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Engine Control System (G4NB/G4NA : NU 1.8L/2.0L MPI)

Service Tips (1)

Circuit Description

The components (sensors, actuators, PCM, injector, etc.) of an engine control module wait in standby when the ignition switch is turned on. The engine is started when the ignition switch is started and exchanges signals with the engine control components (sensor and actuator) continuously or discretely to control fuel injection. It adjusts the injector operation time based on the ratio of the cylinder intake air flow and the air-to-fuel ratio in order to improve the fuel economy, reduce the amount of exhaust gas, and increase the engine's performance. The roles and functions of each component are described below.

PCM Terminal Input/ Output signal

• Connector [C200-A]

Pin No.	Description	Condition	Type	In/Output Signal
				Level
1	[A/T] Overdrive clutch control solenoid valve (OD/C_VFS)	-	Output	0V/Battery voltage level
				9V < Battery voltage level < 16V
				Power supply : V_SOL1
2	ETC Motor [+] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction
				Turn on: Battery voltage
				Frewheeling: Max. 0.1V
				Reverse direction
4	-	-	-	Turn on: Max. 0.1V
				Frewheeling: Max. 0.1V
				-
5	[A/T] Torque converter control solenoid valve (T/CON_VFS)	-	Output	0V/Battery voltage level
				9V < Battery voltage level < 16V
6	[A/T] Line pressure control solenoid valve (LINE_VFS)	-	Output	0V/Battery voltage level
				9V < Battery voltage level < 16V
7	[A/T] 26 brake control solenoid valve (26B_VFS)	-	Output	0V/Battery voltage level
				9V < Battery voltage level < 16V
				Power supply : V_SOL2

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
8	[A/T] Inhibitor switch signal "S2"	High	Input	0V/Battery voltage level
		Low		9V < Battery voltage level < 16V
9	[A/T] Sports mode down switch	Down ON	Input	0V/Battery voltage level
		Other		9V < Battery voltage level < 16V
10	[M/T] Clutch switch signal input	Switch ON	Digital	Min. -0.3V ~Max. 0.5V
		Switch OFF		Battery voltage
	[A/T] Sports mode up switch	Up ON	Input	0V/Battery voltage level
		Other		9V < Battery voltage level < 16V
11	-	-	-	-
13	Not Used	-	-	-
14	Not Used	-	-	-
15	Sensor ground	Idle	DC	Max. 50mV
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
18	-	-	-	-
20	-	-	-	-
21	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V
		IG ON		4.9 ~ 5.1V
22	[A/T] Underdrive brake control solenoid valve (UD_B_VFS)	-	Output	0V/Battery voltage level
				9V < Battery voltage level < 16V
				Power supply : V_SOL2
23	ETC Motor [-] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction
				Turn on: max 0.1V
				Frewheeling: max 0.1V
				Reverse direction
				Turn on: Battery voltage
23	ETC Motor [-] control output	Idle	PWM	Frewheeling: max 0.1V
				-

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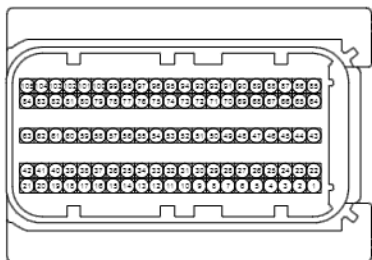
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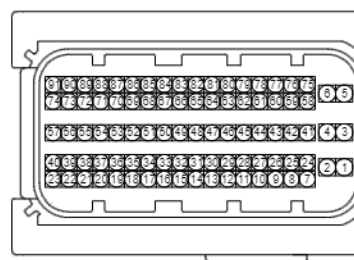
SD313-25

PCM Terminal Information



C200-A

PIN	COLOR	DESCRIPTION	PIN	COLOR	DESCRIPTION	PIN	COLOR	DESCRIPTION
1	O	[AT] VFS-OD	36	-	-	71	-	-
2	R	ETC DC Motor (+)	37	Br	TPS Ground	72	Gr	[AT] Input Speed Signal
3	-	-	38	P/B	TPS 1 Signal	73	L/O	[AT] Output Speed Power
4	-	-	39	-	-	74	G	CKP Ground
5	P	[AT] VFS T/CON	40	G	PWM Control Output	75	-	-
6	G	[AT] VFS-LINE	41	-	-	76	-	-
7	Y	[AT] VFS-26B	42	Y	TPS Supply	77	W	CAM#2 (Exhaust) Signal
8	W	[AT] Position Switch Code S2	43	R	[AT] Solenoid Power 1	78	Br	CAM#1 (Intake) Signal
9	G/O	[AT] Down Shift	44	O	[AT] Solenoid Power 2	79	-	-
10	L, W	[AT] Up Shift, [MT] Clutch S	45	B	Ground	80	-	-
11	-	-	46	B	Ground	81	-	-
12	-	-	47	W	[AT] SS-B	82	-	-
13	Gr	Not Used	48	B	[AT] SS-A	83	W	Oxygen Sensor (Up) - VG
14	G	Not Used	49	G	[AT] Oil Temp. Sensor (-)	84	R	Oxygen Sensor (Up) - VRG
15	L/O	ECT Sensor Ground	50	-	-	85	R	[AT] Memory Power
16	Y	ECT Sensor Signal	51	-	-	86	-	-
17	L/O	TPS 2 Signal	52	-	-	87	-	-
18	-	-	53	-	-	88	-	-
19	-	-	54	-	-	89	-	-
20	-	-	55	B	Not Used	90	-	-
21	L/O	MAP Sensor Power	56	Y	CAM#2 (Exhaust) Ground	91	L	[AT] Oil Temp. Sensor (+)
22	L	[AT] VFS-UD	57	-	-	92	O	[AT] Output Speed Signal
23	W	ETC DC Motor (-)	58	-	-	93	Gr	[AT] Position Switch Code S4
24	-	-	59	-	-	94	R/B	[AT] Input Speed Power
25	-	-	60	Y	Oxygen Sensor (Up) Ground	95	O	CKP Signal
26	G	[AT] VFS 35R	61	B	MAP Sensor Ground	96	-	-
27	L	[AT] Position Switch Code S1	62	Gr	MAP Sensor Signal	97	Br	Not Used
28	-	-	63	G/O	CAM#1 (Intake) Supply	98	G	CAM#1 (Intake) Ground
29	-	-	64	R	[AT] Memory Power	99	G	Knock Sensor Ground
30	Y	[AT] Select Switch	65	-	-	100	W	Knock Sensor Signal
31	L/O	Electrical Load Signal	66	-	-	101	G	Air Temp. Input
32	-	-	67	-	-	102	-	-
33	-	-	68	-	-	103	Gr/O	Oxygen Sensor (Up) Signal
34	Br	Not Used	69	-	-	104	Br	Oxygen Sensor (Up) - VN
35	Gr	Not Used	70	R	[AT] Position Switch Code S3	105	L	Oxygen Sensor (Up) - VP



C200-B

PIN	COLOR	DESCRIPTION	PIN	COLOR	DESCRIPTION	PIN	COLOR	DESCRIPTION
1	B	Ground	30	-	-	61	Br/O	Fuel Tank Level Sender
2	B	Ground	31	-	-	62	G	Oxygen Sensor (Down) Ground
3	R	Engine Control Relay ON Input	32	-	-	63	-	-
4	B	Ground	33	-	-	64	Br	A/C Compressor Switch
5	R	Engine Control Relay	34	G	Start Relay Control	65	L	Brake Light Switch
6	R	ON InputR	35	Y	OCV#2 Control (Exhaust)	66	W	Start Switch Input
7	B	Wheel Speed Sensor (+)	36	G	OCV#1 Control (Intake)	67	G	Engine RPM Output
8	W	Flexray High	37	-	-	68	L/O	IMMO. Communication Line
9	-	-	38	G	A/C COMP Relay	69	-	-
10	L/O	APS #2 Signal	39	L	Injector #4 Control	70	-	-
11	Gr/B	APT Signal	40	B	Ignition Coil #2	71	L	PCSV Control
12	-	-	41	R	ON/START Input	72	-	-
13	G/O	Not Used	42	-	-	73	Y/Br	Oxygen Sensor (Up) Heater
14	O	APT Power	43	-	-	74	W	Ignition Coil #3
15	-	-	44	-	-	75	R	[AT] Memory Power
16	R	APS #2 Supply	45	B	APS #1 Ground	76	G	CCP-CAN High
17	Y	APS #1 Supply	46	Br/B	APS #2 Ground	77	W	C-CAN High
18	W	Engine Control Relay Control	47	-	-	78	-	-
19	Gr/O	F/PUMP Relay Control	48	-	-	79	Y	Vehicle Speed Input
20	Gr	Not Used	49	-	-	80	-	-
21	G	Not Used	50	Br	APT Ground	81	R	Not Used
22	B	Injector #2 Control	51	W	Not Used	82	L	A/C Request Switch
23	W	Injector #3 Control	52	-	-	83	L/O	Brake Test Switch
24	W	Wheel Speed Sensor (-)	53	-	-	84	-	-
25	Br	Flexray Low	54	-	-	85	Br	Not Used
26	O	Blower MAX Singal Input	55	-	-	86	L	C/FAN Relay Control (Low)
27	G	APS #1 Signal	56	G	Injector #1 Control	87	W	C/FAN Relay Control (High)
28	G	Oxygen Sensor (Down) Ground	57	R	Ignition Coil #4	88	Gr	VSV Control
29	Br	Oxygen Sensor (Down) Signal	58	Br	Oxygen Sensor (Down) Signal	89	-	-
			59	O	CCP-CAN Low	90	G	Oxygen Sensor (DN) Heater
			60	Br	C-CAN Low	91	G	Ignition Coil #1

※ [AT] : See Automatic Transaxle Control System (SD450)

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Engine Control System (G4NB/G4NA : NU 1.8L/2.0L MPI)

Service Tips (2)

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
24	-	-	-	-
25	-	-	-	-
26	[A/T] 35R clutch control solenoid valve (35R/C_VFS)	-	Output	0V/Battery voltage level 9V < Battery voltage level < 16V
27	[A/T] Inhibitor switch signal "S1"	High Low	Input	0V/Battery voltage level 9V < Battery voltage level < 16V
28	-	-	-	-
29	-	-	-	-
30	[A/T] Sports mode select switch	Sport mode Other	Input	0V/Battery voltage level 9V < Battery voltage level < 16V
31	Electrical load signal input	Idle	PWM	Freq.: 125Hz or 200Hz or 60Hz Duty rate 0% ~ 100%
32	-	-	-	-
33	-	-	-	-
34	Not Used	-	-	-
35	Not Used	-	-	-
36	-	-	-	-
37	Sensor ground	Idle	DC	Max. 50mV
38	Throttle Position Sensor (TPS) 1 signal input	Idle	Analog	Min. 0.4V ~ Max. 4.5V
39	-	-	-	-
40	Alternator PWM control output	IG OFF IG ON	PWM	Battery voltage Max. 0.5V
41	-	-	-	-
42	Sensor power (+5V)	IG OFF IG ON	DC	Max. 0.5V Min. 4.75V ~ Max. 5.25V
43	[A/T] Solenoid supply power 1	ON OFF	Power	0V/Battery voltage level 9V < Battery voltage level < 16V
44	[A/T] Solenoid supply power 2	ON OFF	Power	0V/Battery voltage level 9V < Battery voltage level < 16V

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
45	Power ground	Idle	DC	Max. 50mV
46	Power ground	Idle	DC	Max. 50mV
47	[A/T] ON/OFF solenoid valve B (SS-B)	High Low	Output	0V/Battery voltage level 9V < Battery voltage level < 16V
48	[A/T] ON/OFF solenoid valve A (SS-A)	High Low	Output	0V/Battery voltage level 9V < Battery voltage level < 16V
49	[A/T] Oil temperature sensor (-)	-	Ground	0V
50	-	-	-	-
55	-	-	-	-
56	Sensor ground	Idle	DC	Max. 50mV
57	-	-	-	-
59	-	-	-	-
60	Sensor ground	Idle	DC	Max. 50mV
61	Sensor ground	Idle	DC	Max. 50mV
62	Manifold Absolute Pressure Sensor (MAPS) signal input	Idle	Analog	Min. 0.8V ~ Max. 4.2V
63	Sensor power (+5V)	IG OFF IG ON	DC voltage	Max. 0.5V 4.9 ~ 5.1V
64	[A/T] Battery power (B+)	ON OFF	Power	0V/Battery voltage level 9V < Battery voltage level < 16V
65	-	-	-	-
67	-	-	-	-
69	-	-	-	-
70	[A/T] Inhibitor switch signal "S3"	High Low	Input	0V/Battery voltage level 9V < Battery voltage level < 16V
71	-	-	-	-
72	[A/T] Input speed sensor signal	High Low	Input	0.7V/1.4V
73	[A/T] Output speed sensor power	ON OFF	Power	0V/7.5V

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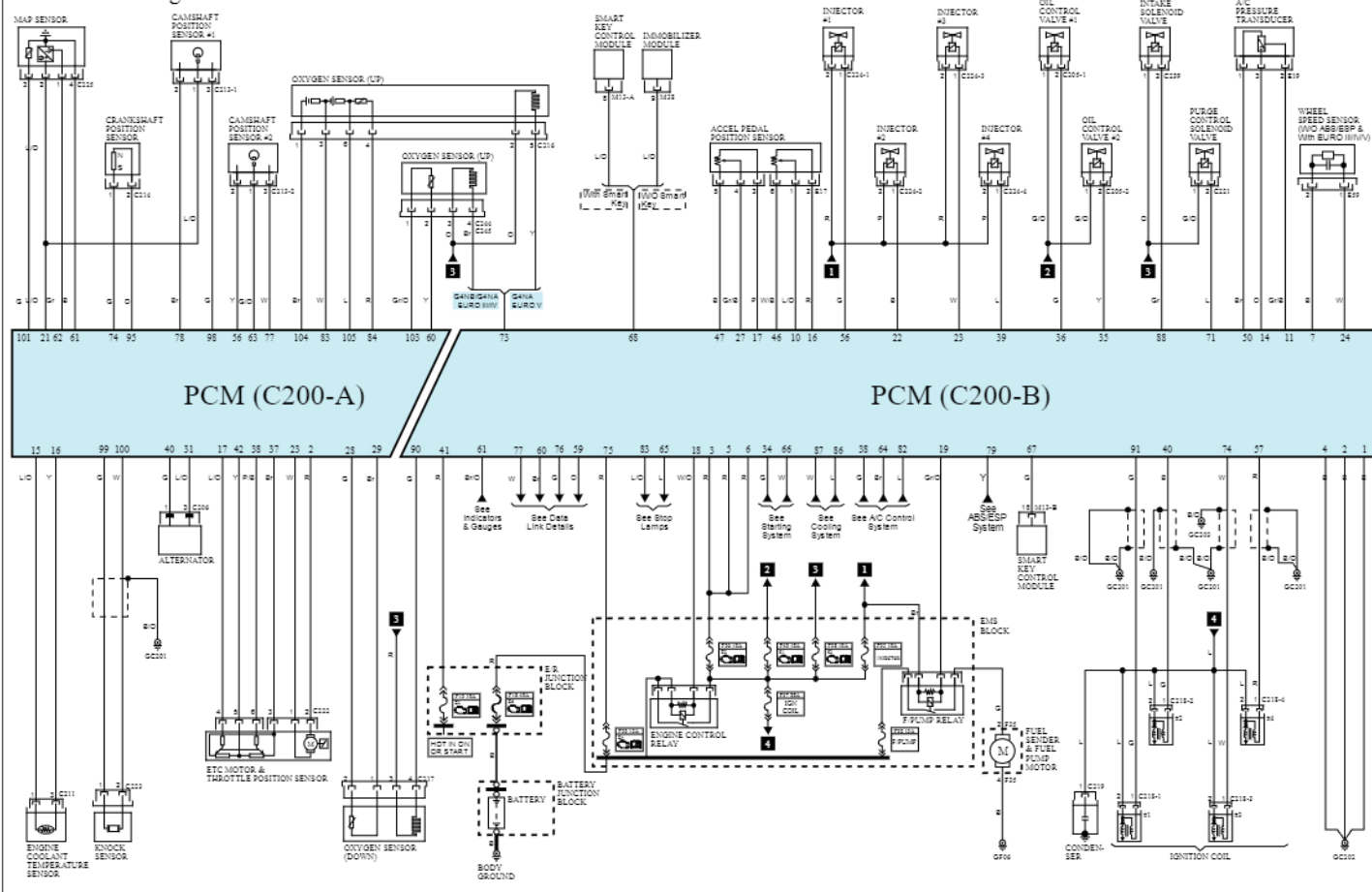
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Engine Control System (G4NB/G4NA : NU 1.8L/2.0L MPI) (2)

SD313-26

Full Circuit Diagrams



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Engine Control System (G4NB/G4NA : NU 1.8L/2.0L MPI)

Service Tips (3)

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
74	Sensor ground	Idle	DC voltage	Max. 50mV
75	-	-	-	-
76	-	-	-	-
77	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	Around 7Hz at 850rpm Around 25Hz at 3000rpm
78	Sensor ground	Idle	DC	Max. 50mV
79	-	-	-	-
80	-	-	-	-
82	-	-	-	-
83	VG (Virtual Ground)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
84	VRC (Current Adjust)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
85	[A/T] Battery power (B+)	ON	Power	0V/Battery voltage level
		OFF		9V < Battery voltage level < 16V
86	-	-	-	-
88	-	-	-	-
90	-	-	-	-
91	[A/T] Oil temperature sensor (+)	ON	Input	0V/3.3V
		OFF		0V/3.3V
92	[A/T] Output speed sensor signal	High	Input	0.7V/1.4V
		Low		0.7V/1.4V
93	[A/T] Inhibitor switch signal "S4"	High	Input	0V/Battery voltage level
		Low		9V < Battery voltage level < 16V
94	[A/T] Input speed sensor power	ON	Power	0V/7.5V
		OFF		0V/7.5V
95	Crankshaft Position Sensor (+) signal input	Idle	Frequency	Vpp Min. : 18V at Idle (for 1 rail) Vpp Max. : 90V at 5000rpm (for 1 rail)
96	-	-	-	-
97	-	-	-	-
98	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	Around 7Hz at 850rpm Around 25Hz at 3000rpm

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
99	Sensor ground	Idle	DC voltage	Max. 50mV
100	Knock Sensor (KS) signal input	Idle	Analog/ Frequency	Freq. : Min. 8KHz ~ Max. 12KHz Level : Min. 180 ~ Max. 300mVpp
101	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	Min. 0.1V ~ Max. 4.7V
102	-	-	-	-
103	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	Engine Running	Analog	Rich: 0.6 ~ 1.0V Lean: Max. 0.4V
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

• Connector [C200-B]

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
1	Power ground	Idle	DD	Max. 50mV
2	Power ground	Idle	DC	Max. 50mV
3	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
4	Power ground	Idle	DC	Max. 50mV
5	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
6	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
7	Wheel speed sensor signal input (A)	-	-	-
8	FLEXRAY [High]	-	-	-
9	-	-	-	-
10	Accelerator Position Sensor (APS) 2 signal input	Idle	Analog	Min. 0.3V ~ Max. 2.1V
11	A/C Pressure Transducer (APT) signal input	-	-	-

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Service Tips (4)

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
12	-	-	-	-
13	-	-	-	-
14	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V - Max. 5.25V
15	-	-	-	-
16	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V - Max. 5.25V
17	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V - Max. 5.25V
18	Main Relay control output	IG OFF	DC voltage	Min. -0.3V ~ Max. 1.2V
		IG ON		Battery Voltage
19	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Min. -0.3V - Max. 1.2V
20	-	-	-	-
21	-	-	-	-
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
				Low : Max. 0.5V
				48 ~ 50V
24	Wheel speed sensor signal input (B)	-	-	-
25	FLEXRAY [Low]	-	-	-
26	Blower Max. signal input	Idle	Analog	Min. 0.5V ~ Max. 4V
27	Accelerator Position Sensor (APS) 1 signal input	Idle	Analog	Min. 0.6V ~ Max. 4.3V
28	[EURO 5] Sensor ground	Idle	DC	Max. 50mV
29	[EURO 5] Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Idle	Analog	Min. 0.6V ~ Max. 1.0V
			DC voltage	
30	-	-	-	-

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
31	-	-	-	-
33	-	-	-	-
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 : 300Hz
				Duty rate : 0% ~ 100%
36	CVVT Oil Control (OCV) Valve [Bank 1/Intake] control output	Idle	PWM	Operating freq. range : 300Hz
				Duty rate : 0% ~ 100%
37	-	-	-	-
38	A/C Compressor Relay control output	Relay OFF	DC voltage	Battery voltage
		Relay ON		Min. -0.3V ~ Max. 1.2V
39	Injector (Cylinder #4) control output	Idle	DC voltage	High : Battery voltage
				Low : Max. 0.5V
				48 ~ 50V
40	Ignition Coil (Cylinder #2) control output	Idle	Pulse	Turn on : Max. 1.6V
	Ignition Coil (Cylinder #3) control output (With Immobilizer/Smart key)			Turn off : Battery voltage
41	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
42	-	-	-	-
44	-	-	-	-
45	Sensor ground	Idle	DC	Max. 50mV
46	Sensor ground	Idle	DC	Max. 50mV
47	-	-	-	-
49	-	-	-	-
50	Sensor ground	Idle	DC	Max. 50mV
51	-	-	-	-
53	-	-	-	-
55	-	-	-	-

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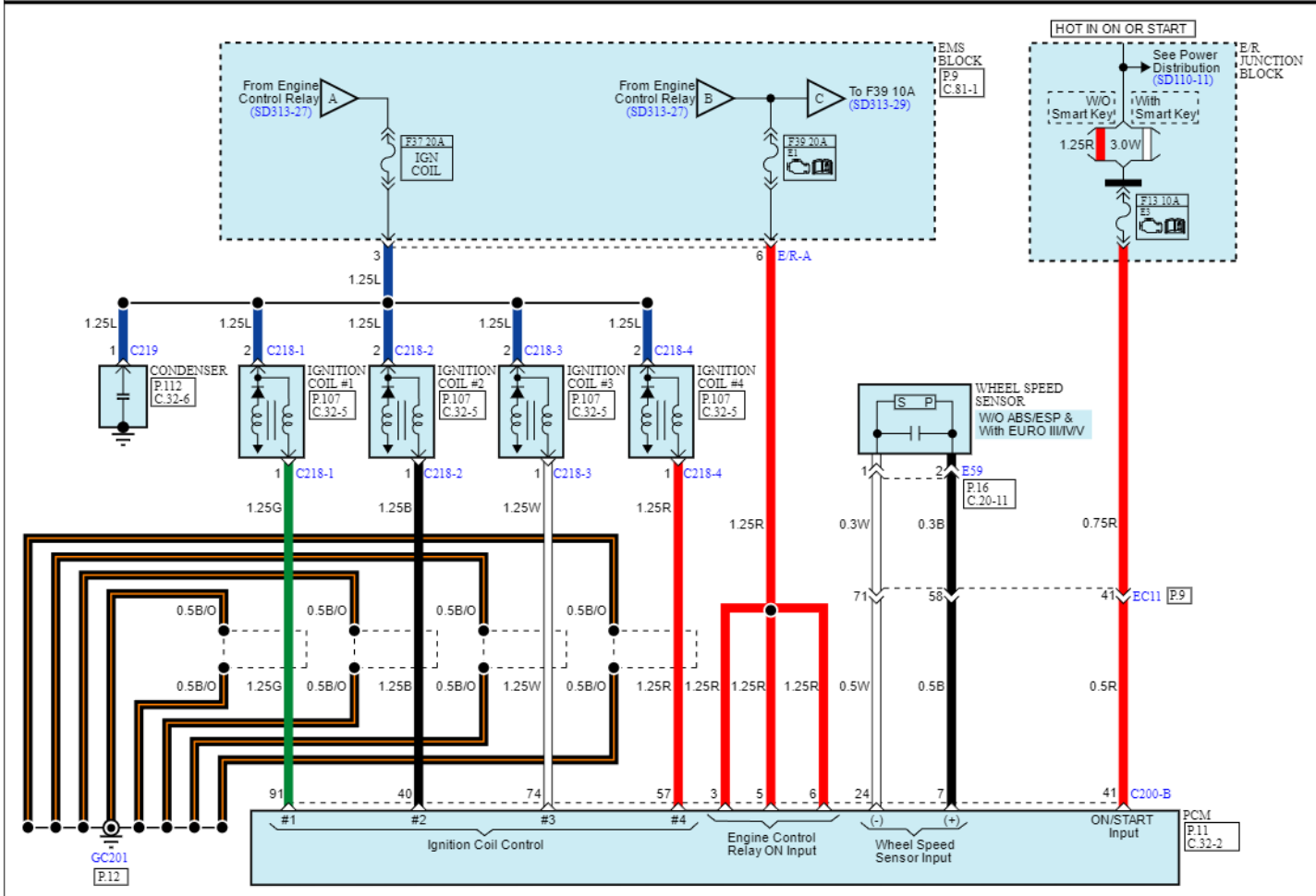
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Service Tips (5)

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
56	Injector (Cylinder #1) control output	Idle	DC voltage	High : Battery voltage
				Low : Max. 0.5V
				48 ~ 50V
57	Ignition Coil (Cylinder #4) control output (W/O Immobilizer/Smart key)	Idle	Pulse	Turn on : Max. 1.6V
	Ignition Coil (Cylinder #1) control output (With Immobilizer/Smart key)			Turn off : Battery voltage
58	[EURO 3/4] Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Idle	Analog	Min. 0.6V ~ Max. 1.0V
			DC voltage	
59	CCP-CAN [Low]	-	-	-
60	C-CAN [Low]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		0-0.5V
61	Fuel Tank Level Sender signal input	-	-	-
62	[EURO 3/4] Sensor ground	Idle	DC	Max. 50mV
63	-	-	-	-
64	A/C Compressor switch signal output	Switch ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~ Max. 0.5V
65	Brake Light Switch signal input	Switch ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~ Max. 0.5V
66	Start signal input	ON	DC	Battery voltage
		OFF		Max. 2V
67	Engine speed signal output	Idle	Frequency	Around 26Hz at 850rpm, idle
				Around 16Hz at 3000rpm
68	Immobilizer communication line	When communicating after IG ON	Pulse	High : Min. 8.5V
				Low : Max. 3.5V
69	-	-	-	-
70	-	-	-	-
71	Purge Control Solenoid Valve (PCSV) control output	Relay OFF	DC voltage	Battery voltage
		Relay ON		Max. 1.76V
72	-	-	-	-

Pin No.	Description	Condition	In/Output Signal	
			Type	Level
73	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Relay OFF	DC voltage	Battery voltage
		Relay ON		Max. 0.5V
74	Ignition Coil (Cylinder #3) control output (W/O Immobilizer/Smart key)	Idle	Pulse	Turn on : Max. 1.6V
	Ignition Coil (Cylinder #2) control output (With Immobilizer/Smart key)			Turn off : Battery voltage
75	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V
		IG ON		Battery Voltage
76	CCP-CAN [High]	-	-	-
77	C-CAN [High]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		2.75 ~ 4.5V
78	-	-	-	-
79	Vehicle speed signal input	Idle	Frequency	Duty rate 40% - 60%
80	-	-	-	-
81	-	-	-	-
82	A/C request switch signal output	Switch ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~ Max. 0.5V
83	Brake Test Switch signal input	Switch ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~ Max. 0.5V
84	-	-	-	-
85	-	-	-	-
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 voltage	Battery voltage
		IG ON		Min. -0.3V ~ Max. 1.2V
88	Variable Intake Solenoid (VS) Valve control output	-	-	-
89	-	-	-	-
90	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Relay OFF	DC voltage	Battery voltage
		Relay ON		Max. 0.5V

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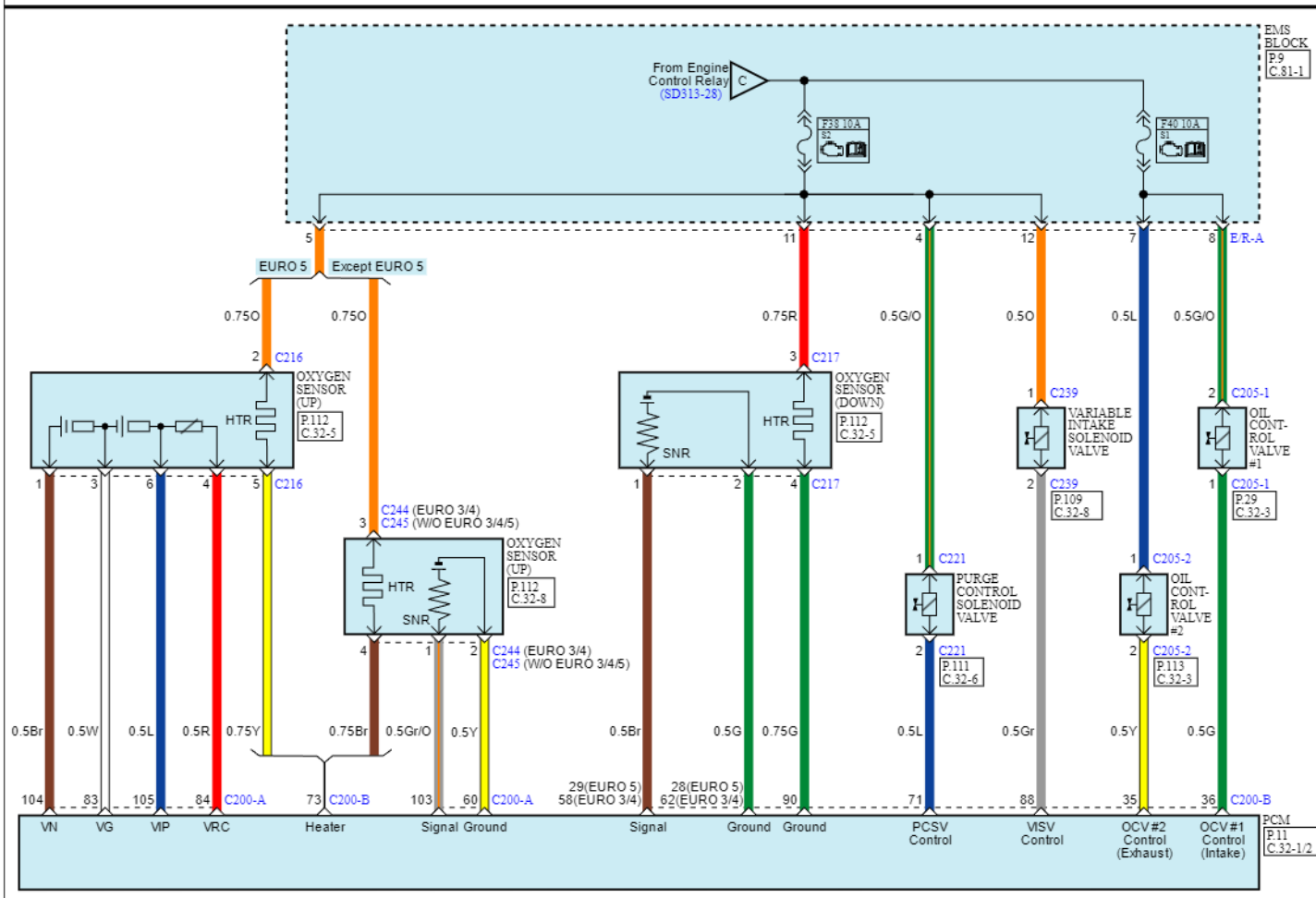
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Engine Control System (G4NB/G4NA : NU 1.8L/2.0L MPI) (5)

SD313-29



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Pin No.	Description	Condition	In/Output Signal	
			Type	Level
91	Ignition Coil (Cylinder #1) control output (W/O Immobilizer/Smart key)	Idle	Pulse	Turn on : Max. 1.6V
	Ignition Coil (Cylinder #4) control output (With Immobilizer/Smart key)			Turn off : Battery voltage

• Engine Coolant Temperature Sensor (ECTS)

The reference +5V is supplied to the ECTS via a resistor in the PCM. That is, the resistor in the PCM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes. During cold engine operation, the PCM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.

• Accelerator Pedal Position Sensor (APS)

The sensor detects the position of the accelerator pedal being stepping on to determine the driver's intention to accelerate.

As fidelity of APS is strongly required, APS is divided into two. One is APS 1, which outputs main signals and the other is APS 2, which monitors APS 1 performance. APS 1 and 2 do not share power supply and ground. Normally, APS 2 output voltage is the half of APS 1 and if the ratio of two signals is out of specified value, error is recognized.

• Vehicle Speed Signal

Information about vehicle speed is sends to PCM. Then the PCM uses this information to control the fuel injection, ignition timing, transaxle shift scheduling and torque converter clutch scheduling.

• Manifold Absolute Pressure Sensor (MAPS)

Manifold Absolute Pressure Sensor (MAPS) is a speed-density type sensor and is installed on the surge tank. It senses absolute pressure of the surge tank and transfers the analog signal proportional to the pressure to the PCM. By using this signal, the PCM calculates the intake air quantity and engine speed.

• Intake Air Temperature Sensor (IATS)

Intake Air Temperature Sensor (IATS) is included inside Manifold Absolute Pressure Sensor and detects the intake air temperature.

To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the PCM uses not only MAPS signal but also IATS signal. This sensor has a Negative Temperature Coefficient (NTC) and its resistance is in inverse proportion to the temperature.

• Knock Sensor

Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. Knock Sensor (KS) is installed on the cylinder block and senses engine knocking.

When knocking occurs, the vibration from the cylinder block is applied as pressure to the piezoelectric element. At this time, this sensor transfers the voltage signal higher than the specified value to the PCM and the PCM retards the ignition timing. If the knocking disappears after retarding the ignition timing, the PCM will advance the ignition timing. This sequential control can improve engine power, torque and fuel economy. speed or low speed. PCM stops the operation of compressor when the temperature of refrigerant line is so high or so low irregularly to optimize air conditioning system.

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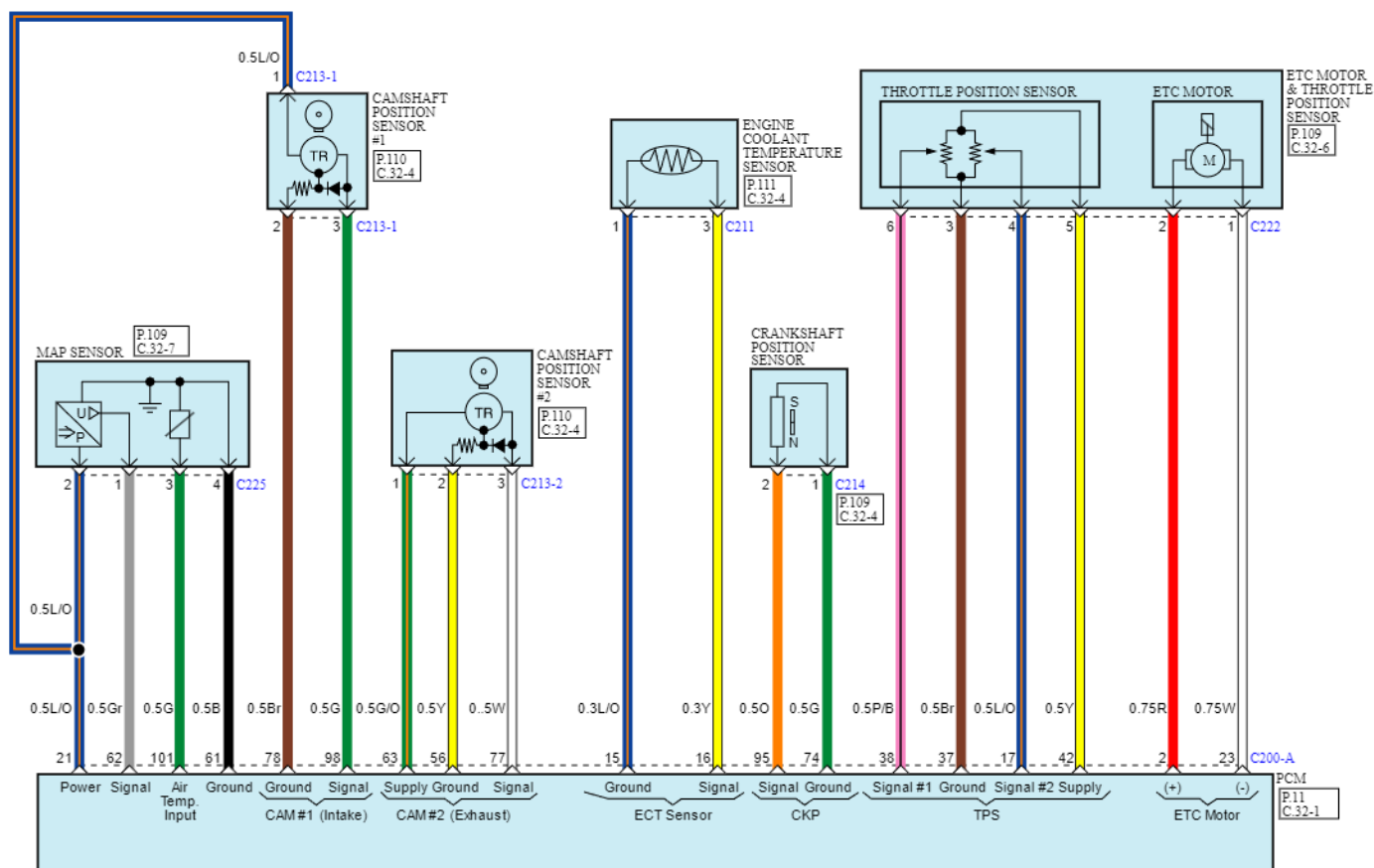
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• Ignition Coil

Ignition timing is controlled by the electronically controlled ignition module. The standard ignition timing data according to the engine condition are stored in the PCM memory. The engine operating conditions (speed, load, warm-up condition, etc.) are detected by various sensors. The module receives the primary current cut-off signal from the PCM based on such sensor signals and ignition timing data to activate the ignition coil and control the ignition timing.

• Injector

Based on information from various sensors, the PCM can calculate the fuel amount to be injected. The fuel injector is a solenoid-operated valve and the fuel injection amount is controlled by length of injection time. The PCM controls each injector by grounding the control circuit. When the PCM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the PCM deenergizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should momentarily peak.

• ETC Motor & Throttle Position Sensor

The Electronic Throttle Control (ETC) System consists of a throttle body with an integrated control motor and throttle position sensor (TPS). Instead of the traditional throttle cable, an Accelerator Position Sensor (APS) is used to receive driver input.

The PCM uses the APS signal to calculate the target throttle angle, the position of the throttle is then adjusted via PCM control of the ETC motor. The TPS signal is used to provide feedback regarding throttle position to the PCM. Using ETC, precise control over throttle position is possible and the need for external cruise control modules/cables is eliminated.

• Camshaft Position Sensor (CMPS)

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element.

It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The CMPS is installed on engine head cover and uses a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow.

• Crankshaft Position Sensor (CKPS)

Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system.

If there is no CKPS signal input, fuel is not supplied. That is, vehicle can't run without CKPS signal. This sensor is installed on the cylinder block or the transaxle housing and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when engine runs.

• Oxygen Sensor

The sensor detects the oxygen content in the exhaust gas and sends the data to the PCM. A duty control type heater is built into the oxygen sensor.

It has the function of heating the sensor tip's temperature to a certain level or higher so that the sensor will operate normally even when the exhaust gas temperature is low.

• Oil Control Valve (OCV)

The PCM controls the Oil Control Valve (OCV), based on the signals output from air flow, throttle position and engine coolant temperature. The CVVT controller regulates the camshaft angle using oil pressure through the OCV.

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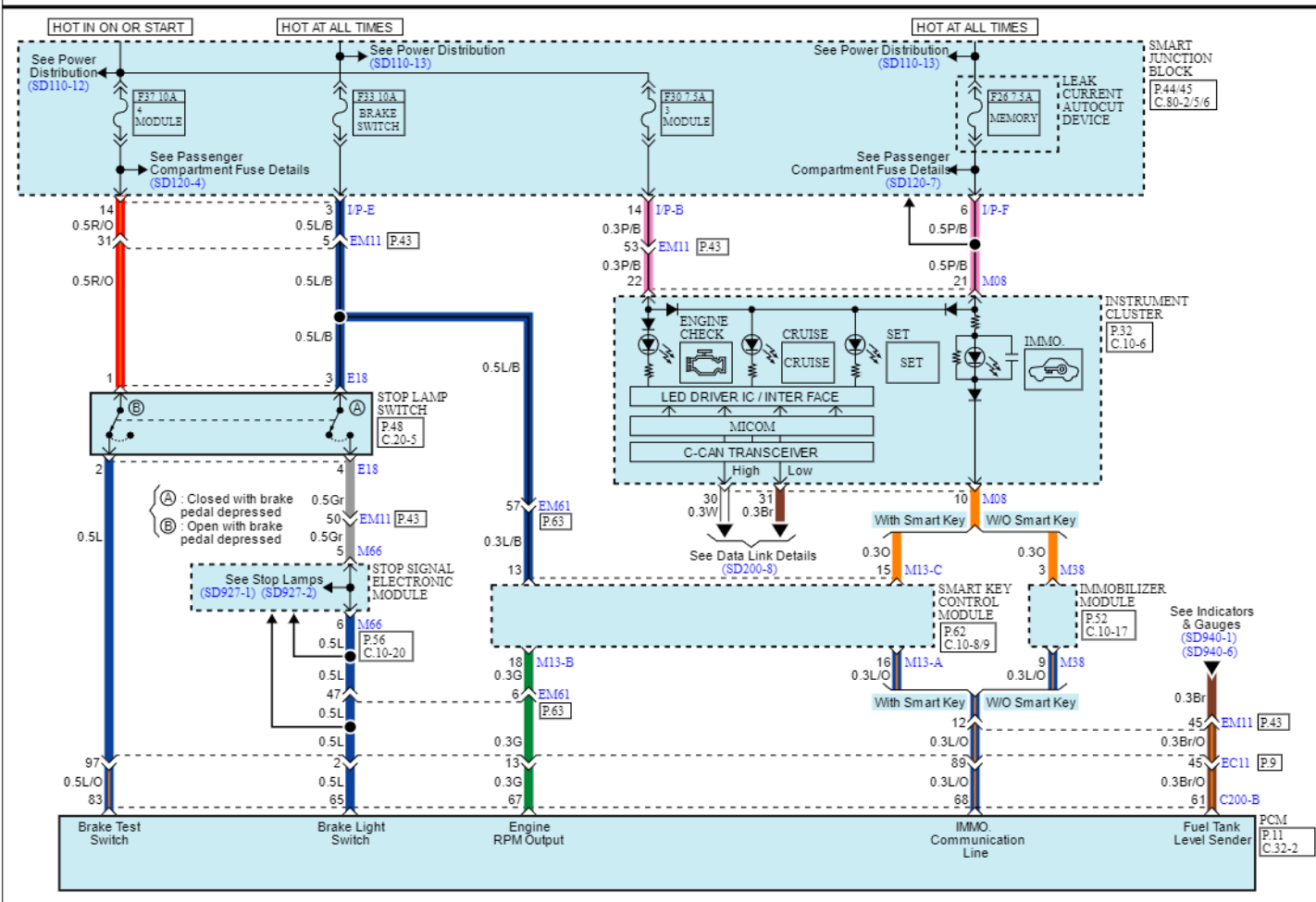
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Engine Control System (G4NB/G4NA : NU 1.8L/2.0L MPI) (7)

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• **Purge Control Solenoid Valve (PCSV)**

Purge Control Solenoid Valve (PCSV) is a solenoid valve and is installed on the surge tank and controls the passage between the canister and the intake manifold.

The evaporative gases gathered in the canister are delivered to the intake manifold when the PCSV is open by PCM control signal.

• **Variable Intake Solenoid Valve (VIS)**

Variable intake solenoid (VIS) valve is installed on the intake manifold. The VIS valve controls the vacuum modulator which activates a valve in the intake manifold. The PCM opens or closes this valve according to engine condition.

• **A/C Pressure Transducer (APT)**

A/C pressure transducer (APT) convert the pressure value of high pressure line into voltage value after measure it.

By converted voltage value, PCM controls cooling fan by operating it high speed or low speed. PCM stops the operation of compressor when the temperature of refrigerant line is so high or so low irregularly to optimize air conditioning system.

• **Stop Lamp Switch**

The PCM uses the brake signal to detect functional defects in the ETC system. To diagnose the brake switch, two signals (brake alarm switch and brake inspection switch) are used.

These two signals send opposite values depending on the brake operation. If the brake is not stepped on, the brake inspection switch sends the power voltage value while the brake alarm switch sends a 0V value. On the other hand, if the brake is stepped on, the opposite values are output.

• **Fuel Pump Relay**

The PCM provides ground to one side of the coil in the fuel pump relay to control the fuel pump relay.

The other side of the fuel pump relay coil is connected to fuel pump relay, which activates when the ignition switch is ON.

The PCM monitors the control circuit between the fuel pump relay and the PCM. When the ignition switch is turned ON, the PCM energizes the fuel pump relay, which sends power to the fuel pump.

• **Clutch Switch**

Clutch switch is connected to clutch pedal and transmits clutch operating state to PCM. Clutch operation is detected through clutch switch signal.

This signal enables PCM to cope with instant change of load condition. Besides, clutch switch signal is used to detect engaged gear with vehicle speed and engine speed.

• **Cruise IND.**

1. Cruise indicator (CRUISE) : The indicator light illuminates when the cruise control system is enabled. The cruise indicator light in the instrument cluster is illuminated when the cruise control ON-OFF button on the steering wheel is pushed. The indicator light turns off when the cruise control ON-OFF button is pushed again.

2. Cruise set indicator (SET) : The indicator light illuminates when the cruise function switch (SET- or RES+) is ON.

The cruise SET indicator light in the instrument cluster is illuminated when the cruise control switch (SET- or RES+) is pushed. The cruise SET indicator light does not illuminate when the cruise control switch (CANCEL) is pushed or the system is disengaged.

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- Cruise Remote Control Switch

Cruise control is a system that automatically controls the speed of a motor vehicle. The system takes over the throttle of the car to maintain a steady speed as set by the driver. Cruise control system will not operate below a minimum speed of 40km/h.

1. Cruise Switch (ON/OFF) : cruise control system is engaged by pressing the "ON/OFF" push button.
2. Resume Switch : increase the vehicle speed.
3. Set Switch : reduce the vehicle speed.
4. Cancel Switch : cruise control speed canceled by this switch.

- Immobilizer IND.

Immobilizer informs status of system and result of Authentication by blinking of immobilizer lamp on instrument cluster.

[With Smart Key System]

When the smart key is in the vehicle, if the ENGINE START/STOP button is in the ACC or ON position, the indicator will illuminate for approximately 30 seconds to indicate that you are able to start the engine. However, when the smart key is not in the vehicle, if the ENGINE START/STOP button is pressed, the indicator will blink for a few seconds to indicate that you are not able to start the engine. When the smart key battery is weak, if the ENGINE START/STOP button is pressed, the indicator blinks, you are not able to start the engine. However, you are able to start the engine by pressing the ENGINE START/STOP button directly with the smart key. Also, if the smart key system related parts have a problem, the indicator will blink.

[Without Smart Key System]

This indicator illuminates when the immobilizer key is inserted and turned to the ON position to start the engine. At this time, you can start the engine. The indicator goes out after approximately 30 seconds. If there's any fault in immobilizer system or in Authentication, lamp blinks after ignition "ON"

- Check Engine IND.

The Check Engine IND is lighted when there is a problem with the various sensors used by the electronic engine control system or exhaust gas control, or when an oil leak in the fuel supply system (fuel tank, fuel filter connector, fuel line, etc.) or a water leak in the evaporated gas control system (canister and connected hoses) is detected. When the Check Engine IND is lighted, the error code is saved in the PCM and the error code memorized by the PCM is not erased even when the engine is turned off.

- Self Diagnosis

The PCM exchanges signals with the engine control system's components (sensors and actuators) continuously or discretely. If an abnormal signal is generated for a certain period, the PCM acknowledges it as a problem and saves the error code in the memory. It then sends the problem signal to the data link connector output terminal. The error code is backed up by the battery so that it is not erased even when the ignition switch is turned off. However, it is erased when the battery terminal or the PCM connector is separated.

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