

Component Procedures: Engine Control Module

Table of Contents

1. Parts and Labor (itype_189)
2. Engine Control Module (ECM) - Schematic Diagrams (Article 44189)
3. Engine Control Module (ECM) - Repair Procedures (Article 44192)
4. All New Technical Service Bulletins (itype_432)
5. All Technical Service Bulletins (itype_100)
6. Engine Control Module (ECM) - Schematic Diagrams (Article 44191)
7. OEM Policies and Procedures (itype_120)
8. Service Campaigns (itype_108)

Component Procedures: Engine Control Module

Parts and Labor (itype_189)

Parts

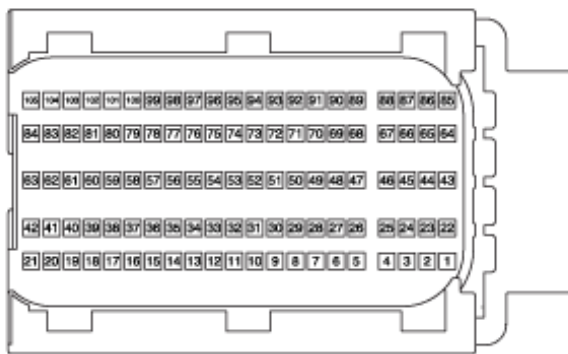
Qualifier	Part #	Name	Price	Note
Powertrain Control > ECM	391712EFD5	Manual Trans	685.10	Order By Vehicle Applicati?
Powertrain Control > ECM > A?	391732EFD0	Sulev Emission	700.10	Order By Vehicle Applicati?
Powertrain Control > ECM > A?	391732EFE0	Ulev Emission	700.10	Order By Vehicle Applicati?

Labor

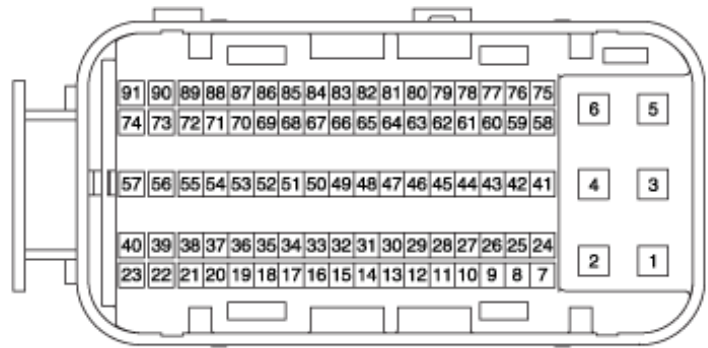
Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Replace	Powertrain Control > ECM, R&R	B	0.5	0.0

Engine Control Module (ECM) - Schematic Diagrams (Article 44189)

- ECM Terminal And Input/Output signal
Harness Connector



Connector [C300-A]



Connector [C300-B]

ECM Terminal Function

Connector [C300-A]

Pin No Description Connected to

- 1 -
- 2 ETC Motor [+] control output ETC Motor
- 3 -
- 4 Motor [-] control output Variable Charge Motion Actuator (VCMA)
- 5 -
- 6 -
- 7 -
- 8 -
- 9 -
- 10 Clutch switch signal input [M/T] Clutch switch
- 11 -
- 12 -
- 13 -
- 14 -
- 15 Sensor ground Engine Coolant Temperature Sensor (ECTS)
- 16 Engine Coolant Temperature Sensor (ECTS) signal input Engine Coolant Temperature Sensor (ECTS)
- 17 Throttle Position Sensor (TPS) 2 signal input Throttle Position Sensor (TPS) 2
- 18 -
- 19 -
- 20 -
- 21 Sensor power (+5V) Manifold Absolute Pressure Sensor (MAPS)
Camshaft Position Sensor (CMPS) [Bank 1/ Intake]
- 22 -

23 ETC Motor [-] control output ETC Motor
24 -
25 Motor [+] control output Variable Charge Motion Actuator (VCMA)
26 -
27 -
28 -
29 -
30 -
31 Electrical load signal input Alternator
32 -
33 -
34 -
35 -
36 -
37 Sensor ground Throttle Position Sensor (TPS) 1, 2
38 Throttle Position Sensor (TPS) 1 signal input Throttle Position Sensor (TPS) 1
39 -
40 Alternator PWM control output Alternator
41 -
42 Sensor power (+5V) Throttle Position Sensor (TPS) 1, 2
43 -
44 -
45 -
46 -
47 -
48 -
49 -
50 -
51 -
52 -
53 -
54 VCMA Feedback ground Variable Charge Motion Actuator (VCMA)
55 -
56 Sensor ground Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust]
57 -
58 -
59 -
60 -
61 Sensor ground Manifold Absolute Pressure Sensor (MAPS)
62 Manifold Absolute Pressure Sensor (MAPS) signal input Manifold Absolute Pressure Sensor (MAPS)
63 Sensor power (+5V) Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust]
Variable Charge Motion Actuator (VCMA)
65 -
66 -
67 -
68 -
69 -
70 -
71 -
72 -
73 -
74 Sensor ground Crankshaft Position Sensor (CKPS)
75 -
76 VCMA Feedback signal input Variable Charge Motion Actuator (VCMA)
77 Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input Camshaft Position Sensor (CMPS) [Bank 1/
Exhaust]
78 Sensor ground Camshaft Position Sensor (CMPS) [Bank 1/ Intake]
79 -
80 -
81 -

82 -
83 VG (Virtual Ground) Heated Oxygen Sensor [Bank 1/ Sensor 1]
84 VRC (Current Adjust) Heated Oxygen Sensor [Bank 1/ Sensor 1]
85 -
86 -
87 -
88 -
89 -
90 -
91 -
92 -
93 -
94 -
95 Crankshaft Position Sensor (CKPS) signal input Crankshaft Position Sensor (CKPS)
96 -
97 -
98 Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input Camshaft Position Sensor (CMPS) [Bank 1/Intake]
99 Sensor ground Knock Sensor (KS)
100 Knock Sensor (KS) signal input Knock Sensor (KS)
101 Intake Air Temperature Sensor (IATS) signal input Intake Air Temperature Sensor (IATS)
102 -
103 -
104 VN (NERNST Cell Voltage) Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1]
105 VIP (Current Pump) Heated Oxygen Sensor [Bank 1/ Sensor 1]
Connector [C300-B]
1 Power ground Chassis Ground
2 Power ground Chassis Ground
3 Battery power (B+) Main Relay
4 Power ground Chassis Ground
5 Battery power (B+) Main Relay
6 Battery power (B+) Main Relay
8 FLEX-RAY (High) Other control module , Data Link Connector (DLC)
10 Accelerator Position Sensor (APS) 2 signal input Accelerator Position Sensor (APS) 2
11 A/C Pressure Transducer (APT) signal input A/C Pressure Transducer (APT)
14 Sensor power (+5V) A/C Pressure Transducer (APT)
Fuel Tank Pressure Sensor (FTPS)
15 -
16 Sensor power (+5V) Accelerator Position Sensor (APS) 2
17 Sensor power (+5V) Accelerator Position Sensor (APS) 1
18 Main Relay control output Main Relay
19 Fuel Pump Relay control output Fuel Pump Relay
21 -
22 Injector (Cylinder #2) control output Injector (Cylinder #2)
23 Injector (Cylinder #3) control output Injector (Cylinder #3)
25 FLEX-RAY (Low) Other control module, Data Link Connector (DLC)
26 Electrical signal input [Blower Max. Switch] Heater & A/C Control module
27 Accelerator Position Sensor (APS) 1 signal input Accelerator Position Sensor (APS) 1
28 Sensor ground Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2]
29 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] signal input Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2]
30 Fuel Tank Pressure Sensor signal input Fuel Tank Pressure Sensor (FTPS)
31 -
34 Start Motor relay control output Start Motor relay
35 CVVT Oil Control (OCV) Valve [Bank 1/ Exhaust] control output CVVT Oil Control Valve (OCV) [Bank 1/ Exhaust]
36 CVVT Oil Control (OCV) Valve [Bank 1/ Intake] #1 control output CVVT Oil Control Valve (OCV) [Bank 1/ Intake] #1
37 -
38 A/C Relay control output A/C Relay
39 Injector (Cylinder #4) control output Injector (Cylinder #3)

40 Ignition Coil (Cylinder #2) control output Ignition Coil (Cylinder #2) [NON-Immobilizer type]
Ignition Coil (Cylinder #3) control output Ignition Coil (Cylinder #3) [Immobilizer type]
41 Battery power (B+) Ignition Switch
42 -
45 Sensor ground Accelerator Position Sensor (APS) 1
46 Sensor ground Accelerator Position Sensor (APS) 2
47 Sensor ground Fuel Tank Pressure Sensor (FTPS)
50 Sensor ground A/C Pressure Transducer (APT)
54 Canister Close Valve (CCV) control output Canister Close Valve (CCV)
55 CVVT Oil Control (OCV) Valve [Bank 1/ Intake] #2 control output CVVT Oil Control Valve (OCV) [Bank 1/Intake] #2
56 Injector (Cylinder #1) control output Injector (Cylinder #1)
57 Ignition Coil (Cylinder #1) control output Ignition Coil (Cylinder #1) [Immobilizer type]
Ignition Coil (Cylinder #4) control output Ignition Coil (Cylinder #4) [NON-Immobilizer type]
60 C- CAN [Low] Other control module, Data Link Connector (DLC)
61 Fuel Tank Level Sensor signal input Fuel Tank Level Sensor (FLS)
62 -
63 -
64 -
65 Brake Light Switch signal input Brake Switch
66 Start signal input Ignition Switch
67 Engine speed signal output Power Distribution Module (PDM)
68 Immobilizer communication line Immobilizer control module
71 Purge Control Solenoid Valve (PCSV) control output Purge Control Solenoid Valve (PCSV)
72 Electronic Thermo Sensor signal input Electronic Thermo Sensor
73 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1] Heater control output Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1]
74 Ignition Coil (Cylinder #2) control output Ignition Coil (Cylinder #2) [NON-Immobilizer type]
76 -
77 C-CAN [High] Other control module, Data Link Connector (DLC)
78 -
79 Vehicle speed signal input ABS/ESC Control Unit
80 Electrical load signal input [Wiper] Wiper [High] Relay
83 Brake Test Switch signal input Brake Switch
84 -
85 LIN communication Battery Sensor
86 Cooling Fan Relay [Low] control output Cooling Fan Relay [Low]
87 Cooling Fan Relay [High] control output Cooling Fan Relay [High]
88 Variable Intake Solenoid (VIS) Valve control output Variable Intake Solenoid (VIS) Valve
90 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] Heater control output Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2]
91 Ignition Coil (Cylinder #1) control output Ignition Coil (Cylinder #1) [NON-Immobilizer type]
Ignition Coil (Cylinder #4) control output Ignition Coil (Cylinder #4) [Immobilizer type]
ECM Terminal Input/Output signal
Pin No Description Condition Type Level
2 ETC Motor [+] control output Idle PWM Operating freq. : 1000 Hz (estimated)
Forward direction
Turn on : Battery voltage
Frewheeling : Max. 0.1V
Reverse direction
Turn on : Max. 0.1V
4 Motor [-] control output
10 Clutch switch signal input [M/T] Switch ON Digital Min. -0.3V - Max. 0.5V
Switch OFF Battery voltage
15 Sensor ground Idle DC Max. 0.5V
16 Engine Coolant Temperature Sensor (ECTS) signal input Idle Analog Min. 0.1V - Max
17 Throttle Position Sensor (TPS) 2 signal input Idle Analog Min. 0.4V - Max. 4.5V
21 Sensor power (+5V) IG OFF DC voltage Max. 0.5V
IG ON 4.9 - 5.1V
23 ETC Motor [-] control output Idle PWM Operating freq. : 1000 Hz (estimated)

Turn on : max 0.1V
Frewheeling : max 0.1V
Reverse direction
25 Motor [+] control output
31 Electrical load signal input Idle PWM Freq. : 125 Hz or 200 Hz or 60 Hz
Duty rate 0% - 100%
37 Sensor ground Idle DC Max. 0.5V
38 Throttle Position Sensor (TPS) 1 signal input Idle Analog Min. 0.4V - Max. 4.5V
40 Alternator PWM control output IG OFF PWM Battery voltage
IG ON Max. 0.5V
42 Sensor power (+5V) IG OFF DC Max. 0.5V
IG ON Min. 4.75V - Max. 5.25V
54 VCMA Feedback ground
56 Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust] signal input Idle Pulse Around 7 Hz at 850 rpm
Around 25 Hz at 3000 rpm
61 Sensor ground Idle DC Max. 0.5V
62 Manifold Absolute Pressure Sensor (MAPS) signal input Idle Analog Min. 0.8V - Max. 4.2V
63 Sensor power (+5V) IG OFF DC voltage Max. 0.5V
74 Sensor ground Idle DC Max. 0.5V
76 VCMA Feedback signal input
77 Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust] signal input Idle Pulse Around 7 Hz at 850 rpm
78 Sensor ground Idle DC Max. 0.5V
83 VG (Virtual Ground) Idle Analog Min. 0.2V - Max. 5.2V
84 VN (NERNST Cell Voltage) Idle Analog Min. 0.2V - Max. 5.2V
95 Crankshaft Position Sensor (+) signal input Idle Frequency Vpp Min. : 18V at Idle (for 1 rail)
Vpp Max. : 90V at 5000 rpm (for 1 rail)
98 Camshaft Position Sensor (CMPS) [Bank 1/ Intake] signal input Idle Pulse Around 7 Hz at 850 rpm
99 Sensor ground Idle DC Max. 0.5V
100 Knock Sensor (KS) signal input Idle Analog / Frequency Freq. : Min. 8 kHz - Max. 12 kHz
Level : Min. 180 - Max. 300 mVpp
101 Intake Air Temperature Sensor (IATS) signal input Idle Analog Min. 0.1V - Max. 4.7V
104 VN (NERNST Cell Voltage) Idle Analog Min. 0.2V - Max. 5.2V
105 VIP (Current Pump) Idle Analog Min. 0.2V - Max. 5.2V
1 Power ground Idle DD Mx 0Va.5m
2 Power ground Idle DC Max. 50 mV
3 Battery power (B+) IG OFF DC Max. 0.5V
IG ON Battery Voltage
4 Power ground Idle DC Max. 50 mV
5 Battery power (B+) IG OFF DC Max. 0.5V
6 Battery power (B+) IG OFF DC Max. 0.5V
8 FLEX-RAY (High)
10 Accelerator Position Sensor (APS) 2 signal input Idle Analog Min. 0.6V - Max. 4.3V
11 A/C Pressure Transducer (APT) signal input
14 Sensor power (+5V) IG OFF DC Max. 0.5V
16 Sensor power (+5V) IG OFF DC Max. 0.5V
17 Sensor power (+5V) IG OFF DC Max. 0.5V
18 Main Relay control output Relay OFF DC Battery Voltage
Relay ON Min. -0.3V -Max. 1.2V
19 Fuel Pump Relay control output Relay OFF DC Battery Voltage
22 Injector (Cylinder #2) control output Idle DC High : Battery voltage
Low : Max. 0.5V
48 - 50V
23 Injector (Cylinder #3) control output Idle DC High : Battery voltage
25 FLEX-RAY (Low)
26 Electrical signal input [Blower Max. Switch]
27 Accelerator Position Sensor (APS) 1 signal input Idle Analog Min. 0.6V - Max. 4.3V
28 Sensor ground Idle DC Max. 50 mV
29 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] signal input Idle Analog Min. 0.6V - Max. 1.0V
DC
30 Fuel Tank Pressure Sensor signal input

34 Start Motor control switch Switch ON Digital Battery voltage
Switch OFF Min. -0.3V - Max. 0.5V

35 CVVT Oil Control (OCV) Valve [Bank 1/ Exhaust] control output Idle PWM Operating freq. range : 300 Hz
Duty rate : 0% - 100%

36 CVVT Oil Control (OCV) Valve [Bank 1/ Intake] #1 control output Idle PWM Operating freq. range : 300 Hz

38 A/C Relay control output Relay OFF DC Battery Voltage

39 Injector (Cylinder #4) control output Idle DC High : Battery voltage

40 Ignition Coil (Cylinder #2) control output Idle Pulse Turn on : Max. 1.6V
Ignition Coil (Cylinder #3) control output Turn off : Battery voltage

41 Battery power (B+) IG OFF DC Max. 0.5V

45 Sensor ground Idle DC Max. 50 mV

46 Sensor ground Idle DC Max. 50 mV

47 Sensor ground Idle DC Max. 50 mV

50 Sensor ground Idle DC Max. 50 mV

54 Canister Close Valve (CCV) control output

55 CVVT Oil Control (OCV) Valve [Bank 1/Intake] #2 control output

56 Injector (Cylinder #1) control output Idle DC High : Battery voltage

57 Ignition Coil (Cylinder #1) control output Idle Pulse Turn on : Max. 1.6V
Ignition Coil (Cylinder #4) control output Turn off : Battery voltage

60 C-CAN [Low] RECESSIVE Pulse 2.0 - 3.0V
DOMINANT 0 - 0.5V

61 Fuel Tank Level Sensor signal input

65 Brake Light Switch signal input Swich ON Digital Battery voltage

66 Start signal input

67 Engine speed signal output Idle Frequency Around 26 Hz at 850 rpm, idle
Around 16 Hz at 3000 rpm

68 Immobilizer communication line When Pulse High : Min. 8.5V
communicating
after IG ON
Low : Max. 3.5V

71 Purge Control Solenoid Valve (PCSV) control output Relay OFF DC Battery voltage
Relay ON Max. 1.76V

72 Electronic Thermo Sensor signal input

73 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1] Heater control output Relay OFF DC Battery voltage
Relay ON Max. 0.5V

74 Ignition Coil (Cylinder #2) control output Idle Pulse Turn on : Max. 1.6V

77 C-CAN [High] RECESSIVE Pulse 2.0 - 3.0V
DOMINANT 2.75 - 4.5V

79 Vehicle speed signal input Idle Frequency Duty rate 40% - 60%

80 Electrical load signal input [Wiper]

83 Brake Test Switch signal input Swich ON Digital Battery voltage

85 LIN communication

86 Cooling Fan Relay [Low] control output IG OFF PWM Battery voltage
IG ON Min. -0.3V - Max. 1.2V

87 Cooling Fan Relay [High] control output IG OFF DC Battery voltage

88 Variable Intake Solenoid (VIS) Valve control output

90 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] Heater control output Relay OFF DC Battery voltage

91 Ignition Coil (Cylinder #1) control output Idle Pulse Turn on : Max. 1.6V

Engine Control Module (ECM) - Repair Procedures (Article 44192)

- Removal

If you replace the PCM , you must perform oil pressure characteristics back up & input (TCU Replacement).
(Refer to Automatic Transaxle System - "Automatic Transaxle Control System")

NOTICE

- If you replace the PCM , you must perform oil pressure characteristics back up & input (TCU Replacement).
(Refer to Automatic Transaxle System - "Automatic Transaxle Control System")

When replacing the ECM , the vehicle equipped withthe immobilizer must be performed procedure asbelow. [In the case of installing used ECM] Perform "ECM Neutral mode" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System") After finishing "ECM Neutral mode", perform "Keyteaching" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System") [In the case of installing new ECM] Perform "Key teaching" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System")

CAUTION

- When replacing the ECM , the vehicle equipped withthe immobilizer must be performed procedure asbelow.
[In the case of installing used ECM]

- Perform "ECM Neutral mode" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System")
- After finishing "ECM Neutral mode", perform "Keyteaching" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System")

[In the case of installing new ECM]

- Perform "Key teaching" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System")

When replacing the ECM, the vehicle equipped withthe smart key system (Button start) must be performed procedure as below. [In the case of installing used ECM] Perform "ECM Neutral mode" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System") After finishing "ECM Neutral mode", insert the key(or press the start button) and turn it to the IGN ONand OFF position. Then the ECM learns the smartkey information automatically. [In the case of installing new ECM] Insert the key (or press the start button) and turn itto the IGN ON and OFF position. Then the ECMlearns the smart key information automatically.

- When replacing the ECM, the vehicle equipped withthe smart key system (Button start) must be performed procedure as below.

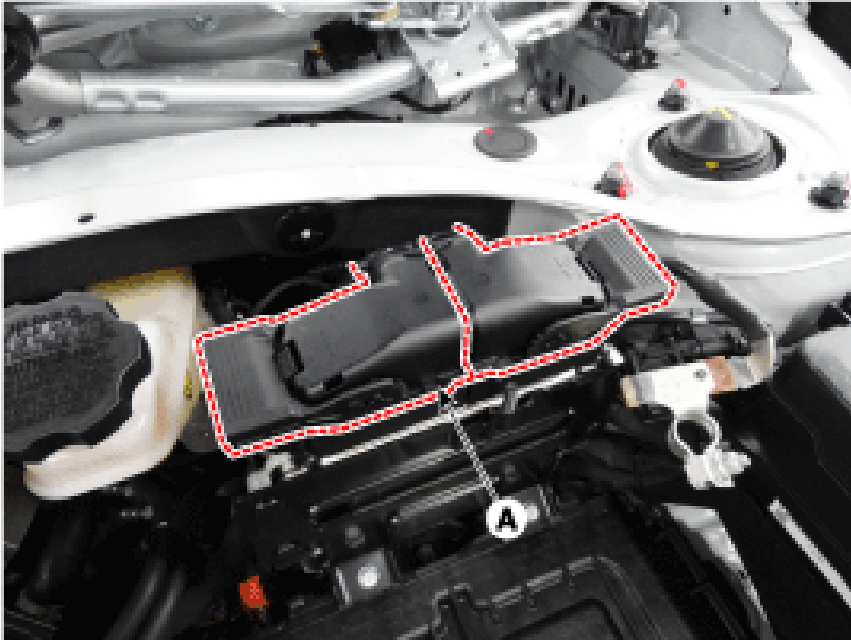
- After finishing "ECM Neutral mode", insert the key(or press the start button) and turn it to the IGN ONand OFF position. Then the ECM learns the smartkey information automatically.

- Insert the key (or press the start button) and turn itto the IGN ON and OFF position. Then the ECMlearns the smart key information automatically.

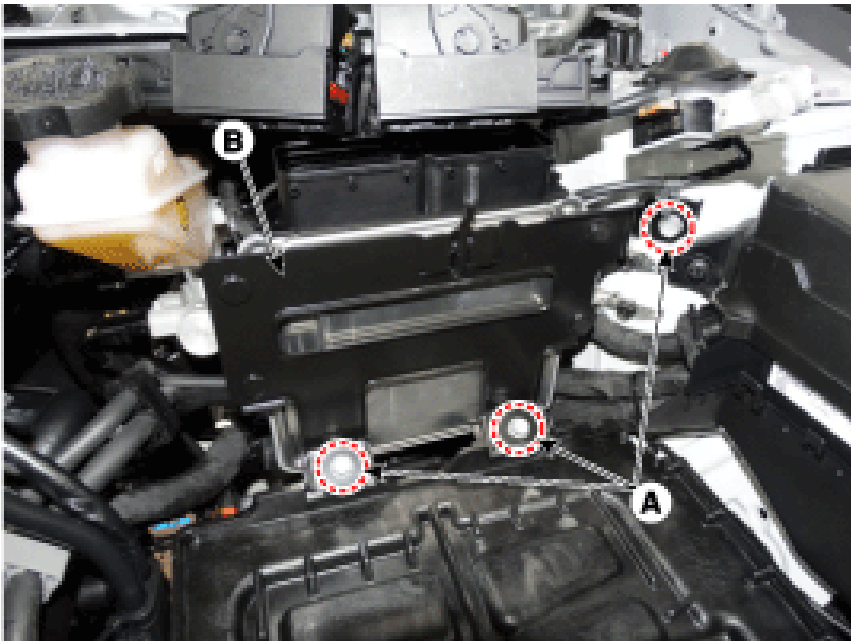
- Turn ignition switch OFF and disconnect the negative (-) battery cable.

- Remove the battery. (Refer to Engine Electrical System - "Battery")

- Disconnect the ECM Connector (A).



- Remove the mounting bolts (A) and then remove the ECM (B).



- Installation

When replacing the ECM, the vehicle equipped with the immobilizer must be performed procedure as below. [In the case of installing used ECM] Perform "ECM Neutral mode" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System") After finishing "ECM Neutral mode", perform "Keyteaching" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System") [In the case of installing new ECM] Perform "Key teaching" procedure with GDS. (Refer to Body Electrical System - "Immobilizer System")

- When replacing the ECM, the vehicle equipped with the immobilizer must be performed procedure as below.

- Installation is reverse of removal. ECM Installation bolt : 7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft) ECM Bracket installation bolt : 9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)

- ECM Problem Inspection Procedure

- TEST ECM GROUND CIRCUIT : Measure resistance between ECM and chassis ground using the backside of ECM harness connector as ECM side check point. If the problem is found, repair it. Specification : Below 1Ω

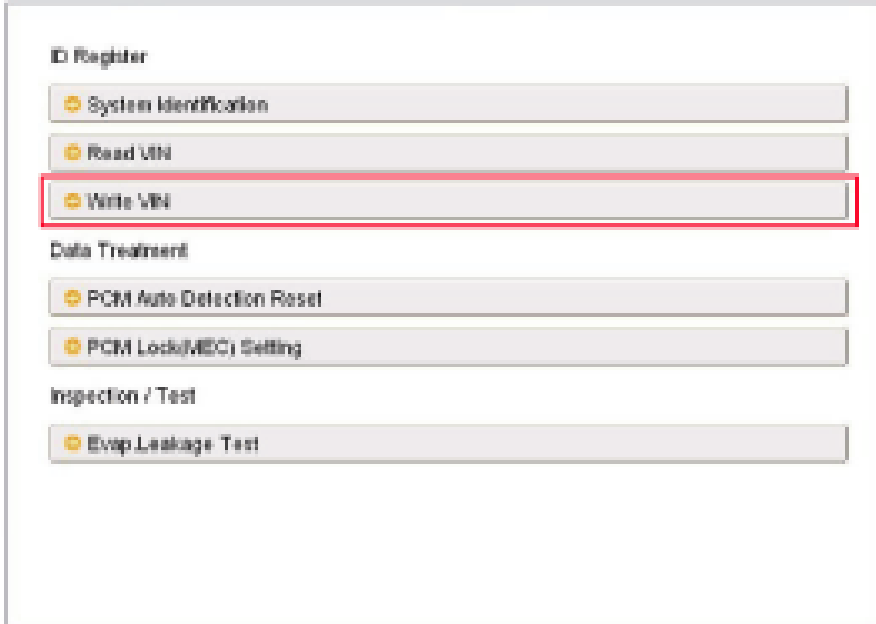
- TEST ECM CONNECTOR : Disconnect the ECM connector and visually check the ground terminals on ECM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.

- If problem is not found in Step 1 and 2, the ECM could be faulty. If so, make sure there were no DTC's before swapping the ECM with a new one, and then check the vehicle again. If DTC's were found, examine this first before swapping ECM.

- RE-TEST THE ORIGINAL ECM : Install the original ECM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original ECM with a new one. If problem does not occur, this is intermittent problem. (Refer to "Intermittent Problem Inspection Procedure" in Basic Inspection Procedure)

VIN Programming Procedure

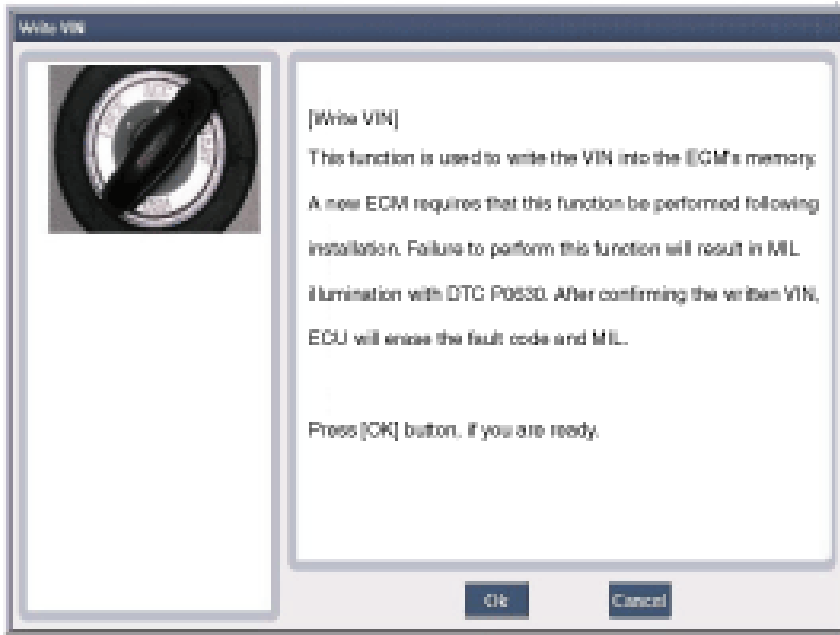
- The programmed VIN cannot be changed. When writing the VIN, confirm the VIN carefully.
- The programmed VIN cannot be changed. When writing the VIN, confirm the VIN carefully.
 - Select "VIN Writing" function in "Vehicle S/W Management".
 - Select "Write VIN" in "ID Register".



- Input the VIN. Before inputting the VIN, confirm the VIN again because the programmed VIN cannot be changed.
- Before inputting the VIN, confirm the VIN again because the programmed VIN cannot be changed.



- Before inputting the VIN, confirm the VIN again because the programmed VIN cannot be changed.



- Turn the ignition switch OFF, then back ON.

All New Technical Service Bulletins (itype_432)

Tsbs

- ECU SOFTWARE UPDATE – OBD-II FUEL SYSTEM READINESS MONITOR DIAGNOSIS (SERVICE CAMPAIGN 968) (25-01-054H, 2025/08/19)

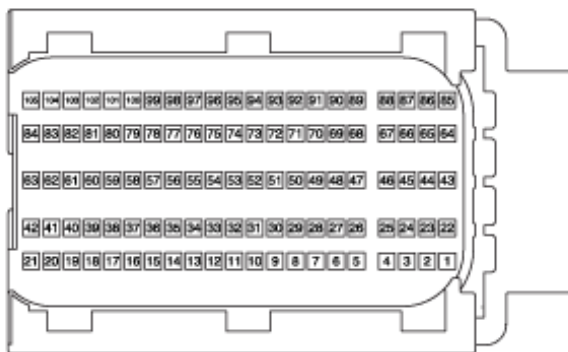
All Technical Service Bulletins (itype_100)

Tsbs

- ECM AND PCM VIN WRITING DURING CONTROL MODULE REPLACEMENT (19-FL-003H, 2019/04/16)
- ECM SOFTWARE UPDATE – MISFIRE DTC LOGIC (SERVICE CAMPAIGN T3W) (20-01-008H, 2020/02/14)
- ECU SOFTWARE UPDATE – OBD-II FUEL SYSTEM READINESS MONITOR DIAGNOSIS (SERVICE CAMPAIGN 968) (25-01-054H, 2025/08/19)
- ENGINE MONITORING LOGIC (SERVICE CAMPAIGN 974) (22-01-043H, 2022/05/09)

Engine Control Module (ECM) - Schematic Diagrams (Article 44191)

- ECM Terminal And Input/Output signal
Harness Connector



Connector [C300-A]



Connector [C300-B]

ECM Terminal Function

Connector [C300-A]

Pin No Description Connected to

1 -

2 ETC Motor [+] control output ETC Motor

3 -
4 Motor [-] control output Variable Charge Motion Actuator (VCMA)
5 -
6 -
7 -
8 -
9 -
10 Clutch switch signal input [M/T] Clutch switch
11 -
12 -
13 -
14 -
15 Sensor ground Engine Coolant Temperature Sensor (ECTS)
16 Engine Coolant Temperature Sensor (ECTS) signal input Engine Coolant Temperature Sensor (ECTS)
17 Throttle Position Sensor (TPS) 2 signal input Throttle Position Sensor (TPS) 2
18 -
19 -
20 -
21 Sensor power (+5V) Manifold Absolute Pressure Sensor (MAPS)
Camshaft Position Sensor (CMPS) [Bank 1/ Intake]
22 -
23 ETC Motor [-] control output ETC Motor
24 -
25 Motor [+] control output Variable Charge Motion Actuator (VCMA)
26 -
27 -
28 -
29 -
30 -
31 Electrical load signal input Alternator
32 -
33 -
34 -
35 -
36 -
37 Sensor ground Throttle Position Sensor (TPS) 1, 2
38 Throttle Position Sensor (TPS) 1 signal input Throttle Position Sensor (TPS) 1
39 -
40 Alternator PWM control output Alternator
41 -
42 Sensor power (+5V) Throttle Position Sensor (TPS) 1, 2
43 -
44 -
45 -
46 -
47 -
48 -
49 -
50 -
51 -
52 -
53 -
54 VCMA Feedback ground Variable Charge Motion Actuator (VCMA)
55 -
56 Sensor ground Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust]
57 -
58 -
59 -
60 -
61 Sensor ground Manifold Absolute Pressure Sensor (MAPS)

62 Manifold Absolute Pressure Sensor (MAPS) signal input Manifold Absolute Pressure Sensor (MAPS)
63 Sensor power (+5V) Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust]
Variable Charge Motion Actuator (VCMA)
65 -
66 -
67 -
68 -
69 -
70 -
71 -
72 -
73 -
74 Sensor ground Crankshaft Position Sensor (CKPS)
75 -
76 VCMA Feedback signal input Variable Charge Motion Actuator (VCMA)
77 Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input Camshaft Position Sensor (CMPS) [Bank 1/
Exhaust]
78 Sensor ground Camshaft Position Sensor (CMPS) [Bank 1/ Intake]
79 -
80 -
81 -
82 -
83 VG (Virtual Ground) Heated Oxygen Sensor [Bank 1/ Sensor 1]
84 VRC (Current Adjust) Heated Oxygen Sensor [Bank 1/ Sensor 1]
85 -
86 -
87 -
88 -
89 -
90 -
91 -
92 -
93 -
94 -
95 Crankshaft Position Sensor (CKPS) signal input Crankshaft Position Sensor (CKPS)
96 -
97 -
98 Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input Camshaft Position Sensor (CMPS) [Bank
1/Intake]
99 Sensor ground Knock Sensor (KS)
100 Knock Sensor (KS) signal input Knock Sensor (KS)
101 Intake Air Temperature Sensor (IATS) signal input Intake Air Temperature Sensor (IATS)
102 -
103 -
104 VN (NERNST Cell Voltage) Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1]
105 VIP (Current Pump) Heated Oxygen Sensor [Bank 1/ Sensor 1]
Connector [C300-B]
1 Power ground Chassis Ground
2 Power ground Chassis Ground
3 Battery power (B+) Main Relay
4 Power ground Chassis Ground
5 Battery power (B+) Main Relay
6 Battery power (B+) Main Relay
8 FLEX-RAY (High) Other control module , Data Link Connector (DLC)
10 Accelerator Position Sensor (APS) 2 signal input Accelerator Position Sensor (APS) 2
11 A/C Pressure Transducer (APT) signal input A/C Pressure Transducer (APT)
14 Sensor power (+5V) A/C Pressure Transducer (APT)
Fuel Tank Pressure Sensor (FTPS)
15 -
16 Sensor power (+5V) Accelerator Position Sensor (APS) 2

17 Sensor power (+5V) Accelerator Position Sensor (APS) 1
18 Main Relay control output Main Relay
19 Fuel Pump Relay control output Fuel Pump Relay
21 -
22 Injector (Cylinder #2) control output Injector (Cylinder #2)
23 Injector (Cylinder #3) control output Injector (Cylinder #3)
25 FLEX-RAY (Low) Other control module, Data Link Connector (DLC)
26 Electrical signal input [Blower Max. Switch] Heater & A/C Control module
27 Accelerator Position Sensor (APS) 1 signal input Accelerator Position Sensor (APS) 1
28 Sensor ground Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2]
29 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] signal input Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2]
30 Fuel Tank Pressure Sensor signal input Fuel Tank Pressure Sensor (FTPS)
31 -
34 Start Motor relay control output Start Motor relay
35 CVVT Oil Control (OCV) Valve [Bank 1/ Exhaust] control output CVVT Oil Control Valve (OCV) [Bank 1/ Exhaust]
36 CVVT Oil Control (OCV) Valve [Bank 1/ Intake] #1 control output CVVT Oil Control Valve (OCV) [Bank 1/ Intake] #1
37 -
38 A/C Relay control output A/C Relay
39 Injector (Cylinder #4) control output Injector (Cylinder #3)
40 Ignition Coil (Cylinder #2) control output Ignition Coil (Cylinder #2) [NON-Immobilizer type]
Ignition Coil (Cylinder #3) control output Ignition Coil (Cylinder #3) [Immobilizer type]
41 Battery power (B+) Ignition Switch
42 -
45 Sensor ground Accelerator Position Sensor (APS) 1
46 Sensor ground Accelerator Position Sensor (APS) 2
47 Sensor ground Fuel Tank Pressure Sensor (FTPS)
50 Sensor ground A/C Pressure Transducer (APT)
54 Canister Close Valve (CCV) control output Canister Close Valve (CCV)
55 CVVT Oil Control (OCV) Valve [Bank 1/ Intake] #2 control output CVVT Oil Control Valve (OCV) [Bank 1/Intake] #2
56 Injector (Cylinder #1) control output Injector (Cylinder #1)
57 Ignition Coil (Cylinder #1) control output Ignition Coil (Cylinder #1) [Immobilizer type]
Ignition Coil (Cylinder #4) control output Ignition Coil (Cylinder #4) [NON-Immobilizer type]
60 C- CAN [Low] Other control module, Data Link Connector (DLC)
61 Fuel Tank Level Sensor signal input Fuel Tank Level Sensor (FLS)
62 -
63 -
64 -
65 Brake Light Switch signal input Brake Switch
66 Start signal input Ignition Sw itch
67 Engine speed signal output Power Distribution Module (PDM)
68 Immobilizer communication line Immobilizer control module
71 Purge Control Solenoid Valve (PCSV) control output Purge Control Solenoid Valve (PCSV)
72 Electronic Thermo Sensor signal input Electronic Thermo Sensor
73 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1] Heater control output Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1]
74 Ignition Coil (Cylinder #2) control output Ignition Coil (Cylinder #2) [NON-Immobilizer type]
76 -
77 C-CAN [High] Other control module, Data Link Connector (DLC)
78 -
79 Vehicle speed signal input ABS/ESC Control Unit
80 Electrical load signal input [Wiper] Wiper [High] Relay
83 Brake Test Switch signal input Brake Switch
84 -
85 LIN communication Battery Sensor
86 Cooling Fan Relay [Low] control output Cooling Fan Relay [Low]
87 Cooling Fan Relay [High] control output Cooling Fan Relay [High]
88 Variable Intake Solenoid (VIS) Valve control output Variable Intake Solenoid (VIS) Valve

90 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] Heater control output Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2]

91 Ignition Coil (Cylinder #1) control output Ignition Coil (Cylinder #1) [NON-Immobilizer type]

Ignition Coil (Cylinder #4) control output Ignition Coil (Cylinder #4) [Immobilizer type]

ECM Terminal Input/Output signal

Pin No Description Condition Type Level

2 ETC Motor [+] control output Idle PWM Operating freq. : 1000 Hz (estimated)

Forward direction

Turn on : Battery voltage

Frewheeling : Max. 0.1V

Reverse direction

Turn on : Max. 0.1V

4 Motor [-] control output

10 Clutch switch signal input [M/T] Swich ON Digital Min. -0.3V - Max. 0.5V

Switch OFF Battery voltage

15 Sensor ground Idle DC Max. 0.5V

16 Engine Coolant Temperature Sensor (ECTS) signal input Idle Analog Min. 0.1V - Max

17 Throttle Position Sensor (TPS) 2 signal input Idle Analog Min. 0.4V - Max. 4.5V

21 Sensor power (+5V) IG OFF DC voltage Max. 0.5V

IG ON 4.9 - 5.1V

23 ETC Motor [-] control output Idle PWM Operating freq. : 1000 Hz (estimated)

Turn on : max 0.1V

Frewheeling : max 0.1V

Reverse direciton

25 Motor [+] control output

31 Electrical load signal input Idle PWM Freq. : 125 Hz or 200 Hz or 60 Hz

Duty rate 0% - 100%

37 Sensor ground Idle DC Max. 0.5V

38 Throttle Position Sensor (TPS) 1 signal input Idle Analog Min. 0.4V - Max. 4.5V

40 Alternator PWM control output IG OFF PWM Battery voltage

IG ON Max. 0.5V

42 Sensor power (+5V) IG OFF DC Max. 0.5V

IG ON Min. 4.75V - Max. 5.25V

54 VCMA Feedback ground

56 Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust] signal input Idle Pulse Around 7 Hz at 850 rpm

Around 25 Hz at 3000 rpm

61 Sensor ground Idle DC Max. 0.5V

62 Manifold Absolute Pressure Sensor (MAPS) signal input Idle Analog Min. 0.8V - Max. 4.2V

63 Sensor power (+5V) IG OFF DC voltage Max. 0.5V

74 Sensor ground Idle DC Max. 0.5V

76 VCMA Feedback signal input

77 Camshaft Position Sensor (CMPS) [Bank 1/ Exhaust] signal input Idle Pulse Around 7 Hz at 850 rpm

78 Sensor ground Idle DC Max. 0.5V

83 VG (Virtual Ground) Idle Analog Min. 0.2V - Max. 5.2V

84 VN (NERNST Cell Voltage) Idle Analog Min. 0.2V - Max. 5.2V

95 Crankshaft Position Sensor (+) signal input Idle Frequency Vpp Min. : 18V at Idle (for 1 rail)

Vpp Max. : 90V at 5000 rpm (for 1 rail)

98 Camshaft Position Sensor (CMPS) [Bank 1/ Intake] signal input Idle Pulse Around 7 Hz at 850 rpm

99 Sensor ground Idle DC Max. 0.5V

100 Knock Sensor (KS) signal input Idle Analog / Frequency Freq. : Min. 8 kHz - Max. 12 kHz

Level : Min. 180 - Max. 300 mVpp

101 Intake Air Temperature Sensor (IATS) signal input Idle Analog Min. 0.1V - Max. 4.7V

104 VN (NERNST Cell Voltage) Idle Analog Min. 0.2V - Max. 5.2V

105 VIP (Current Pump) Idle Analog Min. 0.2V - Max. 5.2V

1 Power ground Idle DD Mx 0Va.5m

2 Power ground Idle DC Max. 50 mV

3 Battery power (B+) IG OFF DC Max. 0.5V

IG ON Battery Voltage

4 Power ground Idle DC Max. 50 mV

5 Battery power (B+) IG OFF DC Max. 0.5V

6 Battery power (B+) IG OFF DC Max. 0.5V
8 FLEX-RAY (High)
10 Accelerator Position Sensor (APS) 2 signal input Idle Analog Min. 0.6V - Max. 4.3V
11 A/C Pressure Transducer (APT) signal input
14 Sensor power (+5V) IG OFF DC Max. 0.5V
16 Sensor power (+5V) IG OFF DC Max. 0.5V
17 Sensor power (+5V) IG OFF DC Max. 0.5V
18 Main Relay control output Relay OFF DC Battery Voltage
Relay ON Min. -0.3V -Max. 1.2V
19 Fuel Pump Relay control output Relay OFF DC Battery Voltage
22 Injector (Cylinder #2) control output Idle DC High : Battery voltage
Low : Max. 0.5V
48 - 50V
23 Injector (Cylinder #3) control output Idle DC High : Battery voltage
25 FLEX-RAY (Low)
26 Electrical signal input [Blower Max. Switch]
27 Accelerator Position Sensor (APS) 1 signal input Idle Analog Min. 0.6V - Max. 4.3V
28 Sensor ground Idle DC Max. 50 mV
29 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] signal input Idle Analog Min. 0.6V - Max. 1.0V
DC
30 Fuel Tank Pressure Sensor signal input
34 Start Motor control switch Switch ON Digital Battery voltage
Switch OFF Min. -0.3V - Max. 0.5V
35 CVVT Oil Control (OCV) Valve [Bank 1/ Exhaust] control output Idle PWM Operating freq. range : 300 Hz
Duty rate : 0% - 100%
36 CVVT Oil Control (OCV) Valve [Bank 1/ Intake] #1 control output Idle PWM Operating freq. range : 300 Hz
38 A/C Relay control output Relay OFF DC Battery Voltage
39 Injector (Cylinder #4) control output Idle DC High : Battery voltage
40 Ignition Coil (Cylinder #2) control output Idle Pulse Turn on : Max. 1.6V
Ignition Coil (Cylinder #3) control output Turn off : Battery voltage
41 Battery power (B+) IG OFF DC Max. 0.5V
45 Sensor ground Idle DC Max. 50 mV
46 Sensor ground Idle DC Max. 50 mV
47 Sensor ground Idle DC Max. 50 mV
50 Sensor ground Idle DC Max. 50 mV
54 Canister Close Valve (CCV) control output
55 CVVT Oil Control (OCV) Valve [Bank 1/Intake] #2 control output
56 Injector (Cylinder #1) control output Idle DC High : Battery voltage
57 Ignition Coil (Cylinder #1) control output Idle Pulse Turn on : Max. 1.6V
Ignition Coil (Cylinder #4) control output Turn off : Battery voltage
60 C-CAN [Low] RECESSIVE Pulse 2.0 - 3.0V
DOMINANT 0 - 0.5V
61 Fuel Tank Level Sensor signal input
65 Brake Light Switch signal input Switch ON Digital Battery voltage
66 Start signal input
67 Engine speed signal output Idle Frequency Around 26 Hz at 850 rpm, idle
Around 16 Hz at 3000 rpm
68 Immobilizer communication line When Pulse High : Min. 8.5V
communicating
after IG ON
Low : Max. 3.5V
71 Purge Control Solenoid Valve (PCSV) control output Relay OFF DC Battery voltage
Relay ON Max. 1.76V
72 Electronic Thermo Sensor signal input
73 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 1] Heater control output Relay OFF DC Battery voltage
Relay ON Max. 0.5V
74 Ignition Coil (Cylinder #2) control output Idle Pulse Turn on : Max. 1.6V
77 C-CAN [High] RECESSIVE Pulse 2.0 - 3.0V
DOMINANT 2.75 - 4.5V
79 Vehicle speed signal input Idle Frequency Duty rate 40% - 60%

80 Electrical load signal input [Wiper]
83 Brake Test Switch signal input Swich ON Digital Battery voltage
85 LIN communication
86 Cooling Fan Relay [Low] control output IG OFF PWM Battery voltage
IG ON Min. -0.3V - Max. 1.2V
87 Cooling Fan Relay [High] control output IG OFF DC Battery voltage
88 Variable Intake Solenoid (VIS) Valve control output
90 Heated Oxygen Sensor (HO2S) [Bank 1/ Sensor 2] Heater control output Relay OFF DC Battery voltage
91 Ignition Coil (Cylinder #1) control output Idle Pulse Turn on : Max. 1.6V

OEM Policies and Procedures (itype_120)

Tsbs

- ECM AND PCM VIN WRITING DURING CONTROL MODULE REPLACEMENT (19-FL-003H, 2019/04/16)

Service Campaigns (itype_108)

Tsbs

- ECM SOFTWARE UPDATE – MISFIRE DTC LOGIC (SERVICE CAMPAIGN T3W) (20-01-008H, 2020/02/14)
- ECU SOFTWARE UPDATE – OBD-II FUEL SYSTEM READINESS MONITOR DIAGNOSIS (SERVICE CAMPAIGN 968) (25-01-054H, 2025/08/19)
- ENGINE MONITORING LOGIC (SERVICE CAMPAIGN 974) (22-01-043H, 2022/05/09)