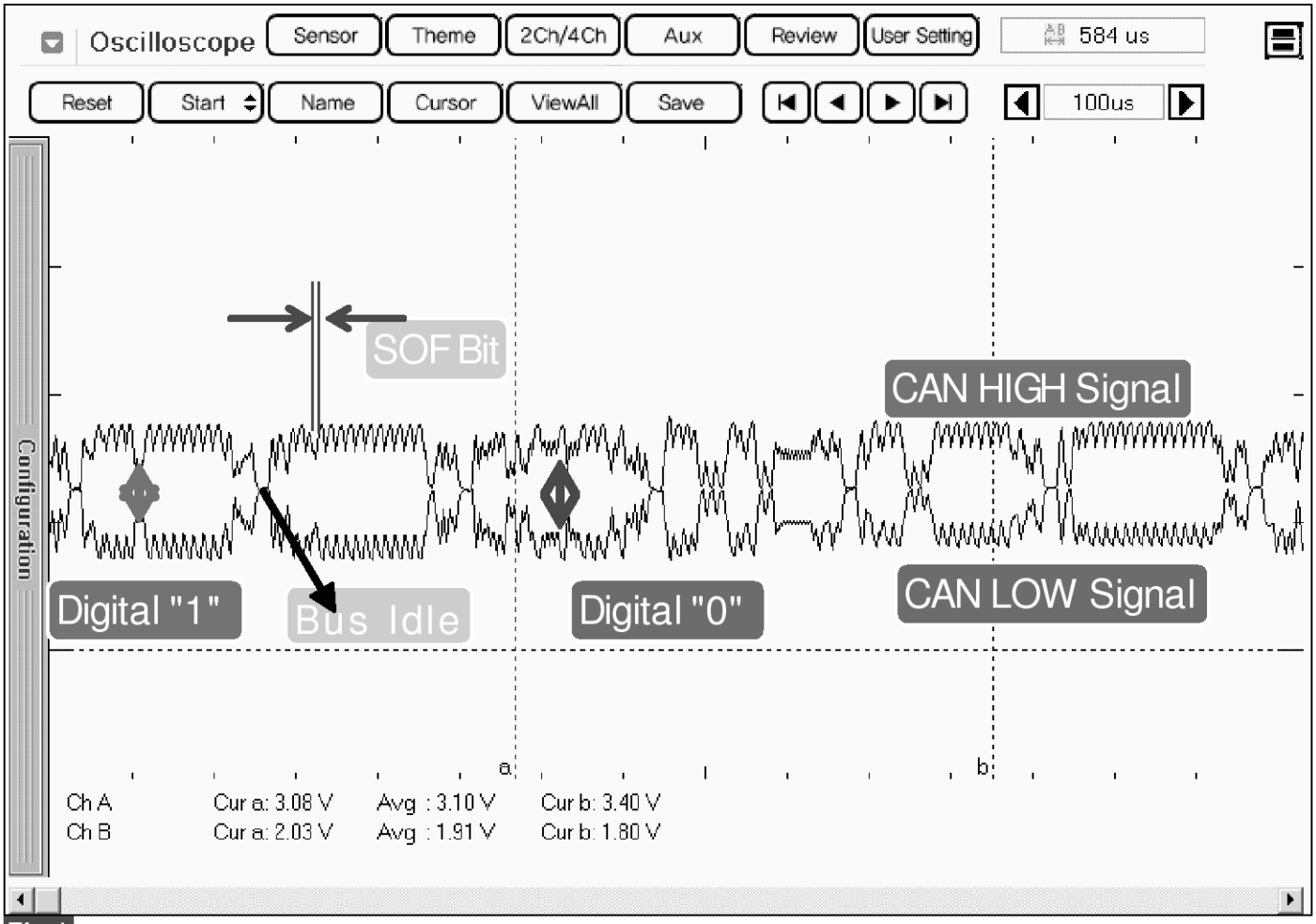


Fig.1

SHMAT9623L

Fig 1) "CAN Communication"

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "verification of vehicle repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure

Signal Circuit Inspection

1. Ignition "OFF".
2. Disconnect "ECU" connector.
3. Measure resistance between CAN high terminal and CAN low terminal of PCM/TCM harness connector.

Specification : Approx. 120 Ω ± 10Ω

4. Is the measured resistance within specifications ?

YES ▶ Substitute with a known-good "PCM/TCM" and check for proper operation. If the problem i s corrected, replace "PCM/TCM" and Go to "v-erification of vehicle repair" procedure.

NO ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage and resistor for CAN communication is open. Repair as necessary and then, go to 'Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

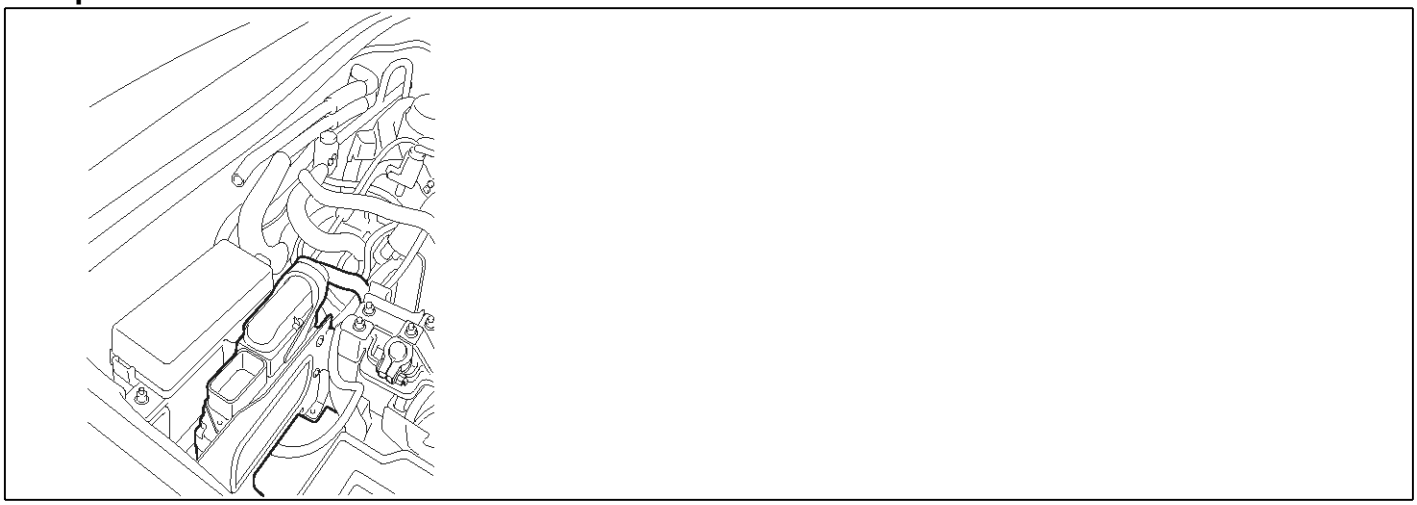
1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Enable conditions in General information.
4. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

U0100 Lost Communication With ECM/PCM "A"

Component Location



SHMAT9497L

General Description

Refer to DTC U0001 : High Speed CAN Communication Bus.

DTC Description

Refer to DTC U0001 : High Speed CAN Communication Bus.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Message Check	• Open or short in CAN line • Faulty ECM • Faulty TCM
Enable Conditions	• IG "ON" • Battery Voltage > 10V • Input Speed > 300rpm	
Threshold Value	• No signal on CAN line	
Diagnostic Time	• More than 0.5sec.	
Fail Safe	• Default value	

Diagnostic Circuit Diagram

Refer to DTC U0001 : High Speed CAN Communication Bus.

Signal Waveform & Data

Refer to DTC U0001 : High Speed CAN Communication Bus.

Terminal & Connector Inspection

Refer to DTC U0001 : High Speed CAN Communication Bus.

Signal Circuit Inspection

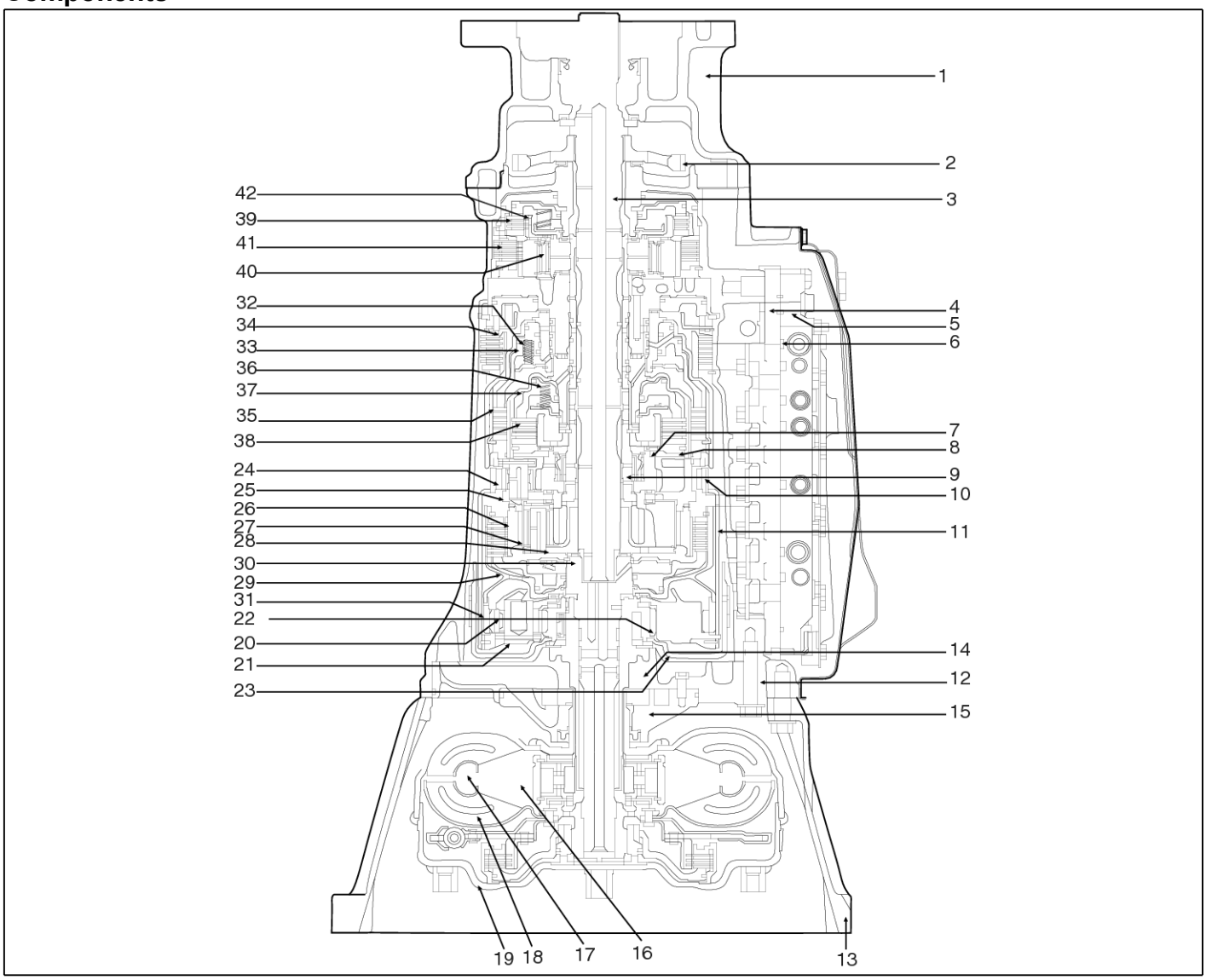
Refer to DTC U0001 : High Speed CAN Communication Bus.

Verification of Vehicle Repair

Refer to DTC U0001 : High Speed CAN Communication Bus.

Automatic Transaxle

Components

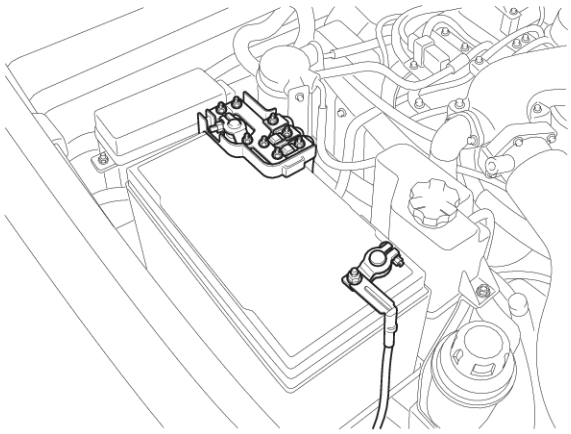


SHMAT8024L

1. Adapter case (4WD)
2. Parking gear
3. Output shaft
4. Control valve upper body
5. Control valve lower body
6. Separator plate assembly
7. Rear sun gear
8. Rear sun plate
9. Middle sun gear assembly
10. Rear annulus gear assembly
11. Rear annulus cell
12. Automatic transmission case
13. Converter housing
14. Oil pump cover
15. Oil pump housing
16. Stator
17. Impeller assembly
18. Turbine & lockup assembly
19. Torque converter cover assembly
20. Front pinion gear
21. Front planetary carrier
22. Front sun gear
23. Front brake drum
24. Rear pinion gear
25. Rear planetary carrier plate
26. Middle annulus gear
27. Middle pinion gear
28. Middle planetary carrier
29. Input clutch drum
30. Input shaft
31. Front annulus gear
32. Direct clutch return spring
33. Direct clutch piston
34. Reverse brake hub
35. Direct clutch assembly
36. High & low reverse clutch return spring
37. High & low reverse clutch piston
38. High & low reveres clutch assembly
39. Low coast brake clutch assembly
40. Forward one-way clutch
41. Forward brake clutch assembly
42. Low coast brake hub

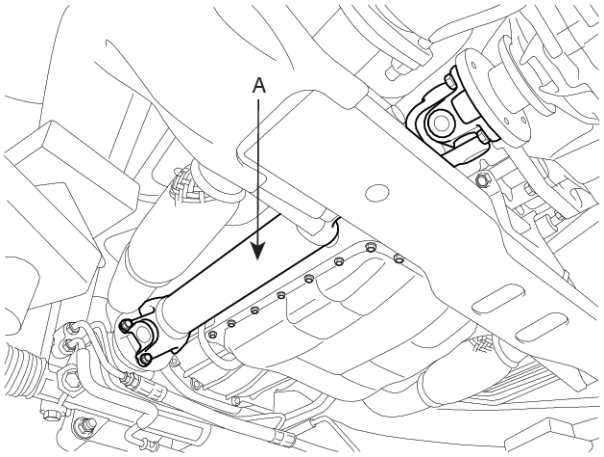
Removal

1. Disconnect the battery (-) terminal.



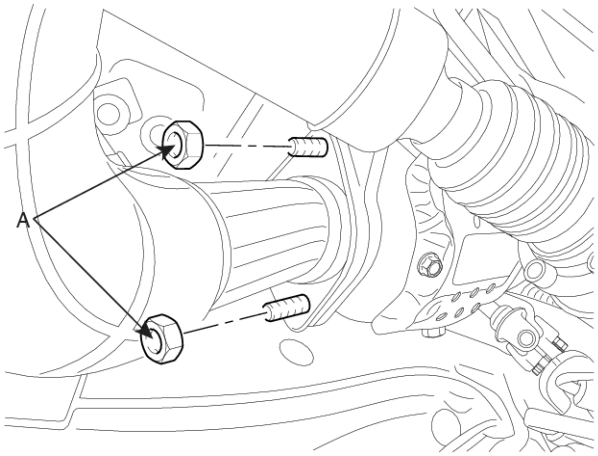
SHMAT8001D

2. Remove the front propeller shaft(A). (4WD)

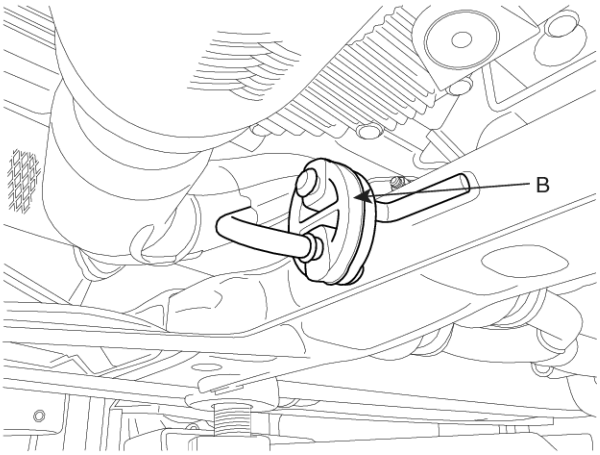


SBLAT6007L

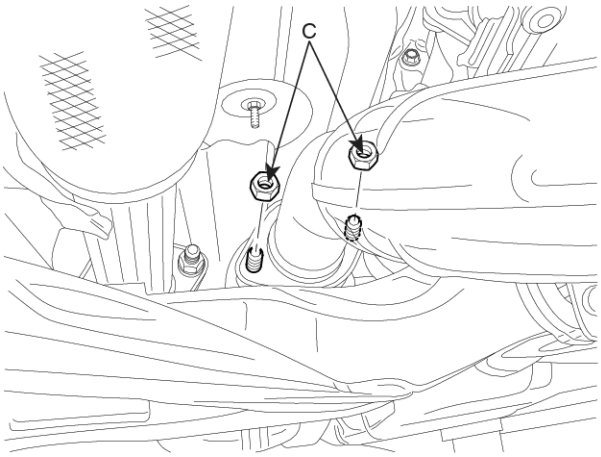
3. Remove the front muffler(A) or muffer hanger rubber(B), by removing rear muffler(C).



SHMAT8002L

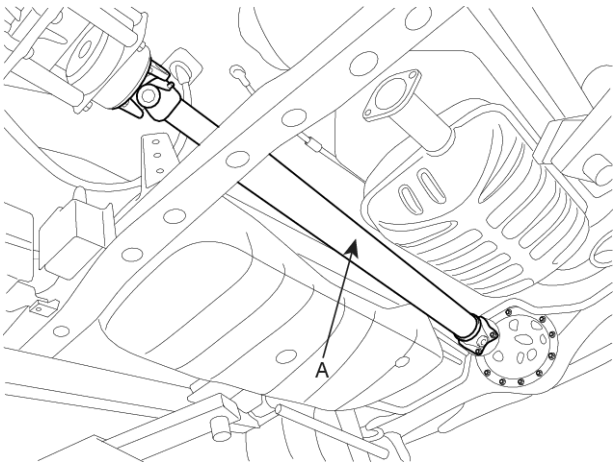


SHMAT8003L



SHMAT8004L

4. Remove the rear propeller shaft(A).

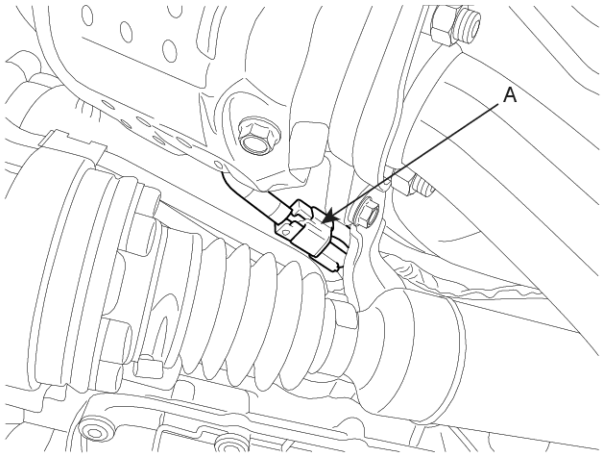


SBLAT6009L

5. Support the transaxle with a jack

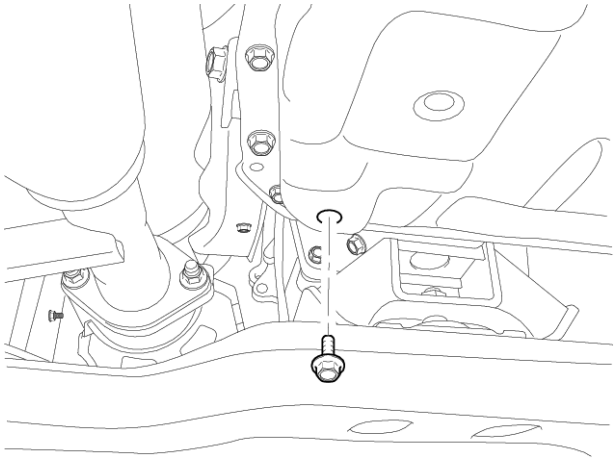
⚠CAUTION
Be careful not to give a shock or damage to the plastic oil pan.

6. Disconnect the oxygen sensor(A) connector.



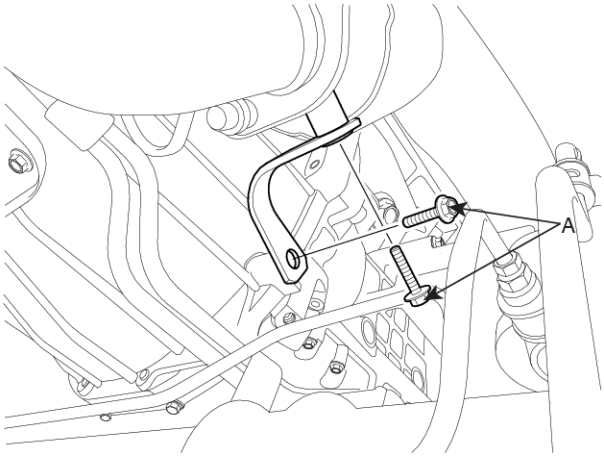
SHMAT8005L

7. Drain the automatic transmission fluid.

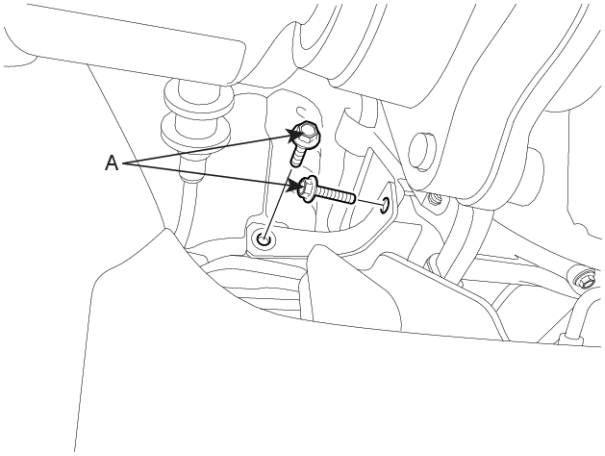


SBLAT6003L

8. Remove the exhaust manifold stay bolt (A).

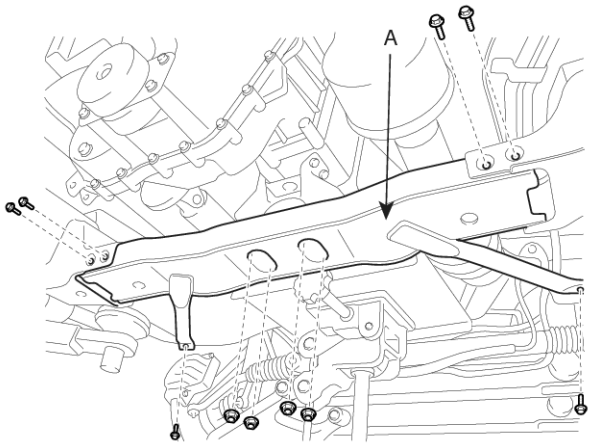


SHMAT8114L



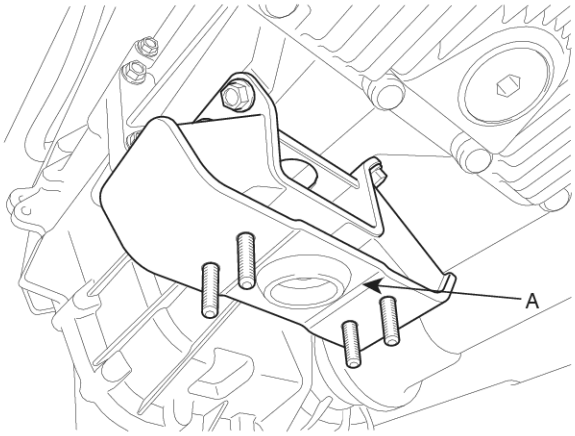
SHMAT8115L

9. Remove the cross member(A).



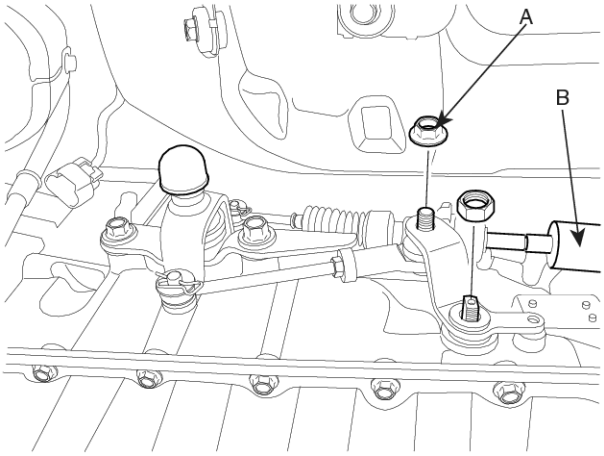
SHMAT8002D

10. Remove the insulator support bracket(A).



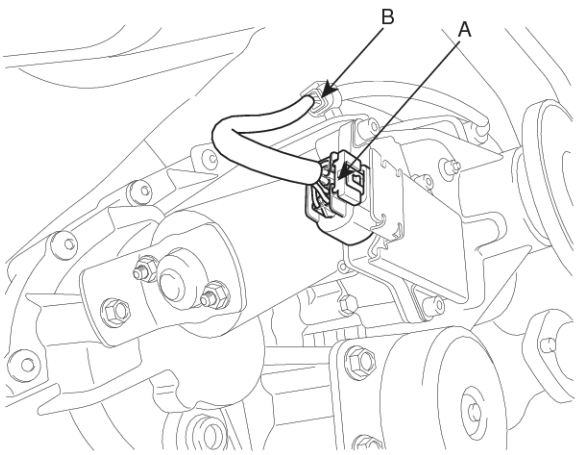
SHMAT8020L

11. Disconnect the shift cable assembly (B) by removing the nut (A-3ea)



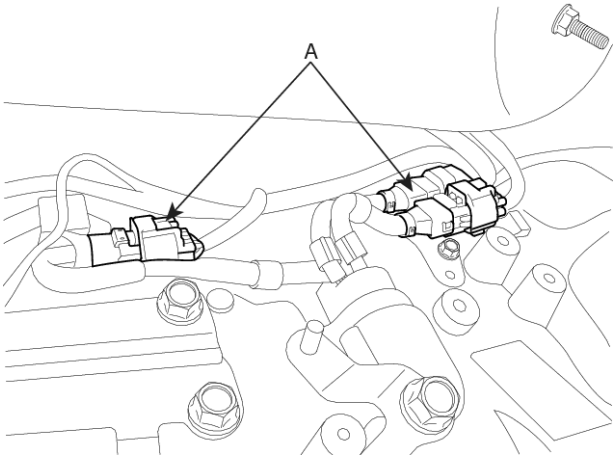
SHMAT8110L

12. Disconnect the 4WD ECU connector(A) or EMC connector(B).



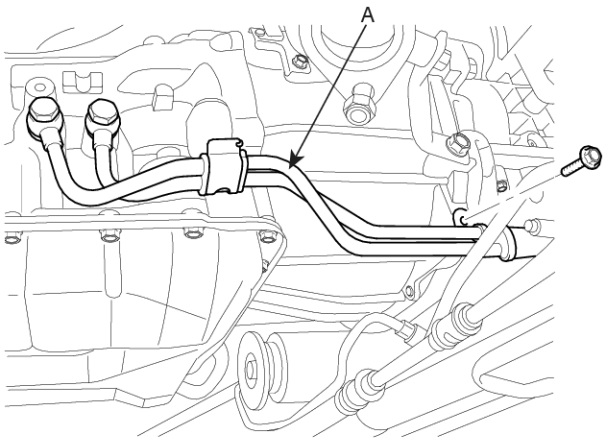
SHMAT8005D

13. Disconnect the transmission wire harness connectors(A)



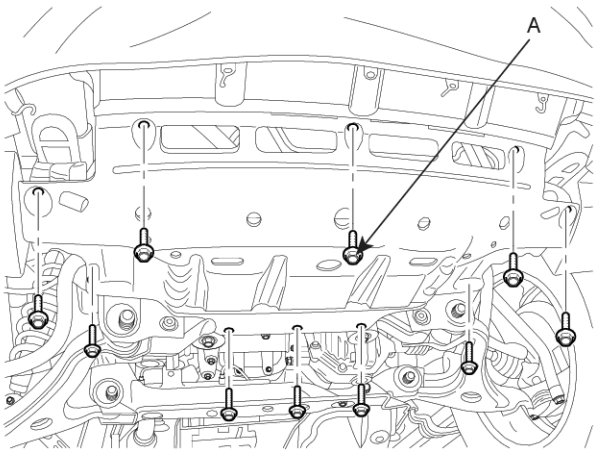
SBLAT6024L

14. Install the oil cooler pipes(A).



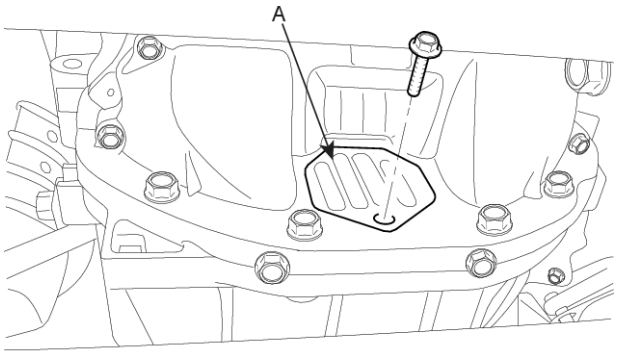
SBLAT6012L

15. Remove the under cover bolts(A-10).



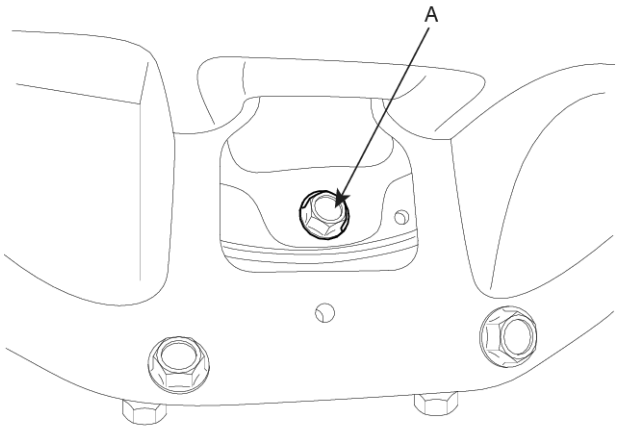
SHMAT8009L

16. Remove the drive plate cover(A).



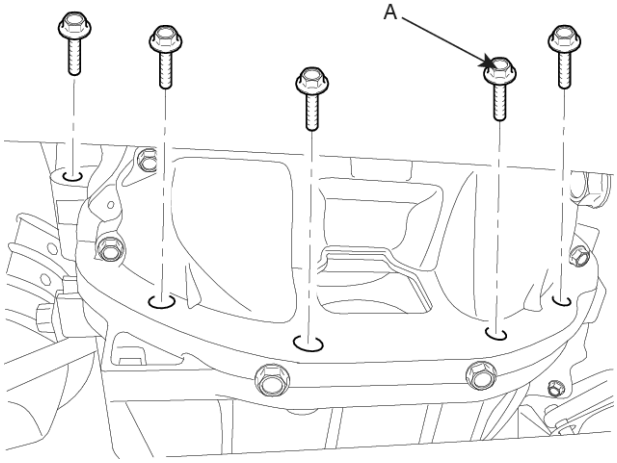
SBLAT6014L

17. Remove the torque converter mounting bolts (A-6ea) by rotating the crank shaft.



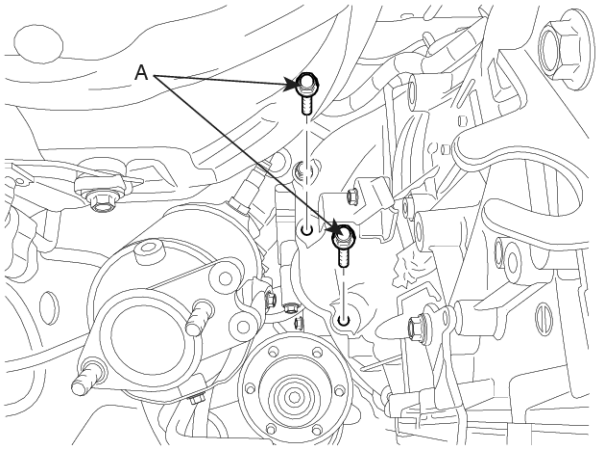
SBLAT6015L

18. Remove the transmission lower mounting bolts(A).



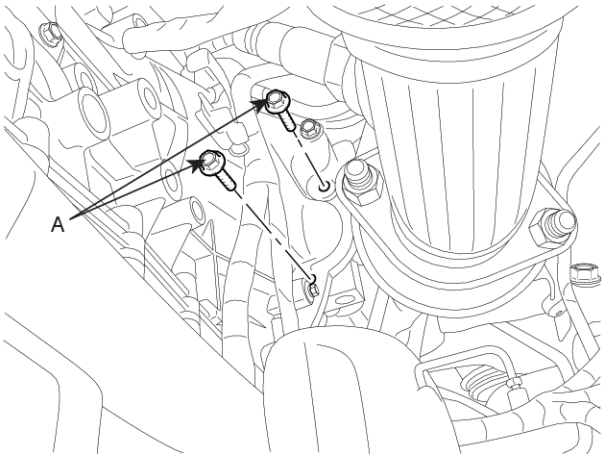
SBLAT6016L

19. Remove the mounting bolts (A-2ea) for the starter motor.



SHMAT8010L

20. Remove the mounting bolts (A-2ea).

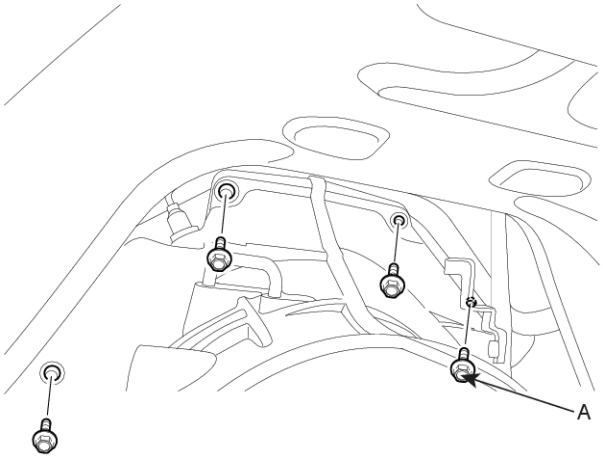


SHMAT8011L

⚠CAUTION

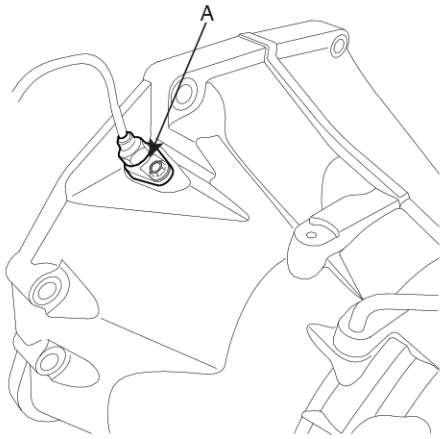
Before removing one mounting bolt on the transmission side and the other bolt for the starter motor, remove the cross member and lower the transmission assembly.

21. Remove the mounting bolts (A-4ea) on the transmission side.



SHMAT8012L

22. Disconnect the CKP sensor(A).



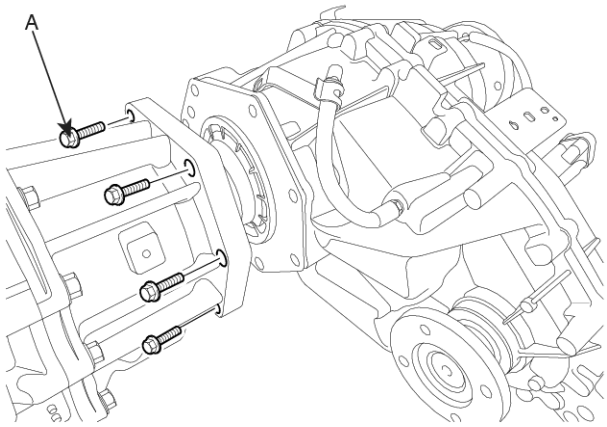
SHMAT8013L

23. Remove the tansmission assembly by lowering the supporting jack.

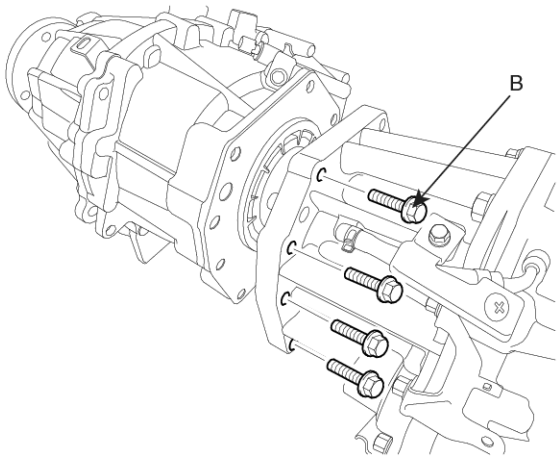
⚠CAUTION

Be careful not to damage tubes, hoses or wire.

24. Remove the mounting bolts(A,B-4ea) and the transfer assembly.



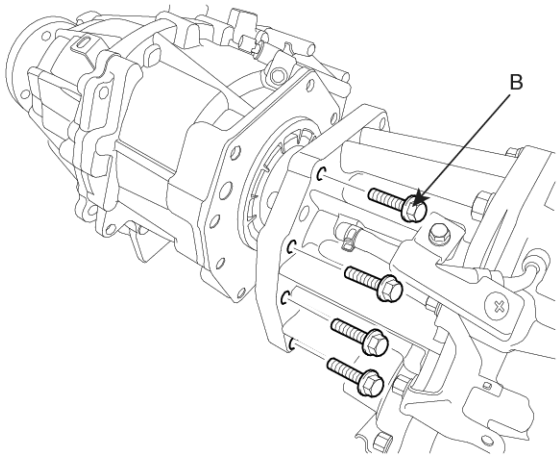
SHMAT8112L



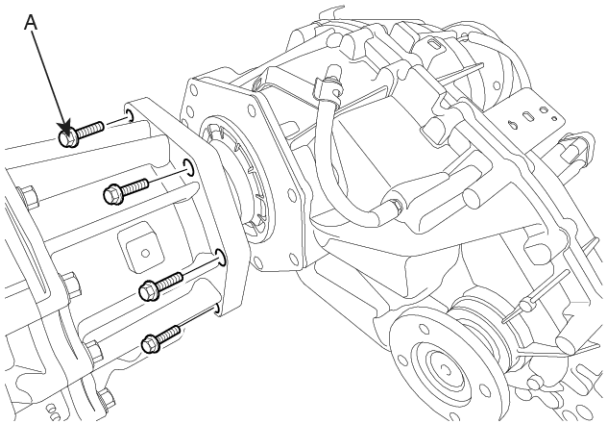
SHMAT8113L

Installation

1. Install the mounting bolts(A,B-4ea) and the transfer assembly.



SHMAT8113L

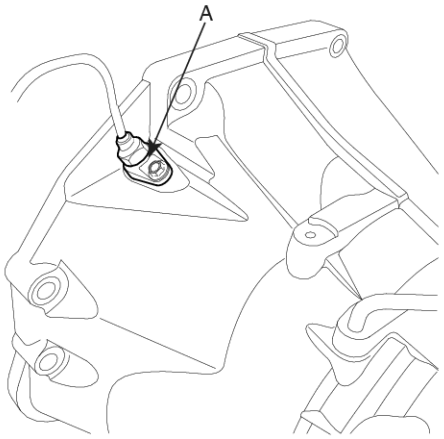


SHMAT8112L

2. Lowering the vehicle or lifting up a jack, install the transmission assembly.

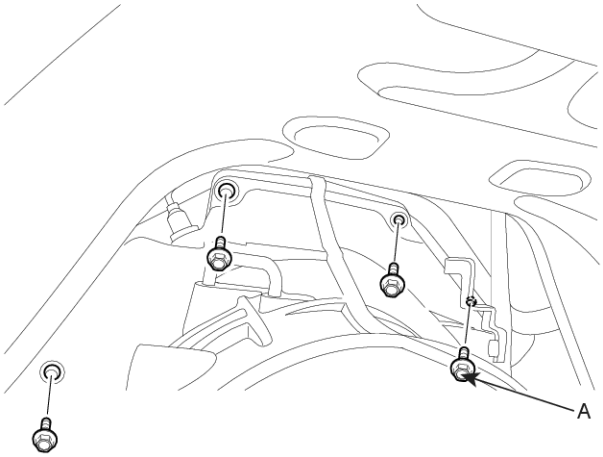
⚠CAUTION
Be careful not to damage tubes, hoses or wire.

3. Connect the CKP sensor(A).



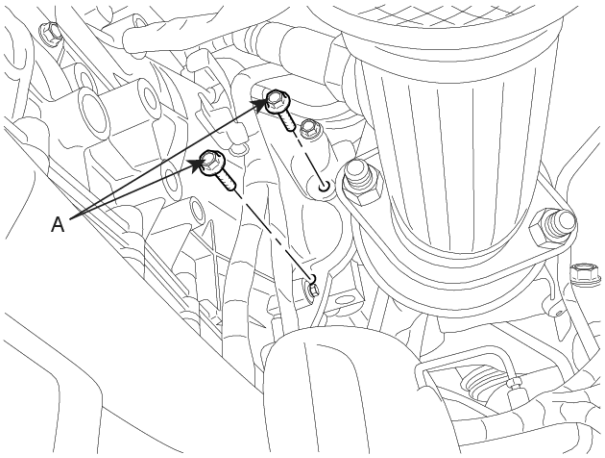
SHMAT8013L

4. Install the mounting bolts (A-4ea) on the transmission side.



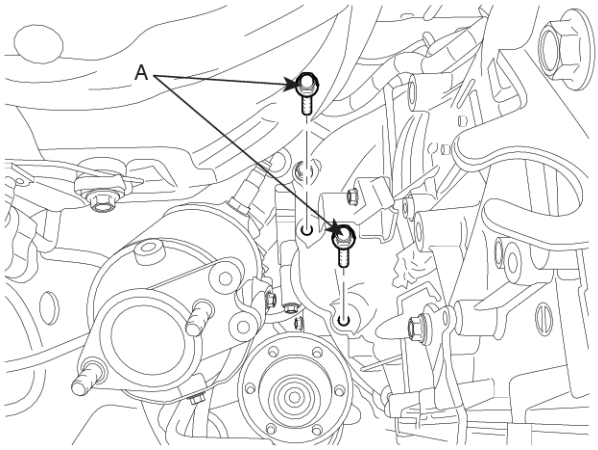
SHMAT8012L

5. Install the mounting bolts (A-2ea).



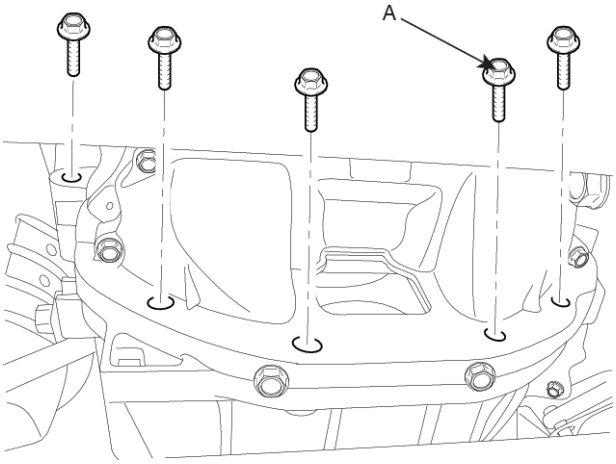
SHMAT8011L

6. Install the mounting bolts (A-2ea) for the starter motor.



SHMAT8010L

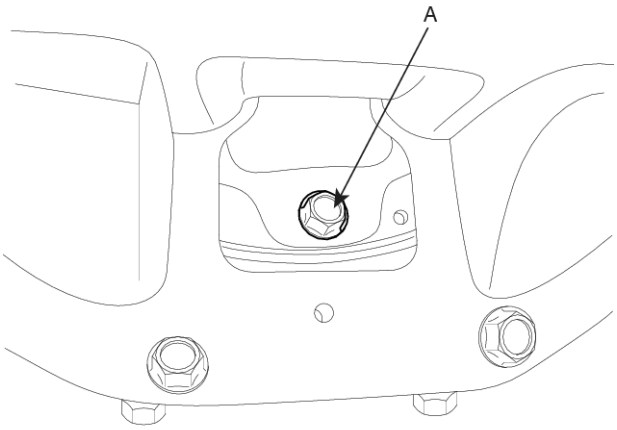
7. Install the transmission lower mounting bolts(A).



SBLAT6016L

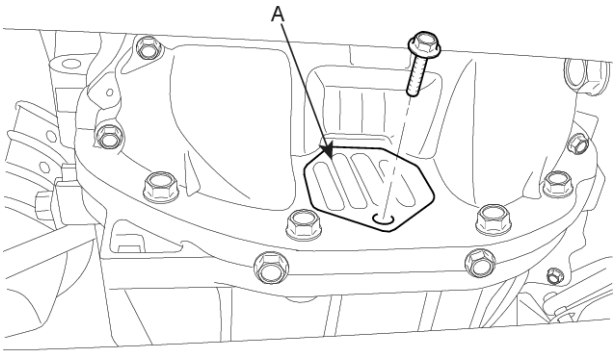
8. Install the torque converter mounting bolts (A-6ea) by rotating the crank shaft.

Tightening torque :
34.3~41.1Nm (3.5~4.2kgf.m, 25.3~30.3lb-ft)



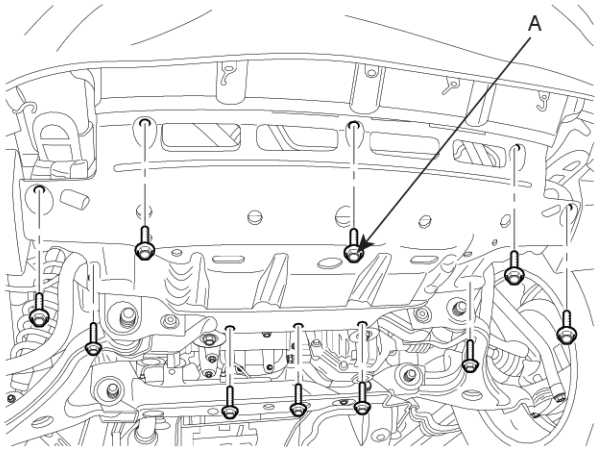
SBLAT6015L

9. Install the drive plate cover(A).



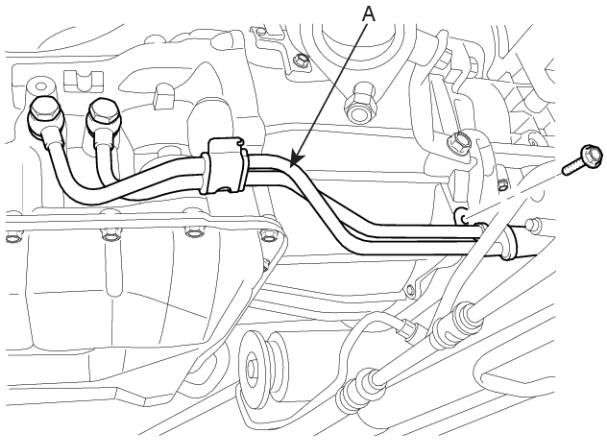
SBLAT6014L

10. Install the under cover bolts(A-10).



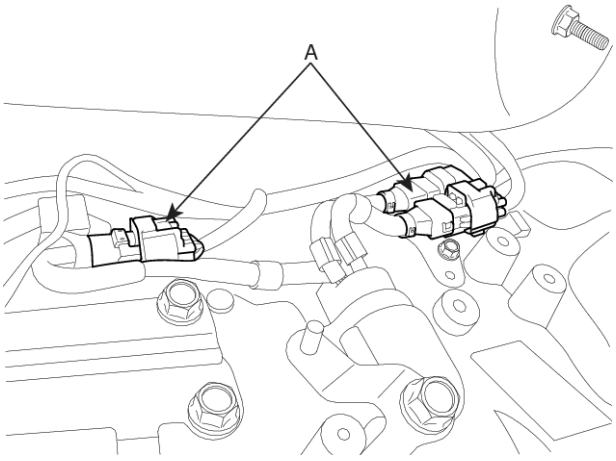
SHMAT8009L

11. Install the oil cooler pipes(A).



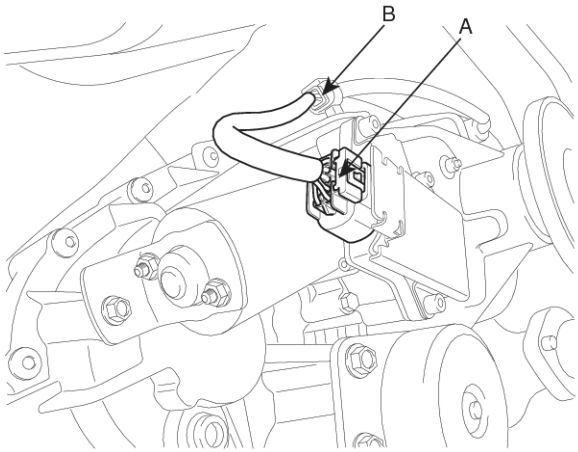
SBLAT6012L

12. Connect the transmission wire harness connectors(A)



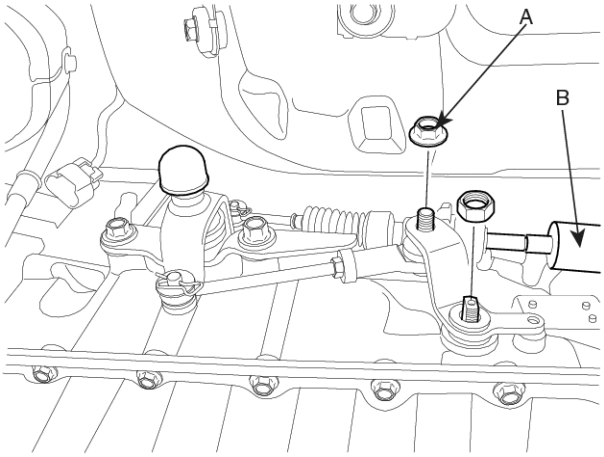
SBLAT6024L

13. Connect the 4WD ECU connector(A) or EMC connector(B).



SHMAT8005D

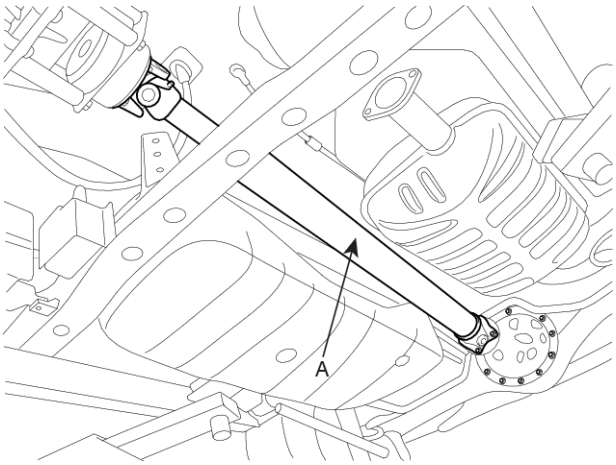
14. Connect the shift cable assembly (B) by tightening the nut (A-3ea)



SHMAT8110L

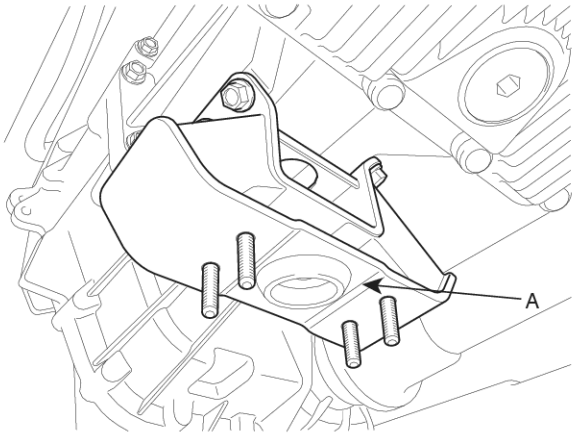
15. Install the rear propeller shaft(A).

Tightening torque :
58.83~68.64Nm(6~7kgf.m, 43.39~50.63lb-ft)



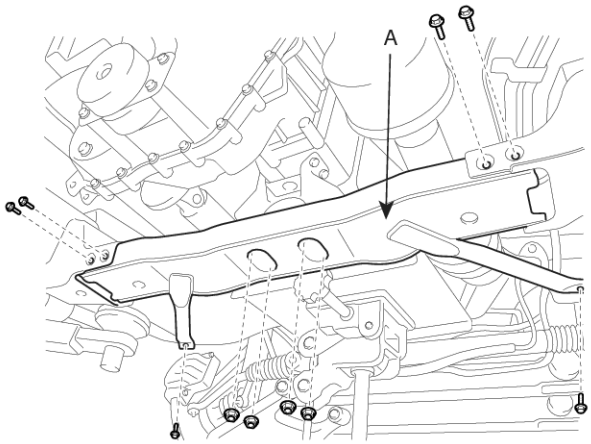
SBLAT6009L

16. Install the insulator support bracket(A).



SHMAT8020L

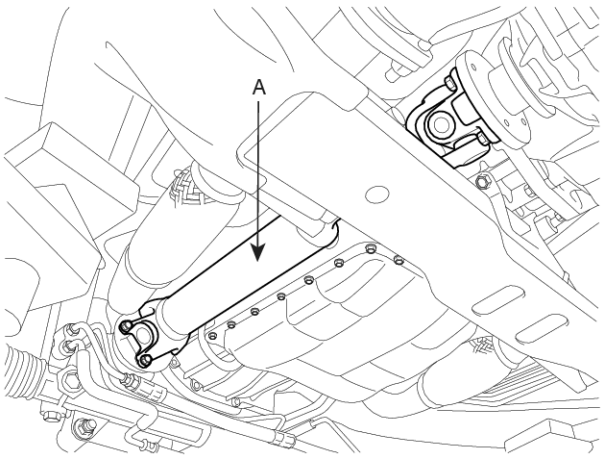
17. Install the cross member(A)



SHMAT8002D

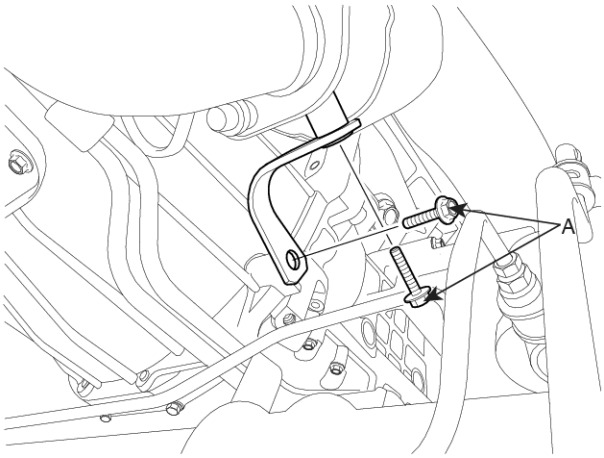
18. Install the front propeller shaft(A). (4WD)

Tightening torque :
58.83~68.64Nm(6~7kgf.m, 43.39~50.63lb-ft)

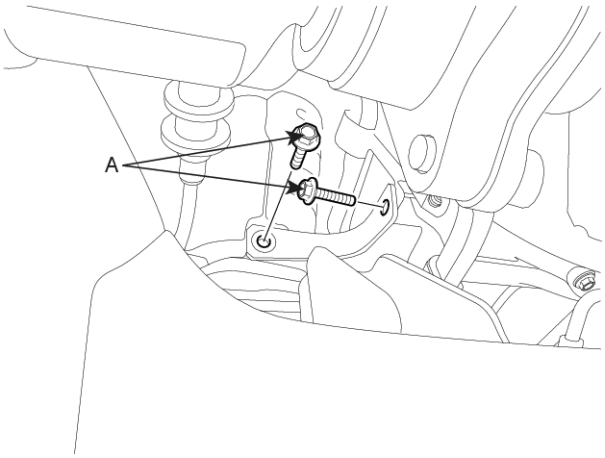


SBLAT6007L

19. Install the exhaust manifold stay bolt (A).

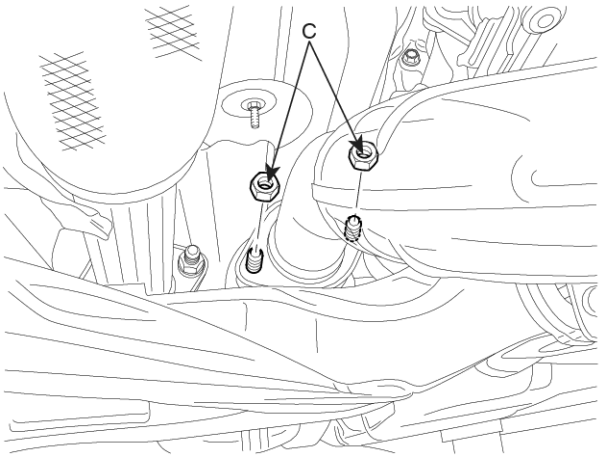


SHMAT8114L

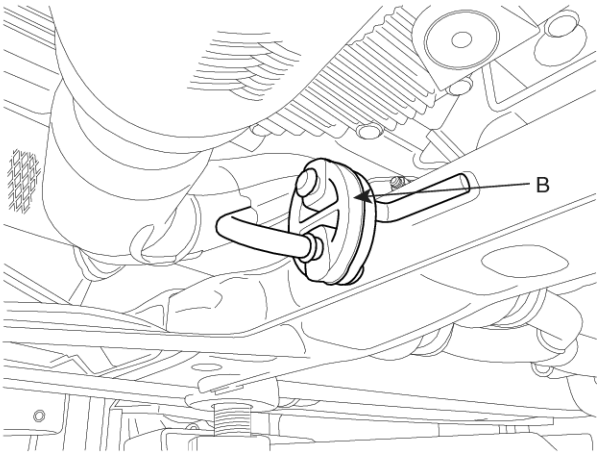


SHMAT8115L

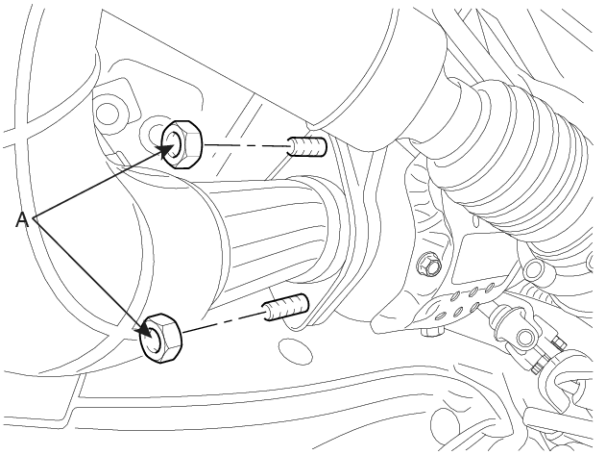
20. Install the front muffler(A) or muffer hanger rubber(B), by removing rear muffler(C).



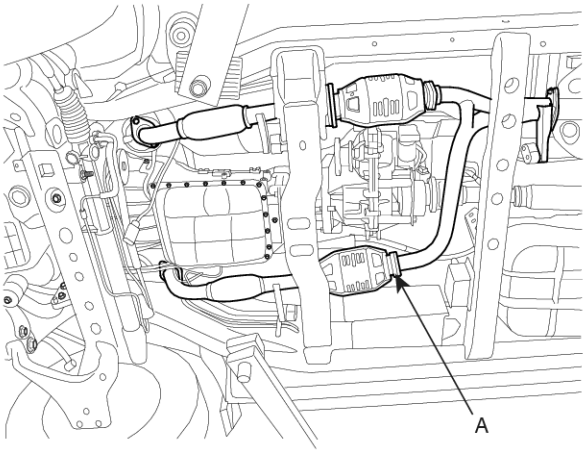
SHMAT8004L



SHMAT8003L

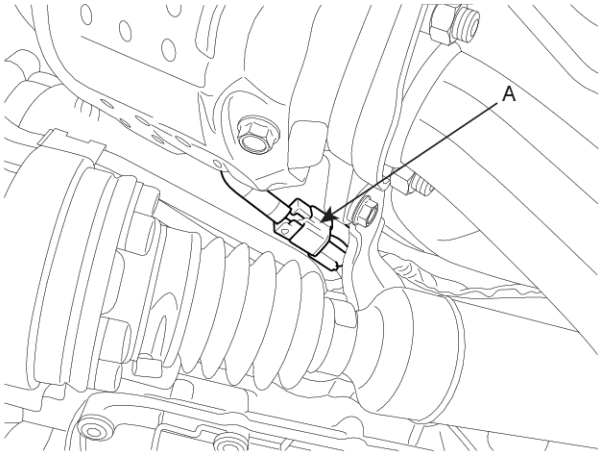


SHMAT8002L



SBLAT6008L

21. Connect the oxygen sensor(A) connector.

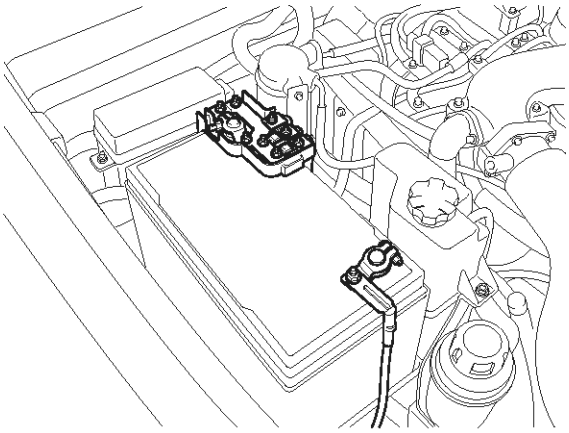


SHMAT8005L

22. Support the transaxle with a jack

⚠CAUTION
Be careful not to give a shock or damage to the plastic oil pan.

23. Install the battery (-) terminal.



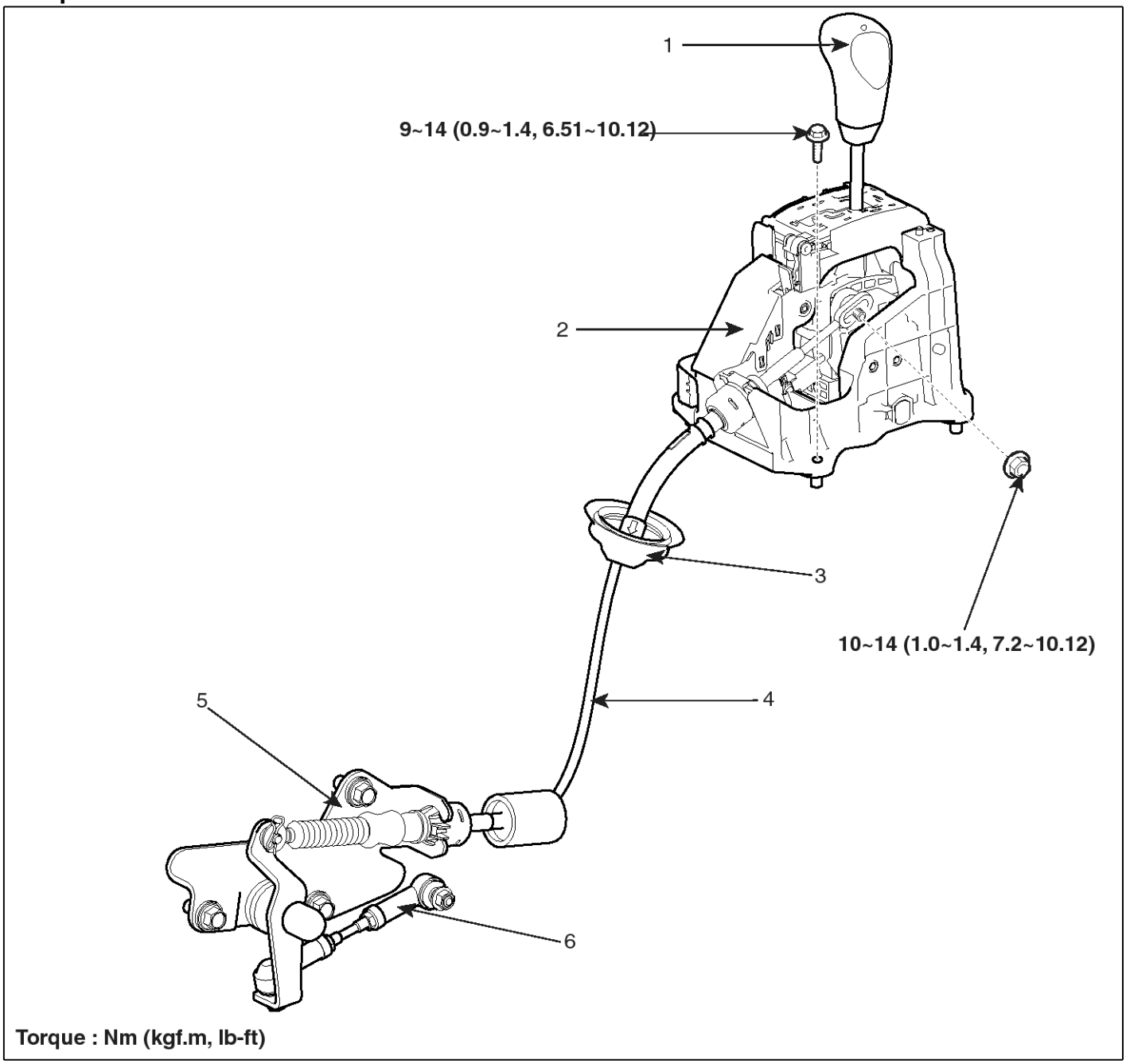
SHMAT8001D

24. Refill the transmission fluid.(See 'service adjustment procedure')

Automatic Transaxle Control System

Shift Lever

Components

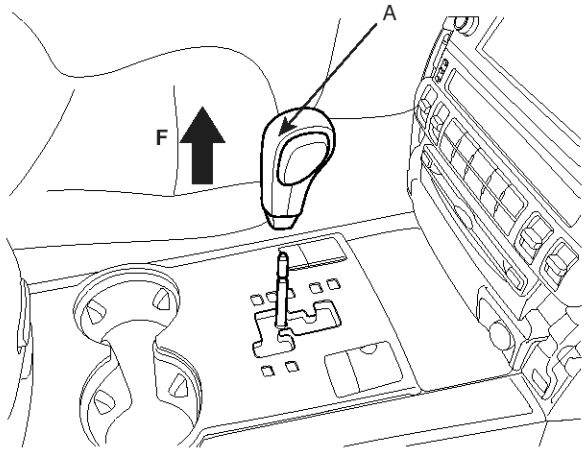


SHMAT8025L

1. Shift lever knob
2. Shift lever assembly
3. Retainer
4. Shift cable assembly
5. Cable bracket
6. Manual lever

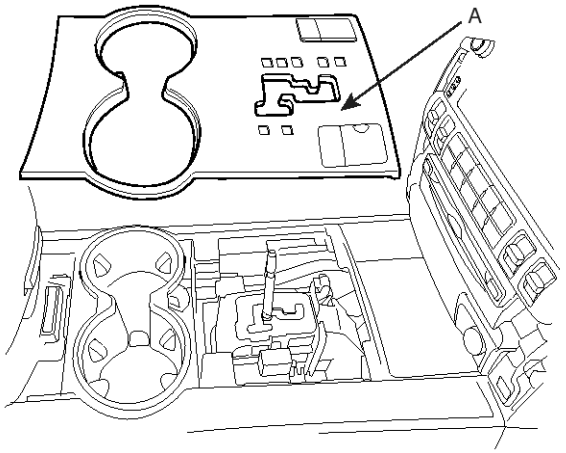
Removal

1. Pull out the shift lever knob (A) in "F" direction.



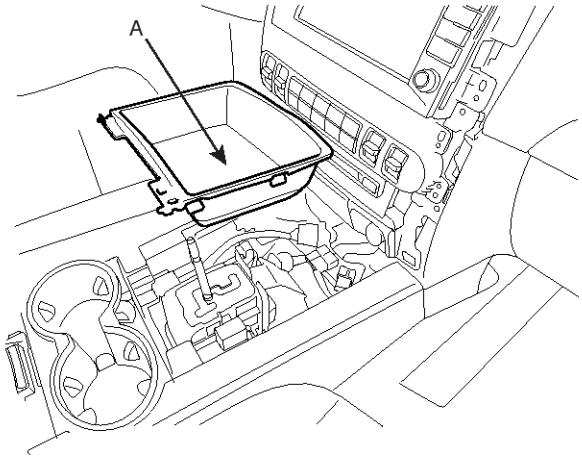
SHMAT8101D

2. Remove the center console cover(A).



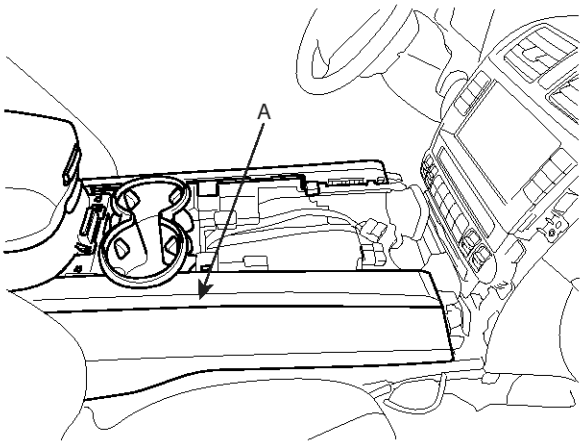
SHMAT8102D

3. Remove the trey(A).



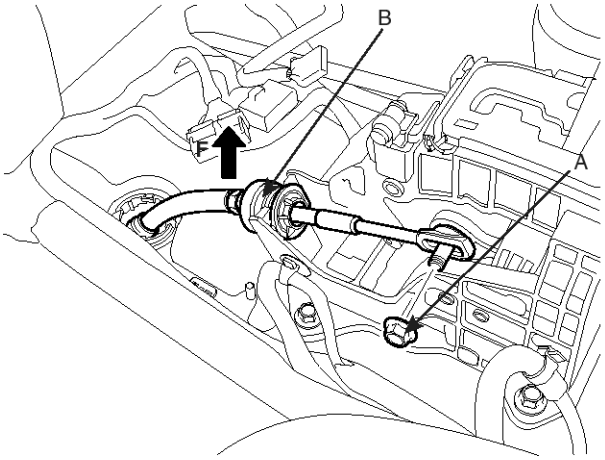
SHMAT8103D

4. Remove the center console(A).(refer to Console in DS group)



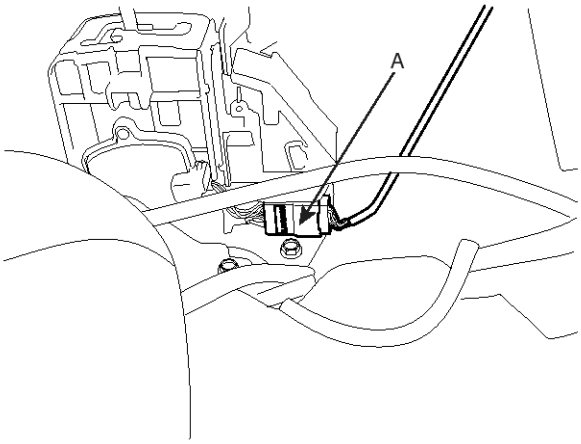
SHMAT8104D

5. After removing the control cable nut (A), remove the shift cable in the 'F' direction by pulling the clib (B) on the floor.



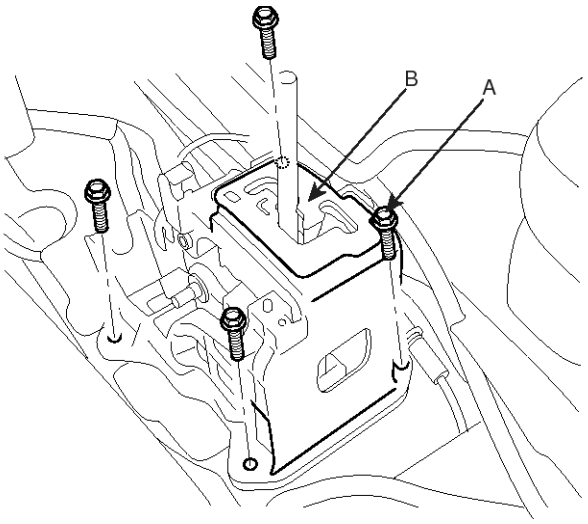
SHMAT8109L

6. Disconnect the sport mode connector (A).



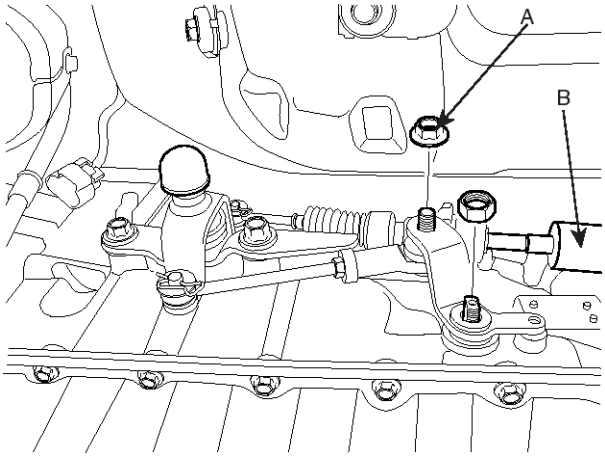
SHMAT8106D

7. Remove the shift lever assembly (B) by removing the four bolts(A).



SHMAT8108D

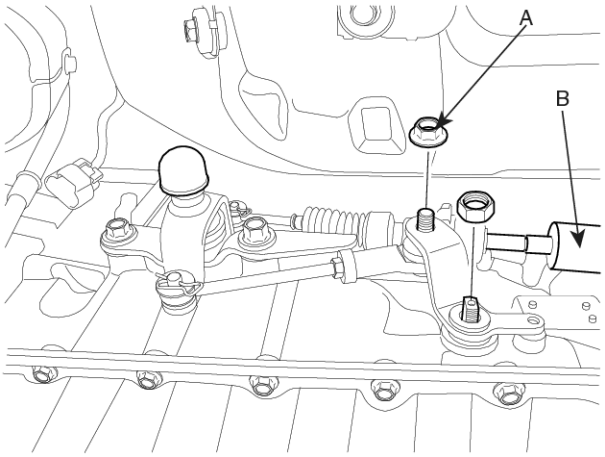
8. Disconnect the shift cable assembly (A)



SHMAT8110L

Installation

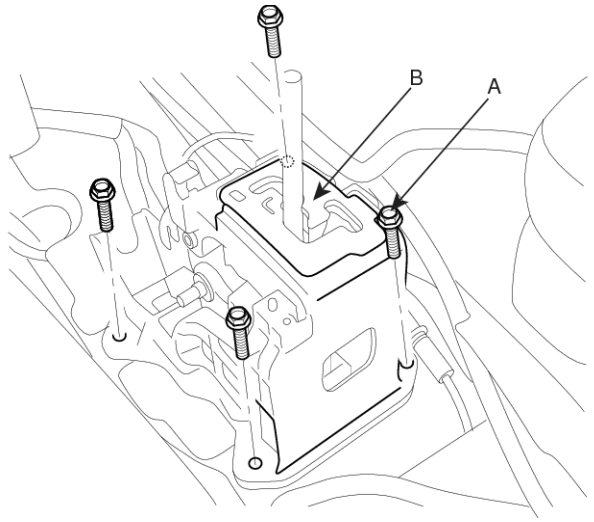
1. Connect the shift cable assembly (A)



SHMAT8110L

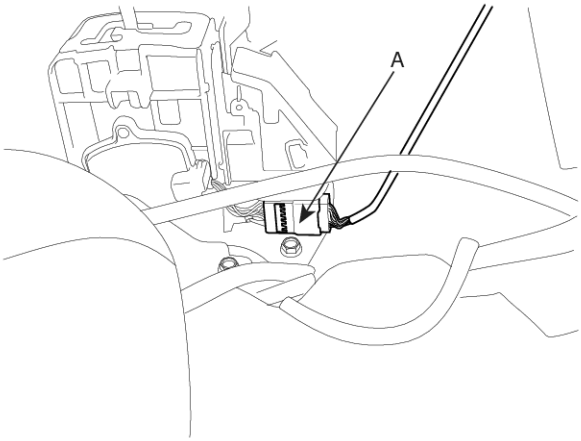
2. Install the shift lever assembly (B) by removing the four bolts(A).

Tightening torque :
9 ~ 14 Nm (5.0 ~ 6.5 Kgf.m, 36.1 ~ 47 lb-ft)



SHMAT8108D

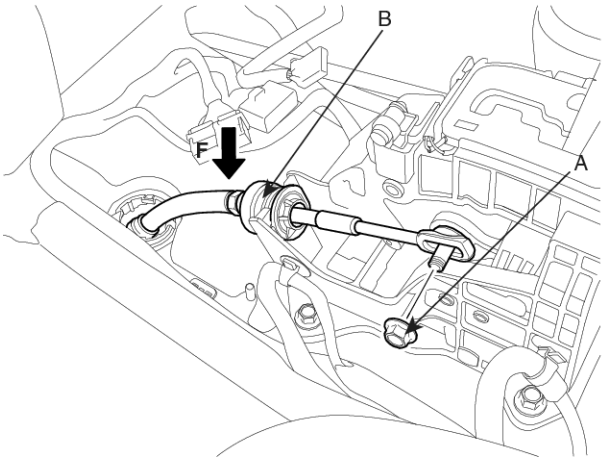
3. Connect the interlock switch connector (A).



SHMAT8106D

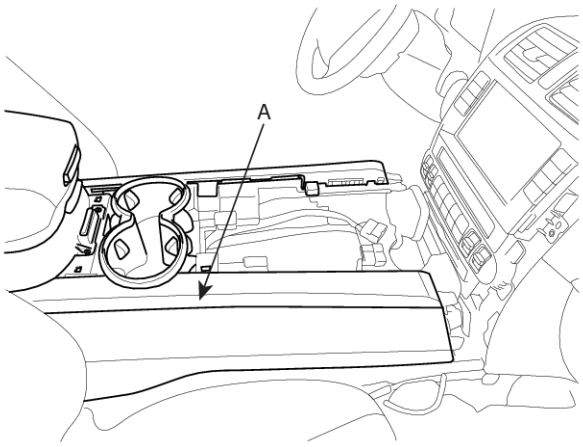
4. After Install the control cable nut (A), Install the shift cable in the 'F' direction by pulling the clib (B) on the floor.

Tightening torque :
9 ~ 13 Nm (1.0 ~ 1.4 Kgf.m, 7.2 ~ 10.1 lb-ft)



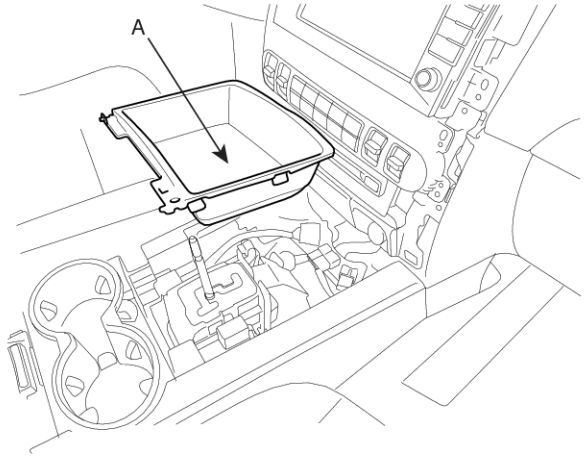
SHMAT8116L

5. Install the center console(A).(refer to Console in DS group)



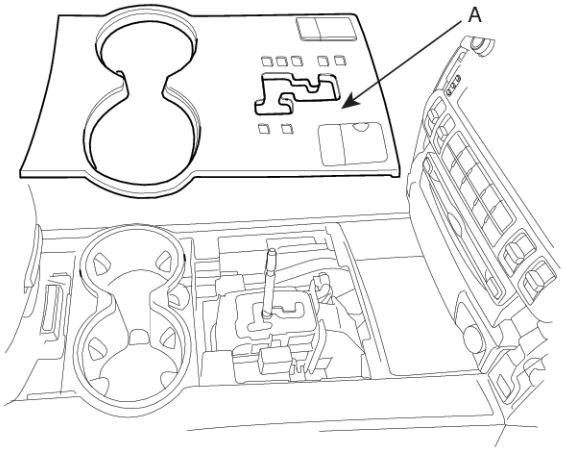
SHMAT8104D

6. Install the trey(A).



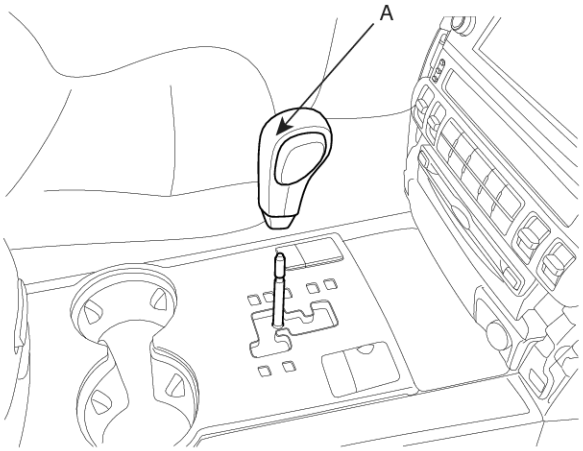
SHMAT8103D

7. Remove the center console cover(A).



SHMAT8102D

8. Insert the shift lever knob (A) with the specified force.



SHMAT8117L

Transfer Case Assembly

Description

Items	Part time	Full time
Type	EST(Electric shift transfer)	TOD(Torque On Demand)
FRT axle connection	FRRD(NAS only)	No FRRD (Full time connection)
Weight (Kg), Length(mm)	35, 351	37.3, 351
Gear ratio (HIGH)	1 : 1	
Gear ratio (LOW)	2.48 : 1	
FRT driving type	Chain	
Lubricant	DEXRON III	
Lub. Quantity (L)	1.6	

EST

EST(Electric Shift Transfer) is selective electric 4 wheel drive system.

The mode switch consists of the 3 modes ; 2High, 4High, 4Low.

When the vehicle speed is 0mi/h(standing) and the shift lever is in neutral position, it can swich 4High to 4Low.

When selects 4Low mode, it has better driving power (torque ratio-2.481:1) in case not exceeds 40kph(25mi/h).

TOD

TOD(Torque On Demend) is electronic 4 wheel drive system.

The mode switch consists of the 3 modes ; Auto, 4High-Lock, 4Low.

In Auto mode TCCU receives load condition, driver's will, and ABS/ESP signal, etc and controls the front/rear driving power in the range of 0:100 to 50:50.

When the vehicle speed is 0mi/h(standing) and the shift lever is in neutral position, it can swich 4High-Lock to 4Low.

When selects 4Low mode, it has better driving power (torque ratio-2.481:1) in case not exceeds 40kph(25mi/h).

Operation

EST

1. TCCU receives the mode switch signal and activates the shift motor.

   The shift cam linked to the shift motor moves the lock-up fork(2High↔4High) or reduction fork(4High↔4Low).

   TCCU controls the motor by receiving MPS(Motor Position Sensor) signal inside the shift motor.

   Driving chain delivers the power to the front propellar shaft.

2. TCCU receives the mode switch signal(2High→4High) and activates the shift motor.

   The shift cam linked to the shift motor moves the lock-up fork(2High↔4High).

   Before moving the fork TCCU magnetizes the EMC coil,

   TCCU synchronizes the lock-up hub(Front) with EMC housing(Rear) for better shifting.

3. TCCU receives the mode switch signal(4High→4Low) and activates the shift motor.

   The shift cam linked to the shift motor moves the reduction fork(4High→4Low).

   The reduction hub connected to the reduction fork moves the planetary gear to change the torque ratio(2.481:1) for better driving force.

TOD

In Auto mode TCCU activates the magnetic clutch by magnetizing the EMC coil and variates the ratio of front/rear driving power by 0:100~50:50 related to the EMC duty.

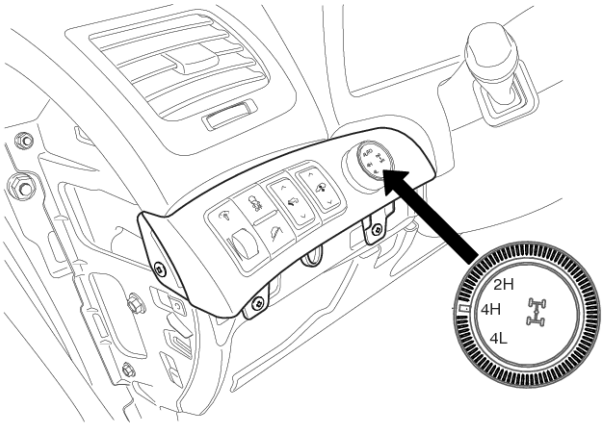
In 4High-Lock mode TCCU fix the ratio of 50:50.

In 4Low mode the torque ratio is 2.481:1.

Operating Elements

EST

1. Mode switch (2High↔4High↔4Low)



SHMAT9031L

   a. Drivers toggle the mode switch to select the 4WD mode(2High, 4High, 4Low)

   b. It can switch 2High↔4High-Lock under the vehicle speed of 80kph(50mph) but mode switching of 2High↔4Low, 4High↔4Low is possible under 3kph(standing) and neutral position of shift lever.

2. Motor Position Sensor (MPS)

   MPS is magnetic field sensor and places inside the shift motor.

   The MPS and round magnetic in TCCU are as an assembly and the angle is calibrated so should not be disassembled in any case.

   Because the angle never be calibrated once the shift motor and TCCU are disassembled.

3. Shift motor

   The shift motor switches the 4WD mode(2High↔4High↔4Low) by receiving TCCU signal.

   The internal circuit consists of two N-channel and two P-channel of MOSFET.

   TCCU moves the shift motor by controlling these FET.

   * The metal–oxide–semiconductor field-effect transistor (MOSFET) is a device used to amplify or switch electronic signals.

   It is by far the most common field-effect transistor in both digital and analog circuits.

4. Electronic Magnet Clutch(EMC) coil

   The EMC coil synchronizes the lock-up hub with the EMC housing for shifting 4High to 4Low while driving.

   EMC is activated before the shift motor moves the lock-up fork and stops after completing shifting 4High.

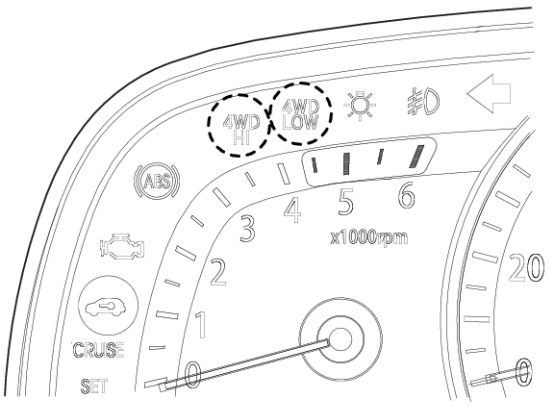
   EMC is activated about 6 seconds. TCCU sends 12V of duty 100%.

5. Indicator and Warning lamp

   The indicator lamp for 4WD mode(4High,4Low) is in the cluster. But there is no indicator lamp for 2High.

   When the 4WD system fails, the 4WD warning lamp(yellow) is on center in the cluster.

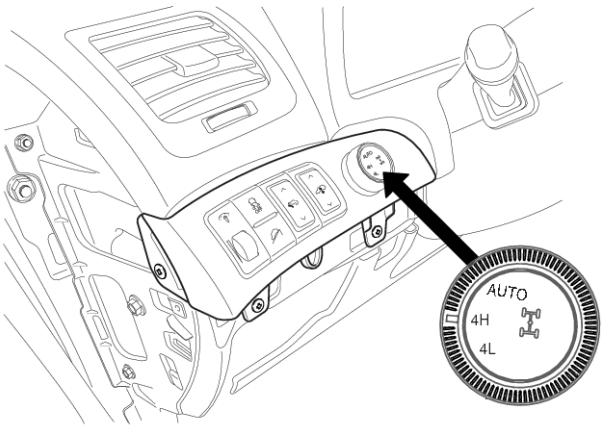
   The cluster controls 4WD related lamps by receiving TCCU signal via CAN.



SHMAT9032L

TOD

1. Mode switch (Auto↔4High↔4Low)



SHMAT9033L

   a. Drivers toggle the mode switch to select the 4WD mode(Auto, 4High, 4Low)

   b. It can switch Auto↔4High-Lock under the vehicle speed of 80kph(50mph) but mode switching of Auto↔4Low, 4High-Lock↔4Low is possible under 3kph(standing) and neutral position of shift lever.

2. Motor Position Sensor (MPS)

   MPS is magnetic field sensor and places inside the shift motor.

   The MPS and round magnetic in TCCU are as an assembly and the angle is calibrated so should not be disassembled in any case.

   Because the angle never be calibrated once the shift motor and TCCU are disassembled.

3. Shift motor

   The shift motor switches the 4WD mode(2High↔4High↔4Low) by receiving TCCU signal.

   The internal circuit consists of two N-channel and two P-channel of MOSFET.

   TCCU moves the shift motor by controlling these FET.

   *The metal–oxide–semiconductor field-effect transistor (MOSFET) is a device used to amplify or switch electronic signals.

   It is by far the most common field-effect transistor in both digital and analog circuits.

4. Electronic Magnet Clutch(EMC) coil

   The driving force deviates by EMC duty.

   TCCU conrols EMC duty by receiving the related sensor signals via CAN.

   EMC duty is normally 200Hz, 12V at duty 100%, and 0V at duty 0%.

   * While ABS/ESP control is activated, EMC duty control is limited.

5. Indicator and Warning lamp

   The indicator lamp for 4WD mode(4High-Lock,4Low) is in the cluster. But there is no indicator lamp for Auto.

   When the 4WD system fails, the 4WD warning lamp(yellow) is on center in the cluster.

   The cluster controls 4WD related lamps by receiving TCCU signal via CAN.

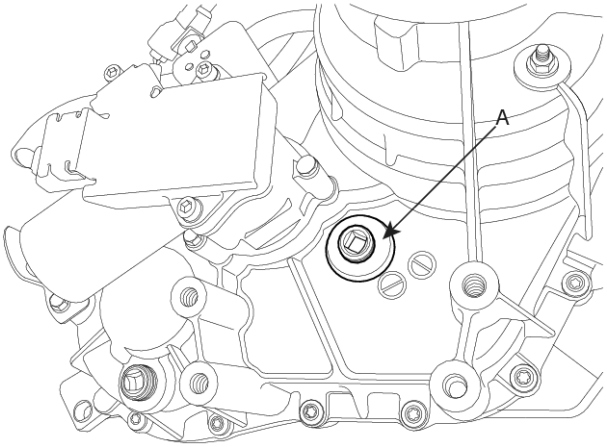
Service Adjustment Procedure

Fluid level inspection

1. Clean the fluid level plug and the surface near.
2. Remove the fluid level plug (A).

NOTICE

When the oil is warm, check or drain the oil.



SHMAT9034L

3. Check that the fluid flows out of the fluid level hole. If not, add fluid as required.
4. When the fluid dribbles out of the fluid level hole, install the fluid level plug.

Tightening torque:
20~30 Nm(2.0~3.0 kgf.m, 14.5~21.7 lb-ft)

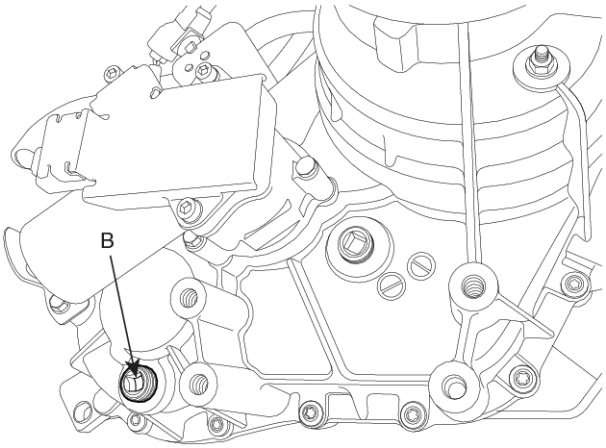
Fluid replacement

1. Clean the fluid level plug and the surface near.
2. Drain the fluid by removing the drain plug (B).

NOTICE

When the oil is warm, check or drain the oil.

Remove the fluid level plug to help drain the fluid.



SHMAT9035L

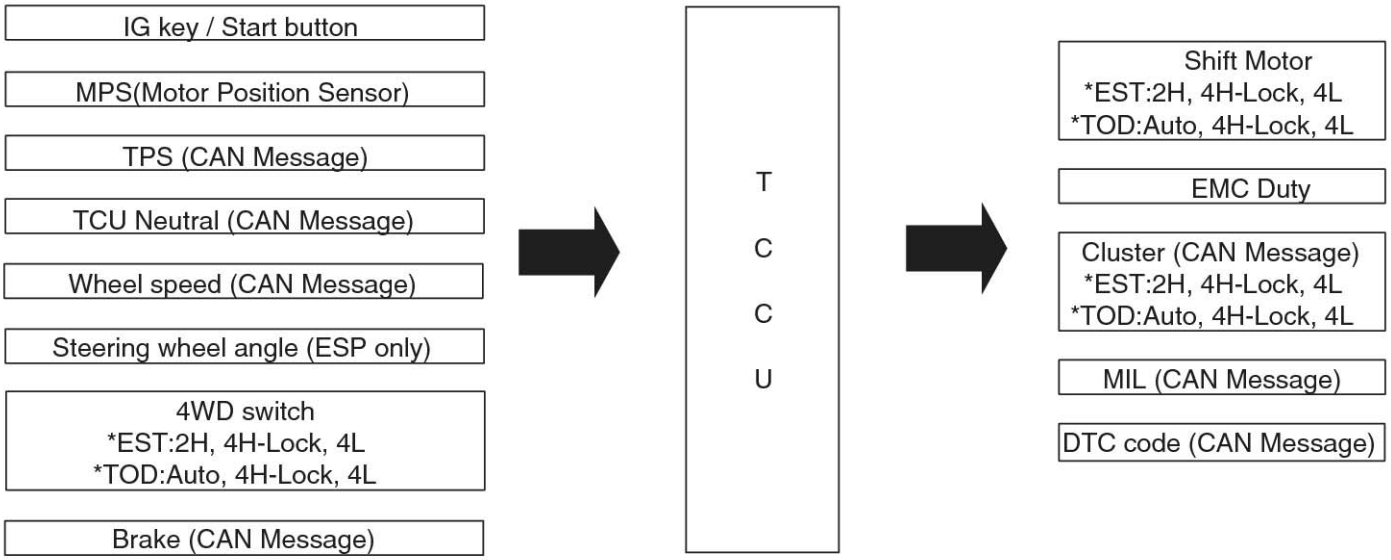
3. Install the dran plug.

Tightening torque:
20~30 Nm(2.0~3.0 kgf.m, 14.5~21.7 lb-ft)

4. Add fluid untill the fluid flows out of the fluid level hole.
5. When the fluid dribbles out of the fluid level hole, install the fluid level plug.

Tightening torque:
20~30 Nm(2.0~3.0 kgf.m, 14.5~21.7 lb-ft)

TCCU In/Out signal



SHMAT9036L

TCCU terminal

CLG16

SHMAT9037L

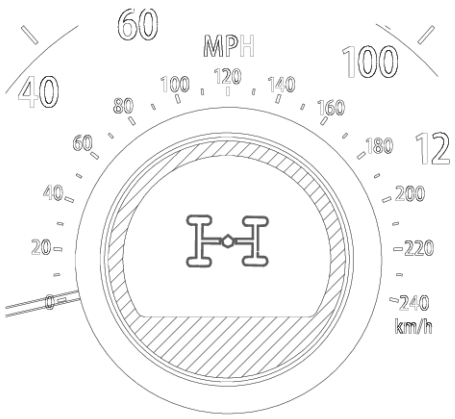
No.	Description
1	Power
2	EMC (+)
3	-
4	CAN High
5	Mode select switch
6	Ground
7	EMC (-)
8	-
9	CAN Low
10	ON/START

Troubleshooting

Warning lamp control

a. The warning lamp is yellow center in the cluster.

b. TCCU communicates the cluster via CAN.



SHMAT9038L

DTC List

EST

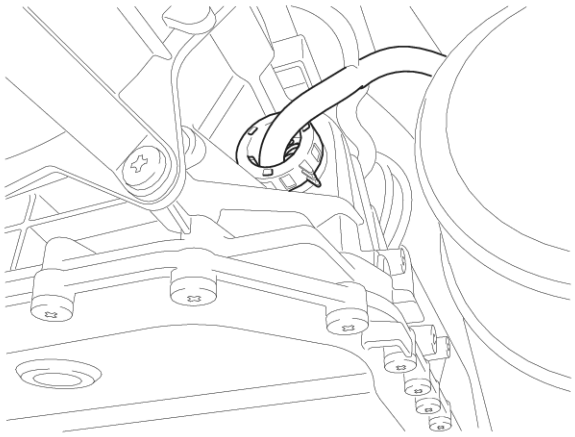
No	DTC code	DTC description	MIL	Remark
1	P1728	EMC open / shorted to battery		
2	P1736	Motor open / shorted to battery		
3	P1737	Motor open / shorted to ground		
4	P1738	Shift system timeout		
5	P1739	General position encoder error		
6	P1746	4WD ECU Thermal Threshold Exceeded		
7	P1758	Mode Select Switch Fault		
8	U0001	High Speed CAN Communication Bus		
9	U0101	Lost Communication with TCM		
10	U0121	Lost Communication with Anti-Lock Brake System (ABS) Control Module		
11	U0122	Lost Communication with Vehicle Dynamics Control Module		

TOD

No	DTC code	DTC description	MIL	Remark
1	P1728	EMC open / shorted to battery		
2	P1736	Motor open / shorted to battery		
3	P1737	Motor open/shorted to ground		
4	P1738	Shift system timeout		
5	P1739	General position encoder error		
6	P1746	4WD ECU Thermal Threshold Exceeded		
7	P1758	Mode Select Switch Fault		
8	U0001	High Speed CAN Communication BUS		
9	U0100	Lost Communication with ECM/PCM “A”		
10	U0101	Lost Communication with TCM		
11	U0121	Lost Communication with Anti-Lock Brake System (ABS) Control Module		
12	U0122	Lost Communication with Vehicle Dynamics Control Module		

P1728 EMC-Open or Short to Battery

Component Location



SHMAT8499D

General Description

TCCU controls EMC (EMC: Electric Magnet Clutch) as duty in order to make different driving force going to front wheels after receiving various signal through CAN communication.

DTC Description

TCCU sets DTC P1728 if EMC control circuit is open, short to ground, or short to battery.

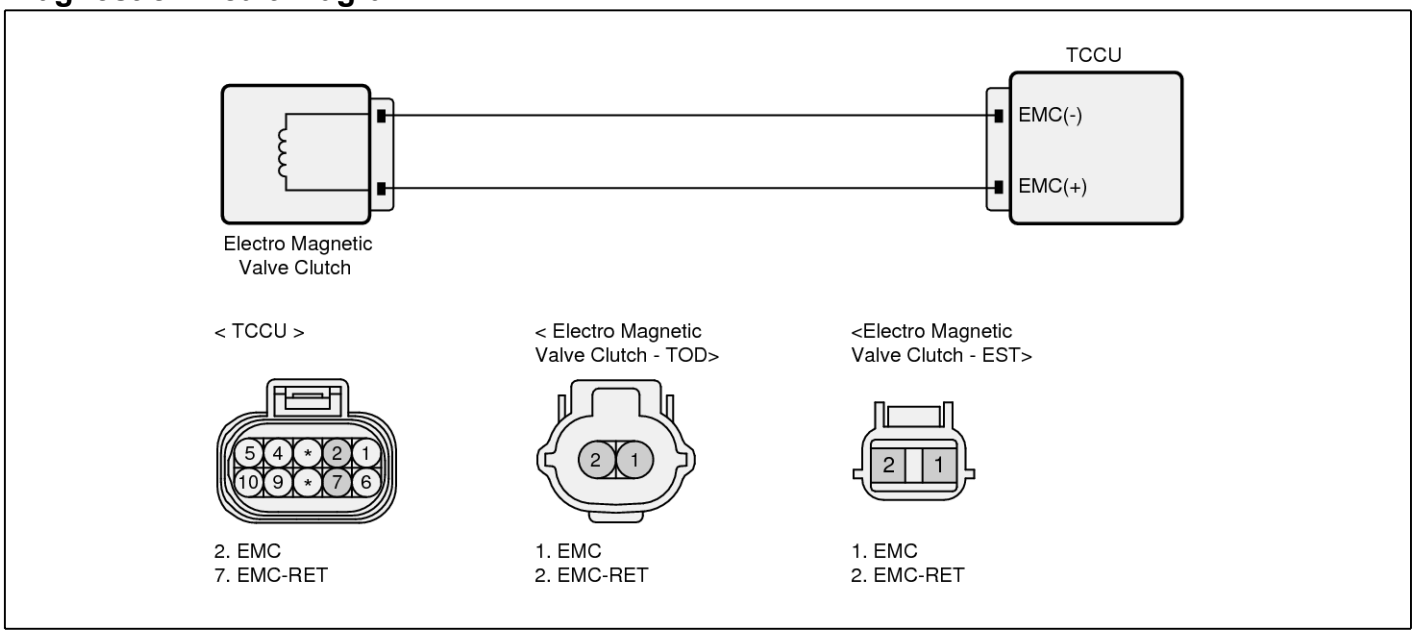
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Check	• Poor Connection • Open in control circuit • Short to battery in control circuit • Short to ground in control circuit • Faulty EMC • Faulty TCCU
Enable Conditions	• IG KEY ON	
Threshold value	• Below 1.8 V when EMC operation. or Higher than battery voltage for 1sec. when EMC coil i-s not working.	
MIL ON Condition	• Lamp ON	

Specification

Temperature (˚C)	Resistance (Ω)
23 ˚C	About 3.6 Ω

Diagnostic Circuit Diagram



SHMMT9503L

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Control Circuit Inspection

■ Short to battery in control circuit

1. IG KEY OFF.
2. Disconnect EMC and TCCU connector.
3. IG KEY ON.
4. Measure voltage between control terminal of EMC harness connector and chassis ground.

Specification : 0V

5. Is the measured value within specification ?

YES ▶ Go to next procedure.

NO ▶ Short to battery in control harness and then, go to "Verification of Vehicle Repair" procedure .

■ Open in control circuit

1. IG KEY OFF.
2. Disconnect EMC and TCCU connector.
3. Measure resistance between control terminal of one and the other of EMC harness connector.

Specification : Below 1Ω

4. Is the measured voltage within specification ?

YES ▶ Go to next procedure.

NO ▶ Check open in control harness. And then, go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in ground circuit

1. IG KEY OFF.
2. Disconnect EMC and TCCU connector.
3. Measure resistance between ground terminal of one and the other of EMC harness connector.

Specification : Below 1Ω

4. Is the measured value within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check open in ground harness. And then, go to 'Verification of Vehicle Repair" procedure.

Component Inspection

■ Check EMC

1. IG KEY OFF.
2. Disconnect EMC connector.
3. Measure resistance between one and the other of EMC connector.

Specification : About 3.6 Ω (at 23˚C)

4. Is the measured value within specification ?

YES ▶ Check TCCM connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known good EMC and check for proper operation.
If the problem is corrected, replace EMC and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

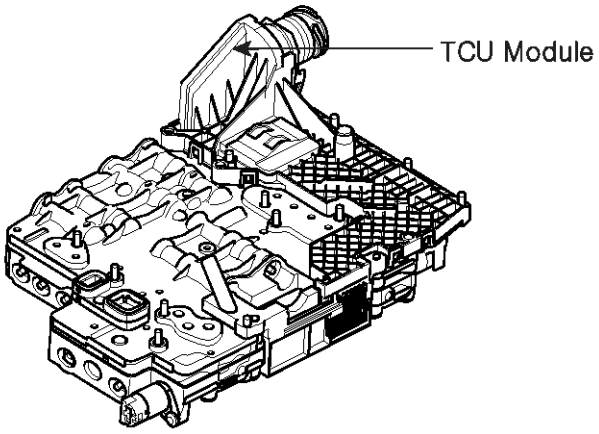
1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System is performing to specification at this time.

P1736 Shift Motor-Open or Short to Battery

Component Location



SHMAT9499L

General Description

Shift motor, controlled by TCCU, is activated by switching Mode selection SW, which has 3 different MODE, AUTO, 4H, 4L.

Position Encorder is installed on shift motor and consists of 4 switches. Whenever switching Mdoe switch, shift motor is operating, making that position encoder point changes ON and OFF. Finallly, with this ON and OFF signal goes to TCCU, TCCU check shift motor operation.

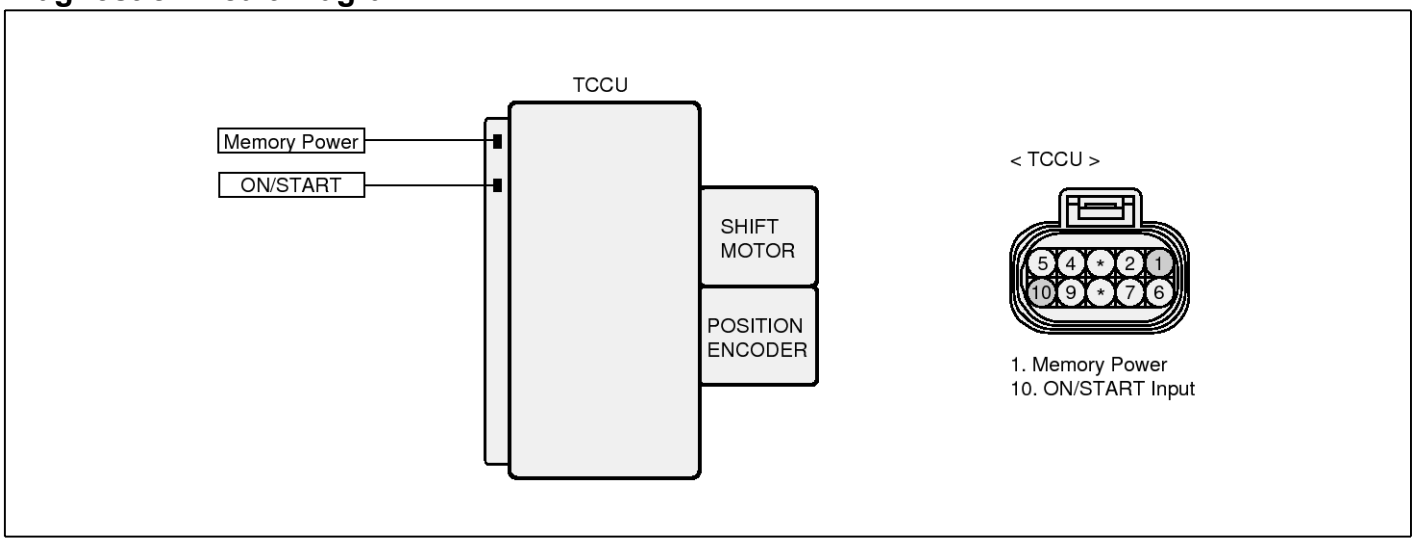
DTC Description

TCCU sets DTC P1736 if TCCU detects shift motor control circuit is open or short to battery.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check voltage	• Poor Connection • Faulty Shift Motor • Faulty TCCU
Enable Conditions	• IG KEY ON	
Threshold value	• Shift motor is open or short to battery for 2sec.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram



SHMMT9504L

Scantool Diagnostics

■ Check DTC

1. Check DTC with Scantool.
2. Erase the DTC with Scantool.
3. Is the DTC erased ?

YES ▶ Check TCCM connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
▶ Check Mechanical problem of Transfer Case .

NO ▶ Substitute with a known good Shift Motor and check for proper operation.
If the problem is corrected, replace Shift Motor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System is performing to specification at this time.

P1737 Shift Motor-Open or Short to Ground

Component Location

Refer to DTC P1736 : Motor open / shorted to battery.

General Description

Refer to DTC P1736 : Motor open / shorted to battery.

DTC Description

TCCU sets DTC P1737 if TCCU detects Shift Motor control circuit is open or short to ground.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Check	• Poor Connection • Faulty Shift Motor • Faulty TCCU
Enable Conditions	• IG KEY ON	
Threshold value	• Shift motor is open or short to ground for 2 sec.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram

Refer to DTC P1736 : Motor open / shorted to battery.

Scantool Diagnostics

Refer to DTC P1736 : Motor open / shorted to battery.

Verification of Vehicle Repair

Refer to DTC P1736 : Motor open / shorted to battery.

P1738 Shift System Timeout

Component Location

Refer to DTC P1736 : Motor open / shorted to battery.

General Description

Refer to DTC P1736 : Motor open / shorted to battery.

DTC Description

DTC P1738 is set if shift motor doesn't work at all, even although TCCU sends signal to control Shift Motor operation

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Check	• Poor Connection • Faulty Shift Motor • Mechanical Problem inside of Shift Motor • Faulty TCCU
Enable Conditions	• IG KEY ON	
Threshold value	• Shift motor doesn't reach the target within 10sec. although TCCU sends control signal to Shift Motor	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram

Refer to DTC P1736 : Motor open / shorted to battery.

Scantool Diagnostics

■ Check DTC

1. Check DTC with Scantool.
2. If there is any other DTC, repair the cause of DTC with referring DTC troubleshooting Guide then, erase the DTC with scantool.
3. Check DTC P1738 is set again with scantool .
4. Erase the DTC P1738 with scantool.
5. Is the DTC erased ?

YES ▶ Check TCCM connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
▶ Check Mechanical problem of Transfer Case .

NO ▶ Substitute with a known good Shift Motor and check for proper operation.
If the problem is corrected, replace Shift Motor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

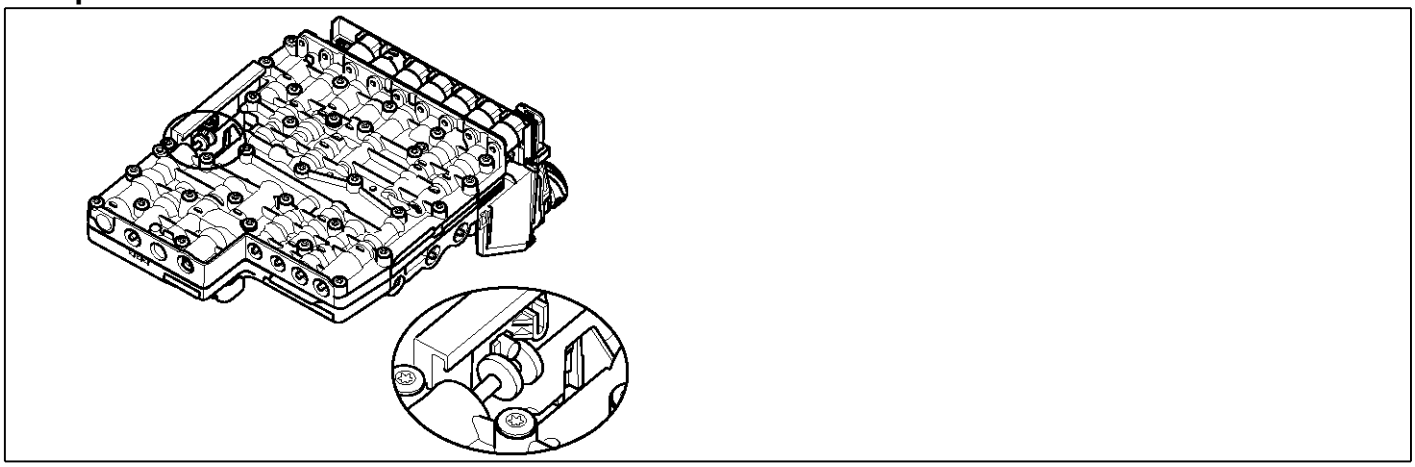
1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System is performing to specification at this time.

P1739 General Position Encoder Fault

Component Location



SHMAT8497D

General Description

Position Encorder is installed on shift motor and consists of 4 switches. Whenever switching Mdoe switch, shift motor is operating, making that position encoder point changes ON and OFF. Finallly, with this ON and OFF signal goes to TCCU, TCCU check shift motor operation.

NOTICE

Never disassemble shift motor. Because it causes that position encoder is misaligned with TCCM memorised setpoint. Therefore, it is never reusable after disassembling shift motor.

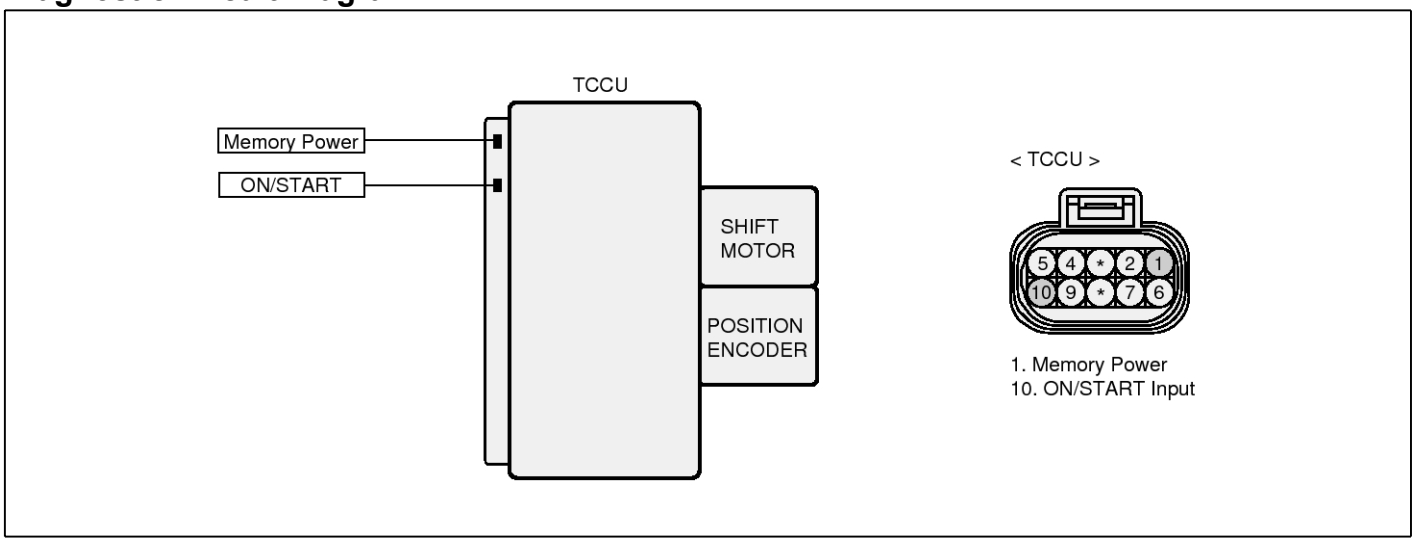
DTC Description

TCCU sets DTC P1739 if TCCU detects the input value from Postion encoder is different from the TCCU memorized.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Check	• Poor Connection • Faulty Position Encoder • Faulty TCCU
Enable Conditions	• IG KEY ON	
Threshold value	• Detected value difference between memorized by TCC-U and input from Postion Encoder for more than 6 sec.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram



SHMMT9504L

Scantool Diagnostics

Refer to DTC P1738 : Shift system timeout.

Verification of Vehicle Repair

Refer to DTC P1736 : Motor open / shorted to battery.

P1746 4WD ECU Thermal Threshold Exceeded

Component Location

Refer to DTC P1739 : General position encoder error.

General Description

TCCU controls and distributes driving force to front and rear wheels according to 3 different Mode switch(AUTO,4H,4L). TCCU controls driving force in accordance with road condition and driving condition.

In addition, TCCU equips self-diagnosis to check the system failure.

DTC Description

TCCU sets P1746 if TCCU detects that its internal temperature is higher than 126℃.

When this DTC is set, if the temperature of transfer case is high, cool down the temperature and replace the TCCU. And then, check system operation.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check temperature	• Faulty TCCU
Enable Conditions	• IG KEY ON	
Threshold value	• PCB temperature is higher than 126℃ for more than 2 min.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram

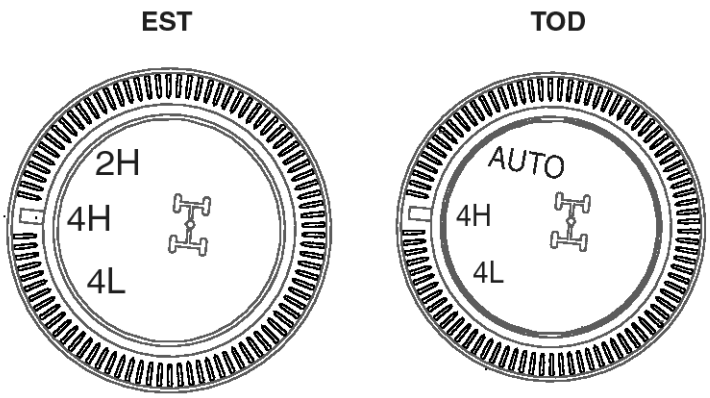
Refer to DTC P1736 : Motor open / shorted to battery.

Verification of Vehicle Repair

Refer to DTC P1736 : Motor open / shorted to battery.

P1758 Mode Select Switch Fault

Component Location



SHMAT9498L

General Description

■ TOD

This is a switch for changing to Auto, 4H-Lock and 4Low according to driver's intention.

Shifting between Auto<->4High-Lock is possible at any time if vehicle speed is below 80KPH.

However, shifting between Auto<->4Low or 4High-Lock<->4Low are possible not only vehicle speed is below 3KPH(Vehicle stationary) but also CAN message from TCM is neutral.

■ EST

This is a switch for changing to 2High, 4High and 4Low according to driver's intention.

Shifting between 2 High<->4High-Lock is possible at any time if vehicle speed is below 80KPH.

However, shifting between 2 High<->4Low or 4High<->4Low are possible not only vehicle speed is below 3KPH(Vehicle stationary) but also CAN message from TCM is neutral.

DTC Description

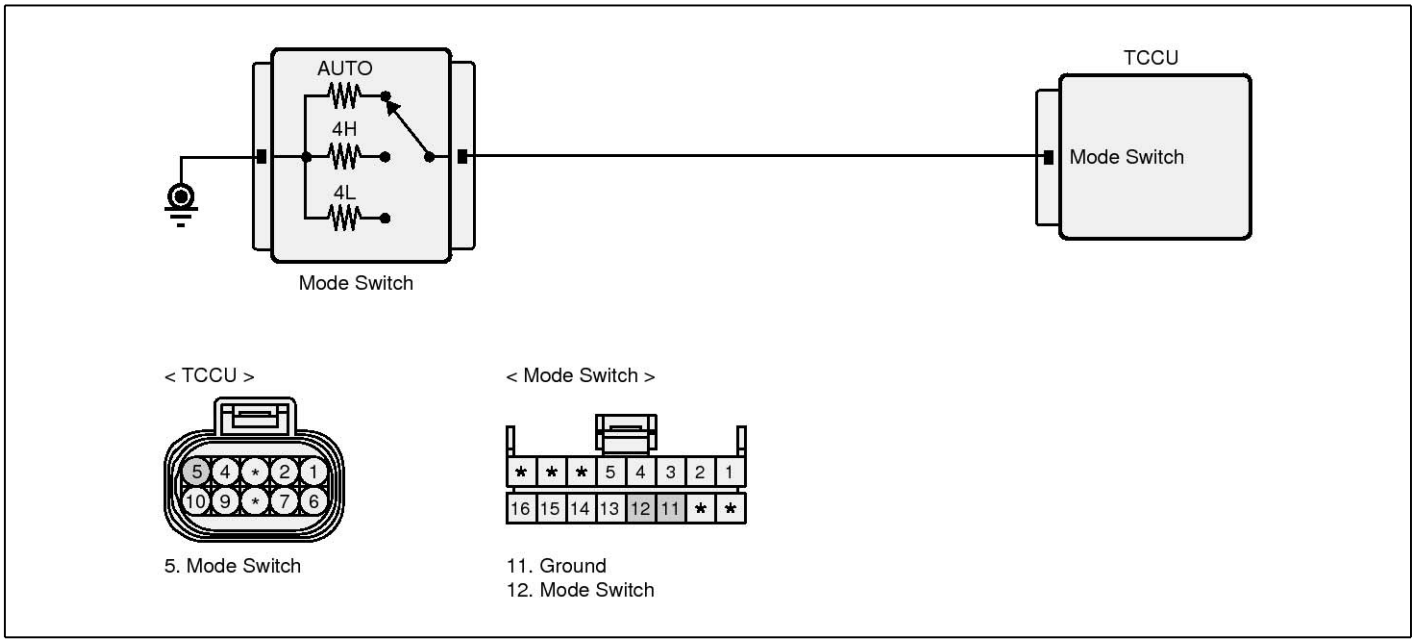
TCCU sets DTC P1758 if TCCU detects signal circuit of Mode switch is short to ground and battery.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Temperature Check	• Poor Connection • Open in signal circuit • Short to battery in signal circuit. • Short to ground in signal circuit • Faulty Mode switch • Fautly TCCU
Enable Conditions	• IG KEY ON	
Threshold value	• Signal voltage at switch is below 0.488V or higher than 4.3V for 1sec.	
MIL ON Condition	• Lamp ON	

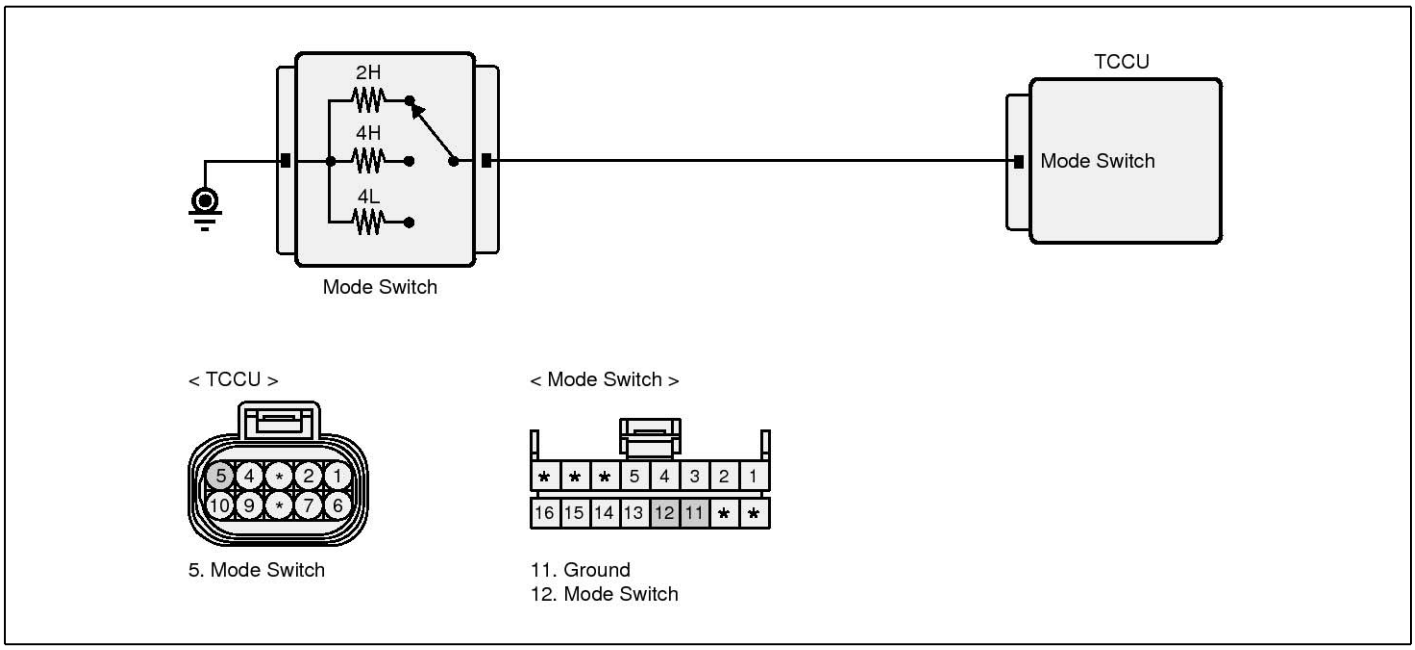
Diagnostic Circuit Diagram

■ TOD



SHMMT9505L

■ EST



SHMMT9506L

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

Signal Circuit Inspection

■ Check short to battery in signal circuit.

1. IG KEY OFF.
2. Disconnect Mode switch and TCCU connector.
3. IG KEY ON.
4. Measure voltage between signal terminal of Mode switch and chassis ground.

Specification : 0V

5. Is the measured value within specification ?

YES ▶ Go to next procedure.

NO ▶ Repair short to battery in signal harness and then, go to 'Verification of Vehicle Repair" procedure.

■ Open in signal circuit

1. IG KEY OFF.
2. Disconnect MODE switch and TCCU connector.
3. Measure resistance between one and the other signal terminal of Mode Switch harness connector.

Specification : Below 1Ω

4. Is the measured value within specification ?

YES ▶ Go to next procedure.

NO ▶ Open in signal circuit and then, go to 'Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in ground circuit

1. IG KEY OFF.
2. Disconnect Mode switch and TCCU connector.
3. Measure resistance between ground terminal of Mode switch harness connector and chassis ground.

Specification : Below 1Ω

4. Is the meausured value within specification ?

YES ▶ Check "Component Inspection" procedure.

NO ▶ Check open in ground circuit and then, go to 'Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Mode Switch

1. IG KEY OFF.
2. Disconnect Mode switch connector.
3. Measure resistance between one and the other terminal of mode switch connector.

Specification :

4. Is the measured value within specification ?

YES ▶ Check TCCM connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known good Mode Switch and check for proper operation.
If the problem is corrected, replace Mode Switch and then go to "Verification of Vehicle Repair" procedure

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System is performing to specification at this time.

U0001 High Speed CAN Communication Bus off

Component Location

Refer to DTC P1739 : General position encoder error.

General Description

CAN communication is circuit, consists of CAN low line, CAN high line and two resister, installed in Cluster and PCM, to communicate with each control module(PCM, TCCU, TCM, ABS)

PCM, TCCU, TCM and ABS communicate their information to control Engine, Transmission and Brake.

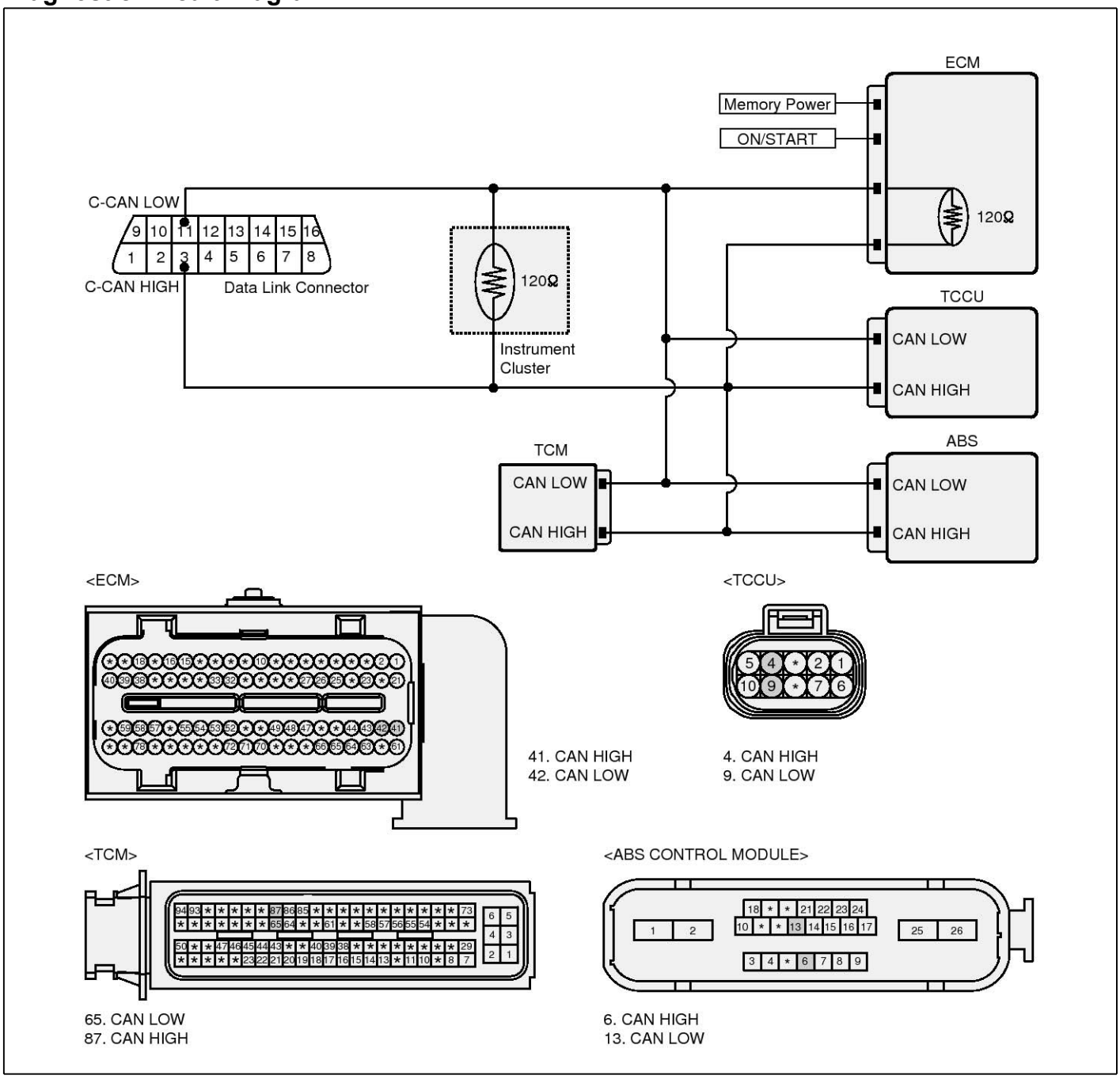
DTC Description

DTC U0001 is set when TCCU detects CAN communication error.

DTC Detecting Condition

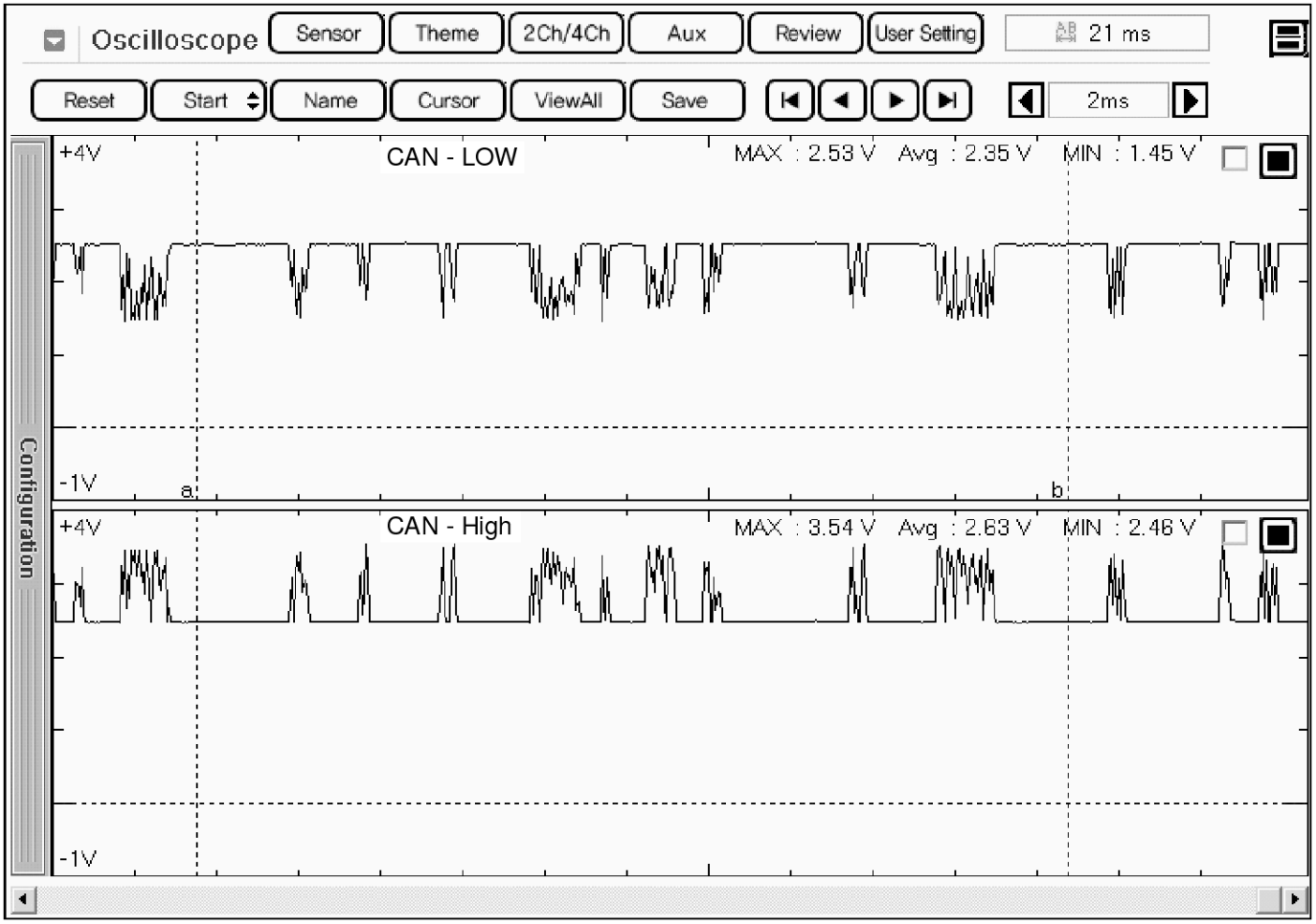
Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor connection • Power supply to each Module • Open or short in PCM communication line • Open or short in TCCU communication line • 120Ω register(Inside cluster) • PCM
Enable Conditions	• IG ON	
Threshold value	• Failure on CAN communication line for more than 5 sec .	
MIL ON Condition	• Lamp OFF	

Diagnostic Circuit Diagram



SHMMT9501L

Signal Waveform



SHMMT9601L

Scantool Diagnostics

■ Check DTC

1. Check DTC with scantool.
2. Check that DTC related CAN communication is set between 4WD ECM and Each Module.
3. If there any DTC related Module, check the DTC first.
4. Erase the DTC after inspection and repair has done.
5. Is the DTC erased ?

YES ▶ Check connectors of each Modules for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
▶ Go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration,or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "W/Harness Inspection" procedure.

CAN register and communication line inspection

■ CAN register and communication line inspection 1

1. IG KEY OFF.
2. Connect PCM, TCCU, TCM, ABS connector.
3. Measure registance between terminal 3 and 11 of diagnostic connector.

Specification : About 60 Ω

4. Is the measured registance within specification ?

YES ▶ Check TCCM connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
▶ Go to next procedure.

NO ▶ If the measured value is out of specification, repair or replace 120Ω CAN register(Inside of PCM and Cluster) and then, go to "Verification of Vehicle Repair" procedure.
▶ If the measured value is lower than 10Ω, repair or replace CAN High and CAN Low are short each other. And then, go to "Verification of Vehicle Repair" procedure.
▶ If the measured value is ∞ Ω, repair or replace the open in CAN High /CAN Low circuit. And then, go to 'Verification of Vehicle Repair" procedure.
▶ Go to next procedure.

■ CAN register and communication line inspection 2

1. IG KEY OFF.
2. Connect PCM, TCCU, TCM and ABS connector.
3. Measure resistance between terminal 3 and 11 of diagnostic terminal.

Specification : About 120 Ω

4. Is the measured value within specification ?

YES ▶ Go to next procedure.

NO ▶ If the measured value is out of specification, repair or replace 120Ω CAN register(Inside of PCM and Cluster) and then, go to "Verification of Vehicle Repair" procedure.
▶ If the measured value is lower than 10Ω, repair or replace CAN High and CAN Low are short each other. And then, go to "Verification of Vehicle Repair" procedure.
▶ If the measured value is ∞ Ω, repair or replace the open in CAN High /CAN Low circuit. And then, go to 'Verification of Vehicle Repair" procedure.

CAN communcation line inspection

■ Check short to battery in CAN communication line.

1. IG KEY OFF.
2. Disconnect PCM, TCCU, TCM and ABS connector.
3. IG KEY OFF.
4. Measure voltage between CAN high terminal(# 3) of diagnostic connector and chassis ground.
5. Measure voltage between CAN low terminal(#11) of diagnostic connector and chassis ground.

Specification : About 0V

6. Is the measured value within specification ?

YES ▶ Go to next procedure.

NO ▶ Check short to battery in communication line . And then, go to 'Verification of Vehicle Repair " procedure.

■ Check short to ground in CAN communication line

1. IG KEY OFF.
2. Disconnect PCM, TCCU, TCM and ABS connector.
3. Measure resistnace between CAN high terminal (# 3) of diagnostic connector and chassis ground.
4. Measure resistance between CAN low terminal (# 11) of diagnostic connector and chassis ground.

Specification : ∞ Ω

5. Is the measured value within specification ?

YES ▶ Go to next procedure.

NO ▶ Check short to ground in communication line . And then, go to 'Verification of Vehicle Repair " procedure.

■ Check open in CAN communication line 1

1. IG KEY OFF.
2. Disconnect PCM, TCCU, TCM and ABS connector.
3. Measure resistance between terminal #3 of diagnostic terminal and CAN high terminal of each module.
4. Measure resistance between terminal #11 of diagnostic terminal and CAN low terminal of each module.

Specification : About 0Ω

5. Is the measured value within specification ?

YES ▶ After disconnecting PCM, 4WD ECM, ABS, TCM, Steering Angle Sensor one by one, check DTC is erased at each module.
▶ Substitute with a known good TCCM and check for proper operation.
If the problem is corrected, replace TCCM and then go to "Verification of Vehicle Repair" procedure.
▶ Go to next procedure.

NO ▶ Check open between 3, 11 terminal of diagnostic terminal and CAN communication line. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check 120Ω resister in PCM and inside of Cluster

1. IG KEY OFF.
2. Disconnect PCM, TCCU, TCM and ABS connector.
3. Measure resistance betweeen CAN HIGH terminal and CAN LOW terminal of PCM.
4. Measure resistance between one and the other of 120Ω resistor in PCM and inside of Cluster.

Specification : About 120Ω

5. Is the measured value within specification ?

YES ▶ Check PCM, TCCM, TCM and ABS ECM connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ If the system is O.K, after replace PCM or 120Ω registor inside Cluster, replace PCM and 120Ω registor inside Cluster. And then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System is performing to specification at this time.

U0100 Lost Communication With ECM/PCM "A"

Component Location

Refer to DTC P1739 : General position encoder error.

General Description

Refer to DTC U0001 : High Speed CAN Communication BUS.

DTC Description

DTC U0100 is set if TCCU can't receive any response signal from PCM.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection • Power supply to each module • Open or short in communication line of PCM • Open or short in communication line of TCCU • Faulty 120Ω registor(Cluster) • Faulty PCM
Enable Conditions	• IG ON	
Threshold value	• No CAN message from PCM for more than 1sec.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram

Refer to DTC U0001 : High Speed CAN Communication BUS.

Signal Waveform

Refer to DTC U0001 : High Speed CAN Communication BUS.

Scantool Diagnostics

Refer to DTC U0001 : High Speed CAN Communication BUS.

Terminal & Connector Inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN register and communication line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN communcation line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

Component Inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

Verification of Vehicle Repair

Refer to DTC U0001 : High Speed CAN Communication BUS.

U0101 Lost Communication With TCM

Component Location

Refer to DTC P1739 : General position encoder error.

General Description

Refer to DTC U0001 : High Speed CAN Communication BUS.

DTC Description

DTC U0101 is set if TCCU can't receive any response signal from TCM

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection in connectors • Power supply to each module • Open or short in CAN communication line of PCM • Open or short in CAN communication line of TCCU • Faulty 120Ω registor(Cluster) • Faulty PCM • Faulty TCM
Enable Conditions	• IG ON	
Threshold value	• No CAN message from TCM for more than 1 sec.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram

Refer to DTC U0001 : High Speed CAN Communication BUS.

Signal Waveform

Refer to DTC U0001 : High Speed CAN Communication BUS.

Scantool Diagnostics

Refer to DTC U0001 : High Speed CAN Communication BUS.

Terminal & Connector Inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN register and communication line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN communcation line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

Component Inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

Verification of Vehicle Repair

Refer to DTC U0001 : High Speed CAN Communication BUS.

U0121 Lost Communication With Anti-Lock Brake System (ABS) Control Module

Component Location

Refer to DTC P1739 : General position encoder error.

General Description

Refer to DTC U0001 : High Speed CAN Communication BUS.

DTC Description

DTC U0121 is set if TCCU can't receive any response signal from ABS

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection • Power supply to each module • Open or short in CAN communication line of PCM • Open or short in CAN communication line of TCCU • Faulty 120Ω registor(Cluster) • Faulty PCM • Faulty ABS
Enable Conditions	• IG ON	
Threshold value	• No CAN message from ABS for more than 1sec.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram

Refer to DTC U0001 : High Speed CAN Communication BUS.

Signal Waveform

Refer to DTC U0001 : High Speed CAN Communication BUS.

Scantool Diagnostics

Refer to DTC U0001 : High Speed CAN Communication BUS.

Terminal & Connector Inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN register and communication line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN communcation line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

Component Inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

Verification of Vehicle Repair

Refer to DTC U0001 : High Speed CAN Communication BUS.

U0122 Lost Communication With Vehicle Dynamics Control Module

Component Location

Refer to DTC P1739 : General position encoder error.

General Description

Refer to DTC U0001 : High Speed CAN Communication BUS.

DTC Description

DTC U0122 is set if TCCU can't receive any response signal from TCS

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection • Power supply to each module • Open or short in CAN communication line of PCM • Open or short in CAN communication line of TCCU • Faulty 120Ω registor(Cluster) • Faulty PCM • Faulty TCS
Enable Conditions	• IG ON	
Threshold value	• No CAN message from TCS for more than 1 sec.	
MIL ON Condition	• Lamp ON	

Diagnostic Circuit Diagram

Refer to DTC U0001 : High Speed CAN Communication BUS.

Signal Waveform

Refer to DTC U0001 : High Speed CAN Communication BUS.

Scantool Diagnostics

Refer to DTC U0001 : High Speed CAN Communication BUS.

Terminal & Connector Inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN register and communication line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

CAN communcation line inspection

Refer to DTC U0001 : High Speed CAN Communication BUS.

Component Inspection

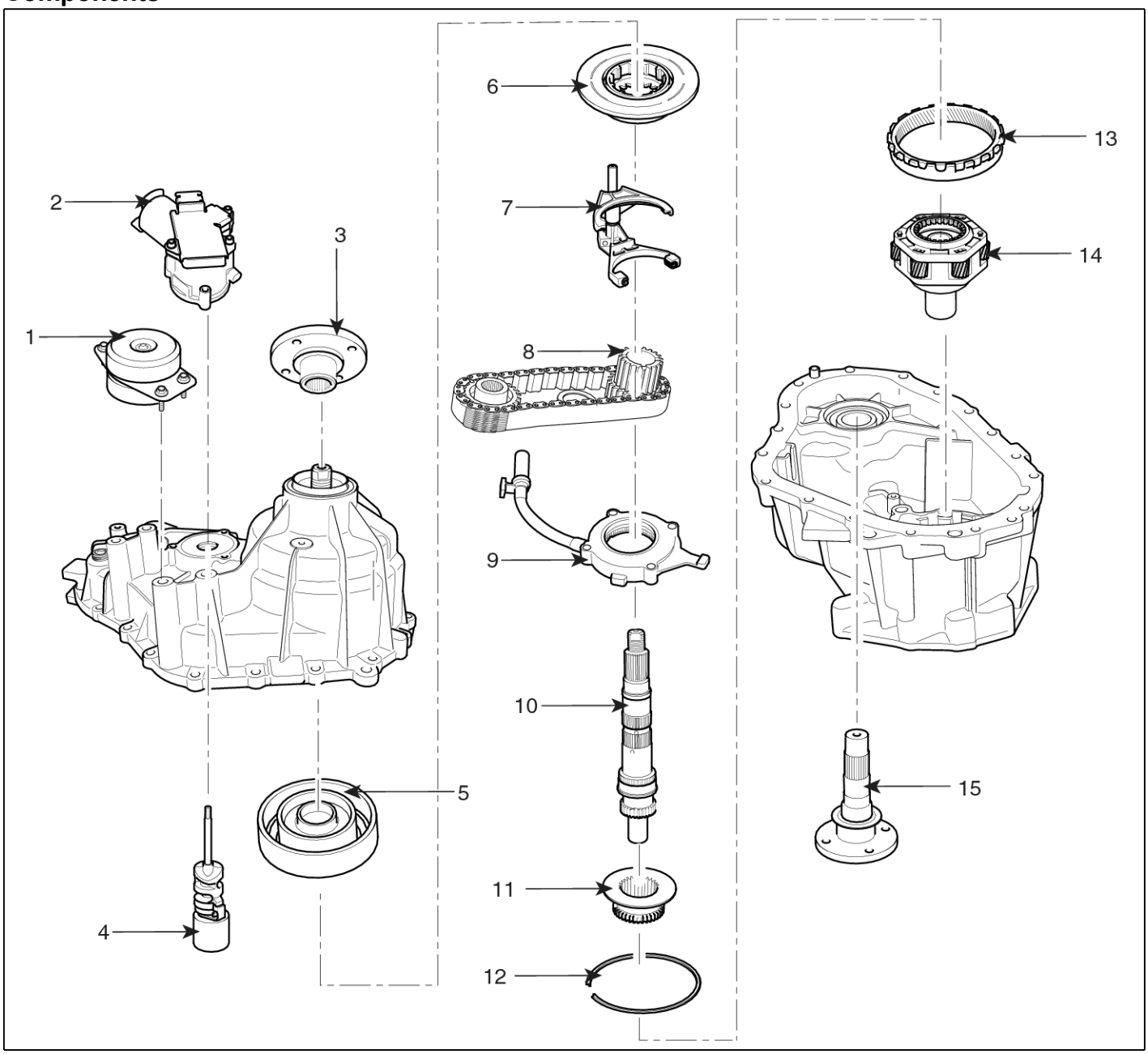
Refer to DTC U0001 : High Speed CAN Communication BUS.

Verification of Vehicle Repair

Refer to DTC U0001 : High Speed CAN Communication BUS.

Transfer Assembly

Components

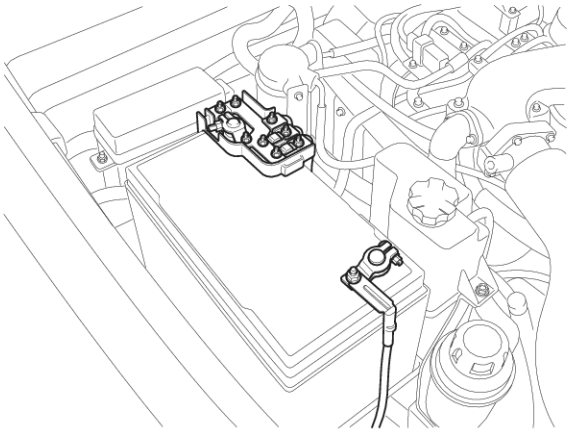


SHMAT9001L

1. Dynamic damper
2. TCCU and assembly
3. Rear flange
4. Shift shaft assembly
5. Clutch hausing
6. Lockup clutch
7. Lockup fork
8. Chian
9. Oil filter
10. Main shaft
11. Reduction hub
12. Snap ring
13. Ring gear
14. Carrier assembly
15. Front output shaft assembly

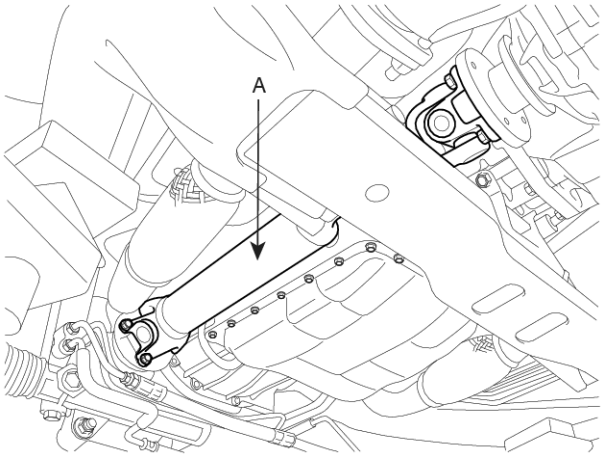
Removal

1. Disconnect the battery (-) terminal.



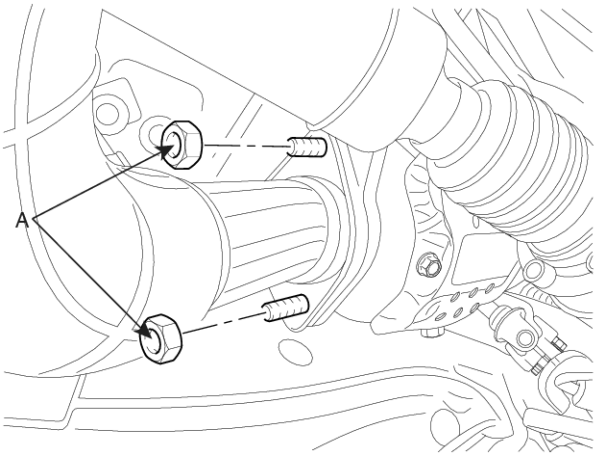
SHMAT8001D

2. Remove the front propeller shaft(A). (4WD)

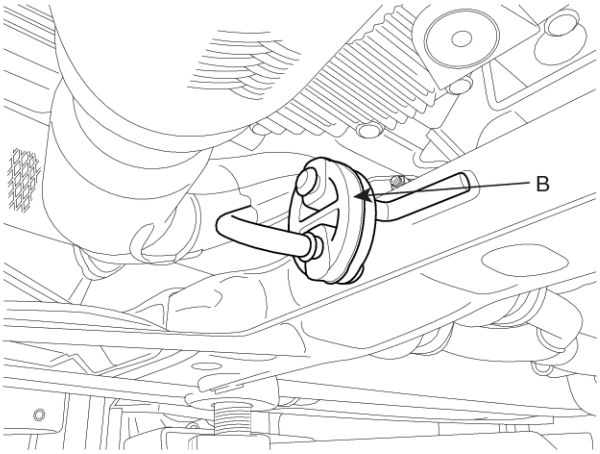


SBLAT6007L

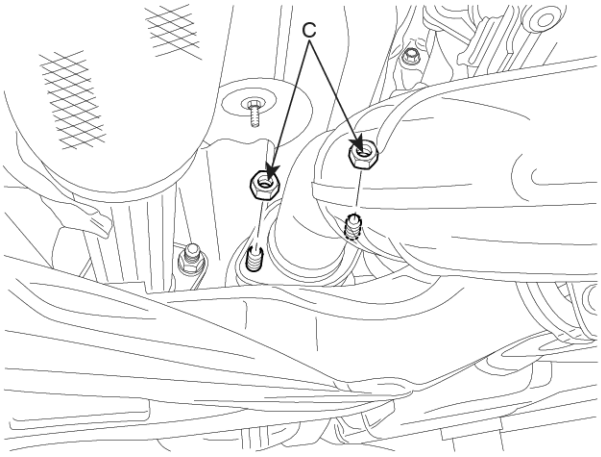
3. Remove the front muffler(A) or muffer hanger rubber(B), by removing rear muffler(C).



SHMAT8002L

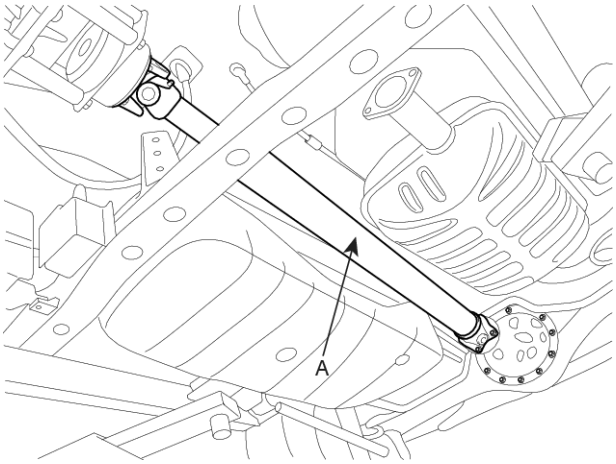


SHMAT8003L



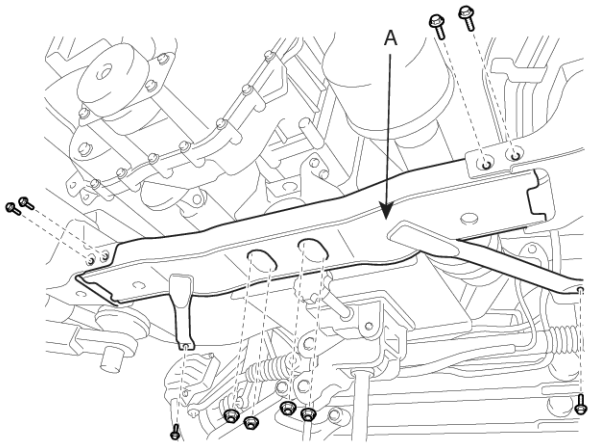
SHMAT8004L

4. Remove the rear propeller shaft(A).



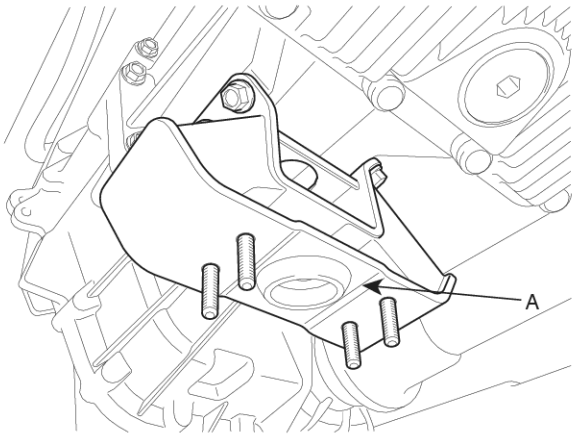
SBLAT6009L

5. Support the transmission assembly with a jack
6. Remove the cross member(A).



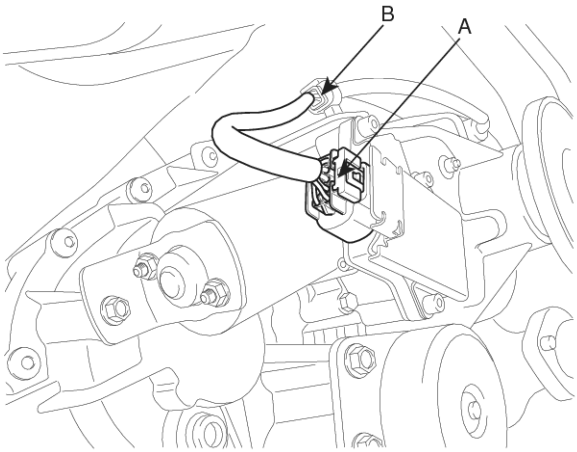
SHMAT8002D

7. Remove the insulator support bracket(A).



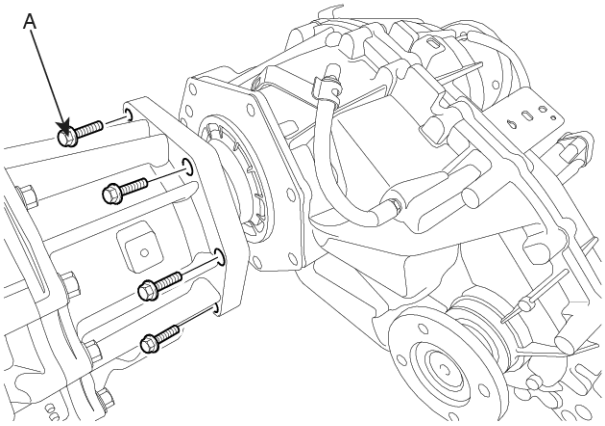
SHMAT8020L

8. Disconnect the 4WD ECU connector(A) or EMC connector(B).

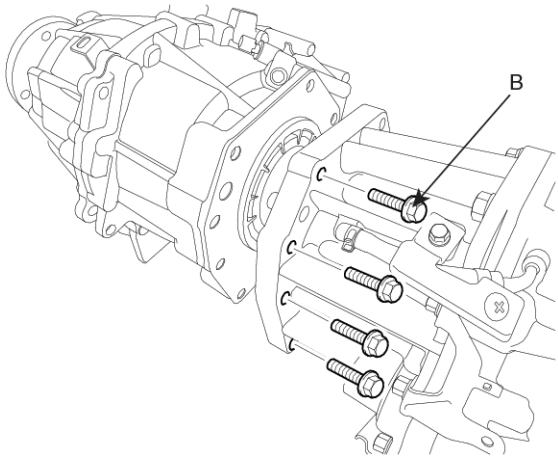


SHMAT8005D

9. Remove the mounting bolts(A,B-4ea) and the transfer assembly.



SHMAT8112L

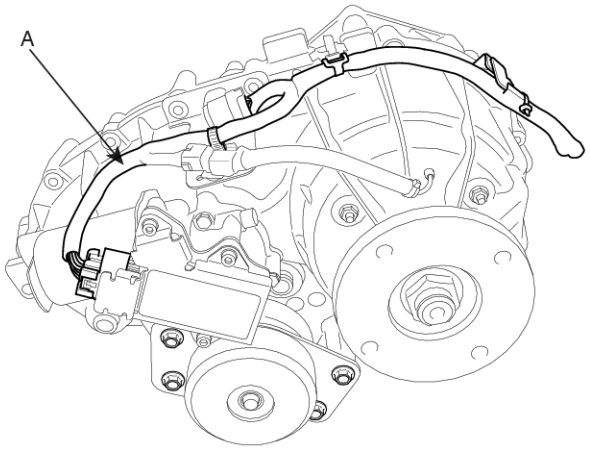


SHMAT8113L

10. Remove the transfer assembly by lowering the supporting jack.

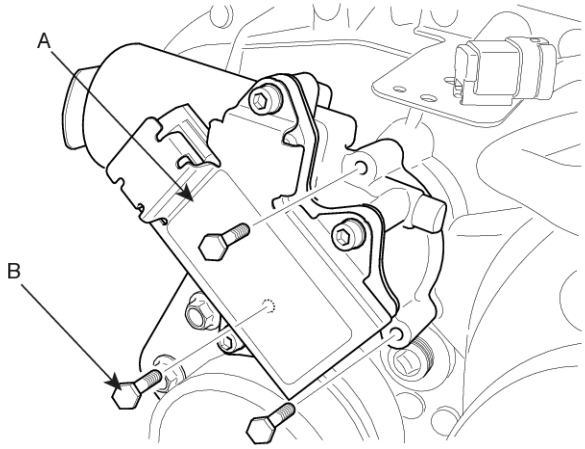
Disassembly

1. Disconnecting the connectors, remove the wiring assembly (A).



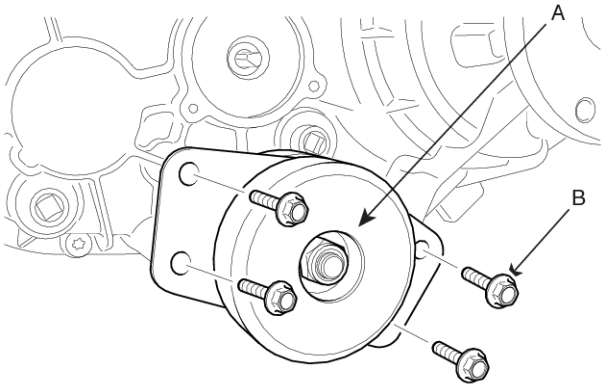
SHMAT9002L

2. Remove the TCCU and motor assembly (A) by removing bolts (B-3ea).



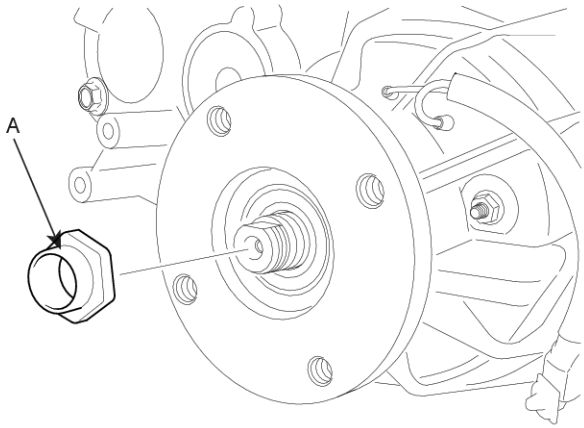
SHMAT9003L

3. Remove the dynamic damper (A) by removing bolts (B-4ea).



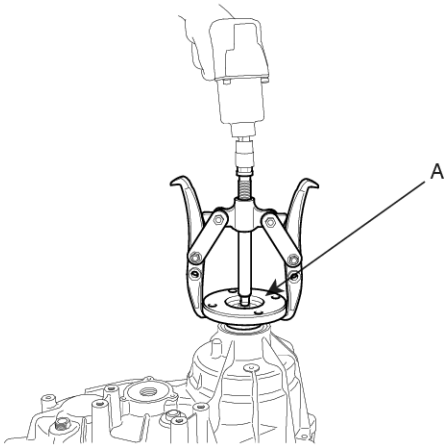
SHMAT9004L

4. Remove the flange nut (A).



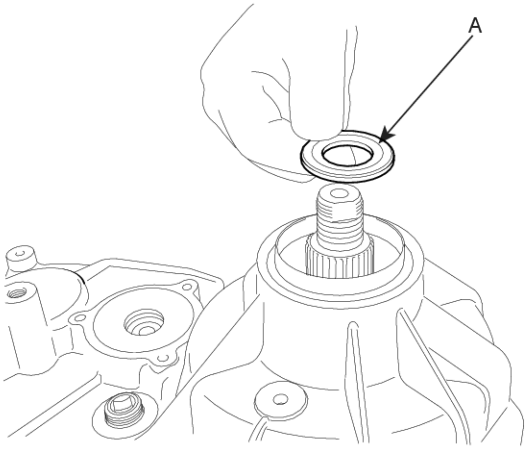
SHMAT9005L

5. Remove the rear flange (A) by using a puller.



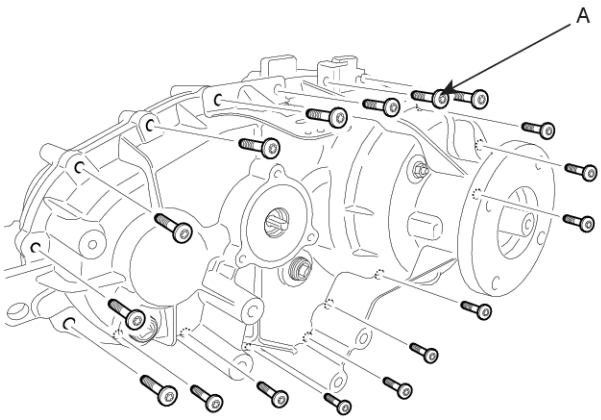
SHMAT9006L

6. Remove the washer (A).



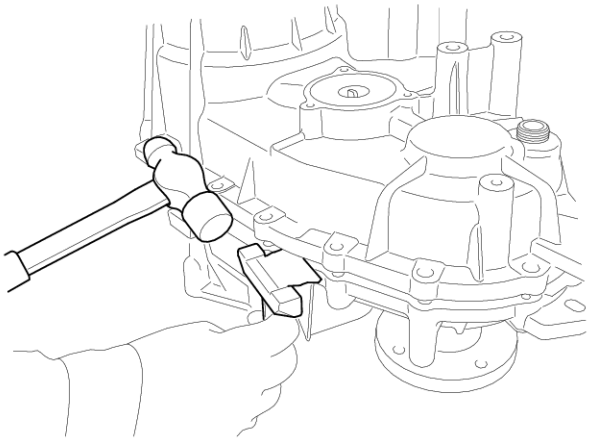
SHMAT9007L

7. Remove the transfer cover bolts (A-17ea).



SHMAT9008L

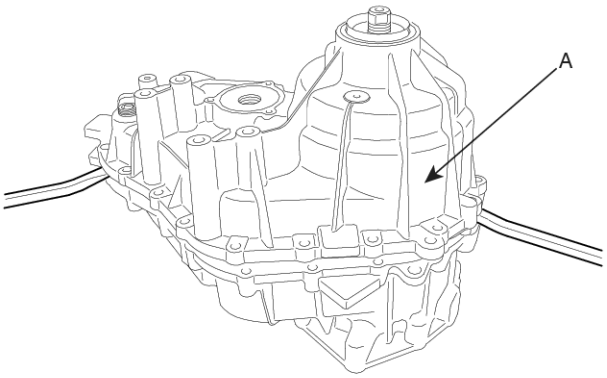
8. Using the special tool (09215-3C000), separate the transfer cover and case in two parts.



SHMAT9009L

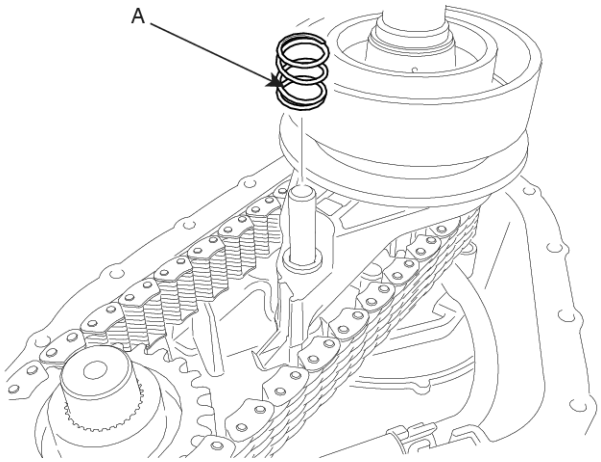
9. Remve the transfer cover (A).

⚠CAUTION
Do not shake the transfer cover not to damage to the inner parts.



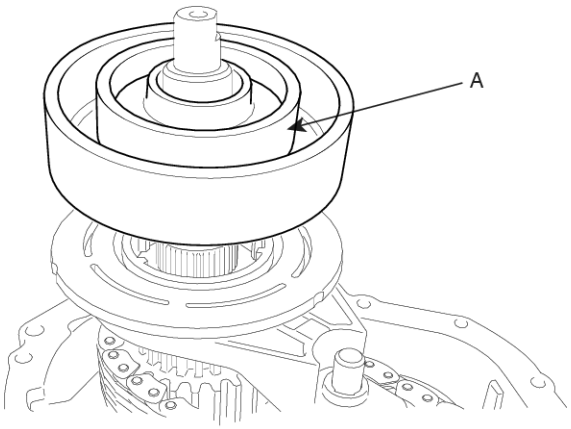
SHMAT9010L

10. Remove the return spring (A).



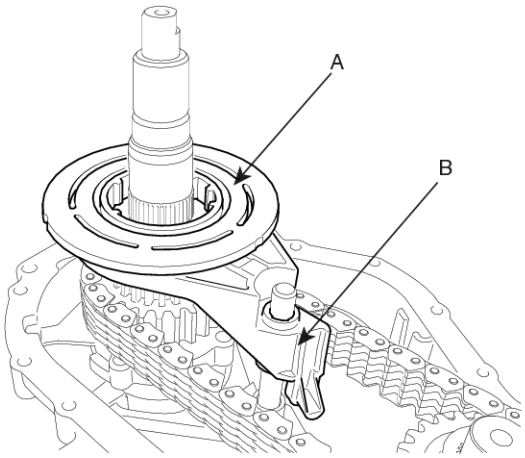
SHMAT9011L

11. Remove the clutch housing (A).



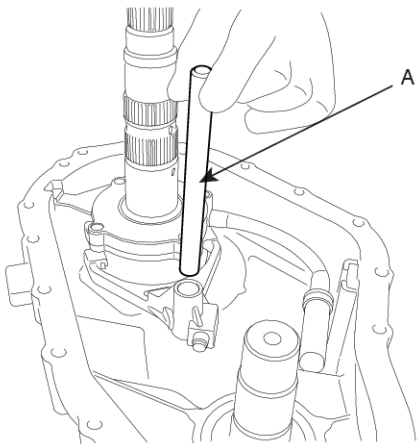
SHMAT9012L

12. Remove the lockup clutch (A) with the lockup fork (B).



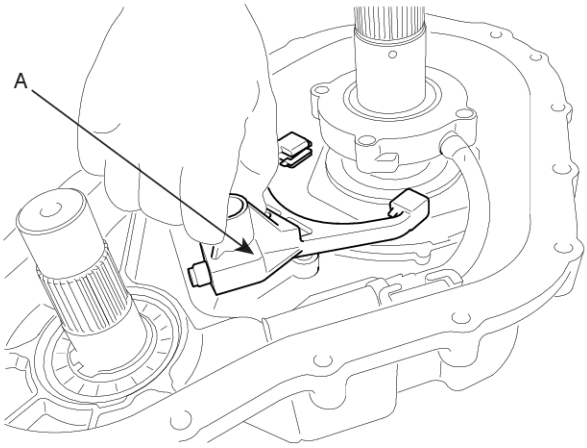
SHMAT9013L

13. Remove the fork rail (A).



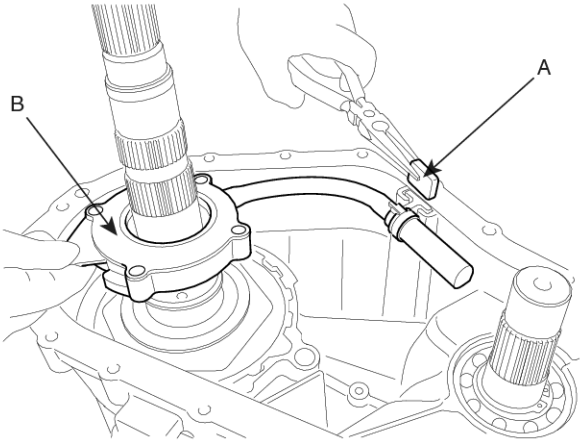
SHMAT9014L

14. Remove the reduction fork (A).



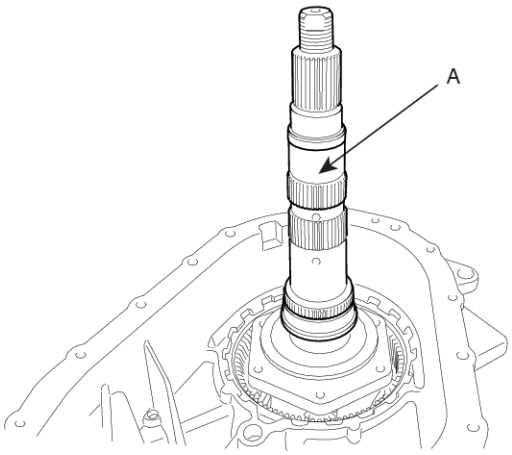
SHMAT9015L

15. Remove the oil filter (B) by removing the magnetic (A).



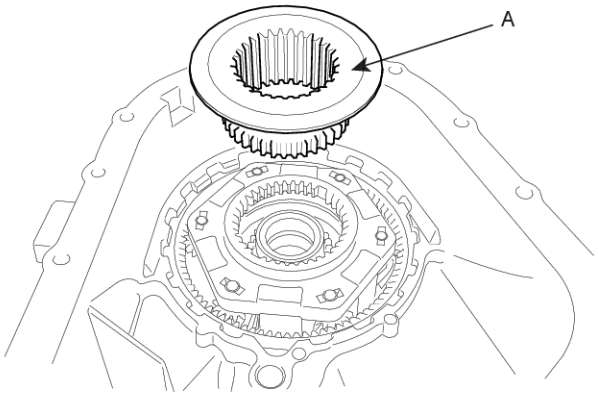
SHMAT9016L

16. Remove the main shaft (A).



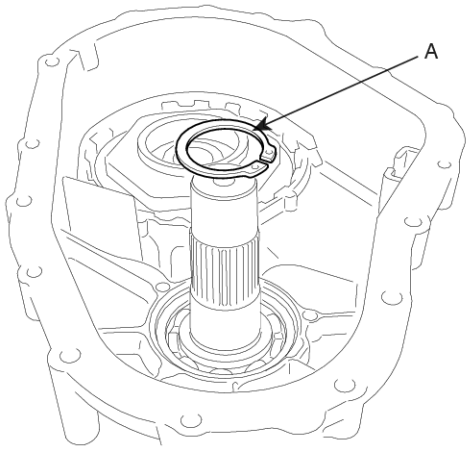
SHMAT9017L

17. Remove the reduction hub (A).



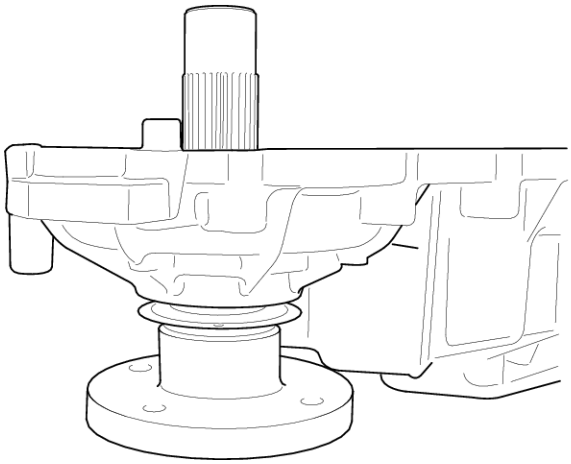
SHMAT9018L

18. Remove the snap ring (A).



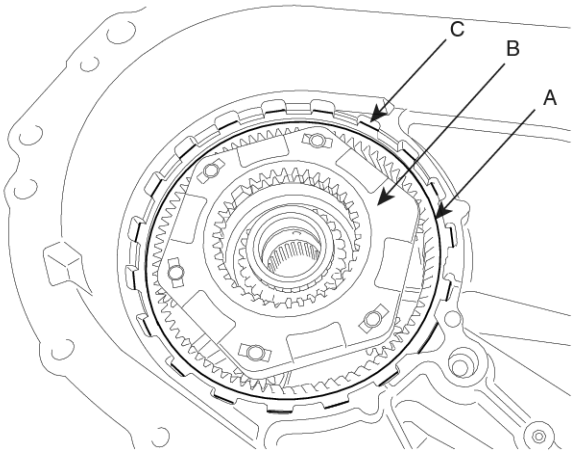
SHMAT9019L

19. Remove the front output shaft assembly outward from the case.



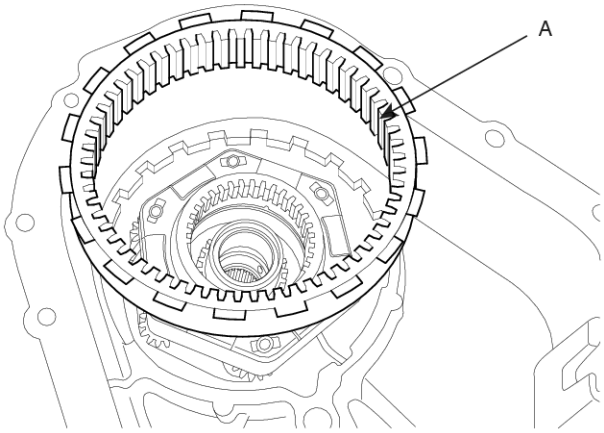
SHMAT9020L

20. Remove the snap ring (A) between the carrier (B) and ring gear (C).



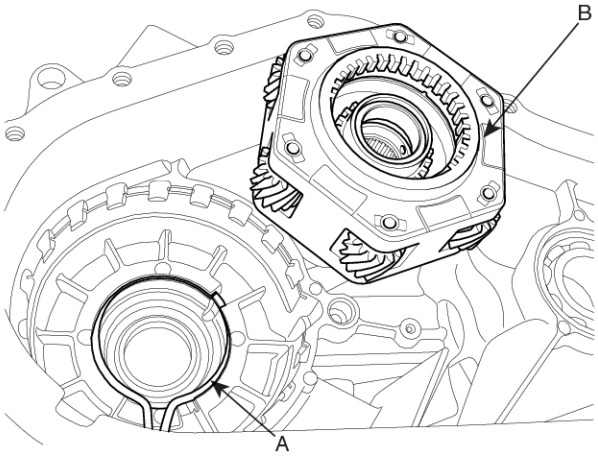
SHMAT9021L

21. Remove the ring gear (A).



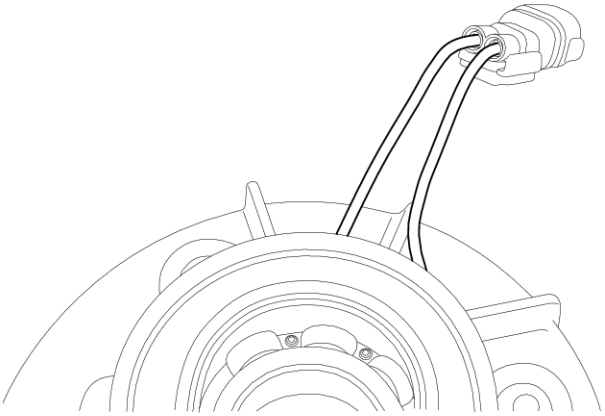
SHMAT9022L

22. Widen two ends of the snap ring (A) and remove the carrier assembly (B).



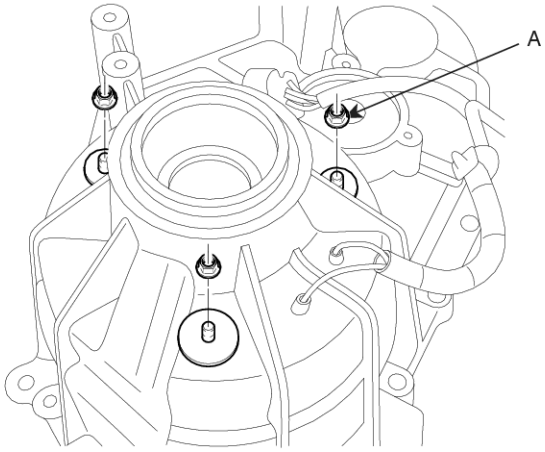
SHMAT9026L

23. Pull each wire from the connector housing.



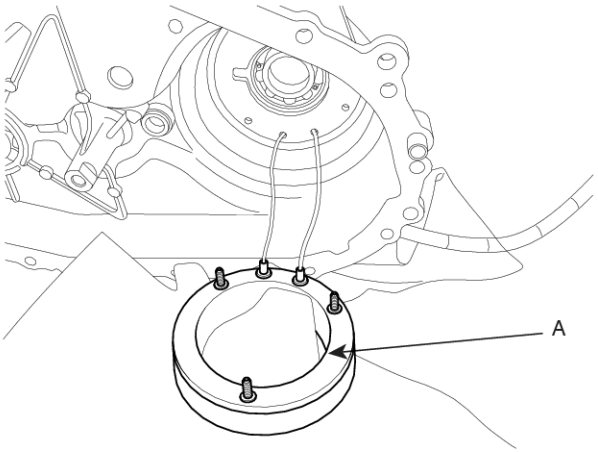
SHMAT9023L

24. Remove the clutch coil nuts (A-3ea).



SHMAT9024L

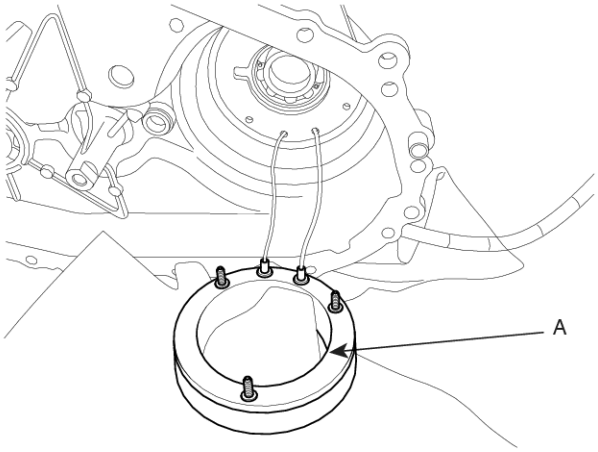
25. Remove the clutch coil (A).



SHMAT9025L

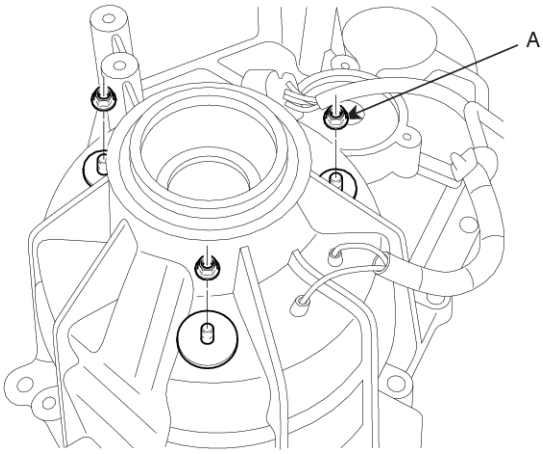
Reassembly

1. Install the clutch coil (A).



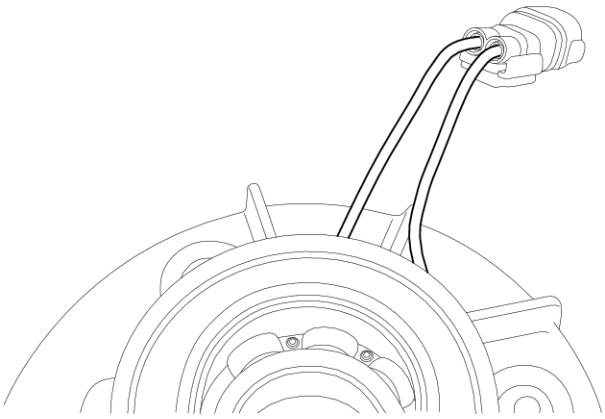
SHMAT9025L

2. Install the clutch coil nuts (A-3ea).



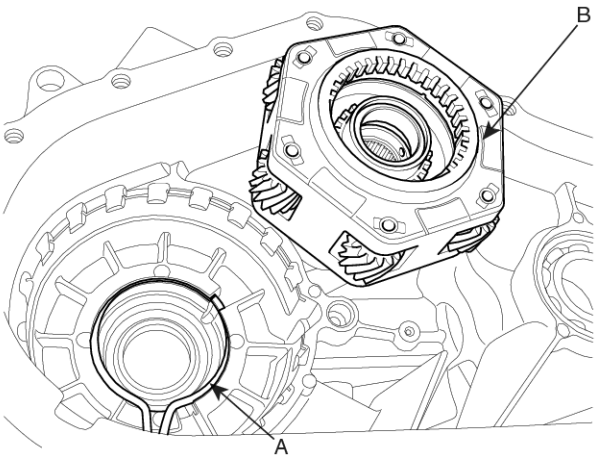
SHMAT9024L

3. Insert each wire to the connector housing.



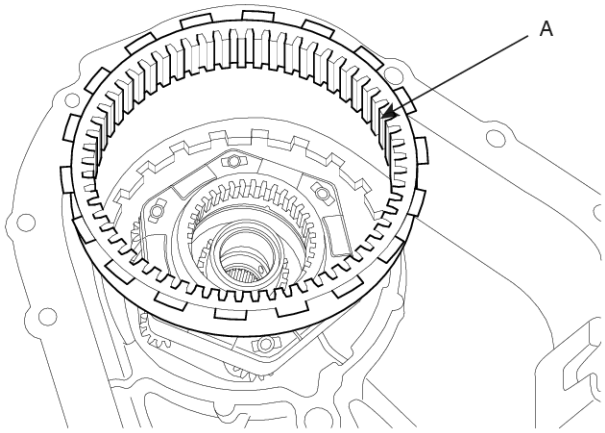
SHMAT9023L

4. Widen two ends of the snap ring (A) and install the carrier assembly (B).



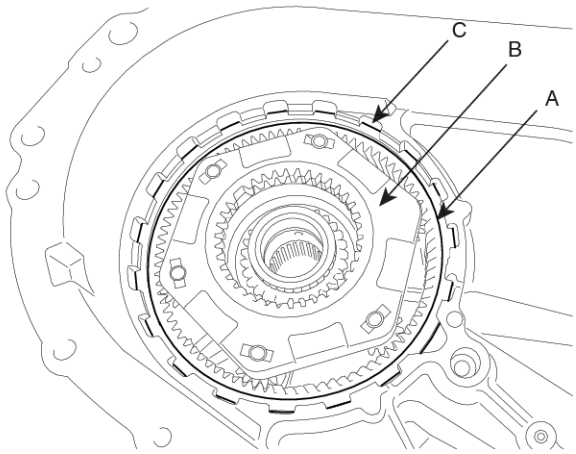
SHMAT9026L

5. Install the ring gear (A).



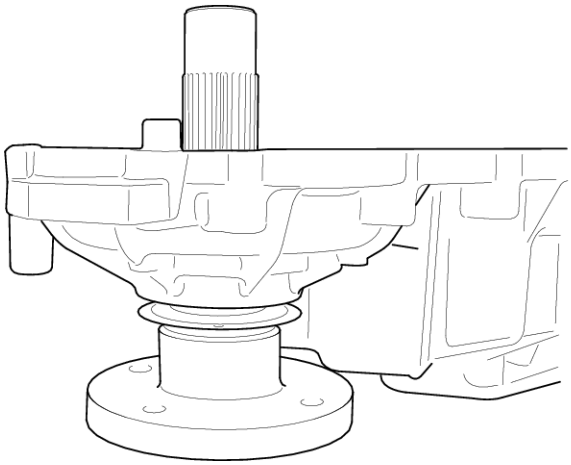
SHMAT9022L

6. Install the snap ring (A) between the carrier (B) and ring gear (C).



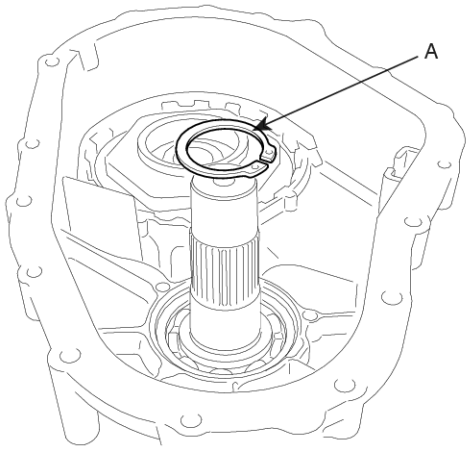
SHMAT9021L

7. Install the front output shaft assembly outward from the case.



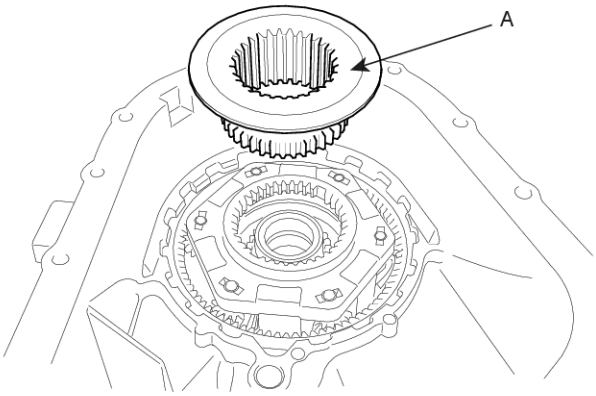
SHMAT9020L

8. Install the snap ring (A).



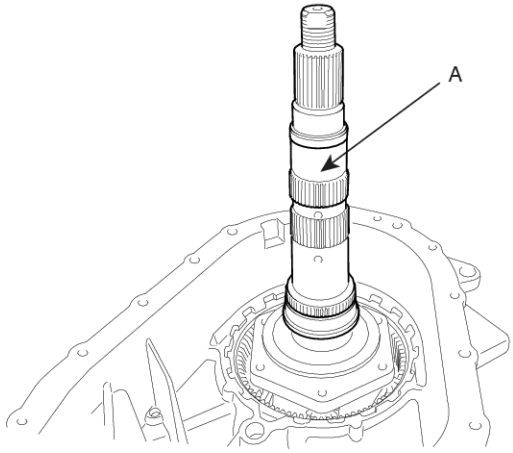
SHMAT9019L

9. Install the reduction hub (A).



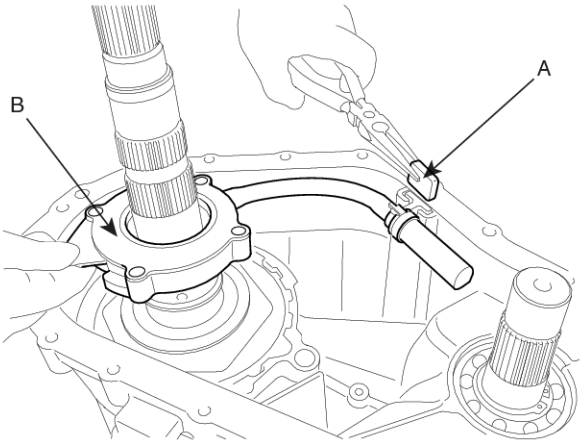
SHMAT9018L

10. Install the main shaft (A).



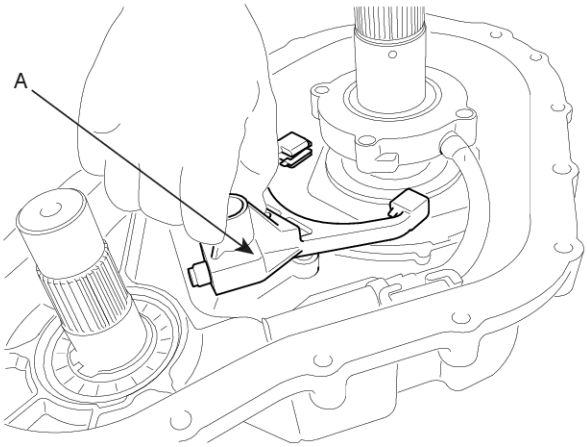
SHMAT9017L

11. Install the oil filter (B) and the magnetic (A).



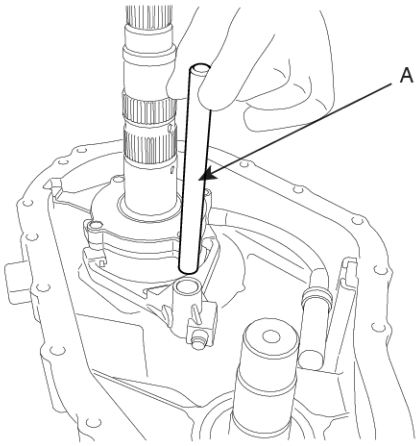
SHMAT9016L

12. Install the reduction fork.



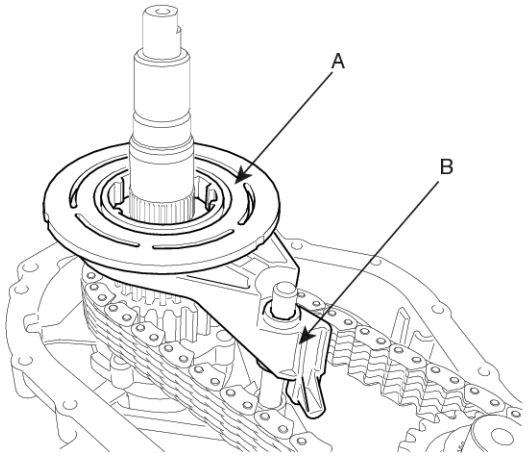
SHMAT9015L

13. Install the fork rail (A).



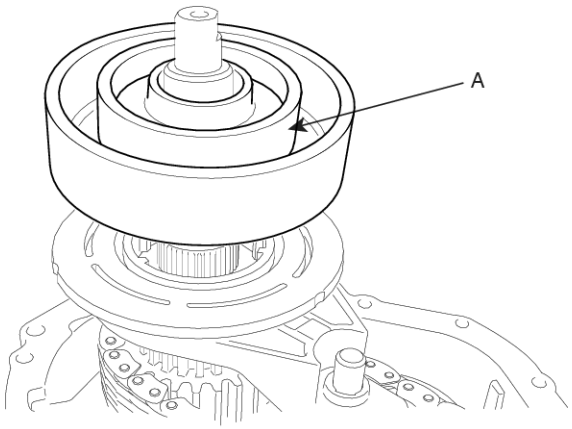
SHMAT9014L

14. Install the lockup clutch (A) with the lockup fork (B).



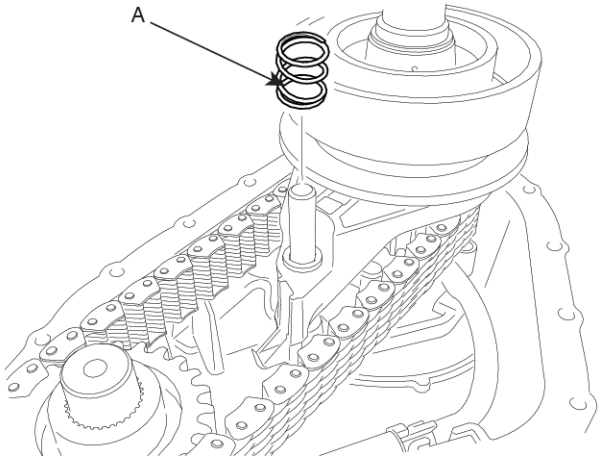
SHMAT9013L

15. Install the clutch housing (A).



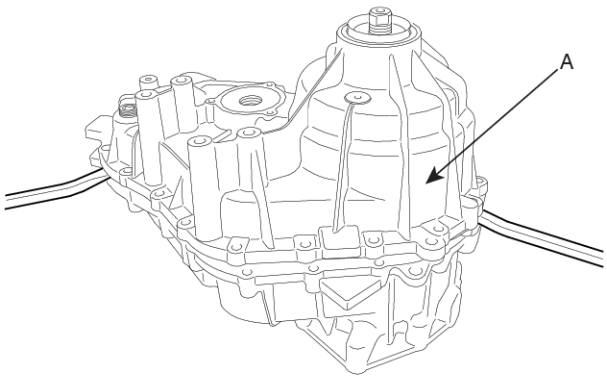
SHMAT9012L

16. Install the return spring (A).



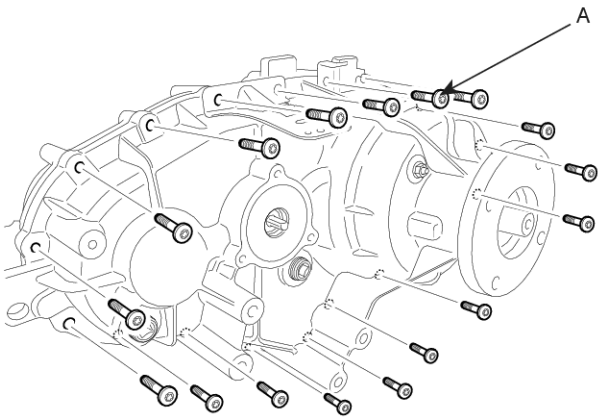
SHMAT9011L

17. Grease the contact surface of the cover and install the transfer cover (A).



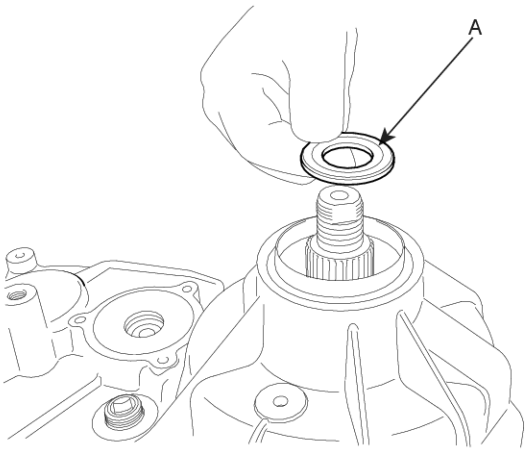
SHMAT9010L

18. Install the transfer cover bolts (A-17ea).



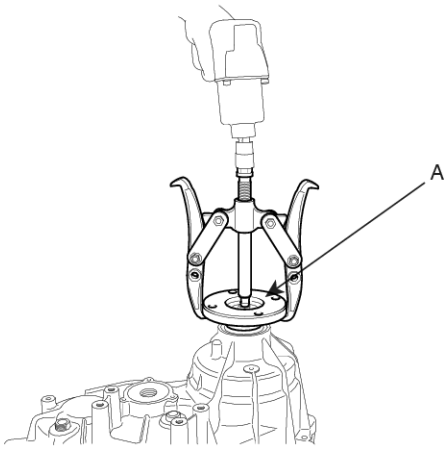
SHMAT9008L

19. Install the washer (A).



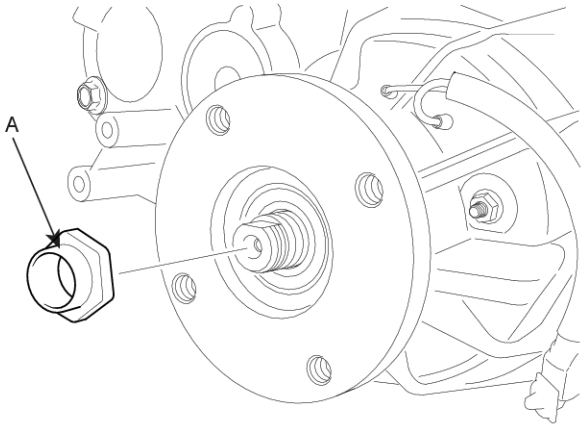
SHMAT9007L

20. Install the rear flange (A) by using press.



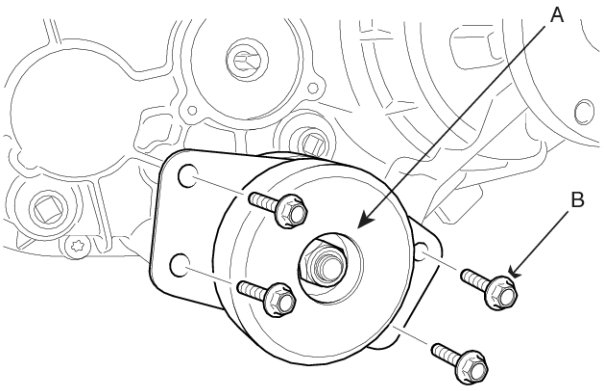
SHMAT9006L

21. Install the flange nut (A).



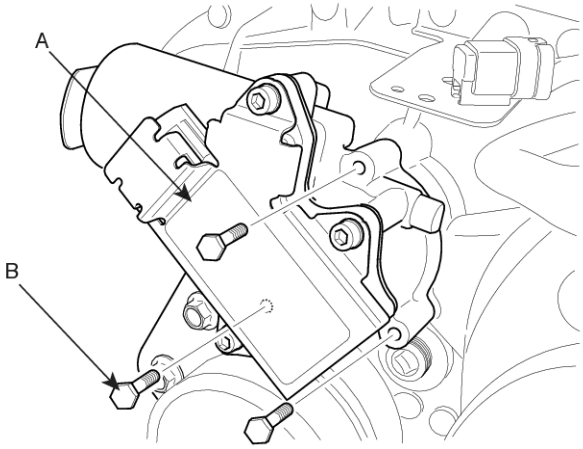
SHMAT9005L

22. Install the dynamic damper (A) by installing bolts (B-4ea).



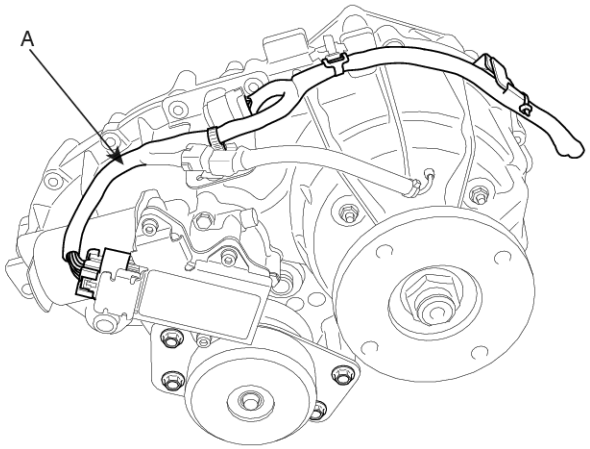
SHMAT9004L

23. Install the TCCU and motor assembly (A) by installing bolts (B-3ea).



SHMAT9003L

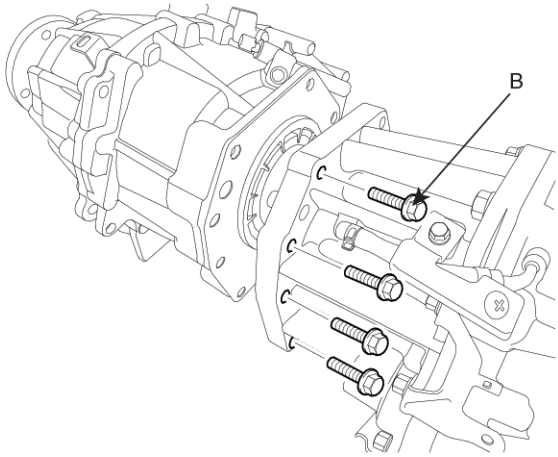
24. Connecting the connectors, install the wiring assembly (A).



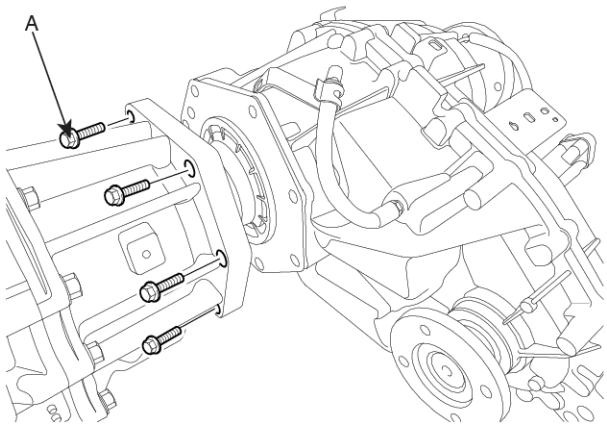
SHMAT9002L

Installation

1. Lowering the vehicle or lifting up a jack, install the transfer assembly.
2. Install the mounting bolts(A,B-4ea) and the transfer assembly.

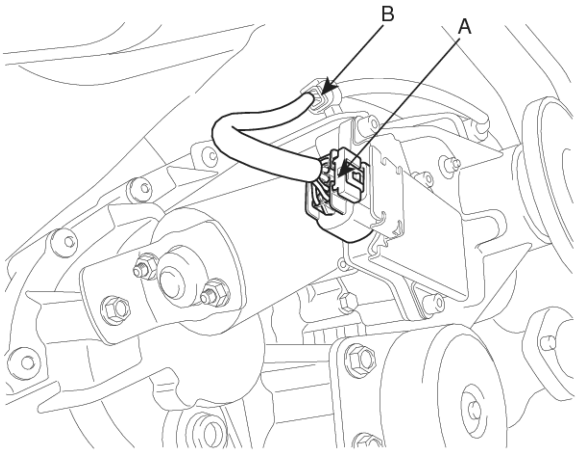


SHMAT8113L



SHMAT8112L

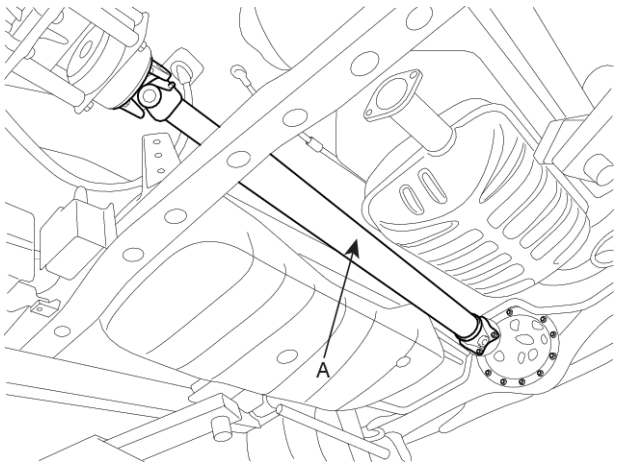
3. Connect the 4WD ECU connector(A) or EMC connector(B).



SHMAT8005D

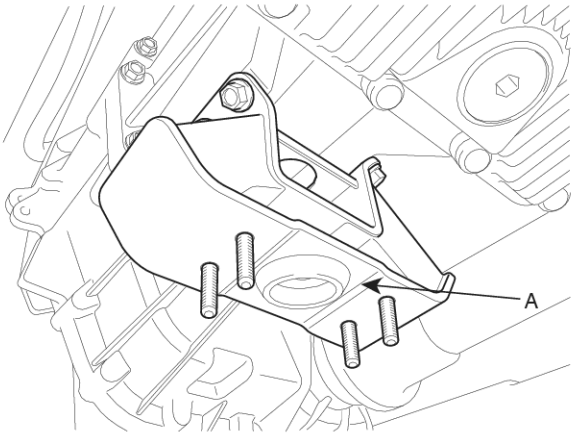
4. Install the rear propeller shaft(A).

Tightening torque :
58.83~68.64Nm(6~7kgf.m, 43.39~50.63lb-ft)



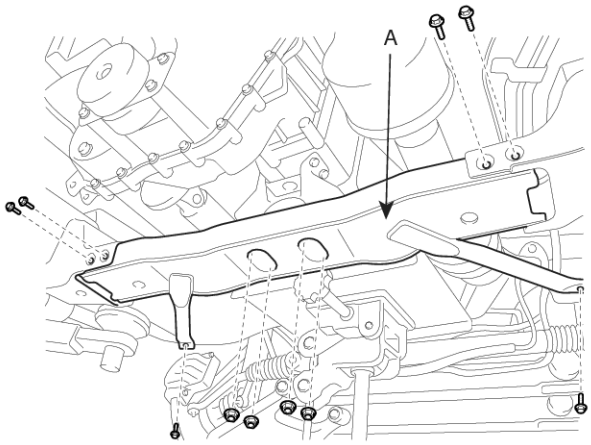
SBLAT6009L

5. Install the insulator support bracket(A).



SHMAT8020L

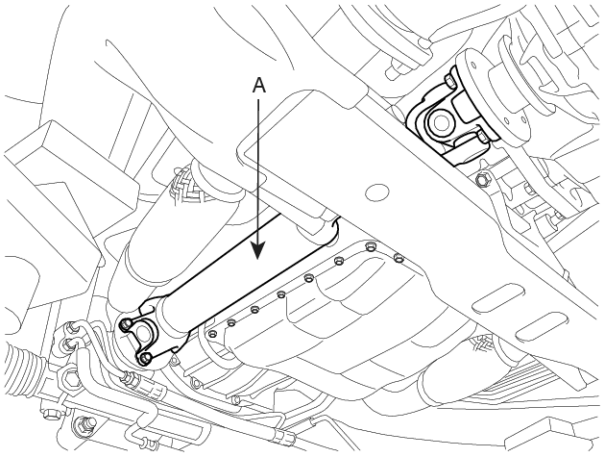
6. Install the cross member(A).



SHMAT8002D

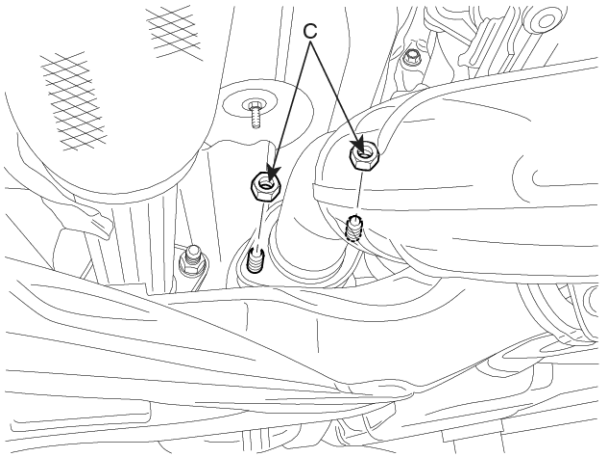
7. Install the front propeller shaft(A). (4WD)

Tightening torque :
58.83~68.64Nm(6~7kgf.m, 43.39~50.63lb-ft)

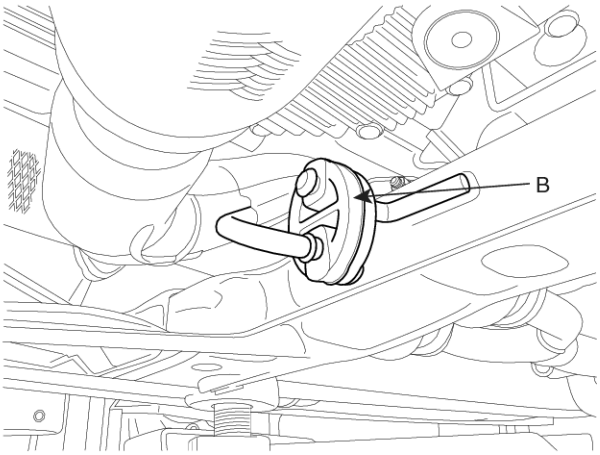


SBLAT6007L

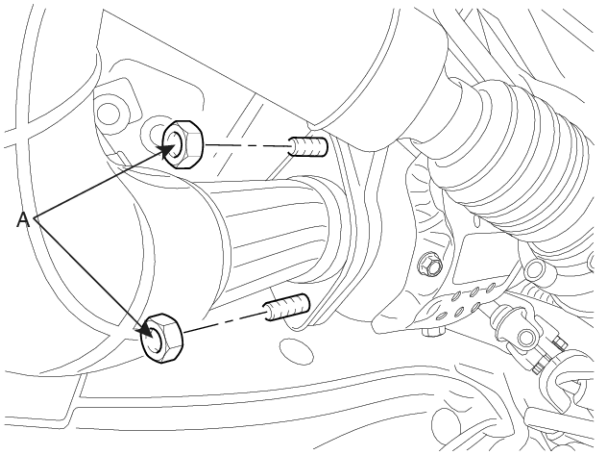
8. Install the front muffler(A) or muffer hanger rubber(B), by removing rear muffler(C).



SHMAT8004L

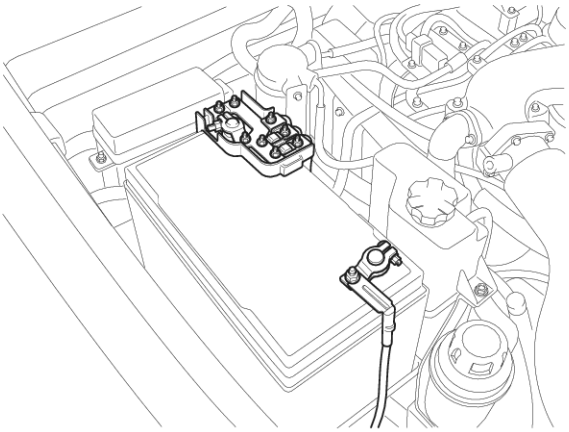


SHMAT8003L



SHMAT8002L

9. Install the battery (-) terminal.



SHMAT8001D