Qashqai timing issue **sorted using logic**

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A Nissan Qashqai J11 with a 1.2 Dig-T HRADDT engine, arrived at an Autobiz Helpline member's workshop, running rough. The fault codes retrieved indicated a Cam and Crank signal correlation problem. The engine was also producing noise from the timing case. Suspecting the timing chain was the issue, the chain was checked. The chain was worn, so a new timing chain kit was fitted.

After fitting the chain kit, the engine refused to start and error codes for Cam and Crank correlation returned, as soon as the engine start was attempted.

When we were contacted, we asked for the cam crank signals to be checked with an oscilloscope to confirm the issue. This trace, compared to a known good trace, confirmed that the timing was incorrect.

The workshop repeated the timing physical checks, paying attention to detail. But the timing did not appear to be incorrect. The 3 coloured links on the timing chain were aligned.

An in-cylinder scope trace was done for clarification. The cylinder pressure trace looked as if the cam timing was correct. The exhaust and intake points were correct. Yet the engine refused to start, and the codes persisted.

Digital sensor logic is the process of converting physical quantities into digital signals that are represented by binary values, such as ones and zeros. Digital sensors are used to indicate the presence of an object, or if a limit value has been reached. The logical value changes from 0 to 1, or vice versa, when a detection or non-detection occurs.

The next step was to look deeper into the signal logic. From Euro 5, with high-resolution engines, it is possible to check the timing logic. When a sensor is in the Off state, it is considered to be Logic 0. When the sensor is in the On state, it is considered to be Logic 1.

High-resolution engines have 2 camshaft sensors, Intake and Exhaust, and the crankshaft has 60 teeth. Some engines have 2 teeth that are a different shape/size, instead of being missing, to signal a reference point for TDC.

At the first TDC reference point on the crankshaft, both cam sensors will also be at Logic 0 (all sensors in the Off state.) and this will be Logic 000. At the next TDC reference point, both cam sensors will be at Logic 1, and this will be Logic 011. The next TDC will be back to repeat this pattern. This engine did not conform to this simple logic for the cam timing.

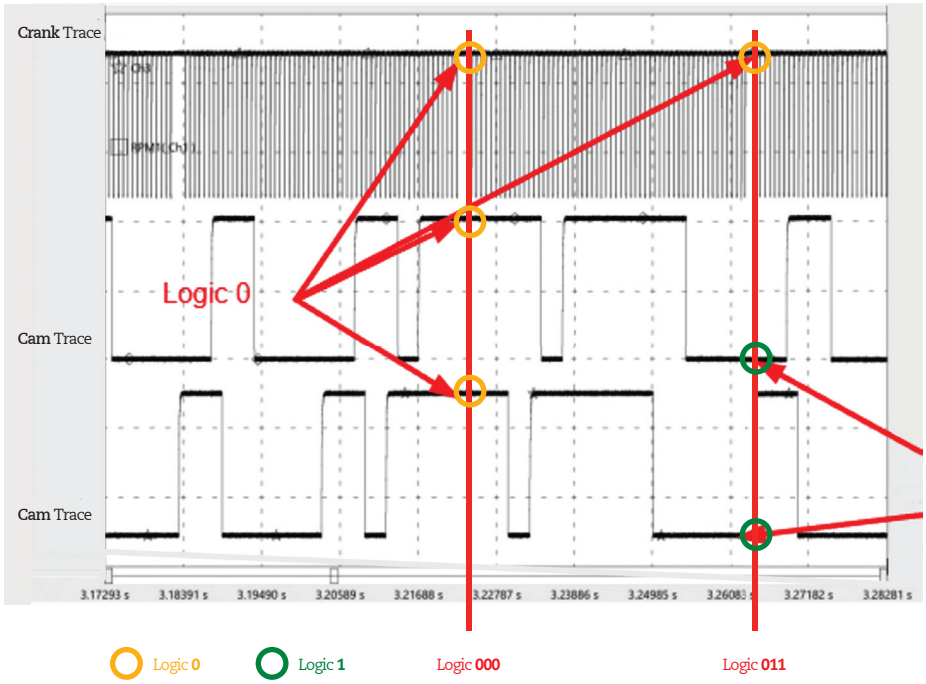
The only logical fault was that the crank sensor signal was out. The Crank Reluctor is part of the flywheel, and cannot move, and therefore was never considered to be an issue. But there was no other explanation for the timing issue, no matter how improbable this could be.

A vehicle with the same engine was found, and all the tests using all the same scope settings were performed. The Crank reference point was indeed

almost 100 degrees in advance on the test vehicle, when compared to the non-starting engine, and the Logic was correct.

To prove that the crank signal was the issue, the crank position sensor was removed and a camera inserted to monitor the position of the reference point. The reference point was at least 100 degrees out. The transmission had to come out to prove the reluctor was the issue. With the transmission off, if was clear that the drive plate was the issue. It had spun 100 degrees and locked up, leaving the crank signal out.

Simple logic checks on the cam and crank signals save time on newer high-resolution engines. And trust the information they give you, even if it goes against what we believe could never happen.



Good scope trace of a crank and two cam signals checked using logic to prove Crank and Cam correlation is correct (Logic 000 followed by Logic 011)

Logic showed the Cam signal was at least 100 degrees off, the result of the reluctor breaking and rotating to cause this unusual fault.