

<b>DTC</b>	<b>P0120</b>	<b>THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT</b>
<b>DTC</b>	<b>P0122</b>	<b>THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT LOW INPUT</b>
<b>DTC</b>	<b>P0123</b>	<b>THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT HIGH INPUT</b>
<b>DTC</b>	<b>P0220</b>	<b>THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT</b>
<b>DTC</b>	<b>P0223</b>	<b>THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT HIGH INPUT</b>
<b>DTC</b>	<b>P2135</b>	<b>THROTTLE/PEDAL POSITION SENSOR/SWITCH "A"/"B" VOLTAGE CORRELATION</b>

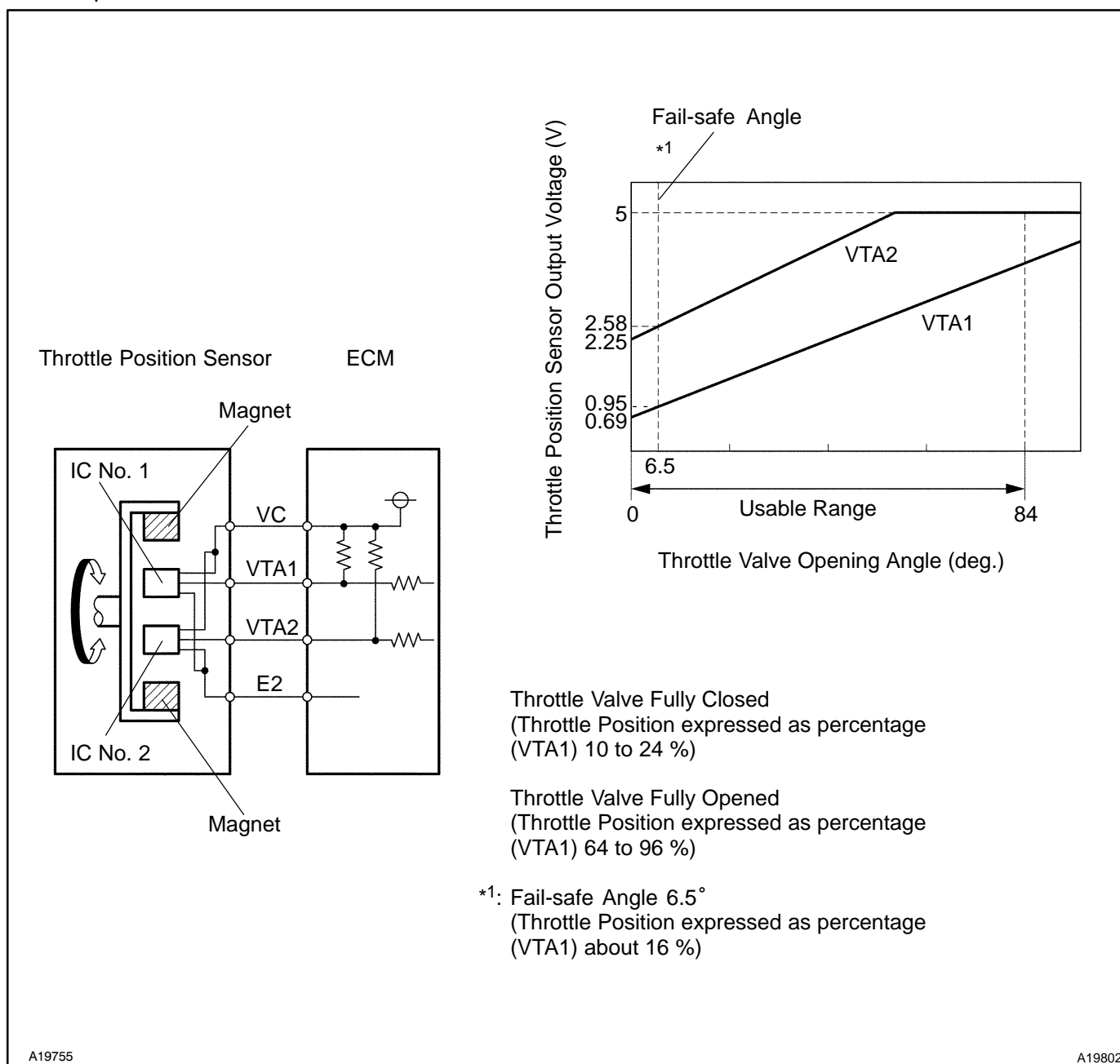
## CIRCUIT DESCRIPTION

### HINT:

- This Electronic 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 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. Voltage applied to VTA1 and VTA2 change between 0 V and 5 V in proportion to the opening angle of the throttle valve. There are several checks that the ECM performs to confirm proper operation of the throttle position sensor and VTA1.

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



A19755

A19802

DTC No.	DTC Detection Condition	Trouble Area
Condition (a) of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 seconds (open or short in the throttle position sensor circuit)		
P0120	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	<ul style="list-style-type: none"><li>• Throttle position sensor</li><li>• ECM</li></ul>
P0122	(a) VTA1 is 0.2 V or less	<ul style="list-style-type: none"><li>• Throttle position sensor</li><li>• Short in VTA1 circuit</li><li>• Open in VC circuit</li><li>• ECM</li></ul>
P0123	(a) VTA1 is 4.8 V or more	<ul style="list-style-type: none"><li>• Throttle position sensor</li><li>• Open in VTA1 circuit</li><li>• Open in E2 circuit</li><li>• Short in VC and VTA1 circuits</li><li>• ECM</li></ul>
P0220	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	<ul style="list-style-type: none"><li>• Throttle position sensor</li><li>• ECM</li></ul>
P0222	(a) VTA2 is 0.5 V or less	<ul style="list-style-type: none"><li>• Throttle position sensor</li><li>• Short in VTA2 circuit</li><li>• Open in VC circuit</li><li>• ECM</li></ul>
P0223	(a) VTA2 is 4.8 V or more and VTA1 is 0.2 V or more and VTA1 is 1.8 V or less	<ul style="list-style-type: none"><li>• Throttle position sensor</li><li>• Open in VTA2 circuit</li><li>• Open in E2 circuit</li><li>• Short in VC and VTA2 circuits</li><li>• ECM</li></ul>
P2135	Condition (a) continues for 0.5 seconds or more, or condition (b) continues for 0.4 seconds 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	<ul style="list-style-type: none"><li>• Short in VTA1 and VTA2 circuits</li><li>• Throttle position sensor</li><li>• ECM</li></ul>

**HINT:**

- After confirming DTCs, use the hand-held tester or the OBD II scan tool to confirm the throttle valve opening percentage and closed throttle position switch condition.
- "THROTTLE POS" is the VTA1 signal. "THROTTLE POS #2" is the VTA2 signal.

**Reference (Normal condition):**

Tester display	Accelerator pedal released	Accelerator pedal fully depressed
THROTTLE POS	10 to 24 %	64 to 96 %
THROTTLE POS #2	2.1 to 3.1 V	4.5 to 5.5 V

## MONITOR DESCRIPTION

The ECM uses the throttle position sensor to monitor the throttle valve opening angle.

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

## FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has a malfunction, the ECM 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 ECM 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 minimal 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.

## MONITOR STRATEGY

Related DTCs	P0120: TP sensor 1 range check (Chattering) P0122: TP sensor 1 range check (Low voltage) P0123: TP sensor 1 range check (High voltage) P0220: TP sensor 2 range check (Chattering) P0222: TP sensor 2 range check (Low voltage) P0223: TP sensor 2 range check (High voltage) P2135: TP sensor range check (Correlation)
Required sensors/components (Main)	TP (Throttle position) sensor
Required sensors/components (Related)	-
Frequency of operation	Continuous
Duration	Accelerator pedal ON: 2 seconds Accelerator pedal OFF: 10 seconds 0.5 seconds or 0.4 seconds (P2135)
MIL operation	Immediate
Sequence of operation	None

## TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	See page <a href="#">05-16</a>
--	--------------------------------

## TYPICAL MALFUNCTION THRESHOLDS

### P0120:

VTA1 voltage	0.2 V or less or 4.8 V or more
--------------	--------------------------------

### P0122:

VTA1 voltage	0.2 V or less
--------------	---------------

### P0123:

VTA1 voltage	4.8 V or more
--------------	---------------

### P0220:

VTA2 voltage	0.5 V or less or 4.8 V or more
--------------	--------------------------------

### P0222:

2005 HIGHLANDER REPAIR MANUAL (RM1144U)

VTA2 voltage	0.5 V or less
--------------	---------------

**P0223:**

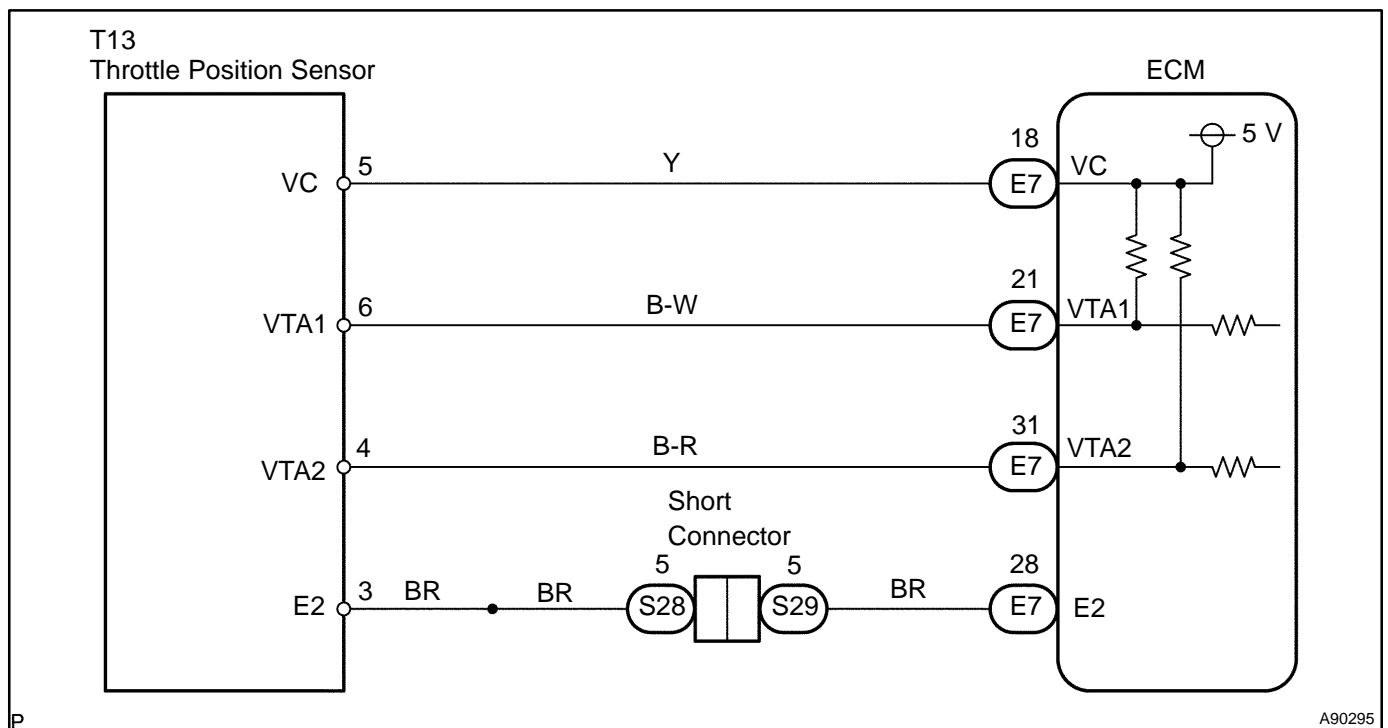
VTA2 voltage when the VTA1 is 0.2 to 1.8 V	4.8 V or more
--	---------------

**P2135:**

Either of the following condition(s) is met:	Condition A or B
<b>Condition A</b>	-
Difference between VTA1 and VTA2 voltages	0.02 V or less
<b>Condition B</b>	-
VTA1 voltage	0.2 V or less
VTA2 voltage	0.5 V or less

**COMPONENT OPERATING RANGE**

VTA1 voltage	0.6 to 3.96 V
VTA2 voltage	2.25 to 4.8 V

**WIRING DIAGRAM****INSPECTION PROCEDURE****HINT:**

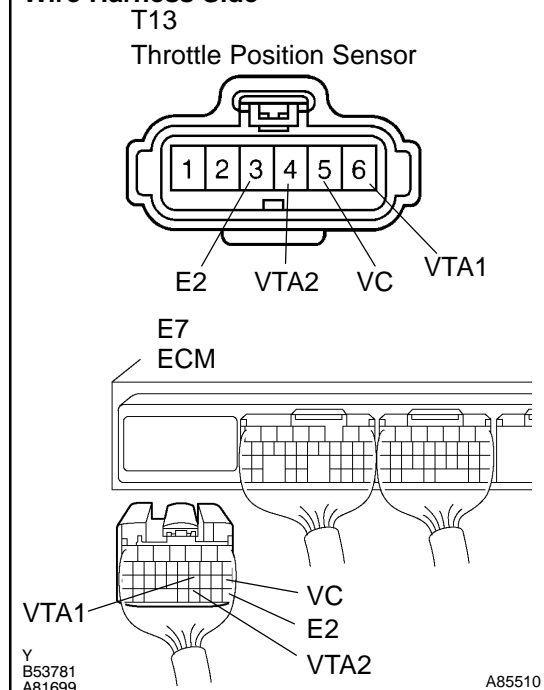
- If DTCs that are related to different systems are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may have an open circuit.
- Read freeze frame data using the hand-held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction 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, and other data from the time the malfunction occurred.

**Hand-held tester:****1 READ VALUE OF HAND-HELD TESTER (THROTTLE POS AND THROTTLE POS #2)**

- (a) On the hand-held tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / THROTTLE POS and THROTTLE POS #2. Read the values.

**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 5.5 V	100 %	4.5 to 5.5 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 5.5 V	about 16 % (fail safe)	0 to 0.2 or 4.5 to 5.5 V	VTA2 circuit open or ground short	
10 to 24 %	2.1 to 3.1 V	64 to 96 % (does not fail safe)	4.5 to 5.5 V (does not fail safe)	Throttle position sensor circuit is normal	B

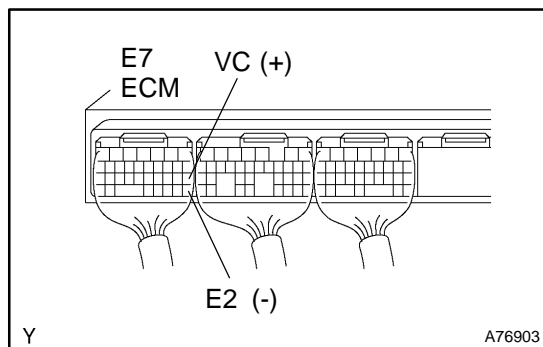
**B****Go to step 5****A****2 CHECK WIRE HARNESS (THROTTLE POSITION SENSOR - ECM)****Wire Harness Side**

- (a) Disconnect the T13 throttle position sensor connector.  
 (b) Disconnect the E7 ECM connector.  
 (c) Measure the resistance of the wire harness side connectors.

**Standard:**

Tester Connection	Specified Condition
T13-5 (VC) - E7-18 (VC) T13-6 (VTA1) - E7-21 (VTA1) T13-4 (VTA2) - E7-31 (VTA2) T13-3 (E2) - E7-28 (E2)	Below 1 $\Omega$
T13-5 (VC) or E7-18 (VC) - Body ground T13-6 (VTA1) or E7-21 (VTA1) - Body ground T13-4 (VTA2) or E7-31 (VTA2) - Body ground	10 k $\Omega$ or higher

**NG****REPAIR OR REPLACE HARNESS AND CONNECTOR****OK**

**3 INSPECT ECM (VC VOLTAGE)**

- Disconnect the T13 throttle position sensor connector.
- Turn the ignition switch ON.
- Measure the voltage of the ECM connector.

**Standard:**

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

**NG****REPLACE ECM (See page 10-9)****OK****4 REPLACE THROTTLE BODY ASSY (See page 10-6)****GO****5 READ OUTPUT DTC (THROTTLE POSITION SENSOR DTCS ARE OUTPUT AGAIN)**

- Clear the DTC (see page 05-38 ).
- Start the engine.
- Run the engine at idle for 15 seconds or more.
- Read the DTC.

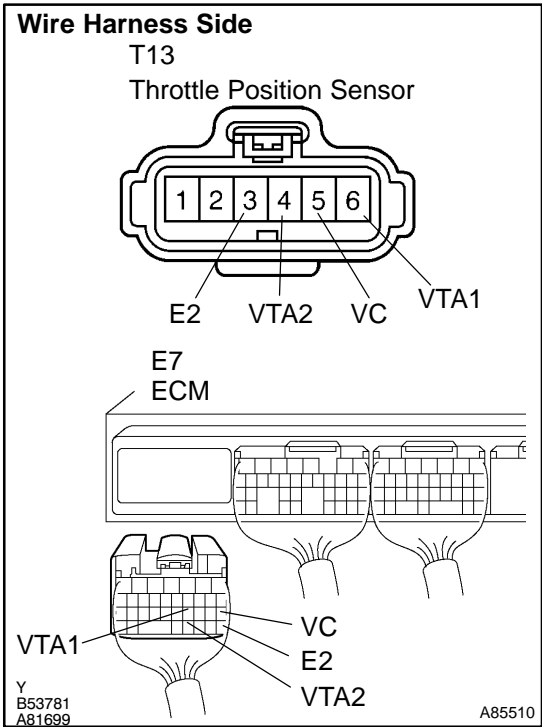
**Result:**

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

**B****SYSTEM OK****A****REPLACE ECM (See page 10-9)**

# OBD II scan tool (excluding hand-held tester):

## 1 CHECK WIRE HARNESS (THROTTLE POSITION SENSOR - ECM)



- Disconnect the T13 throttle position sensor connector.
- Disconnect the E7 ECM connector.
- Measure the resistance of the wire harness side connectors.

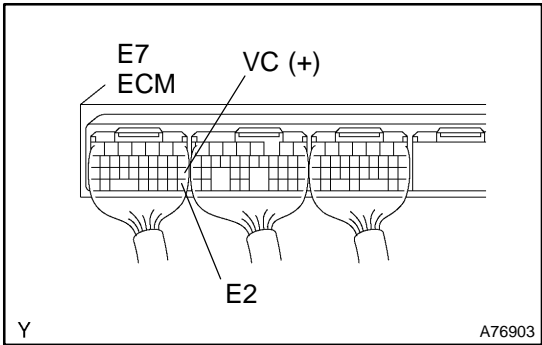
**Standard:**

Tester Connection	Specified Condition
T13-5 (VC) - E7-18 (VC) T13-6 (VTA1) - E7-21 (VTA1) T13-4 (VTA2) - E7-31 (VTA2) T13-3 (E2) - E7-28 (E2)	Below 1 $\Omega$
T13-5 (VC) or E7-18 (VC) - Body ground T13-6 (VTA1) or E7-21 (VTA1) - Body ground T13-4 (VTA2) or E7-31 (VTA2) - Body ground	10 k $\Omega$ or higher

**NG** REPAIR OR REPLACE HARNESS AND CONNECTOR

**OK**

## 2 INSPECT ECM (VC VOLTAGE)



- Disconnect the T13 throttle position sensor connector.
- Turn the ignition switch ON.
- Measure the voltage of the ECM connector.

**Standard:**

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

**NG** REPLACE ECM (See page 10-9)

**OK**

## 3 REPLACE THROTTLE BODY ASSY (See page 10-6)

**G0**

**4 READ OUTPUT DTC (THROTTLE POSITION SENSOR DTCS ARE OUTPUT AGAIN)**

- (a) Clear the DTC (see page [05-38](#) ).
- (b) Start the engine.
- (c) Run the engine at idle for 15 seconds or more.
- (d) Read the DTC.

**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 OK****A****REPLACE ECM (See page [10-9](#) )**