ISG SYSTEM

0000-00

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IDLE STOP AND GO SYSTEM

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ISG SYSTEM (Idle Stop and Go System) 0000-00

GENERAL INFORMATION

1. SPECIFICATIONS

Unit	Description	Specification
Alternator	Rated output	120 A (13.25 V) 70 A/2,000 rpm, 99 A/4,000 rpm, 103 A/6,000 rpm
Battery	Capacity	AGM 70 Ah
	Reserve capacity	110 minutes
	Starting current (when engine cold)	760 A
	Weight	21 Kg
BSC (Battery Sensor Cable)	Operating current	Maximum 20 mA
	Dark current	Maximum 0.35 mA
	Operating voltage	9~18 V
	Operating temperature	−30~110ºC
	Communication	LIN 2.0
Starting motor	Rated voltage	12 V 1.4 kw
	Solenoid operating voltage (V)	Max. 8V
	Motor output (11.5 V at unloaded)	Max. 100 A/min. 3,400 rpm
	Motor output (8.0 V under load)	370 A (min. 7.6 Nm)/min. 1,300 rpm
	Weight	3.3 kg
DC-DC Converter	Conversion Mode	Input voltage: 7~12 V Output voltage: 12 ± 1 V
	By Pass Mode	Input voltage: 9~16 V Output voltage: 9~16 V
	Operating temperature	−30~75ºC
ISG OFF switch	Rated voltage	12 V at 50 mA
	Operating temperature	−30ºC ~ +80ºC
	Rated load	12 V - 50 mA

2. CAUTIONS

CAUTION

- When ISG system is in operation, some warning lights (ABS, brake, ESP, ESP OFF) maybe turn on due to a momentary loss of current when you restart the engine. This is normal and not systems malfunction.
- When the engine stopped automatically, if you unfasten the seat belt or, the door or hood is open, the engine will not start automatically for safety, instead the warning buzzer will sound. If this happens, you must use your REKES key/Smart key (if equipped) to start the engine.
  ISG system does not operate on a sloped road, because a quick acceleration or slip can occur.
- This is normal for your safety, and not system malfunction.
  External navigation without battery built in could be reset upon auto restart if using the cigarette
- jack to power on.
  The navigation with no battery built in can be initialized if connected to the cigarette jack or multi-
- purpose socket upon Auto Start.
  Use only specified power line (RV 12V, current consumption below 2.3 A)
- Connecting the power line to cigarette jack, multi-purpose socket or other wiring and equipment
- of the vehicle can make the audio system inoperable.
  If “AUTO STOP deactivated” message appears several times continuously, The ISG
- system and the battery need to be checked.
  Always use the genuine ISG system battery manufactured by Ssang Yong. If not, ISG system
- could be inoperable in normal conditions.
  Do not charge the ISG system battery with a universal charger to prevent the battery from being damaged or exploded.
  Do not open or remove the battery cap. Doing so may cause an electrolyte leakage resulting in body injuries.

Modification basis	
Application basis	
Affected VIN	

Memo

OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The ISG (Idle Stop and Go) system stops the engine temporarily when the vehicle is stationary (e.g. waiting at a traffic light) to improve fuel consumption and reduce exhaust emissions.
The ISG system is fitted to the vehicle with manual transmission only which uses a high-performance battery, starting motor and alternator due to frequent ignition on/off switching compared to the normal vehicle. In addition, systems such as BSC and DC-DC converter are fitted for smooth operation.

2. COMPONENTS

A ISG-related display

B Starting motor

C Battery sensor (BSC)

D ISG OFF switch

E BCM

Modification basis	
Application basis	
Affected VIN	

F SKM

G Battery

H Brake vacuum pressure sensor

I DC-DC converter

J ECU

K Alternator

Modification basis	
Application basis	
Affected VIN	

3. OPERATING CONDITIONS

The ISG system auto engine stop and start is operated only when the ECU is satisfied with the signals from the relevant units and sensors as conditions for operating the ISG. Otherwise, the ISG does not function.

1) Conditions For Auto Stop

Condition	Status	
	GSL	DSL
Starting engine	Started	
Vehicle speed	Vehicle speed is "0"	
Shift lever	In N (neutral) position	
Clutch pedal	Not depressed	
ISG OFF switch	OFF	
Driver door	Close	
Driver seat belt	Fastened	
Engine compartment hood switches 1 and 2	OFF	
Accelerator pedal value	5% or less	
Engine rpm	0~2,000 rpm	550~1,350 rpm
Coolant temperature	50~115˚C	15~105˚C
Based on certain speed before ISG stop	Above 10 km/h	
Battery information (voltage, current, temperature, SOC and etc.)	Normal	
Driven distance after reset by ISG	Over 5 m	
Brake vacuum pressure	Proper level	
A/C and heater	No signal inhibiting ISG auto stop	
Fuel level	Above certain level	
Gradient of road	Vehicle is not on steep slope	
Minimum required time to stop vehicle before ISG stop	0.5 sec.	0.2 sec.
Atmospheric pressure	Vehicle is not on high altitudes	
ISG-related system and sensor	DTC not found	

Condition	Status	
	GSL	DSL
CDPF	-	DPF regeneration not in progress
Injector MDP learning	-	MDP learning not in progress
Engine torque	-	Below 250 Nm
Fuel temperature	-	15~105˚C
Engine oil temperature	-	15~105˚C
DOC temperature	-	-45~1,000˚C

2) Conditions For Starting From Auto Stop

▶ **Auto start by driver's will**

Condition	Status	
	GSL	DSL
Clutch pedal	Depressed	

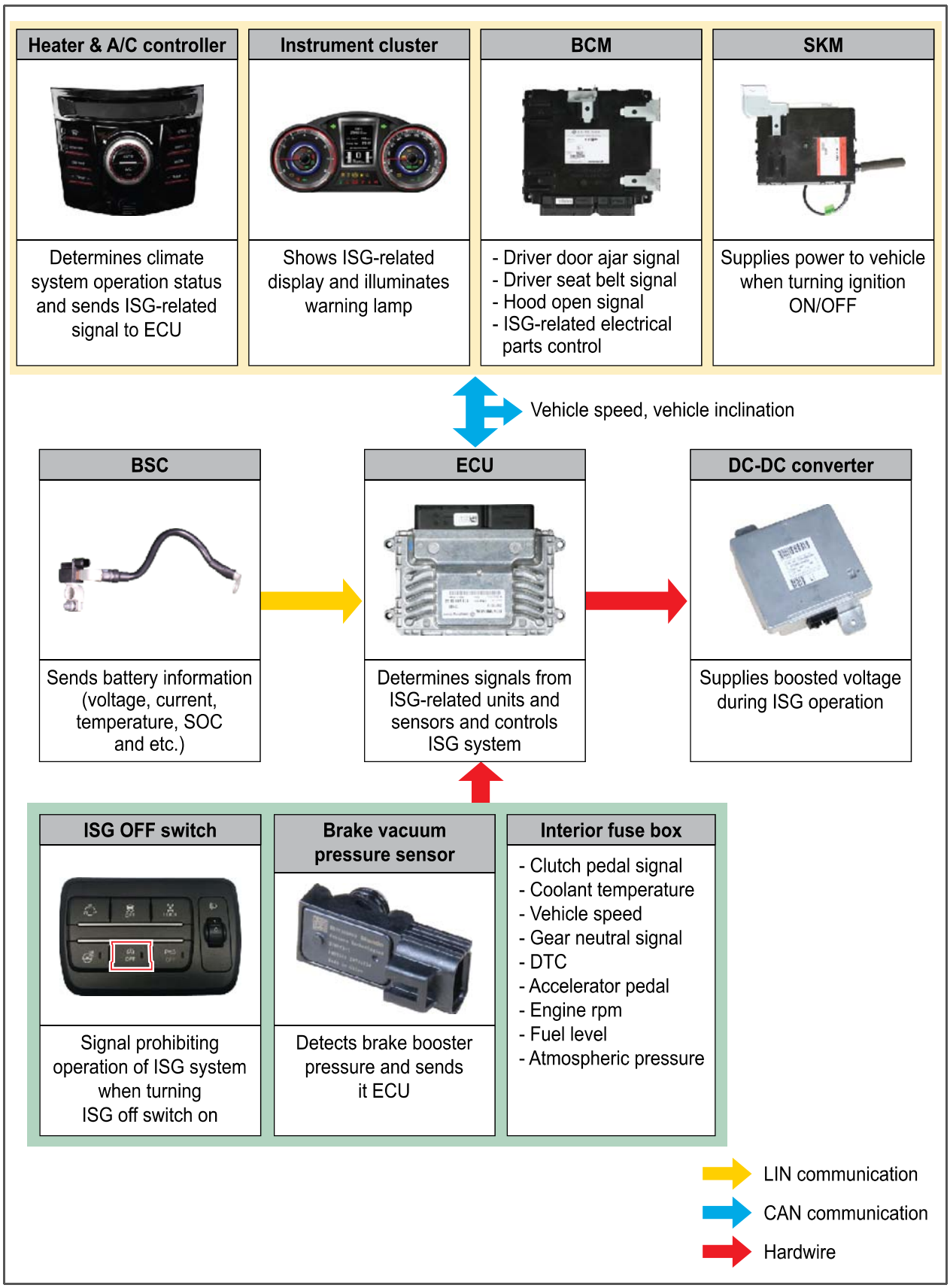
▶ **Forced auto start**

Condition	Status	
	GSL	DSL
ISG OFF switch	ON	
Coolant temperature	Above 130˚C	Above 110˚C
A/C and heater	Certain signal transmitted from A/C controller	
Battery information (voltage, current, temperature, SOC and etc.)	Not OK	
Brake vacuum pressure	Out of correct level	
Elapsed time after auto stop	180 sec. or longer	
Vehicle speed	2 km/h or higher	5 km/h or higher

3) Conditions For Inhibiting Starting From Auto Stop

Condition	Status	Remarks
Engine compartment hood	Open	Key required for re-start when open and closed
Driver door	Open	Auto start available when door closed
Driver seat belt	Unfastened	Auto start available when fastened
Status of accelerator pedal with auto stop on	Depressed	-

4. ISG SYSTEM INPUT/OUTPUT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

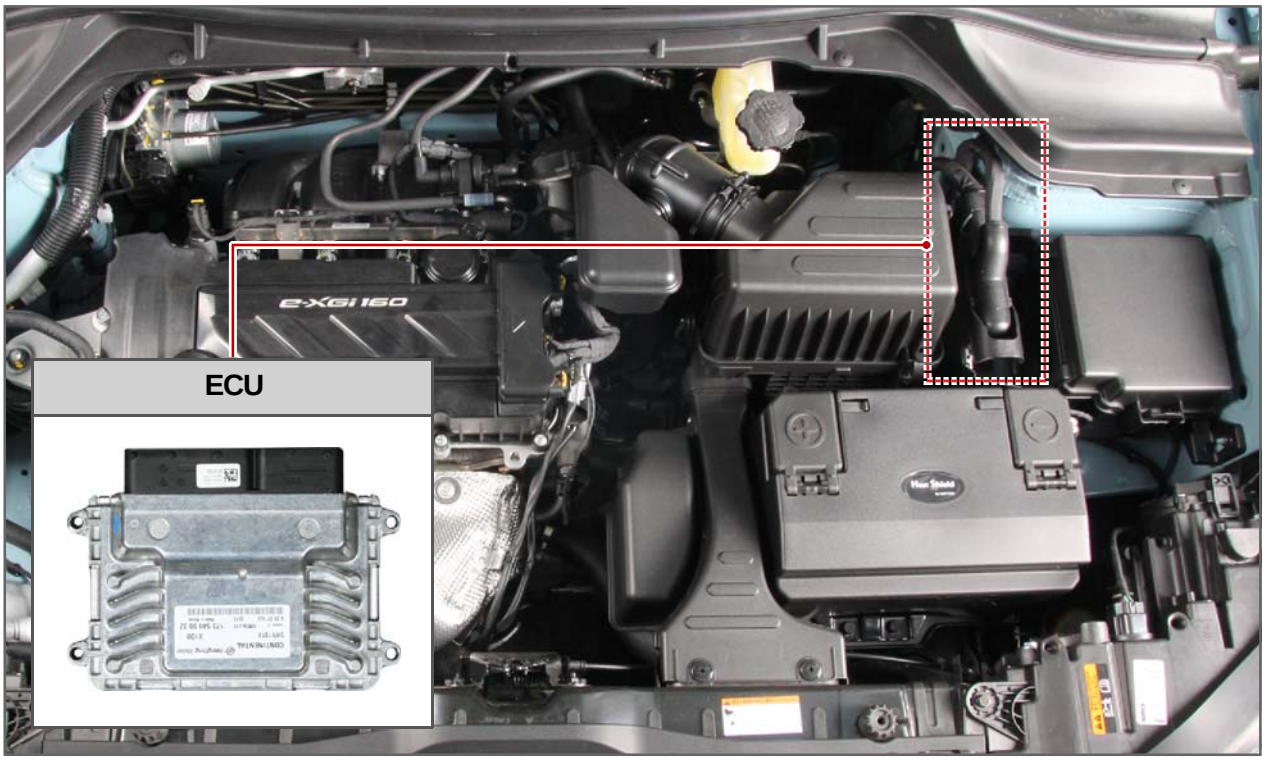
CONFIGURATION AND FUNCTION

S.G.N. 1491-01 ECU

1) Overview

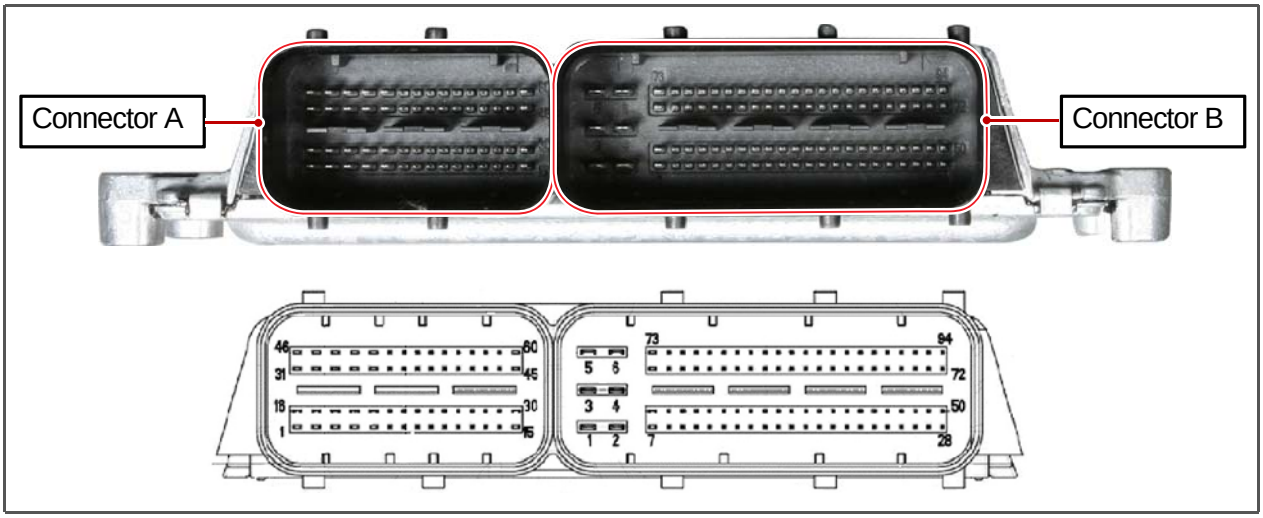
The ECU receives the information from the relevant units and sensors and determines that the ISG-related systems are normal and conditions for operating ISG are met, in order to control the function of the ISG system.

2) Mounting Location and Components



Modification basis	
Application basis	
Affected VIN	

3) ECU Connector



▶ **Connector A**

Pin No.	Function	Pin No.	Function
1	No. 1 ignition coil control (-)	19	-
2	-	20	-
3	Ignition coil shield	21	-
4	-	22	Knock sensor shield
5	-	23	Knock sensor ground
6	Rear oxygen sensor ground	24	T-MAP sensor ground
7	Rear oxygen sensor signal	25	-
8	Knock sensor signal	26	Crankshaft position sensor ground
9	T-MAP sensor (temperature signal)	27	Coolant temperature sensor ground
10	Start switch signal	28	-
11	Alternator voltage signal	29	-
12	Coolant temperature sensor signal	30	No. 3 injector control (-)
13	-	31	No. 4 ignition coil control (-)
14	-	32	-
15	No. 1 injector control (-)	33	-
16	No. 3 ignition coil control (-)	34	-
17	-	35	Camshaft position sensor power (5 V)
18	-	36	-

Pin No.	Function	Pin No.	Function
37	-	49	-
38	-	50	-
39	T-MAP sensor (pressure signal)	51	Front oxygen sensor ground
40	-	52	-
41	-	53	Front oxygen sensor signal
42	Camshaft position sensor ground (exhaust)	54	T-MAP sensor power (5 V)
43	Camshaft position sensor ground (intake)	55	-
44	-	56	Crankshaft position sensor signal
45	No. 4 injector control (-)	57	Camshaft position sensor signal (exhaust)
46	No. 2 ignition coil control (-)	58	Camshaft position sensor signal (intake)
47	-	59	-
48	-	60	No. 2 injector control (-)

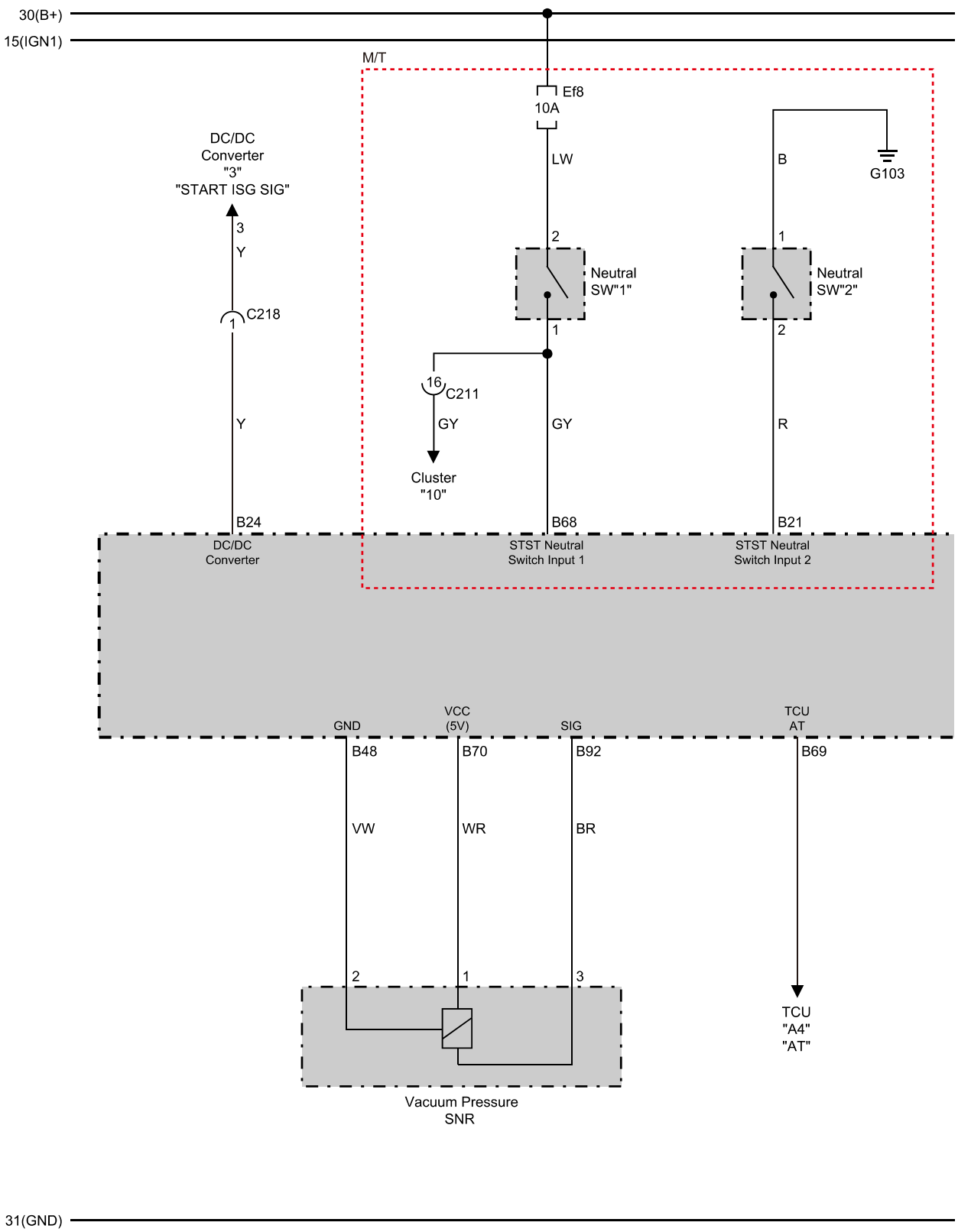
▶ **Connector B**

Pin No.	Function	Pin No.	Function
1	ECU power ground	26	Front oxygen sensor heater control (-)
2	Main relay (B+)	27	Rear oxygen sensor heater control (-)
3	ECU power supply ground (ignition coil)	28	-
4	Main relay (B+)	29	Throttle valve motor (-)
5	ECU logic ground	30	TPS ground
6	B+	31	TPS signal 2
7	Throttle valve motor (+)	32	-
8	TPS signal 1	33	-
9	Clutch switch power supply (5 V)	34	VIS solenoid valve control (-)
10	-	35	-
11	A/C compressor relay control (-)	36	Canister shut-off valve control (-)
12	Alternator PWM output	37	-
13	-	38	PCSV control (-)
14	-	39	Fuel tank pressure sensor ground
15	-	40	Fuel tank pressure sensor signal
16	-	41	Clutch switch ground
17	-	42	ISG OFF switch signal
18	TPS power supply (5 V)	43	Refrigerant pressure sensor ground
19	-	44	Cruise control switch ground
20	-	45	-
21	STST neutral switch input 2	46	Clutch switch signal 2 (DOWN)
22	Cruise control switch signal	47	Fuel sender ground
23	VOP solenoid valve control (-)	48	ISG brake vacuum sensor ground
24	DC/DC converter	49	No. 1 accelerator pedal sensor ground
25	Fuel sender signal	50	No. 2 accelerator pedal sensor ground

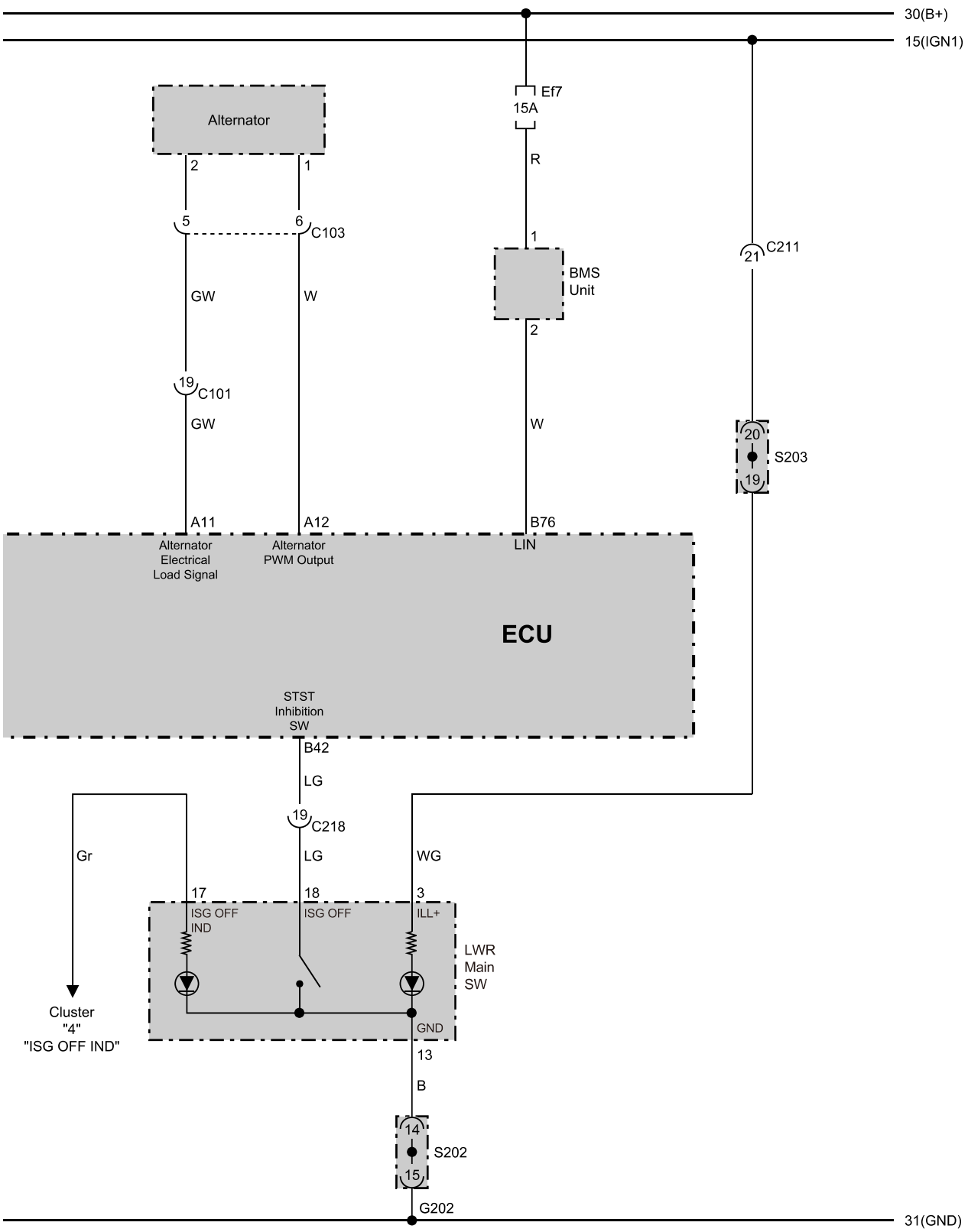
Pin No.	Function	Pin No.	Function
51	IGN 1+	73	-
52	Start relay control (-)	74	Main relay control (-)
53	Electric fan relay control high (-)	75	Fuel pump relay control (-)
54	Electric fan relay control low (-)	76	BSC signal (LIN communication)
55	-	77	P-CAN high
56	-	78	P-CAN low
57	-	79	Clutch switch signal 1 (UP)
58	-	80	Vehicle speed signal
59	-	81	-
60	-	82	Start relay control (+)
61	-	83	-
62	Brake switch signal (test)	84	Brake switch signal
63	-	85	Intake OCV control (-)
64	-	86	Exhaust OCV control (-)
65	Refrigerant pressure sensor power supply (5 V)	87	Refrigerant pressure sensor signal
66	Cruise control switch power supply (5 V)	88	-
67	-	89	Fuel tank pressure sensor power supply (5 V)
68	STST neutral switch input 1	90	A/C switch ON signal
69	-	91	-
70	ISG brake vacuum sensor voltage (5 V)	92	ISG brake vacuum sensor signal
71	No. 1 accelerator pedal sensor signal	93	No. 1 accelerator pedal sensor power supply (5 V)
72	No. 2 accelerator pedal sensor signal	94	No. 2 accelerator pedal sensor power supply (5 V)

Memo

4) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	



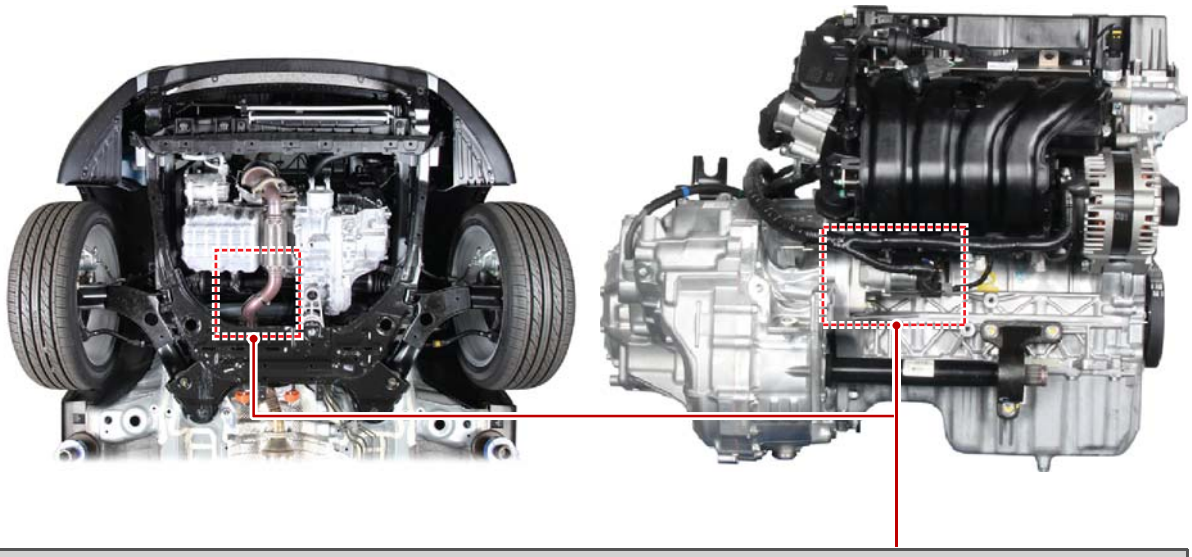
Modification basis	
Application basis	
Affected VIN	

S.G.N.
1462-01 STARTER MOTOR

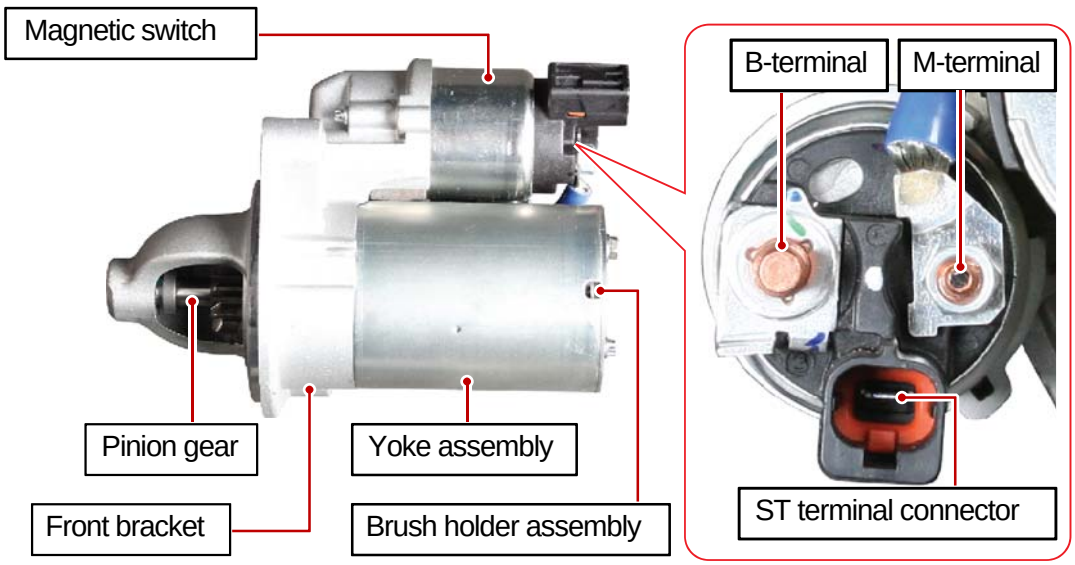
1) Overview

The vehicle with ISG system has the starting motor with improved durability in respect of its power, max. current, lowest speed and etc. to prevent the malfunction caused by the load increase in starting motor due to frequent ignition on/off switching compared to the normal vehicle

2) Mounting Location and Components



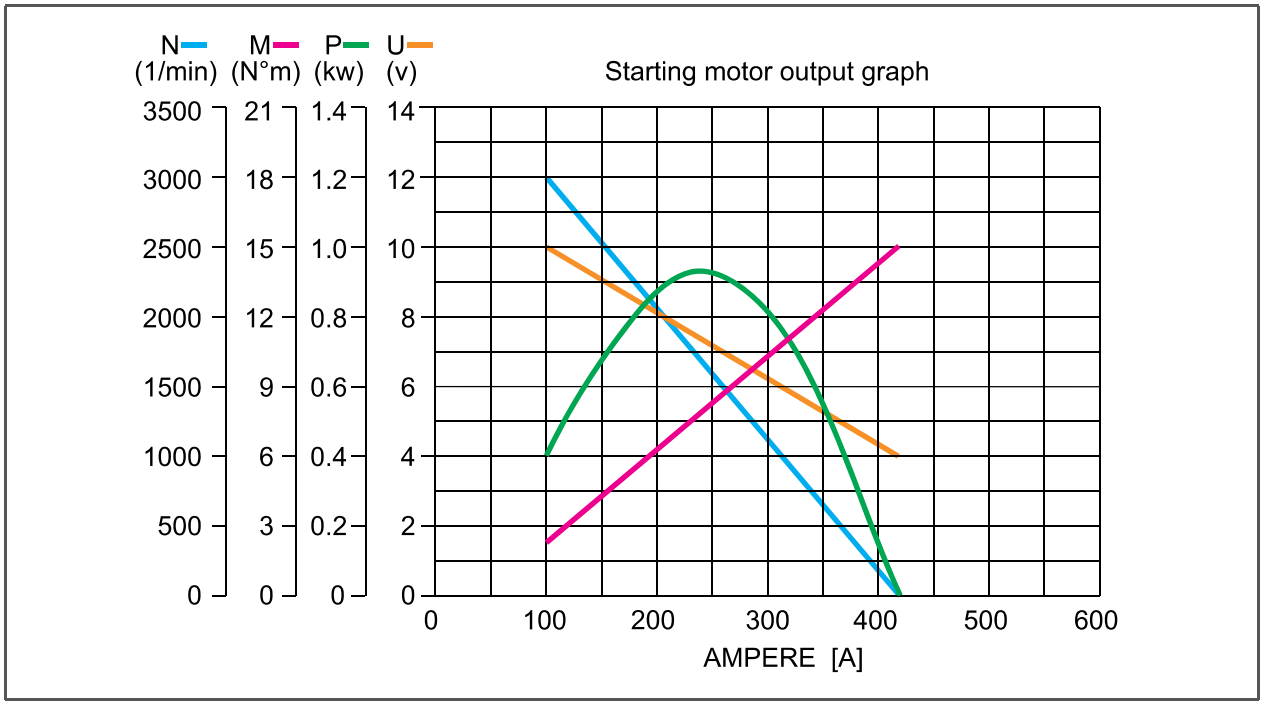
starter motor



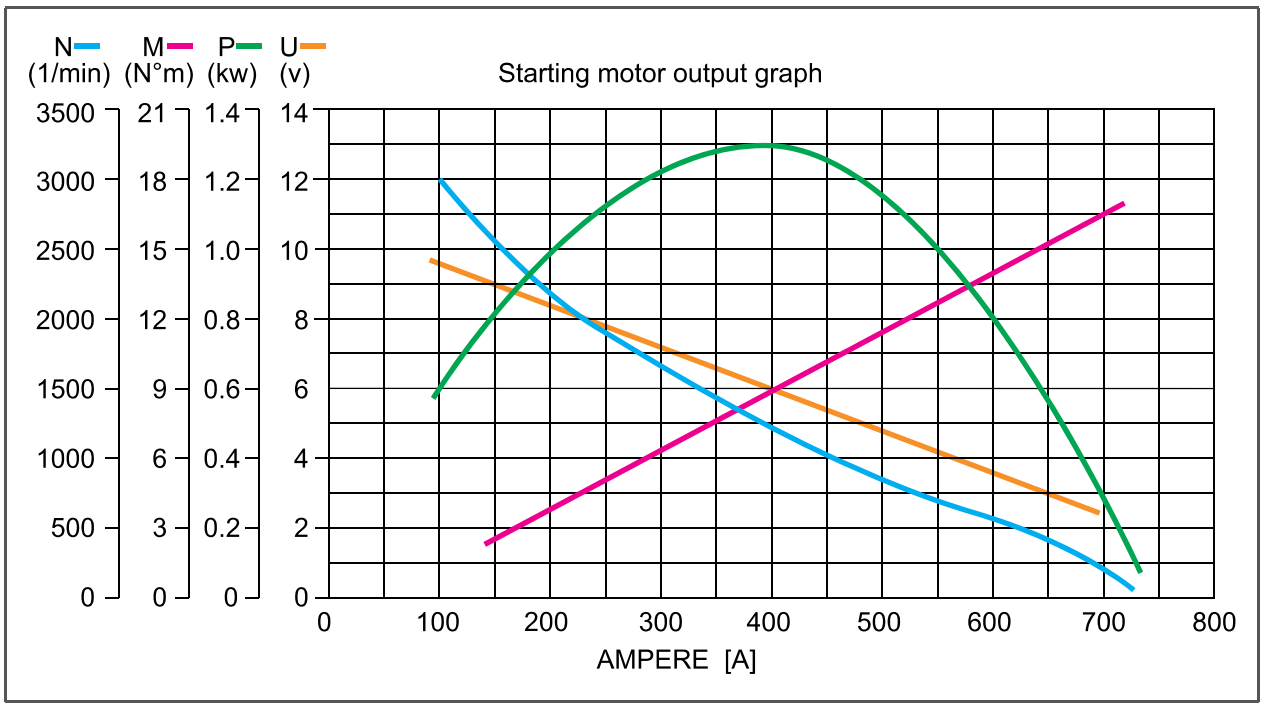
Modification basis	
Application basis	
Affected VIN	

3) starter motor Output

▶ Vehicle without ISG



▶ Vehicle with ISG



Item	Vehicle without ISG	Vehicle with ISG
Rated voltage	12 V 0.9 kw	12 V 1.4 kw
Solenoid operating voltage (V)	Max. 8V	Max. 8V
Motor output (11.5 V at unloaded)	Max. 85A/min. 3,300 rpm	Max. 100 A/min. 3,400 rpm
Motor output (8.0 V under load)	200 A (min. 3.7 Nm)/min. 1,640 rpm	370 A (min. 7.6 Nm)/min. 1,300 rpm
Weight	2.0kg	3.3kg

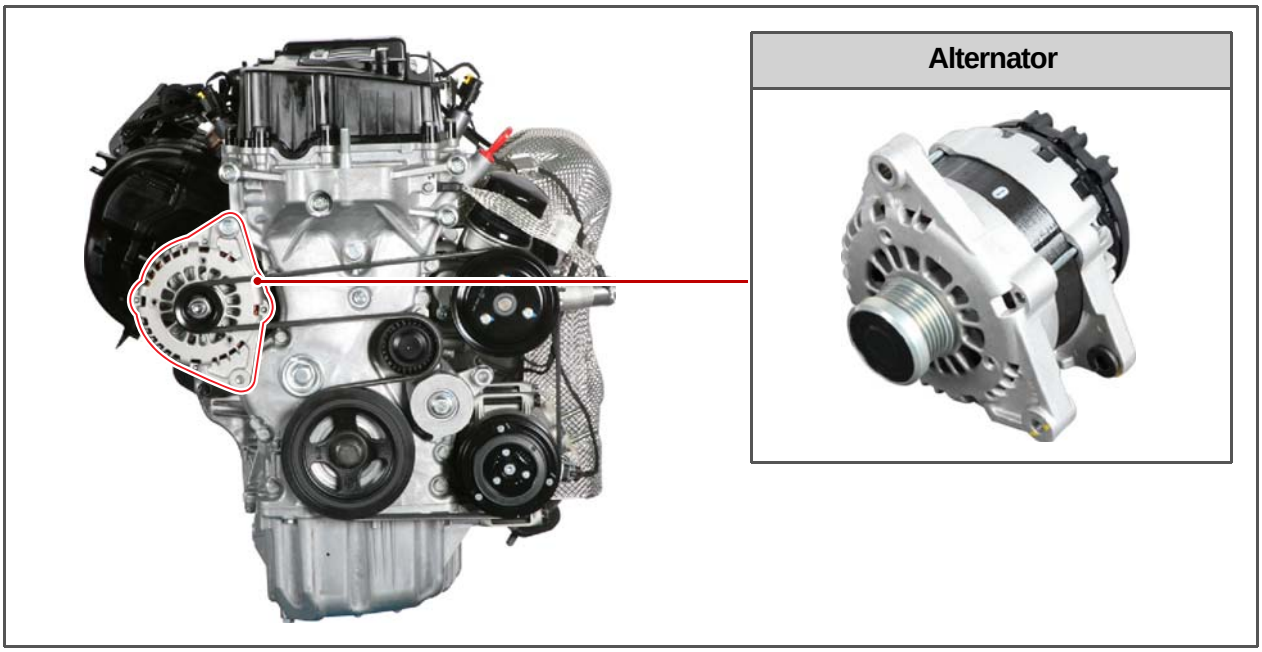
Modification basis	
Application basis	
Affected VIN	

S.G.N.
1452-01 ALTERNATOR

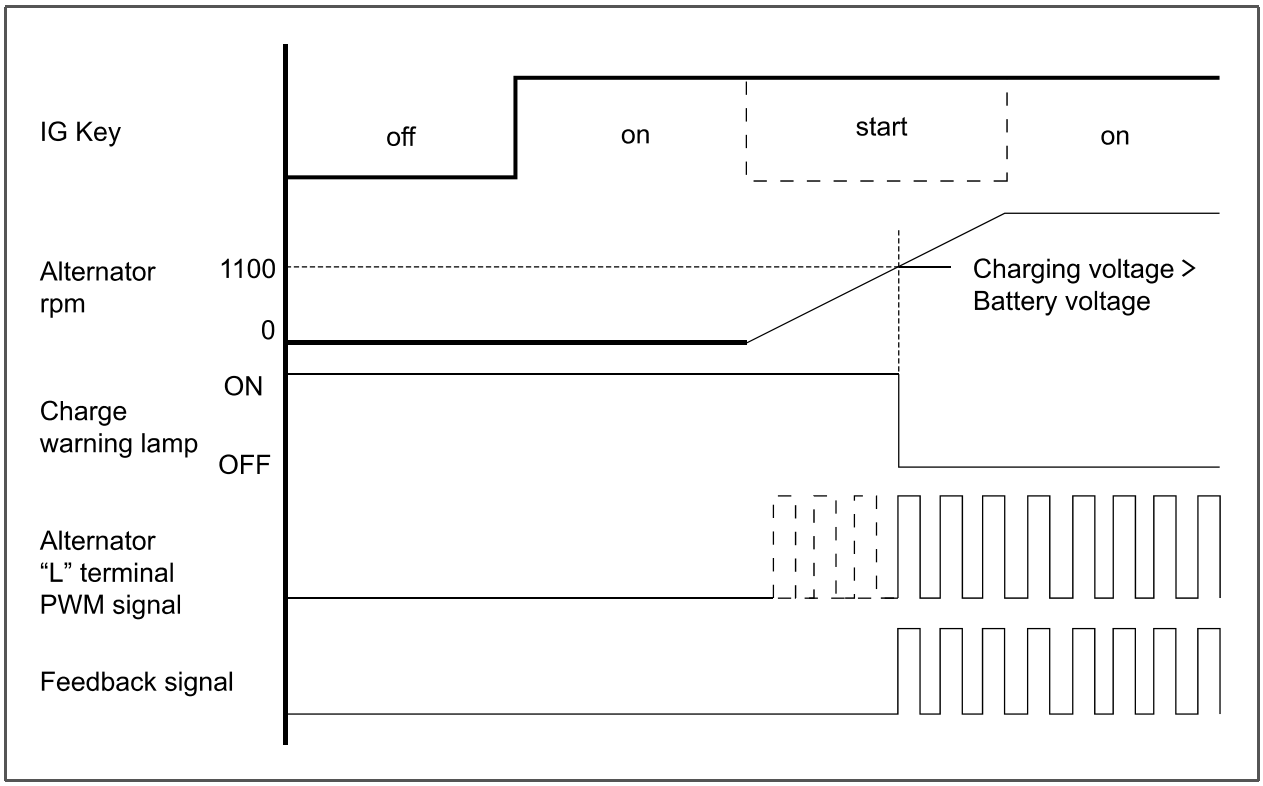
1) Overview

For the vehicle with ISG, the alternator variably controls the charging voltage in the range of 11 V to 15.5 V by using engine ECU. It charges the battery with the fixed voltage of 14.3V when the headlamp is ON, blower motor is operating, rear heated glass is operating or wiper is operating. To prevent under charging and over charging, it charges the battery with 13.6 V in the duty range of 1% to 9% and 91% to 99%. And, it charges the battery with the fixed voltage of 13.8 V in fail-safe mode when the "L" terminal circuit is open or short.

2) Mounting Location and Components

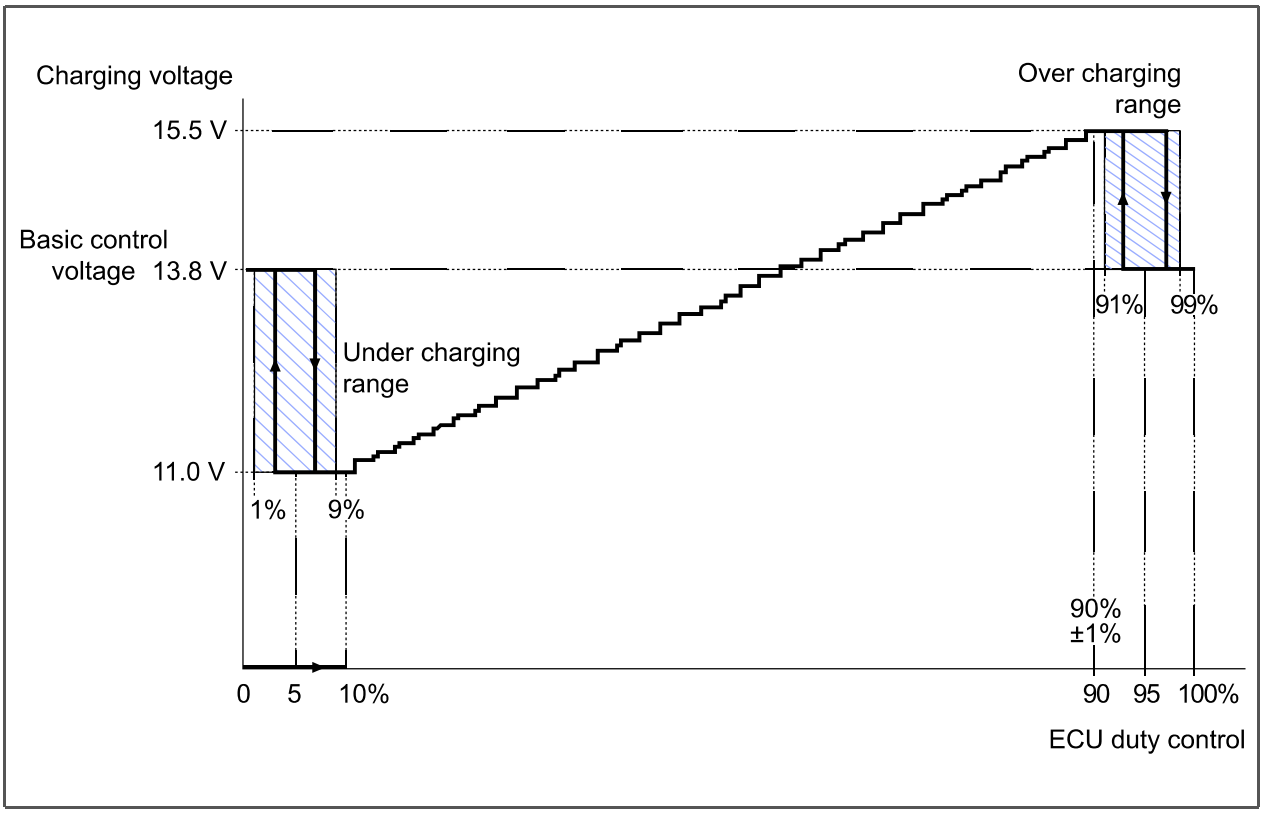


▶ **Initial Generation**



Modification basis	
Application basis	
Affected VIN	

▶ PWM duty value according to charging voltage



The graph above shows the output characteristics of generating voltage according to the increment of ECU duty value. The battery is charged with 13.8 V, with duty control, in under charging range of 1% to 9% and in over charging range of 91% to 99%.
ECU controls the charging voltage in the range of 11 V to 15.5 V with 5% to 95% PWM duty signal through "L" terminal. It controls the charging voltage at fixed value of 14.3 V when electric load is applied (headlamp is ON, blower motor is operating, rear heated glass is operating or wiper is operating).
And, it charges the battery with the fixed voltage of 13.8 V (0~5% and 95~100% of duty range) in fail-safe mode when the "L" terminal circuit is open or short.

▶ Connector

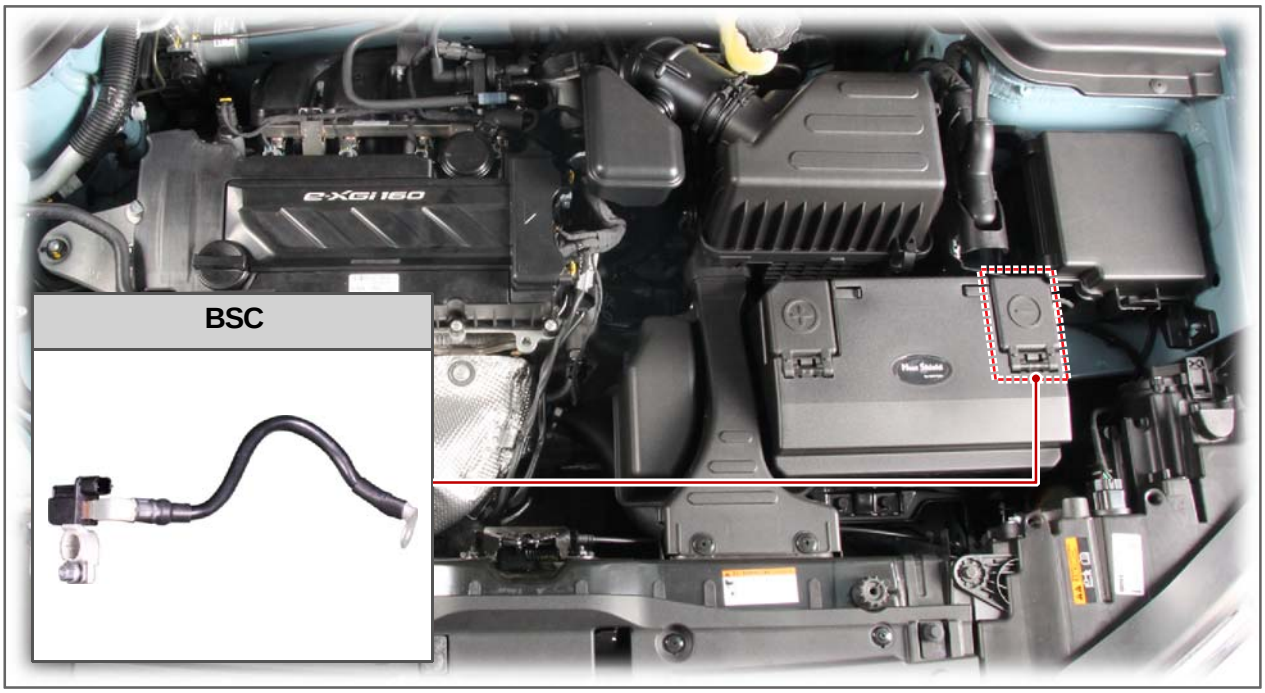
Pin No.	Function
1	L (PWM signal)
2	F (Feedback)

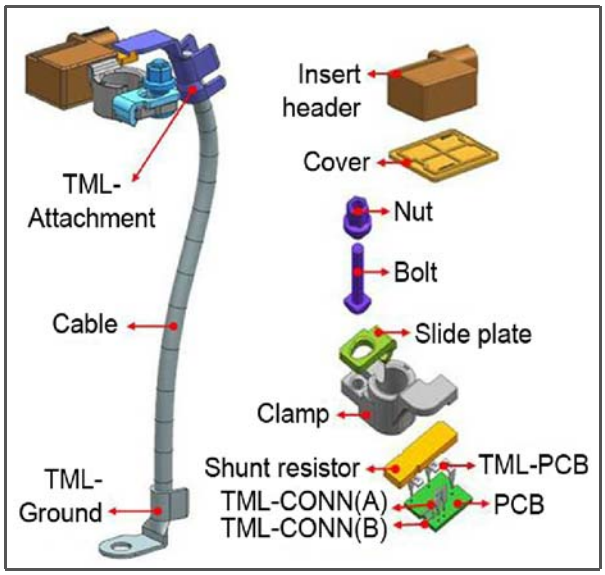
S.G.N.
2610-10 BSC (BATTERY SENSOR CABLE)

1) Overview

For the vehicle with ISG, the battery's state of charge should be checked with care since the frequent ignition on/off cycles are needed, compared to the normal vehicle. The BSC (Battery Sensor Cable) is fitted on the battery's negative (-) terminal, monitors and sends the information of the battery (voltage, current, temperature, charging status and etc.) to the ECU via the LIN communication, in order to operate the ISG (Idle Stop & Go) system and EEM (Energy Efficiency Management).

2) Mounting Location and Components



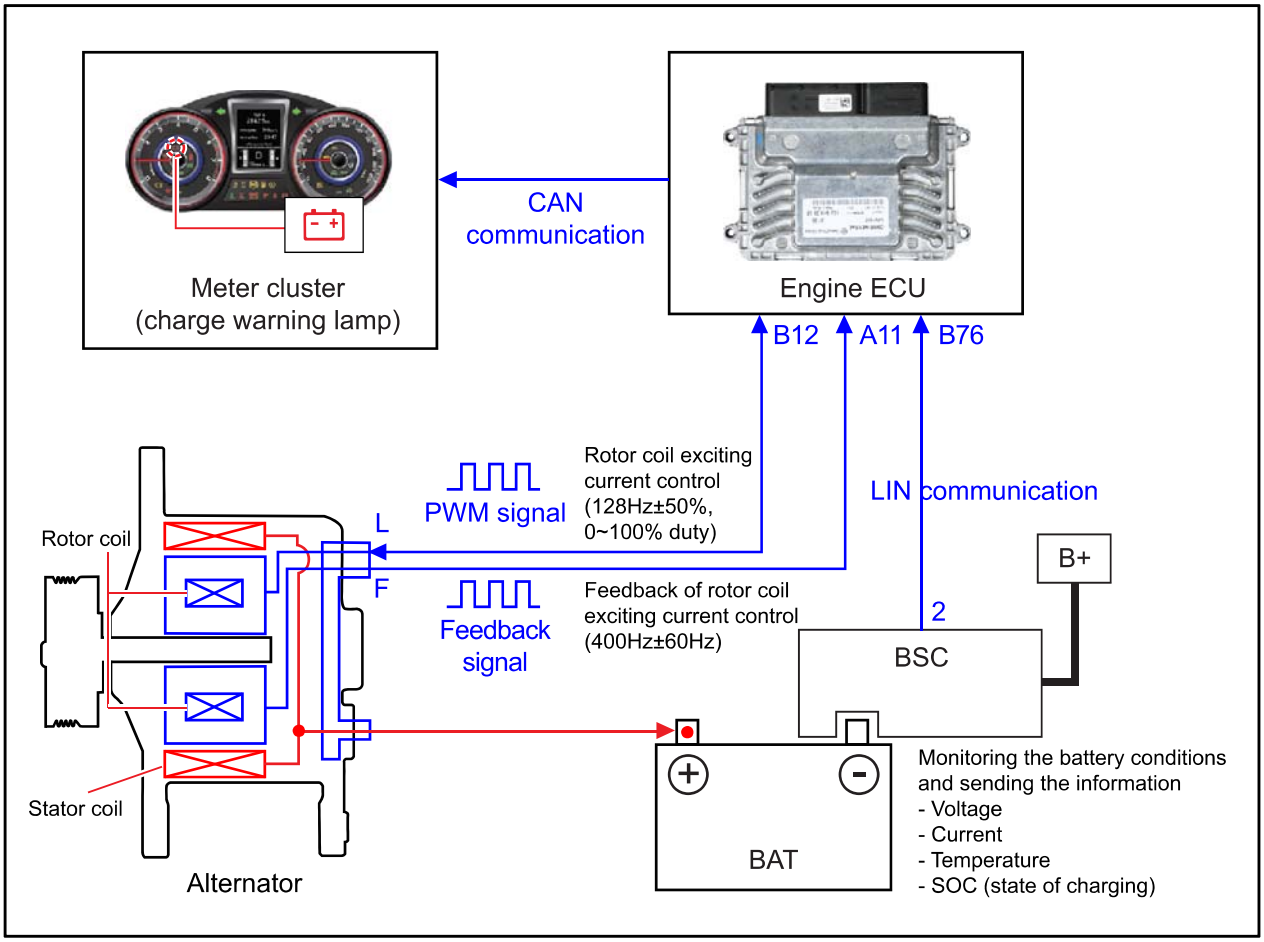


Pin No.	Function
1	B+
2	LIN communication

Modification basis	
Application basis	
Affected VIN	

3) Operating Process of BSC

The ECU monitors the vehicle's electrical load and battery charge status to control the generating voltage.
The BSC fitted to the battery's negative (-) terminal monitors the battery status information (voltage, current, temperature, SOC) and sends it to the engine ECU via LIN communication. The ECU outputs the generating control signal (PWM) for the engine load based on the information from the BSC and driving conditions (idle, acceleration, deceleration) to the alternator terminal L.

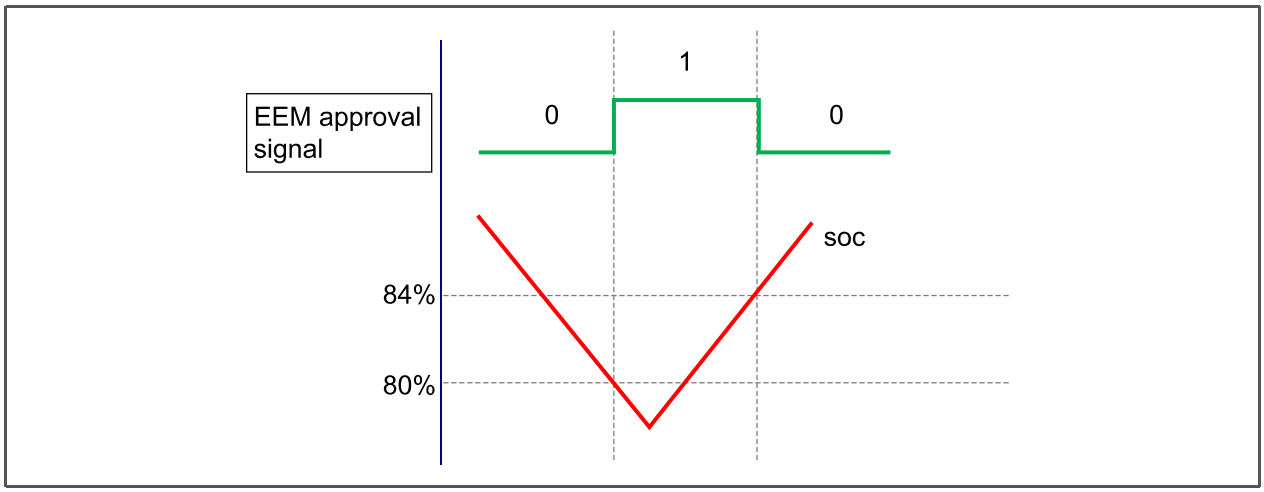


▶ OCV (Open Circuit Voltage)

The OCV is the battery voltage measured with no battery load. There is a correlation between the OCV measured with the battery stabilized and SOC. Therefore, it is possible to predict the SOC based on the OCV. The BSC monitors the voltage measured 3 hours or more after the battery is stabilized without charging/discharging operations.

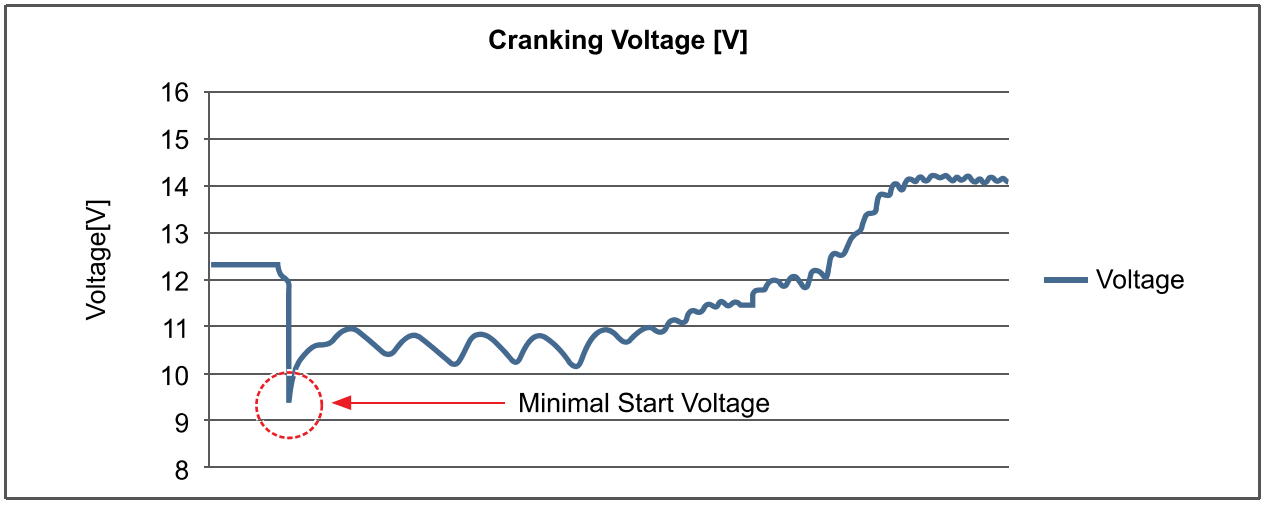
▶ SOC (State of Charge)

EBS outputs "0" when the initial SOC value is over 84% and outputs "1" when it is below 80% (after 10 hours of sleep mode).
If the EEM approval signal is "1", EEM controls the SOC and charging capacity. If it is "0", EEM stops the controlling. (The control function may vary according to the battery conditions and driving conditions)



▶ SOF (State of Function)

The SOF is the cranking minimal start voltage generated at engine start-up as a prediction for the voltage at next start-up. The BSC predicts the next starting voltage taking into account the current starting voltage/current, battery temperature, SOC and SOH (state of health).



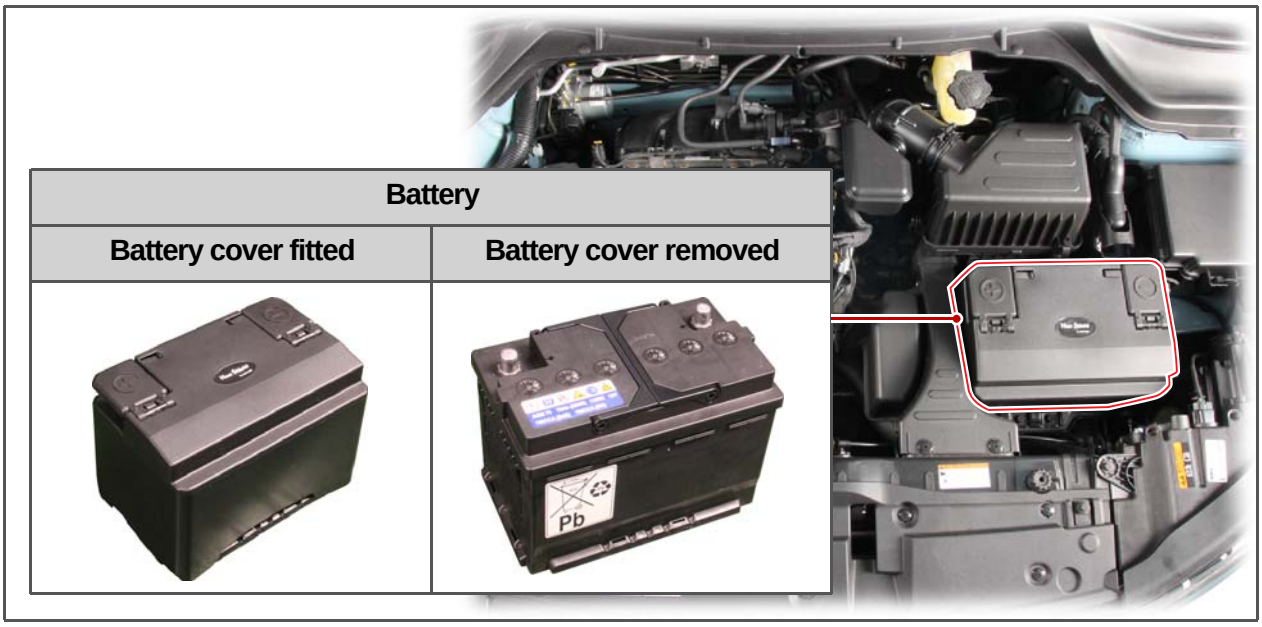
Modification basis	
Application basis	
Affected VIN	

S.G.N.
2610-01 BATTERY

1) Overview

For the vehicle with ISG, the battery's state of charge should be checked with care since the frequent ignition on/off cycles are needed, compared to the normal vehicle. For this reason, these vehicles use the AGM (Absorbent Glass Material) type battery. The AGM battery has an absorbent glass fiber separator in the battery which controls the electrolyte illiquidly by absorbing it and a valve on the top of the battery to minimize the gas emissions. In addition, the battery supplies a stable voltage despite of heavy load due to the frequent charging and discharging.

2) Mounting Location and Components



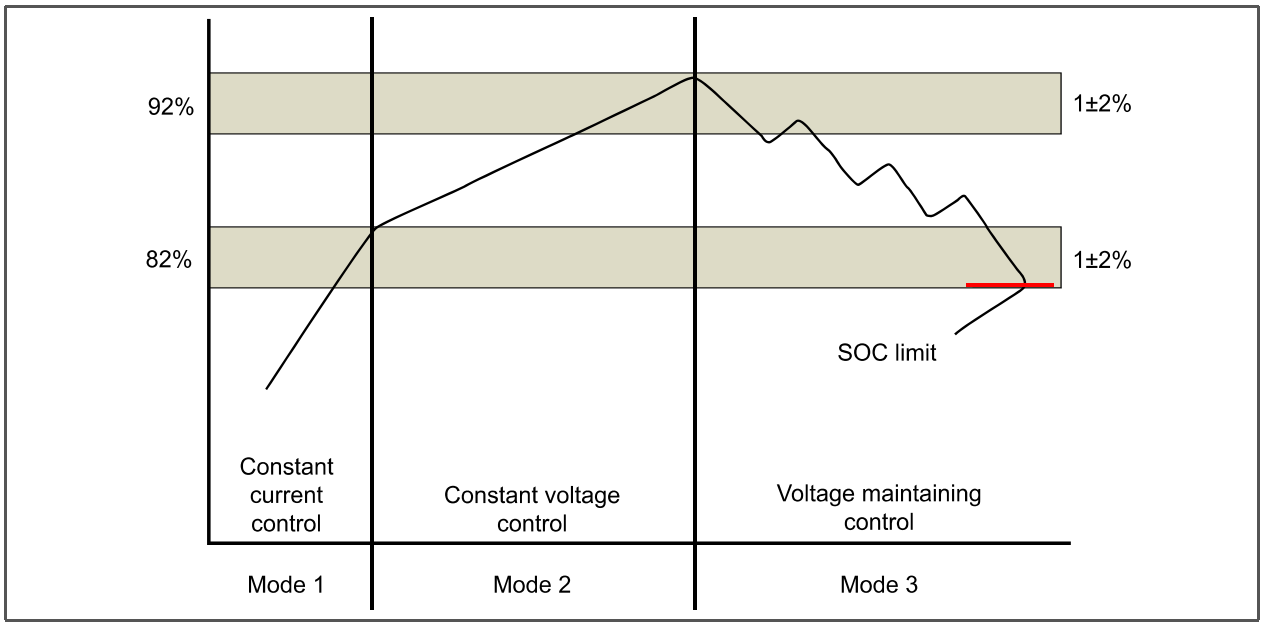
Item	Vehicle without ISG	Vehicle with ISG
Capacity	50 Ah	70 Ah
Type	Maintenance Free	Absorbent Glass Mat Battery
Size (L*W*H)	206 * 175 * 190	278 * 175 * 190
Weight (kg)	13.5 Kg	21 Kg
Reserve Capacity (RC)	80 min	110 min
Cold Cranking Ampere (CCA)	500 A	760 A

3) Operating Process of Battery

▶ SOC management

The battery must be deteriorated as the time goes over.
EEM controls the charging capacity over 80% to provide initial starting. However, if the charging capacity goes below 80%, EEM does not control the voltage generation.

▶ Charging mode



1. **Mode 1 (Constant current control)**
   If the battery charging level is low, the system provides the high constant current to charge the battery rapidly. The system controls the charging current according to the electric load conditions. If the battery temperature increases over 40°C, the charging current is limited by 20 A.

2. **Mode 2 (Constant voltage control)**
   If the battery charging level is in middle range, the battery could be charged slowly when the control voltage is low and the electrolyte could be deteriorated when the control voltage is high. If the electric load increases very rapidly, the battery charging efficiency could be decreased.
   To improve the charging/discharging efficiency and the fuel economy, do not maintain the constant voltage control mode for a long time.

Description		SOC
Initial status	Mode 1	82%
	Mode 2	82 to 92%
	Mode 3	82 to 92%
Target value		94%

Modification basis	
Application basis	
Affected VIN	

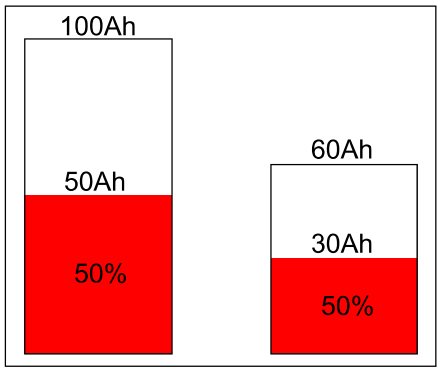
3. **Mode 3 (Voltage maintaining control)**
   If the battery is fully charged, the system tries to keep the current status. In this condition, the system maintains the charging status with low charging voltage.
   If the vehicle is accelerating, the system requires the discharging. The discharging is permitted only when the SOC is over 80%. If the SOC is low (below 80%), the discharge control is not available.

▶ Limitation of charging current according to the temperature

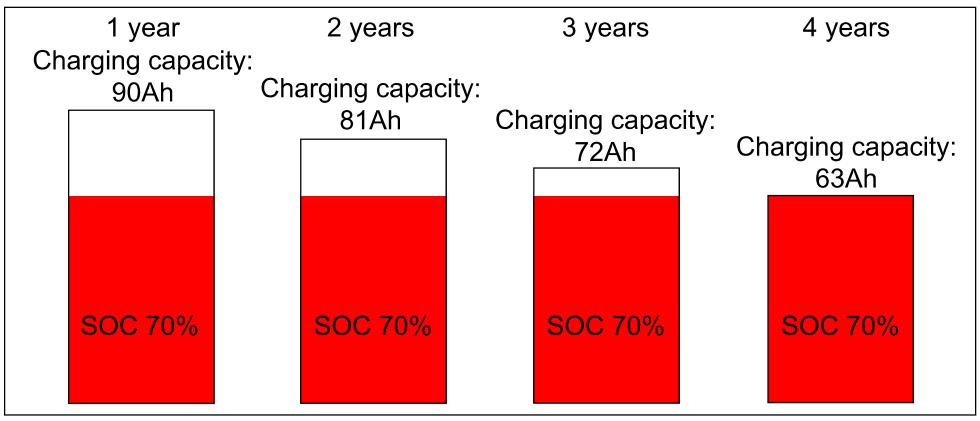
Temperature	Charging		Discharging	
	Current	Time	Current	Time
Below OC	45	No limitation	45	No limitation
0 to 40℃	35		35	
Over 40℃	20		20	

▶ Determination of SOC (State Of Charge)

The charging capacity of battery is decreased as the time goes over.
SOC value is not the calculated value based on charging capacity as shown in the [Figure 1] but the absolute value according to the battery condition as shown in the [Figure 2].



[Figure 1]



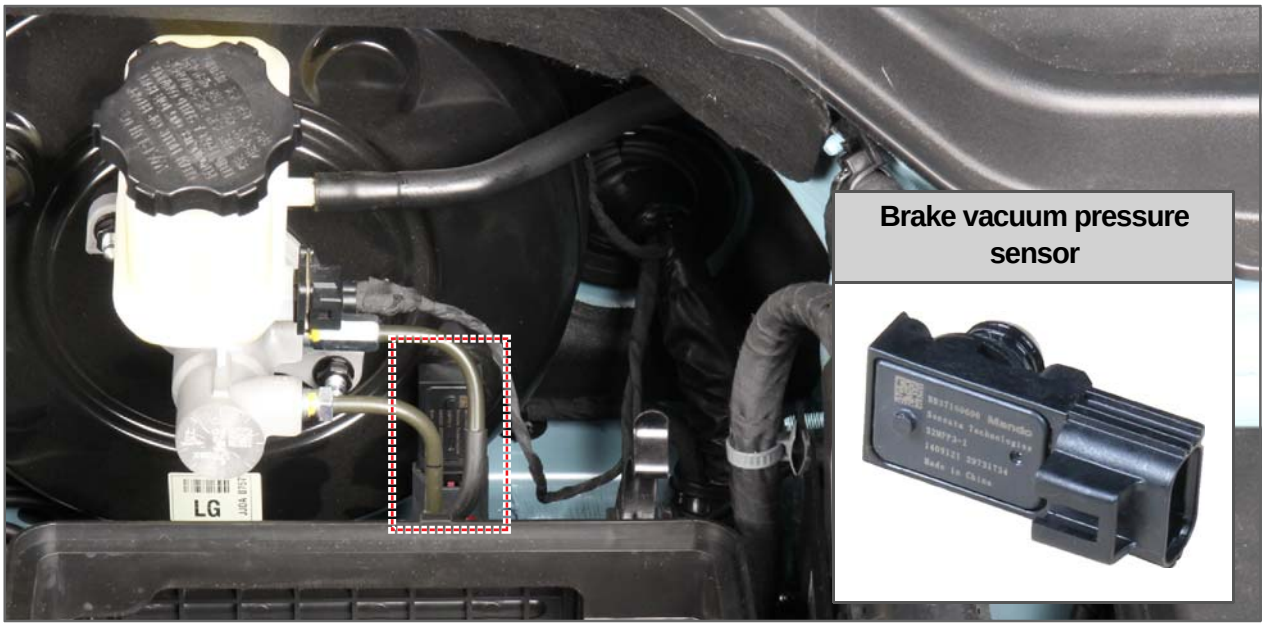
[Figure 2]

S.G.N.
0000-00 BRAKE VACUUM PRESSURE SENSOR

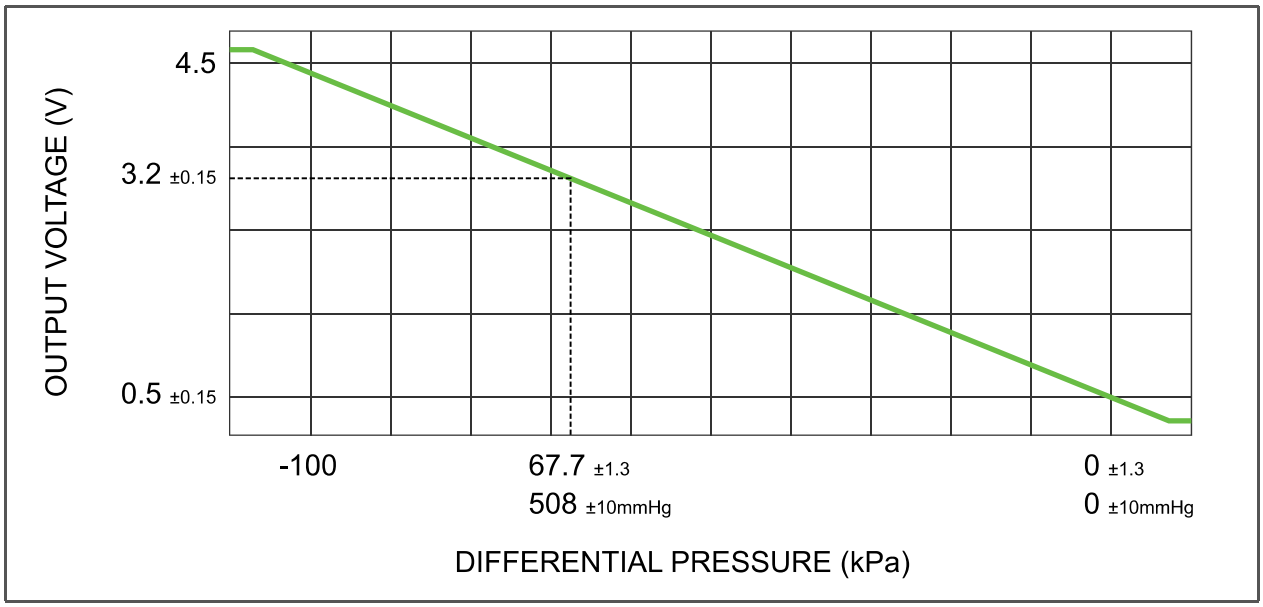
1) Overview

The brake vacuum pressure sensor is fitted to bottom of the brake booster in the vehicle with the ISG. It detects the brake pressure with the ISG system activated, and sends the information to the ECU if the brake negative pressure is low during auto stop. The ECU performs auto start forcedly based on the brake negative pressure information from the brake booster vacuum pressure sensor.

2) Mounting Location and Components



▶ **Characteristics of brake vacuum pressure sensor output**



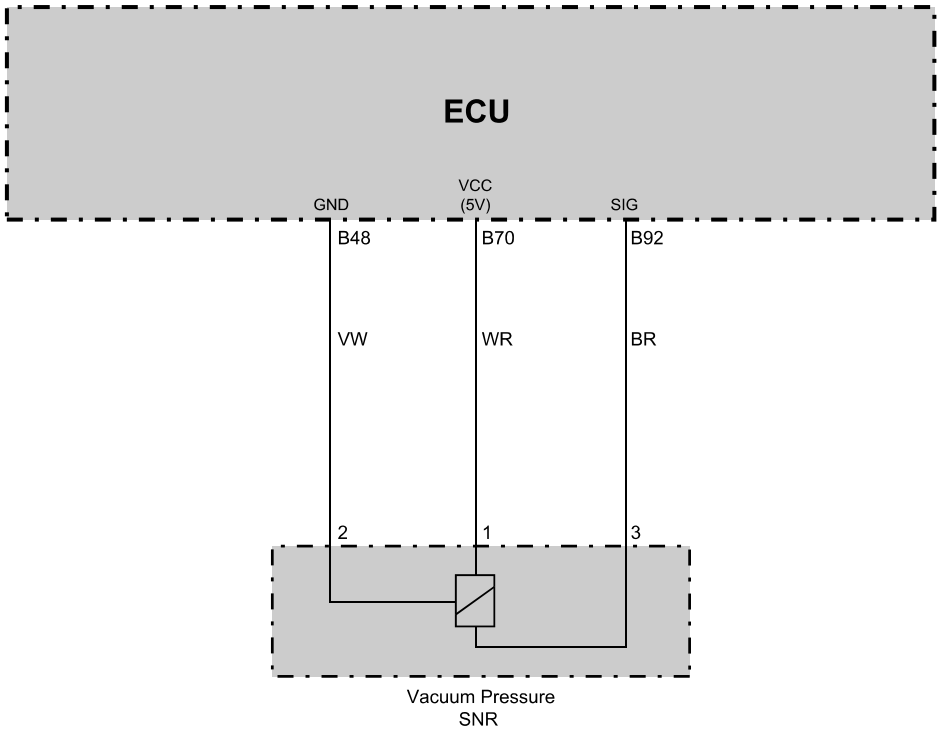
Modification basis	
Application basis	
Affected VIN	

3) Connector

To sensor	To wiring
	

Pin No.	Function
1	Power supply (5 V)
2	Ground
3	Signal

4) Circuit Diagram



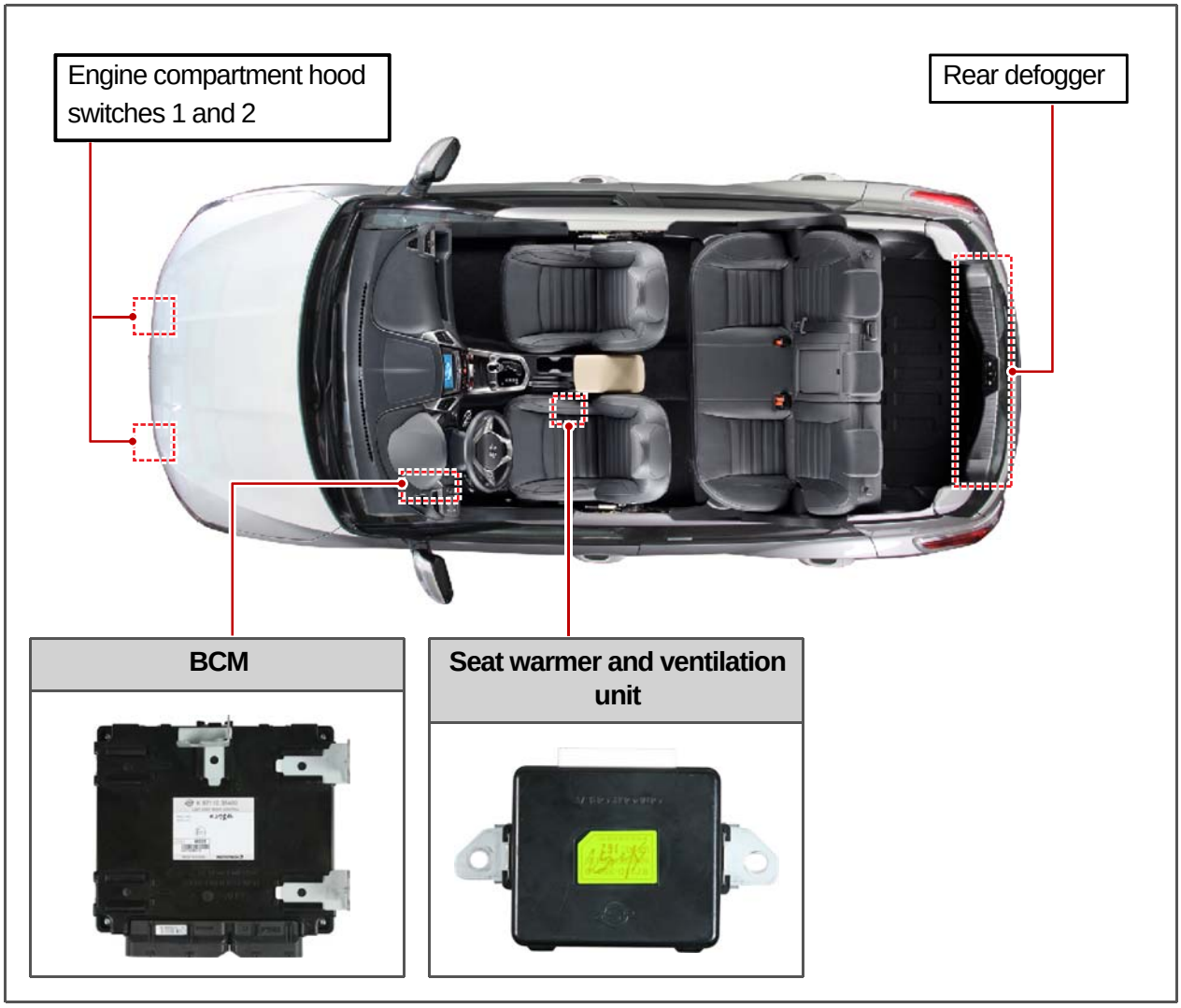
S.G.N. 8710-01

BCM (BODY CONTROL MODULE)

1) Overview

For the vehicle with ISG, the BCM receives the signals from the ISG-related components (engine compartment hood switch, driver door switch and driver seat belt switch). When the ISG system is activated, it controls the wiper and rear defogger to reduce the electrical load and sends the signal to the warmer and ventilation unit to control the seat warmer.

2) Mounting Location and Components



NOTE

The vehicle with ISG has two engine compartment hood switches.

Modification basis	
Application basis	
Affected VIN	

3) Operating Process of BCM

(1) Detecting conditions for operating ISG-related functions

For the vehicle with ISG, the BCM receives the signals from the ISG-related components (engine compartment hood switch, driver door switch and driver seat belt switch). When the driver seat belt is unfastened, driver door or hood is open, ISG (Auto Stop & Start) system does not work. When the driver seat belt is unfastened, driver door or hood is open during auto stop, the auto start will work or driver must use the key for re-starting depending on the conditions.

Condition	Status	Remarks
Engine compartment hood	Open	Key required for re-start when open and closed
Driver door	Open	Auto start available when door closed
Seat belt reminder	Unfastened	Auto start available when fastened

(2) Control ISG-related functions by BCM

▶ **Wiper Control**

- If the ISG Auto Stop signal is received from the ECU during wiper operation, the BCM enters INT fast mode when it was in low/high continuous mode or maintains existing mode when it was in intermittent mode.

	Before ISG Auto Stop	After ISG Auto Stop
Wiper operation	High	Low INT1 (3 sec)
	Low	Low INT1 (3 sec)
	Low INT1 (3 sec)	←
	Low INT2 (7 sec)	
	Low INT3 (11 sec)	
	Low INT4 (15 sec)	
	Low INT5 (19 sec)	

- When the wiper switch is changed during operation above, it operates normally in changed wiper switch mode.
- When the system is changed from ISG Auto Stop to Auto Start, the wiper returns to the existing operation mode.

▶ **Control rear defogger**

- When the BCM receives the ISG Auto Stop signal from the ECU while the rear defogger is in operation, it turns off the rear defogger for 2 minutes and on back.
- At this time, the rear defogger indicator still comes on and operating-time timer also works.

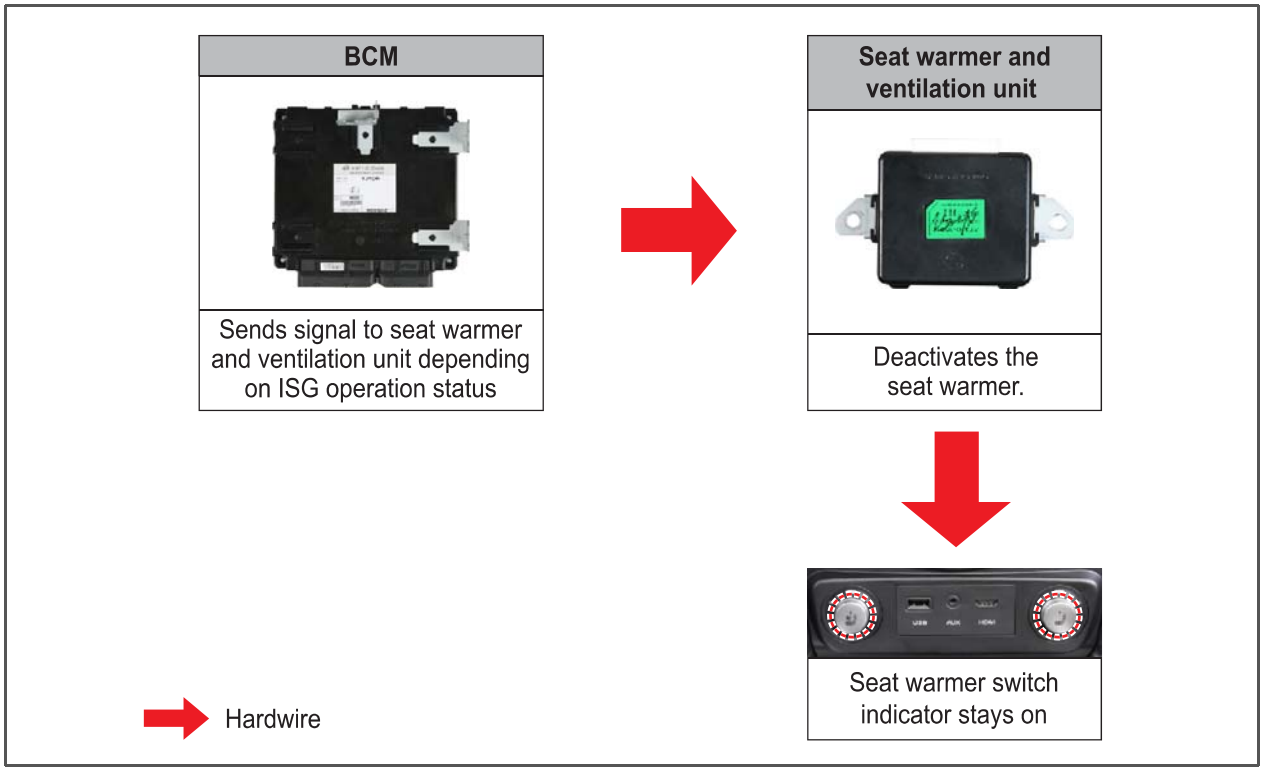
▶ Control seat warmer

When the ISG is activated, the BCM sends the signal to the seat warmer and ventilation unit via the hard wire. Then, the seat warmer and ventilation unit controls the seat warmer.

	Before ISG Auto Stop	After ISG Auto Stop
Operation	ISG enable switch OFF (ON)	ISG enable switch ON (GND)
	Seat warmer works normally	Deactivates the seat warmer. (seat warmer switch indicator still comes on)

NOTE

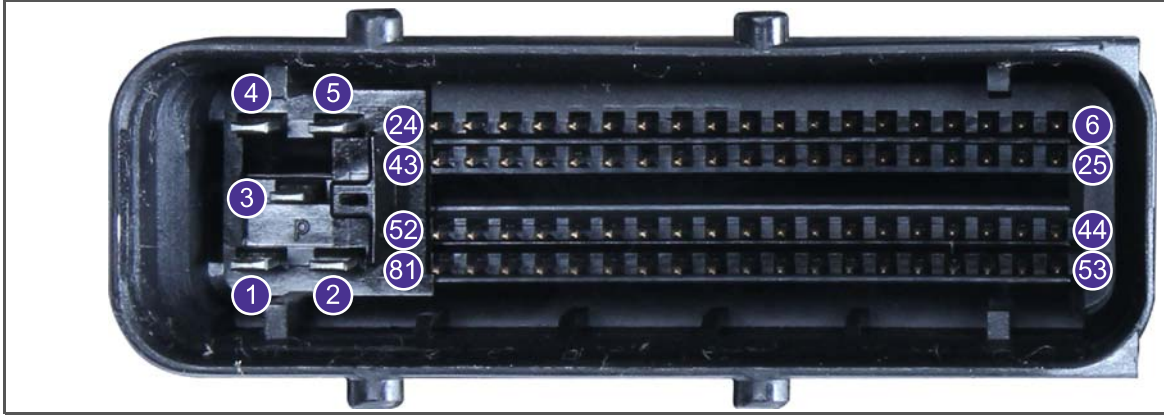
The seat ventilation works normally regardless of the ISG status.



Modification basis	
Application basis	
Affected VIN	

4) BCM Connector

Connector A



No.	Input signal name
1	B+ (BCM logic power)
2	-
3	B+ turn signal power
4	LH turn signal output
5	RH turn signal output
6	B-CAN LOW
7	B-CAN HIGH
8	-
9	Warning horn relay
10	Key hole illumination
11	-
12	Headlamp relay (+)
13	Front PAS ON/OFF indicator
14	-
15	Rear RH seat belt indicator
16	-
17	Rear CTR seat belt indicator
18	Rear heating element (defogger) indicator
19	-
20	Rear LH seat belt indicator

No.	Input signal
21	-
22	External buzzer
23	Immobilizer signal (-)
24	Immobilizer signal (+)
25	ISG mode output
26	-
27	-
28	Tail lamp switch
29	Rear CTR seat belt switch (-) input
30	Rear RH seat belt switch (-) input
31	RH turn signal switch (-) input
32	LH turn signal switch (-) input
33	-
34	Passenger door lock switch (-) input
35	Driver door lock switch (-) input
36	Rear LH door ajar switch (-) input
37	Passenger door ajar switch (-) input
38	Driver door ajar switch (-) input
39	Hood switch (-) input
40	Tailgate switch (-) input

Modification basis	
Application basis	
Affected VIN	

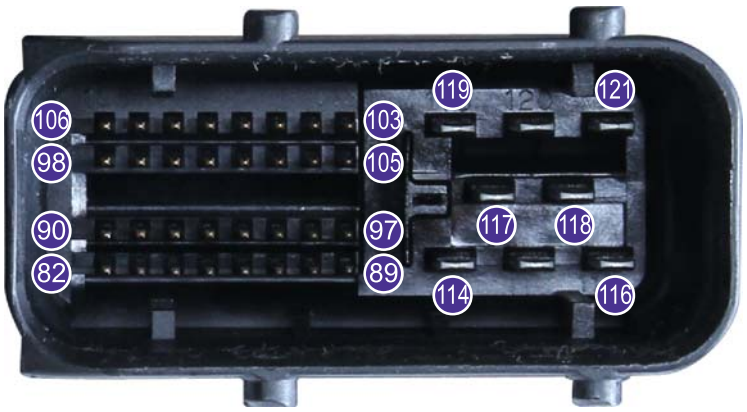
Connector A

No.	Input signal name
41	Rear RH door ajar switch (-) input
42	Unfolding switch (-) input
43	Folding switch (-) input
44	-
45	-
46	-
47	-
48	-
49	-
50	Front wiper intermittent volume
51	Passenger seat belt sensor
52	Headlamp feedback signal
53	Rear LH/RH lock switch (-) input
54	Crash signal
55	Sunroof open switch
56	Rear heating element (defogger) switch
57	Front PAS ON/OFF switch
58	Key hole illumination voltage
59	Central door LOCK/UNLOCK switch
60	Tailgate open switch

No.	Input signal
61	Hazard warning lamp switch
62	Headlamp passing switch
63	PAS_LIN communication
64	Rain sensor_LIN communication
65	Auto light switch (-) input
66	Rear fog lamp switch (-)
67	Driver seat belt switch (-) input
68	Passenger seat belt switch (-) input
69	Rear LH seat belt switch (-)input
70	Rear wiper motor parking signal
71	Key lock switch (-) input
72	Key unlock switch (-) input
73	Rear intermittent wiper switch
74	-
75	Front wiper motor parking signal
76	Windshield washer switch (-) input
77	Rear washer switch (-) input
78	Rear wiper switch (-) input
79	Wiper switch 1 (-) input
80	Wiper switch 2 (-) input
81	Auto washer switch (-) input

Modification basis	
Application basis	
Affected VIN	

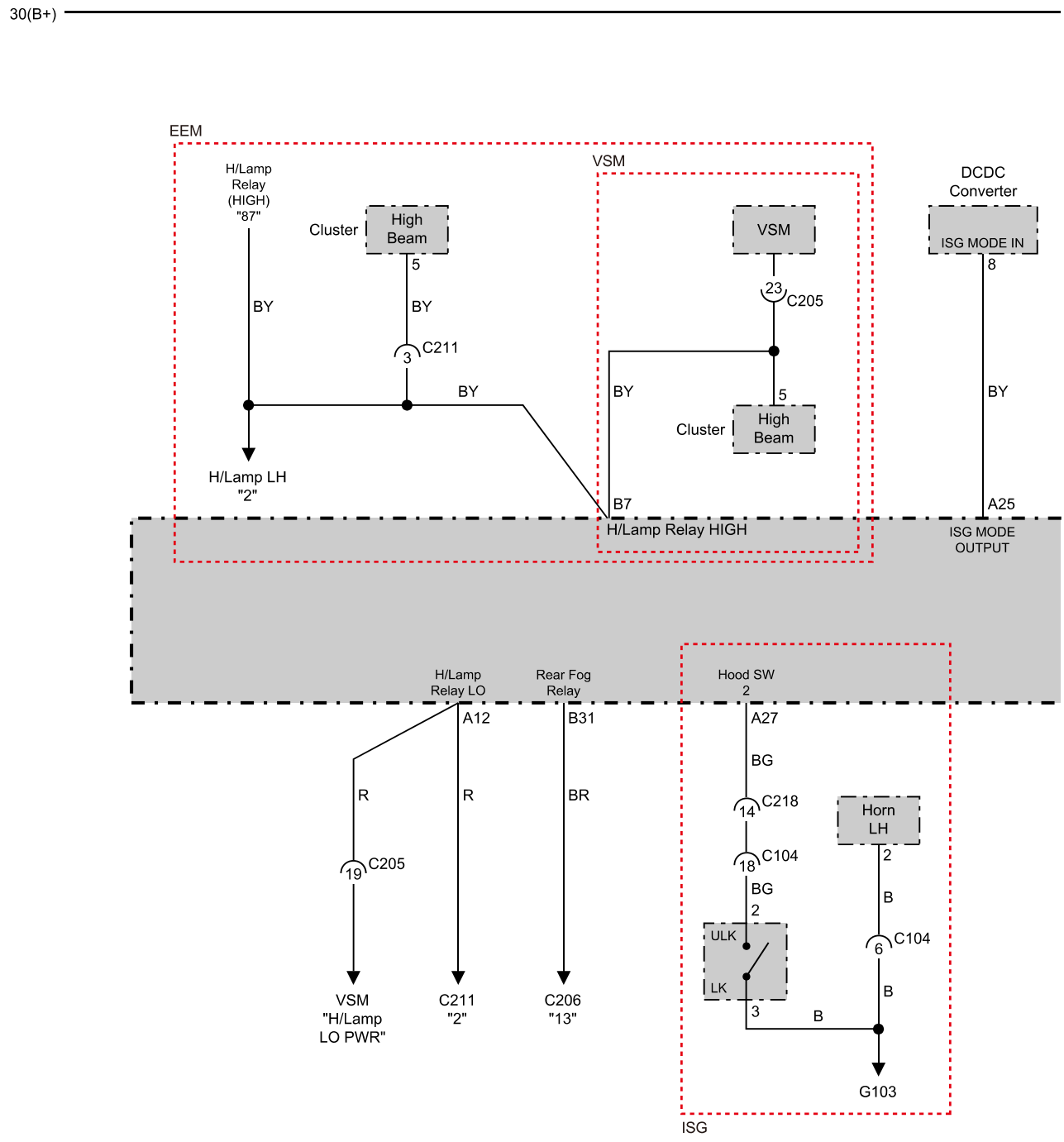
Connector B



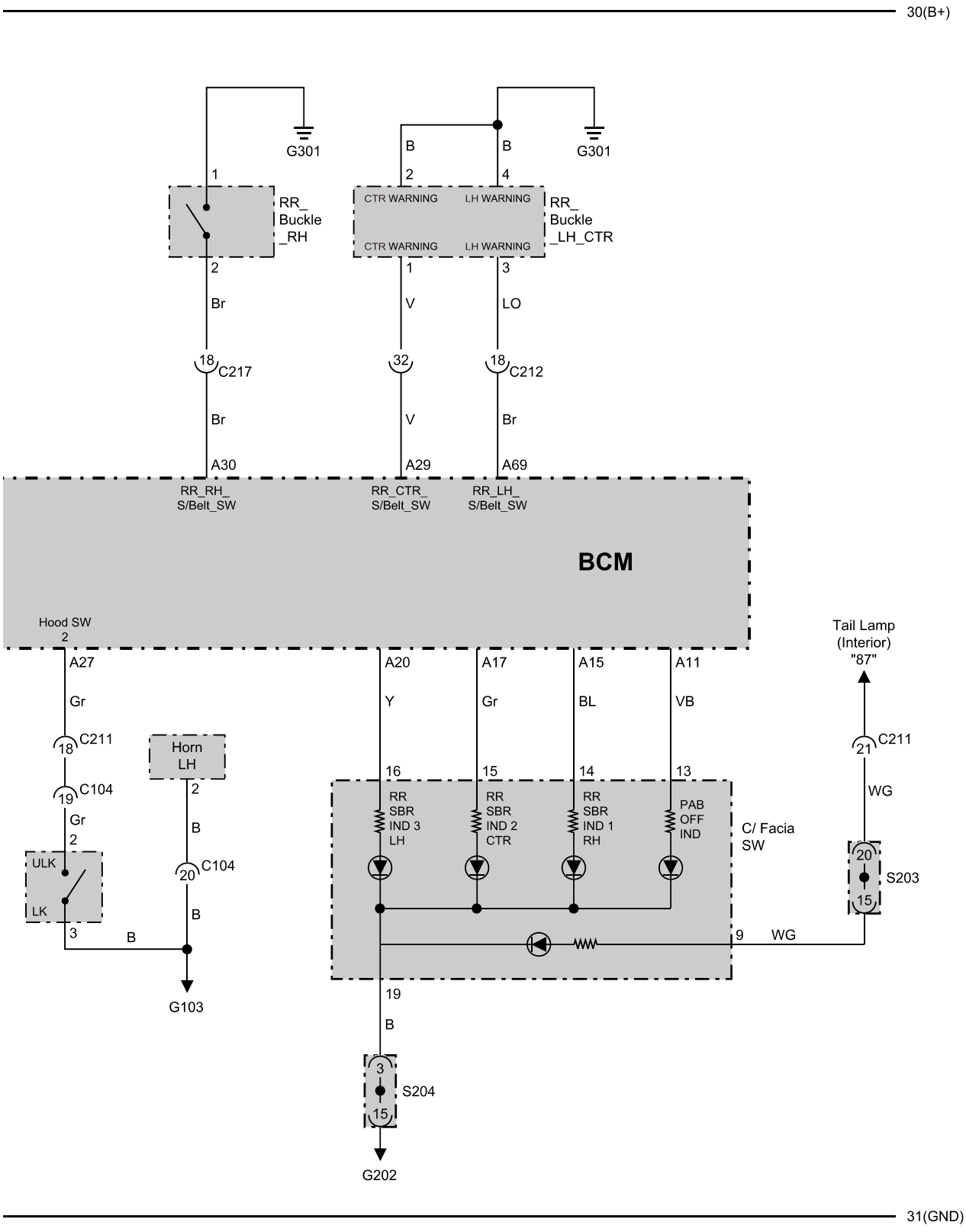
No.	Input signal
82	-
83	IGN2 switch
84	IGN1 switch
85	Key reminder switch
86	Brake switch (+) input
87	Tail lamp relay
88	-
89	Front fog lamp
90	-
91	-
92	Front room lamp control
93	Room lamp control
94	Rear wiper motor relay
95	Rear washer motor relay
96	Tailgate open relay
97	Wiper high relay control
98	Wiper low relay control
99	Power window relay
100	Windshield washer motor relay
101	Rear defog relay control

No.	Input signal
102	-
103	Outside rearview mirror folding relay
104	Door unlock motor relay
105	Headlamp relay (-)
106	P-CAN LOW
107	P-CAN HIGH
108	-
109	Door lock motor relay
110	Tail lamp relay control
111	-
112	Rear fog lamp relay control
113	Outside rearview mirror unfolding relay
114	Ground (BCM logic)
115	Ground (power 2)
116	B+ (brake switch power)
117	Ground (lamp power)
118	Ground (power 1)
119	B+ (DRL power)
120	DRL lamp
121	Brake lamp

5) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	



31(GND)

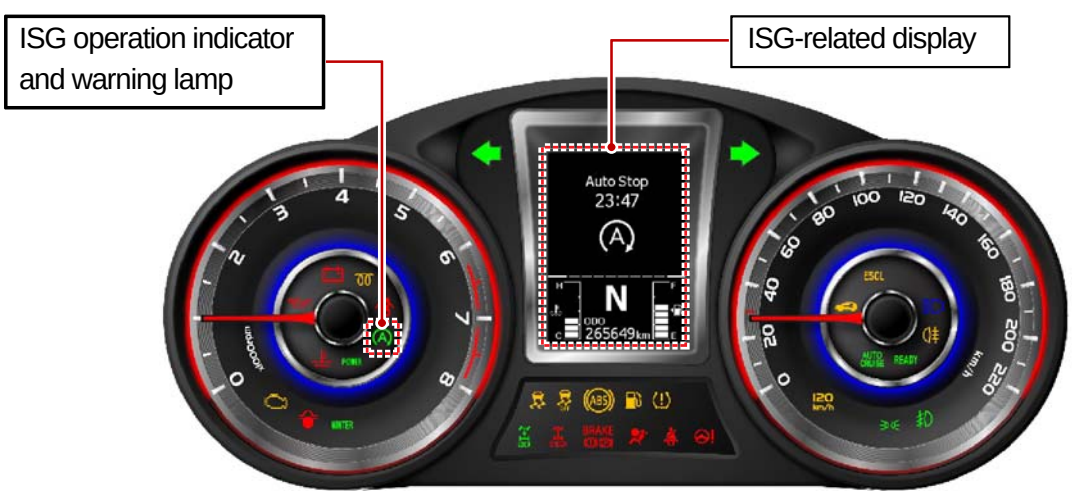
Modification basis	
Application basis	
Affected VIN	

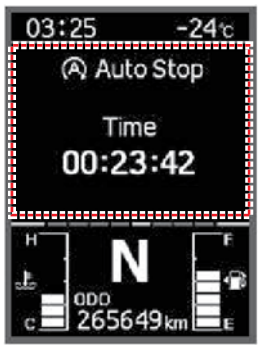
S.G.N.
8010-01 INSTRUMENT CLUSTER

1) Overview

For the vehicle with ISG, the instrument cluster has the different indicators, warning lamps and displays in which the driver can check the operating status and malfunction of the ISG. The instrument cluster sends the data required to operate the ISG to the ECU via CAN communication.

2) Mounting Location and Components



ISG operation indicator		Illuminated when auto start and auto stop of ISG system activated
ISG warning lamp		Illuminated in the event of ISG system malfunction
		ISG-related display is highlighted when ISG operates or malfunctions. Accumulated ISG operation time can be checked at display trip Auto Stop mode. Press the SET button for 1 second or more to reset the time.

Modification basis	
Application basis	
Affected VIN	

▶ ISG-related display

Display	Description
	The message is displayed when the ISG system's auto stop (automatic engine shutdown) is activated.
	The message is displayed when the ISG system's auto start (automatic engine restart) is activated.
	The message is displayed for about 5 seconds when you press the ISG OFF switch to turn the system off.
	The message is displayed when the ISG system operating conditions are not met.
	The message is displayed when the ISG system is deactivated.
	The message is displayed for about 5 seconds if the system check-up is required since the ISG system is malfunctioning.

NOTE

Priorities of ISG system messages

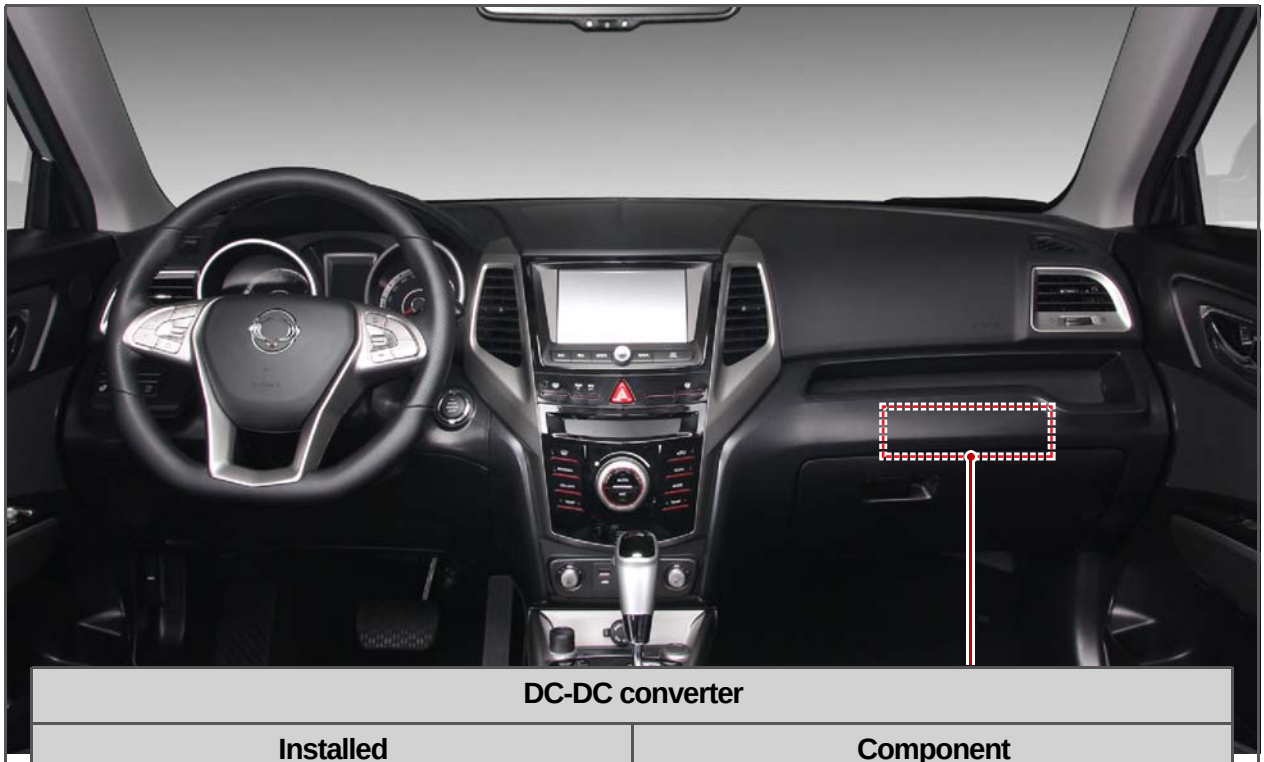
ISG system malfunction → ISG system deactivated → ISG system operating conditions not met → ISG system off → ISG START → ISG STOP

S.G.N.
0000-00 DC-DC CONVERTER

1) Overview

The DC-DC converter is fitted on the inside of the instrument panel glove box assembly. It maintains the stable voltage by supplying the boosted voltage (12 ± 1 V) for max. 1 second within 0.02 seconds when the voltage of 12 V or lower is applied in it, in order to prevent the audio and instrument cluster from being reset due to the voltage drop when restarting the engine by ISG Auto Start. Therefore, the DC-DC converter should be replaced if the audio system and instrument cluster is turned off due to the voltage drop when restarting the engine by the ISG.

2) Mounting Location and Components

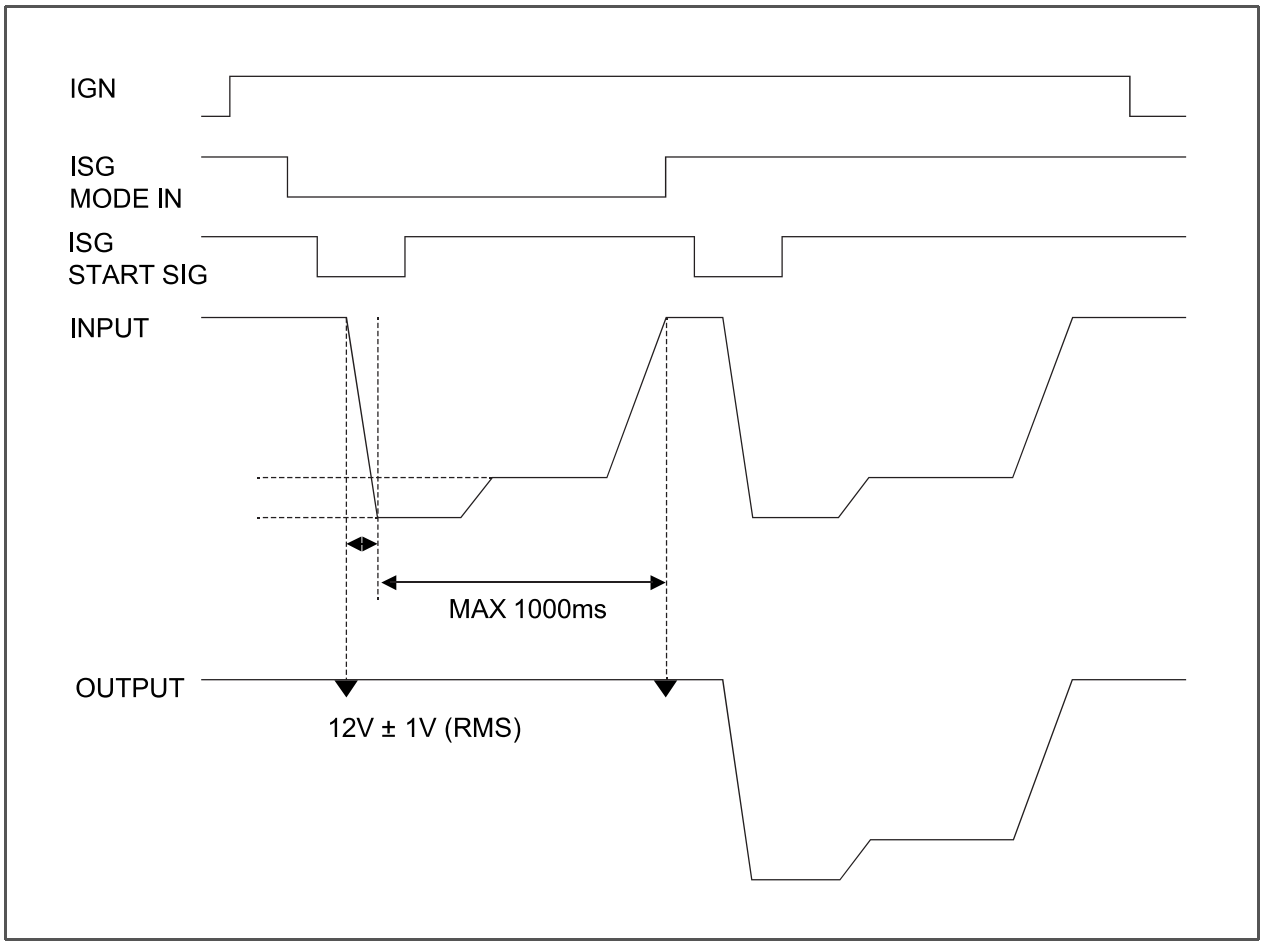


DC-DC converter	
Installed	**Component**
	

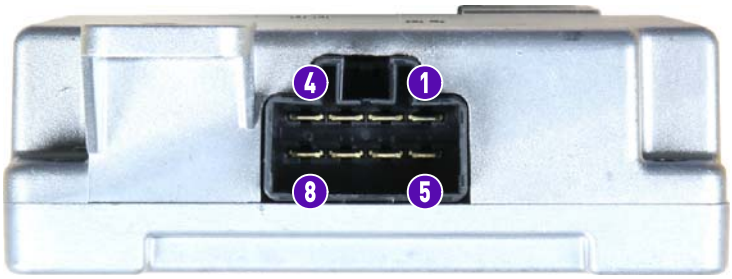
Modification basis	
Application basis	
Affected VIN	

3) Operating Process of DC-DC Converter

1. The INPUT B+ is bypassed and the OUT PUT B+ is outputted with B+ or IGN1 on and ISG switch off.
2. INPUT B+ is detected when the ISG switch is turned on with IGN 1 on. When the voltage drops to 12 V or lower, the system outputs the converting power to compensate for the voltage drop.
   The maximum delay time to convert from bypass output to converting output is within T1 with ISG switch on. Converting output is maintained up to T2(1<s).
   When the INPUT B+ becomes 12 V±1 or higher within T2 (1<s), the system migrates from
3. conversion mode to bypass mode.
   When the INPUT B+ is 12 V or lower and T2 (1<s) elapses, the converting output stops and is
4. converted to bypass output.

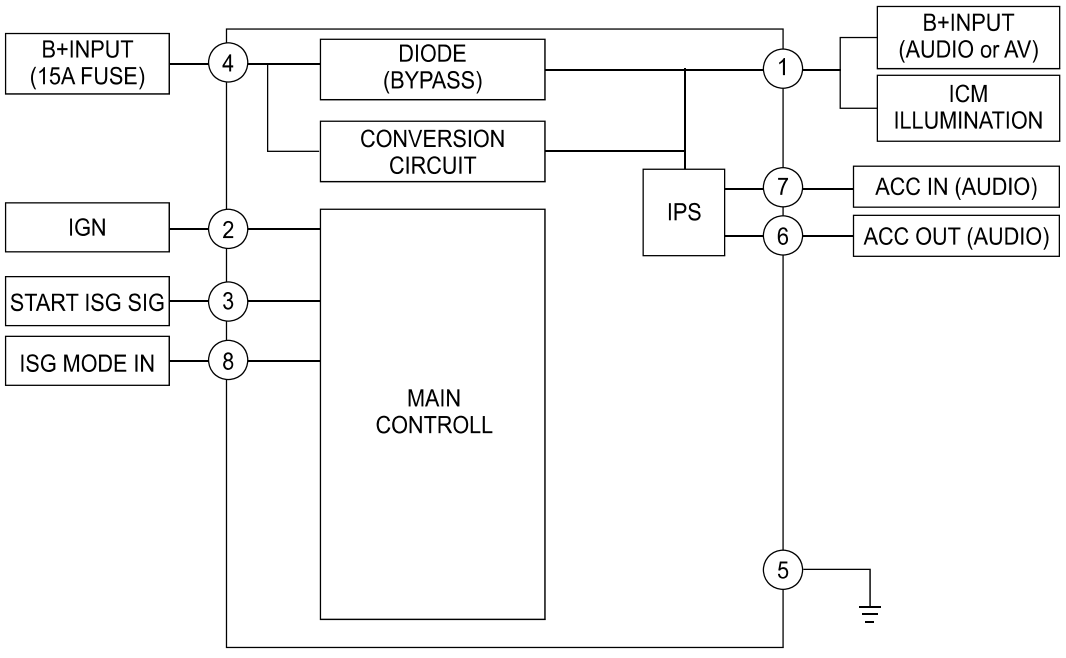


3) Connector



No.	Pin name	Signal definition			
		ON	OFF	FROM	TO
1	B+ OUTPUT	HIGH	LOW	-	AUDIO/AV CLUSTER
2	IGN	HIGH	LOW	IGN SW	-
3	START ISG SIGNAL	GND	OPEN	ECU	-
4	B+ INPUT	HIGH	LOW	B+ (15A FUSE)	-
5	GND	-	-	-	-
6	ACC OUT	LOW	LOW	-	AUDIO ACC
7	ACC IN	HIGH	LOW	ACC SW	-
8	ISG MODE IN	GND	OPEN	BCM	-

4) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

S.G.N.
8510-07 ISG OFF SWITCH

1) Overview

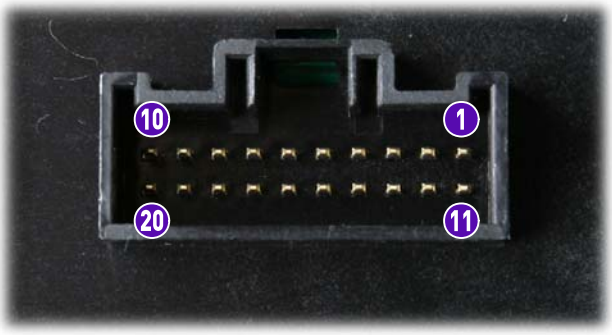
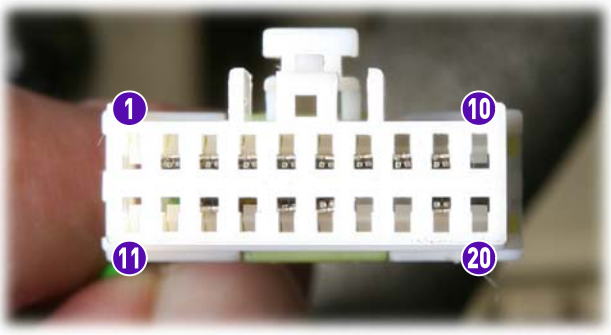
The ISG OFF switch, push-return type, is included in the lower main switch assembly. When the switch is pressed, the message "AUTO STOP System OFF" appears for 5 seconds on the instrument cluster display and the ISG is deactivated.

2) Mounting Location and Components

NOTE

The ISG is not activated when the ISG operating conditions are not met even if the ISG OFF switch is not pressed.

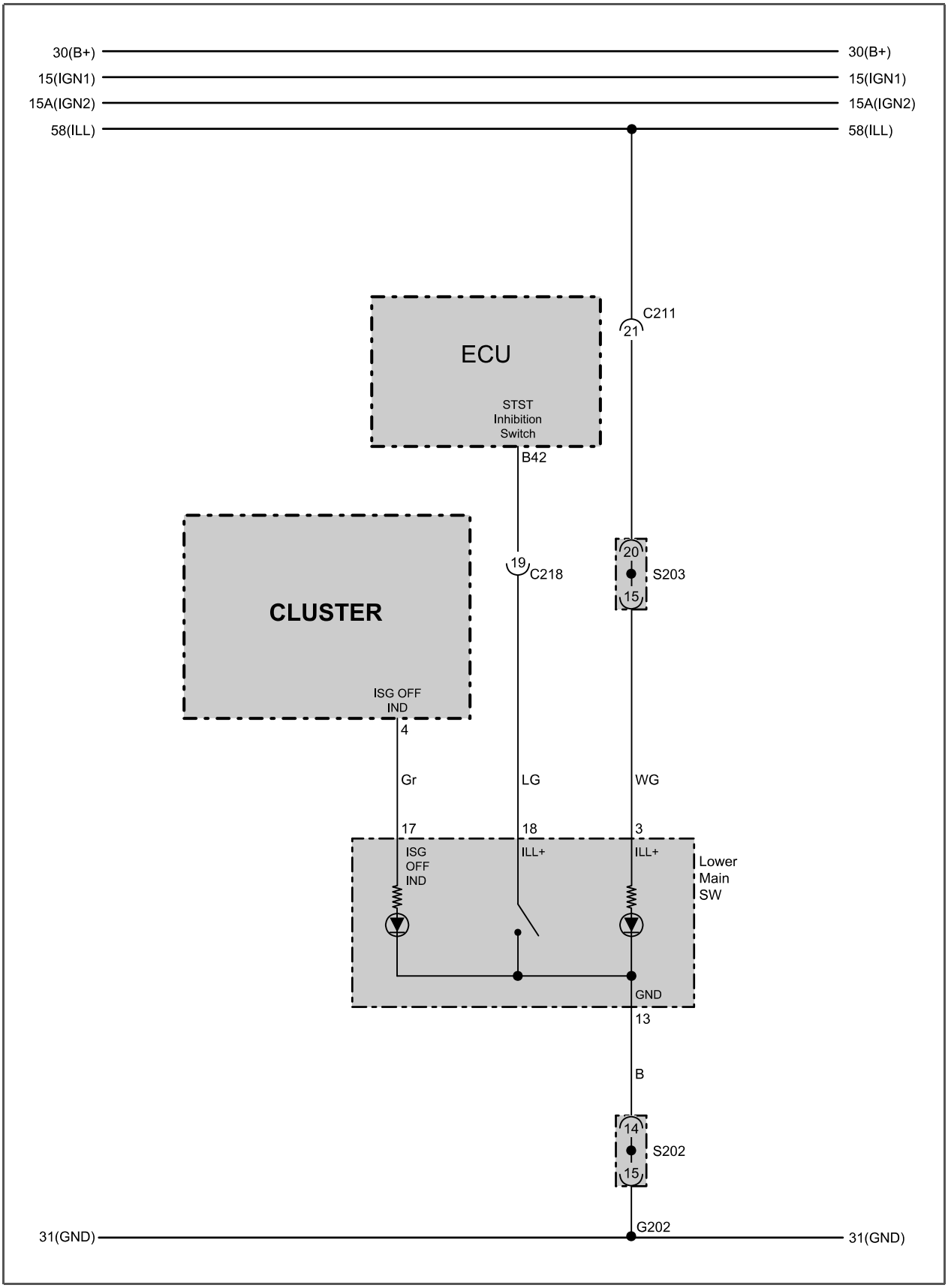
3) Connector

To switch	To wiring
	

Pin No.	Function	Pin No.	Function
1	-	11	-
2	IGN +	12	-
3	Illumination	13	Ground
4	WINTER/POWER mode switch signal	14	-
5	Front PAS OFF switch indicator lamp	15	Steering wheel warmer switch indicator
6	Front PAS OFF switch signal	16	Steering wheel warmer switch signal
7	ESP OFF switch signal	17	ISG OFF indicator
8	Headlamp leveling switch signal	18	ISG OFF switch signal
9	Headlamp GND	19	4WD LOCK switch signal
10	-	20	-

Modification basis	
Application basis	
Affected VIN	

4) Circuit Diagram

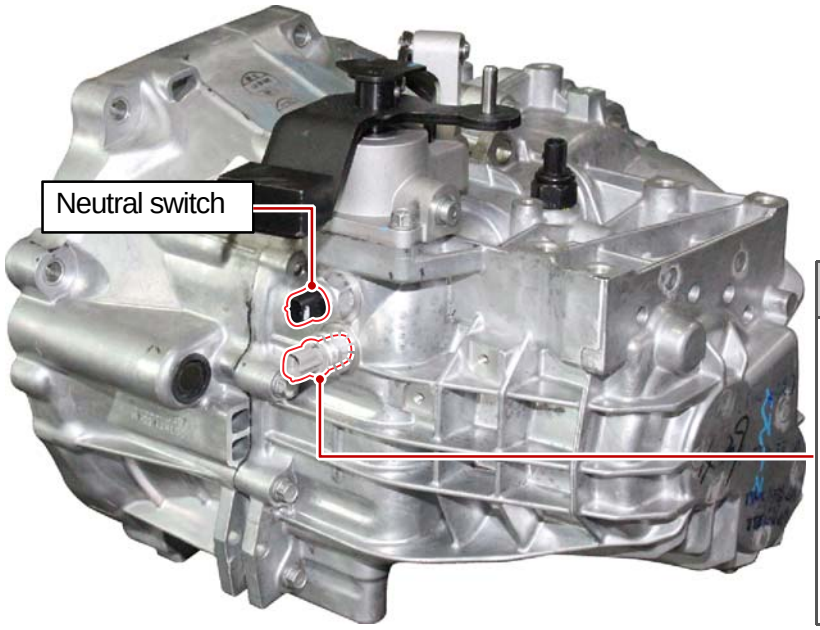


S.G.N.
0000-00 ISG NEUTRAL SWITCH

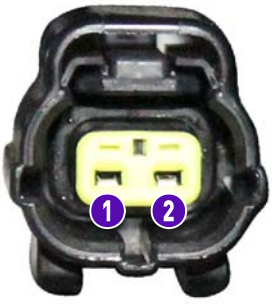
1) Overview

For the vehicle with ISG, the manual transmission has the neutral switch for ISG additionally, which is used for gear neutral signal for ISG system.

2) Mounting Location and Components



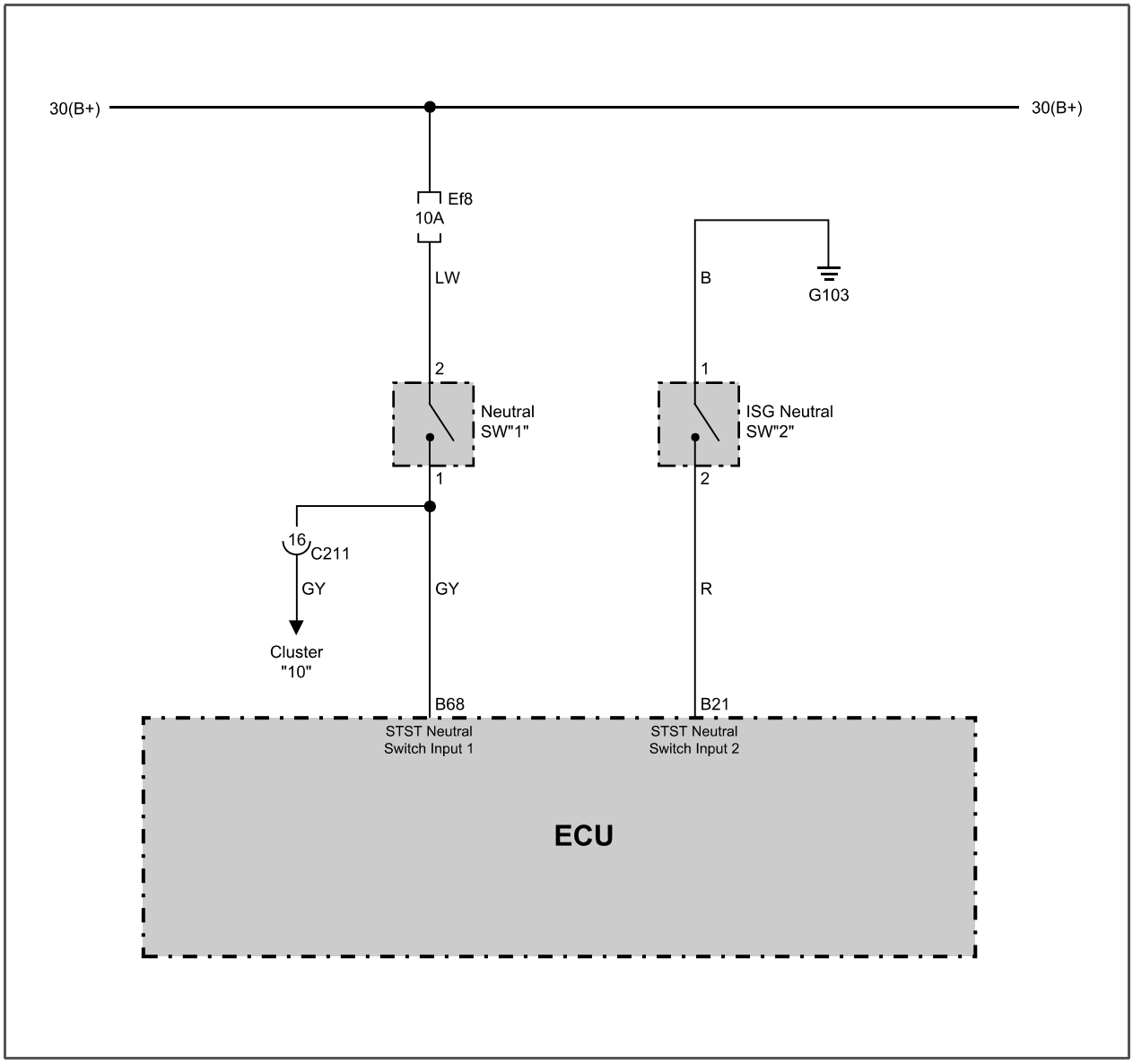
ISG neutral switch

To switch	To wiring
	

Pin No.	Function
1	Signal
2	Ground

Modification basis	
Application basis	
Affected VIN	

3) Circuit Diagram



S.G.N.
6810-20 HEATER AND A/C CONTROL ASSEMBLY

1) Overview

For the vehicle with ISG system, the climate in the cab may not be maintained pleasant since the climate system does not function normally when the ignition is turned off by auto stop function. Therefore, the heater & A/C control assembly monitors the information such as the ambient temperature, blower motor operation, A/C operation, temperature setting and auto stop operation time at the moment (including auto stop status). When the heater & A/C control assembly determines that the climate system should be operated continuously, it sends the signal prohibiting the operation of ISG to the ECU via CAN communication.

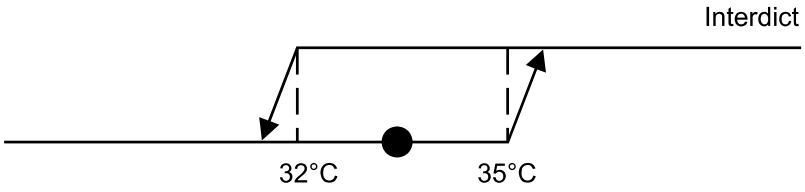
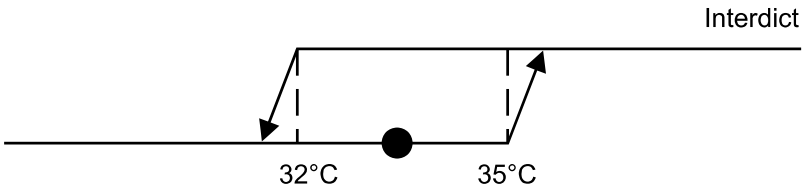
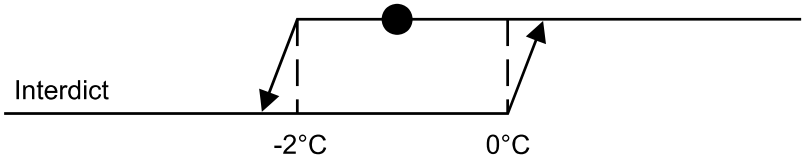
2) Mounting Location & Components

Heater & A/C control assy	
With DATC	**With MTC**
	

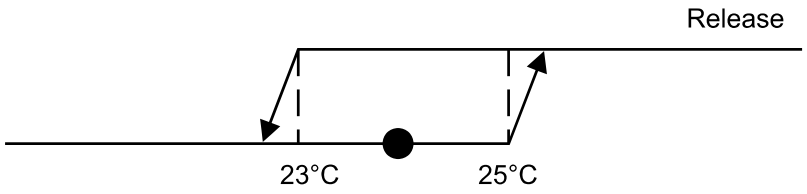
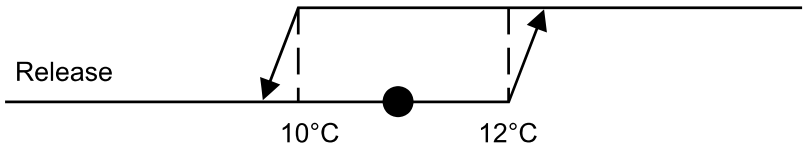
Modification basis	
Application basis	
Affected VIN	

3) ISG Operation Conditions For Climate System

▶ **Conditions for prohibiting auto stop**

Conditions and status	Specifications	
	DATC	MTC
Ambient temperature of 35℃ or higher, A/C ON and temperature setting of 25℃ or lower (DATC) 	O	X
Ambient temperature of 35℃ or higher, A/C ON, temperature control switch 2/8 or less (MTC) and blower ON (no condition for EVAP) 	X	O
Ambient temperature of −2℃ or lower and blower ON 	O	O
Temp. Lo & blower in 6 stage or higher	O	O
DEF mode, A/C on and fan on	O	O
A/C on and blower in 6 stage or higher (blower in 5 stage or higher for MTC)	O	O
Temp. Hi and blower in 6 stage or higher (blower in 5 stage or higher for MTC)	O	O
Max A/C selected (blower on, REC, A/C on)	X	O

▶ **Conditions for changing from auto stop to forced auto start**

Conditions and status	Specifications	
	DATC	MTC
Temp. Lo & blower in 6 stage or higher (blower in 5 stage or higher for MTC)	O	O
Temp. Hi & blower in 6 stage or higher (blower in 5 stage or higher for MTC)	O	O
Max A/C selected (A/C on, REC, vent mode)	X	O
DEF mode (A/C on)	O	O
A/C on and blower in 6 stage or higher (blower in 5 stage or higher for MTC)	O	O
3℃ or more increase in interior temperature (based on calculated value) after auto stop (with blower on)	O	X
3℃ or more decrease in interior temperature (based on calculated value) after auto stop (with blower on)	O	X
Elapse of 70 sec. from auto stop and ambient temperature of 25℃ or higher with blower on (hysteresis 23~25) 	O	O
Elapse of 70 sec. from auto stop and ambient temperature of 10℃ or lower with blower on (hysteresis 10~12) 	O	O

Modification basis	
Application basis	
Affected VIN	

4) Climate System Control (ISG Related)

Status	Control process	
	DATC	MTC
Auto stop activated	1. Blower level decreased to 1st (4 V) 2. Temperature door is in max cool position with A/C on (display maintains previous status) - Auto blower level decreased to 1st (4 V) in auto mode - Temperature actuator maintains max cool position excepting cases where temperature setting is changed in auto mode	1. Blower level decreased to 1st (4 V) 2. Temperature door is in max cool position with A/C on (display maintains previous status)
Auto stop deactivated	1. Blower returns to previous status if no manual change is done (changed to current status if manual change is made) 2. Temperature actuator returns to previous status if no manual change is done (changed to current status if manual change is made)	

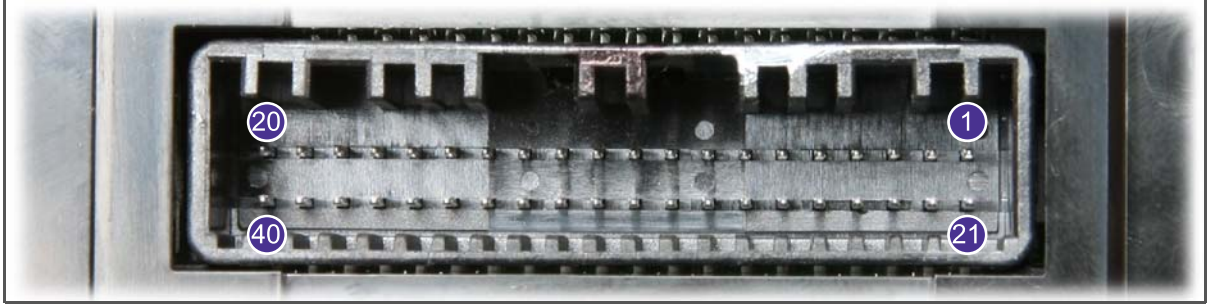
NOTE

In the event of in-car and ambient temperature sensor failure, the heater and A/C control assembly does not determine the ISG system.

5) Heater & A/C Control Assembly Connector

(1) With DATC

DATC connector



Modification basis	
Application basis	
Affected VIN	

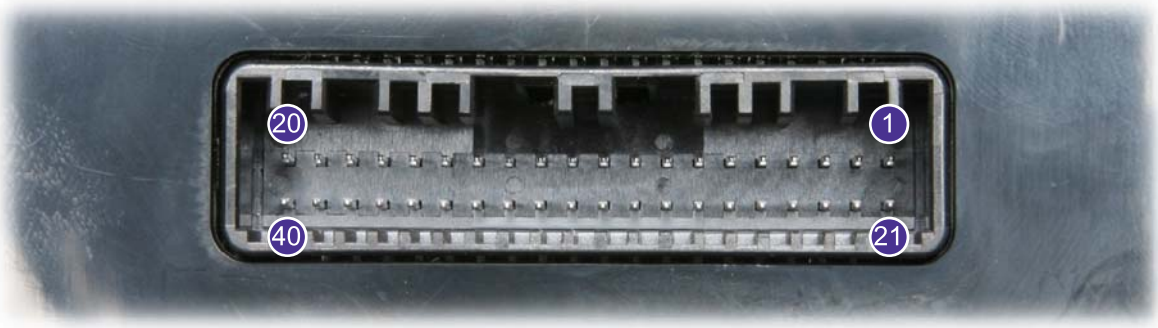
▶ **DATC connector**

Pin No.	Function
1	Ground
2	Sensor ground
3	Detecting passenger's air mix position
4	Detecting intake position
5	Detecting driver's air mix position
6	Detecting mode position
7	Passenger's air mix (P2_COOL)
8	Passenger's air mix (P1_HOT)
9	Intake (P2_RECIRC)
10	Intake (P1_FRESH)
11	Driver's air mix (P2_COOL)
12	Driver's air mix (P1_HOT)
13	Mode (P2_DEF)
14	Mode (P1_VENT)
15	Vehicle speed
16	Illumination ground
17	Illumination voltage
18	Reference voltage (5 V)
19	IGN2
20	B+

Pin No.	Function
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	Amb. temp. sensor ref. vol (5 V)
29	CAN-Low (with ISG)
30	CAN-High (with ISG)
31	Sun-load sensor signal
32	Ambient temperature sensor signal
33	Water temperature sensor signal
34	Intake sensor signal
35	Blower motor feedback
36	Blower motor control
37	-
38	-
39	A/C compressor ON signal (without ISG)
40	-

(2) With MTC

MTC connector



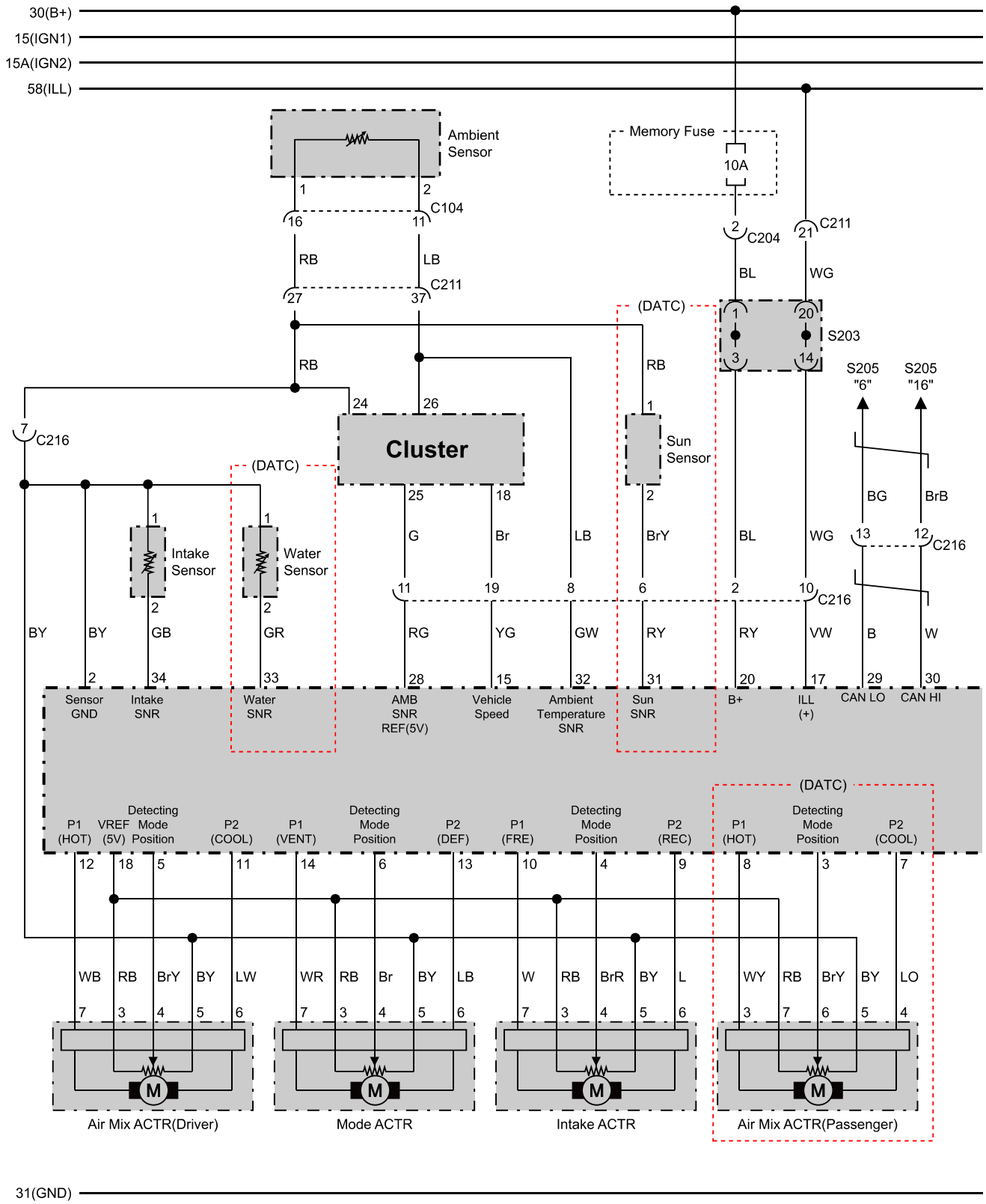
Modification basis	
Application basis	
Affected VIN	

▶ **MTC connector**

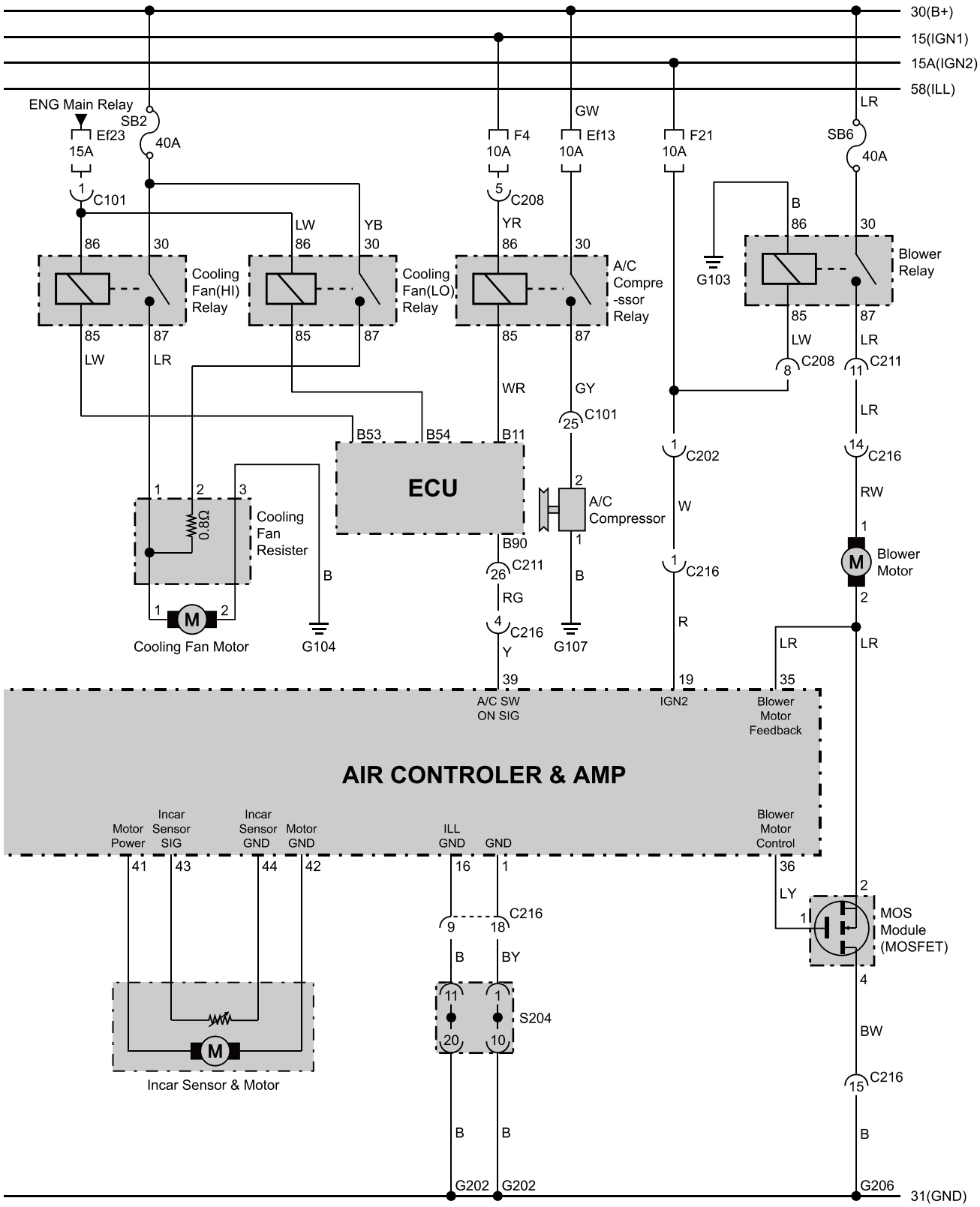
Pin No.	Function
1	Ground
2	Sensor ground
3	-
4	Detecting intake position
5	Detecting air mix position
6	Detecting mode position
7	-
8	-
9	Intake (P2_RECIRC)
10	Intake (P1_FRESH)
11	Air mix (P2_COOL)
12	Air mix (P1_HOT)
13	Mode (P2_DEF)
14	Mode (P1_VENT)
15	Vehicle speed
16	Illumination ground
17	Illumination voltage
18	Reference voltage (5 V)
19	IGN2
20	B+

Pin No.	Function
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	Amb. temp. sensor ref. vol (5 V)
29	CAN-Low (with ISG)
30	CAN-High (with ISG)
31	-
32	Ambient temperature sensor signal
33	-
34	Intake sensor signal
35	Blower motor feedback
36	Blower motor control
37	-
38	-
39	A/C compressor ON signal (without ISG)
40	-

6) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

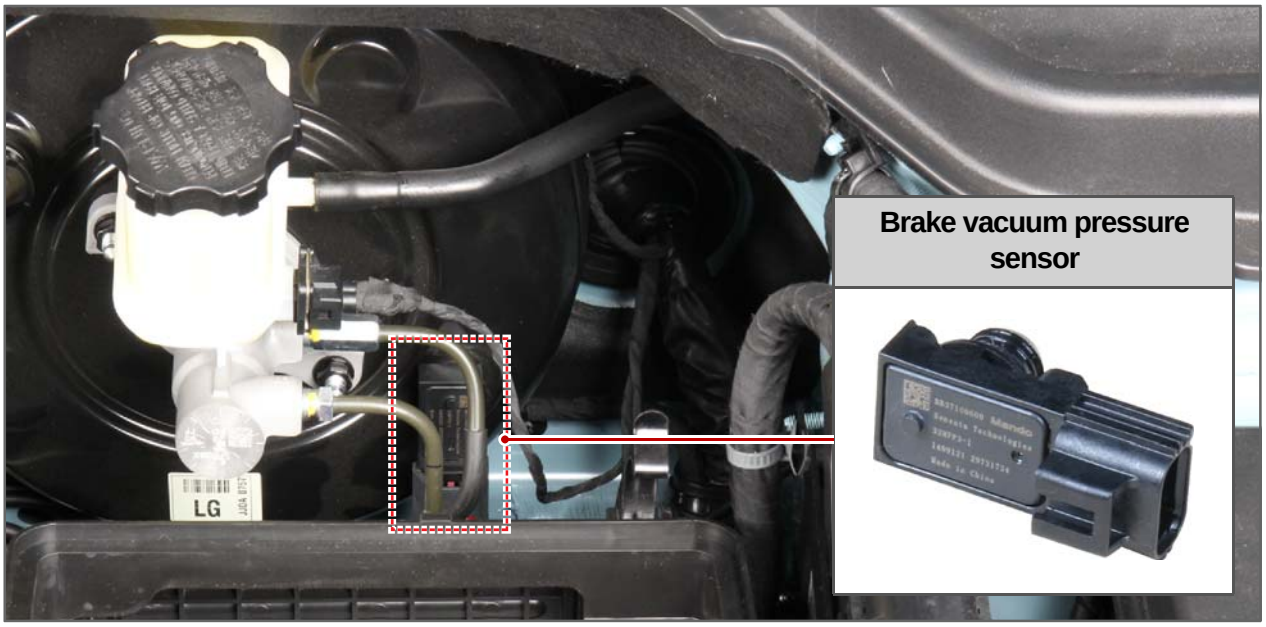


Modification basis	
Application basis	
Affected VIN	

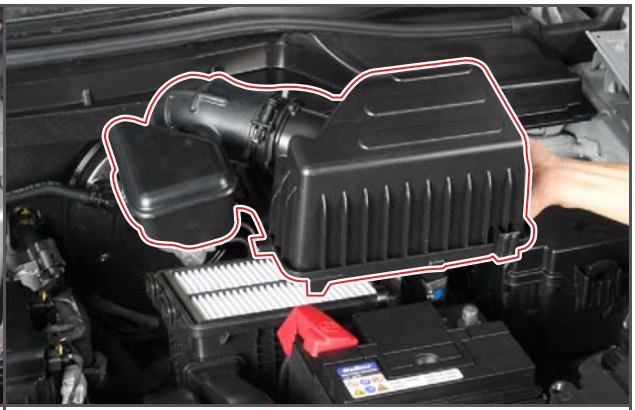
REMOVAL AND INSTALLATION

S.G.N. 0000-00 BRAKE VACUUM PRESSURE SENSOR

Preceding work - Disconnect the negative battery cable.



1. Remove the air duct and air cleaner upper cover to provide working space.

1	
	
Disengage the duct hose spring clamp (10 mm).	Remove the air cleaner upper cover mountings to remove the air duct hose with the air cleaner upper cover.

Modification basis	
Application basis	
Affected VIN	

2

2. Remove the brake vacuum pressure sensor from the brake booster.

NOTE

Care should be taken when removing the brake vacuum pressure sensor since it may break under excessive force.

3

3. Disconnect the brake vacuum pressure sensor connector.

4

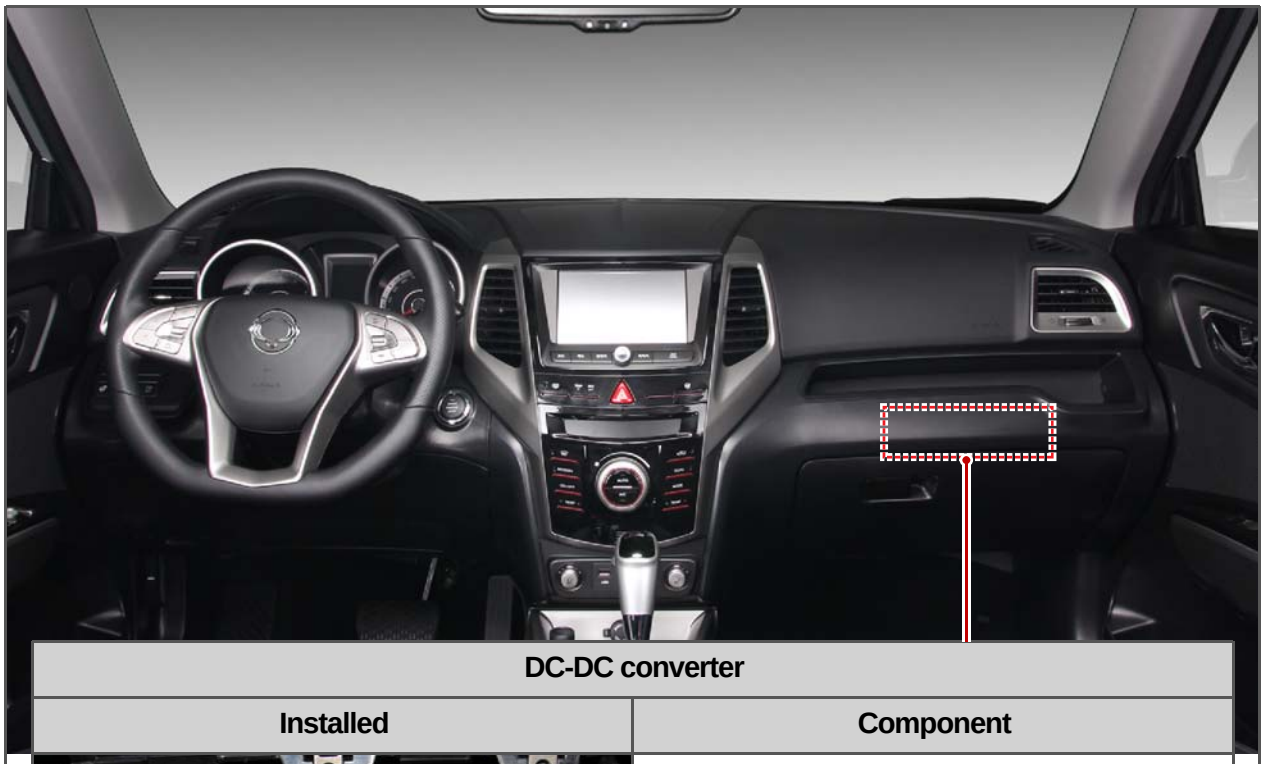
4. Remove the brake vacuum pressure sensor.

5

5. Install in the reverse order of removal.

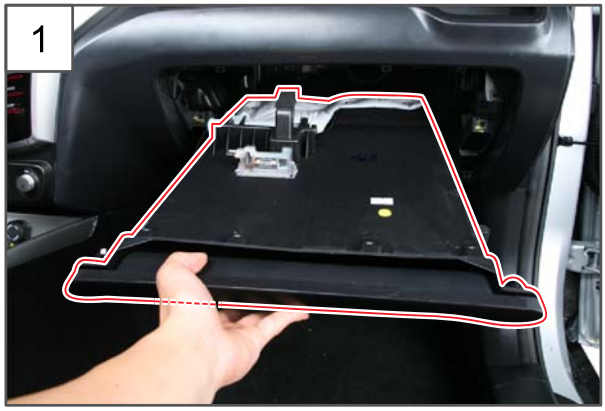
S.G.N.
0000-00 DC-DC CONVERTER

Preceding work - Disconnect the negative battery cable.



DC-DC converter	
Installed	Component
	

1



1. Remove the glove box assembly.

NOTE

Refer to "GLOVE BOX" under "REMOVAL AND INSTALLATION" in "BODY INTERIOR" chapter.

Modification basis	
Application basis	
Affected VIN	

2

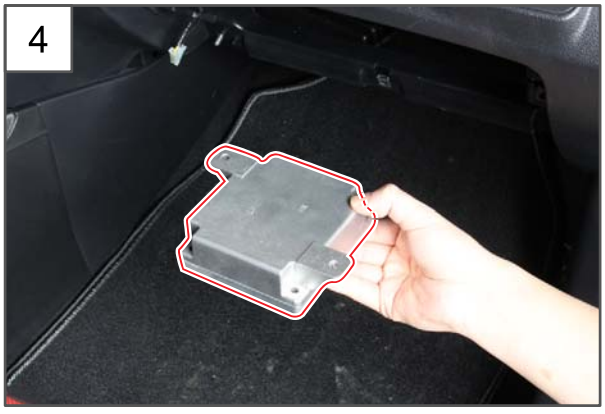
2. Unscrew the two DC-DC converter mounting nuts (10 mm).

Tightening torque 10 ± 1.0 Nm

3

3. Disconnect the DC-DC converter connector.

4



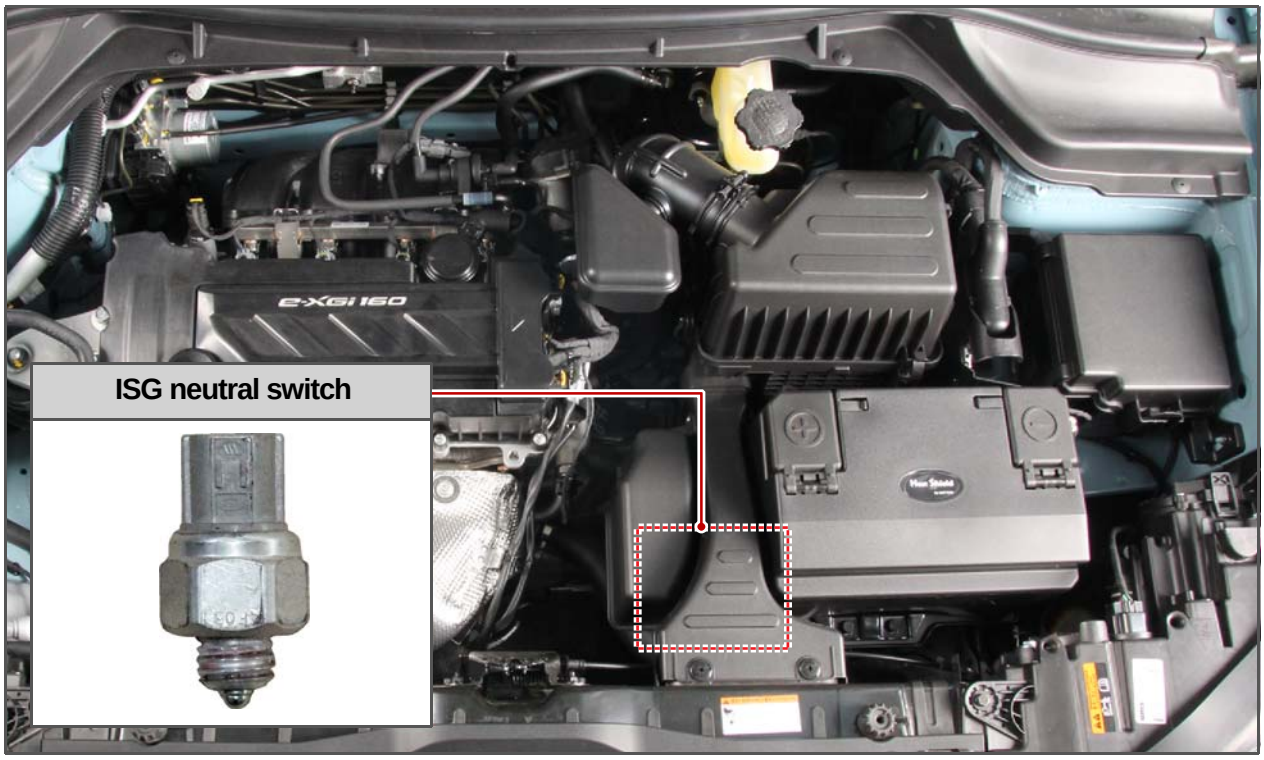
4. Remove the DC-DC converter.

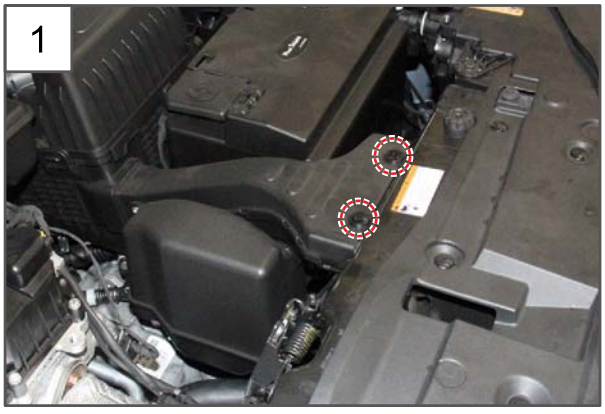
5

5. Install in the reverse order of removal.

S.G.N.
3196-12 ISG NEUTRAL SWITCH

Preceding work - Disconnect the negative battery cable.



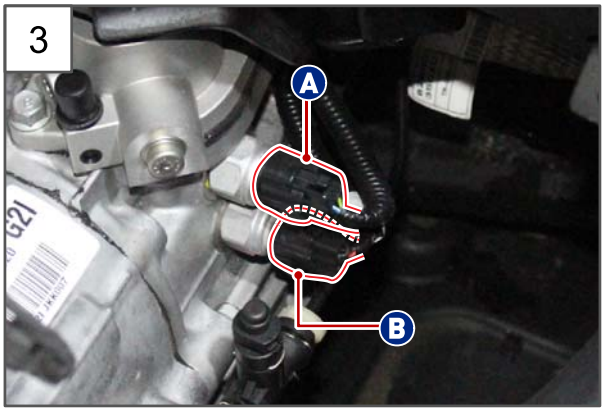


1. Remove the 2 screw rivets securing the snorkel assembly.

2. Remove the snorkel assembly.

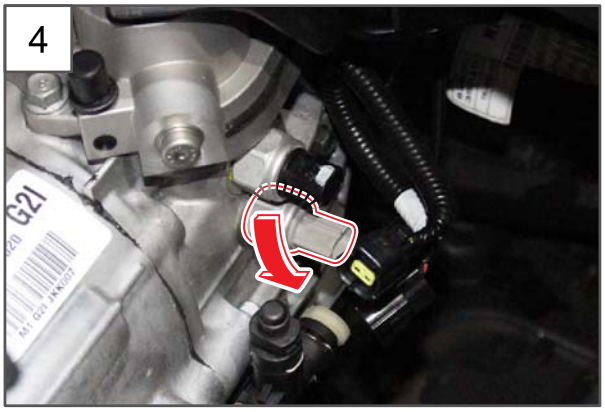
Modification basis	
Application basis	
Affected VIN	

3



3. Disconnect the neutral switch connector (A) and ISG neutral switch connector (B).

4



4. Remove the ISG neutral switch using a 24 mm socket.

Tightening torque **39.2 ~ 58.8 Nm**

5

5. Install in the reverse order of removal.

Memo