

<b>Last Modified:</b> 12-02-2019	6.10:8.0.50	<b>Doc ID:</b> RM100000000RTIS
<b>Model Year Start:</b> 2016	<b>Model:</b> 4Runner	<b>Prod Date Range:</b> [08/2015 - 08/2019]
<b>Title:</b> 1GR-FE (ENGINE CONTROL): SFI SYSTEM: P0120-P0123,P0220,P0222,P0223,P2135; Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction; 2016 - 2019 MY 4Runner [08/2015 - 08/2019]		

<b>DTC</b>	<b>P0120</b>	<b>Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction</b>
------------	--------------	--

<b>DTC</b>	<b>P0121</b>	<b>Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem</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>P0222</b>	<b>Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input</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>
------------	--------------	--

## **CAUTION / NOTICE / HINT**

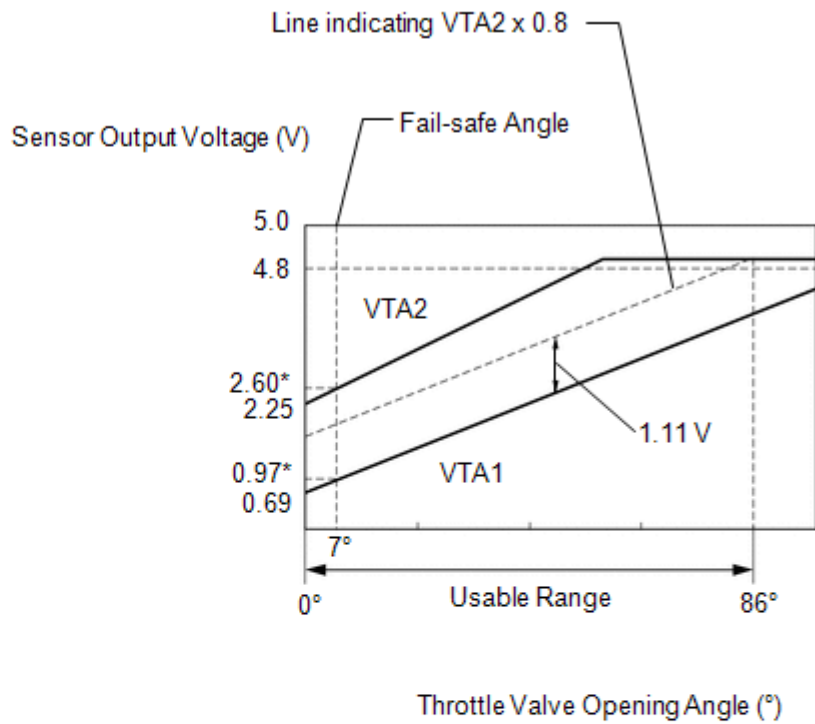
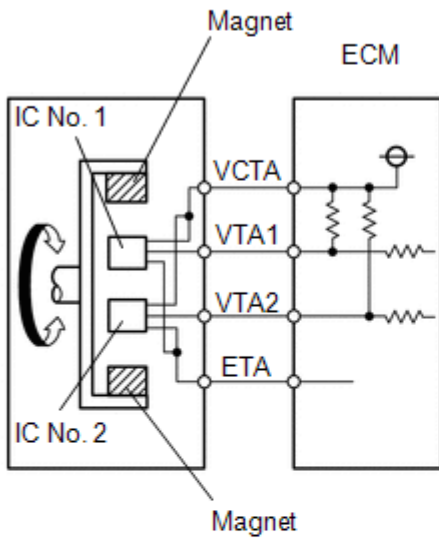
### **DESCRIPTION**

The throttle position sensor is mounted on the throttle body with motor assembly and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.

The throttle position sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.

As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.

### Throttle Position Sensor



#### Note:

The throttle valve opening angle transmitted through sensor terminal VTA1 is expressed as a percentage.

Between 10% and 22%: Throttle valve fully closed

Between 64% and 96%: Throttle valve fully open

Approximately 19.4%: Fail-safe angle (7°)

\*: During fail-safe control

Characteristics of sensor output:

VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V.

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0120	Output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	<ul style="list-style-type: none"> <li>• Throttle position sensor (built into throttle body with motor assembly)</li> <li>• ECM</li> </ul>

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0121	Difference between VTA1 and VTA2 voltages is less than 0.8 V, or higher than 1.6 V for 2 seconds (1 trip detection logic).	<ul style="list-style-type: none"> <li>• Throttle position sensor (built into throttle body with motor assembly)</li> <li>• Throttle position sensor circuit</li> <li>• ECM</li> </ul>
P0122	Output voltage of VTA1 is 0.2 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	<ul style="list-style-type: none"> <li>• Throttle position sensor (built into throttle body with motor assembly)</li> <li>• Short in VTA1 circuit</li> <li>• Open in VC circuit</li> <li>• ECM</li> </ul>
P0123	Output voltage of VTA1 is 4.535 V or higher for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	<ul style="list-style-type: none"> <li>• Throttle position sensor (built into throttle body with motor assembly)</li> <li>• Open in VTA1 circuit</li> <li>• Open in ETA circuit</li> <li>• Short between VC and VTA1 circuits</li> <li>• ECM</li> </ul>
P0220	Output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	<ul style="list-style-type: none"> <li>• Throttle position sensor (built into throttle body with motor assembly)</li> <li>• ECM</li> </ul>
P0222	Output voltage of VTA2 is 1.75 V or less for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	<ul style="list-style-type: none"> <li>• Throttle position sensor (built into throttle body with motor assembly)</li> <li>• Short in VTA2 circuit</li> <li>• Open in VC circuit</li> <li>• ECM</li> </ul>

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P0223	Output voltage of VTA2 is 4.8 V or higher, and VTA1 is between 0.2 V and 2.02 V for 2 seconds when the accelerator pedal is depressed (1 trip detection logic).	<ul style="list-style-type: none"> <li>Throttle position sensor (built into throttle body with motor assembly)</li> <li>Open in VTA2 circuit</li> <li>Open in ETA circuit</li> <li>Short between VC and VTA2 circuits</li> <li>ECM</li> </ul>
P2135	Either condition is met (1 trip detection logic): (a) Difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. (b) Output voltage of VTA1 is 0.2 V or less, and VTA2 is 1.75 V or less for 0.4 seconds or more.	<ul style="list-style-type: none"> <li>Throttle position sensor (built into throttle body with motor assembly)</li> <li>Short between VTA1 and VTA2 circuits</li> <li>ECM</li> </ul>

**HINT:**

- When any of these DTCs are stored, check the throttle valve opening angle by entering the following menus: Powertrain / Engine and ECT / Data List / All Data / Throttle Position No. 1 and Throttle Position No. 2.
- Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.  
Reference (Normal Condition):

TESTER DISPLAY	ACCELERATOR PEDAL FULLY RELEASED	ACCELERATOR PEDAL FULLY DEPRESSED
Throttle Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

## MONITOR DESCRIPTION

The ECM uses the throttle position sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm that the throttle position sensor is operating properly.

**P0120, P0122, P0123, P0220, P0222, P0223 and P2135**

- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

**P0121**

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

This sensor transmits two signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. The ECM performs several checks to confirm that the

throttle position sensor and VTA1 are operating properly.

For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the output voltage difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction of the throttle position sensor. The ECM illuminates the MIL and stores the DTC.

If the malfunction is not repaired successfully, the DTC is stored 2 seconds after the engine is next started.

## **MONITOR STRATEGY**

Related DTCs	P0120: Throttle position sensor 1 range check (Chattering) P0121: Throttle position sensor rationality P0122: Throttle position sensor 1 range check (Low voltage) P0123: Throttle position sensor 1 range check (High voltage) P0220: Throttle position sensor 2 range check (Chattering) P0222: Throttle position sensor 2 range check (Low voltage) P0223: Throttle position sensor 2 range check (High voltage) P2135: Throttle position sensor range check (Correlation)
Required Sensors/Components (Main)	Throttle position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	2 seconds: P0120, P0122, P0123, P0220, P0222 and P0223 Within 2 seconds: P0121 0.5 seconds: P2135 (Case 1) 0.4 seconds: P2135 (Case 2)
MIL Operation	Immediate
Sequence of Operation	None

## **TYPICAL ENABLING CONDITIONS**

### **P0120, P0122, P0123, P0220, P0222, P0223 and P2135**

Monitor runs whenever the following DTCs are not present	None
Either of the following condition is met	A or B
A. Ignition switch on	0.012 seconds or more
B. Electronic throttle actuator power	ON

### **P0121**

Monitor runs whenever the following DTCs are not present	None
Either of the following condition is met	A or B
A. Ignition switch	ON
B. Electronic throttle actuator power	ON
Throttle position sensor malfunction (P0120, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected

## TYPICAL MALFUNCTION THRESHOLDS

### **P0120**

VTA1 voltage	0.2 V or less, or 4.535 V or higher
--------------	-------------------------------------

### **P0121**

Either of the following condition is met	-
Difference of learned throttle position sensor opener position voltage between VTA2 and VTA1	Higher than 1.6 V
Difference of learned throttle position sensor opener position voltage between VTA2 and VTA1	Less than 0.8 V

### **P0122**

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

### **P0123**

VTA1 voltage	4.535 V or higher
--------------	-------------------

### **P0220**

Either of the following condition is met	A or B
A. VTA2 voltage	1.75 V or less
B. VTA2 voltage when VTA1 is 0.2 V or higher and 2.02 V or less	4.8 V or higher

### **P0222**

VTA2 voltage	1.75 V or less
--------------	----------------

### **P0223**

VTA2 voltage when VTA1 is 0.2 V or higher and 2.02 V or less	4.8 V or higher
--	-----------------

### **P2135 (Case 1)**

Difference between VTA1 and VTA2 voltages	0.02 V or less
---	----------------

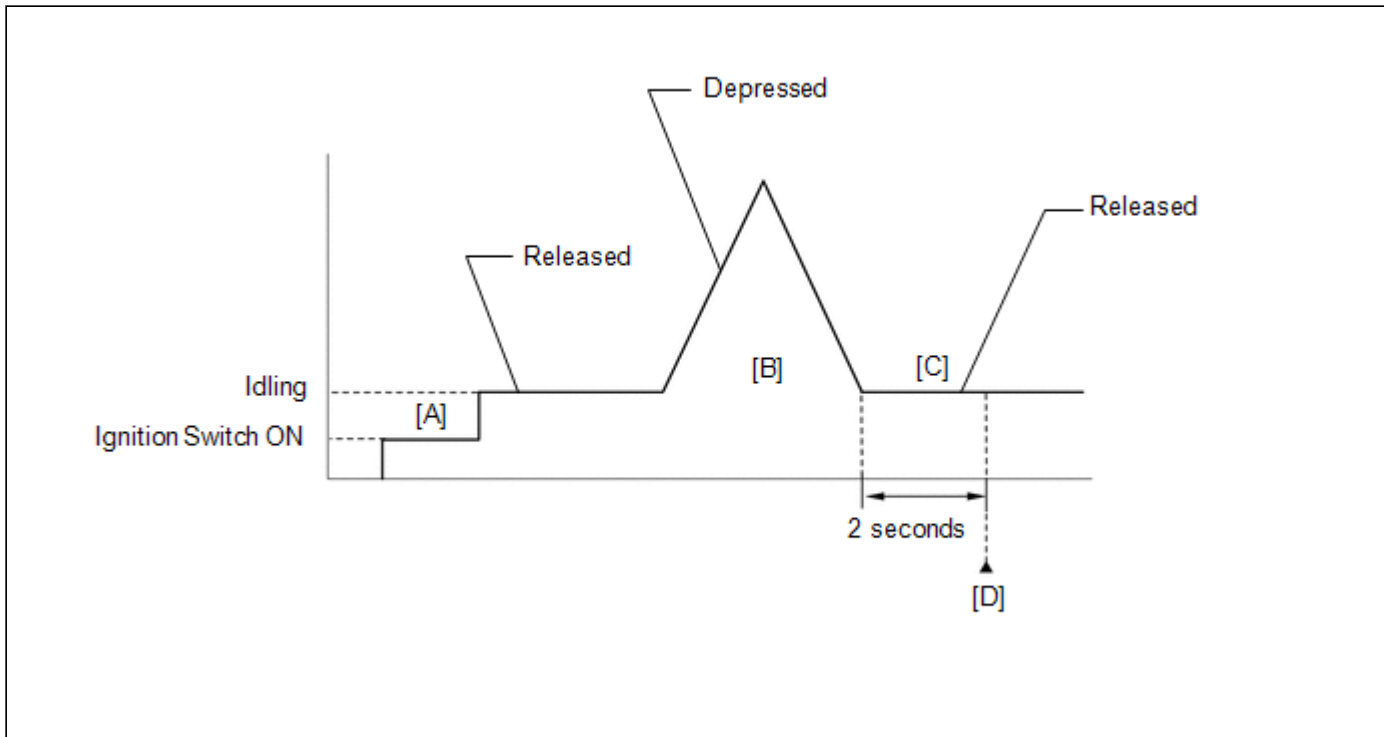
### **P2135 (Case 2)**

VTA1 voltage	0.2 V or less
VTA2 voltage	1.75 V or less

## COMPONENT OPERATING RANGE

VTA1 voltage	Higher than 0.2 V, and less than 4.535 V
VTA2 voltage	Higher than 1.75 V, and less than 4.8 V

## CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
4. Turn the ignition switch off and wait for at least 30 seconds.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. With the vehicle stationary, fully depress and release the accelerator pedal [B].
8. Idle the engine for 2 seconds or more [C].
9. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes [D].
10. Read the pending DTCs.

### HINT:

- If a pending DTC is output, the system is malfunctioning.
  - If a pending DTC is not output, perform the following procedure.
11. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
  12. Input the DTC: P0120, P0121, P0122, P0123, P0220, P0222, P0223 or P2135.
  13. Check the DTC judgment result.

TESTER DISPLAY	DESCRIPTION
NORMAL	<ul style="list-style-type: none"> <li>◦ DTC judgment completed</li> <li>◦ System normal</li> </ul>
ABNORMAL	<ul style="list-style-type: none"> <li>◦ DTC judgment completed</li> <li>◦ System abnormal</li> </ul>

TESTER DISPLAY	DESCRIPTION
INCOMPLETE	<ul style="list-style-type: none"> <li>◦ DTC judgment not completed</li> <li>◦ Perform driving pattern after confirming DTC enabling conditions</li> </ul>
N/A	<ul style="list-style-type: none"> <li>◦ Unable to perform DTC judgment</li> <li>◦ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit</li> </ul>

**HINT:**

- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or N/A, perform steps [B] and [D] again.

14. If no pending DTC is output, perform a universal trip and check for permanent DTCs (See page INFO ).

**HINT:**

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

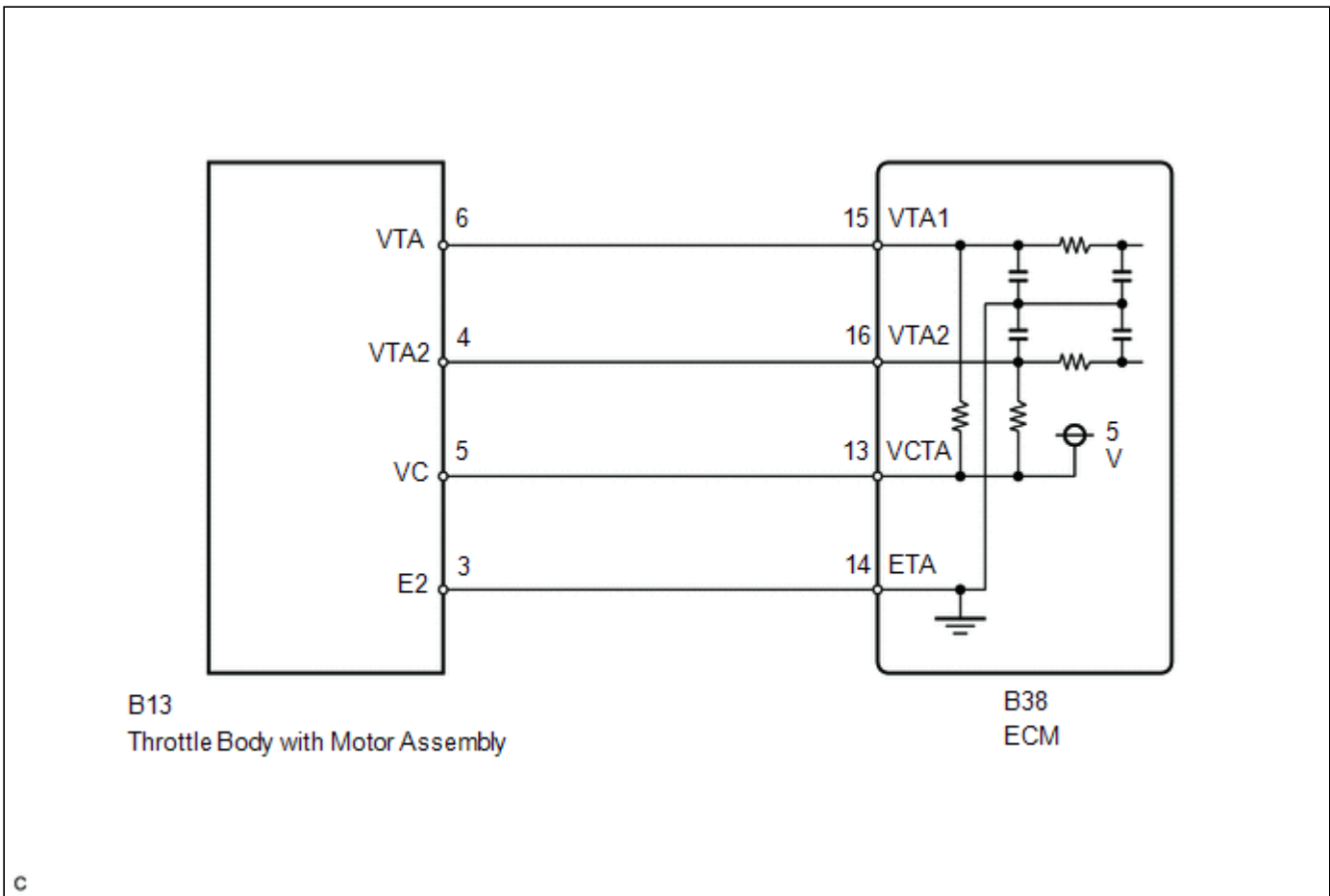
## **FAIL-SAFE**

When any of these DTCs as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 7° opening angle by 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 position to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

The ECM continues operating in fail-safe mode until a pass condition is detected and the ignition switch is turned off.

## **WIRING DIAGRAM**





## CAUTION / NOTICE / HINT

### HINT:

- These DTCs relate to the throttle position sensor.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition 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.

## PROCEDURE

<b>1.</b>	<b>READ VALUE USING TECHSTREAM (THROTTLE POSITION NO. 1 AND NO. 2)</b>
-----------	--

- Connect the Techstream to the DLC3.
- Turn the ignition switch to ON and turn the Techstream on.
- Enter the following menus: Powertrain / Engine and ECT / Data List / Throttle Position No. 1 and Throttle Position No. 2.
- Check the values displayed on the Techstream.

### Result

WHEN ACCELERATOR PEDAL RELEASED	WHEN ACCELERATOR PEDAL DEPRESSED	TROUBLE AREA	PROCEED TO

THROTTLE POSITION NO. 1		THROTTLE POSITION NO. 2		TROUBLE AREA	PROCEED TO
THROTTLE POSITION NO. 1	THROTTLE POSITION NO. 2	THROTTLE POSITION NO. 1	THROTTLE POSITION NO. 2		
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	ETA circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	
0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP sensor circuit normal	B

**B**  **GO TO STEP 5**

**A**



<b>2.</b>	<b>CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)</b>
-----------	---

- (a) Disconnect the throttle body with motor assembly connector.
- (b) Disconnect the ECM connector.
- (c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

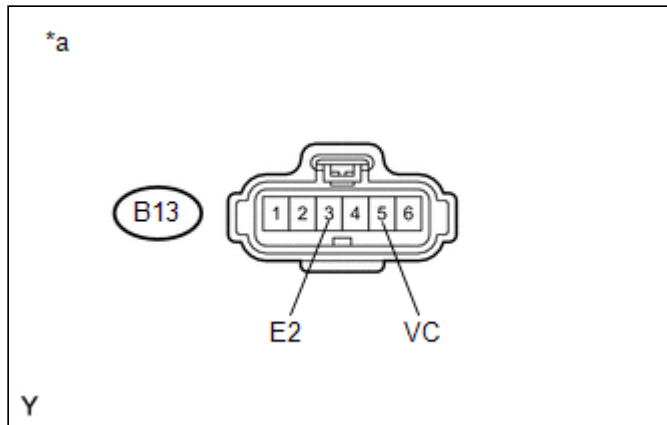
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
B13-5 (VC) - B38-13 (VCTA)	Always	Below 1 $\Omega$
B13-6 (VTA) - B38-15 (VTA1)	Always	Below 1 $\Omega$
B13-4 (VTA2) - B38-16 (VTA2)	Always	Below 1 $\Omega$
B13-3 (E2) - B38-14 (ETA)	Always	Below 1 $\Omega$
B13-5 (VC) or B38-13 (VCTA) - Body ground	Always	10 k $\Omega$ or higher
B13-6 (VTA) or B38-15 (VTA1) - Body ground	Always	10 k $\Omega$ or higher
B13-4 (VTA2) or B38-16 (VTA2) - Body ground	Always	10 k $\Omega$ or higher

- (d) Reconnect the throttle body with motor assembly connector.
- (e) Reconnect the ECM connector.

**NG**  **REPAIR OR REPLACE HARNESS OR CONNECTOR**

**OK**  
▼

**3. INSPECT ECM (VC VOLTAGE)**



- (a) Disconnect the throttle body with motor assembly connector.
- (b) Turn the ignition switch to ON.
- (c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	SWITCH CONDITION	SPECIFIED CONDITION
B13-5 (VC) - B13-3 (E2)	Ignition switch ON	4.5 to 5.5 V

**Text in Illustration**

*a	Front view of wire harness connector (to Throttle Body with Motor Assembly)
----	--

- (d) Reconnect the throttle body with motor assembly connector.

**NG** ► **REPLACE ECM**

**OK**  
▼

**4. REPLACE THROTTLE BODY WITH MOTOR ASSEMBLY**

- (a) Replace the throttle body with motor assembly (See page [INFO](#) ).

## NEXT



### 5. CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)

- (a) Connect the Techstream to the DLC3.
- (b) Turn the ignition switch to ON and turn the Techstream on.
- (c) Clear DTCs (See page [INFO](#) ).
- (d) Start the engine.
- (e) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.
- (f) Read the output DTCs.

#### Result

DISPLAY (DTC OUTPUT)	PROCEED TO
P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135 is output	A
No DTC is output	B

**A** REPLACE ECM

**B** SYSTEM OK

