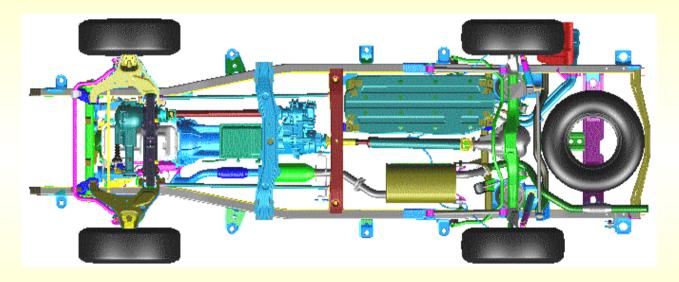
POWERTRAIN

Line-up

Engine			T/M		Area			Remarks
			MT	A/T	EU	General	NA	Remarks
DSL	4D56	Mech.	V5MT1	03-11				
		COVEC-F						EURO-II
	KJ-2.9	C/Rail	M5SR1	30-40LEi				EURO-III
GSL	Sigma 3.5 V6							EURO-III

Terracan



- EST (Electronic Shift Transfer)
- TOD (Torque On Demand)

HP 4WD SYSTEM

Ordering Specifications

		2.5 TCI 2.9 TCI		3.5 V6 DOHC	
Max Power		100 PS / 3800 145 PS / 3800		200 PS / 5500	
Max Torque		24.0 Kg.m / 2000 34.0 Kg.m / 2000		30.8 Kg.m / 3000	
Transmission		M/T & A/T			
Transfer	STD	Part-time 4WD (EST)			
	OPT	None Full-time 4WD (ATT)			

- **EST:** Electrical Shift Transfer is standard on all models and trims for part-time 4WD, allowing drivers to "shift on the fly" between two- and four-wheel-drive modes at speeds up to 80 km/h.
- ATT: Active Torque Transfer (or "Torque-on-Demand") electronically transfers power and torque from the rear to the front as required, enhancing off-road traction, handling agility and steering precision.

HP 4WD SYSTEM

Specifications

Items	Parts time	Full time	
Engine	DSL 2.5, 2.9 GSL 3.5		
Туре	Electronic shift transfer	Active torque transfer	
Model	BWA 44-24 ESOF	BWA 44-24 TOD	
FRT axle connection	CADS	No CADS (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 (Permanent use : No replacement)		
Lub. Quantity (L)	1.42		
CADS solenoid valve		×	
Front speed sensor	×	Hall IC effect type	
Rear speed sensor	×	Hall IC effect type	
Vehicle speed sensor	Pulse generator	Hall IC effect type	

Contents

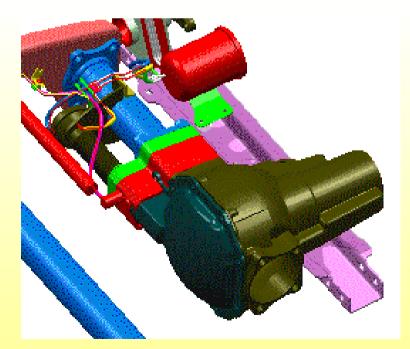
Part time 4WD system (EST)

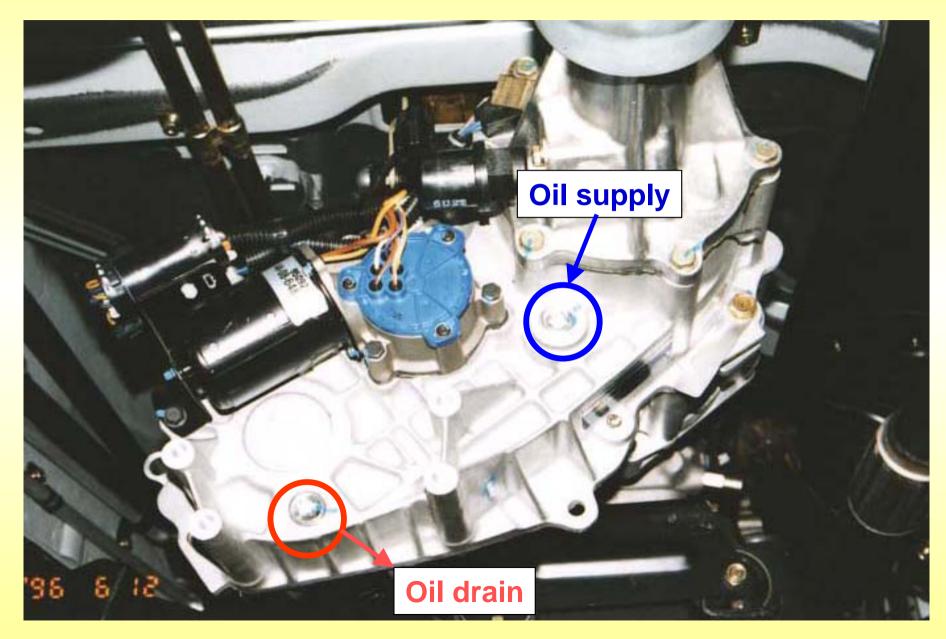
- Introduction
- SOTF
- CADS
- System block diagram
- DTC
- Electrical wiring diagram

Introduction

EST system is a kind of part time 4wheel drive system and its full name is 'Electronic shift transfer. Instead of previous free wheel hub, CADS (center axle disconnect system) was adopted and this one is for SOFT(shift on the fly) while vehicle driving. When the vehicle runs with 2WD again, the front axle will be rotated idly due to the vehicle speed and this makes the noise and vibration on the propeller shaft and ring gear set. Therefore CADS will prevent this phenomena to get a driving stability, efficiency and improved NVH.

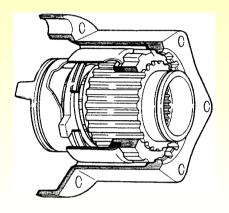
When 2WD is selected by driver, the shift fork is moved due to the spring force of actuator and pressure difference of solenoid valve. Then the sleeve is moved and it results disconnection between axle shaft and differential shaft. Oppositely, if 4WD is selected by driver, the axle shaft and differential shaft is connected so as to be driven by 4WD.



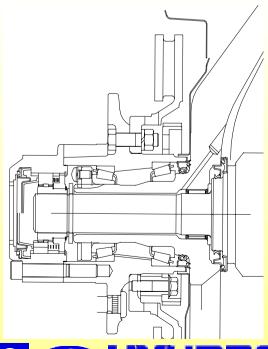


The kinds of SOTF system in part time 4WD

1) CAM type auto free wheel hub

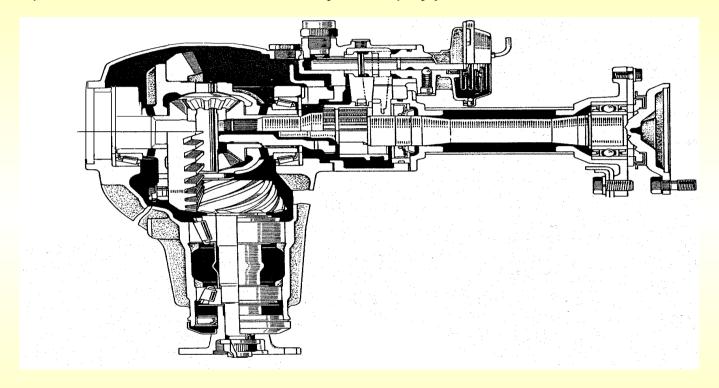


- Application vehicle : Galloper
- SOTF is activated in condition of 40km/h or less.
- For 2WD driving from 4WD, vehicle should be moved backward from 1 to 2 meters approximately.
- 2) Vacuum type free wheel hub
 - Application vehicles: H-1, KMC Sportage
 - SOTF is activated in condition of 80km/h or less.
- In respect of durability, it is difficult to prevent the air leakage on the wheel end side



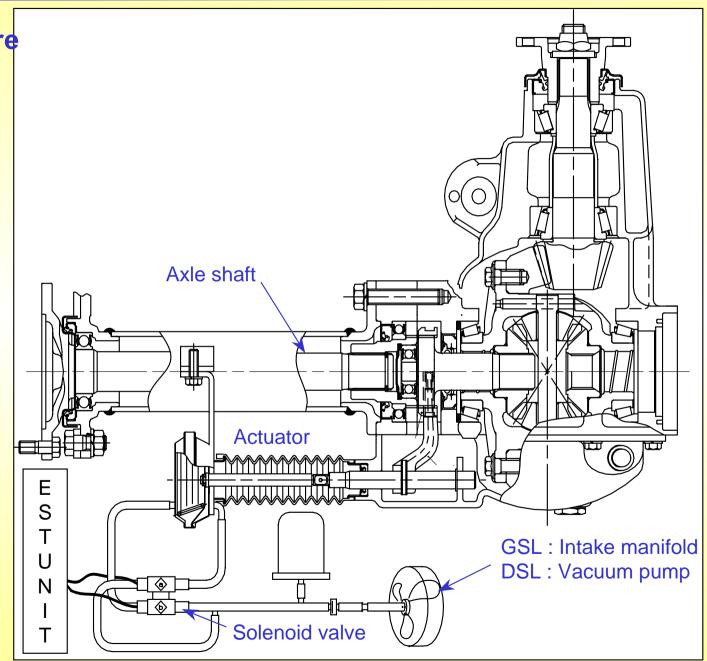
The kinds of SOTF system in part time 4WD

3) CADS (Center axle disconnect system) type

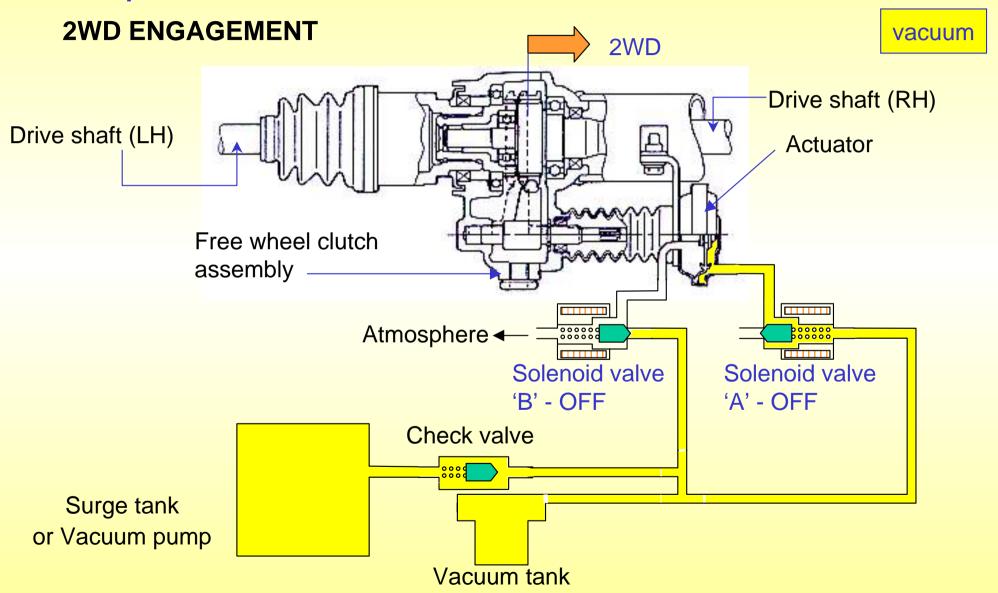


- Application vehicles: HP, MMC Pajero, Challenger, Big horn, Surf
- SOTF is activated in condition of 80km/h or less.

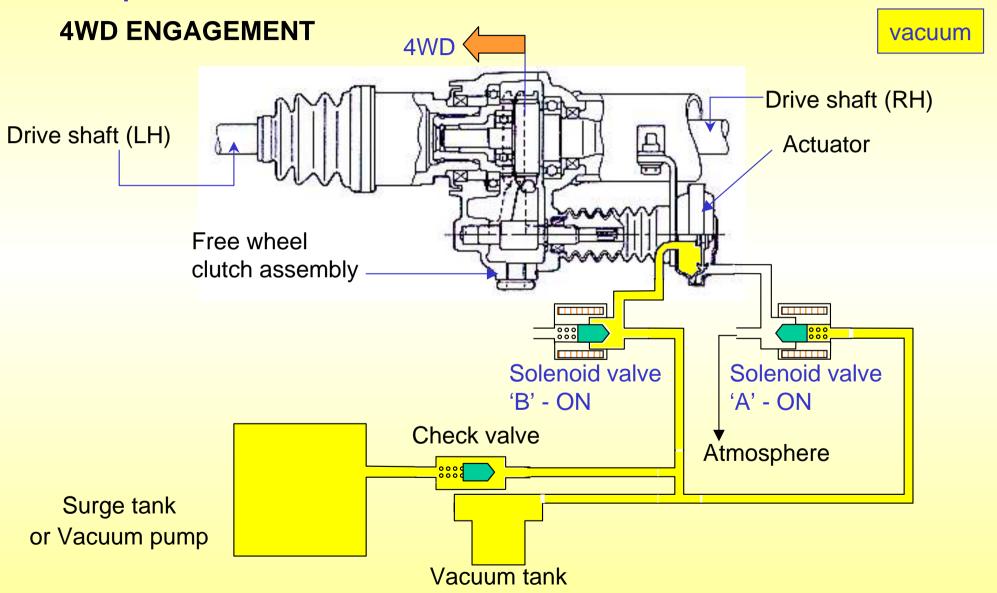
CADS structure



CADS operation



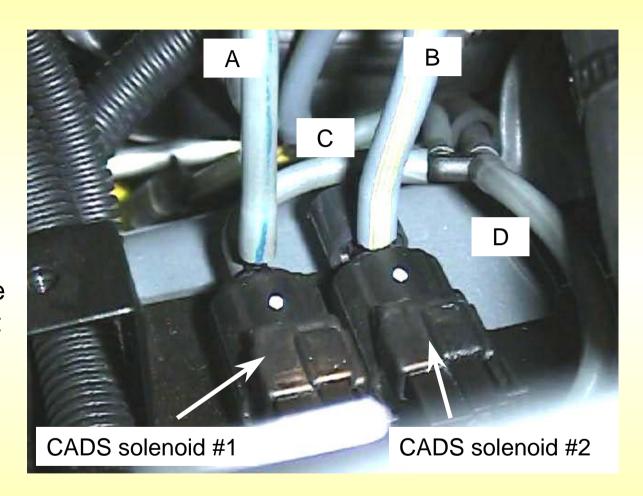
CADS operation



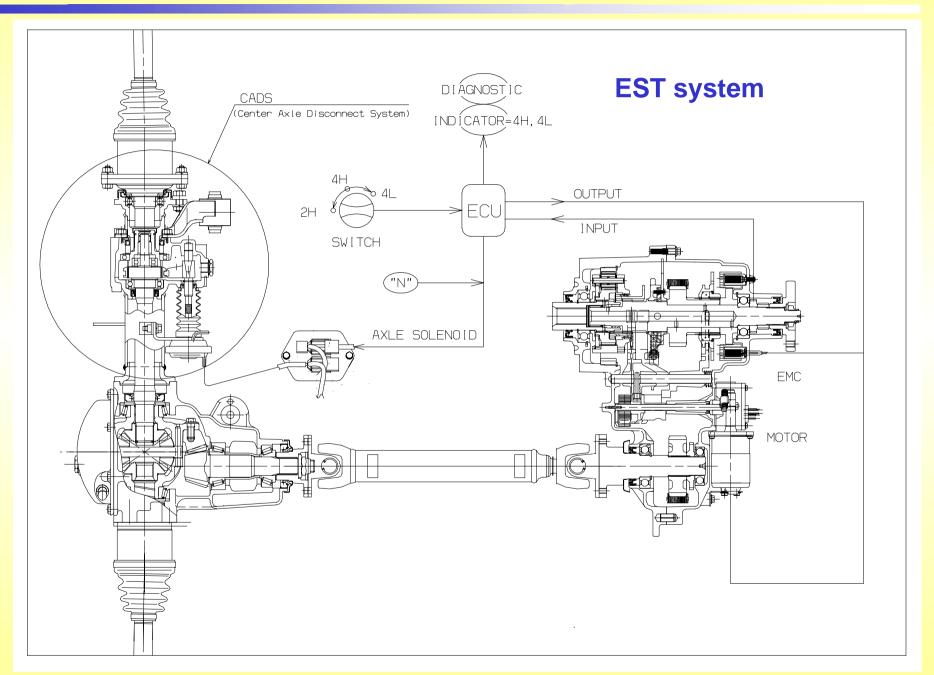
CADS solenoid valve

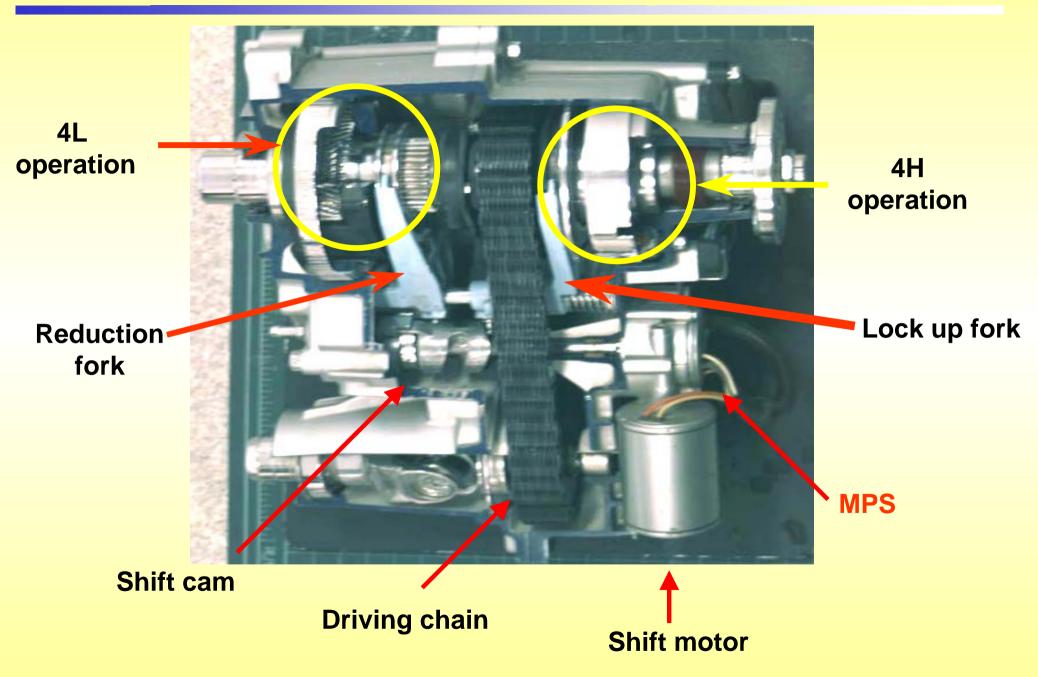
You can find these solenoid valves beside of battery.

The indicated tubes 'A' and 'B' are should not be connected oppositely. But there is no matter even though other tubes such as 'C' and 'D' are connected oppositely. Because the tubes 'C' and 'D' are for just supplying the vacuum from the pump (DSL) or manifold pressure tank (GSL).



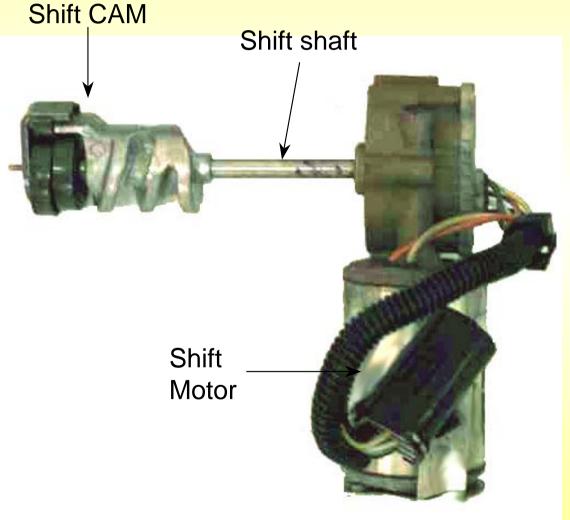
Also the connectors for each solenoid valves can be connected oppositely. Because it is energized both 'ON' or 'OFF' at the 4WD and 2WD.



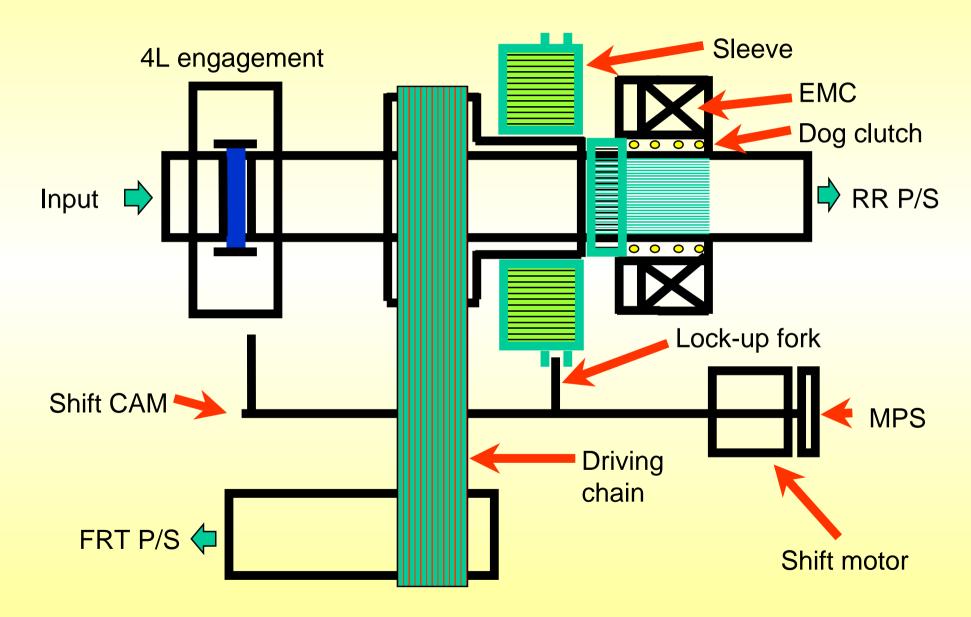


Comparing with shift system of TOD, EST has one more shift fork for engaging from 2WD to 4WD. That is a 'Lock up shift fork'.

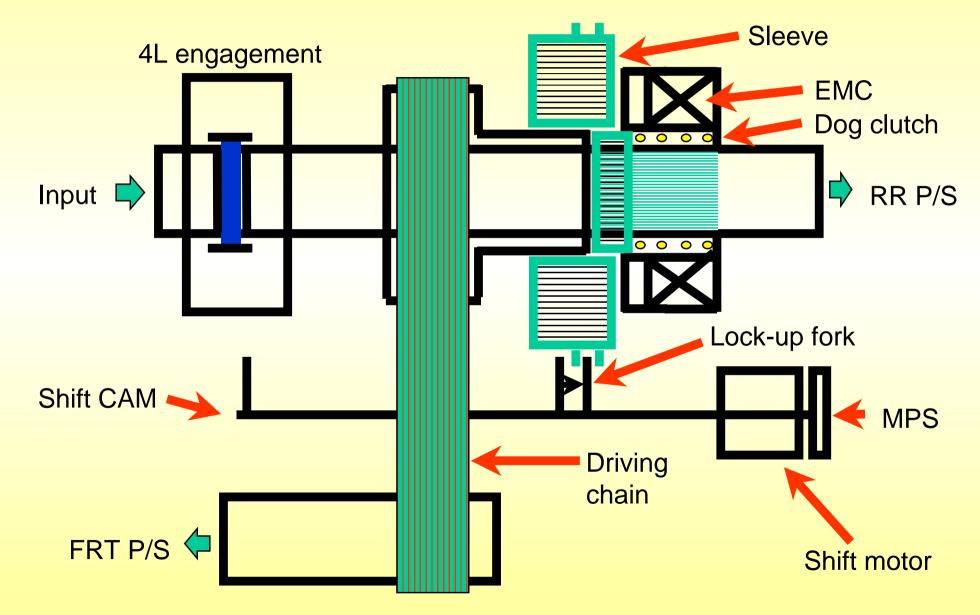
	EST	TOD
Reduction shift fork	Yes	Yes
Lock up shift fork	Yes	No



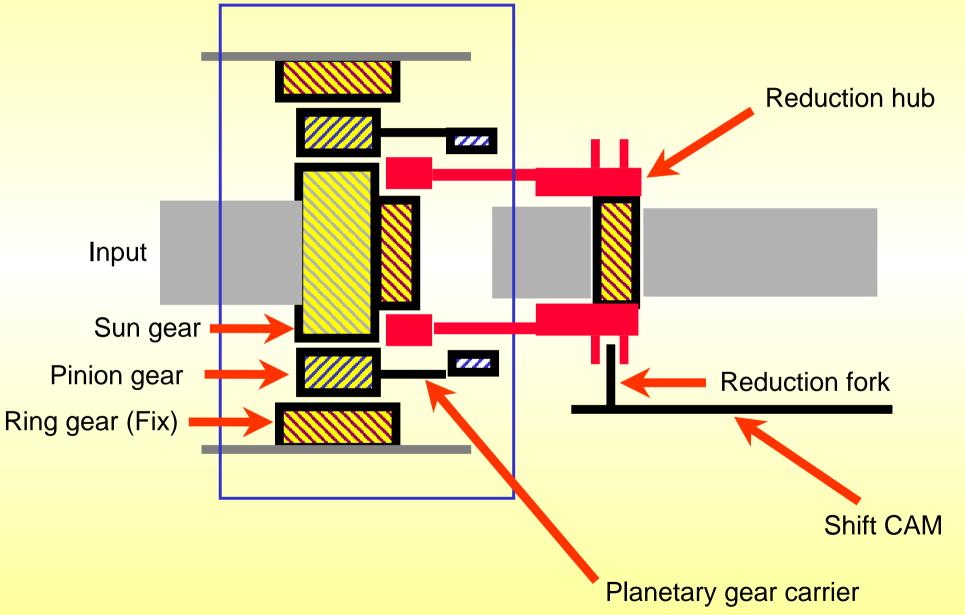
2WD engagement

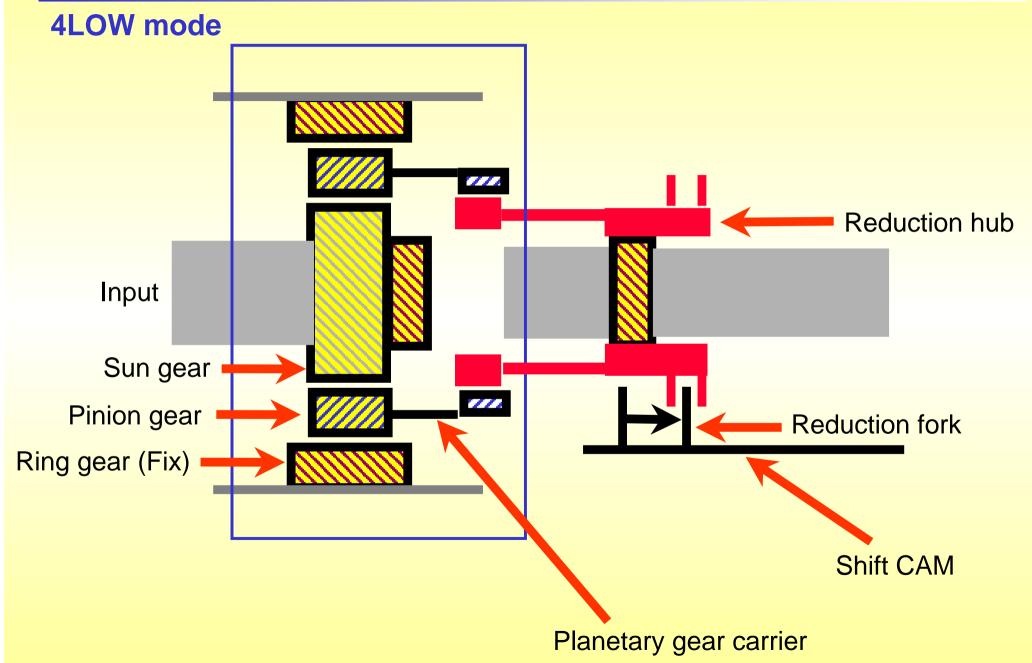


4WD engagement



1:1 connection (2H, 4H)





Selecting mode

- 1) 2H mode
- 2) 4H mode

The 4WD driving can be achieved when the vehicle driving. (SOTF: Shift On The Fly) At this time, the vehicle speed should not be over than 80km/h. If the shift is successfully finished, the 4WD High lamp will be turned on.

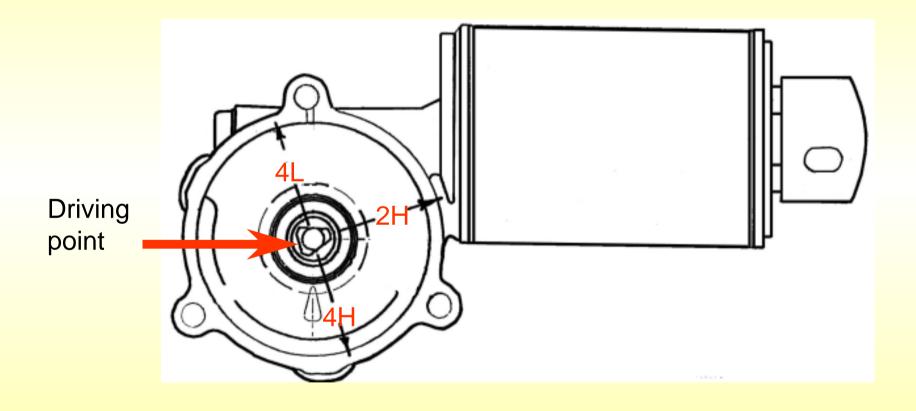
3) 4L mode

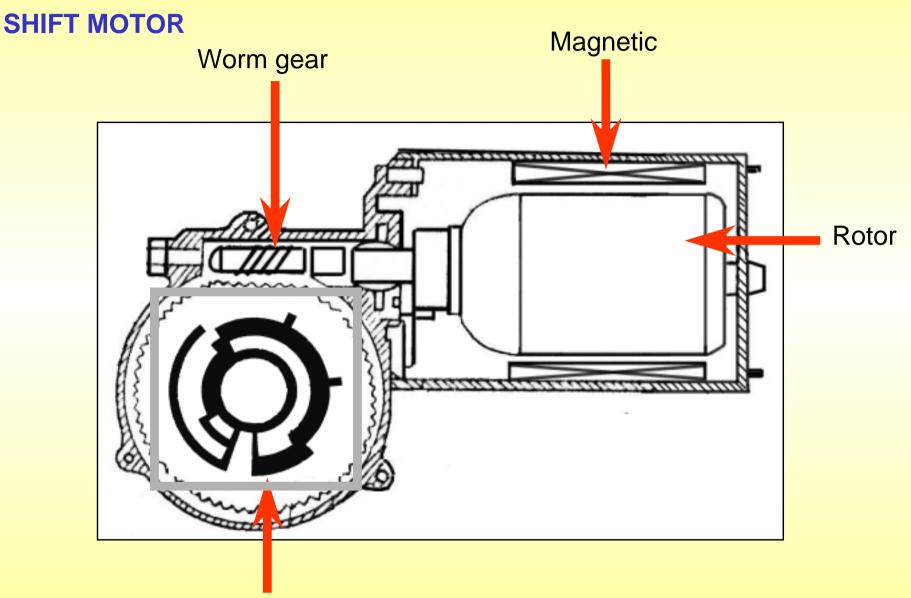
The vehicle should be stopped (3km/h or less) to select this 4L. Also if the shift is successfully finished, the 4L lamp will be turned on.





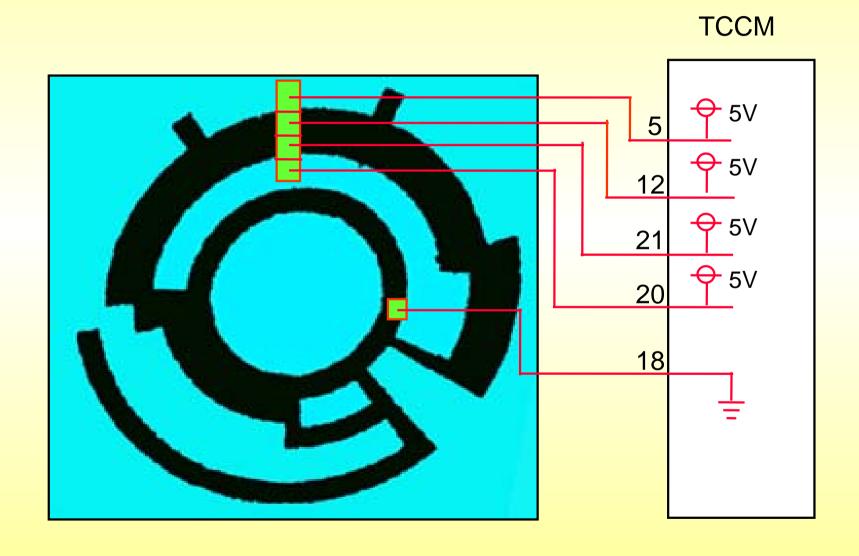
SHIFT MOTOR



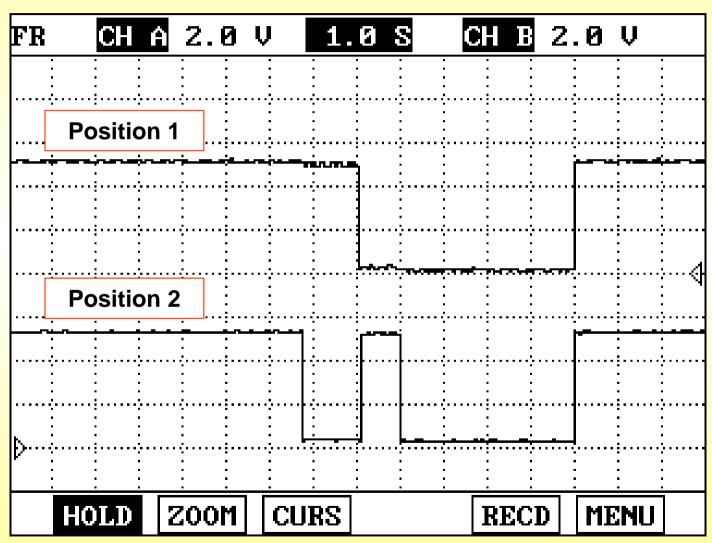


MPS contacting plate

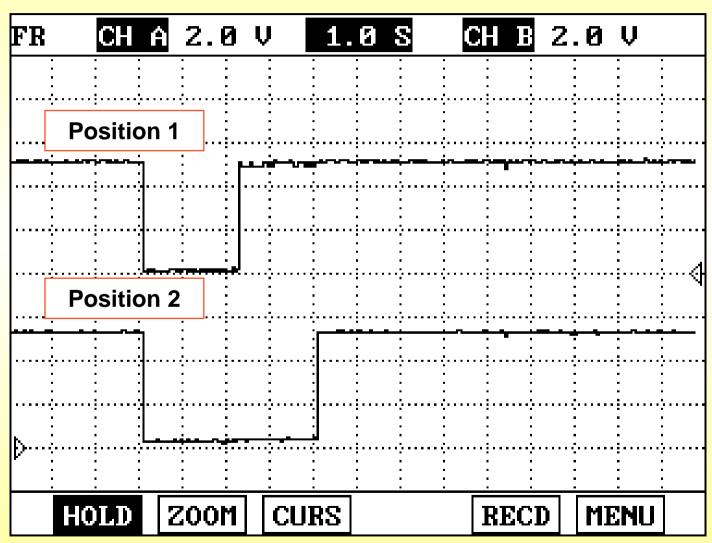
MPS contacting points



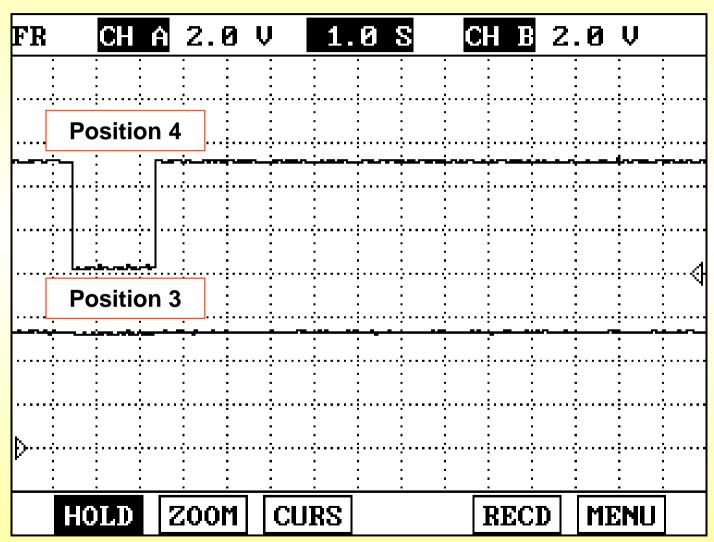
MPS signals (2H \rightarrow 4H)



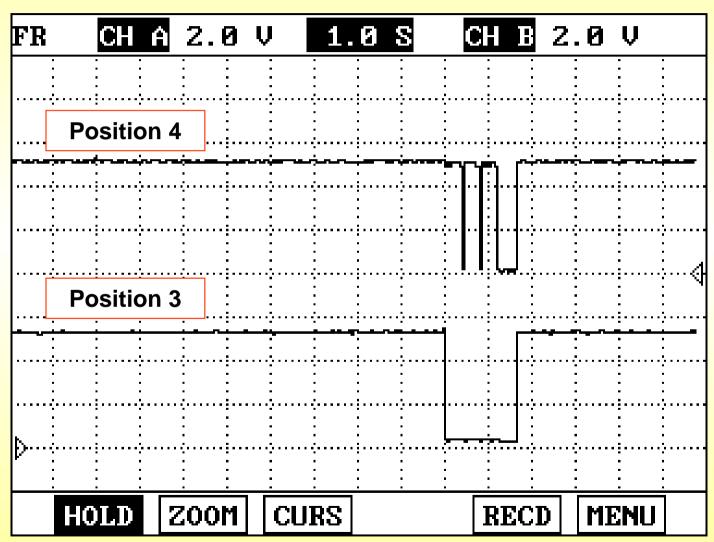
MPS signals $(4H \rightarrow 4L)$



MPS signals (2H \rightarrow 4H)

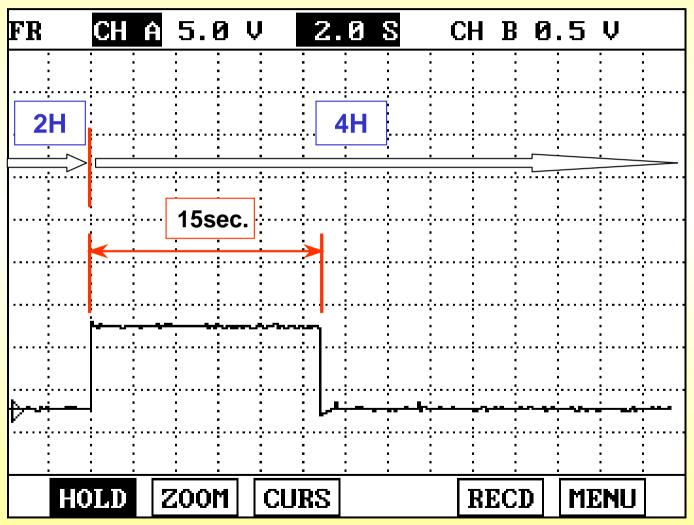


MPS signals $(4H \rightarrow 4L)$

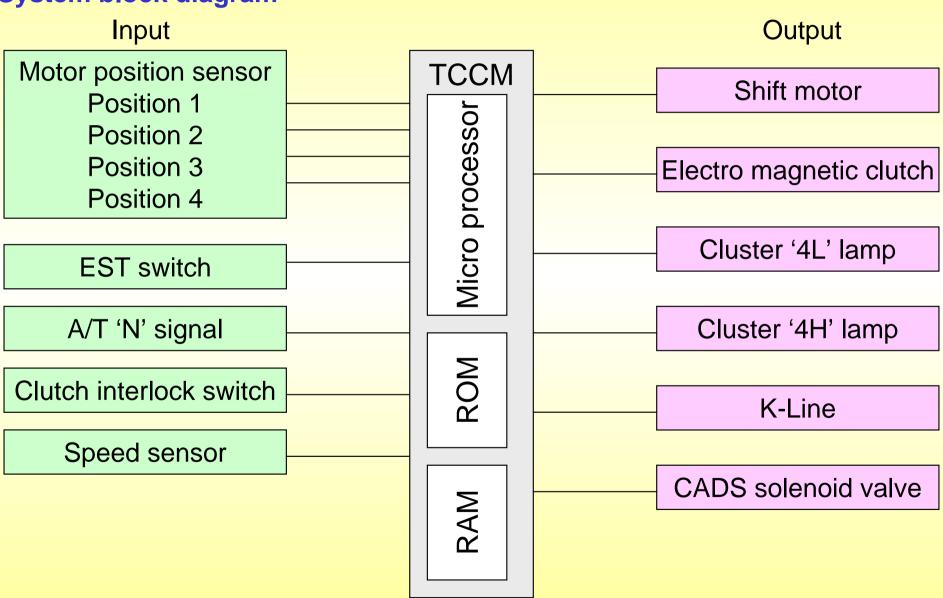


EMC signal (2H \rightarrow 4H)

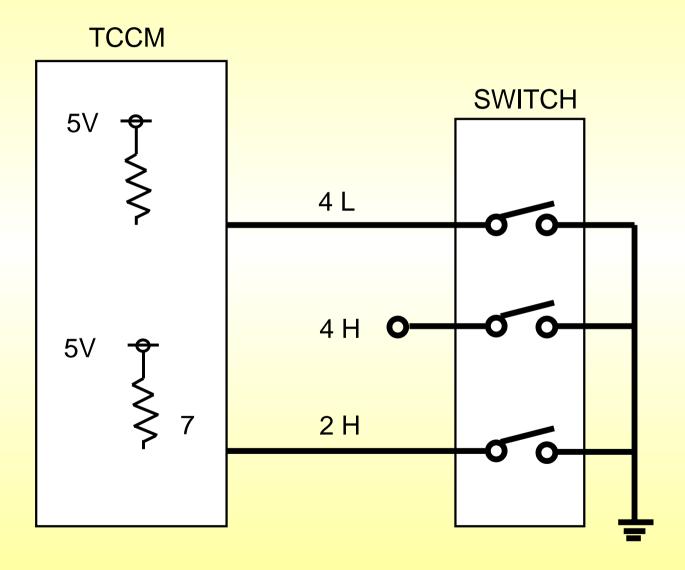
EMC is energized for 15seconds to pull the lock-up shift fork to make 4H mode.

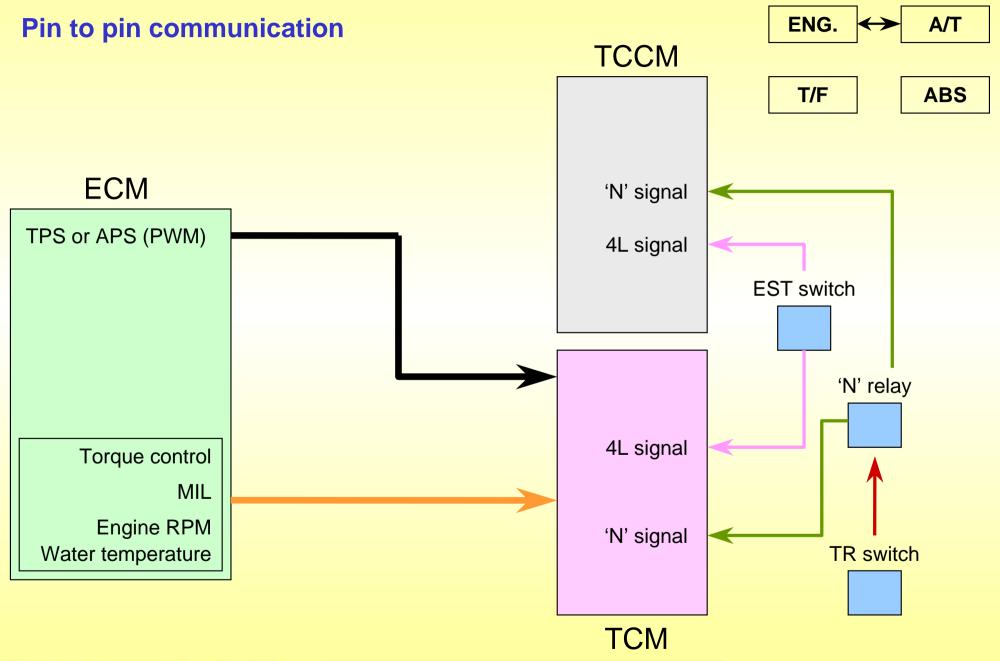


System block diagram



Components – 2H/4H/4L switch





Data Link Connector



DTC

There is no P-code for EST system on HP. DTC is supported with binary code through L terminal of data link connector (16pin). The digital sequence to indicate a fault shall operate in the following manner on ignition initialization and service center connection.

- 1. Bulb check .6 seconds
- 2. Off for 3.0 seconds
- 3. Flash fault code
- 4. Off for 3.0 seconds
- 5. Repeat steps 3, 4 two more times
- 6. Repeat steps 3, 4, 5 for additional faults

The digital code for a fault shall be displayed most significant bit first with a total of three (3) bits. A digital zero is indicated by turning the lamp on for 0.5 seconds. A digital 1 is indicated by turning the lamp on for 1.0 second.

DTC

Decimal	Binary	Fault
1	001	TCCM (Tansfer case control module)
2	010	Shift motor
3	011	EMC (Electro magnetic clutch)
4	100	Speed sensor
5	101	CADS solenoid valve
6	110	2H-4H-4L switch
7	111	MPS (Motor position sensor)

For example, in case of 'Shift Motor Failure', DTC is digital 010 and decimal 2. Sequence of Events is

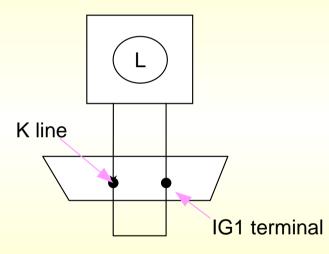
- 1. 0.6 second bulb check -> 2. Light off for 3.0 seconds ->
- 3. Light on 0.5 seconds -> 4. Light off 0.5 second ->
- 5. Light on 1.0 seconds -> 6. Light off 0.5 seconds ->
- 7. Light on 0.5 seconds -> 8. Light off 3.0 seconds ->
- 9. Repeat steps 3-8 two more times

DTC

No.	Fault	Code	Display
1	тссм	001	
2	Shift motor	010	
3	EMC	011	
4	Speed sensor	100	
5	CADS solenoid valve	101	
6	2H/4H switch	110	
7	MPS	111	

DTC reading & erasing

- 1) Reading
 - Connect the 'K' line (pin No. 13) of 4WD system and 'IG1 (pin No. 16)' terminal on the of the data link connector.
 - Finally read the output results.



Data link connector

- 2) Erasing
 - The trouble code is erased automatically after repair

EST

Hi-scan

1. HYUNDAI VEHICLE DIAGNOSIS

MODEL: TERRACAN 2001MY ALL

SYSTEM: 4WD CONTROL

01. EST

02. TOD

No		ltems	Condition		Signal	Remarks	
'	NO	ilems	Condition	Type Level		Remarks	
1	A1	MOTOR OUTPUT	IDLE("N")	DC	Vbatt	* Current :	
		(2H-4H-4L)			OV	INRUSH(+) : 4.64A	
2	A2	MOTOR OUTPUT	IDLE("N")	DC	Vbatt	INRUSH(-) : 4.4A	
		(2H-4H-4L)			OV	Operation : 0.6A	
3	А3	GND					
4	A4	CLUTCH COIL	IDLE	DC	Vbatt	* Current :	
			(2H 4H 4L)		OV	4.28A	
5	A5	POSITION 1 MTR	IDLE	2H	CODE: 1010	* MTR POS. CODE :	
			(P/R/N/D/2/L)	2H 4H	CODE: 0011	1/2/3/4 = XXXX	
				4H 4L	CODE: 1100	(1 = 5V dc)	
					LOGIC HI(1): 5V	(0 0.5V dc)	
					LOGIC LO(0): 0.5V or less		

	No	Items	Condition		Signal	Remarks	
'	INO	ilems	Condition	Type Level		Nemains	
6	A6	SPEED SNSR	IDLE	PULSE		* VSS of 60KPH:	
					V V	HI : 16.4V	
					135Hz at 60KPH	LO : -6.4V	
7	Α7	2H SW	SW OFF	DC	4.5 5.5V		
			SW ON		0.5V or less		
8	A8	4H DISPLAY	SW OFF	DC Vbatt			
			SW ON		0.5V or less		
9	A9	BATT	IGN OFF	DC	Vbatt		
			IGN ON		Vbatt		
10	A10	BATT	IGN OFF	DC Vbatt			
			IGN ON		Vbatt		
11	A11	GND					

EST

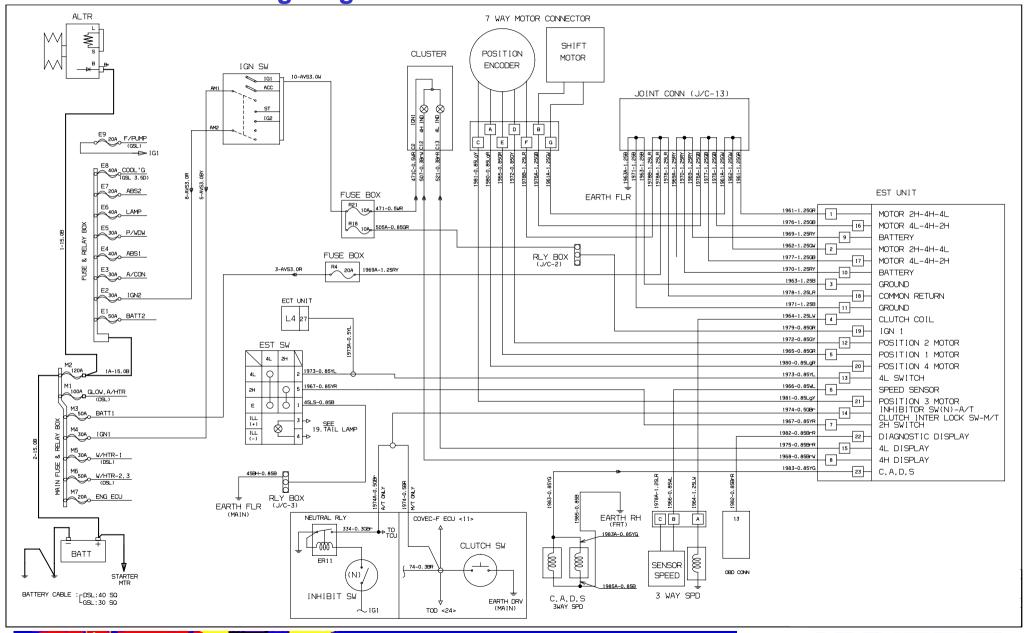
No		ltomo	Condition		Signal	Remarks	
ļ '	NO	ltems	Condition	Type	Level	Remarks	
12	A12	POSITION 2 MTR	IDLE	2H	CODE: 1010	* MTR POS. CODE :	
			(P/R/N/D/2/L)	2H 4H	CODE: 0011	1/2/3/4 = XXXX	
				4H 4L	CODE: 1100	(1 = 5V dc)	
					LOGIC HI(1): 5V	(0 0.5V dc)	
					LOGIC LO(0): 0.5V or less		
13	A13	4L SW	SW OFF	DC 4.5 5.5V			
			SW ON		0.5V or less		
14	A14	INHIBITOR SW(AT)	N	DC	0V		
		CLUTCH INTERLOC	P/R/D/2/L		Vbatt		
		SW(MT)					
15	A15	4L DISPLAY	IDLE("N")	DC Vbatt			
				OV			
16	A16	MOTOR OUTPUT	IDLE("N")	DC Vbatt			
		(4L-4H-2H)			OV		

No		tomo	Condition		Signal	Domorko
'	No Items		Condition	Туре	Level	Remarks
17	A17	MOTOR OUTPUT	IDLE("N")	DC	Vbatt	
		(4L-4H-2H)			OV	
18	A18	COMMON RETURN	IGN OFF	DC	0.9V or less	
			IGN ON		4.75 5.25V	
19	A19	IGN 1	IGN OFF	DC	OV	
			IGN ON		Vbatt	
20	A20	POSITION 4 MTR	IDLE	2H	CODE: 1010	* MTR POS. CODE :
			(P/R/N/D/2/L)	2H 4H	CODE: 0011	1/2/3/4 = XXXX
				4H 4L	CODE: 1100	(1 = 5V dc)
					LOGIC HI(1) : 5V	(0 0.5V dc)
					LOGIC LO(0): 0.5V or less	

	No Items Cond		Condition	Signal		Remarks	
	INO	ilems	Condition	Туре	Level	Remarks	
21	A21	POSITION 3 MTR	IDLE	2H	CODE: 1010	* MTR POS. CODE :	
			(P/R/N/D/2/L)	2H 4H	CODE: 0011	1/2/3/4 = XXXX	
				4H 4L	CODE: 1100	(1 = 5V dc)	
					LOGIC HI(1): 5V	(0 0.5V dc)	
					LOGIC LO(0): 0.5V or less		
22	A22	DIA. DISPLAY	In comm.	PULSE	4V or more 0 0.9V		
23	A23	C.A.D.S	IDLE	OFF	Vbatt		
			(2H 4H)	ON	0.5V or less		

EST

EST electrical wiring diagram



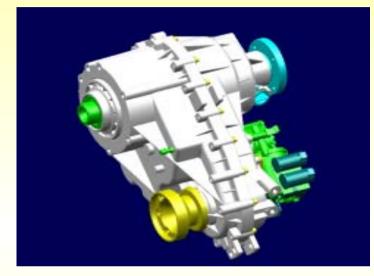
Contents

Full time 4WD system (TOD or ATT)

- Introduction
- Structure
- Components
- Selecting mode

Introduction

TOD system is a kind of full time 4wheel drive system and its full name is 'Torque on demand'. This is a trademark of Borg Warner in USA. The optimum engine torque distribution ratio between front and rear is controlled by TOD transfer case. This transfer case is controlled and operated by independent control module, that is, TCCM (Transfer case control module) and it is located on the below driver passenger seat.



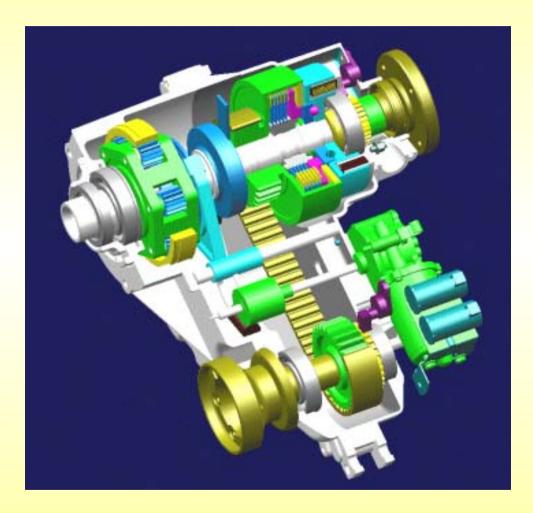
The torque transmission ratio to front and rear side is not fixed and it is changed and controlled continuously depends on the road and vehicle driving condition. Basically the torque split ratio will be 0:100 (that is 'FR' situation) on road driving with low and medium vehicle speed. If there is any amount of slip on the rear wheel, the optimum amount of torque will be distributed to front wheel to get a stable driving performance.

The range of torque split ratio is from 0:100 to 50:50. It means the maximum torque amount of front wheel cannot be higher than rear wheel in any kind of road or vehicle condition.

Introduction

According to the speed signal of front and rear wheel from each sensor, the engine torque information from engine ECM, EMC (Electro magnetic clutch) will be activated and it will result the change of depressing force to the multiple disc clutch. If the force is high, more engine torque will be transmitted to front wheel.

Oppositely, if it becomes low, the torque to front side also will be decreased. It means the slip inside of multiple disc clutch will be increased also. Therefore the oil pump for lubrication of clutch is installed and very important for the overall system durability.



TOD or ATT (Active torque transfer)

Merits and Characteristics

- 1) The fuel consumption is improved while driving in 4WD due to the optimum and proper engine torque distribution between front and rear wheel.
- 2) The maximum adhering force of tire into road can be acquired due to the electronic control depends on the road condition.
- 3) Light weight comparing with another kind of systems.
- 4) Simple internal structure.
- 5) Driving performance and steering stability on the off-road and on-road is very excellent.
- 6) It is easy to handle and control due to the electronic control system.
- 7) The efficiency of ABS operation is improved due to the easy system configuration with ABS system.
- 8) The center differential 'free' and 'locking' is controlled by TCCM so the center differential is not necessary and TCB effect can be prevented.

Torque distribution depends on the driving condition

No.	Items	Condition	Torque distribution	Decision by
1	Fast start	When vehicle starts abruptly to get a enough driving power	50:50	TPS Vehicle speed DIFF.(FRT-RR speed)
2	Normal driving	When vehicle drives at straight road for stable driving and fuel consumption	0:100 30:70	
3	Acceleration	When vehicle catch up with another vehicle to get more power and stable driving	30:70 50:50	
4	Normal steering	When vehicle steers for stable steering performance	20:80 30:70	
5	Driving and steering at slippery road	When vehicle drives or steers at slippery road to minimize wheel slip and get a stability	30:70 40:60	

Torque distribution depends on the driving condition

No.	ltems	Condition	Torque distribution	Decision by
6	Parking control	When vehicle steers and starts in vehicle stopping condition 5:95 20:80		
7	Braking control	When vehicle stops for stable braking and reduce a braking distance	0:100 10:90	Vehicle speed DIFF.(FRT-RR speed)
8	ABS control	When ABS is operated to get a stable braking performance	30:70	ABS operation signal DIFF.(FRT-RR speed)
9	Off-road, Steep slope road	To get a enough driving power	50:50	LOW signal Vehicle speed
10	Fail-safe	1. AUTO mode	0:100	
	Fall-Sale	2. LOW mode	50:50	

DIFF. (FRT-RR speed):

The difference of rotating speed between front and rear propeller shaft.

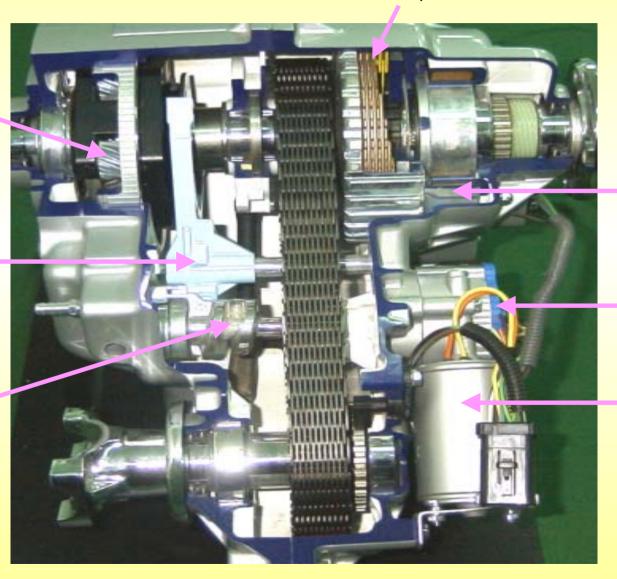
Structure

Multiple disc clutch

Planetary gear set

Shift fork

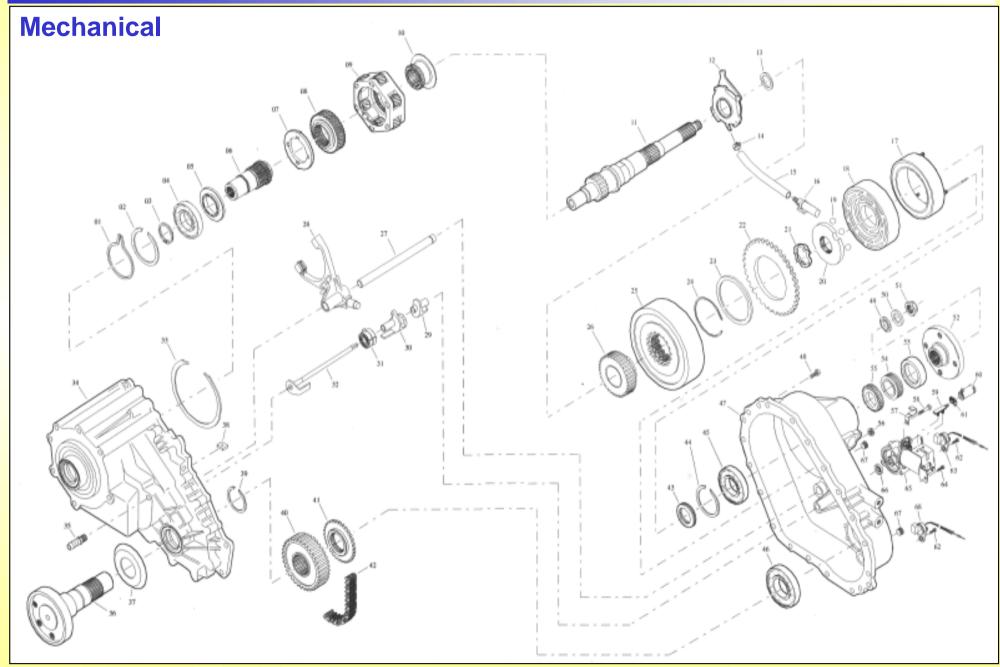
Electric shift cam



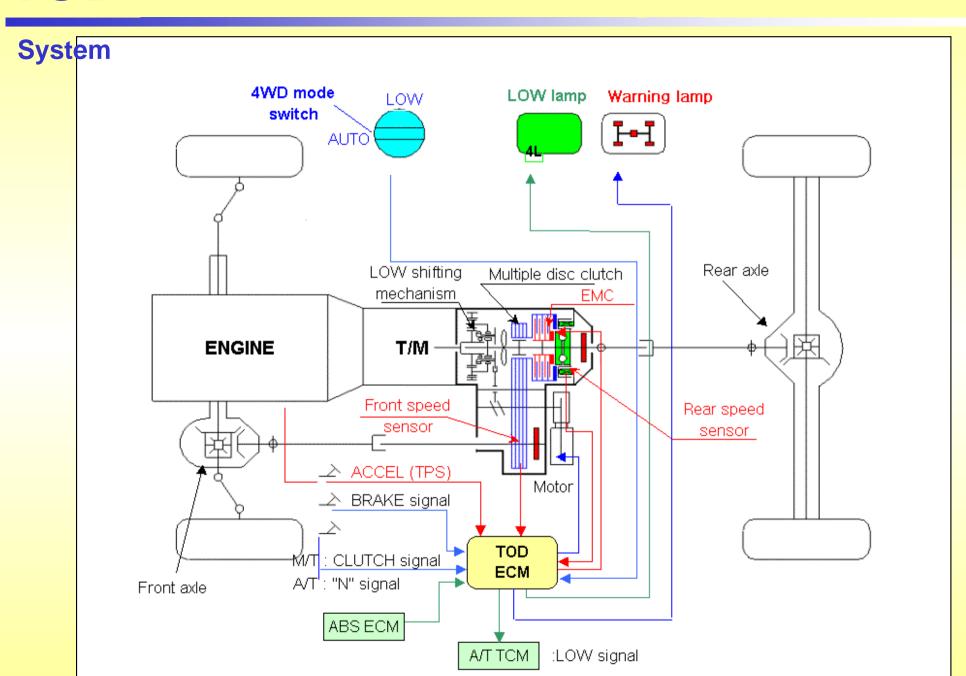
EMC (Electro magnetic clutch)

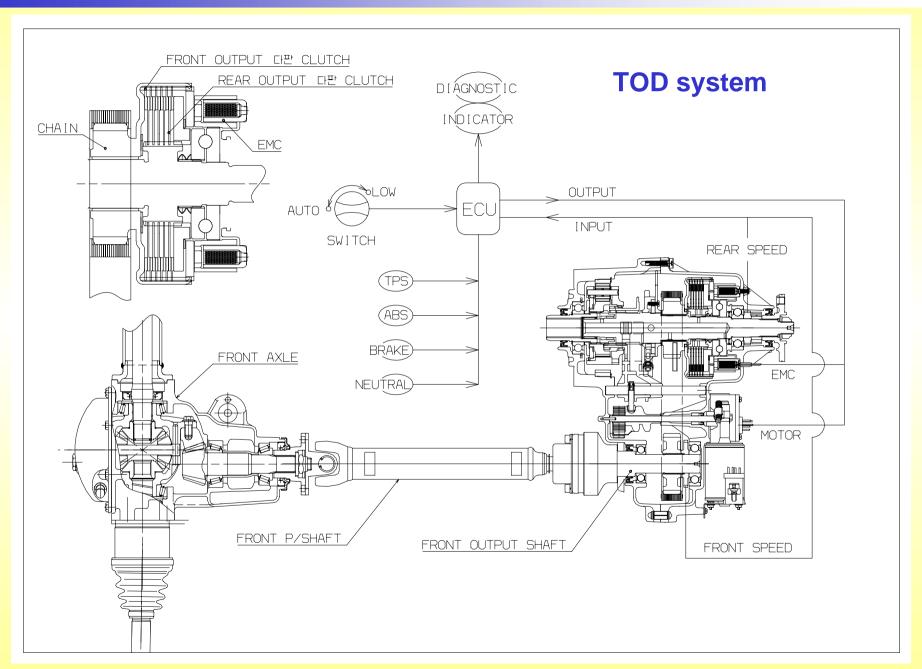
MPS (Motor position sensor)

Shift motor

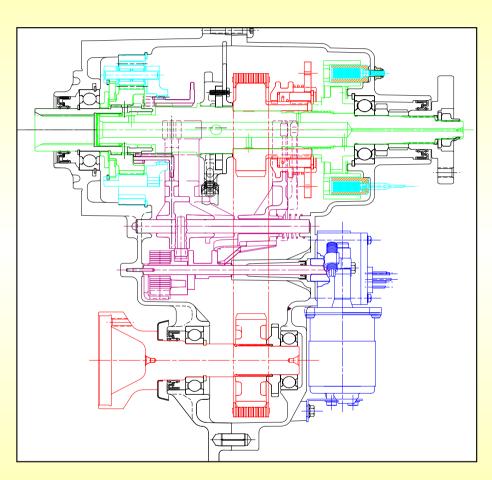


NO	DART MANE	T NO	DART MANE
NO	PART NAME	NO	PART NAME
1	RING-SNAP	36	SHAFT-OUTPUT
2	RING-SNAP	37	DEFLECTOR-DUST
3	RING-SNAP	38	MAGNET
4	BEARING	39	RING-SNAP
5	HUB-CIRCLULA	40	SPROCKET-LOWER
6	SHAFT ASSY - INPUT	41	TONE WHEEL-LOWER
7	PLATE-THRUST	42	CHAIN
8	GEAR - SUN	43	ASSY-BEARING THRUST
9	ASSY - CARRIER	44	RING-RETAINING
10	HUB-REDUCTION	45	BEARING
11	SHAFT-MAIN	46	BEARING
12	ASSY-GEROTOR PUMP	47	COVER
13	WASHER-THRUST	48	BOLT-METRIC
14	CLAMP-HOSE	49	SEAL-OIL
15	HOSE	50	WASHER
16	FILTER	51	NUT-METRIC
17	COIL ASSY-ELECTRIC	52	FLANGE-COMPANION
18	HOUSING ASSY - CAM COIL	53	SEAL-OIL
19	BALL	54	GEAR-SPEEDO
20	CAM APPLY	55	TONE WHEEL-UPPER
21	SPRING-WAVE	56	NUT-METRIC
22	ARMATURE	57	CLIP-J
23	WASHER-INSULATOR	58	BOLT-HEX HEAD
24	RING-RETAINING	59	CLIP
25	ASSY-CLUTCH PACK	60	CONNECTOR
26	SPROCKET ASY - DRIVE	61	LOCK-CONNECTOR
27	RAIL-SHIFT	62	BOLT-HEX HEAD
28	FORK ASSY - SHIFT	63	SENSOR-SPEED,UPPER
29	CAM-ELECTRIC SHIFT	64	CAP SCREW-HEX HEAD
30	CAM-ELECTRIC SHIFT	65	MOTOR ASSY-ELECTRIC
31	SPRING-TORSION	66	SEAL-OIL
32	SHAFT-SHIFT	67	PLUG-PIPE
33	RING-RETAINING	68	SPEED SENSOR-LOWER
34	CASE ASSY-TRANSFER		
35	BARB-BREATHER		



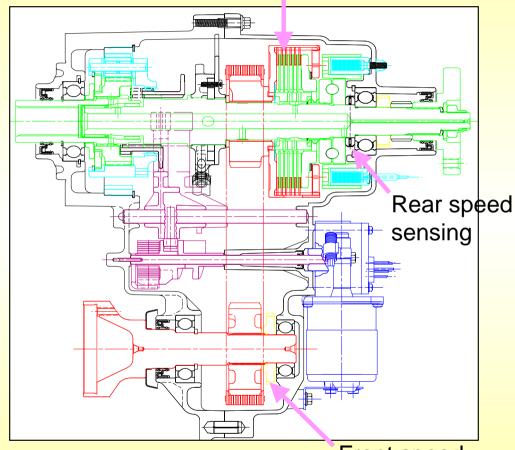


EST & TOD



Electronic Shift Transfer

Multiple disc clutch



Torque On Demand

Front speed sensing

Components – EMC (Electronic magnetic clutch)





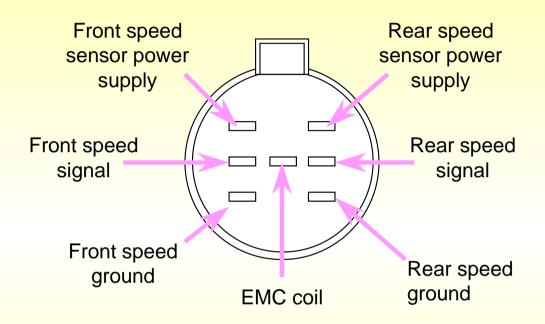
EMC

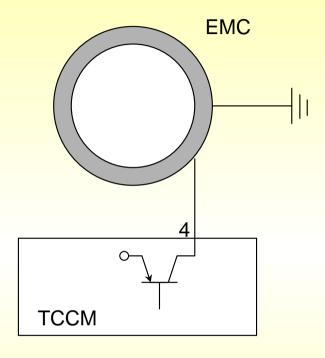
Multiple disc clutch



If EMC is energized, the multiple disc clutch is engaged so the torque is transmitted to front wheel. Depends on EMC duty ratio, the amount of transmitted torque to front side is changed.

Components – EMC (Electro magnetic clutch)





Components – Multiple disc clutch



3 steel balls (Ball ramp mechanism) were installed to be controlled by EMC.



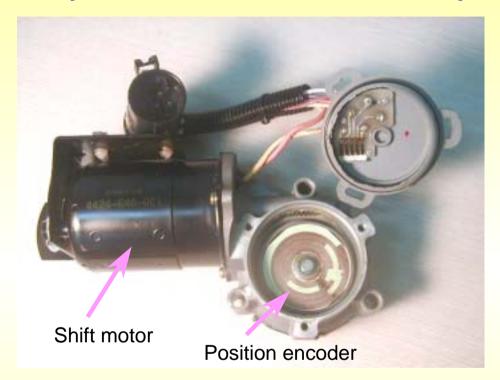
6 Pairs of clutch disc was installed.

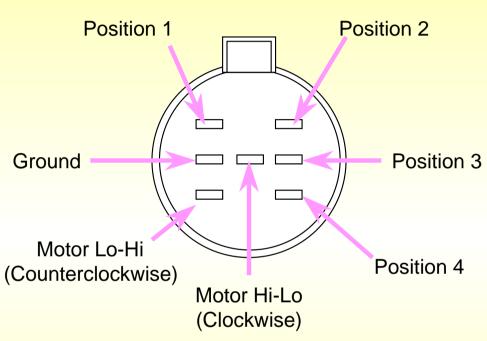
Components – Shift CAM





Components – Shift motor & Motor position sensor



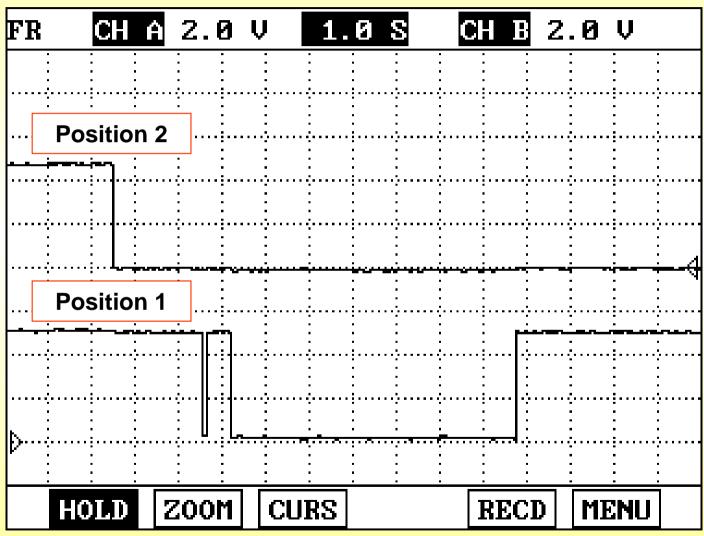


This shift motor is DC motor and controlled by TCCM. Its function is to shift into 4LOW for higher gear ratio. If shift motor is overhauled, the MPS signal is changed and cannot be reused. Therefore shift motor should not be overhauled.

Coil resistance value: 0.78 ± 0.078

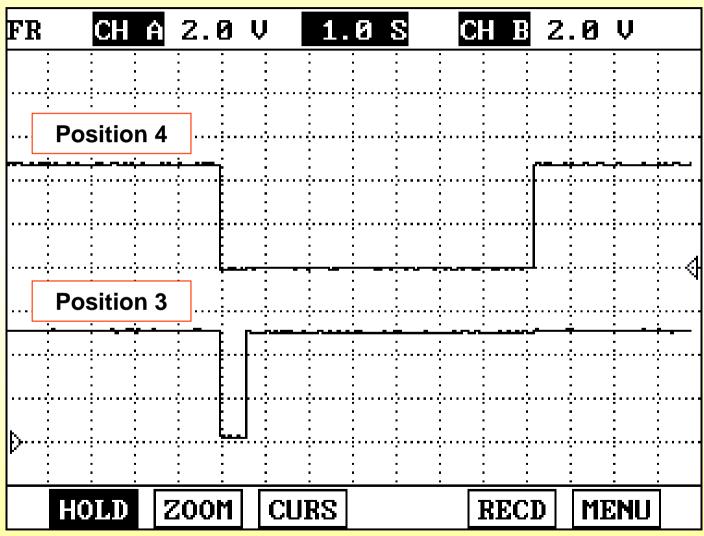
^{*} The shift motor for TOD cannot be replaced with one for EST.

MPS signals (AUTO → LOW)



3.5 GSL with TOD

MPS signals (AUTO → LOW)



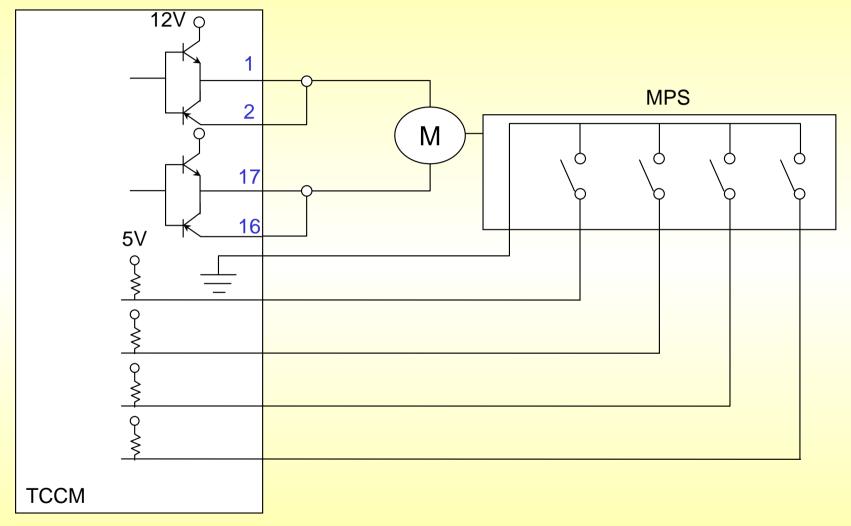
3.5 GSL with TOD

Components – Shift motor & Motor position sensor

Output signal is changed depends on the shift motor position. There are 9 valid codes for the position to be detected by TCCM.

Motor position	Position 1	Position 2	Position 3	Position 4	Reamrks
Left stop	OFF	OFF	OFF	ON	
Left of high	OFF	ON	OFF	ON	
High	ON	ON	OFF	ON	
Right of high	ON	ON	ON	ON	
Zone 1	OFF	OFF	OFF	OFF	ON: 0.8V or less OFF: 4.5V or more
Neutral	OFF	ON	ON	OFF	
Zone 2	ON	ON	ON	OFF	
Low	ON	OFF	ON	OFF	
Right stop	ON	OFF	ON	ON	

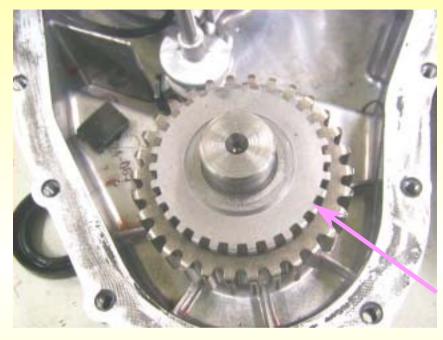
Components – Shift motor & Motor position sensor



Clockwise rotation (Hi->Lo): Terminal 1,2 is B+ (12V), terminal 16,17 is earth.

Counterclockwise (Lo->Hi): Terminal 1,2 is earth, terminal 16,17 is B+ (12V).

Components – Front & Rear speed sensor





Hall effect type speed sensor

Sensing tone wheel for front speed (teeth = 30EA)



Sensing tone wheel for rear speed (teeth = 30EA)

Location: The end of rear propeller shaft

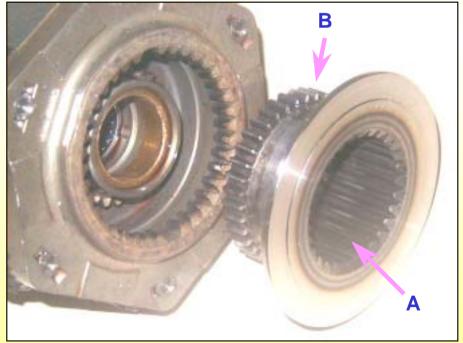
Components – Planetary gear set



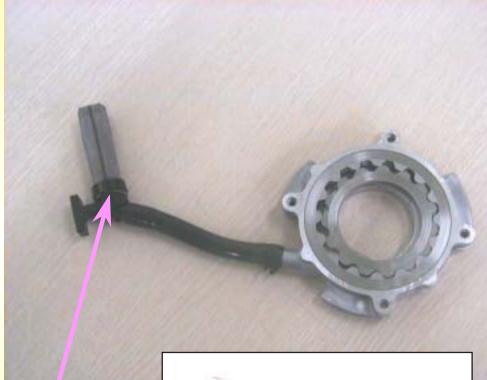
To make 4LOW gear ratio (2.480), the planetary gear set was installed and controlled by electronic shift fork. The connecting point 'A' and 'B' is shifted depends on the moving direction of shift fork.

In case of point 'A' connection : Planetary sun gear -> 1:1

In case of point 'B' connection : Planetary carrier -> 1:2.48 (4LOW)



Components - Oil pump



Oil strainer

The oil pump for lubrication of multiple disc clutch was installed when the vehicle drives 4WD (in AUTO mode).

Oil pump

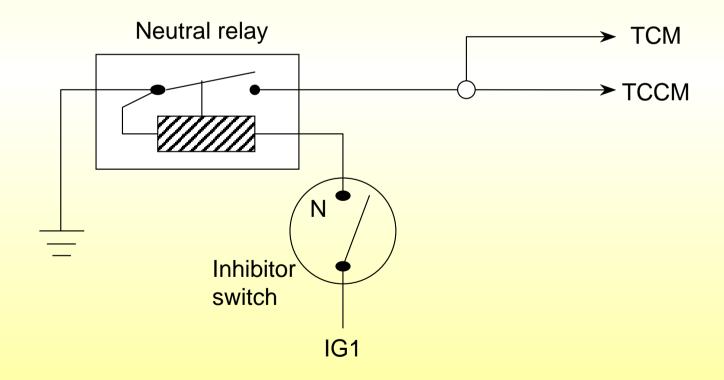


Components - Indicator

Condition	A/T LEVER	TOD SW	INDIC	ATOR	Description
Condition	PVILEVER	mode	4LOW	W/Lamp	- Description
IGN ON	P/R/D/2/1	AUTO	ON (3sec)	ON (3sec)	ON (3sec)> OFF at IG. ON
or IDLE		AUTO 4LOW	Blinking	OFF	'AUTO mode' holding
		4LOW AUTO	OFF	OFF	'AUTO mode' holding
	N	AUTO	ON (3sec)	ON (3sec)	ON (3sec)> OFF at IG. ON
		AUTO 4LOW	7 times blinking > ON	OFF	4LOW indicator : 6 times blinking> Shift motor ON> 1 time blinking> ON
		4LOW AUTO	7 times blinking > OFF	OFF	4LOW indicator : 6 times blinking> Shift motor ON> 1 time blinking> OFF

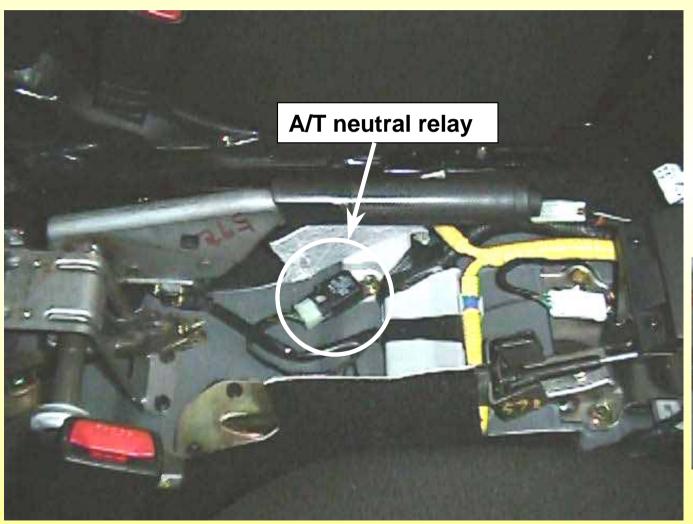
Components – A/T neutral relay (EST / TOD)

In case of automatic transaxle vehicle, there is a A/T neutral relay to detect the condition that shifts from 'Auto mode' to 'Low mode' (TOD) or '4H' to '4L' mode (EST). Due to the characteristics of TCCM, the 'N' signal (battery 12voltage) from inhibitor switch cannot switched directly. That's why neutral relay was installed.



Components – A/T neutral relay (EST / TOD)

In case of manual transaxle, the clutch lock switch was installed instead of A/T neutral relay so as to prevent the '4LOW' engagement during vehicle driving.



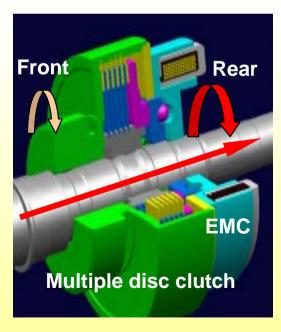


Selecting Mode

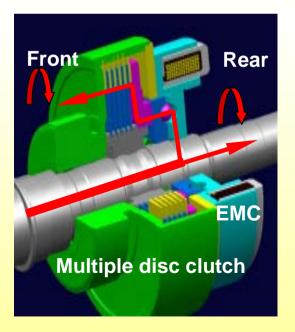
- Auto mode

In Auto mode, TOD system controls the clutch mechanism by detecting the rotating speed of front and rear propeller shaft. If its difference is out of mapping data, the EMC is activated and the engine torque is transmitted to front wheel.

In this time, the gear ratio becomes 1:1 because the output shaft is connected to input shaft through not planetary carrier but sun gear.



2WD situation



4WD situation

Selecting Mode

- Low mode

In Low mode, the driving system for vehicle becomes 4wheel drive low speed. To transmit maximum engine torque to front wheel, the multiple disc clutch with EMC (Electro magnetic clutch) will be "Lock" and the shift motor is activated toward '4L' position. Through the cam mechanism, the output shaft is connected to carrier of planetary gear set. At this time, the gear ratio is changed from 1:1 to 2.48:1.

Selecting Mode

- Shifting from 'Auto mode' to 'Low mode'

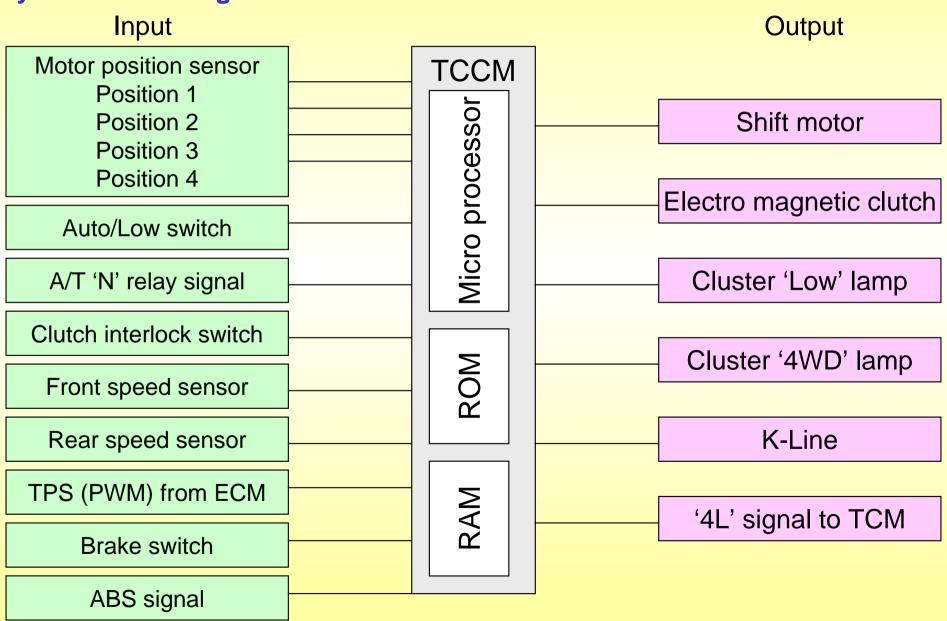
To select 'Low mode' from 'Auto mode' driving, the vehicle should be stopped.

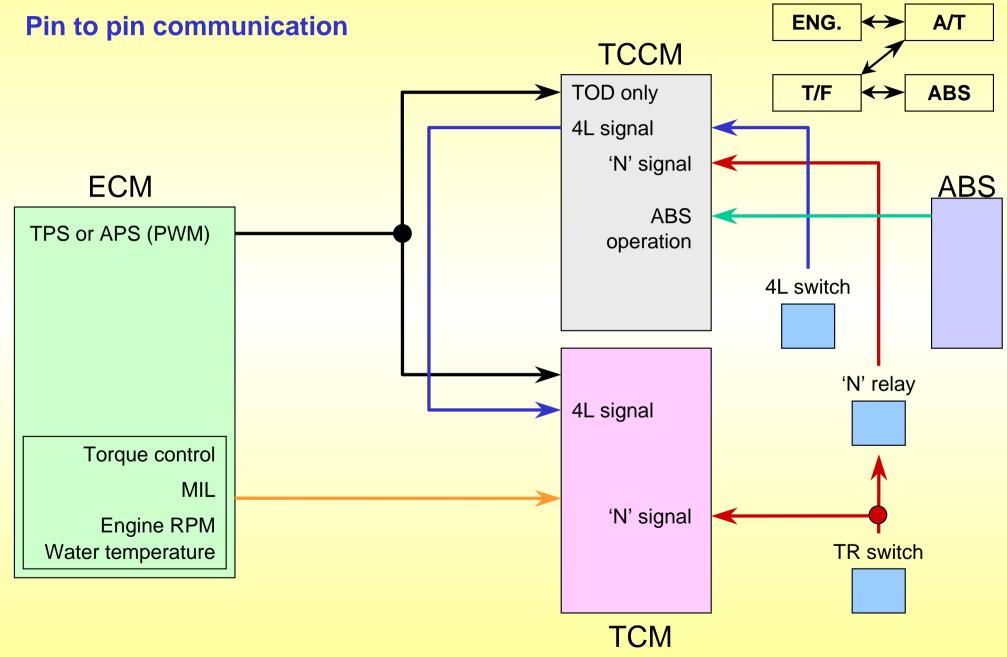
- →The rotating speed of front and rear speed sensor should be 87rpm (2,580pulses per minute) or less.
- * A/T vehicle: Move the shift lever to 'N' position for 2 seconds or more and select 'Low mode' switch.
- * M/T vehicle: Depress the clutch pedal and select 'Low mode' switch.

If above conditions are not satisfied, the shifting from 'Auto mode' to 'Low mode' will be stopped (shift 'default mode' by TCCM) and the 'Low' lamp on the cluster will be blink.

If the shift from 'Auto mode' to 'Low mode' is successfully performed, the blinking of 'Low' lamp will be stopped and the lamp will be turned on continuously.

System block diagram





		HP		
ltems	Condition	INDICATOR		Description
		4LOW	W/Lamp	Description
TPS	OPEN OR	OFF	OFF	1. No warning lamp blink or ON.
	SHORT(GND)			2. AUTO 4LOW shift is possible
SHIFT MOTOR	OPEN	OFF	Blink	1. Warning lamp blinks after 1 sec. since the fault
				is occurred.
				2. Fail at the 'AUTO mode'
				: AUTO mode holding
				: '4LOW' lamp blinks if '4L' is selected
				3. Fail at the '4LOW mode'
				: 4L mode holding
				: '4L OW lamp blinks if 'AUTO' is selected
				4. Even though the fault is repaired, shift
				prevention is still existed.
				If IG. ON again, system is operated normally.

				HP
ltems	Condition	INDIC	ATOR	Description
		4LOW	W/Lamp	Description
SHIFT MOTOR	OPEN			1. Warning lamp blinks after 1 sec. since the fault
POSITION	Short to battery			is occurred.
SENSOR				2. Fail at the 'AUTO mode'
(1), (2), (3),				: AUTO mode holding
(4), (5)				: '4LOW' lamp blinks if '4L' is selected
	SHORT(GND)	OFF	Blink	3. Fail at the '4LOW mode'
				: 4L mode holding
				: '4L OW lamp blinks if 'AUTO' is selected
				4. Even though the fault is repaired, shift
				prevention is still existed.
				If IG. ON again, system is operated normally.

		HP		
ltems	Condition	INDIC	ATOR	Docarintion
		4LOW	W/Lamp	Description
FRT SPEED	OPEN	OFF	OFF	1. Warning lamp blinks after 0.5 sec. since the fault
SENSOR				is occurred.
				2. Fail at the 'AUTO mode'
				: AUTO mode holding
				: '4LOW' lamp blinks if '4L' is selected
				3. Fail at the '4LOW mode'
RR SPEED	OPEN	OFF	OFF	: 4L mode holding
SENSOR				: '4L OW lamp blinks if 'AUTO' is selected
				4. Even though the fault is repaired, shift
				prevention is still existed.
				If IG. ON again, system is operated normally.

				HP
ltems	Condition	INDIC	ATOR	Description
		4LOW	W/Lamp	Description
EMC	OPEN	OFF	Blink	1. Warning lamp blinks after 0.8 sec. since the fault
(ELECTRO-				is occurred.
MAGNETIC				2. Fail at the 'AUTO mode'
CLUTCH)				: AUTO mode holding
				: '4LOW' lamp blinks if '4L' is selected
				3. Fail at the '4LOW mode'
	SHORT(GND)	OFF	Blink	: 4L mode holding
				: '4L OW lamp blinks if 'AUTO' is selected
				4. Even though the fault is repaired, shift
				prevention is still existed.
				If IG. ON again, system is operated normally.

DTC & Fail-safe

No.	Description	P-code	Failure effect	Fail-safe	W/Lamp
1	EEPROM checksum fault	P1725	TOD	Default calibration data	-
2	TPS loss of signal	P1726	TOD (TPS Idle)	TOD Determined by wheel slip only	OFF
3	TPS out of range	P1727	TOD (TPS Idle)	TOD Determined by wheel slip only	OFF
4	EMC open/shorted to battery	P1728	TOD Halted (2WD)	None	Blink
5	EMC shorted to ground	P1729	TOD Halted (2WD)	None	Blink
6	Front speed sensor voltage Low	P1730	TOD	4H mode fail, Rear speed sensor, EMC Touch off level	OFF
7	Front speed sensor voltage High	P1731	TOD	fixing. 4L Mode fail, EMC Maximum level fixing.	OFF

DTC & Fail-safe

LEV LIAN C

No.	Description	P-code	Failure effect	Fail-safe	W/Lamp
8	Rear speed sensor voltage Low	P1732	TOD	4H mode fail, Front speed sensor, EMC Touch off level	OFF
9	Rear Speed sensor voltage High	P1733		fixing. 4L Mode fail, EMC Maximum level fixing.	OFF
10	Vehicle speed sensor reference Voltage Low	P1734	TOD	4H mode fail, Zero speed sensor, EMC Touch off level	OFF
11	Vehicle speed sensor reference Voltage High	P1735		fixing. 4L Mode fail, EMC Maximum level fixing.	OFF
12	Shift motor open/shorted to Battery	P1736	Electric motor shifting(4H-4L-4H)	INO Shitte	
13	Shift motor open/shorted to Ground	P1737	Electric motor shifting(4H-4L-4H)	No Shifts	Blink

DTC & Fail-safe

No.	Description	P-code	Failure effect	Fail-safe	W/Lamp
14	Shift system timeout	P1738	Electric motor shifting(4H-4L-4H)	No Shifts	Blink
15	General position encoder Fault	P1739	Electric motor shifting(4H-4L-4H)	No Shifts	OFF
16	Position 1 shorted to Ground		Electric motor shifting(4H-4L-4H)	No Shifts	
17	Position 2 shorted to Ground	D4740	Electric motor shifting(4H-4L-4H)	No Shifts	OFF
18	Position 3 shorted to Ground	P1740	Electric motor shifting(4H-4L-4H)	No Shifts	OFF
19	Position 4 shorted to Ground		Electric motor shifting(4H-4L-4H)	No Shifts	

	No	Items	Condition		Signal	Remarks
'	INO	ilems	Condition	Туре	Level	Remarks
1	A1	MOTOR OUTPUT	IDLE("N")	DC	Vbatt	
		(HI-LOW)			0V	
2	A2	MOTOR OUTPUT	IDLE("N")	DC	Vbatt	
		(LOW-HI)			0V	
3	А3	EMC	Vehicle	PULSE	Vbatt	* 4LOW DUTY(-):
			driving	(PWM)	ov	88.72%
					FREQ. : 50Hz	
					DUTY(-): 0 88%	
4	A4	BATT	IGN OFF	DC	Vbatt	
			IGN ON		Vbatt	
5	A5	IGN 1	IGN OFF	DC	OV	
			IGN ON		Vbatt	
6	B1	ENCODER GND				
7	B2	DIAGNOSTIC	LAMP OFF	DC	Vbatt	
		DISPLAY	LAMP ON		0.5V or less	

	No	Items	Condition		Signal	Remarks
	INO	items	Condition	Туре	Level	Remarks
8	В3	TPS(PWM)	ACCEL C.T	PWM	HI: 4V MIN	
			& W.O.T		LO : 0.9V MAX	
					FREQ. : 100Hz	
					DUTY(-): C.T - 10%	
					W.O.T - 83%	
9	В4	AUTO/LOW SW	IDLE	AUTO	4V or more	
			(A/T LEVER	LOW	0.9V or less	
			"N")		(AUTO mode : 4V or more)	
10	B5	SHIFT MOTOR	IDLE	AUTO	CODE: 0010 0000	* MTR POS. CODE:
		POSITION 2	(A/T LEVER	LOW	CODE: 0101 0000	1/2/3/4 = XXXX
			"N")		LOGIC HI(1): 4.5V or more	
					LOGIC LO(0): 0.5V or less	
11	В6	FRT SPEED SNSR	Vehicle	PULSE	4V or more	* VSS 60KPH:
			driving		0 0.9V	985Hz
					30PULSE/PROPSHAFT REV.	
					DUTY(-): 50%	

	No Items Condition		Condition		Signal	Remarks
'	NO	items	Condition	Туре	Level	Remarks
12	В7	N.A				
13	В8	SPEED SNSR GND				
14	A6	MOTOR OUTPUT	IDLE("N")	DC	Vbatt	
		(HI-LOW)			0V	
15	A7	MOTOR OUTPUT	IDLE("N")	DC	Vbatt	
		(LOW-HI)			0V	
16	A8	SPEED	IGN OFF	DC	0.9V or less	
		REFERENCE	IGN ON		4.75 5.25V	
17	A9	GND FOR ECU				
18	A10	GND FOR ECU				
19	A11	BATT	IGN OFF	DC	Vbatt	
			IGN ON		Vbatt	
20	A12	K-LINE	In comm.	PULSE	LOGIC "0" : Vbatt 20% or less	
			(10.4Kbps)		LOGIC "1" : Vbatt 80% or more	

	No	Items	Condition		Signal	Remarks	
1	No Items		Condition	Туре	Level	Remarks	
21	В9	4LOW DISPLAY	SW OFF	DC	Vbatt	* IGN ON :	
			SW ON		0.5V or less	Turned on for 3sec.	
22	B10	N.A					
23	B11	N.A					
24	B12	TRANS. NEUTRAL	N	DC	0.9V or less		
			P/R/D/2/L		4.5 5.5V		
25	B13	ABS INPUT	ABS OFF	DC	4.5 5.5V		
			ABS ON		0.9V or less		
26	B14	BRAKE SW	SW OFF	DC	0.9V or less		
			SW ON		Vbatt		
27	B15	SHIFT MOTOR	IDLE	AUTO	CODE: 0010 0000	* MTR POS. CODE:	
		POSITION 1	(A/T LEVER	LOW	CODE: 0101 0000	1/2/3/4 = XXXX	
			"N")		LOGIC HI(1): 4.5V or more		
					LOGIC LO(0): 0.5V or less		

	No	Homo	Condition	Signal		Remarks
'	INO	ltems	Condition	Type	Level	Remarks
28	B16	SHIFT MOTOR	IDLE	AUTO	CODE: 0010 0000	* MTR POS. CODE:
		POSITION 3	(A/T LEVER	LOW	CODE: 0101 0000	1/2/3/4 = XXXX
			"N")		LOGIC HI(1): 4.5V or more	
					LOGIC LO(0): 0.5V or less	
29	B17	RR SPEED SNSR	Vehicle	PULSE	4V or more	* VSS 60KPH :
			driving		0 0.9V	966Hz
					30PULSE/PROPSHAFT REV.	
					DUTY(-): 50%	
30	B18	SHIFT MOTOR	IDLE	AUTO	CODE: 0010 0000	* MTR POS. CODE:
		POSITION 3	(A/T LEVER	LOW	CODE: 0101 0000	1/2/3/4 = XXXX
			"N")		LOGIC HI(1): 4.5V or more	
					LOGIC LO(0): 0.5V or less	

TOD electrical wiring diagram

