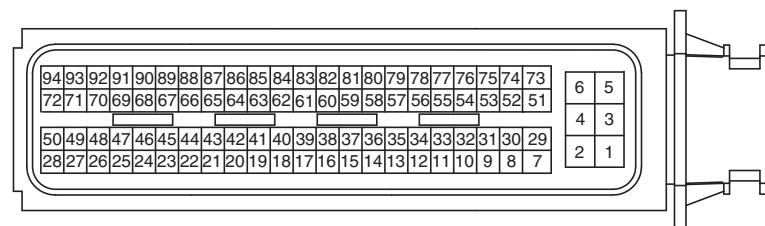
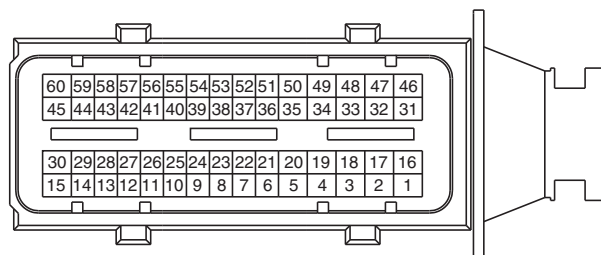


Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI) (1)

SD313-1

PCM Terminal Information



CHG-A

PIN	COLOR	DESCRIPTION	PIN	COLOR	DESCRIPTION
1	L	IGN CYL. 1 Control (W/O SMK & IMMO.)	31	P	IGN CYL. 4 Control (W/O SMK & IMMO.)
		IGN CYL. 4 Control (With SMK / IMMO.)			IGN CYL. 1 Control (With SMK / IMMO.)
2	B/O	Ignition Coil Shield Ground	32	L	[A/T]SS-B
3	L/O	[A/T]LINE_VFS	33	Gr	[A/T]SS-A
4	Y	[A/T]T/CON_VFS	34	B	[A/T]Ground
5	G	[A/T]35R_VFS	35	B	[A/T]Ground
6	R/B	[A/T]Input Speed Supply	36	G/O	[A/T]Down Shift
7	L/O	[A/T]Output Speed Supply	37	L	[A/T]Up Shift
8	Gr	[A/T]Input Speed Signal	38	Y	[A/T]Select Switch
9	B	[A/T]Output Speed Signal	39	-	-
10	-	-	40	L	[A/T]Position Switch Code - S1
11	-	-	41	-	-
12	-	-	42	-	-
13	L	Wiper 'P' Input	43	W	Clutch Switch
14	L/O	Alternator(FR)	44	L/O	Brake Test Switch
15	-	-	45	-	-
16	W	IGN CYL. 3 Control (W/O SMK & IMMO.)	46	G	IGN CYL. 2 Control (W/O SMK & IMMO.)
		IGN CYL. 2Control (With SMK / IMMO.)			IGN CYL. 3 Control (With SMK / IMMO.)
17	W	[A/T]UD_VFS	47	R	[A/T]Solenoid Power 1
18	B	[A/T]26_VFS	48	P	[A/T]Solenoid Power 2
19	B	[A/T]Shift Lock Solenoid	49	R	[A/T]Memory Power
20	O	[A/T]OD_VFS	50	R	[A/T]Memory Power
21	-	-	51	-	-
22	-	-	52	-	-
23	-	-	53	L/W	[A/T]Oil Temp. Sensor (-)
24	-	-	54	G/W	[A/T]Oil Temp. Sensor (+)
25	Br	[A/T]Position Switch Code - S2	55	-	-
26	R	[A/T]Position Switch Code - S3	56	-	-
27	G	[A/T]Position Switch Code - S4	57	-	-
28	Y	Start Overrun (PDM)	58	-	-
29	L/W	Brake Light Switch	59	-	-
30	-	-	60	-	-

CHG-K

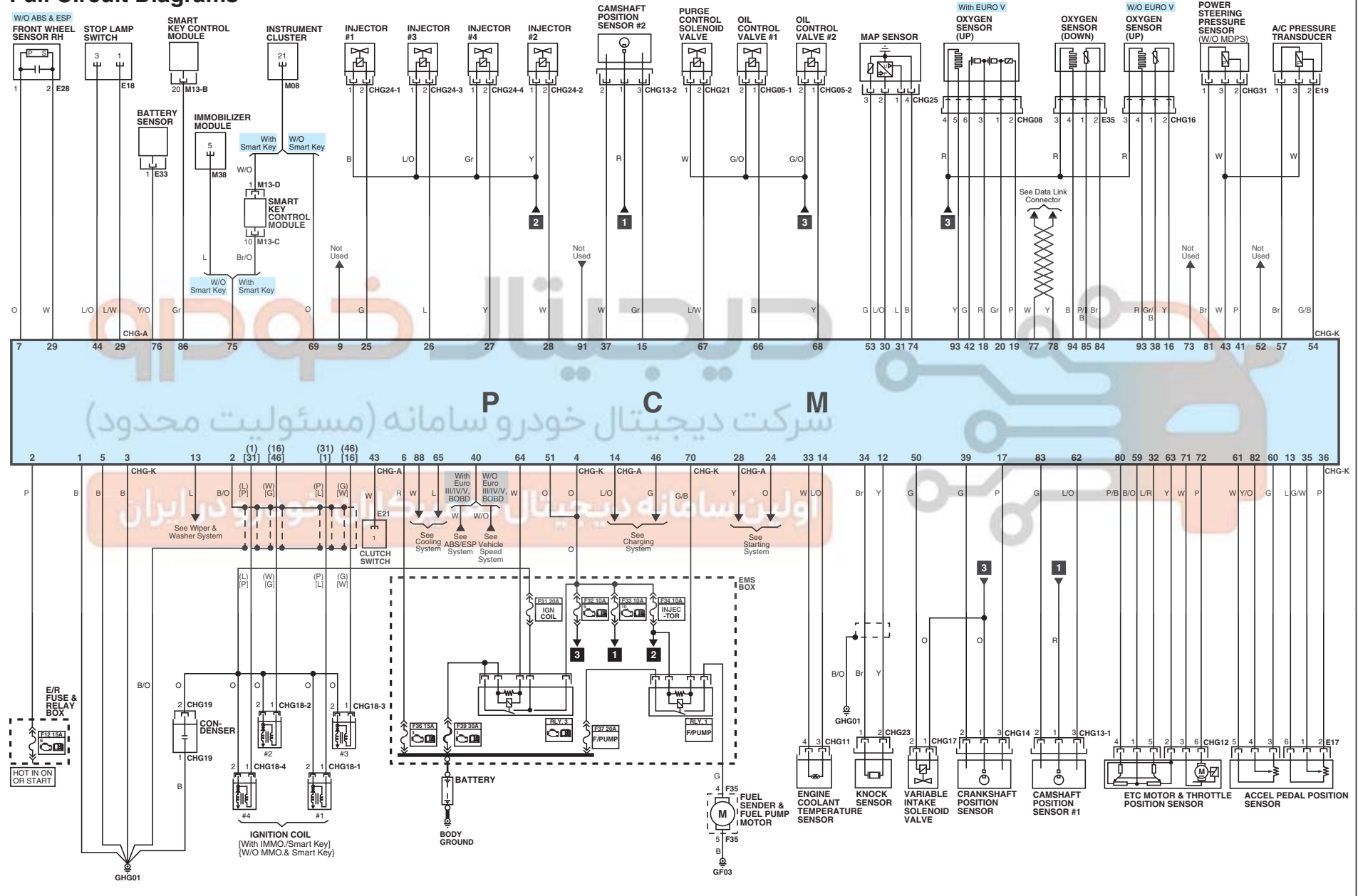
PIN	COLOR	DESCRIPTION	PIN	COLOR	DESCRIPTION	PIN	COLOR	DESCRIPTION
1	B	Ground	33	W	ECTS Signal	65	L	Cooling Fan Relay Control (Low)
2	P	ON/START Input	34	Br	Knock Sensor Ground	66	G	CVVT Actuator Control Signal 1
3	B	Ground	35	G/W	APS. 2 Signal	67	L/W	PCSV Control
4	O	Engine Control Relay 'ON' Input	36	P	APS. 2 Supply	68	Y	CVVT Actuator Control Signal 2
5	B	Ground	37	W	CMPS #2 Ground	69	O	IMMO. IND.
6	R	Memory Power	38	-	O2 Sensor (Up) Signal	70	G/B	Fuel Pump Relay Control
7	O	Wheel Speed Sensor (+)	39	G	CKPS Ground	71	W	ETC DC Motor 1
8	-	-	40	W	Vehicle Speed Input	72	P	ETC DC Motor 2
9	-	-	41	P	Power Steering Sensor Signal	73	-	-
10	-	-	42	G	O2 Sensor (Up) V_RC	74	B	TMAP/TMAF Sensor Ground
11	-	-	43	W	APT, PSPS Sensor Supply	75	L	IMMO. Data Line
12	Y	Knock Sensor Signal	44	-	-	76	Y/O	LIN/Diagnostic Data Line
13	L	APS. 2 Ground	45	-	-	77	W	C-CAN High
14	L/O	ECTS Ground	46	G	Alternator (COM)	78	Y	C-CAN Low
15	Gr	CMPS #2 Signal	47	-	-	79	-	-
16	Y	O2 Sensor (Up) Ground	48	-	-	80	P/B	TPS. 1 Signal
17	P	CKPS Signal	49	-	-	81	Br	Power Steering Sensor Ground
18	R	O2 Sensor (Up) V_IP	50	G	VIS Control	82	Y/O	APS. 1 Signal
19	P	O2 Sensor (Up) V_N	51	O	Engine Control Relay 'ON' Input	83	G	CMPS #1 Ground
20	Gr	O2 Sensor (Up) V_G	52	-	-	84	Br	O2 Sensor (Down) Signal
21	-	-	53	G	IAT Sensor	85	P/B	O2 Sensor (Down) Ground
22	-	-	54	G/B	APT Sensor Signal	86	Gr	Engine Speed Signal
23	-	-	55	-	-	87	-	-
24	O	Start Overrun (GND)	56	-	-	88	W	Cooling Fan Relay Control (High)
25	G	Injector #1 Control	57	Br	APT Sensor Ground	89	-	-
26	L	Injector #3 Control	58	-	-	90	-	-
27	Y	Injector #4 Control	59	B/O	TPS Ground	91	-	-
28	W	Injector #2 Control	60	G	APS. 1 Supply	92	-	-
29	W	Wheel Speed Sensor (-)	61	W	APS. 1 Ground	93	Y (With Euro V) R (W/O Euro V)	O2 Sensor (Up) Heater
30	L/O	MAP Sensor Supply	62	L/O	CMPS #1 Signal			
31	L	MAF/MAP Sensor Signal	63	Y	TPS Supply			
32	L/R	TPS. 2 Signal	64	W	Engine Control Relay Control	94	B	O2 Sensor (Down) Heater

※ [A/T]: See Automatic Transaxle Control System (SD450)

Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI) (2)

SD313-2

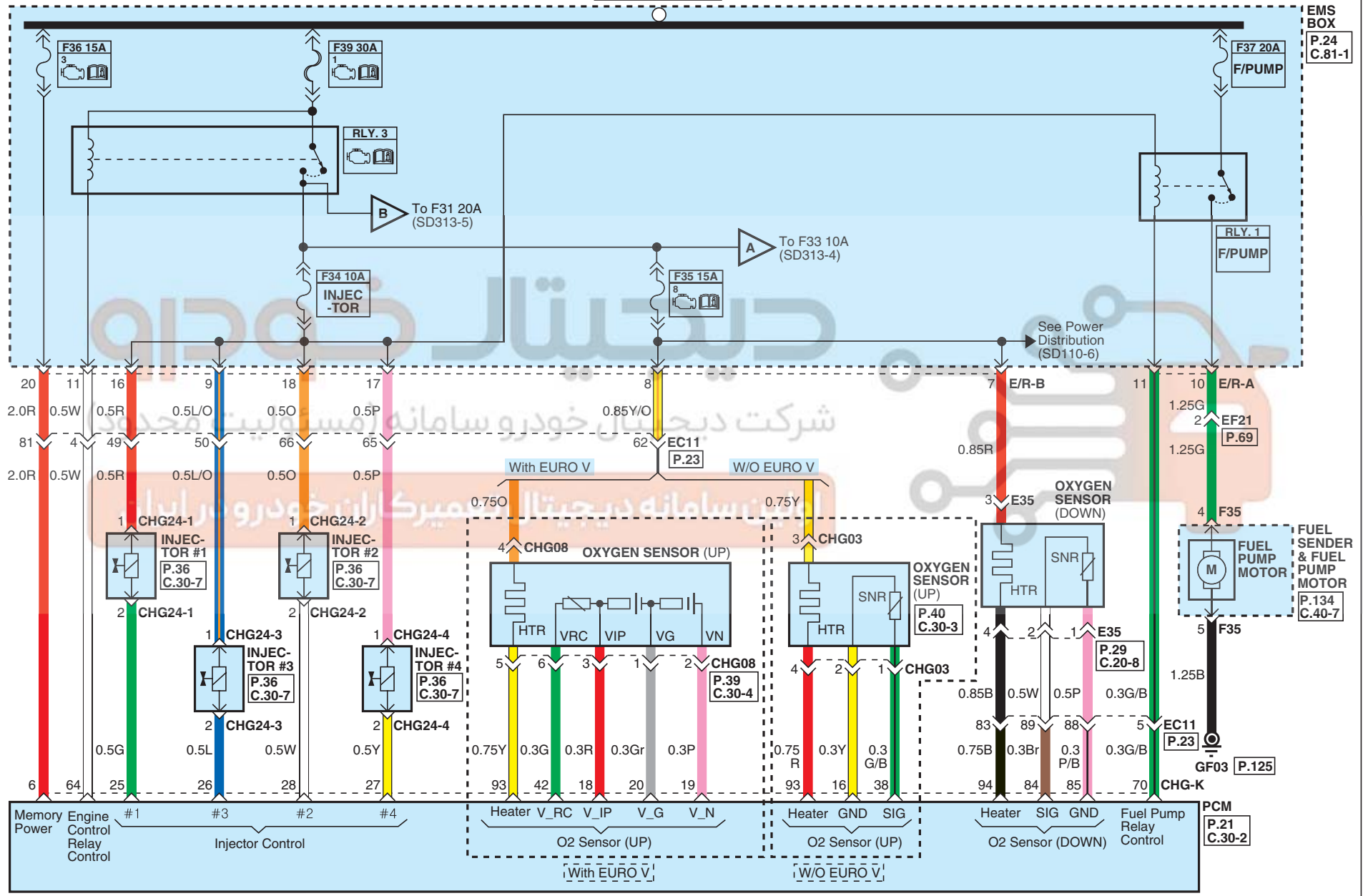
Full Circuit Diagrams



Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI) (3)

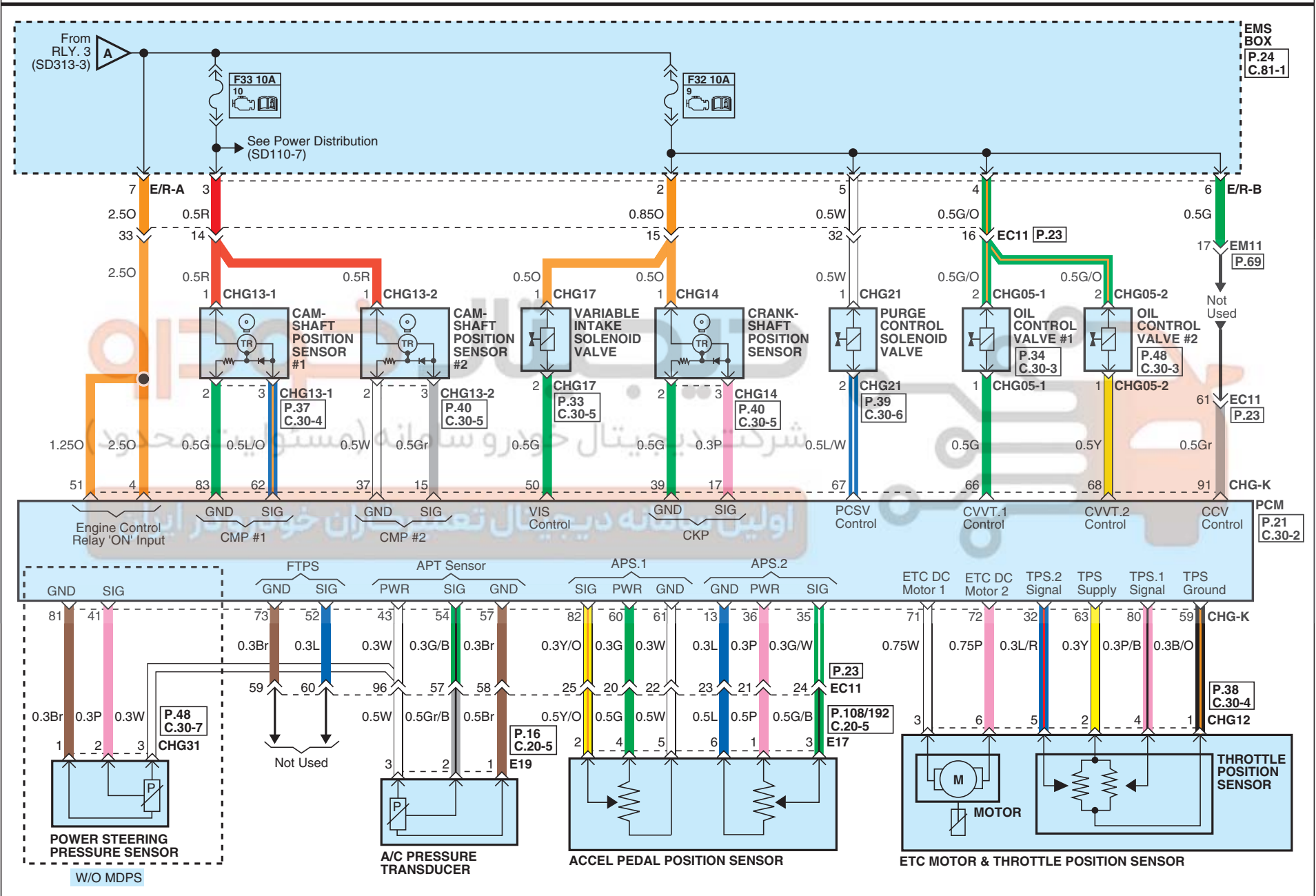
SD313-3

HOT AT ALL TIMES



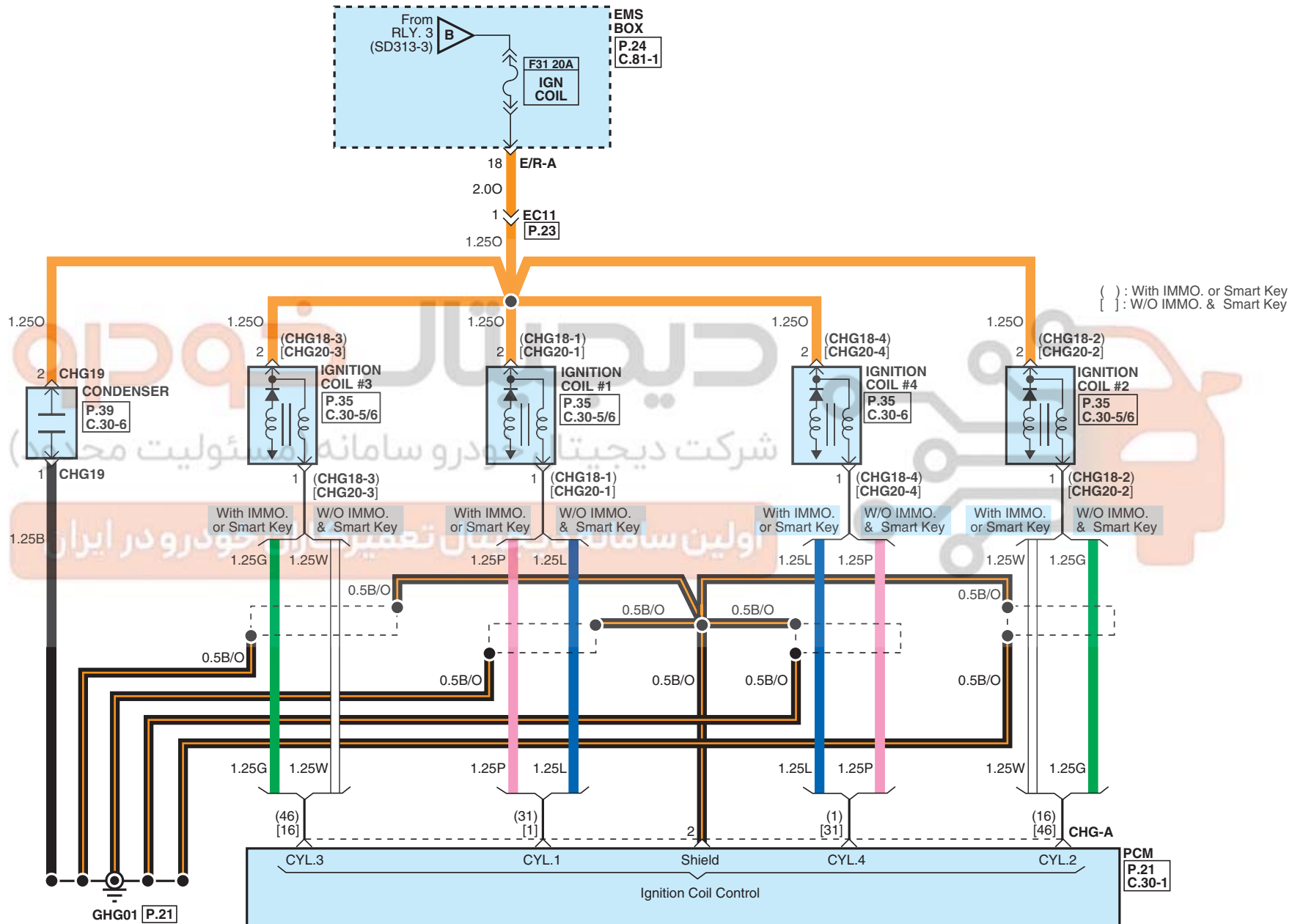
Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI) (4)

SD313-4



Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI) (5)

SD313-5

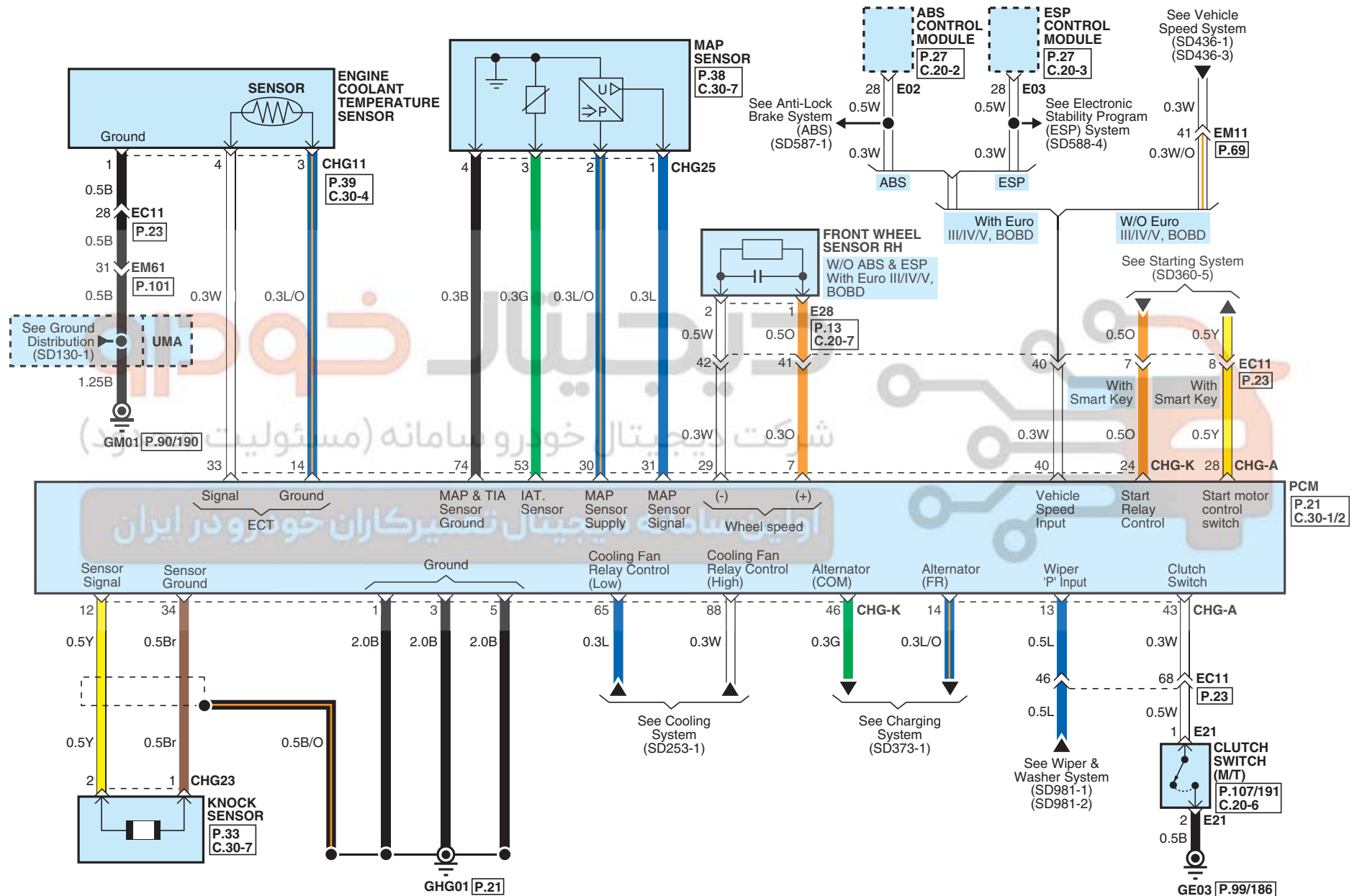


SD313-6



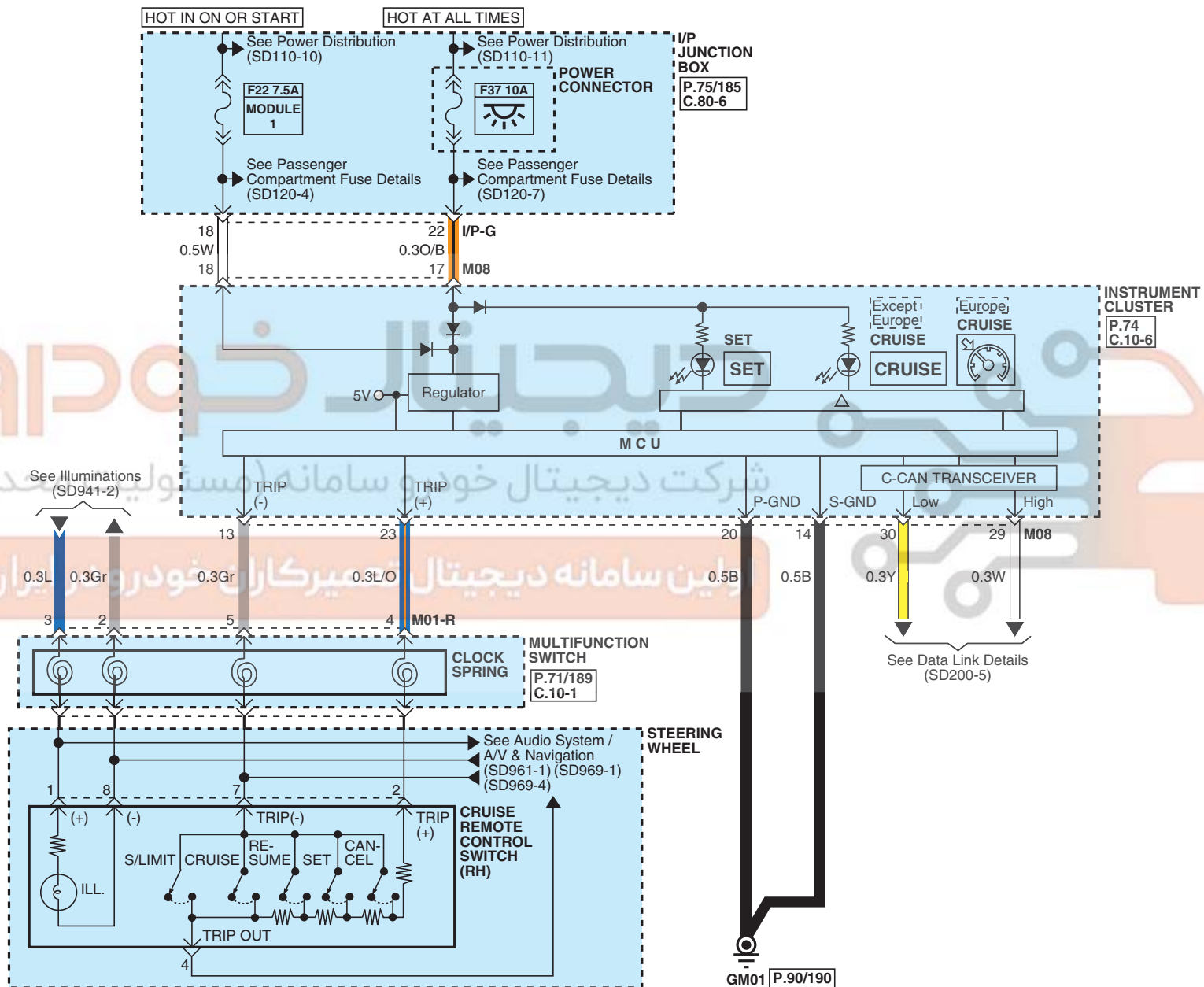
Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI) (7)

SD313-7



Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI) (8)

SD313-8



Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L 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 [CHG-A]

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
1	Ignition Coil (Cylinder #4) control output [With Immobilizer/Smart key]	Idle	Pulse	1st Voltage: 300 ~ 400V	416V
	Ignition Coil (Cylinder #1) control output [W/O Immobilizer/Smart key]			ON Voltage: Max. 2.0V	1.4V
				Frequency	5.2Hz
				Dwell Time	2.78ms
2	Shield	Idle	DC voltage	Max. 50mV	16.8mV
3	[A/T] Line pressure control solenoid valve (LINE_VFS)	-	Output	0V/Battery voltage level 9V < Battery voltage level < 16V	-
4	[A/T] Torque converter control solenoid valve (T/CON_VFS)	-	Output	0V/Battery voltage level 9V < Battery voltage level < 16V	-
5	[A/T] 35R clutch control solenoid valve (35R/C_VFS)	-	Output	0V/Battery voltage level 9V < Battery voltage level < 16V	-
6	[A/T] Input speed sensor power	ON/OFF	Power	0V/7.5V	-
7	[A/T] Output speed sensor power	ON/OFF	Power	0V/7.5V	-
8	[A/T] Input speed sensor signal	High/Low	Input	0.7V/1.4V	-
9	[A/T] Output speed sensor signal	High/Low	Input	0.7V/1.4V	-
10	-	-	-	-	-
12	-	-	-	-	-
13	Electrical load [Wiper] signal input	-	-	-	-

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
14	Alternator (FR)	Idle	Pulse	HI: Battery Voltage LO: Max 1.5V	13.4V 40mV
15	-	-	-	-	-
16	Ignition Coil (Cylinder #2) control output [With Immobilizer/Smart key]	Idle	Pulse	1st Voltage: 300 ~ 400V	416V
	ON Voltage: Max. 2.0V			1.3V	
	Ignition Coil (Cylinder #3) control output [W/O Immobilizer/Smart key]			Frequency	5.2Hz
	Dwell Time			2.73ms	
17	[A/T] Under drive brake control solenoid valve (UD/B_VFS)	-	Output	0V/Battery voltage level	-
				9V < Battery voltage level < 16V	
				Power supply: V_SOL2	
18	[A/T] 26 brake control solenoid valve (26/B_VFS)	-	Output	0V/Battery voltage level	-
				9V < Battery voltage level < 16V	
				Power supply: V_SOL2	
19	[A/T] Shift lock solenoid	High	Output	0V/Battery voltage level	-
		Low		9V < Battery voltage level < 16V	
20	[A/T] Overdrive clutch control solenoid valve (OD/C_VFS)	-	Output	0V/Battery voltage level	-
				9V < Battery voltage level < 16V	
				Power supply: V_SOL1	
22	-	-	-	-	-
23	-	-	-	-	-
24	-	-	-	-	-
25	[A/T] Inhibitor switch signal "S2"	High	Input	0V/Battery voltage level	-
		Low		9V < Battery voltage level < 16V	
26	[A/T] Inhibitor switch signal "S3"	High	Input	0V/Battery voltage level	-
		Low		9V < Battery voltage level < 16V	
27	[A/T] Inhibitor switch signal "S4"	High	Input	0V/Battery voltage level	-
		Low		9V < Battery voltage level < 16V	
28	Start overrun	-	-	-	-
29	Brake Switch 1 signal input	Brake ON	DC voltage	Battery Voltage	-
		Brake OFF		Max. 0.5V	

Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI)

Service Tips (2)

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
30	-	-	-	-	-
31	Ignition Coil (Cylinder #1) control output [With Immobilizer/Smart key]	Idle	Pulse	1st Voltage: 300 ~ 400V	408V
	Ignition Coil (Cylinder #4) control output [W/O Immobilizer/Smart key]			ON Voltage: Max. 2.0V	1.6V
				Frequency	5.2Hz
				Dwell Time	2.74ms
32	[A/T] ON/OFF solenoid valve B(SS-B)	High	Output	0V/Battery voltage level	-
		Low		9V < Battery voltage level < 16V	
33	[A/T] ON/OFF solenoid valve A (SS-A)	High	Output	0V/Battery voltage level	-
		Low		9V < Battery voltage level < 16V	
34	[A/T] Ground (Power 1)	-	Ground	0V	-
35	[A/T] Ground (Power 2)	-	Ground	0V	-
36	[A/T] Sports mode down switch	Down ON	Input	0V/Battery voltage level	-
		Other		9V < Battery voltage level < 16V	
37	[A/T] Sports mode up switch	Up ON	Input	0V/Battery voltage level	-
		Other		9V < Battery voltage level < 16V	
38	[A/T] Sports mode select switch	Sport mode	Input	0V/Battery voltage level	-
		Other		9V < Battery voltage level < 16V	
39	-	-	-	-	-
40	[A/T] Inhibitor switch signal "S1"	High	Input	0V/Battery voltage level	-
		Low		9V < Battery voltage level < 16V	
41	-	-	-	-	-
43	Clutch Switch signal input	Release	DC voltage	Max. 0.5V	-
		Push		Battery Voltage	-
44	Brake Switch 2 signal input	Push	DC voltage	Max. 0.5V	-
		Normal		Battery Voltage	-
45	-	-	-	-	-
46	Ignition Coil (Cylinder #3) control output [With Immobilizer/Smart key]	Idle	Pulse	1st Voltage: 300 ~ 400V	410V
	Ignition Coil (Cylinder #2) control output [W/O Immobilizer/Smart key]			ON Voltage: Max. 2.0V	1.5V
				Frequency	5.2Hz
				Dwell Time	2.78ms

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
47	[A/T] Solenoid supply power 1	ON	Power	0V/Battery voltage level	-
		OFF		9V < Battery voltage level < 16V	
48	[A/T] Solenoid supply power 2	ON	Power	0V/Battery voltage level	-
		OFF		9V < Battery voltage level < 16V	
49	[A/T] TCM Input power 1 (For solenoid)	-	Power	Battery voltage level	-
				9V < Battery voltage level < 16V	
50	[A/T] TCM Input power 2 (For solenoid)	-	Power	Battery voltage level	-
				9V < Battery voltage level < 16V	
53	[A/T] Oil temperature sensor (-)	-	Ground	0V	-
54	[A/T] Oil temperature sensor (+)	ON	Input	0V/3.3V	-
		OFF			
55	-	-	-	-	-
60	-	-	-	-	-

• Connector [CHG-K]

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
1	Power ground	Idle	DC voltage	Max. 50mV	-
2	Battery power (B+)	IG OFF	DC voltage	Max. 0.5V	10.2mV
		IG ON		Battery Voltage	12.02V
3	Power ground	Idle	DC voltage	Max. 50mV	2.8mV
4	Battery power (B+)	IG OFF	DC voltage	Max. 1.0V	3.1mV
		IG ON		Battery Voltage	12.1V
5	Power ground	Idle	DC voltage	Max. 50mV	1.8mV
6	Battery power (B+)	Always (Without Ignition key)	Current	Below 2.0mA	0.4mA
			DC voltage	Battery Voltage	12.88V
7	Wheel Speed Sensor (WSS) [+] signal input	Vehicle Run (30KPH)	SINE	15Hz: Min. 0.13Vpp	-
			WAVE	1000Hz: Min. 0.2Vpp	
9	-	-	-	-	-

Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI)

Service Tips (3)

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
10	-	-	-	-	-
12	Knock Sensor (KS) signal input	Knocking	Variable	-0.3 ~ 0.3V	-
		Normal	Frequency	0V	
13	Sensor ground	Idle	DC voltage	Max. 50mV	30mV
14	Sensor ground	Idle	DC voltage	Max. 50mV	12.4mV
15	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	HI: Vcc or Battery Voltage	5.0V
				LO: Max. 0.5V	0.2V
				FREQ: 5.36Hz	-
16	Sensor ground	Idle	DC voltage	Max. 50mV	29.0mV
17	Crankshaft Position Sensor (CKPS) signal input	Idle	Pulse	HI: Vcc or Battery Voltage	5.00V
				LO: Max. 0.5V	40mV
				FREQ: 600Hz	-
18	Rc/Rp (Pump Cell Voltage)	Idle	Analog	Normal: 450±50mV	-
				Rich: Max. Normal+150mV	
				Lean: Min. Normal-150mV	
19	VS+ (NERNST Cell Voltage)	Idle	Analog	Normal: 450±50mV	-
				Rich: Max. Normal+150mV	
				Lean: Min. Normal-150mV	
20	VS-/IP- (Common Ground for VS, IP)	Idle	Analog	Reference for V_IP, V_N	-
24	Start overrun (Ground)	-	-	-	-
25	Injector (Cylinder #1) control output	Idle	Pulse	HI: Battery Voltage	13.8V
				LO: Max. 1.0V	200mV
				Vpeak: Max. 80V	54.1V
				Frequency	5.21Hz
				Dwell Time	2.74ms
26	Injector (Cylinder #3) control output	Idle	Pulse	HI: Battery Voltage	13.9V
				LO: Max. 1.0V	170mV
				Vpeak: Max. 80V	53.9V
				Frequency	5.18Hz
				Dwell Time	2.73ms
Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
27	Injector (Cylinder #4) control output	Idle	Pulse	HI: Battery Voltage	14V
				LO: Max. 1.0V	160mV
				Vpeak: Max. 80V	54.3V
				Frequency	5.24Hz
				Dwell Time	2.70ms
28	Injector (Cylinder #2) control output	Idle	Pulse	HI: Battery Voltage	14.1V
				LO: Max. 1.0V	160mV
				Vpeak: Max. 80V	53.9V
				Frequency: 5.21Hz	5.21Hz
				Dwell Time: 2.73ms	2.74ms
29	Wheel Speed Sensor (WSS) [-] signal input	Vehicle Run (30KPH)	SINE	15Hz: Min. 0.13Vpp	-
			WAVE	1000Hz: Min. 0.2Vpp	
30	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	0mV
		IG ON		4.9 ~ 5.1V	4.98V
31	Manifold Absolute Pressure Sensor (MAPS) signal input	Idle	Analog	0.8 ~ 1.6V	1.37V
32	Throttle Position Sensor (TPS) 2 signal input	C.T	Analog	4.2 ~ 5.0V	4.52V
		W.O.T		3.3 ~ 3.8V	3.68V
33	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	Analog	0.5 ~ 4.5V	1.02V
34	Sensor ground	Idle	DC voltage	Max. 50mV	8mV
35	Accelerator Position Sensor (APS) 2 signal input	C.T	Analog	Max. 1.0V	0.4V
		W.O.T		1.5 ~ 3.0V	1.9V
36	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	5mV
		IG ON		4.9 ~ 5.1V	5.02V
37	Sensor ground	Idle	DC voltage	Max. 50mV	11mV
38	Heated Oxygen Sensor [Bank 1/Sensor 1] signal input	Idle	DC voltage	Rich: 0.6 ~ 1.0V	926mV
				Lean: Max. 0.4V	20mV
39	Sensor ground	Idle	DC voltage	Max. 50mV	11mV

Engine Control System (G4KD/G4KE : THETA II 2.0L/2.4L MPI)

Service Tips (4)

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
40	Vehicle speed signal input	Vehicle Run	Pulse	HI: Min. 4.5V	5.0V
				LO: Max. 0.5V	0V
				Frequency	46.9Hz at Idle
				Duty(-)	50.4% at Idle
41	Power Steering Pressure Sensor (PSPS) signal input	-	-	-	-
42	Rc (Compensative Resistance)	Idle	Analog	Rc-Rc/Rp < ±0.1V	-
43	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	-
		IG ON		4.9 ~ 5.1V	-
45	-	-	-	-	-
46	Alternator (COM)	-	-	-	-
49	-	-	-	-	-
50	Variable Intake Solenoid (VIS) Valve control output	Active	DC voltage	Max. 1.0V	316mV
		Inactive		Battery Voltage	14.0V
51	Battery power (B+)	IG OFF	DC voltage	Max. 1.0V	3.1mV
		IG ON		Battery Voltage	12.3V
52	-	-	-	-	-
53	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	0 ~ 5.0V	2.55V
54	A/C Pressure Transducer (APT) signal input	Idle	DC voltage	0.4 ~ 4.6V	A/C OFF: 1.29V
					A/C ON: 2.01V
55	-	-	-	-	-
57	Sensor ground	Idle	DC voltage	Max. 50mV	11mV
59	Sensor ground	Idle	DC voltage	Max. 50mV	6mV
60	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	10mV
		IG ON		4.9 ~ 5.1V	5.02V
61	Sensor ground	Idle	DC voltage	Max. 50mV	30mV
62	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	HI: Vcc or Battery Voltage	5.0V
				LO: Max. 0.5V	0.2V
				Frequency	5.2Hz

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
63	Sensor power (+5V)	IG OFF	DC voltage	Max. 0.5V	0V
		IG ON		4.9 ~ 5.1V	5.03V
64	Main Relay control output	Relay OFF	DC voltage	Battery Voltage	12.3V
		Relay ON		Max. 1.0V	730mV
65	Cooling Fan Relay [Low] control output	A/C ON	Pulse	HI: Battery Voltage	10.4V
				LO: 0 ~ 0.5V	60mV
66	CVVT Oil control (OCV) Valve [Bank 1/Intake] control output	Idle	Pulse	HI: Battery Voltage	15.0V
				LO: Max. 1.0V	120mV
				Frequency	300Hz
				Duty(+)	84.70%
67	Purge control Solenoid Valve (PCSV) control output	Inactive	Pulse	HI: Battery Voltage	14.3V
				LO: Max. 1.0V	80mV
		Active		Vpeak: Max. 70V	57.0V
				Frequency	16Hz
68	CVVT Oil control (OCV) Valve [Bank 1/Exhaust] control output	Idle	Pulse	HI: Battery Voltage	13.5V
				LO: Max. 1.0V	100mV
				Vpeak: Max.70V	13.5V
				Frequency	300Hz
69	Immobilizer Lamp control output	Lamp OFF	DC voltage	HI: Battery Voltage	13.2V
		Lamp ON		LO: Max . 2.0V	40mV
70	Fuel Pump Relay control output	Relay OFF	DC voltage	Battery Voltage	12.8V
		Relay ON		Max. 1.0V	40mV
71	ETC Motor [+] control output	Idle	Pulse	HI: Battery Voltage	13.4V
				LO: Max . 1.0V	0V
72	ETC Motor [-] control output	Idle	Pulse	HI: Battery Voltage	13.3V
				LO: Max . 1.0V	0V
73	-	-	-	-	-
74	Sensor ground	Idle	DC voltage	Max. 50mV	7mV
75	Immobilizer communication line	During communicating	Pulse	HI: Min. 8.5V	11.8V
				LO: Max. 3.5V	1.0V

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Service Tips (5)

Pin No.	Description	Condition	In/Output Signal		Test result
			Type	Level	
76	LIN communication signal input	-	-	-	-
77	CAN [High]	Recessive	Pulse	2.0 ~ 3.0V	2.58V
		Dominant		2.75 ~ 4.5V	3.54V
78	CAN [Low]	Recessive	Pulse	2.0 ~ 3.0V	2.64V
		Dominant		0.5 ~ 2.25V	1.52V
79	-	-	-	-	-
80	Throttle Position Sensor (TPS) 1 signal input	C.T	Analog	0.3 ~ 0.9V	0.65V
		W.O.T		1.5 ~ 3.0V	1.63V
81	Sensor ground	-	-	-	-
82	Accelerator Position Sensor (APS) 1 signal input	C.T	Analog	Max. 1.0V	0.8V
		W.O.T		Min. 4.0V	4.0V
83	Sensor ground	Idle	DC voltage	Max. 50mV	12mV
84	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Idle	DC voltage	Rich: 0.6 ~ 1.0V	74mV
				Lean: Max. 0.4V	70mV
85	Sensor ground	Idle	DC voltage	Max. 50mV	10mV
86	Engine speed signal output	Idle	Pulse	HI: Battery Voltage	14.0V
				LO: Max. 0.5V	60mV
				Frequency: 20 ~ 26Hz	21Hz
				Duty(+)	50%
88	Cooling Fan Relay [High] control output	Relay OFF	DC voltage	Battery Voltage	-
		Relay ON		Max. 1.0V	-
90	-	-	-	-	-
93	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Engine Run	Pulse	HI: Battery Voltage	14.4V
				LO: Max. 1.0V	0.36V
				Frequency	10.0Hz
				Duty(+)	58.30%
94	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Engine Run	Pulse	HI: Battery Voltage	14.0V
				LO: Max. 1.0V	0.31V
				Frequency	7.68Hz
				Duty(+)	53.90%

• 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) Thermister and it's resistance changes in reverse proportion to the temperature.

• Engine Coolant Temperature Sensor (ECTS)

The Engine Coolant Temperature Sensor (ECTS) detects the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature. 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.

• 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.

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Service Tips (6)

- **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, the engine may stop because of CKPS signal missing.

- **Camshaft Position Sensor (CMPS)**

The sensor detects a top dead point of cylinder no. 1. It is installed at the end of the camshaft and consists of a hole-type sensor and target wheel.

When the signal detecting unit of a sensor is blocked by a bump of the target wheel, high voltage is generated, while low voltage is generated otherwise.

The PCM recognizes the position of each cylinder using the signal from the camshaft position sensor.

- **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; the need for external cruise control modules/cables is eliminated.

- **Accelerator Pedal Position Sensor (APS)**

Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second sensor monitors the first sensor and its output voltage is half of the first one. If the ratio of the sensor 1 and 2 is out of the range (approximately 1/2), the diagnostic system judges that it is abnormal.

- **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 de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should momentarily peak.

- **Battery Sensor**

A battery sensor installed in the battery (-) terminal detects the battery fluid temperature, voltage and current, which are needed by the control system, using the internal elements (silicon diode and shunt resistance) and mapping values, and then sends them to the PCM using the LIN communication line.

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

Purge Control Solenoid Valve (PCSV) is installed on the surge tank and controls the passage between the canister and the intake manifold. It is a solenoid valve and is open when the PCM grounds the valve control line. When the passage is open (PCSV ON), fuel vapor stored in the canister is transferred to the intake manifold.

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Service Tips (7)

- **Knock Sensor**

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. When a knock occurs, the sensor produces voltage signal. The PCM retards the ignition timing when knocking occurs. 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.

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

Variable Intake manifold 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.

- **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.

- **Power Steering Pressure Sensor**

To reduce the required power to manipulate steering wheel, hydraulic pressure is used in power steering system. A load is sensed at steering oil pressure sensor then inputted to PCM as a wheel position signal. Controlling idle speed valve, PCM performs appropriate electric load correction With this signal.

- **Stop Lamp Switch**

Stop Lamp Switch is mounted on the brake pedal assembly and is used to send the status of the brake pedal to the PCM. There are two separate switches in the switch housing. The Brake Test Switch is normally closed while the Brake Light Switch is normally open.

- **Stop Lamp Relay**

It is used to increasing long-term reliability for stop lamp switch.

- **A/C Pressure Transducer (APT)**

The Air Conditioner Control Module receives air conditioner refrigerants pressure signal from the PCM via CAN communications. The Air Conditioning Pressure Transducer (APT) supplies the A/C line pressure signal to the PCM. The APT signal value is used by the A/C control unit to control engagement of the compressor.

- **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.

- **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.

- **Immobilizer IND.**

Immobilizer informs status of system and result of Authentication by blinking of immobilizer lamp on instrument cluster. Through Authentication procedure immobilizer lamp keep lighting up till engine starts. In normal status. Immobilizer lamp lights up Right after ignition "ON". The light goes out after the engine is running. If there's any fault in immobilizer system or in Authentication, lamp blinks after ignition "ON"

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Service Tips (8)

- **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.

- **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.

- **Data Link Connector**

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.

