

# Toyota

## Service training

## EPS simulation

## Hi-Tech Training Instructions

## Background



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### 1. FOREWORD

Many newly released vehicle models are equipped with an Electric Power Steering system (EPS). Technicians must have now a thorough understanding of the features, construction and operation of these systems to be able to service, check and troubleshoot accurately. This training manual has been designed, in combination with the EPS simulator **STME-001**, to study the Electric Power Steering system thoroughly. The following materials are also available for studying the EPS system.

- |  |                  |
|--|------------------|
| -Repair Manual Furls / Echo sup.                                     | Pub. N° RM 737E  |
| -Repair Manual supplement Yaris / Echo                               | Pub. N° RM 1014E |
| -Electrical Wiring Diagram, Yaris / Echo sup.                        | Pub. N° EWD 528E |
| -New Car Features Yaris 2001 Education & Training Centre publication |                  |

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### 2. OUTLINE OF EPS SYSTEM

#### General

EMPS is adopted and the intermediate shaft is integrated in the steering column. The use of an electric power steering system offers great fuel economy and a lightweight design. The amount of power steering assistance is controlled according the signals from the torque sensor and vehicle speed. The controller activates the P/S warning light in the combination meter in case of system malfunction. Component lay-out:

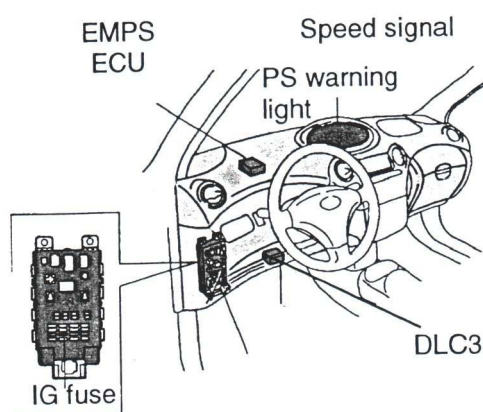


Fig. 2

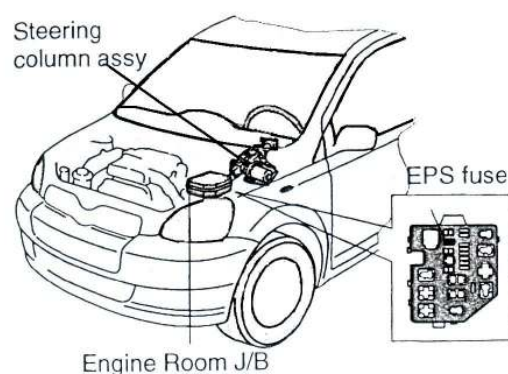


Fig. 3

### 3. FUNCTION OF MAIN COMPONENTS

-Steering column assembly:

-Torque sensor: Detects the twist of the torsion bar. Based on the torque applied to the bar it creates an electric signal and outputs this signal to the EMPS ECU.

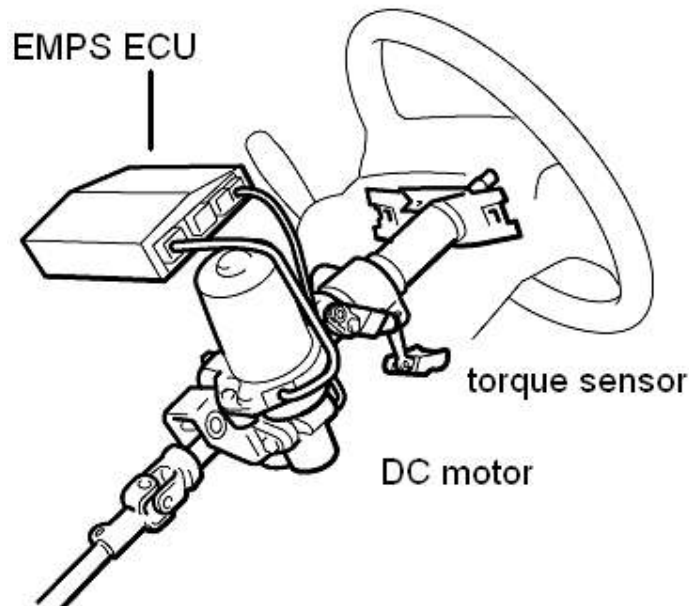


Fig. 4

-DC motor:

Generates power assist in accordance with the signal received from the EMPS ECU.

-EMPS ECU:

Activates the DC motor on the steering column based on the signals received from various sensors, vehicle speed and engine speed signal.

-Engine ECU:

Engine revolution signal outputted to EMPS ECU. No EMPS operation when the engine is not running.

-Combination meter:

-Warning light: In case of malfunction, the driver is alerted by the activation of this light. The indicator light can also be used to read out EMPS related diagnostic trouble codes.

-Vehicle speed from the speed sensor in the combination meter is sent to the EMPS ECU.

-EMPS relay and fuse:

The relay supplies power to the DC motor and EMPS ECU.

**4. CONSTRUCTION**

Steering column assy:

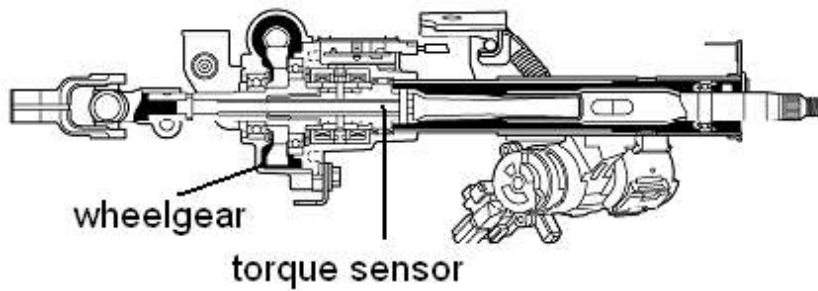


Fig. 5

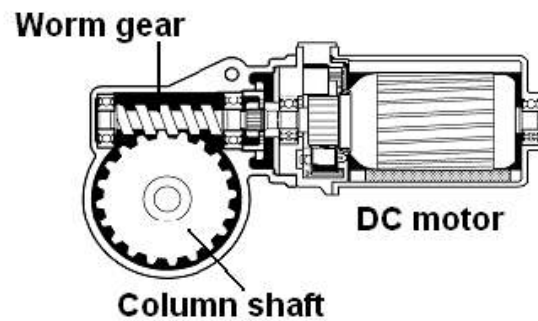


Fig.6

Mounted on the steering column shaft is a plastic wheel gear. On the DC motor shaft, a metal worm gear is connected that engages in the wheel gear. The worm shape is designed in such a way that both gears can drive and can be driven!



Fig. 7

The steering torque sensor consists of a correction coil, three detection rings and a detection coil. The measuring principle is based on the difference in core size created by the torsion of a torsion bar.

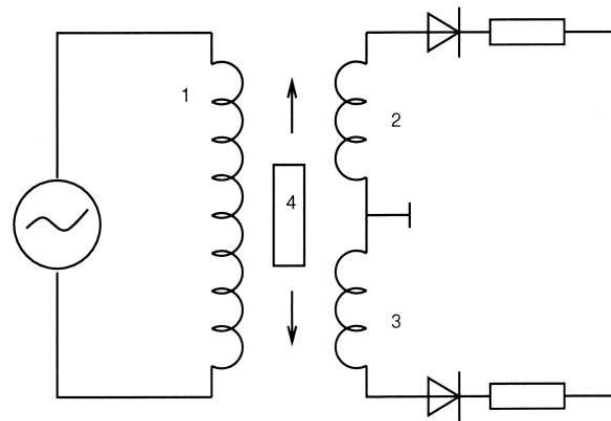


Fig. 8

- 1. Generation coil
- 2. Detection coil
- 3. Detection coil
- 4. Variable core

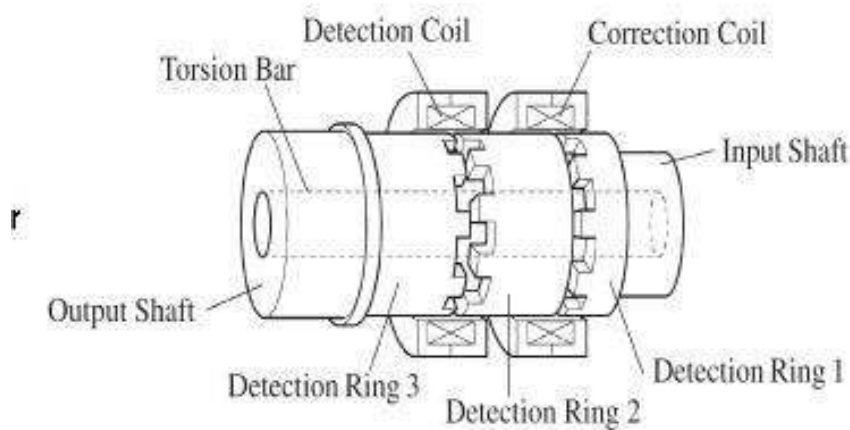


Fig. 9

The generation coil receives an AC current and generates a magnetic field that goes to the transformer. Depending on the position of the variable core a greater or smaller magnetic field is guided through the detection coil. This generates an induction voltage in the coil parts. By moving the core, the induced voltage will change in both coil parts.

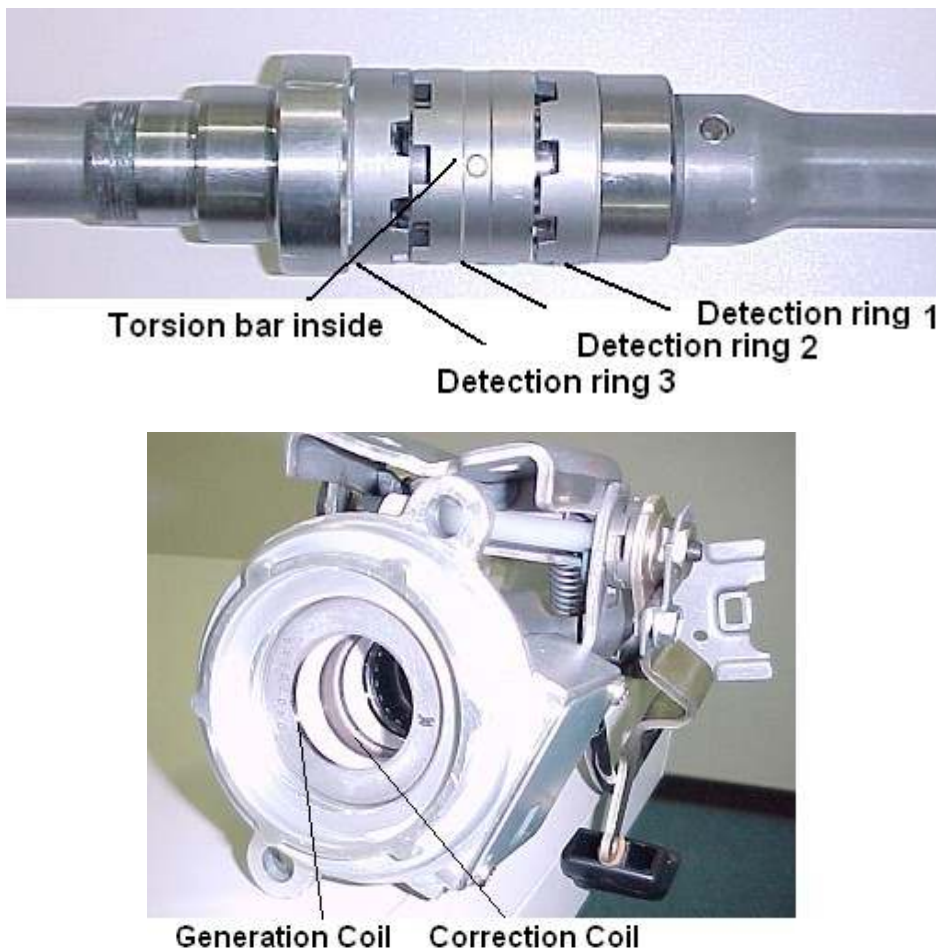


Fig. 10 and 11

The generation coil is underneath the detection ring 1 and 2. When the generation coil receives an AC current, a magnetic field is generated. The detection coil is located underneath ring 2 and 3. Due to the twisting of the torsion bar, the teeth of ring 3 fall more or less in line with the teeth of ring 2. This influences the magnetic field strength received by the detection coil. The induced voltage in this coil is then rectified and is in relation to the applied torque on the steering column.

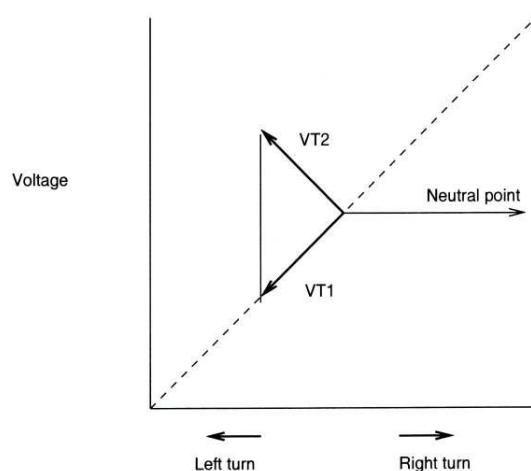


Fig. 12

Combination meter:

The EMPS ECU turns on the warning light when a malfunction is detected. Reading out the blinking code of the indicator or using the Intelligent Tester eases troubleshooting.

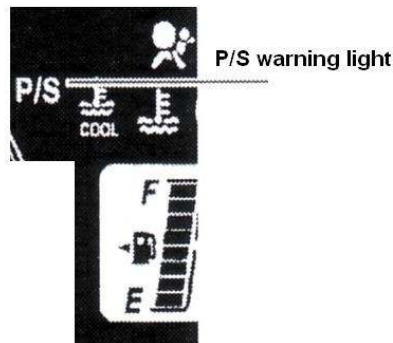


Fig. 13

### 5. Operation

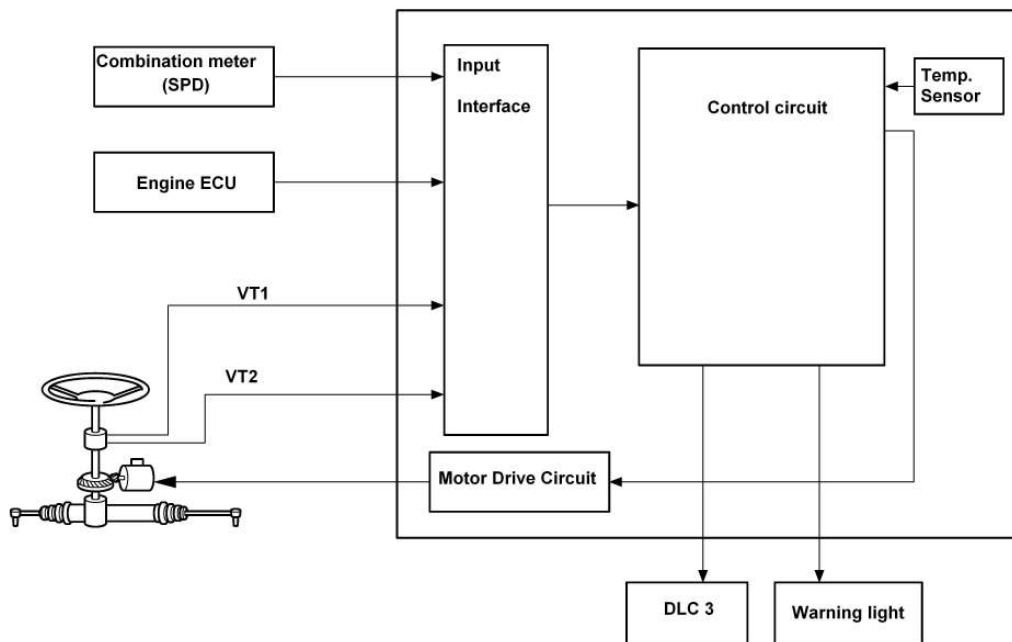


Fig. 14

The EMPS ECU receives vehicle speed, engine speed and torque sensor information. When the driver turns the steering wheel, the torque sensor detects the twist of the torsion bar. Based on this signal and vehicle speed, the EMPS ECU calculates the required assistance and controls the DC motor with a duty ratio in the correct polarity.

A temperature sensor detects if the ECU overheats (power transistors for DC motor control). If overheating is detected, the current to the DC motor is limited to lower the temperature.

Whenever a problem is detected by the ECU, the DC motor will still, if possible, be controlled but with a weak assistance for safety reasons. (Refer RM838E for troubleshooting).

## 6. EPS Questions

1. What do the letters EPS stand for?
2. Why do you think a torque wrench will be needed?
3. What does P/S mean?
4. By which two signals is the amount of power steering controlled?
5. In which way is the driver alerted in case of a malfunction?
6. What is so special about the worm shape of the DC motor?
7. What is the function of the torsion bar between the input and output shaft?
8. What are the main parts of the torque sensor?
9. What is the function of the detection rings?
10. What kind of current is supplied to the generation coil?
11. What do VT1 and VT2 mean?
12. How many output signals does the control unit have?
13. How many input signals does the Control unit have?
14. What happens when the temperature sensor detects that the power transistor is overheating?