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VOLUME 4 | NUMBER 1 | **Spring/Summer 2012**

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Group Publisher
Christopher M. Ayers Jr.
cayers@automotivedatamedia.com

Editorial Director
Bob Freudenberger
bfreud@automotivedatamedia.com

Contributing Editors
Kerry Jonsson
kjonsson@automotivedatamedia.com

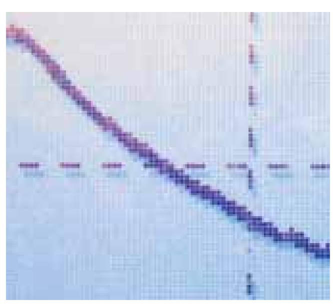
Phil Fournier
pfournier@automotivedatamedia.com

Art Director
Christopher M. Ayers III
ayersc3@automotivedatamedia.com

Volkswagen Group of America Senior Project Manager
TJ Dolliver
thomas.dolliver@vw.com

Volkswagen Group of America Project Manager
Misti Murphey
misti.murphey@vw.com

Editorial and Circulation Offices:
134 B River Rd.
Montague, NJ 07827
Phone: 330.620.3929
www.automotivedatamedia.com



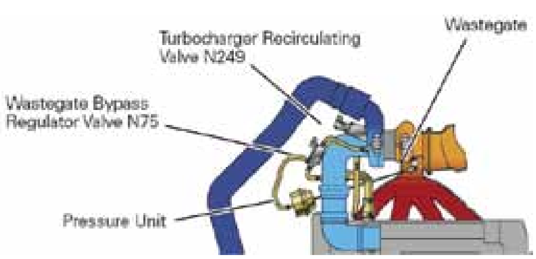
Breathe Deep

Turbocharging is a way to produce more power when needed, but still get small-displacement fuel economy. With the best of both worlds it's becoming popular again. Let's learn how to keep up the boost!

Turbocharging has been around for over a century -- the idea goes back to the birth of the automobile. The supercharger was awarded a patent in 1885 and the turbocharger was patented in 1905. It was used in some cars, such as the Corvair, in the early 1960s, then fell out of popularity until interest revived in the late 1970s. Volkswagen has long seen the wisdom and efficiencies of getting big horsepower out of a small engine, so has been in the forefront of the recent turbo revival.

Priming the Pump

Picture an engine as an air pump. The more air you can pump through the engine the more power you will make. But the old saying, "There's no substitute for cubic inches," doesn't necessarily apply when you factor in pressurizing the intake tract with a turbocharger. Volkswagen has been using turbos on its diesel engines for many years, but in 1998 put a 1.8L turbo gasoline engine in a Passat sedan and dubbed it the AEB engine. In 1999, the New Beetle got the 1.8 liter APH turbo, and in 2000 the Jetta, Golf, and GTI were next with the turbo option. In 2005, the 2.0L TFSI® engine was being phased into most Volkswagen models. As a result, there are quite a few turbo models that are going to eventually need work. So, you'll need a solid understanding of how turbo work and what special problems crop up with wear and tear. Due to the nature of turbocharging, there are differences in diagnosing drivability troubles, and some other, different symptoms that may occur. Be prepared.



Here are the vacuum lines of the Waste-gate Bypass Regulator Valve. As you can see under boost, pressurized air is sent through the solenoid to the waste-gate actuator. When too much boost is made the actuator pushes open the waste-gate and exhaust gases bypass the turbine.

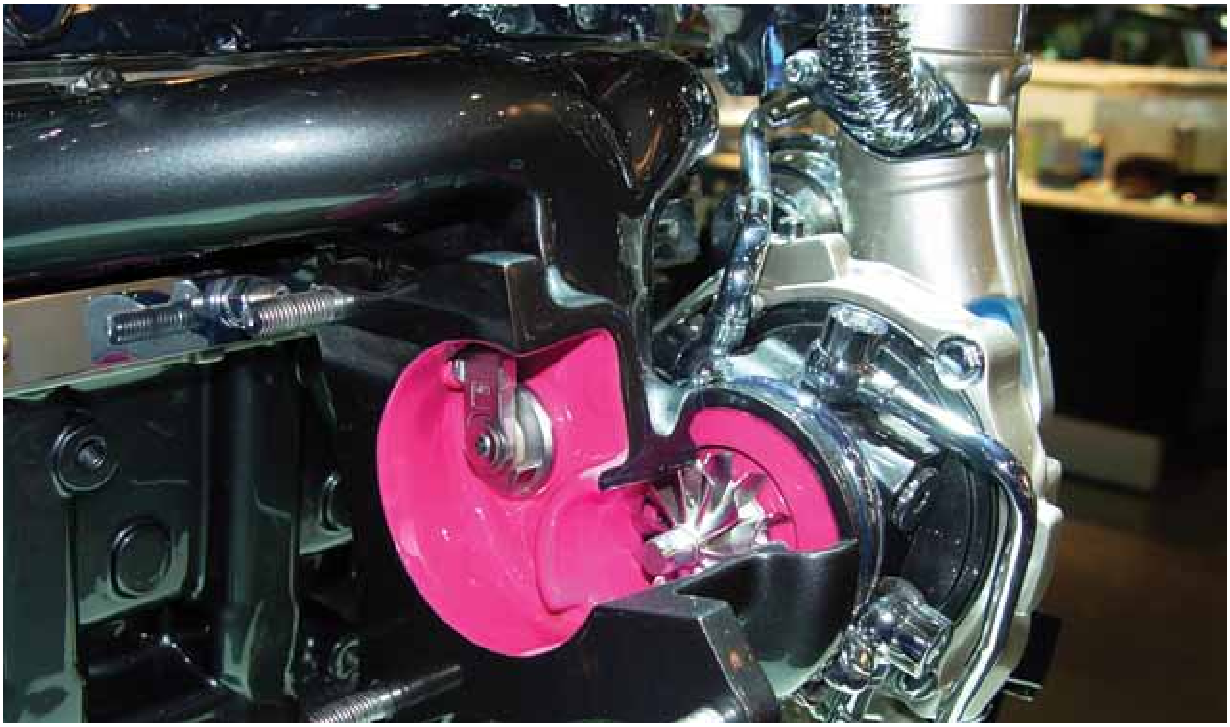
The Basics

Turbocharging is actually a form of supercharging. Supercharging simply means intake air is pressurized and forced into the engine. A supercharger uses the mechanical energy of the crankshaft to turn a high-volume air pump, the output of which is ducted to the intake manifold. This can provide a significant horsepower gain, but some of this horsepower is lost in running the pump. A turbocharger, on the other hand, uses the exiting waste exhaust energy to spin a turbine shaft at high rpm. This shaft is attached to an impeller that compresses the intake air. Since more air is being pumped into and out of the engine, more power is produced than if the same engine were what's called "normally aspirated," meaning it relies on atmospheric pressure alone to fill its cylinders. Since a turbo relies on exiting exhaust to spin the turbine, it is more effective at high rpm where there is plenty of exhaust gas. At low rpm, a turbo is not spinning as fast so it pumps less air. As the engine is accelerated, you may notice what is referred to "turbo lag" -- the time it takes for the turbine to "spool up" and start producing significant boost.

Boost Control

Engineers have come up with ways to help reduce turbo lag. A smaller turbo can be fitted, which will spool up faster, but will add less ultimate horsepower than a larger one. To help reduce the lag effect, yet still get maximum horsepower, Volkswagen has come up with an optimal design. The turbo is designed to always produce enough boost throughout the rpm range.

There is the possibility that a turbocharged engine can go into "over-boost!" This is very dangerous for an engine's internals because too much compression is created in the combustion chamber. Just as in a diesel engine (with very high compression), the fuel/air mixture may ignite from the pressure alone, and not when the spark fires it. This is known as pre-ignition or detonation and can cause severe engine damage as well as poor engine performance. So, the amount of boost in the intake must be



The exhaust exiting the engine spins the exhaust side of the turbo. If the boost pressure becomes excessive, the waste-gate shown here is forced open. This allows gasses to bypass the impeller and exit through the exhaust system.

accurately controlled. In the event the engine is making too much boost, a waste-gate bypass regulator valve allows the excessive pressure to open the waste-gate actuator.

As the pressure builds in this actuator, it pushes on a rod that is connected to a flap on the exhaust side of the turbo. This flap opens an exhaust "bypass" valve allowing the gasses to bypass the turbine and exit directly out of the exhaust. By bypassing the turbine, the impeller is now spinning at a slower, safer speed. The waste-gate bypass regulator valve is always open allowing boost pressure to actuate the waste-gate and produce less boost. If the Motronic control unit wants to increase boost, such as during rapid acceleration, it can pulse the solenoid closed and restrict boost pressure to the waste-gate. This keeps the waste-gate closed longer and exhaust pressure continues to speed up the turbine, producing more boost.

You are looking at the inlet side of the turbo assembly. The black valve at the bottom is the Recirculating or Divert Air valve. Under deceleration, this valve is commanded open by the PCM and any boost is redirected to the intake pipe of the turbo. The valve is closed again under acceleration.

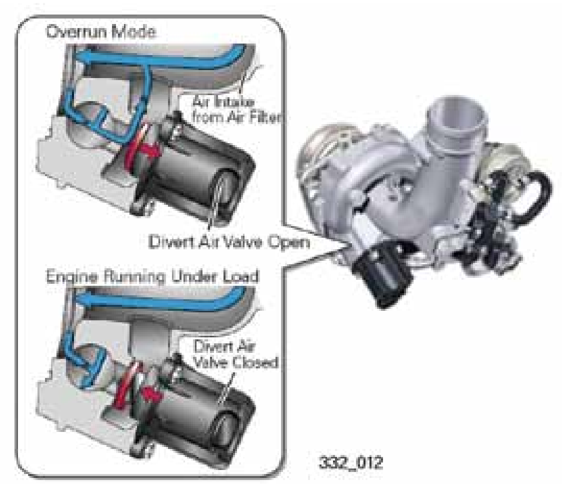
Lag Drag

While under hard acceleration, maximum boost is produced. If the driver suddenly gets off the throttle, backpressure increases in the exhaust side of the turbo. This backpressure also serves to reduce the output of the turbo by slowing down the impeller. If the driver wants to accelerate again, he or she will have to wait for boost pressure to build up, once again experiencing turbo-lag. To prevent this from happening, Volkswagen AXX-series engines have a Charge Pressure Bypass Valve. This valve redirects the pressurized air coming out of the turbo back into the intake air stream before the turbo. The turbo is still spinning fast enough to produce boost, it is just directed to the low pressure air intake side of the turbo. This allows the turbine to keep its speed up in case the throttle is applied rapidly again and boost needs to be made quickly. The bypass valve is held open by manifold vacuum at idle and under rapid deceleration. Under boost, the valve closes keeping pressurized air in the intake system. When the driver decelerates the manifold vacuum opens the valve again allowing pressurized air to recycle back into the inlet side of the turbo's intake system. On early AXX engines, a solenoid mounted on the intake tube could block the boost pressure that is being directed to the bypass valve if the PCM commands it.

On later 2.0 liter TFSI® turbo engines, the bypass valve is built right into the intake side of the turbo and is called the Turbocharging Recirculating Valve, but is sometimes referred to as the Divert Air Valve. The principle is the same just with a few less components. The PCM controls the recirculating valve electrically. It grounds the valve under deceleration to open it, and releases the ground to allow it to close. This valve opens and returns the pressurized air to the intake stream.

Troubleshooting

Turbocharged engines are also just engines underneath, and can have the same drivability symptoms as any other vehicle. Proper valve timing, fuel pressure and exhaust flow still need



Here's the operation of the Recirculating or Divert Air Valve. Under load, the valve is closed directing pressurized air into the engine intake. While decelerating, the valve is opened and pressure is recycled back into the intake of the turbo. This helps reduce turbo lag when re-accelerating.

to be verified. If you feel you cannot tell if it is a turbo-related problem, then simply eliminate the turbocharger. Manually open the waste-gate. You should operate the waste-gate anyway just to verify that it is not sticking and moves freely. The engine should now perform as a normally-aspirated engine, it just will not make as much power. If you still have a hesitation or stumble, the cause is not in the turbo system. Remember, a seized turbo can result in an exhaust system blockage that will restrict air flow through the engine. You should always perform a visual inspection of the air intake hoses, clamps, and, of course, the turbo itself. Make sure the shaft spins freely and you do not feel any play or resistance. Turbos can spin upwards of 100,000 rpm, so there is no room for error.

When diagnosing a drivability problem with a turbo engine, realize that there are a few more components in the system so there are also a few more tests to be performed. For instance, you should always measure manifold vacuum to verify that the mechanical side of things is in order. With a normally-aspirated engine under heavy acceleration, vacuum should drop to near zero as the open throttle plate

If you do not have a VAG 1397, you can use a pressure gauge but you are going to have to watch the gauge while someone else drives as the highest reading will obviously not be saved. Do this test in an isolated place.

allows atmospheric pressure to enter the intake manifold. However, under acceleration a turbo should be producing pressure or boost. First "T" into a vacuum line with a pressure gauge and, either on a dynamometer or during a road test, watch how much pressure builds (on the road, it is always safer to have someone else assist you and drive the vehicle). This way you can focus your attention on reading the boost pressure gauge. If your road test involves going up a hill, that will offer an additional load that should increase boost output to maximum capacity. Limit each test run to 10 seconds. See how much boost you can make. You can also use a VAG 1397 or equivalent to measure boost pressure. You should normally see 20 to 24 psi. Any higher or lower and there may be a problem.

Lower than normal pressure means you either have a leak in the system, or you simply have a turbo that is not up to the task. Leaks can be tricky to diagnose. If the leak is present all the time, then there will also be an air leak after the Mass Air Flow sensor. This will probably also lead to fuel trim and idle control issues ("false air"). You can use a smoke machine to find the source of the leak. Volkswagen also makes available an engine leak detection spray, Part # G 001 800 A1. This spray will help you find vacuum leaks by decreasing the ignition quality of the mixture it has leaked into. You can also use a generic scan tool to perform this test. On a VAG 5052 you enter into address word 33 (aka Generic OBD II). Select "Check Measured Values," or "Live Data" and look at PIDs 06 Short-Term Fuel Correction and 12 Engine RPM. As you spray around the air intake system watch both PIDs for changes in value. The rpm should drop and the short-term fuel trim should move further away from 0%. In the past, you may have been instructed to do this test with carburetor cleaner, but it is combustible and is a dangerous fire hazard.

Losing Boost

Due to the stiffness of air intake boots, the leak may only be present under boost conditions. That is to say, as pressure builds up in the intake manifold it may force open a crack in a hose. Once the pressure has dropped, the hose reforms into its original shape and reseals itself. At idle there is not enough airflow through this cracked hose to have an effect. With little to no load on the engine at idle, it is almost impossible to generate enough boost while in park. If you are working on a 2.0 liter TFSI® (BPY) engine), you can use special service tool VAG 1687, which has an adapter that allows you to seal the intake system. You can then set the tool to .5 bar (7.35psi) and listen for leaks, use a leak detection spray, or a VAG 1842. Do not pressurize the intake system higher than .5 bar or engine damage may occur. Since at some point an intake valve is open in the engine the pressure will eventually bleed down, so don't be alarmed. Typically, if you have a boost leak the engine will run rich under the boost condition as the air is being lost, but extra fuel is still being injected. You may come up with fuel system rich codes in the computer's self-diagnostic system.

A good understanding of Volkswagen's turbo systems will help you provide faster and more accurate diagnosis. Look at the turbo's boost ability, the waste-gate and solenoid to verify you are getting the correct amount of boost. Under deceleration and idle, verify that the bypass valve system can open and close properly. Check the intake system for leaks that can alter the performance potential of the engine and you will have a satisfied customer.

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Castrol

A Failure To Communicate

While computer controls have given drivers and passengers a safer and more comfortable trip, they of course add a greater level of complexity when diagnosis is needed. Volkswagen's engineers have provided us with self-diagnostic capabilities and access to data with the VAG 5052. But what do we do when the vehicle won't communicate with us?

All the important systems are on the CANs, but what happens if they won't talk to your scan tool?

A Failure To Communicate

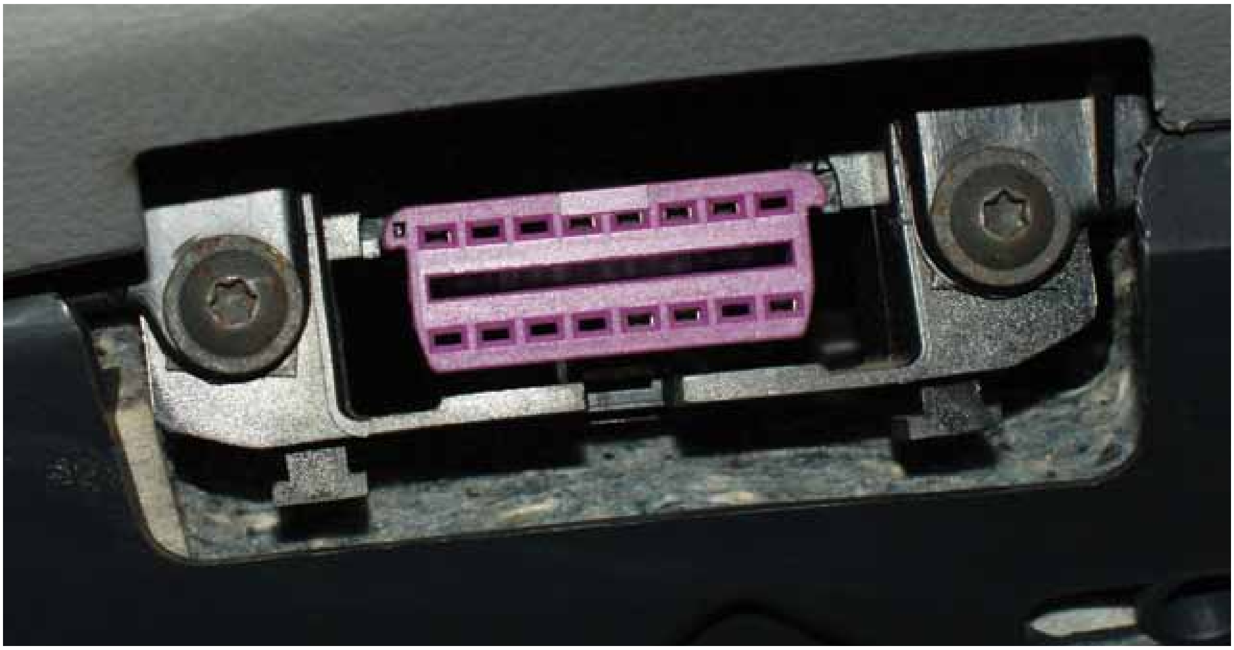
Volkswagen is always trying to build safer vehicles. Naturally, the way it achieves this is through applying the latest technology. With computers, virtually every aspect of the vehicle can be monitored and precisely controlled. It started with electronic fuel injection back in the late 1960s, which evolved into feedback/closed-loop systems a decade later that helped make engines more fuel efficient and cleaner-running. Anti-lock brakes use computer power to help monitor the speed of each wheel, and if any wheel locked up during a panic stop the electronics manage the fluid pressure to that wheel. When electronic throttle control appeared, the computer was given the authority to over-ride driver input. Transmission control units handled shifting decisions with solenoid activation instead of governor pressure in a valve body. Computer-controlled suspensions can change ride height at speed and suspension stiffness at the push of a button.

Integration

Electronic Stability Control (ESC) was one of the first concepts that integrated all these electronically-managed systems and got them to work together in harmony. Anti-lock brakes, for instance, don't only help prevent tires from skidding during a stop. Under hard acceleration, a tire may lose traction, but the ESC system can apply the brakes to that wheel to get it under control. What if, as an added measure of control, we reduce the throttle opening to cut the engine's power output?

Somehow the information that the wheel is spinning out of control needs to get to the engine management system so it can cut the throttle opening. If the engine management system had its own wheel speed sensors, you would need two different sensors on each wheel. If every control unit had its own sensors for all of its inputs, you would have a very complicated system of redundant sensors.

A signal wire could be used to provide this information from the ABS unit to the Powertrain Control Module (PCM), but there is so much information all the control units need to share. For example, the Transmission Control Module (TCM) needs vehicle speed input to determine when it should command shifts, and the instrument cluster also needs this information for the speedometer. And the TCM needs throttle-position input to determine if the transmission should kick down to a lower gear for acceleration. With all this information needing to be shared among control units, a



A scan tool communicates with the control units on the "K" and "L" lines. By scoping these lines, you can see if there is communication with digital square waves.

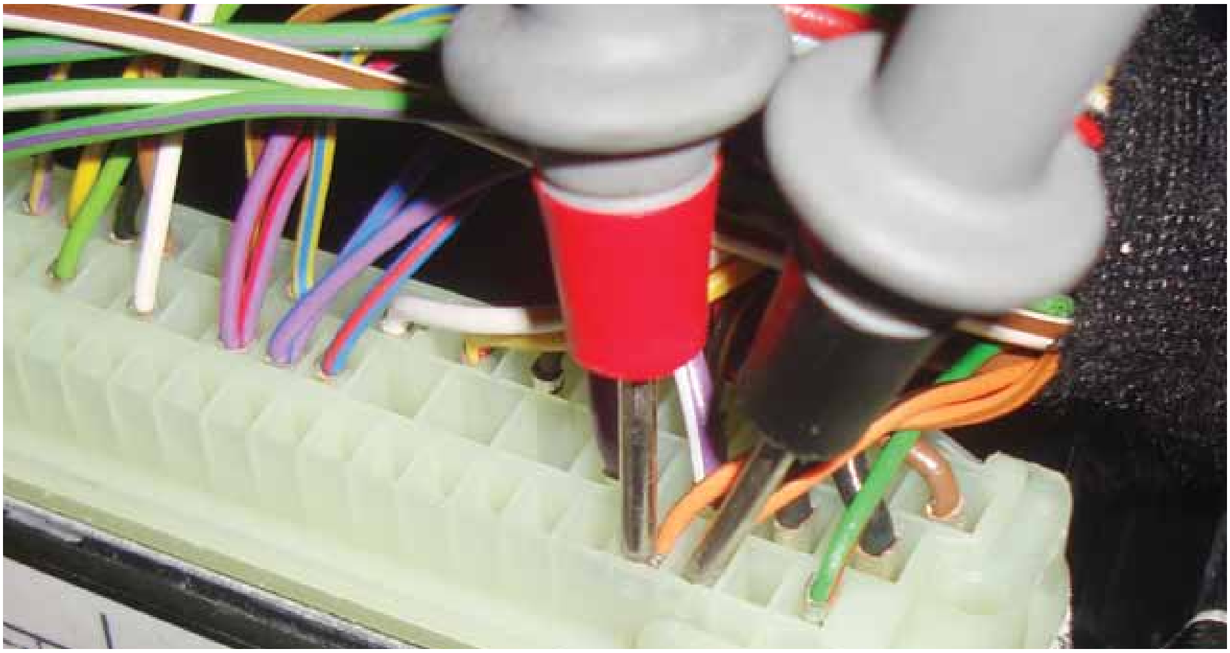
different method of inter-communcation was needed. The Controller Area Network (CAN) concept is one of the most efficient ways to accomplish this. Computers have had self-diagnostic capability for many years, but with a CAN you can read so much more information than you could by pin testing each component.

Two CANs

On most Volkswagen models, such as the Beetle, Jetta and Passat, you will find two CAN systems. One is the Powertrain CAN, and the other is the Body CAN. The former is made up of the PCM, the TCM, and the ABS, and it communicates at a staggering 500kbits per second. This high speed is necessary to respond to changing road and driving conditions. Each control unit distributes its information on a two-wire CAN bus. The two wires have redundant characteristics. They both communicate exactly the same information, but at different voltages. One wire is "CAN High." This starts off at 0 volts and switches between 0 and 5 volts. The other wire is CAN Low. This wire starts off at 5V, and alternates between 5 and 0V. The two signals mirror each other as they both carry the same information.

This redundancy is important in case one of the wires develops an open or short problem. If one CAN wire were to fail, the PCM can still communicate on the other wire. But there is another reason the CAN signals are paired: They are very low-amperage signals and electrical interference can easily disturb them. Since one signal wire is switching from high to low voltage, and at the same time the other signal wire is switching from low to high voltage (remember, they mirror each other), the electromagnetic fields cancel each other out. The wires are twisted together to enhance this property. They are protected from outside electrical interference. So, it's important to remember that if you have to repair a CAN wiring harness you must maintain the same level of interference suppression.

There are also terminating resistors in the CAN circuit, which serve to close the circuit. What does this mean to you? Well, if you have a communication problem between modules you are going to have to perform some tests to isolate the cause. The CAN circuit uses two 120-ohm terminating resistors in the powertrain CAN. If you have diagnostic trouble codes showing that you are running on a single wire, you are going



If you can access the TCM on a '98 Passat, you can measure resistance between pins #86 and #85, which are the CAN High and CAN Low wires for the powertrain CAN. This test will let you know the CAN wiring is okay.

to want to check the integrity of the CAN wiring. You can do this by simply measuring resistance between CAN High and CAN Low wires with CAN communication off. The two 120-ohm resistors wired in parallel yield a 60 ohm overall resistance. For example, you can lift the carpet on an early 1998 Passat and pull out the TCM cover. At the TCM connector you can measure resistance between pins #86 & #85. These are the CAN High and CAN Low wires. If the wiring is intact you should measure approximately 60 ohms. This is one test you can perform to check the wiring.

Protocol

All the control units on the powertrain CAN talk at 500kbits per second, but all of them cannot talk at the same time. Information would "crash" into other information and no one would understand any data. Each control unit has to follow a protocol. One control unit's messages are placed as the most important, and another's as the least important. In the case of the powertrain CAN, the ABS/EDL module's messages are given top priority. The PCM's messages are second, and the TCM's data is the lowest. This is why a tire spinning will "relax" the throttle. Maintaining control of the vehicle during the emergency situation the ABS unit is involved in is more important than brisk acceleration. This information is traveling at a high data rate, so when the tire's speed is under control the throttle will be applied again.

The Body CAN has a central control unit or module in the convenience system and individual door modules. Body features do not need to operate at a high data rate. Volkswagen's body CAN communicates at 62.5kbits per second. It still communicates with a 0 to 5 volt and 5 to 0 volt switching signal on the CAN High and CAN Low circuits. You can check the CAN wiring by measuring resistance from the central control module pins just as you can on the powertrain CAN. Another test you can perform on either CAN is to "scope" the signals. Using an oscilloscope, you can tap into the CAN lines and view the messages being sent. You will not be able to interpret the data, but you can at least see there is communication going on. Your VAG 5052 or equivalent has the necessary software needed to interpret the CAN signals.

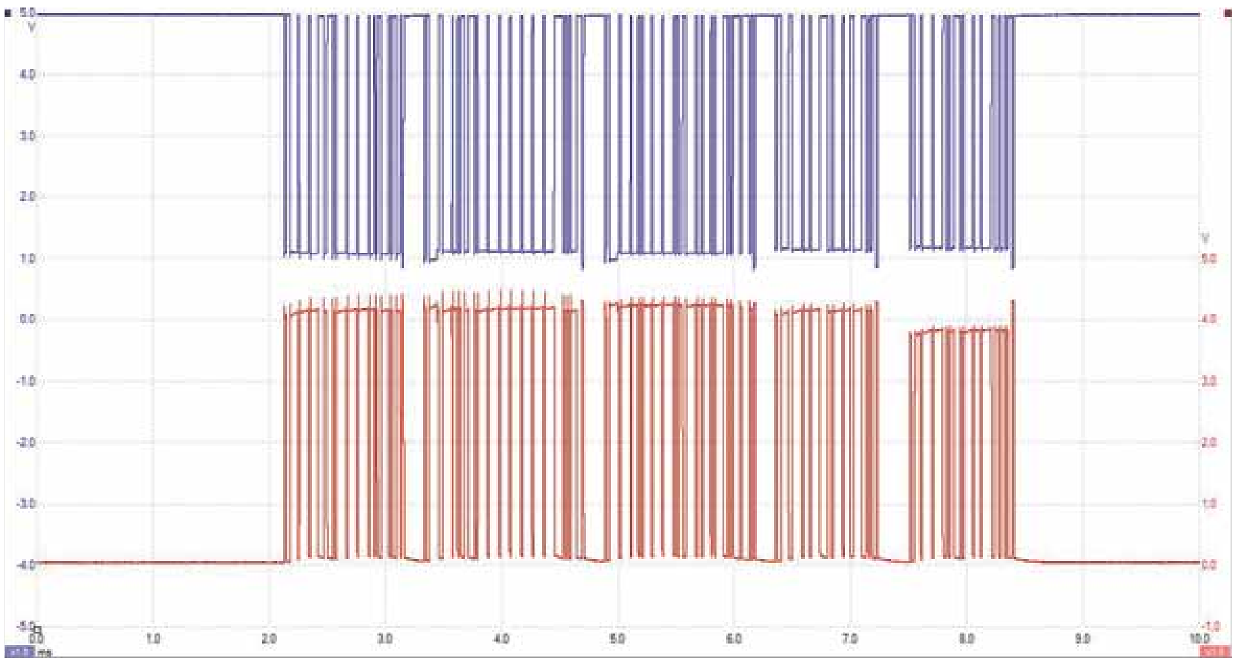
If you measure the resistance of the CAN High and Low lines, you should see approximately 60 ohms. There are two 120-ohm terminating resistors in the CAN in parallel, so that should be their combined resistance if the wiring is good.

Aftermarket radio?

Once you have determined that the CAN wiring is okay and the signals are there (wiring is not shorted to power or ground), you are still going to have to figure out why you are not able to communicate with a specific or group of modules. Components such as the radio are on the diagnostic bus. Aftermarket radios do not have the same CAN diagnostic protocol the OEM radios have. An aftermarket radio can put false electrical signals on the line and interfere with normal CAN communication. If you cannot communicate with any control unit in the vehicle, one of the first things you should do is see if an aftermarket radio is present. If so, temporarily disconnected it and see if you can then communicate with the vehicle. Leave the radio disconnected while you diagnose any other problems. You can reinstall the radio when you are done unless it is the source of the problem.

When you connect your VAG 5052 or equivalent scan tool to the vehicle, you are not always connecting to the CAN data lines. Volkswagen uses a "K" line and an "L" line as a way for scan tools to communicate with computers in its vehicles. For instance, on our 1998 Passat example with the 2.8L engine, pin #7 of the OBD II diagnostic connector is the "K" line, which connects the engine control unit, instrument

You can purchase an OBD II breakout box and monitor each pin at the diagnostic connector without having to back-probe. Pin #7 should be the "K" line, and the "L" line is terminal #15.



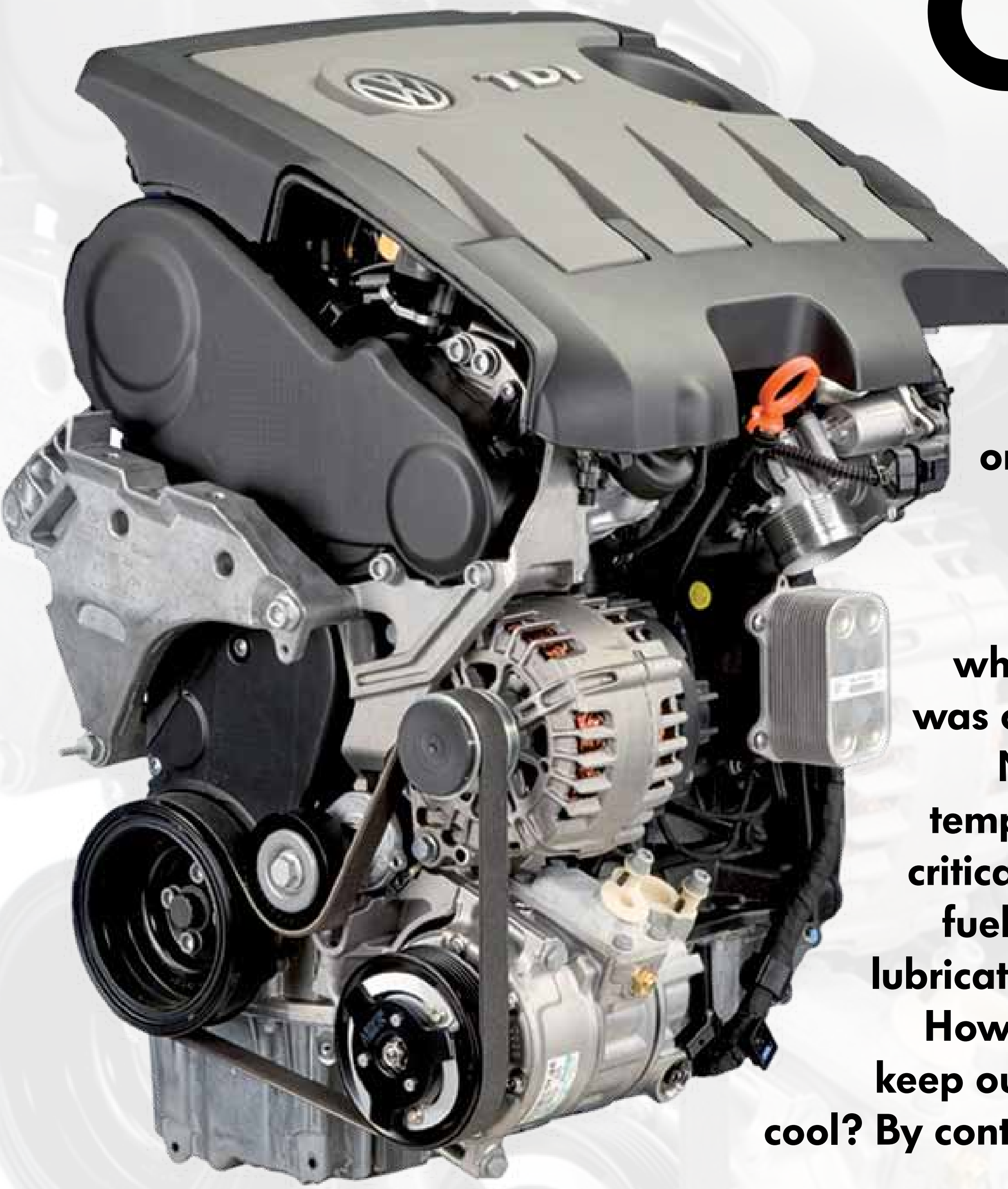
While you can look at the CAN High and CAN Low signals with an oscilloscope, you will not be able to determine the specific data without using the VAG 5052. You will simply be able to see if there is data on the line, and that you should have communication with your scan tool.

cluster, airbag control unit, etc. This line is where scan tool communication happens. On later-model Volkswagen vehicles, there is an "L" line added to the diagnostic connector. This is where the scan tool initiates communication. This way the computers on the diagnostic bus know what protocol to use. Volkswagen vehicles use either J9141-1 communication protocol, or Generic OBD II. You can once again use your oscilloscope or graphing multimeter to verify that the wires have digital square waves and are not shorted to power or ground.

Due to the design of the CAN protocol, all the information is put out on the bus. Each control unit grabs the information it needs. Therefore, if the bus is up you should have communication with each control unit. If you do not have communication with a control unit or you get corrupt information, you have probably encountered a case of a bad control unit. It is possible to have one control unit putting out incorrect communication and interfering with others, but the other control units should be able to determine which one is not speaking the same computer language as they are. Check for codes in each of the systems of that CAN and you should see at least one code in each control unit highlighting the unit that is not communicating properly. Once again, do not forget that an aftermarket radio can bring down communication with your scan tool.

Communication problems should not be a difficult diagnosis. You should become familiar with how to use an oscilloscope to monitor these wires. There are tests you can perform with a Digital Multi-Meter (DMM), such as measuring the resistance of the CAN you are on to check the wiring. You can temporarily disconnect an aftermarket radio if one is installed. Finally, you can use a VAG 5052 or equivalent to talk to each control unit and figure out which one is not talking. Keep in mind that you need to properly identify the vehicle to the scan tool. Look at the 7th and 8th digits to properly identify the chassis if you are having a problem there. All of these steps should help get your started with your diagnostic process, and that should make your life a little easier.

Cooling Off



Gone are the days when we only replaced water pumps and thermostats when a vehicle was overheating. Now, engine temperature is a critical part of the fuel control and lubrication systems. How do we help keep our customers cool? By controlling heat.

Even though modern diesels such as this TDI have relatively low heat rejection, the performance of the cooling system is still critical.

Cooling Off

You probably never thought it would come to this. In the '70s, we had to learn electronic ignition. In the '80s, we had to learn fuel injection and electronic engine management. In the '90s, we had to learn powertrain Controller Area Network (CAN) systems. Finally, in the 2000s everything was put on the network. Thankfully, we still need a mechanical engine under it all, and we still need to help keep it at optimal operating temperature. This may seem like basic information to you, but to an engineer this is a tricky proposition. Your customers drive their Volkswagen models through a wide range of operating conditions. A Touareg may take a family and lots of camping gear up steep grades to a mountain campsite. The sporty CC may cruise along at interstate speeds for hours at a time in hot weather. The Routan may function as a short-trip shuttle for soccer moms, and the versatile Jetta may do all that and have to survive hour-long traffic jams during the commute to work. An engineer must produce a cooling system capable of helping keep the engine in its ideal operating range no matter what the type of use.

Cooling passages are not as simple as they used to be. It is very easy for air to get trapped in the engine's cooling system. Volkswagen has positioned bleed screws to allow you to purge the air out of the system. This one is on the 2005 ATQ motor in a Passat. There is another one on the rear cooling pipe.

If you design a cooling system solely to keep an engine from overheating under heavy load, it will run too cool under normal operating conditions. Conversely, if the cooling system is engineered to cool enough in normal driving, the engine may overheat and its life will be shortened when under hard acceleration or heavy loads. With the implementation of OBD II, the cooling system became a monitored component. No, do not look for it as a continuous or non-continuous monitor. To control harmful exhaust emissions, the EPA and SAE want the engine to leave open loop and enter closed loop as soon as possible. The PCM has logic circuits that help monitor coolant and ambient air temperature to verify the vehicle is getting up to operating temperature as soon as possible. If it takes too long to warm up, it will be delayed going into closed loop where the oxygen sensors provide feedback for the optimal mixture. So, the cooling system does more than prolong engine life. It can also have an effect on exhaust emissions and fuel efficiency. What we have learned from these developments is that running too cold can be a problem we have to repair just like we do an engine that's running too hot.

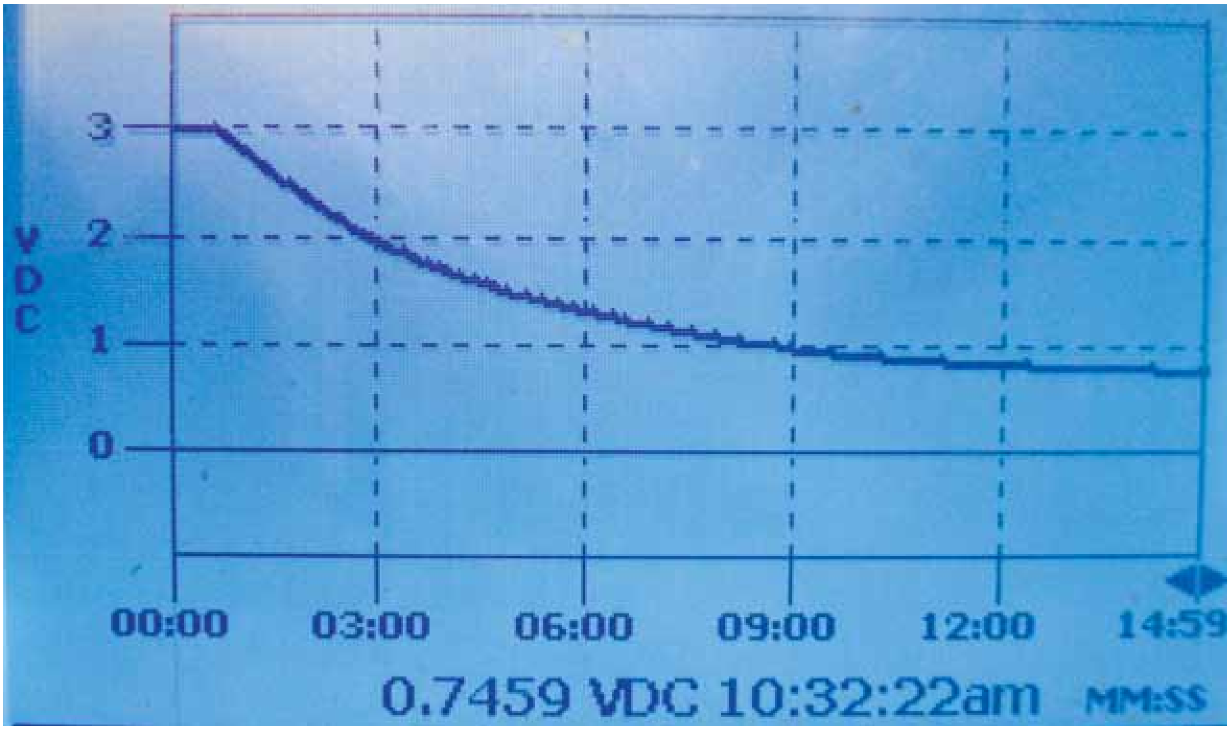
How does the engine maintain its optimal running temperature? We have a water pump to circulate the coolant, thus taking excess heat from the cylinder head and block and bringing it to the radiator to cool off. We have a thermostat to restrict flow when the engine is cold and allow more flow when the engine is hot. Radiator fans provide additional air flow over the fins. This gives the engine a much wider range of operating conditions without the dangers of under or overheating. When something goes wrong with this system, it is your job to figure out which part has failed. Most of the time this is an easy task, but not always. Subtle problems occur with some frequency. You know this if you've ever had a vehicle that had a very hard time running the OBD II monitors, but no codes were set. Or, maybe you had a vehicle that would only overheat at times, or the heater would blow cold air even with the engine running over 15 minutes. You should have a battery of tests that

Here we have a 1.8 liter engine water pump. As you can see the impeller has separated from the water pump drive shaft. This was causing an overheating condition at idle but it passed a pressure test. The impeller may slip on the shaft and cause unusual overheating symptoms.

you run to help you isolate the problem. Let's go over these tests and try to cover every part of the cooling system.

Some of these steps are very basic, but let's list them for the record. Number One on any list should be a coolant level check. All modern Volkswagen vehicles use a remote reservoir as the place to add and check fluid level. You should see level marks for both a cold engine and a hot engine, and you need to be between these two. Of course, we stress the use of Volkswagen OEM coolant available from your dealer. It meets G12 and G22 specifications and offers superior corrosion resistance for internal engine parts with none of the catastrophic problems associated with some aftermarket antifreezes. The coolant is sold pure so you will have to mix it with water (preferably distilled). A mixture of 50/50 coolant to water will give you the widest temperature range for boiling and freezing protection within typical environmental conditions. If you are unsure of the strength of the mixture, you can check it with a specific gravity tester, either the float type, or a refractometer. Volkswagen recommends changing the G12 coolant every two years as a way to remove corrosion from the system. The later G22 coolant can be used up to five years and should then be replaced.

If the coolant level is low, there is a leak somewhere. A pressure test is the logical next step. Apply pressure to the cooling system



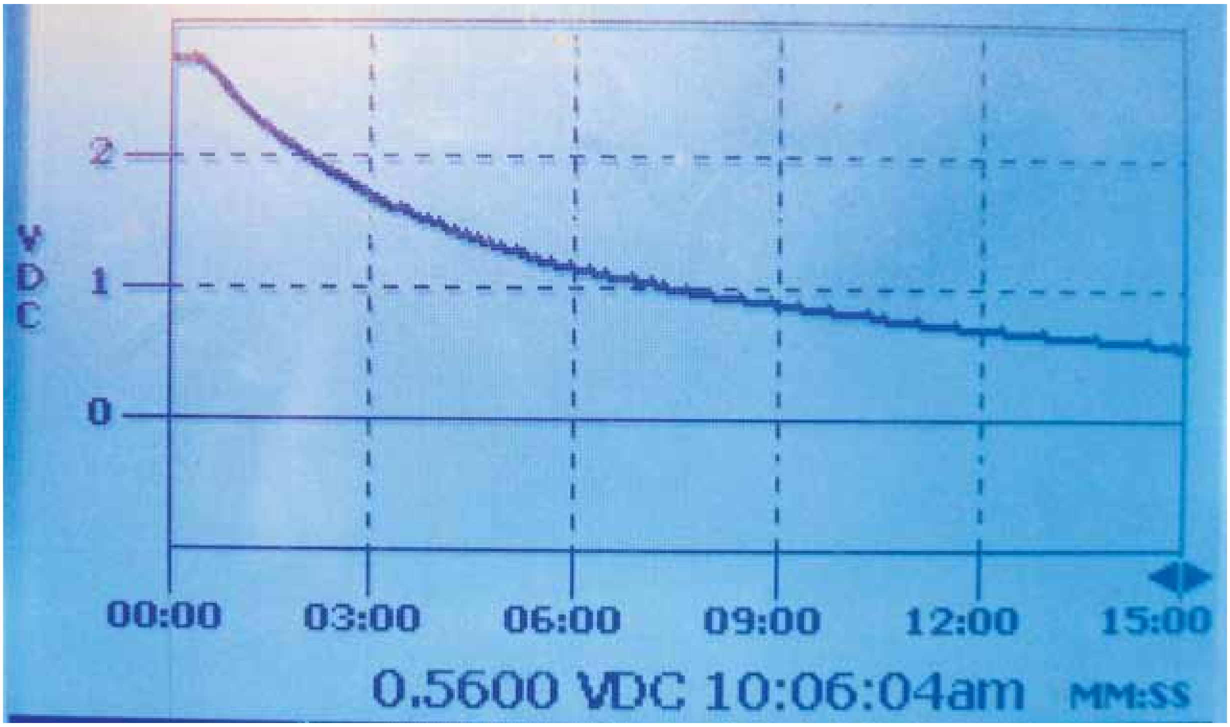
This vehicle was setting a code P0128. By monitoring the CTS signal over a 15 minute period at idle, the reading leveled off at about .75V. This indicates that the engine is not hot enough and the thermostat may be opening too early.

and examine the block, cylinder head, hoses, radiator, and water pump for coolant seeping past a gasket or seal. You may have a leak in the heater core, but this should be easily detected because it will be accompanied by the smell of antifreeze in the cabin with the heat on, and possibly dripping from the HVAC condensation drain. You can block off the two heater core lines and repeat your pressure test. There are fluorescent dyes you can add to cooling systems that will stand out brightly under a black light (the same as they do for refrigerant leaks in an A/C system).

If you do not see any external leaks, the problem could be internal. A large concern would be head gasket failure, or perhaps a cracked head or block. Coolant can leak into the engine oil, so check the oil level. A crack in the oil cooler/ oil filter housing can also leak coolant into the oil and visa versa. Head gaskets can also leak coolant into the combustion chamber. If severe enough, it can lead to a misfiring cylinder and you should pressure test the system with the engine both cold and hot.

There are several ways to check for a leaky head gasket. The most traditional are the compression and cylinder leak-down tests. Or, you can look for bubbling or pressure build-up at the radiator or reservoir cap. More accurate is the blue solution that turns green in the presence of carbon dioxide, which is a byproduct of combustion. Follow the instructions carefully, but they will probably include draining some of the coolant from the reservoir so as to allow a sufficient amount of cooling system gases to build up.

Overheating as a result of a coolant leak is a fairly straightforward repair. Find the leak and you have fixed the problem. What can you do if you have an overheating condition, but still have a full cooling system? Clearly, other factors contribute to keeping an engine cool. This is where your job becomes a little more difficult.



Watch the signal voltage of the CTS over a 15 minute period with a new thermostat and you'll see it drop to just over .5 volts. This lower voltage means the engine is running slightly hotter than before. Code P0128 no longer set on late models.

In this case, overheating may be due to an inoperative or intermittently failing radiator fan (think the coolant temperature switch, or the fan motor brushes). Another common condition is reduced coolant flow. Since radiator hoses are not transparent, you'll have to use a different means of judging flow. Coolant circulation can be blocked by a thermostat that stays partially or completely closed, corrosion blocking the radiator tubes, or a restriction in coolant passages of the block or cylinder head. What are some of the tests we can perform to isolate the problem?

Measuring temperature at various locations using a surface probe or a non-contact infrared pyrometer is the most convenient way to check coolant flow. You have to keep in mind that you are measuring the surface temperature of the cooling jacket, not that of the actual coolant itself, so it's best to compare similar surfaces. Pick several spots around the radiator and you should see the temperature decrease from the inlet toward the outlet. Since you are working near the radiator fan, you must be careful as it can come on at any time even after the engine is shut off. A delay circuit in the fan control module runs those blades for a few minutes to help keep temperatures down during the hot soak-period.

Also, there are cases where the engine may not overheat at idle, but does while being driven. By the same token, an engine can run hot at idle and cool off while driving (which suggests a fan problem). You have to decide if the problem resides with the thermostat, water pump, or fan. Generally, because of their location if you are going to invest the labor to get into the thermostat or pump you may want to do both at the same time. Thermostats can stick closed from corrosion, and water pumps impellers can separate from the shaft and stop spinning. This is why it is so important to use Volkswagen OEM G11, G12, G12+ and G12++ coolants to help increase corrosion protection and save internal cooling system parts. Looking at the normal service maintenance table, Volkswagen does not have recommended intervals for coolant replacement, but at every regular service the level and coolant concentration should be checked, and the system flushed and refilled accordingly. If there is a question of possible mixed coolants read the March 18, 2010 technical service bulletin 19-10-03 for guidance as to which coolants can safely be mixed.

Sticking closed is not the only way a thermostat can fail. If you have ever had a vehicle that had a hard time running the non-continuous monitors for your state inspection program, you know what we mean. Also, if you keep seeing a P0128, it is also an indication of this problem. When a thermostat ages, it can open prematurely, which means at a lower temperature. With coolant flowing when it's not supposed to, the engine might take a long time to reach full operating temperature. This will prevent the O2 sensor monitor from running, and without this it is very difficult to run the other monitors. There are two tests you can perform to verify the condition of the thermostat. The first is to use your VAG 5052 and evaluate your measuring blocks. Watch the coolant temperature PID for a few minutes after the vehicle is fully warmed up and at idle. If you see the reading fluctuating below the 90 deg. C. mark, you probably need to replace the thermostat. Most Volkswagen engines run at a stable 93 to 94 deg. C. at idle with no load. Another test you can perform is to monitor the signal voltage of the coolant temperature sensor over a 15 minute period. On average you should see the voltage drop to .5 volts after this warm-up at idle.

When servicing the cooling system, there are some important directions you need to follow to help ensure a proper repair. These may seem like small issues, but can have a significant impact once the job is complete. For instance, when replacing a thermostat with a Volkswagen OEM part on a 2005 Passat with the 2.8L ATQ motor, the bleed orifice needs to be at the uppermost position. This makes it much easier to allow the air to escape while filling the system. You can use a vacuum lift tool to fill the system, but Volkswagen has provided methods of bleeding that make it unnecessary. While you are filling the system, open the bleed screws. Visit www.vw.erwin.com to look up vehicle-specific service information for the location of the bleed screws. For instance, on the ATQ motor there are two bleed screws, one mounted on a front pipe just inside the driver's side cylinder head, and a second bleed on the driver's side on the rear crossover pipe. An air pocket can also get trapped in the heater core, so one of the hoses has a bleed orifice. By loosening the clamp and sliding the hose off slightly, you'll expose the orifice and allow the air out of the heater core and heater hoses.

To help prevent any air pockets from getting trapped in the heater core, this hose connection has a bleed orifice. After removing the clamp, slide the hose off until the orifice is exposed and liquid coolant starts to flow out.

With the system properly bled and new parts installed, the cooling system should be able to keep the engine cool even in heavy traffic on a hot summer day. By accomplishing this you are also helping keep your customers' tempers cool because they'll know their vehicles have been repaired with the needed Genuine Volkswagen Parts. What more could they want?

Down with the Drain

These days, a dead battery caused by a key-off drain has become one of the more difficult problems to diagnose. It could be a simple switch or relay that's stuck on, but what if it is computer-related? What if one control unit is staying awake? How are you going to troubleshoot this one?

Down with the Drain

Ask five automotive technicians how to isolate a battery drain and you'll get six different answers! Everyone uses his or her own experience as a guide to solve a problem, and, in desperate situations, someone else's. To state the obvious, the battery in a car is there to store electrical power. This energy stands by to be used when the driver turns on the ignition key. Then, there is voltage available to the starter, engine management system, and electrical accessories. This stored power is soon depleted if the charging system isn't replacing it. This is why a battery becomes drained if the key is left on.

The length of time a battery can hold its charge depends on the ambient temperature, state of charge, and life cycle of the battery. If some component in the vehicle stays on while the key is shut off, the drain on the battery may be high enough to reduce the electrical power stored in the battery to the point where the vehicle can no longer be started.

So that there's no confusion, let's define a battery drain as excessive current flow even when the vehicle is shut off. Without the engine running, the alternator can't recharge the battery. If excessive current is flowing with the ignition switch off, the battery will go dead after a short period of time. Unless you connect a battery charger overnight, the vehicle may not start the next day. This is known simply as "battery drain." Some drains are high-current and will deplete the battery in only a few hours. Other drains are much smaller and may only cause a battery to go dead in a matter of days. In order to find the source of the problem, you need a logically-ordered testing procedure. Sure, it's traditional to just put a test light or ammeter in series between a battery terminal and the cable clamp, then pull fuses and unplug components (stuck relay?) until the draw drops to nearly nothing, but there's a lot more to consider today.

When measuring current drain, make sure you are not thrown off by an accessory that the owner may not have told you about. These days there are lots of personal electronics that drivers carry around with them.

Amperage in series

There needs to be a method of measuring the drain, and another method for isolating the source. Of course, you have to measure the drain with the ignition key off, and remember that the doors have to be closed to keep the courtesy lights out. Since it is a drain on the electrical storage capacity of the battery, you need to measure amperage. Basic electrical classes should have taught you that voltage is electromotive force, the "pressure" of the electron flow, and that amperage is the amount or volume of electricity flowing. You also should have been taught that you can measure voltage in parallel, which means you simply have to ground your meter and probe for voltage with the other lead. When measuring amperage, you need to open the circuit and attach a measuring device in "series" -- in other words, all the current consumed by the circuit must go through the meter. Be careful of the capacity of your tester here. A very large short (say, over 10 amps) could exceed its amperage capacity and blow its fuse, or even burn it out. It doesn't matter whether you use the positive or negative battery post, just hook up your leads in series following the direction of current flow and the polarity of your meter.

No more test lights

Measuring amperage in older cars is fairly simple. You were probably taught to use a test light and see if it was lit. Since these cars had little in the way of electronics aboard, there should not be any appreciable current flow with the key off, at least not enough to turn on a test light. Now we have many computers on vehicles, and they may "wake up" by simply pulling on a door handle. Body control modules start communicating with one another, and they may also communicate with the powertrain CAN. With the new 2.0L TFSI® engines, the fuel pump is run once the door handle is pulled in order to prime the fuel injection system, which amounts to another considerable draw.

A low-current inductive pickup plugged into your meter can give you a ballpark figure of what kind of draw is present. Always back up your amp draw reading with a Volkswagen approved meter. You can find this and other service information at www.vw.erwin.com.

For a control unit to be prepared to look for switch inputs with the ignition key off, it needs to have some electrical power all of the time. Some accessories are kept on even after the ignition key has been shut off. This full-time voltage supply would quickly drain a battery, so the engineers gave these control units a "sleep" mode. While the unit is asleep, the electrical draw is brought down to an acceptable minimum that a battery can handle for a few weeks.

The relatively small amount of current needed to supply power to sleeping control units is often enough to make some test lights glow, especially the LED type. Therefore, this is no longer a valid test for a battery drain. You should connect a Volkswagen approved meter in series and set it to amperage so you can accurately measure the drain. The problem is that when you disconnect the battery, you may shut off the existing drain and therefore eliminate the problem you are trying to diagnose (it will almost surely come back). Also, when you reconnect the battery all the control units are going to wake up at the same time. You will then see an abnormally high amperage draw on the battery. You will have to wait for the control units to go back to sleep again to get a normal reading.

When it comes to measuring drains, there are some new tools out there that can make your life easier, but you should always back up your measurements with a Volkswagen approved DMM. Low-current inductive amp probes have been around for many years. They allow you to clip around a large-gauge wire and measure current flow without opening the circuit. This helps you avoid changing the conditions of the draw and skewing your findings.

To help make it easier to understand your readings, you should attach your test leads in the direction of current flow. Current flows from positive to negative, so your red test lead should be on the battery cable, and the black ground lead should be on the battery post.

You don't have to break the circuit

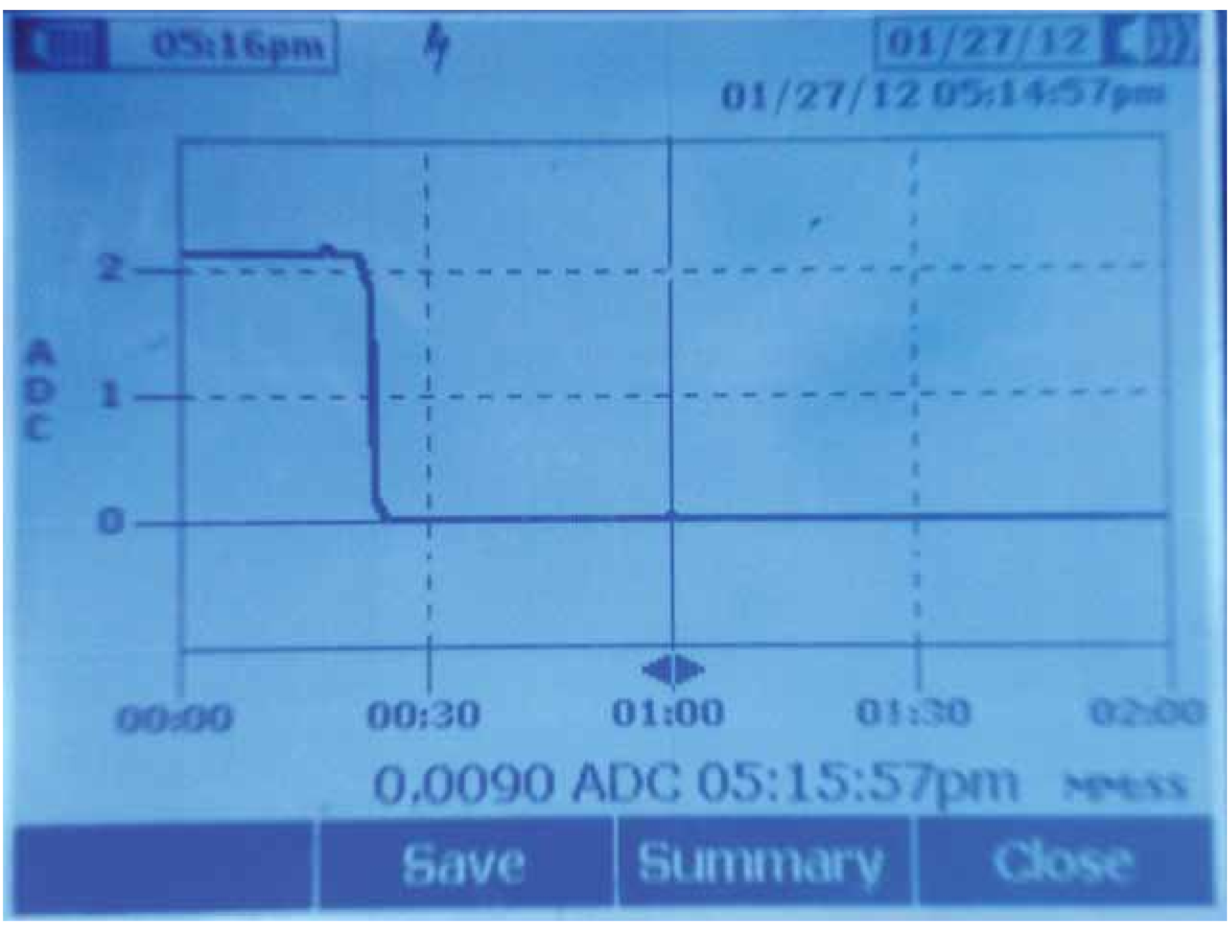
Now for practical procedures. It's not necessary to open the circuit completely when removing the battery cable clamp. When using the negative battery post, simply connect your ammeter's negative lead to the post, then the positive lead to the battery cable. Slowly lift the negative battery cable off the post being careful not to knock your test lead clamps off. This way, the current flow is never interrupted. You can measure the amperage draw with an inductive clamp on your meter, but you will have to get to the battery first. In the case of a 2004 Passat, for example, you are going to have to open the hood, and in order to do that you have to open the door. Once you pull on the handle, the door module is going to see the switch input change. It will then wake up the CAN and transmit the message to the central locking control unit. Now that the CAN is awake, all of the control units on that CAN will wake up and start drawing more current.

You will have to wait for the CAN to go back to sleep to get an accurate amp draw measurement. This may not be possible if you need to keep the door open to access fuse and relay panels. The door module will see the switch status and never allow the CAN to sleep. What can you do? You'll need to "fool" the control units into thinking the doors are closed. You can do this by "tripping" the latches in the doors and trunk while they are open. On most contemporary Volkswagen models, the power door lock actuator, door handle, and door closed switch are all built into the latch. They send signals to the control module for that door. These signals are then sent to the central locking/convenience module. Locking the latches makes the control units think that all the doors are closed and will allow the CAN to go to sleep. Of course, pulling on the door handle again will still wake up the system so don't do that. You can use an oscilloscope to monitor the CAN signals and see when they stop transmitting data. Now you now know the CAN is asleep. At this point you should have your lowest amp draw from the body control system.

Rules of thumb

Since control units absorb some current while the key is off, you should get a small reading. Under 50mA (milliamps) is an acceptable amount of current draw. If you see 100mA, expect that the battery will drain down in a few days. Upwards of 500mA and the battery may die that day. If it is easier for you to think of the draw in terms of amps, then 100mA is .1 of an ampere. If you see 0.50 amps, you know the vehicle is drawing 500mA. Simply move the decimal point three places to the right when converting amps to milliamps, or three places to the left to convert from milliamps to amps. A reading of 50mA converts to under 0.05 amps.

With those basic specs in mind and with the modules in sleep mode, you can check for a draw that may discharge the battery. If you read over 50mA, you are going to have to start isolating the source of the drain. The only way you can do this is by opening each circuit one at a time until the drain goes away.



By recording the readings and graphing them, you can see that the amp draw when the vehicle is off, but the interior light are still on, is just above two amps. At about 30 seconds, the vehicle shuts down and the battery drain is reduced to 9mA.

Since you do not know the source of the draw, you have to unplug every electrical consumer on the vehicle. Unplug each fuse one at a time and check your amp draw measurement. You should see it drop to acceptable levels when you have unplugged the power supply of the problem component. Always keep in mind that a normal draw is just below 50mA. You do not want to see the amp reading going below that since you may have taken away the key-off power supply to modules that need it to function. Another minor problem is the waking up of the CAN. If you unplug the fuse that supplies constant battery voltage (terminal 30) and plug it back in, it will wake up the CAN it is connected to and many control units will start drawing current. When removing and installing these fuses, you are going to have to wait again for the CAN to go into sleep mode.

Diagrams save time

If you do unplug the source of the draw and measure below 50mA, you can now look at a wiring diagram and unplug only the components that are powered by that fuse. This is much easier and less time-consuming than randomly unplugging components you suspect are the problem. Evaluating a wiring diagram before you start unplugging fuses should give you a plan for which fuses to pull and how to proceed.

Obviously, only focus on fuses and relays that have constant power. They will be identified as circuit #30 in the wiring diagram. In the Deutsches Industrie Norm (DIN) Volkswagen wiring diagrams, circuit #30 indicates a constant 12V supply. Terminals with the number 15 will have power only with the ignition on, and that is not when you are having your problem.

Another possible source of the trouble is the battery itself. It should be tested and, if it is found to be weak, be replaced with an OEM Volkswagen battery as aftermarket units may not meet Volkswagen specifications for reserve capacity. Most American aftermarket batteries use Cold Cranking Amps (CCA) as a benchmark for comparison, whereas most European vehicles require batteries with higher reserve capacity. Reserve capacity is a measurement of how long the charge will last in minutes with a specific load applied. Vehicles with CAN systems need higher reserve capacity to maintain system voltage when the CAN is asleep. You can help ensure that you meet these requirements with replacement batteries from your Volkswagen dealer. This final tip will give you the peace of mind of knowing that you have done the best you can for your customers, and who wouldn't want that?

Make sure all of the latches are closed on any door, hood, or trunk that is open. The open door will keep accessories on longer and will give you a false amp draw reading.

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Stratford
Curran Volkswagen, Inc.
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Macon
Butler Volkswagen, Inc.
(478) 781-7701

Marietta
Jim Ellis VW Of Marietta
(770) 955-2580

Martinez
Gerald Jones VW, Inc.
(706) 228-6900

Savannah
Vaden Volkswagen
(912) 629-6989

Snellville
Dwight Harrison Volkswagen
(678) 836-1106

Union City
Heritage Volkswagen, Inc.
(770) 774-0758

Valdosta
Pipkin's Motors, Inc.
(229) 242-9920

Hawaii

Honolulu
Honolulu Volkswagen
(808) 687-6289

Waipahu
Tony Volkswagen
(808) 680-7175

Idaho

Boise
Boise Volkswagen
(208) 377-4977

Idaho Falls
Wackerli Volkswagen
(208) 522-6030

Twin Falls
Con Paulos Volkswagen
(208) 735-3900

Illinois

Bensenville
Larry Roesch VW Of Bensenville
(630) 279-8806

Chicago
Fletcher Jones Volkswagen
(312) 628-4997

Chicago
The Autobarn City VW
(773) 794-7800

Countryside
Autobarn VW Countryside
(708) 354-6600

Crystal Lake
Anderson Volkswagen
(815) 455-4330

Dixon
Dixon Volkswagen
(815) 288-3366

Downers Grove
Pugi Volkswagen
(630) 598-9900

Evanston
The Autobarn Ltd. - VW
(847) 570-3081

Glenview
Jennings Volkswagen, Inc.
(847) 832-3075

Gurnee
Gurnee Volkswagen
(847) 855-1500

Highland Park
Volkswagen Of Highland Park
(847) 433-7900

Joliet
D'Arcy Volkswagen
(815) 741-1100

Libertyville
Liberty Import Center
(847) 680-8000

Mt. Prospect
The Autobarn VW Of Mt. Prospect
(847) 392-6300

Naperville
Bill Jacobs Volkswagen
(866) 599-2527

Normal
Sud's Volkswagen
(800) 345-1679

O'Fallon
Auffenberg Volkswagen
(618) 622-4645

Oak Lawn
Mike Haggerty VW, Inc.
(708) 425-8989

Orland Park
Volkswagen Of Orland Park
(708) 428-5000

Ottawa
Sierra Volkswagen, Inc.
(815) 433-1666

Peoria
Volkswagen Of Peoria
(309) 243-7000

Rockford
Lou Bachrodt Volkswagen
(815) 332-3001

Schaumburg
Fox Valley VW Schaumburg
(224) 353-2481

Springfield
Green On Dirksen, Ltd.
(217) 523-3643

Urbana
O'Brien Volkswagen
(800) 386-6767

West Chicago
Fox Valley Volkswagen
(630) 818-4181

Indiana

Bloomington
Royal VW Of Bloomington
(812) 332-9251

Clarksville
Clapp Volkswagen
(812) 948-1541

Evansville
D-Patrick, Inc.
(812) 473-6500

Fort Wayne
Vorderman Volkswagen
(260) 969-6065

Greenwood
Dreyer & Reinbold Of Greenwood
(317) 885-4809

Indianapolis
Falcone Volkswagen
(317) 803-8767

Indianapolis
Tom Wood Volkswagen
(317) 688-6109

Lafayette
Mike Raisor Imports
(765) 447-0808

Merrillville
Team Volkswagen
(888) 805-3689

Mishawaka
Gurley Leep Imports, Inc.
(574) 254-7130

Iowa

Cedar Falls
Dick Witham Volkswagen
(319) 277-8123

Davenport
Volkswagen Of Quad Cities
(563) 386-1511

Hiawatha
Volkswagen Of Cedar Rapids
(319) 743-6050

Iowa City
Carousel Motors
(319) 354-2550

Johnston
Lithia Volkswagen Of Des Moines
(515) 253-0333

Mason City
Schukei Volkswagen
(641) 423-5402

Kansas

Lawrence
Crown Volkswagen
(785) 843-7700

Olathe
Bud Brown Volkswagen
(913) 393-8183

Topeka
Sunflower Motors, Inc.
(785) 266-8480

Wichita
Steven Volkswagen
(316) 681-1211

Kentucky

Florence
Kerry Volkswagen
(859) 371-8191

Lexington
Don Jacobs Volkswagen
(859) 260-2621

Louisville
Bachman Volkswagen
(502) 719-7250

Louisville
Neil Huffman VW, Inc.
(502) 448-6666

Louisiana

Baton Rouge
Southpoint Volkswagen
(800) 291-0032

Bossier City
Moffitt Volkswagen, Inc.
(318) 746-2175

Lafayette
Southwest Volkswagen
(337) 456-8400

Mandeville
Northshore Volkswagen
(985) 626-1067

Metairie
Walker Volkswagen
(504) 465-2000

Maine

Auburn
Rowe Volkswagen
(207) 784-2321

Augusta
O'Connor Volkswagen
(207) 622-6336

Bangor
Darling's, Inc.
(207) 992-1550

Brunswick
Morong Brunswick
(207) 725-4323

Falmouth
Morong Falmouth VW
(207) 781-4020

Saco
Prime Volkswagen
(207) 283-2900

Waterville
Thompson Volkswagen, Inc.
(207) 873-0777

Maryland

Annapolis
Fitzgerald Automall
(410) 224-3480

Baltimore
Heritage VW Parkville
(410) 661-3400

Baltimore
Russel Volkswagen
(410) 744-2300

Bethesda
Martens Volkswagen
(301) 652-2452

Cockeysville
Volkswagen Of Hunt Valley
(410) 666-7777

College Park
DARCARS Volkswagen
(301) 441-8000

Fallston
Cook Volkswagen, LLC
(410) 877-1500

Frederick
Fitzgerald Volkswagen
(301) 696-9200

Gaithersburg
King Volkswagen
(240) 403-2300

Hagerstown
Sharrett Volkswagen
(301) 739-9999

Laurel
Ourisman VW Of Laurel
(800) 288-6985

Owings Mills
Heritage Volkswagen
(410) 581-6696

Pasadena
Antwerpen Volkswagen
(410) 760-8452

Rockville
Congressional Volkswagen
(301) 340-7668

Waldorf
Waldorf Volkswagen
(301) 843-8950

Massachusetts

Auburn
Patrick Motors
(800) 367-7222

Bedford
Minuteman Volkswagen, Inc.
(781) 275-8000

Braintree
Quirk Volkswagen
(781) 917-1537

Brockton
Paul Clark, Inc.
(508) 587-9040

Danvers
Kelly Volkswagen, Inc.
(978) 605-1555

Fall River
Mattie Imports, Inc.
(508) 678-5555

Hanover
Coastal Volkswagen
(781) 871-4600

Hyannis
Tracy Volkswagen, Inc.
(508) 775-3049

Lawrence
Commonwealth Volkswagen
(978) 687-3001

Medford
Colonial VW Of Medford
(781) 475-5208

Middleboro
Metro Volkswagen
(508) 967-2800

North Attleboro
VW Of North Attleboro, Inc.
(508) 695-7131

Norwood
Volkswagen Gallery
(800) 240-0382

Pittsfield
Flynn Volkswagen
(413) 443-4702

Tewksbury
Atamian Volkswagen, Inc.
(978) 851-4356

Watertown
Boston Volkswagen
(617) 783-1300

Wellesley
Wellesley Volkswagen, Inc.
(781) 237-3553

West Springfield
Fathers & Sons, Inc.
(413) 737-7766

Westboro
Colonial Volkswagen
(508) 366-8383

Michigan

Ann Arbor
Howard Cooper Volkswagen
(888) 822-8707

Bay City
Thelen Volkswagen
(989) 684-2980

Escanaba
Halbinsel Volkswagen, Inc.
(906) 789-9650

Farmington Hills
Suburban VW Of Farmington Hills
(248) 471-0800

Grand Rapids
Betten Imports, Inc.
(616) 301-2100

Grand Rapids
Gezon Volkswagen
(616) 361-7361

Holland
Crown Volkswagen
(616) 393-9205

Kalamazoo
Maple Hill Volkswagen
(269) 327-0816

Lansing
Williams Volkswagen, Inc.
(800) 258-2853

Livonia
Ralph Thayer Volkswagen
(734) 425-5400

Monroe
Elite Volkswagen
(734) 242-3900

Muskegon
My Auto Import Center
(231) 799-2886

Rochester Hills
Fox Volkswagen
(248) 656-0400

Sterling Heights
Vyletel Volkswagen, Inc.
(586) 276-4650

Traverse City
Traverse City Volkswagen
(231) 946-5540

Troy
Suburban Volkswagen, Inc.
(248) 649-2074

Minnesota

Albert Lea
Dave Syverson VW, Inc.
(507) 373-1438

Brainerd
Auto Import, Inc.
(218) 829-3307

Burnsville
Burnsville Volkswagen, Inc.
(952) 892-9470

Inver Grove Heights
Volkswagen Of Inver Grove
(651) 204-4607

Mankato
Mankato Volkswagen
(507) 625-5641

Rochester
Rochester Motors, LLC
(507) 282-9468

Saint Cloud
Eich Motor Company, Inc.
(320) 251-1737

Saint Louis Park
Luther West Side Volkswagen
(952) 374-0700

Saint Paul
Schmelz Countryside VW
(651) 484-0424

Mississippi

Gulfport
Volkswagen Of Gulfport
(888) 861-9626

Jackson
Volkswagen Of Jackson
(601) 987-9090

Missouri

Ballwin
The Dean Team Of Ballwin
(636) 227-6527

Gladstone
Northtowne Volkswagen
(816) 436-2275

Hazelwood
Bommarito VW Of Hazelwood
(800) 731-8270

Kansas City
Molle Volkswagen
(816) 941-9500

Kirkwood
The Dean Team Of Kirkwood
(314) 966-0303

Springfield
Volkswagen Of Springfield
(417) 886-6000

St. Louis
Suntrup Volkswagen
(314) 892-7790

St. Peters
Bommarito VW Of St. Peters
(636) 928-2300

Montana

Billings
Volkswagen Billings
(406) 655-7500

Volkswagen Dealers Listing

Bozeman
Volkswagen Of Bozeman
(406) 586-1771

Great Falls
Bennett Imports
(406) 761-3305

Whitefish
DePratu Volkswagen
(406) 863-2520

Nebraska

Lincoln
Schworer Volkswagen
(402) 435-3300

Omaha
Performance Volkswagen
(888) 502-8675

Omaha
Stan Olsen Auto Center
(402) 393-7006

Nevada

Henderson
Findlay Volkswagen
(702) 558-6600

Las Vegas
Desert Volkswagen
(702) 942-4000

Las Vegas
Findlay North Volkswagen
(702) 982-4839

Reno
Lithia Volkswagen Of Reno
(775) 851-5826

New Hampshire

Greenland
Seacoast Volkswagen, Inc.
(603) 436-6900

Keene
Noyes Volkswagen, Inc.
(888) 355-2488

Lebanon
Miller Volkswagen
(603) 448-6363

Manchester
Quirk Volkswagen NH
(603) 206-2952

Nashua
Tulley Volkswagen
(603) 888-0550

Rochester
Beranger Volkswagen, Inc.
(603) 332-6242

Tilton
Autoserv Volkswagen
(603) 286-3141

New Jersey

Bernardsville
Volkswagen Of Bernardsville
(908) 766-1600

Burlington
Burlington Volkswagen, Inc.
(609) 386-0084

Cape May Court House
Burke Brothers, Inc.
(609) 463-4903

Cherry Hill
Cherry Hill Volkswagen
(855) 524-4678

Clifton
Gensinger Motors, Inc.
(973) 778-8500

Edison
Reydel Volkswagen, Inc.
(732) 287-2444

Egg Harbor Twsp
Atlantic Volkswagen
(609) 646-8600

Englewood Cliffs
East Coast Volkswagen
(201) 568-0053

Fair Lawn
Jack Daniels Motors, Inc.
(201) 398-1209

Flemington
Flemington Volkswagen
(908) 782-2400

Freehold
Volkswagen Of Freehold
(732) 339-6910

Hamilton Square
Hamilton Volkswagen
(800) 348-8816

Linden
Linden Volkswagen
(800)343-5116

Lyndhurst
Three County VW Corp.
(201) 933-6566

Monroeville
Avis Volkswagen, Inc.
(856) 358-8103

Monroeville
Volkswagen Of Salem County
(856) 358-8103

Neptune
World Volkswagen
(732) 922-1500

Newton
Volkswagen Of Newton
(973) 383-2626

Pompton Plains
Crestmont Volkswagen
(973) 839-4832

Pompton Plains
Crestmont Volkswagen
(973) 839-6444

Princeton
Princeton Volkswagen
(609) 921-6401

Ramsey
Joe Heidt Motors, Corp.
(201) 327-2900

Rockaway
Trend Motors, Ltd.
(866) 44T-REND

Shrewsbury
Shrewsbury Volkswagen
(732) 741-8500

Somerville
Open Road VW Of Bridgewater
(908) 685-1068

Summit
Douglas Motors Corp.
(800) 672-1172

Turnersville
Prestige Volkswagen
(856) 629-9200

Union
Union Volkswagen
(908) 687-9000

Union
Union Volkswagen
(908) 766-1600

New Mexico

Albuquerque
University Volkswagen, Inc.
(505) 761-1900

Albuquerque
Uptown Volkswagen
(505) 260-5188

Las Cruces
Sisbarro Autoworld, Inc.
(575) 541-7830

Santa Fe
Volkswagen Of Santa Fe
(505) 471-7007

New York

Amherst
Northtown Volkswagen
(716) 836-4600

Amityville
Legend Autorama, Ltd.
(631) 691-7700

Binghamton
Gault Volkswagen
(607) 772-0700

Bowmansville
Schmitt's Volkswagen
(716) 683-3343

Bronx
Teddy VW Of The Bronx
(718) 920-1404

Brooklyn
Bay Ridge Volkswagen
(718) 680-1006

Brooklyn
Kings Volkswagen
(718) 646-6700

Cicero
Burdick Volkswagen
(800) 233-2002

East Rochester
Vincent Volkswagen
(585) 586-2225

Fayetteville
Romano VW Of Fayetteville
(315) 637-4668

Glenmont
Capital Cities Imported Cars, Inc.
(518) 463-3141

Great Neck
Bayside Volkswagen
(516) 482-3346

Hicksville
Platinum Volkswagen
(516) 822-4800

Huntington Station
Habberstad Volkswagen
(631) 470-8100

Huntington Station
Volkswagen Of Huntington
(631) 439-7000

Ithaca
Maguire Automotive
(607) 257-1515

Kingston
Heart Volkswagen
(845) 336-5300

Latham
Martin Nemer VW Corp.
(518) 785-5581

Lynbrook
Sunrise Volkswagen, Inc.
(516) 596-1111

Middletown
Compass Volkswagen
(845) 344-4448

Mohegan Lake
Mohegan Lake Motors, Inc.
(914) 528-2528

New York
Open Road VW Of Manhattan
(646) 358-8100

Nyack
Palisades Volkswagen
(845) 689-3536

Oneonta
Oneonta Volkswagen
(800) 351-8166

Orchard Park
Volkswagen Of Orchard Park
(716) 662-5500

Pleasantville
Prestige Imports
(914) 769-5100

Queensbury
Garvey Volkswagen, Inc.
(518) 793-3488

Rensselaer
Cooley Motors Corp.
(518) 283-2902

Riverhead
Riverhead Bay Volkswagen
(631) 727-5590

Rochester
Dorschel Volkswagen
(800) 727-8789

Rome
Volkswagen Of Rome, Inc.
(315) 337-8900

Sayville
Donaldson's, Inc.
(631) 567-8100

Schenectady
Langan Motorcar Corp.
(518) 374-2225

St. James
Smithtown Volkswagen
(631) 724-6600

Staten Island
Open Road VW Of Staten Island
(718) 513-7500

Wappingers Falls
Hudson Valley Volkswagen
(845) 298-2365

Watertown
F.X. Caprara Volkswagen
(315) 788-7400

West Islip
Atlantic Volkswagen
(631) 539-3653

Woodside
Koeppel Volkswagen, Inc.
(800) 669-0922

Yorkville
Steet Ponte Volkswagen
(315) 736-3587

North Carolina

Asheville
Volkswagen Of Asheville
(828) 232-4002

Burlington
Maxwell Volkswagen, Inc.
(336) 227-2727

Cary
Leith Volkswagen
(919) 297-1640

Charlotte
Carolina Volkswagen
(800) 489-2336

Charlotte
VW Of South Charlotte
(888) 699-4128

Durham
Southern States VW Durham
(888) 998-0075

Fayetteville
Valley Auto World, Inc.
(910) 867-7000

Goldsboro
Frema Motors, Inc.
(919) 778-1010

Greensboro
Flow Motors Of Greensboro
(336) 856-9050

Greenville
Joe Pecheles Volkswagen, Inc.
(252) 756-1135

Hickory
Paramount Automotive Group
(828) 328-4012

Huntersville
Keffer Volkswagen
(704) 766-2129

Jacksonville
National Volkswagen
(910) 938-1417

Raleigh
Leith Volkswagen Of Raleigh
(919) 828-0828

Raleigh
Southern States Imports, Inc.
(919) 863-6638

Wilmington
Bob King Volkswagen
(910) 392-3889

Winston Salem
Flow Motors Of Winston-Salem, LLC
(336) 761-3698

North Dakota

Fargo
Valley Imports, Inc.
(701) 277-1777

Ohio

Akron
Dave Walter, Inc.
(330) 434-8989

Amherst
Spitzer Volkswagen
(440) 988-4444

Bedford
Ganley VW Of Bedford
(440) 439-3444

Boardman
Volkswagen Of Boardman
(330) 726-8948

Canton
Kempthorn Volkswagen
(330) 580-4916

Cincinnati
Beechmont Volkswagen
(513) 474-4777

Cincinnati
Northland Volkswagen
(800) 521-PART

Columbus
Byers Imports, LLC
(614) 552-5490

Columbus
Hatfield Volkswagen
(614) 465-8989

Dayton
Evans Volkswagen
(937) 890 6200

Dayton
White-Allen European Auto Group
(937) 312-3022

Dublin
Midwestern Auto Group
(614) 889-2571

Fairfield
Fairfield Volkswagen
(888) 932-4734

Loveland
Kings VW Of Loveland
(513) 677-2710

Medina
Medina World Cars, Inc.
(330) 725-4901

Mentor
Classic Volkswagen
(440) 205-6504

North Olmsted
Ganley Westside Imports, Inc.
(440) 734-2000

Perrysburg
Ed Schmidt Volkswagen
(419) 874-4331

Springfield
Bill Marine Auto Center, Inc.
(937) 325-7091

Steubenville
Sunset Motors
(740) 264-1696

Willoughby Hills
Eastside Volkswagen
(440) 944-8700

Wooster
Volkswagen Of Wooster
(330) 264-1113

Youngstown
Stadium Volkswagen
(330) 726-8948

Oklahoma

Norman
Fowler Volkswagen Of Norman
(405) 310-3700

Oklahoma City
Cable Volkswagen
(405) 787-0095

Tulsa
Volkswagen Tulsa, LLC
(918) 712-8989

Oregon

Beaverton
Herzog Meier Volkswagen
(503) 372-3298

Bend
Carrera Motors
(541) 382-1711

Eugene
Sheppard Motors
(541) 343-8811

Gladstone
Armstrong Volkswagen
(503) 656-1215

Mcminnville
Mac Volkswagen, Inc.
(503) 472-4657

Medford
Lithia Volkswagen
(541) 774-7500

Portland
Dick Hannah's VW Of Portland
(360) 256-5000

Salem
Volkswagen Of Salem
(503) 581-1421

Pennsylvania

Allentown
Faulkner-Ciocca Volkswagen
(800) 554-7165

Ardmore
Piazza VW Of Ardmore
(601) 642-4275

Butler
Mikan Volkswagen
(724) 287-4763

Chadds Ford
Garnet Volkswagen
(610) 361-0624

Colmar
North Penn Imports, Inc.
(800) 887-2111

Danville
Jack Metzer Volkswagen
(570) 275-2212

Devon
Fred Beans Volkswagen
(610) 254-9637

Downingtown
Jeff D'Ambrosio Volkswagen
(610) 873-2400

Du Bois
Central Volkswagen, Inc.
(814) 583-5121

Easton
Young Volkswagen, Inc.
(610) 991-9140

Volkswagen Dealers Listing

Edgemont
Y B H Sales & Service, Inc.
(610) 356-3493

Erie
New Motors Inc.
(800) 352-1052

Feasterville
Colonial Volkswagen, Inc.
(215) 355-8856

Greensburg
Sendell Motors, Inc.
(724) 837-9500

Harrisburg
Sutliff Volkswagen
(717) 231-1560

Hollidaysburg
Fiore Volkswagen
(814) 695-5533

Lancaster
Autohaus Lancaster, Inc.
(717) 299-0325

Langhorne
Volkswagen Of Langhorne
(800) 298-4300

Larksville
Wyoming Valley Motors
(570) 288-7411

Lebanon
H.A. Boyd, Inc.
(717) 273-9385

Leesport
Vision Volkswagen
(610) 777-6500

McMurray
Three Rivers Volkswagen
(724) 941-6100

Mechanicsburg
Cumberland Valley Motors
(717) 697-9478

Monroeville
Day Volkswagen
(724) 327-4950

Montoursville
Fairfield Volkswagen
(570) 368-8121

Moon Township
Day Apollo, Inc.
(412) 264-7171

New Kensington
Hillcrest Volkswagen, Inc.
(724) 335-9847

Norristown
Jim Wynn Volkswagen, Inc.
(610) 539-4622

Orwigsburg
J. Bertolet, Inc.
(570) 366-0501

Philadelphia
Chapman Volkswagen
(888) 376-5711

Pittsburgh
Cochran Volkswagen
(412) 245-3333

Scranton
Kelly Volkswagen
(570) 347-5656

State College
Volkswagen State College
(814)237-0368

Warrington
Thompson Volkswagen
(215) 268-6021

Wexford
Billco Motors, Inc.
(724) 940-1000

Whitehall
Gilboy Volkswagen, Inc.
(610) 434-2953

York
York Volkswagen, Inc.
(866) 893-2337

Puerto Rico

San Juan
Euroclass Motors, Inc.
(787) 782-4087

Rhode Island

East Providence
Scott Volkswagen
(401) 431-0334

Wakefield
Speedcraft Volkswagen
(401) 792-3300

West Warwick
Balise Volkswagen
(401) 822-4400

South Carolina

Columbia
McDaniels Volkswagen
(803) 786-6408

Columbia
Wray Volkswagen
(800) 424-0183

Greenville
Steve White Volkswagen
(864) 288-8300

Hardeeville
Hilton Head Volkswagen
(407) 739-9207

Mount Pleasant
Low Country Volkswagen, LLC
(843) 881-8555

Mount Pleasant
Low Country Volkswagen, LLC
(843) 881-8555

Myrtle Beach
East Coast Volkswagen
(843) 215-6500

North Charleston
Stokes Volkswagen
(843) 767-2525

Spartanburg
Vic Bailey Volkswagen
(864) 585-2492

Sumter
Goodwin Volkswagen, Inc.
(803) 469-2595

South Dakota

Rapid City
Liberty Volkswagen
(605) 718-1000

Sioux Falls
Graham Automotive
(605) 336-3655

Tennessee

Bristol
Wallace Volkswagen
(423) 764-1145

Chattanooga
Village VW Of Chattanooga
(423) 855-4981

Clarksville
Gary Mathews North, Inc.
(931) 552-1111

Franklin
Hallmark VW At Cool Springs
(615) 236-3200

Johnson City
Wallace VW Of Johnson City
(423) 952-0888

Kingsport
Fairway Volkswagen
(423) 3781800

Knoxville
Harper Volkswagen, Inc.
(865) 691-5569

Madison
Hallmark Volkswagen, Inc.
(615) 859-3200

Memphis
Gossett Volkswagen
(901) 388-8989

Memphis
Gossett VW Of Germantown
(901) 333-8989

Murfreesboro
Southeast Signature Motors, Inc.
(615) 898-0700

Texas

Abilene
Sterling Volkswagen
(325) 673-4663

Arlington
Randy Hiley VW Of Arlington
(817) 575-6100

Austin
Maund Automotive Group
(512) 420-2409

Beaumont
Volkswagen Of Beaumont
(409) 833-7100

Brownsville
Payne Volkswagen
(956) 350-4488

Bryan
Garlyn Shelton Imports
(979) 776-7600

Corpus Christi
Volkswagen Of Corpus Christi
(361) 653-8400

Dallas
Boardwalk VW Park Cities
(214) 561-8100

El Paso
Hoy-Fox Automotive Market
(915) 778-7788

Fort Worth
Autobahn Motorcar Group
(817) 336-0885

Garland
Rusty Wallis Volkswagen
(972) 271-6767

Georgetown
Hewlett Volkswagen
(512) 681-3510

Houston
Archer Volkswagen
(713) 272-1750

Houston
Demontrond Automotive
Group Inc.
(281) 872-3909

Houston
Momentum Volkswagen
(713) 596-3380

Houston
Momentum VW Jersey Village
(281) 925-5160

Houston
Momentum VW Of Clear Lake
(281) 848-5660

Houston
West Houston Volkswagen
(281) 675-8600

Irving
Metro Volkswagen
(972) 256-1102

Killeen
Automax Volkswagen
(254) 699-2629

Lewisville
Lewisville Volkswagen
(972) 538-0550

Longview
Gorman-McCracken VW
(903) 753-8657

Lubbock
Gene Messer Volkswagen
(806) 793-8844

McKinney
McKinney Volkswagen
(800) 565-9807

Mission
Payne Mission
(956) 584-6300

Richardson
Boardwalk Volkswagen
(214) 453-5030

San Antonio
Ancira Volkswagen
(210) 681-5050

Temple
Garlyn Shelton Volkswagen
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