CERATO

DIAGNOSTIC EQUIPMENT FUNCTIONS
Cerato Option

CERDG2H/2/1

Content

Smart key code saving

- B1676 immobilizer - smarta message error
- B1690 immobilizer - smarta no response
- B1695 immobilizer - EMS memory error
- B1696 immobilizer - authentication fail
- B1699 immobilizer - twice overtrial

Smart key all systems

- B 1602 CAN error
- B1603 CAN bus off
- B1609 CAN timeout between SMK and BCM
- B1625 ECM communication data failure
- B1689 CAN time-out PDM
- B1971 parking position input error
- B1978 electric steering column lock failure

Smart key power distribution module

- B1602 CAN error
- B1603 CAN bus off
- B1987 sub micom failed
- B1988 ESCL battery short circuit to battery
- B1989 ESCL ground short circuit to battery
- B1990 ESCL battery short circuit to ground

Component Location

General Description

1. The PIN is porgrammed in memory of Smart Key ECM, ESCL, PDM, FOB key.
2. The learnt FOB Key identifiers are stored in Smart Key ECM and PDM memory.
3. Corresponding PIN code is learnt and memorized in the Engine ECM

Communication between smart key ECM and ECM, has 2 phase that is IG ON and Engine ON.
After this first IG ON transition phase or starting phase, a commnication between Smart Key ECM and Engine ECM takes place.

■ IG ON Phase (FOB key or Fob Key in Fob holder)

1. Communication between Smart key ECM and ECM, starts from wake-up signal from ECM.
2. After receiving wake-up signal from ECM, Smart Key ECM sends lock or unlock starting signal to ECM.

■ Starting Phase (FOB key or FOB key in Fob Holder)

1. In case driver tries to start engine, although Engine ECM is locked status for starting at IG ON, Engine ECM should send re-authentication to Smart Key ECM. According to the results of re-authentication, it would be decided to start engine or not.
   The Engine ECM controls the engine, in a normal way for starting and running, and starts communication with the Smart Key ECM, sending a PIN request to the Smart Key ECM and waiting for valid release message from it until the release time period has ended.
   In case of Smart Key ECM immobilizer function is locked, the Smart Key ECM answer is the no release message. Engine ECM enters in the locked state, which causes the activation of the imobilization actions of the engine.
   In case of Smart Key ECM immobilizer function state is released, the Smart Key ECM answer is the release message, in cluding the information Smart Key ECM inlearnt mode and the PIN code.

DTC Description

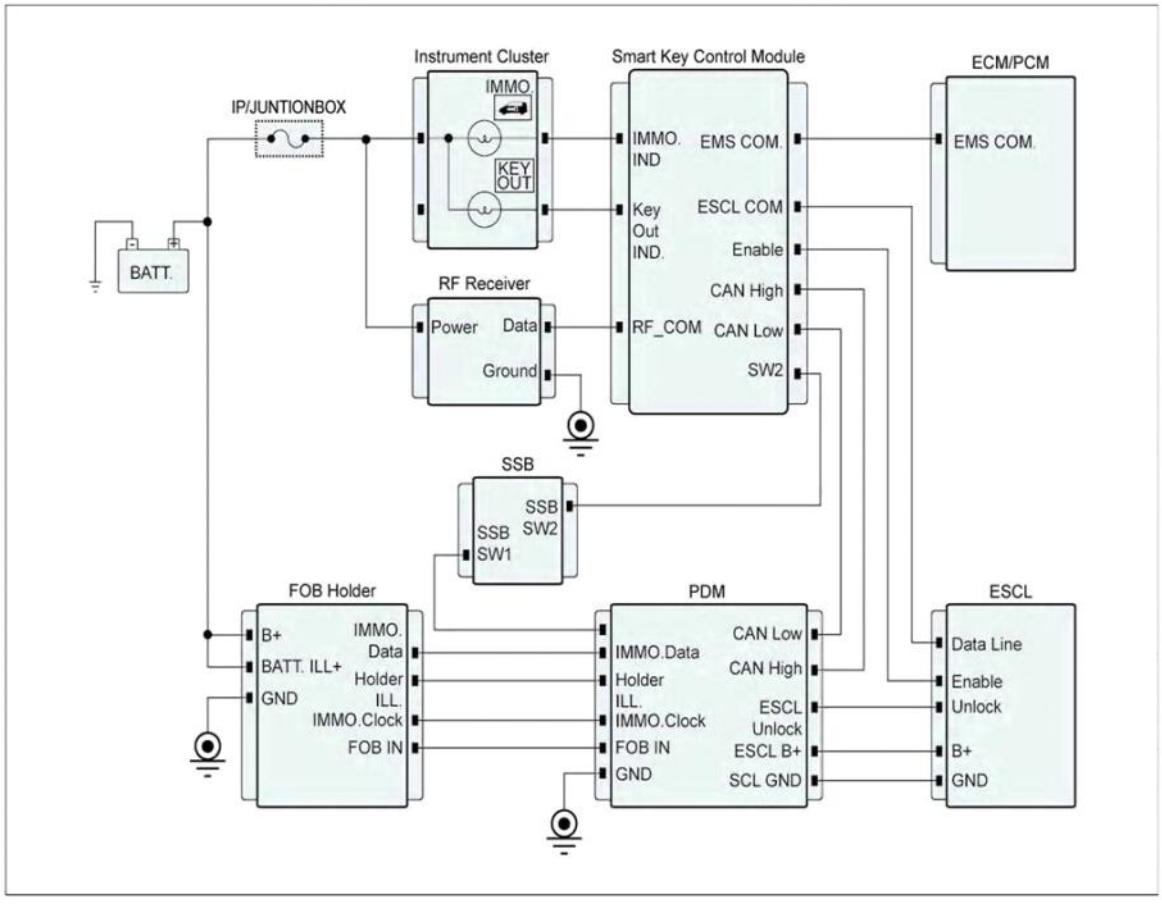
This DTC is set, after Engine ECM sends wake-up signal, if response signal from Smart key ECM is abnormal structure or is not valid message during engine ECM communication.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	

Detecting time	• 1.5 sec.	• Faulty Smart Key ECM
Threshold value	• Data error or timing error 1. Data error : Head value error, checksum value error, Smart Key status unknown error 2. Timing Error : Interval time of response from Smart key ECM after ECM request signal is longer than 40mS	

Diagnostic Circuit



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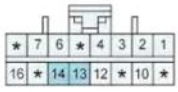
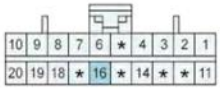


13. Key_Out IND.
14. IMMO. IND

<Instrument Cluster>

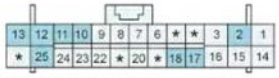


16. Steering Angle Sensor

<RF Receiver>

1. Data
3. Ground
4. Power

<SMK Control Module>

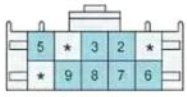


2. IMMO.IND
10. CAN High
11. CAN Low
12. ESCL COM
13. RF_COM
17. Key_Out IND
18. ESCL Enable
25. EMS_COM

<ESCL>

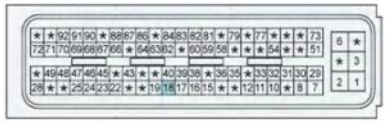
2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL Unlock
6. ESCL Data Line

<FOB Holder>



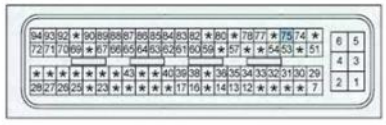
2. IMMO. Clock
3. Holder ILL
5. Ground
6. Power
7. IMMO. Data
8. ILL. (+)
9. Key In S/W

<ECM/PCM>



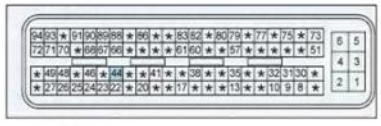
18. EMS_COM

<ECM/PCM>



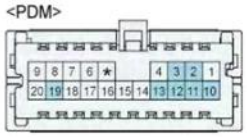
75. EMS_COM

<ECM/PCM>



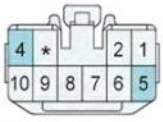
44. EMS_COM

<PDM>



2. IMMO. Clock
3. IMMO. Data
10. CAN Low
11. CAN High
12. FOB IN
13. ESCL Unlock
19. Holder ILL

<PDM>



4. ESCL Power
5. ESCL Ground

Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF".
2. Erase DTC after connecting GDS.
3. Check Smart key status if DTC is retrieved.

Fig.1) It shows that 2(two) FOB key is registered, Smart Key ECM is learnt status.

4. Is the Smart key ECM learnt status ?

YES	▸ Fault is intermittent caused by poor contact in Smart key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Component Inspection" procedure.

Component Inspection

■ Check Smart Key ECM Insepction

1. IG KEY "ON" & Engine "OFF"
2. Neutralize smart key ECM with GDS.
3. Perform key teaching procedure for smart key ECM with GDS.

> **CAUTION**
>
> Pin code must be prepared to Neutralize Smart Key ECM and to perform key teaching procedure.

4. Is the neutralization of Smart Key ECM, Engine ECM and key teaching normal ?

YES	▸ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Substitute with a known-good Smart Key ECM and check for proper operation. If the problem is corrected, replace Smart Key ECM and then go to "Verification of Vehicle Repair" procedure.

> **NOTICE**
>
> ■ PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.
> 1) If the Smart key ECM is not registered with PIN, key teaching process is not proceeded.
> 2) Registering PIN is available after Smart Key ECM is neutralized.
> 3) Neutralization of Engine ECM is available with GDS (Registering PIN code)
> 4) If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.
> 5) Registering PIN code is only possible for virgin or neutralized status.
>
> ■ It is possible to acess to All of the learning procedue only with GDS.
> And, FOB key must be inserted in FOB holder in order to proceed learning procedure.
> (There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)
>
> • Smart Key ECM Learning
> 1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.
> 2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.
> 3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.
> 4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wail for 1 hour.
>
> • PDM Learning
> 1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.
> 2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and Smart key ECM
>
> • ESCL Learning
> 1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component Location

General Description

1. The secret key code is porgrammed in memory of Smart Key ECM, ESCL, PDM, FOB key
2. The learnt FOB Key identifiers are stored in Smart Key ECM and PDM memory.
3. Corresponding PIN code is learnt and memorized in the Engine ECM

Communication between smart key ECM and ECM, has 2 phase that is IG ON and Engine ON.
After this first IG ON transition phase or starting phase, a commnication between Smart Key ECM and Engine ECM takes place.

■ IG ON Phase (FOB key or Fob Key in Fob holder)

1. Communication between Smart key ECM and ECM starts from wake-up signal from ECM.
2. After receiving wake-up signal from ECM, Smart Key ECM sends lock or unlock starting signal to ECM.

■ Starting Phase (FOB key or FOB key in Fob Holder)

1. In case driver tries to start engine, although Engine ECM is locked status for starting at IG ON, Engine ECM should send re-authentication to Smart Key ECM. According to the results of reauthentication, it would be decided to start engine or not.
   The Engine ECM controls the engine, in a normal way for starting and running, and start scommunication with the Smart Key ECM, sending a PIN request to the Smart Key ECMand waiting for valid release message from it until the release time period has ended.
   In case of Smart Key ECM immobilizer function is locked, the Smart Key ECM answer is the no release message. Engine ECM enters in the locked state, which causes the activation of the imobilization actions of the engine.
   In case of Smart Key ECM immobilizer function state is released, the Smart Key ECM answer is the release message, in cluding the information Smart Key ECM in learnt mode and the PIN code.

DTC Description

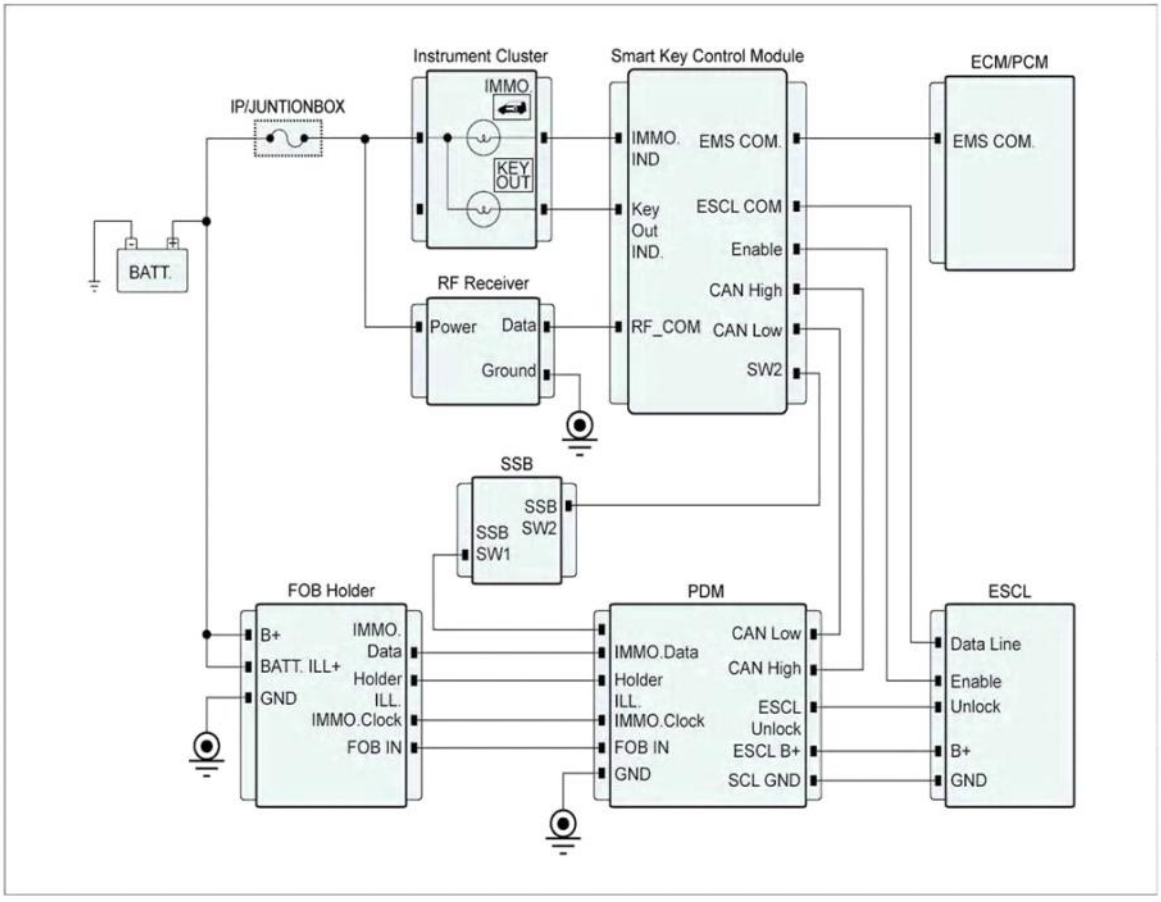
DTC P1690 is set Engine ECM has not received any signals related starting engine, Although Engine ECM sends wake up signal to Smart Key ECM.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	

Detecting time	• 1.5 seconds	• Open or short in circuit • Faulty Smart Key ECM
Threshold value	• No response form Smart Key ECM (Communication line error -Open or short)	

Diagnostic Circuit



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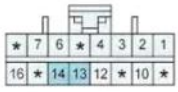
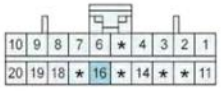


13. Key_Out IND.
14. IMMO. IND

<Instrument Cluster>

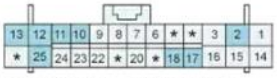


16. Steering Angle Sensor

<RF Receiver>

1. Data
3. Ground
4. Power

<SMK Control Module>

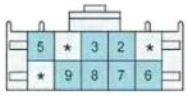


2. IMMO.IND
10. CAN High
11. CAN Low
12. ESCL COM
13. RF_COM
17. Key_Out IND
18. ESCL Enable
25. EMS_COM

<ESCL>

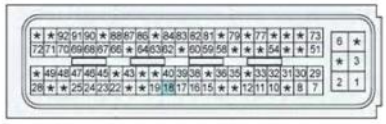
2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL Unlock
6. ESCL Data Line

<FOB Holder>



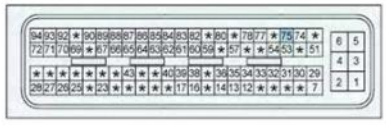
2. IMMO. Clock
3. Holder ILL
5. Ground
6. Power
7. IMMO. Data
8. ILL. (+)
9. Key In S/W

<ECM/PCM>



18. EMS_COM

<ECM/PCM>



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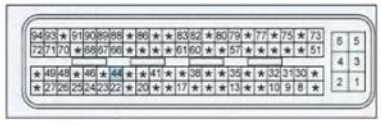
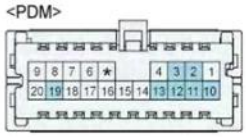
<ECM/PCM>



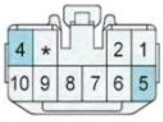
44. EMS_COM

<PDM>



2. IMMO. Clock
3. IMMO. Data
10. CAN Low
11. CAN High
12. FOB IN
13. ESCL Unlock
19. Holder ILL

<PDM>



4. ESCL Power
5. ESCL Ground

Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF".
2. Erase DTC after connecting GDS.
3. Check Smart Key ECM status parameter if DTC is retrieved.

Fig.1) It shows that 2(two) FOB key is registered, Smart Key ECM is learnt status.

4. Is the smart Key ECM learnt ?

YES	▸ Fault is intermittent caused by poor contact in Smart key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Wire Harness Inspection" procedure.

Terminal and Connector Inspection

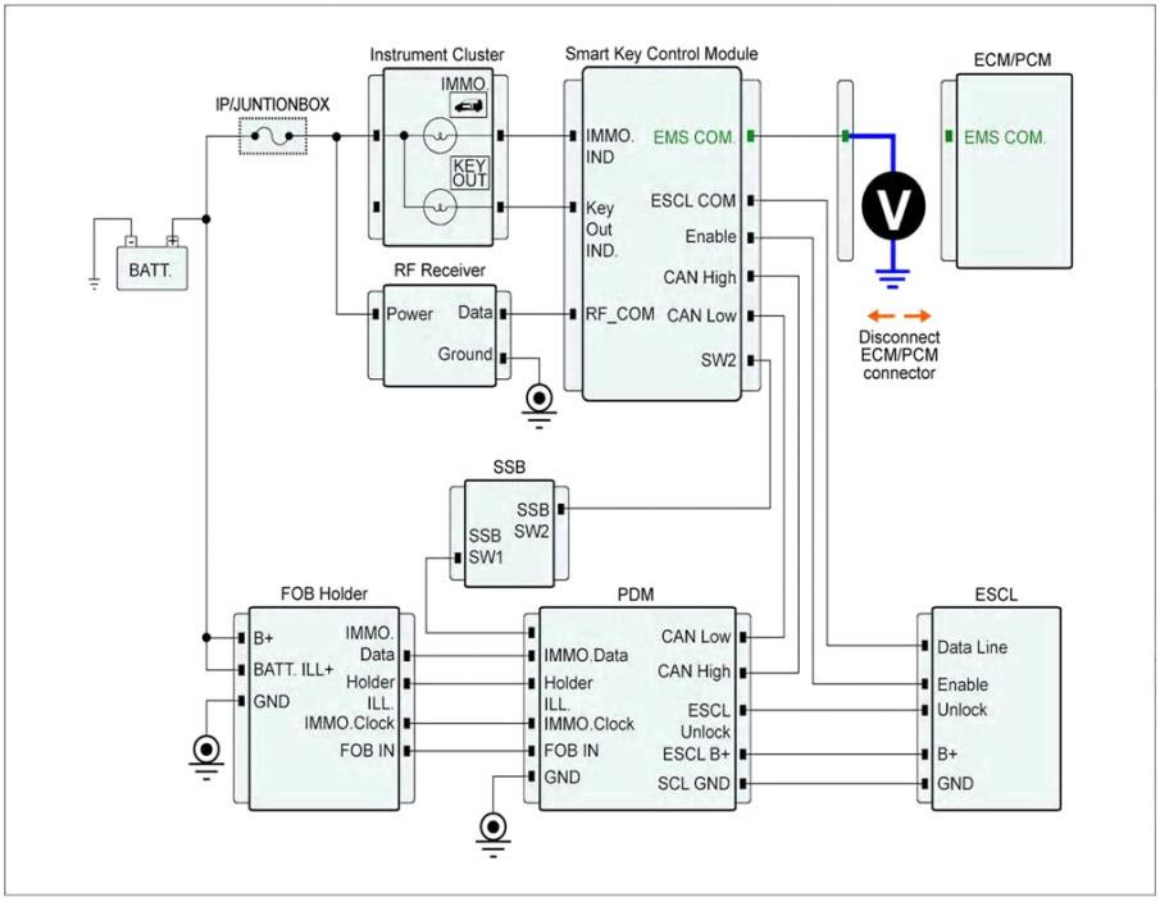
1. Many malfunctions in the electrical system are caused by poor harness and terminal connections.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

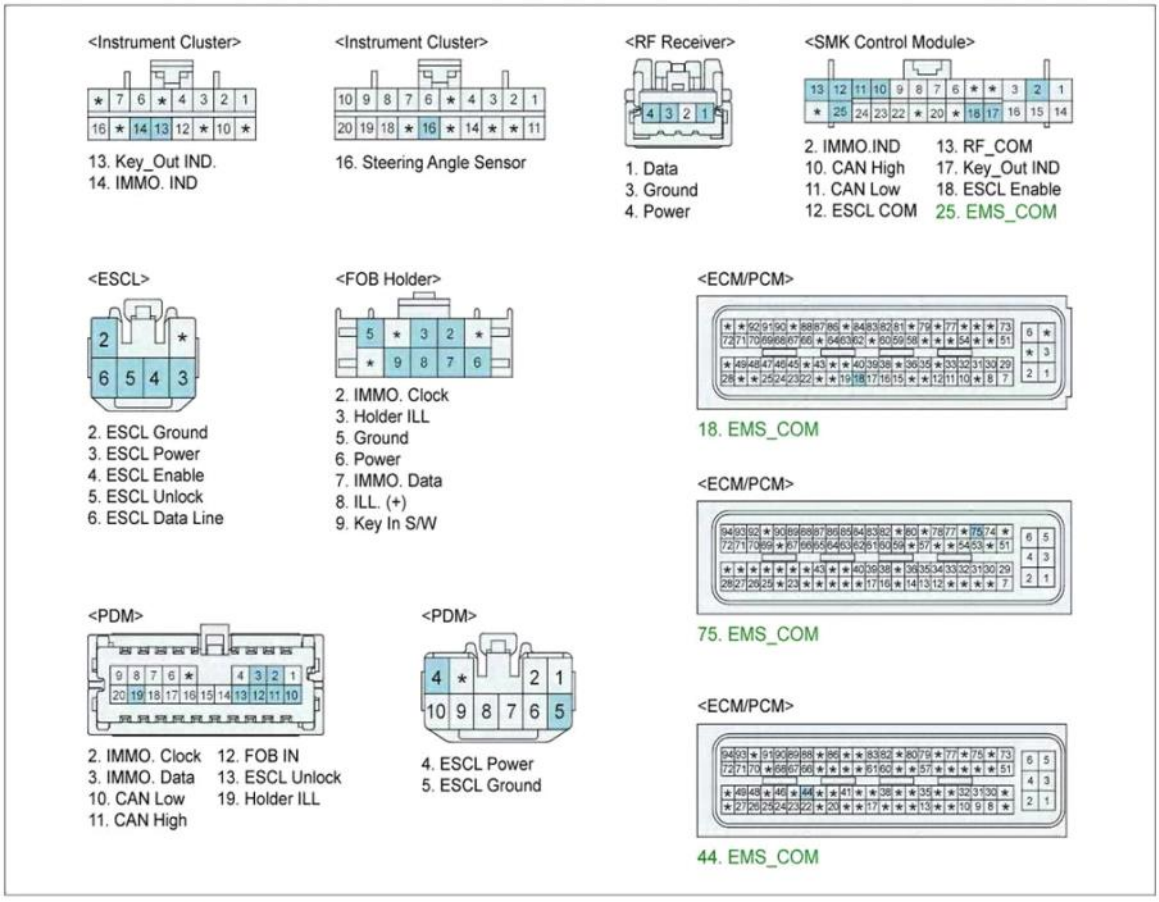
YES	▸ Repair as necessary and go to "Verification Vehicle Repair" procedure
NO	▸ Go to "Signal Circuit Inspection" procedure.

Signal Circuit Inspection

1. IG KEY OFF.
2. Disconnect Engine ECM connector.
3. IG KEY "ON"
4. Measure voltage between signal terminal of ECM harness connector and chassis ground.

Specification : About 12V


Instrument Cluster
IMMO.
KEY OUT
Smart Key Control Module
IMMO. IND
EMS COM.
Key Out IND.
ESCL COM
Enable
CAN High
CAN Low
SW2
RF_COM
ECM/PCM
EMS COM.
IP/JUNTIONBOX
BATT.
RF Receiver
Power
Data
Ground
Disconnect ECM/PCM connector
SSB
SSB
SSB SW2
SSB SW1
FOB Holder
B+
BATT. ILL+
GND
IMMO. Data
Holder
ILL.
IMMO.Clock
FOB IN
PDM
IMMO.Data
Holder
ILL.
IMMO.Clock
FOB IN
GND
CAN Low
CAN High
ESCL Unlock
ESCL B+
SCL GND
ESCL
Data Line
Enable
Unlock
B+
GND



5. Is the measured voltage within specification ?

YES	▸ Go to "Component Inspection" procedure.
NO	▸ Check open or short to signal circuit and then, go to "Verification of Vehicle Repair " procedure.

Component Inspection

■ Check Smart Key ECM insepction

1. IG KEY "ON" & Engine "OFF"
2. Neutralize smart key ECM with GDS.
3. Perform key teaching procedure for smart key ECM with GDS.

> **CAUTION**
>
> Pin code must be prepared to Neutralize Smart Key ECM and to perform key teaching procedure.

4. Is the neutralization of Smart Key ECM, Engine ECM and key teaching normal ?

YES	▸ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Substitute with a known-good Smart Key ECM and check for proper operation. ▸ If the problem is corrected, replace Smart Key ECM and then go to "Verification of Vehicle Repair" procedure.

> **NOTICE**
>
> ■ PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.
> 1) If the Smart key ECM is not registered with PIN, key teaching process is not proceeded.
> 2) Registering PIN is available after Smart Key ECM is neutralized.
> 3) Neutralization of Engine ECM is available with GDS (Registering PIN code)
> 4) If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.
> 5) Registering PIN code is only possible for virgin or neutralized status.
>
> ■ It is possible to acess to All of the learning procedue only with GDS.
> And, FOB key must be inserted in FOB holder in order to proceed learning procedure.
> (There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)
>
> • Smart Key ECM Learning
> 1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.
> 2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.
> 3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.
> 4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wail for 1 hour.
>
> • PDM Learning
> 1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.
> 2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and Smart key ECM
>
> • ESCL Learning
> 1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status.
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component Location

General Description

Information related immobilizer,that are classified as 2(two) parts independently, is memorized in EEPROM. ECM check these 2(two) information berfore proceeding immobilizer authentication. With synchronized both information, ECM starts immobilizer authentication procedure. If both information is not synchronized, ECM stops immobilizer authentication, Limphome function will not be activated, and memorizes DTC P1695. If DTC P1695 is retrieved again, after performing new key teaching procedure, ECM should be replaced with new one.

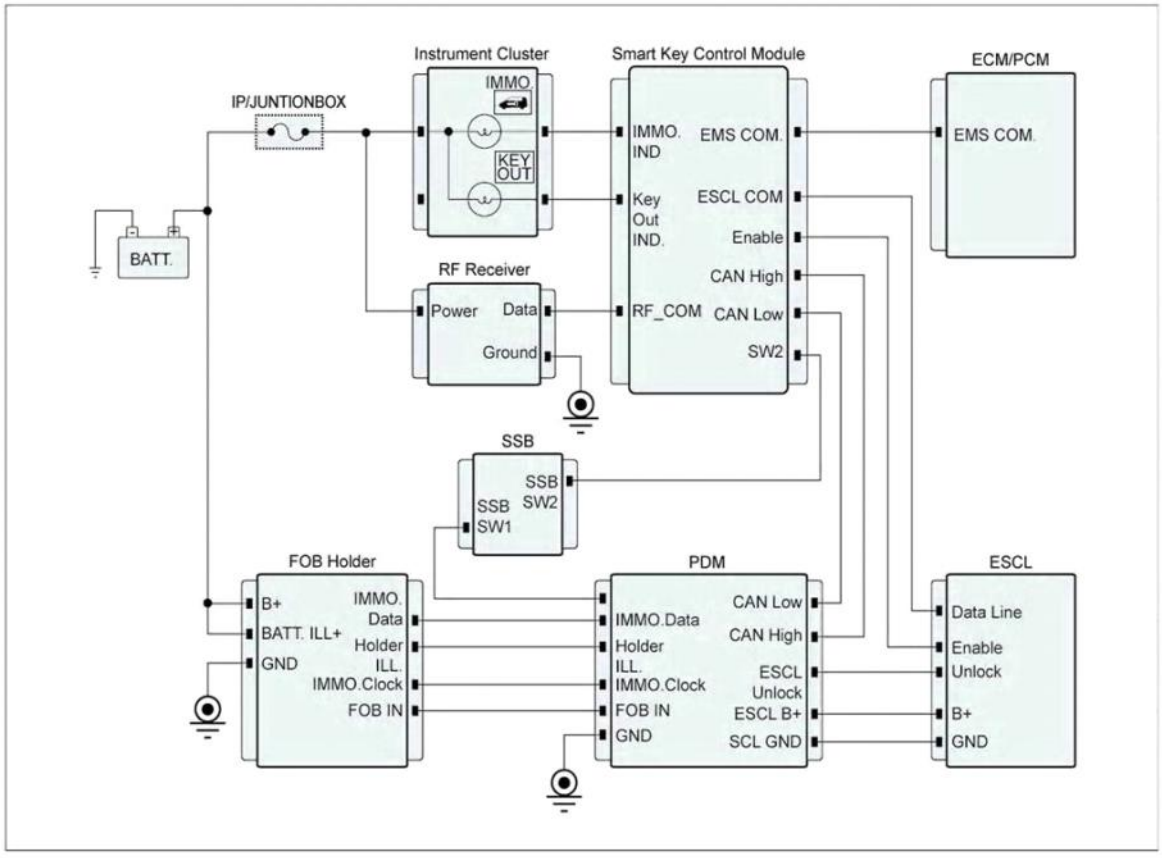
DTC Description

If key/password information in ECM is not matching or there is write error on EEPROM as hardware, DTC P1696 is set.

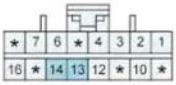
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	• Faulty ECM
Threshold value	• ECM internal memory error(EEPROM or Flash etc.) • Write error on ECM internal memory (EEPROM or Flash etc.)	

Diagnostic Circuit

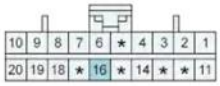

Instrument Cluster
IMMO.
KEY OUT
Smart Key Control Module
IMMO. IND
EMS COM.
Key Out IND.
ESCL COM
Enable
CAN High
CAN Low
SW2
RF_COM
ECM/PCM
EMS COM.
IP/JUNTIONBOX
BATT.
RF Receiver
Power
Data
Ground
SSB
SSB
SSB SW2
SSB SW1
FOB Holder
B+
BATT.
ILL+
GND
IMMO. Data
Holder ILL.
IMMO.Clock
FOB IN
PDM
IMMO.Data
Holder ILL.
IMMO.Clock
FOB IN
GND
CAN Low
CAN High
ESCL Unlock
ESCL B+
SCL GND
ESCL
Data Line
Enable
Unlock
B+
GND

<Instrument Cluster>



13. Key_Out IND.
14. IMMO. IND

<Instrument Cluster>



16. Steering Angle Sensor

<RF Receiver>

1. Data
3. Ground
4. Power

<SMK Control Module>

2. IMMO.IND
10. CAN High
11. CAN Low
12. ESCL COM
13. RF_COM
17. Key_Out IND
18. ESCL Enable
25. EMS_COM

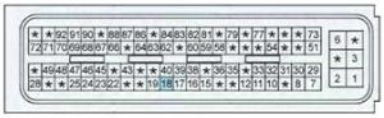
<ESCL>

2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL Unlock
6. ESCL Data Line

<FOB Holder>

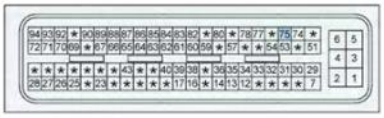
2. IMMO. Clock
3. Holder ILL
5. Ground
6. Power
7. IMMO. Data
8. ILL. (+)
9. Key In S/W

<ECM/PCM>



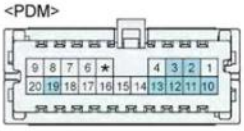
18. EMS_COM

<ECM/PCM>



75. EMS_COM

<PDM>

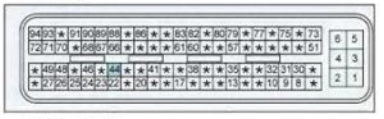


2. IMMO. Clock
3. IMMO. Data
10. CAN Low
11. CAN High
12. FOB IN
13. ESCL Unlock
19. Holder ILL

<PDM>

4. ESCL Power
5. ESCL Ground

<ECM/PCM>



44. EMS_COM

Signal Waveform & Data

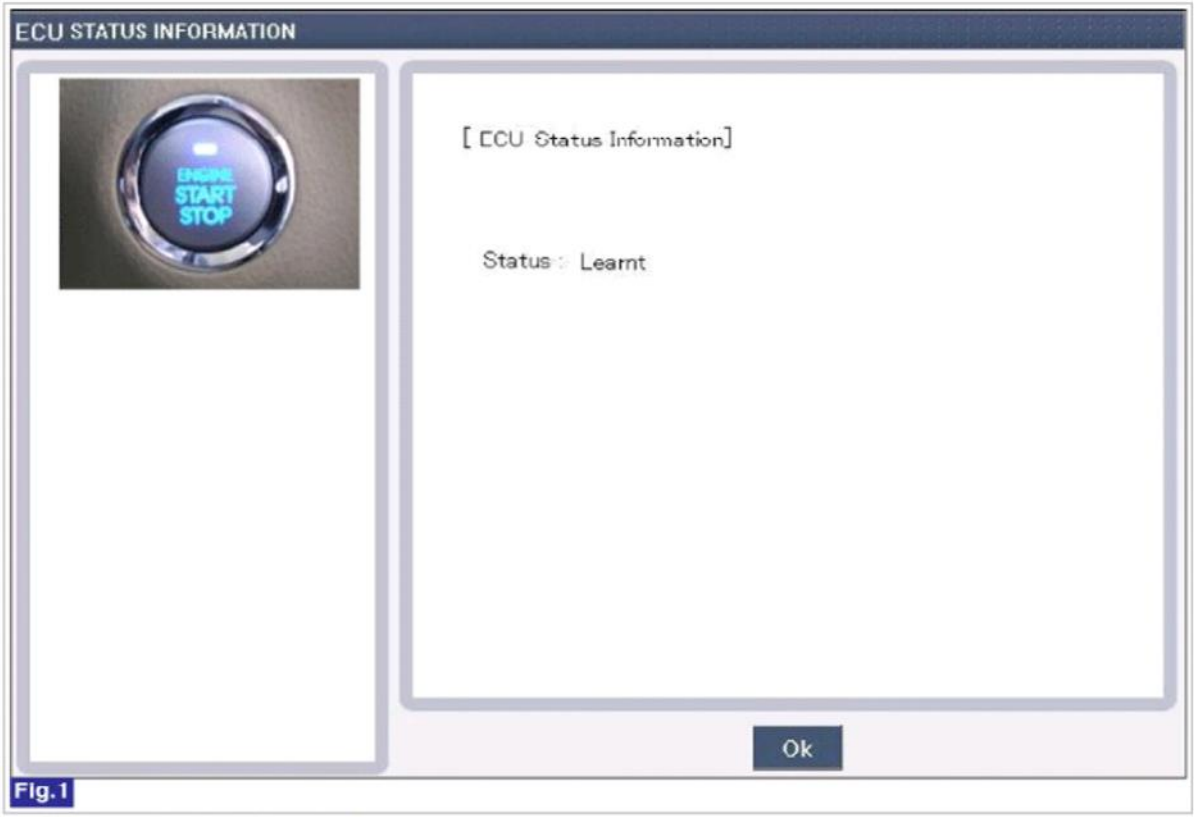


Fig.1) It shows that ECU is learnt status.

Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF"
2. Connect GDS and select ID Register.
3. Check Engine status parameter with GDS.

Fig 1) It shows that ECU is learnt status
(GDS will show that ECM is Not Checked if DTC P1695 is set)

4. Is the ECM status normal ?

YES	▸ Neutralize the Engine ECM after erasing the DTC with GDS. Check that system is normal after checking the DTC againg. (If the DTC is set aganin, repalce Engine ECM) Wait for more than 1 min. with IG ON so that smart key ECM register PIN into Engine ECM automatically.
NO	▸ Perform key teaching procedure after replacing ECM and then, go to "Verification of Vehicle Repair" Procedure.

NOTICE

■ PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.
1) If the Smart key ECM is not registered with PIN, key teaching process is not proceeded.
2) Registering PIN is available after Smart Key ECM is neutralized.
3) Neutralization of Engine ECM is available with GDS (Registering PIN code)
4) If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.
5) Registering PIN code is only possible for virgin or neutralized status.

■ It is possible to acess to All of the learning procedue only with GDS.
And, FOB key must be inserted in FOB holder in order to proceed learning procedure.
(There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)

- Smart Key ECM Learning
  1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.
  2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.
  3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.
  4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wail for 1 hour.
- PDM Learning
  1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.
  2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component

status is moved to right before power shut off and previous PIN is used for communication with PDM and Smart key ECM

- ESCL Learning
  1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component Location

General Description

Smart key System consists of transponder, which is in the FOB key head, and Smart key ECM. Smart Key System has FOB holder, which includes antenna coil, to communicate with transponder for immobilizer communication. Smart Key ECM communicates with PDM via serial communication line so that Smart Key ECM sends signal to PDM.
FOB is requested authentication from Smart Key ECM by using the LF antenna with LF communication. And then, FOB sends authentication signal through the SRx with RF communication.
With this procedure, Smart Key ECM sends authentication signal to Engine ECM in order to allow the engine start. Finally, ESCL control module release steering lock with authentication.
Authentication for immobilizer is classified two different way. one is pre-authentication and the other is general authentication.
Regardless of success or failure, Pre-authentication makes Immoblizer lamp remains OFF. However, General authentication makes Immobilizer lamp is ON for 30 seconds If authentication is successful. However, if authentication is failed, Immobilizer lamp is OFF for 10 seconds.

■ Condition for Pre-authentication.

1. OFF and Driver door is open when FOB is in passenger compartment
(Seek every 3 seconds for 30 seconds.)
2. OFF and Driver door is close when FOB is in passenger compartment
3. FOB is inserted in FOB Holder
4. Pressing Brake padel when FOB is in passenger compartment

■ Condition for general authentication

1. Pressing start butteon when FOB is in the passenger compartment

DTC Description

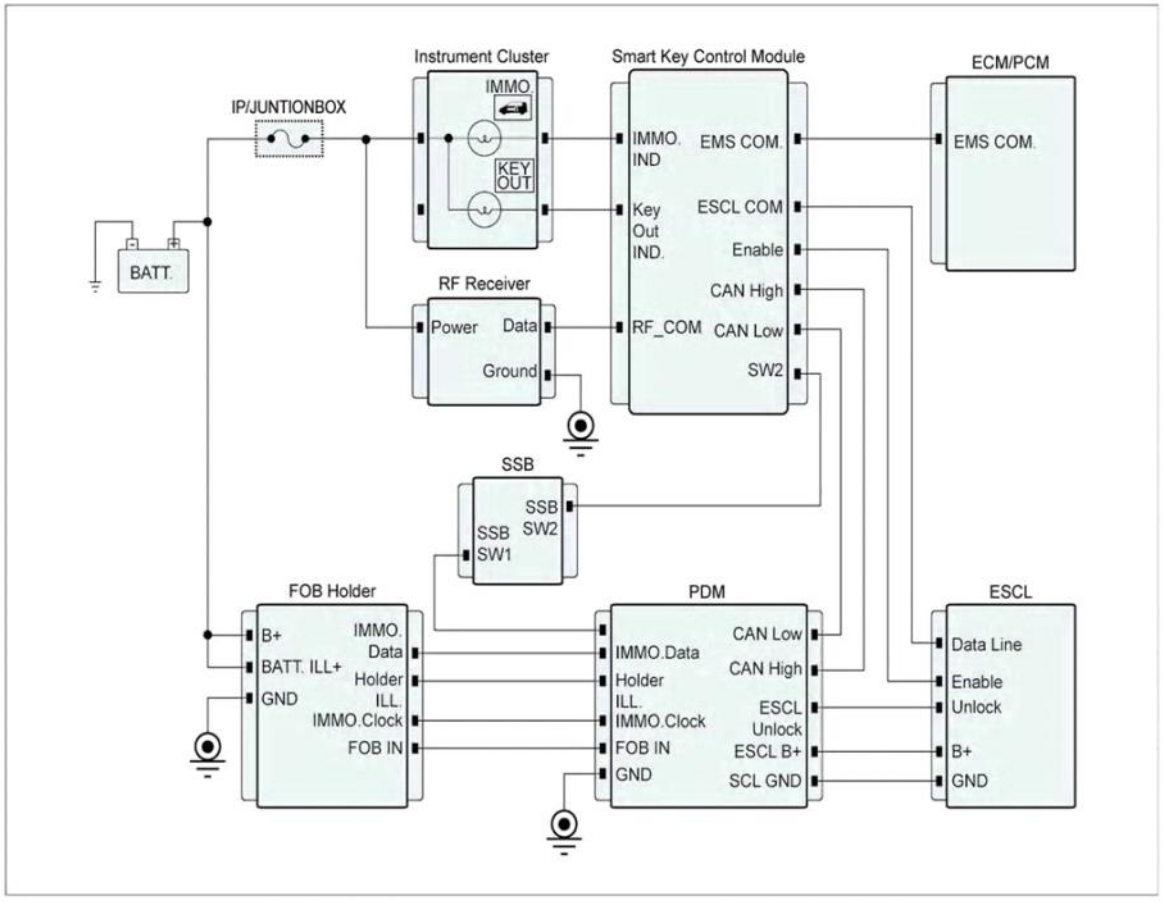
During the Immobilizer authentication, If there is any wrong VIN(Vehicle Identification Number) or MIN(Model Identification Number) signal on the communication message, ECM sets DTC P1696

DTC Detecting Condition

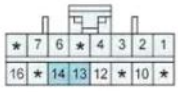
Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	
Detecting time	• 1 time	

Threshold value	• Wrong VIN(Vehicle Identification Number), MIN (Model Identification Number) - No DTC P1676 but wrong VIN or MIN	• Faulty Smart key ECM

Diagnostic Circuit

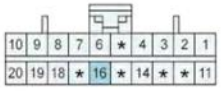


<Instrument Cluster>



13. Key_Out IND.
14. IMMO. IND

<Instrument Cluster>

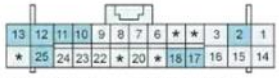


16. Steering Angle Sensor

<RF Receiver>

1. Data
3. Ground
4. Power

<SMK Control Module>

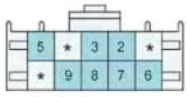


2. IMMO.IND
10. CAN High
11. CAN Low
12. ESCL COM
13. RF_COM
17. Key_Out IND
18. ESCL Enable
25. EMS_COM

<ESCL>

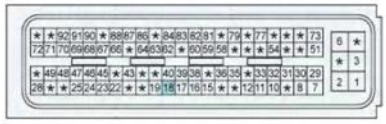
2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL Unlock
6. ESCL Data Line

<FOB Holder>



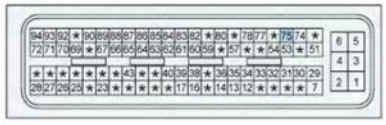
2. IMMO. Clock
3. Holder ILL
5. Ground
6. Power
7. IMMO. Data
8. ILL. (+)
9. Key In S/W

<ECM/PCM>



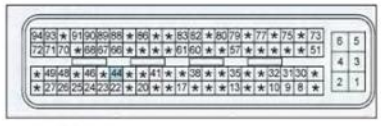
18. EMS_COM

<ECM/PCM>



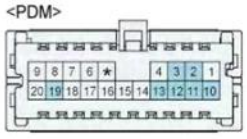
75. EMS_COM

<ECM/PCM>



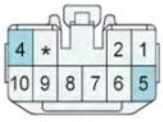
44. EMS_COM

<PDM>



2. IMMO. Clock
3. IMMO. Data
10. CAN Low
11. CAN High
12. FOB IN
13. ESCL Unlock
19. Holder ILL

<PDM>



4. ESCL Power
5. ESCL Ground

Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF".
2. Erase DTC after connecting GDS.
3. Check Smart Key ECM status parameter if DTC is retrieved.

Fig.1) It shows that 2(two) FOB key is registered, Smart Key ECM is learnt status.

4. Is the smart Key ECM learnt ?

YES	▸ Fault is intermittent caused by poor contact in Smart key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Component Inspection" procedure.

Component Inspection

■ Check Smart Key ECM insepction

1. IG KEY "ON" & Engine "OFF"
2. Neutralize smart key ECM with GDS.
3. Perform key teaching procedure for smart key ECM with GDS.

> **CAUTION**
>
> Pin code must be prepared to Neutralize Smart Key ECM and to perform key teaching procedure.

4. Is the neutralization of Smart Key ECM, Engine ECM and key teaching normal ?

YES	▸ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Substitute with a known-good Smart Key ECM and check for proper operation. ▸ If the problem is corrected, replace Smart Key ECM and then go to "Verification of Vehicle Repair" procedure.

> **NOTICE**
>
> ■ PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.
> 1) If the Smart key ECM is not registered with PIN, key teaching process is not proceeded.
> 2) Registering PIN is available after Smart Key ECM is neutralized.
> 3) Neutralization of Engine ECM is available with GDS (Registering PIN code)
> 4) If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.
> 5) Registering PIN code is only possible for virgin or neutralized status.
>
> ■ It is possible to acess to All of the learning procedue only with GDS.
> And, FOB key must be inserted in FOB holder in order to proceed learning procedure.
> (There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)
>
> • Smart Key ECM Learning
> 1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.
> 2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.
> 3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.
> 4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wail for 1 hour.
>
> • PDM Learning
> 1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.
> 2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and Smart key ECM
>
> • ESCL Learning
> 1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

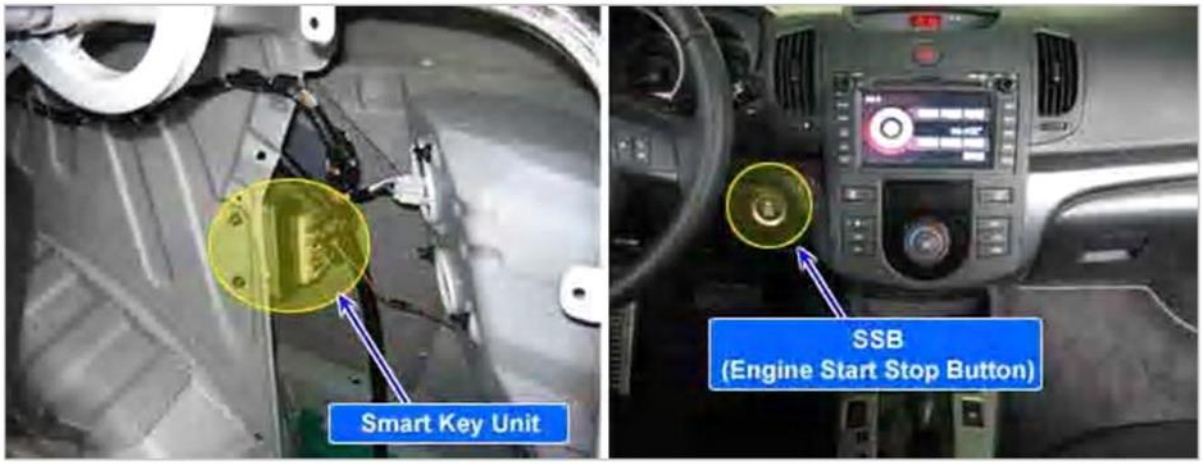
Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component Location



General Description

This is special function that engine can be started for moving to an area where the key learning is processed with twice IG ON. This function is only performed in condtion that Engine EMS, Smart key ECM, Transponder, PDM and ESCL are all virgin status.
Engine can be started by the sequence.

- Ignition ON with no cranking, Ignition OFF, Ignition ON with cranking within a time interval
- The following timing conditions have to be fulfilled for successful start :

- Engine EMS, Smart key ECM, Transponder, PDM and ESCL are all virgin status

1. First Ignition ON more than 0.5 seconds and less than 1.5 seconds.
2. Ignition OFF time is limited by the minimum of 0.2 seconds and the maximum of 1.5 seconds.
3. Ignition ON

The number of engine starts by "twice ignition on" is limited. The maximum value is 32 times regardless of cranking.

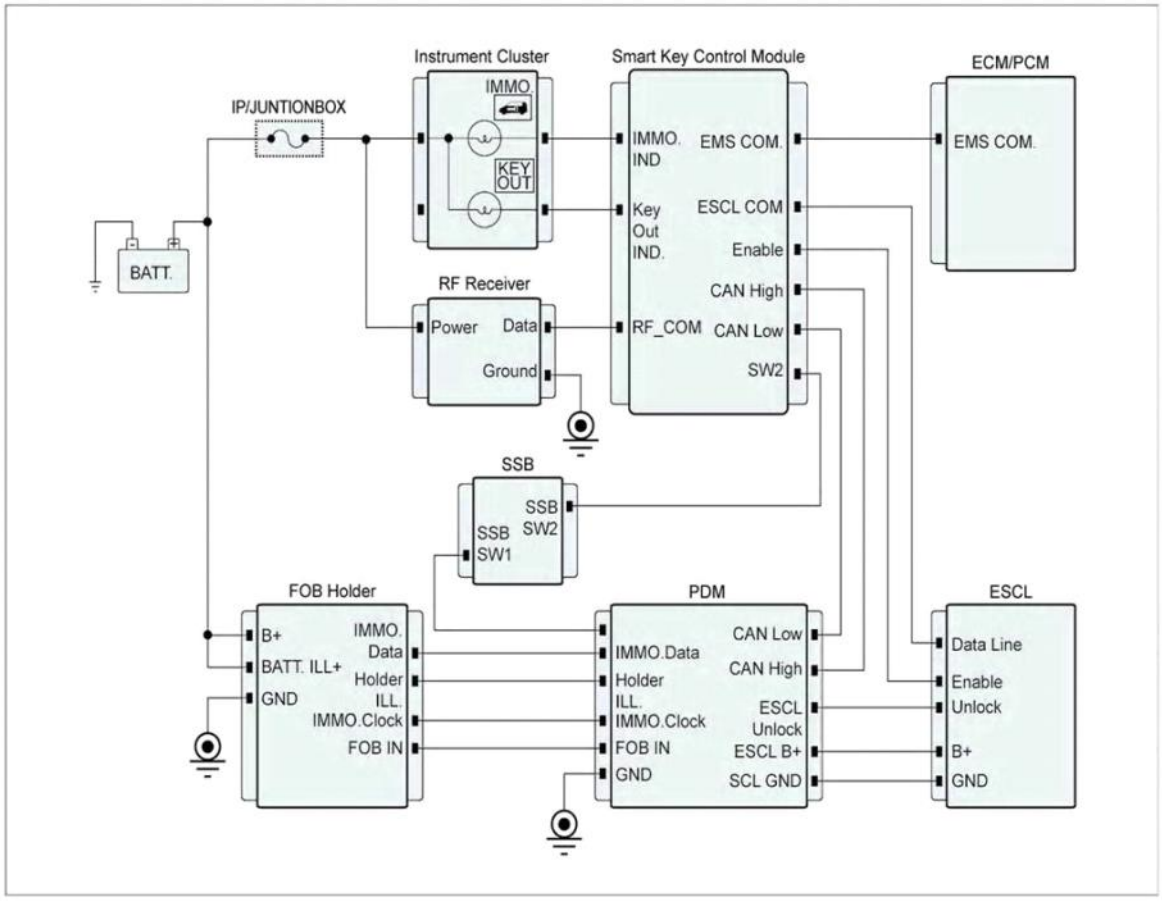
DTC Description

DTC P1699 is set if twice ignition ON exceeds maximum limit over 32 times.

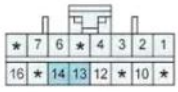
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
Enable Conditions	• IG ON	• Exceed the maximum limit of Twice IGN ON
Detecting time	• Exceed the maximum limit of Twice IGN ON (Over 32 times)	

Diagnostic Circuit

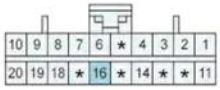

Instrument Cluster
Smart Key Control Module
ECM/PCM
IMMO.
IP/JUNTIONBOX
KEY OUT
IMMO. IND
EMS COM.
EMS COM.
Key Out IND.
ESCL COM
Enable
CAN High
BATT.
RF Receiver
Power
Data
RF_COM
CAN Low
Ground
SW2
SSB
SSB
SSB SW2
SSB SW1
FOB Holder
PDM
ESCL
B+
IMMO. Data
CAN Low
Data Line
BATT. ILL+
IMMO.Data
CAN High
Enable
Holder
GND
Holder
ILL.
ESCL Unlock
Unlock
IMMO.Clock
IMMO.Clock
ESCL B+
B+
FOB IN
FOB IN
SCL GND
GND
GND

<Instrument Cluster>



13. Key_Out IND.
14. IMMO. IND

<Instrument Cluster>

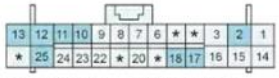


16. Steering Angle Sensor

<RF Receiver>

1. Data
3. Ground
4. Power

<SMK Control Module>

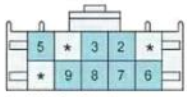


2. IMMO.IND
10. CAN High
11. CAN Low
12. ESCL COM
13. RF_COM
17. Key_Out IND
18. ESCL Enable
25. EMS_COM

<ESCL>

2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL Unlock
6. ESCL Data Line

<FOB Holder>

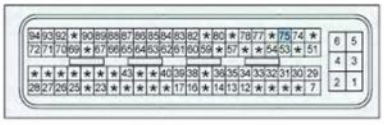


2. IMMO. Clock
3. Holder ILL
5. Ground
6. Power
7. IMMO. Data
8. ILL. (+)
9. Key In S/W

<ECM/PCM>

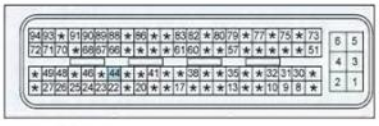
18. EMS_COM

<ECM/PCM>



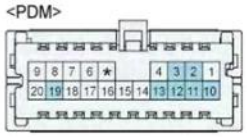
75. EMS_COM

<ECM/PCM>



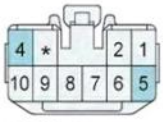
44. EMS_COM

<PDM>



2. IMMO. Clock
3. IMMO. Data
10. CAN Low
11. CAN High
12. FOB IN
13. ESCL Unlock
19. Holder ILL

<PDM>



4. ESCL Power
5. ESCL Ground

Monitor Scantool Data

1. IG KEY "ON" & Engine "OFF"
2. Connect GDS and select ID Register
3. Check Engine status parameter with GDS

Fig.1) It shows that ECU is learnt status

4. Is the ECM status displayed "Lock" ?

YES	▸ Wait for 1 hour until ECM status is unlock with IG ON. After ECM status is unlock, perform the key teaching procedure. Finally, go to 'Verification of Vehicle Repair"procedure.
NO	▸ Fault is intermittent caused by poor contact in Smart Key ECM and/or ECM's connector or was repaired and Smart key ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NOTICE

■ PIN code is programmed in Smart key ECM, Transponder, ESCL, PDM and FOB.

1) If the Smart key ECM is not registered with PIN, key teaching process is not proceeded.
2) Registering PIN is available after Smart Key ECM is neutralized.
3) Neutralization of Engine ECM is available with GDS (Registering PIN code)
4) If the virgin engine ECM is installed on vehicle, Engine ECM is automatically programmed PIN code by Smart Key ECM.
5) Registering PIN code is only possible for virgin or neutralized status.

■ It is possible to acess to All of the learning procedue only with GDS.
And, FOB key must be inserted in FOB holder in order to proceed learning procedure.
(There is only one menu for registering Smart key on the GDS that makes registering all of the component. In case of replacing each module, New registration should be done with GDS)

- Smart Key ECM Learning
  1. Before learning procedure for FOB Key, PDM or ESCL, Smart Key ECM should be registered PIN code first.
  2. In case of replacing Smart Key ECM, All of the keys should be newly registered again.
  3. In case that Smart Key ECM receives 3 times with wrong PIN, It is not allowed for neutralization and Key Teaching for 1 hour.
  4. If the battery is discharged during neutralization or Teaching, Timer will start again from begining. Therefore, it is avoidable to wail for 1 hour.
- PDM Learning
  1. It is O.K for registering PDM just one time. And, it is available for PDM to neutrailze and re-teach with same PIN code.
  2. In case that Power supply is shut off to ESCL right before first FOB key is registered, Every component status is moved to right before power shut off and previous PIN is used for communication with PDM and

Smart key ECM

- ESCL Learning
  1. It is O.K for registering ESCL just one time. And, it is available for ESCL to neutrailze and re-teach with same PIN code.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS and check "No. of Key learnt, ECM status and Smartkey ECM status
2. Selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC
3. Operate the vehicle within the enable condition and monitor the DTC on the GDS.
4. Are any DTCs present ?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component inspection

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units. Control Modules are respectively communicating via CAN line in order to control Body Electrical.

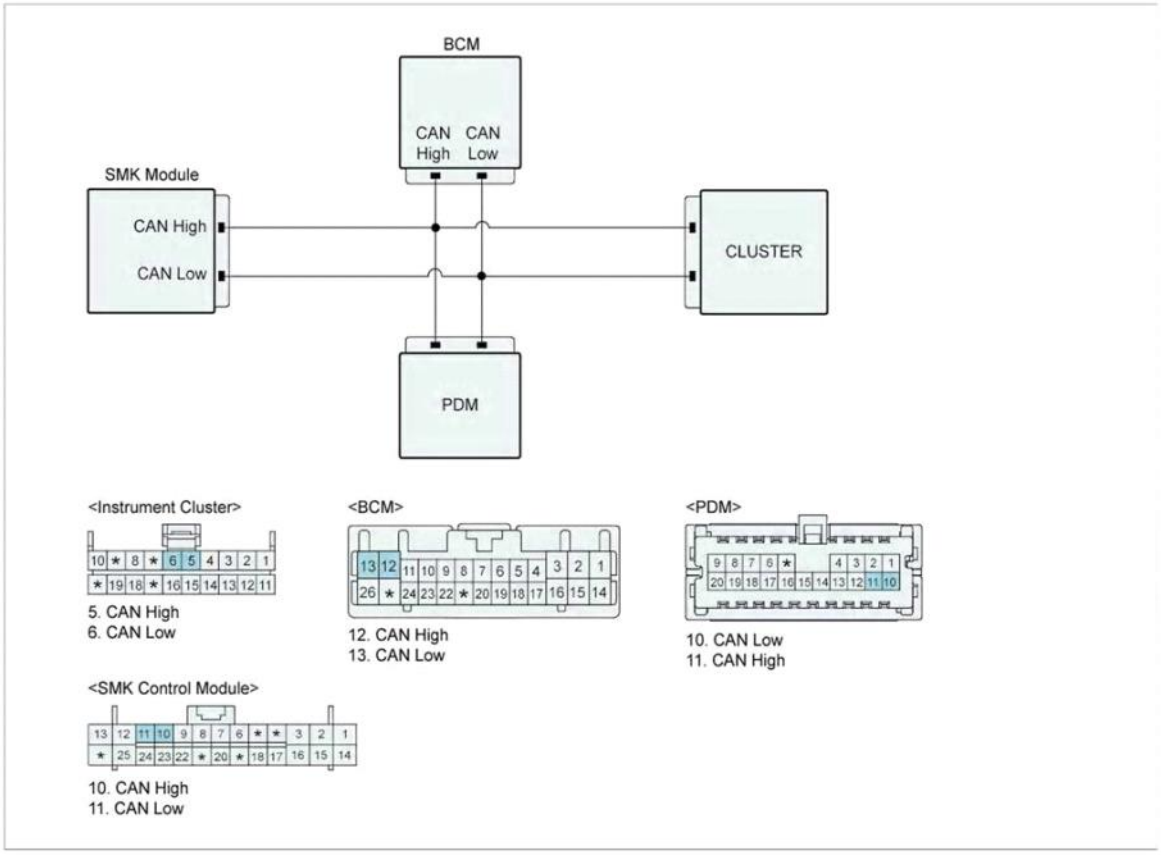
DTC Description

DTC B1602 is set if Smartkey Module detects that CAN HIGH or CAN LOW is short to battery, short to ground, open and short between CAN High and CAN Low each other.

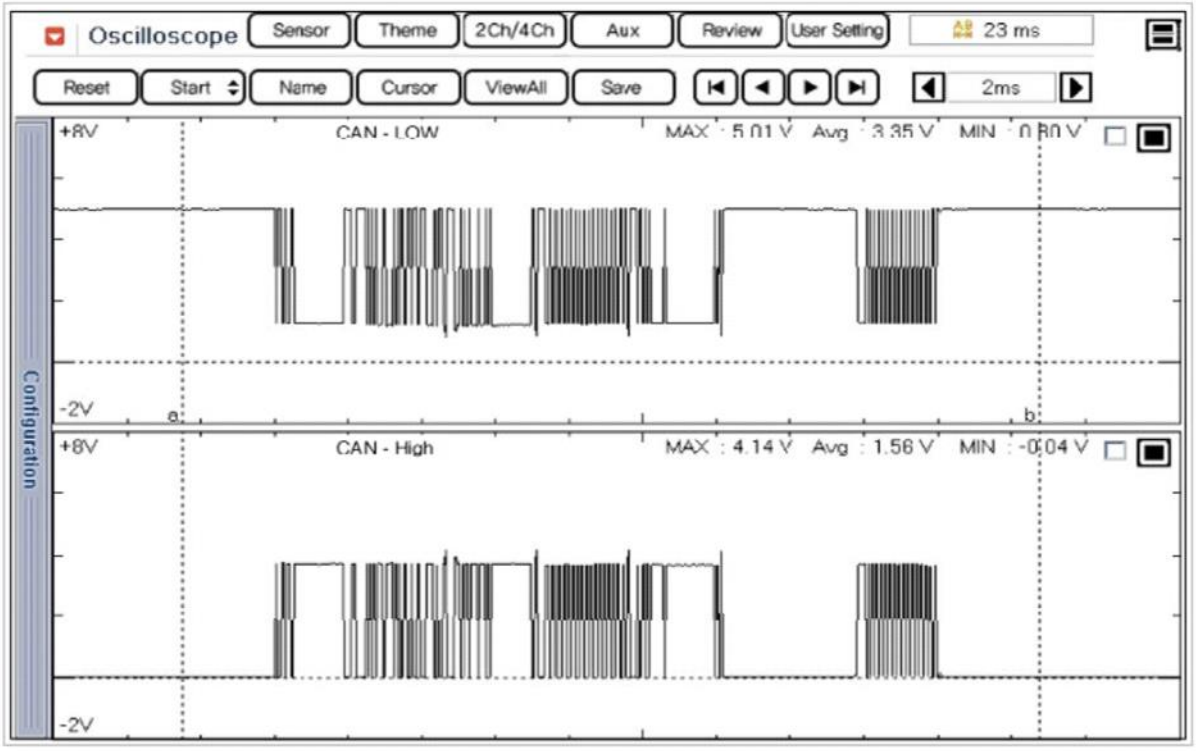
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection • Power source to Smart Key module • Short to battery in CAN communication • Short to ground in CAN communication • Short between CAN high and CAN low each other • Faulty Smartkey Module • Faulty each modules
Enable Conditions	• IG ON	
Threshold value	• CAN communication error for 2 sec.	
Failsafe	• Lamp OFF	

Diagnostic Circuit Diagram



Signal Waveform & Data


Oscilloscope
Sensor
Theme
2Ch/4Ch
Aux
Review
User Setting
23 ms
Reset
Start
Name
Cursor
ViewAll
Save
2ms
Configuration
+8V
CAN - LOW
MAX : 5.01 V
Avg : 3.35 V
MIN : 0.80 V
-2V
a
b
+8V
CAN - High
MAX : 4.14 V
Avg : 1.56 V
MIN : -0.04 V
-2V

Monitor Scantool data

■ **Check DTC**

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on Smartkey Module and every modules.
3. If there is DTC related Module Check the DTC according to troubleshooting guide.
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

YES	▸ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

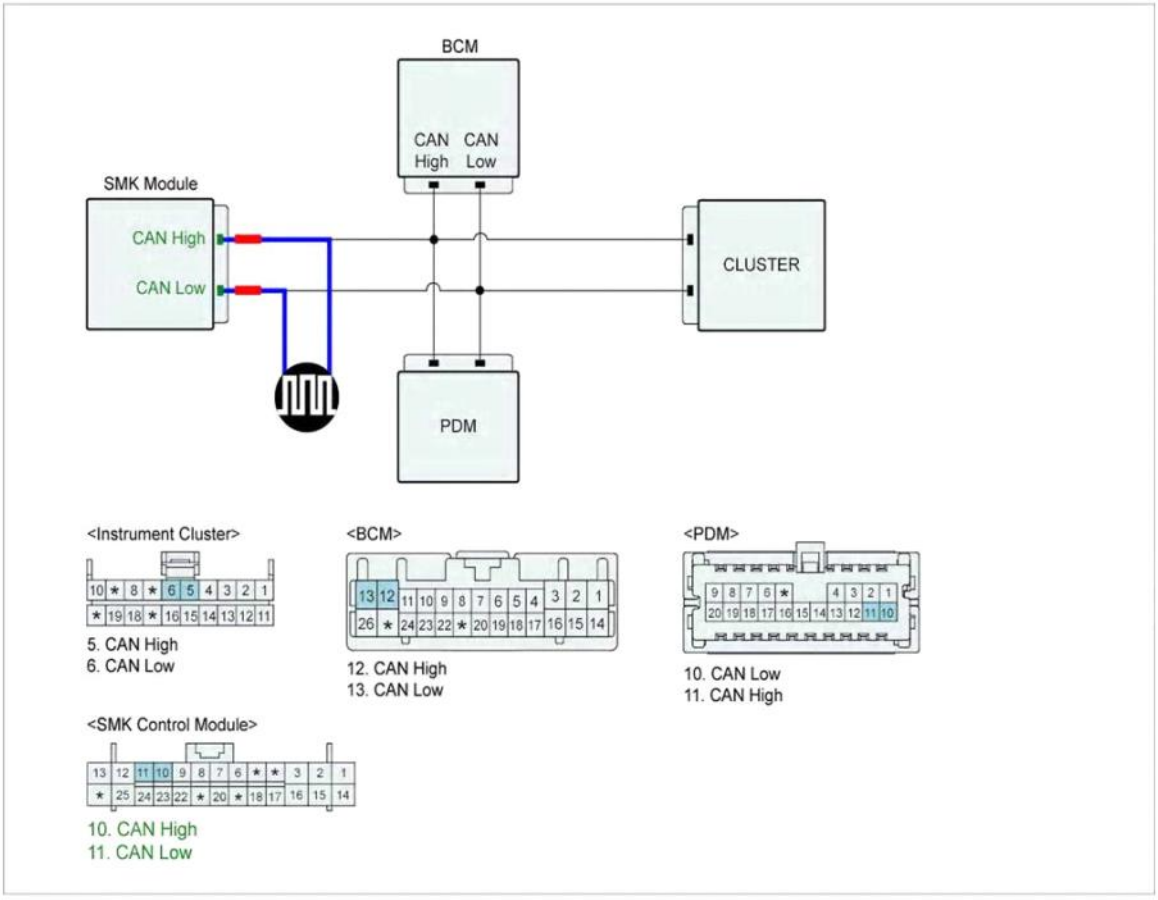
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to 'Check CAN communication Line" procedure.

CAN communication Line Inspection

■ **Check CAN communication**

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of Diagnostic connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of Diagnostic connector and chassis ground.

Specification : Refer to Signal waveform and Data



6. Is the measrured signal waveform normal ?

YES	▸ Check poor connection between harness connector and Smartkey Module or ECM. : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure. ▸ Disconnect SMK Module, BCM, PDM and Instrument Cluster one by one and then, check that DTC is erased with scantool. ▸ Substitute with a known-good module and check for proper operation. If the problem is corrected, replace module and then go to "Verification of Vehicle Repair" procedure
NO	▸ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status. ▸ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component inspection

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units. Control Modules are respectively communicating via CAN line in order to control Body Electrical.

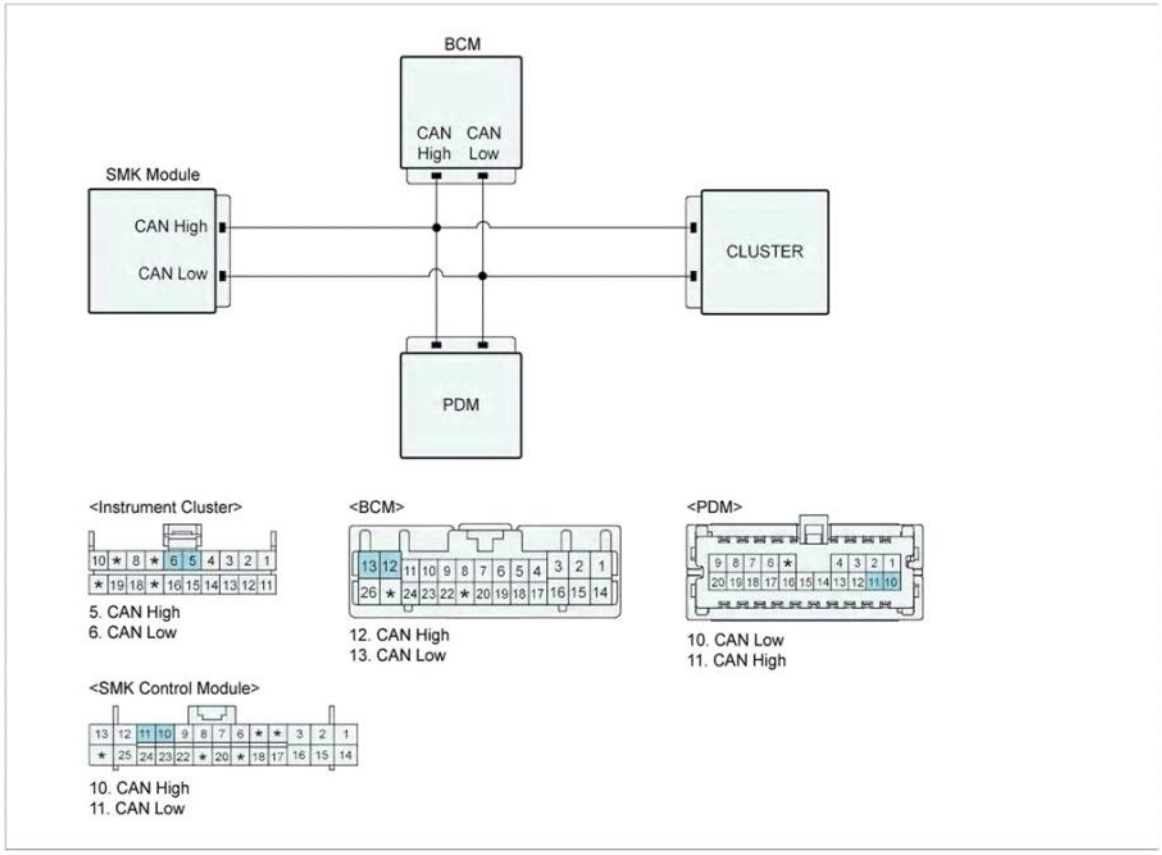
DTC Description

Smartkey Module sets DTC B1603 if smart key module detects short to battery, short to ground in CAN HIGH and CAN low simultaneously.
This DTC means that both CAN HIGH and CAN LOW line are error. Therefore, CAN communication is not available.

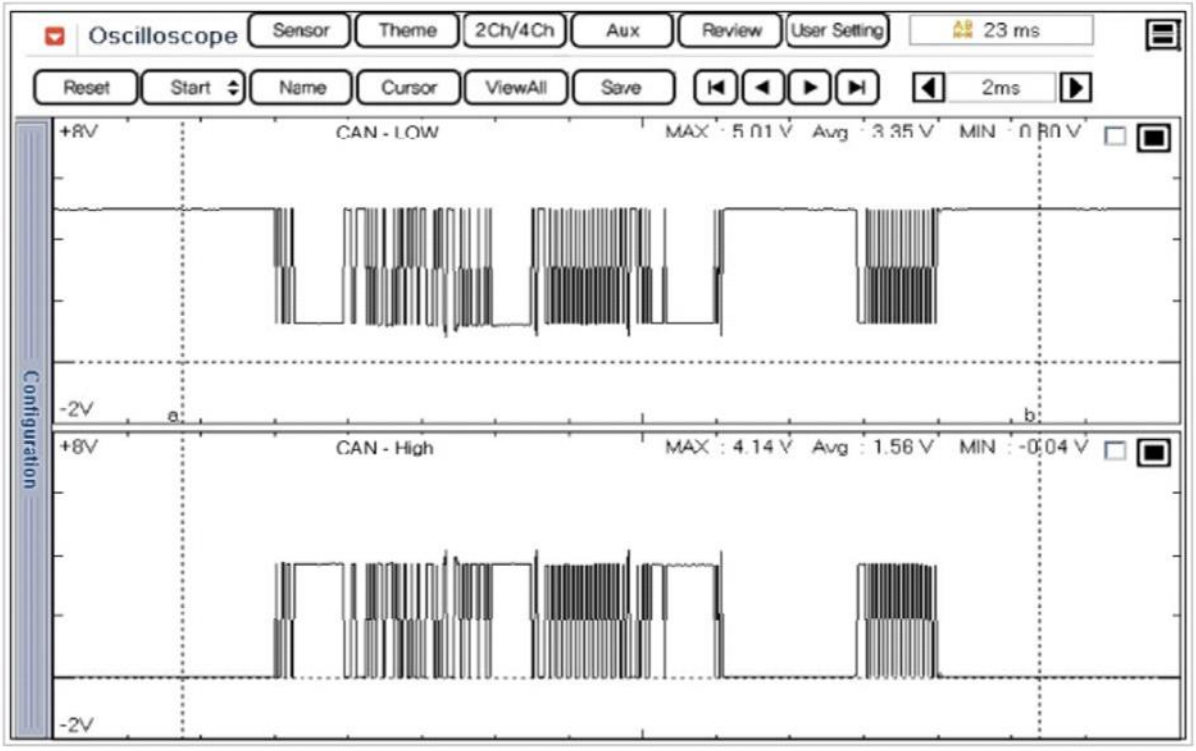
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Signal Check	• Poor Connection • Power Source to smart key module • Short to battery in CAN HIGH LOW or ground simultaneously. • Faulty Smartkey Module
Enable Conditions	• IG ON	
Threshold value	• CAN communication Error for 2 sec.	
Failsafe	• -	

Diagnostic Circuit Diagram



Signal Waveform & Data


Oscilloscope
Sensor
Theme
2Ch/4Ch
Aux
Review
User Setting
23 ms
Reset
Start
Name
Cursor
ViewAll
Save
2ms
Configuration
+8V
CAN - LOW
MAX : 5.01 V
Avg : 3.35 V
MIN : 0.80 V
-2V
a
b
+8V
CAN - High
MAX : 4.14 V
Avg : 1.56 V
MIN : -0.04 V
-2V

Monitor Scantool data

■ **Check DTC**

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on Smartkey Module and every modules.
3. If there is DTC related Module Check the DTC according to troubleshooting guide.
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

YES	▸ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

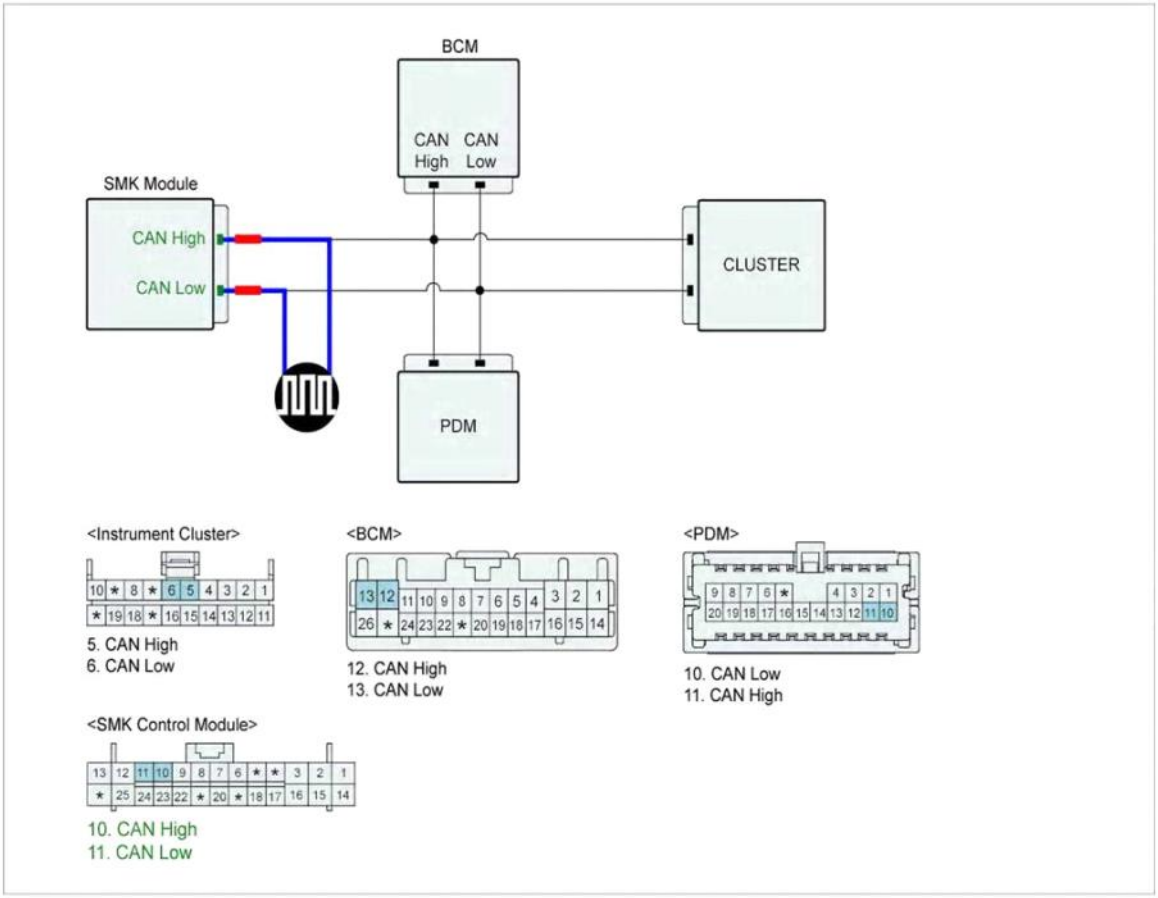
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to 'Check CAN communication Line" procedure.

CAN communication Line Inspection

■ **Check CAN communication**

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of Diagnostic connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of Diagnostic connector and chassis ground.

Specification : Refer to Signal waveform and Data



6. Is the measrured signal waveform normal ?

YES	▸ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure. ▸ Disconnect SMK Module, BCM, PDM and Instrument Cluster one by one and then, check that DTC is erased with scantool. ▸ Substitute with a known-good module and check for proper operation. If the problem is corrected, replace module and then go to "Verification of Vehicle Repair" procedure.
NO	▸ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status. ▸ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component inspection

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units. Control Modules are respectively communicating via CAN line in order to control Body Electrical.

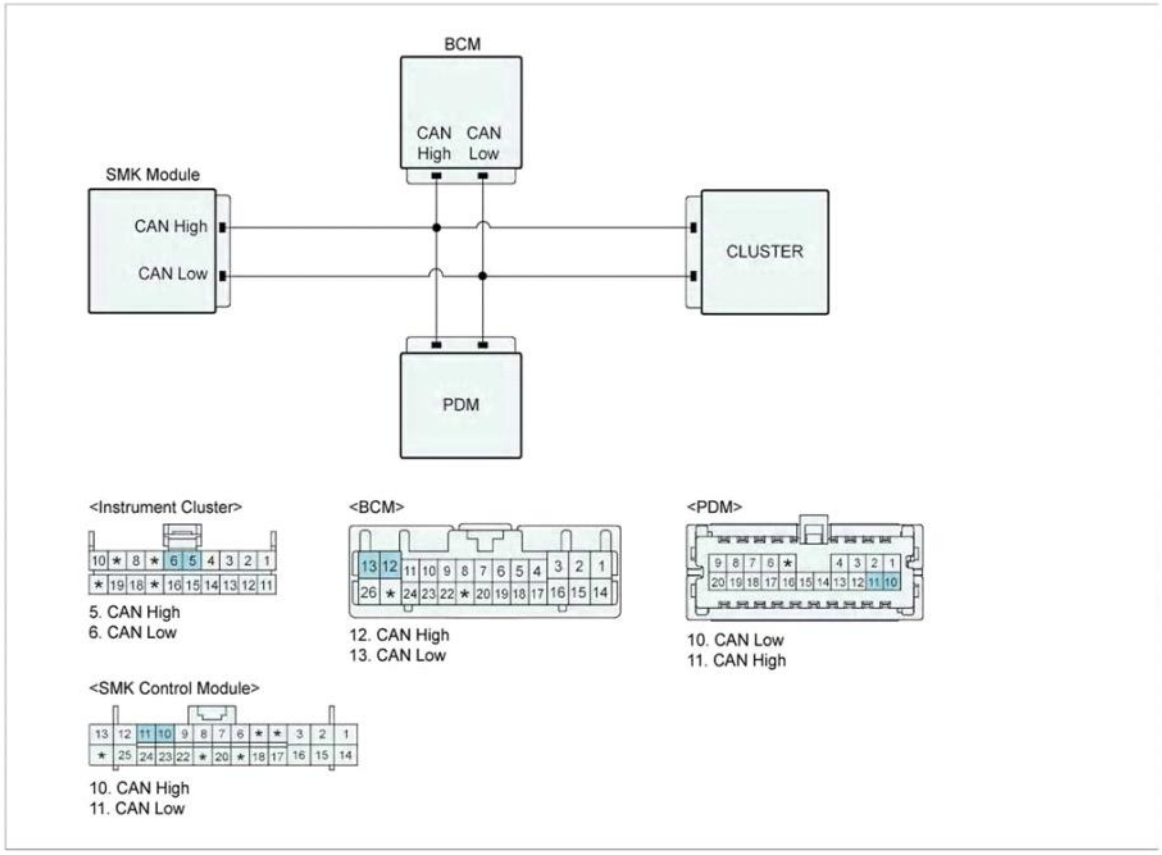
DTC Description

This code is outputted when BCM can't receive data from SMK by CAN Line for 10 sec.

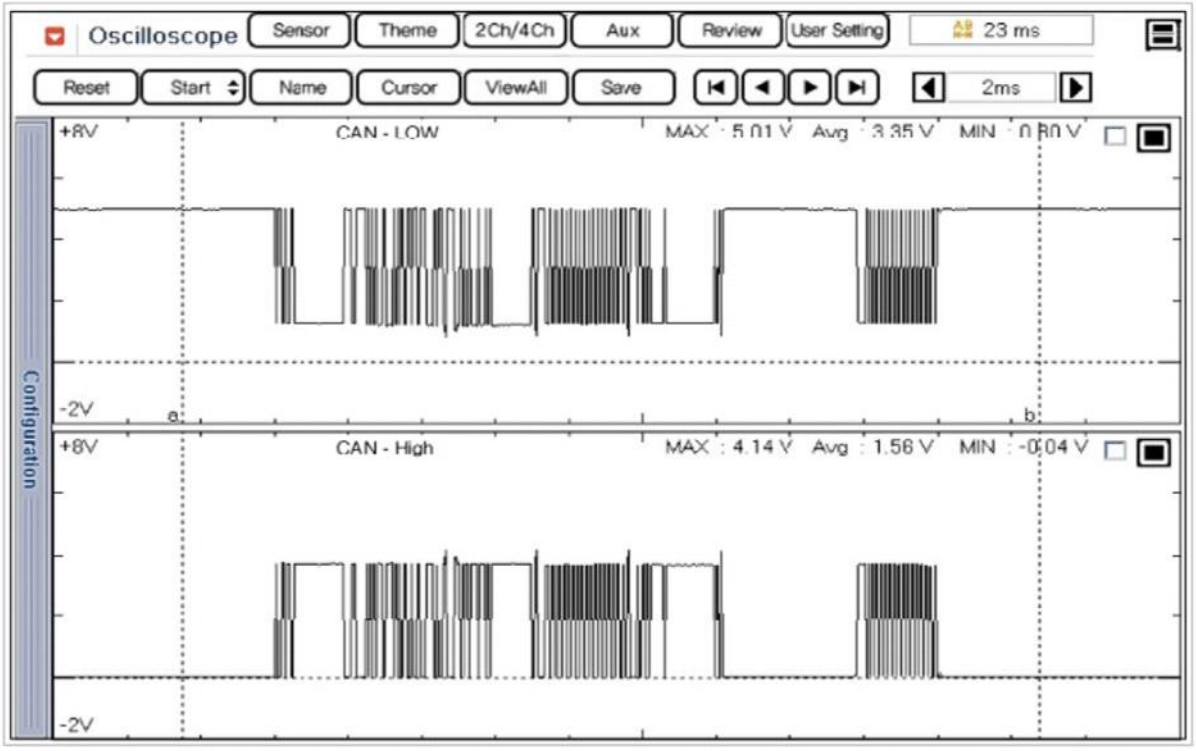
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN Comm. Check (BCM ↔ SMK)	• Poor Connection • Power source to BCM • Short to battery in CAN communication • Short to ground in CAN communication • Short between CAN high and CAN low each other • Faulty Smartkey Module • Faulty each modules
Enable Conditions	• IPM power on	
Threshold value	• No message from SMK to BCM for 10 sec	
Failsafe	• DTC is erased immediately after receiving data from SMK.	

Diagnostic Circuit Diagram



Signal Waveform & Data


Oscilloscope
Sensor
Theme
2Ch/4Ch
Aux
Review
User Setting
23 ms
Reset
Start
Name
Cursor
ViewAll
Save
2ms
Configuration
+8V
CAN - LOW
MAX : 5.01 V
Avg : 3.35 V
MIN : 0.80 V
-2V
a
b
+8V
CAN - High
MAX : 4.14 V
Avg : 1.56 V
MIN : -0.04 V
-2V

Monitor Scantool data

■ **Check DTC**

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on Smartkey Module and every modules.
3. If there is DTC related Module Check the DTC according to troubleshooting guide
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

YES	▸ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

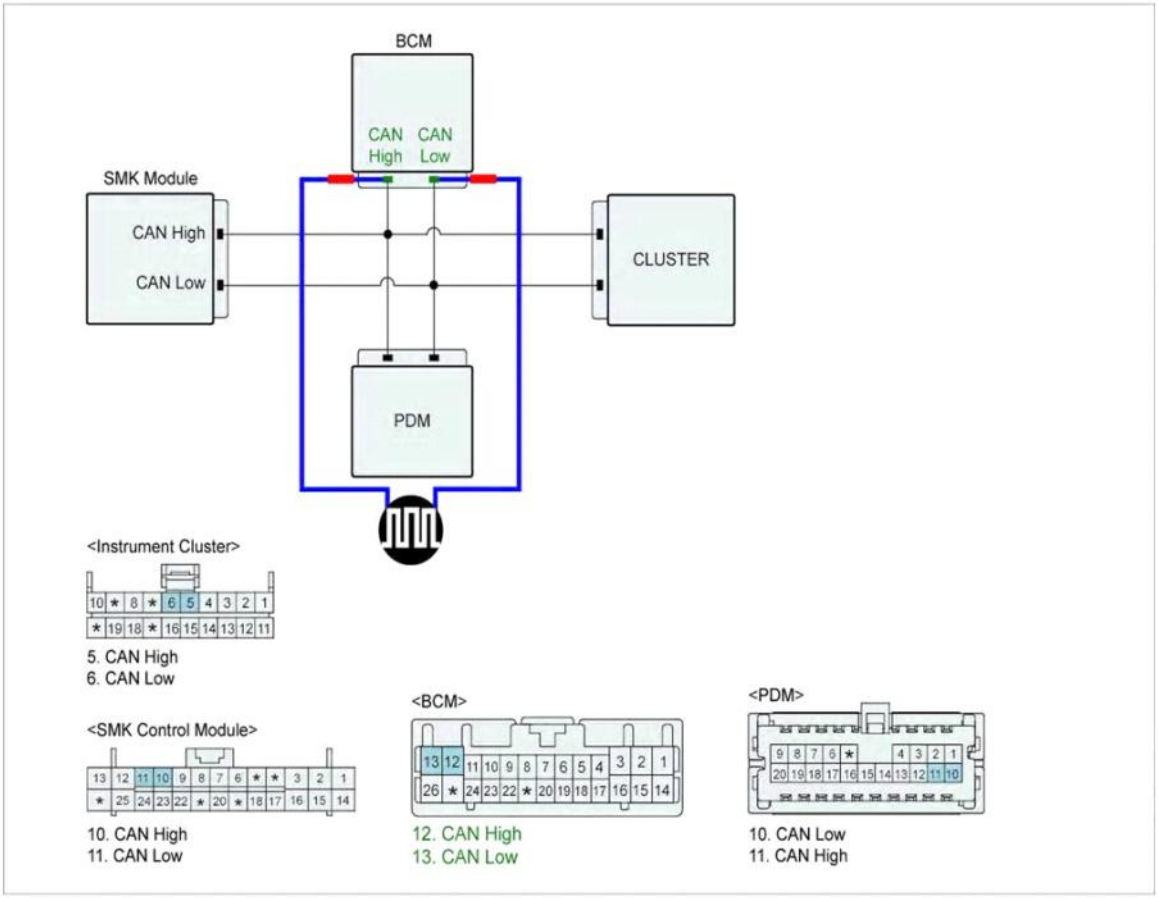
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to 'Check CAN communication Line" procedure.

CAN communication Line Inspection

■ **Check CAN communication**

1. Connect all of control module connector.
2. IG KEY ON
3. Make CAN communication is wake up status (Ex. ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of BCM Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of BCM Module connector and chassis ground.

Specification : Refer to Signal waveform and Data



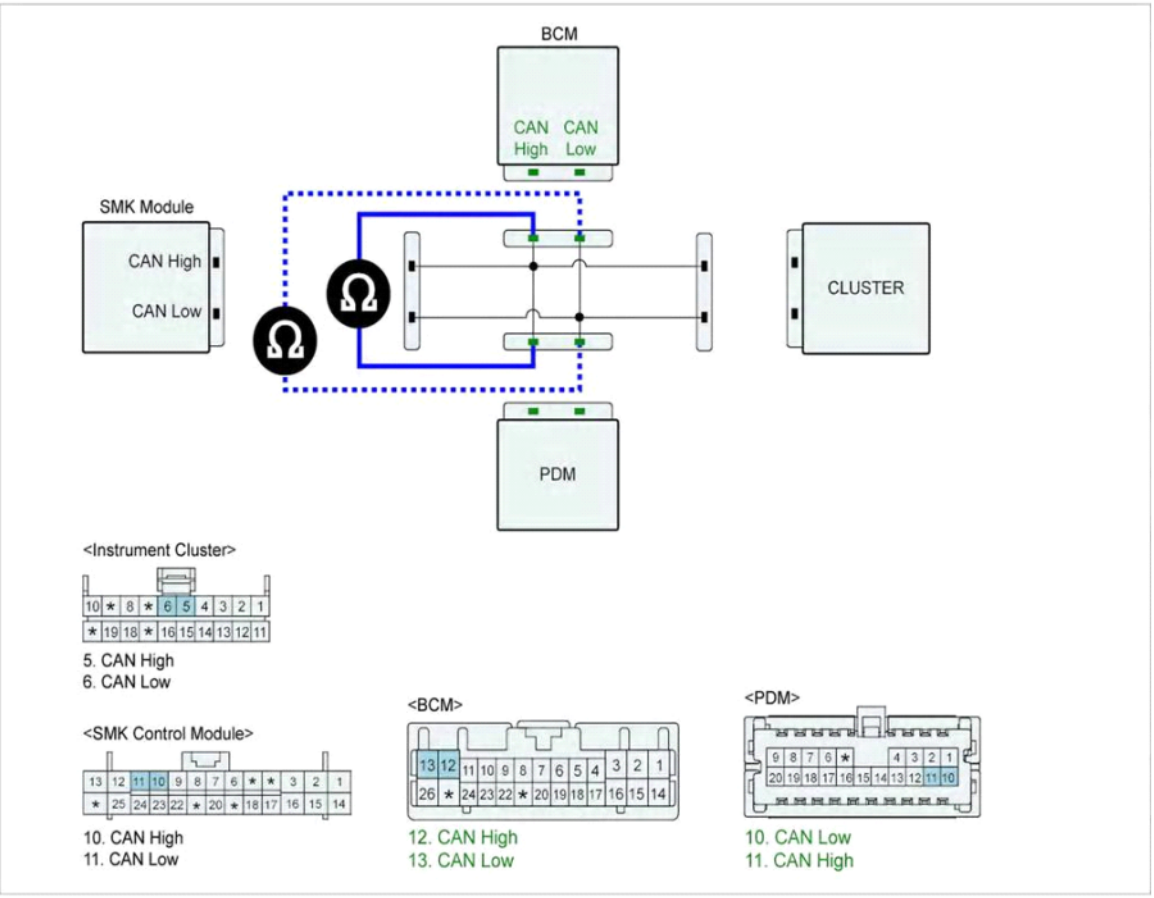
6. Is the measrured signal waveform normal ?

YES	▸ Go to next procedure.
NO	▸ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status. ▸ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

■ Check open in CAN communication line

1. IG KEY OFF.
2. Disconnect Smartkey Module and PDM, BCM, CLUSTER connector.
3. Measure resistance between communication line terminal of Smartkey Module connector and communication line of BCM harness connector.

Specification : About below 1Ω



4. Is the measured resistance within specification ?

YES	▸ Check poor connection between harness connector and Smartkey Module or BCM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Repair or replace open in CAN communication line and go to 'Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component inspection

General Description

Smartkey Module communicates with ECM through the serial communication line.
If ECM requests authetication from Smartkey Module after IG ON, Smartkey Module check authentication with transponder then, sends this signal to ECM whether authentication is O.K or not.

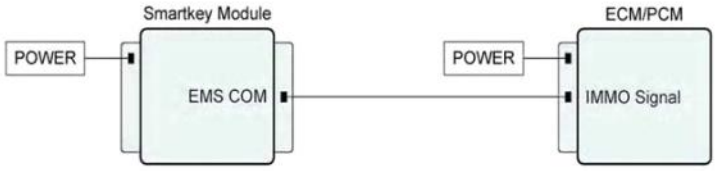
DTC Description

Smartkey Module sets DTC B1625 if Data from ECM is error such as check sum error, Data Frame error, ID Unknown error, Data length error and Time out error.

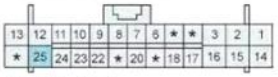
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check received Data Status from ECM	• Poor Connection in Harness • Input Power to Smartkey Module • Open or short in EMS communication line. • Faulty Smartkey Module • Faulty ECM
Enable Conditions	• Data that Smartkey Module received from ECM is error after IGN OFF to IGN ON	
Threshold value	• Received data error from ECM	
Failsafe	• -	

Diagnostic Circuit Diagram

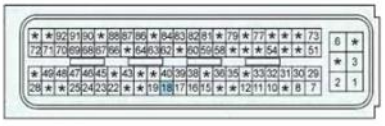


<SMK Control Module>



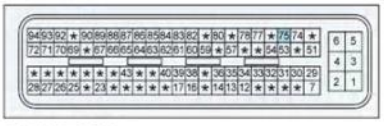
25. EMS_COM

<ECM/PCM>



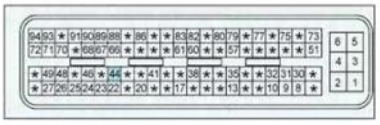
18. EMS_COM

<ECM/PCM>



75. EMS_COM

<ECM/PCM>



44. EMS_COM

Monitor Scantool data

■ **Check DTC status**

1. Check DTC on the ECM with Scantool.
2. Check that there is any DTC related ECM.
3. Perform Troubleshooting the DTC from ECM with appropriate DTC Troubleshooting Guide first.
4. Repair or replace as necessary after erasing DTC with Scantool.
5. Check DTC on SMK Module side and erase the DTC with scantool.
6. Has the DTC gone after erasing with scantool ?

YES	▸ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to " Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

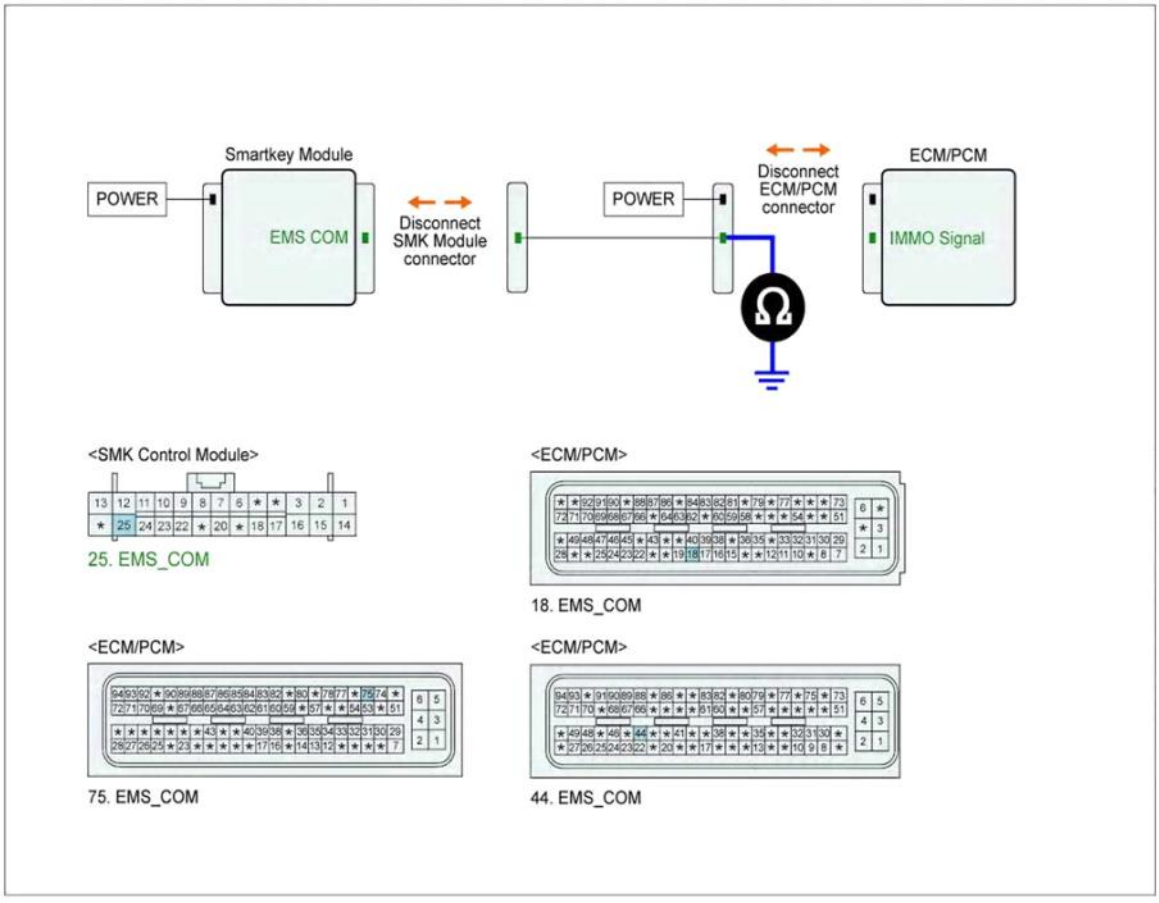
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to " Check serial commuication Cricuti Inspection" as follow.

Serial Communicatin Circuit Inspection

■ **Check short in serial communication line**

1. "IG KEY OFF"
2. Disconnect Smartkey Module connector and ECM connector.
3. Measure resistance between serial communication signal terminal of ECM harness connector and chassis ground.

Specificatin : Infinite (∞)



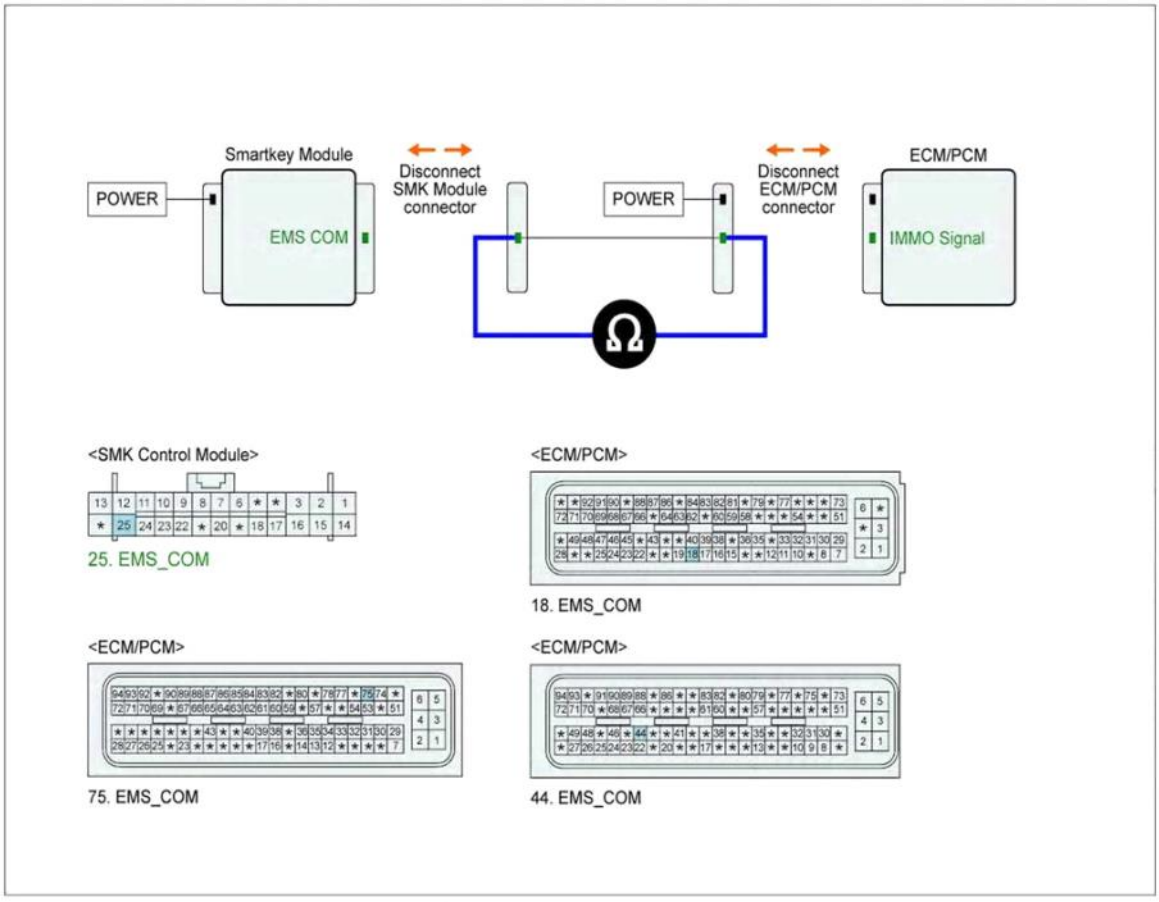
4. Is the measured resistance within specification ?

YES	▸ Go to open in harness as follow
NO	▸ Check short to ground in harness. And then, repair or replace as necessary. Finally, go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG KEY OFF.
2. Disconnect Smartkey Module connector and ECM connector.
3. Measure resistance between signal terminal of Smartkey Module harness connector and signal terminal of ECM harness connector.

Specification : About below 1Ω



4. Is the measured resistance within specification ?

YES	▸ Check poor connection between harness connector and Smartkey Module or ECM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Check open in signal harness. And, repair or replace as necessary then, go to "Verification of Vehicle Repair " procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component Location

General Description

CAN Communication is a circuit, consists of CAN LOW and CAN HIGH, in order to communicate among control units. Control Modules are respectively communicating via CAN line in order to control Body Electrical.

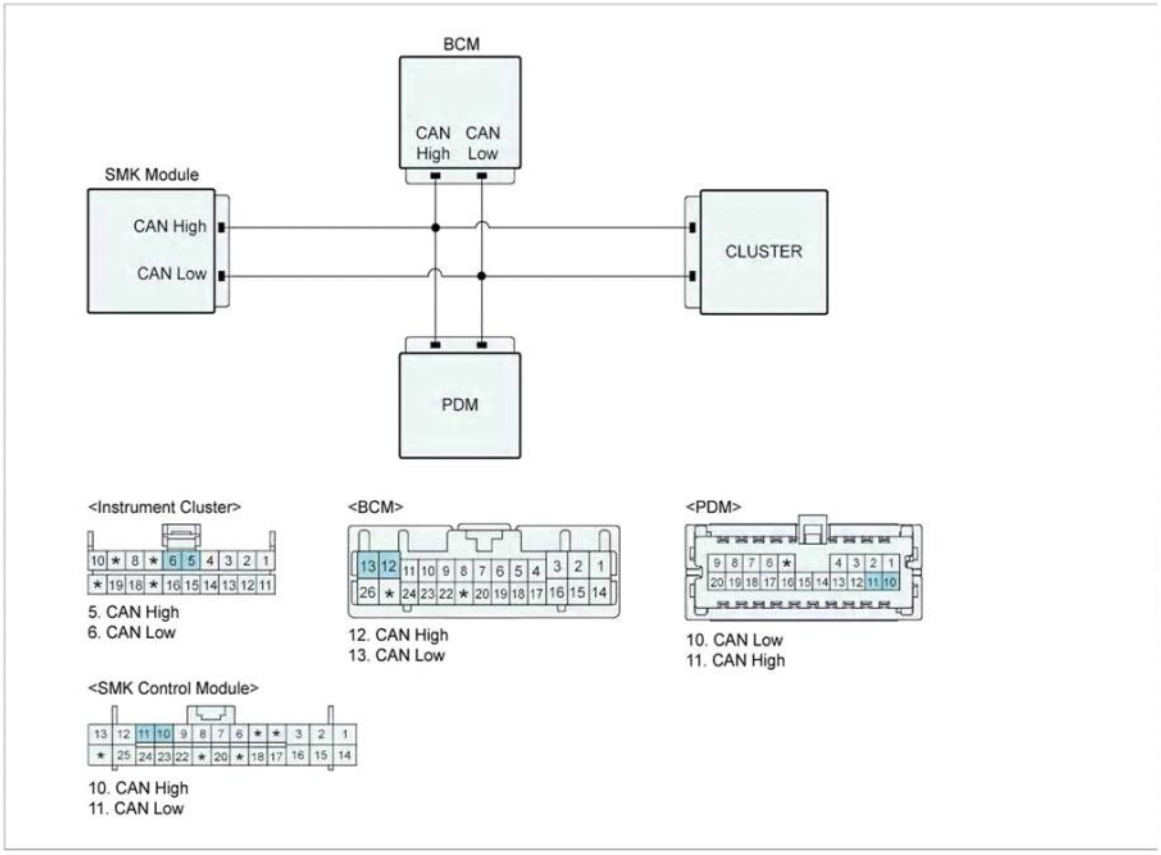
DTC Description

Smart Key module sets DTC B1689 if Smartkey Module have not received CAN signal from PDM for 3 sec.

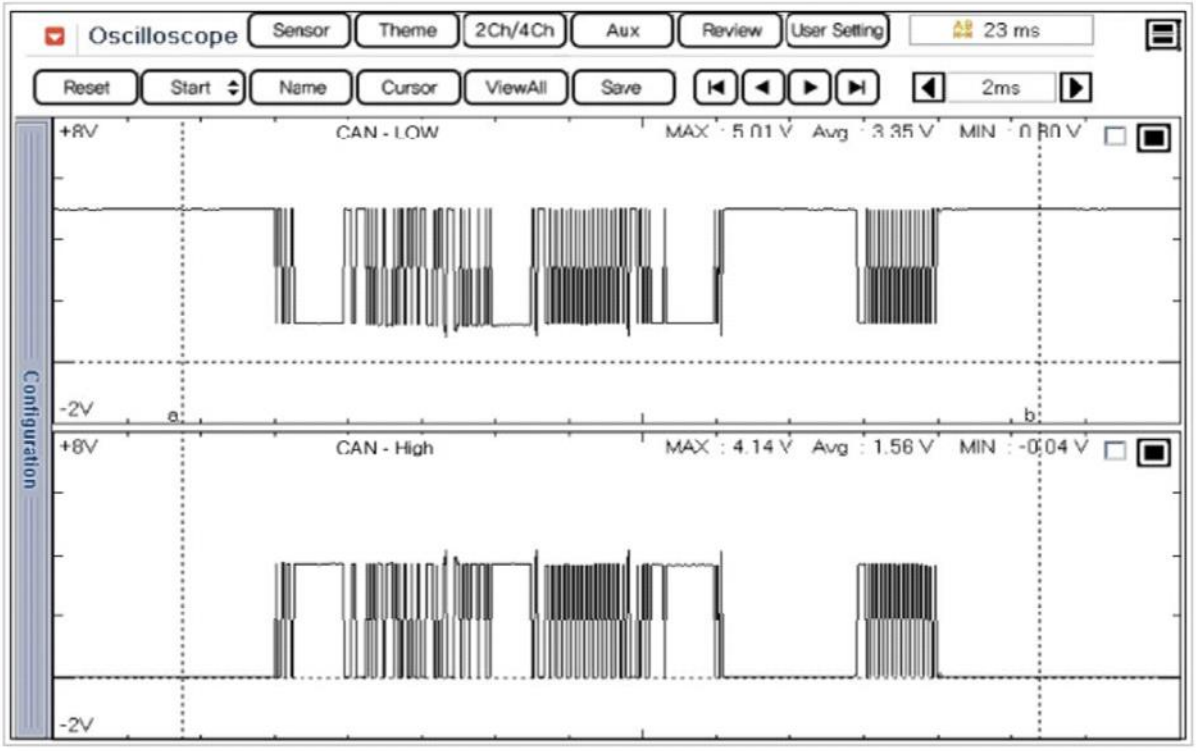
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN signal check	• Poor Connection • Power source to Smart Key module • Power source to PDM • Short to battery in CAN communication line • Short to ground in CAN communication line • Short between CAN HIGH AND LOW communication line each other • Faulty Smartkey Module • Faulty PDM
Enable Conditions	• IG ON	
Threshold value	• No can signal message from PDM for 3 sec.	
Failsafe	• -	

Diagnostic Circuit Diagram



Signal Waveform & Data


Oscilloscope
Sensor
Theme
2Ch/4Ch
Aux
Review
User Setting
23 ms
Reset
Start
Name
Cursor
ViewAll
Save
2ms
Configuration
+8V
CAN - LOW
MAX : 5.01 V
Avg : 3.35 V
MIN : 0.80 V
-2V
a
b
+8V
CAN - High
MAX : 4.14 V
Avg : 1.56 V
MIN : -0.04 V
-2V

Monitor Scantool data

■ **Check DTC**

1. Check DTC with scantool.
2. Check DTC related CAN communication is set on PDM.
3. If there is DTC related PDM, Check the DTC according to troubleshooting guide
4. Repair and erase the DTC with Scantool.
5. Is the DTC erased ?

YES	▸ Check poor connection between harness connector and each module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to next procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

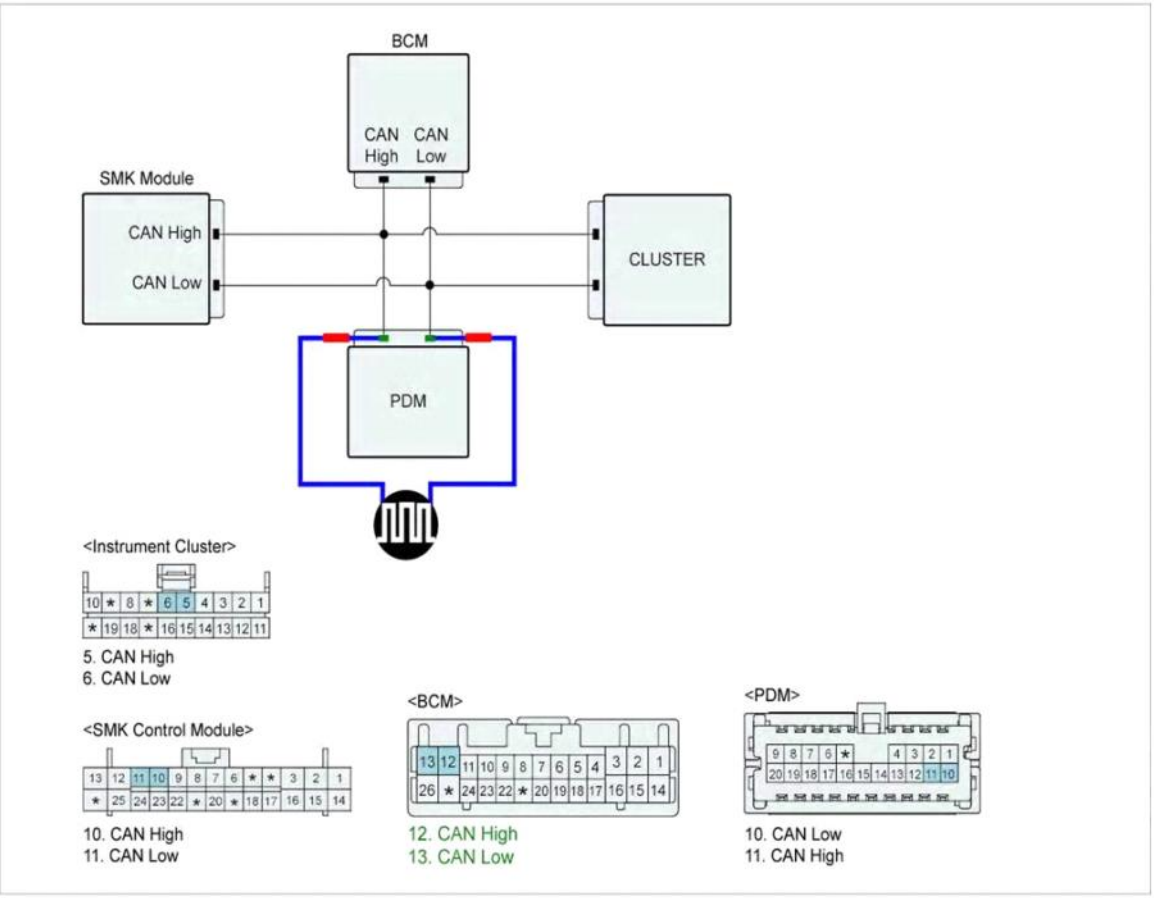
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Check CAN communication Line" procedure.

CAN communication Line Inspection

■ **Check CAN communication**

1. Connect all of control module connector.
2. IG KEY ON.
3. Make CAN communication is wake up status (Ex. ON/OFF Door SW)
4. Measure signal waveform of B-CAN-HIGH terminal of Smartkey Module connector and chassis ground.
5. Measure signal waveform of B-CAN-LOW terminal of Smartkey Module connector and chassis ground.

Specification : Refer to Signal waveform and Data



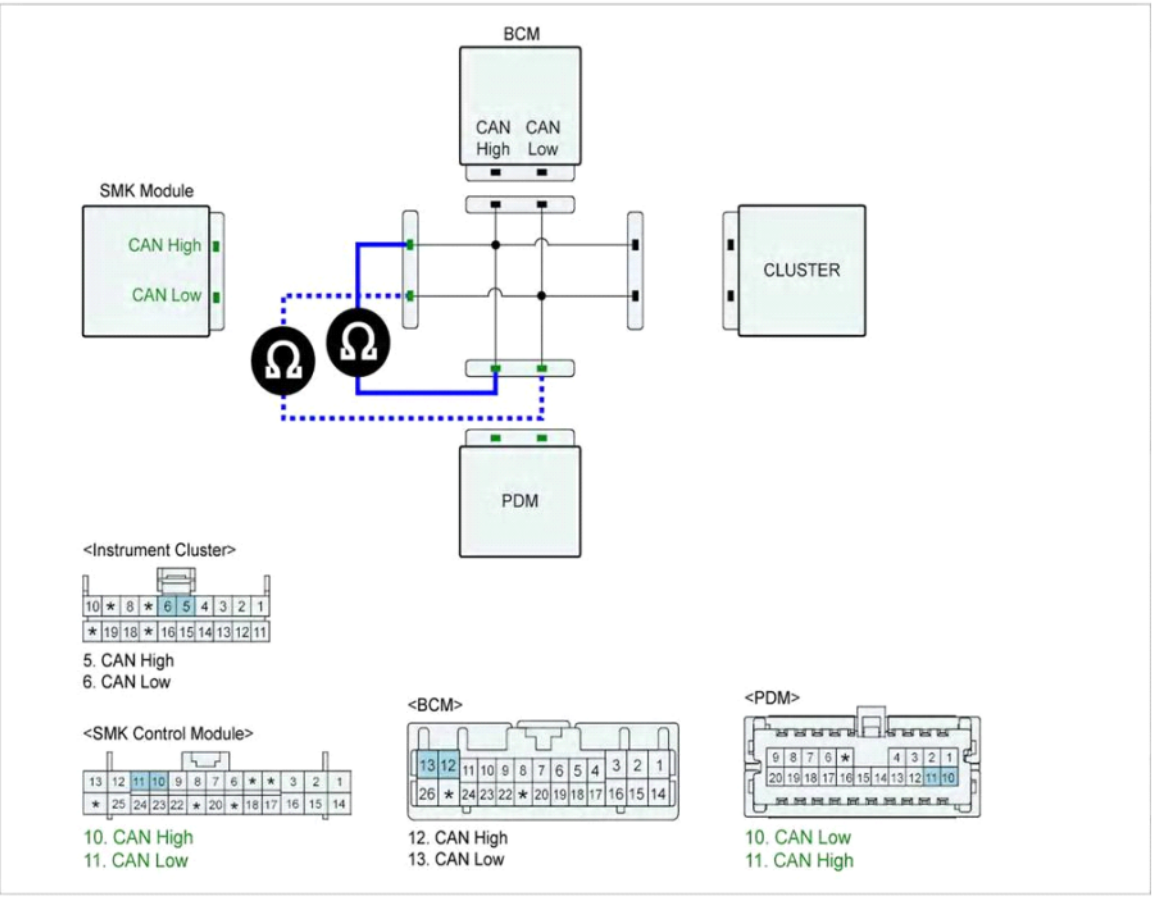
6. Is the measrured signal waveform normal ?

YES	▸ Go to next procedure.
NO	▸ If the measured value is battery voltage, check short to battery in CAN line. Repair or replace as necessary. And then, go to "Verification of Vehicle Repair" procedure. In case that Communication is in sleep mode, 12V will be measured. Therefore, check that communication is in Wake up status. ▸ If 0V is detected, Check short to ground, short between CAN high and low each other or open in CAN high or CAN low harness. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

■ Check open in CAN communication line

1. IG KEY OFF.
2. Disconnect Smartkey Module and PDM, BCM, CLUSTER connector.
3. Measure resistance between communication line terminal of Smartkey Module connector and communication line of PDM harness connector.

Specification : About below 1Ω



4. Is the measured resistance within specification ?

YES	▸ Check poor connection between harness connector and Smartkey Module or PDM : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Repair or replace open in CAN communication line and go to "Verification of Vehicle Repair" procedure.

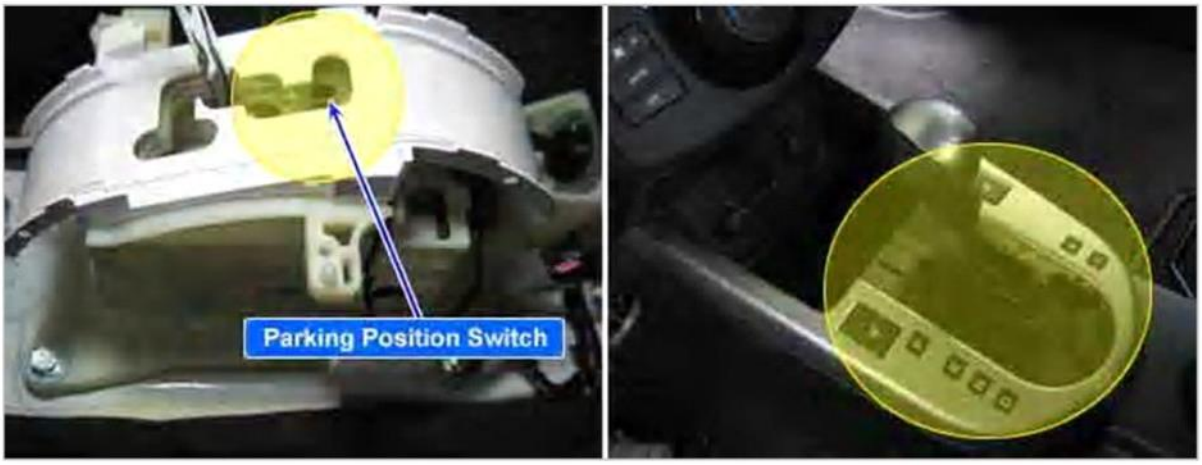
Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component inspection



General Description

Parking Position Switch indicates that Shift Lever is in P range or not.
Smartkey Module decides that engine starting is enable after receiving Parking Position Switch signal.

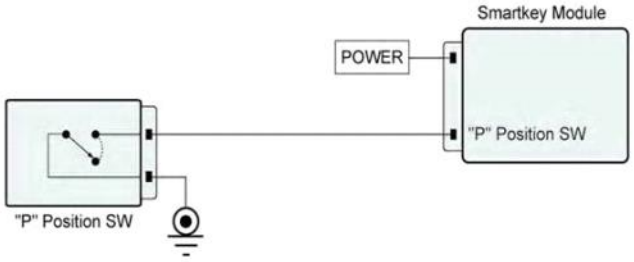
DTC Description

SMARTKEY Module sets DTC B1971 if vehicle speed is over 3km/h while parking switch signal is ON.

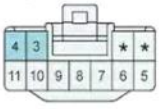
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check Voltage	• Poor Connection in harness • Faulty Parking Switch • Faulty Smartkey Module
Enable Conditions	• After battery Voltage is energized to Smartkey Module	
Threshold value	• After IGN ON, Vehicle speed is over 3km/h with brake switch ON for 10 seconds.	
Failsafe	• -	

Diagnostic Circuit Diagram

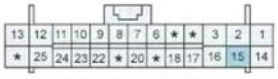


<Sport Mode Switch>



3. 'P' Position/ Clutch SW
4. Ground

<SMK Control Module>



15. 'P' Position/ Clutch SW

Monitor Scantool data

■ **Check parking position switch status.**

1. Connect scantool with diagnostic connector.
2. Check current data with scantool.
3. Check "Shift lever P position" parameter on current data.
4. Check that data is appropriately changeable according to the shift lever position in P or others.

Specification : P position : ON, Not in P position : OFF.

5. Is the shift lever P position normal ?

YES	▸ Check poor connection between harness connector and Parking Postion switch or Smartkey Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to " Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration or damage.
3. Has a problem been found?

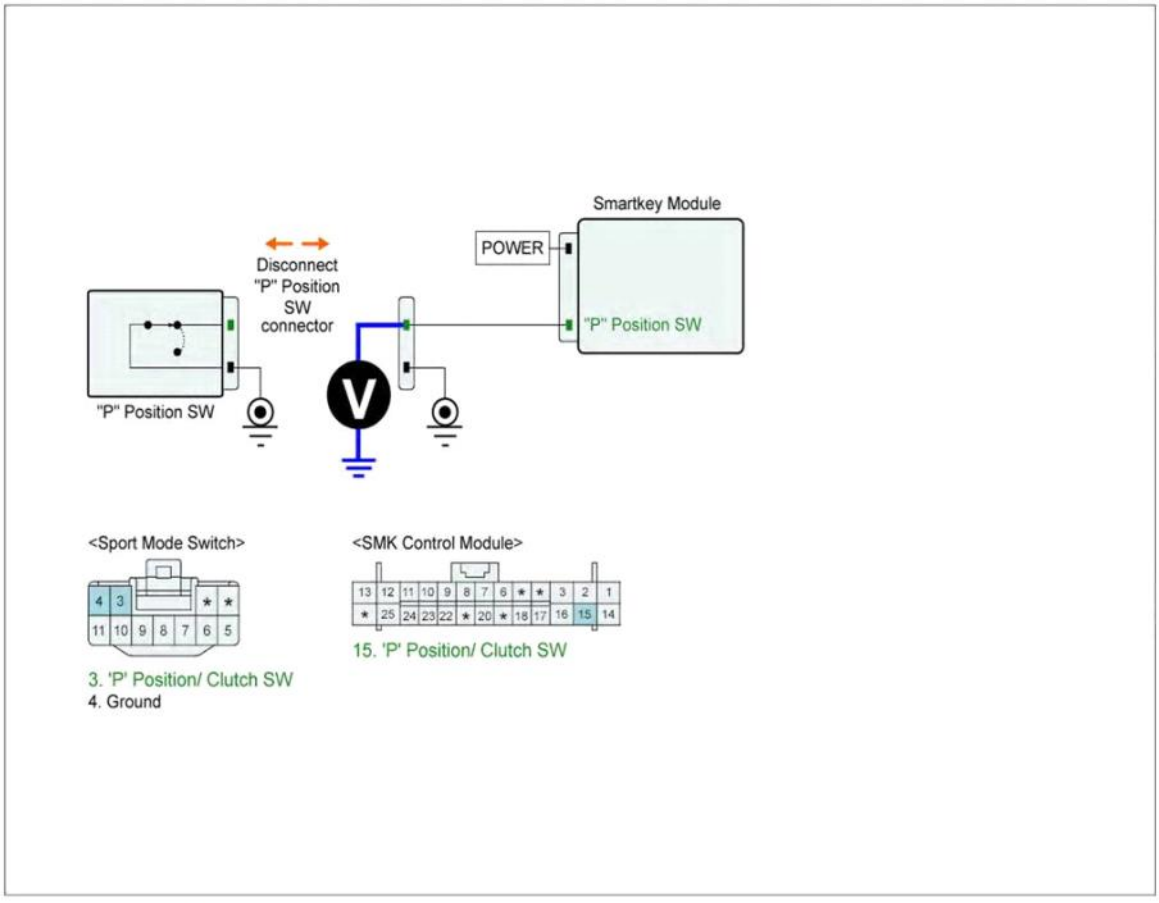
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to check "signal circuit Inspection" procedure.

Signal Circuit Inspection

■ **Check Signal Circuit**

1. IG KEY OFF.
2. Disconnect parking position switch connector.
3. IG KEY ON.
4. Measure voltage between signal terminal of parking position switch harness connector and chassis ground.

Specification : Battery Voltage



5. Is the measured voltage within specification ?

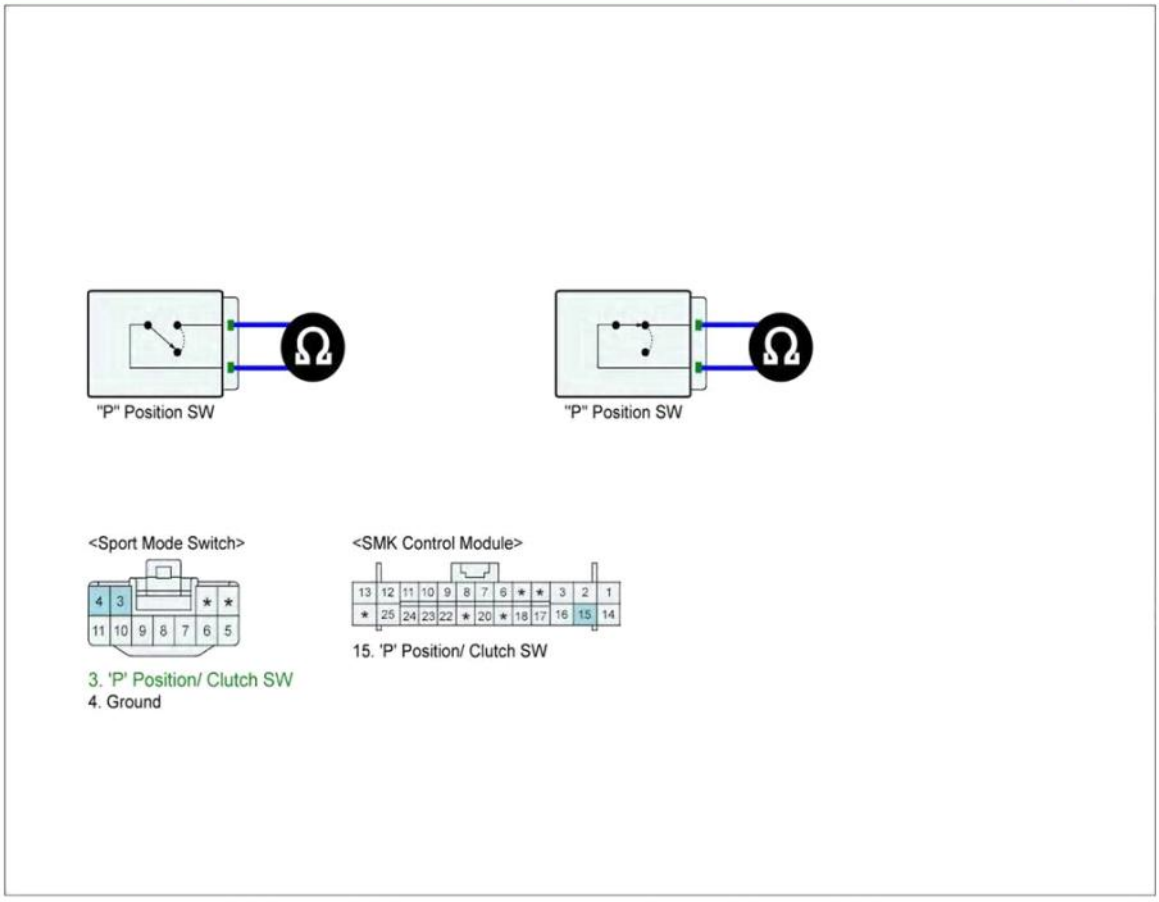
YES	▸ Check open in ground harness. And then, repair or replace as necessary, Finally go to "Verification of Vehicle Repair " procedure.
NO	▸ Check open or short to ground in signal harness. And then, repair or replace as necessary finally go to "Verification of Vehicle Repair " procedure.

Component Inspection

■ Check Parking Position Switch

1. IG KEY OFF.
2. Disconnect Parking Position switch connector.
3. Measure resistance between one and the other connector when parking postion switch ON and OFF.

Specification : Measurement 1: Infinite (∞), Measurement 2 : About below 1Ω



4. Is the measured resistance within specification ?

YES	▸ Check poor connection between harness connector and Parking Postion switch or Smartkey Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Substitute with a known-good parking position switch and check for proper operation. If the problem is corrected, replace parking postion switch and then go to "Verification of Vehicle Repair" procedure.

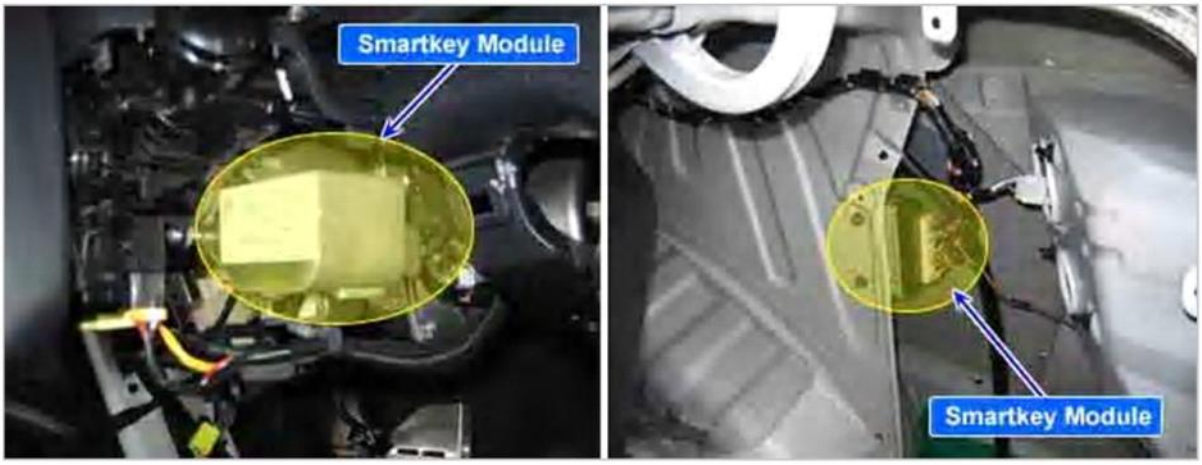
Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component inspection



General Description

ESCL(Electronic Steering Column Lock) is a system to control the lock or unlock of the Steering Column.
It is installed on steering column and Smartkey Module is located inside of instrument panel, left knee of driver side.
It consists of ESCL control Module, Smartkey Module, PDM and SSB(engine Start Stop Button)
It is operating as follows
1. Pushing SSB → 2. Switch 1 signal goes to PDM, Switch 2 signal goes to Smartkey Module → 3. PDM supplies power supply to ESCL → 4. SMARTKEY Module sends ENABLE signal and operation signal to ESCL → 5. ESCL controls bolt to lock or unlock ESCL → 6. PDM detects ESCL Unlock signal.

DTC Description

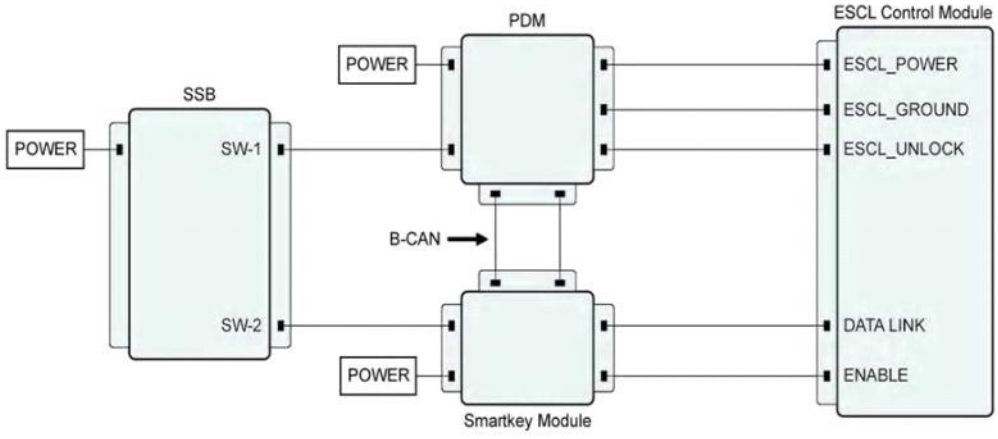
Smartkey Module receives ESCL lock or unlock stuatus signal from ESCL and PDM(via CAN). And then, Smartkey Module compares PDM is lock or unlock signal with ESCL is lock or unlock signal.
If the both signals are unmathing, Smartkey Module sets DTC B1971.

DTC Detecting Condition

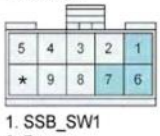
Item	Detecting Condition	Possible cause
DTC Strategy	• Check voltage and Data	• Poor connection in harness or connector. • After battery voltage is supplied to Smartkey Module - If IPM detects pins related ESCL are failed 1. Faulty ESCL control Module 2. Open or short in battery / ground curcuit of ESCL 3. Open or short to battery / ground in communicantion circuit of ESCL 4. Open in O_ESCL Enable circuit from Smartkey Module
Enable Conditions	• After battery voltage is suppiled to Smartkey Module	

Threshold value	• When both signal from ESCL lock or unlock status and PDM lock or unlock stuatus are unmatching	5. Open or short in ESCL_Unlock circuit to PDM - DTC is set although it is not ESCL fault 6. No battery voltage to PDM 7. Short to battery in power relay on the PDM line such as ACC, IGN1, IGN2, Starter Rly 8. When actuation test for PDM9. It is leant status but not with same PIN code for all Smartkey Module / PDM/ESCL • Faulty Smartkey Module • Faulty PDM • Faulty ESCL control Module
Failsafe	• -	

Diagnostic Circuit Diagram

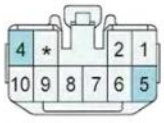


<SSB SW>



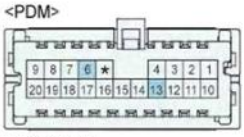
1. SSB_SW1
6. Power
7. SSB_SW2

<PDM>



4. ESCL Power
5. ESCL Ground

<PDM>



6. SSB_SW1
13. ESCL_Unlock

<ESCL>

2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL Unlock
6. ESCL Data Line

<SMK Control Module>

12. ESCL_Com
18. ESCL_Enable
23. SSB_SW2

Monitor Scantool data

■ Check DTC status

1. Check DTC on PDM side with scantool.
2. Check that there is any DTC on PDM side or ESCL side.
3. Inspect DTC related ESCL first if there is any DTC on the PDM side according to DTC troubleshooting guide.
4. After inspetion and repair, erase DTC related ESCL.
5. Erase DTC B1971 ESCL failure on Smartkey Module side.
6. Has the DTC gone after erasing DTC with scantool ?

YES	▸ Check poor connection between harness connector and ESCL, PDM or Smartkey Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to check current dat as follows if there is DTC B1971 ESCL failure.

■ Check current Data

1. Select current data parameters related Smartkey Module with scantool.
2. Monitor "ESCL ENABLE" and "SMK State" are normal.
3. Select current data parameter related PDM.
4. Monitor "ESCL BATTERY OUTPUT" , "ESCL GND OUTPUT" and "ESCL UNLOCK STATE INPUT" are normal.

Specification : - Current Data parameter related Smartkey Module -
1. ESCL ENABLE : It is ON, if IPM sends enable signal to ESCL
2. SMK State : It shows ESCL current status. It shows ESCL FAULURE if there is a failure

Specification : - Current Data parameter related PDM -
1. ESCL BATTERY OUTPUT : It will be changed form OFF to ON when PDM supplies operation voltage with PDM.
2. ESCL GND OUTPUT : It will be changed form OFF to ON when PDM supplies operation voltage with PDM.
3. ESCL UNLOCK STATE INPUT : In case that ESCL bolts is unlock, it will be ON.

5. Are all parameters related ESCL funtioning normally ?

YES	▸ Check poor connection between harness connector and ESCL, PDM or Smartkey Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.
NO	▸ Check harness and system related ESCL if "SMK STATE" is shown ESCL FAILURE ▸ If there is any parameter on the system or harness displayed abnormal, check harness and system. ▸ Go to "Inspection & Repair " procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.
   Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

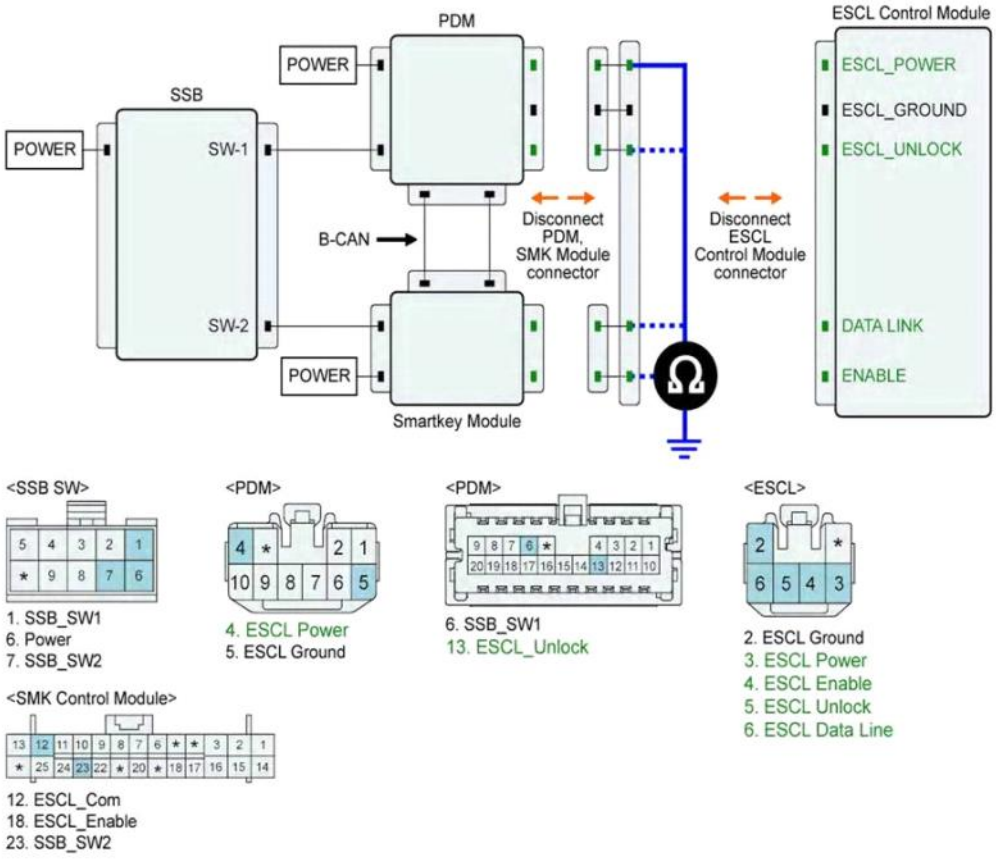
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Check ESCL Circuit " procedure.

Check ESCL circuit

■ **Check short to ground in ESCL circuit.**

1. IG KEY OFF
2. Disconnect ESCL control Module, PDM and Smartkey Module connector.
3. Measure resistance between all the terminals of ESCL harness connector and chassis ground.

Specification : Infinite



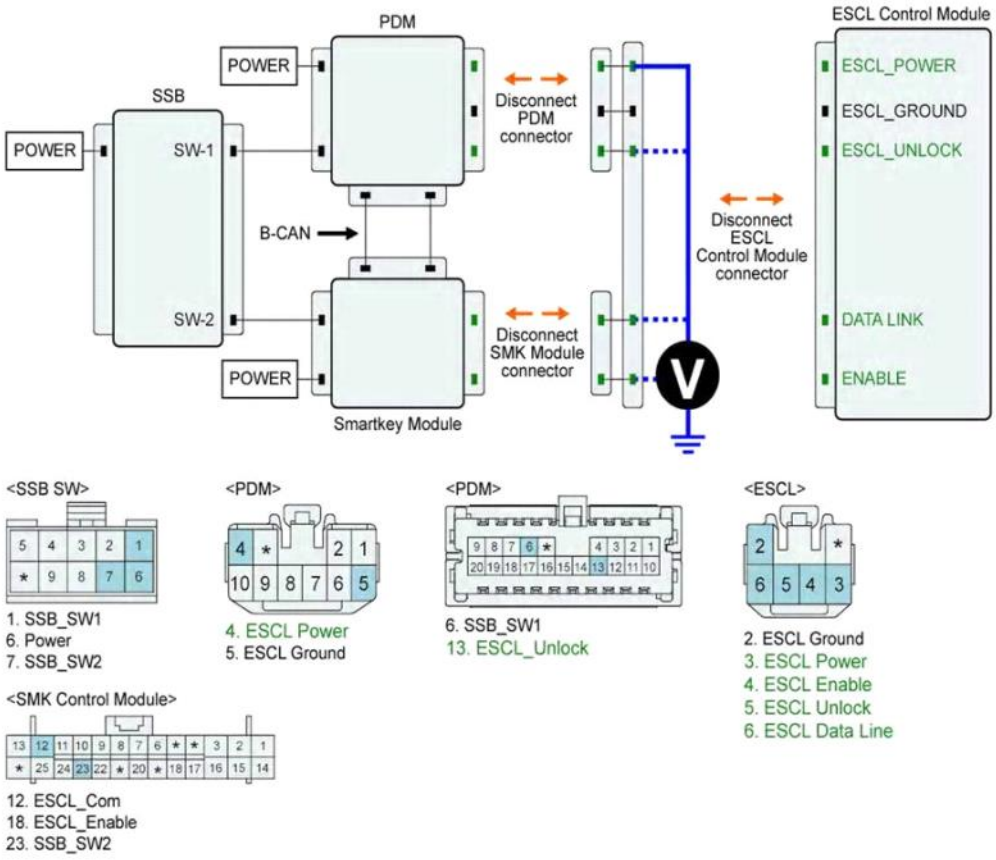
4. Is the measured resistance within specification ?

YES	▸ Go to "Check short to battery in ESCL harness " procedure.
NO	▸ Repair or replace as necessary and then, go to "Verification of Vehicle Repair"procedure.

■ Check short to battery in ESCL harness

1. IG KEY OFF.
2. Disconnect ESCL control Module, PDM and SMARTKEY Module connector.
3. Measure resistance between each terminal of ESCL control Module harness connector and chassis ground.

Specification : About 0V



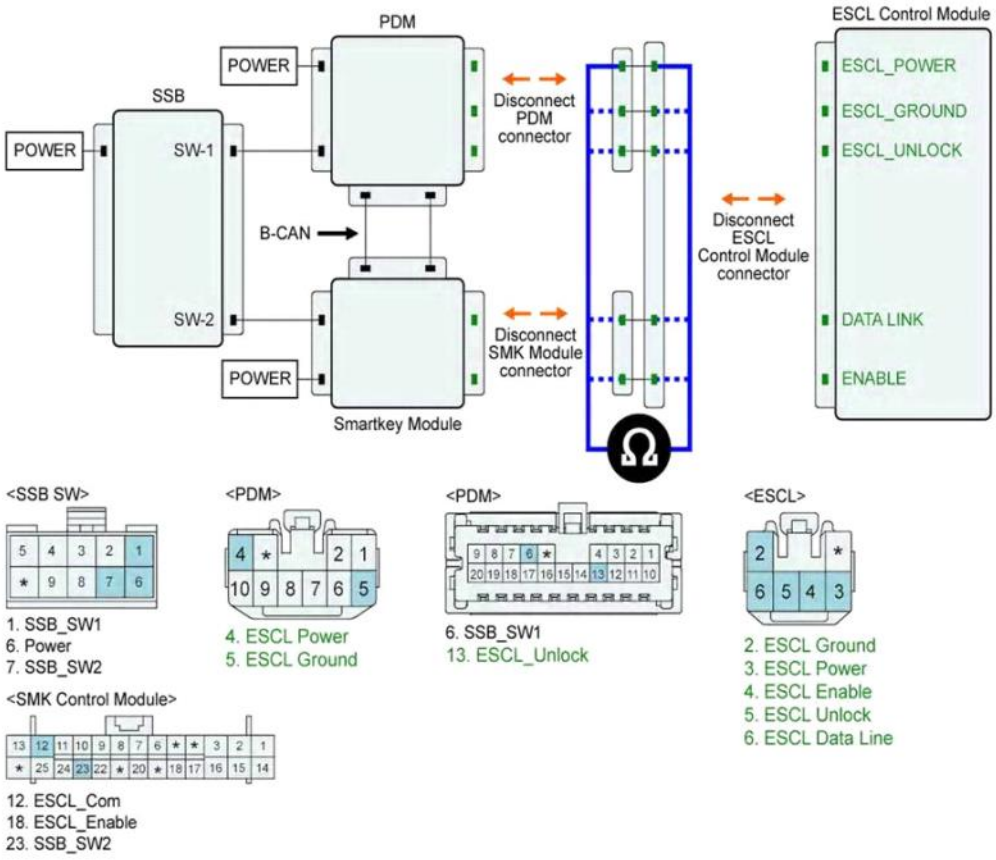
4. Is the measured voltage within specification ?

YES	▸ Go to "check open in ESCL harness " as follows
NO	▸ Repair or replace the short to battery as necessary and then, go to 'Verification of Vehicle Repair" procedure.

■ Check open in ESCL harness

1. IG KEY OFF.
2. Disconnect ESCL control Module, PDM and Smartkey Module connector.
3. Measure resistance between one and the other terminal of ESCL control module harness connector or IPM harness connector.

Specification : About below 1Ω



4. Is the measured resistance within specification ?

YES	▸ Check poor connection between harness connector and ESCL Control Module, PDM or Smartkey Module : Thoroughly check the looseness, poor connection, bent, corrison, contamination, deformation or damage of connector. Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure. ▸ After replacing ESCL control module or Smartkey Module, perform Key teaching procedure with scantool.
NO	▸ Repair open in harness or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

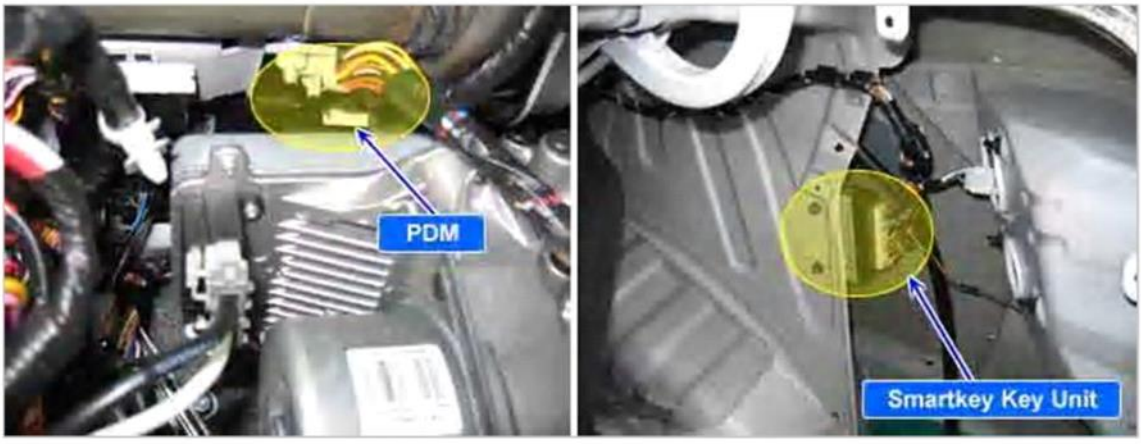
Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and selet "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Operate the vehicle and monitor the DTC on the scantool.
3. Are any DTCs present?

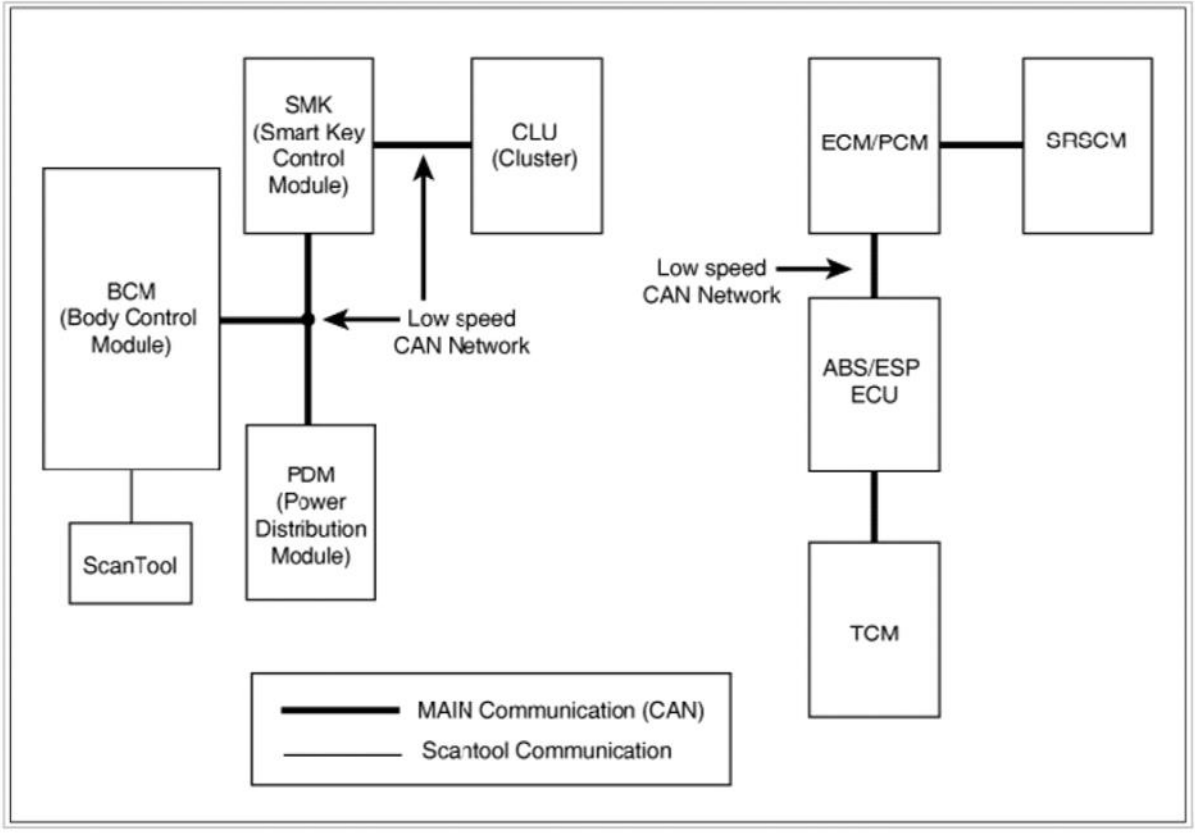
YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System is performing to specification at this time.

Component Location



General Description

This is DTC which is related with communication error between PDM and other units.
※ Control Units : BCM(Body Control Module), PDM(Power Distribution Module), CLUSTER, SMK(Smart Key) ECU.
*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.
*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



DTC Description

Pattern	Status
1	Open in CAN High circuit
2	Open in CAN Low circuit
3	Short to battery in CAN High circuit
4	Short to battery in CAN Low circuit
5	Short to ground in CAN High circuit
6	Short to ground in CAN Low circuit
7	Short between CAN High and Low circuit

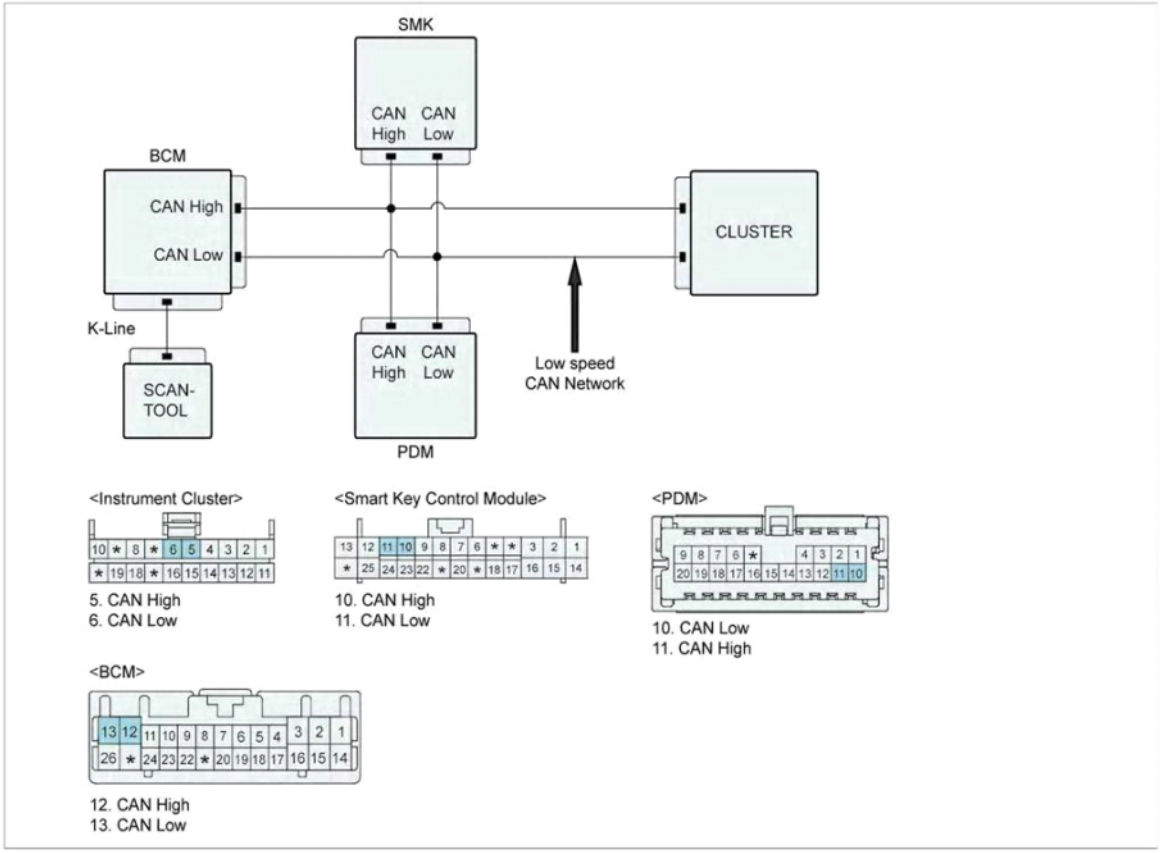
Communication is normal but DTC set if PDM detects 7 error status as follows.

1. Short to battery in CAN High circuit
2. Short to ground in CAN High circuit
3. Short to battery in CAN Low circuit
4. Short to ground in CAN Low circuit
5. Short between CAN High and Low circuit
6. Open or Poor connection in CAN Low circuit
7. Open or Poor connection in CAN High circuit

DTC Detecting Condition

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• CAN communication status</td><td rowspan="8">• Short to battery / ground in CAN high circuit
• Short to battery / ground in CAN low circuit
• Short between CAN high and CAN low circuit
• Open or poor connection in CAN high and low circuit.
• Faulty IPM</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG "ON"
• Engine "START"
• B/T voltage engerzied to PDM</td></tr>
<tr><td rowspan="4">Threshold Value</td><td rowspan="2">CAN high</td><td>0 V</td><td>Short to ground</td></tr>
<tr><td>B+ V</td><td>Short to battery</td></tr>
<tr><td rowspan="2">CAN low</td><td>0 V</td><td>Short to ground</td></tr>
<tr><td>B+ V</td><td>Short to battery</td></tr>
<tr><td>Diagnostic Time</td><td colspan="3">• Failure has been continued for 2sec.</td></tr>
<tr><td>DTC Erasing Time</td><td colspan="3">• DTC is erased immediately after trouble fixed (In case of the past error, perform DTC erasing procedure.)</td></tr>
</table>

Diagnostic Circuit Diagram



Signal Waveform & Data

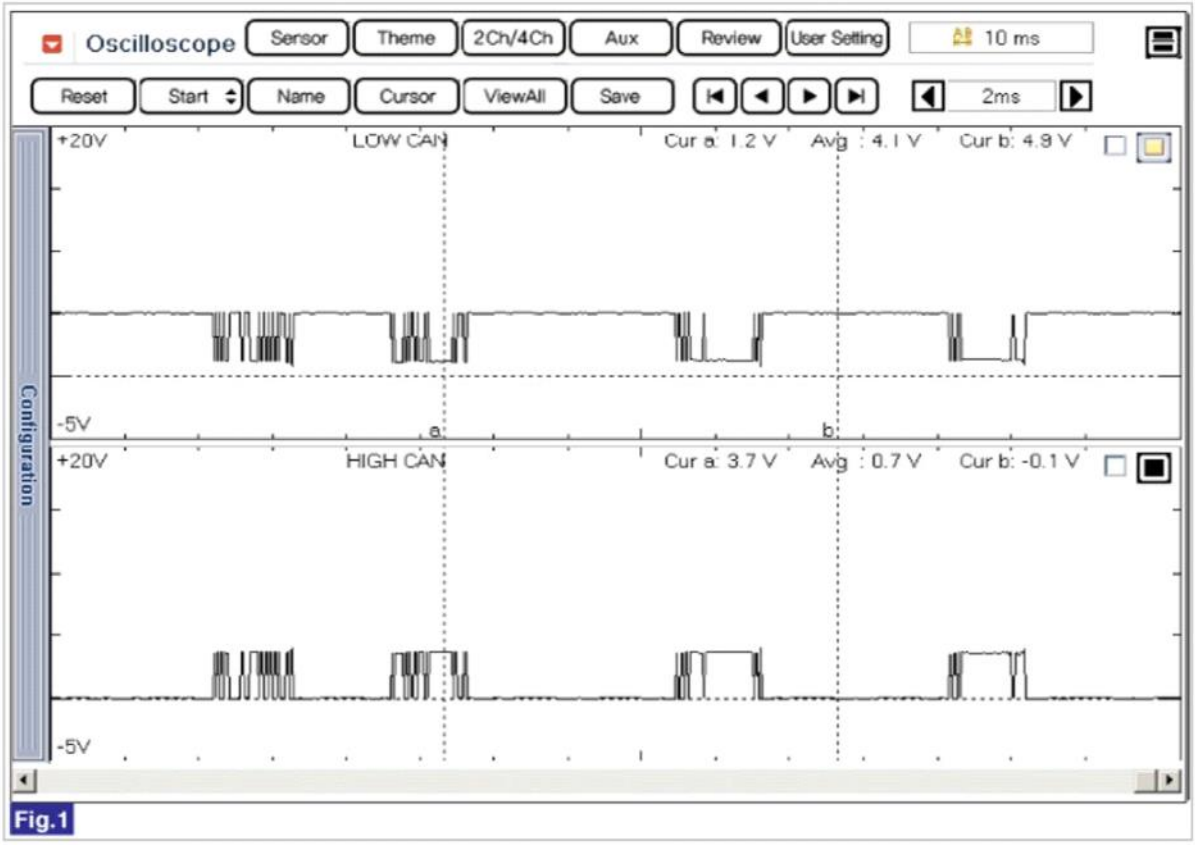


Fig.1

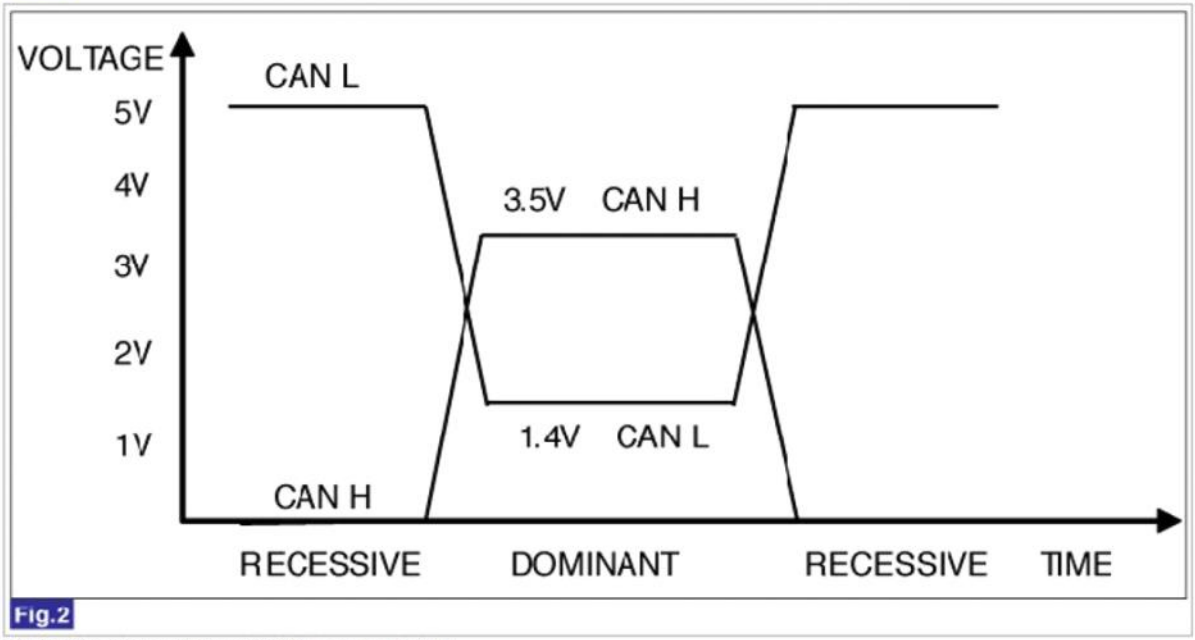


Fig.2

Fig.1) Signal waveform of CAN Low and HIGH
Fig.2) CAN BUS VOLTAGE LEVEL (LOW SPEED CAN)

Monitor Scantool Data

■ **Check DTC**

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions"
   (Refer to "DTC Detecting Condition" table)

5. Is the same DTC occurred again?

YES	▸ Go to next procedure.
NO	▸ Fault is intermittent caused by poor contact in the sensor's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Monitor Scantool Data

■ **Check DTC**

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions"
   (Refer to "DTC Detecting Condition" table)

5. Is the same DTC occurred again?

YES	▸ Go to next procedure.
NO	▸ Fault is intermittent caused by poor contact in the sensor's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

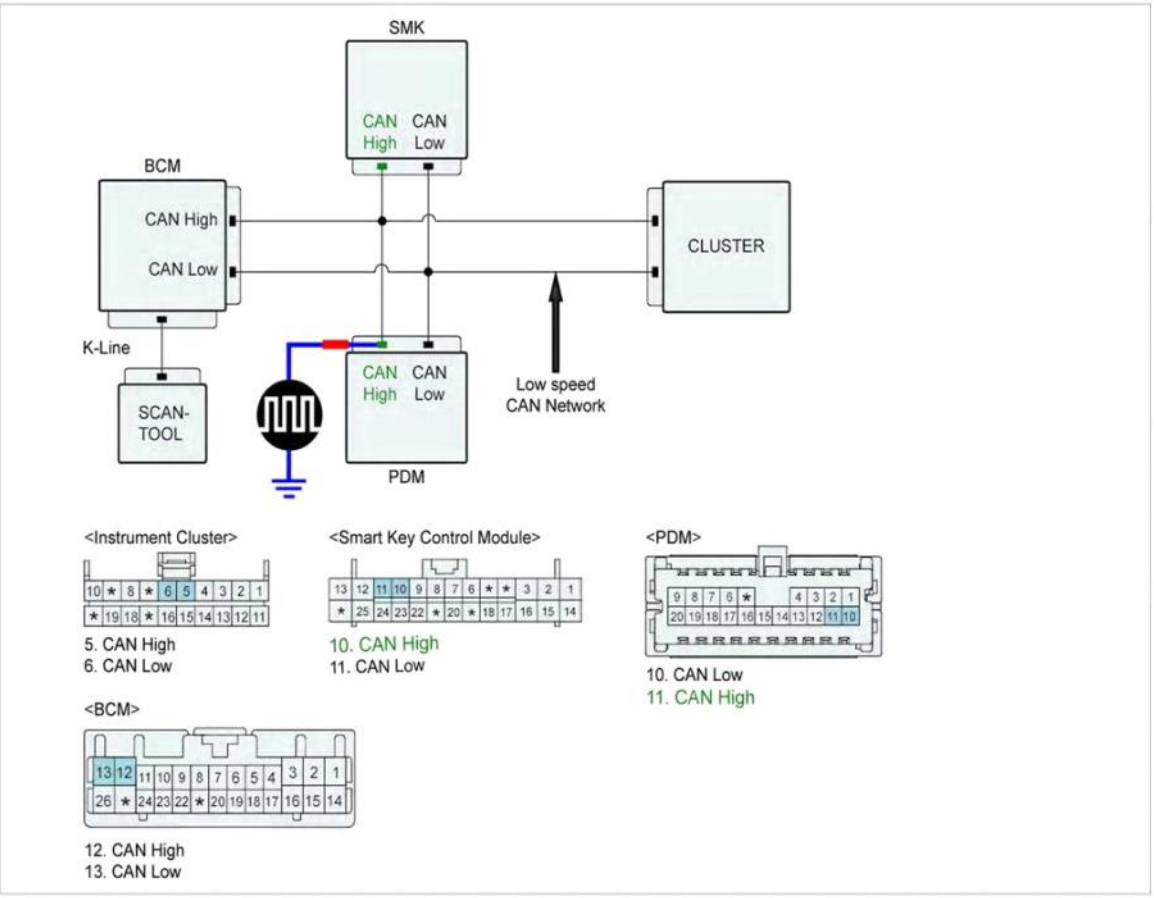
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to " Signal Circuit Inpsection " procedure.

Signal Circuit Inpsection

■ **Check CAN high circuit**

1. IG "ON" & ENG "OFF".
2. Connect GDS and select Scope meter fucntion.
3. Measure signal waveform of PDM CAN High line.

Specification : Refer to signal waveform and data



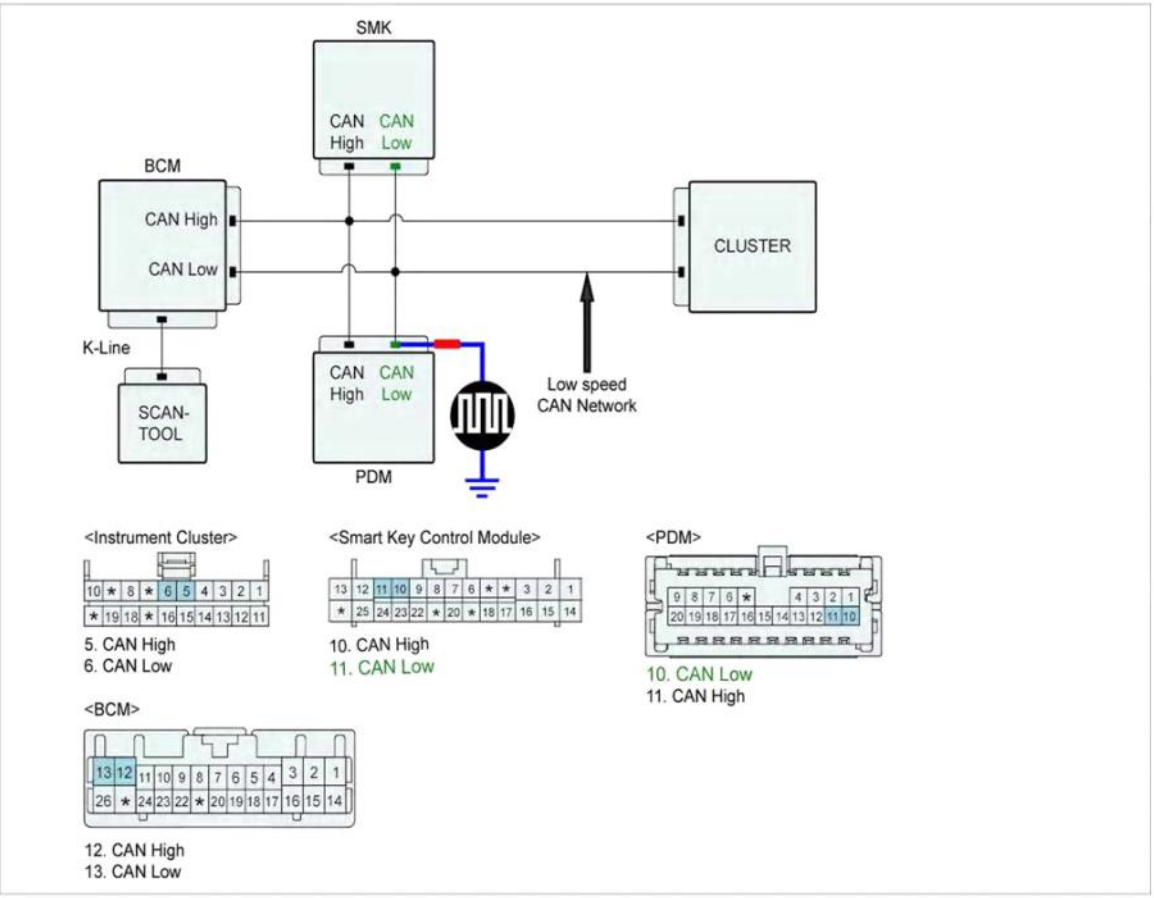
4. Is the measured signal waveform of CAN high circuit normal ?

YES	▸ Go to next procedure
NO	▸ Check short to battery / ground in CAN high circuit, and repair or replace as necessary. Go to "Verification of Vehicle Repair" procedure.

■ Check CAN Low circuit

1. IG "ON" & ENG "OFF"
2. Connect GDS and select Scope meter fucntion.
3. Measure signal waveform of PDM CAN Low line.

Specification : Refer to signal waveform and data



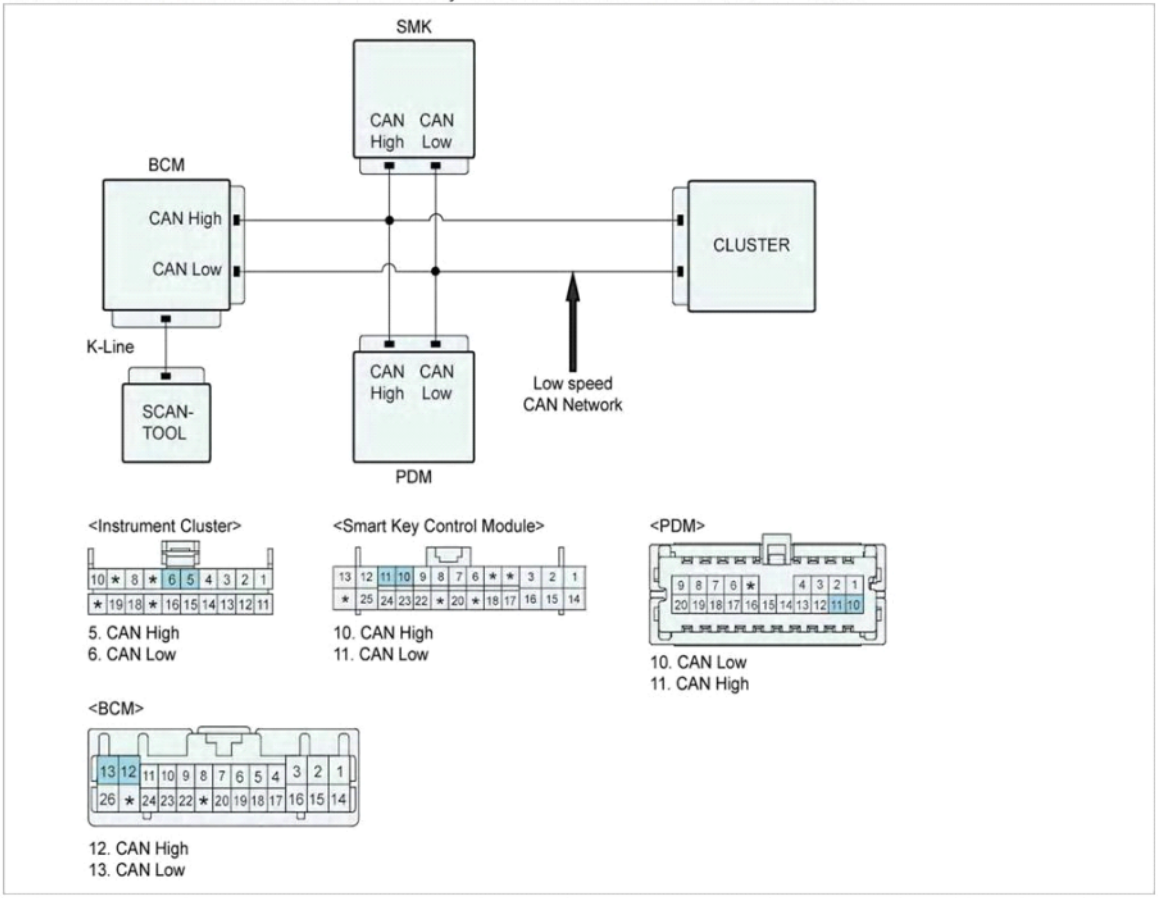
4. Is the measured signal waveform of CAN low circuit normal ?

YES	▸ Go to next procedure.
NO	▸ Check short to battery/ground in CAN low circuit and, repair or replace as necessary. And then, go to 'Verification of Vehicle Repair" procedure.

Component Inspection

■ Check internal errors of CAN communication units

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. Disconnect CAN communication units one by one and monitor DTC to find the cause.



*CAN communication units : BCM(Body Control Module), PDM(Power Distribution Module), CLUSTER, SMK (Smart Key) ECU.

5. Is the code erased?

YES	▸ Substitute with a known - good unit and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure.
NO	▸ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

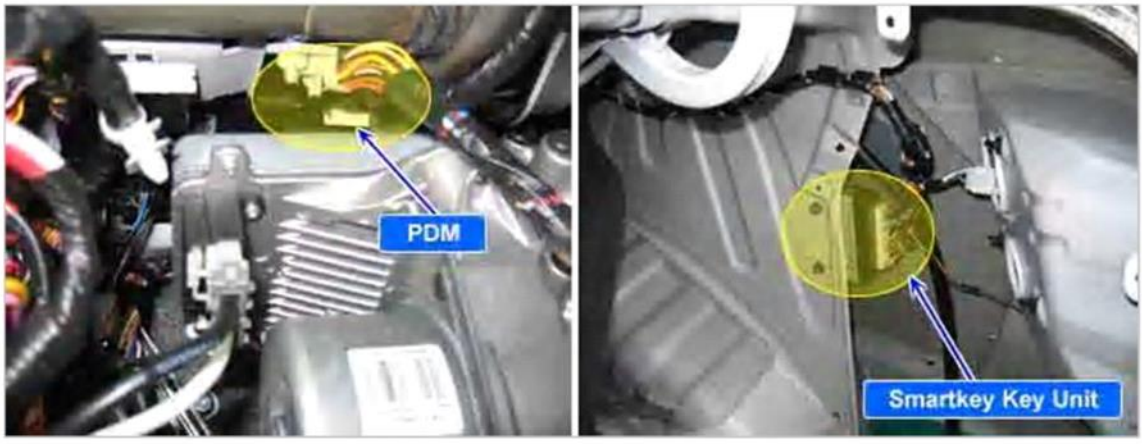
Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

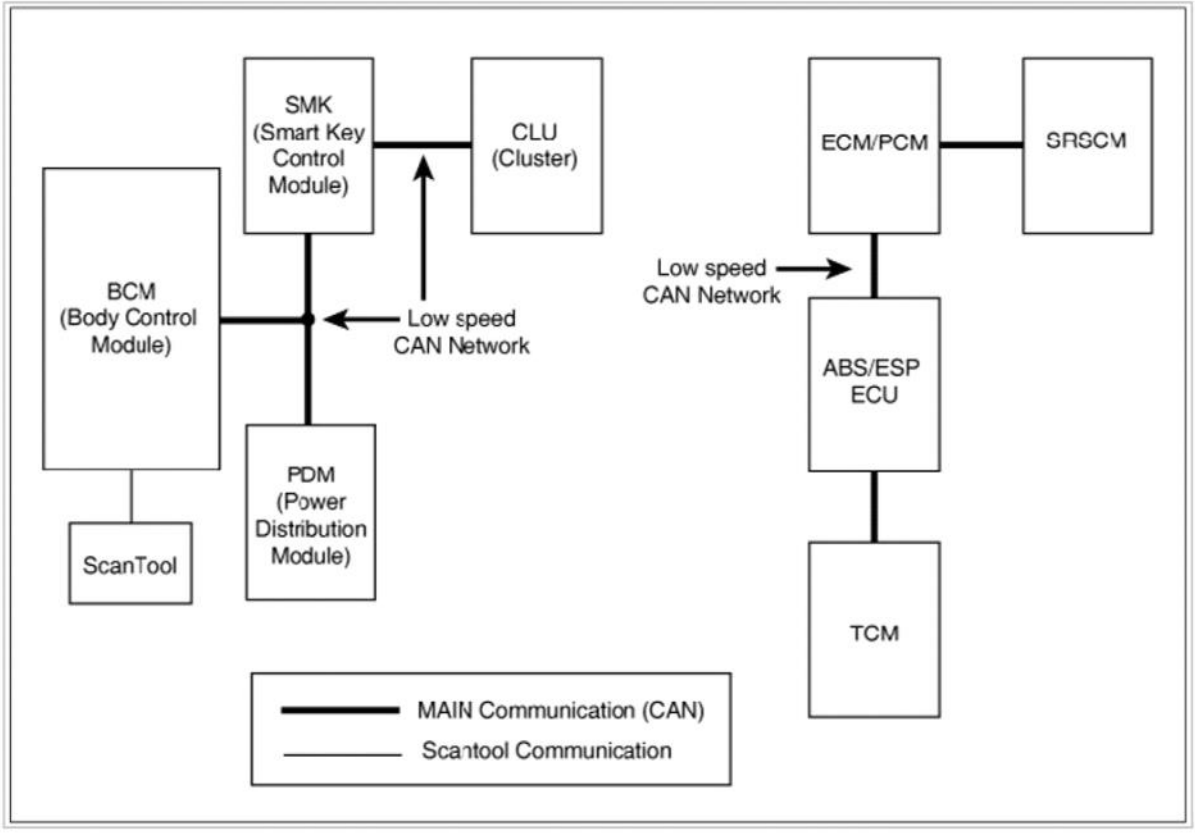
YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System performing to specification at this time.

Component Location



General Description

This is DTC which is related with communication error between PDM and other units.
(※ Control Units : BCM(Body Control Module), PDM(Power Distribution Module), CLUSTER, SMK(Smart Key) ECU.
*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.
*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



DTC Description

This is DTC which is related with communication error between PDM and other units.
※ Control Units : BCM (Body Control Module), PDM(Power Distribution Module), CLU(Cluster), SMK(Smart Key) ECU.
Case1: After short between PDM CAN Low Line and High Line, short to ground together.
Case2: After short between PDM CAN Low Line and High Line, short to power together.
※ This code is occurred when It is not possible to transmit data by CAN Line in those way of Software and Hardware. But, It is possible to receive data by CAN Line.
This code reports BUS OFF status when data transmit error count number is over 255. The purpose is to verify the status of CAN controller and CAN communication line when error is detected.
According to operation condition, some of module which are connected to CAN line may not detect B1603.
Also, B1602 coincides with B1603 at all times.

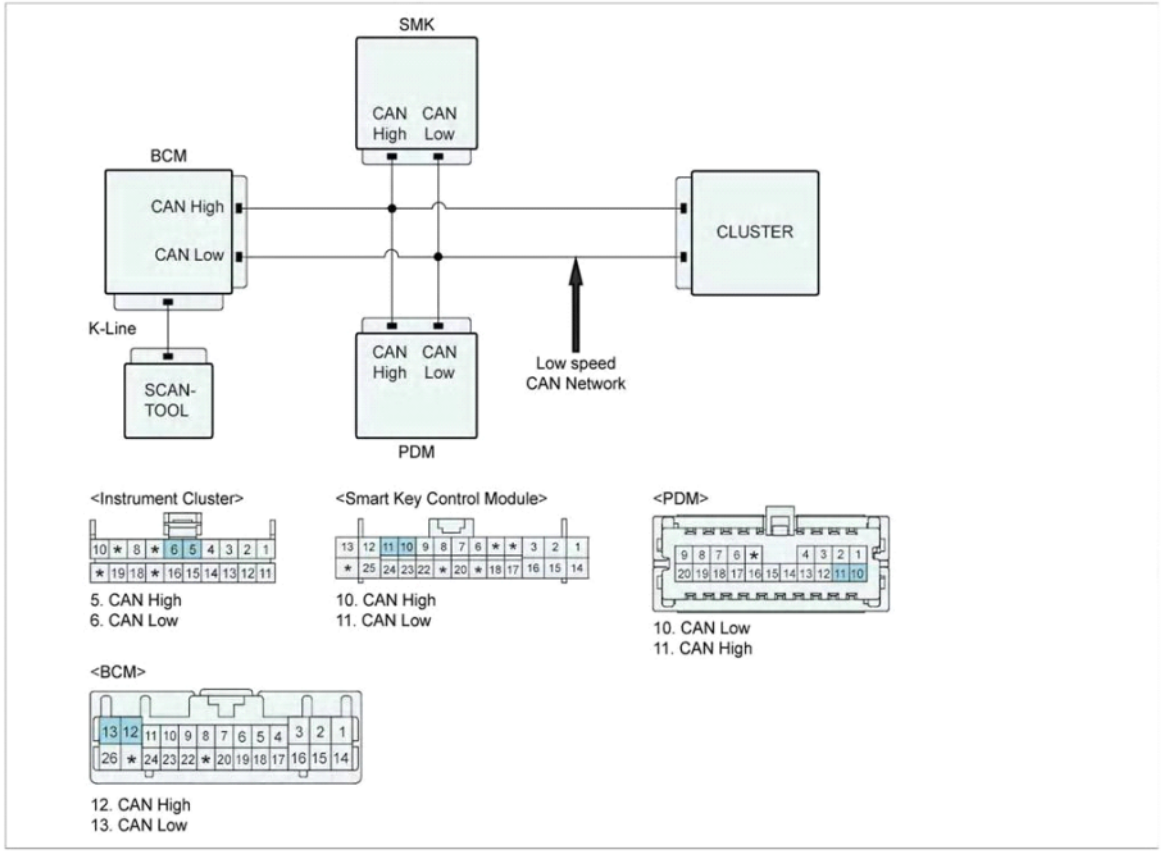
CAUTION

Difference between CAN ERROR and CAN BUS ERROR
CAN Error : MIL On, CAN Bus Error : No MIL

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• CAN Communication Check	• BCM, PDM are not Sleep condition 1) CAN High and Low Line short to ground coincident 2) CAN High and Low Line short to battery coincident
Enable Conditions	• BCM, PDM power on	
Threshold Value	• CAN High/Low : 0V or B+	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed.	

Diagnostic Circuit Diagram



Signal Waveform & Data

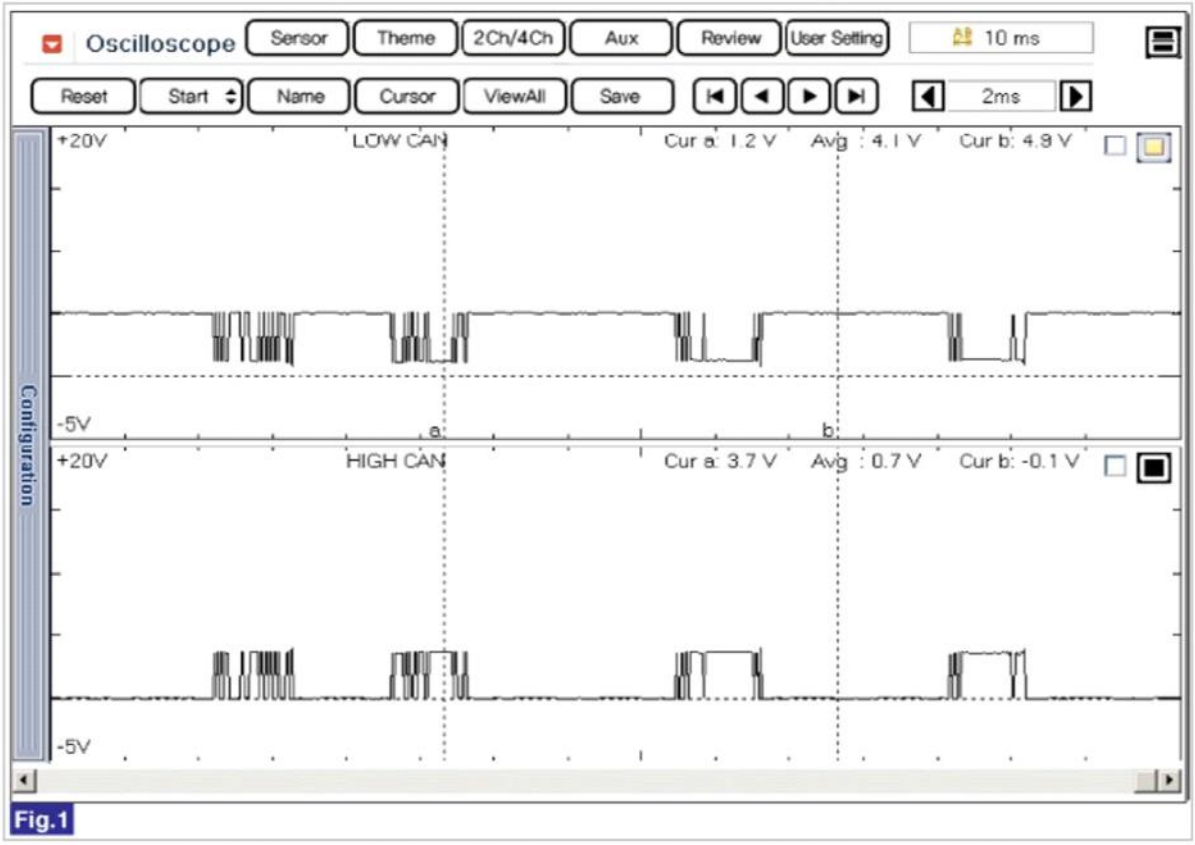


Fig.1

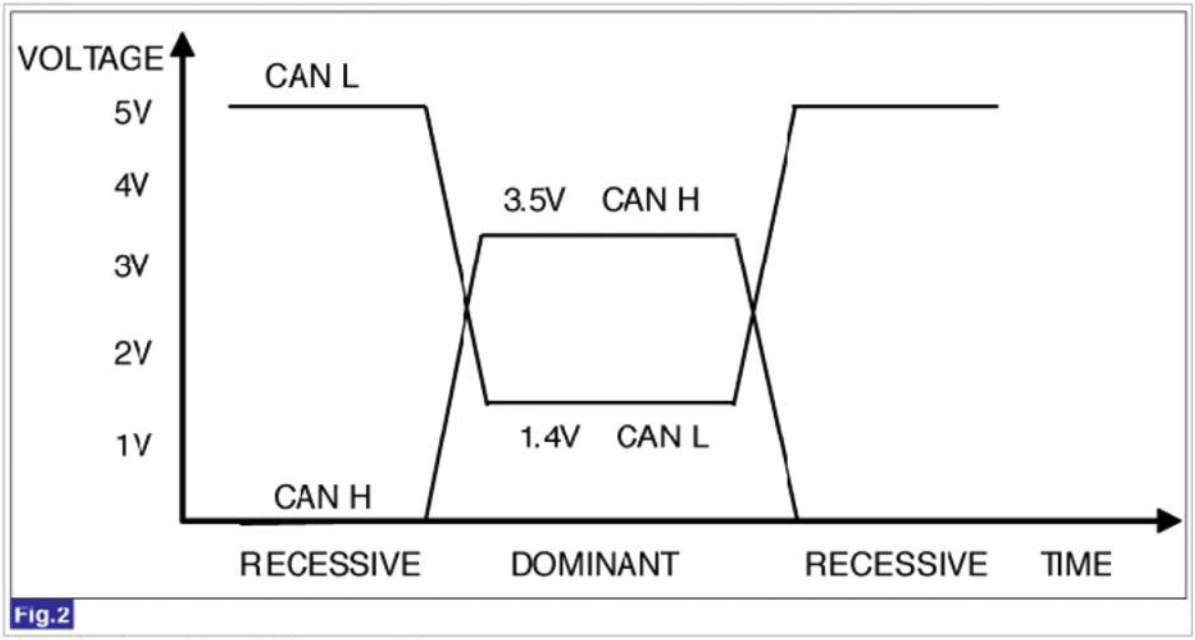


Fig.2

Fig.1) Signal waveform of CAN Low and HIGH
Fig.2) CAN BUS VOLTAGE LEVEL (LOW SPEED CAN)

Monitor Scantool Data

■ **Check DTC**

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions"
   (Refer to "DTC Detecting Condition" table)

5. Is the same DTC occurred again?

YES	▸ Go to next procedure.
NO	▸ Fault is intermittent caused by poor contact in the sensor's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Terminal & Connector Inspection

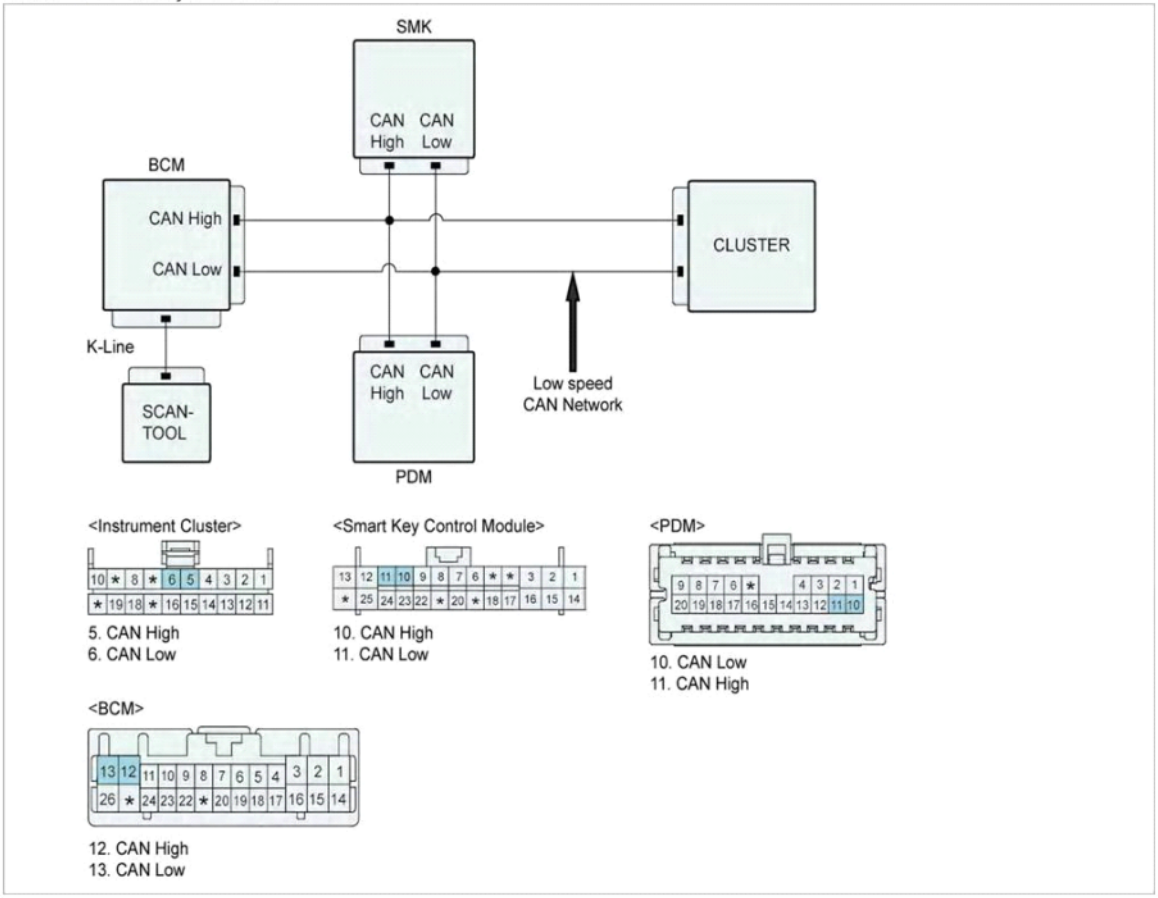
1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Component Inspection" procedure.

Component Inspection

■ Check internal errors of CAN communication in PDM.

1. Check internal errors of CAN communication in PDM.
2. Connect GDS.
3. IG "ON" and engine "OFF".
4. Select "DTC Analysis" mode.



5. Is the code erased?

YES	▸ Substitute with a known - good unit and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure.
NO	▸ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

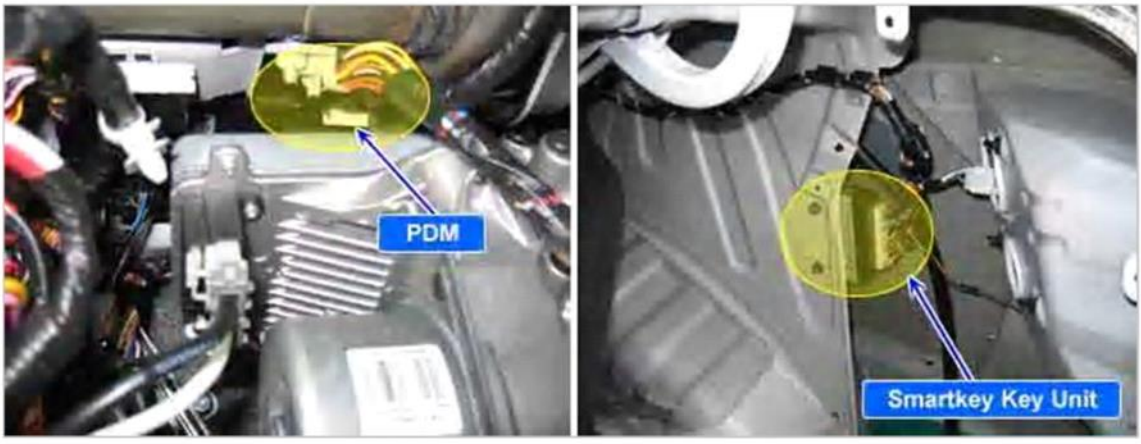
Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

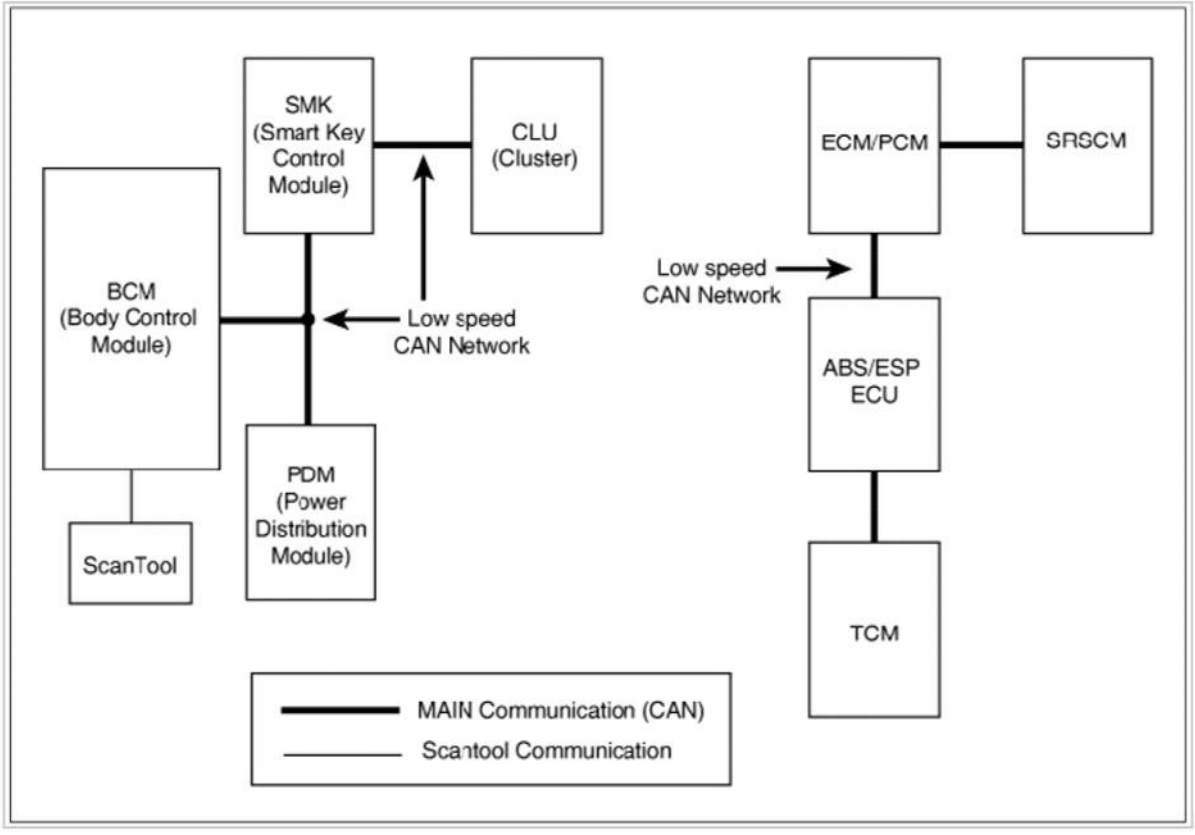
YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System performing to specification at this time.

Component Location



General Description

This is DTC which is related with communication error between PDM and other units.
※ Control Units : BCM(Body Control Module), PDM(Power Distribution Module), CLUSTER, SMK(Smart Key) ECU.
*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.
*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



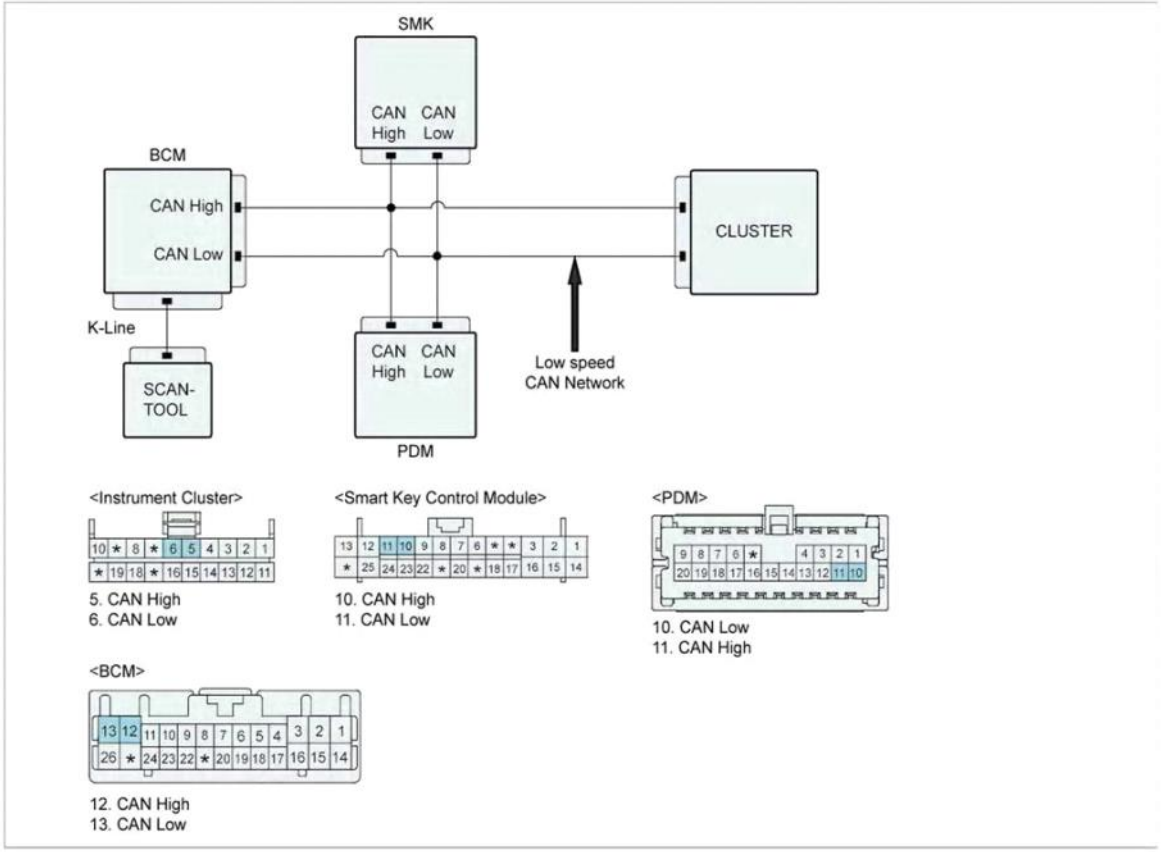
DTC Description

This code reports the malfunction of NEC MCU inside PDM. This is the case which there is the NEC MCU communication error.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• NEC MCU Communication Check	• Short to ground/ power or open in communication circuit of NEC MCU inside PDM • Replace PDM (In case It is unable to verify the cause.)
Enable Conditions	• PDM power on	
Threshold Value	• Communication error	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed.	

Diagnostic Circuit Diagram



Signal Waveform & Data

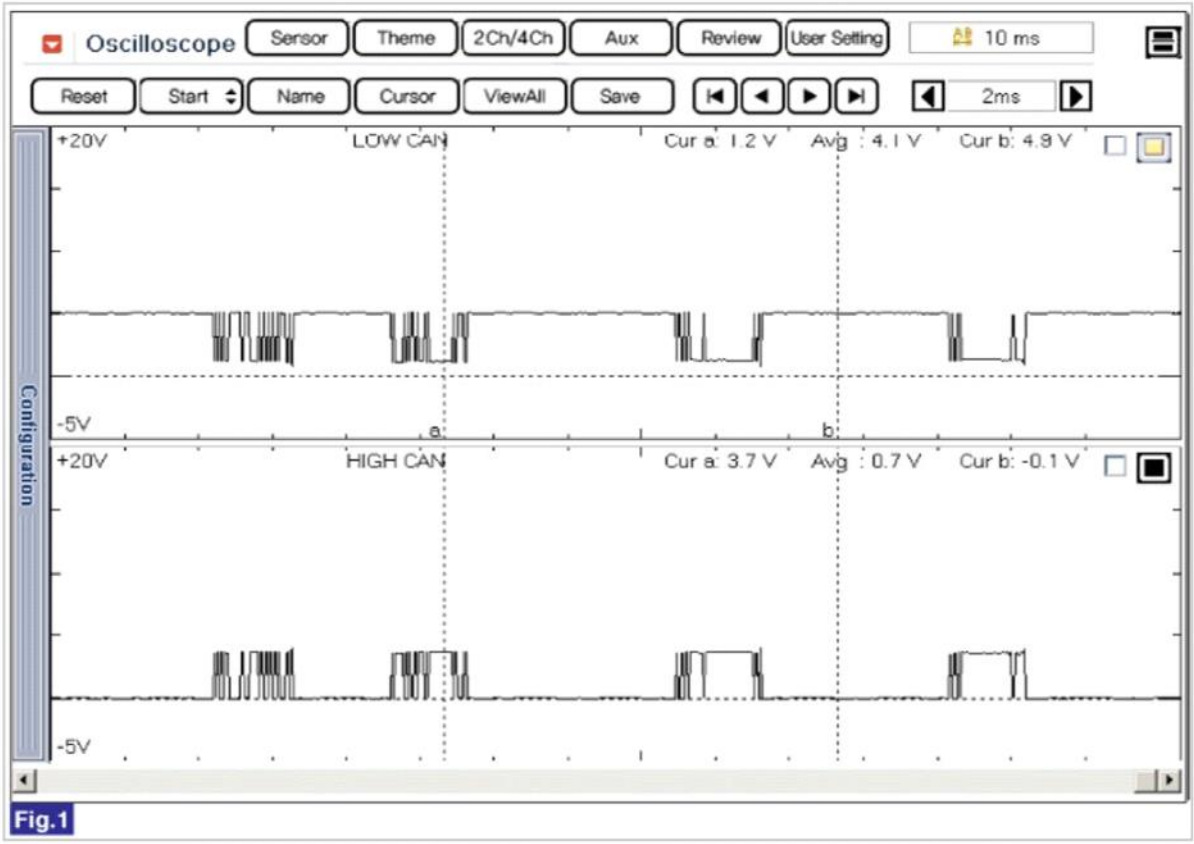


Fig.1

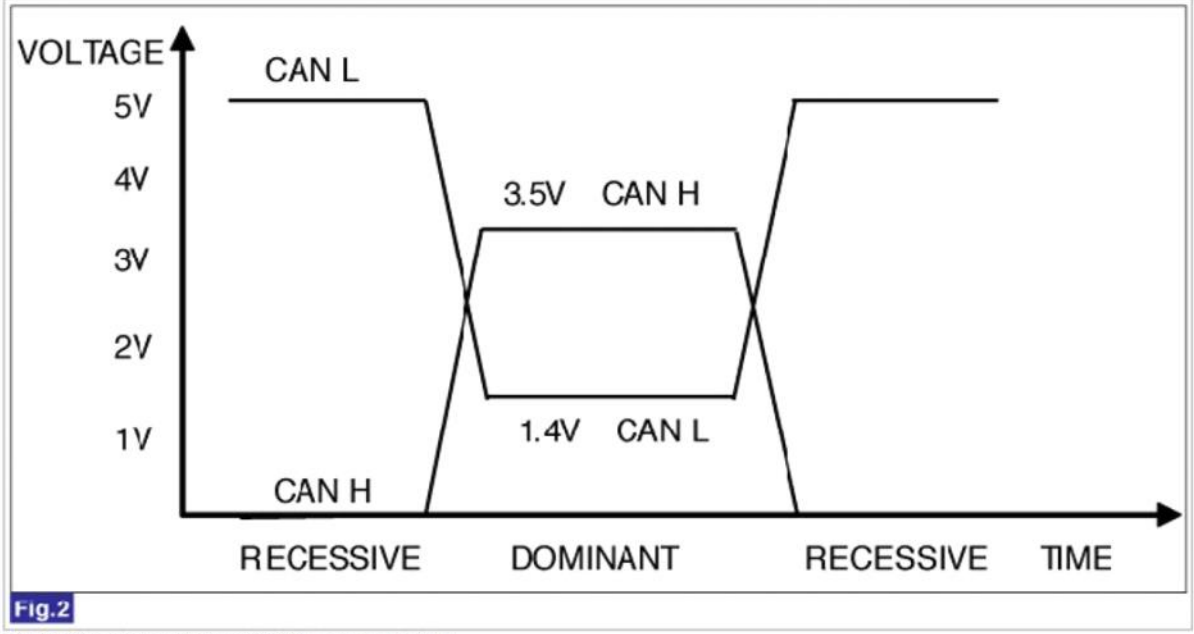


Fig.2

Fig.1) Signal waveform of CAN Low and HIGH
Fig.2) CAN BUS VOLTAGE LEVEL (LOW SPEED CAN)

Monitor Scantool Data

■ **Check DTC**

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions"
   (Refer to "DTC Detecting Condition" table)

5. Is the same DTC occurred again?

YES	▸ Go to next procedure.
NO	▸ Fault is intermittent caused by poor contact in the sensor's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Terminal & Connector Inspection

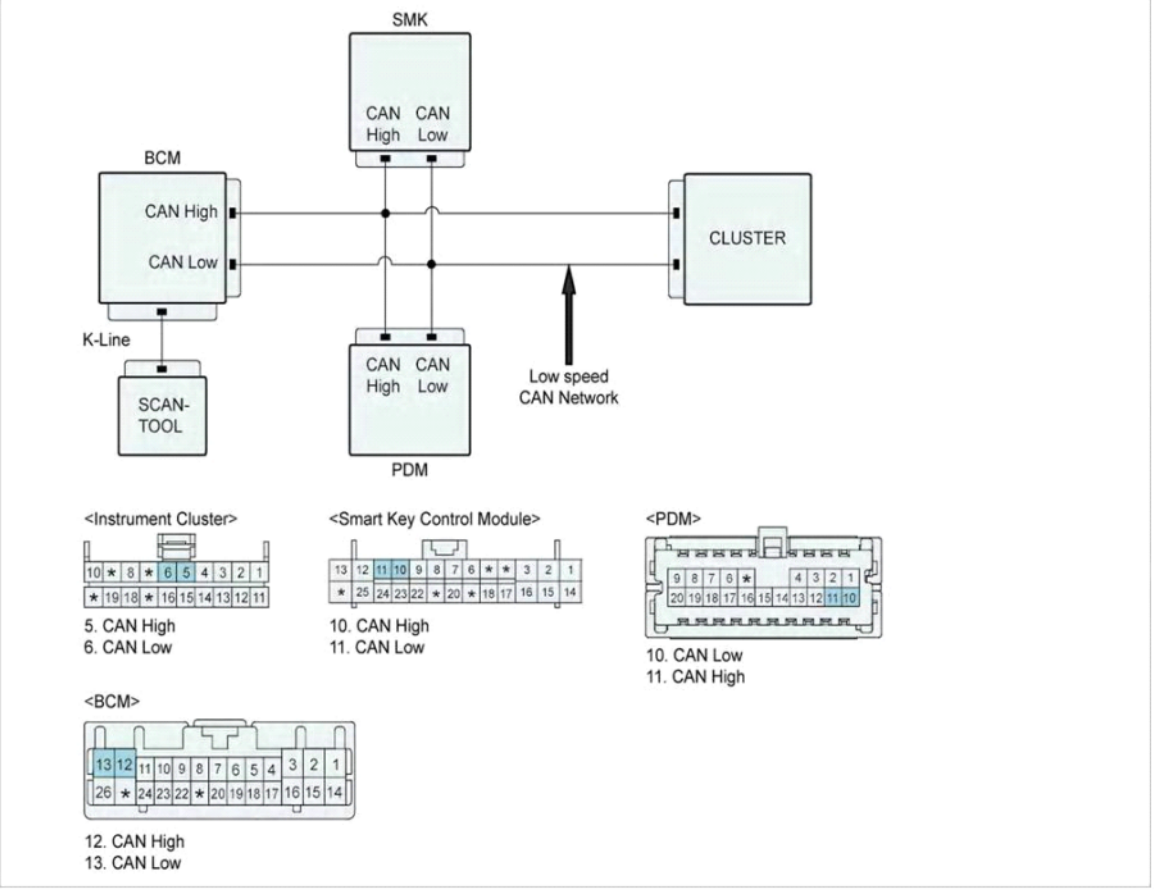
1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Component Inspection" procedure.

Component Inspection

■ Check internal errors of CAN communication in PDM

1. Replace with a known-good PDM after removing installed PDM.
2. Connect GDS.
3. IG "ON" and engine "OFF".
4. Select "DTC Analysis" mode.



5. Is the code erased?

YES	▸ Substitute with a known - good unit and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure.
NO	▸ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

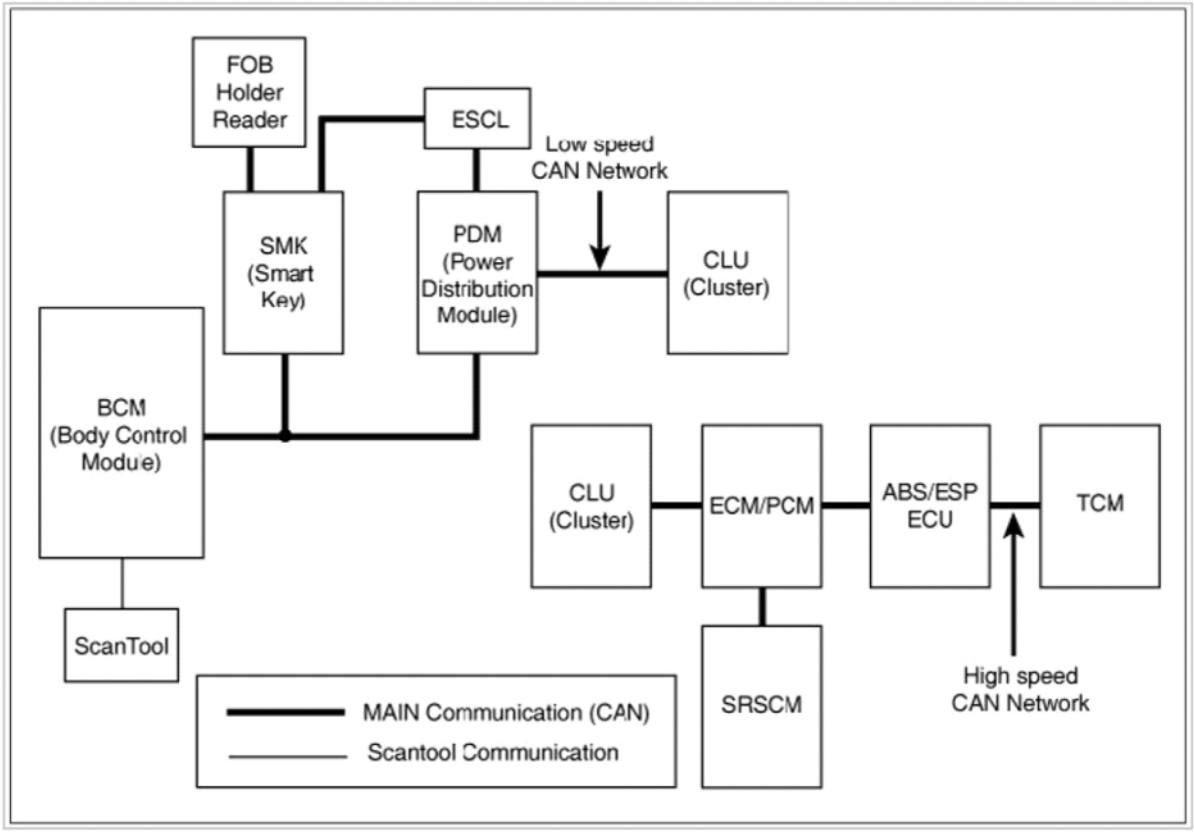
1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System performing to specification at this time.

Component Location

General Description

The body electrical system is comprised of four ECU applied CAN*1 communication nodes.
※ Control Units : BCM(Body Control Module), PDM(Power Distribution Module), SMK(Smart Key) ECU.
The steering wheel lock/unlock state of ESCL and the required data when EMS(Engine Management System) controls starting are sent to PDM by the serial communication line.
*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.
*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



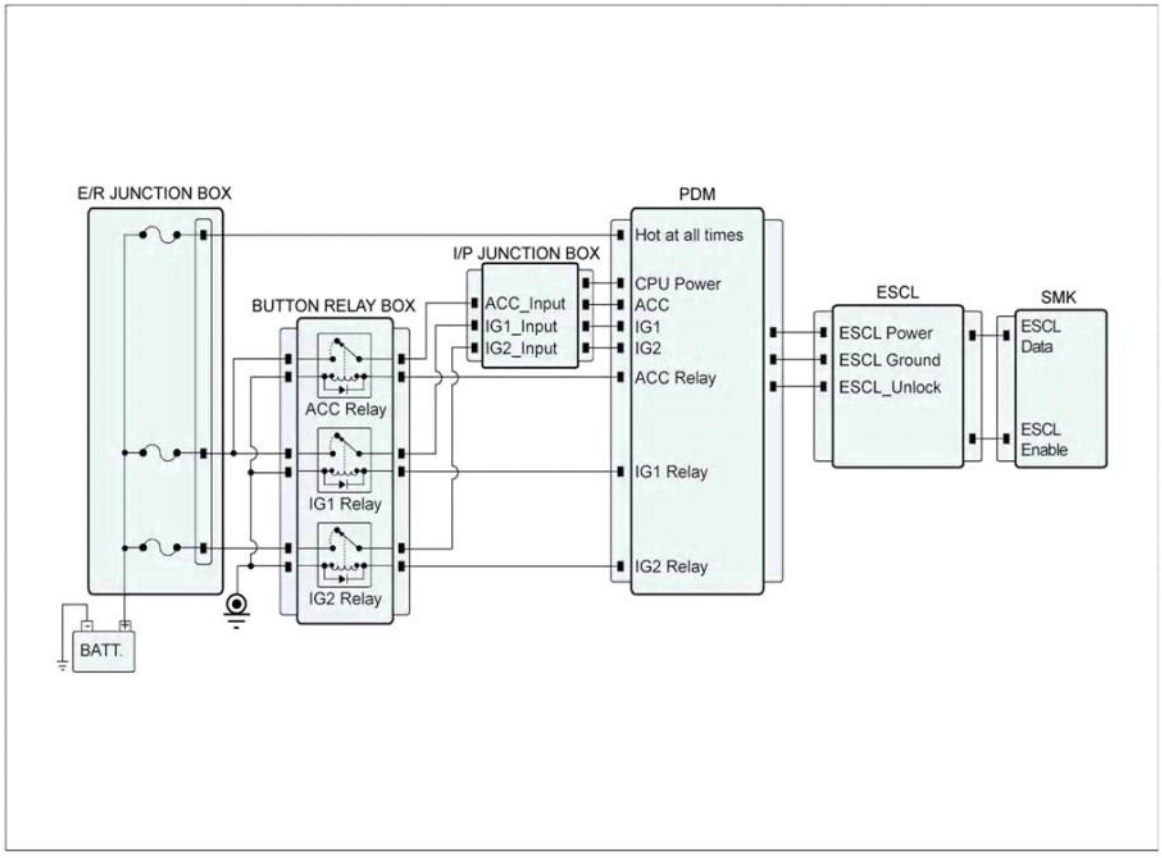
DTC Description

This code is outputted when power circuit is shorted to battery.
(During no power supply from PDM to ESCL)

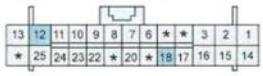
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• ESCL power output line check (by voltage monitoring)	• Short to power in ESCL power circuit
Enable Conditions	• No power supply from PDM to ESCL	
Threshold Value	• ESCL power circuit is shorted to power (7V and above)	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed. (Under no power supply from PDM to ESCL state)	

Diagnostic Circuit Diagram


E/R JUNCTION BOX
BUTTON RELAY BOX
I/P JUNCTION BOX
PDM
ESCL
SMK
Hot at all times
CPU Power
ACC
IG1
IG2
ACC Relay
IG1 Relay
IG2 Relay
ACC_Input
IG1_Input
IG2_Input
ESCL Power
ESCL Ground
ESCL_Unlock
ESCL Data
ESCL Enable
BATT.

<SMK Control Module>



12. ESCL Data
18. ESCL Enable

<Button Relay Box>

1. IG2
2. Power

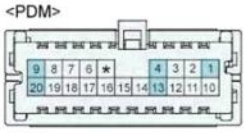
<Button Relay Box>

1. ACC RLY
4. IGN2 RLY
6. ACC
7. Power
8. IG1
10. IGN1 RLY

<PDM>

4. ESCL Power
5. ESCL Ground
7. IGN1 Relay
8. IGN2 Relay
9. ACC Relay
10. Hot at all times

<PDM>



1. IG2
4. ACC
9. IG1
13. ESCL Unlock
20. Hot at all times

<ESCL>

2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL-Unlock
6. ESCL Data Line

Signal Waveform & Data

Fig.1) ESCL Data Signal Waveform

Scantool Data Analysis

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions" (Refer to "DTC Detecting Condition" table).

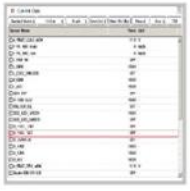
5. Is the same DTC occurred again?

YES	▸ Go to next procedure.
NO	▸ Fault is intermittent caused by poor contact in ESCL's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

■ Service Data Analysis

1. IG "OFF" and connect GDS.
2. IG "ON" and select "Current Data" menu.
3. Check the service data of ESCL BATT.

Specification : OFF



4. Is the service data within specifications?

YES	▸ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

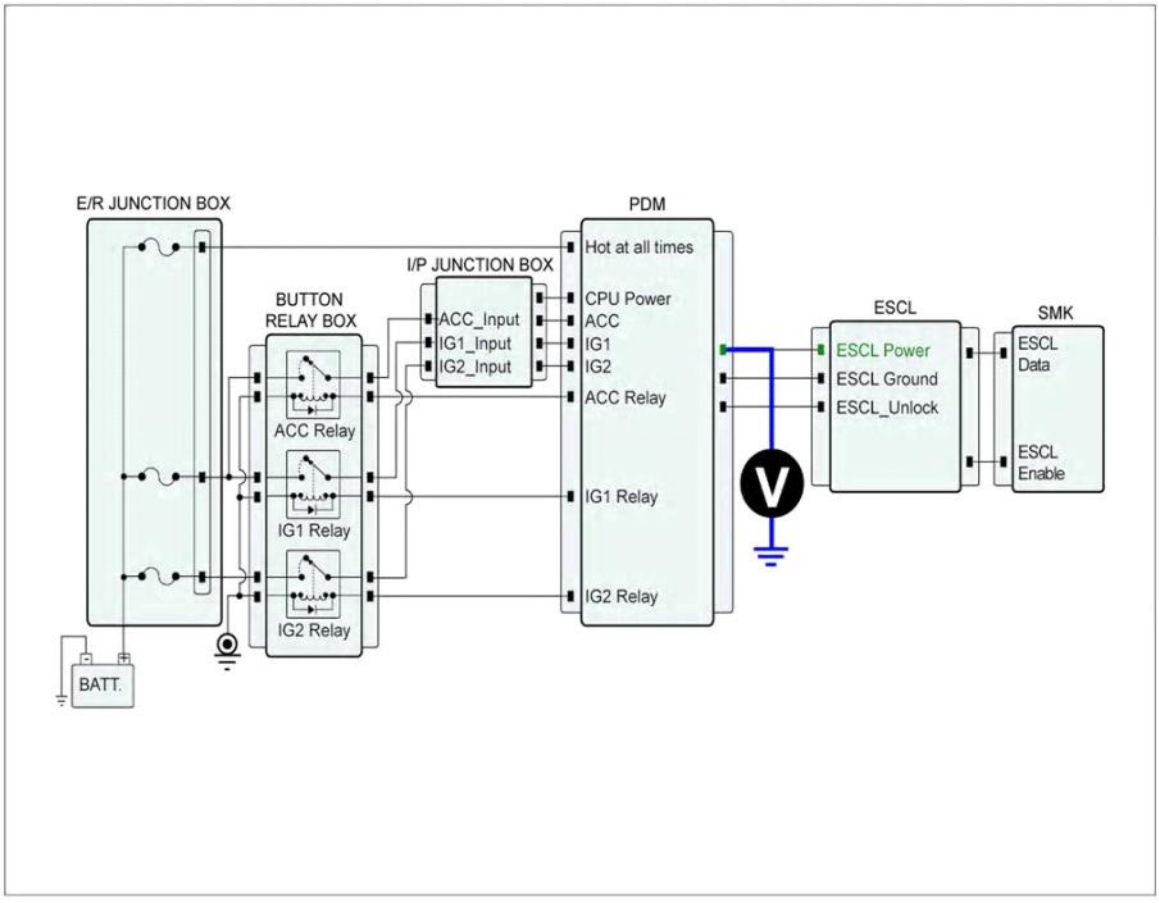
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Component Inspection" procedure.

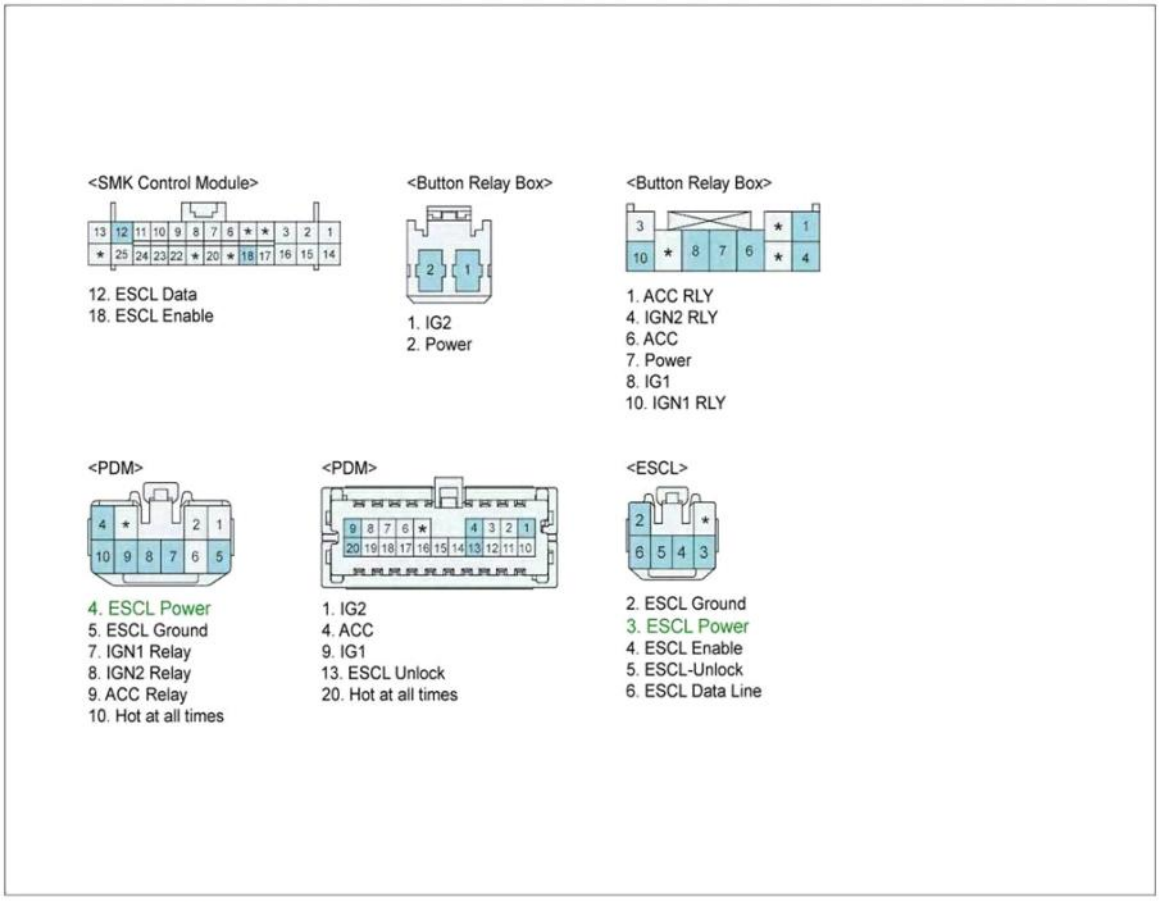
PDM Ground Circuit Inspection

■ **Check short at power terminal of PDM**

1. IG "ON" & ENG "OFF".
2. Measure voltage between ESCL power terminal of PDM and chassis ground.
   (Measure the voltage while ESCL doesn't work.)

Specification : Approx. 0 V


E/R JUNCTION BOX
PDM
Hot at all times
I/P JUNCTION BOX
BUTTON
RELAY BOX
ACC_Input
IG1_Input
IG2_Input
CPU Power
ACC
IG1
IG2
ESCL
SMK
ESCL Power
ESCL Ground
ESCL_Unlock
ESCL
Data
ESCL
Enable
ACC Relay
ACC Relay
IG1 Relay
IG1 Relay
IG2 Relay
IG2 Relay
V
BATT.



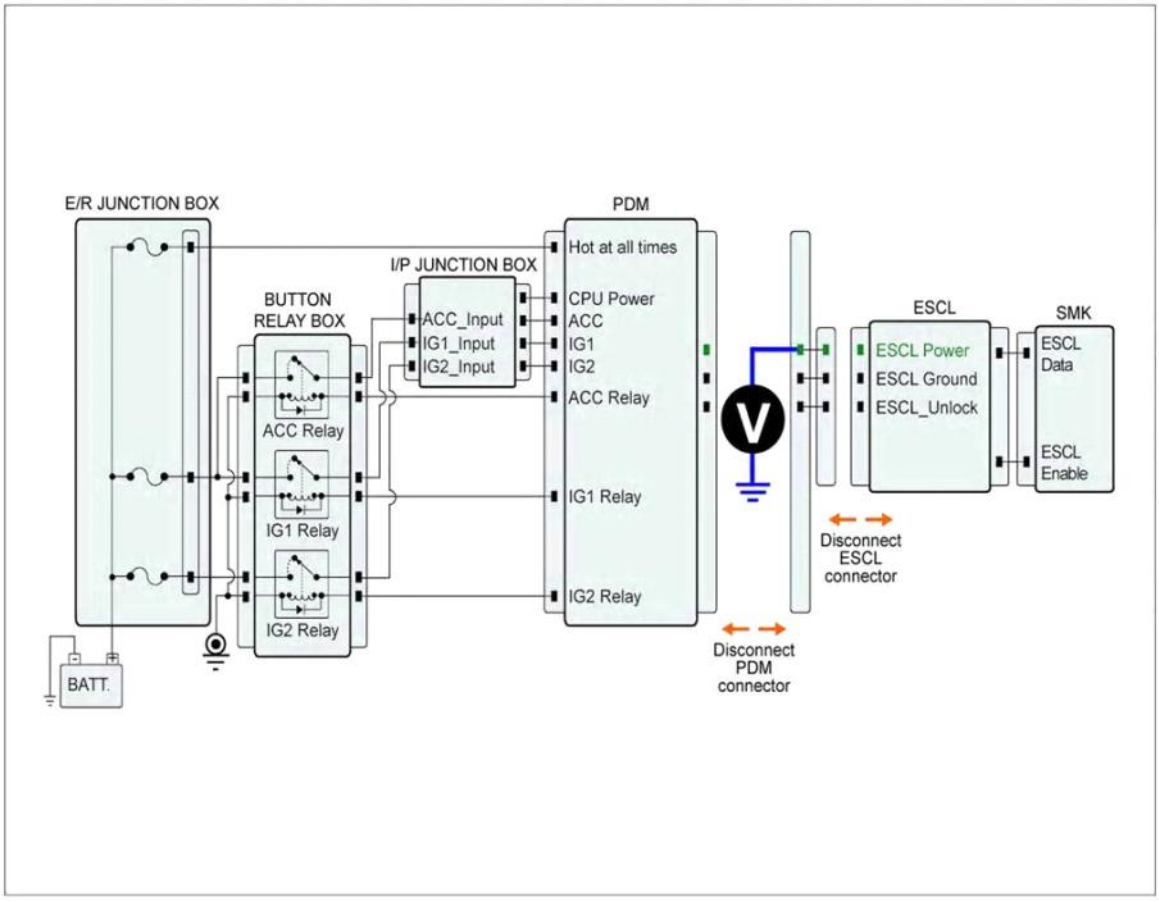
3. Is the measured voltage within specifications?

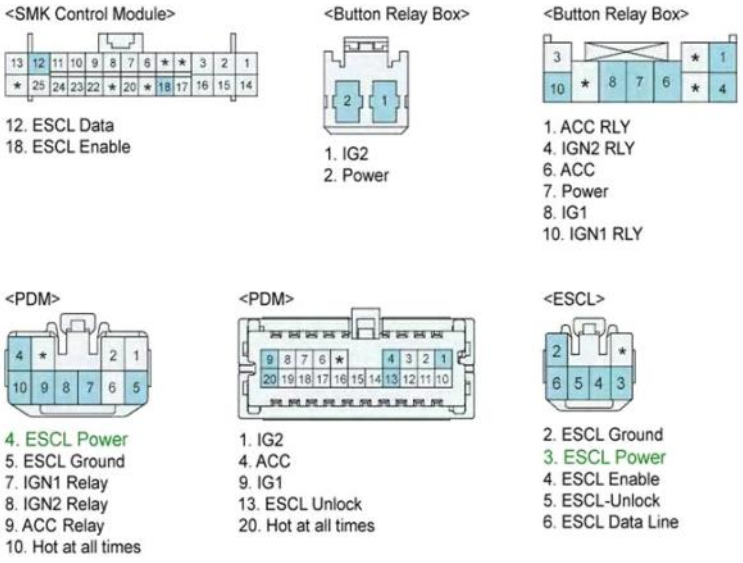
YES	▸ Go to next procedure.
NO	▸ Check open or short on the power circuit between PDM and ESCL. Repair as necessary and go to "Verification of Vehicle Repair"

■ Check short to power on ESCL power circuit

1. IG "ON" & ENG "OFF"
2. Disconnect the connectors of IPM, PDM, ESCL.
3. Measure voltage between ESCL power terminal and chassis ground.

Specification : Approx. 0 V


E/R JUNCTION BOX
PDM
Hot at all times
I/P JUNCTION BOX
BUTTON
RELAY BOX
ACC_Input
IG1_Input
IG2_Input
CPU Power
ACC
IG1
IG2
ESCL
SMK
ESCL Power
ESCL Ground
ESCL_Unlock
ESCL
Data
ESCL
Enable
ACC Relay
ACC Relay
IG1 Relay
IG1 Relay
IG2 Relay
IG2 Relay
V
Disconnect
ESCL
connector
Disconnect
PDM
connector
BATT.



4. Is the measured voltage within specifications?

YES	▸ Substitute with a known - good ESCL and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure. ▸ Substitute with a known - good PDM and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure.
NO	▸ Repair as necessary and go to "Verification of Vehicle Repair".

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

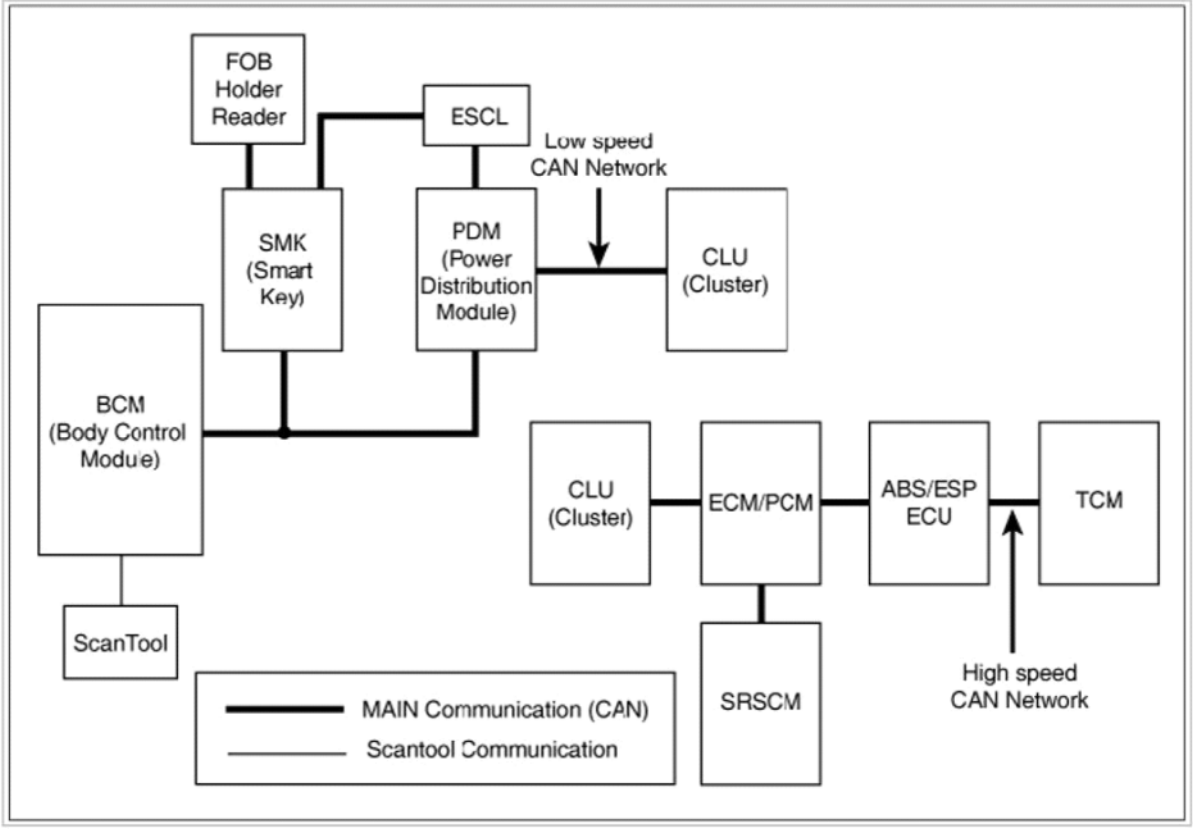
1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System performing to specification at this time.

Component Location

General Description

The body electrical system is comprised of four ECU applied CAN*1 communication nodes.
※ Control Units : BCM(Body Control Module), PDM(Power Distribution Module), CLU(Cluster), SMK(Smart Key) ECU.
The steering wheel lock/unlock state of ESCL and the required data when EMS(Engine Management System) controls starting are sent to PDM by the serial communication line.
*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.
*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



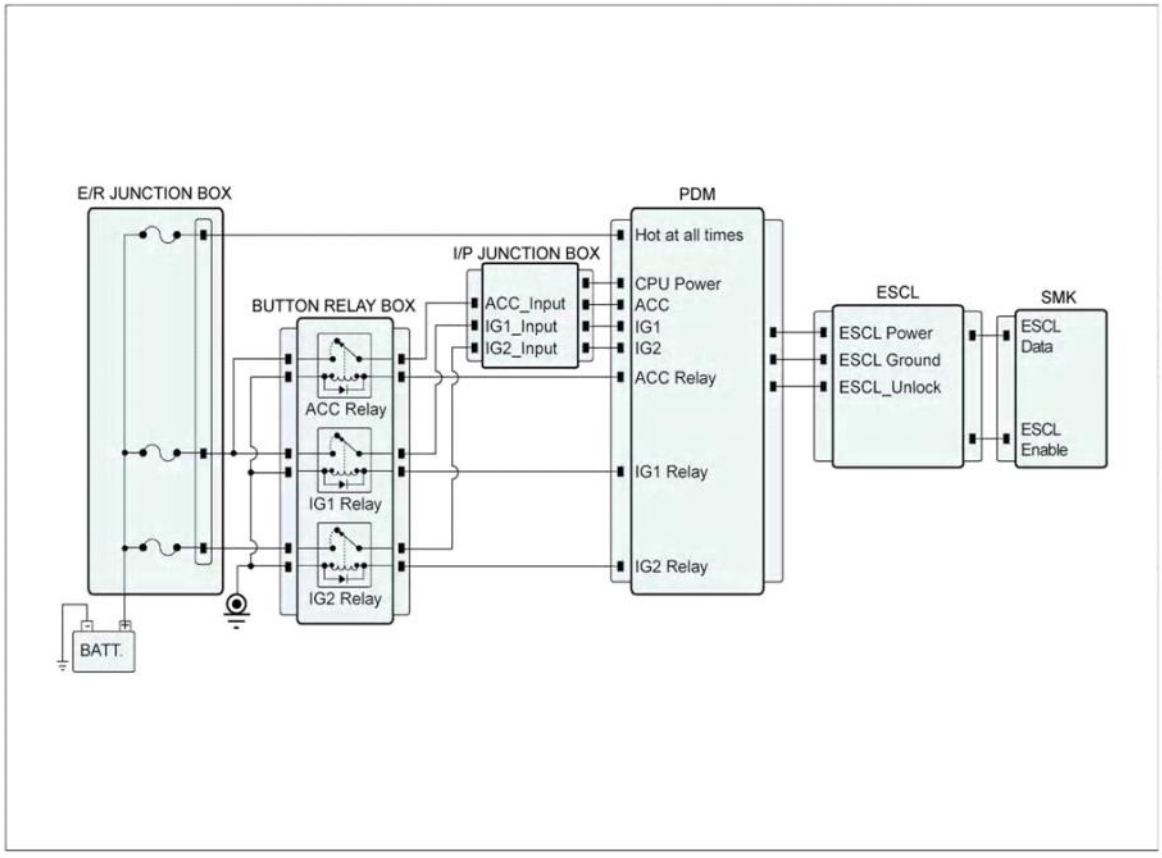
DTC Description

This code is outputted when ground circuit is shorted to battery.
(During no power supply from PDM to ESCL)

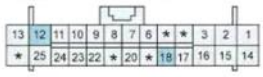
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• ESCL ground output line check (by voltage monitoring)	• Short to power in ESCL ground circuit
Enable Conditions	• No power supply from PDM to ESCL	
Threshold Value	• ESCL ground circuit is shorted to power (7V and above)	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed. (Under no power supply from PDM to ESCL state)	

Diagnostic Circuit Diagram


E/R JUNCTION BOX
BUTTON RELAY BOX
ACC Relay
IG1 Relay
IG2 Relay
BATT.
I/P JUNCTION BOX
ACC_Input
IG1_Input
IG2_Input
PDM
Hot at all times
CPU Power
ACC
IG1
IG2
ACC Relay
IG1 Relay
IG2 Relay
ESCL
ESCL Power
ESCL Ground
ESCL_Unlock
SMK
ESCL Data
ESCL Enable

<SMK Control Module>



12. ESCL Data
18. ESCL Enable

<Button Relay Box>

1. IG2
2. Power

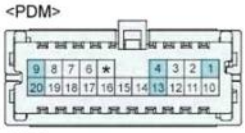
<Button Relay Box>

1. ACC RLY
4. IGN2 RLY
6. ACC
7. Power
8. IG1
10. IGN1 RLY

<PDM>

4. ESCL Power
5. ESCL Ground
7. IGN1 Relay
8. IGN2 Relay
9. ACC Relay
10. Hot at all times

<PDM>



1. IG2
4. ACC
9. IG1
13. ESCL Unlock
20. Hot at all times

<ESCL>

2. ESCL Ground
3. ESCL Power
4. ESCL Enable
5. ESCL-Unlock
6. ESCL Data Line

Signal Waveform & Data

Fig.1) ESCL Data Signal Waveform

Scantool Data Analysis

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions" (Refer to "DTC Detecting Condition" table).

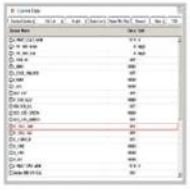
5. Is the same DTC occurred again?

YES	▸ Go to next procedure.
NO	▸ Fault is intermittent caused by poor contact in ESCL's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

■ Service Data Analysis

1. IG "OFF" and connect GDS.
2. IG "ON" and select "Current Data" menu.
3. Check the service data of ESCL GND.

Specification : OFF



4. Is the service data within specifications?

YES	▸ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

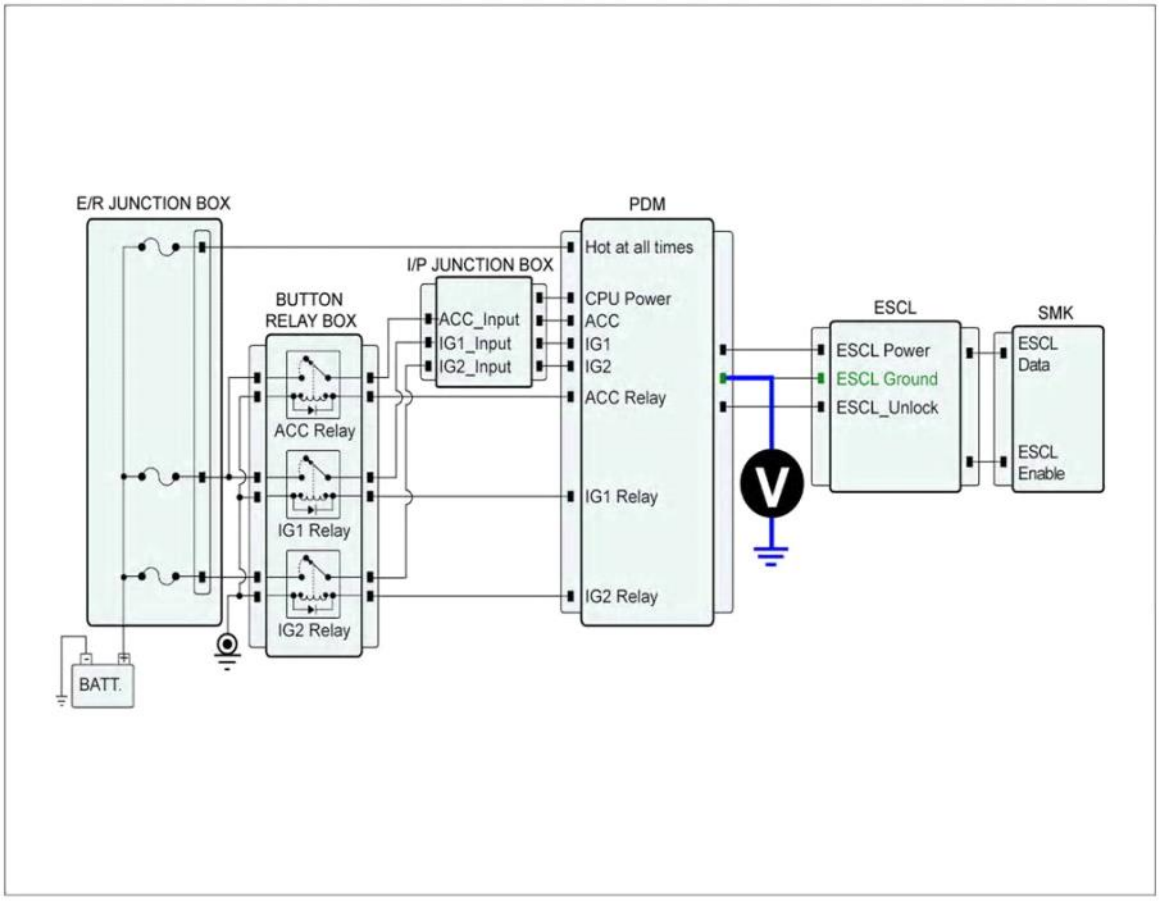
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Component Inspection" procedure.

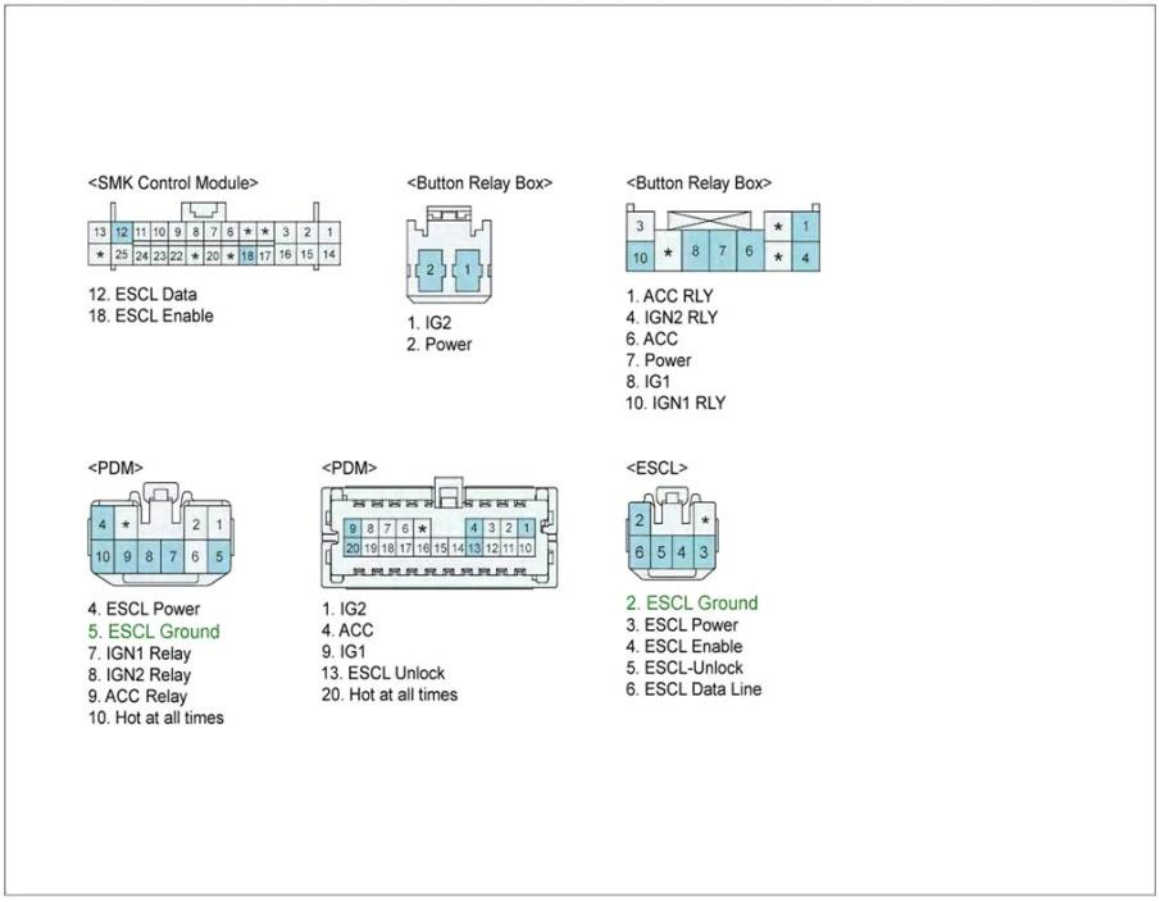
PDM Ground Circuit Inspection

■ **Check short at ground terminal of PDM**

1. IG "ON" & ENG "OFF".
2. Measure voltage between ESCL ground terminal of PDM and chassis ground.
   (Measure the voltage while ESCL doesn't work.)

Specification : Approx. 0 V


E/R JUNCTION BOX
BUTTON
RELAY BOX
I/P JUNCTION BOX
PDM
ESCL
SMK
Hot at all times
CPU Power
ACC
IG1
IG2
ACC_Input
IG1_Input
IG2_Input
ACC Relay
IG1 Relay
IG2 Relay
ACC Relay
IG1 Relay
IG2 Relay
ESCL Power
ESCL Ground
ESCL_Unlock
ESCL
Data
ESCL
Enable
V
BATT.



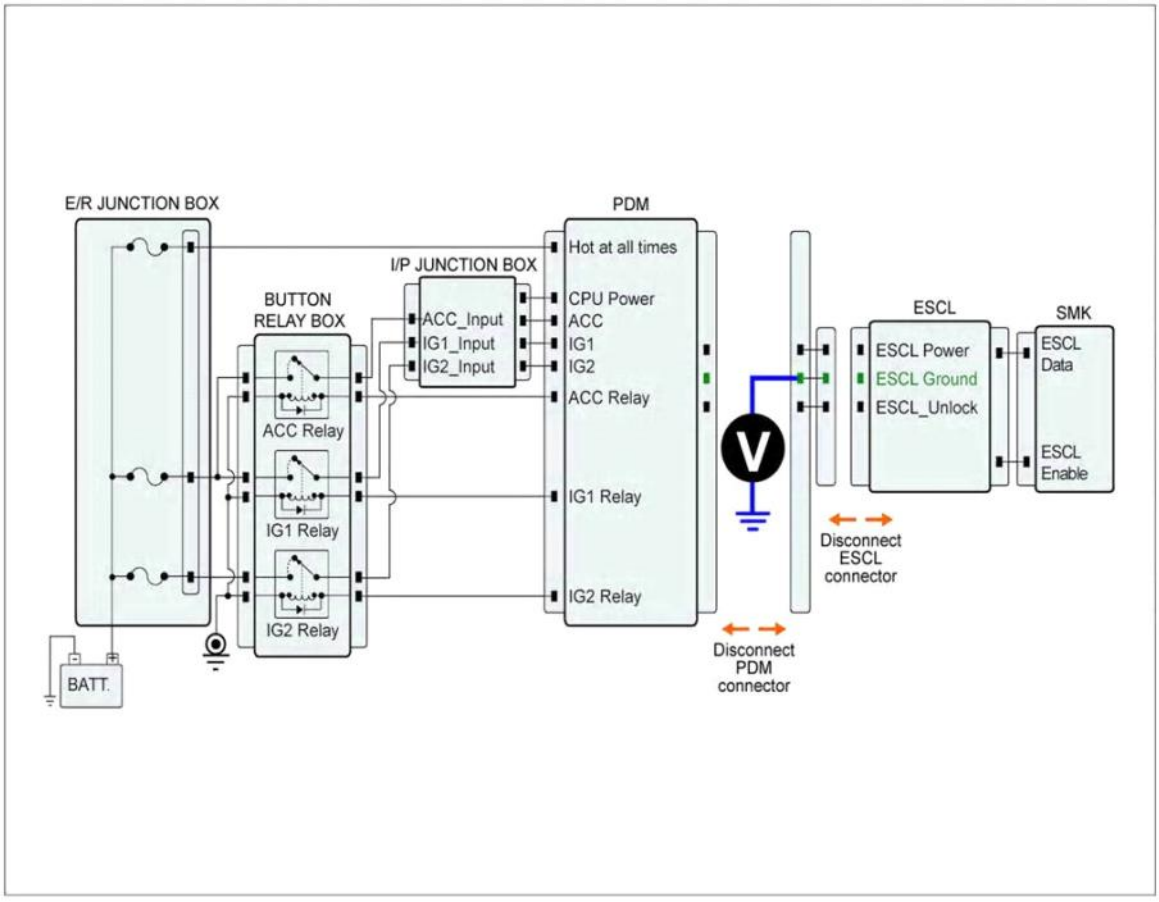
3. Is the measured voltage within specifications?

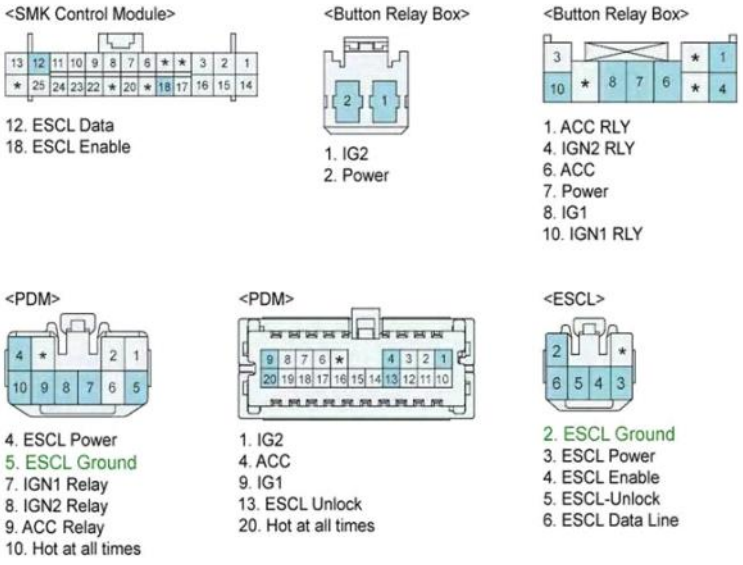
YES	▸ Go to next procedure.
NO	▸ Check open or short on the ground circuit between PDM and ESCL. Repair as necessary and go to "Verification of Vehicle Repair"

■ Check short to power on ESCL GND circuit

1. IG "ON" & ENG "OFF"
2. Disconnect the connectors of IPM, PDM, ESCL.
3. Measure voltage between ESCL ground terminal and chassis ground.

Specification : Approx. 0 V


E/R JUNCTION BOX
PDM
Hot at all times
I/P JUNCTION BOX
BUTTON
RELAY BOX
ACC_Input
IG1_Input
IG2_Input
CPU Power
ACC
IG1
IG2
ESCL
SMK
ESCL Power
ESCL Ground
ESCL_Unlock
ESCL
Data
ESCL
Enable
ACC Relay
ACC Relay
IG1 Relay
IG1 Relay
IG2 Relay
IG2 Relay
V
Disconnect
ESCL
connector
Disconnect
PDM
connector
BATT.



4. Is the measured voltage within specifications?

YES	▸ Substitute with a known - good ESCL and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure. ▸ Substitute with a known - good PDM and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure.
NO	▸ Repair as necessary and go to "Verification of Vehicle Repair".

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

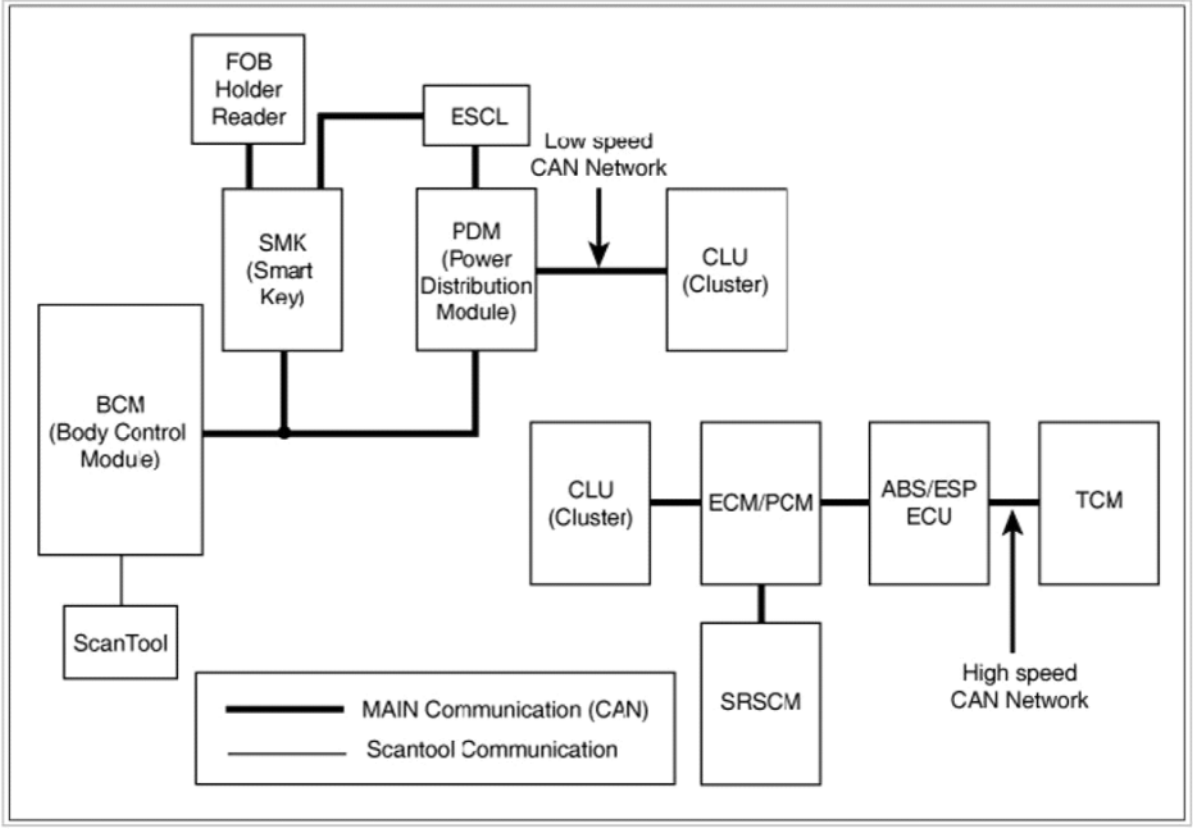
1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System performing to specification at this time.

Component Location

General Description

The body electrical system is comprised of four ECU applied CAN*1 communication nodes.
※ Control Units : BCM(Body Control Module), PDM(Power Distribution Module), CLU(Cluster), SMK(Smart Key) ECU.
The steering wheel lock/unlock state of ESCL and the required data when EMS(Engine Management System) controls starting are sent to PDM by the serial communication line.
*1 CAN (Controller Area Network) : CAN is serial bus communication type which links not only communication system but also control units each other.
*2 LIN (Local Interconnect Network) : LIN is serial communication type which is used in electrical control system. (This is less expensive.)



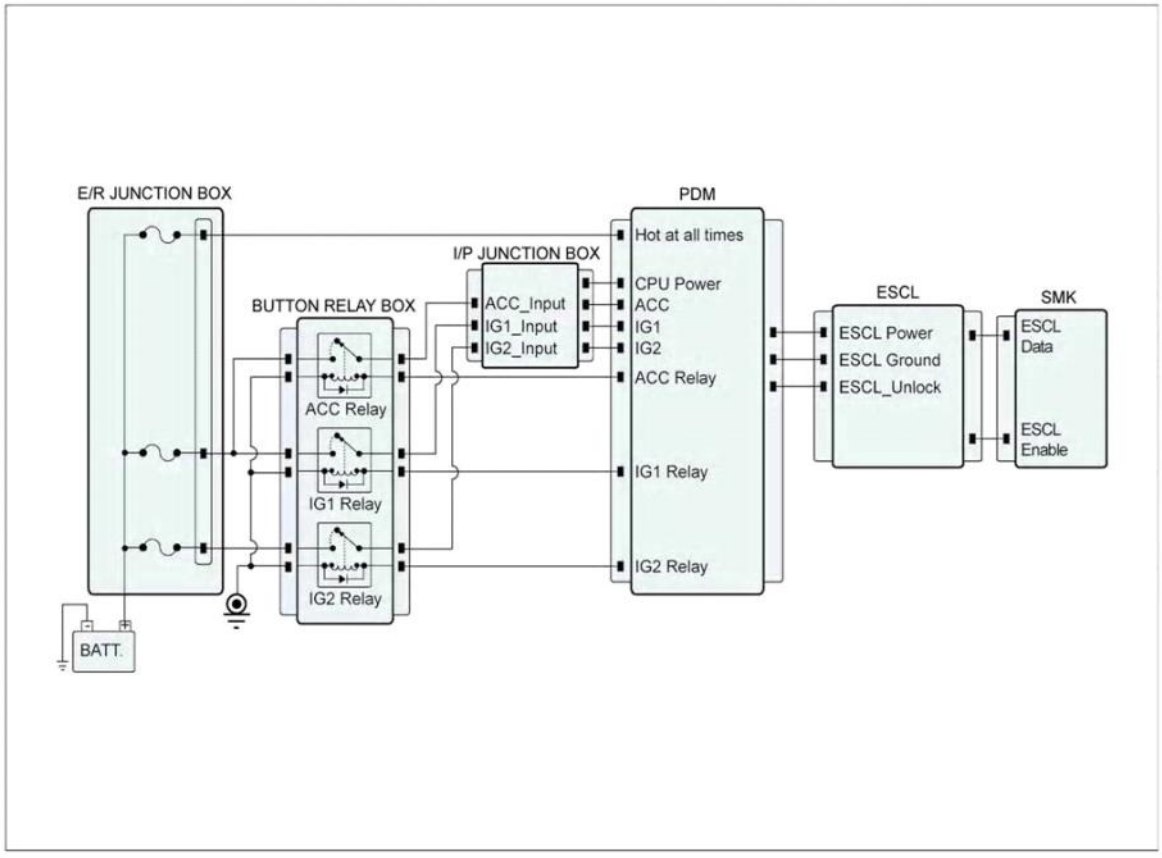
DTC Description

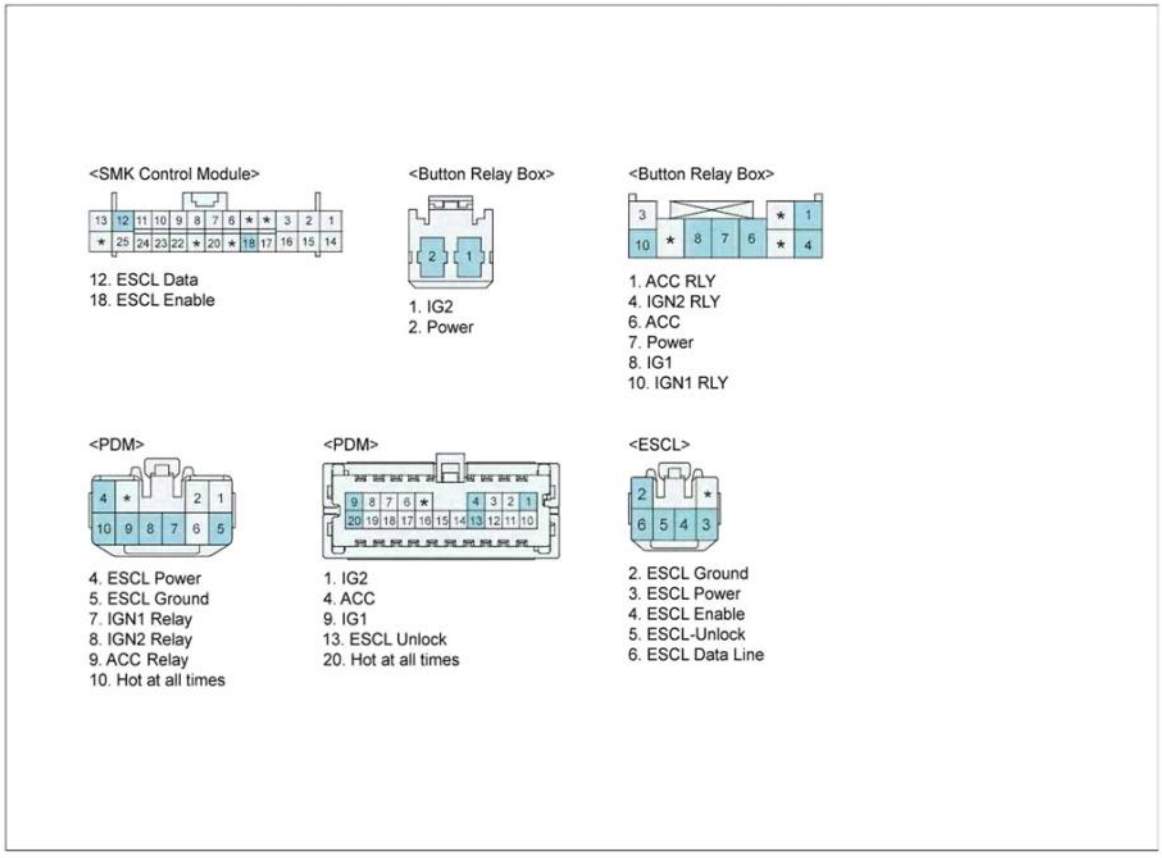
This code is outputted when power circuit is shorted to ground.
(During power supply from PDM to ESCL)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• ESCL power output line check (by voltage monitoring)	• Short to ground in ESCL power circuit
Enable Conditions	• Under power supply from PDM to ESCL	
Threshold Value	• ESCL power circuit is shorted to ground(2V and below)	
Diagnostic Time	• Immediately	
DTC Erasing Time	• DTC is erased immediately after trouble fixed. (Under power supply from PDM to ESCL state)	

Diagnostic Circuit Diagram


E/R JUNCTION BOX
BUTTON RELAY BOX
I/P JUNCTION BOX
PDM
ESCL
SMK
Hot at all times
CPU Power
ACC
IG1
IG2
ACC Relay
IG1 Relay
IG2 Relay
ACC_Input
IG1_Input
IG2_Input
ESCL Power
ESCL Ground
ESCL_Unlock
ESCL Data
ESCL Enable
BATT.



Signal Waveform & Data

Fig.) ESCL Data Signal Waveform

Scantool Data Analysis

1. Connect GDS.
2. IG "ON" and engine "OFF".
3. Select "DTC Analysis" mode.
4. After erase DTC, keep the vehicle condition within "the enable conditions" (Refer to "DTC Detecting Condition" table).

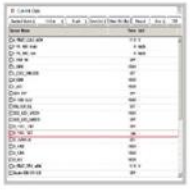
5. Is the same DTC occurred again?

YES	▸ Go to next procedure.
NO	▸ Fault is intermittent caused by poor contact in ESCL's and/or PDM's connector or was repaired and PDM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

■ Service Data Analysis

1. IG "OFF" and connect GDS.
2. IG "ON" and select "Current Data" menu.
3. Check the service data of ESCL BATT.

Specification : ON



4. Is the service data within specifications?

YES	▸ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to next procedure.

Terminal & Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

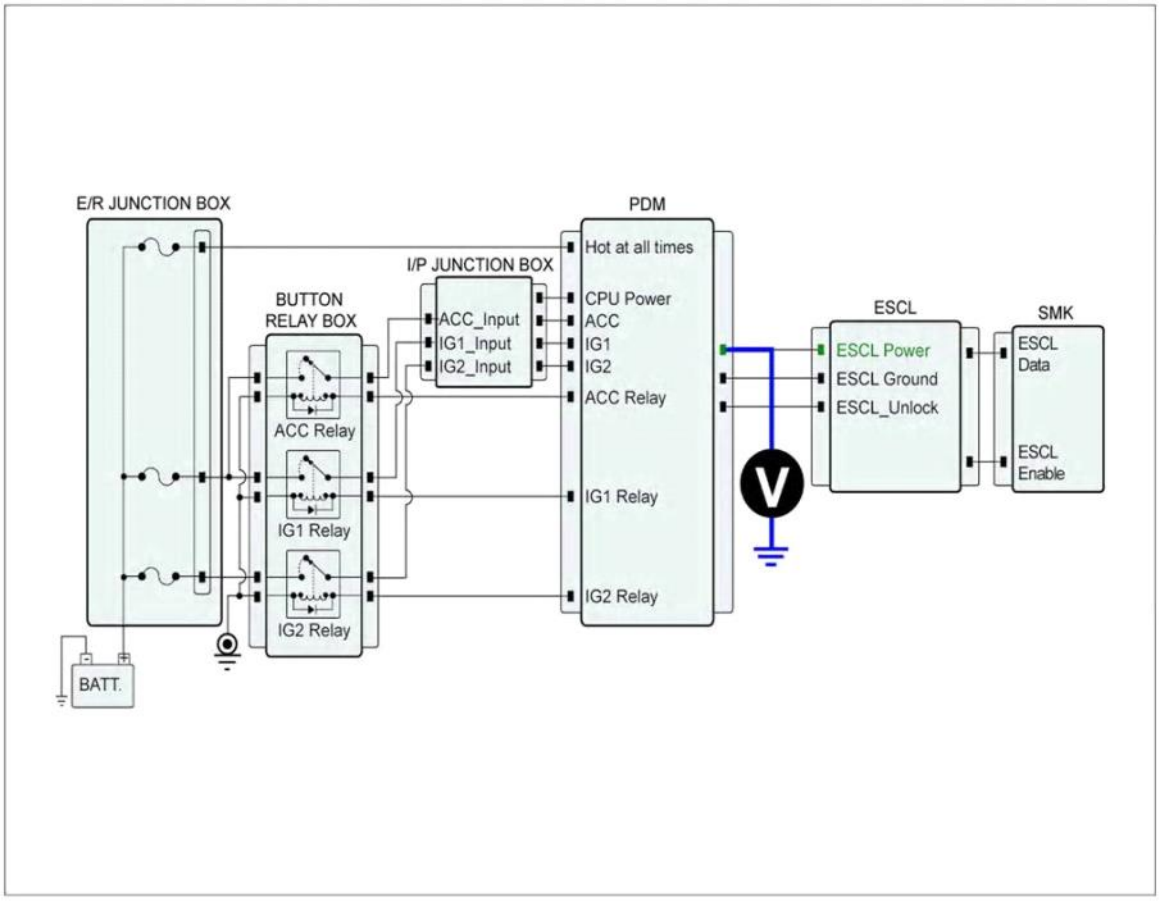
YES	▸ Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO	▸ Go to "Component Inspection" procedure.

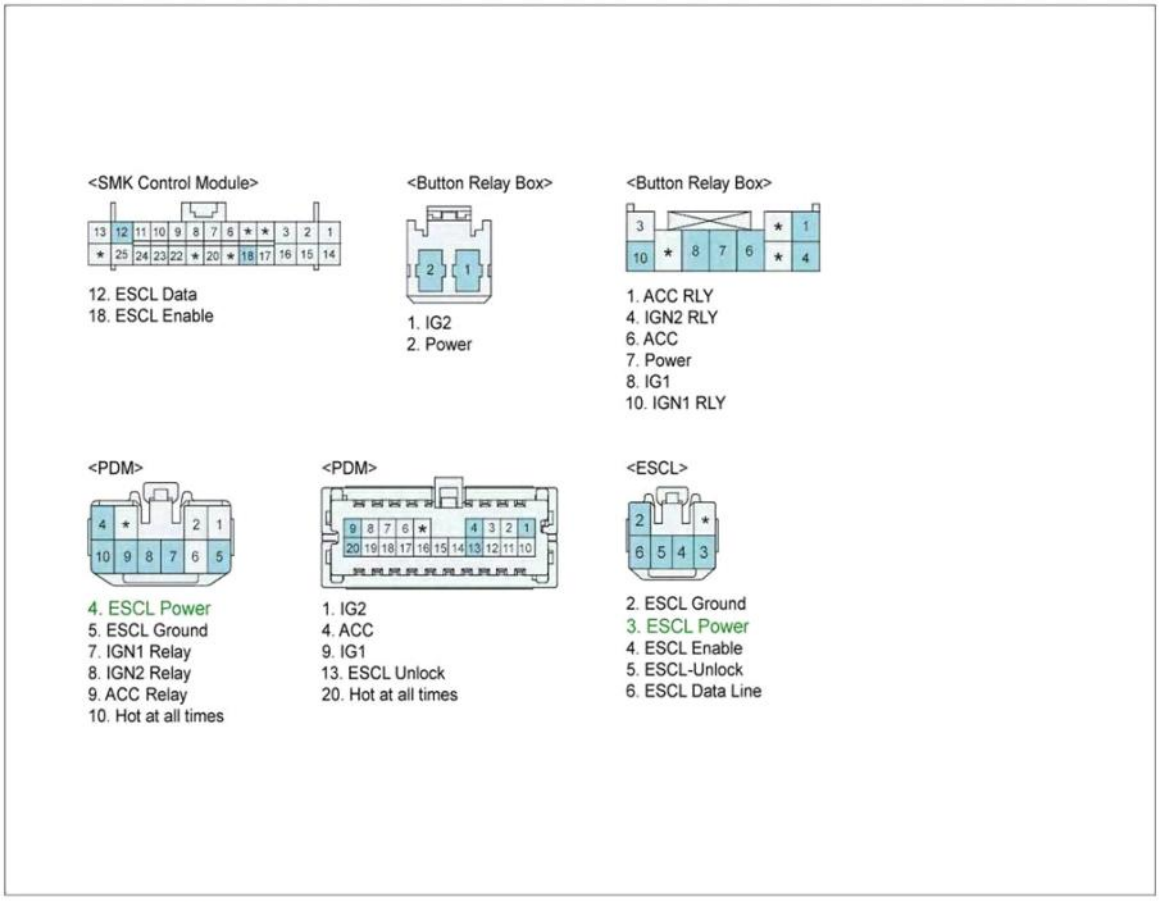
PDM Ground Circuit Inspection

■ **Check short at power terminal of PDM**

1. IG "ON" & ENG "OFF".
2. Measure voltage between ESCL power terminal of PDM and chassis ground.
   (Measure the voltage while ESCL doesn't work.)

Specification : Approx. 12 V


E/R JUNCTION BOX
PDM
Hot at all times
I/P JUNCTION BOX
BUTTON
RELAY BOX
CPU Power
ACC_Input
ACC
IG1_Input
IG1
IG2_Input
IG2
ESCL
SMK
ESCL Power
ESCL
Data
ESCL Ground
ACC Relay
ESCL_Unlock
ACC Relay
ESCL
Enable
IG1 Relay
IG1 Relay
V
IG2 Relay
IG2 Relay
BATT.



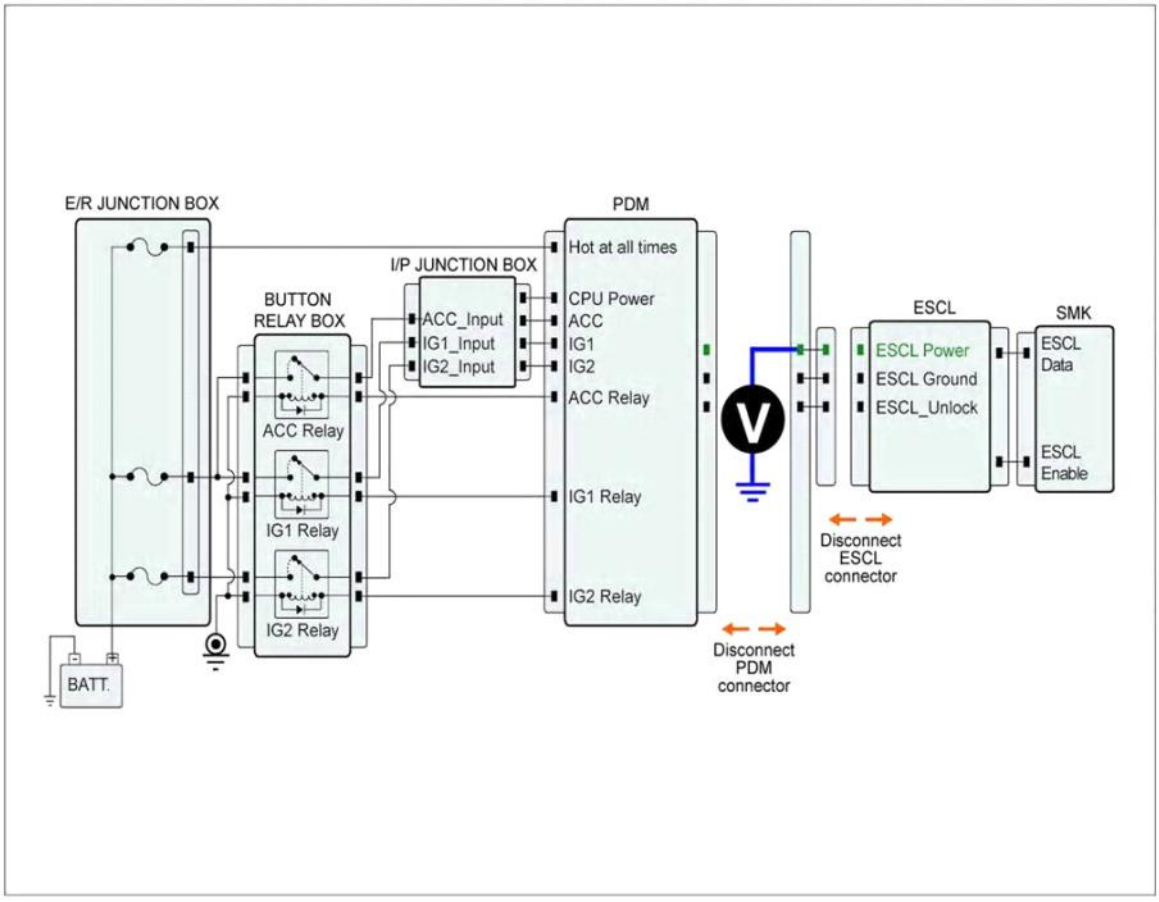
3. Is the measured voltage within specifications?

YES	▸ Go to next procedure.
NO	▸ Check open or short on the power circuit between PDM and ESCL. Repair as necessary and go to "Verification of Vehicle Repair"

■ Check short to ground on ESCL power circuit

1. IG "ON" & ENG "OFF"
2. Disconnect the connectors of IPM, PDM, ESCL.
3. Measure resistance between ESCL power terminal and chassis ground.

Specification : ∞ Ω


E/R JUNCTION BOX
BUTTON
RELAY BOX
ACC Relay
IG1 Relay
IG2 Relay
BATT.
I/P JUNCTION BOX
ACC_Input
IG1_Input
IG2_Input
PDM
Hot at all times
CPU Power
ACC
IG1
IG2
ACC Relay
IG1 Relay
IG2 Relay
V
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connector
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ESCL
connector
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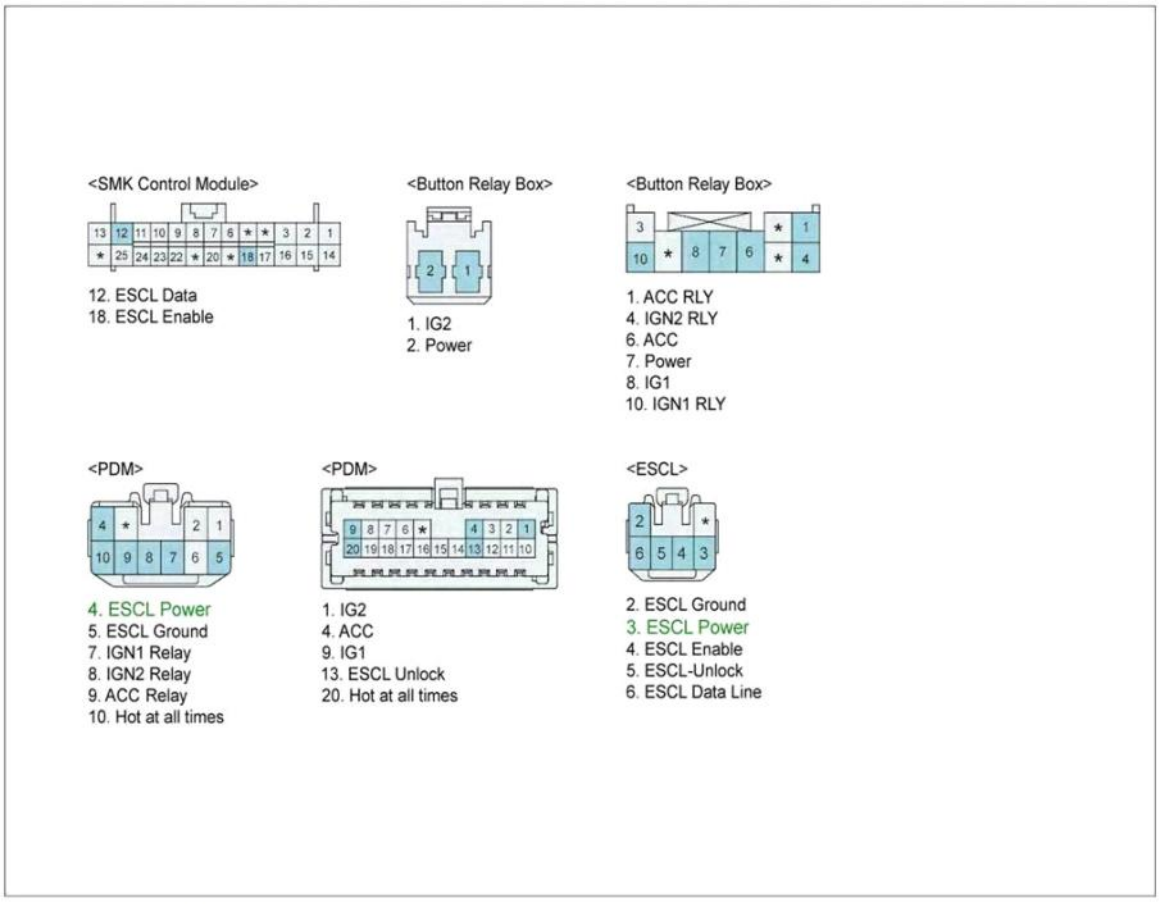
ESCL Ground
ESCL_Unlock
SMK
ESCL
Data
ESCL
Enable



4. Is the measured voltage within specifications?

YES	▸ Substitute with a known - good ESCL and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure. ▸ Substitute with a known - good PDM and check for proper operation. If the problem is corrected, replace the unit and go to "Verification of Vehicle Repair" procedure.
NO	▸ Repair as necessary and go to "Verification of Vehicle Repair".

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scan tool and select "DTC Analysis" mode.
2. Clear the DTCs and Operate the vehicle within DTC Enable conditions in General information.
3. Is any DTC outputted again?

YES	▸ Go to the applicable troubleshooting procedure.
NO	▸ System performing to specification at this time.

SAIPA YADAK

DAROU PAKHSH St.-KM17 KARAJ MAKHSOOS ROAD-TEHRAN

www.saipayadak.org