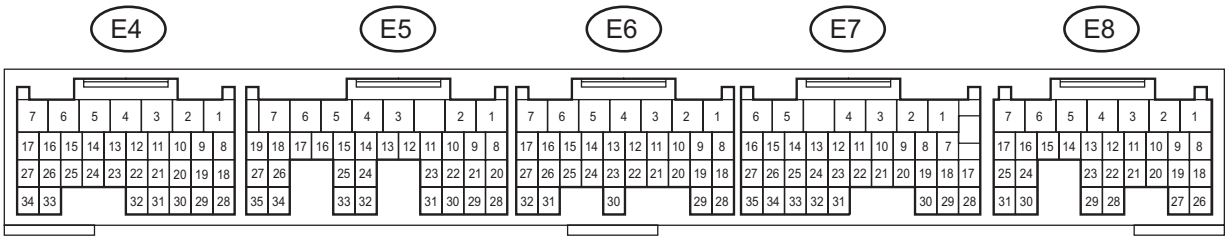
TERMINALS OF ECM



Y

A121603E02

HINT:
The standard normal voltage between each pair of ECM terminals is shown in the table below. The appropriate conditions for checking each pair of terminals are also indicated.
The result of checks should be compared with the standard normal voltage for that pair of terminals, displayed in the STD Voltages column.
The illustration above can be used as a reference to identify the ECM terminal locations.

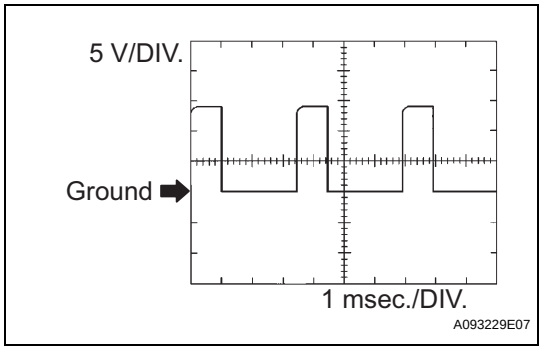
Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
BATT (E8-3) - E1 (E6-1)	L - BR	Battery (for measuring the battery voltage and for the ECM memory)	Always	9 to 14 V
+BM (E8-7) - E1 (E6-1)	LG - BR	Power source of throttle motor	Always	9 to 14 V
IGSW (E8-9) - E1 (E6-1)	O - BR	Ignition switch	Ignition switch ON	9 to 14 V
+B (E8-1) - E1 (E6-1)	B - BR	Power source of ECM	Ignition switch ON	9 to 14 V
+B2 (E8-2) - E1 (E6-1)	B - BR	Power source of ECM	Ignition switch ON	9 to 14 V
OC1+ (E6-17) - OC1- (E6-16)	G-Y - L-B	Camshaft timing oil control valve (OCV)	Ignition switch ON	Pulse generation (see waveform 1)
OC2+ (E6-15) - OC2- (E6-14)	L-W - L-R	Camshaft timing oil control valve (OCV)	Ignition switch ON	Pulse generation (see waveform 1)
MREL (E8-8) - E1 (E6-1)	G-W - BR	EFI relay	Ignition switch ON	9 to 14 V
VC (E4-23) - E2 (E4-28)	L - BR	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.0 V
VG (E4-30) - E2G (E4-29)	R-Y - R-W	Mass air flow meter	Idling, Shift lever position P or N, A/C switch OFF	0.5 to 3.0 V
THA (E4-22) - E2 (E4-28)	R-L - BR	Intake air temperature sensor	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V
THW (E4-21) - E2 (E4-28)	Y-B - BR	Engine coolant temperature sensor	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
VTA1 (E4-20) - E2 (E4-28)	G-B - BR	Throttle position sensor (for engine control)	Ignition switch ON, Throttle valve fully closed	0.5 to 1.2 V
VTA1 (E4-20) - E2 (E4-28)	G-B - BR	Throttle position sensor (for engine control)	Ignition switch ON, Throttle valve fully open	3.2 to 4.8 V

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
VTA2 (E4-19) - E2 (E4-28)	G-W - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully released	2.1 to 3.1 V
VTA2 (E4-19) - E2 (E4-28)	G-W - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully depressed	4.5 to 5.0 V
VPA (E8-18) - EPA (E8-20)	R-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully released	0.5 to 1.1 V
VPA (E8-18) - EPA (E8-20)	R-Y - LG-B	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal fully depressed	2.6 to 4.5 V
VPA2 (E8-19) - EPA2 (E8-21)	GR-B - R-B	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully released	1.2 to 2.0 V
VPA2 (E8-19) - EPA2 (E8-21)	GR-B - R-B	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal fully depressed	3.4 to 5.0 V
VCPA (E8-26) - EPA (E8-20)	R - LG-B	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.0 V
VCP2 (E8-27) - EPA2 (E8-21)	L-W - R-B	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.0 V
HA1A (E5-2) - E04 (E5-7) HA2A (E5-1) - E05 (E5-6)	R - W-B B-W - W-B	A/F sensor heater	Idling	Below 3.0 V
HA1A (E5-2) - E04 (E5-7) HA2A (E5-1) - E05 (E5-6)	R - W-B B-W - W-B	A/F sensor heater	Ignition switch ON	9 to 14 V
A1A+ (E5-22) - E1 (E6-1)	P - BR	A/F sensor	Ignition switch ON	3.3 V*1
A2A+ (E5-23) - E1 (E6-1)	W - BR	A/F sensor	Ignition switch ON	3.3 V*1
A1A- (E5-30) - E1 (E6-1)	L - BR	A/F sensor	Ignition switch ON	2.9 V*1
A2A- (E5-31) - E1 (E6-1)	R - BR	A/F sensor	Ignition switch ON	2.9 V*1
HT1B (E4-1) - E1 (E6-1) HT2B (E5-5) - E1 (E6-1)	G - BR L - BR	Heated oxygen sensor heater	Idling	Below 3.0 V
HT1B (E4-1) - E1 (E6-1) HT2B (E5-5) - E1 (E6-1)	G - BR L - BR	Heated oxygen sensor heater	Ignition switch ON	9 to 14 V
OX1B (E4-18) - E2 (E4-28) OX2B (E5-33) - E2 (E4-28)	W - BR B - BR	Heated oxygen sensor	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation (see waveform 2)
#10 (E6-2) - E01 (E4-7) #20 (E6-3) - E01 (E4-7) #30 (E6-4) - E01 (E4-7) #40 (E6-5) - E01 (E4-7) #50 (E6-6) - E01 (E4-7) #60 (E6-7) - E01 (E4-7)	R-L - W-B B - W-B R - W-B G - W-B Y - W-B L - W-B	Injector	Ignition switch ON	9 to 14 V
#10 (E6-2) - E01 (E4-7) #20 (E6-3) - E01 (E4-7) #30 (E6-4) - E01 (E4-7) #40 (E6-5) - E01 (E4-7) #50 (E6-6) - E01 (E4-7) #60 (E6-7) - E01 (E4-7)	R-L - W-B B - W-B R - W-B G - W-B Y - W-B L - W-B	Injector	Idling	Pulse generation (see waveform 3)
KNK1 (E5-29) - EKNK (E5-28)	B - W	Knock sensor	Maintain engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
KNK2 (E5-21) - EKN2 (E5-20)	G - R	Knock sensor	Maintain engine speed at 4,000 rpm after warming up	Pulse generation (see waveform 4)
VV1+ (E6-19) - VV1- (E6-29)	R - G	Variable valve timing (VVT) sensor	Idling	Pulse generation (see waveform 5)

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
VV2+ (E6-18) - VV2- (E6-28)	Y - L	Variable valve timing (VVT) sensor	Idling	Pulse generation (see waveform 5)
NE+ (E6-21) - NE- (E6-20)	B - W	Crankshaft position sensor	Idling	Pulse generation (see waveform 5)
IGT1 (E4-8) - E1 (E6-1) IGT2 (E4-9) - E1 (E6-1) IGT3 (E4-10) - E1 (E6-1) IGT4 (E4-11) - E1 (E6-1) IGT5 (E4-12) - E1 (E6-1) IGT6 (E4-13) - E1 (E6-1)	P - BR P-L - BR LG - BR LG-B - BR GR - BR G - BR	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (see waveform 6)
IGF1 (E4-24) - E1 (E6-1)	W-R - BR	Ignition coil with igniter (ignition confirmation signal)	Ignition switch ON	4.5 to 5.0 V
IGF1 (E4-24) - E1 (E6-1)	W-R - BR	Ignition coil with igniter (ignition confirmation signal)	Idling	Pulse generation (see waveform 6)
PRG (E4-34) - E1 (E6-1)	Y - BR	Purge VSV	Ignition switch ON	9 to 14 V
PRG (E4-34) - E1 (E6-1)	Y - BR	Purge VSV	Idling	Pulse generation (see waveform 7)
SPD (E7-8) - E1 (E6-1)	V-W - BR	Speed signal from combination meter	Ignition switch ON, Rotate driving wheel slowly	Pulse generation (see waveform 8)
STA (E6-11) - E1 (E6-1)	B-Y - BR	Starter signal	Cranking	9 to 14 V
STP (E8-15) - E1 (E6-1)	L - BR	Stop light switch	Brake pedal depressed	7.5 to 14 V
STP (E8-15) - E1 (E6-1)	L - BR	Stop light switch	Brake pedal released	Below 1.5 V
ST1- (E8-16) - E1 (E6-1)	V-W - BR	Stop light switch (opposite to STP terminal)	Ignition switch ON, Brake pedal depressed	Below 1.5 V
ST1- (E8-16) - E1 (E6-1)	V-W - BR	Stop light switch (opposite to STP terminal)	Ignition switch ON, Brake pedal released	7.5 to 14 V
NSW (E5-8) - E1 (E6-1)	V - BR	Park/Neutral position switch	Ignition switch ON, Shift lever position in P or N	Below 3.0 V
NSW (E5-8) - E1 (E6-1)	V - BR	Park/Neutral position switch	Ignition switch ON, Shift lever position other than P and N	9 to 14 V
M+ (E4-5) - ME01 (E5-3)	P - W-B	Throttle motor	Idling with warm engine	Pulse generation (see waveform 9)
M- (E4-4) - ME01 (E5-3)	L - W-B	Throttle motor	Idling with warm engine	Pulse generation (see waveform 10)
FC (E8-10) - E1 (E6-1)	L-B - BR	Fuel pump control	Ignition switch ON	9 to 14 V
FPR (E6-30) - E1 (E6-1)	Y-R - BR	Fuel pump control	Ignition switch ON	9 to 14 V
W (E7-30) - E1 (E6-1)	BR - BR	MIL	Ignition switch ON	Below 3.0 V
W (E7-30) - E1 (E6-1)	BR - BR	MIL	Idling	9 to 14 V
ELS (E7-13) - E1 (E6-1)	G - BR	Electric load	Defogger switch OFF	0 to 1.5 V
ELS (E7-13) - E1 (E6-1)	G - BR	Electric load	Defogger switch ON	7.5 to 14 V
ELS2 (E7-12) - E1 (E6-1)	B-W - BR	Electric load	Taillight switch OFF	0 to 1.5 V
ELS2 (E7-12) - E1 (E6-1)	B-W - BR	Electric load	Taillight switch ON	7.5 to 14 V
TC (E8-23) - E1 (E6-1)	P-B - BR	Terminal TC of DLC 3	Ignition switch ON	9 to 14 V
TACH (E7-1) - E1 (E6-1)	B-W - BR	Engine speed	Idling	Pulse generation (see waveform 11)
ACIS (E4-33) - E1 (E6-1)	W-L - BR	VSV for ACIS	Ignition switch ON	9 to 14 V
PSW (E6-10) - E1 (E6-1)	G-W - BR	P/S pressure switch	Ignition switch ON	9 to 14 V
VPMP (E8-5) - E1 (E6-1)	V-W - BR	Vent valve (built into canister pump module)	Ignition switch ON	9 to 14 V
MPMP (E8-6) - E1 (E6-1)	G - BR	Leak detection pump (built into canister pump module)	Leak detection pump OFF	0 to 3 V

Symbols (Terminal No.)	Wiring Colors	Terminal Descriptions	Conditions	STD Voltages
MPMP (E8-6) - E1 (E6-1)	G - BR	Leak detection pump (built into canister pump module)	Leak detection pump ON	9 to 14 V
PPMP (E8-22) - E2 (E4-28)	GR - BR	Canister pressure sensor (built into canister pump module)	Ignition switch ON	3 to 3.6 V
F/PS (E7-32) - E1 (E6-1)	R - BR	Airbag sensor assembly	Idling with warm engine	Pulse generation (see waveform 12)
CANH (E7-33) - E1 (E6-1)	B - BR	CAN communication line	Ignition switch ON	Pulse generation (see waveform 13)
CANL (E7-34) - E1 (E6-1)	W - BR	CAN communication line	Ignition switch ON	Pulse generation (see waveform 14)

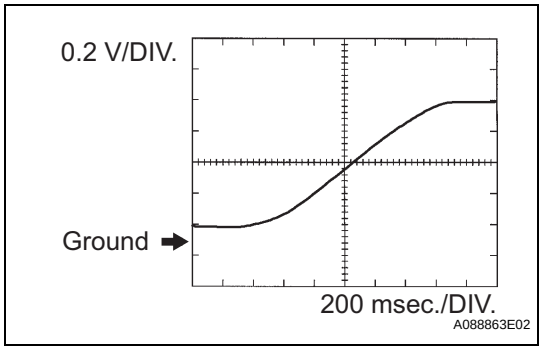
*1: The ECM terminal voltage is constant regardless of the output voltage from the sensor.



1. WAVEFORM 1
Camshaft timing oil control valve (OCV)

ECM Terminal Names	Between OC1+ and OC1- or OC2+ and OC2-
Tester Ranges	5 V/DIV, 1 msec./DIV
Conditions	Idling

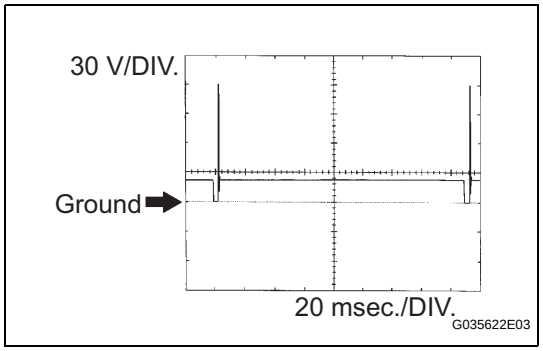
HINT:
The wavelength becomes shorter as the engine rpm increases.



2. WAVEFORM 2
Heated oxygen sensor

ECM Terminal Names	Between OX1B and E2 or OX2B and E2
Tester Ranges	0.2 V/DIV, 200 msec./DIV
Conditions	Engine speed maintained at 2,500 rpm for 2 minutes after warming up sensor

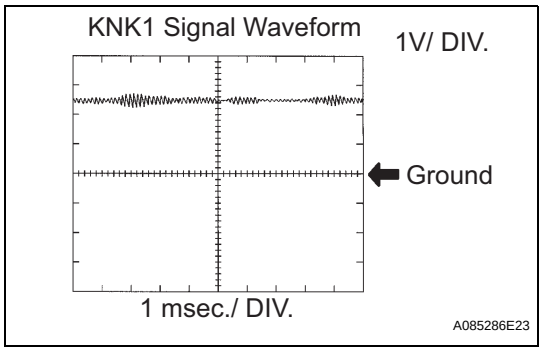
HINT:
In the DATA LIST, item O2S B1S2 or O2S B2S2 shows the ECM input values from the heated oxygen sensor.



3. WAVEFORM 3
Fuel injector

ECM Terminal Names	Between #10 (to 60) and E01
Tester Ranges	30 V/DIV, 20 msec./DIV
Conditions	Idling

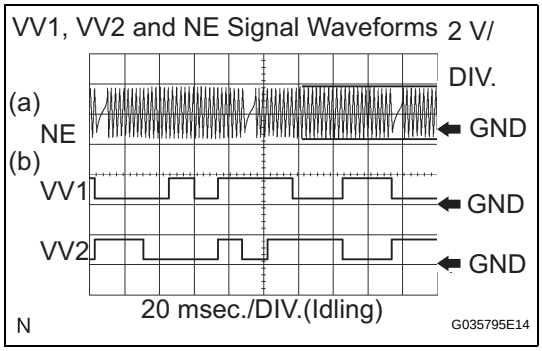
HINT:
The wavelength becomes shorter as the engine rpm increases.



4. WAVEFORM 4
Knock sensor

ECM Terminal Names	Between KNK1 and EKNK or KNK2 and EKN2
Tester Ranges	0.01 to 10 V/DIV, 0.01 to 10 msec./DIV
Conditions	Engine speed maintained at 4,000 rpm after warming up engine

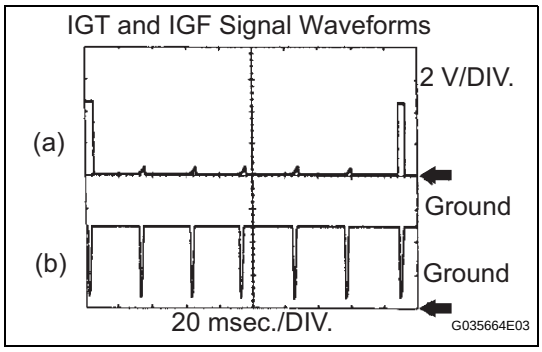
HINT:
- The wavelength becomes shorter as the engine rpm increases.
- The waveforms and amplitudes displayed on the tester differ slightly depending on the vehicle.



5. WAVEFORM 5
(a) VVT sensor
(b) Crankshaft position sensor

ECM Terminal Names	(a) Between NE+ and NE- (b) Between VV1+ and VV1- or VV2+ and VV2-
Tester Ranges	2 V/DIV, 20 msec./DIV
Conditions	Idling

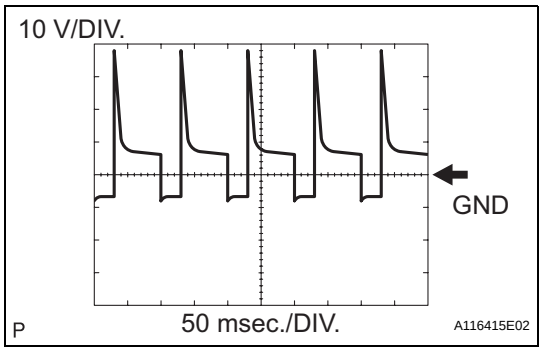
HINT:
The wavelength becomes shorter as the engine rpm increases.



6. WAVEFORM 6
(a) Igniter IGT signal (from ECM to igniter)
(b) Igniter IGF signal (from igniter to ECM)

ECM Terminal Names	(a) Between IGT (1 to 6) and E1 (b) Between IGF1 and E1
Tester Ranges 2	2 V/DIV, 20 msec./DIV
Conditions	Idling

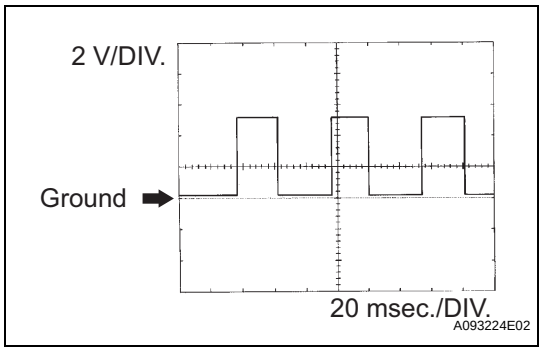
HINT:
The wavelength becomes shorter as the engine rpm increases.



7. WAVEFORM 7
Purge VSV

ECM Terminal Names	Between PRG and E01
Tester Ranges	10 V/DIV, 50 msec./DIV
Conditions	Idling

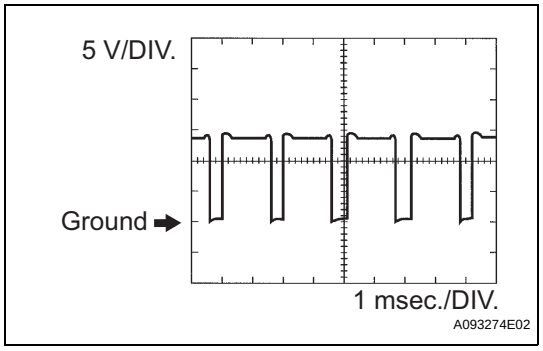
HINT:
If the waveform is not similar to the illustration, check the waveform again after idling for 10 minutes or more.



8. WAVEFORM 8
Vehicle speed signal

ECM Terminal Names	Between SPD and E1
Tester Ranges	2 V/DIV, 20 msec./DIV
Conditions	Driving at 12 mph (20 km/h)

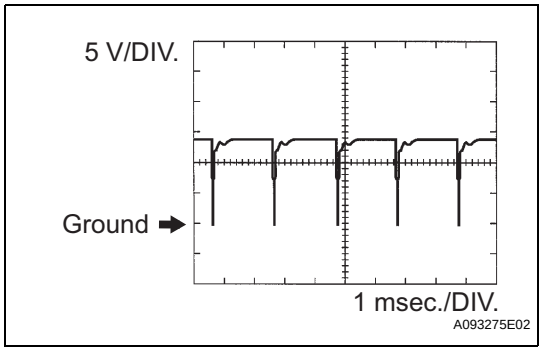
HINT:
The wavelength becomes shorter as the vehicle speed increases.



9. WAVEFORM 9
Throttle actuator positive terminal

ECM Terminal Names	Between M+ and ME01
Tester Ranges	5 V/DIV, 1 msec./DIV
Conditions	Idling with warm engine

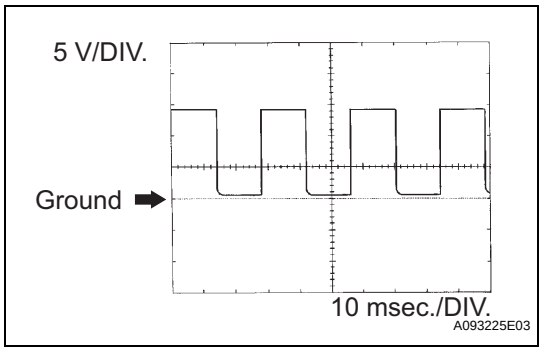
HINT:
The duty ratio varies depending on the throttle actuator operation.



10. WAVEFORM 10
Throttle actuator negative terminal

ECM Terminal Names	Between M- and ME01
Tester Ranges	5 V/DIV, 1 msec./DIV
Conditions	Idling with warm engine

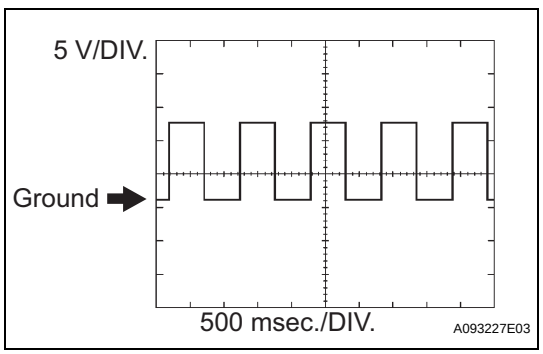
HINT:
The duty ratio varies depending on the throttle actuator operation.



11. WAVEFORM 11
Engine speed signal

ECM Terminal Names	Between TACH and E1
Tester Ranges	5 V/DIV, 10 msec./DIV
Conditions	Idling

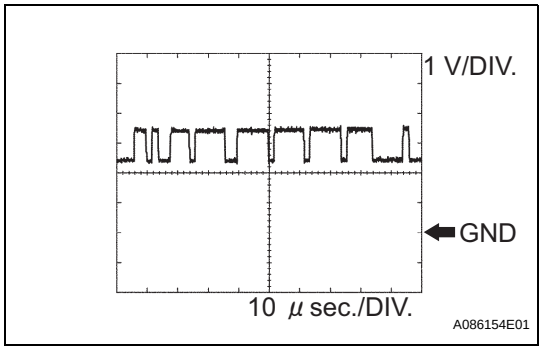
HINT:
The wavelength becomes shorter as the engine rpm increases.



12. WAVEFORM 12
Airbag sensor assembly

ECM Terminal Names	Between F/PS and E1
Tester Ranges	5 V/DIV, 500 msec./DIV
Conditions	Idling with warm engine

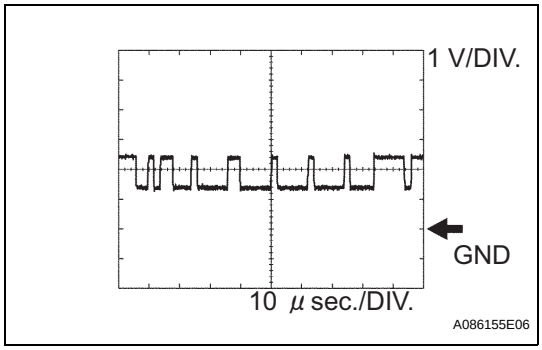
ES



13. WAVEFORM 13
CAN communication signal

ECM Terminal Names	Between CANH and E1
Tester Ranges	1 V/DIV, 10μsec./DIV
Conditions	Stop engine and ignition switch ON

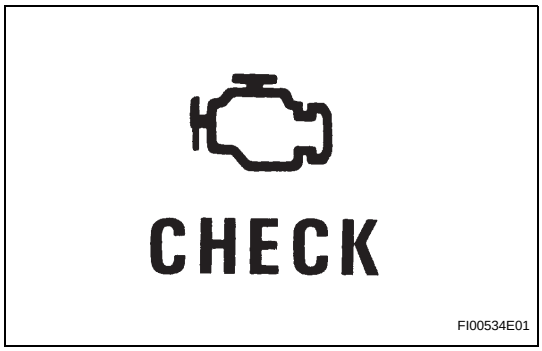
HINT:
The wavelength varies depending on the CAN communication signal.



14. WAVEFORM 14
CAN communication signal

ECM Terminal Names	Between CANL and E1
Tester Ranges	1 V/DIV, 10μsec./DIV
Conditions	Stop engine and ignition switch ON

HINT:
The wavelength varies depending on the CAN communication signal.

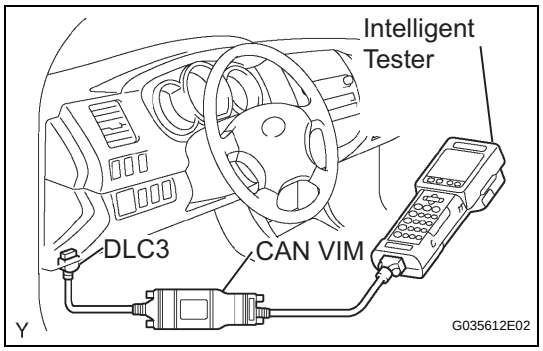


DIAGNOSIS SYSTEM

1. DESCRIPTION

When troubleshooting OBD II (On-Board Diagnostics) vehicles, an intelligent tester (complying with SAE J1987) must be connected to the DLC3 (Data Link Connector 3) of the vehicle. Various data in the vehicle's ECM (Engine Control Module) can be then read.
OBD II regulations require that the vehicle's on-board computer illuminates the MIL (Malfunction Indicator Lamp) on the instrument panel when the computer detects a malfunction in:

(a) The emission control systems and components
(b) The power train control components (which affect vehicle emissions)



(c) The computer itself
In addition, the applicable DTCs (Diagnostic Trouble Codes) prescribed by SAE J2012 are recorded on 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.
To check DTCs, connect an intelligent tester to the DLC3. The tester displays DTCs, freeze frame data, and a variety of engine data. The DTCs and freeze frame data can be erased with the tester (See page ES-38).
In order to enhance OBD function on vehicles and develop the Off-Board diagnosis system, CAN communication is introduced in this system (CAN: Controller Area Network). It minimizes a gap between technician skills and vehicle technology. CAN is a network, which uses a pair of data transmission lines, spanning multiple computers and sensors. It allows a high speed communication between the systems and to simplify the wire harness connection.
Since this system is equipped with the CAN communication, connecting the CAN VIM (VIM: Vehicle Interface Module) with an intelligent tester is necessary to display any information from the ECM. (Also the communication between an intelligent tester and the ECM uses CAN communication signals.) When confirming the DTCs and any data of the ECM, connect the CAN VIM between the DLC3 and an intelligent tester.

2. NORMAL MODE AND CHECK MODE

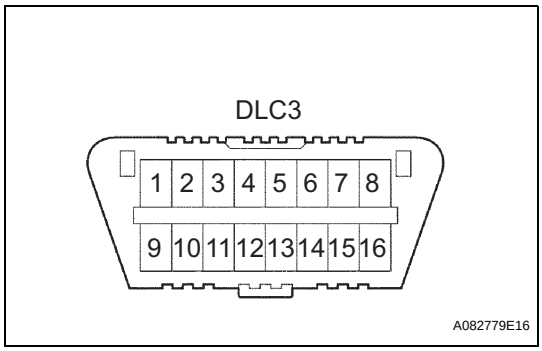
The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the system's ability to detect malfunctions, including intermittent problems (intelligent tester only) (See page ES-12).

3. 2 TRIP DETECTION LOGIC

When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent drive cycle, the MIL is illuminated (2nd trip).

4. FREEZE FRAME DATA

Freeze frame data record the engine condition (fuel system, calculated engine load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc) when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.



5. DLC3 (Data Link Connector 3)

The vehicle's ECM uses the ISO 15765-4 for communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 15765-4 format.

Symbols	Terminal No.	Names	Reference terminals	Results	Conditions
SIL	7	Bus "+" line	5 - Signal ground	Pulse generation	During transmission
CG	4	Chassis ground	Body ground	1 Ω or less	Always
SG	5	Signal ground	Body ground	1 Ω or less	Always
BAT	16	Battery positive	Body ground	9 to 14 V	Always
CANH	6	CAN "High" line	CANL	54 to 69 Ω	Ignition switch OFF*
CANH	6	CAN "High" line	Battery positive	1 MΩ or higher	Ignition switch OFF*
CANH	6	CAN "High" line	CG	200 Ω or higher	Ignition switch OFF*
CANL	14	CAN "Low" line	Battery positive	1 MΩ or higher	Ignition switch OFF*
CANL	14	CAN "Low" line	CG	200 Ω or higher	Ignition switch OFF*

HINT:

*: Before measuring the resistance, leave the vehicle as is for at least 1 minute and do not operate the ignition switch, any other switches or the doors.

HINT:

The DLC3 is the interface prepared for reading various data from the vehicle's ECM. After connecting the cable of an intelligent tester, turn the ignition switch ON and turn the tester ON. If a communication failure message is displayed on the tester screen (on the tester: UNABLE TO CONNECT TO VEHICLE), a problem exists in either the vehicle or tester. In order to identify the location of the problem, connect the tester to another vehicle.

If communication is normal: Inspect the DLC3 on the original vehicle.

If communication is impossible: The problem is probably with the tester itself. Consult the Service Department listed in the instruction manual.

6. BATTERY VOLTAGE

Battery Voltage:

11 to 14 V

If the voltage is below 11 V, recharge the battery before proceeding.

7. MIL (Malfunction Indicator Lamp)

(a) The MIL is illuminated when the ignition switch is first turned ON (the engine is not running).

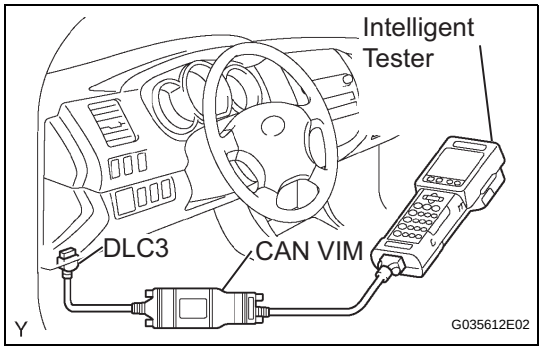
(b) The MIL should turn off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.
HINT:
If the MIL is not illuminated when the ignition switch is first turned ON, check the MIL circuit (See page ES-411).

ES

DTC CHECK / CLEAR

NOTICE:
When the diagnosis system is changed from normal mode to check mode or vice versa, all DTCs and freeze frame data recorded in normal mode are erased. Before changing modes, always check and make a note of DTCs and freeze frame data.
HINT:

- DTCs which are stored in the ECM can be displayed on an intelligent tester. An intelligent tester can display current and pending DTCs.
- Some DTCs are not set if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.



1. CHECK DTC (Using an intelligent tester)
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Check the DTC(s) and freeze frame data, and then write them down.
(f) Check the details of the DTC(s) (See page ES-57).

2. CLEAR DTC (Using an intelligent tester)
(a) Connect an intelligent tester to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES.
(e) Press the YES button.

3. CLEAR DTC (Without using an intelligent tester)
(a) Perform either one of the following operations.
(1) Disconnect the negative battery cable for more than 1 minute.
(2) Remove the EFI and ETCS fuses from the Relay Block (R/B) located inside the engine compartment for more than 1 minute.