SECTION STR
STARTING SYSTEM

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PRECAUTION

PRECAUTIONS

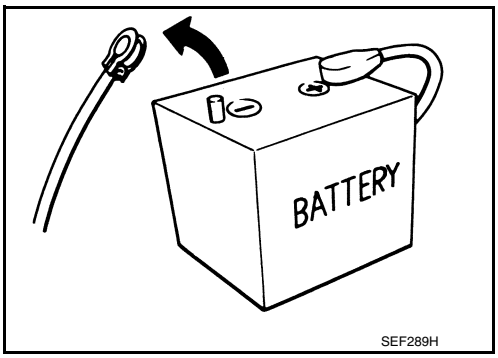
Precautions for Removing Battery Terminal

INFOID:0000000013549204

When disconnecting the battery terminal, pay attention to the following.

- Always use a 12V battery as power source.
- Never disconnect battery terminal while engine is running.
- When removing the 12V battery terminal, turn OFF the ignition switch and wait at least 30 seconds.
- For vehicles with the engine listed below, remove the battery terminal after a lapse of the specified time:

BR08DE	: 4 minutes	YD25DDTi	: 2 minutes
D4D engine	: 20 minutes	YS23DDT	: 4 minutes
HRA2DDT	: 12 minutes	YS23DDTT	: 4 minutes
K9K engine	: 4 minutes	ZD30DDTi	: 60 seconds
M9R engine	: 4 minutes	ZD30DDTT	: 60 seconds
R9M engine	: 4 minutes		
V9X engine	: 4 minutes		



NOTE:
ECU may be active for several tens of seconds after the ignition switch is turned OFF. If the battery terminal is removed before ECU stops, then a DTC detection error or ECU data corruption may occur.

- After high-load driving, if the vehicle is equipped with the V9X engine, turn the ignition switch OFF and wait for at least 15 minutes to remove the battery terminal.

NOTE:
- Turbocharger cooling pump may operate in a few minutes after the ignition switch is turned OFF.
- Example of high-load driving
  - Driving for 30 minutes or more at 140 km/h (86 MPH) or more.
  - Driving for 30 minutes or more on a steep slope.

- For vehicles with the 2-batteries, be sure to connect the main battery and the sub battery before turning ON the ignition switch.

NOTE:
If the ignition switch is turned ON with any one of the terminals of main battery and sub battery disconnected, then DTC may be detected.

- After installing the 12V battery, always check "Self Diagnosis Result" of all ECUs and erase DTC.

NOTE:
The removal of 12V battery may cause a DTC detection error.

PREPARATION

PREPARATION

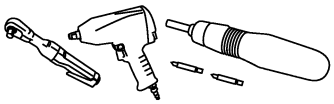
Special Service Tools

INFOID:0000000013566787

Tool number (Kent-Moore No.) Tool name	Description
— (—) Model GR8-1200 NI Multitasking battery and electrical diagnostic station  AWIIA1239ZZ	Tests batteries, starting and charging systems and charges batteries. For operating instructions, refer to diagnostic station instruction manual.

Commercial Service Tools

INFOID:0000000013566788

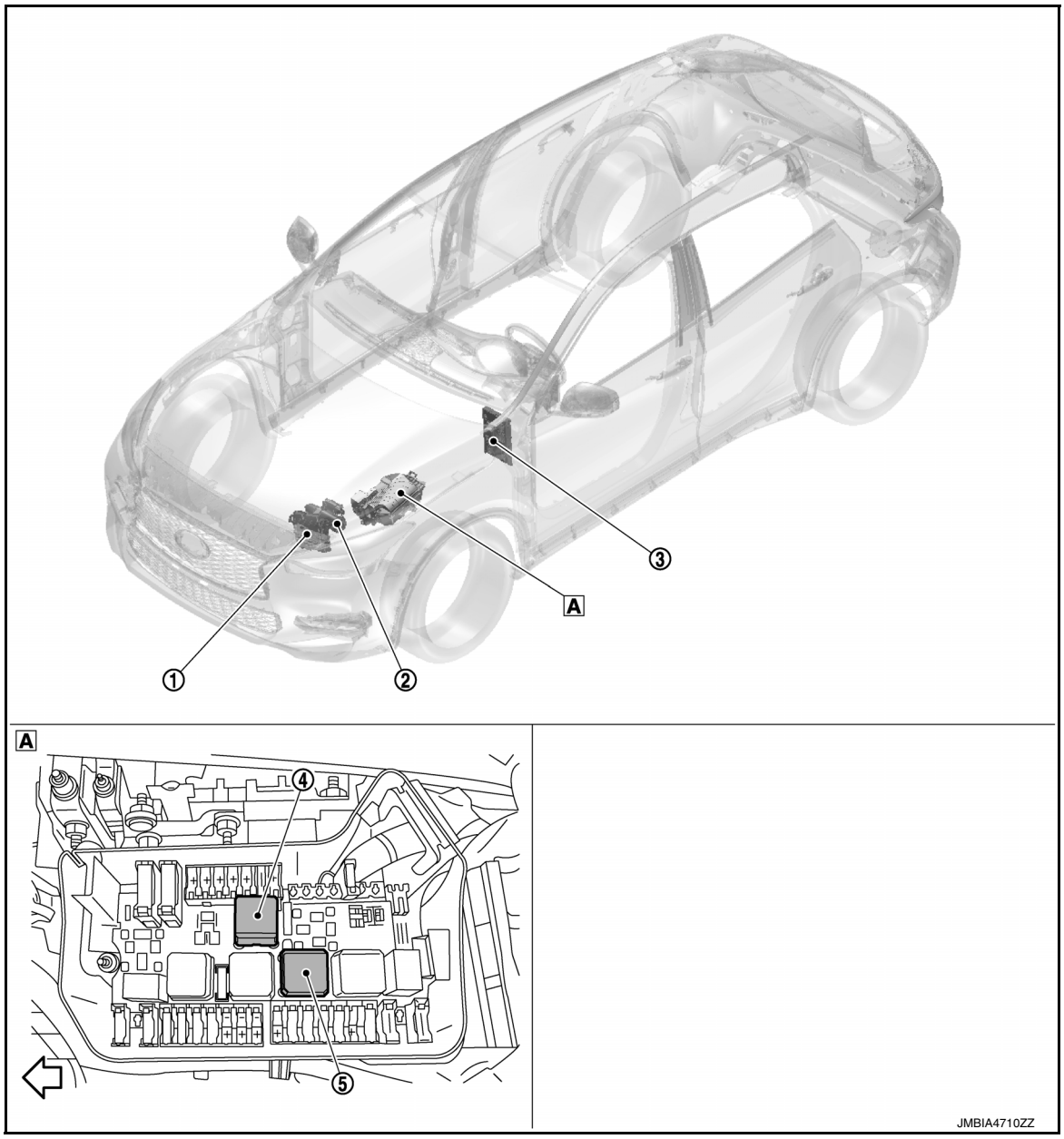
Tool name	Description
Power tool  PIIB1407E	Loosening bolts, nuts and screws

SYSTEM DESCRIPTION

COMPONENT PARTS

Component Parts Location

INFOID:0000000013563009



A Fuse and fusible link block 1

No.	Component	Function
①	ECM	ECM controls starter relay. Refer to EC-27, "Component Parts Location" for detailed installation location.
②	Starter motor	Refer to STR-5, "Starter motor".
③	BCM	BCM controls injection relay. Refer to BCS-8, "BODY CONTROL SYSTEM : Component Parts Location" for detailed installation location.

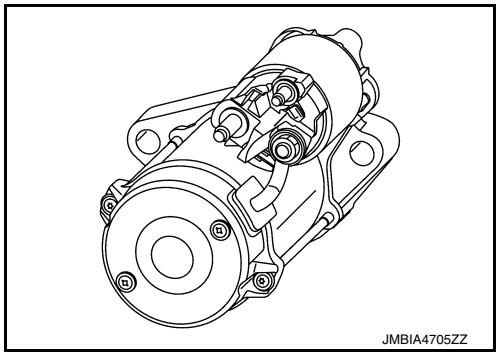
No.	Component	Function
④	Injection relay	Injection relay is turned ON by BCM when ignition switch is ON or START.
⑤	Starter relay	Starter relay is turned ON by ECM when starter operating condition is satisfied.

Starter motor

INFOID:0000000013563010

Starter motor plunger closes and motor is supplied with battery power, which in turn cranks engine, when “S” terminal is supplied with electric power.

- “B” terminal: “B” terminal is constantly supplied with battery power.
- “S” terminal: Starter motor magnetic switch (“S” terminal) is supplied with power when the cranking condition is satisfied.

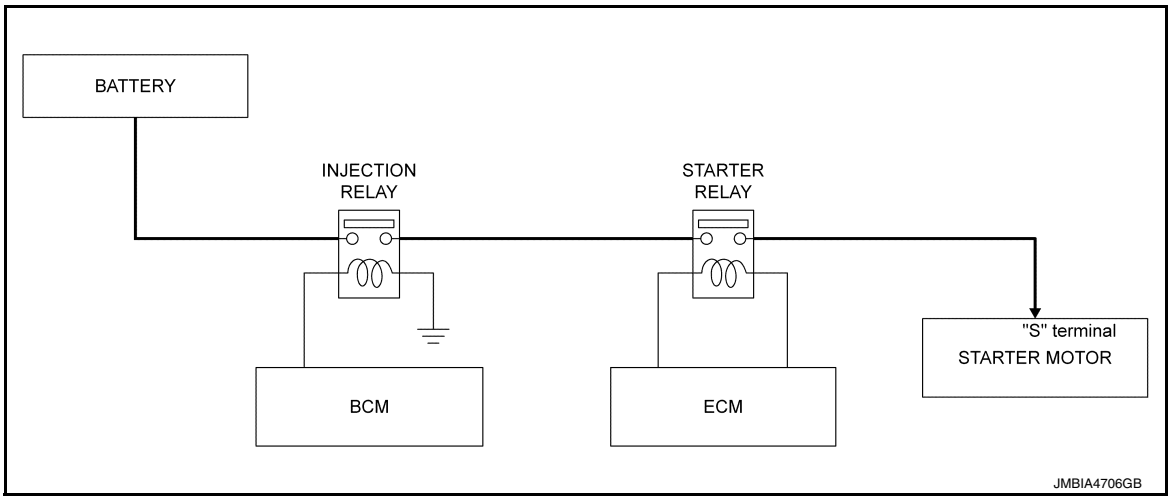


SYSTEM

System Description

INFOID:0000000013563011

SYSTEM DIAGRAM



SYSTEM DESCRIPTION

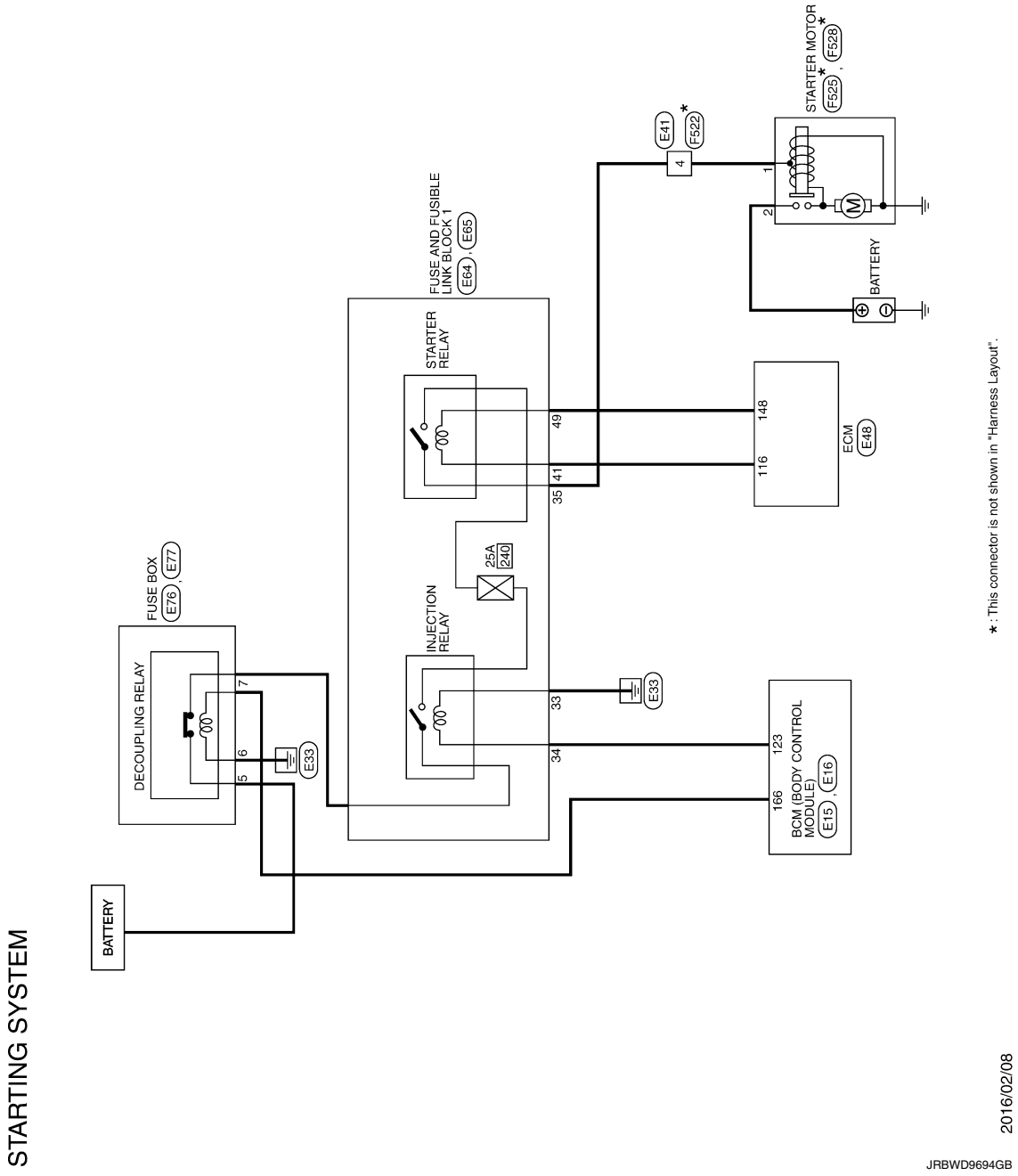
- When ignition switch is ON or START, BCM turns injection relay ON.
- When starter operating condition is satisfied, ECM turns starter relay ON.
- Then battery power is supplied to starter motor (“S” terminal) through injection relay and starter relay.

WIRING DIAGRAM

STARTING SYSTEM

Wiring Diagram

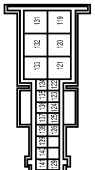
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STARTING SYSTEM

Connector No.	E15
Connector Name	BCM (BODY CONTROL MODULE)
Connector Type	MB_A1665400081

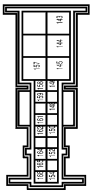
H.S.



Terminal No.	Color Of Wire	Signal Name [Specification]
119	V	RR WASHER CONT
120	GR	FR WASHER CONT
121	W	BRAKE PEDAL
122	Y	SPARY NOZZLE HOSE HEATER POWER SUPPLY
123	G	INJECTION RELAY CONT
124	BR	HOOD SWITCH STATUS 1
125	B	KI-15 MOTORST
126	GR	PARKING LAMP LH
129	G	FRONT WIPER STOP POSITION
131	Y	FRONT FOG LAMP LH
132	O	HIGH BEAM LH
133	L	LOW BEAM RH [With halogen lamp]
133	Y	LOW BEAM RH [With LED lamp]
134	BR	WASHER LEVEL SW GND
135	P	HORN CONT
136	R	FR WIPER RELAY CONT
137	V	FR WIPER HI/LO RELAY CONT
138	G	BRAKE FLUID LEVEL SW SIG
139	L	WASHER LEVEL SW SIG
140	Y	HOOD SWITCH STATUS 2
141	R	WARM START
142	V	FRONT TURN SIGNAL LH

Connector No.	E16
Connector Name	BCM (BODY CONTROL MODULE)
Connector Type	MB_A1665400181

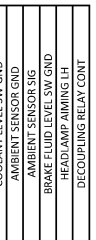
H.S.



Terminal No.	Color Of Wire	Signal Name [Specification]
143	Y	FRONT FOG LAMP RH
144	W	HIGH BEAM RH
145	GR	LOW BEAM LH
146	P	FRONT TURN SIGNAL RH
148	V	FR BRAKE WEAR SENSOR RH
150	GR	PARKING LAMP RH
152	L	LIN (BAT SENSOR)
154	Y	HEADLAMP AIMING RH
157	O	SSK STAT
158	R	COOLANT LEVEL SW SIG
159	BR	COOLANT LEVEL SW GND
161	P	AMBIENT SENSOR GND
162	G	AMBIENT SENSOR SIG
164	O	BRAKE FLUID LEVEL SW GND
165	V	HEADLAMP AIMING LH
166	R	DECOUPLING RELAY CONT

Connector No.	E41
Connector Name	WIRE TO WIRE
Connector Type	MB_A0275459826

H.S.



Terminal No.	Color Of Wire	Signal Name [Specification]
1	G	-
2	-	-
3	R	-
4	V	-
8	V	-
10	P	-
11	G	-
12	BR	-
14	W	-

Connector No.	E48
Connector Name	ECM
Connector Type	MB_A0075406981

H.S.



Terminal No.	Color Of Wire	Signal Name [Specification]
97	R	POWER SUPPLY (ECM)
98	BR	ECM GROUND
99	V	POWER SUPPLY (ECM)
100	BR	ECM GROUND
101	R	POWER SUPPLY (ECM)
102	B	ECM GROUND
103	L	COOLING FAN CONTROL SIGNAL
104	R	SENSOR POWER SUPPLY (ACCELERATOR PEDAL POSITION SENSOR 1)
105	G	SENSOR POWER SUPPLY (ACCELERATOR PEDAL POSITION SENSOR 2)
106	BR	SENSOR GROUND (ACCELERATOR PEDAL POSITION SENSOR1)
111	B	IGNITION SIGNAL
112	Y	POWER SUPPLY (BATTERY)
116	W	STARTER RELAY-L
119	GR	SENSOR GROUND (ACCELERATOR PEDAL POSITION SENSOR 2)
120	O	SENSOR GROUND
122	R	HOT START SIGNAL
123	GR	MOTOR RELAY CONTROL SIGNAL
127	O	FUEL PUMP ON SIGNAL
132	G	ACCELERATOR PEDAL POSITION SENSOR 1
136	Y	POWERTRAIN SENSOR CAN-H
137	W	CAN-H
138	GR	POWERTRAIN CAN-H
141	B	WATER PUMP RELAY CONTROL SIGNAL
145	W	ACCELERATOR PEDAL POSITION SENSOR 2
146	G	FUEL TANK PRESSURE SENSOR
147	L	CRASH SIGNAL
148	W	STARTER RELAY-H

149	B	POWERTRAIN SENSOR CAN-L
150	G	CAN-L
151	L	POWERTRAIN CAN-I
152	V	EVAP CANISTER VENT CONTROL VALVE
153	BR	EVAP PURGE CONTROL VALVE

Connector No.	E64
Connector Name	FUSE AND FUSIBLE LINK BLOCK 1
Connector Type	MB_A0315459626

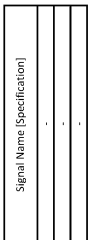
H.S.



Terminal No.	Color Of Wire	Signal Name [Specification]
33	BR	-
34	G	-
35	V	-
36	P	-
37	R	-
38	V	-
39	P	-
41	W	-
42	R	-

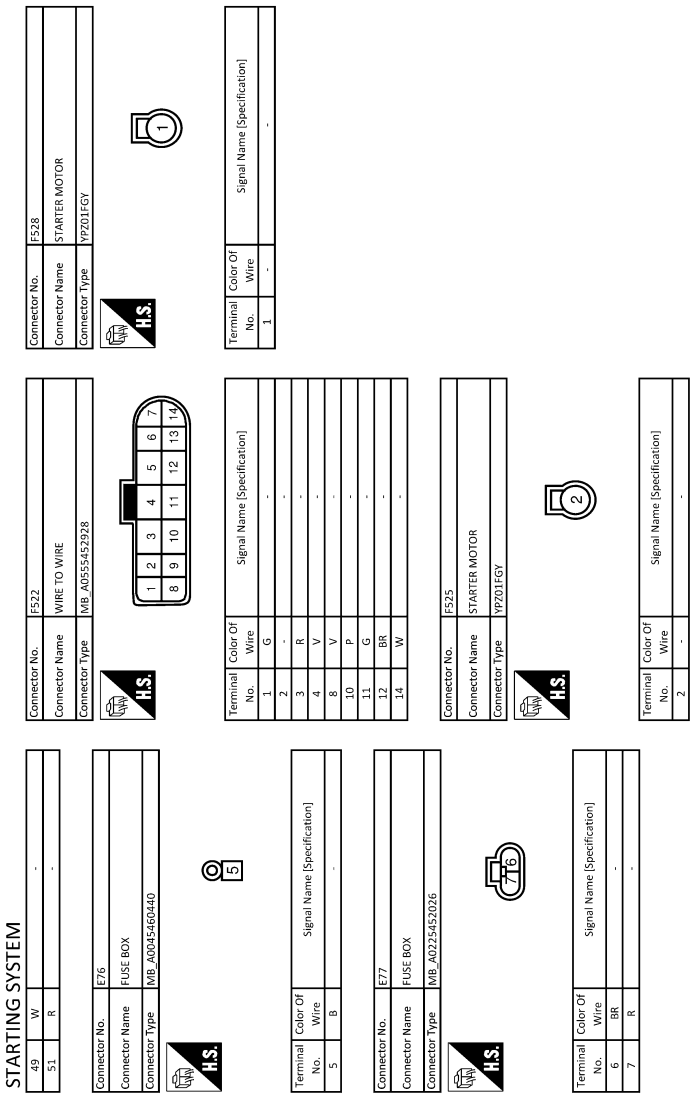
Connector No.	E65
Connector Name	FUSE AND FUSIBLE LINK BLOCK 1
Connector Type	MB_A0315459926

H.S.



Terminal No.	Color Of Wire	Signal Name [Specification]
43	B	-
44	BR	-
45	GR	-

JRBWD9695GB



JRBWD9696GB

BASIC INSPECTION

DIAGNOSIS AND REPAIR WORK FLOW

Work Flow (With GR8-1200 NI)

INFOID:0000000013565751

STARTING SYSTEM DIAGNOSIS WITH GR8-1200 NI

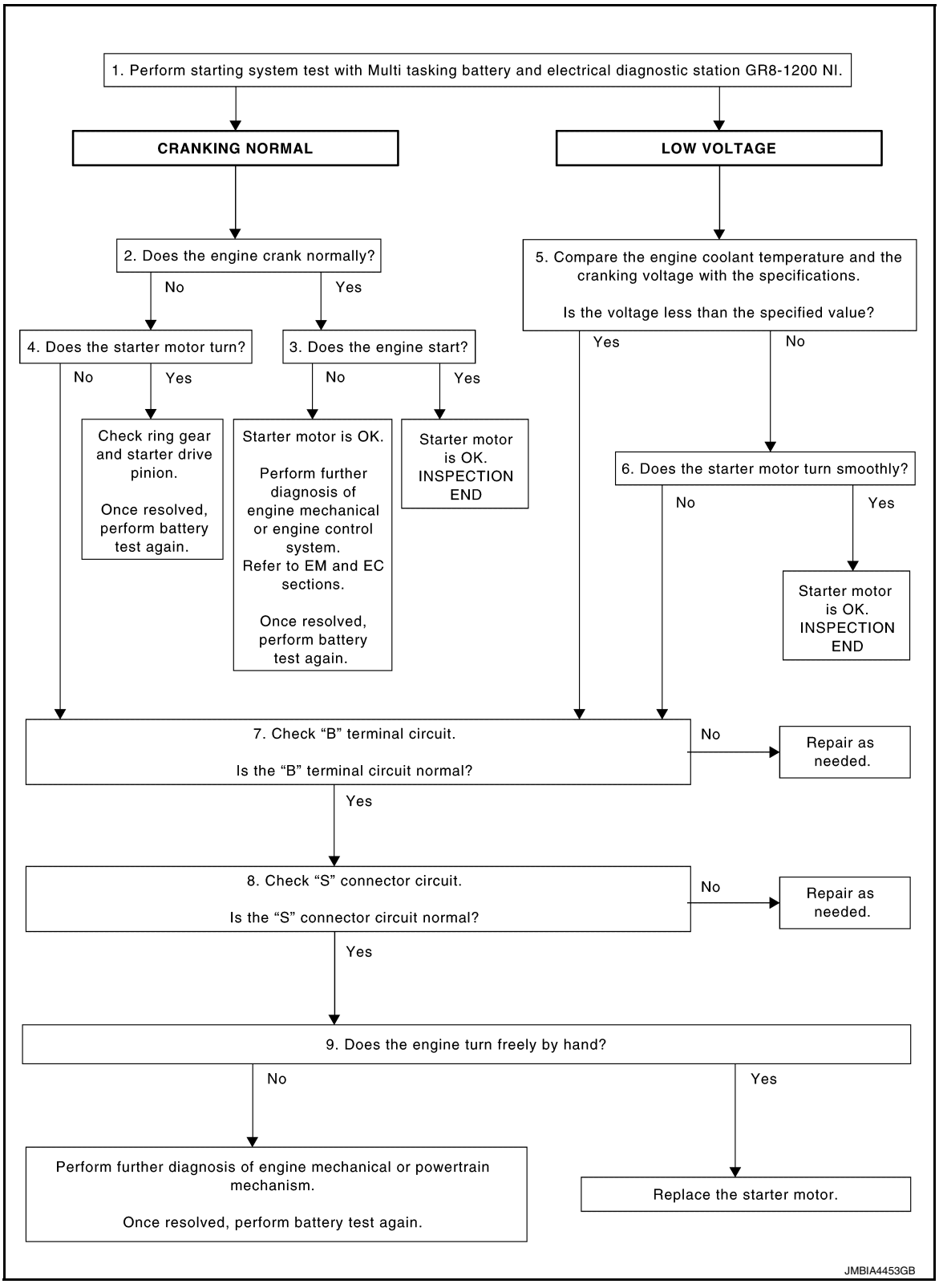
To test the starting system, use the following special service tool:

- GR8-1200 NI Multitasking battery and electrical diagnostic station

NOTE:

Refer to the diagnostic station Instruction Manual for proper starting system diagnosis procedures.

OVERALL SEQUENCE



DETAILED FLOW

NOTE:

To ensure a complete and thorough diagnosis, the battery, starter motor and alternator test segments must be done as a set from start to finish.

1.DIAGNOSIS WITH MULTITASKING BATTERY AND ELECTRICAL DIAGNOSTIC STATION GR8-1200 NI

Perform the starting system test with Multitasking battery and electrical diagnostic station GR8-1200 NI. For details and operating instructions, refer to diagnostic station Instruction Manual.

Test result

CRANKING NORMAL>>GO TO 2.
LOW VOLTAGE>>GO TO 5.
CHARGE BATTERY>>Perform the slow battery charging procedure. (Initial rate of charge is 10A for 12 hours.) Perform battery test again. Refer to diagnostic station instruction manual.
REPLACE BATTERY>>Before replacing battery, clean the battery cable clamps and battery posts. Perform battery test again. Refer to diagnostic station instruction manual. If second test result is “REPLACE BATTERY”, then do so. Perform battery test again to confirm repair.

2.CRANKING CHECK

Check that the starter motor operates correctly.

Does the engine crank normally?

YES >> GO TO 3.
NO >> GO TO 4.

3.ENGINE START CHECK

Check that the engine starts.

Does the engine start?

YES >> Starter motor is OK. INSPECTION END
NO >> Perform further diagnosis of engine mechanical or engine control system. Refer EM and EC sections. Once resolved, perform battery test again.

4.STARTER MOTOR ACTIVATION

Check that the starter motor operates.

Does the starter motor turn?

YES >> Check ring gear and starter motor drive pinion. Once resolved, perform battery test again.
NO >> GO TO 7.

5.COMPARISON BETWEEN ENGINE COOLANT AND CRANKING VOLTAGE

Compare the engine coolant temperature and the cranking voltage with the specifications.

Minimum Specification of Cranking Voltage Referencing Coolant Temperature

Engine coolant temperature [°C (°F)]	Voltage [V]
−30 to −20 (−22 to −4)	8.6
−19 to −10 (−2 to 14)	9.1
−9 to 0 (16 to 32)	9.5
More than 1 (More than 34)	9.9

Is the voltage less than the specified value?

YES >> GO TO 7.
NO >> GO TO 6.

6.STARTER OPERATION

Check the starter operation status.

Does the starter motor turn smoothly?

YES >> Starter motor is OK. INSPECTION END
NO >> GO TO 7.

7.“B” TERMINAL CIRCUIT INSPECTION

Check “B” terminal circuit. Refer to STR-15, "Diagnosis Procedure".

Is “B” terminal circuit normal?

YES >> GO TO 8.
NO >> Repair as needed.

8.“S” CONNECTOR CIRCUIT INSPECTION

Check “S” connector circuit. Refer to STR-16, "Diagnosis Procedure".

Is “S” connector circuit normal?

YES >> GO TO 9.
NO >> Repair as needed.

9.ENGINE ROTATION STATUS

Check that the engine can be rotated by hand.

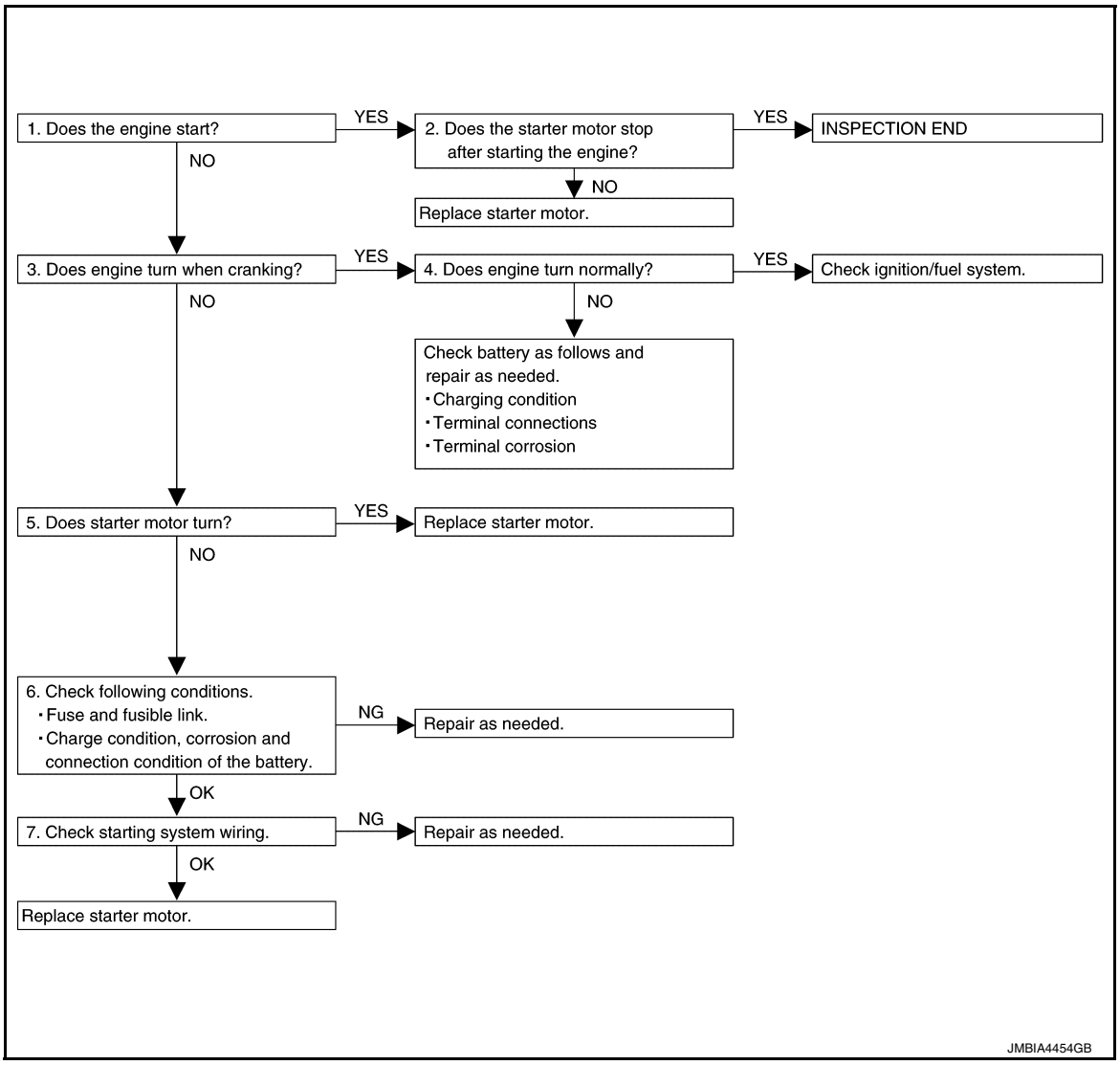
Does the engine turn freely by hand?

YES >> Replace starter motor. Refer to STR-18, "1.6L/2.0L TURBO ENGINE : Removal and Installation".
NO >> Perform further diagnosis of engine mechanical or powertrain mechanism. Once resolved, perform battery test again using Multitasking battery and electrical diagnostic station GR8-1200 NI. Refer to the diagnostic station Instruction Manual for proper testing procedures.

Work Flow (Without GR8-1200 NI)

INFOID:0000000013565752

OVERALL SEQUENCE



DETAILED FLOW

NOTE:
If any malfunction is found, immediately disconnect the battery cable from the negative terminal.

1.CHECK ENGINE START

Crank the engine and check that the engine starts.

Does the engine start?

YES >> GO TO 2.

NO >> GO TO 3.

2.CHECK THAT THE STARTER MOTOR STOPS

Check that the starter motor stops after starting the engine.

Does the starter motor stop?

YES >> INSPECTION END
NO >> Replace starter motor. Refer to STR-18, "1.6L/2.0L TURBO ENGINE : Removal and Installation".

3.CHECK THAT THE ENGINE TURNS WHEN CRANKING

Check that the engine turns when cranking.

Does engine turn when cranking?

YES >> GO TO 4.
NO >> GO TO 5.

4.CHECK THE ENGINE SPEED WHEN CRANKING

Check that the engine speed is not low when cranking.

Does engine turn normally?

YES >> Check ignition/fuel system.
NO >> Check charge condition, corrosion and connection condition of the battery. Refer to PG-102, "MAIN BATTERY : Work Procedure" (main battery) and PG-104, "SUB BATTERY : Work Procedure" (sub battery).

5.CHECK STARTER MOTOR ACTIVATION

Check that the starter motor runs at cranking.

Does starter motor turn?

YES >> Replace starter motor. Refer to STR-18, "1.6L/2.0L TURBO ENGINE : Removal and Installation".
NO >> GO TO 6.

6.CHECK POWER SUPPLY CIRCUIT

Check the following conditions.

- Fuse and fusible link
- Charge condition, corrosion and connection condition of the battery. Refer to PG-102, "MAIN BATTERY : Work Procedure" (main battery) and PG-104, "SUB BATTERY : Work Procedure" (sub battery).

Are these inspection results normal?

YES >> GO TO 7.
NO >> Repair as needed.

7.CHECK STARTING SYSTEM WIRING

Check the following.

- “B” terminal circuit. Refer to STR-15, "Diagnosis Procedure".
- “S” connector circuit. Refer to STR-16, "Diagnosis Procedure".

Are these inspection results normal?

YES >> Replace starter motor. Refer to STR-18, "1.6L/2.0L TURBO ENGINE : Removal and Installation".
NO >> Repair as needed.

DTC/CIRCUIT DIAGNOSIS

B TERMINAL CIRCUIT

Diagnosis Procedure

INFOID:0000000013563014

CAUTION:

Perform diagnosis under the condition that engine cannot start by the following procedure.

1. **Remove fuel pump fuse.**
2. **Crank or start engine (where possible) until fuel pressure is released.**

1.CHECK “B” TERMINAL CIRCUIT

1. Turn ignition switch OFF.
2. Check that starter motor “B” terminal connection is clean and tight.
3. Check voltage between starter motor “B” terminal and ground.

(+)		(–)	Voltage (Approx.)
Starter motor			
Connector	Terminal		
F525	2	Ground	Battery voltage

Is the inspection result normal?

YES >> GO TO 2.

NO >> Check harness between battery and starter motor for open circuit.

2.CHECK BATTERY CABLE CONNECTION STATUS (VOLTAGE DROP TEST)

1. Shift electric shift selector lever to “P” or “N” position.
2. Check voltage between battery positive terminal and starter motor “B” terminal.

(+)	(–)		Condition	Voltage (Approx.)
	Starter motor			
	Connector	Terminal		
Battery positive terminal	F525	2	When ignition switch is in START position	Less than 0.5

Is the inspection result normal?

YES >> GO TO 3.

NO >> Check harness between battery and starter motor for poor continuity.

3.CHECK GROUND CIRCUIT STATUS (VOLTAGE DROP TEST)

1. Shift electric shift selector lever to “P” or “N” position.
2. Check voltage between starter motor case and battery negative terminal.

Terminals		Condition	Voltage (Approx.)
(+)	(–)		
Starter motor case	Battery negative terminal	When ignition switch is in START position	Less than 0.2

Is the inspection result normal?

YES >> “B” terminal circuit is OK. Further inspection is necessary. Refer to STR-10, "Work Flow (With GR8-1200 NI)" (with GR8-1200 NI) or STR-13, "Work Flow (Without GR8-1200 NI)" (without GR8-1200 NI).

NO >> Check starter motor case and ground for poor continuity.

S CONNECTOR CIRCUIT

Diagnosis Procedure

INFOID:0000000013563015

CAUTION:

Perform diagnosis under the condition that engine cannot start by the following procedure.

1. **Remove fuel pump fuse.**
2. **Crank or start engine (where possible) until fuel pressure is released.**

1.CHECK “S” CONNECTOR CIRCUIT

1. Turn ignition switch OFF.
2. Disconnect starter motor connector.
3. Shift electric shift selector lever to “P” or “N” position.
4. Check voltage between starter motor harness connector and ground.

(+)		(–)	Condition	Voltage
Starter motor				
Connector	Terminal			
F525	2	Ground	When ignition switch is in START position	Battery voltage

Is the inspection result normal?

YES >> “S” connector circuit is OK. Further inspection is necessary. Refer to STR-10, "Work Flow (With GR8-1200 NI)" (with GR8-1200 NI) or STR-13, "Work Flow (Without GR8-1200 NI)" (without GR8-1200 NI).

NO >> GO TO 2.

2.CHECK FUSIBLE LINK

1. Turn ignition switch OFF.
2. Check that the following fusible link is not blown (open).

Fusible link No.	Capacity
G	25 A

Is the inspection result normal?

YES >> GO TO 3.

NO >> Replace fusible link after repairing applicable circuit.

3.CHECK INJECTION RELAY

Check injection relay. Refer to STR-17, "Component Inspection".

Is the inspection result normal?

YES >> GO TO 4.

NO >> Replace injection relay.

4.CHECK STARTER RELAY

Check starter relay. Refer to STR-17, "Component Inspection".

Is the inspection result normal?

YES >> GO TO 5.

NO >> Replace starter relay.

5.CHECK STARTER RELAY CIRCUIT

Check continuity between starter motor harness connector and starter relay harness connector.

Starter motor		Starter relay		Continuity
Connector	Terminal	Connector	Terminal	
F528	1	E64	35	Existed

Is the inspection result normal?

YES >> Further inspection is necessary. Check BCM and ECM.

NO >> Repair or replace harness.

Component Inspection

INFOID:0000000013563016

1. CHECK INJECTION RELAY AND/OR STARTER RELAY

1. Turn ignition switch OFF.
2. Remove injection relay and/or starter relay.
3. Apply battery voltage to injection relay and/or starter relay between terminals 1 and 2.
   NOTE:
   Terminal No. is written down on injection relay and/or starter relay.
4. Check continuity of injection relay and/or starter relay.

Injection relay and/or Starter relay		Condition		Continuity
Terminal				
3	5	Voltage	Apply	Existed
			Not Apply	Not existed

Is the inspection result normal?

YES >> injection relay and/or starter relay is normal.
NO >> Replace injection relay and/or starter relay.

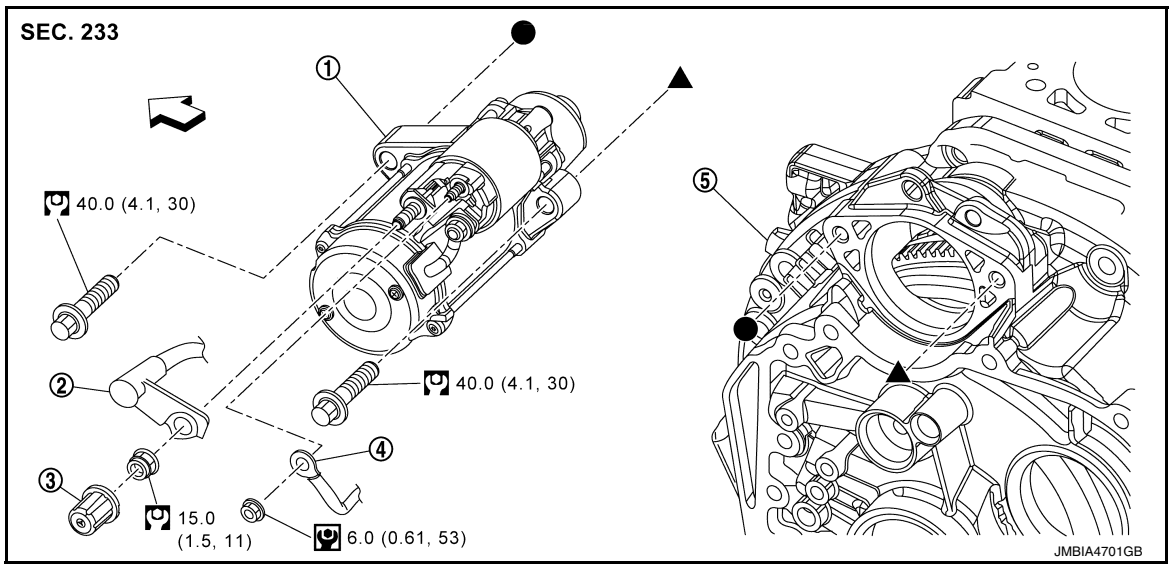
REMOVAL AND INSTALLATION

STARTER MOTOR

1.6L/2.0L TURBO ENGINE

1.6L/2.0L TURBO ENGINE : Exploded View

INFOID:0000000013563017



① Starter motor
② "B" terminal harness
③ Terminal cap
④ "S" terminal harness
⑤ Transmission housing
⇦ Vehicle front
: N·m (kg-m, in-lb)
: N·m (kg-m, ft-lb)
●, ▲: Indicates that the part is connected at points with same symbol in actual vehicle.

1.6L/2.0L TURBO ENGINE : Removal and Installation

INFOID:0000000013563018

REMOVAL

1. Remove main battery. Refer to PG-109, "MAIN BATTERY : Removal and Installation".
2. Remove main battery tray. Refer to PG-117, "MAIN BATTERY : Removal and Installation".
3. Remove ECM. Refer to EC-963, "Removal and Installation".
4. Remove air cleaner housing. Refer to EM-23, "Removal and Installation".
5. Remove terminal cap and "B" terminal nut, and then disconnect "B" terminal harness.
6. Remove "S" terminal nut, and then disconnect "S" terminal harness.
7. Remove starter motor mounting bolts and ground cable, and then remove starter motor upward.

INSTALLATION

Note the following items, and then install in the reverse order of removal.

CAUTION:

- **Before installation, check pinion on starter motor for damage and wear. If there are problems, replace starter motor with a new one.**
- **Be careful to tighten "B" terminal nut to the specified torque.**
- **Erase the starter operation counter when the starter motor for models with STOP/START SYSTEM is replaced. Refer to EC-197, "Description".**

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

Starter Motor

INFOID:0000000013563019

Applied model		1.6L/2.0L turbo engine
Type		MS438000-2050
		DENSO make
System voltage	[V]	12