

Testing Coolant Temperature Sensor

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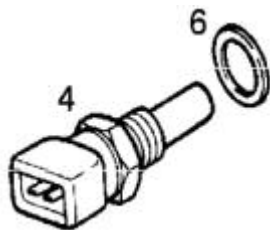
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Revision 2



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Typical 2-pin CTS.

What is a 'Coolant Temperature Sensor'?

The coolant temperature sensor (CTS) is commonly found on modern injection engines. It measures the coolant (water) temperature in the engine itself, it is not to be confused with the thermostat as found on car radiators. The Engine Control Unit (ECU) uses the CTS value to calculate the ignition timing and injector pulse duration.

How does a CTS work?

For more information on the CTS, how it works and where it is located on the engine, read the [Technical guide](#).

How do I test the CTS?

These sensors are thermistors, it transforms heat energy into a electronic signal that the ECU can read. Its a variable resistor inside that changes value according to temperature. These usually follow the NTC (Negative Temperature Coefficient) principle. But other manufactures may use the PTC (Positive Temperature Coefficient).

A NTC decreases (negatively) in resistance as the temperature increases, a PTC operates in the opposite direction. The open circuit supply to the sensor is a 5v reference level and this voltage reduces to a value dependent upon the resistance of the CTS resistor. Normal operating temperature is between 80°C to 100°C.

A new CTS from a Vauxhall dealer is about £20.

Basic checks:

1. Inspect the CTS plug and socket for signs of corrosion. Clean contact pins with a solvent to remove tarnish marks (this may cause a resistance).
2. Check that the connector on the loom connects to the sensor plug fully, that its not lose and makes good contact with the pins.

Checking CTS voltage signal:

1. If possible roll back the rubber boot on the back of the CTS loom connector.
2. Identify the signal and earth terminals on the back of the connector.
3. Connect the Positive probe of the DVM (Digital Volt-a-Meter) to the CTS signal wire.
4. Connect a DVM negative probe to the engine (for earth/GND contact).
5. Switch off the engine and allow the engine to become cold. Switch on the ignition only (to supply power to the CTS) measure



Location of CTS on thermostat housing under coolant pipe on C20XE engines.
CTS located on 2L 8v engine.

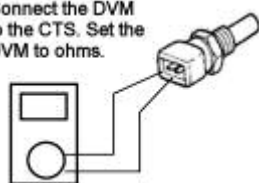


2L 16v C20XE engine with manifold removed.
CTS (2-pin) Thermostat.
CTS located on 2L 16v engine.



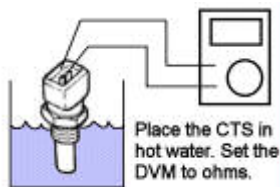
CTS (yellow 2-pin connector)
Temperature Gauge Sender (1-pin spade)
CTS located on 2L 16v Ecotec engine.

Connect the DVM to the CTS. Set the DVM to ohms.



Measure the resistance of

the CTS.



Test the CTS is hot what.

the voltage on the signal wire. Depending on the temperature a voltage of approximately 2v to 3v should be measured. See the chart below.

CTS voltage and resistance values (typical):

Temp (°C)	Resistance Ohms	Volts
0	4800 to 6600	4.00 to 4.50
10	4000	3.75 to 4.00
20	2200 to 2800	3.00 to 3.50
30	1300	3.25
40	1000 to 1200	2.50 to 3.00
50	1000	2.50
60	800	2.00 to 2.50
80	270 to 380	1.00 to 1.30
110	-	0.50
Open-circuit = 5v ±0.1v		
Short circuit to earth = Zero (0v)		

1. Check that the voltage measured corresponds to the temperature of the CTS.
2. Start the engine and allow it to warm up to normal operating temperature. While its warming up, measure the voltage from the CTS, it should also be slowly decreasing (if its a NTS item).
3. If the CTS varies in voltage (or resistance) that's goes outside the normal range, the CTS works but its faulty as its sending the wrong information to the ECU. This will NOT result in the ECU warning light to come on, because the CTS is still operating within its design parameters. This is a common fault if the engine is being difficult to start warm or cold, yet there is no ECU warning light on the dash. A new CTS should be fitted in this case.

Zero Volts obtained on the CTS signal:

1. Make the following tests and checks if the CTS voltage signal was zero (supply is open-circuit or short to earth/GND).
2. Check that the CTS signal wire/terminal is not shorted to earth anywhere. Check the cable form too for splits or cuts etc.
3. Check the continuity along the loom from the sensor to the ECU.
4. If the wire loom appears to be OK and you get good continuity on the CTS signal back to the ECU check all voltage supplies and earth/GND connections. If they too appear OK, then suspect a fault ECU (very rare).

Constant 5v at the CTS terminal:

This is the open-circuit voltage fault, and will be obtained in the event of the following conditions.

1. The signal pin on the loom connector is not making contact with the CTS.
2. The CTS has gone open-circuit inside the sensor.
3. The CTS earth/GND connection is open-circuit (i.e. the pin is not

making contact on the CTS).

Resistance Checks, CTS on the engine:

You can make a resistance check on the CTS too. You can do this with the CTS in the engine or it can be taken out and submerged in some hot water. When you check the resistance with the CTS still in the engine, you do it with the engine/power OFF and the CTS loom connector disconnected.

1. Disconnect the CTS loom connector.
2. Place the Positive probe on one pin and the Negative probe on the other pin on the CTS sensor.
3. Set the DM to ohms to measure resistance. With the engine cold, make a resistance check against the chart above. With a cold engine (20°C) the coolant temperature should be within $\pm 5^\circ\text{C}$ of that figure.
4. An allowance should be made for the temperature obtained by the probing the outside of the CTS or coolant passage. This is because the actual temperature of the coolant may be hotter than the surface temperature of the CTS.

Resistance Checks, CTS off the vehicle:

1. Remove the CTS from the engine.
2. Place the CTS in a container of water, do NOT submerge the contact pins in the water, just the probe of the sensor only.
3. Connect the Positive probe to one pin and the Negative probe to the other. Set the DMM to ohms (to measure resistance).
4. Measure the CTS resistance in cold water first. Compare this value against the chart above. Then measure again but with hot water (or known temperature) and again compare the result with the chart.
5. If no change of resistance or no resistance can be measured (i.e. 0 ohms or infinity measured) then the CTS is faulty. Replace with new sensor.

Article based on text in the [Haynes Books](#) series and peoples personal experiences.

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