Fall 2015 | Volume 8 | Issue 3

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Properly trained technicians have the equipment, tools, safety instructions, and know-how to perform repairs correctly and safely. If a condition is described, DO NOT assume that a topic covered in these pages automatically applies to your vehicle or that your vehicle has that condition.

Understanding Camshaft Control Systems Part II

Servicing Timing Chains & Sprockets

Timing chains are strong, but they can fail. Many technicians find diagnosing these failures difficult. Let's shed some light on the common issues timing chains can have, so we can better diagnose and repair vehicles correctly the first time.

In the first installment of this series, we covered an overview of the entire camshaft timing system in both engines of the 2015 Nissan Altima. This time we are going to take an in-depth look at timing chains and sprockets. We will focus on the QR25 and VQ35 engines but keep in mind that some of the principles that we discuss can be applied to any Nissan timing chain engines. Nissan uses silent type timing chains, and these systems are low maintenance, strong, and very reliable. However, as with any mechanical device, they can develop problems. We will discuss how timing chains can fail. Then we will look at how to diagnose these failures, regardless of whether or not they generate a DTC. And finally, we will cover repairing failures once they have been identified.

Common Failure

The most common failure of timing chains is excessive stretching. The links of the chain do not stretch, but the pins wear and the pinholes become elongated. This wear creates a greater distance between each link, increasing the overall length of the chain. Over time, the timing chain will naturally stretch to some extent. This is normal, and the reason timing chain tensioners are variable length. As the chain stretches through normal operation, the tensioner extends to take up the slack. However, if the chain stretches excessively, engine performance will suffer. The tensioner can compensate for the increased length, and keep the chain tight and quiet, however the chain is still physically longer. This causes valve timing to be retarded, and retarded valve timing causes diminished engine performance. At some point, the ECM may report a DTC, such as P0335 Crankshaft Position Sensor, P0340 Camshaft Position Sensor, or P0300 Multi Cylinder Misfire. However, these codes have many possible causes, and can sometimes lead us down the wrong path during diagnosis.

The most common cause of excessive timing chain wear is lack of lubrication. This comes down to one thing: proper maintenance. Oil must be changed regularly, with high quality oil of the correct viscosity, and a Genuine Nissan Oil Filter. The majority of engine wear occurs upon startup, because oil pressure is gradually lost while the motor is at rest. When the motor is started, it spins briefly with little or no lubrication. Genuine Nissan Oil Filters combat this with high quality anti drain-back valves, which keeps oil pressure in the engine while it's at rest. The difference may seem minor, but over the life of the vehicle it adds up. Even when Genuine Nissan Oil Filters are used, the oil still must be changed at the recommended intervals. Extending oil changes past these intervals promotes sludge formation. This sludge, a product of oil mixing with blowby gasses, clogs oil passages, and greatly contributes to lubrication issues.

Diagnosing Chain Wear

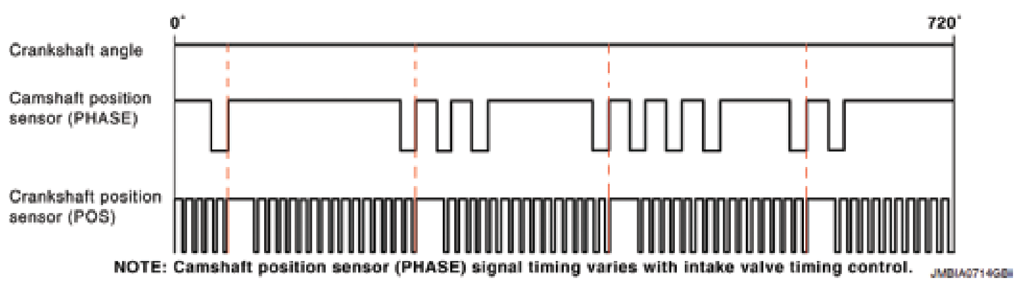
On older engines, we can check the timing chain mechanically. This procedure can only be used on engines that use a non-ratcheting timing chain tensioner. We must be able to see the camshaft sprockets. Most Nissan engines have a cover that can be removed to achieve this. Once we have gained access to the camshaft sprockets, the crankshaft pulley should be rotated clockwise two full rotations to take up any slack that may be present. Now slowly rotate the crankshaft pulley backwards, in a counterclockwise direction. Watch the camshaft sprockets and stop rotating the crankshaft pulley as soon as the camshaft sprockets move. If the crankshaft pulley has been rotated more than 5° before the camshaft sprockets move, then the chain has excessive wear and should be replaced.

Newer engines, like the QR25 and VQ35 have ratcheting timing chain tensioners that do not retract once they have been extended. The mechanical check will not work for these engines. Furthermore, the mechanical check is labor intensive and requires removing covers that may be difficult to access. A more appropriate check for timing chain wear can be performed with the aid of a dual trace oscilloscope. The Nissan CONSULT III plus is capable of tracing these patterns.

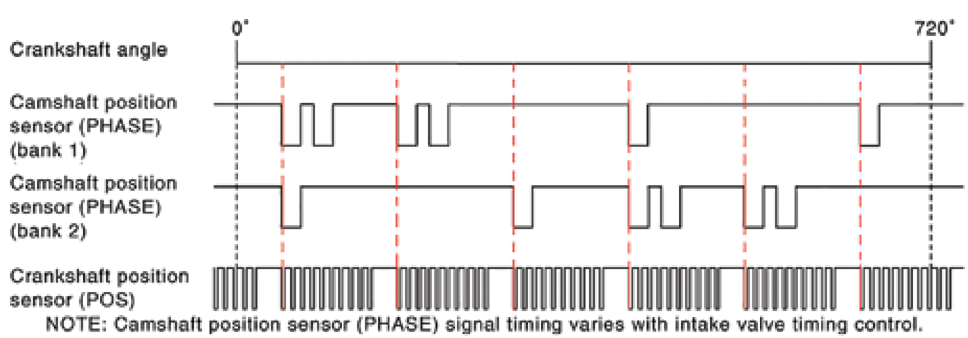
Connect the lead for one trace to the camshaft position sensor (PHASE) signal wire, and connect the other lead to the crankshaft position sensor (POS) signal wire. Then, disable any variable valve timing by disconnecting the connector to the valve timing control solenoids. Start the engine and let it warm up to normal operating temperature. Once the engine is warm and stabilized, take a look at how the traces line up with each other. The crankshaft signal will have high frequency pulses with larger gaps that indicate a piston at TDC. The camshaft signal will have a specific set of voltage pulses that indicate which cylinder is at TDC compression. These pulses should line up in a certain way. How they line up varies depending on the engine, so be sure to refer to the appropriate service manual information.

For the QR25 engine, the leading edge of the crankshaft TDC pulse should line up with the trailing edge of the camshaft signal pulse. For the VQ35 engine, the trailing edge of the crankshaft TDC pulse should line up with the leading edge of the camshaft pulse. A stretched timing chain will cause camshaft timing to be retarded, and you will see the camshaft pulses later than normal. When graphed on the oscilloscope, they will be shifted to the right and no longer line up properly with the crankshaft pulses. There are other possible failures that can cause this condition. An improperly indexed flywheel, for example, will cause the pulses to all be off by the degree of misalignment. However, this can only happen if the flywheel is installed incorrectly. It will never happen naturally, due to engine wear. Another possible cause is a camshaft sprocket that has spun on its hub. If this is the case, the timing chain will require removal to access the sprockets, and the procedure will be the same. Although this test requires having access to an oscilloscope, it is fairly simple and cheap to perform, and no engine components need be removed.

Once it has been determined that timing chain or sprocket wear is excessive, the system must be serviced. Servicing the QR25 timing chain requires removing the engine from the vehicle. The VQ35 timing chain can be serviced in the vehicle, but it is much easier to access if the engine is removed.



The QR25 trace should look like this. Notice how the pulses align with each other. If the camshaft pulses are shifted to the right, then the timing chain is excessively stretched.



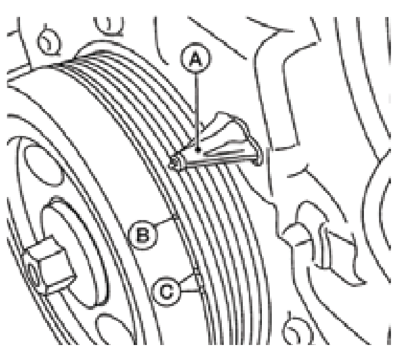
The VQ35 trace should look like this. Notice how the pulses align with each other. If the camshaft pulses are shifted to the right, then the timing chain is excessively stretched.

We'll outline procedures common to all timing chain engines, and some specifics of these two engines. It is imperative that you consult the Nissan factory service manual before any repairs begin, as this article will not cover every detail required to service the timing chain.

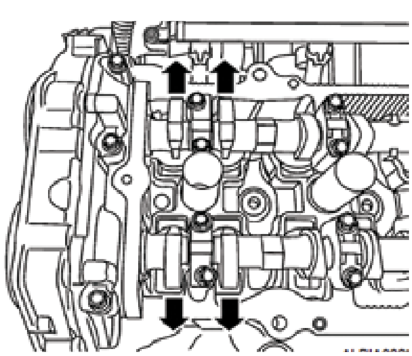
Disassembly

Regardless of the engine being serviced, cylinder 1 must be at TDC compression before any repairs can begin. Cylinder 1 will always be the cylinder closest to the front of the engine. On the VQ35, this is the first cylinder on the right bank, the bank closest to the firewall. There are a few different ways of finding TDC compression on cylinder 1, choose the most appropriate for the engine being serviced.

The crankshaft pulley has a single notch that indicates TDC. This notch should be lined up with the timing indicator on the front cover. Be sure to use the appropriate notch, as most crankshaft pulleys have multiple marks.



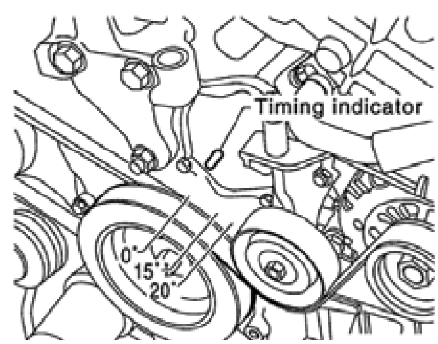
Cylinder 1 on the QR25 is at TDC when the single mark, B, is aligned with the timing pointer, A. Be sure to use the single mark, B, and not the white timing marks, C.



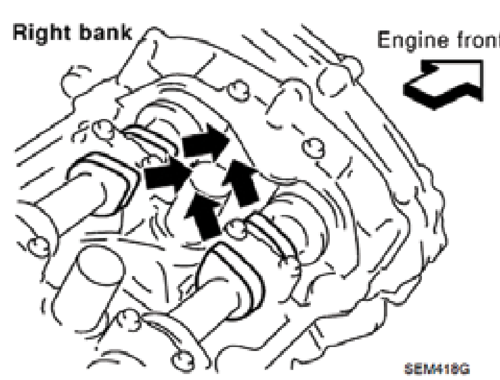
When cylinder 1 is at TDC compression with the QR25, its cam lobes will face out and away from each other as shown here.

The QR25 pulley has a single unpainted notch for TDC, but also 2 white paint marks that are used for measuring timing. When aligned, the engine is at TDC on cylinder 1, but we don't know if the cylinder is on the compression stroke or the exhaust stroke. If the valve covers have been removed, the camshaft positions can be used to determine this. The QR25 engine will have the cam lobes on cylinder 1 facing outwards and away from each other when on compression. The VQ35 will have cylinder 1 cam lobes facing up and in toward each other on compression. If the valve covers have already been removed, this is the quickest way to determine if cylinder 1 is at TDC compression. However, removing of the valve covers is not required for servicing the timing chain.

If the valve covers have not been removed, the best way to find TDC compression is with the use of a compression tester hose. Remove the spark plug from cylinder 1, and install the hose. Now, rotate the engine clockwise and stop about 90°



To find TDC for cylinder 1 on the VQ35, align the grooved line WITHOUT color with the timing indicator on the front cover.



When cylinder 1 on the VQ35 is at TDC compression, its camshaft lobes will face up and in towards each other as shown here.

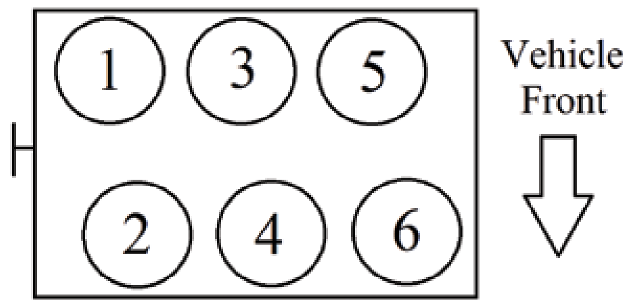
before TDC. Place your thumb over the hose and rotate the motor to TDC. If pressure is felt on your thumb, then the cylinder is at TDC compression. If no pressure is felt, the cylinder is at TDC exhaust and the engine must be rotated one full turn to be at the correct position. This procedure is simple enough on the QR25, but the VQ35 poses an interesting challenge. Cylinder 1 spark plug cannot be accessed without removing the intake manifold. So on this engine we will instead use cylinder 4, the middle cylinder on the left bank. Cylinder 4 is mated with cylinder 1; they are both at TDC at the same time, but on opposite strokes.

When cylinder 4 is at TDC exhaust, cylinder 1 is at TDC compression. Use the same procedure, and when no pressure is felt on your thumb. Cylinder 4 is at TDC exhaust. Therefore cylinder 1 must be at TDC compression.

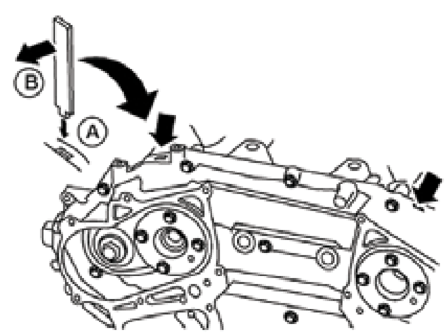
After the engine is set to TDC compression, install a ring gear stopper to keep the crankshaft from rotating during repairs. Now, timing chain removal can begin. Remove the crankshaft pulley and front timing cover to expose the chain system. You may notice that the colored links of the chains do not line up with the notches on the sprockets. The engine can be rotated so that these links line up, but it is not necessary. The colored links are really only used when installing a new chain, which we will likely be doing. If the chain is to be reused, simply mark the links that do line up with the notches in the sprockets with a paint pen. Then reinstall them in the same place. It is common for the main chain to be replaced, but the balancer chain, on the QR25, or the secondary chains, on the VQ35, to be in good condition and reused.

Release the timing chain tensioners, then remove them along with the guides. Inspect the guides for wear, and be sure the tensioner piston moves freely. The main timing chain can now be removed and inspected. Look closely for cracks or abnormal wear. Next, remove and inspect the sprockets for wear. The longer the engine has been driven with a stretched timing chain, the more likely it is that the sprockets will have excessive wear and require replacement. If the timing chain is to be replaced it is always best to replace all components that it contacts. Compared with the cost labor involved with timing chain replacement, the cost of new sprockets, guides, and tensioners is minimal.

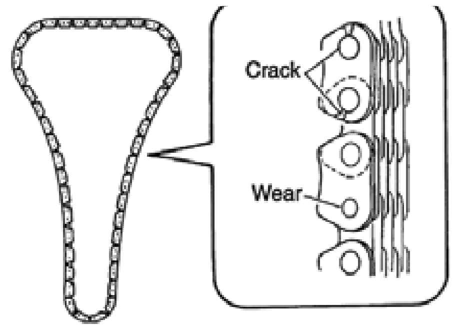
Use this opportunity to also inspect for sludge buildup. If any sludge is observed, it must be thoroughly cleaned before installing any components. The VQ35 utilizes two small mesh



On the VQ35 engine, cylinders 1, 3, & 5 are on the rear bank and are covered by the intake manifold. However, cylinders 2, 4, & 6 are easily accessible. When cylinder 4 is at TDC exhaust, cylinder 1 is at TDC compression.

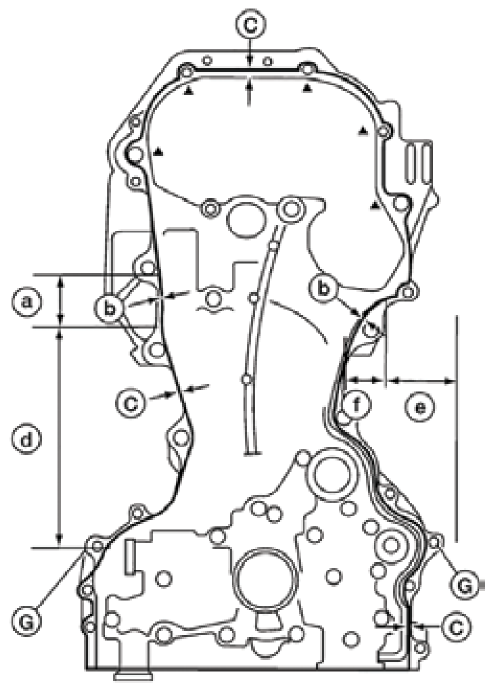


Once all of the bolts are removed from the VQ35 front timing cover, it can be removed. Pry the cover off by using a suitable tool inserted into the notches shown here.

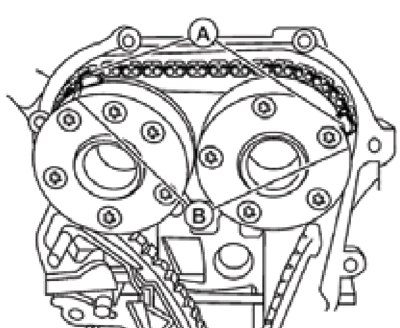


Carefully inspect the timing chain for wear if you do not already plan to replace it. Any cracks or looseness in link pins warrants replacement.

filters placed near the center of the front timing cover, and the QR25 uses one filter in the upper left area of the front cover. These filters protect the valve timing solenoids. Be sure to inspect these filters for debris, and replace them if any blockage is found. There are also multiple O-rings that will be removed with the front cover. These should never be reused, even if they appear to be in good condition. When replacing the timing chain on the VQ35, the water pump should be replaced as well. After all components have been inspected and the timing case has been cleaned, installation can begin.



Here we see a diagram depicting the proper application of RTV on the front cover. Notice that the bead thickness varies, and is to applied around the outside of some of the bolt holes. Be sure to follow the diagram for the engine you are working on.

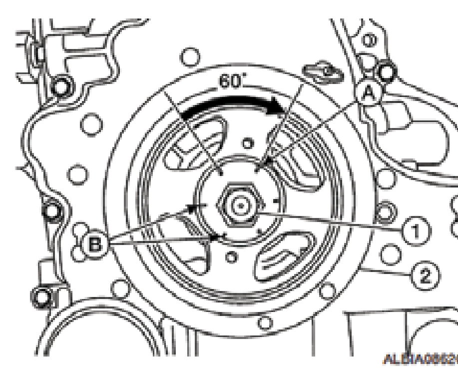


The colored links, A, of the QR25 main timing chain must be aligned with the mating marks, B, of the camshaft sprockets.

Installation

At this point, I must reiterate, that it is essential that you have read and comprehended all procedures outlined in the service manual. In particular, torque specs and tightening sequences. If these are not followed precisely major problems can arise. The front covers are sealed with liquid gasket, referred to by Nissan as "Ultra Grey." This must be applied exactly as stated in service manual, as there is a specific pattern of application. Be sure you are ready to reinstall covers before the sealer is applied. It dries quickly and must be installed within five minutes of application. Always check timing marks multiple times during the process, ideally after each new component is installed. It is easy for the chain to slip a tooth between steps. If this goes unnoticed, engine damage may occur and the entire job will need to be redone.

The installation of the QR25 timing chain is fairly straightforward. Install the sprockets first. When installing the camshaft sprockets be sure to line up the indexing grooves with the dowel pins on the camshaft. Crankshaft sprockets will be aligned by the keyway in the crankshaft snout. Next, install the balancer chain, being sure to align the colored links with the mating marks of the sprockets, then the balancer chain tensioner. Now we are ready to install the guides and the main timing chain. Once again, be absolutely sure all mating marks are aligned with the colored links. The last component



The QR25 crank pulley bolt must be tightened to 31 ft.lbs. and then an additional 60°. The bolt has six stamps on it, each 60° apart. Simply mark the pulley at one stamp then tighten the bolt until the next stamp lines up with the paint mark.

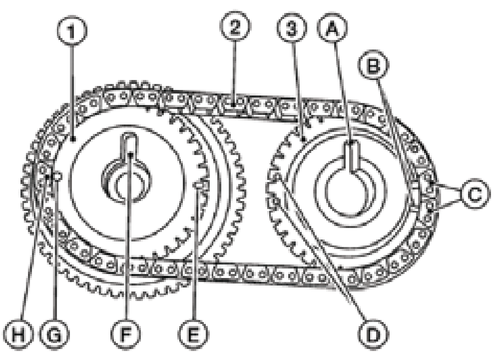
to be installed is the main timing chain tensioner. Install it with a stopper pin holding the tensioner fully retracted. Recheck all alignment marks then remove the stopper pin. Be sure the tensioner plunger extends and moves freely. Make one final check of all alignment marks then install the front cover and crankshaft pulley.

The VQ35 timing chain installation follows a similar procedure, however instead of a balancer chain, there are two secondary chains. The secondary chain installation is unique in two ways. The first difference is the fact that the secondary chain tensioners will be installed first. The second difference is the fact that the secondary chain must be assembled with the camshaft sprockets before being installed on the engine. The sprockets for the left bank are the same as for the right bank, therefore, they all have both mating marks. These marks are on the rear of the sprockets. The right bank will use the single circle mark on the intake sprocket, matched with the single colored link on the chain, and the double oblong marks on the exhaust sprocket, matched with the double colored links on the chain. The left bank will use the opposite marks. If this seems a bit confusing, just keep in mind that both dowel pin grooves should face upwards. As the mating marks on the camshaft sprockets are on the rear, they will not be visible once the sprockets are installed. To make rechecking alignment easier, a paint mark should be made extending from the mating marks up to the teeth of the sprockets.

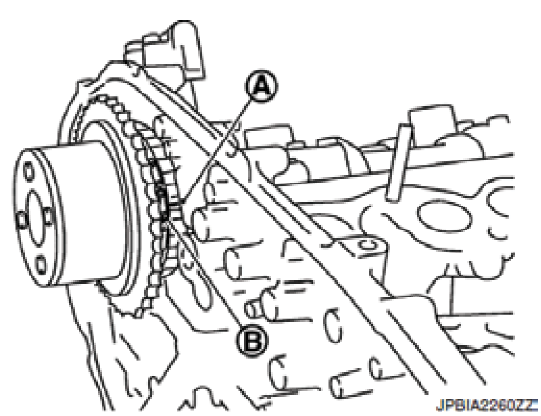
Once assembled, the secondary chains and sprockets are ready to be installed. Line up the grooves in the sprockets with the dowels on the camshafts, tighten the bolts to spec, release the secondary tensioners, and check that they are still properly aligned. After this is done, the main chain can be installed. Align the colored links on the main chain with the stamped marks on the front of the sprockets. Then install the three guides, and finally the main tensioner. Release the tensioner and recheck all alignment marks. Once it is confirmed that the timing marks are lined up, install the front cover and crankshaft pulley.

Final Check

After all repairs are completed, rotate the crankshaft pulley to ensure nothing is binding. Be sure all fluids are at the correct level before starting the engine. Upon initial startup, there will be a thumping or rattling noise heard for the first few seconds. This is because the timing chain tensioner doesn't function until oil pressure has built up inside it. The noise is normal, and it should go away quickly. Check for any leaks and abnormal noises. Let the engine warm to operating temperature, and be sure the cooling fan cycles at least one time. Allow the vehicle to cool and recheck all fluid levels. If no problems are found, the repair is complete and the vehicle is ready for delivery to the customer.

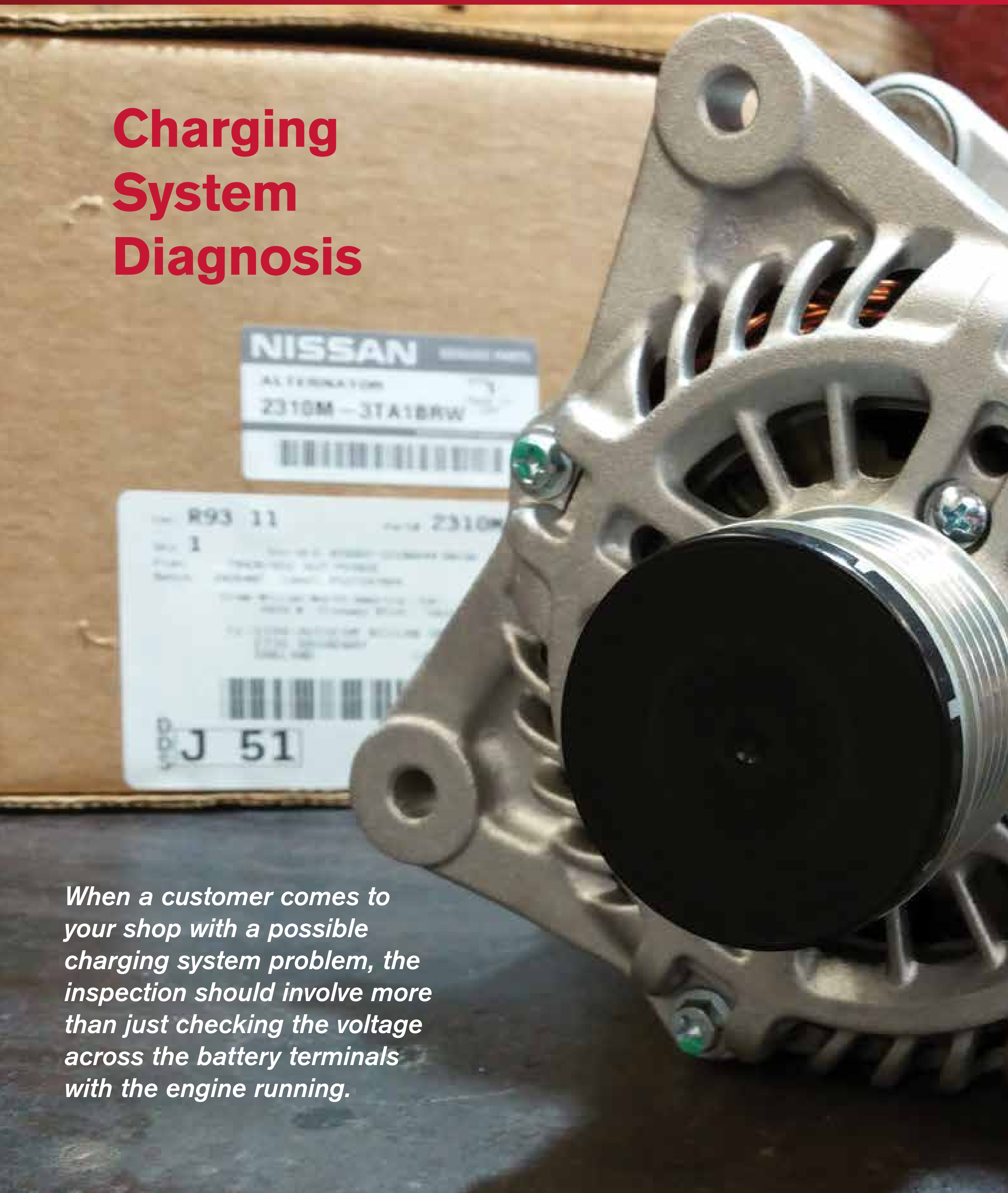


Here is a rear view of an assembled secondary chain for the right bank of the VQ35. The colored links, H & C, must be aligned with the mating marks, B & G. The left bank secondary chain will be reversed.



To make rechecking VQ35 alignment easier, make a paint mark extending from the mating mark to the teeth of the sprocket.

Charging System Diagnosis



When a customer comes to your shop with a possible charging system problem, the inspection should involve more than just checking the voltage across the battery terminals with the engine running.

Let's cover the information you'll need to avoid being bit by an incorrect diagnosis from a review of the charging system basics that have been the same since you started repairing cars, to some of the newer and perhaps unfamiliar control systems that have been added to fine tune the charging system for optimum efficiency.

The Battery

The battery has several functions. It powers electronic systems when the engine is off; it provides the power needed to start the engine; it can act as a ballast to stabilize voltage during periods of high electrical demand; and it provides backup power in the event of a charging system failure. The battery needs the charging system and the charging system needs the battery, so verifying that the battery is charged and in good condition is an important first step when testing the charging system.

One of the most common symptoms of a charging system failure is a discharged battery. More often than not, when a car arrives in your shop with a charging system problem, the battery will be discharged. The first step should always be to charge and test the battery. The best way to do this is with the GR8 Diagnostic Fast Charger, available from Nissan's Tech-Mate tool and equipment program. Time is money and the GR8 is a time saver. The GR8 will quickly test the battery before fully charging to make sure you aren't wasting time. It also uses proprietary pulse-charging algorithms to charge the battery faster than a conventional charger could while reducing battery sulfation at the same time. After the battery is charged to around 70%, the GR8 will alert you so you can begin charging system testing instead of waiting for the top-off mode to complete.

Charging Voltage

A 12V automotive battery is made up of six 2.1V cells connected in series for a total nominal voltage of 12.6V. The ideal charging voltage per cell is between 2.3V and 2.45V, so the charging system output should ideally be between 13.8V and 14.7V. At the lower end of the range, the battery will not reach full charge and the negative plates can become sulfated resulting in a reduction of battery capacity over time. At the higher end of the range the battery will get a full charge and maintain its capacity, but the positive plate may erode and the electrolyte may gasify, causing damage and loss of electrolyte.

What is the perfect charging voltage? The answer depends on a number of factors: the battery's state of charge, the battery's temperature, the condition of the battery, and the design of the battery. Most older Nissan cars simply kept the charging voltage fixed anywhere between 14.1V and 14.7V. Newer Nissan vehicles use information from temperature sensors and current sensors to modulate alternator output by using a control unit. This allows for increased fuel economy as well as optimized battery capacity and life. We'll discuss how this happens and how you can diagnose the variable voltage controlled charging systems later in this article.

Alternator Overview

The alternator consists of a variable-strength electro-magnet rotor, a regulator, a 3-phase stator and a rectifier. The rotor is linked to the crankshaft through pulleys and a drive belt, so when the crankshaft is spinning, the rotor speed varies proportionally to the crankshaft speed. The rotor's moving magnetic field passes through the windings in the stator causing it to generate AC voltage. The faster the rotor spins, the more voltage the stator will generate. A voltage regulator controls the current through the rotor, which in turn, controls the magnetic field generated by the rotor. The greater the strength of the magnetic field, the more voltage the stator will generate. To increase charging voltage, the regulator increases voltage to the rotor and vice versa. The regulator has internal logic to control alternator output, but can also receive input from other control units to maximize fuel efficiency. Finally, the AC voltage generated by the stator is transformed to DC voltage by a full-bridge rectifier built with 6 diodes.

The Stator, Rectifier and Ripple

AC current cannot be used to charge a battery because, even though the positive peak of the AC sine wave would push current into the battery, the negative peak would pull the same amount of current back out. Therefore, an alternator must convert the AC current into DC current that can be stored by the battery.

A rectifier is an arrangement of diodes that converts the AC current to DC current which can be used to charge the battery and power the vehicle's electrical systems. A diode is an electrical check valve that only allows current to flow in one direction. An arrangement of 6 diodes allows the positive half of the sine wave to pass and inverts (flips) the negative portion of the sine wave so it too is positive. This results in a nearly complete DC output since there is a positive peak every 60 degrees. The alternator's rectified DC output is further smoothed with a capacitor, which stores and releases current to eliminate the remaining ripple.

As technicians, why do we care about how the alternator creates DC output? We don't need to build an alternator, we just need to find out if it's working, right? The answer is that knowing how the alternator works will help us diagnose failures.

The GR8 Diagnostic Fast Charger is available from Tech-Mate.

By checking for ripple – the peaks of the AC sine waves remaining after rectification – we have a window into the function of an alternator. If a phase has a turn-to-turn short, reducing its inductance and output, it will show up in the ripple. If a rectifier or capacitor has failed, it will show up in the ripple.

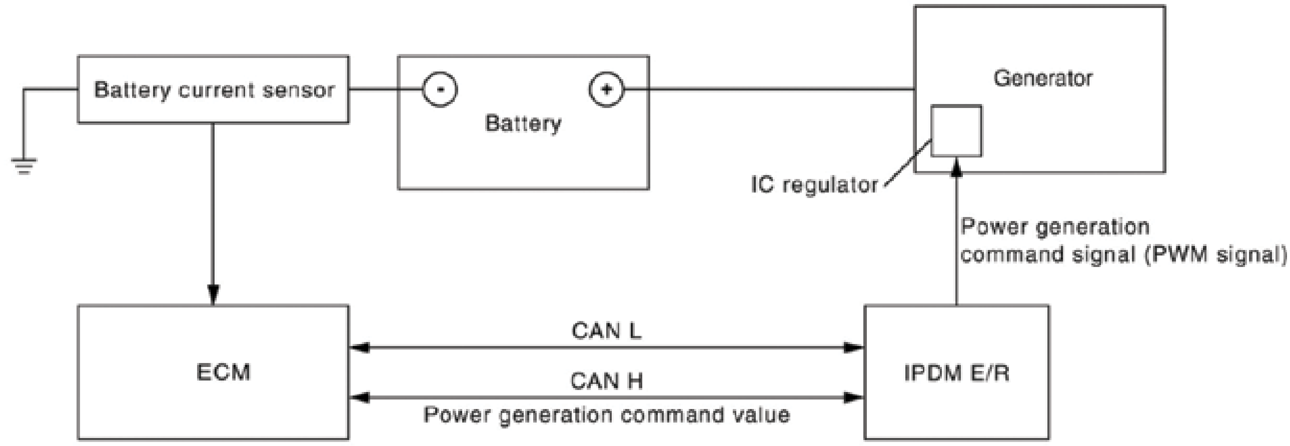
Ripple can be checked in a number of ways. If your DVOM is fairly fast, you can check charging voltage using the AC scale. The ripple will be displayed as AC voltage while the DC output will not be measured. An oscilloscope can also be used to check ripple, with the added benefit of being able to see the pattern of the ripple. There is a peak every 60° and there are 360° in a rotation, so you'll be able to see any faults repeat every six peaks. Test for ripple voltage at low engine RPM and low electrical load. Testing at high RPM or high electrical load with the 0.5V max recommendation could lead to falsely classifying a good alternator as bad. If in doubt over a ripple voltage reading, compare the value to a known good vehicle under the same engine RPM, electrical load and battery state of charge conditions.

The EXP-800 can be used to quickly test many aspects of charging system performance.

The quickest and easiest way to test for ripple is to use the Nissan-approved EXP-800 Battery and Electrical System Analyzer (also available from Tech-Mate) or the GR8. Both tools are capable of testing for ripple and making a good/bad determination. Once again, using the right tool saves a lot of time and decreases the chances of making an error when interpreting the test results.

Rotor, Brushes, & Voltage Regulator

The stator and rectifier are not the only way the alternator can fail. The rotor, brushes, and voltage regulator can also break. The rotor is an electromagnet, so it must be powered to work. Because the rotor spins, the power must be delivered to it through spring-loaded carbon brushes that push against two commutator rings wired to either end of the winding in the rotor. An output of 13.8V-14.7V is maintained by



The alternator is commanded by the ECM on many modern Nissan vehicles. Make sure the alternator isn't just "following orders" before condemning a unit with seemingly low output.

regulating the current to the rotor. More current means a stronger magnet and a more alternator output. Less current means a weaker magnet and less alternator output. The voltage regulator is responsible for controlling the voltage to the rotor to control the alternator output. The brushes, commutator rings, rotor winding and voltage regulator can all fail, typically producing the same symptom – no charging.

Brushes

The brushes are made of carbon and are pushed against spinning copper rings, so the brushes will wear away with use. As the brushes wear and become shorter, the springs pressing against the brushes will extend. When the springs become longer, they press on the brushes with less pressure, increasing the possibility of poor electrical contact. Also, the brushes are typically rectangle-shaped when new, but will eventually wear into a square shape. When the brushes wear beyond a square shape, they can get cocked in the brush holder and stick, preventing contact with the slip rings.

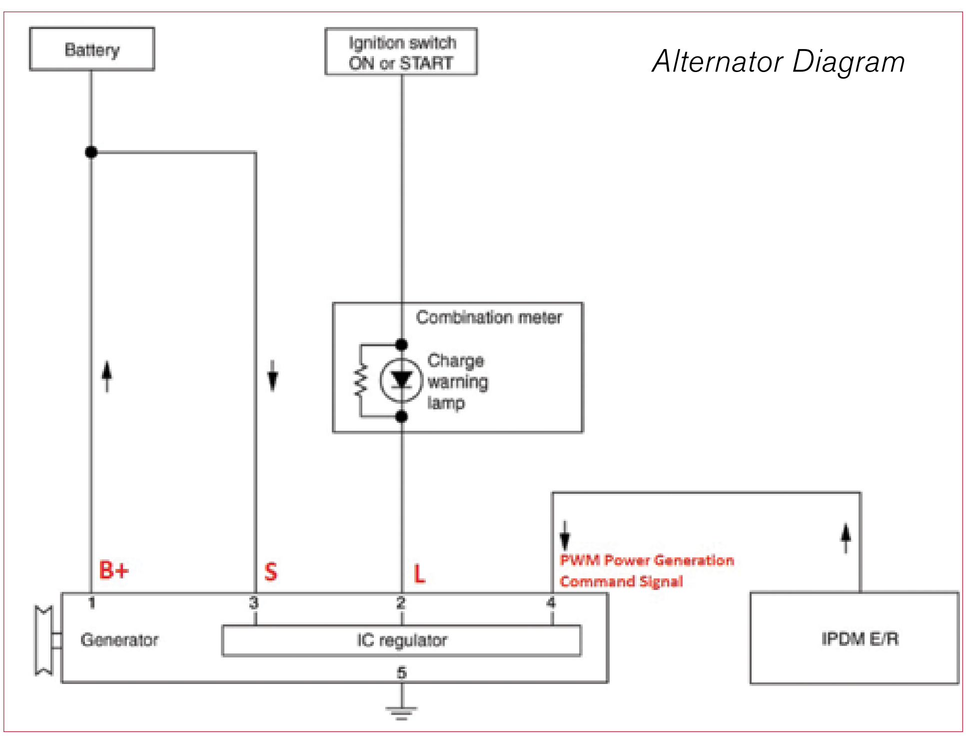
Some technicians will tap on an alternator to dislodge stuck brushes while monitoring the charging voltage as a quick test. If the charging voltage jumps to "normal" at the exact same time the alternator is tapped, it's a pretty good bet the alternator is bad. This test does frequently work. However, overzealous or poorly aimed "tapping" can result in a damaged alternator, which is especially bad if the alternator wasn't the problem to begin with. It can also result in an avoidable core chargeback. You may have noticed that Genuine Nissan remanufactured alternators do not come with hammer marks on them. Unless you're stuck on the side of the road, it's best to use standard diagnostic techniques.

Regulator

Earlier in the article we said Nissan is using current and temperature sensors to decrease fuel consumption and optimize battery life. The voltage regulator does not monitor these sensors directly. A control unit with more processing power monitors these sensors and makes decisions, then relays a command to the regulator.

For instance, the ECM may monitor the sensors, send a charging command via the CAN bus to the IPDM E/R (Intelligent Power Distribution Module Engine/Room, usually part of an engine room fuse box), the IPDM E/R then issues the command to the voltage regulator with a PWM (Pulse Width Modulated) signal. In the event that the IPDM E/R signal is not received by the voltage regulator, it charges the battery based on its own logic, without the benefit of the information provided by the additional sensors.

Why is knowing this important? Well, if alternator output is lower than expected, we need to know if



this is because that's what the ECM is trying to do, or if there is an alternator fault. So, before doing any further testing, we need to disable what Nissan calls the "Power Generation Variable Voltage System." The easiest way to do this is with the CONSULT III plus using "alternator duty%" active test. When the duty cycle is either 0% or 100%, the voltage regulator will run the alternator, based on its own logic, just like on older cars. This will allow you to perform alternator testing without the ECM interfering.

If you don't have a CONSULT III plus, you should probably get one because it makes fixing Nissan products a lot easier. In the meantime, you may be able to disable the ECM control by disconnecting the current sensor depending on the car. Check the service manual and then verify the system has been disabled by checking duty cycle at the voltage regulator Pin 4. A steady state voltage, either ground or B+ means the voltage regulator is in control and the ECM isn't affecting the charging voltage.

As implied by the fact there is a Pin 4, there are 3 other alternator terminals, and they are also important to diagnosis. Let's cover these now.

The B+ terminal is the alternator output. If charging voltage is low at the battery, it's important to make sure that it's also low at the alternator, and not being "eaten up" by voltage drops on the way to the battery. You could measure voltage across the battery terminals and then from the B+ terminal to the alternator case and compare them. They should, of course, be very nearly equal. However, a better way is to connect one lead to the positive battery terminal and the other the B+ terminal. Any voltage displayed on the meter is being "eaten" by the cable and connections. The same test should be performed between the alternator case and the negative battery terminal. By checking for voltage drops this way, you'll know which side of the circuit is in trouble and you'll also be testing both locations at the exact same time, so you'll know the current flow was the same during the testing. Which brings us to another important fact about voltage-drop testing: the amount of voltage drop on a circuit is proportional to the current flowing through the circuit. If you want to really test for drops, make the alternator work hard by activating electrical loads like the headlights, blower, seat heaters, etc.

This car has very little voltage drop on the B+ cable while idling with no loads, but it should be tested with several loads turned on before declaring the positive side of the circuit "good."

Another terminal is the "S" terminal, or sense terminal. This terminal is how the voltage regulator knows the charging voltage so it can make adjustments. This information is pretty important for charging system operation. You may wonder why the voltage regulator doesn't just tee into the B+ terminal internally. The B+ wire goes right from the alternator to the battery right? Here's why: remember the voltage drops we were checking a paragraph ago? The S terminal wire does tee into the B+ wire, but it does so closer to the battery so the system will be more tolerant of voltage drops on the B+ wire. This will allow for more accurate voltage regulation at the battery, where it matters.

Finally, there's the "L" terminal. L is for "lamp," as in the charging system warning lamp. When the alternator isn't charging, the L terminal is grounded through the voltage regulator. When the alternator is charging, the L terminal has battery power. The charge warning lamp in the combination meter is connected to key-on power and the other side is connected to the L terminal. So, when the key is in the ON position and the engine isn't running, the warning lamp should illuminate. After the engine is started and the alternator starts charging, the lamp should go off. A bulb check is an important, and very easy, test when performing charging system diagnosis.

In closing, keep these rules in mind for your next Nissan charging system challenge:

1. Make sure the battery is charged and in good condition before testing the rest of the charging system.
2. Use the CONSULT III plus or other methods to disable the Power Generation Variable Voltage System before testing the alternator output.
3. Check voltages at all 4 alternator terminals whenever alternator output is low, high, or non-existent.
4. Use voltage drop testing to find poor connections and damaged wiring to prevent repeat failures, especially for ground, and the B+ and S terminals.

When checking voltage at the terminals of the alternator everything should be plugged in and the car should be running. Carefully sliding a T-pin between the weather packing and the wire provides a way to check voltage on a live circuit without disconnecting or causing damage.

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Unlocking the Mysteries of Keyless Entry Systems

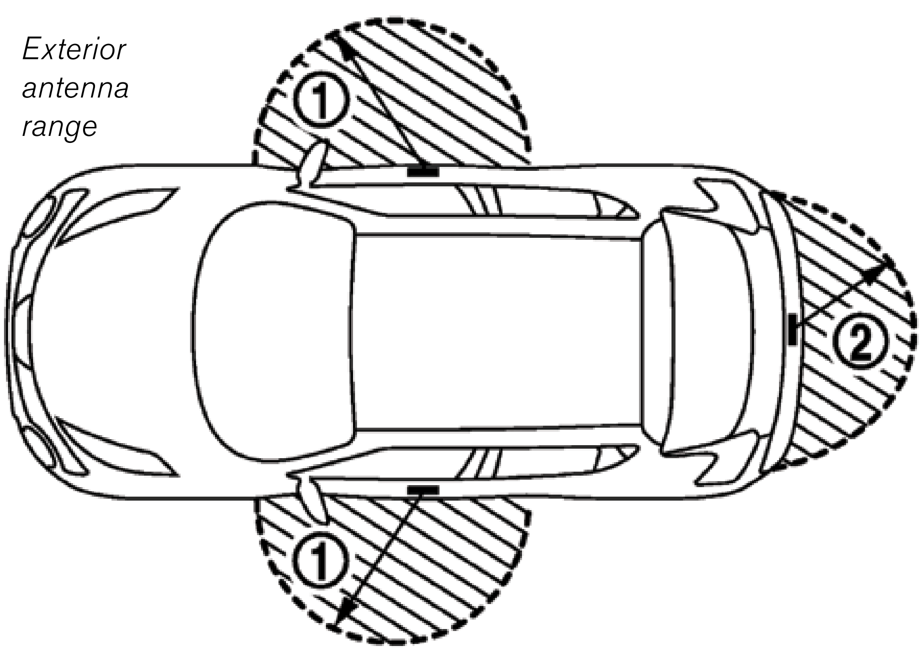
Entering and starting modern vehicles has gotten more complicated. We'll explore the different implementations of keyless entry, as well as their dependent systems, take a look at the most common malfunction scenarios, and discuss logical diagnostics.

Keyless entry and remote starting functions are on just about every modern car. For technicians, the challenge is keeping informed about the constantly changing technologies. We will discuss Nissan's various keyless designs, and how to logically evaluate misbehaving systems.

With or Without Intelligent Key

Let's classify Nissan keyless entry types into two large groups: those with Intelligent Key, and those without. The Intelligent Key is silver-faced, oval-shaped fob. Its emergency metal key slides into the back and serves as the key ring. If the vehicle is not equipped with Intelligent Key, the key fob will be separate from the actual key, or it will be built into the hilt.

So what's the difference? With the Intelligent Key in her purse, a driver could push the button on the door handle to unlock the door, then start the engine without ever removing it from the purse, by merely pushing a button. The car also knows whether the key is within the cabin, and can prevent the driver from accidentally locking herself out.



Start Simple

Let's briefly discuss the simpler implementation of a traditional key with keyless entry remote. Each fob has a unique Key ID, and each vehicle has however many Key IDs registered in its BCM. When a driver presses a button on her remote, the fob transmits its stored Key ID signal. This signal is "heard" by the vehicle's remote keyless entry receiver located in a model-specific spot. The remote keyless entry receiver will relay the Key ID it hears to the BCM. If the transmitted Key ID matches a registered Key ID value, the BCM will relay the lock or unlock command to the relevant power door lock actuator(s). Likewise, some fobs can open the trunk or operate the power sliding doors using the same authentication method. These circuits are all integrated with CAN, so there is no redundant wiring for signal distribution. If the power sliding door disable switch is pressed, the signal will be defeated as well. The keyless entry remotes of this design play no role in starting the vehicle.

Evolution of the Design

The Intelligent Key implementation extends the simple keyless entry system. It adds interior and exterior antenna modules to detect whether the Intelligent Key is within close proximity. There are switches on the exterior door handles (and trunk, if applicable) for the driver to use instead of pushing buttons on a fob. Likewise, the car can normally be started without physically inserting the key anywhere.

There are two sub-designs for Intelligent Key systems: those with push-button engine start, and those without. The designs without push-button start are older, typically found around MY 2006, and have a separate Intelligent Key Module to manage authentication. Also, the ignition switch is a knob that must be turned as though it were a normal keyed design. It has detents for LOCK, ACC, ON, and START positions. The push-button systems toggle from OFF to ACC to ON with each press of the start button while the key is present and the brake pedal is NOT depressed.

Both sub-designs have multiple interior and exterior short-range antennae located in model-specific locations. When an exterior door handle button is pressed, either the BCM (for push-button systems) or the Intelligent Key Module (for turn-knob types) will start the authentication process. First, the control module will activate the exterior antenna nearest to the pressed button. If the trunk button is pressed, for example, then only the exterior trunk antenna will activate. The antenna will broadcast a Key ID request, to which any Intelligent Key within range will respond with its Key ID. The antenna will relay the Key ID value back to the control module that then compares the value to stored Key IDs. Assuming a matching Key ID is detected, the control module will then command the appropriate powered component to work. The command is done directly by the BCM in the case of push-button designs, or delivered via CAN from the Intelligent Key Module to the BCM in the case of turn-knob types.

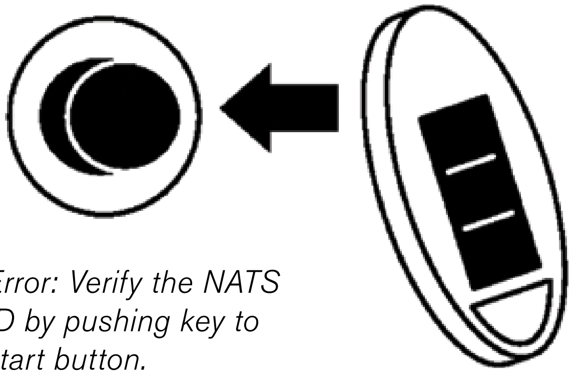
If the driver presses a lock or unlock button on the Intelligent Key itself, the system behaves just like a non-Intelligent keyless entry system. The Key will broadcast its Key ID, and be “heard” by a remote keyless entry receiver module in push-button systems, or by the Intelligent Key Module itself for turn-knob designs. Once the Key ID is heard, it is authenticated and the signal relayed to the appropriate power lock. Each Intelligent Key sub-system starts the engine in a different method.

Starting the Engine with a Push Button

When the start button is pushed, the BCM will activate the interior antennae to request nearby Key IDs. The range on the interior antennae is deliberately short, and an Intelligent Key may not be detected if it is in the pocket of an open door, in the glove box, or on top of the gauge cluster. The Intelligent Key will then respond with its Key ID, and this is verified with the BCM in the same fashion as the above-described exterior antenna authentication method. Once the Key ID is verified, the BCM will command the fuse box (Intelligent Power Distribution Module Engine/Room: IPDM E/R) to provide ACC power and engage the starter control relay. Then, the BCM will verify that the brake pedal is pressed and the shift select is in park. If these start conditions are met, the BCM will command the IPDM E/R to turn the starter motor relay to ON and crank the engine. The main ECM

Push-button ignition.

Error: Can't find the key within the cabin any longer.



Error: Verify the NATS ID by pushing key to start button.

will return a signal to BCM that the engine started successfully, and the BCM will command the IPDM to shut off the starter motor relay. If the key is removed from the vehicle interior antenna range during cranking, the car will fail to start. After 5 seconds of cranking, if the engine has not started, the ECM will turn the starter motor relay OFF.

Key-related malfunctions can illuminate the KEY indicator on the gauge cluster, and output relevant information to the combination meter display during this time. Refer to the service manual for a complete listing.

Starting the Engine with the Turn-Knob Style

The Intelligent Key design with a turn-knob rotates like a normal key cylinder, but authenticates with a remote key like the push-button system described above. The knob must first be depressed inward before rotating; this pressure switch starts the authentication process. The Intelligent Key Module will activate the interior antennae to request Key IDs. Once authenticated, the Intelligent Key Module will use the CAN to release the steering lock, allowing the switch to be rotated out of LOCK position and the car to start.

Non-push-button ignition.

Remove the metal key insert, and use a plastic pry or electric tape-coated screw driver to separate the press-fit key halves.

DIAGNOSTICS & TROUBLESHOOTING

General Considerations

An Intelligent Key from the push-button design is not compatible with the turn-knob style – or vice-versa – despite their nearly identical appearances. This pertains to how the NATS identifier is stored, and we will discuss this shortly.

The most common problems with Intelligent Key systems originate from defective or discharged key units. Each key fob is equipped with a 3v non-rechargeable coin battery. Disassemble the key fob according to the diagram shown and test or replace the battery. Nissan expects a two-year lifespan on OEM batteries in their Intelligent Keys; however, actual operating duration may become shortened if the key is constantly broadcasting. This may be due to storage of the key too near to computers or smart phones, or simply from frequent vehicle usage.

Checking Intelligent Key Signal Output

If the unit has a known-good battery voltage, the actual signal strength of the unit can be checked and verified. Nissan offers a special service tool (SST J-50190) through Tech-Mate called the Signal Tech II that can check Intelligent Key, standard keyless entry remotes, as well as TPMS sensor signal outputs. More information is available from Technical Service Bulletin NTB10-048b. Please see Nissan TechNews TSB Corner at the end of this issue.

Checking Intelligent Key Vehicle Interior/ Exterior Antennae

First, be aware the decreased range and responsiveness for the Intelligent Key can be caused by low key voltage. If you still suspect that an antenna is nonresponsive, they can be tested easily using the CONSULT III plus. The interior and exterior antennae do not have standardized locations, so be certain to check the service manual for their exact positions.

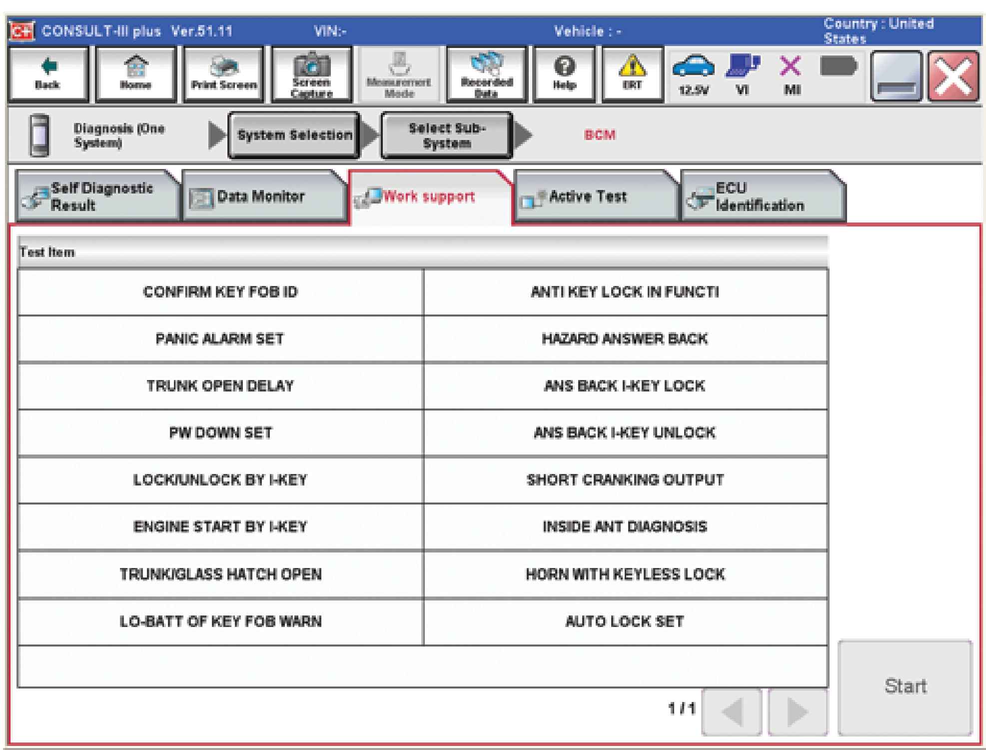
Connect the CONSULT III plus, and choose DIAGNOSIS > ONE SYSTEM. From here, you can choose BCM then, from within BCM, choose INTELLIGENT KEY. Run a self-diagnostic first, because there are relevant DTCs for out-of-specification antenna modules. WORK SUPPORT provides an on-board test for the interior antennae. The Signal Tech II can also test antenna signal strength, but you may need to use CONSULT III plus to ensure they are broadcasting. The service manual includes reference data in case you wish to back-probe the antenna connector and compare results.

Starting Issues

Logically, if an Intelligent Key allows remote entry into a vehicle, it should also start the engine. This means the Key ID authentication was at one point successful, and the failure to start is more likely caused by an interior antenna malfunction or something unrelated to the Intelligent Key components. Use CONSULT III plus to verify operation of the interior antennae.

The BCM can enter a fail-safe mode due to repeated authentication errors. Let's say a customer bought a used Nissan and only acquired one Intelligent Key from the seller – a very common situation. Unaware of the intricacies of the system, the customer buys a new key then attempts to start the vehicle without having registered it. The car does not start. Now, the customer decides to try their original key, but it too WILL NOT CRANK! The BCM was forced into fail-safe. In most instances, the car cannot be started until the DTC is erased with a scan tool. This may seem excessive, but the protection is there to prevent some hacker device from responding sequentially with possible Key IDs until one is found to work.

Similarly, another common DTC is "DIFFERENCE OF KEY" whose B-code is model-specific. This fault will set when something – not necessarily a key – is detected by the interior antennae or the NATS antenna amp but no valid ID is stored in vehicle memory. In other words, if you have two Intelligent Keys in your pocket, one for your wife's G35 and the other for your FX35, and your car sees the wrong key FIRST, it can set the fault and go into fail-safe mode. Even if you remove the offending non-registered key from detection range, the fail-safe cannot be lifted until the fault is cleared.



The Work Support section can provide useful tools for testing, and it is home to some customization options.

Sometimes it's necessary to tap the starter for diagnostic purposes or engine work. Using the CONSULT III plus Intelligent Key WORK SUPPORT section, you can choose SHORT CRANKING OUTPUT to crank for as little as 70ms. For full cranking (with ignition or fuel delivery defeated), you could use CONSULT III plus to connect to the IPDM E/R system, then choose ACTIVE TEST, and toggle the starter relay to ON.

Dead Intelligent Keys

In the event of emergency, a discharged Intelligent Key can still be recognized by the vehicle and start the engine. The process is different based on whether the ignition is push-button or turn-knob.

For turn-knob designs, the physical key insert that slides into the back of the Intelligent Key remote holds the NATS immobilizer information. You can use this metal insert to open the driver's door lock. Likewise, this key will plug into the knob, and the NATS antenna amp will communicate with the transponder chip in the plastic base of the metal key. Once the knob is pressed in, as the Intelligent Key Module does not hear a response to its Key ID request, the module asks the BCM to activate the NATS antenna amp which communicates in very short proximity (e.g. the knob insert slot) to the metal key's transponder. If the transponder's reported NATS ID matches with stored values in the NATS antenna amp, authentication is confirmed, and the knob will turn allowing the engine to start. Bear in mind that the knob release solenoid is electronically controlled; therefore, if the vehicle battery is discharged, the knob cannot be turned even with a registered metal key.

If the inserted metal key is not registered to the vehicle, the transponder will not reply correctly to the antenna amp's NATS ID request. Therefore, the knob will not turn and a colored warning indicator around the knob will illuminate.

For push-button designs, the Intelligent Key itself is programmed with a NATS identifier. The metal key insert does not hold any data. The push-button can be depressed using the Intelligent Key, thus triggering a similar secondary authentication procedure as described above. Without a valid Key ID detected when the start button is pressed, the BCM will ask the NATS antenna amp to request nearby for an appropriate transponder's NATS ID. If authenticated, the vehicle will then continue through the rest of the push-button starting operation steps.

Customers can use their in-dash computers to enable or disable Intelligent Key starting (as well as exterior unlocking). This feature may also be inadvertently toggled without user's awareness, so it's worth checking into during diagnosis. Likewise, you can use CONSULT III plus to set these functions.

Typically below and left of the steering wheel is a slot to insert the Intelligent Key. It does not charge the key, despite what some customers believe. The slot is there to serve as a place to verify the NATS ID without having to take the metal key insert out of the unit. Be aware that putting things other than a good registered Intelligent Key for the car can trigger DTC B2190. Refer to TSB NTB13-015a for more information. Please see Nissan TechNews TSB Corner at the end of this issue.

FAIL-SAFE CONTROL BY DTC

BCM performs fail-safe control when any DTC are detected.

Display contents of CONSULT	Fail-safe	Cancellation
B2190: NATS ANTENNA AMP	Inhibit engine cranking	Erase DTC
B2191: DIFFERENCE OF KEY	Inhibit engine cranking	Erase DTC
B2192: ID DISCORD BCM-ECM	Inhibit engine cranking	Erase DTC
B2193: CHAIN OF BCM-ECM	Inhibit engine cranking	Erase DTC
B2195: ANTI SCANNING	Inhibit engine cranking	Ignition switch ON → OFF
B2196: DONGLE NG	Inhibit engine cranking	Erase DTC

Various Intelligent Key DTCs will prevent the car from starting until the fault is cleared.

The Ghost in the Machine

Intelligent Keys are also capable of controlling auto-down functionality of the power windows. If equipped with this feature, pressing and holding the unlock button for at least three seconds will cause the windows to roll down. It's conceivable that a customer may leave the key in the bottom of a heavy bag whose contents may rest on the unlock button long enough to cause this behavior. The feature can be enabled or disabled using CONSULT III plus.

Occasionally, a driver new to the push-start ignition system may be confused about how to shut the engine off. Remind them to push and hold the start button for a full count of two to turn off the engine. Or, press the start button three times within 1.5 seconds to do the same.

Registering & Removing Intelligent Keys

The exact procedures involved in registering NATS or Intelligent Keys can be complicated. In short, you must be a nationally registered locksmith, own a CONSULT III plus scan tool, have procured the security professional card to unlock CONSULT III plus immobilizer functionality, and have an active Nissan TechInfo subscription to request immobilizer reset codes.

You do not need any of this equipment to pair additional keyless entry remotes of the traditional design. However, the metal keys that accompany the keyless entry remotes require NATS registration.

Once set up, you can easily add more Intelligent Keys – up to four per vehicle. If needed, you could remove a previously functional Intelligent Key that was lost or stolen (technically, this can be performed without adding any replacement keys).

If you are replacing a body control module on push-start implementations, or the Intelligent Key Module on turn-knob styles, re-registration of the Intelligent Keys is required. Do not attempt to replace these modules without all of the customer's Intelligent Keys or the equipment listed above. If you install a new module and only have one of two customer keys, the key not present will lose programming.

The Future of Keyless Entry

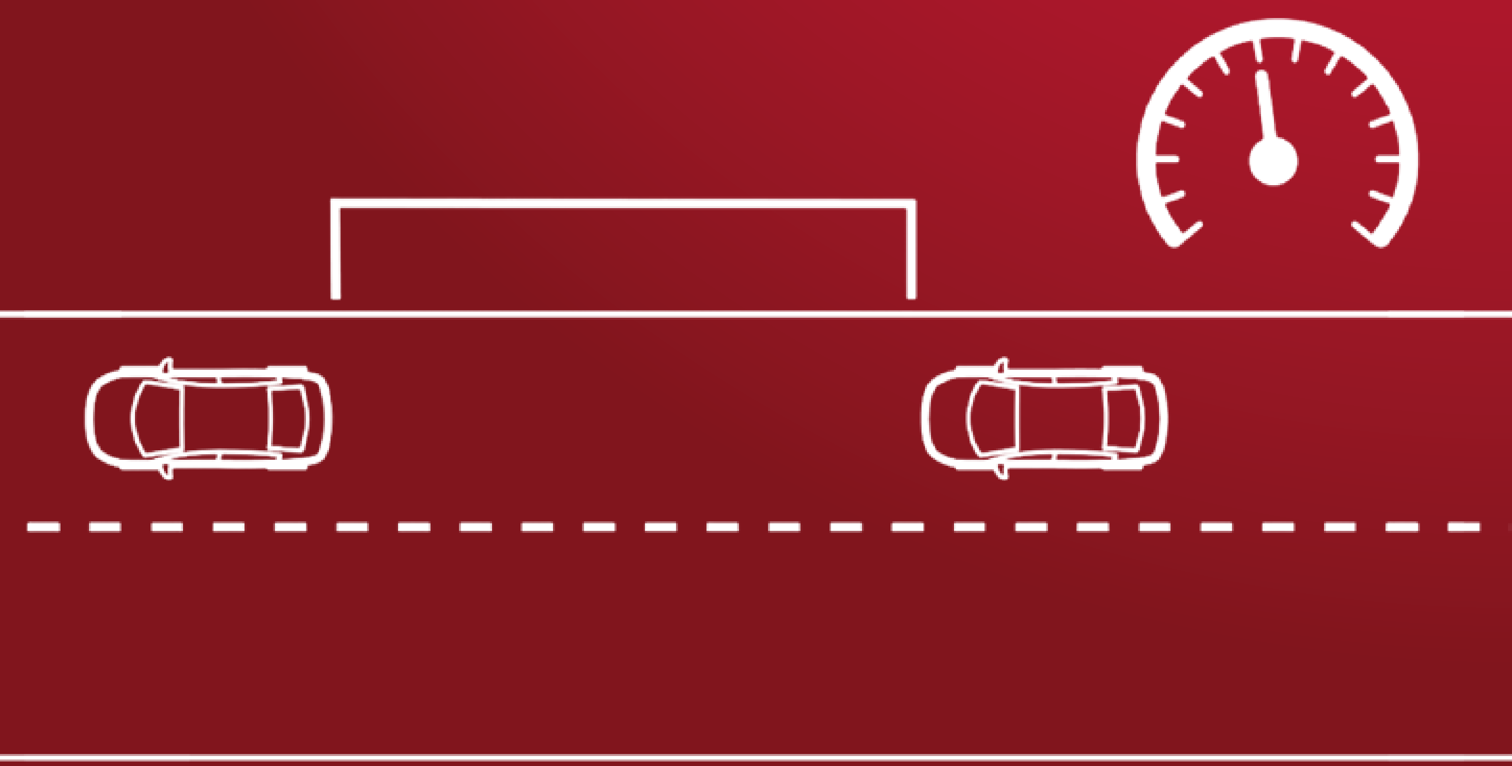
Intelligent Key and similar hands-free vehicle features are always going to be around due to consumer demand. Implementation of these systems is likely to continue changing in the future due to security considerations. Understanding the logical authentication process will aid significantly in figuring out where to begin when a customer says their key fob doesn't work.

The CONSULT III plus will require an appropriate immobilizer unlock card to do work with Intelligent Keys.

Nissan Safety Shield Technologies

Intelligent Protection

Nissan is at the forefront of advanced driver assistance technology for enhanced driving safety. Here are a few tips to inform collision technicians to some of the new systems and service procedures required to restore the sophisticated safety technology to factory performance if an accident does occur.



Nissan's comprehensive approach to vehicle safety combines monitoring of vehicle road handling, passenger protection based on reinforced structure and crumple zones at both ends, and advanced driver assistance technologies to help reduce the risk of potentially harmful driving situations.

The advanced driver assist technologies are based on a combination of camera and radar sensors that help give visibility of potential collision risks 360° around the vehicle, plus software and hardware that react to emergency situations faster than could any human operator, and if the driver is not responsive, take over throttle control and braking to avoid or mitigate collision damage.

The Safety Shield technologies include Intelligent Cruise Control (ICC)[1], Blind Spot Warning (BSW)[2], Around View Monitor (AVM)[3] with Moving Object Detection (MOD)[4], and several interactive braking strategies (see the Safety Systems Overview sidebar for additional details).

X-Ray Vision

Unlike traditional cruise control that kept a constant pre-set speed, Nissan's Intelligent Cruise Control (ICC)[1] is designed to maintain a driver-selected distance between itself and the vehicle ahead. Available on many 2015 Nissan models, Intelligent Cruise Control[1] monitors the distance and relative speed of the vehicle ahead, and adjusts throttle and braking to keep the vehicle at a driver-determined distance.

Intelligent Cruise Control[1] relies on millimeter wave radar, a technology that has been around in the military for years. Nissan is among the first manufacturers applying the technology to automotive safety systems use. A sensor mounted in the front grille area on the vehicle sends millimeter wave radar signals out in front of the vehicle. The sensor detects if the radar waves are reflected back cleanly. The distance from the vehicle ahead is calculated by the amount of time it takes for the reflected radar signal to return.

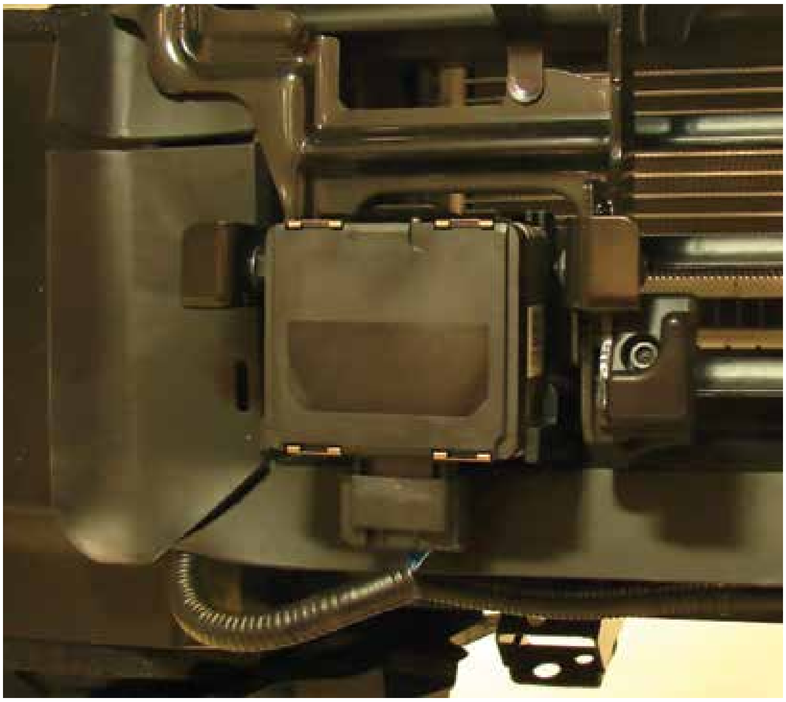
In addition to the ability to maintain a preferred buffer distance from the vehicle ahead, millimeter wave radar gives Nissan vehicles another uncommon advantage. Millimeter wave radar functions somewhat like the technology used by airport scanners to detect if someone is hiding anything dangerous under their clothing.

The sensor transmits high-frequency radio waves around and through the vehicle ahead to monitor the preceding vehicle. Called Predictive Forward Collision Warning (PFCW)[5], the system calculates both the distance and relative velocity of the second vehicle ahead, to determine if it is slowing at a rate that could present a collision risk. It then sends the data to the ICC[1] software, which can generate an alert for the driver, if necessary.

If the driver does not apply the brakes, the Forward Emergency Braking (FEB)[5] system sends a request for immediate braking through

The Intelligent Cruise Control (ICC)[1] sensor sends radar waves out in front of the vehicle and uses the bounce back time to determine distance and velocity relative to the vehicle ahead.

the Advanced Driver Assistance System (ADAS) control module to the anti-lock braking system. The ABS actuator automatically applies braking force to bring the vehicle to a stop.



ICC[1] sensor alignment is mandatory after a repair that affects the sensor or its mounting bracket. The hex head screw to the right of the square sensor is used to adjust sensor alignment.

ICC[1] Sensor Calibration

ICC[1] sensor alignment is critical to proper operation of the ICC[1], FEB[3] and PFCW[4] functions. If either system is not working properly, the ICC[1] sensor may need realigning to make sure it is aiming in the proper direction. The ICC[1] must also be aligned whenever the sensor is removed and reinstalled or replaced. Prior to alignment, perform a four-wheel alignment to ensure that the vehicle has the proper thrust angle.

Accurate alignment requires use of an ICC[1] target board, wheel adapter, laser assembly, and that the stationary target is properly positioned. Refer to the ESM for detailed setup procedures.

Note that in order to adjust the ICC sensor vertically, you must follow the ESM, which uses target boards and the CONSULT III plus to perform vertical alignment.

When you have completed all of the calibration steps, perform an ICC[1] system action test to make sure the system operates normally. Refer to the proper service manual for test procedure.

Note that Intelligent Cruise

Side radar sensors at the rear corners of the vehicle provide information to the Blind Spot Warning (BSW)[2] and Rear Cross Traffic Avoidance (RCTA)[7] control modules about the distance from any objects behind or in the side blind spot areas.

Control[1] is intended for use primarily on straight, dry, level roads with light traffic. Curved roads, heavily congested highways, heavy rain, fog, or icy roads are all conditions that may interfere with the ICC[1] system's ability to accurately control vehicle following distance. Additionally, a heavy load in the back of the vehicle may alter where the sensor is pointed, reducing its accuracy.


Side camera


Rear camera

Front camera


The Around View Monitor (AVM)[3] system uses a front camera in the Nissan logo on the front grille, cameras in each side mirror, and a rear camera above the license plate area to provide the driver with a 360° view of the immediate area around the vehicle.

360° Camera Vision

To capture real-time views of all areas around the vehicle, the Around View Monitor (AVM)[3] utilizes four cameras – one each for the front, rear, left and right sides. The four cameras send data to the AVM[3] system. The AVM[3] control unit also contains processing logic called Moving Object Detection (MOD)[4] that can analyze camera images and determine if a moving object is present in any of the four camera coverage areas. The AVM[3] control module sends images from the exterior cameras to an in-dash monitor, and alerts the driver with visual and audible warnings of a potential hazard.

If a camera or AVM[3] control unit must be replaced, a variety of procedures must be followed to reset and calibrate the new component. Even if you are


Rear wheel


Front wheel

ICC[1] sensor alignment requires use of a wheel-mounted laser assembly and target board at the front wheel, plus a stationary target at the rear wheel. Refer to the service manual for the specific model to obtain detailed setup procedures.

only removing or replacing the front grille, door mirror, or other body components to which a camera is mounted, you must re-calibrate the camera.

There are different calibration steps for each of the four cameras. There are also instructions to fine-tune how the in-dash monitor displays the different data types, including birds-eye view, rear wide-angle view, forward predictive travel view, and others. Refer to the Work Support program in the CONSULT III plus for step-by-step instructions applicable to the device you are replacing.

Nissan engineers have combined powerful radar and camera technologies with sophisticated software and process algorithms for control modules. The result is a vehicle featuring technology that can help minimize collision risk, even if the driver is less than attentive to traffic conditions. For future driving peace of mind and service provider liability purposes, collision repair technicians must be nothing less than 100% attentive to safety technology restoration.

Safety Systems Overview

Safety System	Description
Intelligent Cruise Control (ICC)[1]	Uses a front radar sensor to determine distance between the vehicle and the vehicle ahead. Automatically applies throttle or braking to maintain the user-selected distance during cruise control.
Blind Spot Warning (BSW)[2]	Uses side radar sensors to detect the presence of vehicles in adjacent lanes, and warns the driver with visual and audible alarms.
Around View Monitor (AVM)[3]	Uses four cameras around the vehicle to display 360° of vehicle surroundings on the A/V monitor. Combined with MOD[4] to provide on-screen warning information.
Moving Object Detection (MOD)[4]	Detects and warns if moving objects are present around the vehicle exterior. MOD[4] is a sub-function of the AVM[3] system.
Forward Emergency Braking (FEB)[5]	While PFCW[4] is a warning system, FEB[3] uses the same front radar data to decide whether to intervene on behalf of the driver. If the FEB[3] system determines that braking is necessary to avoid a collision, the system cuts throttle and applies the brakes at a rate needed to safely stop the vehicle.
Predictive Forward Collision Warning (PFCW)[6]	Uses the front radar sensor to determine if the distance between the vehicle and the vehicle ahead is not sufficient. Based on relative speed and closing distance, the system alerts the driver with visual and audible warnings.
Rear Cross Traffic Alert (RCTA)[7]	When in reverse, the system uses the side radar sensors to detect the presence of vehicles crossing in the intended path of the vehicle. The system alerts the driver with visual and audible warnings.

1. *ICC: Intelligent Cruise Control is not a collision avoidance system or warning device. Designed to use limited braking. Failure to apply the brakes could result in an accident.*
2. *BSW: Blind Spot Warning is not a substitute for proper lane change procedures. The system will not prevent contact with other vehicles or accidents. It may not detect every vehicle or object around you.*
3. *AVM: Parking aid/convenience feature. Cannot completely eliminate blind spots. May not detect every object and does not warn of moving objects. Always check surroundings and turn to look behind you before moving vehicle.*
4. *MOD cannot completely eliminate blind spots and may not detect every object. MOD operates at vehicle speeds below 5 mph. Always check surroundings and turn to look behind you before moving vehicle.*
5. *FEB cannot prevent accidents due to carelessness or dangerous driving techniques. It may not provide warning or braking in certain conditions. Speed limitations apply.*
6. *PFCW is intended to warn you before a collision occurs; it cannot prevent a collision. Speed & other limitations apply. See owner's manual for details.*
7. *RCTA: Not a substitute for proper backing procedures. May not detect all moving vehicles. Speed and other limitations apply. See owner's manual for details.*

Nissan Technical Service Bulletins to help make diagnosing and servicing Nissan vehicles a little easier.

Title: 2002-2003 Maxima and Altima with VQ35 Engine; Rattle Noise When Started Cold

TSB: NTB03-060a

Applied Vehicles: 2003-2003 Altima and Maxima with VQ35DE Engine

The engine in an applied vehicle makes a rattle noise for about 1 second when started cold.

Determine if the noise is coming from the left or right side VTC (Valve Timing Control) sprocket:

- Do not start or run the engine for at least 4 hours (cold-soak). Overnight cold soak is preferred.
- Have one person start the engine while a second person is near the front of the engine to listen for the noise.
- Listen around the VTC sprocket areas. NOTE: The incident noise will only last for about 1 second.

Replace the VTC sprocket that is making noise:

- Refer to the appropriate Service Manual, Section EM, for VTC sprocket replacement procedures.
- A very small amount of noise from the new VTC sprocket during a cold start is considered normal and acceptable.

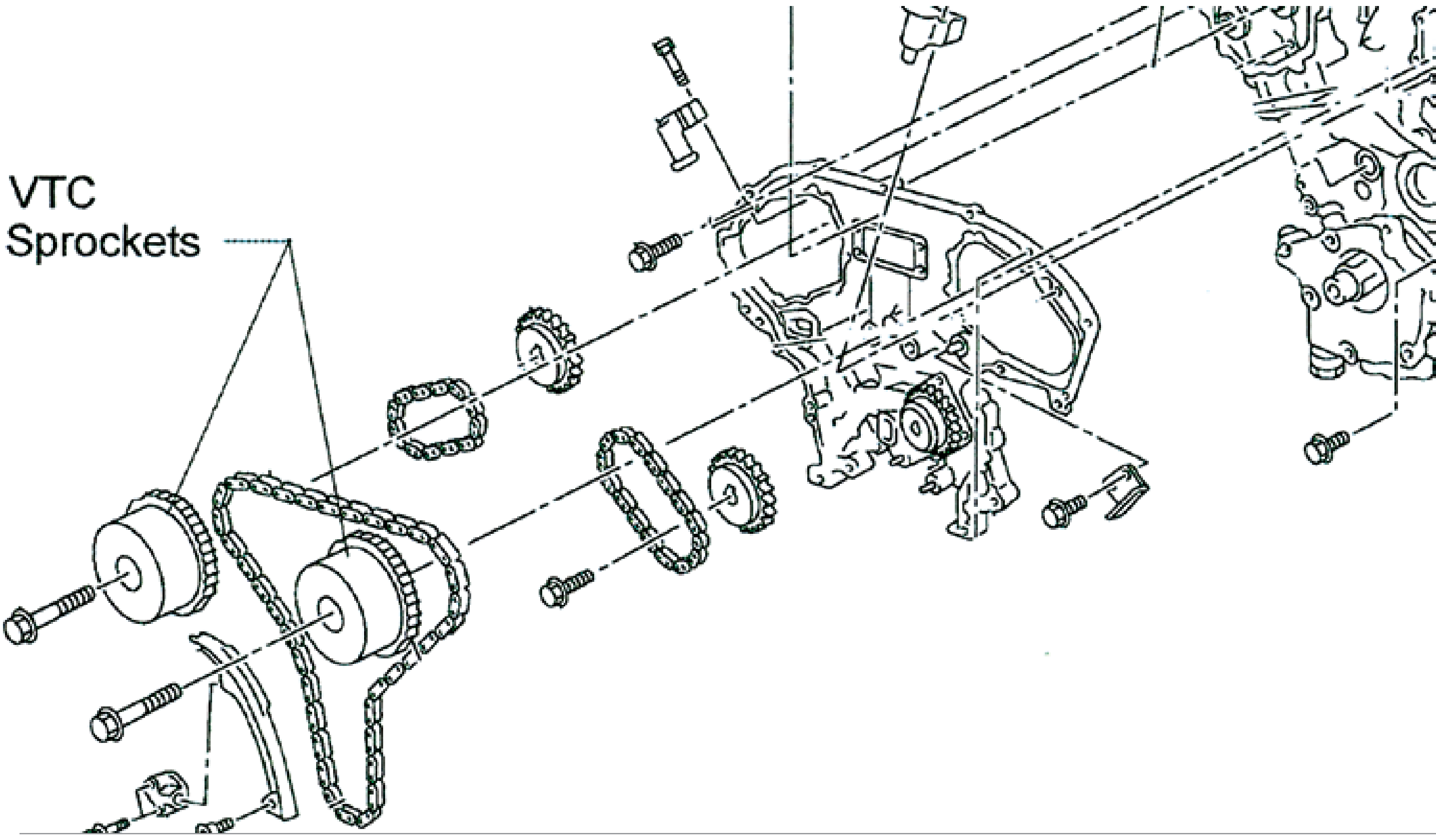
Title: Intelligent Key Warning Lamp On, With DTC B2190

TSB: NTB13-015a

Applied Vehicles: All Nissan models equipped with a Key-Slot for an Intelligent Key.

A DTC B2190 (NATS ANTENNA AMP) can be stored for the following reasons:

1. Something other than an Intelligent Key is inserted into the Key-Slot.
2. There is an Intelligent Key issue.



3. There is a wiring issue between the Key-Slot and the BCM.
4. There is a Key-Slot issue.

If the problem is due to numbers 1 or 2 above, it will not erase until a known good registered Intelligent Key is inserted into the Key-Slot and diagnostic procedures are followed using a CONSULT III plus.

For problems due to numbers 3 and 4 above, further diagnostic service and is required. Refer to the model-specific manual for information.

Title: Signal Tech II Diagnostic Tool

TSB: NTB10-048b

Applied Vehicles: All Nissan models

This Technical Service Bulletin describes the availability and uses for the Signal Tech II Diagnostic Tool.

The Tire Pressure Monitor System/Intelligent Key Tester (Special Tool J-50190) is used to read tire pressure sensor IDs and PSI, connect to OBDII, read and compare, register IDs and reset control module, check signal strength of Intelligent Key and other vehicle components.

The Signal Tech II will quickly:

- Activate and display TPMS Sensor IDs.
- Display tire pressure reported by the TPMS sensor.

Signal Tech II Diagnostic Tool

- Read TPMS Diagnostic Trouble Codes (DTCs) and register TPMS IDs.
- Store and print reports for warrantable repairs.
- Check Intelligent Key relative signal strength.
- Confirm vehicle Intelligent Key antenna relative signal strength output.
- Read Engine DTCs.

Periodic updates for the Signal Tech II are available and strongly recommended for maximum accuracy and efficiency.

The Signal Tech II is available through the Nissan Tech-Mate Tool & Equipment Program website which can be accessed at www.nissan-techinfo.com.

Title: Electronic Control Unit Damage Can Result from Improper Battery Connection

TSB: NTB09-030

Applied Vehicles: All Nissan models

The 12-volt battery is an important part of the vehicle electrical system and is required to stay connected when the engine is running.

To prevent damage to the vehicle's electronic components (ECM, TCM, BCM, etc.), follow these instructions:

- Make sure the ignition is OFF during battery service and replacement.
- Do not disconnect or connect any battery cables while the ignition switch is turned ON.
- When disconnecting a battery, always disconnect the negative cable first. When connecting a battery, always connect the positive cable first.
- Do not leave a battery cable loose. Tighten battery cables immediately after attachment.
- If a battery cable is loose, do not operate any electrical loads. This includes turning the ignition ON, starting the engine, operating accessories such as the A/C system, power seats, interior lights, exterior lights, etc.
- When "jump starting" or "boosting" a battery – be careful. Don't accidentally reverse the polarity of the cables.

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