

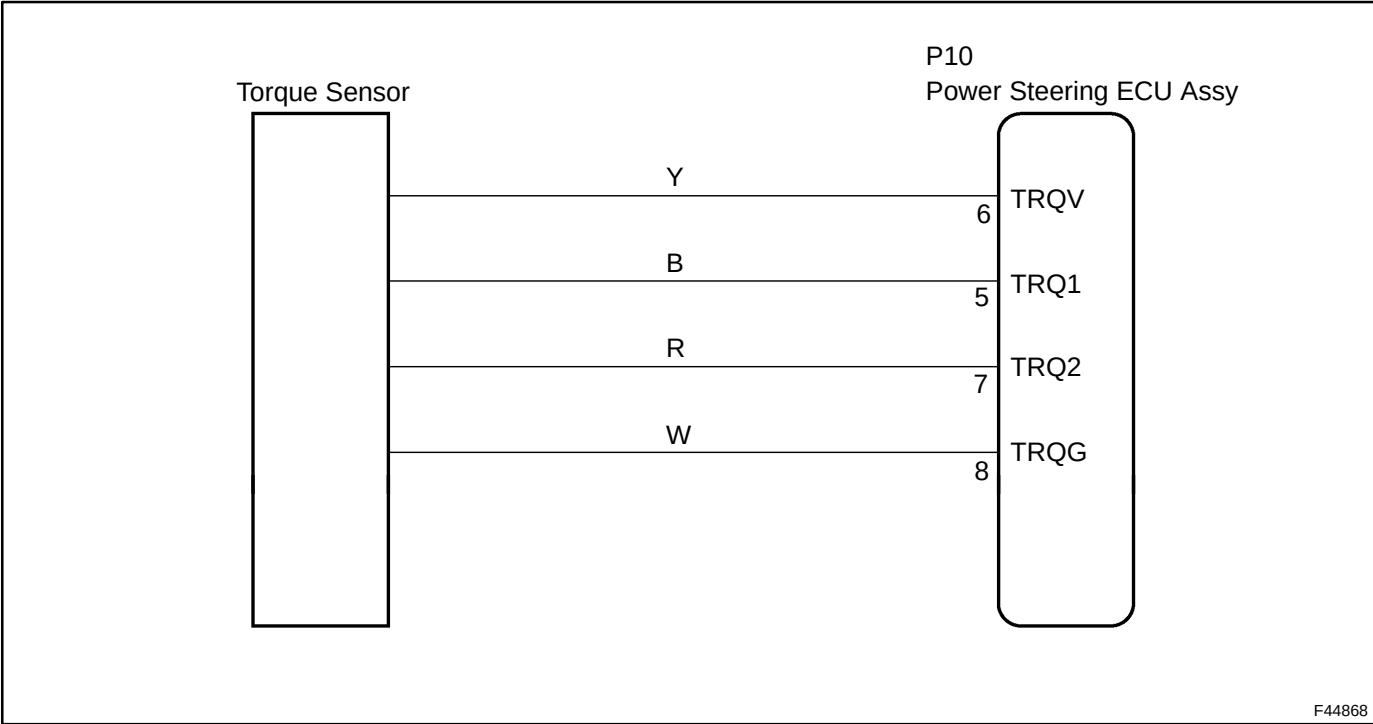
DTC	C1511	TORQUE SENSOR ABNORMAL
DTC	C1512	TORQUE SENSOR ABNORMAL
DTC	C1513	TORQUE SENSOR ABNORMAL
DTC	C1514	TORQUE SENSOR POWER SUPPLY ABNORMAL
DTC	C1517	TORQUE HOLD ABNORMAL

CIRCUIT DESCRIPTION

The torque sensor converts rotation torque input to the steering wheel into an electrical signal and sends it to the ECU. Based on this signal, the ECU detects steering effort.

DTC No.	Detection Item	Trouble Area
C1511	Torque sensor (TRQ1) signal error or stop	• Torque sensor (built into steering column assy) • Power steering ECU assy
C1512	Torque sensor (TRQ2) signal error or stop	• Torque sensor (built into steering column assy) • Power steering ECU assy
C1513	Deviation between torque sensors TRQ1 and TRQ2 is out of specification	• Torque sensor (built into steering column assy) • Power steering ECU assy
C1514	Torque sensor power source voltage error	• Torque sensor (built into steering column assy) • Power steering ECU assy
C1517	Temporary control due to malfunction related to torque sensor continues for a long time	• Torque sensor (built into steering column assy) • Power steering ECU assy

WIRING DIAGRAM



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INSPECTION PROCEDURE

1 READ VALUE ON HAND-HELD TESTER

- (a) Connect the hand-held tester to the DLC3.
 (b) Turn the power switch on (IG), and turn the hand-held tester main switch on.
 (c) Select the items "TRQ1" and "TRQ2" in the DATA LIST.

Item	Item Description	Inspection Condition	Reference Value
TRQ1	Torque sensor 1 output value/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V
TRQ2	Torque sensor 2 output value/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V

- (d) Read the values of "TRQ1" and "TRQ2" on the tester display when the steering wheel is centered (without load).

Standard:

Voltage: 2.3 to 2.7 V

- (e) Check the difference in values between "TRQ1" and "TRQ2" when the steering wheel is centered (without load).

Standard:

Voltage: 0.3 V or less

- (f) Read the value of the torque sensor on the tester display when the steering wheel is turned.

- (1) Turn the steering wheel from its center position to the right full lock position and read the values of "TRQ1" and "TRQ2" on the tester display.

Standard:

Voltage: 2.5 to 4.7 V

- (2) Turn the steering wheel from its center position to the left full lock position and read the values of "TRQ1" and "TRQ2" on the tester display.

Standard:

Voltage: 0.3 to 2.5 V

- (3) Check the difference in values between "TRQ1" and "TRQ2".

Standard:

Voltage: 0.3 V or less

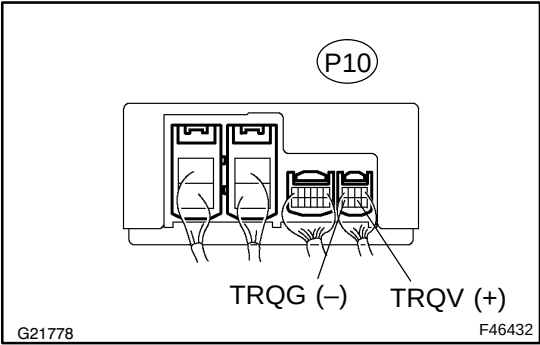
NG

Go to step 2

OK

REPLACE POWER STEERING ECU ASSY

2 INSPECT STEERING COLUMN ASSY(TORQUE SENSOR)



- (a) Measure the voltage according to the value(s) in the table below.

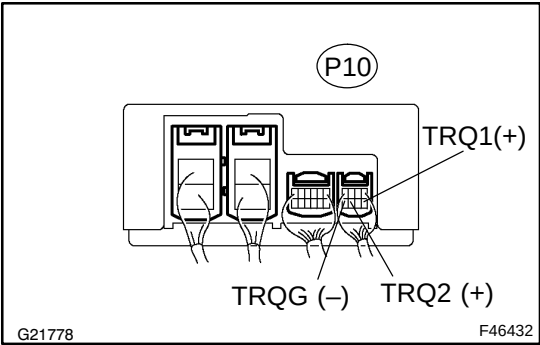
Standard:

Tester Connection	Condition	Specified Condition
P10-6 (TRQV) – P10-8 (TRQG)	Power switch is on (IG)	7.5 to 8.5 V

OK REPLACE POWER STEERING ECU ASSY
(SEE PAGE 50-16)

NG

3 INSPECT POWER STEERING ECU ASSY



- (a) Measure the voltage according to the value(s) in the table below.

Standard:

Tester Connection	Condition (Steering position)	Specified Condition
P10-5 (TRQ1) – P10-8 (TRQG)	Power switch is on (IG) (Center position)	2.3 to 2.7 V
P10-7 (TRQ2) – P10-8 (TRQG)	Power switch is on (IG) (Center position)	2.3 to 2.7 V
P10-5 (TRQ1) – P10-8 (TRQG)	Power switch is on (IG) (Turned to the right)	2.5 to 4.7 V
P10-7 (TRQ2) – P10-8 (TRQG)	Power switch is on (IG) (Turned to the right)	2.5 to 4.7 V
P10-5 (TRQ1) – P10-8 (TRQG)	Power switch is on (IG) (Turned to the left)	0.3 to 2.5 V
P10-7 (TRQ2) – P10-8 (TRQG)	Power switch is on (IG) (Turned to the left)	0.3 to 2.5 V

OK REPLACE STEERING COLUMN ASSY
(SEE PAGE 50-8)

NG

REPLACE POWER STEERING ECU ASSY (SEE PAGE 50-16)

DTC	C1515	TORQUE SENSOR ZERO POINT ADJUSTMENT UNDONE
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CIRCUIT DESCRIPTION

This DTC does not indicate a malfunction. The power steering ECU assy outputs this DTC when it determines that steering zero point calibration has not been performed.

DTC No.	DTC Detection Condition	Procedure
C1515	This DTC is detected when steering zero point calibration has not been performed.	There is no malfunction if this DTC is not output again after performing zero point calibration.

INSPECTION PROCEDURE

1	PERFORM ZERO POINT CALIBRATION OF TORQUE SENSOR (SEE PAGE 05-1211)
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2	RECONFIRM DTC (SEE PAGE 05-1220)
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(a) Check for DTCs.

Result:

A	DTCs are still output even after performing steering zero point calibration 3 times.
B	DTCs are still output even after performing steering zero point calibration once or twice.
C	Normal system code is output.

HINT:

Replace the steering column assy if DTCs are still output even after performing steering zero point calibration 3 times.

B	Go to step 1
C	END



REPLACE STEERING COLUMN ASSY

DTC	C1516	TORQUE SENSOR ZERO POINT ADJUSTMENT INCOMPLETE
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CIRCUIT DESCRIPTION

This DTC does not indicate a malfunction. The power steering ECU assy outputs this DTC when it determines that torque sensor zero point calibration has not been completed normally.

DTC No.	DTC Detection Condition	Procedure
C1516	Steering zero point calibration has not been completed normally due to touching the steering wheel during calibration.	There is no malfunction if this DTC is not output again after clearing the DTCs, initializing the zero point calibration signal, and performing zero point calibration.

INSPECTION PROCEDURE

1	CLEAR DTC (SEE PAGE 05-1220)
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2	INITIALIZE ZERO POINT CALIBRATION SIGNAL OF TORQUE SENSOR (SEE PAGE 05-1211)
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3	PERFORM ZERO POINT CALIBRATION OF TORQUE SENSOR (SEE PAGE 05-1211)
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4	RECONFIRM DTC (SEE PAGE 05-1220)
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(a) Check for DTCs.

Result:

A	DTCs are still output even after performing steering zero point calibration 3 times.
B	DTCs are still output even after performing steering zero point calibration once or twice.
C	Normal system code is output.

HINT:

Replace the steering column assy if DTCs are still output even after performing steering zero point calibration 3 times.

B	Go to step 3
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C	END
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REPLACE STEERING COLUMN ASSY

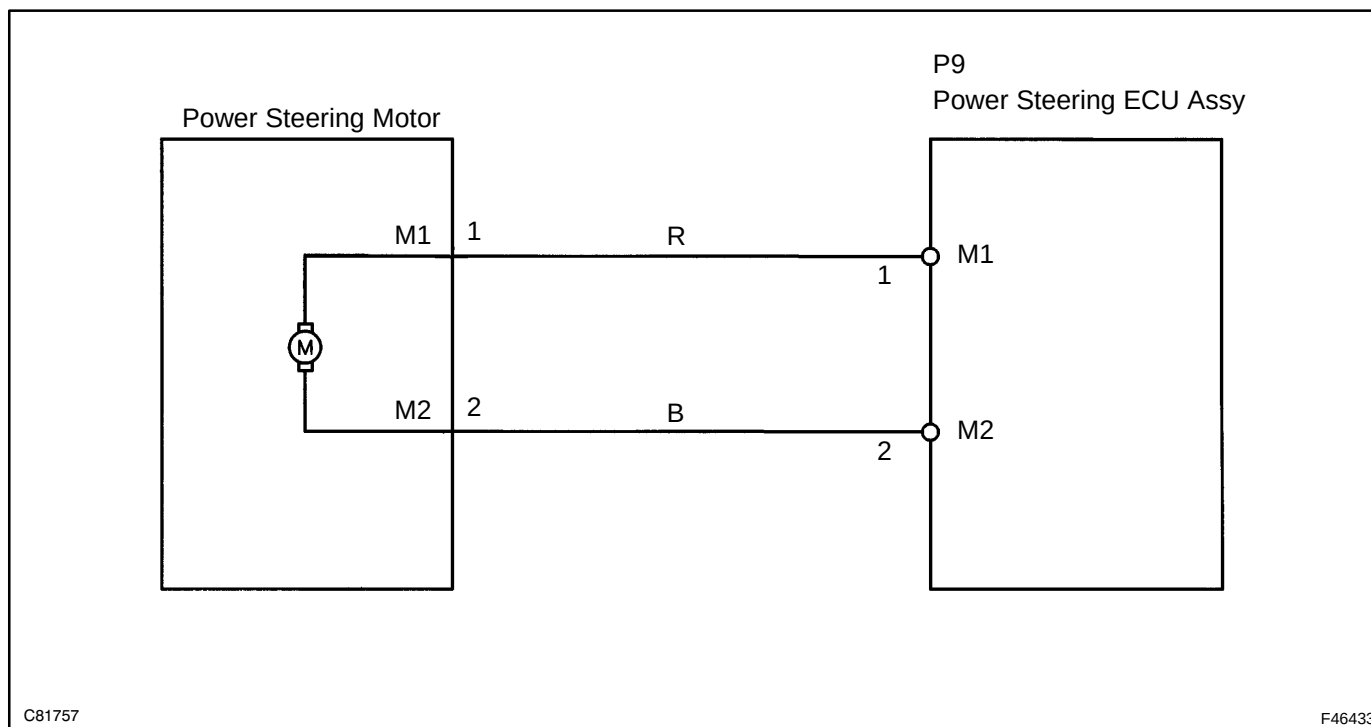
DTC	C1524	MOTOR ABNORMAL
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CIRCUIT DESCRIPTION

The power steering ECU assy supplies current to the power steering motor through this circuit.

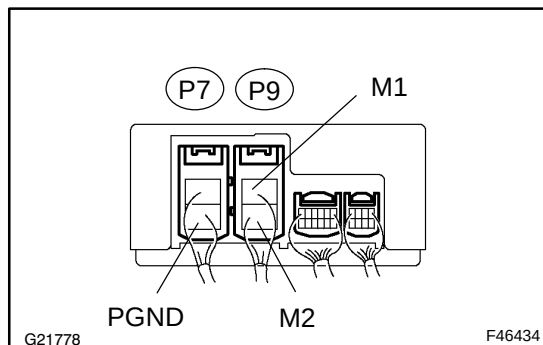
DTC No.	DTC Detection Item	Trouble Area
C1524	Voltage error between motor terminals	• Power steering motor • Power steering ECU assy

WIRING DIAGRAM



INSPECTION PROCEDURE

1 INSPECT POWER STEERING ECU ASSY



- (a) Turn the power switch on (IG).
 (b) Measure the voltage according to the value(s) in the table below.

Standard:

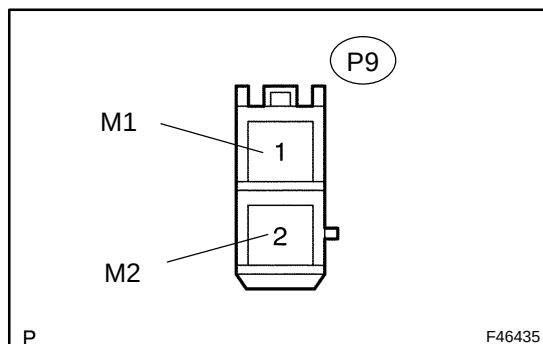
Tester Connection	Condition	Specified Condition
P9-1 (M1) – P7-2 (PGND)	The steering wheel is turned to the left.	Below 1 V
P9-1 (M1) – P7-2 (PGND)	The steering wheel is turned to the right.	10 to 16 V
P9-2 (M2) – P7-2 (PGND)	The steering wheel is turned to the left.	10 to 16 V
P9-2 (M2) – P7-2 (PGND)	The steering wheel is turned to the right.	Below 1 V

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**REPLACE POWER STEERING ECU ASSY
 (SEE PAGE 50-16)**

OK

2 INSPECT POWER STEERING MOTOR ASSY



- (a) Turn the power switch off.
 (b) Disconnect the "P9" connector from the power steering ECU assy.
 (c) Measure the resistance according to the value(s) in the table below.

Standard:

Tester Connection	Condition	Specified Condition
P9-1 (M1) – P9-2 (M2)	Always	0.04 to 0.1 Ω
P9-1 (M1) – Body ground	Always	10 k Ω or higher
P9-2 (M2) – Body ground	Always	10 k Ω or higher

NG

**REPLACE POWER STEERING MOTOR ASSY
 (SEE PAGE 50-8)**

OK

REPLACE POWER STEERING ECU ASSY (SEE PAGE 50-16)

DTC	C1531	ECU ABNORMAL
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DTC	C1532	ECU ABNORMAL
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DTC	C1533	ECU ABNORMAL
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DTC	C1534	ECU ABNORMAL
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CIRCUIT DESCRIPTION

Fail-safe function operates to stop power assist while DTCs indicating ECU malfunctions are output. However, power assist continues when DTC C1534 is output because it indicates an EEPROM error in the ECU.

DTC No.	DTC Detection Item	Trouble Area
C1531	ECU internal malfunction (CPU malfunction) is detected.	Power steering ECU assy
C1532	ECU internal malfunction (Peripheral circuit malfunction) is detected.	Power steering ECU assy
C1533	ECU internal malfunction (Substrate temp. sensor malfunction) is detected.	Power steering ECU assy
C1534	ECU internal malfunction (EEPROM error) is detected.	Power steering ECU assy

INSPECTION PROCEDURE

1	RECONFIRM DTC (SEE PAGE 05-1220)
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- (a) Check for DTCs.

OK:

DTCs other than C1531, C1532, C1533 and C1534 are not output.

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REPAIR CIRCUIT INDICATED BY OUTPUT CODE (SEE PAGE 05-1226)

OK

REPLACE POWER STEERING ECU ASSY (SEE PAGE 50-16)

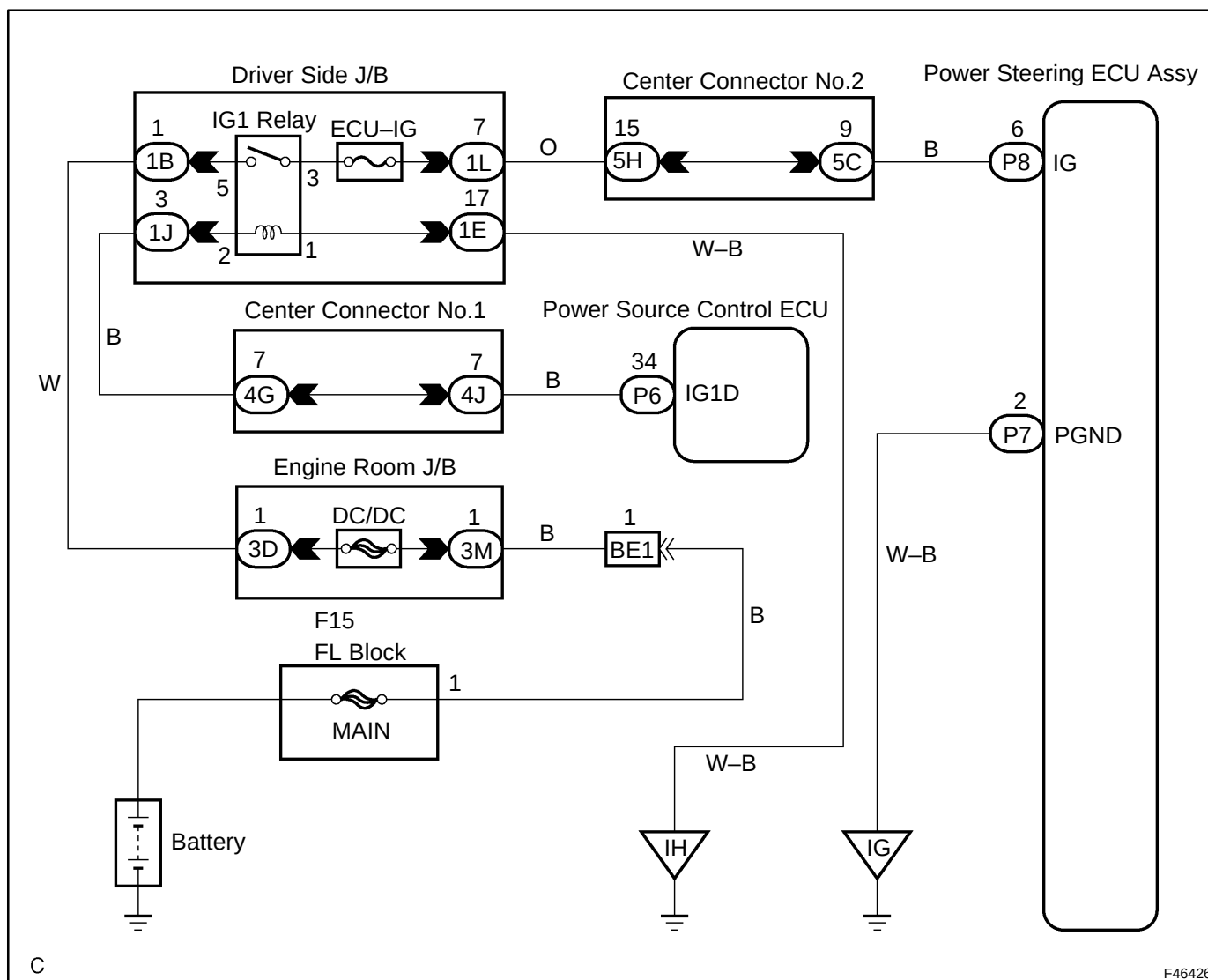
DTC	C1551	IG POWER SOURCE VOLTAGE MALFUNCTION
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CIRCUIT DESCRIPTION

The power steering ECU Assy distinguishes on/off status of the power switch through this circuit.

DTC No.	DTC Detection Item	Trouble Area
C1551	There is an open or short in the IG power source circuit with the power switch on (IG).	• ECU-IG Fuse • IG power source circuit • Power steering ECU Assy

WIRING DIAGRAM



INSPECTION PROCEDURE

1 INSPECT FUSE(ECU-IG)

- (a) Remove the ECU-IG fuse from the driver side J/B.
- (b) Check continuity of the ECU-IG fuse.

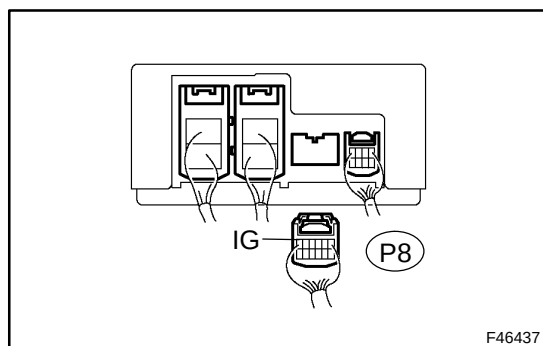
Standard: Continuity

NG

INSPECT FOR SHORT IN ALL COMPONENTS CONNECTED TO FUSE AND REPAIR OR REPLACE THEM IF NEEDED, AND REPLACE FUSE

OK

2 CHECK HARNESS AND CONNECTOR(POWER STEERING ECU ASSY – BODY GROUND)



- (a) Disconnect the "P8" connector from the power steering ECU assy.
- (b) Turn the power switch on (IG).
- (c) Measure the voltage according to the value(s) in the table below.

Standard:

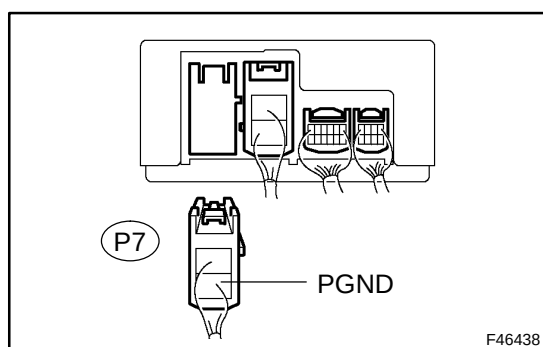
Tester Connection	Condition	Specified Condition
P8-6 (IG) – Body ground	Power switch is on (IG)	10 to 16 V

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REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3 CHECK HARNESS AND CONNECTOR(POWER STEERING ECU ASSY – BODY GROUND)



- (a) Turn the power switch off.
- (b) Disconnect the "P7" connector from the power steering ECU assy.
- (c) Measure the resistance according to the value(s) in the table below.

Standard:

Tester Connection	Condition	Specified Condition
P7-2 (PGND) – Body ground	Always	Below 1 Ω

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE POWER STEERING ECU ASSY (SEE PAGE 50-16)

DTC	C1552	PIG POWER SUPPLY VOLTAGE ABNORMAL
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DTC	C1554	POWER SUPPLY RELAY FAILURE
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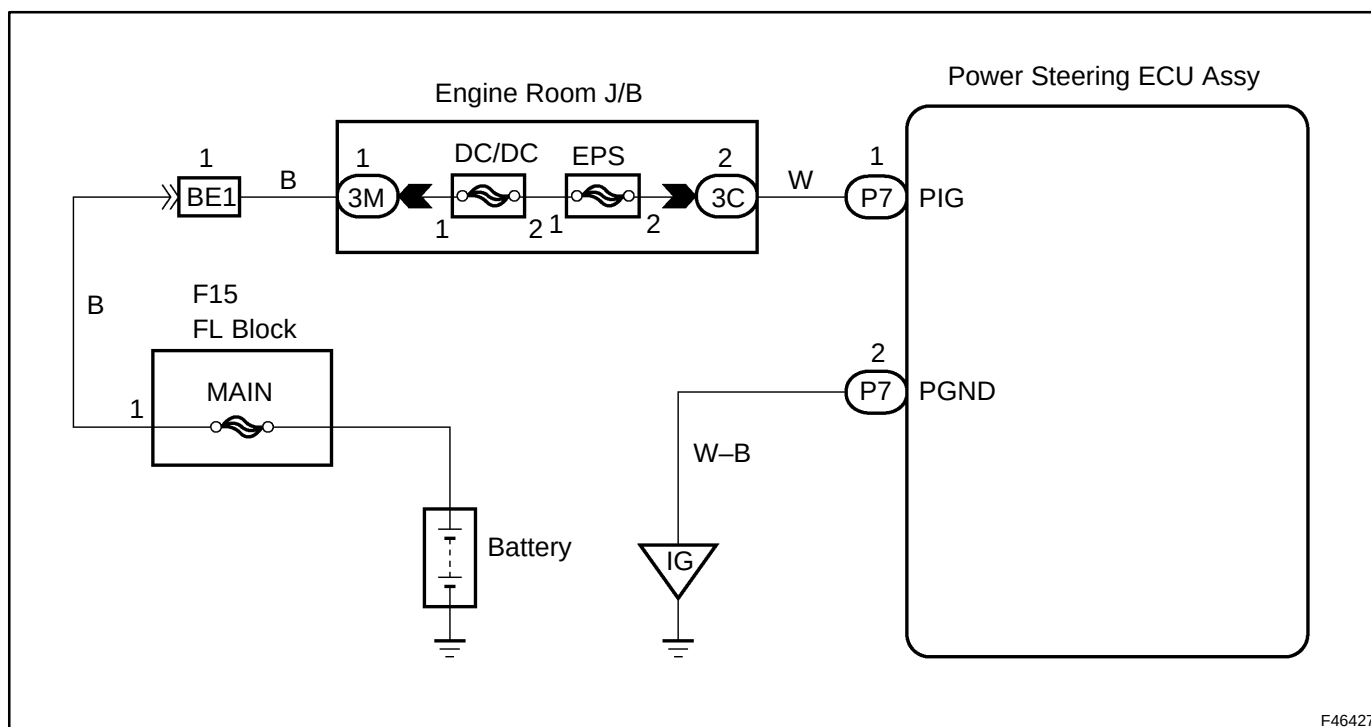
DTC	C1555	MOTOR RELAY WELDING FAILURE
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CIRCUIT DESCRIPTION

When a problem occurs in the system, the power source relay (built into the power steering ECU Assy) circuit and the motor relay (built into the power steering ECU Assy) circuit are shut off to stop power assist. It is necessary to replace the ECU when there is a problem in the relay because each relay is built into the ECU.

DTC No.	DTC Detection Item	Trouble Area
C1552	PIG power source voltage error	• EPS Fuse • Power source relay (built into the power steering ECU Assy) • Motor relay (built into the power steering ECU Assy) • PIG power source circuit • Power steering ECU Assy
C1554	Power source relay malfunction	• EPS Fuse • Power source relay (built into the power steering ECU Assy) • PIG power source circuit • Power steering ECU Assy
C1555	Motor relay malfunction	• EPS Fuse • Motor relay (built into the power steering ECU Assy) • PIG power source circuit • Power steering ECU Assy

WIRING DIAGRAM



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INSPECTION PROCEDURE

1 INSPECT FUSE(EPS FUSE)

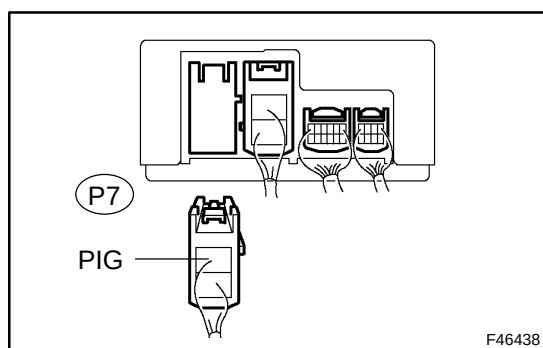
- (a) Remove the EPS fuse from the engine room J/B.
 (b) Check continuity of the EPS fuse.

Standard: Continuity

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INSPECT FOR SHORT IN ALL COMPONENTS CONNECTED TO FUSE AND REPAIR OR REPLACE THEM IF NEEDED, AND REPLACE FUSE

OK

2 CHECK HARNESS AND CONNECTOR(POWER STEERING ECU ASSY – BODY GROUND)

- (a) Disconnect the "P7" connector from the power steering ECU assy.
 (b) Measure the voltage according to the value(s) in the table below.

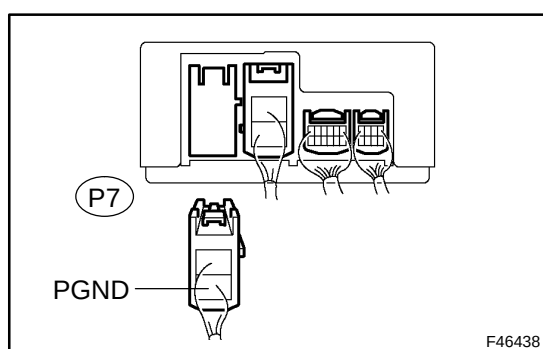
Standard:

Tester Connection	Condition	Specified Condition
P7-1 (PIG) – Body ground	Always	10 to 16 V

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3 CHECK HARNESS AND CONNECTOR(POWER STEERING ECU ASSY – BODY GROUND)

- (a) Measure the resistance according to the value(s) in the table below.

Standard:

Tester Connection	Condition	Specified Condition
P7-2 (PGND) – Body ground	Always	Below 1 Ω

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE POWER STEERING ECU ASSY (SEE PAGE 50-16)

DTC	C1581	ASSIST MAP NUMBER UN-WRITING
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CIRCUIT DESCRIPTION

The power steering ECU Assy outputs this DTC when it determines that assist map is not written in the ECU. It is necessary to replace the power steering ECU Assy when this code is output because this malfunction cannot be repaired.

HINT:

The assist map is data written in the power steering ECU Assy to control assisting power. The assist map is selected from four types based on the vehicle specification communication data (designation and grade package information).

DTC No.	DTC Detection Item	Trouble Area
C1581	Assist map is not written in the power steering ECU Assy.	Power steering ECU Assy

INSPECTION PROCEDURE

1	RECONFIRM DTC (SEE PAGE 05-1220)
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- (a) Check for DTCs.

OK:

DTCs other than C1581 are not output.

NG

REPAIR CIRCUIT INDICATED BY OUTPUT CODE (SEE PAGE 05-1226)

OK

REPLACE POWER STEERING ECU ASSY (SEE PAGE 50-16)

CALIBRATION

1. INITIALIZATION OF TORQUE SENSOR ZERO POINT CALIBRATION SIGNAL

NOTICE:

Under the following conditions, perform torque sensor zero point calibration after initializing the torque sensor zero point calibration signal in the ECU:

- The steering column assy (containing the torque sensor) has been replaced.
 - The power steering ECU assy has been replaced.
 - The steering wheel has been replaced.
 - The steering gear assy has been replaced.
 - There is a difference in steering effort between right and left.
- (a) Center the steering wheel and align the front wheels straight ahead.
- (b) Connect the hand-held tester to the DLC3.
- (c) Turn the power switch on (IG) and then initialize the torque sensor zero point calibration signal by following the tester screen.

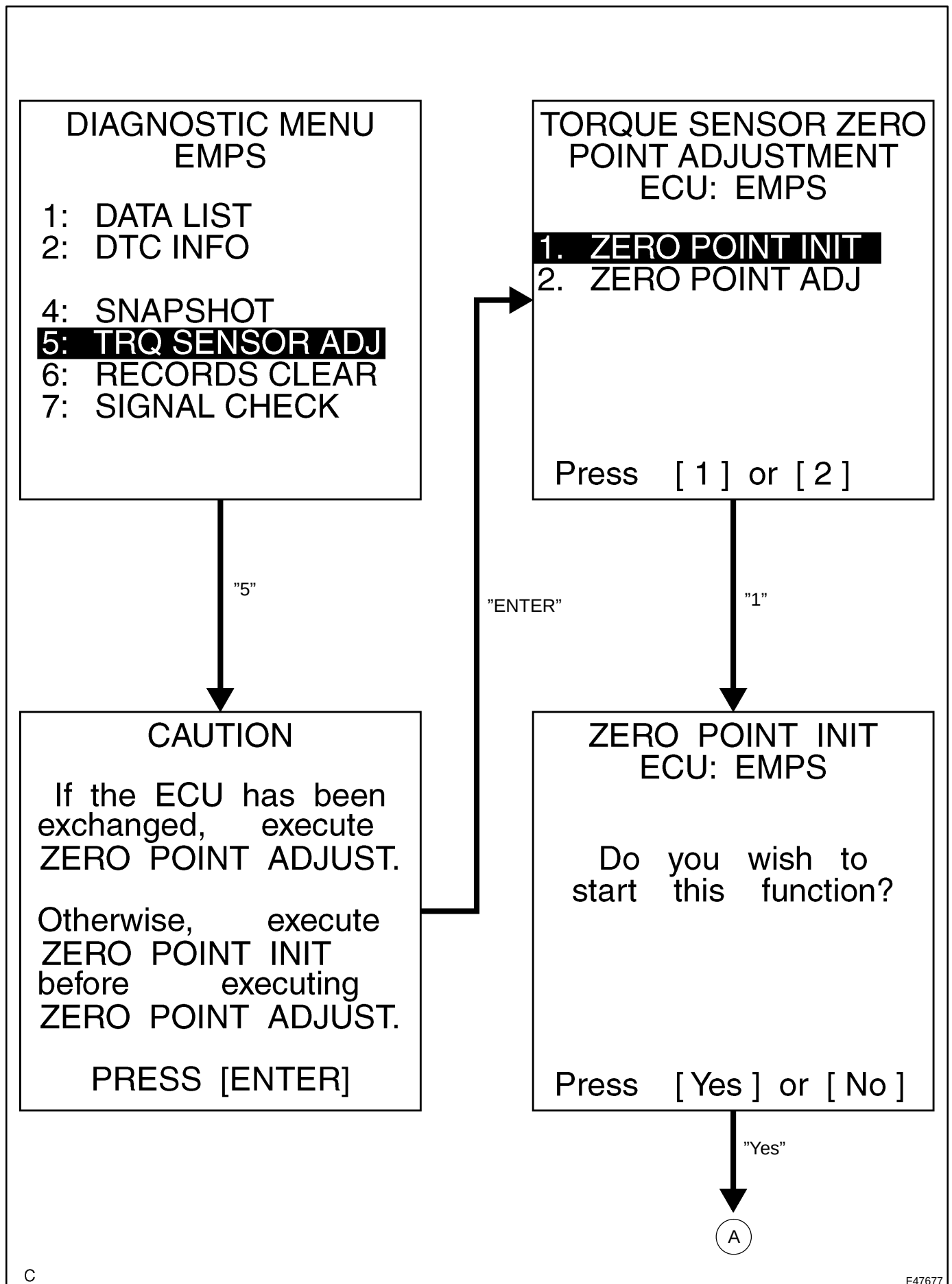
NOTICE:

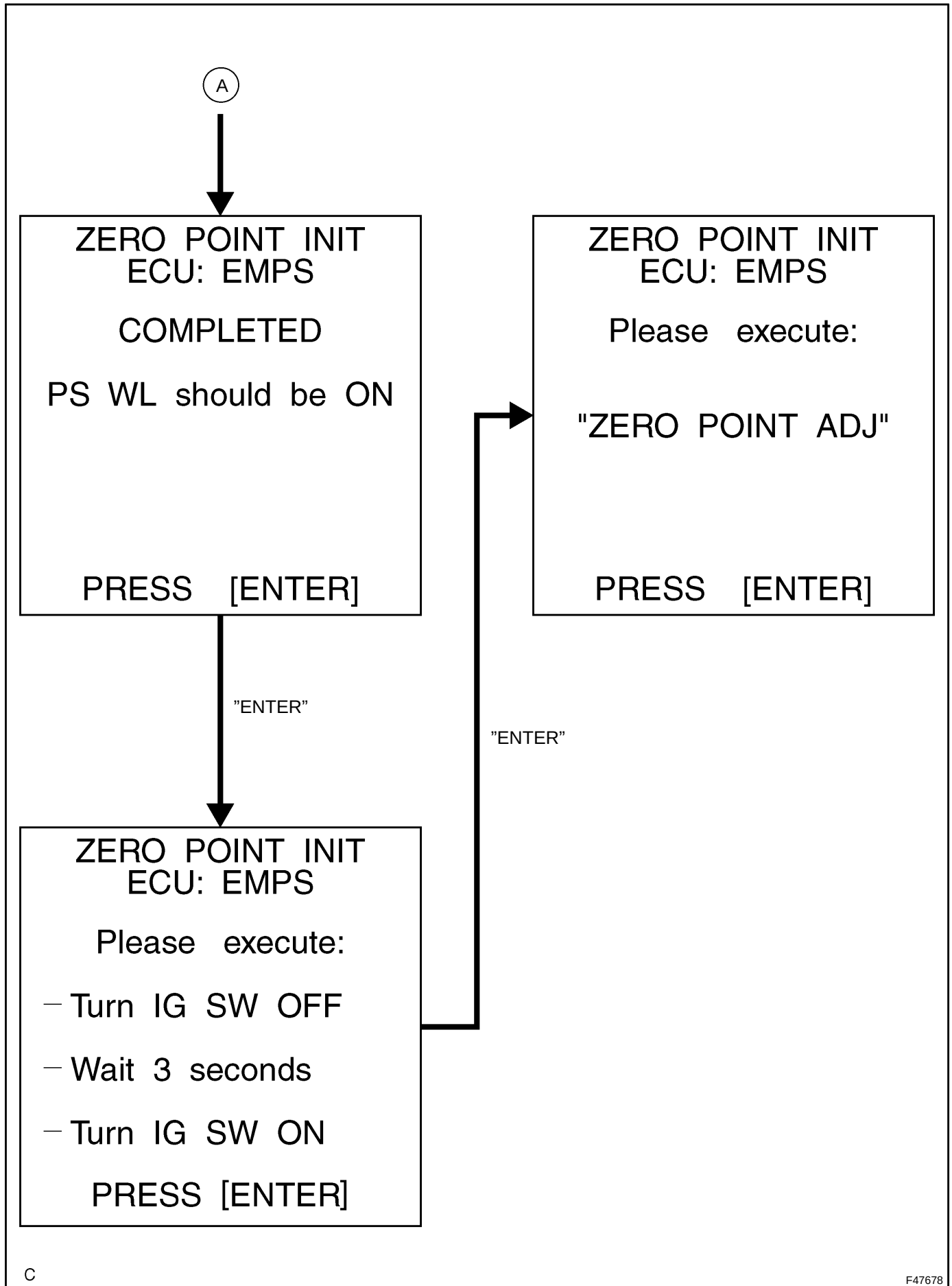
Do not turn the steering wheel while initializing the zero point calibration signal.

- (d) Perform steering zero point calibration after turning the power switch off.

NOTICE:

Zero point calibration cannot be carried out with the power switch on (IG) after initialization of the zero point calibration signal is completed.





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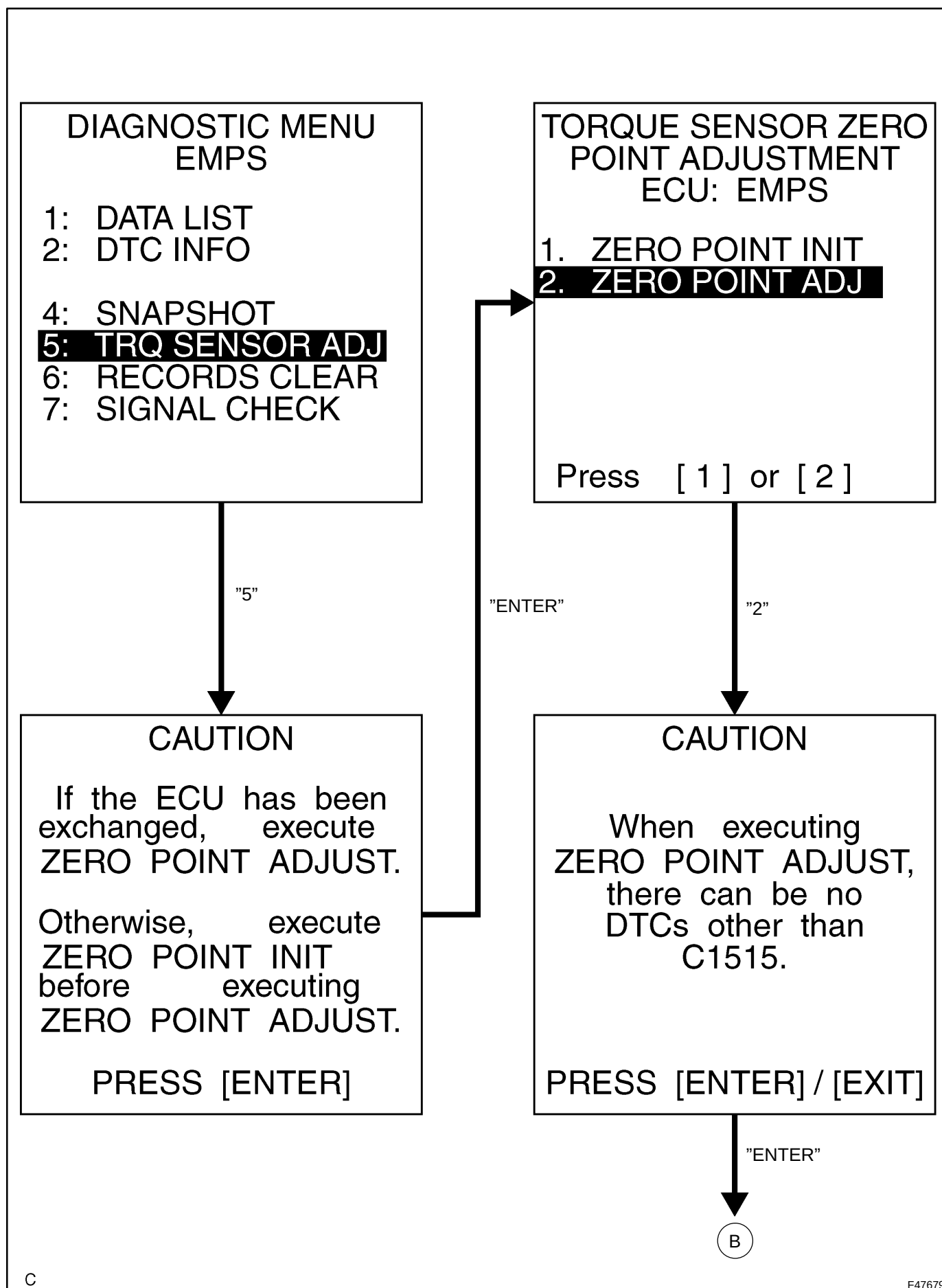
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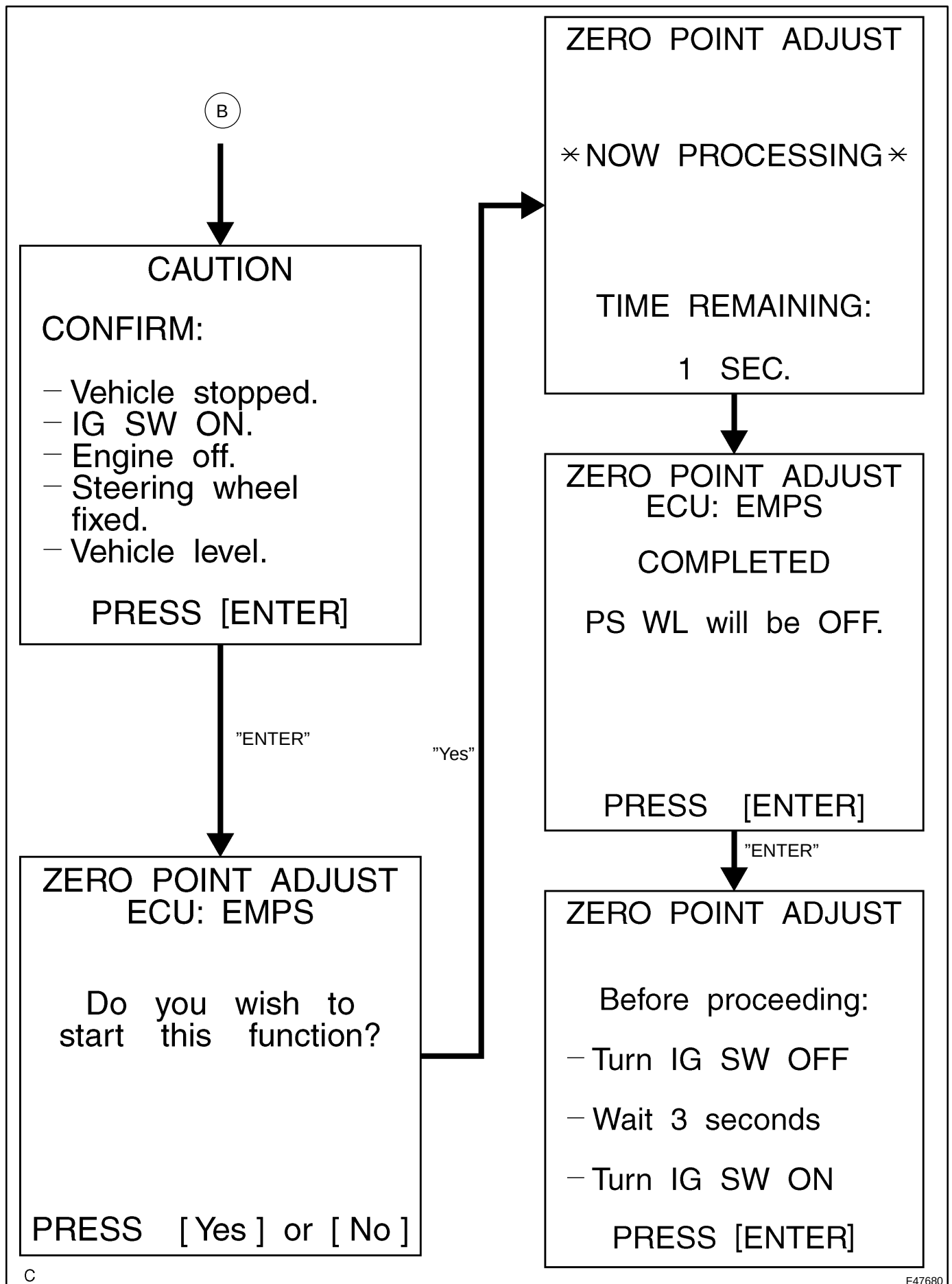
2. TORQUE SENSOR ZERO POINT CALIBRATION

- (a) Center the steering wheel and align the front wheels straight ahead.
- (b) Connect the hand-held tester to the DLC3.
- (c) Turn the power switch on (IG) and then perform the zero point calibration by following the tester screen.

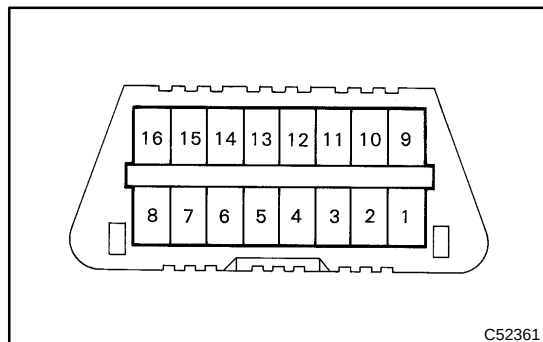
NOTICE:

- **The vehicle is stopped.**
 - **Do not start the engine. (Do not turn the power switch on (READY).)**
 - **Do not turn the steering wheel.**
 - **The vehicle is on level ground.**
- (d) Confirm that no DTCs are output after completing the operation.
 - (1) When DTC C1515 is output, see page [05-1231](#).
 - (2) When DTC C1516 is output, see page [05-1232](#).
 - (3) When DTC C1534 is output, see page [05-1235](#).





DIAGNOSIS SYSTEM



1. CHECK THE DLC3

(a) Check the DLC3:

The power steering ECU Assy uses CAN and ISO 9141-2 for communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 9141-2 format.

Symbols (Terminal No.)	Terminal Description	Condition	Specified Condition
SIL (7) – SG (5)	Bus "+" line	During transmission	Pulse generation
CG (4) – Body ground	Chassis ground	Always	Below 1 Ω
SG (5) – Body ground	Signal ground	Always	Below 1 Ω
BAT (16) – Body ground	Battery positive	Always	11 to 14 V
CANH (6) – CANL (14)	HIGH-level CAN bus line	Power switch off	54 to 67 Ω
CANH (6) – Battery positive	HIGH-level CAN bus line	Power switch off	1 M Ω or higher
CANH (6) – CG (4)	HIGH-level CAN bus line	Power switch off	3 K Ω or higher
CANL (14) – Battery positive	LOW-level CAN bus line	Power switch off	1 M Ω or higher
CANL (14) – CG (4)	LOW-level CAN bus line	Power switch off	3 K Ω or higher

HINT:

If the display shows "UNABLE TO CONNECT TO VEHICLE" after connecting the hand-held tester cable to the DLC3 and turning the ignition switch to the ON position, there is a problem either with the vehicle or the tester.

- If communication is normal when connecting the tester to another vehicle, inspect the DLC3 on the original vehicle.
- If communication is still not possible when connecting the tester to another vehicle, the problem is probably in the tester itself. Consult the Service Department listed in the tester's operator's manual.

2. WARNING LIGHT

- (a) When a problem occurs in the electric power steering system, the PS warning is indicated on the multi-display and the master warning light on the combination meter comes on to inform the driver of the problem.

DATA LIST/ACTIVE TEST

1. DATA LIST

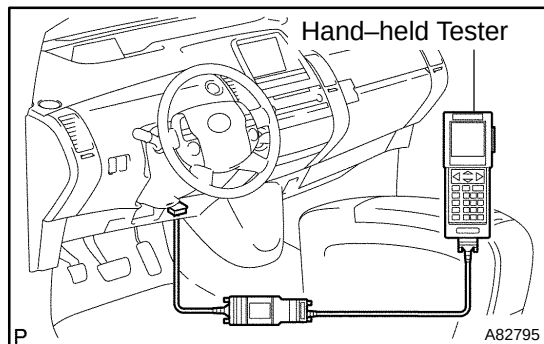
- Connect the hand-held tester to the DLC3.
- Turn the power switch on (IG).
- Operate the hand-held tester according to the steps on the display and select "DATA LIST".

Item	Item Description	Inspection Condition	Reference Value
TRQ1	Torque sensor 1 output value/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V
TRQ2	Torque sensor 2 output value/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V
TRQ3	Torque value for assist control/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V
SPD	Vehicle speed from meter/ Min.: 0 km/h, Max.: 255 km/h	1. Vehicle is stopped 2. Vehicle is driven at a constant speed	1. 0 km/h 2. No significant fluctuation
MOTOR ACTUAL	Amount of current to motor/ Min.: -128 A, Max.: 127 A	—	—
COMMAND VALUE	Demanded amount of current to motor/ Min.: -128 A, Max.: 127 A	—	—
THERMISTOR TEMP	ECU substrate temperature/ Min.: -50 °C, Max.: 205 °C	Power switch is on (IG)	—
PIG SUPPLY	Power source voltage to activate motor/ Min.: 0 V, Max.: 25.5 V	Power steering is in operation	10 to 16 V
IG SUPPLY	ECU power source voltage/ Min.: 0 V, Max.: 25.5 V	—	10 to 16 V
TRQ1 ZERO VAL	Zero point value of torque sensor 1/ Min.: 0 V, Max.: 5 V	Steering wheel is not turned (without load)	2.3 to 2.7 V
TRQ2 ZERO VAL	Zero point value of torque sensor 2/ Min.: 0 V, Max.: 5 V	Steering wheel is not turned (without load)	2.3 to 2.7 V
TRQ3 ZERO VAL	Zero point value of torque sensor for assist control/ Min.: 0 V, Max.: 5 V	Steering wheel is not turned (without load)	2.3 to 2.7 V
MTR TERMINAL (+)	Motor terminal M1 voltage/ Min.: 0 V, Max.: 25.5 V	1. Turning steering wheel to right 2. Turning steering wheel to left	1. 10 to 16 V 2. Below 1 V
MTR TERMINAL (-)	Motor terminal M2 voltage/ Min.: 0 V, Max.: 25.5 V	1. Turning steering wheel to right 2. Turning steering wheel to left	1. Below 1 V 2. 10 to 16 V
MTR OVERHEAT	Continuous overheat prevention control record/ REC/UNREC	—	—

DIAGNOSTICS – ELECTRIC POWER STEERING SYSTEM

Item	Item Description	Inspection Condition	Reference Value
MTR LOW POWER	PIG power source voltage drop record/ REC/UNREC	–	–
CONTROL MODE	Codes indicating DTC detection timing during ECU control are displayed in hexadecimal	–	–
IG ON/OFF TIMES	Number of times power switch is turned on (IG) after DTC detection/ Min.: 0 time, Max.: 255 times	–	–
# CODES	Number of detected DTCs when freeze frame data is stored/ Min.: 0 time, Max.: 255 times	–	–
ASSIST MAP	Selected assist map	–	–
ECU I.D.	ECU identification information	–	–
TEST MODE STAT	Selected mode/ NORMAL MODE/TEST MODE	–	–
READY STATUS	HV system "READY"/ OFF/ON	HV system "READY" ⇔ Not "READY"	ON ⇔ OFF

DTC CHECK/CLEAR



1. CHECK FOR DTCs

- (a) Check for DTCs.
 - (1) Connect the hand-held tester to the DLC3.
 - (2) Turn the power switch on (IG).
 - (3) Read the DTCs by following the display on the hand-held tester.

HINT:

Refer to the hand-held tester operator's manual for further details.

2. CLEAR THE DTCs

- (a) Clear the DTCs from the memory.
 - (1) Connect the hand-held tester to the DLC3.
 - (2) Turn the power switch on (IG).
 - (3) Clear the DTCs by following the display on the hand-held tester.

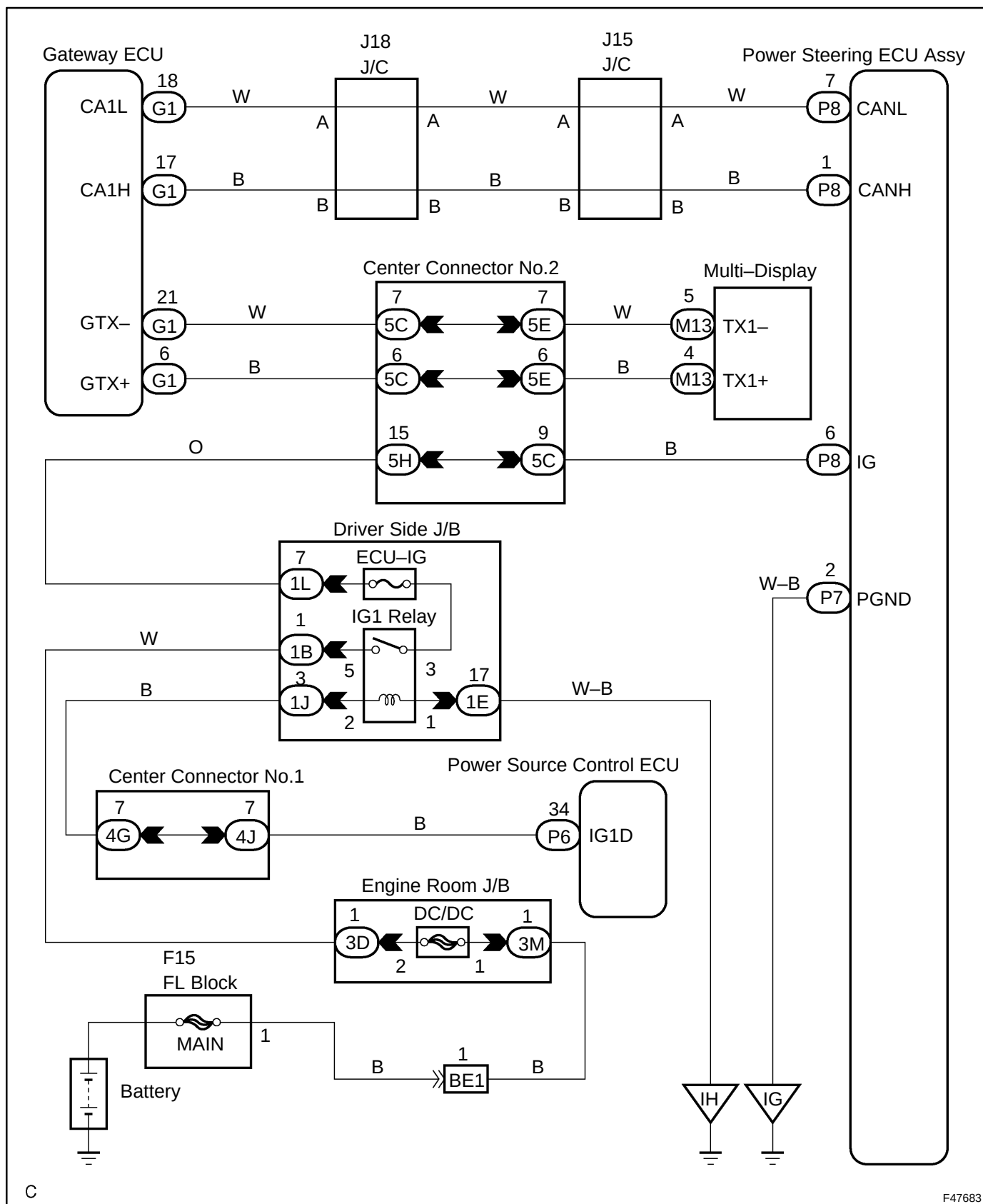
HINT:

Refer to the hand-held tester operator's manual for further details.

PS WARNING IS ALWAYS SHOWN ON MULTI-DISPLAY**CIRCUIT DESCRIPTION**

Troubleshooting procedure for a situation when no DTCs are output but PS warning is always indicated is specified here. The PS warning remains on when there is an open in the IG circuit inputting power source voltage to the power steering ECU assy.

WIRING DIAGRAM



INSPECTION PROCEDURE

1 CHECK HARNESS AND CONNECTOR

- (a) Check the indication condition of the PS warning while by wiggling the power steering ECU assy connector and wire harness up and down, and right and left.

OK:

PS warning indication does not change.

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

2 INSPECT CAN COMMUNICATION SYSTEM

- (a) Using the hand-held tester, check for DTCs and confirm that there are no problems in the CAN communication system.

OK:

DTCs are not output.

NG

**GO TO CAN COMMUNICATION SYSTEM
(SEE PAGE [05-2628](#))**

OK

3 INSPECT MULTIPLEX COMMUNICATION SYSTEM(BEAN)

- (a) Using the hand-held tester, check for DTCs and confirm that there are no problems in the multiplex communication system (BEAN).

OK:

DTCs are not output.

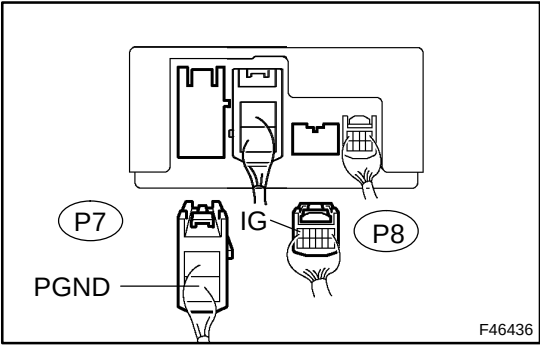
NG

**GO TO MULTIPLEX COMMUNICATION SYSTEM
(SEE PAGE [05-2549](#))**

OK

4

INSPECT POWER STEERING ECU ASSY



- (a) Disconnect the "P7" and "P8" connectors from the power steering ECU assy.
- (b) Turn the power switch on (IG).
- (c) Measure the voltage according to the value(s) in the table below.

Standard:

Tester Connection	Condition	Specified Condition
P8-6 (IG) – P7-2 (PGND)	Power switch is on (IG)	10 to 16 V

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

5

REPLACE POWER STEERING ECU ASSY (SEE PAGE 50-16)

6

CHECK PS WARNING ON MULTI DISPLAY

- (a) Check for the PS warning indication on the multi-display.

OK:

The PS warning is not indicated.

OK

END

NG

REPLACE MULTI DISPLAY (SEE PAGE 67-7)

FREEZE FRAME DATA

NOTICE:

- It is difficult to show the specified values (judgement values) clearly because freeze frame data values significantly change due to differences in measurement conditions, surroundings or vehicle conditions. Because of this reason, there may be a problem even when the values are within specifications.
 - Turn the power switch on (IG) and park the vehicle on level ground to check the freeze frame data by using the hand-held tester.
- (b) Connect the hand-held tester to the DLC3.
- (c) Turn the power switch on (IG) and check the freeze frame data by following the prompts on the display on the hand-held tester.

Item	Item Description	Inspection Condition	Reference Value
TRQ1	Torque sensor 1 output value/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V
TRQ2	Torque sensor 2 output value/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V
TRQ3	Torque value for assist control/ Min.: 0 V, Max.: 5 V	1. Steering wheel is not turned (without load) 2. Turning steering wheel to right with vehicle stopped 3. Turning steering wheel to left with vehicle stopped	1. 2.3 to 2.7 V 2. 2.5 to 4.7 V 3. 0.3 to 2.5 V
SPD	Vehicle speed from meter/ Min.: 0 km/h, Max.: 255 km/h	1. Vehicle is stopped 2. Vehicle is driven at a constant speed	1. 0 km/h 2. No significant fluctuation
MOTOR ACTUAL	Amount of current to motor/ Min.: -128 A, Max.: 127 A	—	—
COMMAND VALUE	Demanded amount of current to motor/ Min.: -128 A, Max.: 127 A	—	—
THERMISTOR TEMP	ECU substrate temperature/ Min.: -50 °C, Max.: 205 °C	Power switch is on (IG)	—
PIG SUPPLY	Power source voltage to activate motor/ Min.: 0 V, Max.: 25.5 V	Power steering is in operation	10 to 16 V
IG SUPPLY	ECU power source voltage/ Min.: 0 V, Max.: 25.5 V	—	10 to 16 V
TRQ1 ZERO VAL	Zero point value of torque sensor 1/ Min.: 0 V, Max.: 5 V	Steering wheel is not turned (without load)	2.3 to 2.7 V
TRQ2 ZERO VAL	Zero point value of torque sensor 2/ Min.: 0 V, Max.: 5 V	Steering wheel is not turned (without load)	2.3 to 2.7 V
TRQ3 ZERO VAL	Zero point value of torque sensor for assist control/ Min.: 0 V, Max.: 5 V	Steering wheel is not turned (without load)	2.3 to 2.7 V

Item	Item Description	Inspection Condition	Reference Value
MTR TERMINAL (+)	Motor terminal M1 voltage/ Min.: 0 V, Max.: 25.5 V	1. Turning steering wheel to right 2. Turning steering wheel to left	1. 10 to 16 V 2. Below 1 V
MTR TERMINAL (-)	Motor terminal M2 voltage/ Min.: 0 V, Max.: 25.5 V	1. Turning steering wheel to right 2. Turning steering wheel to left	1. Below 1 V 2. 10 to 16 V
# CODES	Number of detected DTCs when freeze frame data is stored/ Min.: 0 time, Max.: 255 times	–	–
READY STATUS	HV system "READY"/ OFF/ON	HV system "READY" ⇔ Not "READY"	ON ⇔ OFF

FAIL-SAFE CHART

When a problem occurs in the electronic motor power steering system, the PS warning is indicated on the multi-display, the master warning light on the combination meter comes on, and steering power assist is stopped, fixed at a particular point, or decreased simultaneously to protect the system.

DTC No.	Malfunction	Fail-safe
C1511 C1512 C1513 C1514 C1517	Torque sensor malfunction	Power assist stops.
C1524	Motor malfunction	Power assist stops.
C1531 C1532	Power steering ECU malfunction	Power assist stops.
C1533	Temperature sensor malfunction in power steering ECU	Amount of power assist is limited.
C1551	IG power source voltage error	Power assist stops.
C1552	PIG power source voltage error	Power assist stops.
C1554	Power source relay malfunction	Power assist stops.
C1555	Motor relay malfunction	Power assist stops.
U0073	CAN bus malfunction	Amount of power assist is fixed for a speed of 43 mph (70 km/h).
U0121	ABS (ECB) ECU communication error	Amount of power assist is fixed for a speed of 43 mph (70 km/h).
–	Extremely high temperature in ECU	Amount of power assist is limited until ECU temperature goes down.
–	Power source voltage drop	Power assist is interrupted, but normal power assist is resumed when voltage returns.

HINT:

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 that case, amount of power assist returns to normal if the steering wheel is not turned for approximately 10 minutes with the engine idling.

SYSTEM DESCRIPTION

1. DESCRIPTION

- (a) The EPS system generates torque through the operation of the motor and the reduction gear installed on the column shaft in order to assist steering effort.

Directions and amount of assisting power are determined by signals from the torque sensor built into the steering column assy and by the power steering ECU assy, and controlled in accordance with vehicle speed. As a result, steering effort is controlled to be light during low speed driving and moderately high during high speed driving.

- (1) Power steering ECU assy:

The power steering ECU assy calculates assisting power based on a steering torque signal from the torque sensor and a vehicle speed signal from the skid control ECU. It generates specified assisting torque by controlling current to the motor.

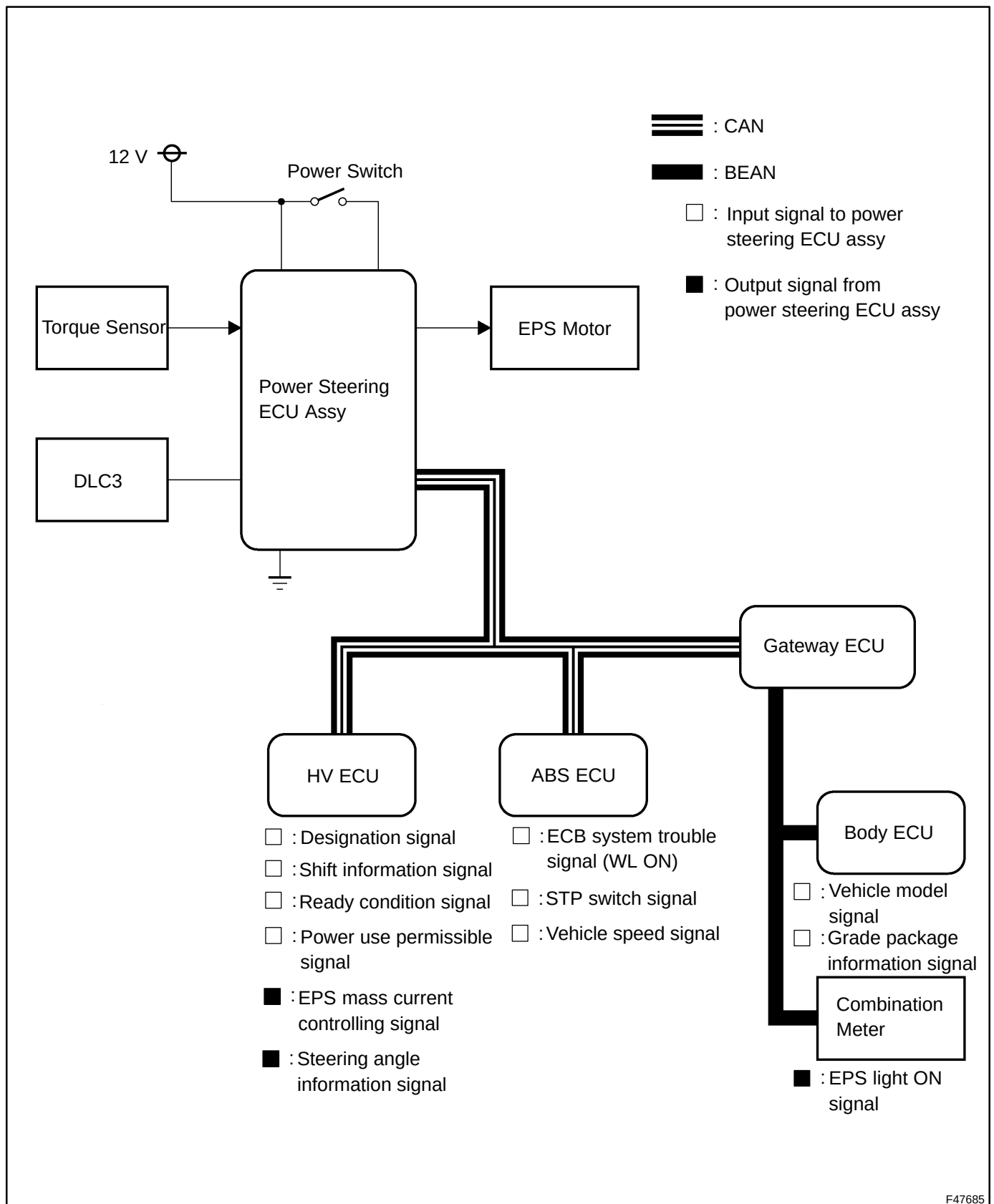
- (2) Torque sensor:

The torque sensor detects steering effort generated when the steering wheel is turned and converts it to an electrical signal.

- (3) EPS motor:

The EPS motor is activated by the current from the power steering ECU assy and generates torque to assist steering effort.

SYSTEM DIAGRAM



F47685

DTC	U0073	CONTROL MODULE COMMUNICATION BUS OFF
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DTC	U0121	LOST COMMUNICATION WITH ANTI-LOCK BRAKE SYSTEM (ABS) CONTROL MODULE
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CIRCUIT DESCRIPTION

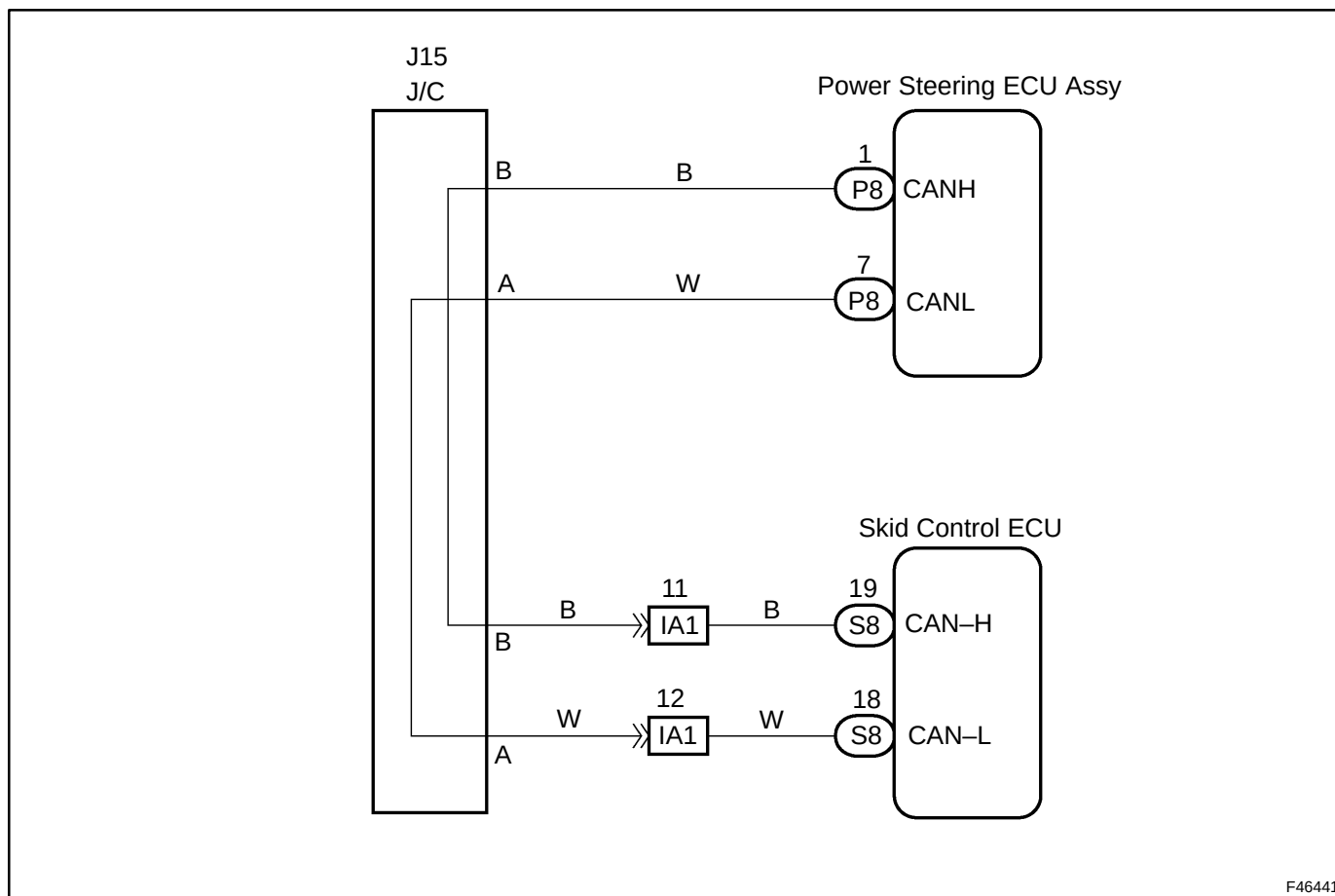
The power steering ECU Assy receives signals from the skid control ECU (ECB ECU) via CAN communication.

DTC No.	DTC Detection Item	Inspection Area
U0073	CAN communication error (CAN bus is off)	CAN communication system
U0121	Skid control ECU communication error	• CAN communication system • Skid control ECU (when only U0121 is output)

HINT:

When two or more DTCs starting with "U" are output simultaneously, inspect the connectors and wire harness of each ECU.

WIRING DIAGRAM



F46441

INSPECTION PROCEDURE

1	CHECK DTC (SEE PAGE 05-1220)
----------	---

(a) Using the intelligent tester II, check for DTCs.



GO TO CAN COMMUNICATION SYSTEM TROUBLESHOOTING (SEE PAGE 05-2602)
--

CUSTOMER PROBLEM ANALYSIS CHECK

EPS Check Sheet

Inspector's :
Name _____

Customer's Name		VIN	
		Production Date	/ /
Vehicle Model		Licence Plate No.	
Date Vehicle Brought In	/ /	Odometer Reading	km miles

Date Problem First Occurred	/ / (Engine ☐ Cold ☐ Warmed up)
Frequency Problem Occurs	☐ Continuous ☐ Intermittent (times a day)

Symptoms	☐ Steering is heavy.
	☐ Steering effort differs between right and left or is uneven.
	☐ While driving, steering effort does not change in accordance with vehicle speed.
	☐ The steering wheel does not return properly.
	☐ The steering wheel vibrates or abnormal noise comes from the steering column.
	☐ When a problem occurs: ☐ While turning the wheel around the center ☐ When turning the wheel with the vehicle stopped ☐ Always
	☐ Others

Master Warning Light Status	☐ ON ☐ OFF
Indication on Multi-display	☐ PS warning is indicated ☐ PS warning is not indicated

DTC Check	1st Time	☐ Normal System Code ☐ Trouble Code (Code)
	2nd Time	☐ Normal System Code ☐ Trouble Code (Code)

Freeze Frame Data

When any DTCs are output during the 1st time, record the freeze frame data as well as the DTCs.

DIAGNOSTIC TROUBLE CODE CHART

HINT:

If a trouble code is displayed during the DTC check, inspect the circuit listed for that code. For details of each code, refer to the "See page" under respective "DTC No." in the DTC chart.

DTC No. (See page)	Detection Item	Trouble Area
C1511 (05-1227)	Torque sensor abnormal	- Steering column assy (Torque sensor) - Power steering ECU assy
C1512 (05-1227)	Torque sensor abnormal	- Steering column assy (Torque sensor) - Power steering ECU assy
C1513 (05-1227)	Torque sensor abnormal	- Steering column assy (Torque sensor) - Power steering ECU assy
C1514 (05-1227)	Torque sensor power supply abnormal	- Steering column assy (Torque sensor) - Power steering ECU assy
C1515 (05-1231)	Torque sensor zero point adjustment undone	–
C1516 (05-1232)	Torque sensor zero point adjustment incomplete	–
C1517 (05-1227)	Torque hold abnormal	- Steering column assy (Torque sensor) - Power steering ECU assy
C1524 (05-1233)	Motor abnormal	- Power steering motor - Power steering ECU assy
C1531 (05-1235)	ECU abnormal	Power steering ECU assy
C1532 (05-1235)	ECU abnormal	Power steering ECU assy
C1533 (05-1235)	ECU abnormal	Power steering ECU assy
C1534 (05-1235)	ECU abnormal	Power steering ECU assy
C1551 (05-1236)	IG power source voltage abnormal	- ECU-IG fuse - IG power source circuit - Power steering ECU assy
C1552 (05-1238)	PIG power supply voltage abnormal	- EPS fuse - PIG power source circuit - Power steering ECU assy
C1554 (05-1238)	Power supply relay failure	- EPS fuse - PIG power source circuit - Power steering ECU assy
C1555 (05-1238)	Motor relay welding failure	- EPS fuse - PIG power source circuit - Power steering ECU assy
C1581 (05-1240)	Assist map number un-writing	Power steering ECU assy
U0073 (05-1241)	Control module communication bus off	–
U0121 (05-1241)	Lost communication with anti-lock brake system (ABS) control module	–

HOW TO PROCEED WITH TROUBLESHOOTING

Perform troubleshooting according to the following flowchart.

HINT:

- For further details, see the page given.
- The hand-held tester can be used at steps 3, 4, 7, 10 and 13.

1	VEHICLE BROUGHT TO WORKSHOP
----------	------------------------------------



2	CUSTOMER PROBLEM ANALYSIS (SEE PAGE 05-1210)
----------	---



3	CHECK DTC AND FREEZE FRAME DATA (SEE PAGE 05-1220)
----------	---

(a) Record DTCs and freeze frame data.



4	CLEAR DTC AND FREEZE FRAME DATA (SEE PAGE 05-1220)
----------	---



5	PROBLEM SYMPTOM CONFIRMATION
----------	-------------------------------------

	SYMPTOM DOES NOT OCCUR (GO TO STEP 6)
--	--

	SYMPTOM OCCURS (GO TO STEP 7)
--	--------------------------------------

6	SYMPTOM SIMULATION (SEE PAGE 01-37)
----------	--



7	CHECK DTC (SEE PAGE 05-1220)
----------	-------------------------------------

(a) Recheck for DTCs.

HINT:

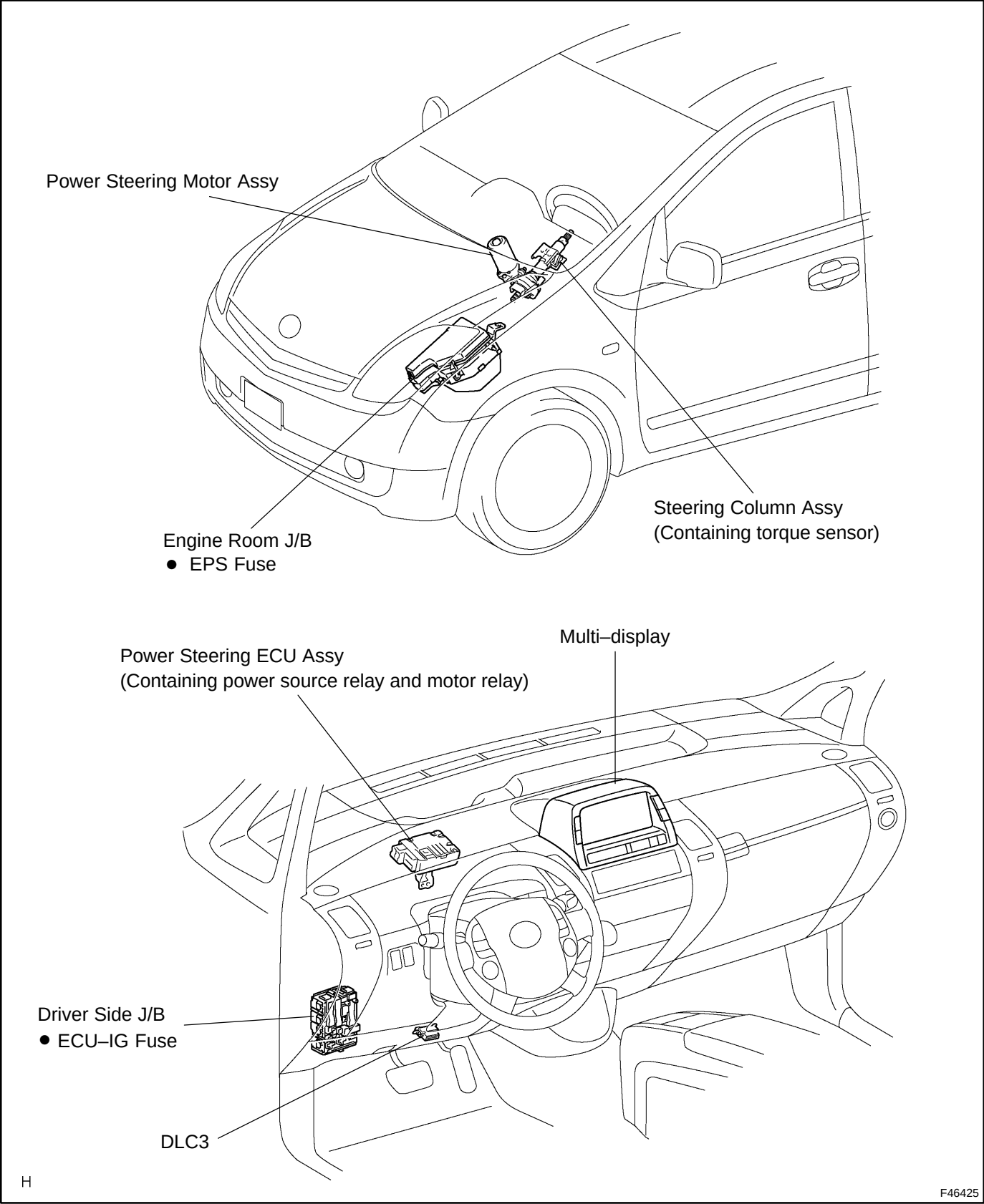
- Refer to the diagnostic trouble code chart when any DTCs are output.
- When any CAN communication system DTCs are output, perform troubleshooting on the CAN communication system first (see page 05-2628).
- When communication to the power steering ECU Assy is not established through the hand-held tester, inspect terminals SIL of the DLC3 and power steering ECU Assy and inspect the IG circuit of the power steering ECU Assy.

	NORMAL SYSTEM CODE IS OUTPUT: GO TO STEP 8
--	---

	TROUBLE CODE IS OUTPUT: GO TO STEP 9
--	---

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LOCATION



ELECTRIC POWER STEERING SYSTEM

05IP3-02

PRECAUTION

1. PRECAUTION

NOTICE FOR INITIALIZATION:

When the negative (–) battery terminal is disconnected, initialize the following system after the terminal is reconnected.

System Name	See page
Power Window Control System	01-28

NOTICES FOR HYBRID SYSTEM ACTIVATION:

- When the warning lamp is illuminated or the battery has been disconnected and reconnected, pressing the power switch may not start the system on the first try. If so, press the power switch again.
- With the power switch's power mode changed to ON (IG), disconnect the battery. If the key is not in the key slot during reconnection, DTC B2799 may be output.

2. HANDLING PRECAUTIONS

(a) When handling the electronic parts:

- (1) Avoid any impact to electronic parts such as ECUs and relays. Replace with new ones if dropped or subjected to a severe blow.
- (2) Do not expose any electronic parts to high temperature and humidity.
- (3) Do not touch the connector terminals in order to prevent deformation or malfunctions due to static electricity.
- (4) When the power steering ECU Assy has been replaced with a new one, perform steering zero point calibration (see page 05-1211).

(b) When handling the steering column Assy:

- (1) Avoid any impact to the steering column Assy, especially to the motor or torque sensor. Replace with new parts if dropped or subjected to a severe blow.
- (2) Do not pull on the wire harness when moving the steering column Assy.
- (3) When the steering column Assy has been replaced, perform steering zero point calibration after initializing the steering zero point calibration signal (see page 05-1211).

(c) When disconnecting and reconnecting the connectors:

- (1) When disconnecting the connector related to the electric power steering system, turn the power switch on (IG), center the steering wheel, turn the power switch off, and then disconnect the connector.
- (2) When reconnecting the connector related to the electric power steering system, ensure that the power switch is off. Center the steering wheel and then turn the power switch on (IG).

NOTICE:

Do not turn the power switch on (IG) when the steering wheel is not centered.

- (3) If the above operations are not carried out properly, the steering center point (zero point) will deviate, which may lead to a difference in steering effort between right and left. If there is a difference in steering effort between right and left, perform steering zero point calibration (see page 05-1211).

3. PRECAUTIONS FOR CAN COMMUNICATION

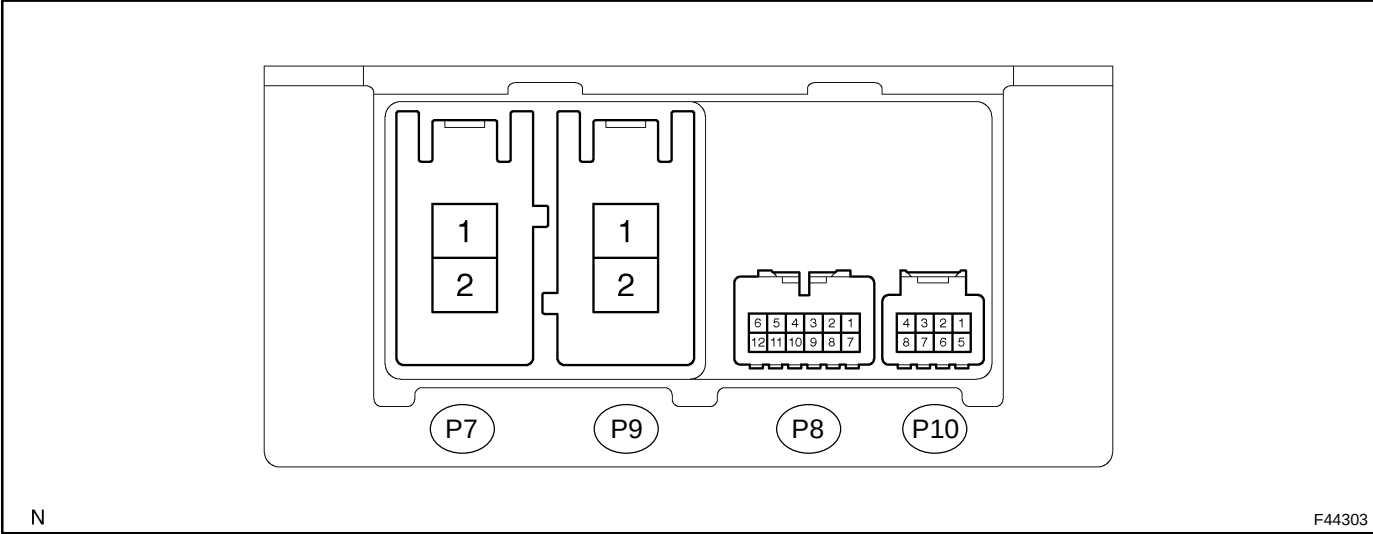
- (a) CAN communication is used to receive information from the skid control ECU (ECB ECU) and to transmit warnings to the meter and the multi-display. When there are any problems in the CAN communication lines, DTCs indicating the communication line malfunctions are output.
- (b) Perform troubleshooting for the communication line problems when the CAN communication DTCs are output. Be sure to start troubleshooting on the electronic motor power steering system when data communication is normal.
- (c) Temporary fix or repair with bypass wiring, etc. is impossible because the length and path of each CAN communication line is specified.

PROBLEM SYMPTOMS TABLE

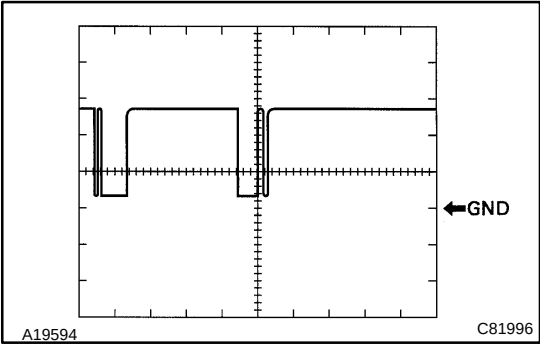
If the problem still occurs even after the normal system code was displayed during the DTC check, check the components for each problem symptom in the order given in the following table and proceed to the relevant troubleshooting page.

Symptom	Suspected Area	See page
Steering is heavy	1. Front tires (Improperly inflated, unevenly worn) 2. Front wheel alignment (Incorrect) 3. Front suspension (Lower ball joint) 4. Steering gear assy 5. Torque sensor (built into steering column) 6. Steering column assy 7. Power steering motor 8. Battery and power source system 9. Power source voltage of power steering ECU assy 10. Power steering ECU assy	28-1 26-6 26-22 51-6 50-8 50-8 50-8 – 01-37 01-37
Steering effort differs between right and left or is uneven	1. Steering center point (zero point) is not recorded completely 2. Front tires (Improperly inflated, unevenly worn) 3. Front wheel alignment (Incorrect) 4. Front suspension (Lower ball joint) 5. Steering gear assy 6. Torque sensor (built into steering column) 7. Steering column assy 8. Power steering motor 9. Power steering ECU assy	05-1211 28-1 26-6 26-22 51-6 50-8 50-8 50-8 01-37
While driving, steering effort does not change in accordance with vehicle speed or steering wheel does not return properly	1. Front suspension 2. Speed sensor 3. Skid control ECU 4. Engine speed detection circuit 5. ECM 6. Torque sensor (built into steering column) 7. Power steering motor 8. Power steering ECU assy 9. Controlling CAN communication system	– 32-62 32-68 – 10-24 50-8 50-8 01-37 05-2602
Clunking sound occurs when turning steering wheel back and forth while power steering is in operation	1. Front suspension 2. Steering intermediate shaft 3. Steering gear assy	– – 51-6
Friction sound occurs when turning steering wheel during low speed driving	1. Power steering motor 2. Steering column assy	50-8 50-8
High-pitched sound (squeaking) occurs when turning steering wheel slowly with vehicle stopped	Power steering motor	50-8
Steering wheel vibrates and noise occurs when turning steering wheel with the vehicle stopped	1. Power steering motor 2. Steering column assy	50-8 50-8
PS warning is always indicated on multi-display	Refer to flowchart	05-1243

TERMINALS OF ECU



Symbols (Terminals No.)	Wiring Color	Terminal Description	Condition	Specified Condition
PIG (P7-1) – PGND (P7-2)	W – W-B	EPS fuse	Always	10 to 16 V
PGND (P7-2) – Body ground	W-B – Body ground	Body ground	Always	Below 1 Ω
M1 (P9-1) – PGND (P7-2)	R – W-B	Power steering motor	•With power switch on (IG), turn the steering wheel to left •With power switch on (IG), turn the steering wheel to right	Below 1 V 10 to 16 V
M2 (P9-2) – PGND (P7-2)	B – W-B	Power steering motor	•With power switch on (IG), turn the steering wheel to left •With power switch on (IG), turn the steering wheel to right	10 to 16 V Below 1 V
CANH (P8-1) – CANL (P8-7)	B – W	CAN BUS	Power switch is off	108 to 132 Ω
SIL (P8-2) – PGND (P7-2)	W – W-B	DLC3	Communication is established by connecting the intelligent tester II to the DLC3	Pulse generation (See waveform 1)
IG (P8-6) – PGND (P7-2)	B – W-B	ECU-IG fuse	Power switch is on (IG)	10 to 16 V
TRQ1 (P10-5) – PGND (P7-2)	B – W-B	Torque sensor	With power switch on (IG), turn the steering wheel to left and right	0.3 to 4.7 V
TRQV (P10-6) – PGND (P7-2)	Y – W-B	Torque sensor	Power switch is on (IG)	7.5 to 8.5 V
TRQ2 (P10-7) – PGND (P7-2)	R – W-B	Torque sensor	With power switch on (IG), turn the steering wheel to left and right	0.3 to 4.7 V
TRQG (P10-8) – PGND (P7-2)	W – W-B	Torque sensor	Always	Below 1 Ω



Waveform 1

Reference:

Terminal	SIL – Body ground
Tool setting	5 V/DIV, 1 ms/DIV
Condition	Communication is established by connecting the intelligent tester II to the DLC3