STARTUNED®

Information for the Independent Mercedes-Benz Service Professional

December 2007 U.S. $6.00 € 12.50

Superchargers

Power Windows

The First 100 Years

Volume 7 Number 4

TO OUR READERS

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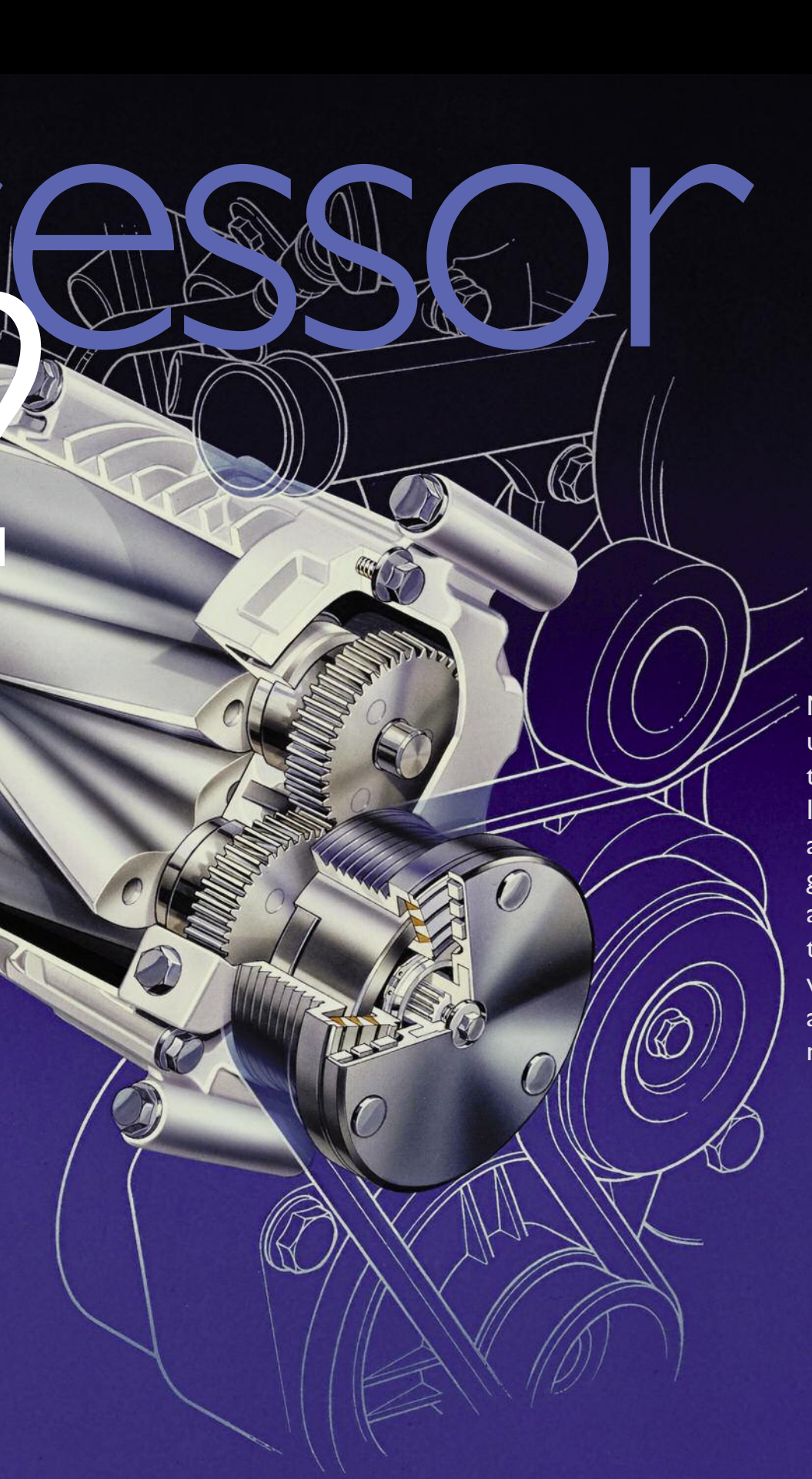
Kompr Kaputt?

Raising the pressure in an intake system can create a significant horsepower increase. Supercharging is one way of accomplishing this. Here's how Mercedes-Benz manages the boost.

essor



Mercedes-Benz uses a "Roots" type supercharger. It performs well at low rpm, but generates quite a bit of heat in the intake air, which makes an intercooler necessary.

In 1998, Mercedes-Benz introduced the SLK (170 chassis) into the United States, a lightweight, nimble, two-seat sports car. Its small size meant it was not able to fit the six- or eight-cylinder engines that were installed in the C280 and C36 AMG models. So, the new four-cylinder, 2.3L (111) engine was used. While this engine is solid, a sports car really should offer more performance than an entry-level C-Class (C230).

The solution to this was the addition of forced air induction in the form of supercharging. In '02, the SLK by AMG received a 3.2L supercharged V6, in '03 the C230 got a 1.8L supercharged engine, and all of the AMG 5.5L engines were "artificially aspirated" as well.

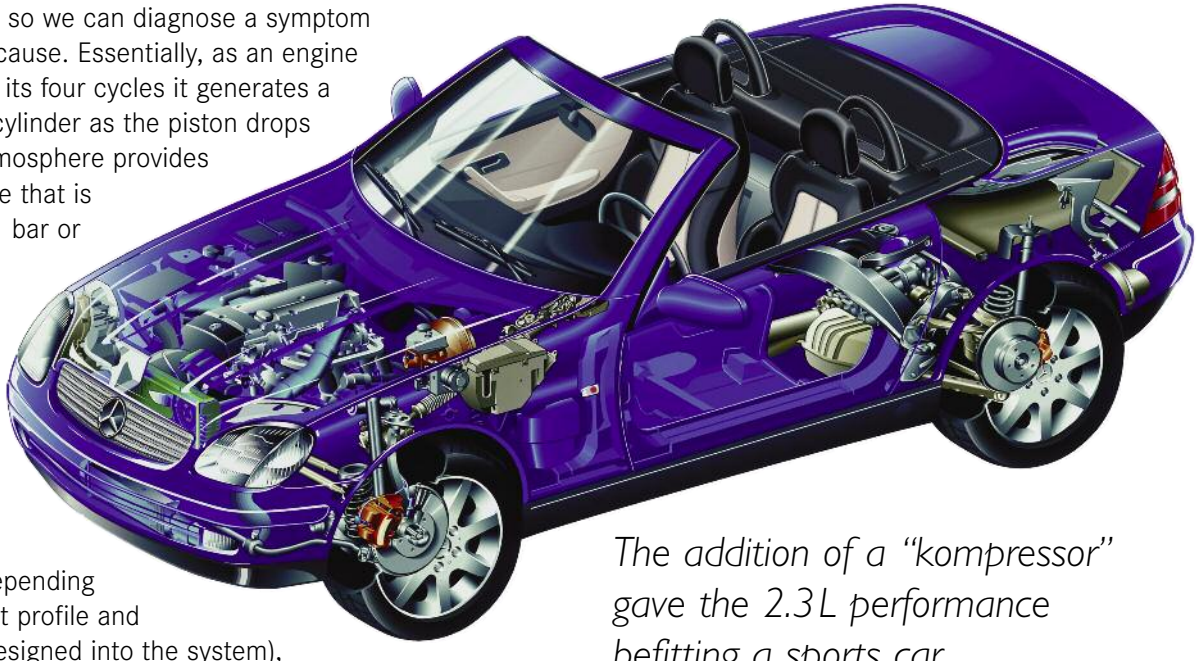
This was not a simple matter of bolting on a blower and some plumbing. Managing boost and minimizing acceleration lag are engineering challenges that the Mercedes-Benz engineers dealt with very well indeed. Here we'll examine the layout of the supercharging system so that we may better understand how to diagnose it when a problem occurs.

Supercharging 101

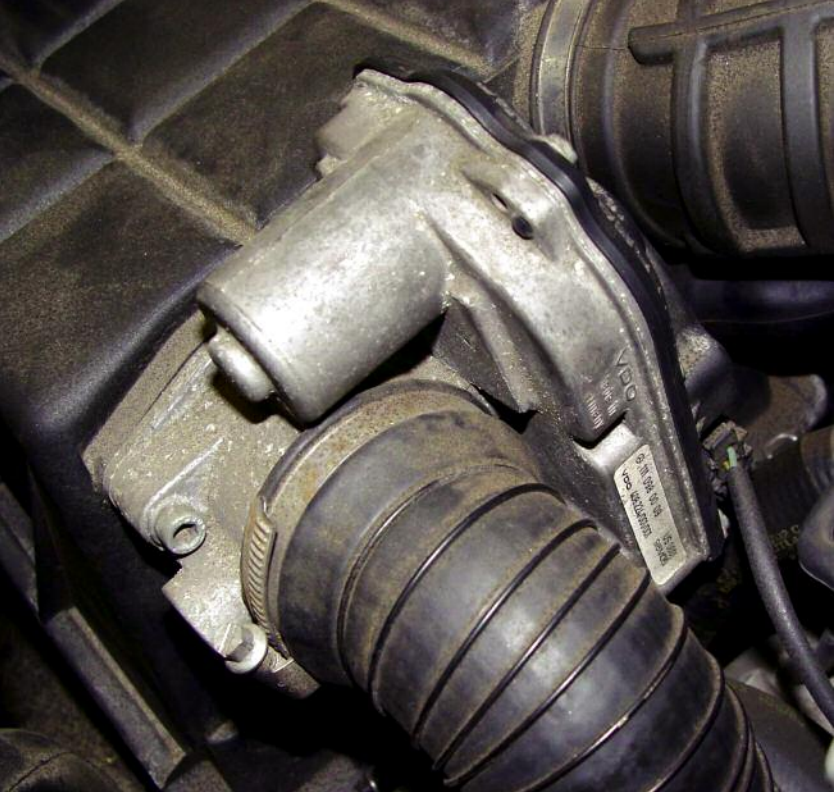
Without getting too deeply into the theory of supercharging, we do need to understand the basic principles so we can diagnose a symptom by isolating its cause. Essentially, as an engine rotates through its four cycles it generates a vacuum in the cylinder as the piston drops to BDC. The atmosphere provides outside pressure that is approximately 1 bar or 14.7 psi. This pressure flows toward the vacuum in the cylinder through the open intake valve. At this point the intake valve closes (depending on the camshaft profile and "scavenging" designed into the system), and the piston starts to travel upwards toward TDC, creating the compression. The power produced by the following piston stroke is limited by how much air finds its way into the cylinder during the intake stroke.

By increasing the pressure in the intake system to something higher than 14.7 psi, we can force a greater quantity of air into the cylinder, therefore creating more power. Supercharging achieves this by using the engine's own power to drive a belt that spins an air compressor. This "kompressor" or "blower" forces higher pressure air into the engines air intake system. This "boost" can produce significant horsepower gains.

There are limits to this phenomenon, however. With too much pressure, the mixture may ignite before the intended time. This pre-ignition (also known as detonation) can quickly destroy an engine. This is why on turbocharged and supercharged engines the compression ratio is reduced. Also, lower octane fuels compound this problem by being easier to ignite. So, there must be some pressure limiting feature built into the supercharging system. A pressure "pop-off" valve can be used, but it is inefficient to waste engine horsepower to drive a supercharger only to blow-off excess pressure that is not needed.



The addition of a "kompressor" gave the 2.3L performance befitting a sports car.

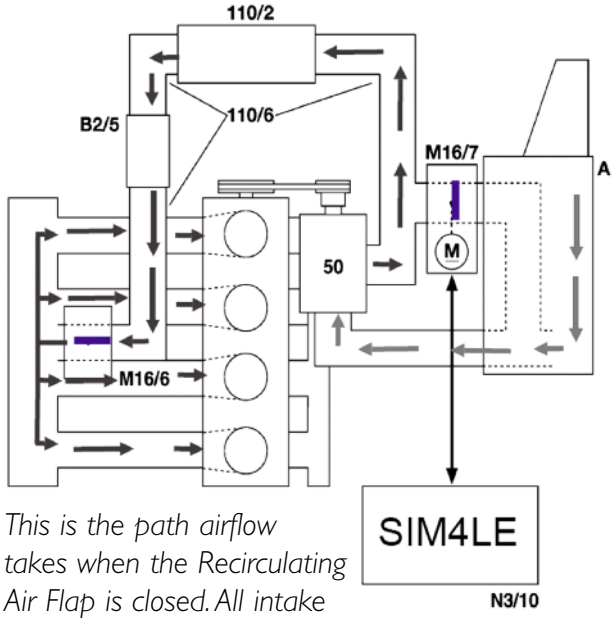


Here Is the Recirculating Air Valve Actuator. This flap is normally open. A pulse-width modulated signal controls the flap. The larger the duty-cycle (positive slope) the more the flap is commanded closed. When it is fully closed, all of the intake air goes through the blower to produce boost.

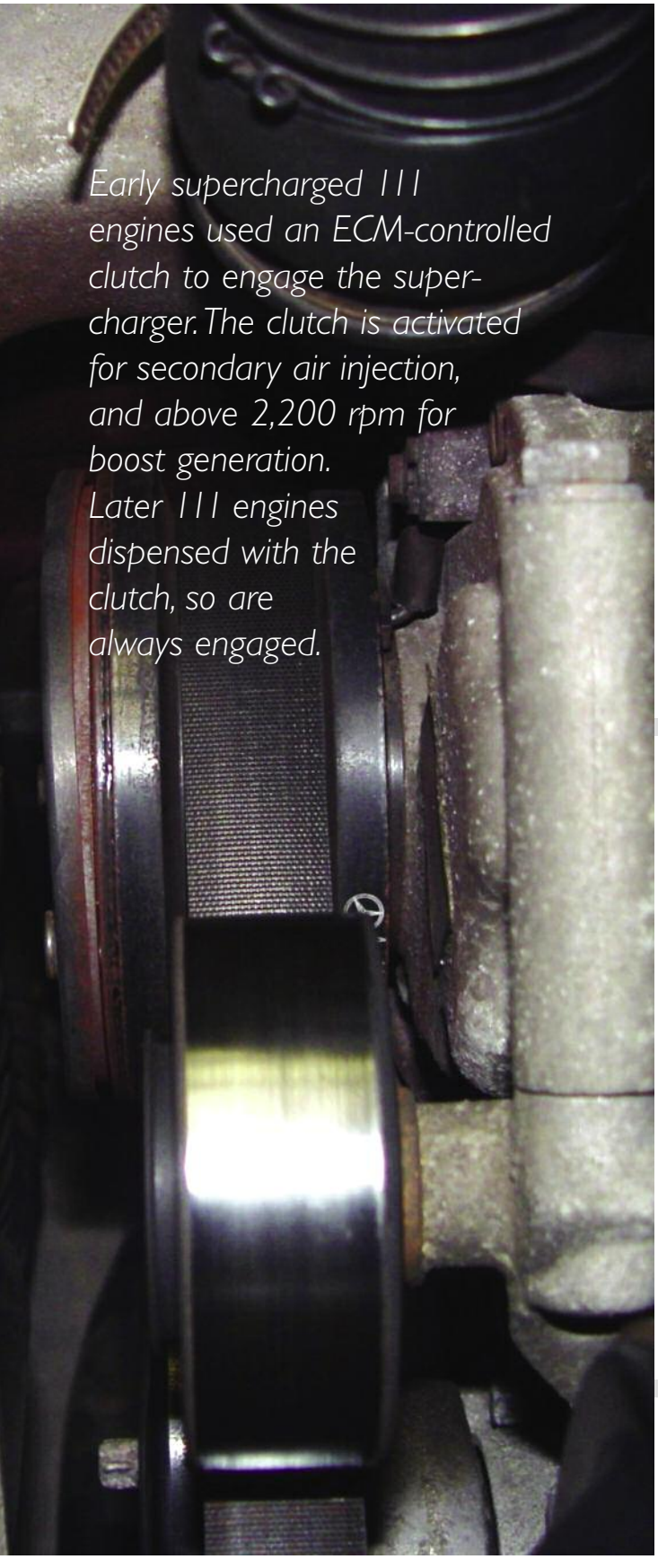
A Tale of Two Paths

Let's start by following the air flow of the supercharged 111 engine (2.3L). Of course, a conventional air intake system starts in the air box, which houses the air filter. However, from here we have two different paths the filtered air can take. Under acceleration, it is directed down to the back of the supercharger. Mercedes-Benz uses a "Roots" type blower. Interestingly, Gottlieb Daimler installed this type of super-charger on early production industrial engines 19th century, but, of course, engineering advancements have increased its efficiency tremendously. The Roots supercharger is a positive displacement pump that starts to build pressure at relatively low rpm (about 2,000). It does heat up the pressurized air it produces, though, so the air needs to be cooled by means of an intercooler, which may be of the air-to-air or air-to-water type. The SLK's air-to-air unit travels along the lower front bumper and resurfaces on the driver's side of the engine, entering the throttle plate. Later model larger displacement supercharged engines use a air-to-water intercooler, but more on that later.

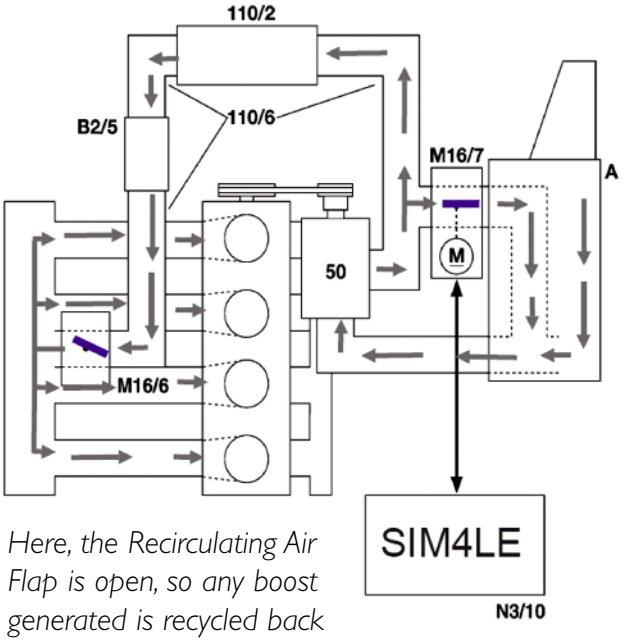
The SLK uses a "fly-by-wire" electronic throttle or EA (Electronic Accelerator) mounted on top of the intake manifold on the driver's side. But how does Mercedes-Benz control the boost pressure in the intake system? You have probably noticed what looks like an electronic throttle assembly right off of the air-box. This is indeed a similar assembly, but it has a different task.



This is the path airflow takes when the Recirculating Air Flap is closed. All intake air is routed through the blower so maximum boost can be achieved.



Early supercharged 111 engines used an ECM-controlled clutch to engage the supercharger. The clutch is activated for secondary air injection, and above 2,200 rpm for boost generation. Later 111 engines dispensed with the clutch, so are always engaged.



Here, the Recirculating Air Flap is open, so any boost generated is recycled back into the airbox. Therefore, no positive pressure is built up in the intake system.

The second air path engineered into the system is dependent upon a Recirculating Air Flap assembly. It acts just like an electronic throttle plate except that when it is closed, intake air is forced through the supercharger and pressurized air is sent to the engine's intake system. If too much boost pressure is being made for the throttle application (determined by monitoring CPS, TPS and MAP sensor signals), the Recirculating Air Bypass valve is opened to allow air to bypass the blower and continue straight to the intake manifold, or to allow boost pressure to bleed off back through the airbox. This reduces the amount of air passing through the blower and reduces boost pressure. The Recirculating Air Bypass assembly is not just open or closed. The ME control unit can vary the position of the valve to maintain consistent boost pressure. This helps reduce lag when changing from deceleration to acceleration. It also reduces boost if the level becomes dangerous to the engine.

On early 111.973 engines, an electromechanical clutch was used, much like an A/C compressor clutch. This would allow the "kompressor" to be disengaged entirely, therefore not generating any boost or causing any parasitic drag at low rpm. Above 2,200 rpm, the clutch is engaged

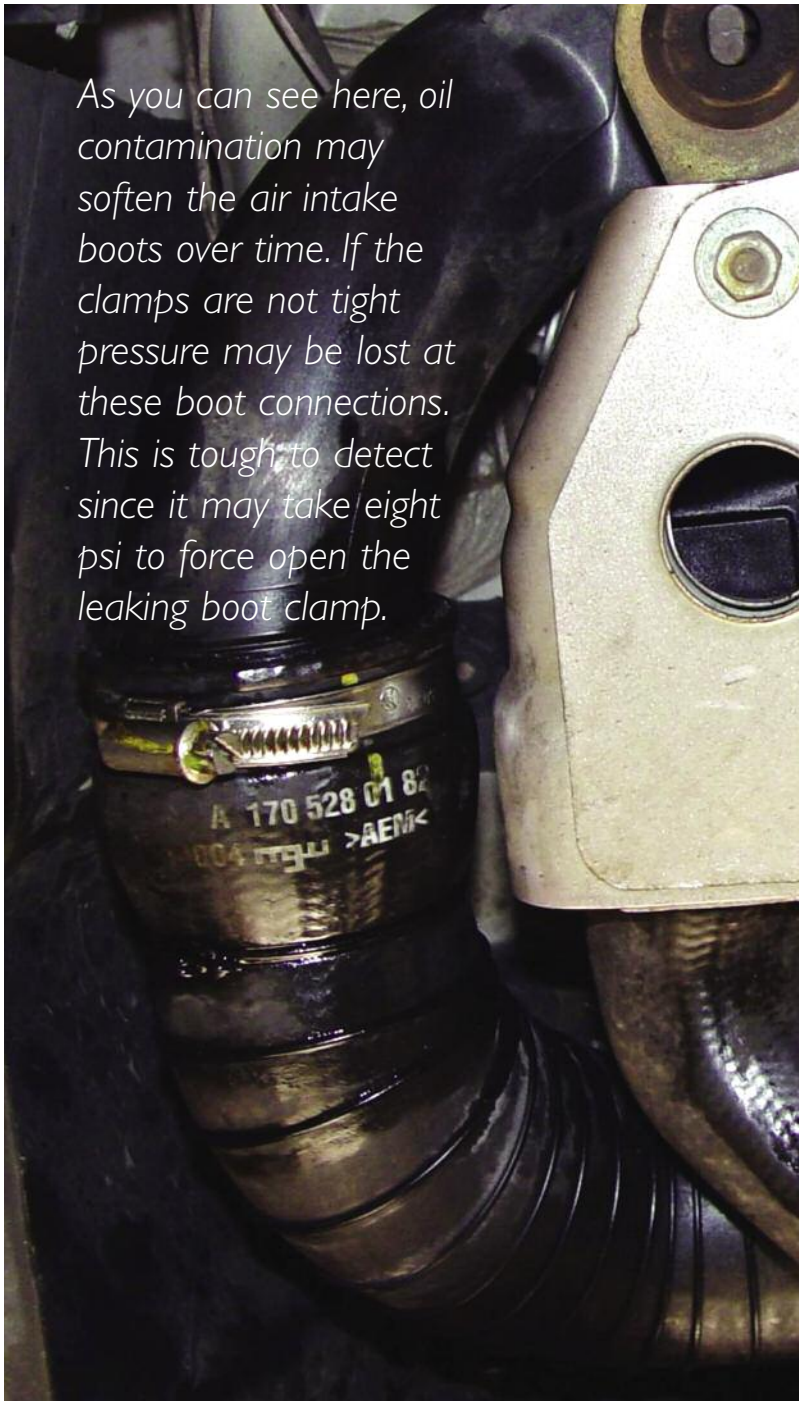
This engine was generating too much boost from a Recirculation Air Flap actuator that was sticking closed. The engine started missing as injectors were being shut off and timing was being retarded.

and boost is produced. In 2001, Mercedes-Benz phased out the clutch mechanism, so boost is managed by the Recirculating Air Flap alone.

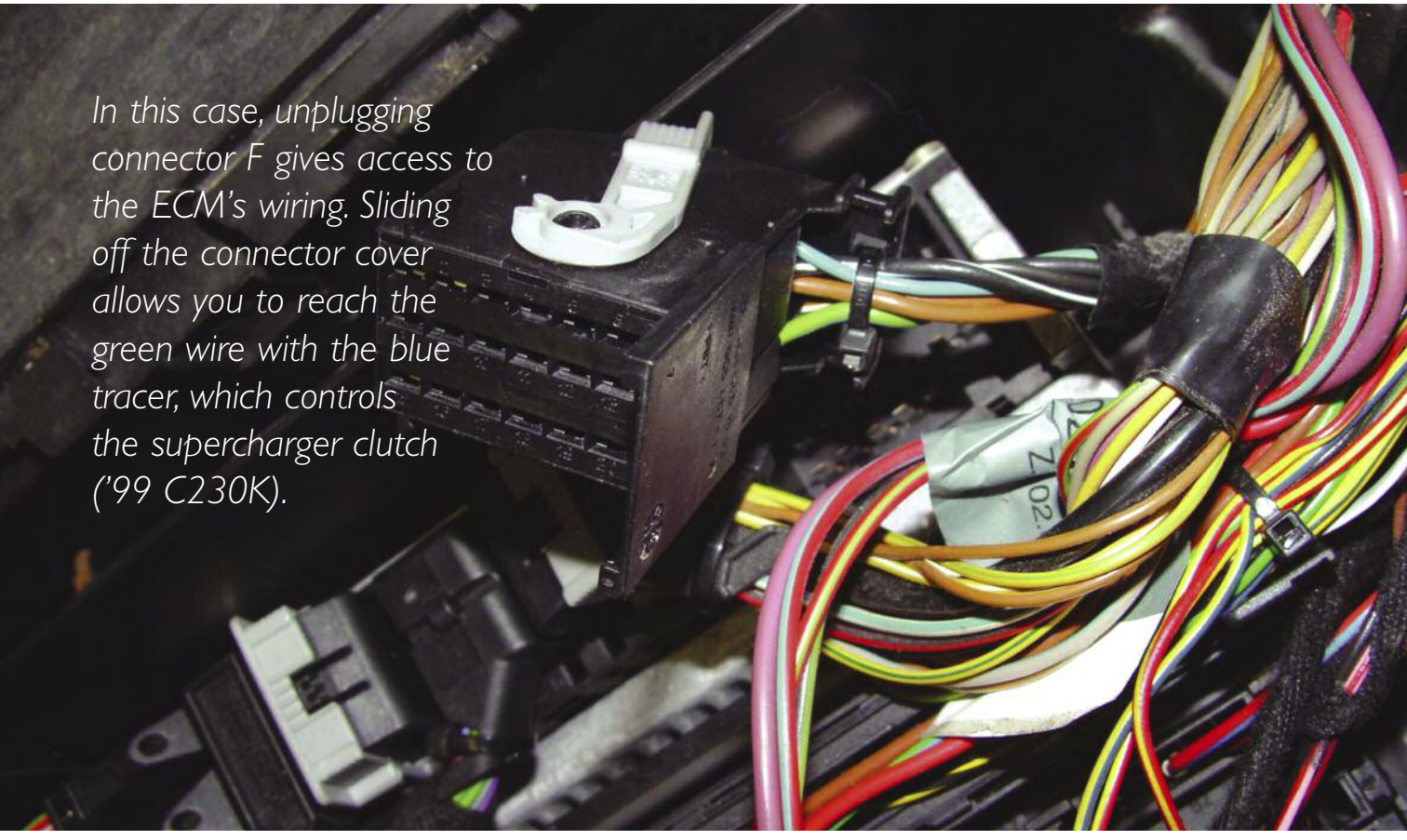
Okay, Now How Do I Fix It?

So what are some of the service issues we're going to face? Let us start with codes. If you pull a code P0805 and/or P1235, then you're dealing with overall supercharger function. Connecting a pressure gauge to the intake system will tell us if we are achieving proper supercharger pressure. Here in the United States, the 92 to 94 octane gasoline available will not allow any forced air induction vehicle to produce excessive boost without fear of detonation, so boost is limited to just under eight psi. These codes are letting us know that even though rpm, throttle application and load show boost conditions, proper boost is never achieved. This could be caused by a binding Recirculating Air Flap, but more than likely is caused by an air leak in the air intake system. A torn boot or a leak at any plumbing joints will often lead to these codes, which may be accompanied by a driveability problem such as a sudden loss of power, or a “bogging."

Introducing smoke into the intake system may not indicate the source of the leak since the rubber may only leak when significant pressure is applied. Keep in mind worn or broken motor mounts can add stress to air intake plumbing.



As you can see here, oil contamination may soften the air intake boots over time. If the clamps are not tight pressure may be lost at these boot connections. This is tough to detect since it may take eight psi to force open the leaking boot clamp.



In this case, unplugging connector F gives access to the ECM's wiring. Sliding off the connector cover allows you to reach the green wire with the blue tracer, which controls the supercharger clutch ('99 C230K).

Monitoring boost pressure with a gauge while under load is a good way to determine if boost pressure is being lost – just verify proper operation of the Recirculation actuator.

If you pull codes P0806 and/or P1236, they deal with supercharger clutch operation. There is no speed sensor for the blower, so proper operation is determined by monitoring the supercharger clutch electronic signal. You can monitor the voltage and current draw of the clutch and check for proper activation. This is most easily achieved at the powertrain control unit. For example, on a '98 SLK 230, power is provided to the clutch from fuse F2 in the relay module (mounted in the under-hood, passenger side electrical housing). This fuse also powers up the O2 sensor heaters and the Canister Vent Shut Off valve, so be careful of these other codes. By evaluating the wiring diagram we see that the control unit, connector F, pin 21 is the ground control of the clutch. By monitoring the voltage and amp draw of the solenoid we should be able to determine proper clutch operation and isolate a fault between the clutch and the ECM's driver.

Another set of codes that are part of the forced air induction system are P0803 and P1243. These are for Recirculating Air Flap operation. This actuator is normally open. A pulse-width modulated signal is sent from the ECM to the recirculating actuator commanding it to close and produce boost pressure. As a general rule, the wider the duty cycle (positive slope) of the signal the more the flap is commanded closed. The ECM monitors the boost pressure, throttle angle and mass air flow signals and determines if the flap is working. If you feel comfortable using a dual-trace scope, you should scope the pressure sensor and the flap actuator command signal. As long as rpm is increasing, the pulse width on the command line should increase as the signal voltage on the pressure sensor indicates more boost pressure. If the pressure is dropping while the duty cycle command is increasing, either the actuator flap is malfunctioning, or boost pressure is leaking out of the intake system.

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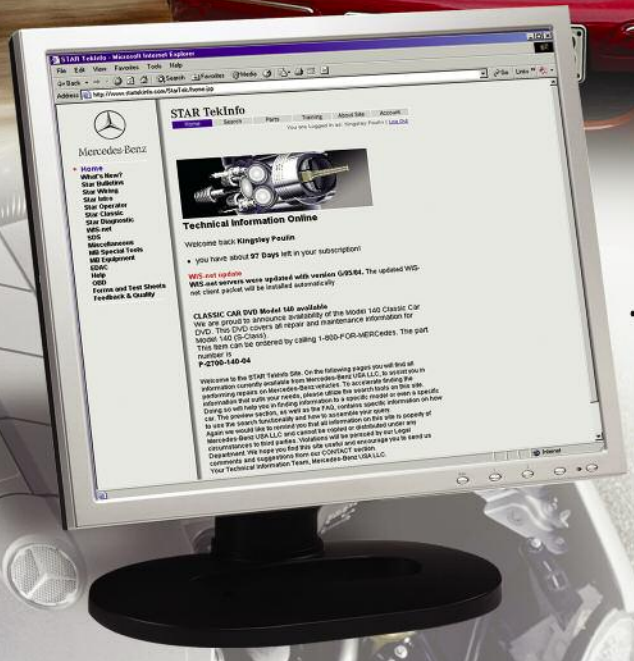

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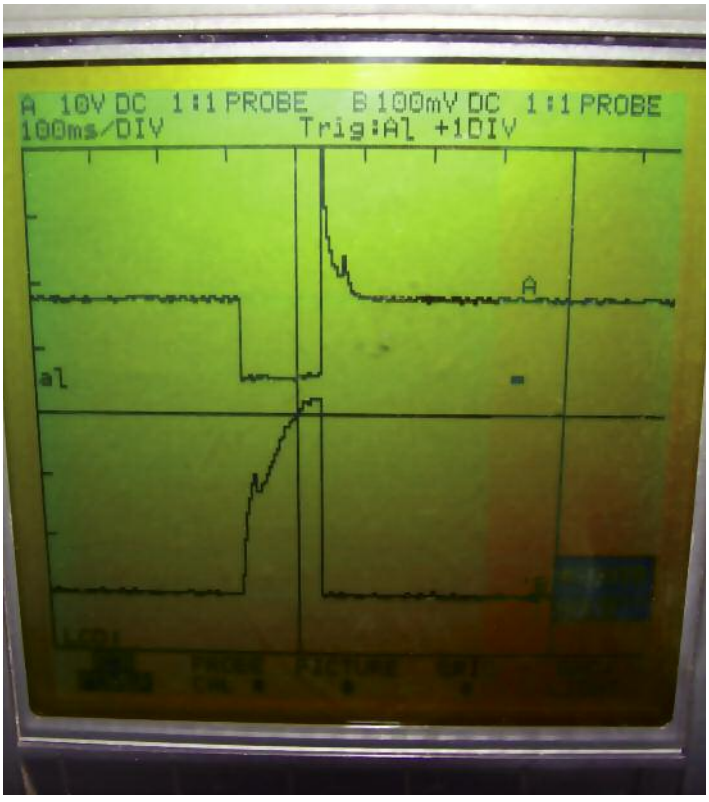

On this scope, we are monitoring the voltage pattern (top trace) and amperage pattern (lower trace) of a supercharger clutch. Notice how the amperage draw peaks at just over 3.0 amps. About 3.5 amps is the maximum you should see on a good one.

What If I Have A P0410?

On the 111 engine (2.3L), the supercharger doubles as the secondary air pump. This means the supercharger clutch must be activated for 30 to 90 seconds after the vehicle is started to supply the exhaust system with fresh air to aid in heating up the catalytic converters. So, diagnosing a secondary air injection code includes testing supercharger function. Activating the blower clutch and the secondary air control solenoid while at idle should pump fresh air into the exhaust. You can monitor additive (idle) adaptation to see that fuel is being added. Remember to have the fuel system in closed loop so that fuel trim adaptation is functioning. You can also watch O2 sensor voltage to see that it drops to under 100mv indicating a lean condition.

How Do I Prevent Costly Supercharger Repairs?

By its design, the Roots supercharger has a non-contact air gap so rotor vanes should not be rubbing together. However, the supercharger assembly does require special lubrication. As per the StarTuned article "Liquid Diet" (archived on the website in the June, 2006 issue), the C230K and SLK230 have their own lubricant, Part Number 000 989 62 01. It is added through the fill/inspection plug hole. The 3.2L and 5.5L AMG engines use a different supercharger lubricant – Mobil Jet Oil II. Also, the 3.2L and 5.5L AMGs have a Charge Air Cooler Circulation pump. This uses liquid coolant to keep the temperature of the supercharger within bounds. As mentioned earlier, the 3.2L and 5.5L engines by AMG use an air-to-water intercooler, so be sure to drain coolant and bleed the cooling system when servicing the intercooler. As with any other belt-driven component, belt wear and proper tension are important.

In Conclusion

While Mercedes-Benz engine management systems are very good at monitoring problems and indicating faults through their self-diagnostic functions, a driveability problem may still need some good old fashioned hands-on testing. Monitoring boost pressure, sensor signal voltage and solenoid voltage control/amperage draw may be the final steps in verifying the cause of the customer's complaint. Of course, there is always the most important ingredient: a thorough understanding of the system at hand.

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A Breath of Fresh Air: Mercedes-Benz Po

Regardless of all the advancements in climate control technology, nothing beats mother nature's fresh air. With the added complexity of convertible tops and other body control features, however, the simple act of opening a window becomes a symphony of computer-controlled communication.

wer Windows

Gone are the days when push-button controls supplied power or ground to power window motors. In an effort to add features to these well-engineered vehicles, computer controls were enlisted. In any system, if a computer is in control of outputs, these outputs can be manipulated with a variety of inputs. As far back as 1990, Mercedes-Benz introduced the option of a "Comfort System," at the heart of which was the Convenience Control Module. This module not only controlled power door locks and the sunroof, but also communicated with the Anti-Theft Alarm Control Unit. These advancements meant more features for the owner, but they also meant a greater diagnostic effort to keep these features functioning. Let's look at the various systems Mercedes-Benz has used.

Today, just opening a window is part of a highly-orchestrated electronic process.

This connector is for a power window motor with a motor position sensor. In this application, pins #3 and #6 operate the window. The other pins are for the position/speed sensor. Pin #1 is the ground, pin #4 is the power supply, and pins #2 and #3 are the signal wires used for position.

Evolution vs. Revolution

Previous to 1990, Mercedes-Benz power window controls were merely switches that toggled power or ground to each motor. By switching the polarity, the motors would drive the windows either up or down. Each front power window switch had five wires: one each for power and ground, two to control the motor, and one for illumination. The rear switches had six wires, the additional one coming from the front driver's switch to control the motors.

As mentioned earlier, the computer-control revolution began in 1990. The 124 and 129 chassis were the first vehicles to have the power windows controlled by an electronic unit. The 124 chassis power window circuit is controlled by a Convenience Control Unit, as we said, and the 129 chassis is slightly different in that it is a convertible. With convertibles, the power windows are controlled by a Power Soft Top control module. The reason for this is the power windows have to work in concert with the convertible top. When the driver commands the convertible top to open, each window is opened to provide clearance so the window doesn't rub against the door seals.

The front power window switches on these computer-controlled systems still have five wires, but a few of them now serve a different purpose. We still have one wire providing power to illuminate the switch. We also have one wire devoted to ground. The other three wires come directly from the Convenience Control Unit, not the power window motors. These wires have signal voltages on them. By toggling the switch up or down, one of these three wires would be connected to the ground wire effectively grounding this signal. When the Convenience Control Unit receives this ground signal, it

provides the proper polarity to the window motor to drive the motor up or down, depending on which signal was brought to ground. We have three signal wires, one is to command the motor up and the other is to command the motor down, so what's the third one for?

Value-Added Features

Mercedes-Benz added a new feature. Switching this third wire to ground signals the control unit to command the window motor all the way open. The driver no longer has to hold down the button to pay a toll. This "Auto Down" feature allowed the driver to get back to driving. Keep in mind that the 126 and 201 chassis never got the "Comfort System," having instead conventional power window wiring.

Starting in 1992, Mercedes-Benz introduced the 140 chassis. This being the company's luxury flagship, it included more control of the power window circuit. The motors included a four-wire position/speed sensor. This sensor determines when the window is reaching its travel limit, and stops the motor (more on this later). In '94, the entire Mercedes-Benz line-up (except convertibles) utilized the Comfort System and the Convenience Control Unit to control the sun/moon roof as well as the power windows. Another interesting feature is the pair of signal wires from the PSE control unit to the Convenience Module. In the lock mode, if the key is held in that position the PSE module will signal the Convenience Module to close any open windows. Knowing how these features work will help in diagnosis of a problem with window operation.

At the same time that computer-controlled features reduced the amount of wiring in a vehicle, paradoxically it also increased the amount of wiring in a vehicle by adding more control units. A greater effort was required to reduce wiring complexity. Let's see how Mercedes-Benz chose to achieve that.

(Continued on page 20)

Here we have the result of "resistive multiplexing." Four wires control the front power windows on a two-door convertible. The brown wire is ground, and the grey and green wires carry the signals that command the motors, grey for the driver's side and green for the passenger's side.

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A 000 230 05 11 80	260E 300CE 300E/TE 300SE/ SEL 300SL 350SD 350SDL E320 SL320 SL600	1987-1989 1988-1993 1986-1993 1988-1991 1990-1993 1991 1990-1991 1994-1995 1994-1997 1996-1997
A 000 230 06 11 80	400E/ 500E 500SL E420 E500 SL500	1992-1993 1990-1993 1994-1995 1994 1994-1999
A 000 230 11 11 80	190D 190DT/ 300DT/ TDT 190E 260E 300CE 300D 300E 300SE 300SEL/ TE E300D	1986-1989 1987 1985-1993 1987-1989 1988-1989 1987-1993 1986-1992 1988-1992 1988-1991 1995
A 000 230 13 11 80	C220/ C280 C36 AMG	1994-1995 1995
A 000 230 17 11 80	300SD 300SE/ 600SEC 600SEL S320/ S350D S420 S600	1992-1993 1993 1992-1993 1994-1995 1997-1999 1994-1996
A 000 230 22 11 80	CL600 S320 S350D S600	1998-1999 1995-1999 1995 1996-1999
A 000 230 24 11 80	190D 190DT/ 300D/ DT/ TDT 190E 260E 300CE 300E 300SE 300SDL 300SEL/ TE	1986-1989 1987 1985-1993 1987-1989 1988-1989 1986-1992 1988-1992 1986-1987 1988-1991
A 000 230 25 11 80	420SEL/ 560SEC/ SEL 560SL	1986-1991 1986-1989
A 119 230 00 11 80	400SE 400SEL/ 500SEC 500SEL S420/ 500	1992 1993 1992-1993 1994-1995
A 000 230 70 11 80	C280/C43 AMG CLK320 CLK430 CLK55 AMG/ML320 E320 E430/E55 AMG ML430 ML55 AMG SLK230/SLK320	1998–2000 1998–2003 1999–2003 2001–2002 1998–2002 2000–2002 1999–2001 2000 2001–2004
A 001 230 02 11 80	CL500 CL55 AMG S430 S500 S55 AMG	2001–2003 2001–2002 2002–2003 2002–2003 2002–2003

INTRODUCING: NEW APPLICATIONS

PART NUMBER	MODELS	YEAR
A000 230 91 11 80	C240/C320/S430 S500/CL500/CLK320	2004
A001 230 12 11 80	E320/E500	2003-2006
	CLS500	2006+
A001 230 28 11 80	ML350/ML500/ML55AMG	2003+
	G500/G55 (NOT G55K)	2003+
A001 230 68 11 80	ML320/ML430	UP TO 2000
A000 230 90 11 80	S55AMG/CL55AMG	2003-2005
	C240/C320	UP TO 2003
	CLK320	2003
A000 230 78 11 80	C32AMG KOMPRESSOR	2002-2004
A000 230 97 11 80	C230K M271 (VIN RANGE SPECIFIC)	2004
A001 230 01 11 80	S600/CL600	2001+
	S65AMG/CL65AMG	2005+
A001 230 14 11 80	E55AMG	2004-2006
	CLS55AMG	2006
	E350/E550	2007
	CLS550	2007
	E320CDI	2005-2006
A001 230 19 11 80	CLK550	2007
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	C55AMG	2005+
A001 230 55 11 80	C230K M271 (VIN RANGE SPECIFIC)	2004

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 (Continued from page 17)

New Layout

With the introduction of the 170 (SLK) and 208 (CLK) chassis, a new power window switch was added. In fact, a whole new layout was launched. Too many body control features are present for one Convenience Control Unit to handle. Mercedes-Benz chose to distribute more control units throughout the vehicle. Instead of the Comfort System using the Convenience Control Unit as a single central control, the Comfort System features were distributed to several components such as the Door Control Modules. These modules control the power window motor, mirror heating and mirror retract functions. More features would be added later. It would also relay memory function requests to other control units such as those for the telescopic steering wheel and power seat module. Since the power seat and memory switches are mounted in the driver's side door, all of the wiring is directed to the driver's side door module. This relays the seat commands through the CAN bus to the power seat control unit, which eliminates the need to run wiring outside of the door directly to the seat module, thus helping to reduce wiring.

In an additional effort to reduce wiring, the power window switch no longer has five wires attached to it, but only three. One wire is still used for illumination. That leaves two wires to inform the door control module to open the window, close the window, or open the window all the way. This is achieved with "resistive multiplexing." Multiplexing is the process of using multiple signals on a single wire. Resistive multiplexing is all about changing the signal voltage by changing the resistance applied for each switch position. In other words, with the switch in one position, the first wire carries reference voltage, which is sent through a resistor to the second wire that is grounded, generating a specific signal voltage. By putting the switch in a different position, a different resistor changes the reference voltage to a different signal voltage. When the control unit sees these different voltages it is programmed to respond with a different output for each voltage input. This is how we can have three different signals on one wire, therefore reducing the number of wires in the vehicle.

Power Window Diagnostics

With power window systems previous to 1990, testing is straightforward. You could remove the door panel and check for power and ground to the motor, but that would involve additional labor that we have not yet justified. Also, banging on the inner door panel to see if you can loosen up a stuck armature is at best inconclusive. We would suggest you start by checking fuses. This requires the least amount of labor. However, you may still have to diagnose why the fuse blew.

We would suggest you continue testing at the power window switch. It is easier to get to and you can perform many more electrical tests without removing the door panel. By removing the ashtray and storage tray (if applicable), you can remove the shifter cover and expose the window switch wiring. From here, you can determine if the switches have the power supply and ground they need. We can also test the switch contacts providing power and ground to the motor. Additionally, we can bypass the switch contacts with jumper wires and verify that correcting a power or ground problem will operate the motor. If we verify power and ground to a motor and it still does not work, we can now justify removing the door panel for further testing.

If you have a power window problem with the Comfort System, there are three steps you can take to isolate the cause. Step one is to perform functional testing of other related components. If the driver's side window motor is not working with the manual push button, you may want to see if you can command the motor open or closed using the Comfort System. By turning the key in the door lock, or holding the remote button down, you can command the windows closed (and open in some models). If the window functions at this point, you know that the window motor and a portion of the Convenience or Door Control Module are working fine. If the window does not function, you may want to focus your testing on the door control unit and the window motor.

Another weapon we have in our troubleshooting arsenal is Star Diagnosis. The ability to use a scan tool to monitor inputs and bi-directionally control outputs is a tremendous advantage over

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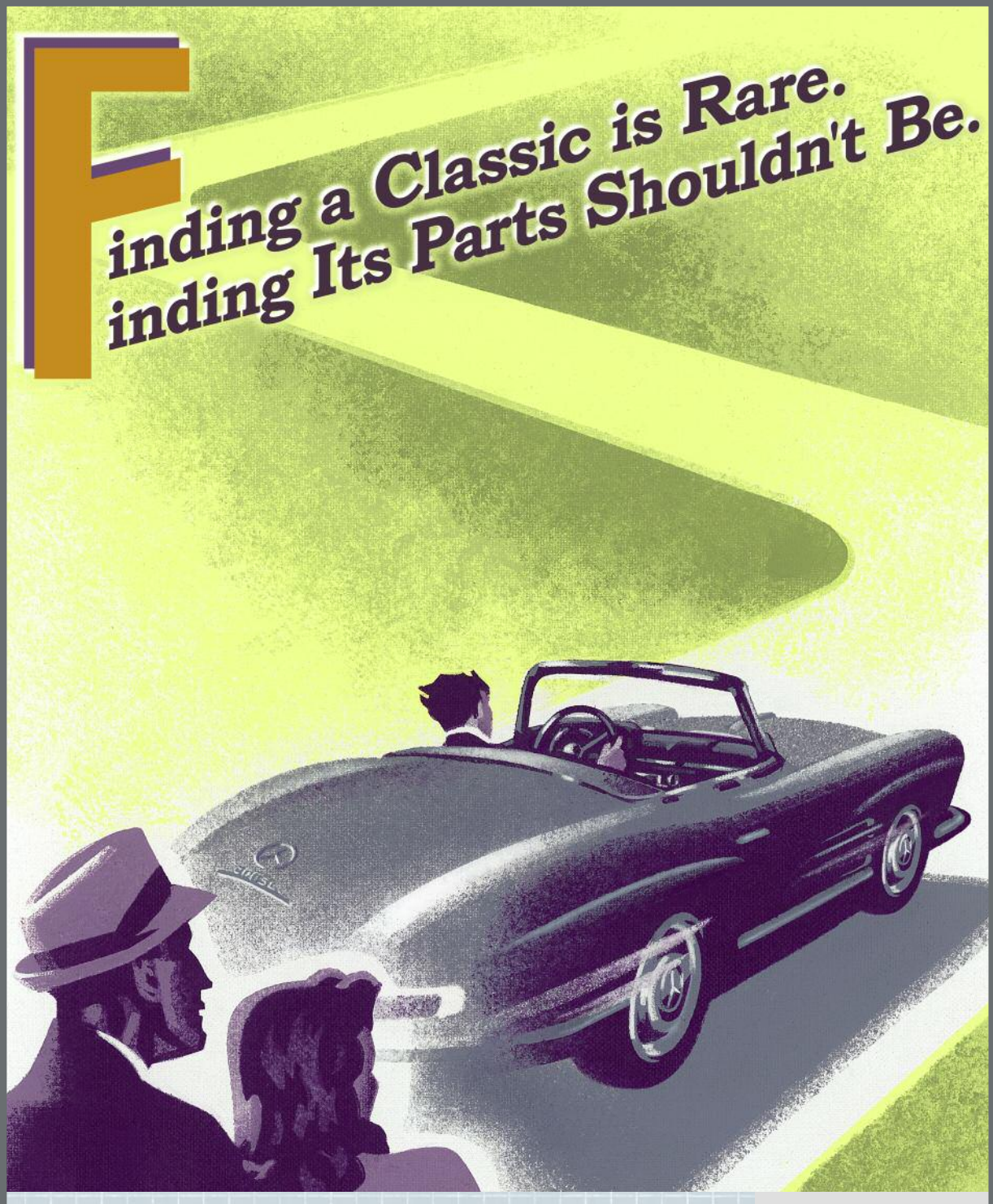

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In this test of the reference voltage from the door control module, we see approximately 10 volts. Pushing the button for the driver's side power window should make this voltage reading change.

basic electrical testing. Of course, scanning for any trouble codes may give an indication of where to begin your testing regimen.

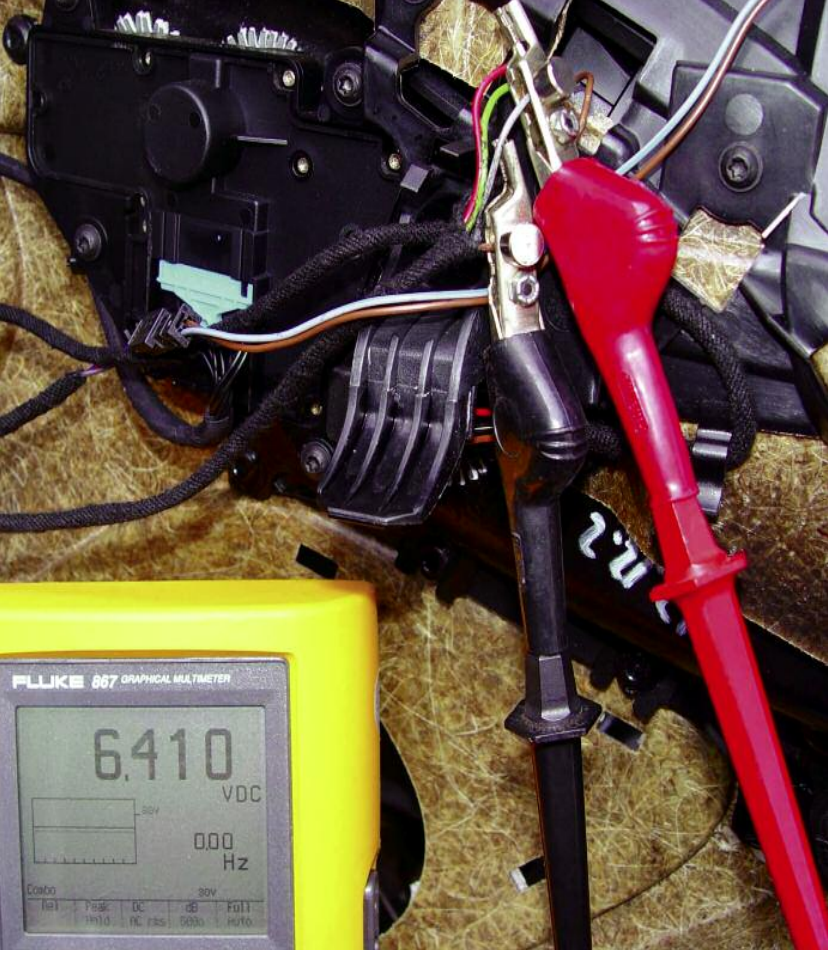
If you monitor the power window switch inputs, you can see if the door control module recognizes the signal change. If you see the change, you can move on to the output of the window motor. If you do not see the switch input change, you now know the problem is in the switch. At this point, you need to verify if the switch is malfunctioning or if there is a wiring problem.

Don't forget that there is more involved in the power window motor of the 140 and 220 chassis. These motors have a position/speed sensor built into them. If the symptom is erratic position of the window, you may have a bad position/speed sensor. This is a four-wire sensor, one wire is the 12V power supply, one is ground, and the last two carry the signals back to the control unit. If you scope these wires, you will see that they carry 5V square wave signals. The signals are out of phase by 50%, so you will observe them alternating back and forth. The control unit memorizes the square wave position and counts the square waves to know in which direction the motor is moving and how far it's gone. It also counts pulses to check the speed of the glass to detect blockage in the up direction.

As well as verifying that you have a power and ground command to the power window motor, you may have to verify that the position/speed signals are indicating motor position to the control unit. This would be your third step in the diagnostic process, verifying your scan tool findings with electrical testing. This may involve some additional labor to remove panels and get access, but you should be able to give an estimate on the time involved and get it approved. Functional testing, scan tool diagnostics and electrical testing will ensure that your diagnosis is accurate and timely.

Now We Actually Have To Fix It

Once you have determined what the problem is, you now have to fix it. If you isolated the problem to a control unit, you simply have to



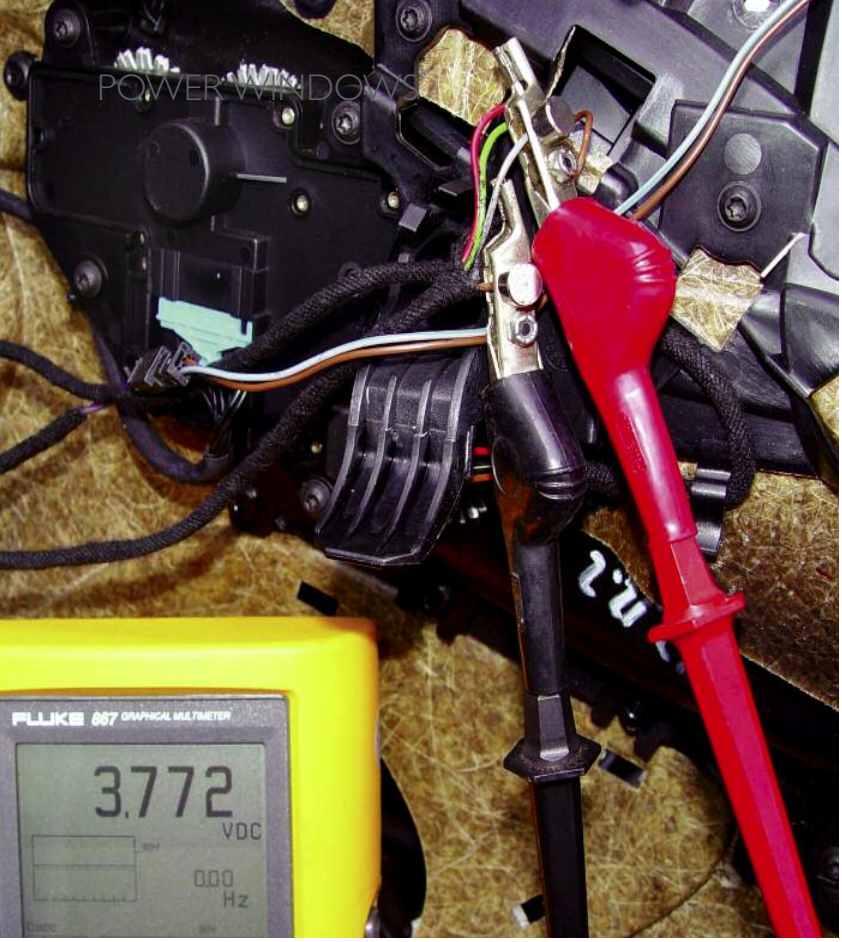
This is the result of pushing the power window button in the up position. The voltage on the signal wire has indeed changed. When the door control unit sees this specific voltage, it will command the motor up.

replace it. Very often when replacing a control unit, you have to version code it. Different options may have been installed on this vehicle and to make sure these features work, the new control unit has to be "personalized" to this particular vehicle. This process is known as version coding. Most often, the Star Diagnosis scan tool will download the programming that is already in the old control unit. After the new unit is replaced, the scan tool will then upload the program to it. Now, the new unit will have the same programming function as the old unit. If the problem is in the switch, then simply replacing the switch is all you have to do. In some older models, coding can be done manually.

Replacing the power window motor is a little more involved. First, you have to remove the door panel. This is a cosmetic piece, so you want to know exactly how it is to be removed so it's not damaged. Also, since it is a cosmetic piece, many of the mounting bolts and nuts are hidden behind plastic covers. Take the time to evaluate your service information and you will save time and money. Almost every door panel Mercedes-Benz produces uses mounting bolts and clips to hold it on. Some other models use guides that slide into channels in the door frame, so sometimes they have to be maneuvered in a particular direction for removal. Once the panel is off, you have to contend with the sound-proofing material. This can be a plastic sheet, or a foam insert glued to the door frame. Care should be taken during its removal so it can be reinstalled properly during reassembly. At this point you will need to know how the power window motor is serviced.

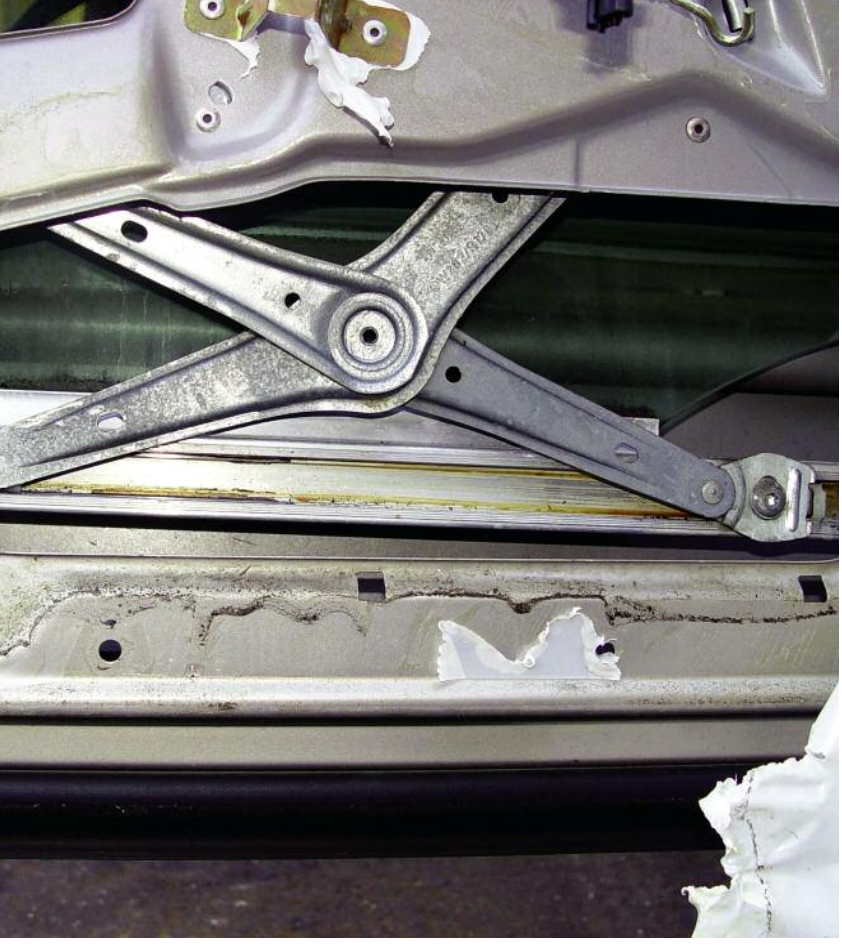
On some models, the motor is replaced. On other models, the motor and regulator assembly are replaced as one unit. Check your service information. Sometimes the window needs to be in a particular position in order to be removed. This may be a problem if the motor is malfunctioning and is not stopped in that position. You may have to disassemble the assembly inside the door and/or drill out additional access holes to remove a stuck motor.

Upon reassembly, lubricate sliding components with light grease to reduce the chances of the regulator binding. Any friction in the regulator will



Here we have the result of moving the switch in the down position. Notice how on the same wire we have a different voltage. When the door module sees this voltage reading it commands the motor down.

These are the mounting points for the motor. Removing the three Torx screws will release the motor. But if the new part is an assembly, you will have to drill out the rivets that mount the regulator to the door frame. Rivets give more clearance than a nut and bolt, so stick with rivets.



Here is the regulator assembly in the door. The channel going across the bottom of the scissors arms needs to be lubricated as these parts slide in the channel. If you have to replace the regulator assembly, you must separate the glass from the channel and support the glass. You will also have to drill out the rivets that secure the assembly.

increase the load handled by the window motor. This can cause premature failure, or it can cause the "excessive force limiter" to kick in and stop window operation. Also, these regulator units are sometimes mounted with rivets instead of bolts in low clearance applications. The rivets have to be drilled out and the proper size rivet has to be used to reattach the assembly so nothing comes in contact as the window is being operated.

Final Touches

Mercedes-Benz recommends that we disconnect the battery when the power window is serviced. This action, or replacing the control unit, will put the windows out of "sync" with the control unit. If the power windows are not synchronized, then the automatic features will not work. On most models, to synchronize the windows with the control unit manually, push the up button only to the first detent until the windows are closed and hold the switch for two to four seconds. This will need to be done for each control unit/window combination, and on some models the doors must be closed for it to work. Now, each control unit knows the motors are at their upper limit and can start using the position/speed sensor to operate the automatic features. This procedure is not required on the new S-Class and CL.

"I Need To Check The Oil In Your Power Windows"

If We would be remiss if we did not inform you of a special protection option that is NOT available in the U.S.: hydraulically-operated windows! The door control module operates a valve block that uses hydraulic fluid pressure, provided by a pump, to open and close the power windows. This is a special option that most of us will never see, but we felt it was our responsibility to inform you that this technology exists.

Milestones in a Legend

No other carmaker in this galaxy has a longer or more distinguished heritage than Mercedes-Benz. The following is a look at some milestones reached in the first 100 years of that history:

1885 - On August 29, Gottlieb Daimler of Cannstadt, Germany, is granted a patent on a motorized bicycle, the world's first vehicle powered by a four-stroke internal combustion engine.

1886 - On January 29, Karl Benz of Mannheim, Germany patents the three-wheeled Benz Motorwagen -- the world's first viable automobile. Later that year, Daimler builds the first four-wheeled car. With 1.5 hp, it had 50% more power than the Benz, so the horsepower race had begun.

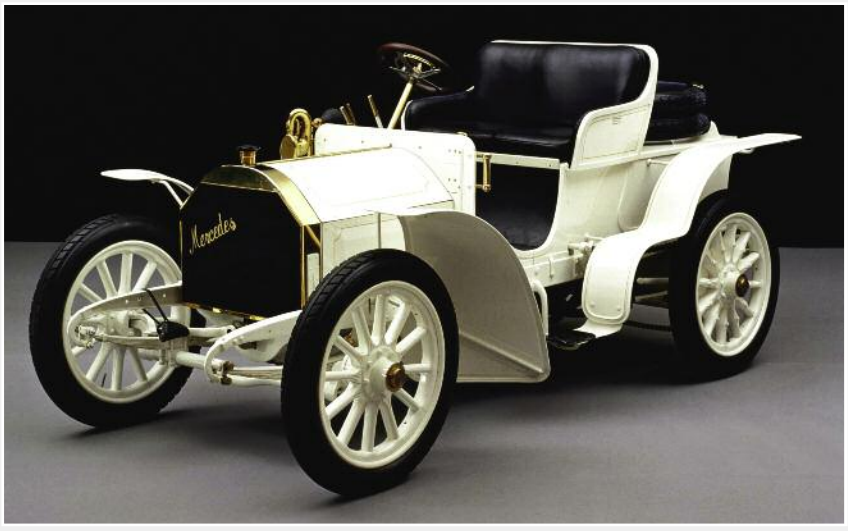
's First Hundred Years

1888 - Steinway & Sons, the New York piano maker, obtains the rights to all Daimler patents in the U.S. with the intention of producing engines and cars in this country. This is the first example of a strategy that's now become a trend.

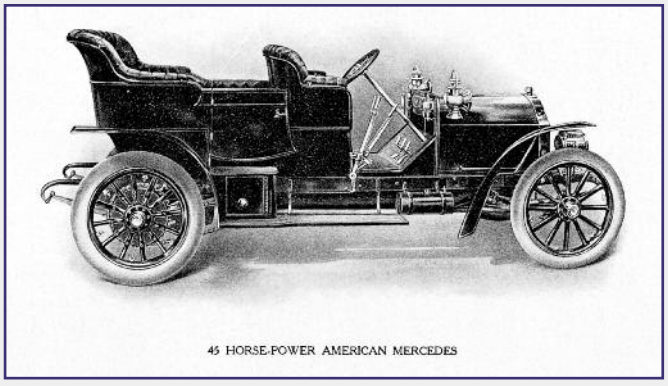
1894 - In France, the first-ever sanctioned automobile race is won by a Daimler-powered car.

1895 - Benz & Co. produces the first internal-combustion-powered bus. In the first U.S. race (Chicago to Waukegon and back), a Benz comes in second.

1900 - Benz replaces the tiller with the steering wheel, and becomes the largest automobile manufacturer in the world, delivering 603 cars.



1901- Daimler introduces a revolutionary front engine/rear drive car with four cylinders, four-speeds, a honeycomb radiator, and pneumatic tires. Austro-Hungarian businessman Emil Jellinek, an unofficial agent for Daimler, orders 36 on the condition that the model carry the name "Mercedes" after his daughter.

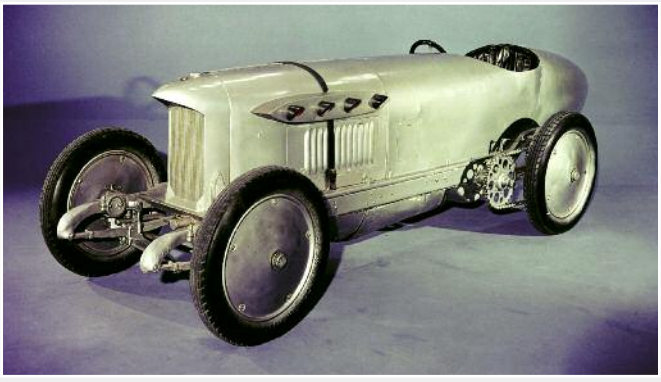

45 HORSE-POWER AMERICAN MERCEDES

1905 - The Steinway deal comes to fruition with the production of American Mercedes cars in a Long Island City, NY, factory. This continues through '07.

1910 – At Daytona Beach, Barney Oldfield ups the world's land speed record to 129 mph in a 200 hp Benz.

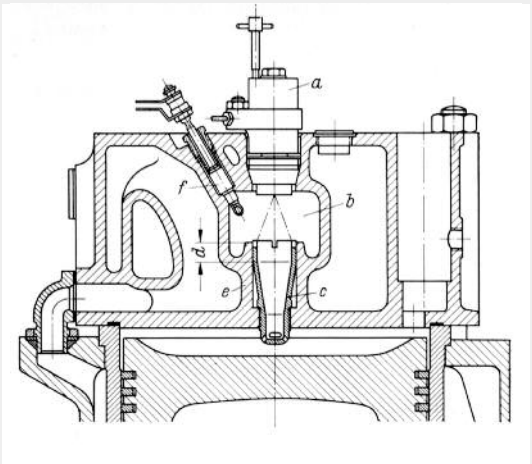
1926 - Daimler and Benz merge to form Mercedes-Benz.

1931 - The SSKL produces 300 hp and tops out at 150 mph.



1909 - The Blitzen Benz establishes the world's land speed record, which the car holds for 16 years.

1936 - Mercedes Benz builds the first diesel powered automobile.



Above: Diesel Patent

1954 - The Mercedes Benz 300SL Gullwing is produced with mechanical gasoline fuel injection (similar to a diesel system, it's direct!).

1958 - Mercedes-Benz is first with gas shocks.

1965 - Daimler-Benz AG becomes the largest manufacturer of commercial vehicles in Europe.

1970 - M-B pioneers ABS and air bags.

1985 - The company shows off its first ASR (Acceleration Slip Reduction) system.

Today - Many Mercedes-Benz cars have become classics, and all models tend to last much longer than other vehicles. So, chances are you'll be repairing or restoring M-B cars that are decades old. If that idea makes you worry about parts availability, we've got good news: Visit MBUSA.com/classic, or call 1-866-MBCLASSIC, and you'll be well on your way to tracking down the genuine Mercedes-Benz part you need.

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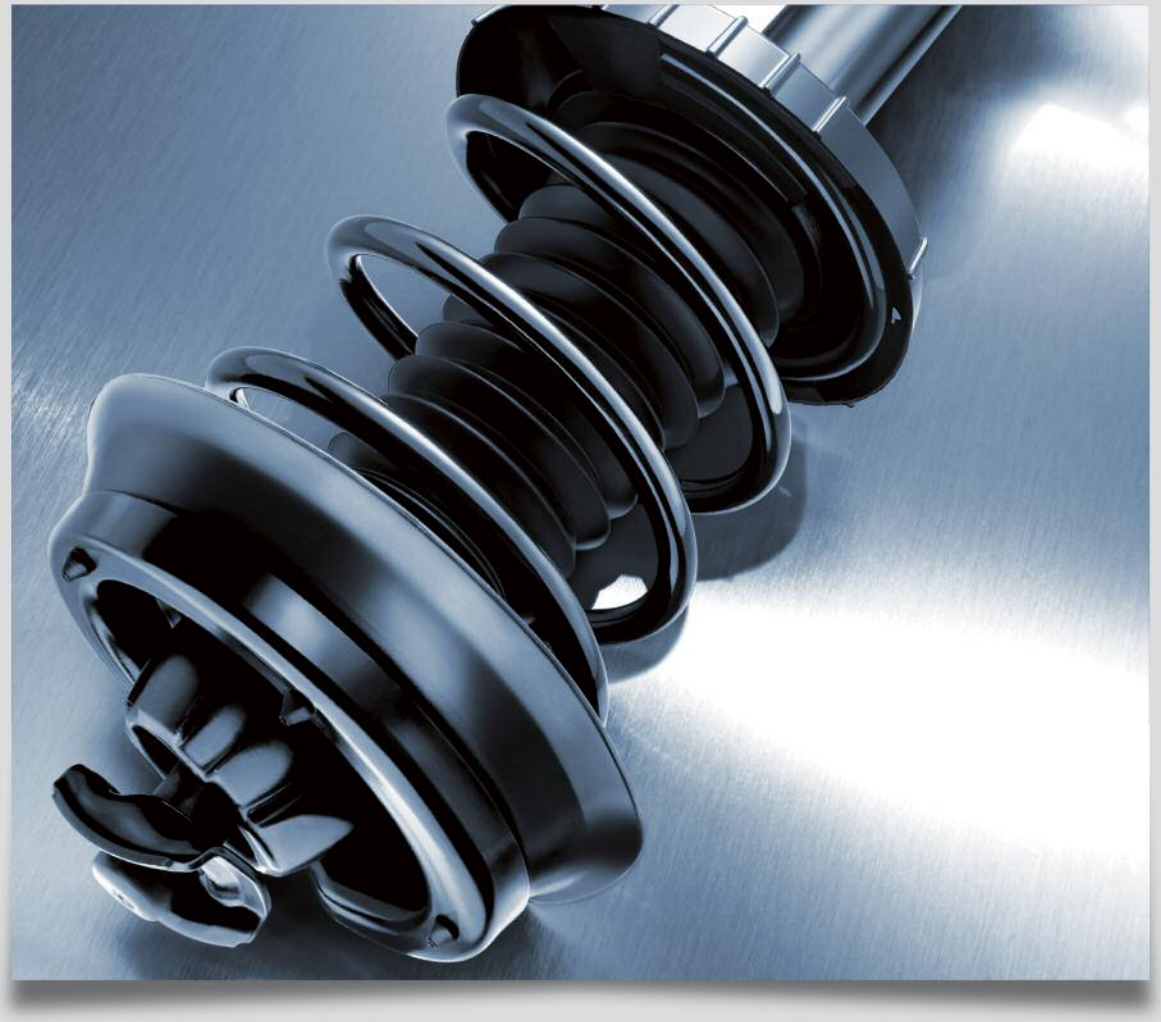

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FACTORY SERVICE BULLETINS

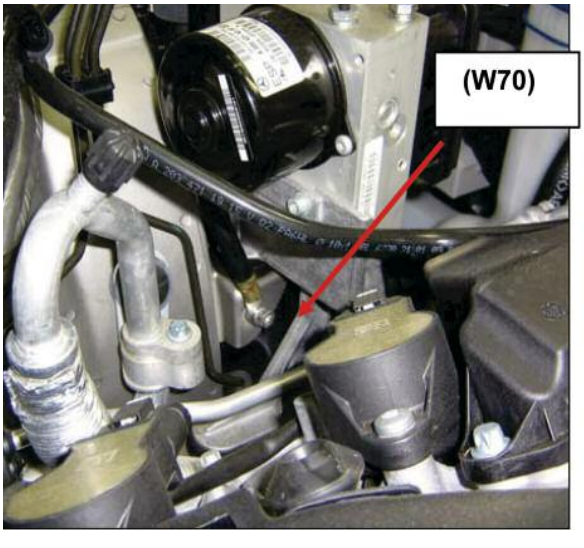
"ESP Visit Workshop" Displayed In Instrument Cluster

All Model 203 Vehicles, As of August 1, 2001 Series Production

If "ESP – Visit Workshop" is being displayed in the instrument cluster, and for vehicles with an automatic transmission, the selector lever cannot be moved from position "P" after the engine is started, and various fault codes are stored in the relevant control units, perform the following repair.

Note: In vehicles equipped with tire pressure loss warning system this function will also not be available.

The conditions listed above are caused by an inadequate ground connection at the ESP (W70) ground point (Figure 1, arrow) due to the heat shrinkable tube protruding under the ground cable lug's attachment point.



1 Remove the excess length of the heat-shrinkable tube on the ground cable lug so that a complete ground connection can be established (Figure 2).

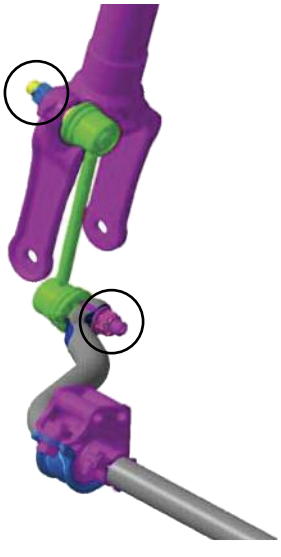
Note: Do not damage the coating on the ground cable lug. Additionally, ensure that the heat-shrinkable tube is only removed in the area of the screw attachment point.

2.Tighten the nut on the ground bolt (W70) to 8 Nm.

Thumping Noise from Front Axle

Model 164.122/175/177/186/822/871, Model 251.122/165/175/177

If there are thumping noises coming from the front axle when driving over bumps, retighten the bolted connections to 200 Nm between the torsion bar and the stabilizer bar and between the torsion bar and the suspension strut to resolve.



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Bowling Green
Buchanan Imports
270-745-0001

Lexington
James Motor
859-268-1150

Louisville
Tafel Motors
502-896-4411

Louisiana

Alexandria
Walker Automotive
318-445-6421

Baton Rouge
Mercedes-Benz of Baton Rouge
225-490-3101

Lafayette
Moss Motors
337-235-9086

Metairie
Mercedes-Benz of New Orleans
504-456-3727

Shreveport
Holmes European Motors
318-212-1212

Maine

Bangor
Quirk Auto Park of Bangor
207-941-1017

Falmouth
Prime Motor Cars
207-510-2250

Maryland

Annapolis
Mercedes-Benz of Annapolis
410-268-2222

Bethesda
Euro Motorcars
301-986-8800

Cockeysville
Mercedes-Benz of Hunt Valley
410-666-7777

Germantown
Euro Motorcars Germantown, Inc.
240-686-1300

Hagerstown
Mercedes-Benz of Hagerstown
301-733-2301

Owings Mills
R & H Motor Cars
410-363-3900

Salisbury
Mercedes-Benz of Salisbury
410-548-3411

Silver Springs
Herb Gordon Auto Group
301-890-3030

Massachusetts

Boylston
Wagner Motor Sales
508-869-6766

Haverhill
Smith Motor Sales of Haverhill
978-372-2552

Hyannis
Trans-Atlantic Motors
508-775-4526

Lynnfield
Flagship Motorcars
781-596-9700

Natick
Mercedes-Benz of Natick
508-655-5350

Somerville
Chambers Motorcars of Boston
617-666-4100

Westwood
Mercedes-Benz of Westwood
781-688-1000

Michigan

Acme
Mercedes-Benz of Traverse City
231-938-3800

Ann Arbor
Mercedes-Benz of Ann Arbor
734-663-3300

Bloomfield Hills
Mercedes-Benz of Bloomfield Hills
248-644-8400

Grand Blanc
Grand Blanc Motorcars
810-695-4400

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Betten Imports
616-301-2100

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Orrin B. Hayes
269-345-0167

Novi
Mercedes-Benz of Novi
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Okemos
Okemos Auto Collection
517-853-2600

Rochester
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St.Claire Shores
Mercedes-Benz of St.Claire Shores
734-483-0322

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Bloomington
Feldmann Imports
952-837-6300

Maplewood
Maplewood Imports
651-483-2681

Minnetonka
Sears Imported Autos
952-546-5301

Mississippi

Gulfport
Ray Brandt Motors of Mississippi
228-864-6622

Jackson
Higginbotham
601-956-4211

Missouri

Columbia
Legend Automotive Group
573-875-5000

Creve Coeur
Plaza Motor
314-301-1715

Ellisville
Tri-Star Imports
636-458-5222

Joplin
Frank Fletcher Imports
417-781-1177

Kansas City
Mercedes-Benz of Kansas City
816-943-7000

Springfield
Elite Automotive Group
417-889-5750

Weldon Spring
Mercedes-Benz of Progress Point
636-300-2277

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Missoula
DeMarois Olds-GMC
406-721-4000

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Husker Auto Group
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Omaha
Mercedes-Benz of Omaha
402-384-9999

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Fletcher Jones Imports
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775-326-4000

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Greenland
Dreher-Holloway
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Holloway Motor Cars of Manchester
603-669-6788

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Millennium Automotive Group
908-685-0800

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David Michael Motor Car of Freehold
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609-771-8040

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732-842-5353

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856-327-3000

Morristown
Mercedes-Benz of Morristown
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Newton
Intercar
973-383-8300

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Prestige Motors
201-265-7800

Union
Ray Catena of Union
908-379.7200

West Atlantic City
Precision Cars of AtlanticCity
609-645-9000

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Mercedes-Benz of Albuquerque
505-821-4000

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Helms Brothers
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Sovereign Motor Cars
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Romano Motors
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Estate Motors
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631-549-2369

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Mercedes-Benz of Larchmont
914-275-4000

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518-785-4197

Long Island City
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845-624-1500

New York
Mercedes-Benz Manhattan
212-629-1600

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Hahn Motor
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Enterprise Motorcars
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Concours Motors
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Zimbrick European
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Waukesha
Mercedes-Benz of Elmbrook
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