

DL: Cylinder Head Temperature (CHT) Sensor

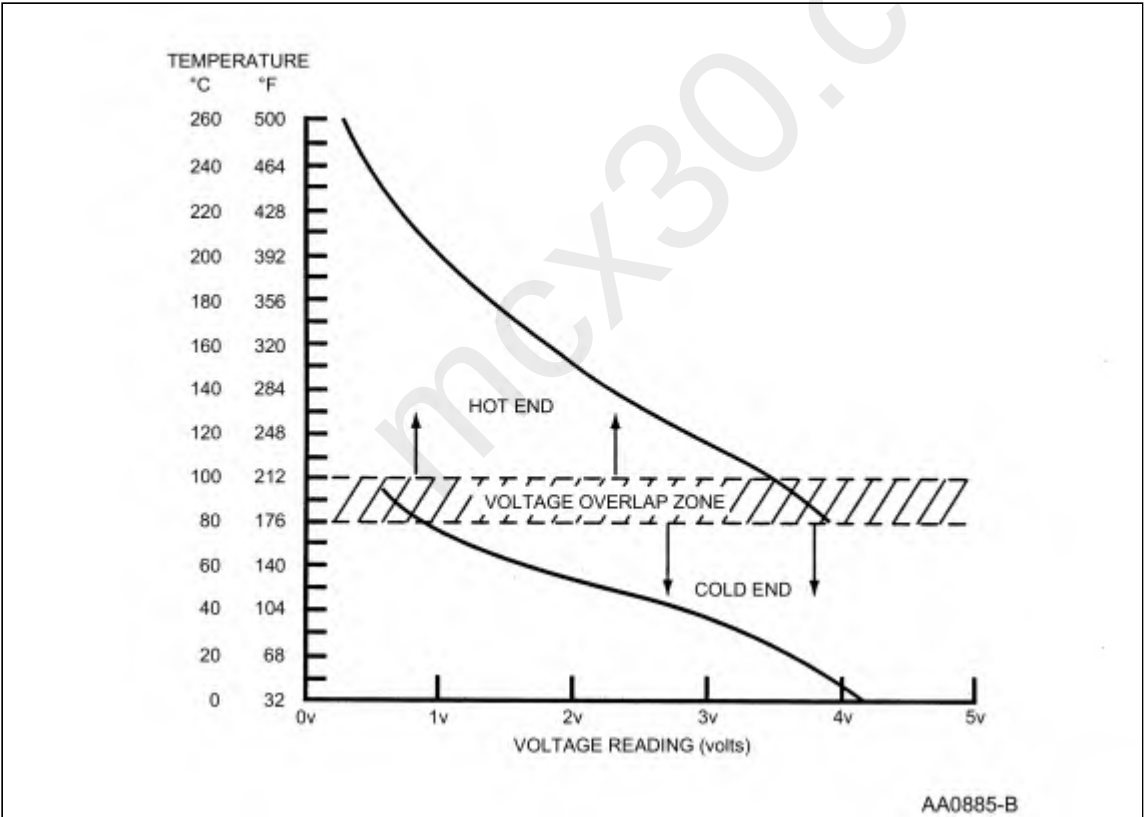
Note: On a typical vehicle, the CHT sensor is located in the cylinder head and the CHT2 sensor is located in the exhaust manifold.

This pinpoint test is intended to diagnose the following:

- cylinder head temperature (CHT) sensor (6G004)
- cylinder head temperature 2 (CHT2) sensor (6G004)
- harness circuits: CHT, CHT2, and SIGRTN
- PCM (12A650)

On applications that do not use an engine coolant temperature (ECT) sensor, the CHT sensor is used to determine the engine coolant temperature. To cover the entire temperature range of both the CHT and ECT sensors, the PCM has a dual switching resistor circuit on the CHT input. A graph showing the temperature switching from the COLD END line to the HOT END line, with increasing temperature and back with decreasing temperature is included. Note the temperature to voltage overlap zone. Within this zone it is possible to have either a COLD END or HOT END value at the same temperature. For example, at 90°C (194°F) the voltage could read either 0.60 volt or 3.71 volts. Refer to the table for the expected values.

Voltage values calculated for VREF = 5 volts. These values can vary by 15% due to sensor and VREF variations.



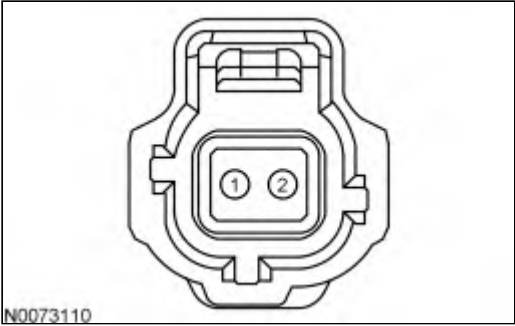
Cylinder Head Temperature (CHT) And CHT2 Sensor Expected Values

Temperature		CHT Sensor Values		
°C	°F	Cold End (volts)	Hot End (volts)	Resistance (K ohms)
-40	-40	4.89	-	965.808

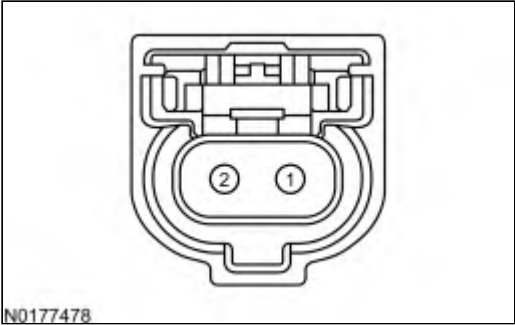
Temperature		CHT Sensor Values		
°C	°F	Cold End (volts)	Hot End (volts)	Resistance (K ohms)
-30	-22	4.81	-	513.019
-20	-4	4.67	-	283.664
-10	14	4.45	-	162.584
0	32	4.14	-	96.255
10	50	3.73	-	59.175
20	68	3.26	-	37.387
30	86	2.74	-	24.215
40	104	2.23	-	16.043
50	122	1.76	-	10.85
60	140	1.36	-	7.487
70	158	1.04	-	5.268
80	176	0.79	3.99	3.775
85	185	0.69	3.86	3.215
90	194	0.60	3.71	2.75
95	203	0.53	3.56	2.361
100	212	0.46	3.41	2.034
110	230	-	3.07	1.523
120	248	-	2.74	1.155
130	266	-	2.41	0.8866
140	284	-	2.10	0.6891
150	302	-	1.81	0.5417
160	320	-	1.55	0.4301
170	338	-	1.33	0.3449
180	356	-	1.13	0.2791
190	374	-	0.96	0.2278
200	392	-	0.82	0.1875
210	410	-	0.70	0.155
220	428	-	0.60	0.130
230	446	-	0.51	0.109
240	464	-	0.44	0.092
250	482	-	0.35	0.078
260	500	-	0.33	0.067

Cylinder Head Temperature (CHT) Sensor Connector

A



B



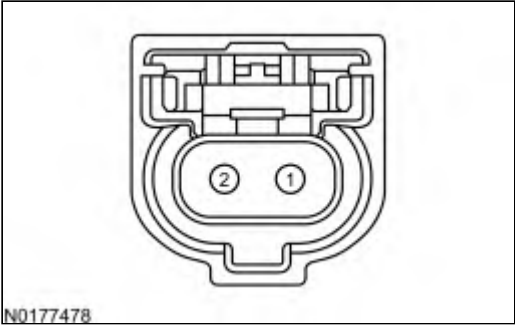
C



Vehicle	Connector	Pin	Circuit
E-Series, Fusion 2.5L	A	2 1	SIGRTN CHT
F-150 5.0L, Motorhome / Stripped Chassis / Step Van	B	2 1	SIGRTN CHT
All other vehicles	C	2 1	SIGRTN CHT

Cylinder Head Temperature 2 (CHT2) Sensor Connector

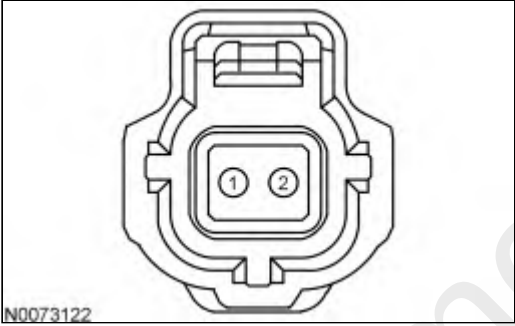
A



B



C



Vehicle	Connector	Pin	Circuit
Corsair, EcoSport 1.5L, Escape/Kuga, Explorer 2.3L	A	2 1	SIGRTN CHT2
EcoSport 2.0L	C	2 1	SIGRTN CHT2
All other vehicles	B	2 1	SIGRTN CHT2

Powertrain Control Module (PCM) Connector

For PCM connector views or reference values, refer to Section 6.

Vehicle	Connector	Pin	Circuit
Aviator, Explorer 3.0L, Explorer 3.3L, F-150 2.7L	306 PIN	E99 E8	SIGRTN CHT2
Continental 2.0L, Continental 2.7L, Continental 3.0L, EcoSport 1.0L Automatic Transmission, EcoSport 2.0L, Fusion 2.0L, Fusion 2.7L, MKZ 3.0L	198 PIN	E20 E36	SIGRTN CHT2
Continental 3.7L, E-Series, F-650 / F-750, Flex TiVCT 3.5L, Mustang TiVCT 5.2L	198 PIN	E47 E49	CHT SIGRTN
Corsair 2.5L, Escape/Kuga 2.5L	198 PIN	E39 E40	CHT SIGRTN
EcoSport 1.0L Manual Transmission	198 PIN	E10 E36	SIGRTN CHT2
EcoSport 1.5L Automatic Transmission, KA 1.5L Automatic Transmission	198 PIN	E35 E39	SIGRTN CHT2
EcoSport 1.5L Manual Transmission, KA 1.2L, KA 1.5L Manual Transmission	112 PIN	E5 E21	SIGRTN CHT2
Edge 2.7L, Nautilus 2.7L	306 PIN	E20 E8	SIGRTN CHT2
Expedition, F-150 3.5L High Output, Navigator	198 PIN	E36 E10	CHT SIGRTN
F-150 3.3L, F-150 5.0L, F-Series Super Duty, Motorhome / Stripped Chassis / Step Van, Mustang 5.0L, Transit TiVCT 3.5L	306 PIN	E8 E99	CHT SIGRTN
F-150 3.5L	306 PIN	E8	CHT
Flex GTDI 3.5L	198 PIN	E36 E20	CHT SIGRTN
Ford GT	198 PIN	E36 E56	CHT SIGRTN

Vehicle	Connector	Pin	Circuit
Fusion 1.5L, MKZ 2.0L	198 PIN	E20 E46	SIGRTN CHT2
Fusion 2.5L	198 PIN	E39 E35	CHT SIGRTN
Mustang 5.2L Supercharged	306 PIN	E47 E49	CHT SIGRTN
Transit GTDI 3.5L	306 PIN	E8 E20	CHT SIGRTN
Transit Connect 2.0L	198 PIN	E40 E13	CHT SIGRTN
Transit Connect 2.5L	198 PIN	E39 B35	CHT SIGRTN
All other vehicles	198 PIN	E13 E40	SIGRTN CHT2

DL1 CHECK FOR DTCS

Are DTCs P0116, P0119, P0125, P0128, P017C, P017D, P017E, P1021, P1022, P1023, P1024, P1026, P1285, P1289, P128A, or P1290 present?

Yes	GO to DL2 .
No	For temperature warning indicator lamp or gauge (applications with CHT sensor only) symptom, GO to DL13 . For all others, RETURN to Section 3, Symptom Charts for further direction.

DL2 CHECK THE COOLING SYSTEM

 **WARNING:** To avoid personal injury do not unscrew the coolant pressure relief cap while the engine is operating or hot. The cooling system is under pressure. Steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in personal injury.

Note: The DTC P0125 or P0128 indicates the engine coolant temperature has not achieved the required engine operation temperature level, since start up within a specified amount of time.

- Check the cooling system for:
 - correct coolant level
 - internal or external coolant leaks
 - blockage of the radiator
 - cooling fan operation

Is the cooling system OK?

Yes	For DTCs P0125 or P0128, GO to DL12 . For all others, GO to DL3 .
No	REFER to the Workshop Manual Section 303-03, Engine Cooling to diagnose a cooling system concern. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.

DL3 CHECK THE RESISTANCE OF THE CHT SENSOR WITH THE ENGINE OFF

Note: Refer to the Cylinder Head Temperature (CHT) And CHT2 Sensor Expected Values chart for the resistance specifications.

- Ignition OFF.
- For the CHT2 sensor,
- CHT2 Sensor connector disconnected.
- Measure the resistance between:

(+) CHT2 Sensor Connector, Component Side	(-) CHT2 Sensor Connector, Component Side
CHT2	SIGRTN

- For all others,
- CHT Sensor connector disconnected.
- Measure the resistance between:

(+) CHT Sensor Connector, Component Side	(-) CHT Sensor Connector, Component Side
CHT	SIGRTN

Is the resistance within specification?

Yes	GO to DL4 .
No	INSTALL a new CHT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CLEAR the DTCs. REPEAT the self-test.

DL4 CHECK FOR AN OPEN CIRCUIT

- Ignition OFF.
- PCM connector disconnected.
- For the CHT2 sensor,
- Measure the resistance between:

(+) PCM Connector, Harness Side	(-) CHT2 Sensor Connector, Harness Side
CHT2	CHT2
SIGRTN	SIGRTN

- For all others,
- Measure the resistance between:

(+) PCM Connector, Harness Side	(-) CHT Sensor Connector, Harness Side
CHT	CHT
SIGRTN	SIGRTN

Are the resistances less than 5 ohms?

Yes	GO to DL5 .
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No	REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.
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DL5 CHECK FOR A SHORT TO GROUND

- For the CHT2 sensor,
- Measure the resistance between:

(+) CHT2 Sensor Connector, Harness Side	(-)
CHT2	Ground

- For all others,
- Measure the resistance between:

(+) CHT Sensor Connector, Harness Side	(-)
CHT	Ground

Are the resistances greater than 10K ohms?

Yes	GO to DL6 .
No	REPAIR the short circuit. CLEAR the DTCs. REPEAT the self-test.

DL6 CHECK FOR A SHORT TO VOLTAGE

- Ignition ON, engine OFF.
- For the CHT2 sensor,
- Measure the voltage between:

(+) CHT2 Sensor Connector, Harness Side	(-)
CHT2	Ground

- For all others,
- Measure the voltage between:

(+) CHT Sensor Connector, Harness Side	(-)
CHT	Ground

Is any voltage present?

Yes	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.
No	GO to DL7 .

DL7 CHECK THE RESISTANCE OF THE CHT SENSOR

Note: Refer to the Cylinder Head Temperature (CHT) And CHT2 Sensor Expected Values chart for the resistance specifications.

- Ignition OFF.

- CHT Sensor connector connected.
- CHT2 Sensor connector connected.
- PCM connector connected.
- Run the engine until the engine temperature stabilizes.
- Ignition OFF.
- For the CHT2 sensor,
- CHT2 Sensor connector disconnected.
- Measure the resistance between:

(+) CHT2 Sensor Connector, Component Side	(-) CHT2 Sensor Connector, Component Side
CHT2	SIGRTN

- For all others,
- CHT Sensor connector disconnected.
- Measure the resistance between:

(+) CHT Sensor Connector, Component Side	(-) CHT Sensor Connector, Component Side
CHT	SIGRTN

Is the resistance within specification?

Yes	For the CHT2 sensor, GO to DL8 . For all others, GO to DL10 .
No	INSTALL a new CHT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CLEAR the DTCs. REPEAT the self-test.

DL8 CHECK THE CHT2 SENSOR

- Ignition ON, engine OFF.
- Measure the voltage between:

(+) CHT2 Sensor Connector, Harness Side	(-) CHT2 Sensor Connector, Harness Side
CHT2	SIGRTN

- Observe the digital multi meter (DMM) for an indication of a concern while shaking, wiggling, and bending the CHT2 circuit between the CHT2 and the PCM. Note that voltage changes suddenly when a concern is detected.

Is a concern present?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to DL9 .

DL9 TEMPERATURE SENSOR CORRELATION

Note: Cold soak the vehicle at ambient temperature for at least 6 hours while not in direct sunlight.

Note: All PID's may not be available on all vehicles.

- Ignition OFF.
- CHT2 Sensor connector connected.
- Ignition ON, engine OFF.
- Access the PCM and monitor the AAT (TEMP), CHT (TEMP), CHT2 (TEMP), ECT (TEMP) and ECT1 (TEMP) PIDs.

Are the PID values within 16.67°C (30°F) of each other?

Yes	Unable to duplicate or identify the concern at this time. GO to Pinpoint Test Z .
No	INSTALL a new CHT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test.

DL10 INTERMITTENT CHECK

- Ignition OFF.
- CHT Sensor connector connected.
- Ignition ON, engine OFF.
- Access the PCM and monitor the CHT (TEMP) PID.
- While observing the PID, carry out the following:
 - Tap on the sensor to simulate road shock
 - Wiggle the sensor connector

Is there a large change in the PID value?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	For DTC P1285, GO to DL11 . For all others, Unable to duplicate or identify the concern at this time. GO to Pinpoint Test Z .

DL11 CHECK THE CHT SENSOR OPERATION

Note: The engine temperature warning indicator (gauge or lamp) is a warning system that gives the driver information during an engine overheating condition. The PCM monitors the CHT sensor and determines if fail-safe cooling mode is needed. If fail-safe cooling mode is needed, the PCM sends a controller area network (CAN) message to the instrument cluster to signal an overheating condition. This causes the instrument cluster indicator to illuminate and forces the temperature gauge to the H (hot) zone. DTC P1285 is stored in the PCM.

- Run the engine until the engine temperature stabilizes.
- Verify the radiator hoses are hot and the cooling system is pressurized.
- Carry out the PCM self-test.

Is DTC P1285 present?

Yes	REFER to the Workshop Manual Section 303-03, Engine Cooling to diagnose the cooling system concern. Clear the PCM DTCs. REPEAT the self-test.
No	The system is operating correctly at this time. REPAIR any other DTCs as necessary. Clear the PCM DTCs. REPEAT the self-test.

DL12 CHECK THE SENSOR OPERATION

- Run the engine until the engine temperature stabilizes.
- Verify the radiator hoses are hot and the cooling system is pressurized.
- Access the PCM and monitor the CHT (TEMP) PID.
- Record the PID value.

Is the PID temperature greater than 77 C (170.6 F)?

Yes	The system is operating correctly at this time. CLEAR the DTCs. REPEAT the self-test.
No	REFER to the Workshop Manual Section 303-03, Engine Cooling, to diagnose the engine not reaching normal operating temperature. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.

DL13 ENGINE TEMPERATURE INDICATOR LAMP ON OR TEMPERATURE GAUGE INDICATES HOT WITH NO DTCS

Note: For Engine Temperature Warning Indicator system problems, refer to the Workshop Manual Section 413-01, Instrument Cluster.

- PCM connector disconnected.
- Ignition ON, engine OFF.

Does the engine temperature warning indicator lamp turn OFF (prove out) and/or the temperature gauge return to the normal zone with the PCM disconnected?

Yes	GO to DL14 .
No	REFER to the Workshop Manual Section 413-01, Instrument Cluster to diagnose the incorrect temperature gauge. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.

DL14 ENGINE OVERHEAT CONDITION INDICATED

 **WARNING:** To avoid personal injury do not unscrew the coolant pressure relief cap while the engine is operating or hot. The cooling system is under pressure. Steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in personal injury.

- Check the engine coolant level.

Is the engine coolant fill level correct?

Yes	REFER to the Workshop Manual Section 303-03, Engine Cooling, to diagnose the engine overheating symptom. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.
No	REFER to the Workshop Manual Section 303-03, Engine Cooling to diagnose the loss of coolant. REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.

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