

DTC	P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction
DTC	P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem
DTC	P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input
DTC	P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input
DTC	P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit
DTC	P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input
DTC	P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input
DTC	P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

DESCRIPTION

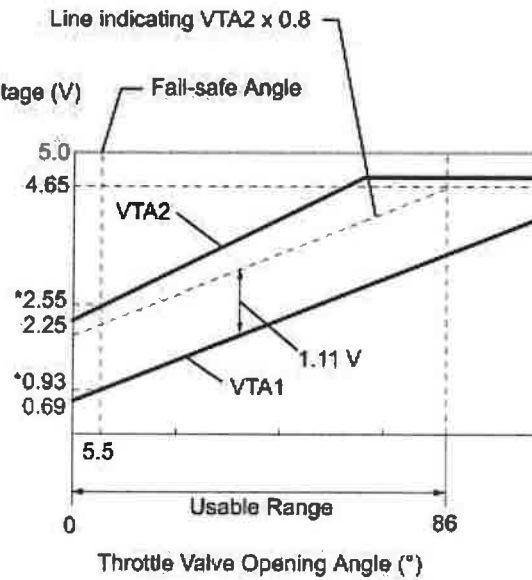
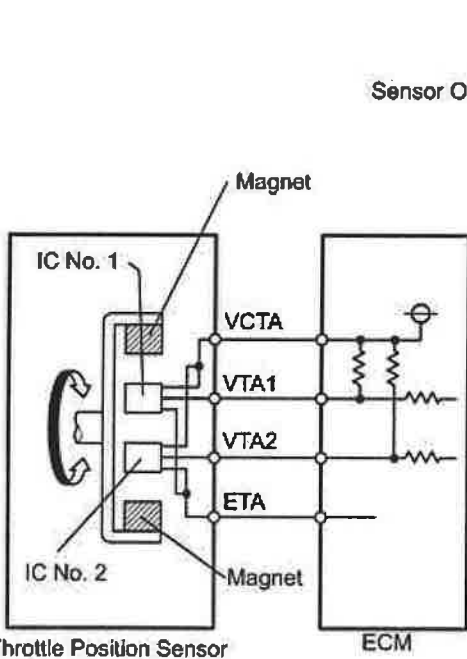
HINT:

- These DTCs relate to the throttle position sensor.

The throttle position sensor is mounted on the throttle body 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 conditions.

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 enrichment correction and fuel-cut control.



*: During fail-safe control

Note:

The throttle valve opening angle detected by the 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 18.6%: Fail safe angle (5.5°)

Features of sensor output:

The difference in voltage between VTA1 and $VTA2 \times 0.8$ is approximately 1.11 V.

($VTA2 \times 0.8$ is approximately equal to $VTA1 + 1.11$ V)

DTC No.	DTC Detection Condition	Trouble Area
P0120	Output voltage of VTA1 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds or more (1 trip detection logic)	<ul style="list-style-type: none"> Throttle position sensor (built into throttle body assembly) ECM
P0121	Difference between VTA1 and VTA2 voltages less than 0.8 V, or more than 1.6 V for 2 seconds (1 trip detection logic)	<ul style="list-style-type: none"> Throttle position sensor (built into throttle body assembly) Throttle position sensor circuit ECM
P0122	Output voltage of VTA1 0.2 V or less for 2 seconds or more (1 trip detection logic)	<ul style="list-style-type: none"> Throttle position sensor (built into throttle body assembly) Short in VTA1 circuit

DTC No.	DTC Detection Condition	Trouble Area
		<ul style="list-style-type: none"> • Open in VC circuit • ECM
P0123	<p>Output voltage of VTA1 4.54 V or more for 2 seconds or more (1 trip detection logic)</p>	<ul style="list-style-type: none"> • Throttle position sensor (built into throttle body assembly) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	<p>Output voltage of VTA2 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds or more (1 trip detection logic)</p>	<ul style="list-style-type: none"> • Throttle position sensor (built into throttle body assembly) • ECM
P0222	<p>Output voltage of VTA2 1.75 V or less for 2 seconds or more (1 trip detection logic)</p>	<ul style="list-style-type: none"> • Throttle position sensor (built into throttle body assembly) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	<p>Output voltage of VTA2 4.8 V or more, and VTA1 between 0.2 V and 2.02 V, for 2 seconds or more (1 trip detection logic)</p>	<ul style="list-style-type: none"> • Throttle position sensor (built into throttle body assembly) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	<p>Either condition (a) or (b) met (1 trip detection logic): (a) Difference between output voltages of VTA1 and VTA2 0.02 V or less for 0.5 seconds or more</p>	<ul style="list-style-type: none"> • Short between VTA1 and VTA2 circuits • Throttle position sensor (built into

DTC No.	DTC Detection Condition	Trouble Area
	(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	throttle body assembly) <ul style="list-style-type: none"> • ECM

MONITOR DESCRIPTION

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

The ECM uses the throttle position sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the throttle position sensor.

- 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 circuit, and sets 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 circuit, and sets 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 circuit, and sets a DTC.

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

P0121

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 the proper operation of the throttle position sensor and VTA1.

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 in 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)
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	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	Immediately
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0120, P0122, P0123, P0220, P0222, P0223, P2135:

Monitor runs whenever following DTCs are not present	None
Either of the following conditions A or B is met	-
Power switch on (IG)	0.012 seconds or more
B. Electronic throttle actuator power	ON

P0121:

Monitor runs whenever following DTCs are not present	None
Either of the following conditions A or B is set	-
A. Power switch	On (IG)
B. Electric throttle motor 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 4.54 V or more
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P0121

Either of the following conditions is set	-
Difference of throttle position sensor voltage between VTA1 and (VTA2 x 0.8)	Higher than 1.6 V
Difference of throttle position sensor voltage between VTA1 and (VTA2 x 0.8)	Lower than 0.8 V

P0122

VTA1 voltage	0.2 V or less
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P0123

VTA1 voltage	4.54 V or more
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P0220

Either of the following conditions is met	A or B
A. VTA2 voltage	1.75 V or less
B. All of the following conditions are met	(a) and (b)
(a) VTA2 voltage	4.8 V or more
(b) VTA1 voltage	0.2 V or more, and 2.02 V or less

P0222

VTA2 voltage	1.75 V or less
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P0223

VTA2 voltage when VTA1 0.2 V or more, and 2.02 V or less	4.8 V or more
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P2135 Case 1

Difference between VTA1 and VTA2 voltages	0.02 V or less
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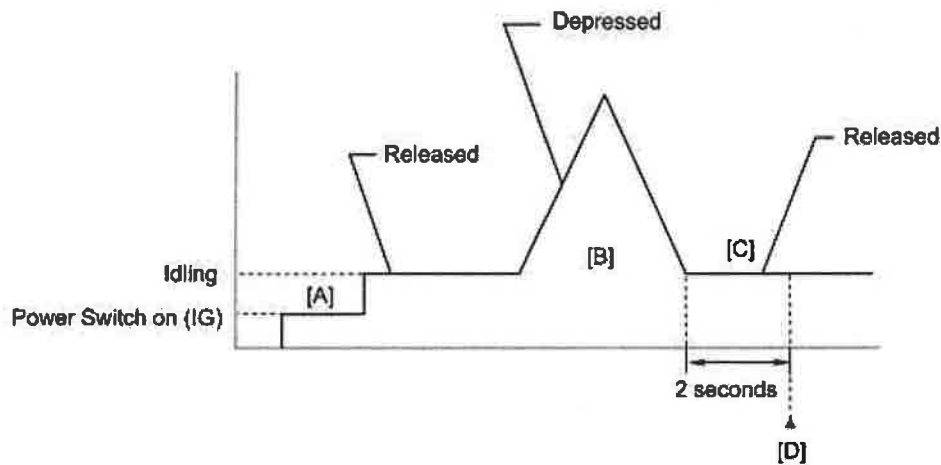
P2135 Case 2

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

COMPONENT OPERATING RANGE

VTA1 voltage	0.2 to 4.54 V
VTA2 voltage	1.75 to 4.8 V

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) INFO.
4. Turn the power switch off and wait for 30 seconds.
5. Turn the power switch on (IG) and turn the Techstream on [A].
6. Put the engine in inspection mode INFO.
7. Start the engine.
8. With the vehicle stationary, fully depress and release the accelerator pedal [B].
9. Idle the engine for 2 seconds or more [C].
10. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
11. Read the DTC [D].
12. If a DTC is output, the system is malfunctioning.

HINT:

If a DTC is not output, perform the following procedure.

13. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
14. Input the DTC: P0120, P0121, P0122, P0123, P0220, P0222, P0223 or P2135.
15. Check the DTC judgment result.


Techstream Display	Description
NORMAL	<ul style="list-style-type: none"> ○ DTC judgment completed ○ System normal
ABNORMAL	<ul style="list-style-type: none"> ○ DTC judgment completed ○ System abnormal
INCOMPLETE	<ul style="list-style-type: none"> ○ DTC judgment not completed

Techstream Display	Description
	<ul style="list-style-type: none"> ○ Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	<ul style="list-style-type: none"> ○ Unable to perform DTC judgment ○ Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
 - If the judgment result shows NORMAL, the system is normal.
 - If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.
16. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
17. Check the judgment result.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
 - If the judgment result shows NORMAL, the system is normal.
18. If the test result is INCOMPLETE or UNKNOWN and no DTC is output, perform a universal trip and check for permanent DTCs .

HINT:

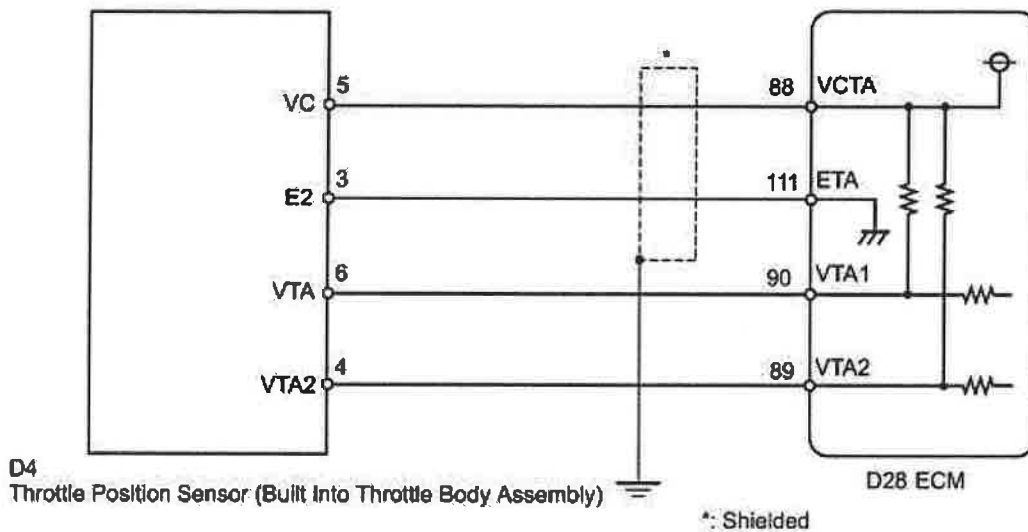
- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to 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 5.5° throttle angle by the return spring. The ECM stops the engine and the vehicle can be driven using solely the hybrid system. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the power switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.

Features of sensor output:

$VTA2 \times 0.8$ is approximately equal to $VTA1 + 1.11 \text{ V}$

VTA1: Throttle Position No. 1

VTA2: Throttle position No. 2

- If DTC P0121 is output, proceed to "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

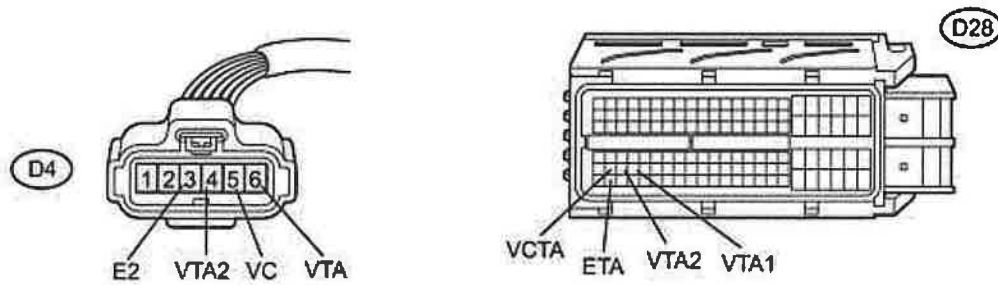
PROCEDURE

1. CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

(a) Disconnect the throttle body assembly connector.

*1

*2



(b) Disconnect the ECM connector.

(c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

Tester Connection	Condition	Specified Condition
D4-5 (VC) - D28-88 (VCTA)	Always	Below 1 Ω
D4-6 (VTA) - D28-90 (VTA1)	Always	Below 1 Ω
D4-4 (VTA2) - D28-89 (VTA2)	Always	Below 1 Ω
D4-3 (E2) - D28-111 (ETA)	Always	Below 1 Ω

Standard Resistance (Check for Short):

Tester Connection	Condition	Specified Condition
D4-5 (VC) or D28-88 (VCTA) - Body ground	Always	10 k Ω or higher
D4-6 (VTA) or D28-90 (VTA1) - Body ground	Always	10 k Ω or higher
D4-4 (VTA2) or D28-89 (VTA2) - Body ground	Always	10 k Ω or higher

Text in Illustration

*1	Front view of wire harness connector (to Throttle Body Assembly)	*2	Front view of wire harness connector (to ECM)
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(d) Reconnect the throttle body assembly connector.

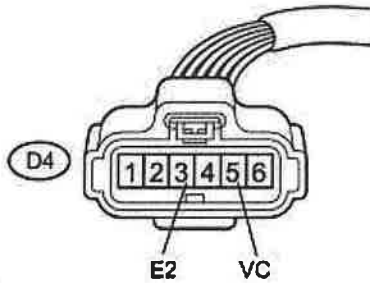
(e) Reconnect the ECM connector.

NG ► REPAIR OR REPLACE HARNESS OR CONNECTOR (THROTTLE POSITION SENSOR - ECM)
OK



2. INSPECT ECM (VC VOLTAGE)

*1



(a) Disconnect the throttle body assembly connector.

N

(b) Turn the power switch on (IG).

(c) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

Tester Connection	Condition	Specified Condition
D4-5 (VC) - D4-3 (E2)	Power switch on (IG)	4.5 to 5.5 V

Text in Illustration

*1	Front view of wire harness connector (to Throttle Body Assembly)
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(d) Reconnect the throttle body assembly connector.

NG ▶ REPLACE ECM

OK



3. REPLACE THROTTLE BODY ASSEMBLY



(a) Replace the throttle body assembly .

NEXT



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

(a) Connect the Techstream to the DLC3.

- (b) Turn the power switch on (IG).
- (c) Turn the Techstream on.
- (d) Clear the DTCs .
- (e) Put the engine in inspection mode .
- (f) Start the engine.
- (g) Drive the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.
- (h) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- (i) Read the DTCs.

Result:

Result	Proceed to
DTC P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135 is output	A
DTC is not output	B

B ▶ END

A ▶ REPLACE ECM