| DTC | P1115 | COOLANT TEMPERATURE SENSOR CIRCUIT FOR COOLANT HEAT STORAGE SYSTEM |
|---|---|---|

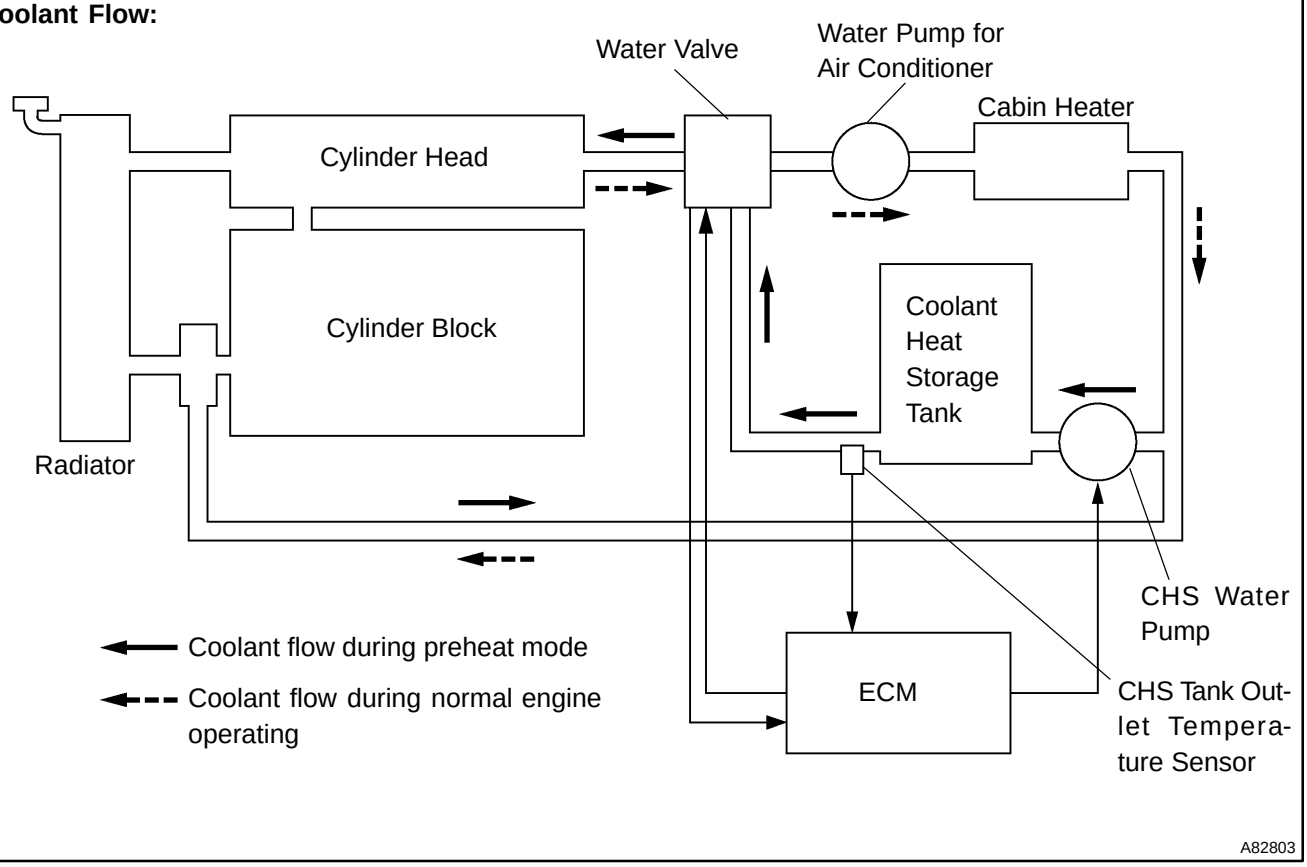
| DTC | P1117 | COOLANT TEMPERATURE SENSOR CIRCUIT LOW FOR COOLANT HEAT STORAGE SYSTEM |
|---|---|---|

| DTC | P1118 | COOLANT TEMPERATURE SENSOR CIRCUIT HIGH FOR COOLANT HEAT STORAGE SYSTEM |
|---|---|---|

HINT:
Although each DTC title says ”Coolant Temperature Sensor”, these DTCs are related to the coolant heat storage tank outlet temperature sensor.

## CIRCUIT DESCRIPTION

**Coolant Heat Storage System (CHS System)**
**Coolant Flow:**



This system uses an electric pump to supply hot coolant stored in the coolant heat storage tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the heat storage tank into the engine, in order to heat the cylinder head (this process is called ”preheat mode” ). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During the normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.
The sensor for the system, which is provided at the tank outlet, is constructed similarly to the engine coolant temperature sensor and is connected to the ECM. The CHS tank outlet temperature sensor has a built in thermistor, whose resistance varies with the coolant temperature.
HINT:
If the ECM detects the DTC P0115, P0117 or P0118, it operates the fail–safe function in which the engine coolant temperature is assumed to be 80°C (176°F).

| DTC No. | Proceed to | DTC Detection Condition | Trouble Area |
|---|---|---|---|
| P1115 | Step 1 | Open or short in CHS tank outlet temperature sensor circuit for 0.5 second | • Open or short in CHS tank outlet temperature sensor circuit<br>• CHS tank outlet temperature sensor<br>• ECM |
| P1117 | Step 4 | Short in CHS tank outlet temperature sensor circuit. | • Short in CHS tank outlet temperature sensor circuit<br>• CHS tank outlet temperature sensor<br>• ECM |
| P1118 | Step 2 | Open in CHS tank outlet temperature sensor circuit | • Open or short in CHS tank outlet temperature sensor circuit<br>• CHS tank outlet temperature sensor<br>• ECM |

## MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to control the coolant heat storage (CHS) system properly. If the sensor output voltage deviates from the normal operating range, the ECM determines that the CHS tank outlet temperature sensor circuit has malfunctioned, and outputs a DTC.
Example:
A sensor output voltage of –40°C (–40°F) or 140°C (284°F) is determined to be malfunction.

## MONITOR STRATEGY

| | |
|---|---|
| Related DTCs | P1115: Coolant temperature sensor circuit for coolant heat storage system<br>P1117: Coolant temperature sensor circuit low for coolant heat storage system<br>P1118: Coolant temperature sensor circuit high for coolant heat storage system |
| Required sensors / components | Coolant heat storage tank outlet temperature sensor |
| Frequency of operation | Continuous |
| Duration | 0.5 second |
| MIL operation | Immediately |
| Sequence of operation | None |

## TYPICAL ENABLING CONDITIONS

| | |
|---|---|
| The monitor will run whenever the following DTCs are not present | See page 05–20 |

## TYPICAL MALFUNCTION THRESHOLDS

**P1115:**

| | |
|---|---|
| Sensor resistance (coolant temperature at CHS tank outlet) | Less than 79 Ω or more than 156 kΩ<br>(more than 140°C (284°F) or –40°C (–40°F) or less) |

**P1117:**

| | |
|---|---|
| Sensor resistance (coolant temperature at CHS tank outlet) | Less than 79 Ω<br>(more than 140°C (284°F)) |

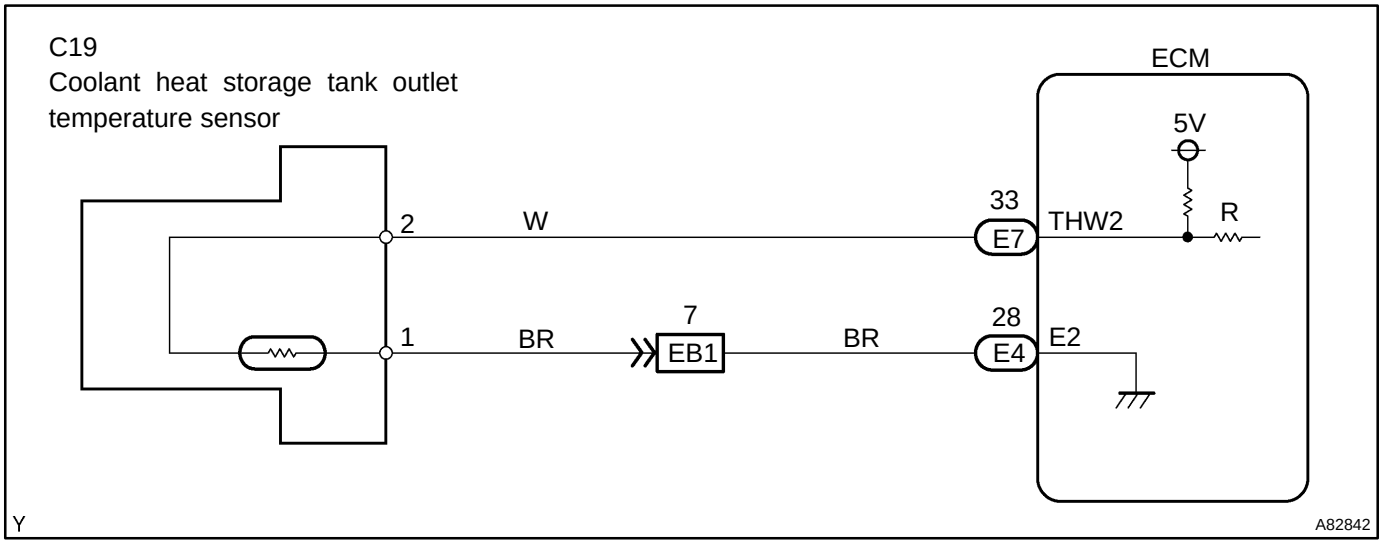
**P1118:**

| | |
|---|---|
| Sensor resistance (coolant temperature at CHS tank outlet) | More than 156 kΩ<br>(–40°C (–40°F) or less) |

## COMPONENT OPERATING RANGE

| | |
|---|---|
| Sensor resistance | 79 Ω (140°C (284°F)) to 156 kΩ (–40°C (–40°F)) |

## WIRING DIAGRAM




## INSPECTION PROCEDURE

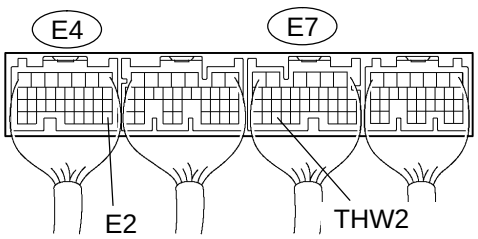
**CAUTION:**

**Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.**

HINT:

- If different DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester II. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

## 1 INSPECT ECM(THW2 – E2 VOLTAGE)



ECM Connector
A18294

(a) Turn the power switch ON (IG).
(b) Measure voltage between the terminals THW2 and E2 of the ECM E4 and E7 connector.

**Standard:**

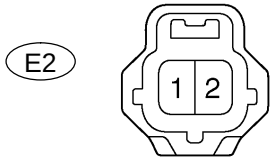
| Water Temperature ˚C (˚F) | Voltage |
|---|---|
| 20 (68) | 0.5 to 3.4 V |
| 60 (140) | 0.2 to 1.0 V |

**OK** → **CHECK FOR INTERMITTENT PROBLEMS (See page 05–17)**

**NG**

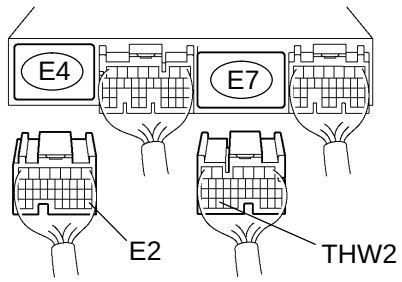
## 2 CHECK HARNESS AND CONNECTOR(CHS TANK OUTLET TEMPERATURE SENSOR – ECM)

**Wire Harness Side:**
CHS Tank Outlet Temperature Sensor Connector



Front View

Y A82813



Y ECM Connector A82814

(a) Check the harness and the connectors between the coolant heat storage tank outlet temperature sensor and the ECM connectors.
(1) Disconnect the E2 engine coolant heat storage tank outlet temperature sensor connector.
(2) Disconnect the E4 and E7 ECM connector.
(3) Check the resistance between the wire harness side connectors.

**Standard (Check for open):**

| Tester Connection | Specified Condition |
|---|---|
| CHS temperature sensor (E2–2) – THW2 (E7–33) | Below 1 Ω |
| CHS temperature sensor (E2–1) – E2 (E4–28) | Below 1 Ω |

**Standard (Check for short):**

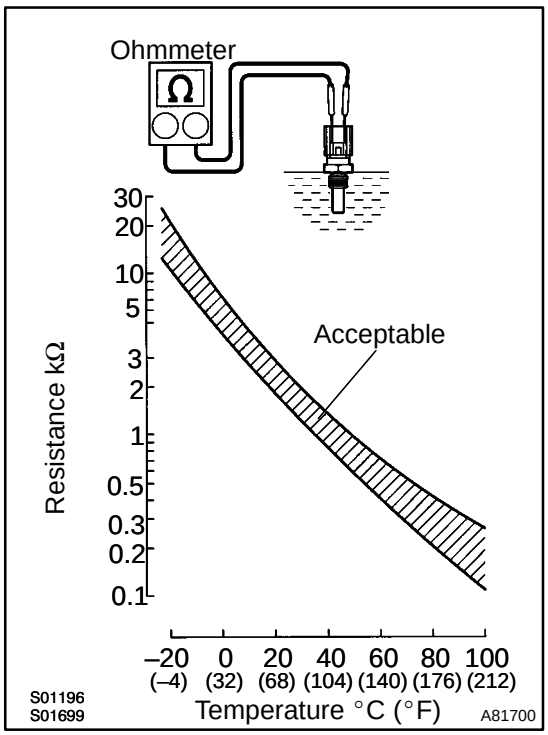
| Tester Connection | Specified Condition |
|---|---|
| CHS temperature sensor (E2–2) or THW2 (E7–33) – Body ground | 10 kΩ or higher |

(4) Reconnect the coolant heat storage tank outlet temperature sensor connector.
(5) Reconnect the ECM connector.

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

**OK**

| 3 | INSPECT TEMPERATURE SENSOR(CHS TANK OUTLET TEMPERATURE SENSOR) |
|---|---|




(a) Remove the coolant heat storage (CHS) tank outlet temperature sensor.

(b) Measure the resistance between the terminals.

**Standard:**

| Tester Connection | Specified Condition |
|---|---|
| 1 – 2 | 2 to 3 kΩ at 20°C (68°F) |
| 1 – 2 | 0.2 to 0.4 kΩ at 80°C (176°F) |

**NOTICE:**

**In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.**

HINT:

Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

(c) Reinstall the coolant heat storage tank outlet temperature sensor.

**NG** → **REPLACE TEMPERATURE SENSOR**

**OK**

**REPLACE ECM (See page 10–24)**