

|            |              |  |
|------------|--------------|--|
| <b>DTC</b> | <b>P2120</b> | <b>Throttle/Pedal Position Sensor/Switch "D" Circuit</b> |
|------------|--------------|--|

|            |              |  |
|------------|--------------|--|
| <b>DTC</b> | <b>P2122</b> | <b>Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input</b> |
|------------|--------------|--|

|            |              |   |
|------------|--------------|---|
| <b>DTC</b> | <b>P2123</b> | <b>Throttle/Pedal Position Sensor/Switch "D" Circuit High Input</b> |
|------------|--------------|---|

|            |              |  |
|------------|--------------|--|
| <b>DTC</b> | <b>P2125</b> | <b>Throttle/Pedal Position Sensor/Switch "E" Circuit</b> |
|------------|--------------|--|

|            |              |  |
|------------|--------------|--|
| <b>DTC</b> | <b>P2127</b> | <b>Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input</b> |
|------------|--------------|--|

|            |              |   |
|------------|--------------|---|
| <b>DTC</b> | <b>P2128</b> | <b>Throttle/Pedal Position Sensor/Switch "E" Circuit High Input</b> |
|------------|--------------|---|

|            |              |  |
|------------|--------------|--|
| <b>DTC</b> | <b>P2138</b> | <b>Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation</b> |
|------------|--------------|--|

**HINT:**

This is the repair procedure for the "accelerator pedal position sensor".

## CIRCUIT DESCRIPTION

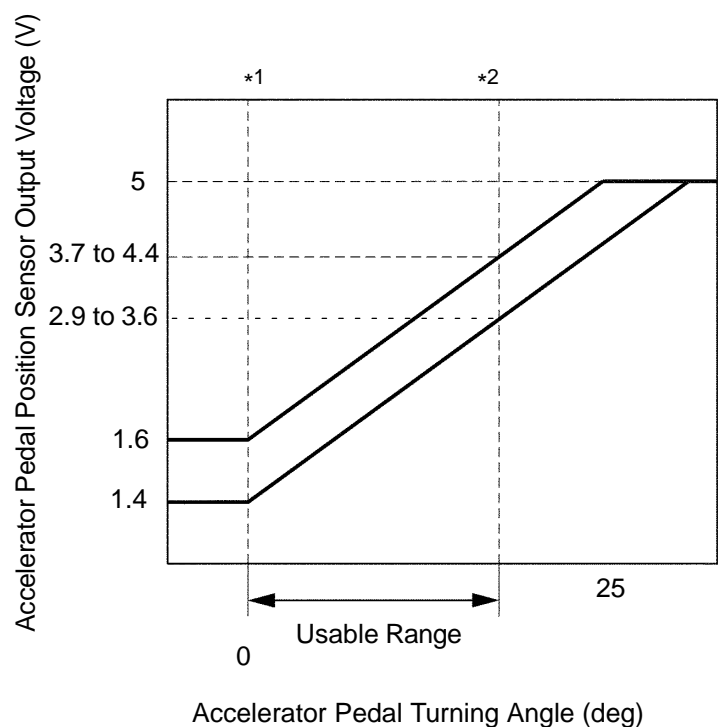
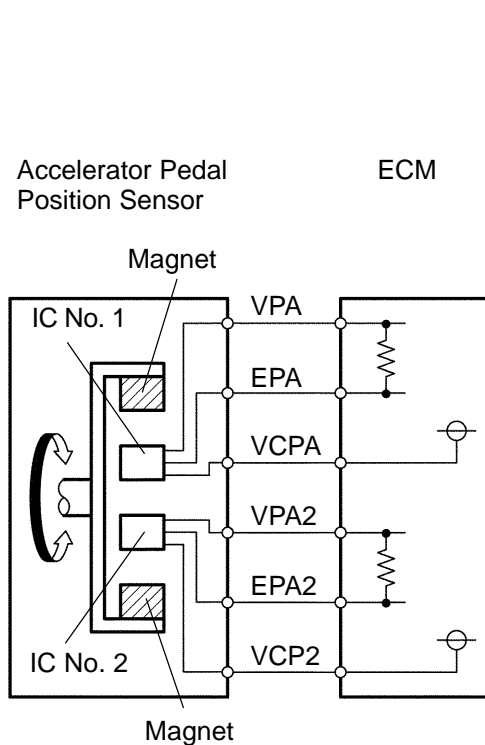
### HINT:

- This electrical throttle control system does not use a throttle cable.
- This accelerator pedal position sensor is a non-contact type.

The accelerator pedal position sensor is mounted in the accelerator pedal to detect the angle of the accelerator pedal. This sensor is electronically controlled and uses Hall-effect elements.

In the accelerator pedal position sensor, the voltage applied to terminals VPA and VPA2 of the ECM changes between 0 V and 5 V in proportion to the angle of the accelerator pedal. The VPA is a signal to indicate the actual accelerator pedal angle and is used for the engine control. VPA2 is used to detect malfunctions of the sensor itself.

The ECM judges the current angle of the accelerator pedal from these signals input from terminals VPA and VPA2, and the ECM controls the throttle motor based on these signals.



\*1 : Accelerator Pedal Fully Released

\*2 : Accelerator Pedal Fully Depressed

| DTC No. | DTC Detection Condition<br>(Open or short in accelerator pedal position sensor circuit)   | Main trouble Area  |
|---------|---|--|
| P2120   | Condition (a) continues for 0.5 seconds or more:<br>(a) $VPA \leq 0.4 \text{ V}$ or $VPA \geq 4.8 \text{ V}$  | <ul style="list-style-type: none"> <li>• Accelerator pedal position sensor</li> <li>• ECM</li> </ul>   |
| P2122   | Condition (a) and (b) continues for 0.5 seconds or more:<br>(a) $VPA \leq 0.4 \text{ V}$<br>(b) $VPA2 \geq 0.04 \text{ V}$                                      | <ul style="list-style-type: none"> <li>• Accelerator pedal position sensor</li> <li>• VCPA circuit open</li> <li>• VPA circuit open or ground short</li> <li>• ECM</li> </ul>  |
| P2123   | Condition (a) continues for 2.0 seconds or more:<br>(a) $VPA \geq 4.8 \text{ V}$  | <ul style="list-style-type: none"> <li>• Accelerator pedal position sensor</li> <li>• EPA circuit open</li> <li>• ECM</li> </ul>   |
| P2125   | Condition (a) continues for 0.5 seconds or more:<br>(a) $VPA2 \leq 1.2 \text{ V}$ or $VPA2 \geq 4.8 \text{ V}$ and $0.4 \text{ V} \leq VPA \leq 3.45 \text{ V}$ | <ul style="list-style-type: none"> <li>• Accelerator pedal position sensor</li> <li>• ECM</li> </ul>   |
| P2127   | Condition (a) and (b) continues for 0.5 seconds or more:<br>(a) $VPA2 \leq 1.2 \text{ V}$<br>(b) $VPA \geq 0.04 \text{ V}$                                      | <ul style="list-style-type: none"> <li>• Accelerator pedal position sensor</li> <li>• VCP2 circuit open</li> <li>• VPA2 circuit open or ground short</li> <li>• ECM</li> </ul> |
| P2128   | Condition (a) and (b) continues for 2.0 seconds or more:<br>(a) $VPA2 \geq 4.8 \text{ V}$<br>(a) $0.4 \text{ V} \leq VPA \leq 3.45 \text{ V}$                   | <ul style="list-style-type: none"> <li>• Accelerator pedal position sensor</li> <li>• EPA circuit open</li> <li>• ECM</li> </ul>   |
| P2138   | Condition (a) or (b) continues for 2.0 seconds or more:<br>(a) $ VPA - VPA2  \leq 0.02 \text{ V}$<br>(b) $VPA \leq 0.4 \text{ V}$ and $VPA2 \leq 1.2 \text{ V}$ | <ul style="list-style-type: none"> <li>• VPA and VPA2 circuit are short circuited</li> <li>• Accelerator pedal position sensor</li> <li>• ECM</li> </ul>                       |

**HINT:**

After confirming DTC P2120, P2122, P2123, P2125, P2127, P2128 and P2138 use the OBD II scan tool or the hand-held tester to confirm the accelerator pedal opening percentage.

| Trouble area                      | Accelerator pedal position expressed as voltage |              |                                   |              |
|-----------------------------------|---|--------------|-----------------------------------|--------------|
|                                   | Accelerator pedal completely released           |              | Accelerator pedal fully depressed |              |
|                                   | ACCEL POS #1                                    | ACCEL POS #2 | ACCEL POS #1                      | ACCEL POS #2 |
| VC circuit open                   | 0 to 0.2 V                                      | 0 to 0.2 V   | 0 to 0.2 V                        | 0 to 0.2 V   |
| VPA circuit open or ground short  | 0 to 0.2 V                                      | 1.2 to 2.0 V | 0 to 0.2 V                        | 3.4 to 5.3 V |
| VPA2 circuit open or ground short | 0.5 to 1.1 V                                    | 0 to 0.2 V   | 2.6 to 4.5 V                      | 0 to 0.2 V   |
| E2 circuit open                   | 4.5 to 5.5 V                                    | 4.5 to 5.5 V | 4.5 to 5.5 V                      | 4.5 to 5.5 V |

**MONITOR DESCRIPTION**

When VPA or VPA2 deviates from the standard, or the difference between the voltage outputs of the two sensors is less than threshold, the ECM concludes that there is a defect in the accelerator pedal position sensor. The ECM turns on the MIL and a DTC is set.

Example:

When the voltage output of the VPA is below 0.4 V or exceeds 4.8 V.

**FAIL SAFE**

The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the remaining circuit is used to calculate the accelerator pedal opening to allow the vehicle to continue driving.

If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal to be fully closed. In this case, the throttle valve will remain closed as if the engine is idling.

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                | P2120                       | Accelerator position sensor 1 (VPA) range check (Fluttering)    |
|                             | P2122                       | Accelerator position sensor 1 (VPA) range check (Low voltage)   |
|                             | P2123                       | Accelerator position sensor 1 (VPA) range check (High voltage)  |
|                             | P2125                       | Accelerator position sensor 2 (VPA2) range check (Fluttering)   |
|                             | P2127                       | Accelerator position sensor 2 (VPA2) range check (Low voltage)  |
|                             | P2128                       | Accelerator position sensor 2 (VPA2) range check (High voltage) |
|                             | P2138                       | Accelerator position sensor correlation range check             |
| Required sensors/components | Accelerator position sensor |   |
| Frequency of operation      | Continuous                  |   |
| Duration                    | 2 sec.                      |   |
| MIL operation               | Immediate                   |   |
| Sequence of operation       | None                        |   |

## TYPICAL ENABLING CONDITIONS

| Item   | Specification                  |         |
|--|--------------------------------|---------|
|  | Minimum                        | Maximum |
| The monitor will run whenever these DTCs are not present | See page <a href="#">DI-18</a> |         |
| Ignition switch  | ON                             |         |
| Throttle control motor power                             | ON                             |         |

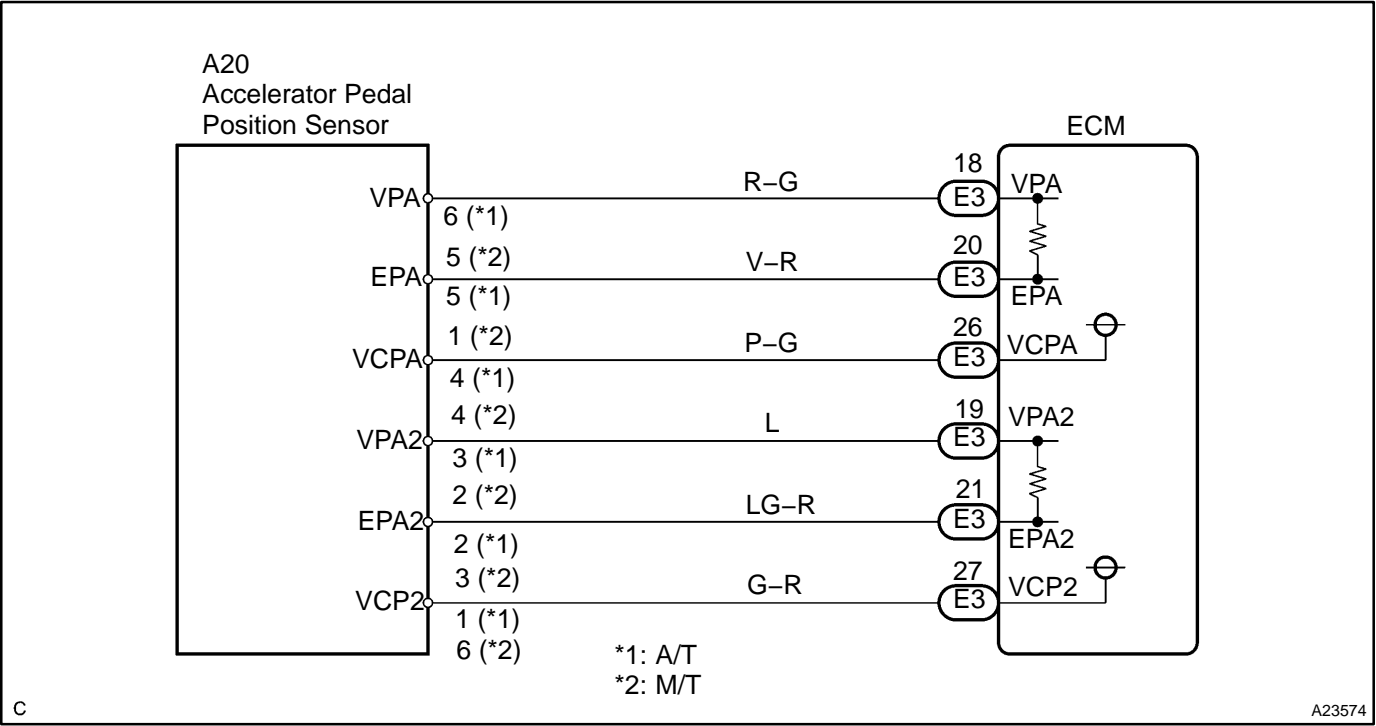
## TYPICAL MALFUNCTION THRESHOLDS

| Detection Criteria                                  | Threshold        |
|---|------------------|
| <b>P2120:</b>                                       |                  |
| Either of the following conditions is met           | Condition 1 or 2 |
| 1. VPA1 voltage when VPA2 voltage is 0.04 V or more | 0.4 V or less    |
| 2. VPA1 voltage                                     | 4.8 V or more    |
| <b>P2122:</b>                                       |                  |
| VPA1 voltage when VPA2 voltage is 0.04 V or more    | 0.4 V or less    |
| <b>P2123:</b>                                       |                  |
| VPA1 voltage  | 4.8 V or more    |
| <b>P2125:</b>                                       |                  |
| Either of the following conditions is met           | Condition 1 or 2 |
| 1. VPA2 voltage when VPA1 voltage is 0.04 V or more | 1.2 V or less    |
| 2. VPA2 voltage when VPA1 voltage is 0.4 to 3.45 V  | 4.8 V or more    |
| <b>P2127:</b>                                       |                  |
| VPA2 voltage when VPA1 voltage is 0.04 V or more    | 1.2 V or less    |
| <b>P2128:</b>                                       |                  |
| VPA2 voltage when VPA1 voltage is 0.4 to 3.45 V     | 4.8 V or more    |
| <b>P2138:</b>                                       |                  |
| Either of the following condition is met:           | Condition 1 or 2 |
| 1. Difference between VPA1 and VPA2 voltage         | 0.02 V or less   |
| 2. Both of the following conditions are met:        | (a) and (b)      |
| (a) VPA1 voltage                                    | 0.4 V or less    |
| (b) VPA2 voltage                                    | 1.2 V or less    |

## COMPONENT OPERATING RANGE

| Parameter                                | Standard Value                      |
|--|-------------------------------------|
| VPA voltage                              | More than 0.4 V and less than 4.8 V |
| VPA2 voltage                             | More than 1.2 V and Less than 4.8 V |
| Difference between VPA and VPA2 voltages | More than 0.02 V                    |

WIRING DIAGRAM



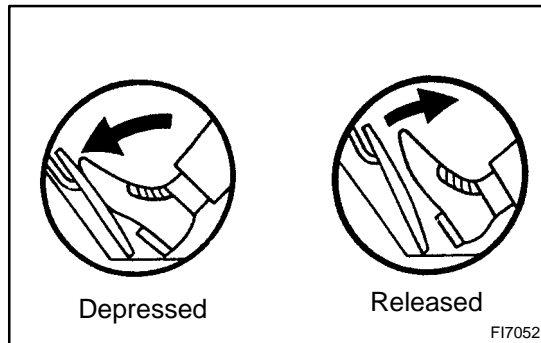
## INSPECTION PROCEDURE

### HINT:

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.

1

**Connect hand-held tester, and read the voltage for accelerator pedal position sensor data.**



### PREPARATION:

- Connect the hand-held tester to the DLC3.
- Turn the ignition switch to ON and push the hand-held tester main switch ON.
- Enter the following menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / ACCEL POS #1 and ACCEL POS #2.

### CHECK:

Read the voltage for the accelerator pedal position sensor data.

### OK:

#### Standard:

| Accelerator pedal | ACCEL POS #1 | ACCEL POS #2 |
|-------------------|--------------|--------------|
| Released          | 0.5 to 1.1 V | 1.2 to 2.0 V |
| Depressed         | 2.6 to 4.5 V | 3.4 to 5.3 V |

OK

**Go to step 5.**

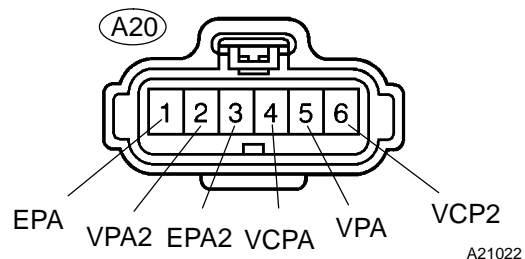
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2

**Check for open and short in harness and connector in VCPA, VCP2, VPA, VPA2 EPA and EPA2 circuit between ECM and accelerator pedal position sensor.**

**Wire Harness Side:**

Accelerator Pedal Position Sensor (M/T)

**PREPARATION:**

- Disconnect the A20 accelerator pedal position sensor connector.
- Disconnect the E3 ECM connector.

**CHECK:**

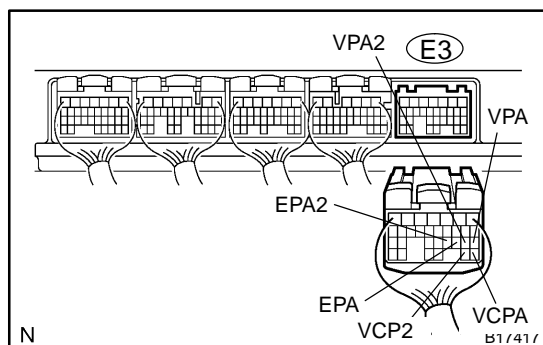
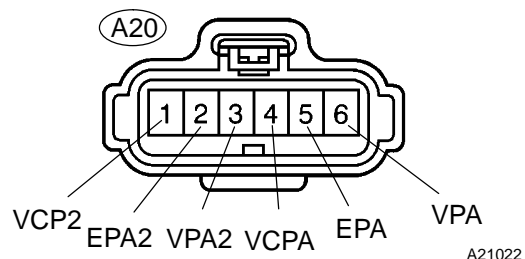
Measure the resistance between the wire harness side connectors.

**OK:****Standard:**

| Tester Connection  | Specified Condition |
|--|---------------------|
| VPA (A20-5) – VPA (E3-18)* <sup>1</sup>                  | Below 1 Ω           |
| VPA (A20-6) – VPA (E3-18)* <sup>2</sup>                  | Below 1 Ω           |
| EPA (A20-1) – EPA (E3-20)* <sup>1</sup>                  | Below 1 Ω           |
| EPA (A20-5) – EPA (E3-20)* <sup>2</sup>                  | Below 1 Ω           |
| VCPA (A20-4) – VCPA (E3-26)                              | Below 1 Ω           |
| VPA2 (A20-2) – VPA2 (E3-19)* <sup>1</sup>                | Below 1 Ω           |
| VPA2 (A20-3) – VPA2 (E3-19)* <sup>2</sup>                | Below 1 Ω           |
| EPA2 (A20-3) – EPA2 (E3-21)* <sup>1</sup>                | Below 1 Ω           |
| EPA2 (A20-2) – EPA2 (E3-21)* <sup>2</sup>                | Below 1 Ω           |
| VCP2 (A20-6) – VCP2 (E3-27)* <sup>1</sup>                | Below 1 Ω           |
| VCP2 (A20-1) – VCP2 (E3-27)* <sup>2</sup>                | Below 1 Ω           |
| VPA (A20-5) or VPA (E3-18) – Body ground* <sup>1</sup>   | 10 kΩ or higher     |
| VPA (A20-6) or VPA (E3-18) – Body ground* <sup>2</sup>   | 10 kΩ or higher     |
| EPA (A20-1) or EPA (E3-20) – Body ground* <sup>1</sup>   | 10 kΩ or higher     |
| EPA (A20-5) or EPA (E3-20) – Body ground* <sup>2</sup>   | 10 kΩ or higher     |
| VCPA (A20-4) or VCPA (E3-26) – Body ground               | 10 kΩ or higher     |
| VPA2 (A20-2) or VPA2 (E3-19) – Body ground* <sup>1</sup> | 10 kΩ or higher     |
| VPA2 (A20-3) or VPA2 (E3-19) – Body ground* <sup>2</sup> | 10 kΩ or higher     |
| EPA2 (A20-3) or EPA2 (E3-21) – Body ground* <sup>1</sup> | 10 kΩ or higher     |
| EPA2 (A20-2) or EPA2 (E3-21) – Body ground* <sup>2</sup> | 10 kΩ or higher     |
| VCP2 (A20-6) or VCP2 (E3-27) – Body ground* <sup>1</sup> | 10 kΩ or higher     |
| VCP2 (A20-1) or VCP2 (E3-27) – Body ground* <sup>2</sup> | 10 kΩ or higher     |

\*<sup>1</sup>: M/T\*<sup>2</sup>: A/T**Wire Harness Side:**

Accelerator Pedal Position Sensor (A/T)





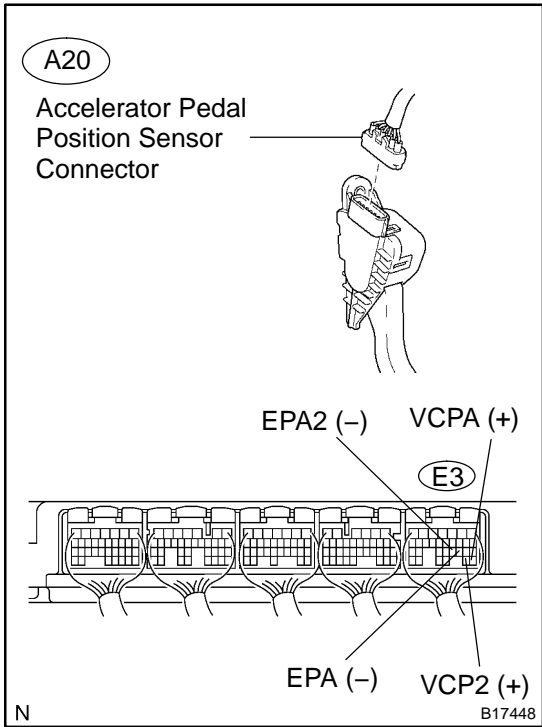
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Repair or replace harness and connector.

OK

3

Check voltage between terminals VCPA and EPA, and VCP2 and EPA2 of ECM terminals.



**PREPARATION:**

- (a) Disconnect the A20 accelerator pedal position sensor connector.
- (b) Turn the ignition switch to ON.

**CHECK:**

Measure the voltage between the specified terminals of the E3 ECM connector.

**OK:**

**Standard:**

| Tester Connection           | Specified Condition |
|-----------------------------|---------------------|
| VCPA (E3-26) – EPA (E3-20)  | 4.5 to 5.5 V        |
| VCP2 (E3-27) – EPA2 (E3-21) | 4.5 to 5.5 V        |

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Replace ECM (See page [SF-66](#)).

OK

4

Replace accelerator pedal assembly.

NEXT

|   |   |
|---|---|
| 5 | Check whether DTC output recurs (DTC P2120, P2122, P2123, P2125, P2127, P2128 or P2138) |
|---|---|

**PREPARATION:**

- (a) Connect the hand-held tester to the DLC3.
- (b) Disconnect the battery terminals or remove the EFI No. 1 fuse and ETCS fuse (Clear DTCs).
- (c) Start the engine.
- (d) Drive the engine at idle for 15 seconds or more.
- (e) On the hand-held tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.

**CHECK:**

Read the DTC output.

**RESULT:**

| Display (DTC Output)                              | Proceed To |
|---|------------|
| P2120, P2122, P2123, P2125, P2127, P2128 or P2138 | A          |
| No output   | B          |

**B****System is OK.****A****Replace ECM (See page [SF-66](#)).**