

STEERING

Power Steering System (Diagnostics - Introduction) - Sienna

POWER STEERING SYSTEM

PRECAUTION

PRECAUTION

1. IGNITION SWITCH EXPRESSIONS

- a. The type of ignition switch used on this model differs according to the specifications of the vehicle. The expressions listed in the table below are used in this information.

Expression	Ignition Switch (Position)	Engine Switch (Condition)
Ignition switch off	LOCK	Off
Ignition switch ACC	ACC	On (ACC)
Ignition switch ON	ON	On (IG)
Engine start	START	Start

2. HANDLING PRECAUTION

- a. When handling the electronic parts;
- Avoid any impact to parts such as ECUs and relays. Replace with new ones if dropped or subjected to a severe blow.
 - Do not expose to high temperatures or humidity.
 - Do not touch the connector terminals, in order to prevent deformation or malfunctions due to static electricity.
- b. When handling the steering column assembly;
- Avoid any impact to the steering column assembly, especially to the power steering motor, torque sensor and rotation angle sensor. Replace with new ones if dropped or subjected to a severe blow.
 - Do not pull the wire harness when moving the steering column assembly.
 - When the steering column assembly has been replaced, perform the assist map writing. Refer to **REGISTRATION**.

3. PRECAUTIONS FOR CAN COMMUNICATION

- a. CAN communication lines are used to receive information from the skid control ECU and the ECM, and to transmit warnings to the combination meter. When there are any problems in the CAN

communication lines, CAN communication line DTCs are output.

- b. Perform troubleshooting of the communication line problems when the CAN communication DTCs are output. Be sure to start troubleshooting on the electronic power steering system after confirming that the CAN communication system is normal.
- c. Since the CAN communication line has its own length and route, it cannot be repaired temporarily with a bypass wire, etc.

4. POWER STEERING SYSTEM FUNCTIONS

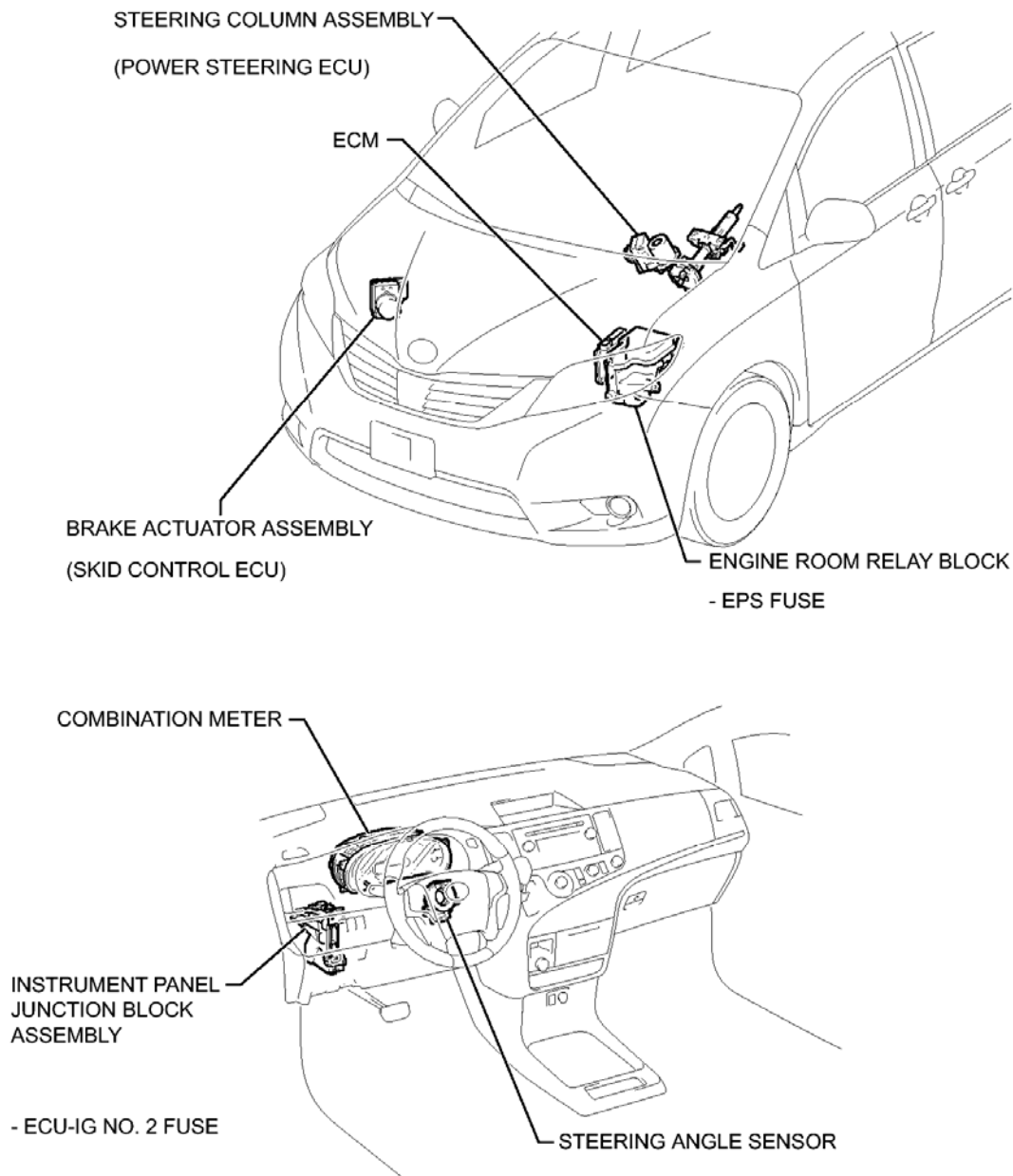
- a. If the battery is not sufficiently charged or the voltage decreases temporarily, the amount of power assist may be reduced and the EPS warning light may come on. In such cases, the amount of power assist returns to normal when the battery voltage recovers.

HINT:

If the EPS warning light comes on but no DTCs are stored, check the Data List "Battery Voltage Lo Record". Refer to **DATA LIST / ACTIVE TEST**.

PARTS LOCATION

ILLUSTRATION



P

Fig. 1: Power Steering System Components Location
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SYSTEM DIAGRAM

SYSTEM DIAGRAM

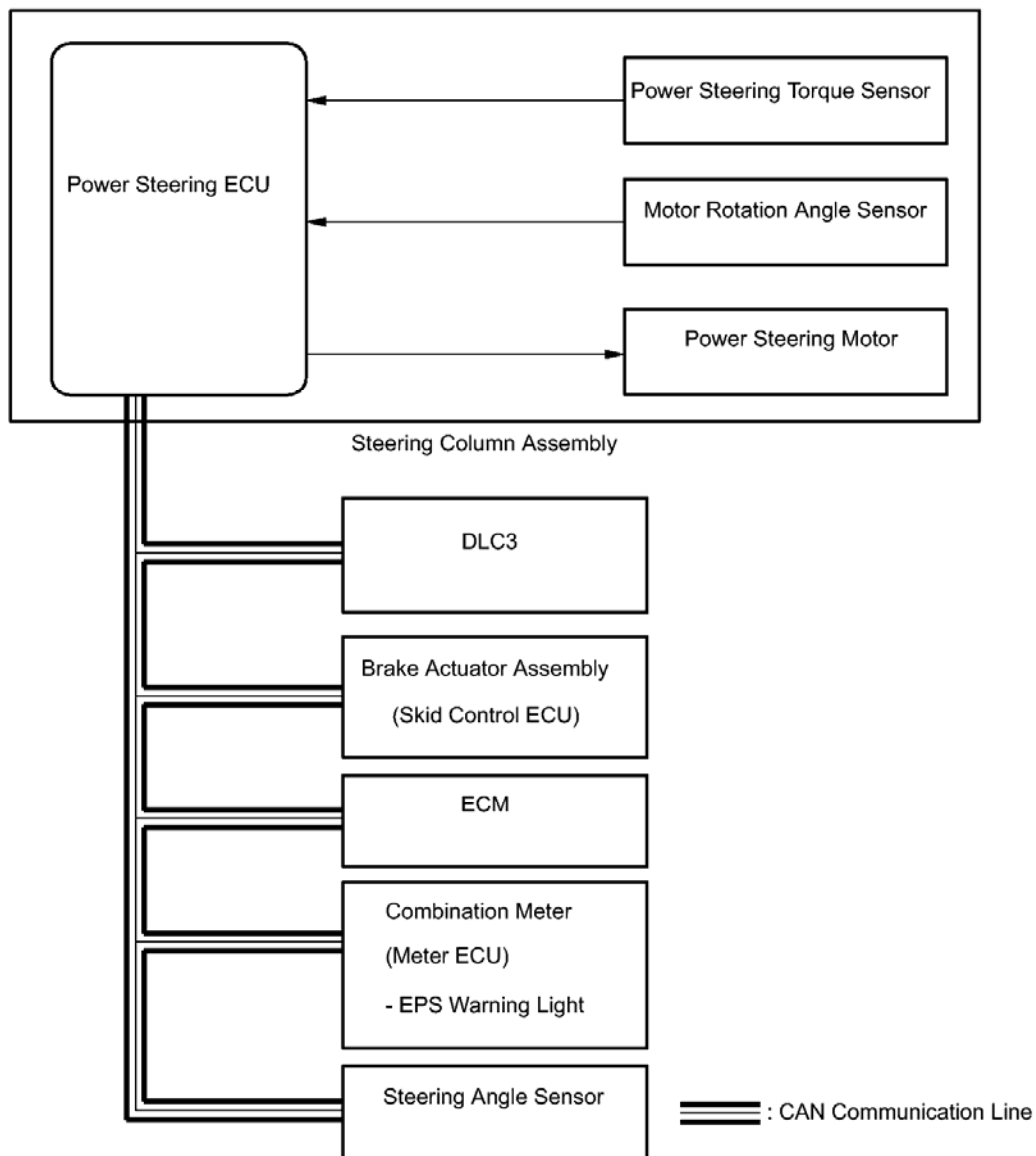


Fig. 2: Power Steering System Diagram

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Transmitting ECU (Transmitter)	Receiving ECU	Signal	Communication Method
		• Engine variation information signal • Drive train variation signal • Vehicle destination information signal	

ECM	Power Steering ECU	• Variation information of transmission signal • Engine speed signal • TC terminal signal • Actual output torque signal • Gear position signal	CAN
Skid Control ECU	Power Steering ECU	• Vehicle speed signal • VSC operation prohibition state signal • Steering assist request signal	CAN
Steering Angle Sensor	Power Steering ECU	• Steering angle sensor status • Steering angle signal	CAN
Power Steering ECU	ECM	• EPS idle up request signal	CAN
Power Steering ECU	Combination Meter	• EPS warning light on request signal • EPS diagnostic information signal	CAN

SYSTEM DESCRIPTION

SYSTEM DESCRIPTION

1. DESCRIPTION

The power steering system generates torque through the operation of the motor and the reduction gear installed on the column shaft in order to assist power steering effort.

The power steering ECU determines the direction and the amount of assisting power in accordance with the vehicle speed signals and signals from the power steering torque sensor and motor rotation angle sensor. As a result, steering effort is controlled to be light during low speed driving and moderately high during high speed driving.

2. FUNCTION OF MAIN COMPONENTS

The power steering ECU, power steering torque sensor, power steering motor and motor rotation angle sensor are built into the steering column assembly.

Component	Function
	The torque

Power Steering Torque Sensor	sensor detects the steering effort generated when the steering wheel is turned and converts it to an electrical signal.
Motor Rotation Angle Sensor	The motor rotation angle sensor consists of the resolver sensor, which excels in reliability and durability. The rotation angle sensor detects the rotation angle of the motor and outputs it to the power steering ECU. As a result, it ensures efficient EPS control.
	The power steering motor is activated by the current

Power Steering Motor	from the power steering ECU and generates torque to assist the steering effort.
Power Steering ECU	The power steering ECU calculates assisting power based on steering torque signals from the torque sensor and vehicle speed signals from the skid control ECU.
EPS Warning Light	Lights up to alert the driver when the power steering ECU detects a malfunction in the power steering system.

HOW TO PROCEED WITH TROUBLESHOOTING

HOW TO PROCEED WITH TROUBLESHOOTING

HINT:

- Use these procedures to troubleshoot the power steering system.
- *: Use the Techstream.

1. VEHICLE BROUGHT TO WORKSHOP

NEXT: Go to next step

2. CUSTOMER PROBLEM ANALYSIS

- Confirm problem symptoms. Refer to GENERAL INFORMATION.

NEXT: Go to next step

3. INSPECT BATTERY VOLTAGE

Standard Voltage

11 to 14 V

If the voltage is below 11 V, recharge or replace the battery before proceeding.

NEXT: Go to next step

4. CHECK DTC AND FREEZE FRAME DATA*

- Refer to DTC Check/Clear. Refer to DTC CHECK / CLEAR.

NEXT: Go to next step

5. PROBLEM SYMPTOM CONFIRMATION

NEXT: Go to next step

6. CHECK CAN COMMUNICATION SYSTEM*

- Refer to DTC output for the CAN communication system. Refer to DIAGNOSIS SYSTEM.

RESULT

Result	Proceed to
CAN system DTC is not output	A
CAN system DTC	B

is output	
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HINT:

- When any CAN communication system DTCs are output, perform troubleshooting on the CAN communication system first.
- When communication to the power steering ECU is not established through the Techstream, inspect terminals CANH and CANL of the DLC3 and the power steering ECU, and the IG circuit of the power steering ECU.

B --> PROCEED TO CAN COMMUNICATION SYSTEM. Refer to HOW TO PROCEED WITH TROUBLESHOOTING

A: Go to next step

7. CHECK DTC*

- Refer to DTC Check/Clear. Refer to **DTC CHECK / CLEAR.**

HINT:

Refer to Diagnostic Trouble Code Chart when any DTCs are output. Refer to **DIAGNOSTIC TROUBLE CODE CHART.**

RESULT

Result	Proceed to
DTC is not output	A
DTC is output	B

B --> Go to step 10

A: Go to next step

8. PROBLEM SYMPTOMS TABLE

- Refer to **PROBLEM SYMPTOMS TABLE.**

RESULT

Result	Proceed to
Fault is	

not listed in Problem Symptoms Table	A
Fault is listed in Problem Symptoms Table	B

B --> Go to step 10

A: Go to next step

9. OVERALL ANALYSIS AND TROUBLESHOOTING*

- a. Refer to Terminals of ECU. Refer to **TERMINALS OF ECU.**
- b. Refer to Data List/Active Test. Refer to **DATA LIST / ACTIVE TEST.**

NEXT: Go to next step

10. REPAIR OR REPLACE

NEXT: Go to next step

11. CONFIRMATION TEST

NEXT --> END

REGISTRATION

REGISTRATION

1. ASSIST MAP WRITING

NOTE: Perform the assist map writing when the steering column assembly is replaced.

HINT:

If the assist map is not recorded, DTC C1581 (Assist Map Un-Writing) is stored, and the EPS warning light illuminates. Also, after the assist map is recorded, if data that does not match the vehicle specifications is received through CAN communication, DTC C1582 (Assist Map Number Mismatch) is stored.

- a. Turn the ignition switch off.

- b. Connect the Techstream to the DLC3.
- c. Turn the ignition switch to ON.
- d. Turn the Techstream on.
- e. Enter the following menus: Chassis / EMPS / Utility / Signal Check.
- f. Wait for 3 seconds or more.
- g. Confirm that the EPS warning light changes from illuminated to blinking at 4 Hz (4 blinks per second).
- h. If the EPS warning light does not change from illuminated to blinking at 4 Hz, check for DTCs. Refer to **DTC CHECK / CLEAR**.

HINT:

If C1581 or C1582 is output, troubleshoot by DTC.

DTC No.	Proceed to
C1581 is output	Refer to <u>DTC C1581: Assist Map Number Un-Writing</u>
C1582 is output	Refer to <u>DTC C1582: Assist Map Number Mismatch</u>

PROBLEM SYMPTOMS TABLE

PROBLEM SYMPTOMS TABLE

HINT:

- Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.
- Inspect the fuses and relays related to this system before inspecting the suspected areas below.

POWER STEERING SYSTEM

Symptom	Suspected Area	See
Steering is heavy.	Front tires (improperly inflated, unevenly worn)	Refer to <u>INSPECTION</u>
	Front wheel alignment (incorrect)	Refer to <u>ADJUSTMENT</u>
	Front suspension (Lower ball joint)	Refer to <u>INSPECTION</u>
	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
	Steering column assembly (Torque sensor, Power steering motor, Power steering ECU)	Refer to <u>REMOVAL</u>
	Speed sensor	Refer to <u>TEST MODE PROCEDURE</u>
	Brake actuator (Skid control ECU)	Refer to <u>REMOVAL</u>
	Battery and power source system	-
	Power source voltage of steering column assembly (Power steering ECU)	Refer to <u>TERMINALS OF ECU</u>
Steering effort differs between right and left or is uneven.	Front tires (improperly inflated, unevenly worn)	Refer to <u>INSPECTION</u>
	Front wheel alignment (incorrect)	Refer to <u>ADJUSTMENT</u>
	Front suspension (Lower ball joint)	Refer to <u>INSPECTION</u>
	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
	Steering column assembly (Torque sensor, Power steering motor, Power steering ECU)	Refer to <u>REMOVAL</u>
While driving, steering effort does not change	Front suspension (Lower ball joint)	Refer to <u>INSPECTION</u>
	CAN communication system	Refer to <u>HOW TO PROCEED WITH TROUBLESHOOTING</u>
	Speed sensor	Refer to <u>TEST MODE PROCEDURE</u>
	Brake actuator (Skid control ECU)	Refer to <u>REMOVAL</u>

in accordance with vehicle speed or the steering wheel does not return properly.	Combination meter	Refer to <u>REMOVAL</u>
	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
	Steering column assembly (Torque sensor, Power steering motor, Power steering ECU)	Refer to <u>REMOVAL</u>
A knocking (or cranking) sound occurs when turning the steering wheel while power steering is operating.	Front suspension (Lower ball joint)	Refer to <u>INSPECTION</u>
	Steering intermediate shaft	-
	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
Noise occurs when turning the steering wheel during low speed driving.	Steering column assembly	Refer to <u>REMOVAL</u>
	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
	Steering column assembly	Refer to <u>REMOVAL</u>
Friction occurs when turning the steering wheel during low speed driving.	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
	Steering column assembly	Refer to <u>REMOVAL</u>
High pitched sounds (squeaking) occurs when turning the steering wheel slowly with the vehicle stopped.	Steering column assembly	Refer to <u>REMOVAL</u>
	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
The steering wheel vibrates and noise occurs when turning the steering wheel from lock to lock.	Steering column assembly (Power steering motor)	Refer to <u>REMOVAL</u>
	Power steering gear (for 2GR-FE)	Refer to <u>INSPECTION</u>
	Power steering gear (for 1AR-FE)	Refer to <u>INSPECTION</u>
EPS warning light remains on.	Steering column assembly	Refer to <u>REMOVAL</u>
	Proceed to PS warning light remains on	Refer to <u>PS Warning Light Remains ON</u>

TERMINALS OF ECU

TERMINALS OF ECU

1. CHECK STEERING COLUMN ASSEMBLY (POWER STEERING ECU)

*a

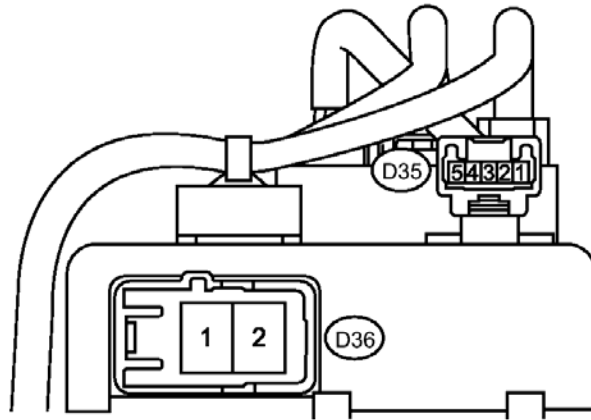


Fig. 3: Steering Column Assembly (Power Steering ECU) Connector Terminal Identification
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a	Steering Column Assembly (Power Steering ECU)	--
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- a. Measure the voltage and resistance according to the value(s) in the table below.

HINT:

In the table, first follow the information under "Condition". Look under "Terminal No. (Symbol)" for the terminals to be inspected. The standard voltage between the terminals is shown under "Specified Condition". Use the illustration above as a reference for the power steering ECU terminals.

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
D35-1 (CANL) - D35-2 (CANH)	W - BR	CAN bus	Ignition switch off	54 to 69ohms
D35-5 (IG) - D36-2 (PGND)	L - W-B	IG power supply	Ignition switch ON	11 to 14 V
D36-1 (PIG) - D36-2	B - W-B	Battery power supply	Always	11 to 14 V

(PGND)				
D36-2 (PGND) - Body ground	W-B - Body ground	Body ground	Always	Below 1 ohms

DIAGNOSIS SYSTEM

DIAGNOSIS SYSTEM

1. CHECK DLC3
2. CHECK EPS WARNING LIGHT

*1



Fig. 4: Identifying EPS Warning Light
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

	EPS
*1	Warning Light

- a. When a problem occurs in the power steering system, the EPS warning light on the combination meter comes on to inform the driver of the problem.
- b. If the battery is not sufficiently charged or the voltage decreases temporarily, the amount of power assist may be reduced and the EPS warning light may come on. In such cases, the amount of power assist returns to normal when the battery voltage recovers.

HINT:

If the EPS warning light comes on but no DTCs are stored, check the Data List "Battery Voltage Lo Record". Refer to **DATA LIST / ACTIVE TEST**.

DTC CHECK / CLEAR

DTC CHECK / CLEAR

1. CHECK DTC

- a. Connect the Techstream to the DLC3.
- b. Turn the ignition switch to ON.
- c. Turn the Techstream on.
- d. Enter the following menus: Chassis / EMPS / Trouble Codes.
- e. Check the DTC(s) and freeze frame data, and then write them down.
- f. Check the details of the DTC(s). Refer to **DIAGNOSTIC TROUBLE CODE CHART**.

2. CLEAR DTC

- a. Connect the Techstream to the DLC3.
- b. Turn the ignition switch to ON.
- c. Turn the Techstream on.
- d. Enter the following menus: Chassis / EMPS / Trouble Codes.
- e. Clear the DTCs.

FREEZE FRAME DATA

FREEZE FRAME DATA

1. FREEZE FRAME DATA

NOTE:

- It is difficult to show the specified values (judgment values) clearly because freeze frame data values change significantly due to differences in measurement conditions, surroundings, or vehicle conditions. For this reason, there may be a problem even when the values are within specifications.
- Turn the ignition switch to ON and park the vehicle on level ground. Check the freeze frame data by using the Techstream.

- a. Turn the ignition switch off.
- b. Connect the Techstream to the DLC3.
- c. Turn the ignition switch to ON.
- d. Turn the Techstream on.
- e. Check the freeze frame data by following the prompts on the Techstream display.

EMPS

Tester Display	Measurement Item/Range	Inspection Condition	Reference Value
Meter Vehicle Velocity	Vehicle speed from meter: Minimum: 0 km/h (mph), Maximum: 300 km/h (186.4 mph)	The vehicle is stopped.	0 km/h (mph)
		The vehicle is driven at a constant speed.	No significant fluctuation
Engine Revolution	Engine revolution: Minimum: 0 RPM, Maximum: 12800 RPM	Engine running at constant speed.	No significant fluctuation
Motor Actual Current	Current to motor: Minimum: - 327.68 A, Maximum: 327.67 A	The engine is running and steering wheel is being turned.	Value changes in proportion to steering effort
Command Value Current	Requested current to motor: Minimum: - 327.68 A, Maximum: 327.67 A	The engine is running and steering wheel is being turned.	Value changes in proportion to steering effort
Steering Angle Velocity	Steering angle speed: Minimum: - 32768 deg/s, Maximum: 32767 deg/s	The engine is running and steering wheel is being turned.	Value changes in proportion to steering effort
Thermistor Temperature	ECU substrate temperature: Minimum: - 40°C (-40°F), Maximum: 150°C (302°	Ignition switch ON	-

	F)		
PIG Power Supply	Power source voltage to activate motor: Minimum: 0 V, Maximum: 20.1531 V	The engine is running and power steering is operating	11 to 14 V
IG Power Supply	ECU power source voltage: Minimum: 0 V, Maximum: 20.1531 V	Ignition switch ON	11 to 14 V
Steering Wheel Torque	Steering wheel torque: Minimum: -327.68 Nm, Maximum: 7.0 Nm	The engine is running and steering wheel is being turned.	Value changes in proportion to steering effort
Motor Rotation Angle	Motor rotation angle: Minimum: 0 deg, Maximum: 1441.77 deg	The engine is running and steering wheel is being turned.	During steering operation, motor rotation angle value changes from 0 to 360°
Motor Voltage	Motor Power Supply Voltage: Minimum: 0 V, Maximum: 98 V	Ignition switch ON	11 to 14 V
Motor Terminal Volt(U)	Motor terminal voltage (U phase): Minimum: 0 V, Maximum: 98 V	The engine is running and steering wheel is being turned.	Value changes within 4 to 35 V range
		The	

Motor Terminal Volt(V)	Motor terminal voltage (V phase): Minimum: 0 V, Maximum: 98 V	engine is running and steering wheel is being turned.	Value changes within 4 to 35 V range
Motor Terminal Volt(W)	Motor terminal voltage (W phase): Minimum: 0 V, Maximum: 98 V	The engine is running and steering wheel is being turned.	Value changes within 4 to 35 V range
Torque Sensor 1 Output	Torque sensor 1 output value: Minimum: 0 V, Maximum: 4.9725 V	The engine is running and steering wheel is not turned (without load).	2.3 to 2.7 V
		The engine is running and steering wheel is turned to right with vehicle stopped.	2.5 to 3.8 V
		The engine is running and steering wheel is turned to left with vehicle stopped.	1.2 to 2.5 V
		The engine is running	

Torque Sensor 2 Output	Torque sensor 2 output value: Minimum: 0 V, Maximum: 4.9725 V	and steering wheel is not turned (without load).	2.3 to 2.7 V
		The engine is running and steering wheel is turned to right with vehicle stopped.	1.2 to 2.5 V
		The engine is running and steering wheel is turned to left with vehicle stopped.	2.5 to 3.8 V
Battery Voltage	Battery voltage: Minimum: 0 V, Maximum: 25.5 V	Always	11 to 14 V
PS Assist Signal	Status of the Record of Power Steering Assist Signal: ON or OFF	The engine is not running.	OFF
		The engine is running.	ON

FAIL-SAFE CHART

FAIL-SAFE CHART

When a problem occurs in the power steering system, the EPS warning light on the combination meter comes on, and the ECU stops the steering power assist, maintains the amount of power assist constant, or reduces the amount of power assist to protect the system.

DTC No.	Malfunction	Fail-safe
C1511 C1512 C1513 C1514	Torque sensor malfunction	Power assist stopped
C1521	Power steering motor circuit overcurrent malfunction	Power assist stopped
C1524	Power steering motor malfunction	Power assist stopped
C1528	Motor rotation angle sensor malfunction	Power assist stopped
C1531	Power steering ECU malfunction	Power assist stopped (In some cases, amount of power assist remains constant at the level for speed at which malfunction was detected)
C1532	Power steering ECU malfunction	Power assist stopped
C1533	Temperature sensor malfunction in power steering ECU	Power assist control continues
C1534	EEPROM abnormal	Assist force restricted
C1541	Vehicle speed signal malfunction	Amount of power assist remains constant at the level for speed at which malfunction was detected
C1551	IG power source voltage error	Power assist control continues
C1552	PIG power source voltage error	Power assist control continues
C1554	Power source relay malfunction	Power assist stopped
C1555	Power steering motor relay malfunction	Power assist stopped
C1581	Assist map not written in power steering ECU	Power assist control continues
C1582	Assist map mismatch written in power steering ECU	Power assist permitted using default map
U0100	ECM communication error	Amount of power assist remains constant at the level for speed at which malfunction was detected
U0129	Skid control ECU communication error	Amount of power assist remains constant at the level for speed of 140 km/h (87 mph)
-	Extremely high temperature in ECU	Assist force restricted until normal ECU temperature recovers
-	Power source voltage drop	Assist force suspended until voltage recovers

HINT:

The amount of power assist may be decreased to prevent the motor and ECUs from overheating if the steering wheel is continuously turned when the vehicle is either stopped or driven at a low speed, or if the steering wheel is kept at either full lock position for a long time. In such cases, the amount of power assist returns to normal if the steering wheel is not turned for approximately 10 minutes with the engine idling.

DATA LIST / ACTIVE TEST

DATA LIST / ACTIVE TEST

1. DATA LIST

HINT:

Using the Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTE: In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

- Turn the ignition switch off.
- Connect the Techstream to the DLC3.
- Turn the ignition switch to ON.
- Turn the Techstream on.
- Enter the following menus: Chassis / EMPS / Data List.
- According to the display on the Techstream, read the Data List.

EMPS

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Meter Vehicle Velocity	Vehicle speed from meter: Minimum: 0 km/h (mph), Maximum: 300 km/h (186.4 mph)	0 km/h (mph): Vehicle stopped	-
		Vehicle driven at constant speed	No significant fluctuation
Engine Revolution	Engine revolution: Minimum: 0 RPM, Maximum: 12800 RPM	Engine running at constant speed	No significant fluctuation
Motor Actual Current	Current to motor: Minimum: -327.68 A,	Value changes in proportion to steering	-

	Maximum: 327.67 A	effort	
Command Value Current	Requested current to motor: Minimum: - 327.68 A, Maximum: 327.67 A	Value changes in proportion to steering effort	-
Steering Angle Velocity	Steering angle speed: Minimum: - 32768 deg/s, Maximum: 32767 deg/s	Value changes in proportion to steering effort	The engine is running and steering wheel is being turned
Thermistor Temperature	ECU substrate temperature: Minimum: - 40°C, Maximum: 150°C	-	-
PIG Power Supply	Power source voltage to activate motor: Minimum: 0 V, Maximum: 20.1531 V	11 to 14 V: Always	-
IG Power Supply	ECU power source voltage: Minimum: 0 V, Maximum: 20.1531 V	11 to 14 V: Ignition switch ON	-
Steering Wheel Torque	Steering Wheel Torque: Minimum: - 327.68 Nm, Maximum: 7 Nm	Value changes in proportion to steering effort	Ignition switch ON and power steering is operating
Motor	Motor rotation angle: Minimum: 0	During steering operation, motor rotation	The engine is running and

Rotation Angle	deg, Maximum: 1441.77 deg	angle value changes from 0 to 360°	steering wheel is being turned
Motor Voltage	Motor Power Supply Voltage: Minimum: 0 V, Maximum: 98 V	11 to 14 V: Ignition switch ON	-
Motor Terminal Volt(U)	Motor terminal voltage (U phase): Minimum: 0 V, Maximum: 98 V	Value changes within 4 to 35 V range	The engine is running and steering wheel is being turned.
Motor Terminal Volt(V)	Motor terminal voltage (V phase): Minimum: 0 V, Maximum: 98 V	Value changes within 4 to 35 V range	The engine is running and steering wheel is being turned.
Motor Terminal Volt(W)	Motor terminal voltage (W phase): Minimum: 0 V, Maximum: 98 V	Value changes within 4 to 35 V range	The engine is running and steering wheel is being turned.
Torque Sensor 1 Output	Torque sensor 1 output value: Minimum: 0 V, Maximum:	2.3 to 2.7 V	The engine is running and steering wheel is not turned (without load).
		2.5 to 3.8 V	The engine is running and steering wheel is turned to right with

	4.9725 V		vehicle stopped.
		1.2 to 2.5 V	The engine is running and steering wheel is turned to left with vehicle stopped.
Torque Sensor 2 Output	Torque sensor 2 output value: Minimum: 0 V, Maximum: 4.9725 V	2.3 to 2.7 V	The engine is running and steering wheel is not turned (without load).
		1.2 to 2.5 V	The engine is running and steering wheel is turned to right with vehicle stopped.
		2.5 to 3.8 V	The engine is running and steering wheel is turned to left with vehicle stopped.
IG ON/OFF Times	Number of times ignition switch turned to ON after DTC detection: Minimum: 0 times, Maximum: 65535 times	-	-

Motor Overheat Record	Continuous overheat prevention control record: Unrec or Rec	Unrec	-
Motor Lo Power Record	PIG power source voltage drop record: Unrec or Rec	Unrec	-
Eng Rev Inter Record	Status of the Record of Engine Revolution Signal Interrupt: Unrec or Rec	Unrec	-
Spd Sig Invalid Record	Record of vehicle speed signal invalid: Unrec or Rec	Unrec	-
Battery Voltage Lo Record	Battery voltage drop record: Minimum: 0 times, Maximum: 65535 times	0 times	-
Battery Voltage	Battery voltage: Minimum: 0 V, Maximum: 25.5 V	11 to 14 V: Always	-
PS Assist Signal	Status of the Record of Power Steering Assist Signal: ON or OFF	ON or OFF	-
The Number of DTCs	Number of detected DTCs when freeze frame data stored: Minimum: 0, Maximum: 255	-	-

DIAGNOSTIC TROUBLE CODE CHART

DIAGNOSTIC TROUBLE CODE CHART

HINT:

If any DTCs are displayed during the DTC check, inspect the circuit listed for those DTCs. For details of each DTC, refer to the information indicated in the DTC chart.

POWER STEERING SYSTEM

DTC Code	Detection Item	Trouble Area	Normal Return	EPS Warning Light	See
C1511	Torque Sensor Circuit Malfunction	- Steering column assembly	Ignition switch ON again	Comes on	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1512: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1513: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1514: Torque Sensor Power Supply Abnormal</u> ; <u>DTC C1521: Motor Circuit Malfunction</u> ; <u>DTC C1524: Motor Circuit Malfunction</u> ; <u>DTC C1528: Motor Rotation Angle Sensor Malfunction</u> ; <u>DTC C1531: ECU Malfunction</u> ; <u>DTC C1532: ECU Malfunction</u> ; <u>DTC C1533: ECU Malfunction</u> ; <u>DTC C1534: ECU Malfunction</u> ; <u>DTC C1555: Motor Relay Welding Failure</u>
C1512	Torque Sensor Circuit Malfunction	- Steering column assembly	Ignition switch ON again	Comes on	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1512: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1513: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1514: Torque Sensor Power Supply Abnormal</u> ; <u>DTC C1521: Motor Circuit Malfunction</u> ; <u>DTC C1524: Motor Circuit Malfunction</u> ; <u>DTC C1528: Motor Rotation Angle Sensor Malfunction</u> ; <u>DTC C1531: ECU Malfunction</u> ; <u>DTC C1532: ECU Malfunction</u> ; <u>DTC C1533: ECU Malfunction</u> ; <u>DTC C1534: ECU Malfunction</u> ; <u>DTC C1555: Motor Relay Welding Failure</u>
					Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1512: Torque Sensor Circuit Malfunction</u> ; <u>DTC C1513: Torque Sensor Circuit</u>

C1513	Torque Sensor Circuit Malfunction	- Steering column assembly	Ignition switch ON again	Comes on	<u>Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1514	Torque Sensor Power Supply Abnormal	- Steering column assembly	Ignition switch ON again	Comes on	<u>Refer to DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1521	Motor Circuit Malfunction	- Steering column assembly	Ignition switch ON again	Comes on	<u>Refer to DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
					<u>Refer to DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC</u>

C1524	Motor Circuit Malfunction	- Steering column assembly	Ignition switch ON again	Comes on	<u>C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1528	Motor Rotation Angle Sensor Malfunction	- Steering column assembly	Ignition switch ON again	Comes on	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1531	ECU Malfunction	- Steering column assembly	Ignition switch ON again	Comes on	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1532	ECU Malfunction	- Steering column	Ignition switch ON	Comes on	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit</u>

		assembly	again		<u>Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1533	ECU Malfunction	- Steering column assembly	After normal condition	Does not come on	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1534	ECU Malfunction	- Steering column assembly	Ignition switch ON again	Does not come on*1	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1541	Vehicle Speed Signal Malfunction	- CAN communication system - Vehicle stability control system - Steering column assembly	After normal condition	Comes on	Refer to <u>DTC C1541: Vehicle Speed Signal Malfunction</u>
		- IG power	Ignition		

C1551	IG Power Supply Voltage Malfunction	source circuit - Steering column assembly	switch ON again and after normal confirmation	Comes on	Refer to <u>DTC C1551: IG Power Supply Voltage Malfunction</u>
C1552	PIG Power Supply Voltage Malfunction	- PIG power source circuit - Steering column assembly	After normal condition	Comes on	Refer to <u>DTC C1552: PIG Power Supply Voltage Malfunction; DTC C1554: Power Supply Relay Failure</u>
C1554	Power Supply Relay Failure	- PIG power source circuit - Steering column assembly	Ignition switch ON again	Comes on	Refer to <u>DTC C1552: PIG Power Supply Voltage Malfunction; DTC C1554: Power Supply Relay Failure</u>
C1555	Motor Relay Welding Failure	- Steering column assembly	Ignition switch ON again	Comes on	Refer to <u>DTC C1511: Torque Sensor Circuit Malfunction; DTC C1512: Torque Sensor Circuit Malfunction; DTC C1513: Torque Sensor Circuit Malfunction; DTC C1514: Torque Sensor Power Supply Abnormal; DTC C1521: Motor Circuit Malfunction; DTC C1524: Motor Circuit Malfunction; DTC C1528: Motor Rotation Angle Sensor Malfunction; DTC C1531: ECU Malfunction; DTC C1532: ECU Malfunction; DTC C1533: ECU Malfunction; DTC C1534: ECU Malfunction; DTC C1555: Motor Relay Welding Failure</u>
C1581	Assist Map Number Un-Writing	- Assist map is not written - CAN communication system - SFI system - Vehicle stability control system - Steering column assembly	Assist map written	Comes on	Refer to <u>DTC C1581: Assist Map Number Un-Writing</u>
C1582	Assist Map Number	- CAN communication system - Incorrect ECM - Incorrect	After normal	Does not	Refer to <u>DTC C1582: Assist Map</u>

	Mismatch	brake actuator assembly (Skid control ECU) - Steering column assembly	condition	come on	<u>Number Mismatch</u>
U0100	Lost Communication with ECM	- CAN communication system - ECM	After normal condition	*2	Refer to <u>DTC U0100: Lost Communication with ECM; DTC U0129: Lost Communication with Brake System Control Module</u>
U0129	Lost Communication with Brake System Control Module	- CAN communication system - Brake actuator assembly (Skid control ECU)	After normal condition	Comes on	Refer to <u>DTC U0100: Lost Communication with ECM; DTC U0129: Lost Communication with Brake System Control Module</u>

HINT:

- *1: The offset is set to the default value and control is continued. In this case, the warning light illuminates.
- *2: When an error occurs during steering assist, the warning light does not illuminate. For errors that occur before assist (at the time of the decision to start assist), the warning light illuminates.