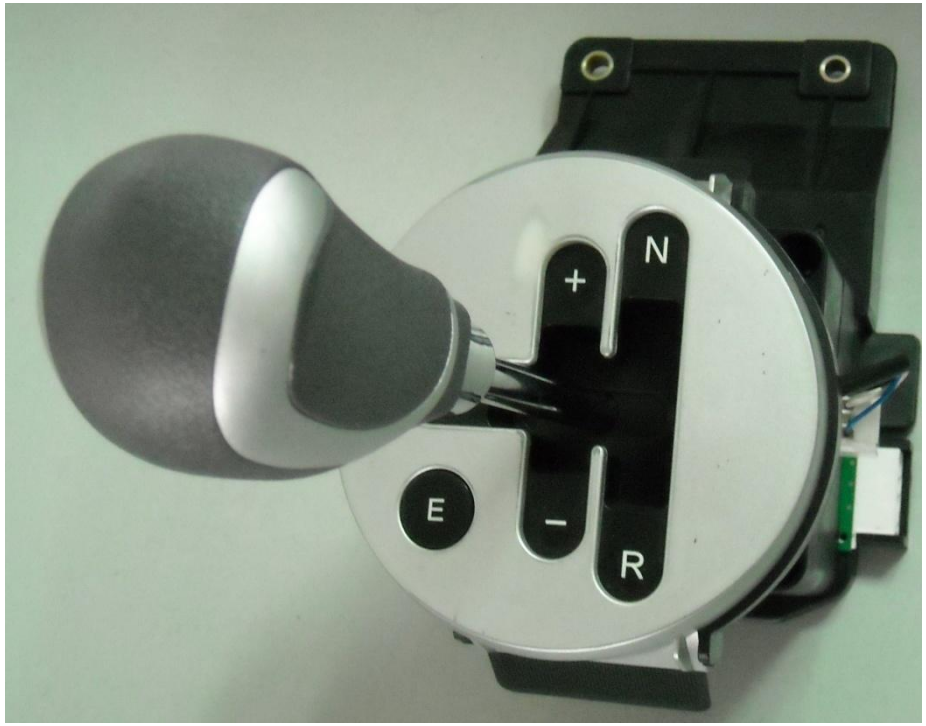



# Automatic Mechanical Transmission

Sandy · Mar, 2010

After-sale Service Department

## Kindly attention：

1.The course will take you approx 45 minutes

2.Please linsten carefully,and we will have a test

3.Please refer to the remarks at the bottom

4.Keep your cellphone on mute condition

# Catalog

# System overview

# Human-computer interface

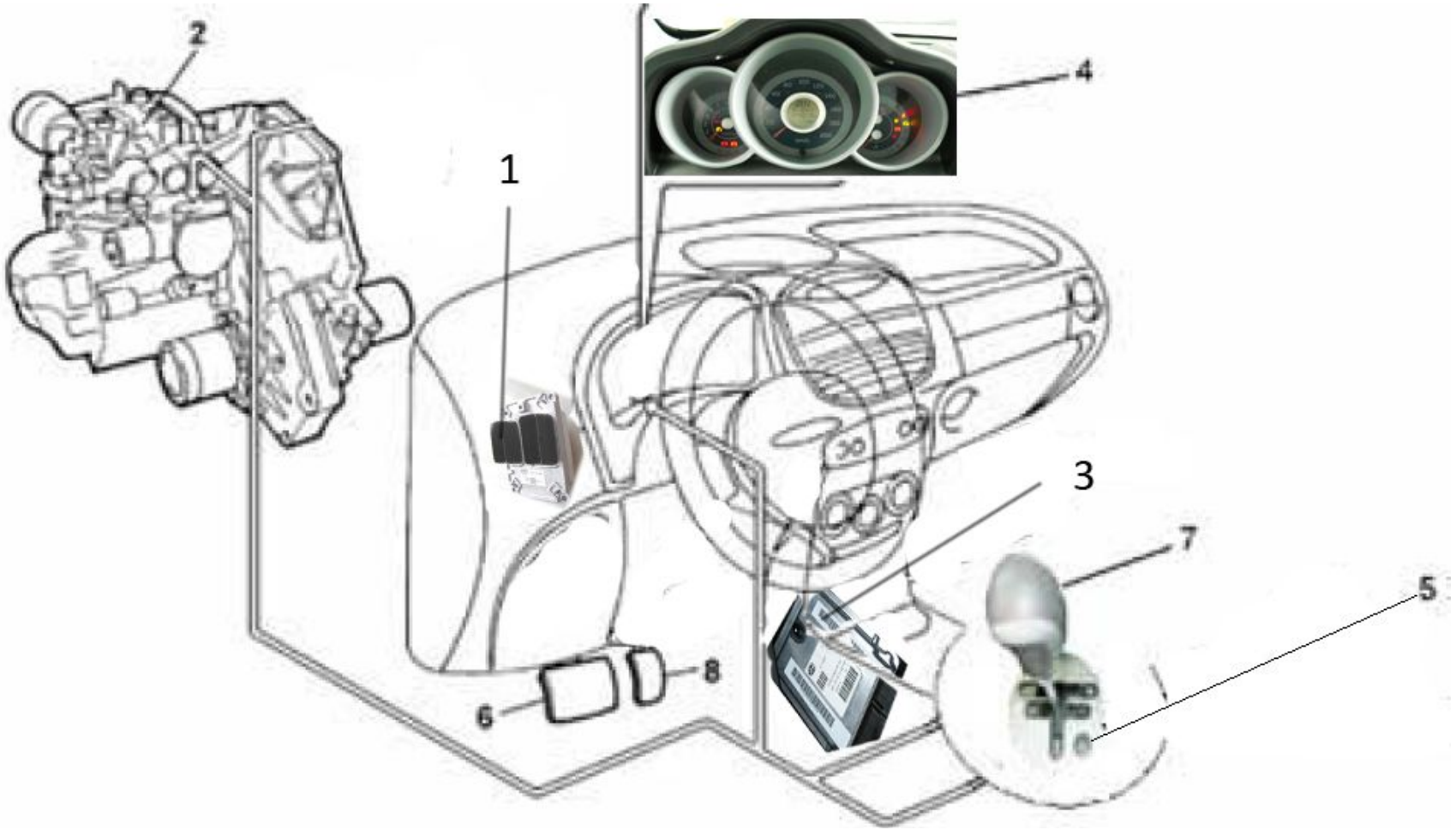
Following information display on LCD and cluster:

- Current gears，Current mode(Auto/Manual)
- Normal/Economical(Shifting pattern under auto Mode)
- Fault light

Buzzer in cluster will work under following conditions：

- Reverse gear request to ECU
- After system self-learning
- Illogical gears request from shifting lever
- System fault

# System layout




1ECU 2 Electrohydraulic unit 3TCU 4 Cluster
5Econ/Norm button 6brake switch 7Shift lever 8Accelerator

# System introduction

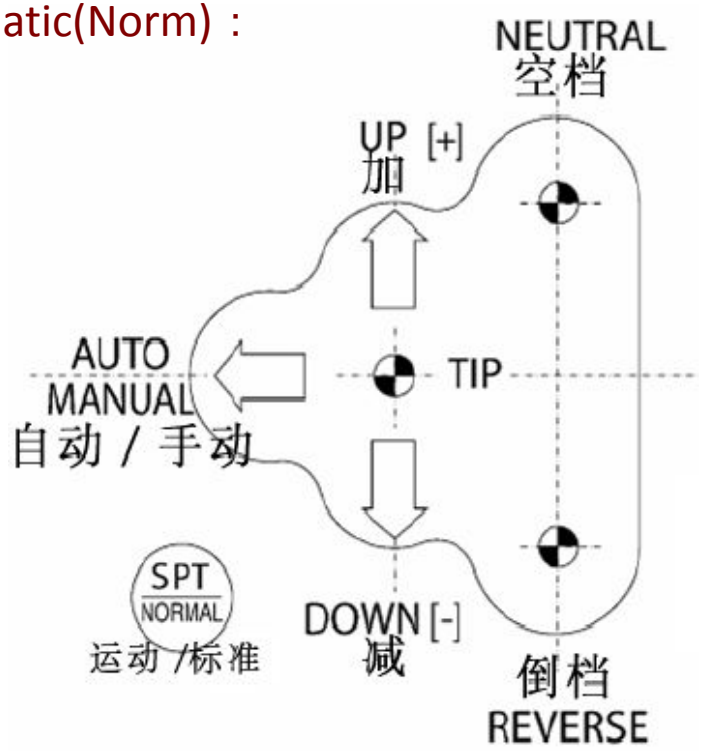
1. On the basis of the original manual transmission gearbox and clutch to add auxiliary hydraulic power control unit , Which retains all the advantages of clutch and mechanical gearbox (weight, strength and reliability, low power consumption), and to have automatic transmission.
2. Eliminated clutch pedal and shift wires, gear lever machines were replaced by an electronic joystick marked with (+/-/ N / R) reduce costs, improve the system reliability.
3. Improved user interface, less operation to improve the driving safety , especially in urban conditions.
4. Shifting point will alter with the vehicle and driver’s willing.

# Shift lever

Manual（semi-auto mode）

Automatic(Eco)：

Automatic(Norm)：





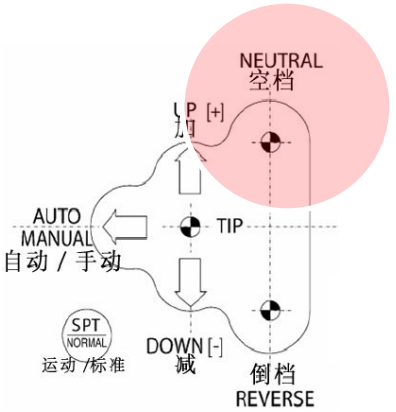
Shift lever position with three stable and three unstable position, the position signal was transformed by the Hall sensor into electrical signals.

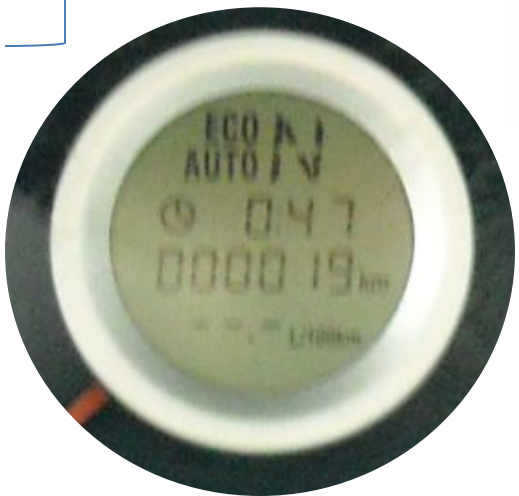
## Shift to Neutral during running

**APP sensor released**

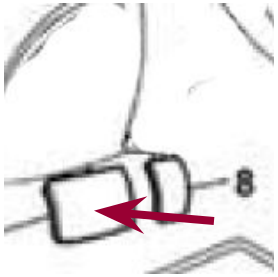

**Vehicle speed <80KM/H**

**requirement**



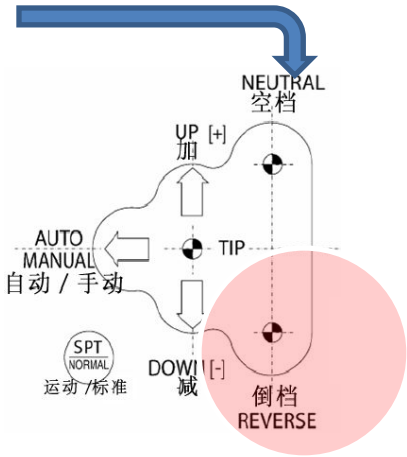
## Shift to Reverse



**Brake pedal was depressed**


**Vehicle speed <2Km/h**

**Requirement**



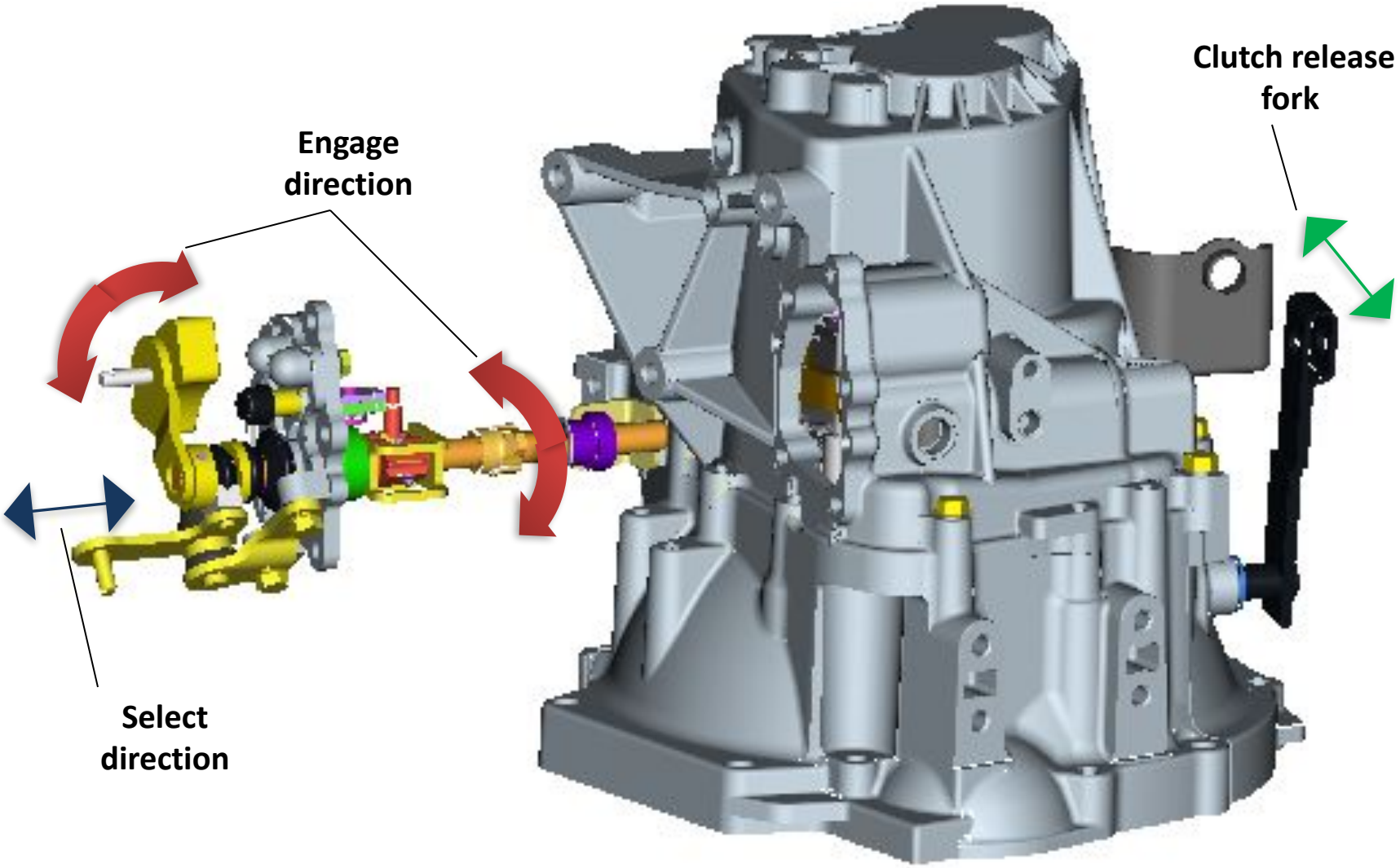

# Shift lever instructions

Possible following situation may cause when the driver try to move shift lever without depressing the brake pedal.

| Transmission engaged in | LCD displays | Shift lever final position | buzzer | Fault light |
|---|---|---|---|---|
| Neutral | [N] | TIP | On | Off |
| Reverse | [R] | TIP | On | Off |
| Reverse | [R] | Neutral | On | Off |
| A gears | [A] | Neutral | On | Off |
| Neutral | [N] | Reverse | On | Off |
| A Gears | [A] | Reverse | On | Off |

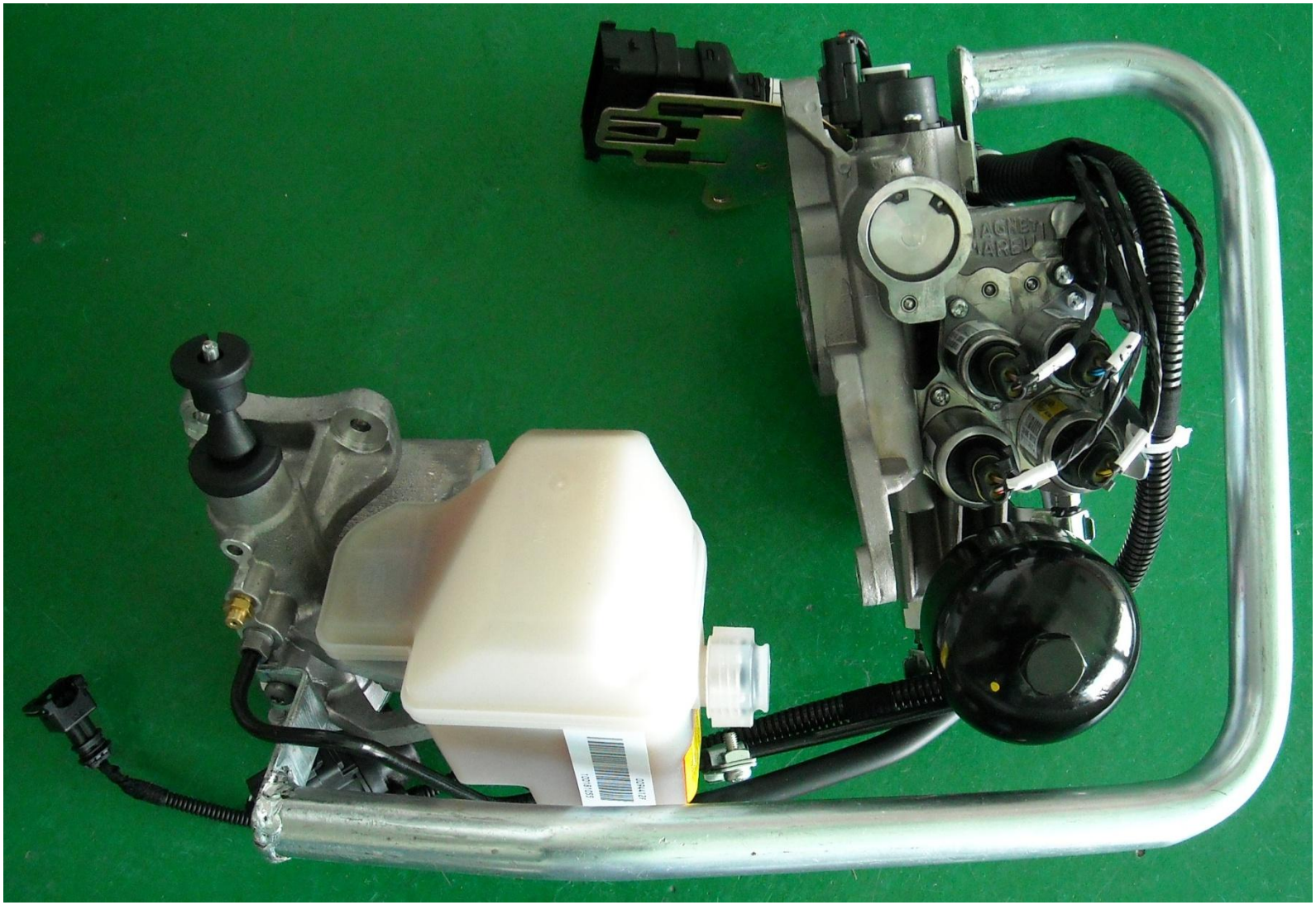
**System will automatically switch to Neutral gear once the driver's door opens**

# Knowledge prepration




Three types of operation on transmission are replace by Actuator ( Electrohydraulic mechanism )

# Electrohydraulic Mechanism



# AMT Electrical Control Components

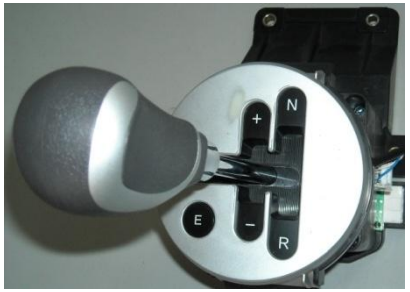
ECU<----------□
Brake switch ----------□
Clutch speed --- --- --- □
Clutch fork position--□
Gear selected position□
Gear engaged position□
Fluid pressure----------□
Shift lever input--------□
Driver's door switch--□
Ignition switch ---------□

----- □□Gear selection
----- □□Gear selection
----- □□Gear engage
----- □□Gear engage solenoid valve 2

# Input signal

APP sensor

Engine speed sensor



Mode switch(M/A)

Econ/Norm button

Shift Up/down(+/-) switch

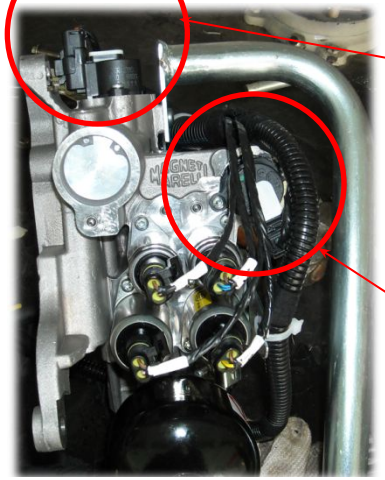
**TCU**

Vehicle speed sensor

Coolant temperature sensor

Brake switch

# Input signal



Gear engage position sensor

Gear selection sensor

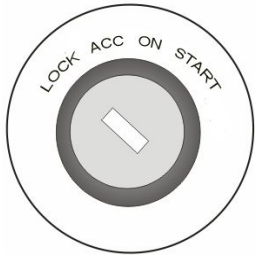
Clutch fork position sensor

Fluid pressure sensor

TCU

Driver door switch

Ignition switch

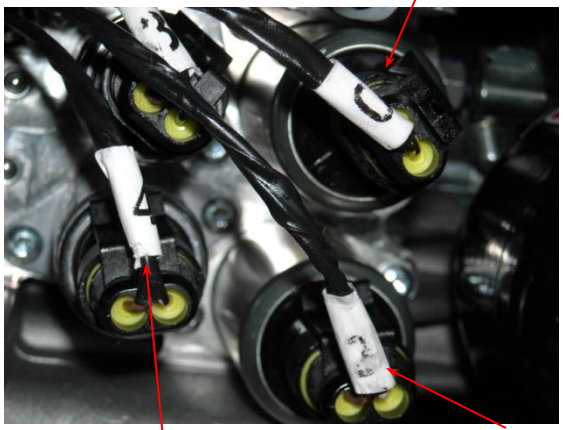



Friction disc speed sensor of Clutch

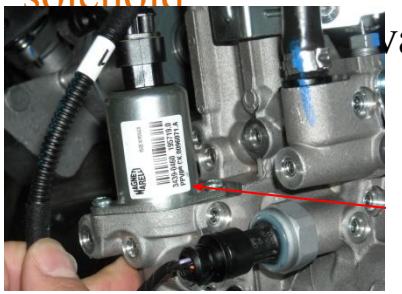
# Output signal

1-2 gears selection solenoid valve(EV3)

Clutch solenoid valve(EV0)



5-R gears selection solenoid

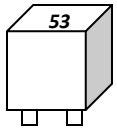


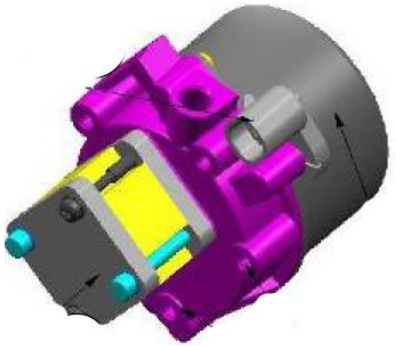
Even gears engage solenoid valve(EV2)

Odd gears engage solenoid valve(EV1)

**TCU**

Relay of pump



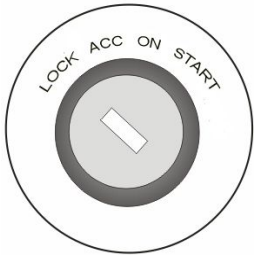
# System specification

# System wake up

System will be woke up in two ways:

— **Open the driver's side door**: The system will automatically wake up and hydraulic pump will run to supply enough pressure for starting.

— **Turn on the ignition switch**.



## Start requirement:

1. Once TCU receives the brake (except Neutral gear) and the start signal, it will automatically ground the control wire and run the starter.
2. After starting conditions are met, TCU simultaneously through CAN bus to send a start signal to allow engine control system (ECU) to start.

## Emergency start:

Battery with low energy fails to start engines but with enough electric power to run the pump supplying enough fluid pressure to shift operations, that is gears can still be engaged.

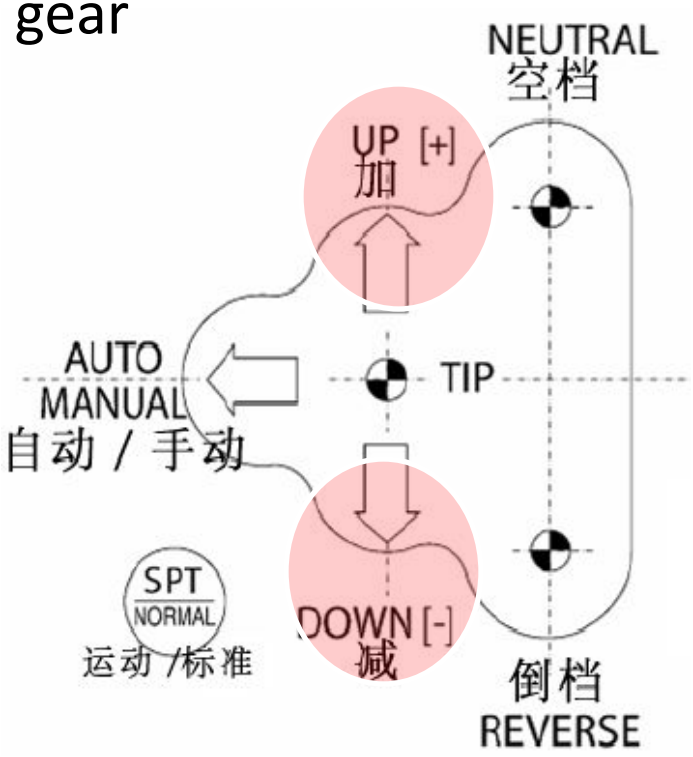
Set the transmission under Manual mode and pull vehicle to certain low speed, shift the gear manually to $1^{st}/2^{nd}$ gear.

# Starting move

Vehicle can start to move on 1st & 2nd gear

**Tip +**

**Tip —**




Driver release brake pedal and stepping on the accelerator pedal, the system will gradually engage the clutch. When the system detects the engine speed with the clutch rotational speed synchronized, the clutch will be fully engaged. Different gears in different APP and speeds ,the engagement will vary to ensure rapid and smooth start.

# Shift process under Manual Mode

## Shift process

**When vehicle is running and the clutch engaged, driver can manually shift gears.**

**Three stages:**

**Stage 1: engine decrease torque output**

**Stage 2: shift process**

**Stage 3: increase engine torque output**

**Shift request will only be accepted by ECU when it does not cause the overspeed or stall.**

# Control intervention under Manual Mode

In Manual mode, TCU will control the gears automatically avoid overspeed or stall under following situations:

1. Downshift intervention: higher gear when the driver began to slow down, the system will automatically help the driver to downshift.

2. Upshift intervention: System will automatically upshift  avoid overspeed.

**Attention:** that these two cases the system is still in manual mode, the following, the main reason is to help the driver to take control rather than driving engine for the purpose of protection, engine protection should be the engine control system (EMS) functions.

# Auto mode

Shift lever can switch to automatic mode at any time(If condition is met).Once automatic mode is activated ,the letter “AUTO” will be shown in cluster. At the same time the meter will display under the E button is in the state of economic model or the ordinary mode 。


In automatic mode, there are two sets of shift curve, it has considered economy and power to meet the different driving needs.

# Kick down

**When the driver stepped on the accelerator to fully open, TCU will downshift one or two gears to increase the torque.**

# Deceleration

TCU will automatically downshift during deceleration and the gears above 2nd gear.

For example, in 5th gear, clutch engaged and accelerator pedal released, when the engine speed reach idle speed, the system will automatically downshift from 5th to 4th , to avoid the engine speed drops below the target idle speed which led to stall.

When a downshift depends on the following parameters: stalls, engine idling, the brake pedal and engine deceleration rate.

Continuous deceleration until the vehicle stopped, TCU will be automatically shift to Neutral, and disengage the clutch.

**Auto clutch engagement**

**During the downhill and the vehicle speed increase, if the gear engaged during running and APP was released, when the reach a certain speed, the clutch will automatically engage to provide engine braking.**

# System security features

## System security features

When the vehicle stopped but the engine working and engage gear (such as 1st , 2nd and Reverse).

1. When the driver‘s door open, if the driver stepped on the brakes or APP, the system will remain the current gear.
2. If the driver's side door open and the driver has not stepped on the brake or accelerator more than three seconds, the system will automatically switch to Neutral gear dashboard displays the current operating mode and N.

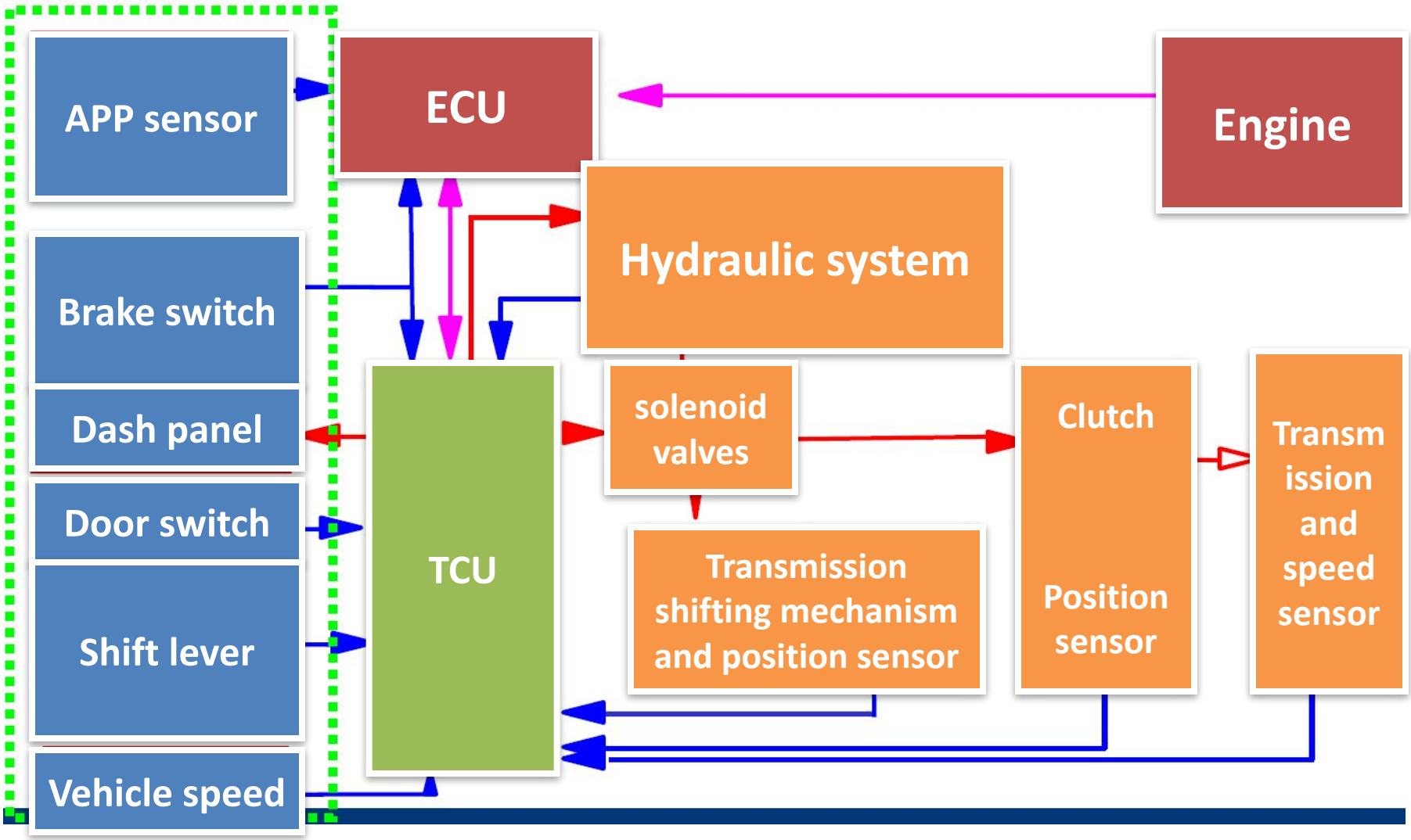
3. If the driver does not take any action (except depress the brake pedal) more than three minutes, the system will automatically switch to Neutral gear dashboard displays the current operating mode and N.

4. If the driver depresses the brake more than 10 minutes without any operation, the system will automatically select the Neutral. Dashboard displays the current operating mode and Neutral.

# Emergency start during brake switch is broken

If the TCU detected brake switch is broken, Ignition key remains in the starting position about 10 seconds before starting vehicle. After the start, TCU will inform the driver by warning lights.

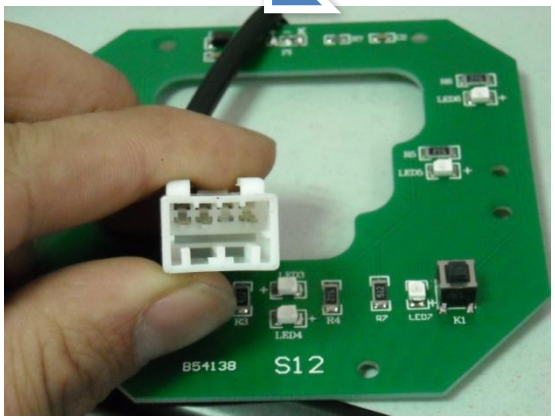
# System control theory



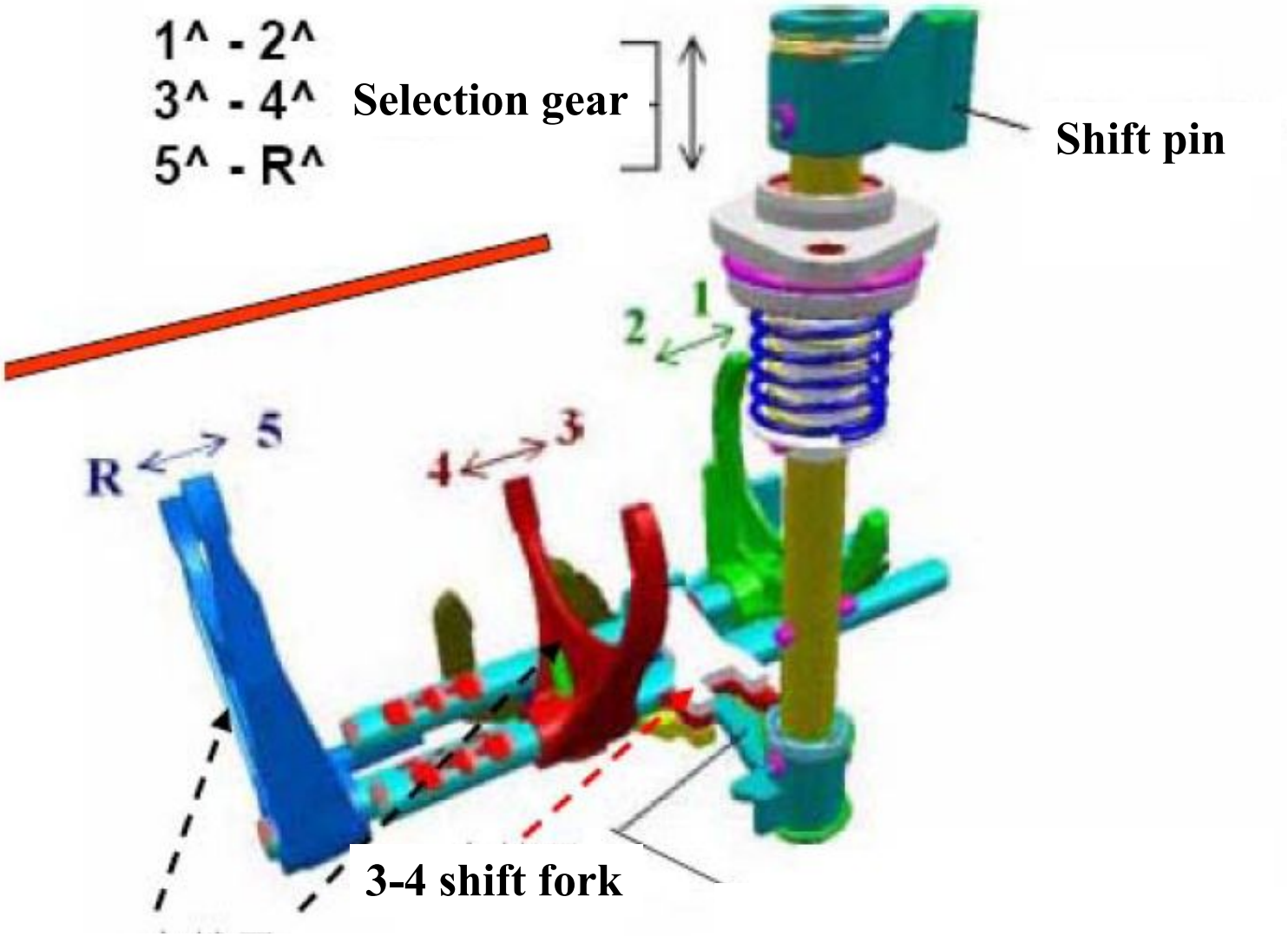
# Components

# Shift components

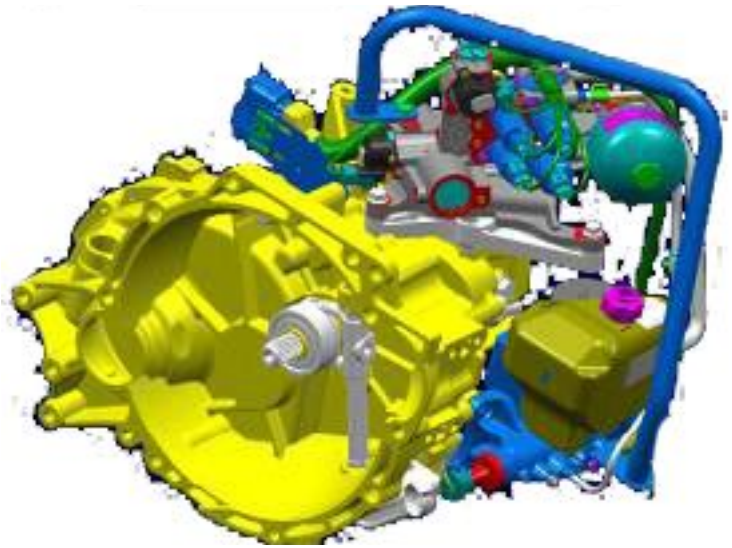


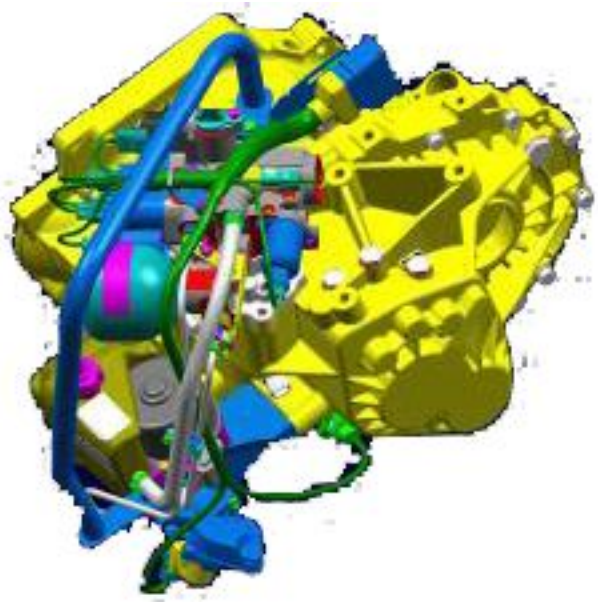



# Shift gears


1^ - 2^
3^ - 4^
5^ - R^
Selection gear
Shift pin
2
1
R
5
4
3
3-4 shift fork
5-R shift fork

# Hydraulic actuator



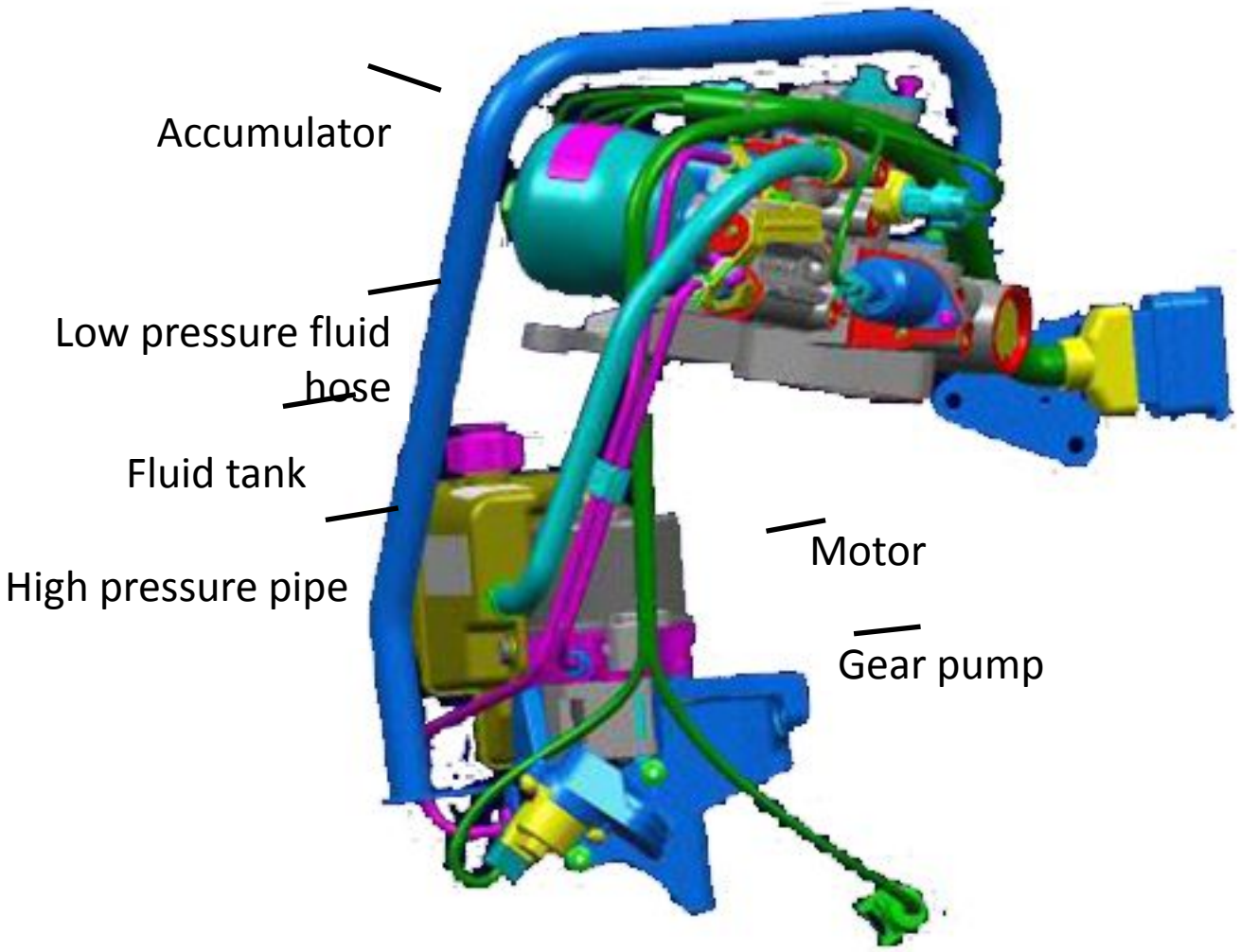


## SQR 513 transmission hydraulic actuator location

（Bracket of hydraulic actuator must be remove）

# Power Unit

**Hydraulic power unit provides power to hydraulic.**



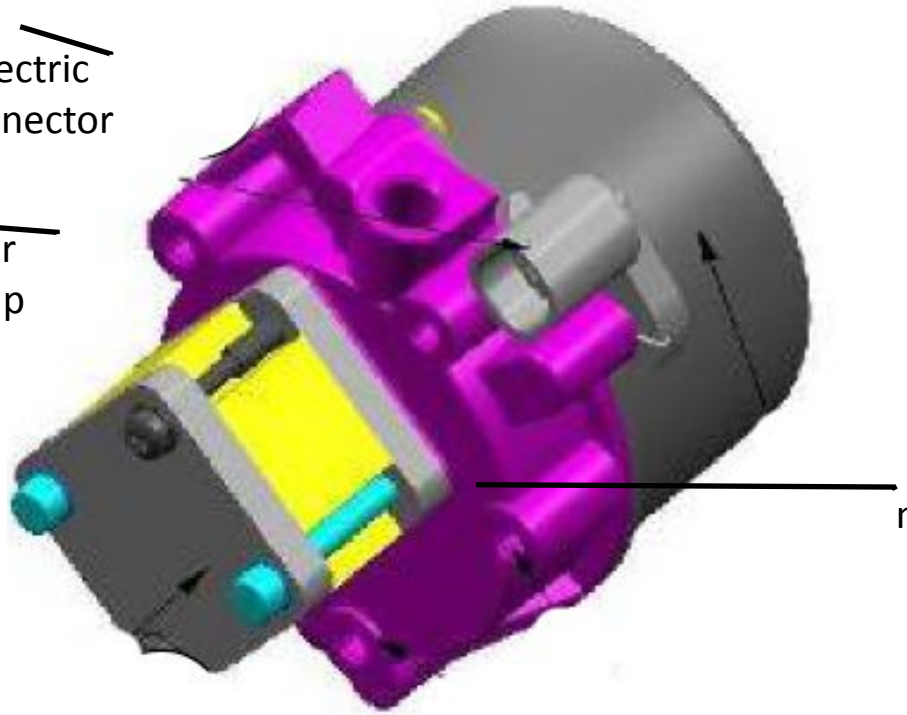
# Pump

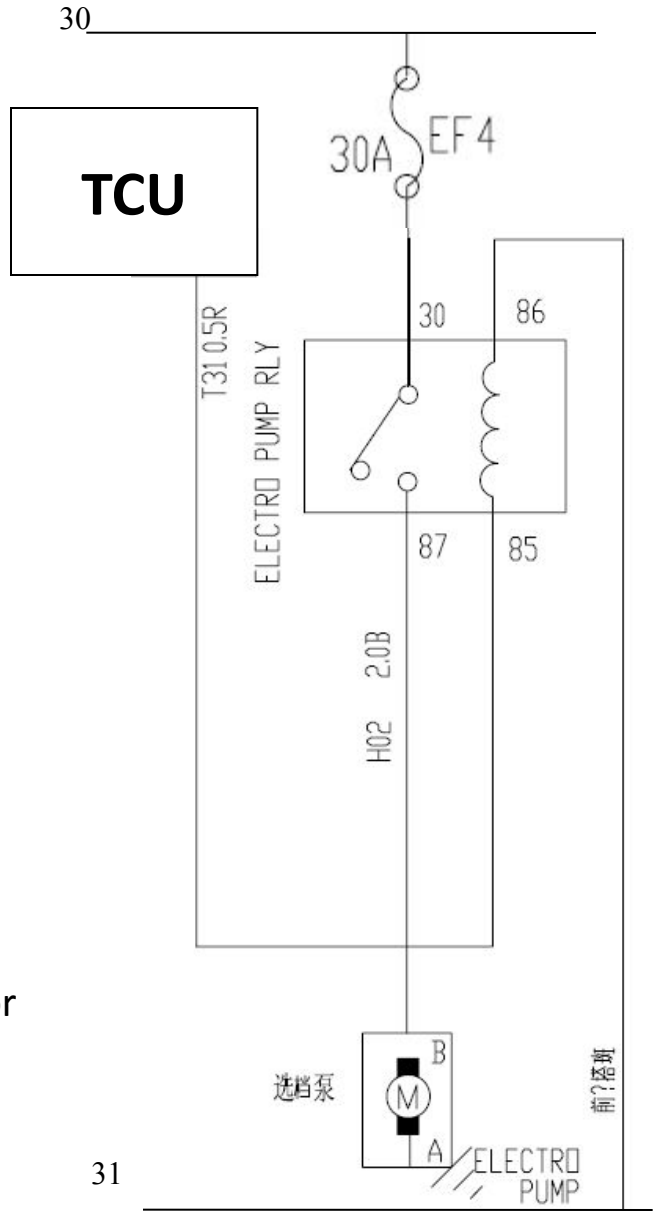
12V DC。

System pressure:

<36 bar run

>46 bar stop



# Tank

150 micrometer filter was fitted in exports of tank.

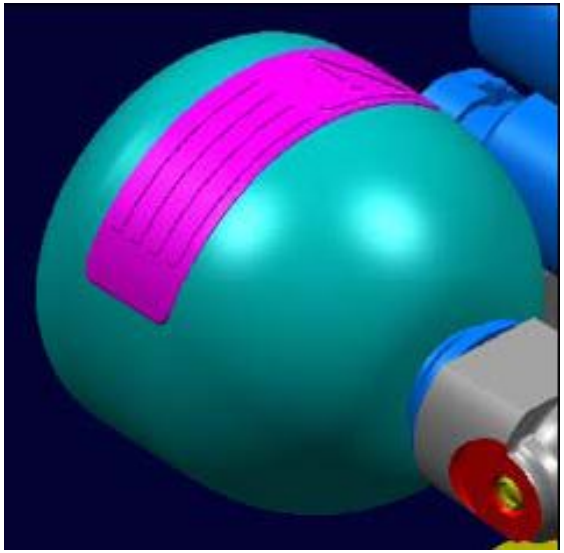
**Fluid level standard**

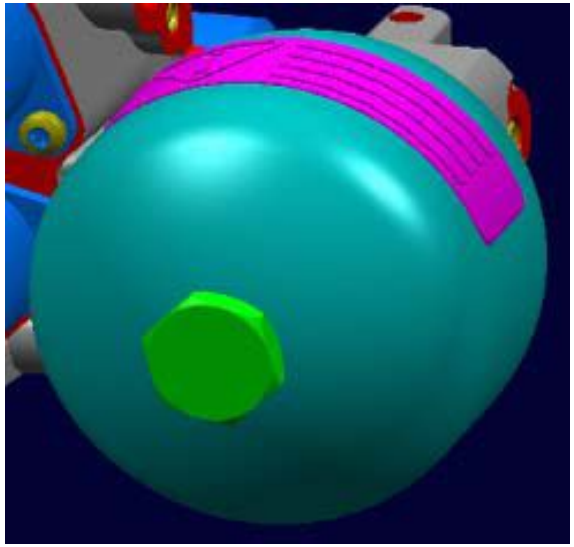
Relief system pressure using X431 and then observe the liquid level inside the tank.

**Pressure fluid manufacturer: -TUTELA CAR CS SPEED**

**PN:EW.0011602.A**

# Accumulator



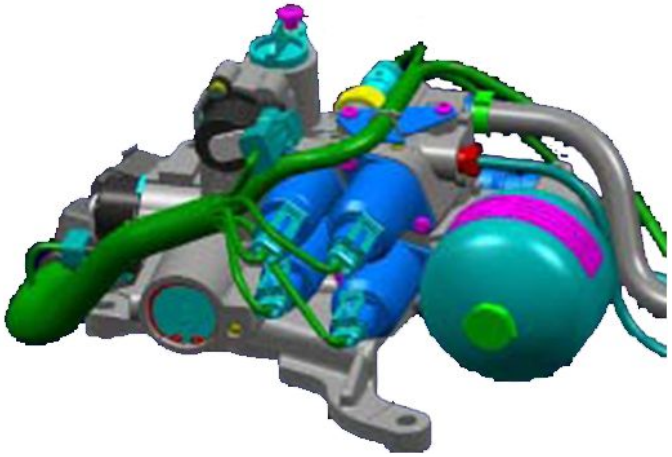


**Capacity:250 cm3**

# Valve body

Valve body has follow functions：

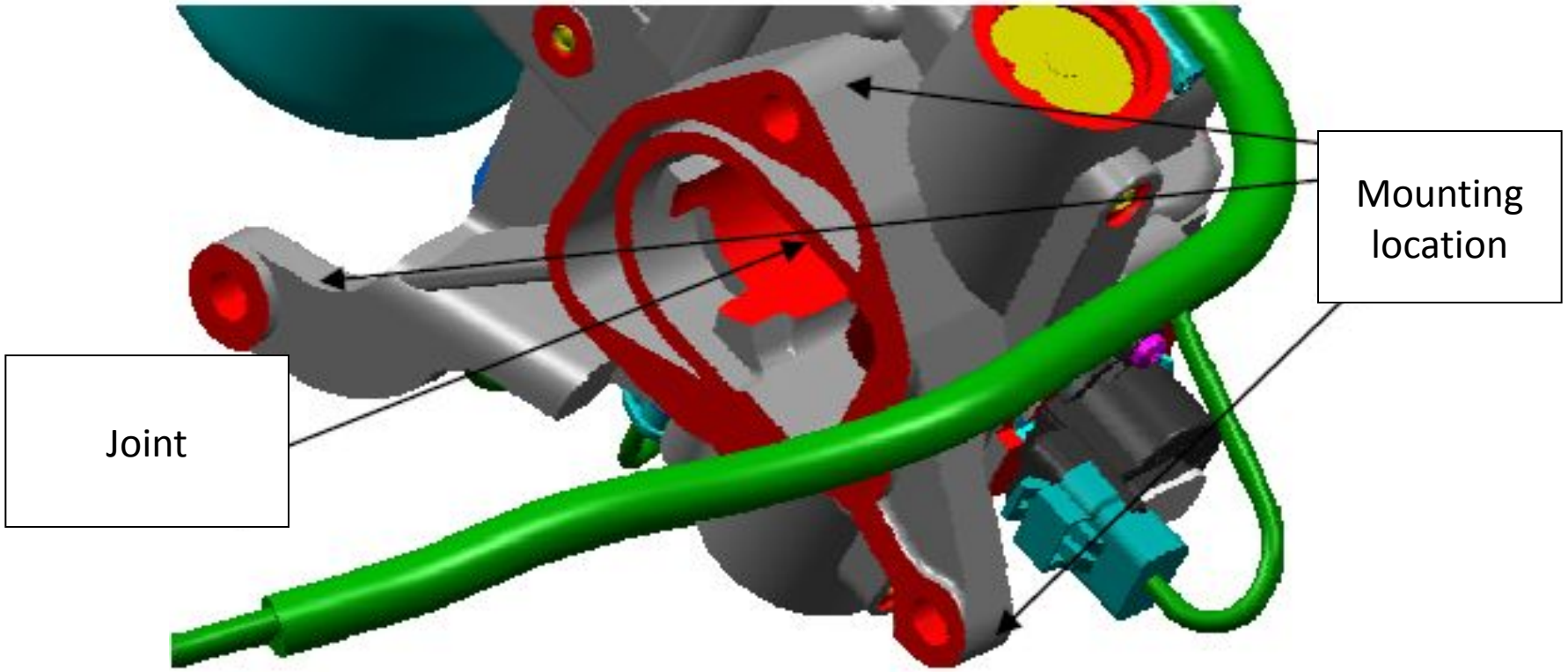
1. Control gear engage and detach。
2. Control gear selection
3. Control clutch engage and detach



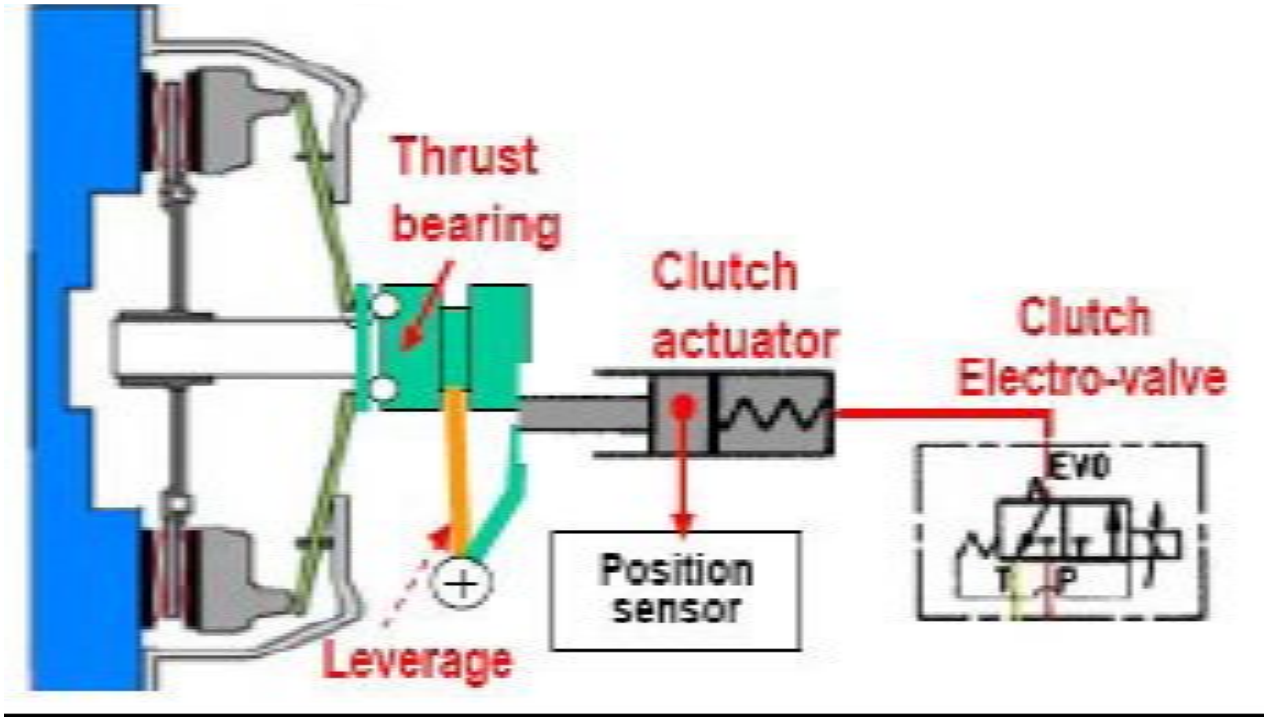
Components:

1. Clutch solenoid valve(EV0)
2. Even gear engage valve(EV2)
3. Odd gear engage valve(EV1)
4. 1-2 selection gears solenoid valve(EV3)
5. 5-R selection gears solenoid valve(EV4)
6. Gear engage position sensor
7. Gear selection position sensor
8. Press sensor（0-70 bar）
9. Valve body

# Valve body

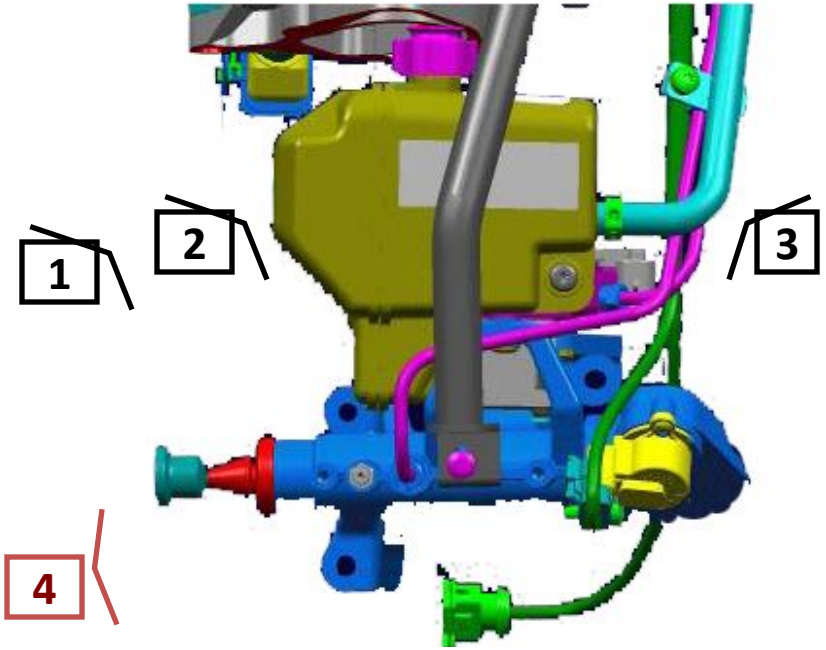


# Clutch actuator

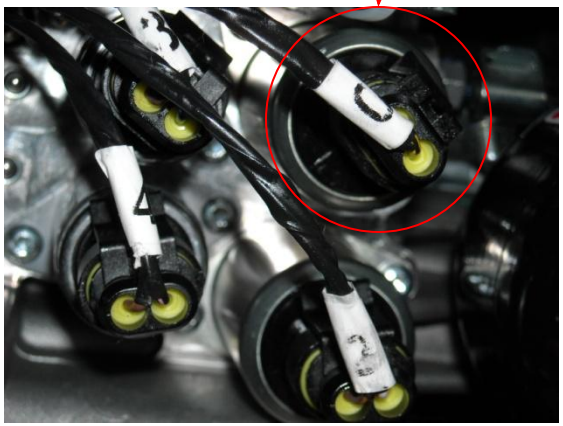


# Clutch actuator assembly

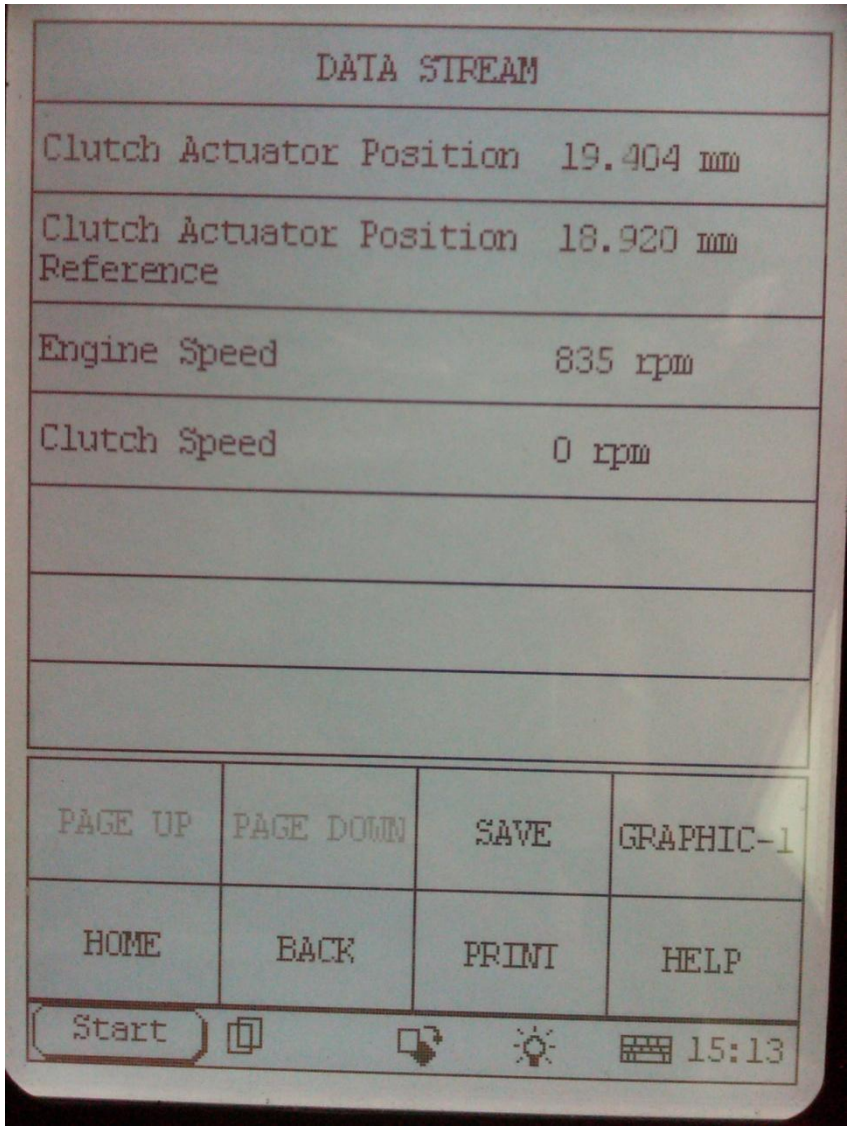
1. Release cable
2. Clutch actuator body
3. Clutch cable position sensor
4. **System air bleed bolt**




Clutch
solenoid valve
(EV0)



# Data stream in X431 concerning clutch

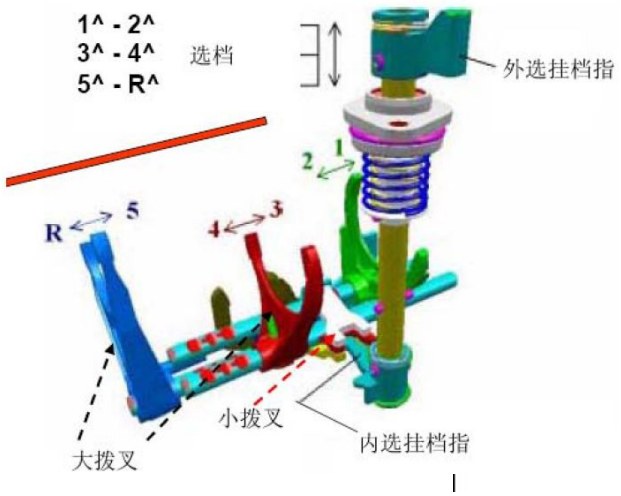


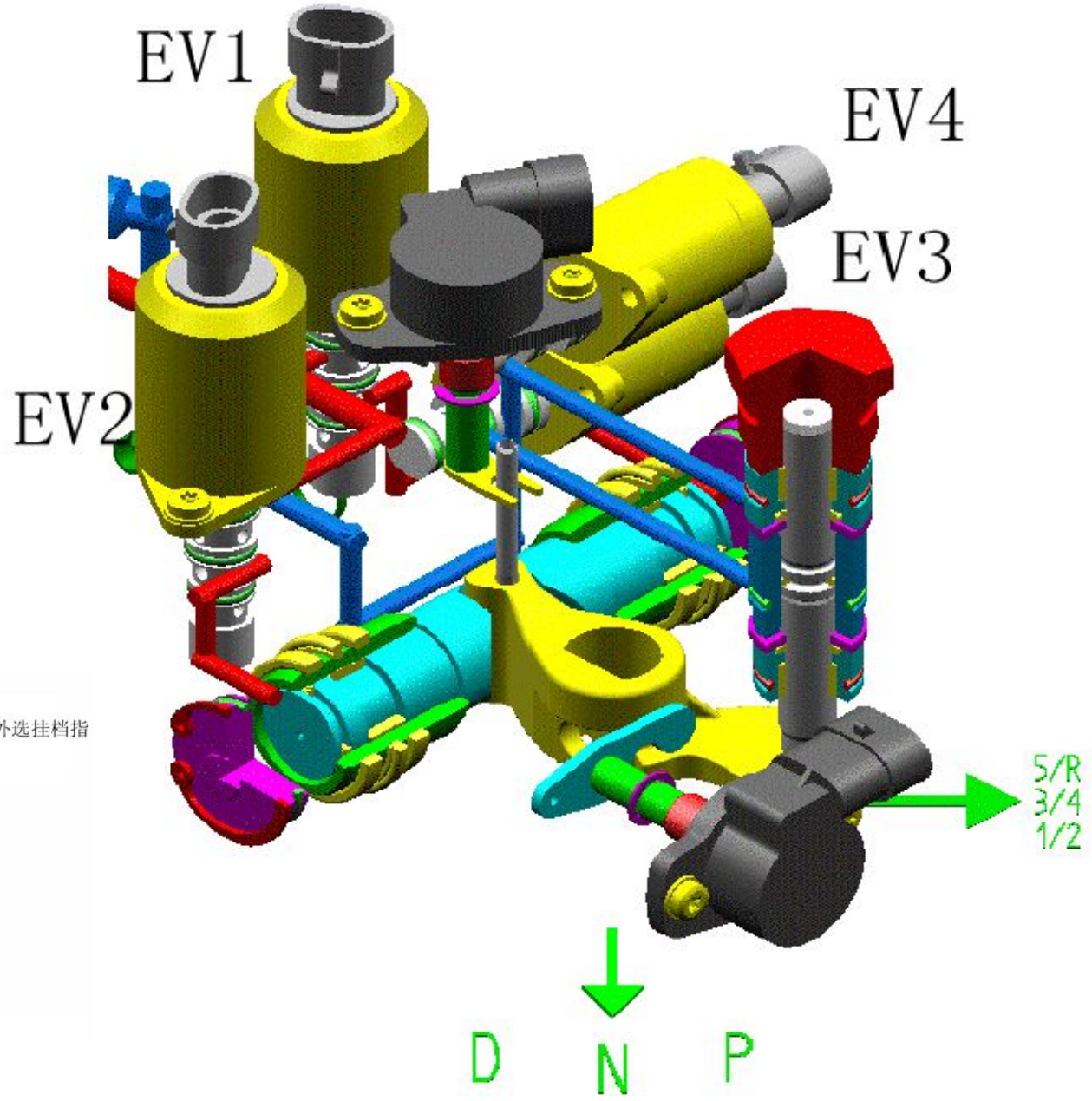
# Clutch cable position sensor

**Function: feedback the clutch cable position signal to TCU**

| DATA stream | IG ON, Engine off, 1st gear | IG ON, Engine off, Neutral gear | Engine running Neutral gear |
|---|---|---|---|
| Clutch actuator position | 26.356mm | 26.312 | 18.084mm |
| Clutch actuator position Reference | 26.356mm | 26.268 | 18.084mm |

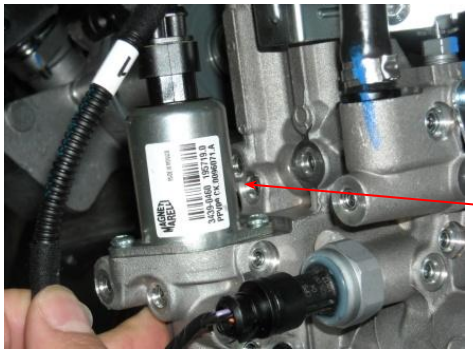
# Gear engage and selection solenoid valves



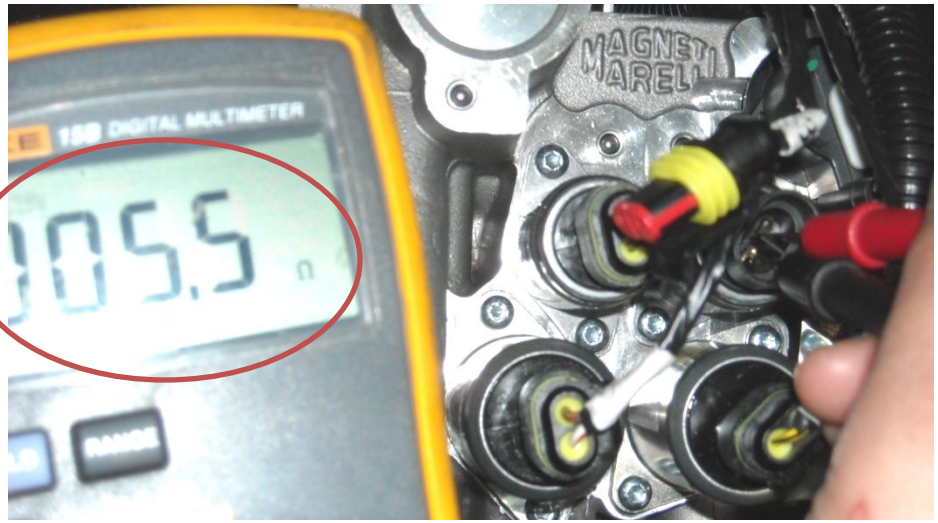
# Gear engage solenoid valves


Even gear engage valve(EV2)

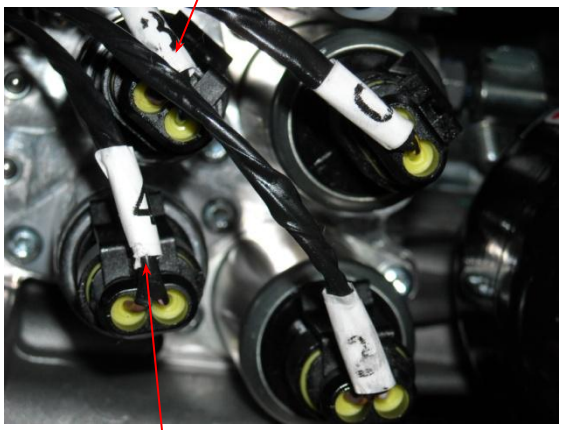


Odd gear engage valve(EV1 )

# Gear selection valves




1-2 gears selection solenoid valve(EV3)

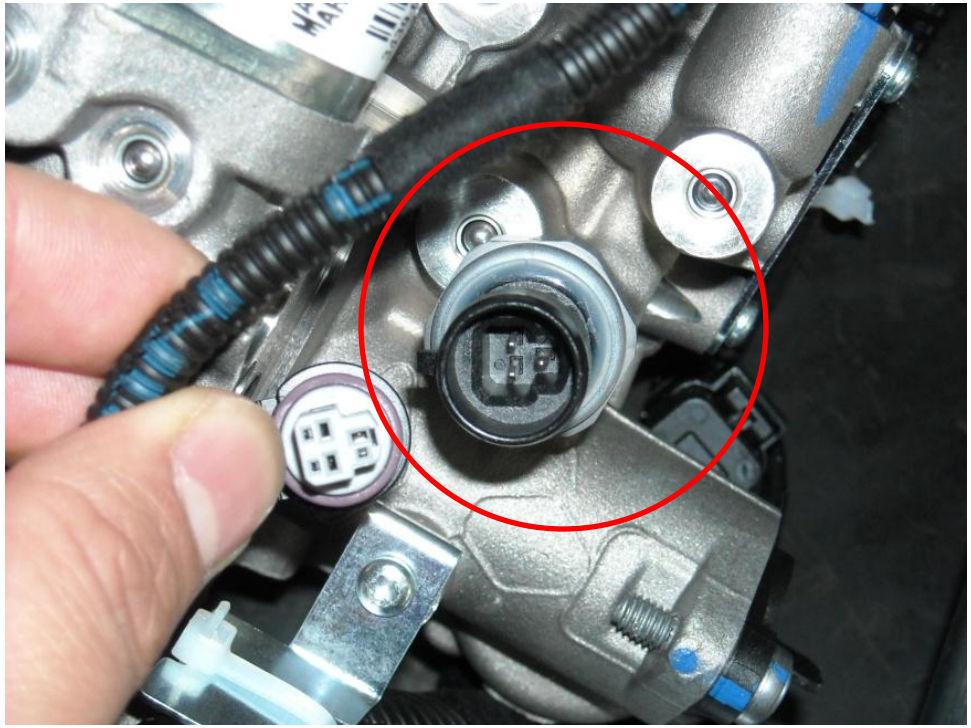



5-R gears selection solenoid valve(EV4)

# Summary of solenoid valves

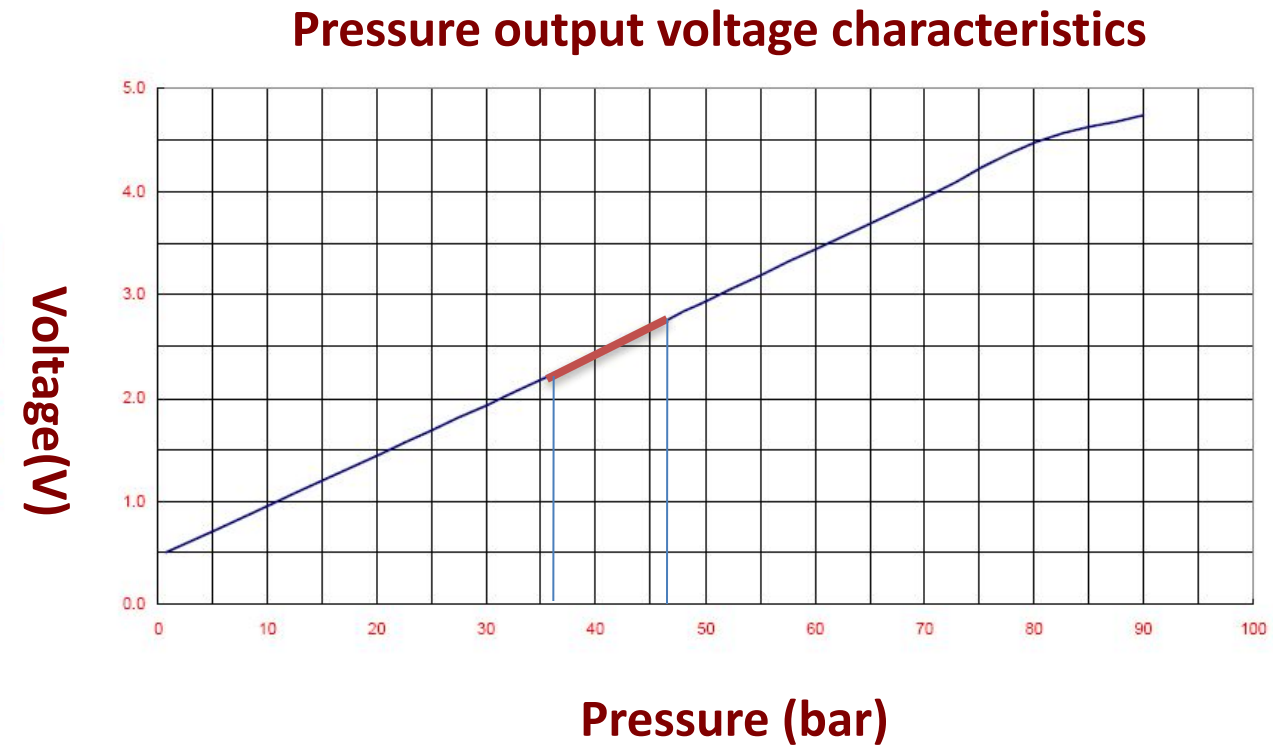
| No. | Generation No. | Name | Fault code | Standard R（Ω） |
|---|---|---|---|---|
| 1 | EV0 | Clutch solenoid valve | P0900 | 2.7 |
| 2 | EV1 | Odd gear engage valve | P0750 | 2.7 |
| 3 | EV2 | Even gear engage valve | P0755 | 2.7 |
| 4 | EV3 | 1-2 gears selection solenoid valve | P209D | 5.5 |
| 5 | EV4 | 5-R gears selection solenoid valve | P209E | 5.5 |

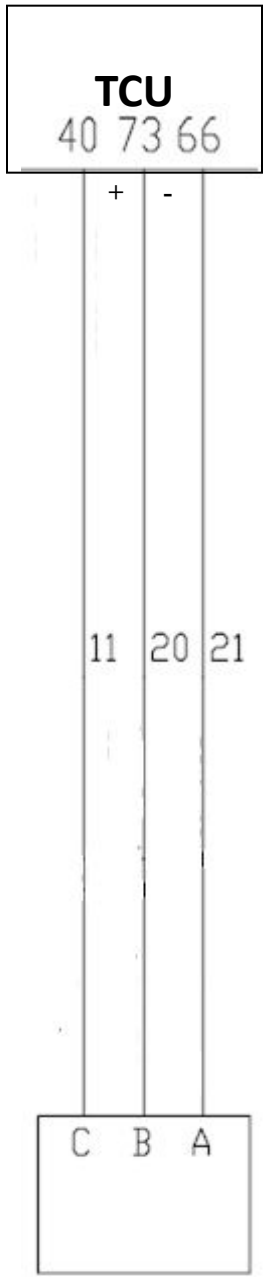
# Pressure sensor



**Function :Monitor system pressure**

# Pressure sensor




What is special meaning that the range from 36-46 bar?

# Maintenance specification

**——AMT system self-learn**

**Replace or assemble parts must perform the following functions in whole or in part:**

| NO. | |
|---|---|
| service1 | System air-bleed |
| service2 | Relief system pressure |
| service3 | Clutch kiss point self-learn |
| service4 | Gear self- learn |
| service6 | New actuator |
| × | Shift lever self-learn |
| service5 | Clear the data in the TCU |
| × | Write data |

**After replace the following parts: clutch actuator, tank, pump, high pressure pipe, pressure sensors, accumulators and other major parts, Bleed the system 3, and then take gear self-learn one time, 3 to 5 times the clutch self-learning. Finally check the oil level according to the method.**

# Service should be taken after parts replacement

| Items | Name of parts | Service 1 | Service 2 | Service 3 | Service 4 | Service 5 | Service 6 |
|---|---|---|---|---|---|---|---|
| 1 | Electro-hydraulic (AMT)ASSY | after replacement | before replacement | after replacement | after replacement | after replacement | after replacement |
| 2 | hose | after replacement | before replacement | | | | |
| 3 | Pressure sensor | after replacement | before replacement | after replacement | after replacement | | |
| 4 | accumulator | after replacement | before replacement | after replacement | after replacement | after replacement | |
| 5 | Wire harness | | | after replacement | after replacement | after replacement | |
| 6 | Clutch position sensor | | | after replacement | | | |
| 7 | Gear selection sensor | | | after replacement | after replacement | | |
| 8 | tank | after replacement | before replacement | after replacement | after replacement | | |
| 9 | Clutch actuator | after replacement | before replacement | after replacement | after replacement | after replacement | |
| 10 | motor | after replacement | before replacement | after replacement | after replacement | after replacement | |
| 12 | High pressure pipe | after replacement | before replacement | after replacement | after replacement | | |
| 13 | TCU | | | after replacement | after replacement | | |
| 14 | Clutch | | | after replacement | | after replacement | |
| 15 | transmission | | | after replacement | after replacement | after replacement | |
| 16 | Pump relay | | | | | after replacement | |
| 17 | Shift lever | | | | | after replacement | |

# Maintenance specification

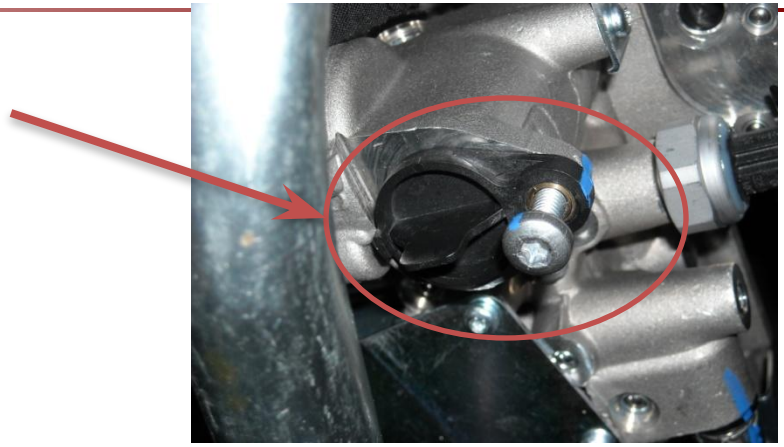
## ——Guide of dismount and assemble

# Pressure Fluid

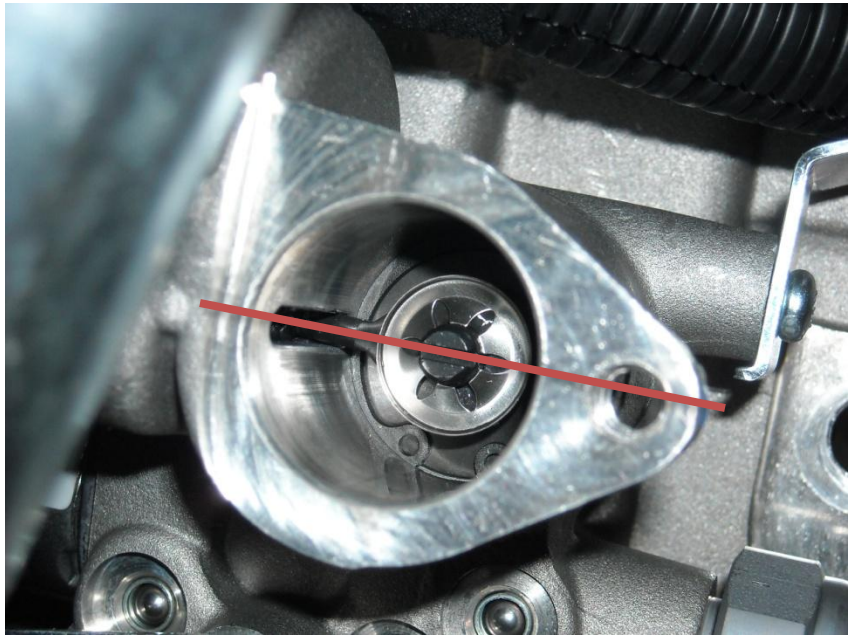
**Abnormal pressure fluid add into system will cause a serious situation and miss the warranty!**


# Dismount select shaft

1. Before removing the AMT ASSM, selection shaft must be released. Remove the cover

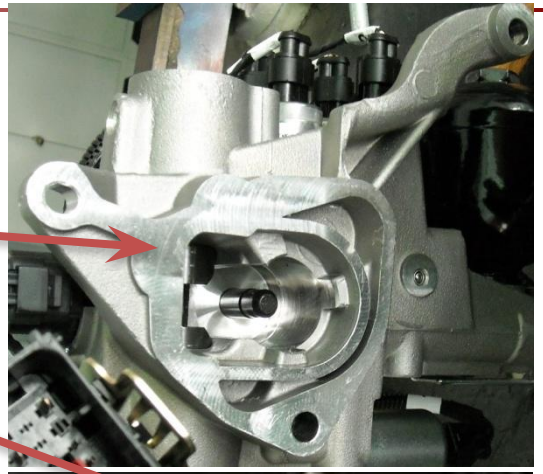


2. Rotate the selection shaft 90° with flat screwdriver .(both directions can be rotated)

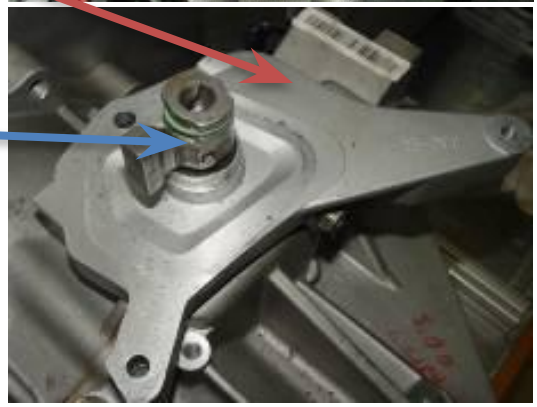


# Mount guide

1. First of all, after cleaning and coating sealant, should ensure a good seal interfaces

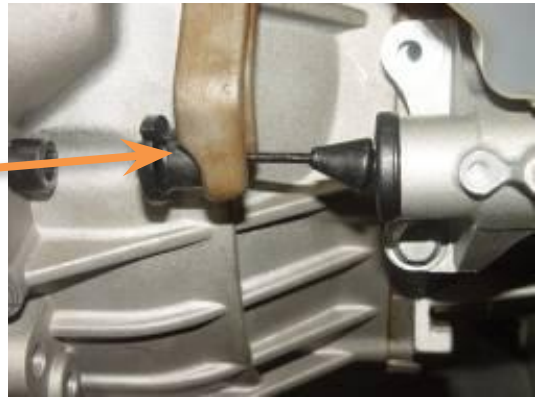


2. Adjust the transmission gear selector position to Neutral



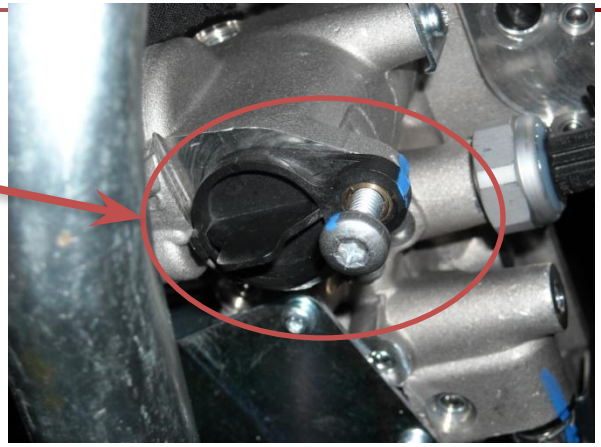
2. Fasten the bolts

3. Assemble the release cable

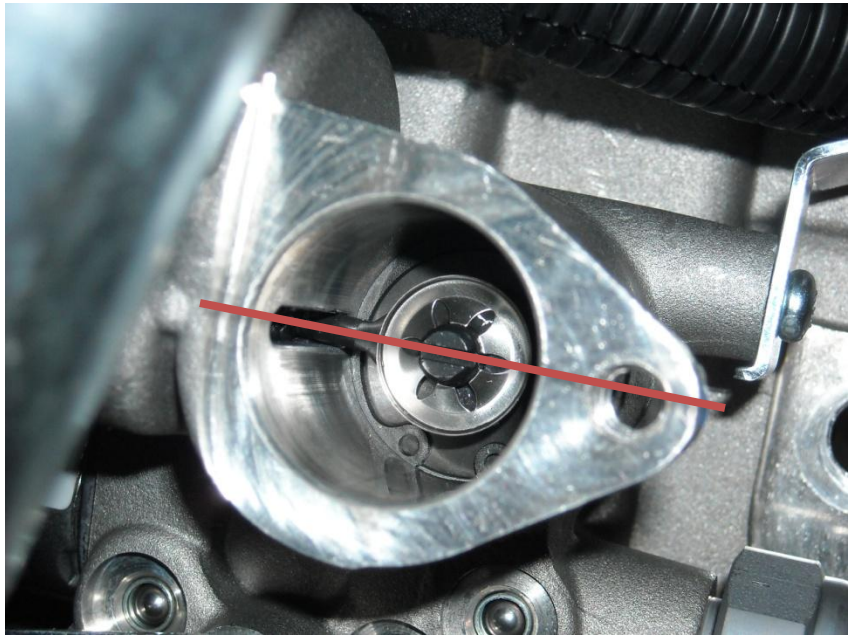


# Assemble select shaft

1. Remove cover



2. Select shaft must be adjusted to the self-locking pole position, then press it down, such as the right picture. Hear the "click," engagement is finish.



3. Assemble the cover

# Fault code

| NO. | DTC 代码 | Description |
|---|---|---|
| 1 | P0880 | TCU +5V  supply |
| 2 | P0932 | pressure sensor |
| 3 | P0823 | shift lever signal |
| 4 | P0561 | battery voltage too low（<3V） |
| 5 | P0914 & P290A | gear selection position sensor |
| 6 | P0822 | shift lever signal 1 |
| 7 | P0805 | clutch position sensor |
| 8 | P0821 | Shift lever signal 2 |
| 9 | P0820 | Shift lever signal 0 |
| 10 | P0904 | gear selection position sensor |
| 11 | P0710 | Engine temperature |
| 12 | P2906 | CAN  engine torque |
| 13 | P2903 | CAN  APP sensor |
| 14 | P0719 | brake switch |
| 15 | P0703 | CAN brake switch signal |
| 16 | P0725 | Engine speed |
| 17 | P0715 | Clutch friction disc speed |
| 18 | P0720 | Vehicle speed |
| 19 | P2901 | Accumulator self relief |
| 20 | P2909 | shift failed |
| 21 | P2905 | Transmission error |

# Fault code

| | | |
|---|---|---|
| 22 | P2904 | clutch error |
| 23 | P2908 | clutch control error |
| 24 | P2900 | ECO button |
| 25 | P0825 | shift lever stuck |
| 26 | P0933 | Pump relay error |
| 27 | P0755 | even gears shift solenoid valve |
| 28 | P0750 | Odd gears  shift solenoid valve |
| 29 | P0900 | Clutch solenoid valve |
| 30 | P290E | 5—R gears selection solenoid valve |
| 31 | P290D | 1—2 gears selection solenoid valve |
| 32 | P0701 | solenoid valve interior fault |
| 33 | P0881 | TCU 12V power supply |
| 34 | P081A | starter relay |
| 35 | P0945 | pump relay（open or ground） |
| 36 | P0560 | battery voltage too low |
| 37 | P0780 | Illogical operation |
| 38 | P2712 | pressure system relief and leakage |
| 39 | P0942 | system pressure too or pump overheat |
| 40 | P0613 | SMP (vice-processor）error |
| 41 | P060C | MMP（main processor ）error |
| 42 | U1701 | CAN bus fault |
| 43 | U1601 | CAN fault |
| 44 | P0604 | microprocessor error |

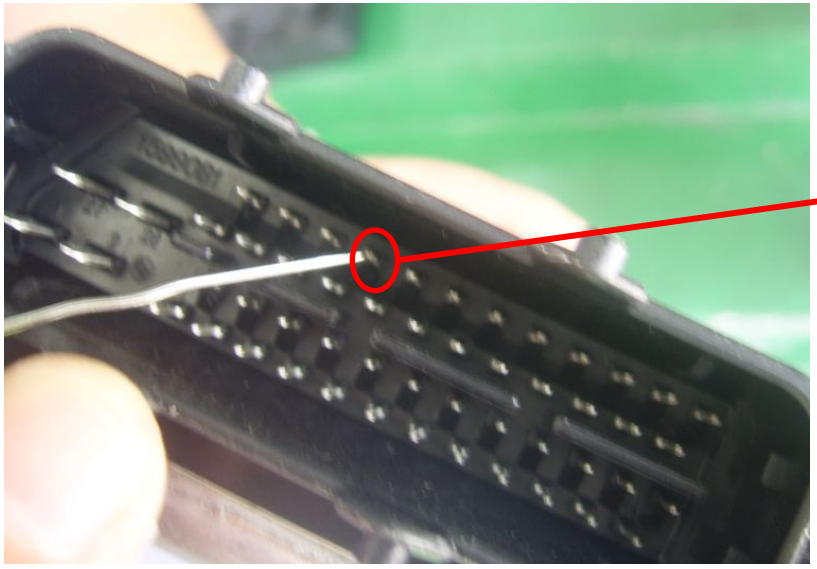
# Trouble-shooting and solutions

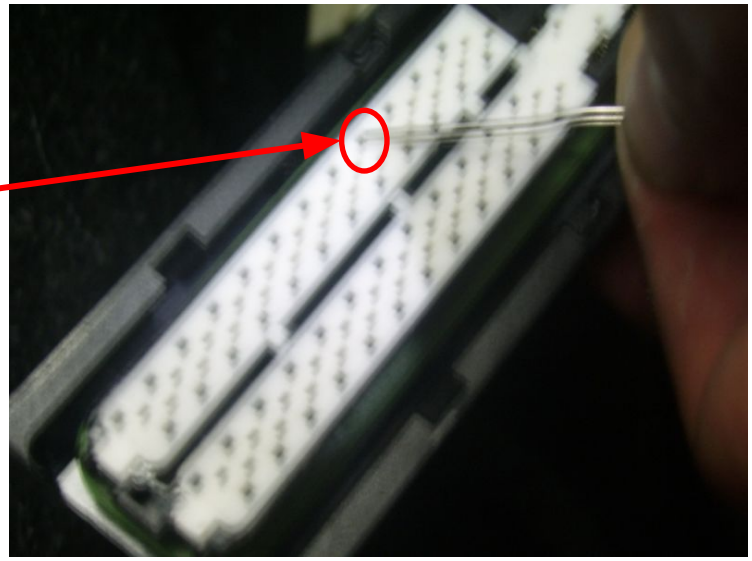
**Problem I: The vehicle shivers noticeably upon releasing the accelerator pedal at the first, second or third gear or slightly depressing the brake pedal, with low comfort level.**

**Failure code: P0500 (Vehicle speed sensor failure)**

**Testing and solution: Start the engine, and use the dianalyzer software to collect the data at real time. The vehicle speed signal is detected in TCU, but none in ECU. It is judged that the harness from the sensor to the ECU fails.**

**By testing with a multi-meter, it is found that TCU Pin 36 and ECU Pin 44 are in closed circuits. So ECU is in poor contact with its interface. Slightly bend the ECU Pin 44, and after connection, start the engine. The problem is thereby solved.**





**Problem II: The transmission failure lamp is lit during movement, and the failure code P0715 (friction disc revolution sensor open circuit) is indicated, with the gearshift disabled.**
**Testing and solution: Revolution signal failure; TCU issues the gear locking command. Remove the revolution sensor, and add a 0.2mm shim. Thereafter, upgrade TCU data to its latest version（CAA05QN0）, and carry out the gear self-learn and clutch engagement point self-learn.**

**Add a 0.2mm shim here.**

**Problem III: Friction disc revolution sensor failure; the gear is locked at the first/second gear, allowing no shift to higher gears. After the failure code is eliminated and the self-learn conducted, this problem appears again later.**

**Causes:**

**1.Disproportionate speed ratio: Under certain operating conditions (for example, from first gear to the reverse gear, or from the reverse gear to the neutral gear), the radial run-out may occur on the shaft on which the signal wheel is mounted in the transmission, leading to the abnormality of signals collected by the clutch speed sensor. This case may bring an incorrect proportion among the engine revolution, clutch revolution and vehicle speed, consequently resulting in the wrong report by TCU and the activation of the safe operation mode.**

**2. No signals from the clutch revolution sensor: Under certain operating conditions (for example, from first gear to the reverse gear, or from the reverse gear to the neutral gear), the severe radial run-out may occur on the shaft on which the signal wheel is mounted in the transmission, leading to the mutual interference between the signal wheel and the senor and also the damages of the senor, which further causes no signal output, to consequently result in the wrong report by TCU and the activation of the safe operation mode.**

**3. Serious skidding of the clutch: Owing to the serious wear of the clutch, there is a significant deviation in the proportion among the engine revolution, clutch revolution and vehicle speed under certain working conditions.**

4. Clutch position sensor failure (in this case, P1810 and P0715 will be indicated at the same time): Some vehicles are not made accessible to such a technical upgrade that a waterproof pad is provided for the clutch position sensor, which leads to the water ingress into the sensor, consequently resulting in this problem.
5. transmission internal failure, for example, the disabled gear locking function (in this case, P1818 or P0720 will be indicated at the same time): The speed ratio does not conform to the actual gear.
6. Other electric failures (may be accompanied by the failure code 1810): The harness is damaged or improperly earthed.

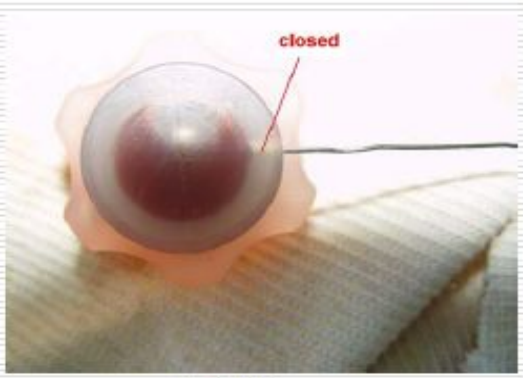
Solutions:

1. Renew TCU, and calibrate it to CAA04OH0 version: This problem corresponds to Problem I (the disproportionate speed ratio), and the solution is to largely increase the judgment threshold value.
2. Repair of transmission: If there is interference between the transmission signal wheel and the senor, and the sensor is damaged, the recovery by software is impossible, but the only way is to repair the transmission.
3. Water ingress in the clutch position sensor: Replace this sensor and provide waterproof pad (this pad will be supplied together with the sensor).
4. Clutch skidding: Replace the clutch, and use a diagnoser to initiate the TCU.

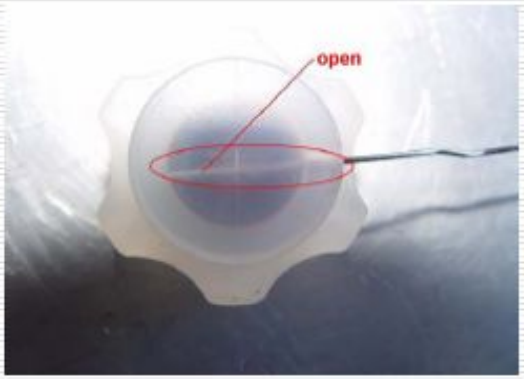
**Problem IV: Oil leakage in the oil pot**

**Causes: 1. The vent on the pot cover is blocked: during the service, in the oil pot, the negative pressure will be produced at low temperature while positive pressure at high temperature, leading to the expansion and breakage of the pot.**

**2. The sealing ring on the pot cover is not removed after it is fitted: leading to the blocking of the vent. This problem is frequently reported in the after-sales service.**




Cover blocked




Cover not blocked


Sealing ring not removed

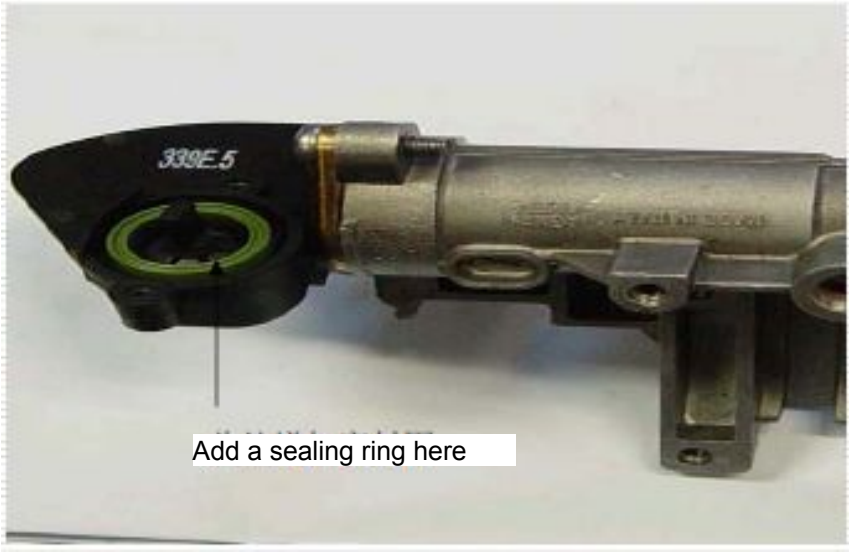
**Solutions:**

1. **Replacement of the oil pot cover**
2. **The sealing ring on the pot must be removed: This ring is used to prevent the oil leakage in the speed selector during transportation, and must be removed after the pot is fitted onto the vehicle; otherwise, the pressure in the pot may become abnormal, which will consequently influence the oil return, or increase air bubbles in the hydraulic oil to adversely affect the system pressure.**

**Problem V: There is trip stop or failure of gear engagement in the vehicle, and the failure code P1810 or P1743 is indicated.**

**Causes:**

**At the initial design of AMT, neither Chery nor Marelli has taken waterproof requirements into account. In actual application, the speed selector is mounted at a low position, which usually brings the sensor to be in contact with water spattered from the road. The entry of water into the sensor may cause abnormal signal output.**




**Solution: Marelli has conducted engineering modification, namely, providing a sealing ring in the clutch position sensor to improve its waterproof performance.**

**Problem VI: One of direct gears is always missing in the operation, for example, the transmission directly moves from the second gear to the fourth gear, with the third gear skipped, but can directly move from the fourth gear to the third gear. Sometimes, a failure code P1810 will be indicated; when the vehicle is stopped, all gears will work correctly.**

**Causes:**

1. **The synchronizer of the transmission is excessively worn, and can't work. If serious , the sound of collision of teeth may be heard. This case mostly occurs in vehicles produced prior to 2007.**
2. **The transmission synchronizer is separated.**
3. **One of direct gears is always missing during the operation.**

**Solution:**

1. **In the first case, relevant parts must be replaced.**
2. **In the second case, only the reassembly of the transmission is required.**

**Problem VII**

1. **No depression of the accelerator pedal is required in the engagement of the first gear when the vehicle moves.**
2. **The vehicle shivers seriously at the beginning of movement, but restores its normal operation after the move-up.**

**Causes:**

1. **The clutch engagement point self-learn is not conducted, or the system is not disconnected from the power supply after the self-learn is finished. (Note: The data can be only successfully written into TCU 10s after the ignition switch is turned off after the each self-learn is finished.)**
2. **The clutch is not replaced until it skids due to the excessive wear. After the replacement, TCU is not initialized via a diagnoser.**
3. **The clutch friction plate is uneven, including new parts. (This case may occur at self-learn of the engagement point. The return values after each learn are different, which can be used for judgment.)**
4. **There is water ingress in the clutch position sensor.**
5. **The clutch and TCU calibrations are misused.**

**Solutions:**

1. **Relevant personnel in the service station shall learn how to use the diagnoser. Each time after any part is replaced, the self-learn (clutch engagement point self-learn, gear self-learn) shall be conducted. The power supply shall be disconnected for 10s after the self-learn.**
2. **Replace the Valeo clutch and upgrade the TCU calibration to CAA05QM5: CAA04QHO is used together with Changchun Yidong clutch, while CAA05QM5 is used together with Valeo clutch. No confusion is allowed; otherwise, the vehicle may move up automatically, or does not move after refueling, or gears can’t be shifted smoothly.**

**Problem VIII:**

**After the transmission is shifted to the first gear and the vehicle is stopped, the neutral gear is engaged automatically and immediately.**

**Possible causes:**

**1. The cab door lamp switch is disabled. (Move the roof lamp switch to its middle position, and if the lamp is lit suddenly, this fault can be identified.)**

**Solutions:**

**1. Replace the door switch.**

# Thank you very much!

# Pratice

- Check resistence of each solenoid valve。

| | Function | Resistence |
|---|---|---|
| EV0 | | |
| EV1 | | |
| EV2 | | |
| EV3 | | |
| EV4 | | |

- Remove gear selection/gear engage sensor/ clutch sensor and how it works

- Perform how to check the oil level.

- Gear and clutch self-learn

- **Function the location of following parts**

| | location | |
|---|---|---|
| Pressure Pump relay | | |
| TCU | | |
| ECU | | |

- **Disconnect the following part,find how the vehicle works and use X431 to detect the falut code**

| | Vehicle can run?/fault light on? | Fault code |
|---|---|---|
| Pressure Pump relay | | |
| Engine speed sensor | | |
| Clutch speed sensor | | |
| Vehicle speed sensor | | |