

**AWD****3270-01/3280-01/3280-02/3281-00/9210-10/****INDEX****ALL WHEEL DRIVE****GENERAL INFORMATION**

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# دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



**AWD****3270-01****GENERAL INFORMATION****1. SPECIFICATIONS**

Categor	Item	Specifications		
		A/T-G16DF	A/T-D16DTF	M/T
PTU (Power transfer unit)	Gear ratio	2.53	2.533	1.333
	Numbers of hypoid gear (Ring gear/pinion gear)	34/19	38/15	28/21
	Numbers of helical gear (Input shaft/idle shaft)	41/29	-	-
	Oil specification	80W-90 API GL5		
	Oil volume	Approx. 0.6ℓ	Approx. 0.25ℓ	Approx. 0.5ℓ
	Weight (including fluid)	16.0kg	11.8kg	10.8kg
	Operation type	Electronic magnetic		
	Torque capacity	Max. 800Nm		
	Whole length	154.95mm		
	Spline	Input (external): 21T / output (internal): 21T		
E-coupling	Input flange type	Rubber coupling 3-lobe		
	Connector type	2-pin		
	Weight	5.985kg		
	Oil specification	AMSOIL FTH2-1		
	Oil capacity	100 ± 5 mL		
E-coupling control unit	Operation mode	4WD AUTO / 4WD LOCK		
	Communication mode	CAN communication		
	Diagnostic mode	CAN diagnosis		
	Weight	230g		
	Size	160 x 87 x 37mm		
4WD LOCK switch	Type	Self return		

Modification basis	
Application basis	
Affected VIN	

AWD

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AISIN 6  
SPEED6-SPEED  
M/T

CLUTCH

PROPELLER

DRIVE  
SHAFT

AWD

SUSPENSION

BRAKE  
SYSTEM

ESP

ABS

ELECTRIC  
POWERWHEEL  
AND TIRE

TPMS

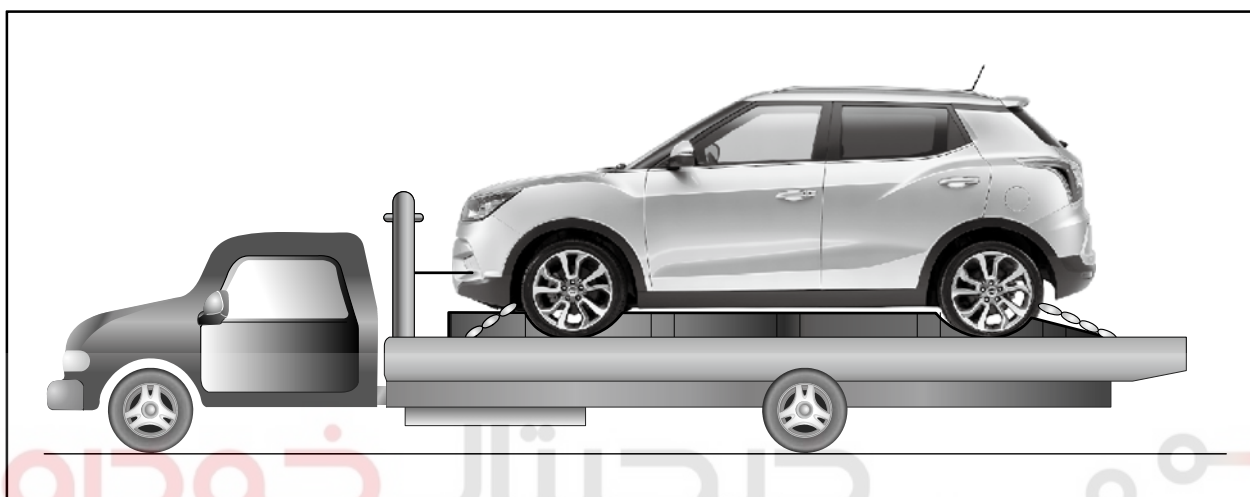
SUB  
FRAME

## 2.NOTICES

### 1) Towing Vehicle

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

If towing the vehicle with the rear propeller shaft connected in place, the E-coupling's clutch could be damaged.



### 2) Work On Vehicle Using Lift



When working on the vehicle using a lift, do not run the tires with all the wheels off the ground and the parking brake applied, as this may damage the E-coupling's clutch.



## OPERATING PROCESS

### 1. OVERVIEW

The AWD system uses an electronically controlled coupling to distribute driving force between the front and rear wheels, depending on road conditions and driving style for maximizing driving performance. It delivers all driving force to the front wheels only for good fuel economy on the normal road while the 4WD mode is activated automatically when driving in snow and poor driving conditions for improved straight-ahead driving stability and hill-climbing ability. In particular, the initial driving force is applied to enable the vehicle to start smoothly without wheel spin when starting on the hill as well as to maximize the AWD vehicle's advantages. It also has the self-protect feature that prevents the driving system from being damaged in advance by decreasing the driving force to the rear wheels when the component parts such as E-coupling become too hot due to a tire out of specification or malfunctioning AWD system. When driving the vehicle on a rough road such as muddy road or off-road and slippery road with rain or snow, the driver can select "Lock Mode" to deliver a larger driving force to the rear wheels than AWD "Auto Mode" to achieve the vehicle posture stability. The AWD "Lock Mode" is designed to be activated only at a slow speed (below 40 km/h) for safety and smooth driving. In addition, we focused on the safety as well as its own intrinsic performance including to control the driving force from the AWD by means of an organized control between ESP/ABS and AWD, thus helping ensure the vehicle's braking performance. The E-coupling also has reduced the noise and vibration and improved the fuel economy through a low drag torque.

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران







Modification basis	
Application basis	
Affected VIN	

AWD

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## 2. CONFIGURATION

		
4WD LOCK switch	4WD LOCK indicator lamp	4WD warning lamp
		
The 4WD lock switch is of self-return type. When this switch is turned on, the torque to the rear wheels increases.	Comes on during 4WD LOCK mode	Comes on or blinks in the event of malfunction of 4WD system



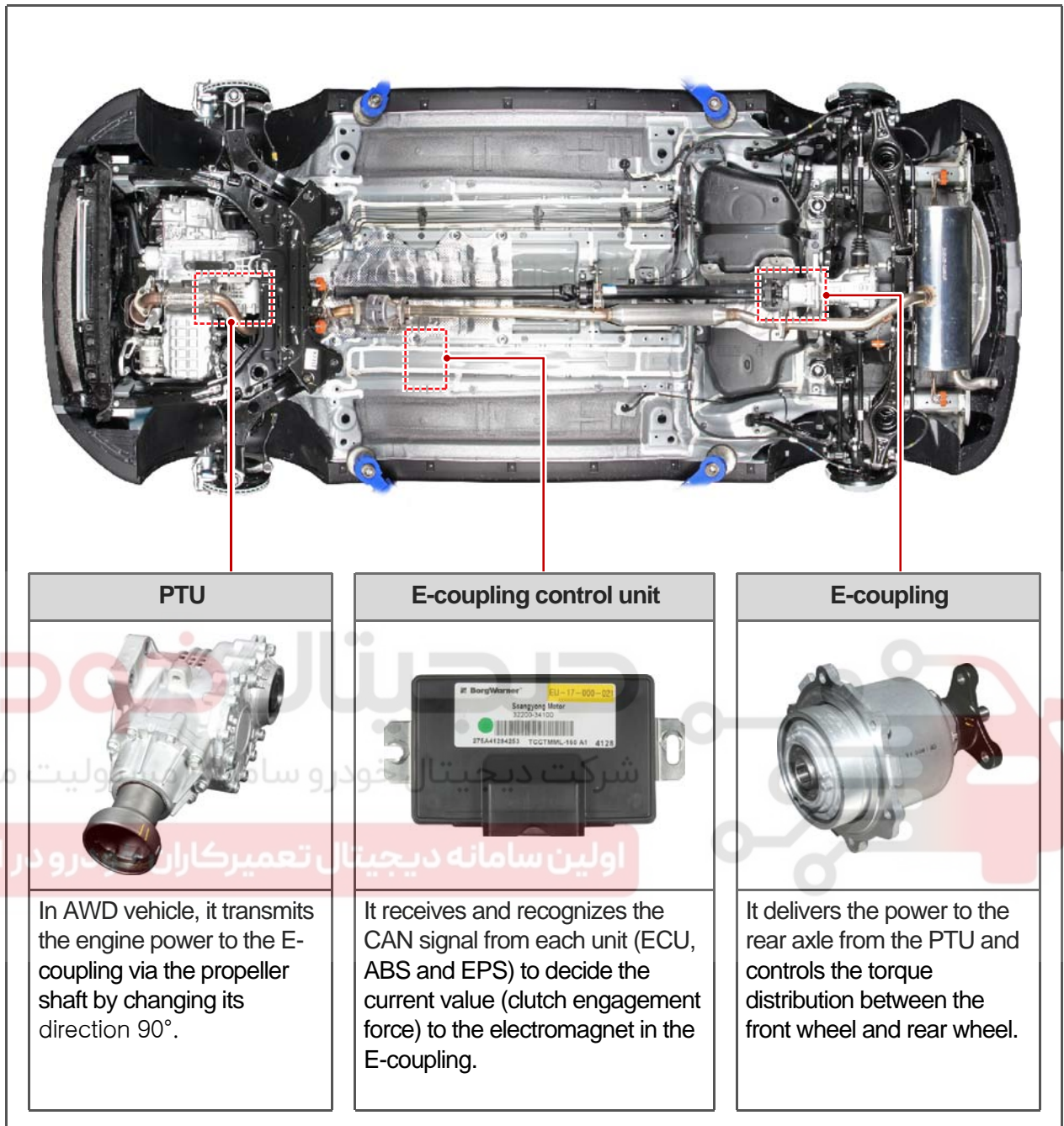
### NOTE

#### - 4WD warning lamp comes on when:

A temporary error occurs in the 4WD system or relevant system has any fault - For temporary error, the 4WD system is normal if the lamp goes out after a certain time or when the engine is restarted.

#### 4WD warning lamp blinks:

- This is for preventing the 4WD system from being damaged. When the lamp blinks, you must stop operating the accelerator pedal immediately and cool down the 4WD system. If the 4WD system is cooled down sufficiently, the lamp will go out and will start working normally again.



Modification basis	
Application basis	
Affected VIN	

AWD

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AISIN 6  
SPEED6-SPEED  
M/T

CLUTCH

PROPELLER

DRIVE  
SHAFT

AWD

SUSPENSION

BRAKE  
SYSTEM

ESP

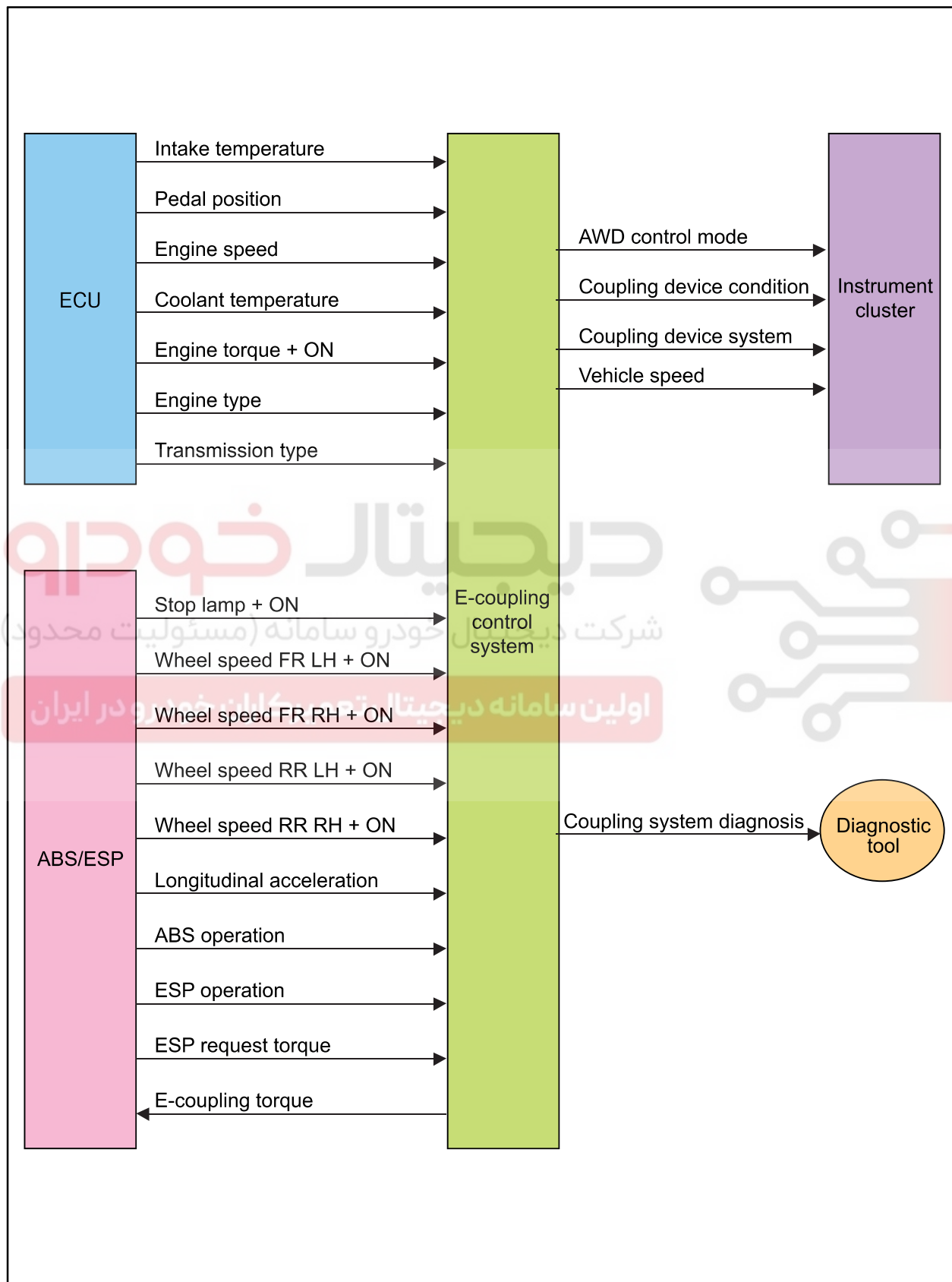
ABS

ELECTRIC  
POWERWHEEL  
AND TIRE

TPMS

SUB  
FRAME

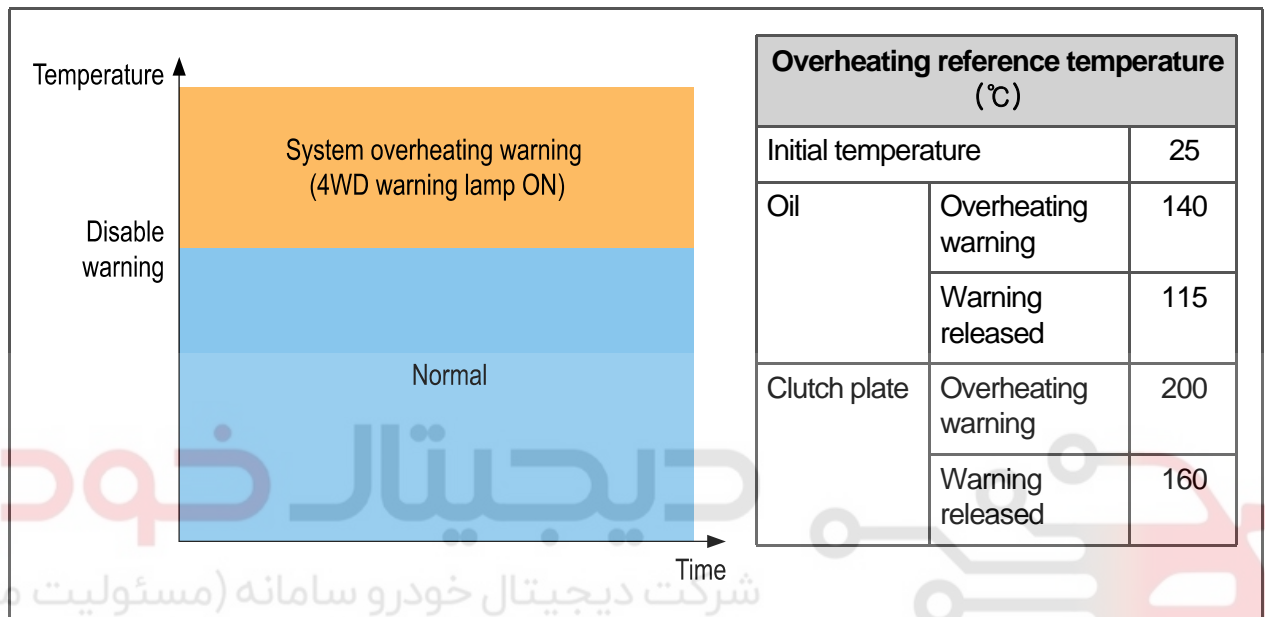
### 3. INPUT/OUTPUT ELEMENTS



## 4. MAJOR FUNCTIONS

### 1) Overheating Protect For E-coupling

The E-coupling control unit calculates the E-coupling's slip (input/output speed), ambient temperature, magnetic coil resistance and etc. to protect the oil and clutch plate from being overheated. If the E-coupling get too hot, the E-coupling control unit reduces the torque to the rear wheels and sets a diagnostic trouble code (DTC).



If the oil temperature in the E-coupling is above 140°C or the temperature of the clutch plate is above 200°C, the warning lamp comes on which indicates the system has been overheated. If the oil temperature drops below 115°C or the clutch plate temperature drops below 160°C, the warning will be released.

### 2) Parking Brake Logic

If the rear wheels are not rotating correctly while driving with the parking brake applied, the E-coupling control unit calculates the difference between the CAN signals on wheel speed to reduce the torque to the rear wheels.

### 3) Detecting Tire Out Of Specification

When a tire out of specification such as the spare tire is installed, the E-coupling control unit calculates the difference between the CAN signals on wheel speed to detect that the wrong tire has been installed. At this time, it reduces the torque to the rear wheels and sets a diagnostic trouble code (DTC).

Modification basis	
Application basis	
Affected VIN	

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#### 4) 4WD LOCK mode (4WD LOCK mode switch depressed)



In 4WD LOCK mode, the 4WD LOCK control works in the same way as the AUTO mode, but it increases the driving force to the rear wheels more than in AUTO mode. If the rear wheel speed is over 40 km/h in LOCK mode, the vehicle enters into the 4WD AUTO mode automatically. If the speed is below 40 km/h, the vehicle returns to the 4WD LOCK mode.

#### 5) PRNDL Logic

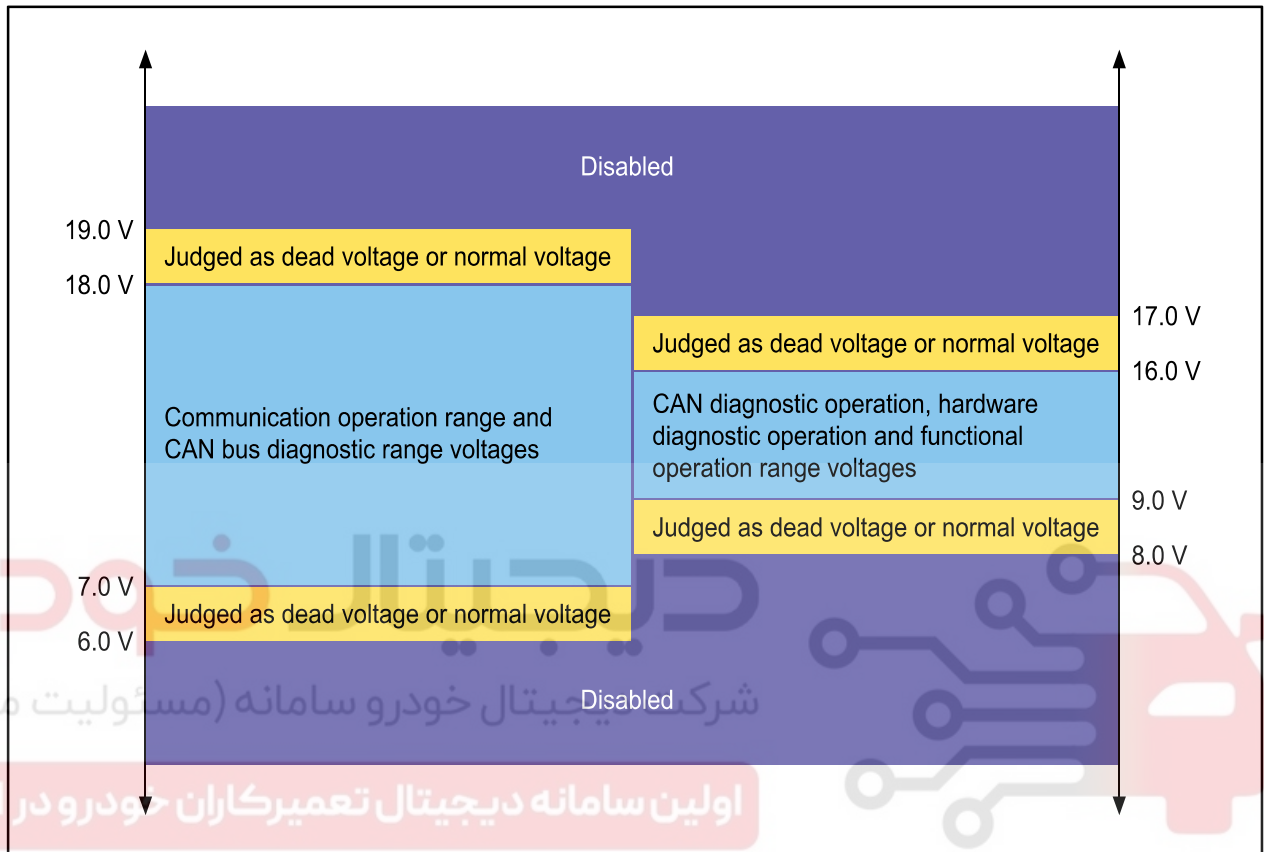


Function for reducing the noise and vibration caused by an operation of the gear shift lever from D to R, D to N, R to D and R to N.



## 6) Operating Voltage Range Detection

The E-coupling control unit detects the supply voltage to determine CAN diagnostic operation, hardware diagnostic operation and functional operation range voltages. It restricts the functions of the 4WD and sets a diagnostic trouble code (DTC) if the supply voltage is too high or too low.

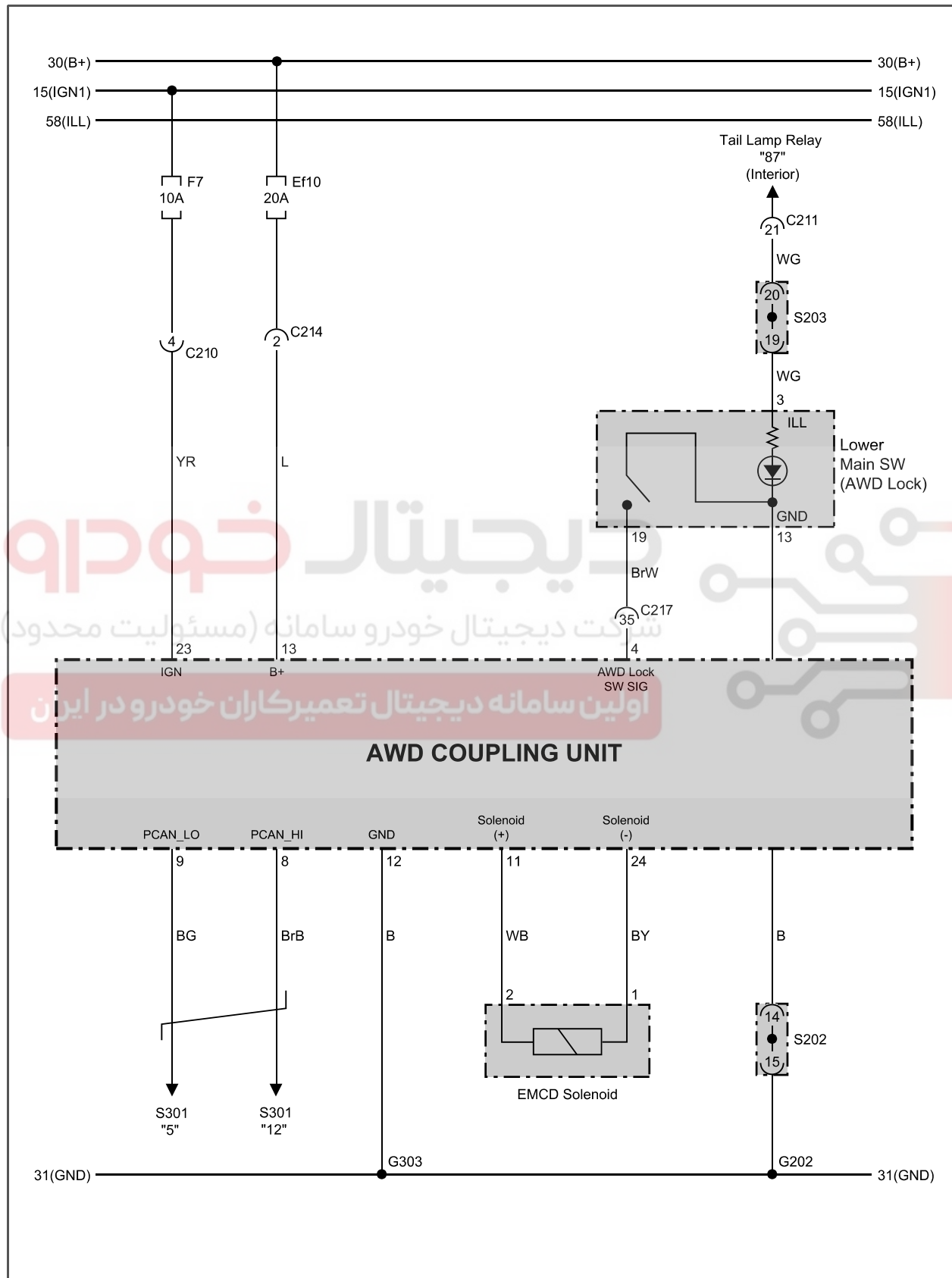


Modification basis	
Application basis	
Affected VIN	

AWD

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## 5. CIRCUIT DIAGRAM



AWD

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Modification basis	
Application basis	
Affected VIN	



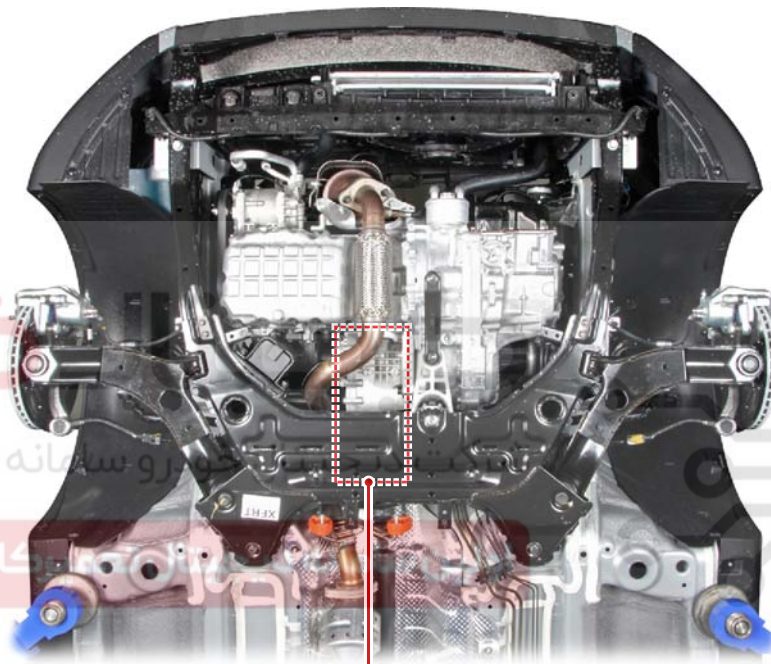
## CONFIGURATION AND FUNCTIONS



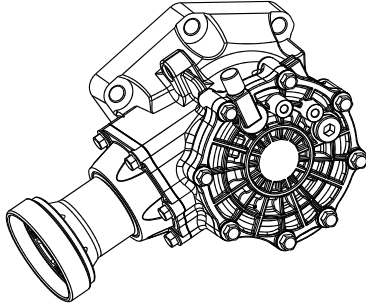
### 3270-01 PTU (POWER TRANSFER UNIT)

#### 1) Overview

In 4WD vehicle, it transmits the engine power to the E-coupling via the propeller shaft by changing its direction 90°.

#### 2) Mounting Location



PTU		
Gasoline (A/T)	Diesel (A/T)	Gasoline & diesel (M/T)
		

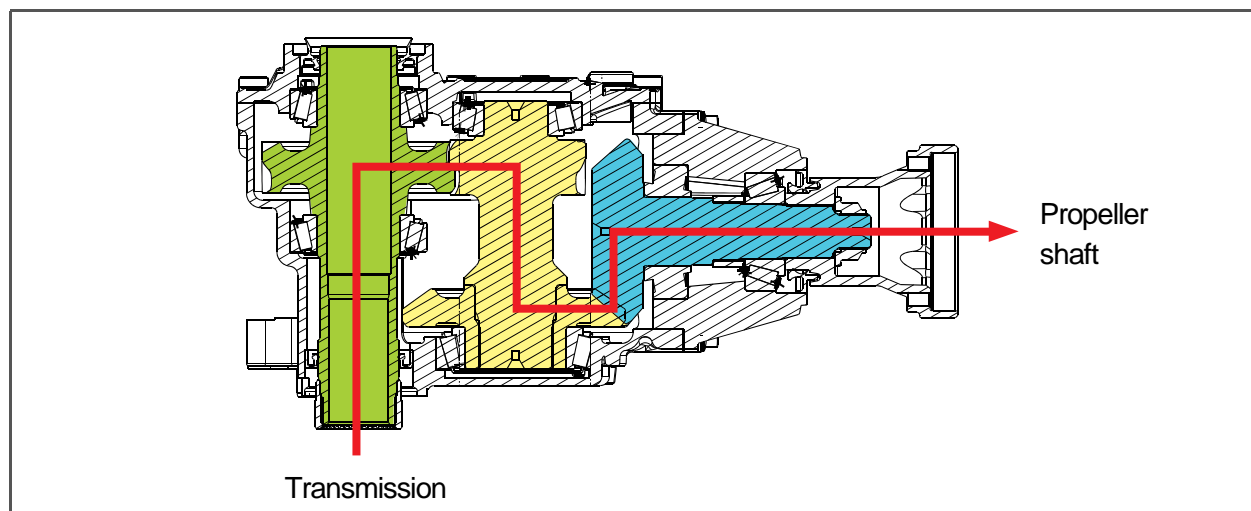
Modification basis	
Application basis	
Affected VIN	

AWD

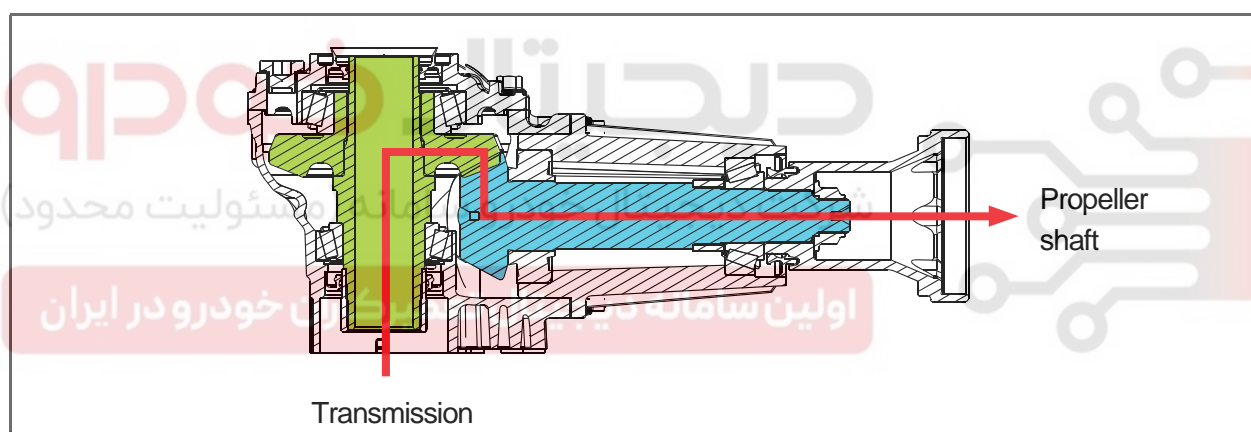
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### 3) Power Transfer Process For PTU

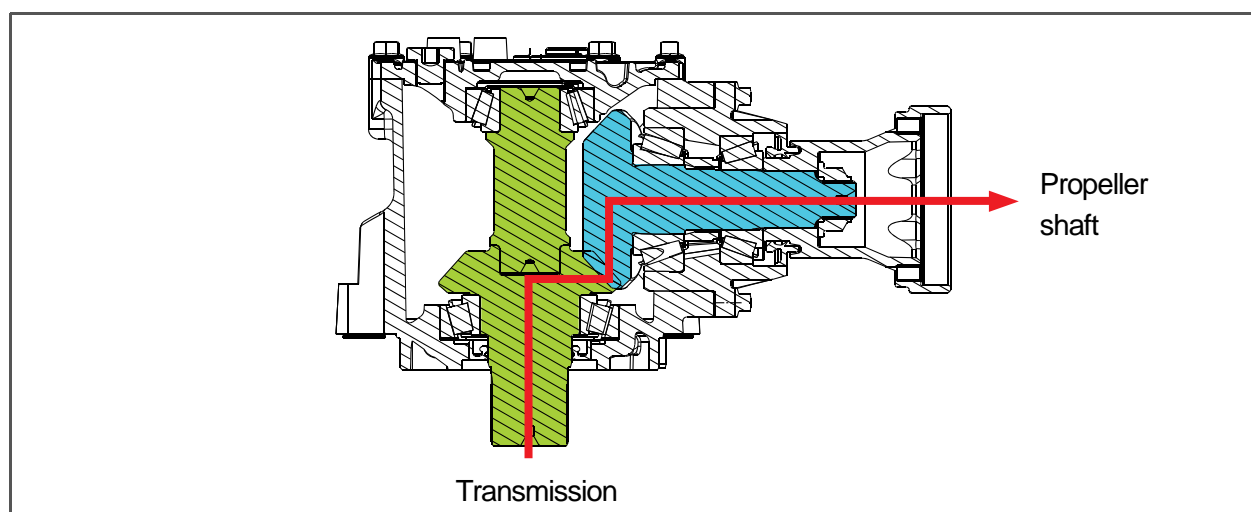
#### ► Gasoline (A/T)



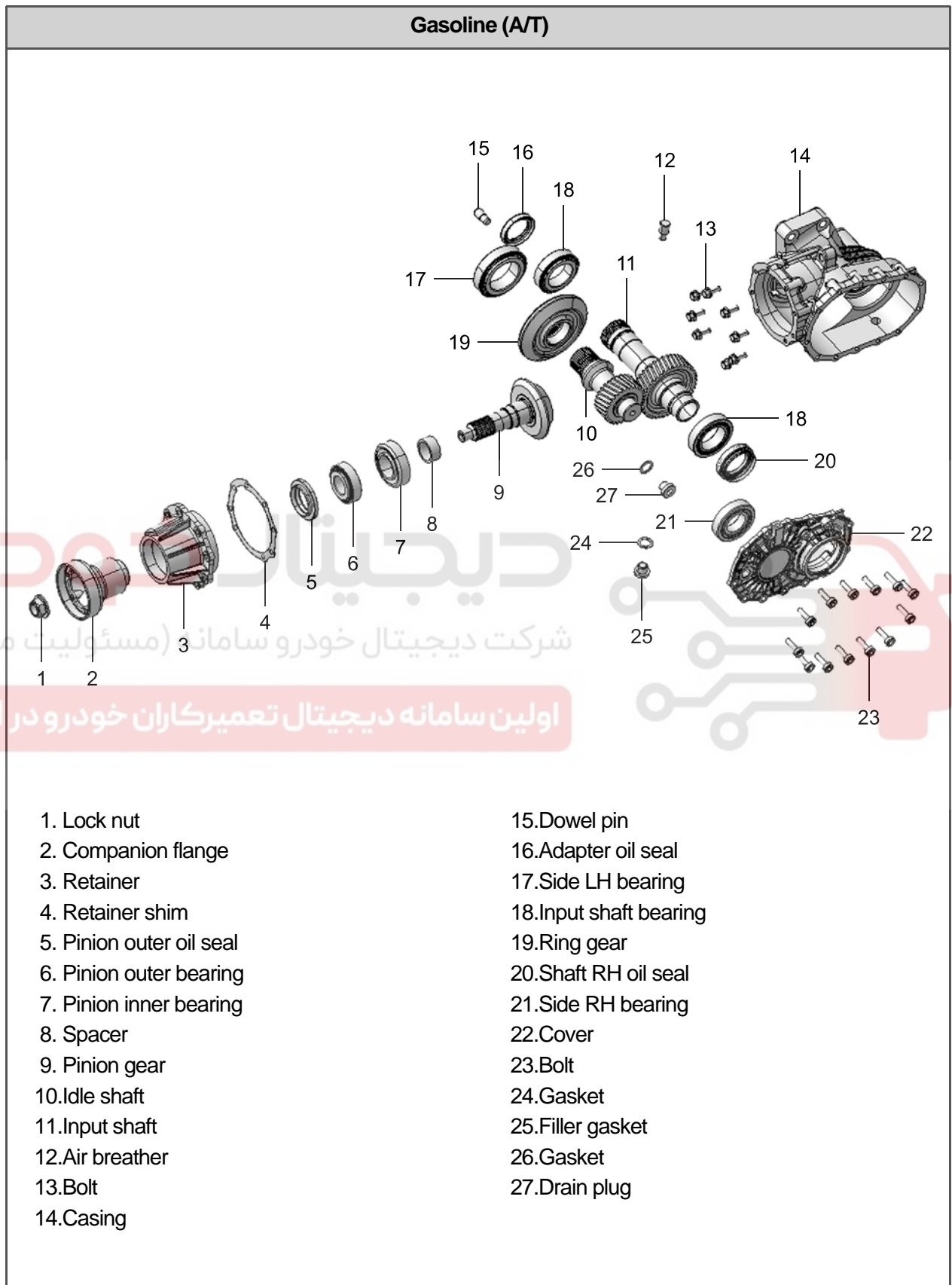
#### ► Diesel (A/T)



#### ► Gasoline & diesel (M/T)



#### 4) Exploded Diagram For PTU

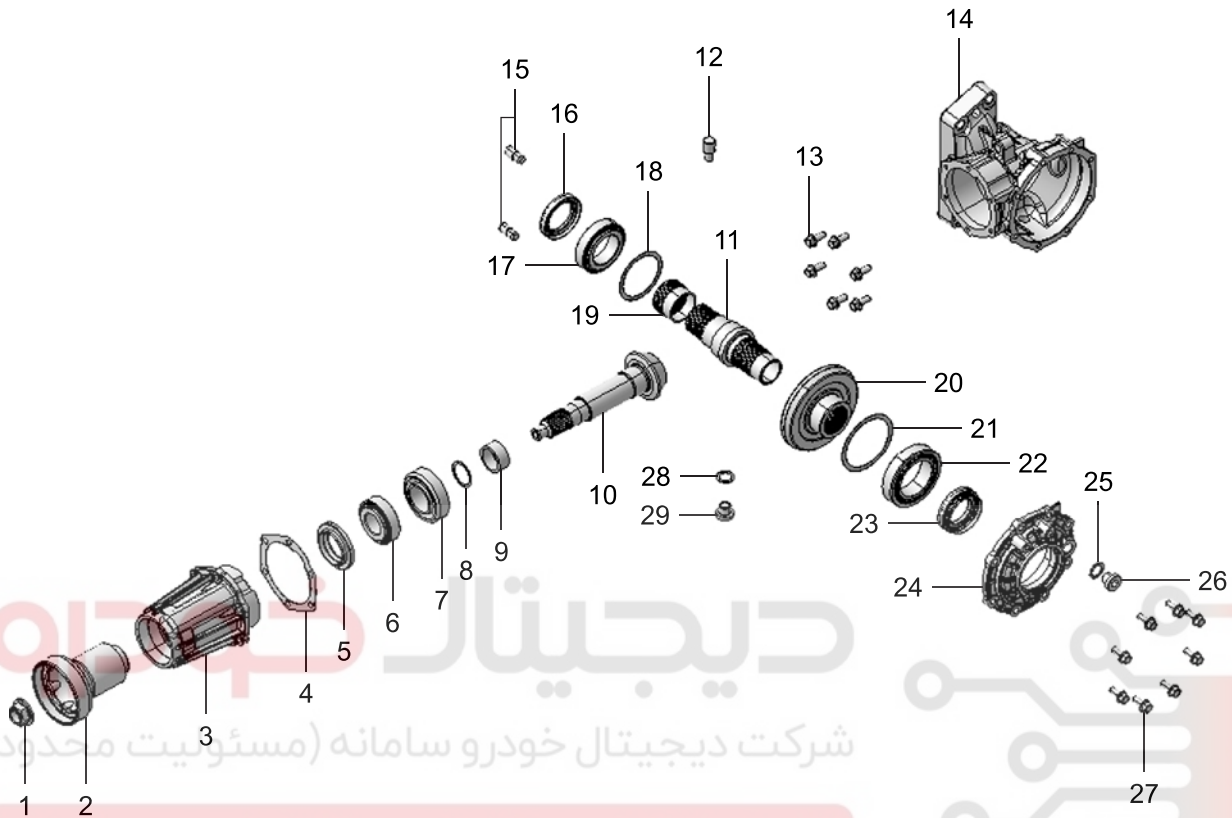


Modification basis	
Application basis	
Affected VIN	

AWD

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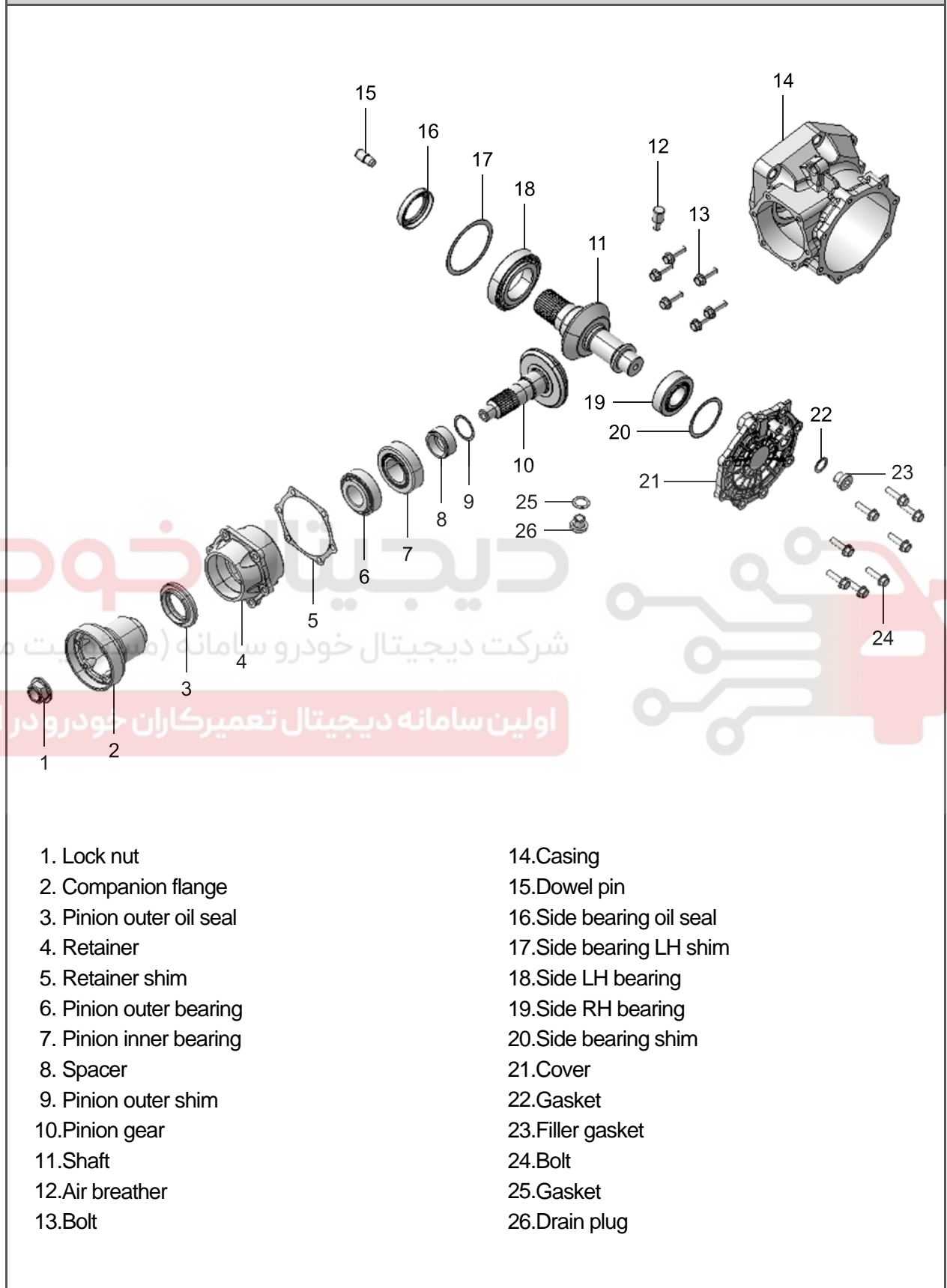
## Diesel (A/T)



- |                          |                     |
|--------------------------|---------------------|
| 1. Lock nut              | 16.Side LH oil seal |
| 2. Companion flange      | 17.Side LH bearing  |
| 3. Retainer              | 18.Side LH shim     |
| 4. Retainer shim         | 19.Adapter          |
| 5. Pinion outer oil seal | 20.Ring gear        |
| 6. Pinion outer bearing  | 21.Side RH shim     |
| 7. Pinion inner bearing  | 22.Side RH bearing  |
| 8. Pinion outer shim     | 23.Side RH oil seal |
| 9. Spacer                | 24.Cover            |
| 10.Pinion gear           | 25.Gasket           |
| 11.Shaft                 | 26.Filler gasket    |
| 12.Air breather          | 27.Bolt             |
| 13.Bolt                  | 28.Gasket           |
| 14.Casing                | 29.Drain plug       |
| 15.Dowel pin             |                     |

Modification basis	
Application basis	
Affected VIN	

## Gasoline &amp; diesel (M/T)



Modification basis	
Application basis	
Affected VIN	

AWD

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AISIN 6  
SPEED6-SPEED  
M/T

CLUTCH

PROPELLER

DRIVE  
SHAFT

AWD

SUSPENSION

BRAKE  
SYSTEM

ESP

ABS

ELECTRIC  
POWERWHEEL  
AND TIRE

TPMS

SUB  
FRAME



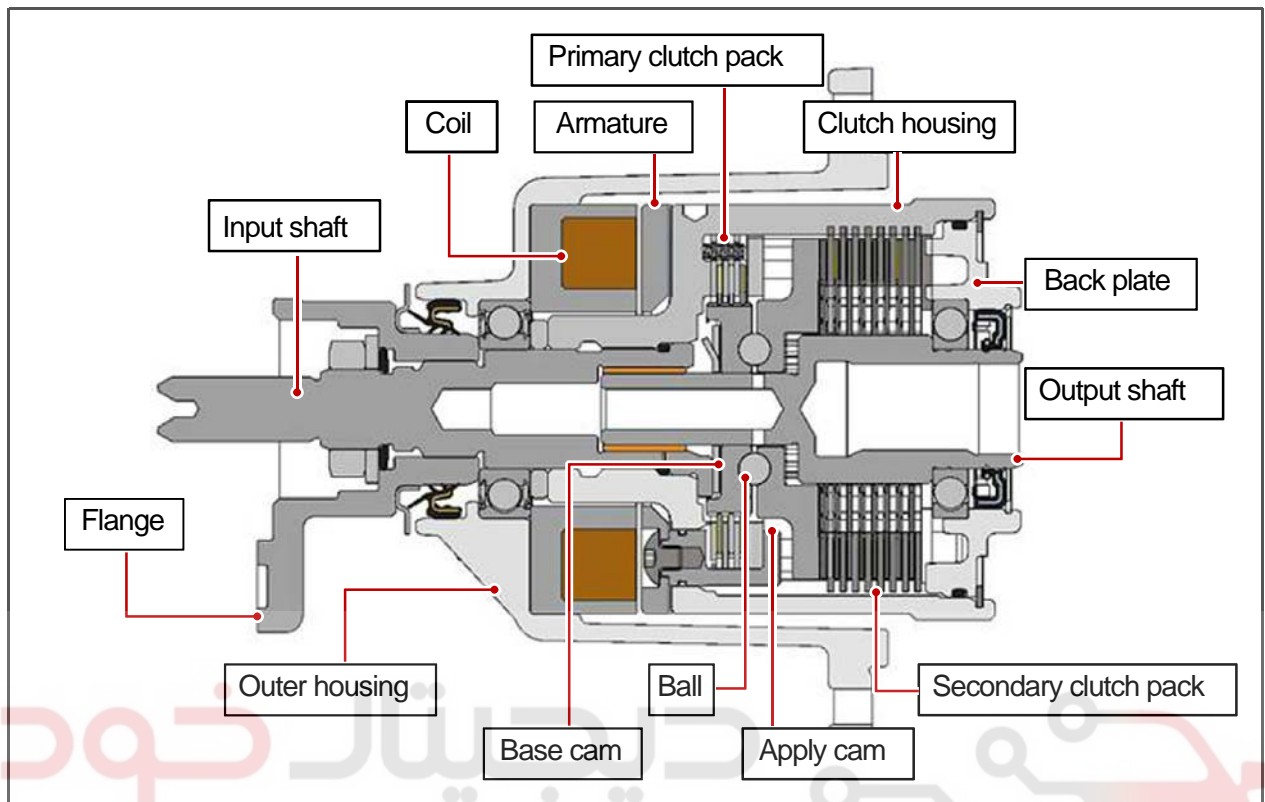
S.G.N.

**3280-01 E-COUPLING****1) Overview**

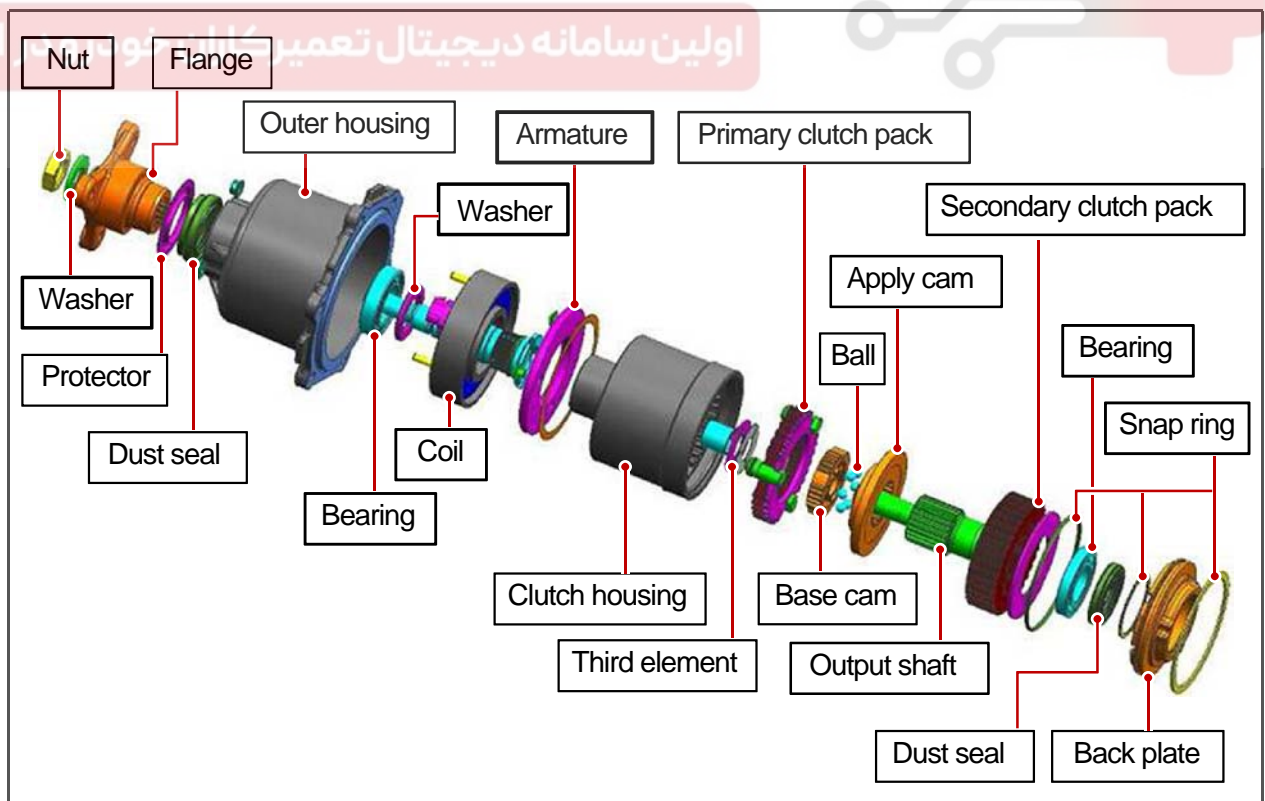
It delivers the power to the rear axle from the PTU and controls the torque distribution between the front wheel and rear wheel.

**2) Mounting Location**

### 3) Sectional View



### 4) Internal Gear Configuration

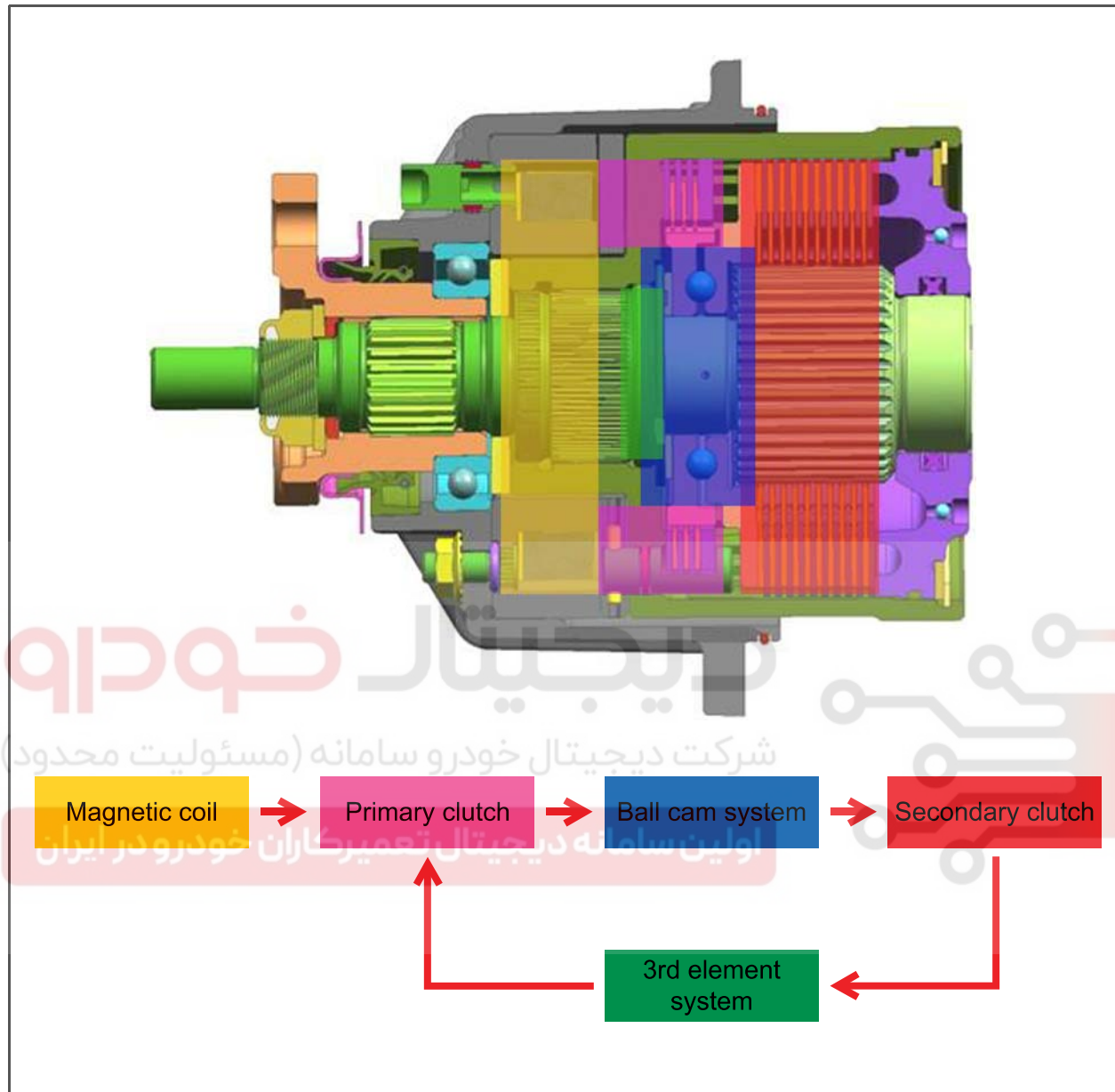


Modification basis	
Application basis	
Affected VIN	

AWD

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## 5) Operation Process



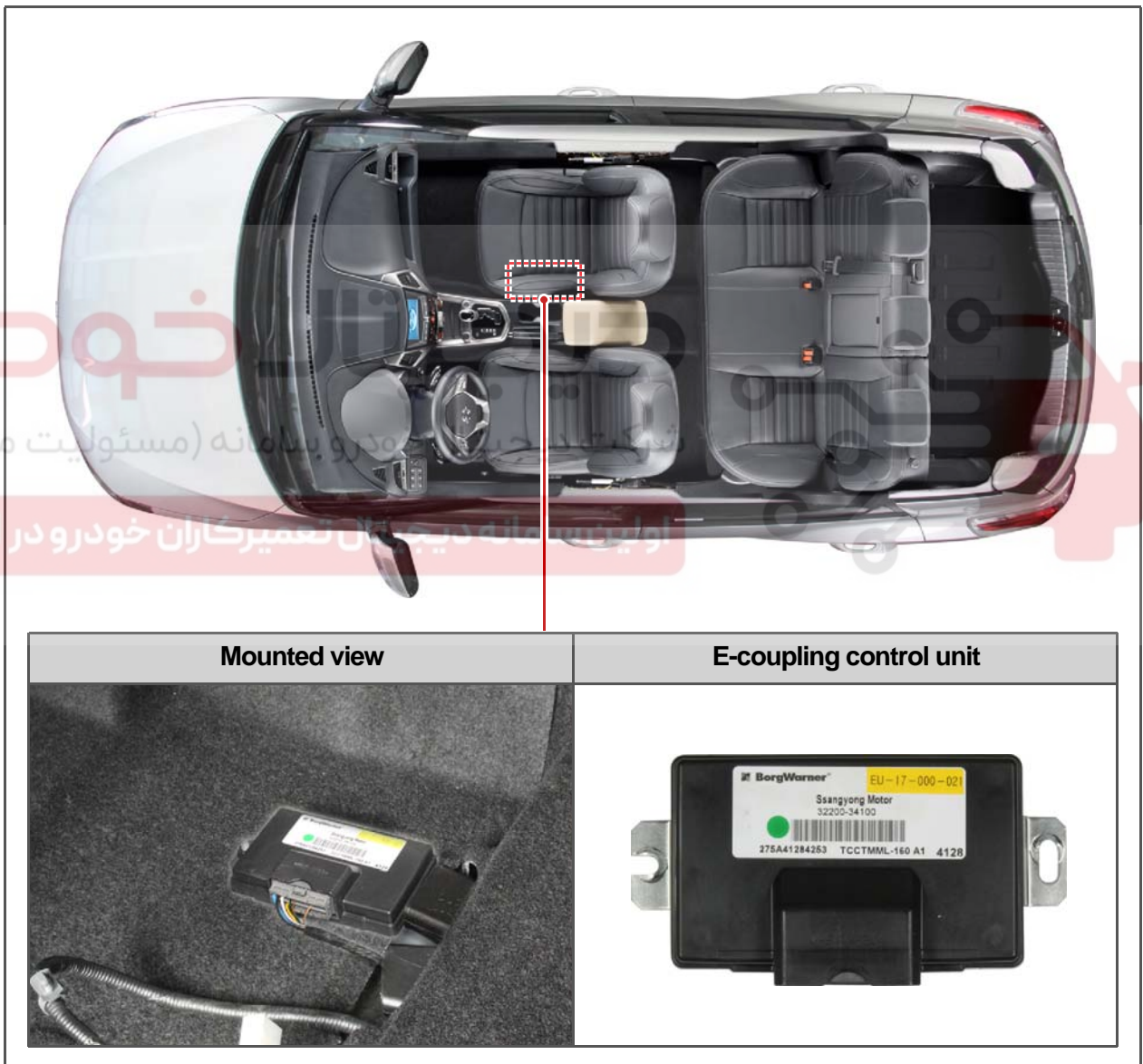
The driving force is delivered from the PTU to the input shaft via the propeller shaft and yoke flange. An electromagnet is energized according to the control commands from the E-coupling control unit and at the same time, magnetic flux is created in the coil based on the current value. The armature moves by a magnetic induction effect which causes the primary clutch to be engaged. If this happens, when there is a difference between the front axle and rear axle speeds, a speed difference between the base cam and apply cam also occurs. Then, the ball will be sliding and rolling along the grooves on the base cam and apply cam according to this relative speed deviation between the base cam and apply cam, and these cams are pushed back. Therefore, the ball cam system with a cam thrust pushes against the secondary clutch which is engaged between the housing and hub. The driving force is delivered from the housing to hub, driving pinion and rear differential and finally to the rear axle through this process.



S.G.N.

**3280-02 E-COUPLING CONTROL UNIT****1) Overview**

The E-coupling control unit is mounted on the bottom of the floor mat under the front passenger seat. It is a control unit which monitors the CAN signals (e.g. wheel speed, engine torque, pedal value, ABS/ESP CAN signal) from other units to determine the current value (clutch clamping force) for the electronic magnetic in the E-coupling.

**2) Mounting Location**

Modification basis	
Application basis	
Affected VIN	

AWD

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AISIN 6  
SPEED6-SPEED  
M/T

CLUTCH

PROPELLER

DRIVE  
SHAFT

AWD

SUSPENSION

BRAKE  
SYSTEM

ESP

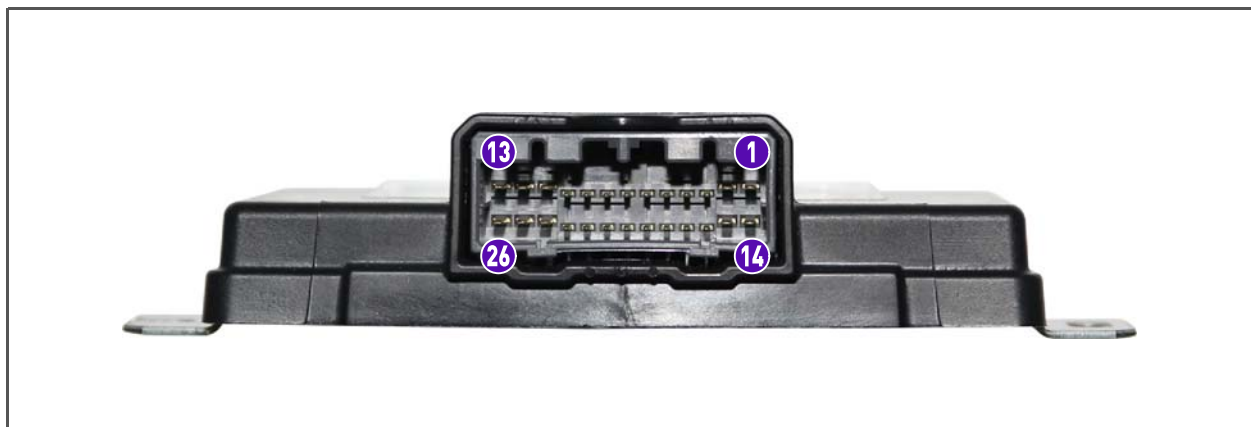
ABS

ELECTRIC  
POWERWHEEL  
AND TIRE

TPMS

SUB  
FRAME

### 3) E-coupling Control Unit Connector



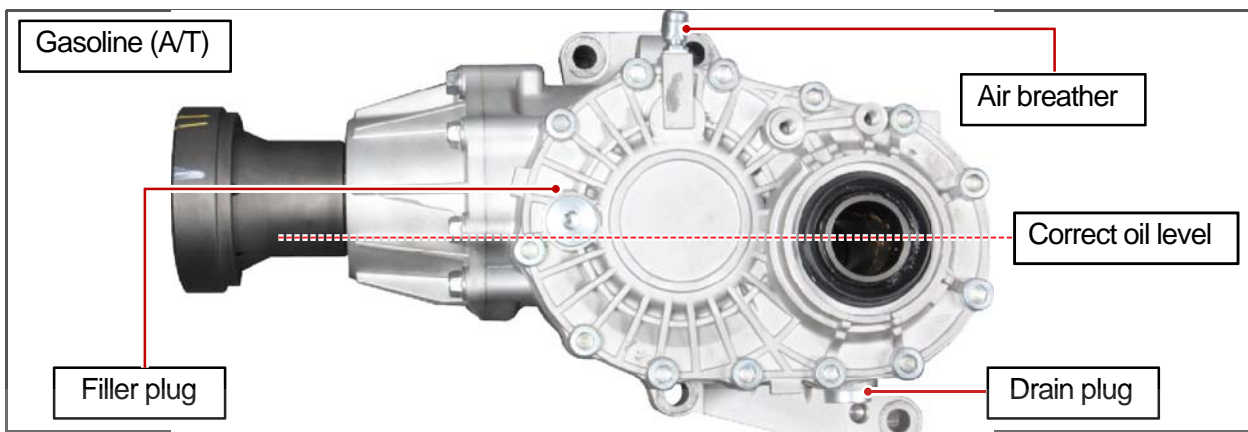
Pin No.	Function	Pin No.	Function
1	-	14	-
2	-	15	-
3	-	16	-
4	4WD LOCK mode switch	17	-
5	-	18	-
6	-	19	-
7	-	20	-
8	CAN HI	21	-
9	CAN LO	22	-
10	-	23	IGN 1+
11	Electromagnetic coil driver	24	Electromagnetic coil return
12	Ground	25	-
13	B+	26	-

## REMOVAL AND INSTALLATION

### 9210-10 CHANGE AND TOP UP PTU FLUID

**Preceding work** - Remove the rear under cover.

**reference** This manual is based on working on the gasoline A/T vehicle.

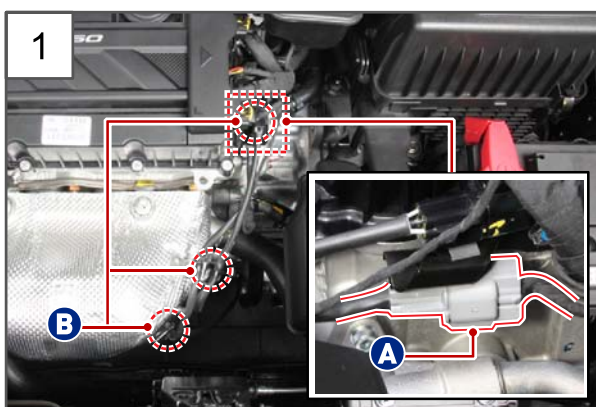


#### Specifications of PTU fluid

Fluid specification		80W-90 API GL5
Oil capacity	Gasoline (A/T)	Approx. 0.6 liters
	Diesel (A/T)	Approx. 0.25 liters
	Gasoline & diesel (M/T)	Approx. 0.5 liters
Fluid check and change interval		Fluid check and change interval: check and add at every 60,000 km of driving or 3 year, and replace as necessary (however, replace at every 120,000 km of driving under severe conditions)

#### CAUTION

- Perform the work with the vehicle parked on the level ground.
- Let the exhaust muffler cool down before starting the work.



1. Disconnect the rear oxygen sensor connector (A) and remove the 3 wiring fixing keys (B).

#### NOTE

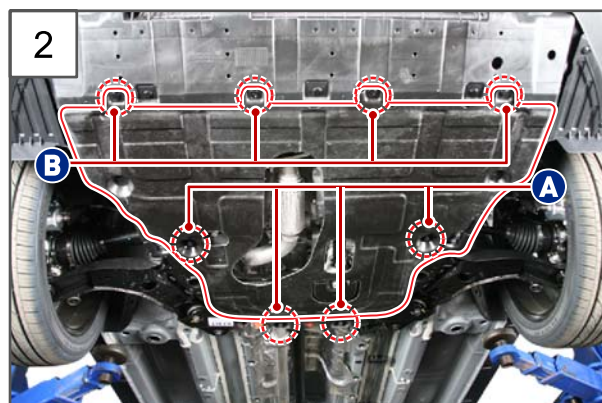
Removing the rear oxygen sensor connector applies only to the gasoline vehicle.

Modification basis	
Application basis	
Affected VIN	

AWD

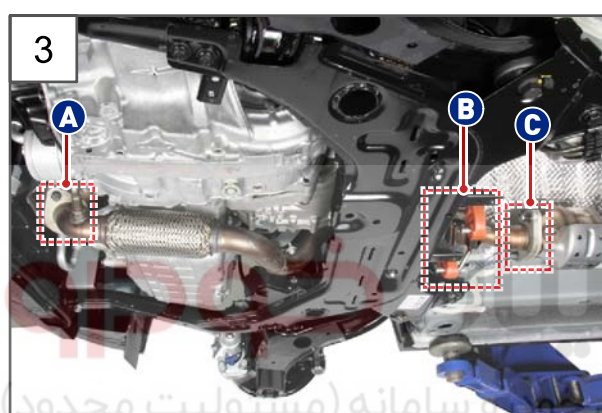
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2. Remove the under cover by unscrewing the 4 rear under cover mounting screws and 4 mounting bolts (12 mm).

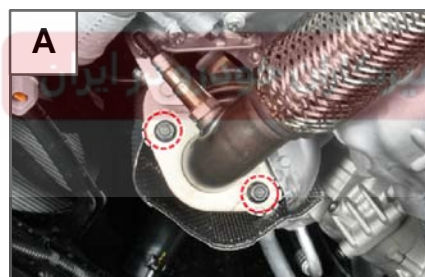
**Tightening torque (A) 13.8 ~ 17.6Nm**



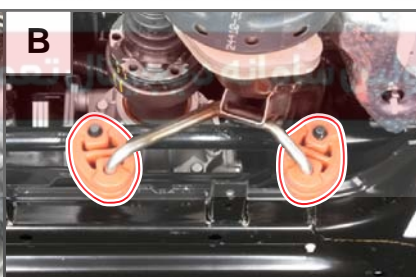
3. Remove each fixing part at the front exhaust muffler and separate the front exhaust muffler.

**Tightening torque (A) 34 ~ 37Nm**

**(C) 34 ~ 37Nm**



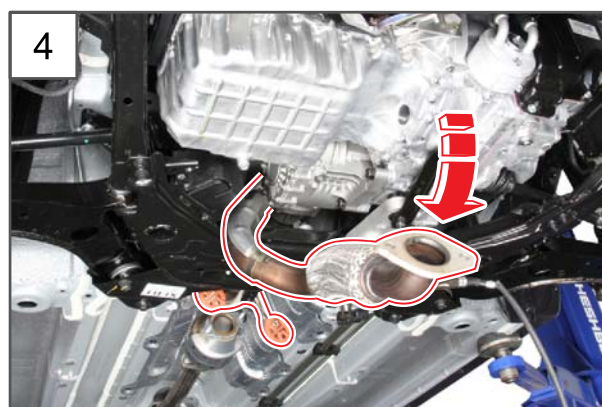
Unscrew the 2 mounting nuts (14 mm) at the front of the front exhaust muffler.



Remove the 2 front exhaust muffler hangers from the subframe.



Unscrew the 2 mounting nuts (14 mm) at the rear of the front exhaust muffler.

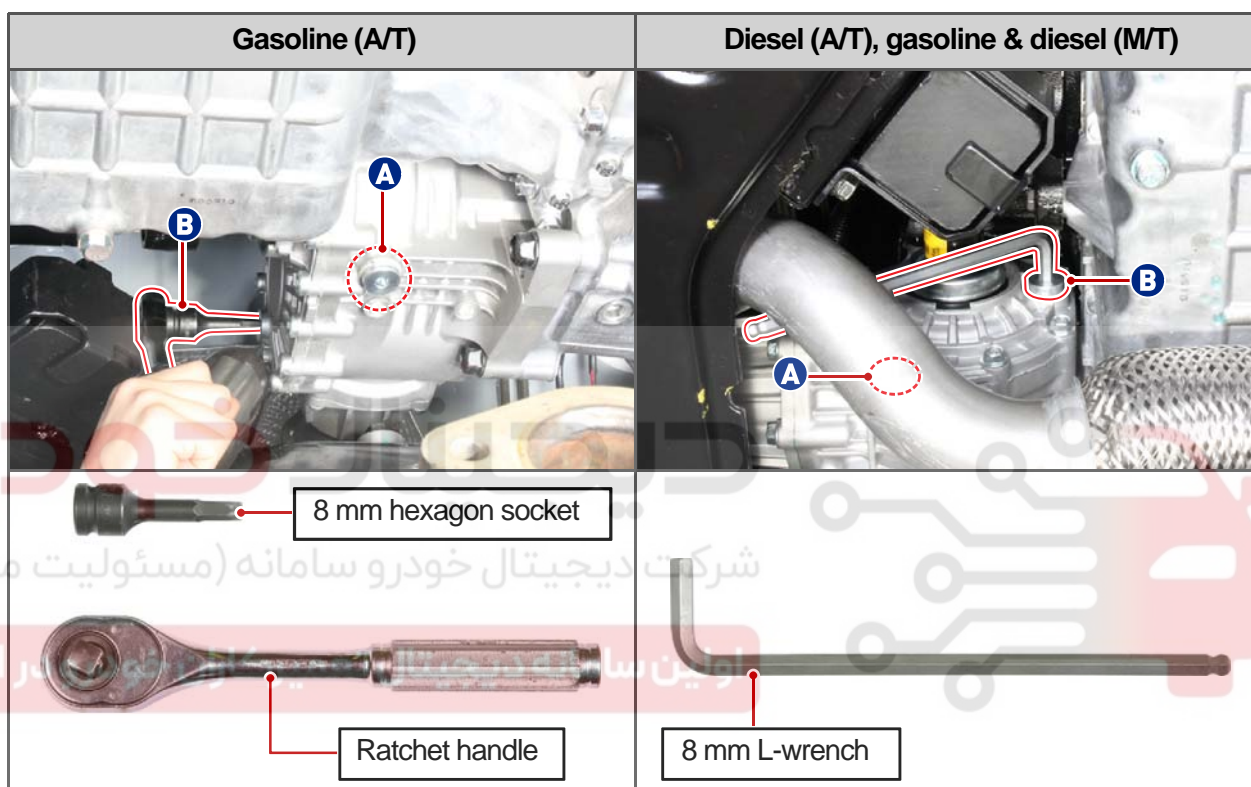


4. Remove the front exhaust muffler and hang it on the subframe.

5. Drain and top up the PTU fluid.

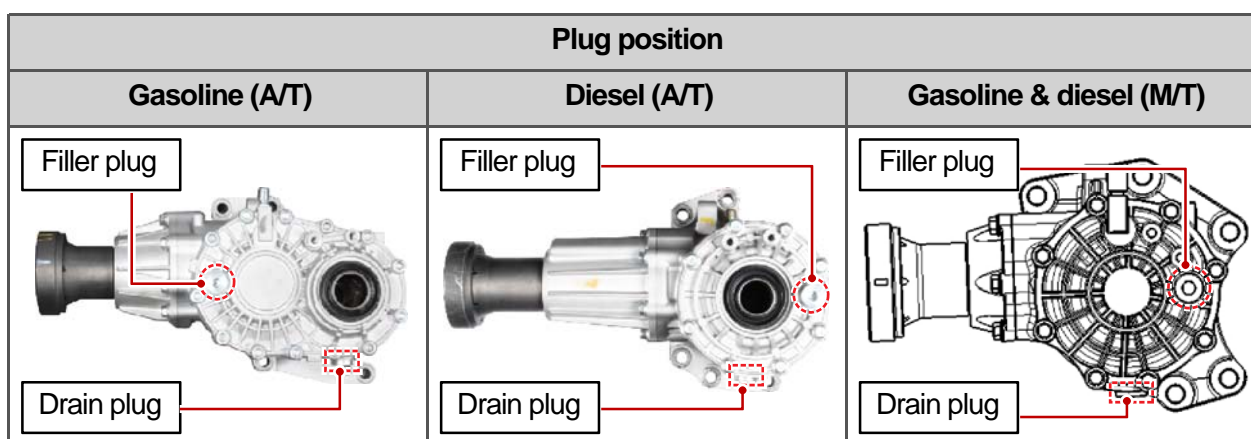
- Remove the drain plug (A) (hexagon, 8 mm) to drain the fluid.
- Remove the filler plug (B) (hexagon, 8 mm), top up the fluid and tighten the filler plug to the specified torque.

**Tightening torque** 60 ~ 80Nm



### ⚠ CAUTION

Take care to ensure that the fluid does not contact with the front exhaust muffler when draining it.



Modification basis	
Application basis	
Affected VIN	

AWD

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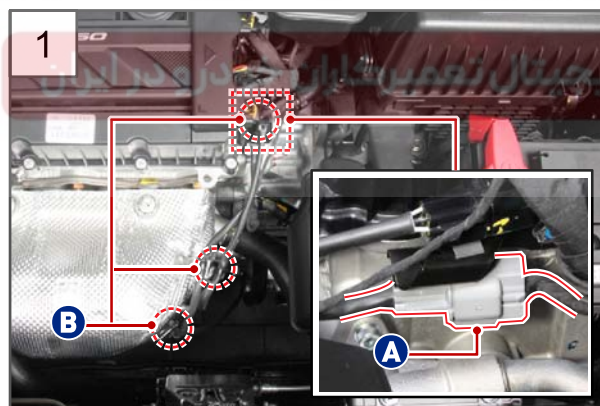
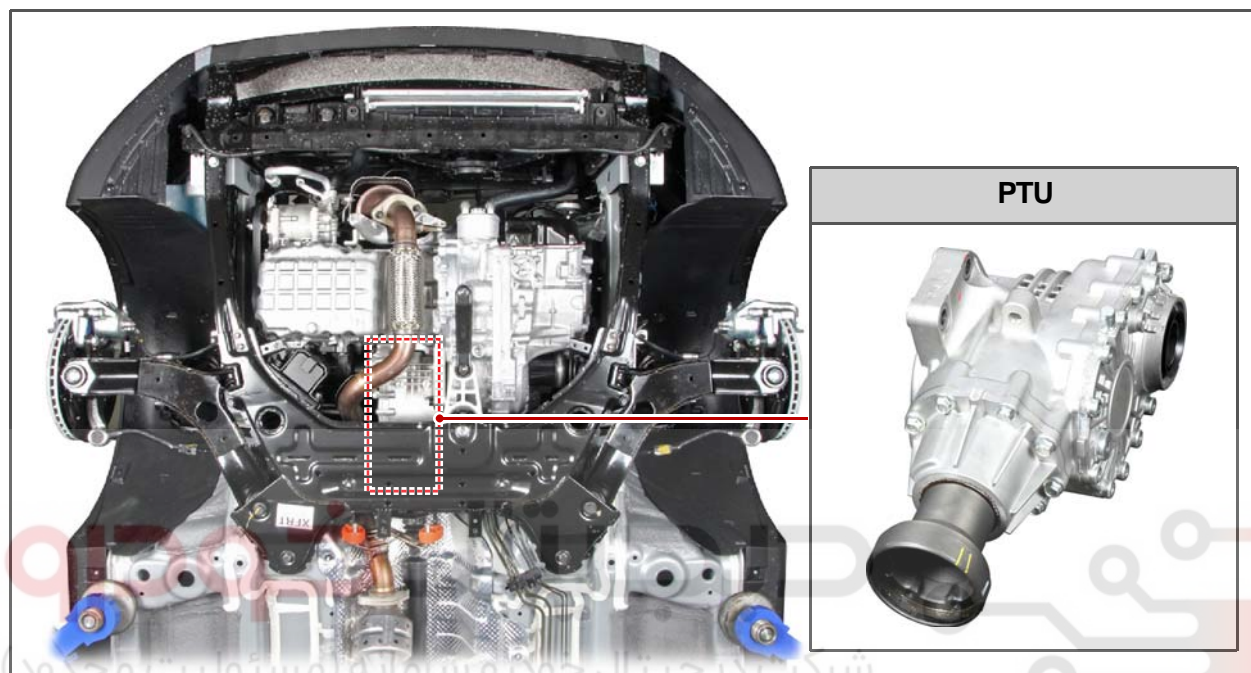
S.G.N.

**3270-01 PTU****Preceding work**

- Remove the rear under cover.
- Remove the front RH wheel.

**reference**

This manual is based on working on the gasoline A/T vehicle.



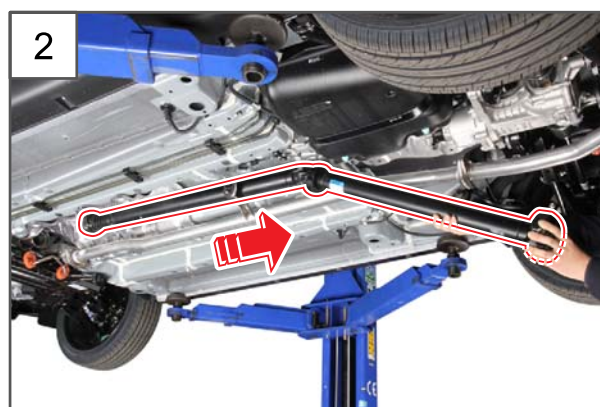
1. Disconnect the rear oxygen sensor connector (A) and remove the 3 connector fixing keys (B).

**NOTE**

Removing the rear oxygen sensor connector applies only to the gasoline vehicle.

**CAUTION**

Let the exhaust muffler cool down before starting the work.

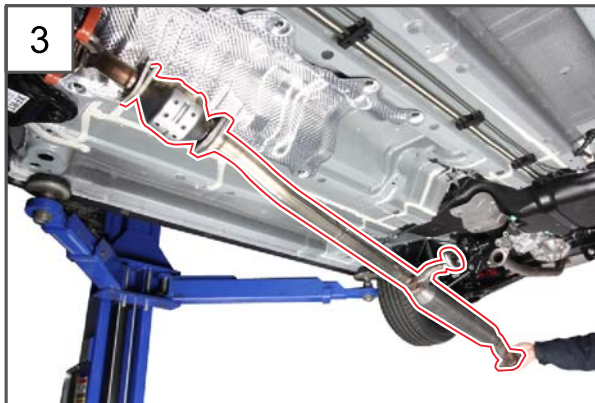


2. Remove the propeller shaft.

**NOTE**

Refer to "PROPELLER SHAFT" under "REMOVAL AND INSTALLATION" in "PROPELLER SHAFT SYSTEM".

Modification basis	
Application basis	
Affected VIN	



3. Remove the center exhaust muffler.



#### NOTE

Refer to "CENTER EXHAUST MUFFLER" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.



#### CAUTION

Perform the work after the muffler cools down in order to getting burn.



4. Remove the front RH drive shaft.



#### NOTE

See "DRIVE SHAFT" in "REMOVAL AND INSTALLATION" under "DRIVE SHAFT AND AXLE SYSTEM".



5. Unscrew the 3 intermediate shaft mounting bolts (12 mm).

**Tightening torque** 24.5 ~ 29.4Nm



6. Remove the intermediate shaft.

Modification basis	
Application basis	
Affected VIN	

AWD

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7. Unscrew the 3 mounting bolts (17 mm) for the rear engine mounting insulator.

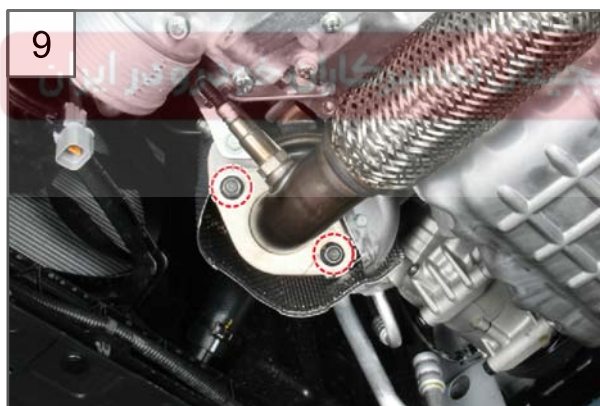
**Tightening torque** 68.6 ~ 88.2Nm

**CAUTION**

Please note that the bolts have different shapes.



8. Remove the rear engine mounting insulator.



9. Unscrew the 2 mounting nuts (14 mm) at the front of the front exhaust muffler.

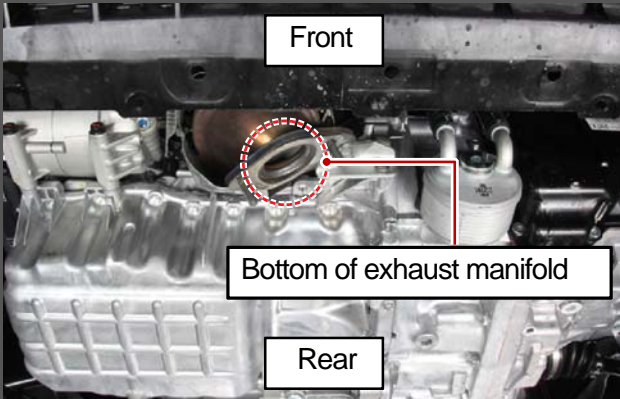
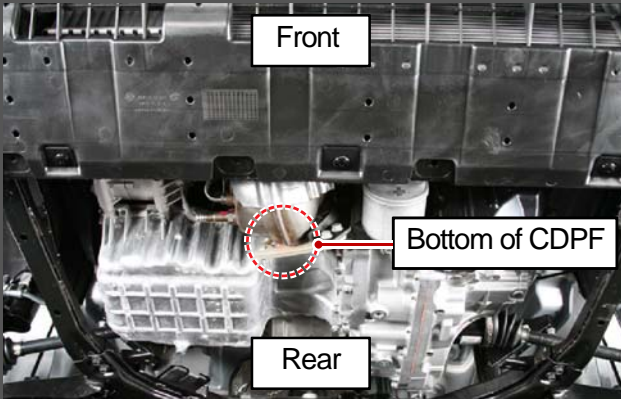
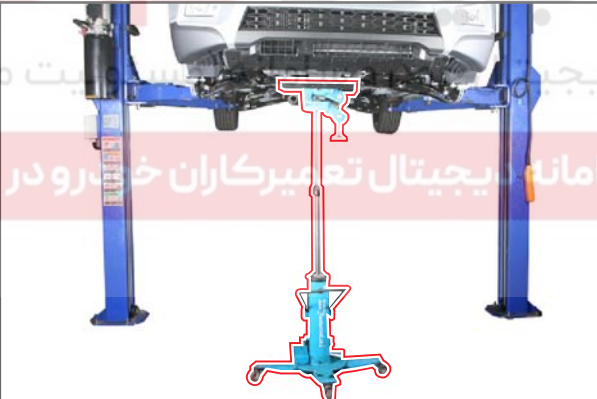
**Tightening torque** 34 ~ 37Nm



10. Remove the 2 front exhaust muffler hangers from the subframe.



11. Make a space at the PTU flange at the rear side of the engine to remove the front exhaust muffler.

Gasoline	Diesel
 <p>Front</p> <p>Bottom of exhaust manifold</p> <p>Rear</p>	 <p>Front</p> <p>Bottom of CDPF</p> <p>Rear</p>
<p>Make a space at the PTU flange at the rear side of the engine by lifting up the bottom of the exhaust manifold with a transmission jack.</p>	<p>Make a space at the PTU flange at the rear side of the engine by lifting up the bottom of the CDPF with a transmission jack.</p>
	
<p><b>CAUTION</b> Do not apply excessive force when operating the transmission jack.</p>	

Modification basis	
Application basis	
Affected VIN	

AWD

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12. Prise off the bellows part (A) of the front exhaust pipe and pull out it towards the rear of the vehicle.

**CAUTION**

Take care not to damage the front exhaust muffler due to any interference.



13. Remove the front exhaust muffler.



14. Unscrew 4 PTU bracket mounting bolts (12 mm).

**Tightening torque** 22 to 26 Nm



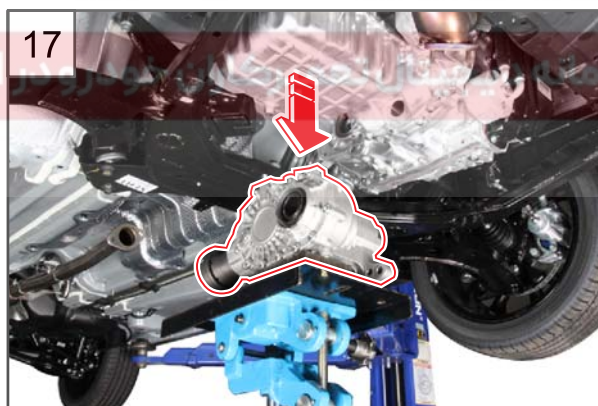
15. Remove the PTU bracket.



16. Unscrew the PTU mounting bolts (19 mm).

**Tightening torque** 85 ~ 100 Nm

Bolt position		
Gasoline (A/T) : 4 ea	Diesel (A/T) : 5 ea	Gasoline/Diesel (M/T) : 5 ea



17. Remove the PTU assembly.



18. Install in the reverse order of removal.

Modification basis	
Application basis	
Affected VIN	

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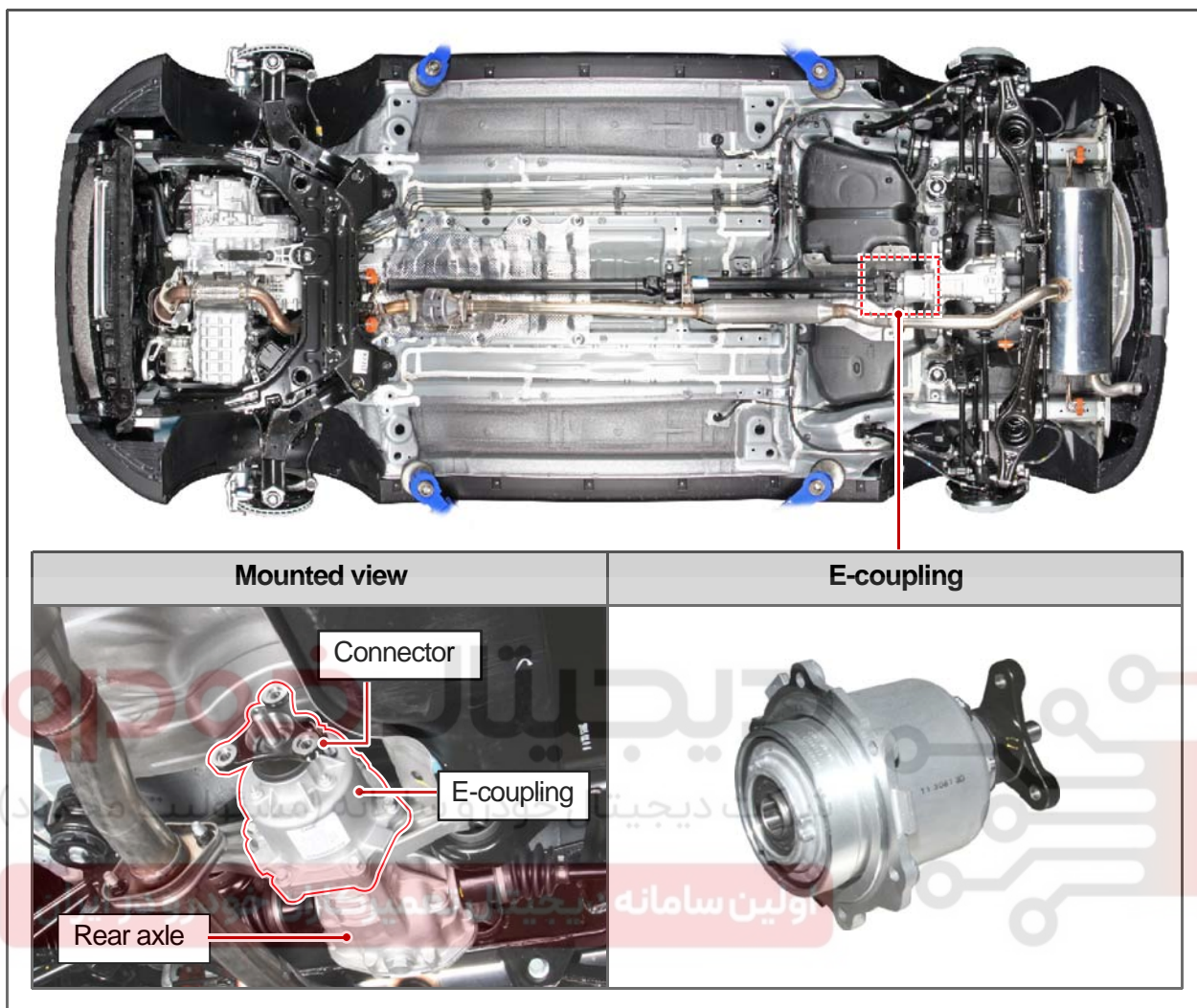


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3280-01

T I V O L I

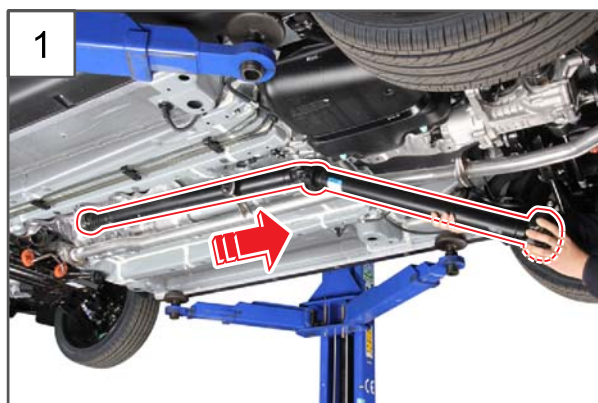
S.G.N.

**3280-01 E-COUPLING**

AWD

TIVOLI 2015.06

Modification basis	
Application basis	
Affected VIN	



1. Remove the propeller shaft.



#### NOTE

Refer to "PROPELLER SHAFT" under "REMOVAL AND INSTALLATION" in "PROPELLER SHAFT SYSTEM".



2. Disconnect the E-coupling connector (A).



3. Unscrew the 6 E-coupling mounting bolts (12 mm).

**Tightening torque** 19.6 ~ 24.5 Nm



4. Remove the E-coupling.

5. Install in the reverse order of removal.

Modification basis	
Application basis	
Affected VIN	

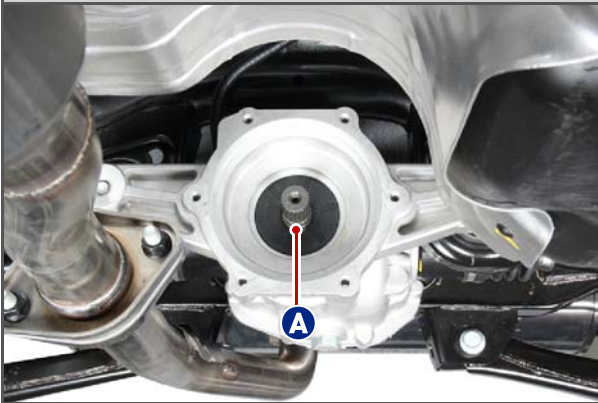
AWD

TIVOLI 2015.06

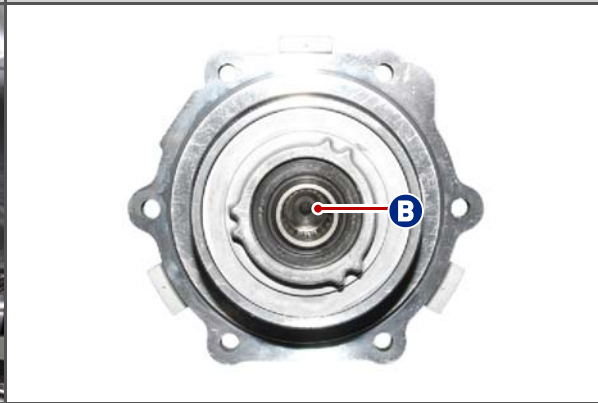
### Cautions for installation

1. Apply the extreme pressure grease to the rear axle's input shaft spline part (A) and E-coupling's spline groove (B).

Rear axle's input shaft spline part

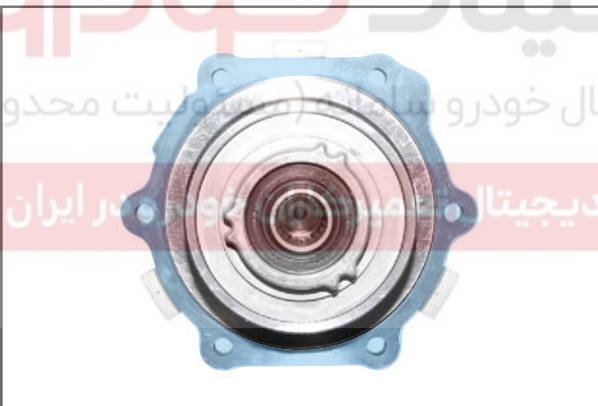


E-coupling's spline part



#### NOTE

Extreme pressure grease: grease for KLUBER MICROLUBE GNY 202 or transmission (MS 511-55, TMG-2)



2. Apply the sealant (liquid gasket B type: MS 721-40, LT 5702 or the equivalent) to the E-coupling housing in the following order:

- A. Clean the contact surface before applying the sealant.
- B. Make sure that the starting point and ending point of the sealant bead are overlapped by about 10 mm.
- C. Fit the E-coupling to the rear axle housing within about 3 minutes of applying the sealant.



#### CAUTION

Make sure that you do not get the sealant on other parts.



3. The arrow marked on the E-coupling outer housing should be at 12 o'clock when fitting.



3281-00

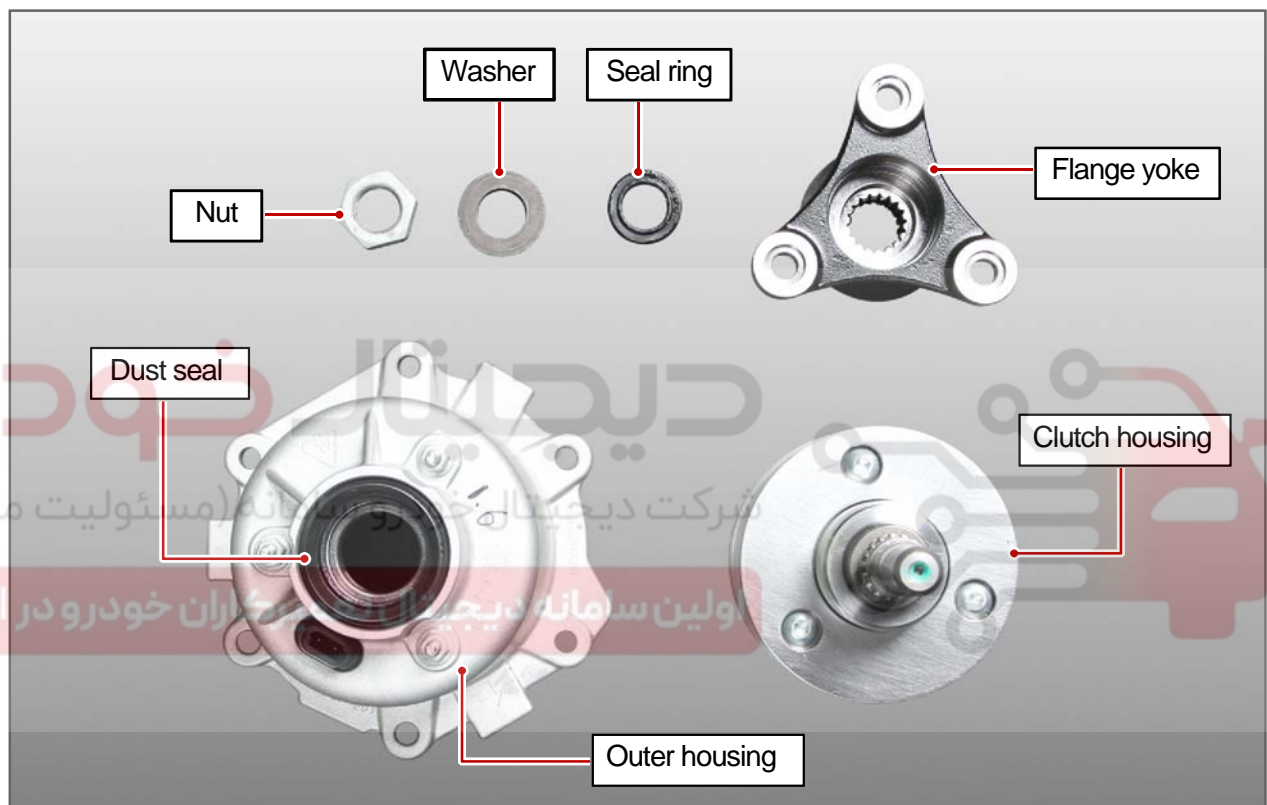
## DISMANTLING AND ASSEMBLING OF E-COUPLING

**Preceding work** - Remove the E-coupling from the vehicle.

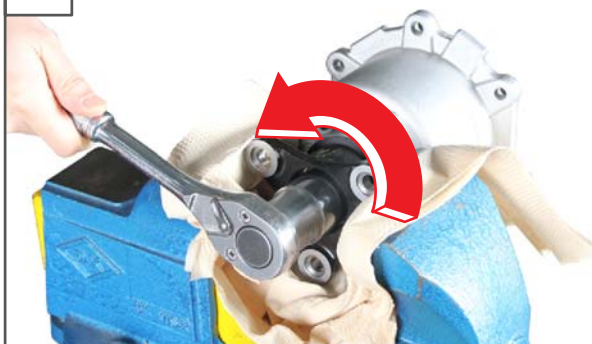


### NOTE

The dismantling and assembling of the E-coupling should be carried out when replacing the dust seal or flange yoke on the coupling housing. Avoid further dismantling and assembling for the E-coupling. Therefore, carry out only the work described below.



1



1. Wrap the flange yoke of the E-coupling assembly with a cloth, place it in a vice and unscrew a lock nut (30 mm).

**Tightening torque** 129 to 152 Nm

Nut, washer and seal ring



Modification basis	
Application basis	
Affected VIN	

AWD

TIVOLI 2015.06



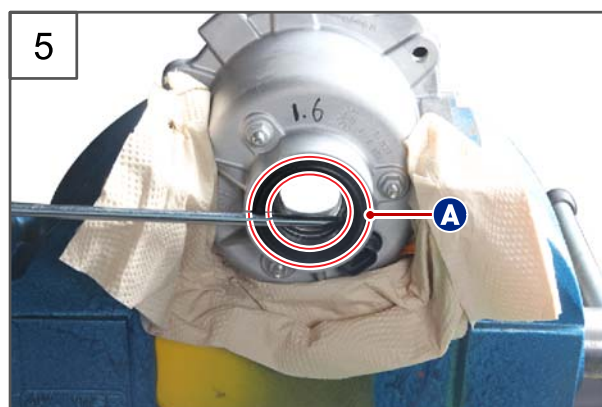
2. Use a puller (special tool) to remove the flange yoke (A) from the E-coupling.



3. Remove the flange yoke from the E-coupling.



4. Remove the outer housing.



5. Remove the dust seal (A) from the outer housing with a screwdriver or etc.  
6. Assemble in the reverse order of disassembly.

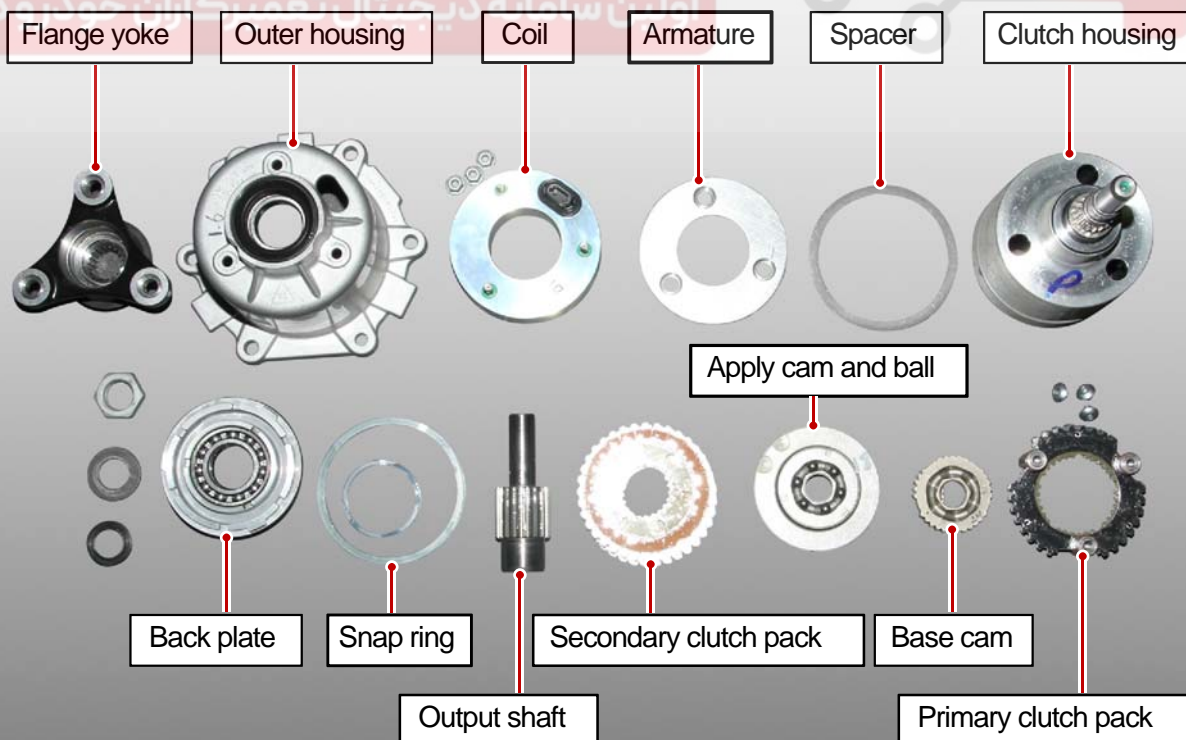
#### **CAUTION**

- Replace the dust seal on the outer housing with a new one. Tight the dust seal against the housing when fitting.
- Replace the lock nut on the flange yoke with a new one.



**Note: Internal components in E-coupling****NOTE**

This exploded view is only intended to show how the E-coupling is configured, not for explaining how to dismantle it. It is unnecessary to dismantle the E-coupling and replace it as necessary.



Modification basis	
Application basis	
Affected VIN	

AWD

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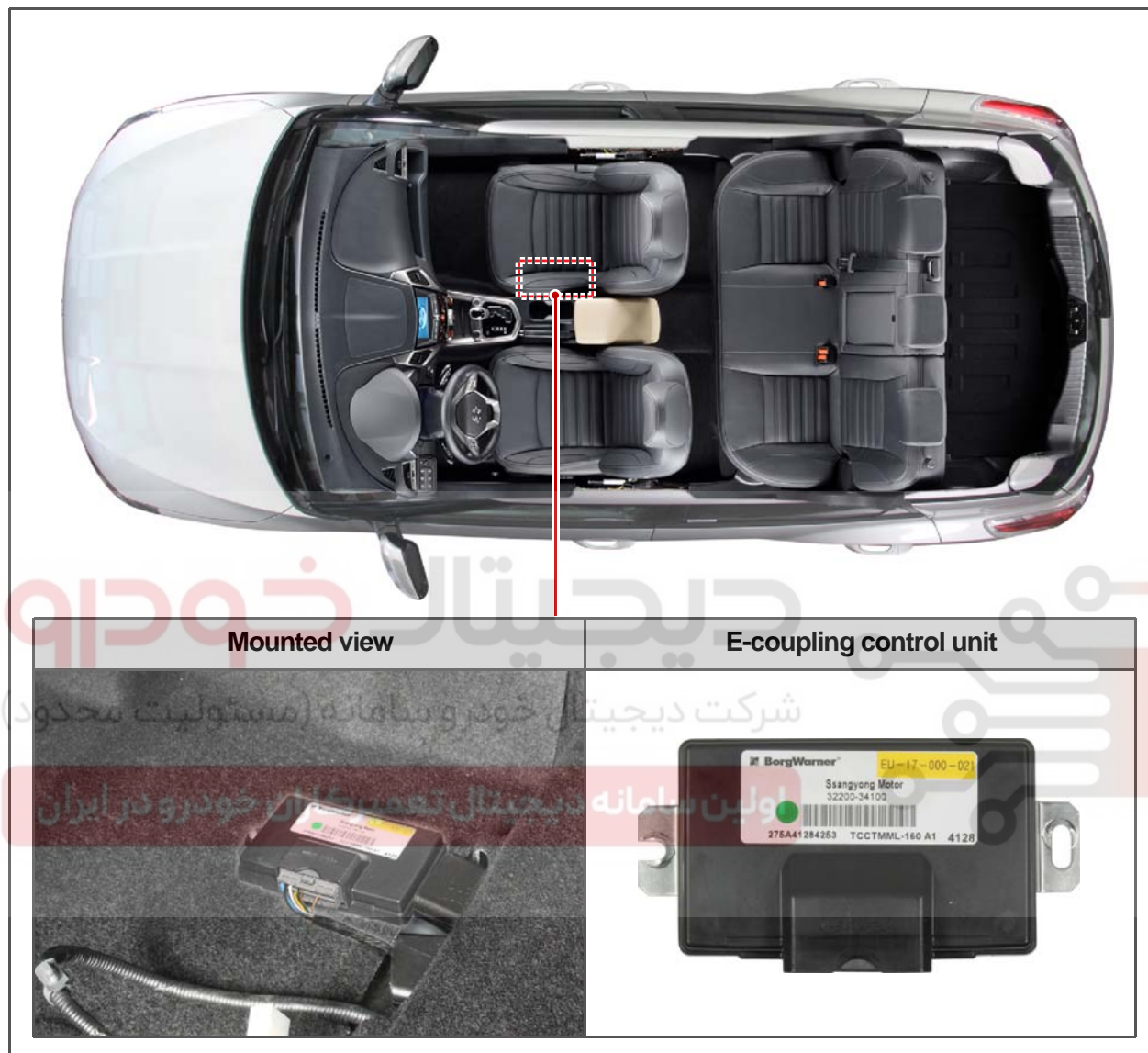
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3280-02

## E-COUPLING CONTROL UNIT

Preceding work

- Disconnect the negative battery cable.



Mounted view

E-coupling control unit



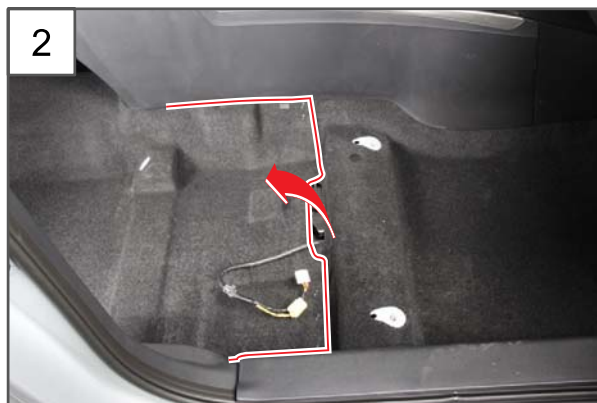
1

1. Remove the passenger seat.

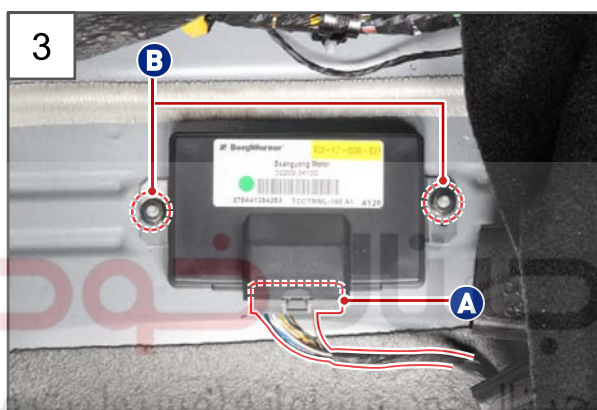
**NOTE**

Refer to "FRONT PASSENGER SEAT" under "REMOVAL AND INSTALLATION" in "BODY INTERIOR".

Modification basis	
Application basis	
Affected VIN	



2. Turn over the carpet to provide working space.



3. Disconnect the E-coupling control unit connector (A) and unscrew the 2 mounting nuts (B, 10 mm).



4. Remove the E-coupling control unit.



5. Install in the reverse order of removal.

Modification basis	
Application basis	
Affected VIN	

AWD

TIVOLI 2015.06

## Memo

# دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

