| DTC | P0112 | Intake Air Temperature Circuit Low Input |
|------|-------|------------------------------------------|
| DTC | P0113 | Intake Air Temperature Circuit High Input |

# DESCRIPTION

Fig. 1:

Resistance

(kΩ)

```
30
20
10
 5
 3
 2
 1
0.5
0.3
0.2
0.1
    -20   0   20   40   60   80  100 (°C)
    -4   32   68  104  140  176 212 (°F)
```
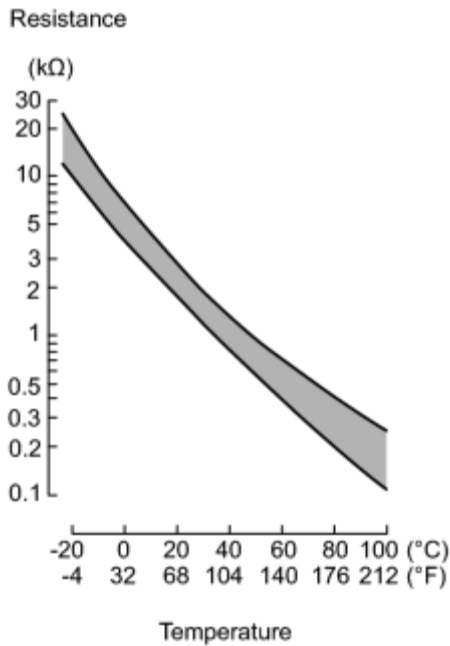
Temperature

- The intake air temperature sensor, mounted in the mass air flow meter sub-assembly, monitors the intake air temperature. The intake air temperature sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the intake air temperature becomes low, the resistance of the thermistor increases. When the temperature becomes high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).
- The intake air temperature sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R which is located inside the ECM.
- Resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes, according to changes in the intake air temperature, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When either DTC P0112 or P0113 is set, the ECM enters fail-safe mode. During fail-safe mode, the intake air temperature is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

| DTC No. | DTC Detection Condition | Trouble Area |
|---------|-------------------------|--------------|

| DTC No. | DTC Detection Condition | Trouble Area |
|---|---|---|
| P0112 | Short in intake air temperature sensor circuit for 0.5 seconds<br><br>(1 trip detection logic) | • Short in intake air temperature sensor circuit<br><br>• Intake air temperature sensor (built into mass air flow meter sub-assembly)<br><br>• ECM |
| P0113 | Open in intake air temperature sensor circuit for 0.5 seconds<br><br>(1 trip detection logic) | • Open in intake air temperature sensor circuit<br><br>• Intake air temperature sensor (built into mass air flow meter sub-assembly)<br><br>• ECM |

HINT:

When any of these DTCs are set, check the intake air temperature by entering the following menus: Powertrain / Engine and ECT / Intake Air.

| Temperature Displayed | Malfunction |
|---|---|
| -40°C (-40°F) | Open circuit |
| 140°C (284°F) | Short circuit |

# MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the intake air temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the intake air temperature sensor and sets a DTC.

Example:

If the sensor output voltage is more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the intake air temperature sensor circuit, and sets DTC P0113. Conversely, if the output voltage is less than 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.

If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

# MONITOR STRATEGY

| Related DTCs | P0112: Intake Air Temperature sensor range check (Low voltage)<br><br>P0113: Intake air temperature sensor range check (High voltage) |
|---|---|
| Required Sensors/Components (Main) | Intake air temperature sensor |

| Required Sensors/Components (Related) | - |
|---|---|
| Frequency of Operation | Continuous |
| Duration | 0.5 seconds |
| MIL Operation | Immediately |
| Sequence of Operation | None |

## TYPICAL ENABLING CONDITIONS

| Monitor runs whenever following DTCs are not present | None |
|---|---|
| Battery voltage | 8 V or more |
| Power switch | On (IG) |

## TYPICAL MALFUNCTION THRESHOLDS

**P0112**

| Intake air temperature sensor voltage | Less than 0.18 V |
|---|---|

**P0113**

| Intake air temperature sensor voltage | More than 4.91 V |
|---|---|

## COMPONENT OPERATING RANGE

| Intake air temperature sensor voltage | 0.18 to 4.91 V |
|---|---|

## CONFIRMATION DRIVING PATTERN

Power Switch on (IG)

[A]

0.5 seconds or more

[B]
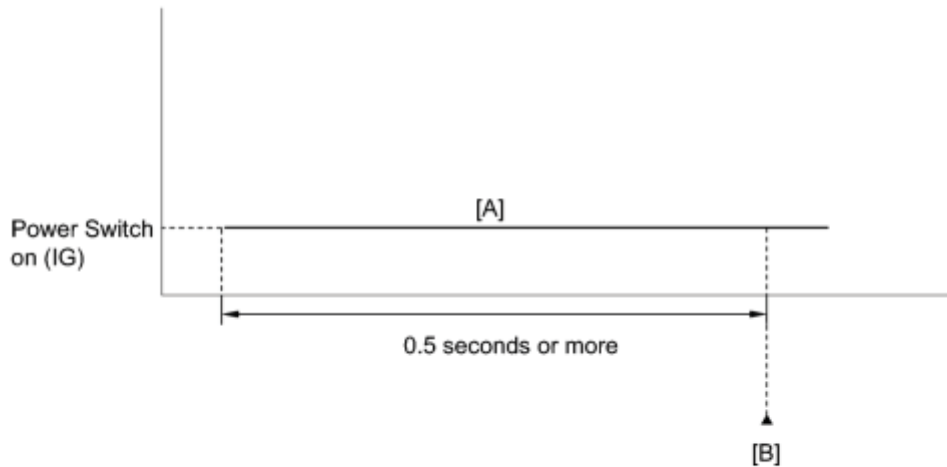
1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) `INFO`.
4. Turn the power switch off and wait for 30 seconds.
5. Turn the power switch on (IG) and turn the Techstream on.
6. Wait 0.5 seconds or more [A].
7. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
8. Read the DTC [B].
9. If a DTC is output, the system is malfunctioning.

   HINT:

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

10. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
11. Input the DTC: P0112 or P0113.
12. Check the DTC judgment result.

| Techstream Display | Description |
|---|---|
| NORMAL | o  DTC judgment completed<br>o  System normal |
| ABNORMAL | o  DTC judgment completed<br>o  System abnormal |
| INCOMPLETE | o  DTC judgment not completed<br>o  Perform driving pattern after confirming DTC enabling conditions |
| UNKNOWN | o  Unable to perform DTC judgment |

| Techstream Display | Description |
|---|---|
| | o Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit |

HINT:

- o If the judgment result shows ABNORMAL, the system has a malfunction.
- o If the judgment result shows NORMAL, the system is normal.
- o If the judgment result shows INCOMPLETE or UNKNOWN, perform step [A] again.

13. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
14. Check the judgment result.

HINT:

- o If the judgment result shows ABNORMAL, the system has a malfunction.
- o If the judgment result shows NORMAL, the system is normal.

15. If the test result is INCOMPLETE or UNKNOWN and no DTC is output, perform a universal trip and check for permanent DTCs INFO .

HINT:

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

# WIRING DIAGRAM



D5
Intake Air Temperature Sensor (Built into
Mass Air Flow Meter Sub-assembly)
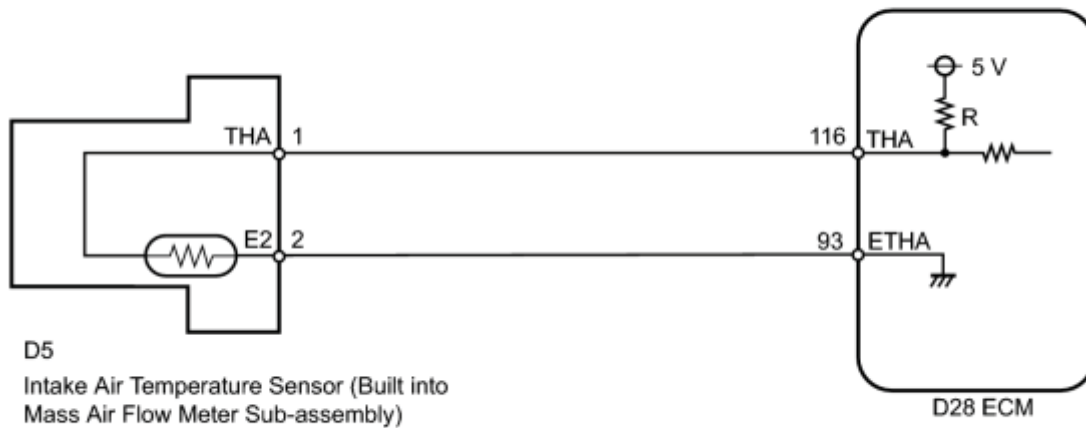
# INSPECTION PROCEDURE

HINT:

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. | READ VALUE USING TECHSTREAM (INTAKE AIR TEMPERATURE) |

(a) Connect the Techstream to the DLC3.

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

(c) Turn the Techstream on.

(d) Enter the following menus: Powertrain / Engine and ECT / Intake Air.

(e) Read the value displayed on the Techstream.

OK:

Same as actual intake air temperature.

Result:

| Result | Proceed to |
|---|---|
| -40°C (-40°F) | A |
| 140°C (284°F) | B |
| Same as actual intake air temperature | C |

HINT:

- If there is an open circuit, the Techstream indicates -40°C (-40°F).

- If there is a short circuit, the Techstream indicates 140°C (284°F).
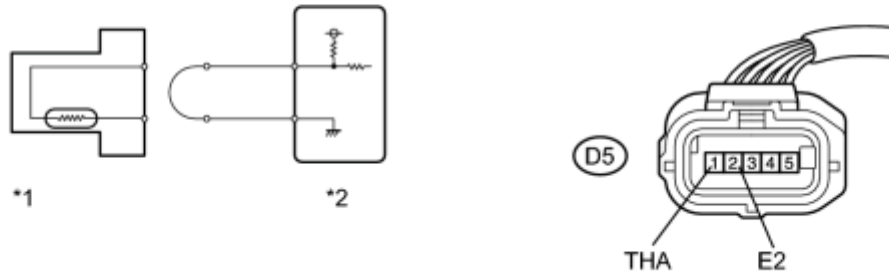
C ▶ CHECK FOR INTERMITTENT PROBLEMS
B ▶ READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)
A
▼

| 2. | READ VALUE USING TECHSTREAM (CHECK FOR OPEN IN WIRE HARNESS) |

(a) Confirm good connection at the mass air flow meter sub-assembly.

**Text in Illustration**

| *1 | Mass Air Flow Meter Sub-assembly | | *2 | ECM |
|---|---|---|---|---|
| *3 | Front view of wire harness connector<br><br>(to Mass Air Flow Meter Sub-assembly) | | - | - |

(b) Disconnect the mass air flow meter sub-assembly connector.

(c) Connect terminals THA and E2 of the mass air flow meter sub-assembly connector on the wire harness side.

(d) Connect the Techstream to the DLC3.

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

(f) Turn the Techstream on.

(g) Enter the following menus: Powertrain / Engine and ECT / Data List / Intake Air.

(h) Read the value displayed on the Techstream.

Standard:

140°C (284°F)

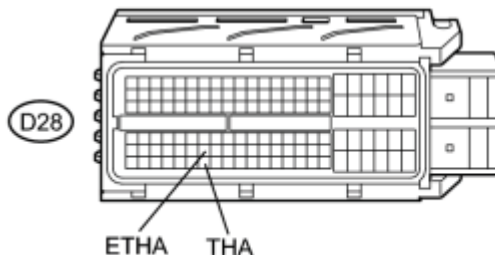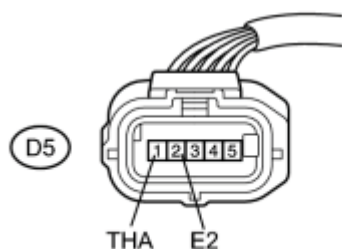(i) Reconnect the mass air flow meter sub-assembly connector.

NG ▶ CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM)
OK ▶ **REPLACE MASS AIR FLOW METER SUB-ASSEMBLY**

| 3. | CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM) |
|---|---|

(a) Disconnect the mass air flow meter sub-assembly connector.

THA   E2                          ETHA   THA

N

(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 |
|---|---|---|
| D5-1 (THA) - D28-116 (THA) | Always | Below 1 Ω |
| D5-2 (E2) - D28-93 (ETHA) | Always | Below 1 Ω |

**Text in Illustration**

| *1 | Front view of wire harness connector<br><br>(to Mass Air Flow Meter Sub-assembly) | *2 | Front view of wire harness connector<br><br>(to ECM) |
|---|---|---|---|

(d) Reconnect the mass air flow meter sub-assembly connector.

(e) Reconnect the ECM connector.

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM)
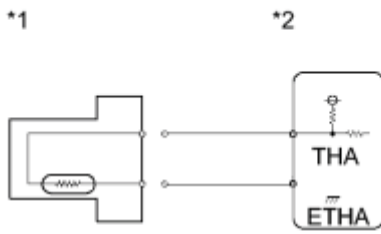
OK ▶ **REPLACE ECM**

| 4. | READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS) |
|---|---|

(a) Disconnect the mass air flow meter sub-assembly connector.

## Text in Illustration

| *1 | Mass Air Flow Meter Sub-assembly |
|---|---|
| *2 | ECM |

*1 | *2

(b) Connect the Techstream to the DLC3.

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

(d) Turn the Techstream on.

(e) Enter the following menus: Powertrain / Engine and ECT / Intake Air.

(f) Read the value displayed on the Techstream.

Standard value:

-40°C (-40°F)

(g) Reconnect the mass air flow meter sub-assembly connector.

NG ▶ CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM)
OK ▶ REPLACE MASS AIR FLOW METER SUB-ASSEMBLY

| 5. | CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM) |
|---|---|

(a) Disconnect the mass air flow meter sub-assembly connector.



*1 | *2
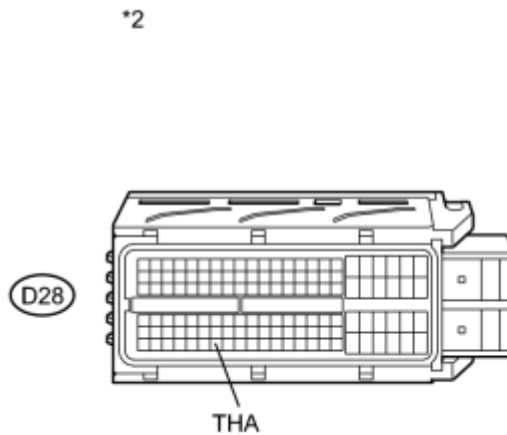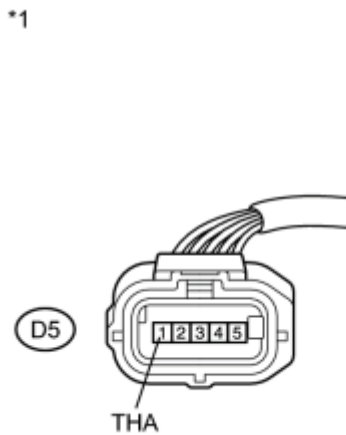
(b) Disconnect the ECM connector.

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

Standard Resistance (Check for Short):

| Tester Connection | Condition | Specified Condition |
|---|---|---|
| D5-1 (THA) or D28-116 (THA) - Body ground | Always | 10 kΩ or higher |

**Text in Illustration**

| *1 | Front view of wire harness connector<br><br>(to Mass Air Flow Meter Sub-assembly) | *2 | Front view of wire harness connector<br><br>(to ECM) |
|---|---|---|---|

(d) Reconnect the mass air flow meter sub-assembly connector.

(e) Reconnect the ECM connector.

NG ▶ REPAIR OR REPLACE HARNESS OR CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM)

OK ▶ **REPLACE ECM**