

<b>DTC</b>	<b>P0120/41</b>	<b>Throttle/Pedal Position Sensor/Switch "A" Circuit</b>
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<b>DTC</b>	<b>P0122/41</b>	<b>Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input</b>
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<b>DTC</b>	<b>P0123/41</b>	<b>Throttle/Pedal Position Sensor/Switch "A" Circuit High Input</b>
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<b>DTC</b>	<b>P0220/41</b>	<b>Throttle/Pedal Position Sensor/Switch "B" Circuit</b>
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<b>DTC</b>	<b>P0222/41</b>	<b>Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input</b>
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<b>DTC</b>	<b>P0223/41</b>	<b>Throttle/Pedal Position Sensor/Switch "B" Circuit High Input</b>
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<b>DTC</b>	<b>P2135/41</b>	<b>Throttle/Pedal Position Sensor/Switch "A"/"B" Voltage Correction</b>
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**HINT:**

This is the purpose for the "throttle position sensor".

## CIRCUIT DESCRIPTION

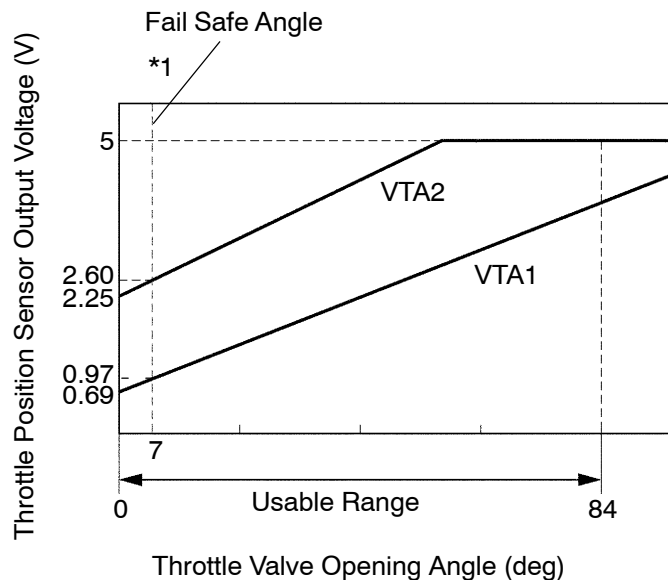
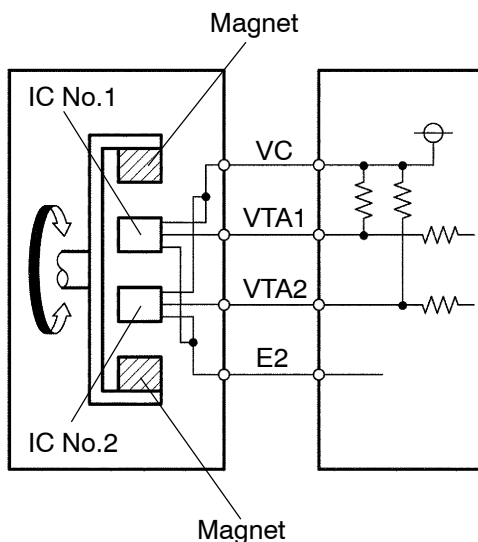
### HINT:

- This Electrical Throttle Control System (ETCS) does not use a throttle cable.
- This throttle position sensor is a non-contact type.

The throttle position sensor is mounted on the throttle body and it detects the opening angle of the throttle valve. This sensor is electronically controlled and uses Hall-effect elements, so that accurate control and reliability can be obtained. The throttle position sensor has 2 sensor elements / signal outputs: VTA1 and VTA2. VTA1 used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. Voltage applied to VTA1 and VTA2 change between 0V and 5V in proportion to the opening angle of the throttle valve. There are several checks that the engine control ECU performs to confirm proper operation of the throttle position sensor and VTA1.

The engine control ECU judges the current opening angle of the throttle valve from these signals input from terminals VTA1 and VTA2, and the engine control ECU controls the throttle motor to make the throttle valve angle properly in response to driver inputs.

Throttle Position Sensor Engine Control ECU



Throttle Valve Fully Closed  
(Throttle Position expressed as percentage  
(VTA1) 10 to 20%)

Throttle Valve Fully Opened  
(Throttle Position expressed as percentage  
(VTA1) 64 to 96%)

\*1: Fail Safe Angle 7°  
(Throttle Position expressed as percentage  
(VTA1) about 10 to 24%)

## DIAGNOSTICS – ENGINE

DTC No.	DTC Detection Condition	Trouble Area
Condition (a) of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 sec. (Open or short in the throttle control motor and sensor circuit)		
P0120/41	Detection conditions for DTCs P0122 and P0123 are not satisfied but condition (a) is satisfied (a) VTA1 is "0.2 V or less" or VTA1 is "4.8 V or more" (1 trip detection logic)	<ul style="list-style-type: none"><li>• Throttle control motor and sensor</li><li>• Engine control ECU</li></ul>
P0122/41	(a) VTA1 is 0.2 V or less (1 trip detection logic)	<ul style="list-style-type: none"><li>• Throttle control motor and sensor</li><li>• Short in VTA1 circuit</li><li>• Open in VC circuit</li><li>• Engine control ECU</li></ul>
P0123/41	(a) VTA1 is 4.8 V or more (1 trip detection logic)	<ul style="list-style-type: none"><li>• Throttle control motor and sensor</li><li>• Open in VTA1 circuit</li><li>• Open in E2 circuit</li><li>• VC and VTA1 circuit are short-circuited</li><li>• Engine control ECU</li></ul>
P0220/41	Detection conditions for DTCs P0222 and P0223 are not satisfied but condition (a) is satisfied (a) VTA2 is "0.5 V or less" or VTA2 is "4.8 V or more" and VTA1 is "0.2 V or more" and VTA1 is "1.8 V or less" (1 trip detection logic)	<ul style="list-style-type: none"><li>• Throttle control motor and sensor</li><li>• Engine control ECU</li></ul>
P0222/41	(a) VTA2 is 0.5 V or less (1 trip detection logic)	<ul style="list-style-type: none"><li>• Throttle control motor and sensor</li><li>• Short in VTA2 circuit</li><li>• Open in VC circuit</li><li>• Engine control ECU</li></ul>
P0223/41	(a) VTA2 is "4.8 V or more" and VTA1 is "0.2 V or more" and VTA1 is "1.8 V or less" (1 trip detection logic)	<ul style="list-style-type: none"><li>• Throttle control motor and sensor</li><li>• Open in VTA2 circuit</li><li>• Open in E2 circuit</li><li>• VC and VTA2 circuit are short-circuited</li><li>• Engine control ECU</li></ul>
P2135/41	Condition (a) continues for 0.5 sec. or more, or condition (b) continues for 0.4 sec. or more: (a) Difference between VTA1 and VTA2 is 0.02 V or less (b) VTA1 is "0.2 V or less" and VTA2 is "0.5 V or less" (1 trip detection logic)	<ul style="list-style-type: none"><li>• VTA1 and VTA2 circuit are short-circuited</li><li>• Throttle control motor and sensor</li><li>• Engine control ECU</li></ul>

## HINT:

- After confirming DTCs, use the hand-held tester to confirm the throttle valve opening percentage and closed throttle position switch condition.
- THROTTLE POS means VTA1 signal as well as the THROTTLE POS #2 for the VTA2 signal.

**Reference (Normal condition):**

Tester display	Accelerator pedal fully released	Accelerator pedal fully depressed
THROTTLE POS	10 to 24 %	66 to 98%
THROTTLE POS #2	2.1 to 3.1 V	4.5 to 5.0 V

## MONITOR DESCRIPTION

The engine control ECU uses throttle position sensor to monitor the throttle valve opening angle.

- (a) There is a specific voltage difference expected between VTA1 and VTA2 for each throttle opening angle.
  - If the difference between VTA1 and VTA2 is incorrect the engine control ECU interprets this as a fault and will set a DTC.
- (b) VTA1 and VTA2 each have a specific voltage operating range.
  - If VTA1 or VTA2 is out of the normal operating range the engine control ECU interprets this as a fault and will set a DTC.
- (c) VTA1 and VTA2 should never be close to the same voltage levels.
  - If VTA1 is within 0.02 V of VTA2 the engine control ECU interprets this as a short circuit in the throttle position sensor system and will set a DTC.

This monitor runs for 2 seconds (for first 2 seconds of engine idle) after the engine started.

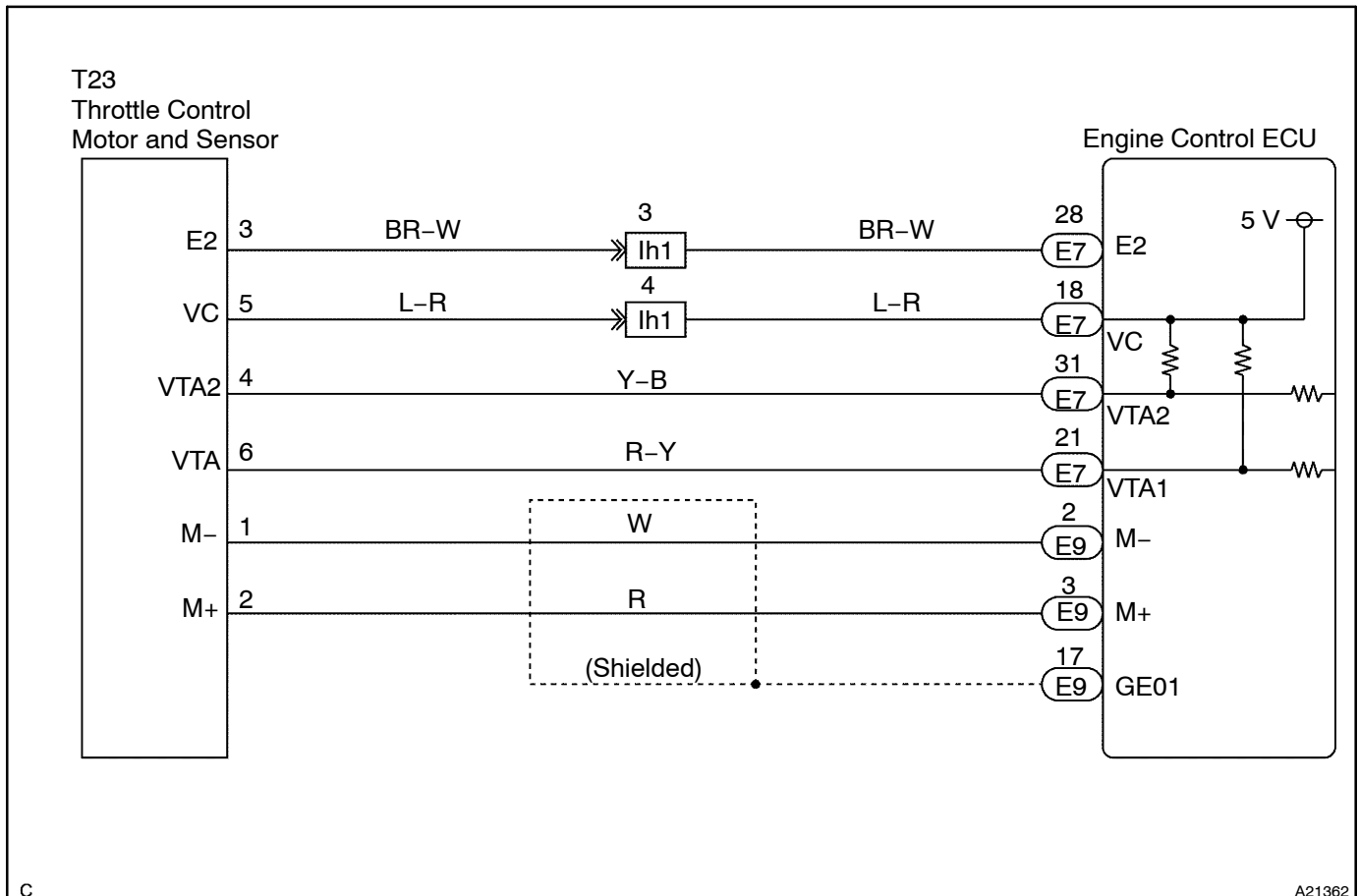
## FAIL SAFE

If the ETCS (Electronic Throttle Control System) has a malfunction, the engine control ECU cuts off current to the throttle control motor. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of the return spring. The engine control ECU then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue at a minimum speed.

If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a "pass" condition is detected and then the ignition switch is turned OFF, the fail-safe operation will stop and the system will return to normal condition.

## WIRING DIAGRAM



## INSPECTION PROCEDURE

### HINT:

- If DTCs related to different system that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the hand-held tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, as well as other data from the time when a malfunction occurred.

### Hand-held tester:

1	Connect hand-held tester, and read the voltage for throttle position sensor data.
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### PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch ON and push the hand-held tester main switch ON.
- Enter the following menus: DIAGNOSIS / OBD/MOBD / DATA LIST / ALL / THROTTLE POS and THROTTLE POS #2.

### CHECK:

Read voltage value displayed on the hand-held tester.

### OK:

### RESULT:

Throttle position expressed as percentage and voltage				Trouble area	Proceed to
Accelerator pedal released		Accelerator pedal depressed			
THROTTLE POS (VTA1)	THROTTLE POS #2 (VTA2)	THROTTLE POS (VTA1)	THROTTLE POS #2 (VTA2)		
0 %	0 to 0.2 V	0 %	0 to 0.2 V	VC circuit open	A
100 %	4.5 to 5.0 V	100 %	4.5 to 5.0 V	E2 circuit open	
0 % or 100 %	2.1 to 3.1 V (Fail safe)	0 % or 100 %	2.1 to 3.1 V (Fail safe)	VTA1 circuit open or ground short	
about 16 % (Fail safe)	0 to 0.2 or 4.5 to 5.0 V	about 16 % (Fail safe)	0 to 0.2 or 4.5 to 5.0 V	VTA2 circuit open or ground short	
10 to 24 %	2.15 to 3.05 V	64 to 96 % (Does not fail safe)	4.5 to 5.0 V (Does not fail safe)	Throttle position sensor circuit is normal	B

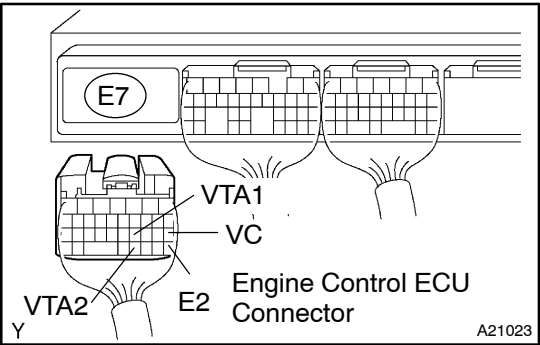
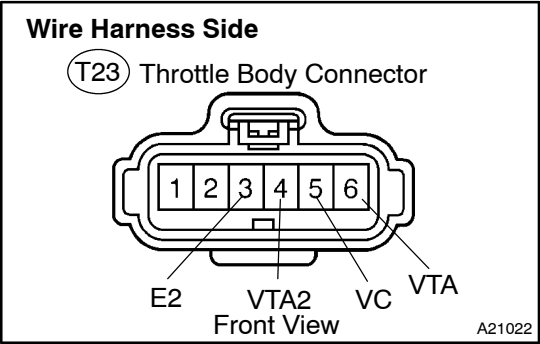
**B**

**Go to step 5.**

**A**

2

Check for open and short in harness and connector between engine control ECU and throttle position sensor.



**PREPARATION:**

- (a) Disconnect the T23 throttle control motor and sensor connector.
- (b) Disconnect the E7 engine control ECU connector.

**CHECK:**

Check the resistance between the wire harness side connectors.

**OK:**

Tester Connection	Specified Condition
VC (T23-5) - VC (E7-18)	Below 1 $\Omega$
VTA (T23-6) - VTA1 (E7-21)	
VTA2 (T23-4) - VTA2 (E7-31)	
E2 (T23-3) - E2 (E7-28)	
VC (T23-5) or VC (E7-18) - Body ground	10 k $\Omega$ or higher
VTA (T23-6) or VTA1 (E7-21) - Body ground	
VTA2 (T23-4) or VTA2 (E7-31) - Body ground	

NG

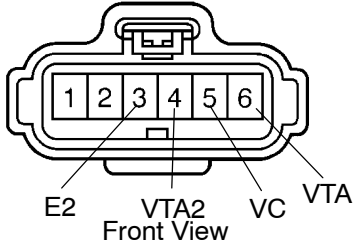
Repair or replace harness or connector.

OK

**3 Check voltage between terminals VC and E2 of engine control ECU connector.**

**Wire Harness Side:**

(T23) Throttle Body Connector



**PREPARATION:**

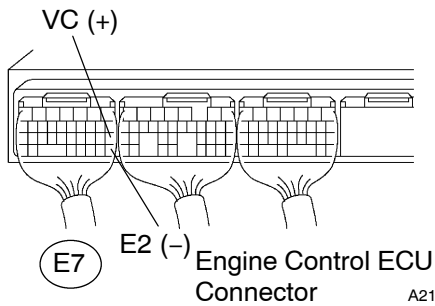
- (a) Disconnect the T23 throttle control motor and sensor connector.
- (b) Turn the ignition switch ON.

**CHECK:**

Measure the voltage between the specified terminals of the E7 engine control ECU connector.

**OK:**

Tester Connection	Specified Condition
VC (E7-18) - E2 (E7-28)	4.5 to 5.5 V



**NG**

**Replace engine control ECU (See Pub. No. RM630E, page FI-74).**

**OK**

**4 Replace throttle body (See Pub. No. RM630E, page FI-42).**

**Go**

5

Check if DTC output recur.

PREPARATION:

- (a) Clear the DTC (See page DI-3)
- (b) Start the engine.
- (c) Run the engine at idle for 15 seconds or more.

CHECK:

Read the DTC (See page DI-3)

RESULT:

Display (DTC Output)	Proceed to
"P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135" are output again	A
No DTC output	B

B

System is OK.

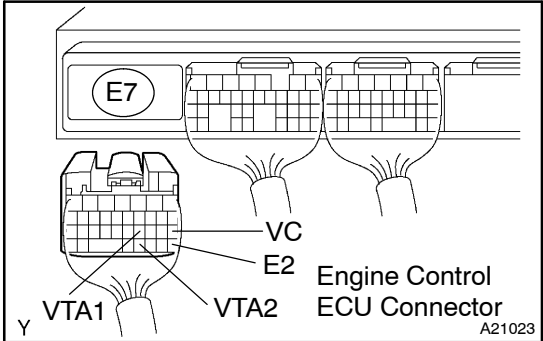
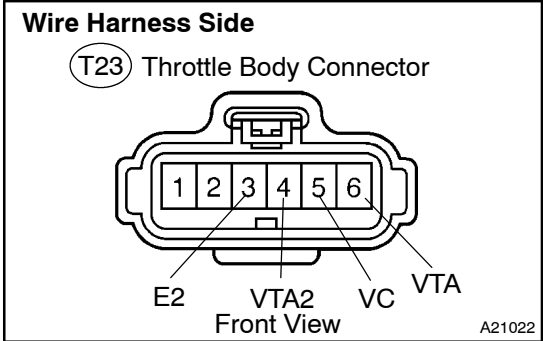
A

Replace engine control ECU (See Pub. No. RM630E, page FI-74).



# When not using hand-held tester:

1	Check for open and short in harness and connector between engine control ECU and throttle position sensor.
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## PREPARATION:

- Disconnect the T23 throttle control motor and sensor connector.
- Disconnect the E7 engine control ECU connector.

## CHECK:

Check the resistance between the wire harness side connectors.

## OK:

Tester Connection	Specified Condition
VC (T23-5) - VC (E7-18)	Below 1 $\Omega$
VTA (T23-6) - VTA1 (E7-21)	
VTA2 (T23-4) - VTA2 (E7-31)	
E2 (T23-3) - E2 (E7-28)	
VC (T23-5) or VC (E7-18) - Body ground	10 k $\Omega$ or higher
VTA (T23-6) or VTA1 (E7-21) - Body ground	
VTA2 (T23-4) or VTA2 (E7-31) - Body ground	

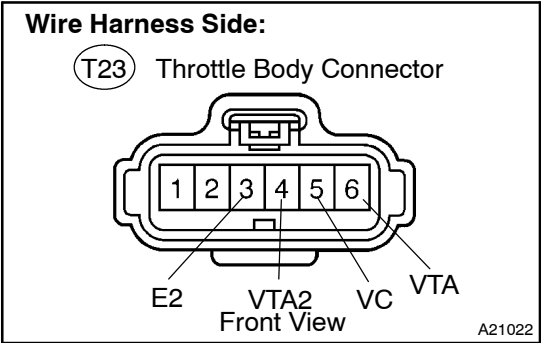
NG

Repair or replace harness or connector.

OK

2

Check voltage between terminals VC and E2 of engine control ECU connector.



**PREPARATION:**

(a) Disconnect the T23 throttle control motor and sensor connector.

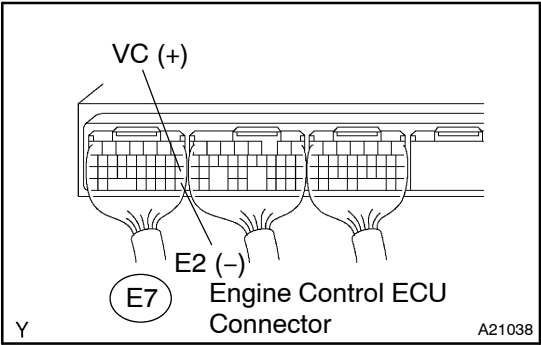
(b) Turn the ignition switch ON.

**CHECK:**

Measure the voltage between the specified terminals of the E7 engine control ECU connector.

**OK:**

Tester Connection	Specified Condition
VC (E7-18) - E2 (E7-28)	4.5 to 5.5 V



**NG**

Replace engine control ECU (See Pub. No. RM630E, page FI-74).

OK

3

Replace throttle body (See Pub. No. RM630E, page FI-42).

Go

4

Check if DTC output recur.

**PREPARATION:**

- (a) Clear the DTC (See page DI-3)
- (b) Start the engine.
- (c) Run the engine at idle for 15 seconds or more.

**CHECK:**

Read the DTC (See page DI-3)

**RESULT:**

Display (DTC Output)	Proceed to
"P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135" are output again	A
No DTC output	B

B

System is OK.

A

Replace engine control ECU (See Pub. No. RM630E, page FI-74).