CAN SYSTEM

GENERAL INFORMATION

System Description

Most controllers of T1D data communication system and diagnostic interfaces are connected via CAN gateway module (CGW), CAN controller and CAN transceiver are integrated into gateway module. Termination resistors are respectively integrated into gateway module, ICM, BCM, ECM, audio module (IHU) to form body CAN bus with CGW and ICM as the termination resistors, ECM and CGW are termination resistor power CAN bus, IHU and CGW are termination resistor information entertainment CAN bus, EPB and CGW are termination resistor chassis CAN bus. Termination resistance is 120 Ω, termination resistance of gateway module connected with diagnostic interface is 60 Ω.

Operation

CAN bus is also called vehicle bus, and full name is “Controller Area Network” which means local area network, it connects all control units together in some way to form a complete system. Each control unit collects different signals by each sensor, and transmits data among modules under the same rules. Network information can meet different real-time requirements by its priority. Data transmitted via CAN bus control unit is level model of binary format, and data transmission line transmits the voltage signal.

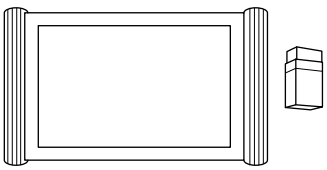
Composition

- Bus speed is: 500 Kbit/s;
- Cannot run in single line - If a CAN line of module is disconnected, CAN signal of this module cannot be transmitted;
- Vehicle driving CAN diagnosis is performed through No.6 pin and No.14 pin of diagnostic interface.

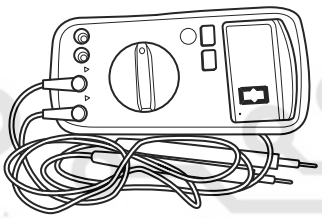
OBD: Diagnostic Interface	CGW: Central Network Module
IHU: Audio Head Unit	TBOX
TCU: DCT Transmission Controller	ECM: Electronic Engine Injection Controller
ESP (EPB) Module	ABM: Airbag Control Module
CLM: Automatic A/C Module	APM: Central Control Integration Panel
BCM: Body Electrical Controller	PEPS
ICM: Instrument Cluster	AVM: Panoramic View Monitor Control Module
RADAR: Reverse Radar Module	PLGM: Power Back Door Module
SAM: Steering Wheel Angle Sensor	EPS: Electronic Power Steering
EPB: Electronic Parking Brake	

Tools

Special Tool

Tool Name	Tool Drawing
X-431 PAD Diagnostic Tester	 RCH0001006

General Tool

Tool Name	Tool Drawing
Digital Multimeter	 RCH0002006

DIAGNOSIS & TEST

Problem Symptoms Table

Caution
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

Symptom	Possible Cause
Diagnostic interface cannot access to the system	Fuse
	CAN bus
	Gateway module
Engine control system failure	CAN bus
	Battery voltage
	Module damaged
	Ground wire
Brake control system failure	Wire harness or connector
	EPB module
Airbag system failure	ECM
	Wire harness and connector
	Airbag module failure
Body electrical failure	Body Control Module (BCM) failure
	Wire harness or connector
	Instrument cluster
Transmission failure	Transmission Control Module (TCU) failure
	Wire harness or connector
	ECM

Diagnosis Procedure

Hint:
Use following procedures to troubleshoot the control system.

1	**Vehicle brought to workshop**

Next

2	**Examine vehicle and check basic items**

Check system power supply voltage, and check that fuse, wire harness and connector are connected normally.

OK

Standard voltage: Not less than 12 V.

Result

NG → **Check and replace malfunctioning parts**

OK

3	**Using a diagnostic tester, read related DTC and data stream information**

Result

Result	Go to
No DTC	A
DTC occurs	B

A → **Perform troubleshooting procedure without DTCs according to malfunction symptom**

B

4	**Troubleshoot according to DTCs troubleshooting procedure**

Result

Result	Go to
Problem is not resolved	A
Problem is resolved	B

A → **Return to procedure 1 and troubleshoot the process again**

B

5	**According to airbag system malfunction repair completion inspection and delivery, confirm that malfunction is resolved**

Result

Result	Go to
Delivery inspection is failed	A
Delivery inspection is qualified	B

A

Return to procedure 1 and troubleshoot the process again

B

6	**Finished**

DTC Confirmation Procedure

Confirm that battery voltage is normal before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software) to Data Link Connector (DLC).
- Turn ENGINE START STOP switch to ON.
- Use diagnostic tester to record and clear DTCs stored in supplemental restraint system.
- Turn the ENGINE START STOP switch to OFF and wait for several seconds.
- Turn ENGINE START STOP switch to “ON”, and then select read DTC.
- If DTC is detected, it indicates current malfunction. Go to inspection procedure - Step 1.
- If no DTC is detected, malfunction indicated by the DTC is intermittent.

Intermittent DTC Troubleshooting

If malfunction is intermittent, perform the followings:

- Check if connector is loose.
- Check if wire harness is worn, pierced, pinched or partially broken.
- Monitor diagnostic tester (the latest software) data that is related to this circuit.
- Wiggle related wire harnesses and connectors and observe if signal is interrupt in related circuit.
- If possible, try to duplicate the conditions under which DTC was set.
- Look for data that has changed or DTC to reset during wiggling test.
- Look for broken, bent, protruded or corroded terminals.
- Inspect airbag components and mounting areas for damage, foreign matter, etc. that will cause incorrect signals.
- Check and clean all wire harness connectors and ground parts related to DTC.
- If multiple trouble codes were set, refer to circuit diagrams to look for any common ground circuit or power supply circuit applied to DTC.
- Refer to any Technical Bulletin that may apply to this malfunction.

Ground Inspection

Ground points are very important to the proper operation of circuits. Ground points are often exposed to moisture, dirt and other corrosive environments. Corrosion (rust) may increase load resistance. This

situation may change the way in which a circuit operates. Circuits are very sensitive to proper grounding. A loose or corroded ground can seriously affect the control circuit. Check the ground points as follows:

1. Remove ground bolt or nut.
2. Check all contact surfaces for tarnish, dirt and rust, etc.
3. Clean as necessary to ensure that contact is in good condition.
4. Reinstall ground bolt or nut securely.
5. Check if any additional accessories interfere with ground circuit.
6. If several wire harnesses are crimped into one ground terminal, check for proper crimp condition. Make sure that all wire harnesses are clean and securely fastened while providing a proper ground path.

Failure Analysis Method

1. Use diagnostic tester to diagnose and analyze the trouble code.

   When a module or several modules need to receive the data sent by a module to complete the corresponding function, once the data is not received, the module received the data will generate trouble codes, which could be read by diagnostic tester as: “Lost communication with XX module”, “Communication with XX module is not normal”; When the bus is out of work, the trouble code will be read as CAN bus close; When there is malfunction on module CAN configuration, code will be reported as “configuration code error”.

   CAN network failures consist of the following types:

   a. Receive continuous invalid signals: This type of fault indicates communication effective bit received by control module is “invalid” or invalid signal after processing.
   b. Signal is below normal range: This type of fault indicates serial data bus signal is below normal range.
   c. Signal is above normal range: This type of fault indicates serial data bus signal is above normal range.
   d. Invalid signal: This type of fault indicates serial data bus signal does not match specified execution condition.
   e. Lost signal: This type of fault indicates specified no specified information is received.
   f. Bus closed: This type of fault indicates bus is out of work.
   g. Unstable signal: This type of fault indicates a transient distortion or interruption of a bus signal.

2. Circuit diagram analysis.

   Use multimeter, diagnostic tester and combine with circuit diagram to determine where is the fault.

Common Troubleshooting

1. Diagnostic tester reads trouble code of CAN configuration error.

   Fault expression: CAN or configuration code error is not performed by meter or BCM, read “Software configuration error”, “Configuration code error” with diagnostic tester.

   Exclusion methods and steps:

   This type of situation usually belongs to CAN system software failure. Write correct configuration code to these modules or sensors or calibrate these sensors, clear the trouble code and verify the malfunction phenomenon again.

2. Diagnostic tester cannot communicate with all modules.

   Malfunction symptom: If diagnostic tester can be used normally on other vehicle, but cannot communicate with each module on faulty vehicle, malfunction indicators or warning lights on the meter turn on.

   Malfunction reason: Diagnostic interface power supply and ground malfunction, diagnostic interface CAN line is open to normal CAN line, bus CAN-H is short to CAN-L, CAN-H is short to ground, CAN-L is short to ground, CAN-H is short to power supply, CAN-L is short to power supply, CAN line is mixed, node (module) is malfunctioning or power supply grounding is abnormal.

3. Exclusion methods and steps:

1	**Diagnose if power supply voltage and grounding resistance are correct.**

NG → **Inspect and repair diagnosis interface power supply or ground, verify the fault phenomenon again.**

OK ↓

2	**Use multimeter to detect parallel termination resistor, and check if resistance is correct**

NG → **Check and repair connecting wire between diagnostic interface and two modules with termination resistor or replace module with incorrect resistance to verify the malfunction symptom again.**

OK ↓

3	**Determine type of fault, inspect and repair, then verify the fault phenomenon again.**

4. The diagnostic tester cannot communicate with several modules.

   Malfunction symptom: The diagnostic tester cannot communicate with several modules, but can communicate with at least one module.

   Malfunction cause: Module power supply malfunction, CAN main line open, CAN line mixed fitting, node (module) malfunction, gateway module malfunction.

5. Power supply malfunction (power supply and ground).

   The core part of vehicle multiplex system is an electronic control unit containing a communication IC chip. The normal operating voltage of the electronic control unit is generally in the range of operating voltage: 9 V $\leqslant$ U $\leqslant$ 16 V. CAN network communication voltage range: 6 V $\leqslant$ U $\leqslant$ 16 V. If the operating voltage provided by vehicle power system is lower than this value, some electronic control units with higher requirements on operating voltage will temporarily stop working, thus making multiplex system unable to communicate. The CAN hardware controller inside ECM may not work under 6 V. Use battery tester to detect, if it does not meet the requirements, charge the battery or replace the battery (and also detect the power generated by alternator).

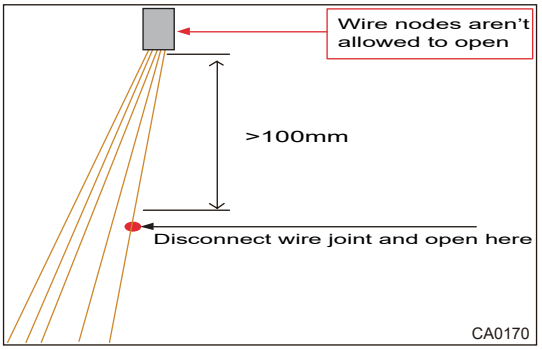
6. Link malfunction.

   Link refers to a communication connection line between nodes. Link malfunction refers to malfunction of data communication lines, such as short circuit, open circuit and communication signal attenuation or distortion caused by changes in physical properties of the lines. These factors often cause multiple electronic control units to fail to work properly or the control system to operate improperly. To determine whether the link is malfunctioning, use an oscilloscope or a specific vehicle CAN tester to observe whether the current data communication signal matches the standard data communication signal. Maintenance methods are generally to repair shorted or open twisted-pair lines, or to eliminate the root cause of changing the physical properties of twisted-pair lines.

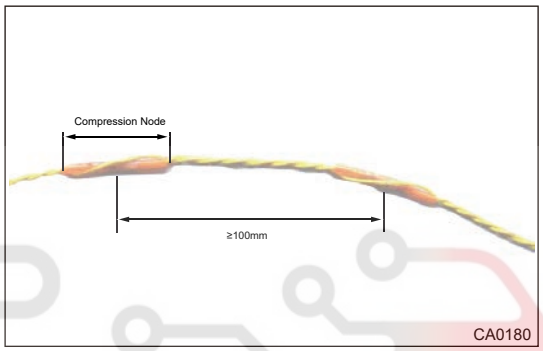
a. Maintenance instructions for CAN line.

Sometimes, in order to determine the malfunction, it is necessary to disconnect a control unit from line connection point and disconnect the CAN bus connected to the control unit, or to repair wire harness after the malfunction has been determined. The data transmitted by CAN bus may even affect vehicle safety and life safety of personnel. Improper maintenance of CAN bus may cause interference or loss of signals, resulting in these data not being transmitted. Therefore, the following regulations must be observed during maintenance:

- During CAN bus maintenance, the disconnection point is required to be at least 100 mm away from the line node, and the line node must never be opened, maintained and updated;

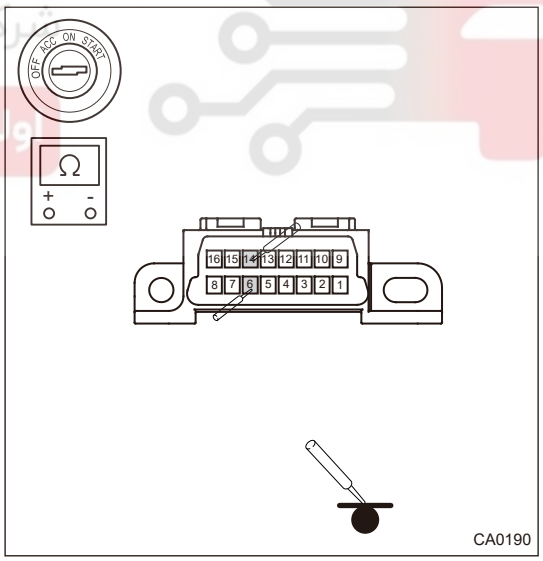


- If the CAN line is to be disconnected, it is only allowed to be carried out at a distance of ⩾ 100 mm from the next pressure node; The twisting of CAN lines is of decisive significance to the interference effect of CAN. Only if the twisting is not damaged, the CAN can be protected from interference, so keep as little interference with the twisting as possible during maintenance.

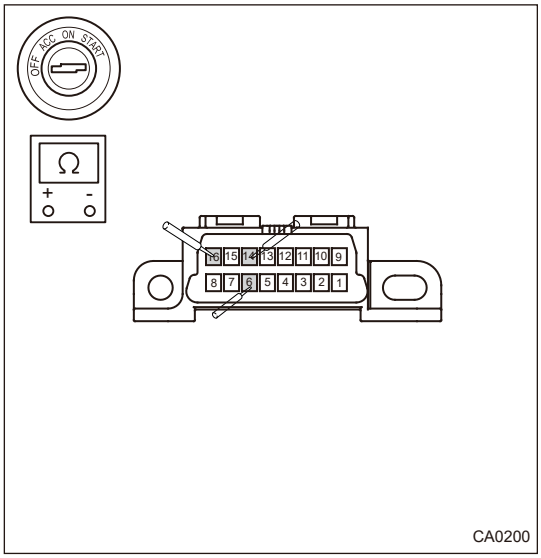


b. Use a multimeter to measure the resistance to ground and power supply of CAN-H and CAN-L.

- After disconnecting battery for 5 minutes, the measured resistance values between diagnostic interfaces 6# (CAN-H) and 14# (CAN-L) and ground are both 32 MΩ.



- After disconnecting battery for 5 minutes, the measured resistance values between diagnostic interfaces 6# (CAN-H) and 14# (CAN-L) and 16# are both 33.5 MΩ.

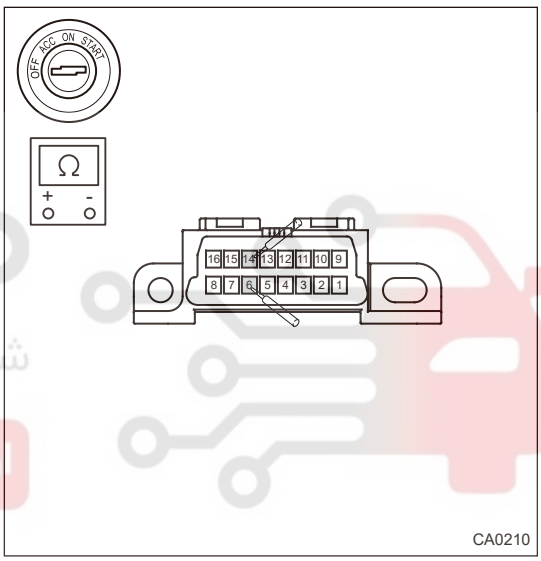


c. Termination resistor.

The termination resistor is installed in gateway module of system and is used to prevent CAN bus signal from reflecting the changing voltage on CAN bus. When the termination resistor fails and the square wave is transmitting, because of the reflection of line, if it is serious, the signal will be deformed and the signal of control unit will be invalid. When measuring the CAN bus signal with an oscilloscope, if the signal does not match standard signal, it is also necessary to check whether the termination resistor is damaged.

Measurement step of termination resistor:

1. Turn ENGINE START STOP switch to OFF, disconnect the negative battery cable;
2. Wait about 5 minutes until all capacitors are fully discharged;
3. Connect the measuring instrument and measure total resistance. Using ohmmeter, measure resistance between diagnostic interfaces (6) and (14) (standard resistance is 60 Ω).

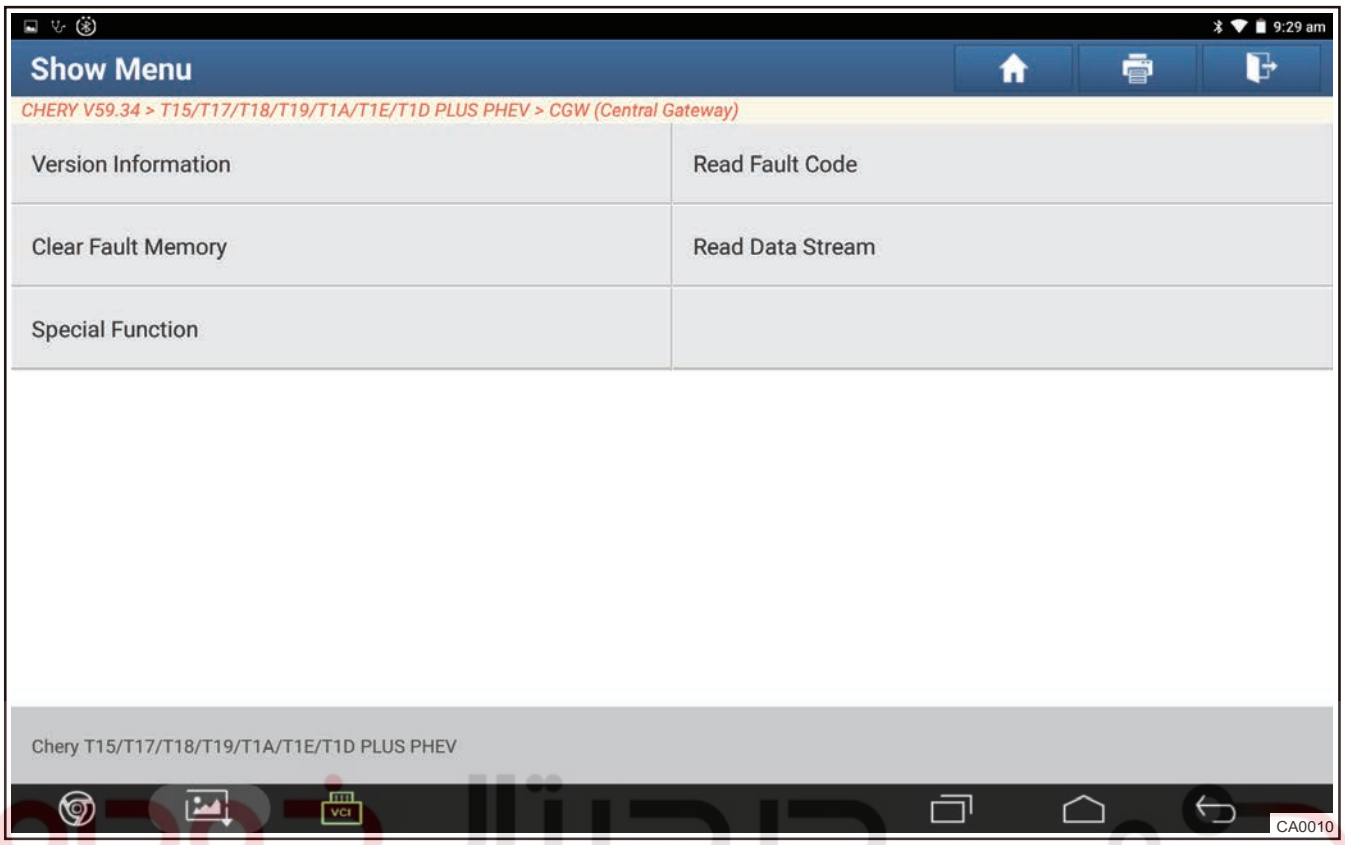


Measured value (for reference only): the measured resistance between diagnostic interfaces 6 # and 14 # is 58.7Ω (the two termination resistors are connected in parallel), after gateway module is disconnected separately, and the measured resistance between diagnostic interfaces 6 # and 14 # is ∞.

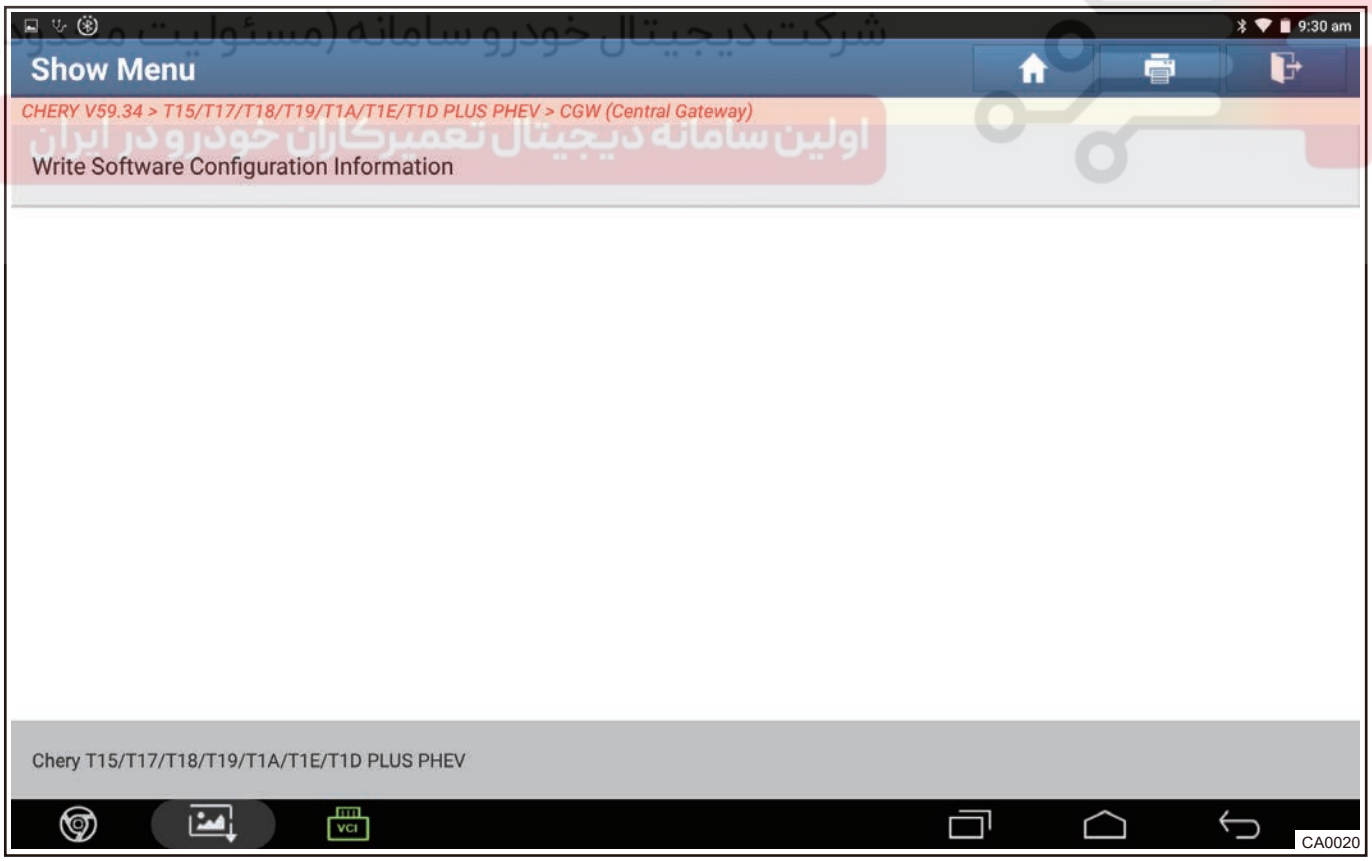
Matching Learning

Software configuration information writing

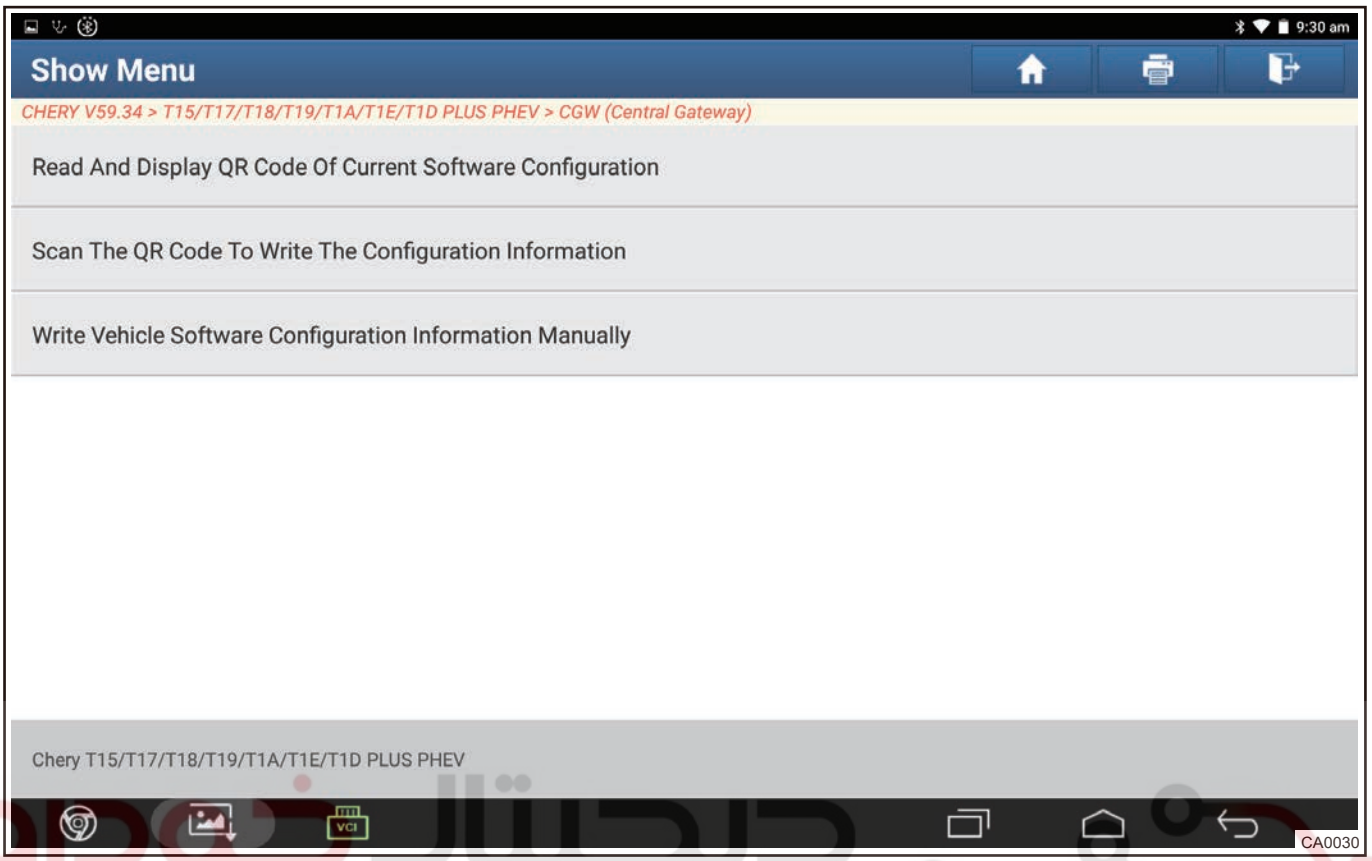
1. Connect the diagnostic tester, turn ENGINE START STOP switch to ON and select “T1D” model, then enter “CGW”.
2. Click “Special Function”.



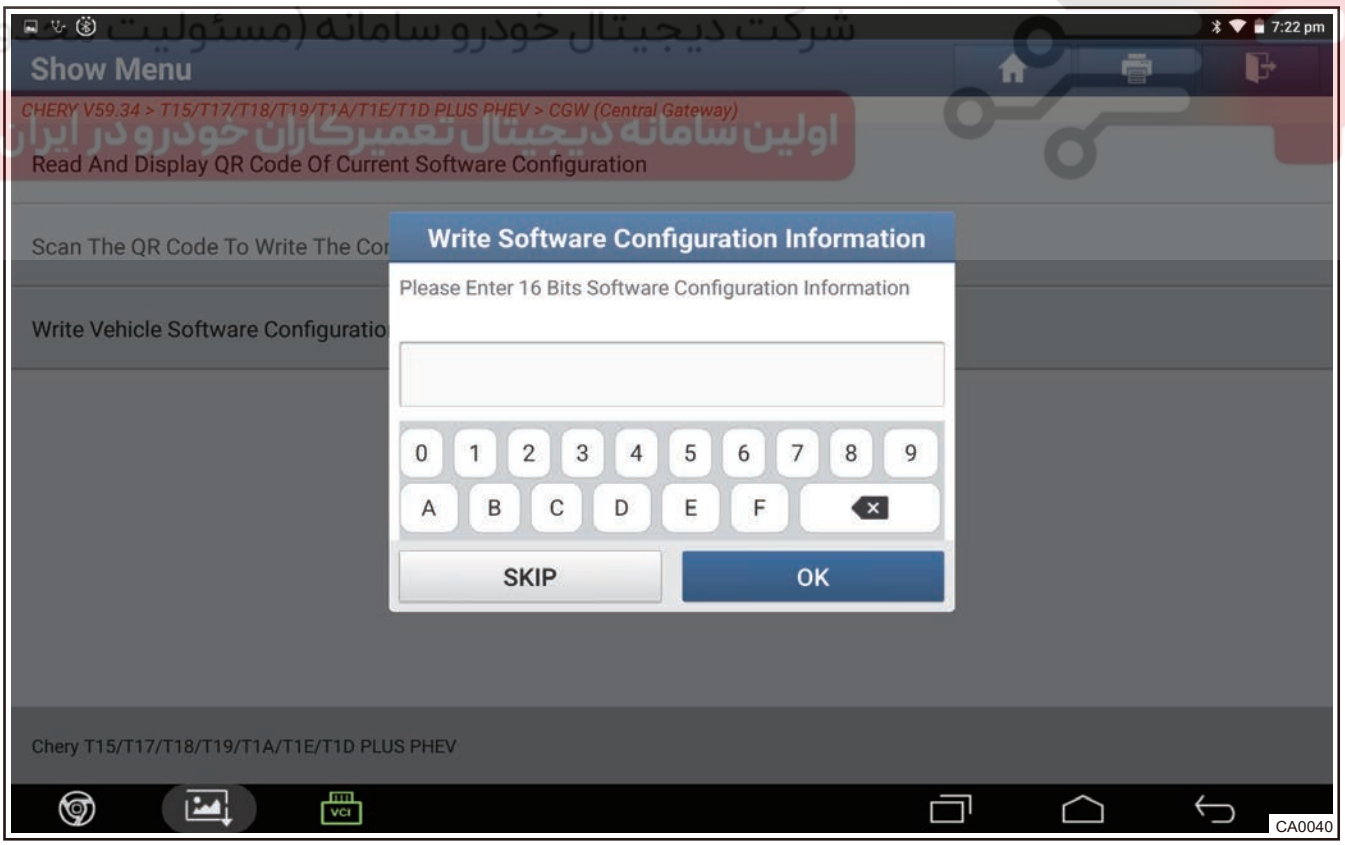
3. Enter next screen and click “Write software configuration information”.



4. Enter next screen and click “Write vehicle software configuration information manually”.



5. Input corresponding configuration information and click “OK”.



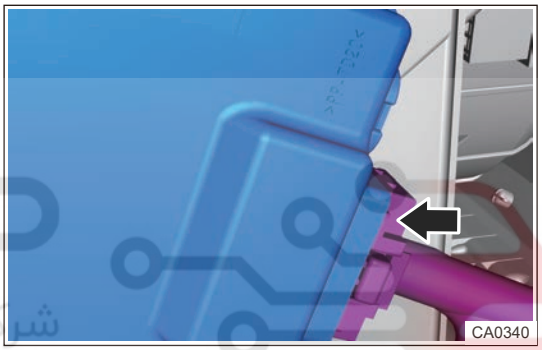
ON-VEHICLE SERVICE

Gateway Module (CGW)

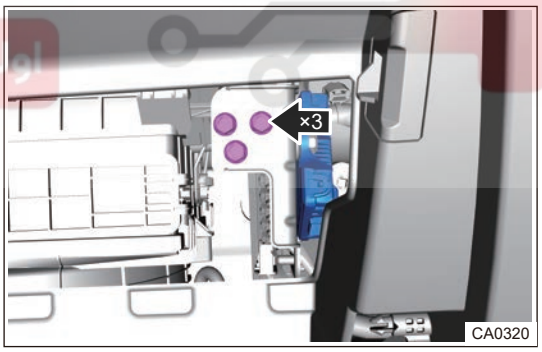
Removal

CAUTION
• Read configuration code of CGW module and record it with a diagnostic tester, before removing gateway module. • Try to prevent interior and body paint surface from being scratched, when removing gateway module.

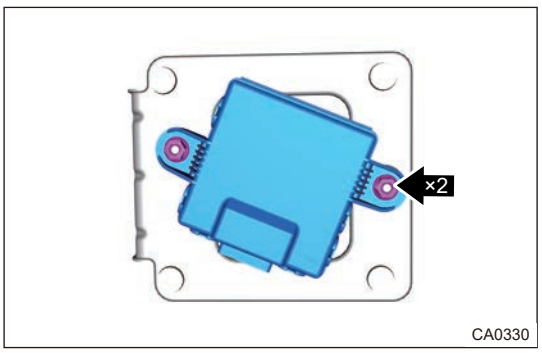
1. Turn ENGINE START STOP switch to OFF.
2. Disconnect the negative battery cable.
3. Remove the glove box assembly.
4. Remove the gateway module.
   a. Disconnect the gateway module connector (arrow).



   b. Remove 3 fixing bolts (arrow) from gateway bracket.



   c. Remove 2 fixing nuts (arrow) from gateway module secured on gateway bracket.



   d. Remove the gateway module.

Installation

1. Installation is in the reverse order of removal.

2. Write configuration code with diagnostic tester to check module for proper operation after installation.