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Information for the Independent Mercedes-Benz Service Professional

December 2019
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StarTuned®

December 2019

Welcome to *StarTuned®*, the magazine for independent service technicians working on Mercedes-Benz vehicles. Your Mercedes-Benz dealer sponsors *StarTuned®* and provides the information coming your way in each issue.

Mercedes-Benz wants to present the information you need to know to diagnose and repair Mercedes-Benz vehicles accurately, quickly and the first time; text, graphics, online and other technical sources combine to make this possible.

Feature articles, derived from approved company sources, focus on being useful and interesting.

Our digest of technical information can help you solve unanticipated problems quickly and expertly.

We want *StarTuned®* to be both helpful and informative, so please let us know just what kinds of features and other diagnostic services you'd like to see in it. We'll continue to bring you selected service bulletins from Mercedes-Benz and articles covering the different systems on these vehicles.

Send your suggestions, questions or comments to us at:

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Mercedes-Benz
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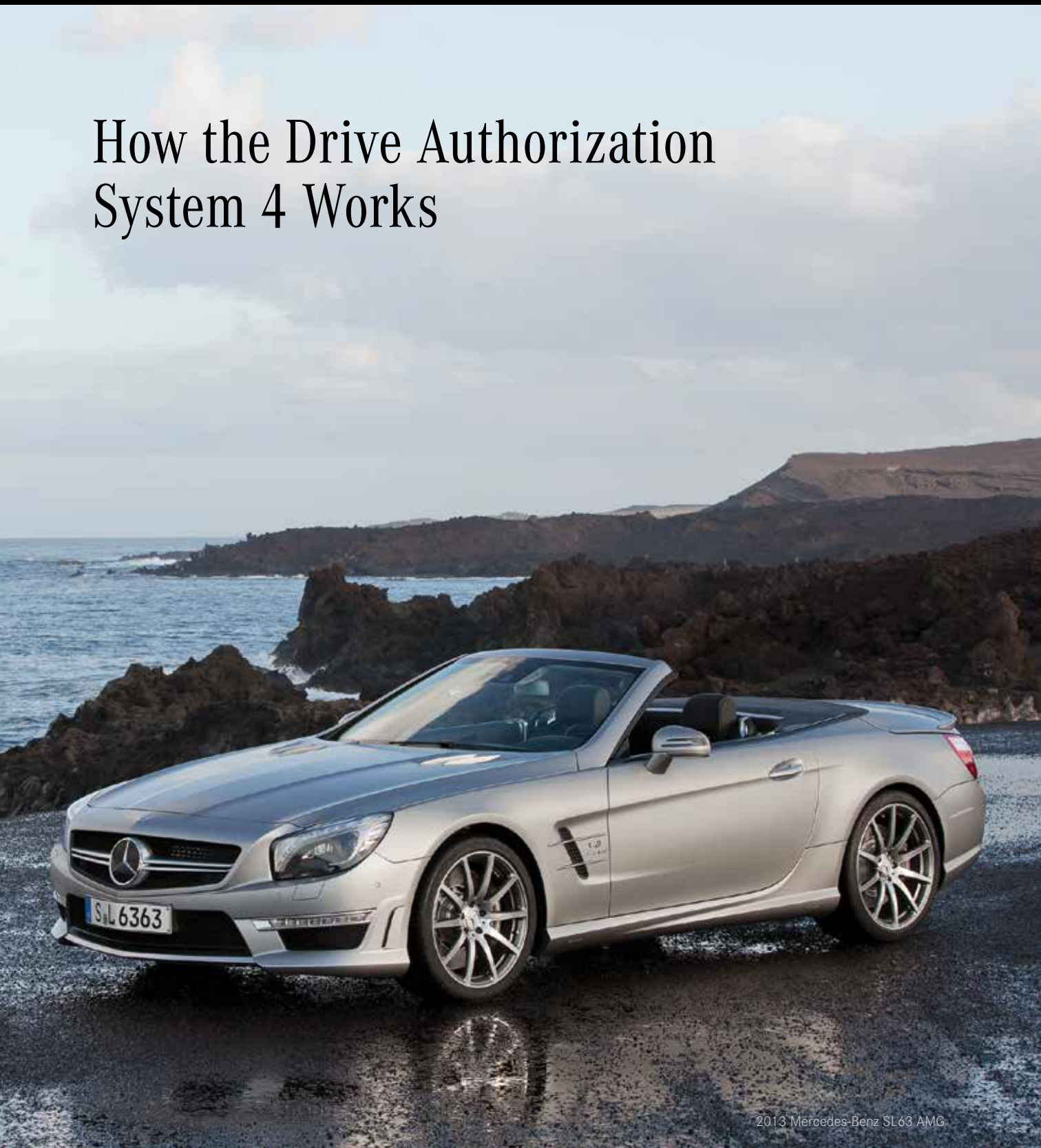
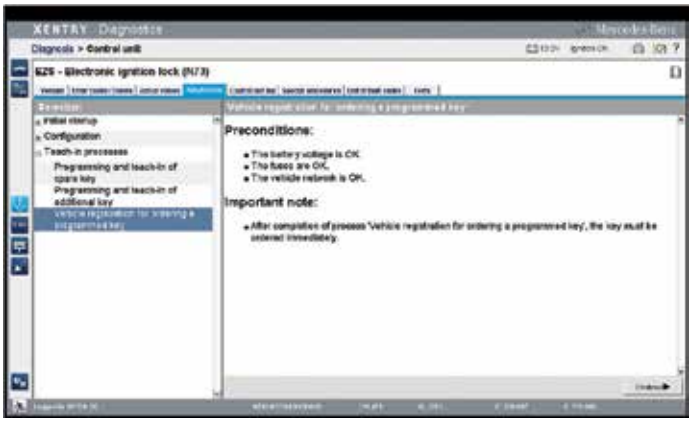
How the Drive Authorization System 4 Works



2013 Mercedes-Benz SL63 AMG

Since 1992, some kind of electronic immobilizer system has been installed on Mercedes-Benz vehicles. Designed to make the unauthorized use of the vehicle difficult or impossible, they have been proven to reduce vehicle theft. Named *Drive Authorization System* (DAS), Mercedes-Benz is currently in the 6th generation of the 4th major version of these systems. In this article, we will explain how the system works to aid in troubleshooting. Here's how it works.

The electronic SmartKey was introduced with DAS3 (3rd generation), an electronic key that completely eliminated the mechanical tumblers in the ignition switch. New generations of DAS4 have eliminated the ignition switch, in favor of a button on the dash, a system called KEYLESS START. DAS4 was first introduced in the 231 (SL) in early 2012, and was adopted by Models 166 (GLE/GLS), 207 (E-Coupe/Cab), 212 (E-Class) and 222 (S-Class) as of Model Year 2014. In vans, DAS4 was introduced with the Metris in MY 2015 and the Sprinter as of MY 2019. All subsequent new models are equipped with DAS4 now.



Before a DAS4 key can be programmed, the vehicle must be "registered" with the Daimler servers. Anyone with a XENTRY Diagnostics system and XENTRY Flash rights can do this.

The DAS4 SmartKey looks just like the previous version, but it uses more modern technology to enhance speed and security.

In German, the term Fahrberechtigungssystem (FBS) is directly translated as Drive Authorization System. In some of the Mercedes-Benz literature, you may see it referred to as FBS, although DAS is used most often. Don't confuse this with the Diagnosis Assistance System (DAS), which is a version of the diagnostic software used with older vehicles in the XENTRY Diagnosis system.

The Two Sides of DAS

In principle, DAS has two nearly independent functions: vehicle access and engine starting. In DAS4, vehicle access uses radio frequency (RF) signals exclusively, unlike DAS3 which also used infrared light. As an emergency function, two lock cylinders, one for the driver door (beneath a cover) and one for the trunk, also allow vehicle access.

Engine starting is accomplished when either the vehicle key is inserted into the Electronic Ignition Switch (EIS, or in German EZS) or the key is located within range of the vehicle and the Engine Start button is pressed. The DAS4 system performs its communication routine and, when all involved control units agree, the engine is started. More on that in a moment.

In earlier versions of DAS4, the engine-start button is a simple piece of plastic, with no electronic functionality at all, that can easily be removed from the EIS, revealing the familiar

SmartKey slot. Starting with the model 213 E-Class in model year 2017, the button is a permanent part of the dashboard, and the EIS has been relocated to the driver's footwell, inaccessible to the customer. Mercedes-Benz calls this DAS4 Generation 6. To allow for vehicle starting even with a depleted key battery, there is a special position in the console, near the ashtray, where the key can be placed.

System Design – Engine Starting

DAS4 is a composite system of five control units, each of which has a unique role in the overall system. Aside from the SmartKey, these control units are all networked via CAN Bus and share encrypted messages. We will take a brief look at each of these:

- Electronic SmartKey (A8/1)
- Electronic Ignition Switch control unit (EIS, N73)
- Engine control unit, ME-SFI or CDI (N3/10 or N3/9)
- Fully-integrated transmission control unit (ETC, Y3/8n4)
- Intelligent servo module (ISM, A80)
- The Instrument Cluster, while not TRP, also participated in the DAS4 system

The SmartKey transmitter key is similar in appearance to the DAS3 key, but with updated internal electronics having greater security and computational speed. The SmartKey has several functions, such as locking and unlocking the vehicle, as well as starting the engine, which is what we'll focus on here. More details are found in the vehicle owners manual.

Before we move on to engine starting, here are a few common troubleshooting tips concerning SmartKeys:

If there is any complaint involving key function, ask your customer to bring in all available keys. That way, you can isolate a faulty key, or be sure the correct key number is ordered as a replacement.

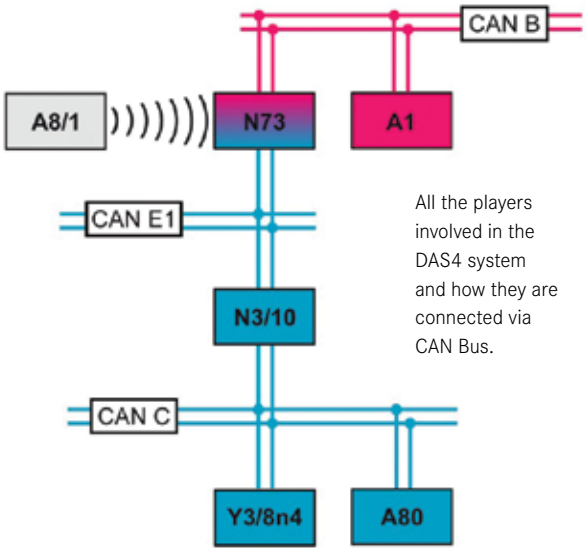
If your customer complains that the key has reduced range or is inoperative, check the battery (a single CR2032 button cell). Press and hold any key button: After a brief pause, an LED will light briefly to verify the battery is good. When replacing the battery, avoid touching it, since skin oils can interfere with electrical flow. We use a clean paper towel to handle the battery.

The Generation 6 SmartKey has a KEYLESS GO disable function: Pressing the lock button twice disables KEYLESS GO until a button on the key is pressed. If the lock button is pressed twice inadvertently, your customer may not realize it and complain that KEYLESS GO stopped working.

Electronic Ignition Switch

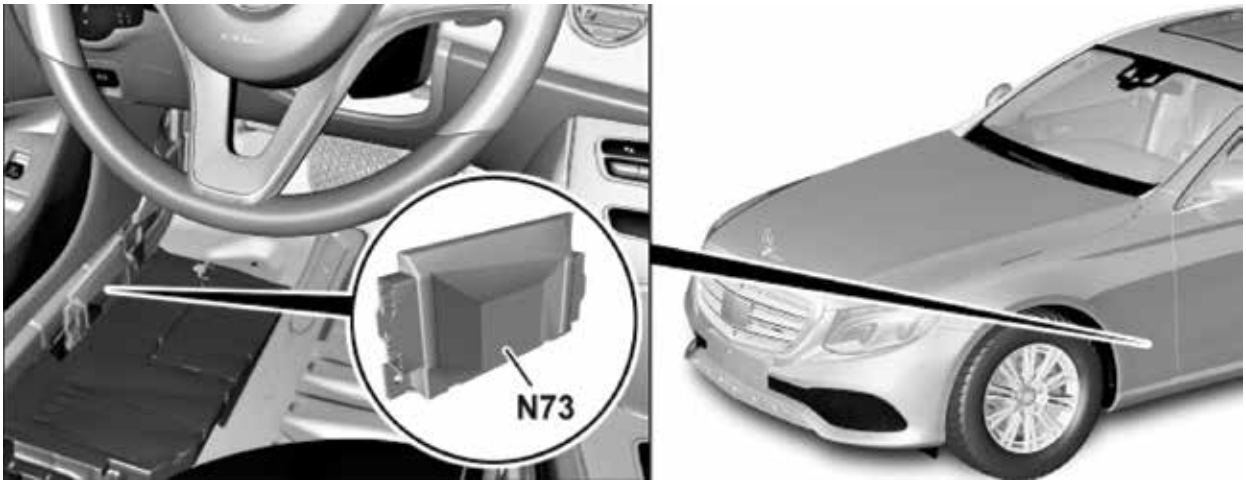
The Electronic Ignition Switch (EIS) has two basic forms: DAS4 Generation 5 (Gen5) has an EIS that looks just like the DAS3 EIS, mounted in the dash. The Gen6 EIS is mounted in the driver's footwell, inaccessible to the customer, and the engine-start button (S2/3) is mounted in the dashboard.

The conventional EIS has four positions, labeled A, B, C and D in the image to the right. When a SmartKey is

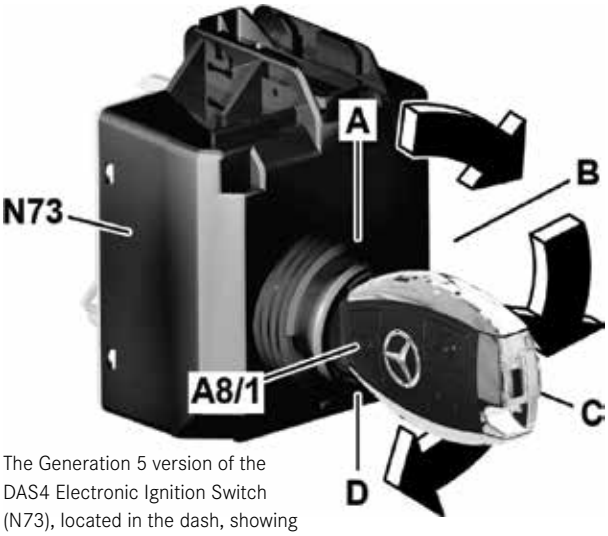


All the players involved in the DAS4 system and how they are connected via CAN Bus.

A Generation 6 DAS4 key. It doesn't go into a key slot – the customer just needs to have it nearby. This shows how the mechanical key is used to open the battery compartment.



The Generation 6 version of the DAS4 Electronic Ignition Switch (N73) is nowhere near the steering column. The engine is started with the press of a button.



The Generation 5 version of the DAS4 Electronic Ignition Switch (N73), located in the dash, showing the four key positions.

inserted into the EIS (Position A) Circuit 15C is switched on. The inductive coil surrounding the key is energized, providing enough energy for the key to send its code to the EIS through an infrared LED in the tip of the key. The EIS receives and decrypts this signal in a fraction of a second, deciding if the key is correct for the vehicle. If the key is not correct, a message is displayed in the instrument cluster.

When the key is turned to Position B, Circuit 15R is switched on. The status of Circuit 15R is communicated to control units via the interior CAN Bus and chassis CAN 1. Most accessories are then available for use, such as the radio and power windows.

If the key is turned to Position C, Circuit 15 is switched on. Again, this is communicated via CAN. At the same time, the EIS sends a coded number to each of the other DAS4-relevant control units in turn. The control unit perform a calculation on the number and sends the result to the EIS. The EIS compares the answer with its own calculation results on the same number and, if they match, that control unit is released for operation.

The actual communications are encrypted and somewhat more complicated than described. Although one can see these messages on a CAN bus, it is of no value: As long as normal CAN Bus diagnosis methods (voltage measurements, no short-to-ground or -power) show no faults, it is safe to assume the CAN Bus isn't the source of a problem.

The last step in starting the engine is to briefly turn the key to Position D: This energizes Circuit 50, engaging the starter and starting the engine. The Circuit 50 signal is sent redundantly via discrete wire and CAN Bus signal to the ME-SFI (or CDI) control module, which ultimately controls the starter. The redundancy helps ensure the engine can be started, but a fault will set a diagnostic trouble code.

Button Starting

If the engine-start button is inserted into the EIS, its behavior changes. Vehicles with the Generation 6 system behave the same way: With the brake pedal NOT pressed, the first button press is equivalent to Position B, and the second press equivalent to Position C. If the brake pedal is pressed, the first push starts the engine. In both cases – position C or engine running – another push switches the ignition off.

The engine is started (and stopped) using this button. In DAS4 vehicles equipped with the Generation 6 system, there is no key slot in the vehicle.

In the Gen 6 system, the encrypted data is exchanged between the EIS and SmartKey at the first press of the button using Radio Frequency signals: The EIS wakes up the SmartKey using the KEYLESS GO or KEYLESS START antenna system, and the key responds by transmitting its data to the EIS. If the SmartKey does not respond, a message appears in the instrument cluster: "Place key in marked location." There is a hidden inductive coil in the stowage compartment, although the exact location may vary between models. Laying the key there allows the vehicle to be started, although there is a short delay – a few seconds – while sufficient energy is delivered to the SmartKey for it to be able to respond.

Note that many newer models incorporate the KEYLESS GO system within the EIS. Refer to the Workshop Information System for model-specific details.

Process differences between DAS3 and DAS4

For a replacement EIS, the blue programming key (known from DAS3) is not used: Instead the programming of a new EIS takes place with your XENTRY Diagnosis system and XENTRY Flash access.

Unlike the pre-programmed keys used with DAS3, in the DAS4 system, keys are programmed in the vehicle, using XENTRY Diagnostics and requiring special programming rights, only available to select dealer personnel. A two-step process is used: First, the vehicle must be 'registered' to the online Daimler server using XENTRY Diagnostics,

If the key battery is depleted, the engine can still be started: Lay the key into the marked area (shown here shown in a Model 213 E-Class) and a hidden coil will deliver enough energy to the key to perform its DAS4 security functions.

This is the emergency starting slot in a Model 907 Sprinter van.

which anyone with a XENTRY system and a working key can do. Then, within 72 hours, the new key must be programmed, but this requires special permissions.

As with DAS3, there are a maximum of 8 keys ('tracks") that can be active at any moment, and a total of 3 copies of a track can be made. Speak with your dealer to determine which replacement keys can and cannot

be ordered. It helps to know which keys you already have, which can be determined by inserting each key into the EIS and reading out its track number using XENTRY Diagnostics.

In the case where all keys are lost there is no way to switch the ignition on and therefore the vehicle cannot be registered, the dealer can use the so-called Fallback Process: After completing a small pile of paperwork, Daimler performs the registration, allowing a key to be programmed. A pre-programmed key can also be purchased, but again, even MBUSA cannot program a key at their Parts Distribution Center until the vehicle has been registered. Of course, the mechanical key blade is still cut at the PDC.

1	Standard
2	Standard
3	Additional Key
4	Additional Key
5	Additional Key
6	Additional Key
7	Remote Start (USA)
8	Remote Start 2 (USA)

In the DAS4 system, there are 8 key 'tracks', six of which are available to be used for vehicle keys. If a key is lost or damaged, up to two replacements per track can be made.

So if it seems like your dealer is giving you a hard time on ordering a key, they aren't – the process is just a little more complicated.

Replacing DAS4 Components

If a careful and complete diagnosis proves that a new Electronic Ignition Switch, Engine Control unit, Transmission Contact Plate, or any other DAS4 component is needed, you can of course bring the vehicle to your local dealer to have the work done, but if you are a registered Vehicle Security Professional (VSP) using the Secure Data Release Model (SDRM) administered by the North American Service Task Force (NASTF), you can buy any of these parts from your dealer and install it yourself.

According to the MBUSA TRP policy, VSPs can buy the following parts 'over the counter' by submitting a parts purchase request via the startekinfo.com website. You can also find the policy document there. Just visit the website and click the Theft-Relevant Parts Info link.

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- Electronic Ignition Switch (EIS/EZS), including those with integrated central gateway
- Electronic Steering Lock (ESL/ELV/ESCL)
- Electronic Selector Lever module (EWM/ESM)
- Transmission Control Unit for 722.9 (VGS, TCM) including the 722.9 Repair kit
- Intelligent Shift Module (ISM)
- Engine control module (ME-SFI, CDI)

If you are a registered Vehicle Security Professional (VSP), use this website to order certain Theft-Relevant Parts. To learn how to become a VSP, visit the NASTF website. It's easy and relatively inexpensive, and is recognized by virtually all vehicle manufacturers.

Note that all other TRP items, aside from keys, may be sold 'over the counter' to any vehicle owner or authorized representative. It should go without saying that certain paperwork is required, but only what is needed to ensure that no crime is being committed and you can positively identify yourself.

OK, so you bought a new DAS4 thingamabob and you want to install it. Although the complete procedure is explained in the Workshop Information System, the short version of the process goes like this:

1. Purchase and install the new component. Return the old one to the dealer.
2. Program the new component using XENTRY Diagnostics and online XENTRY Flash rights (standard for all users of XENTRY Diagnosis systems obtained through Mercedes-Benz USA).
3. Perform version coding of the component.
4. Personalize (teach-in to DAS) the component.

Ordering TRP

We at *StarTuned* have heard stories of other Independent Service Providers (ISPs) having to jump through hoops to buy TRP from their dealer. It doesn't have to be that way.

First off, if the part you need isn't restricted to Vehicle Security Professionals (VSPs) as listed in the MBUSA TRP Policy, just visit your dealer with the correct paperwork and buy it. Couldn't be simpler.

If the part needed is one of those that is VSP-only, you can become a VSP. While we admit the process of registering with NASTF (nastf.org) may appear difficult, it really is not. Read the info on their website, watch the videos (there are dozens!), complete the registration forms and send it all in. After a few weeks – there's a background check involved – you'll get your VSP credentials.

Honestly, anyone in the car repair business should do this. VSP credentials are not limited to Mercedes-Benz. Virtually every automotive manufacturer in the United States uses the VSP program as the basis for selling theft-relevant parts.

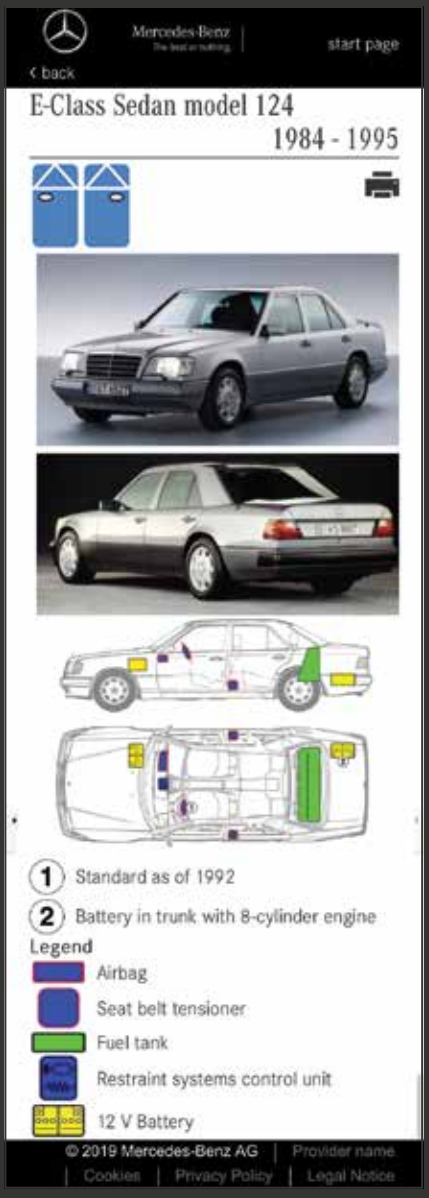
So, what "paperwork" is needed by your dealer to sell TRP? It's in the MBUSA TRP policy:

1. Proof of vehicle ownership (Original registration or title)
2. Owner's proof of identity (Photocopy of driver license)
3. Authorization: An original signed letter from the owner authorizing you to buy TRP for their vehicle. For VPSs, the completed D-1 form can be used for this.
4. Your proof of identity (Your original driver license)

Mercedes-Benz does not want to get in your way as you repair your customer's vehicle, but they are keenly interested in preventing criminals from stealing their customer's property. Surely this is also in your own best interest as well. So if you ever have any questions that aren't answered by the TRP Policy, just ask your dealer – they are happy to help.

Mercedes-Benz Rescue Assist

Critical Information for First Responder



A sample of the kind of information found after scanning the Rescue Assist QR Code for a model 124 E-Class Sedan. Labels are available at no charge for all models produced since 1990, and standard in production since November 2013.

Since November 2013, the innovative Mercedes-Benz Rescue Assist℠ has been installed in all vehicles in production. While simple in concept, Rescue Assist delivers real-world lifesaving information in critical situations where every second counts.

Rescue Assist is a pair of small labels fastened to the vehicle that contain a QR code. In passenger cars, one label is fastened to the driver's B-pillar, and the other is inside the fuel filler flap. Research has shown that at least one of these locations is accessible after an accident, even a severe one.

The QR code, which can be scanned by virtually any smartphone, leads to a dedicated website containing critical information needed by emergency personnel and other first responders about the particular vehicle model in front of them, showing the locations of key vehicle components and any special vehicle characteristics. No advertising or unnecessary information is shown, and the data is small to ensure fast loading times even if network coverage is impaired: Just the needed details, and nothing distracting. After all, there's a job to do, and perhaps lives in the balance.

For example, first responders often cut the battery cable to cut the risk of fire: The battery location is shown, and if there is a secondary battery, that's shown as well. Ideal cut points for extrication are shown, as are the locations of airbags and other potentially dangerous components. If the vehicle has high-voltage (HV) components on board, not only are their locations shown but how to deal with them.

Mercedes-Benz has produced Rescue Assist labels for all vehicles from Model Year 1990 and later, and it can be retrofitted into these vehicles at any local dealership, at no charge. You can encourage your customers to contact their local dealer to arrange installation, or visit the MBUSA website at mbusa.com/rescueassist to set it up.

As an independent shop, you've probably been in your community for quite a while and have gotten to know some of the local first responders. A few of our High School classmates are either professional or volunteer firemen, EMS, police and other first responders. On the website mentioned above, there's a link for first responders, not only showing how to use Rescue Assist, but links to QR scanner apps, a fact sheet and how-to guide.

Spend a few minutes letting your customers and local emergency services know about Rescue Assist. Just another way to show how much you really care about your customers.

C-Class Coupé

E-Class Sedan

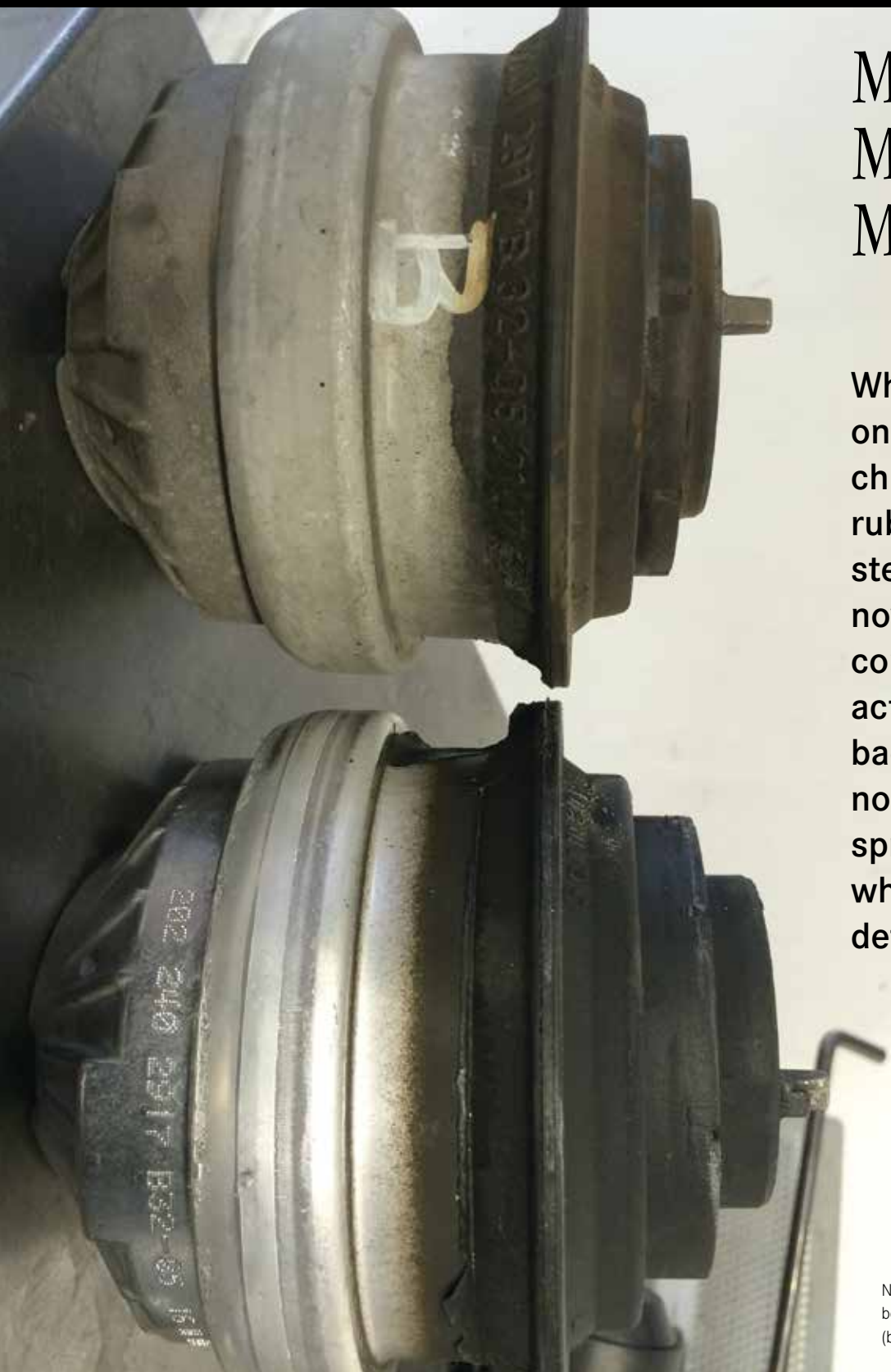
M-Class HYBRID

smart fortwo cabrio electric drive

Scan these four sample Rescue Assist codes with your smartphone to see what information is offered.

Modern Motor Mounts

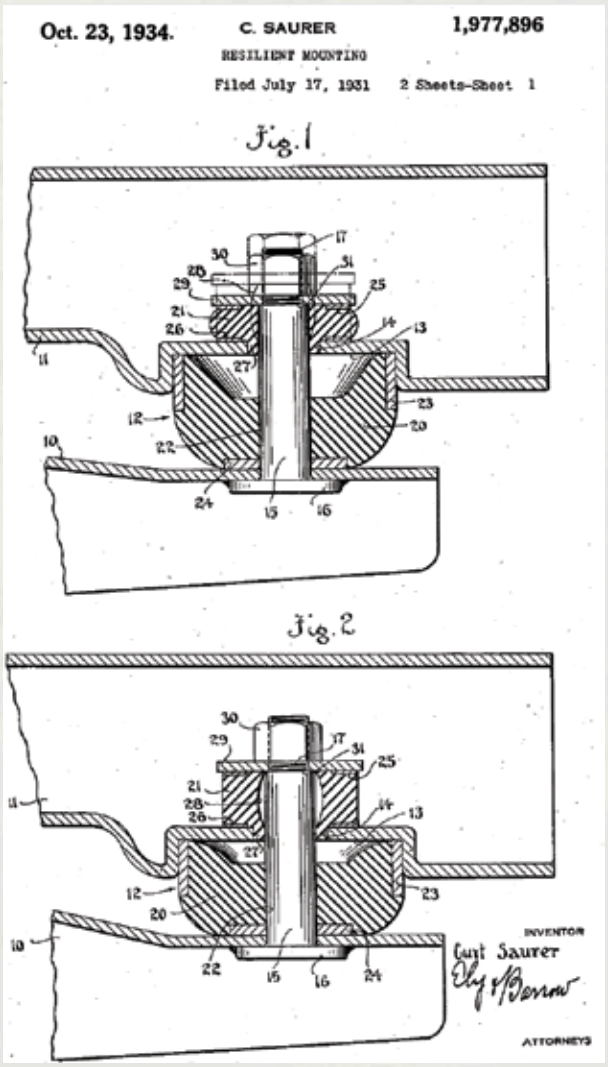
What were once just chunks of rubber and steel have now become complex and active. Expect bad vibes, noises, and spreading fluid when they deteriorate.



Note the height difference between the old (top) and new (bottom) motor mount.

"Isolate." The Oxford dictionary defines this as "...to cause (a person or place) to be or remain alone or apart from others; To identify (something) and examine or deal with it separately."

When we think of motor mounts, we often think of metal cups with rubber between, something for the engine to sit on. But today's motor mounts are quite a lot more than that: Not just fluid-filled, but active and electronically-controlled. Let's take a look at some of the newer technologies of the humble motor mount.

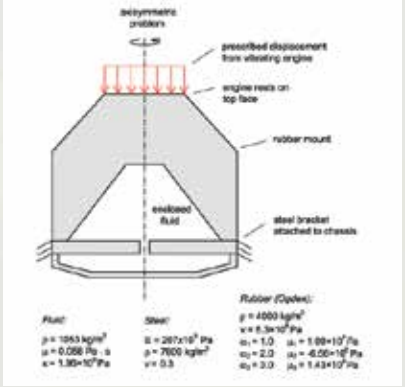


The design of an early motor mount, from the patent application. Basically rubber sandwiched between metal plates. Courtesy Google patents.

Motor (or engine) mounts have been in place for years to "isolate" the engine vibrations from the rest of the vehicle. I remember an older Norton motorcycle I owned when I was much younger that touted what was called "isolastic engine mounts", using a play on the words isolate and elastic to describe what the engineers had designed to smooth the ride of the bike.

Motor mounts not only support the engine and transmission but also dampen noise, vibration and harshness (NVH). The mounts isolate the engine and transmission from the chassis so that vibrations and noise are not transmitted to the rest of the vehicle. Since the power plant is the largest concentrated mass in the vehicle, it must be properly constrained and isolated or it will cause vibrations in the body.

If you think about it, you have all kinds of motions and energies generated during the combustion process. Pistons are traveling up and down, exploding fuel energizes and spins the crankshaft, cams and valves bounce along. Torques and other forces are applied through the drivetrain to the wheels. Now add road forces, pavement imperfections and dynamic motions as the vehicle travels down the road, coupled with the



A schematic diagram of a modern hydraulic motor mount. Courtesy ADINA.

weight of the engine and its lateral forces, and it is easy to see the that the motor mount is one of the hardest working components of the modern automobile.

History and the earliest mounts

The details of early motor mounts are a little fuzzy as to exact vehicles and ideas but one thing is certain: All the early mounts used a type of rubber or elastic material that has some flex or "give" to it, sandwiched in between two pieces of metal, fixing the power plant to the frame. An early patent granted in 1934 to Bridgestone Firestone Inc. has a mounting system described as: "springs made of rubber or other material having high internal friction, e.g. thermoplastic elastomers characterized by the mode of stressing loaded in combined stresses."

The earliest automobiles simply had the engines mounted directly to the chassis of the vehicle. These cars or carriages did not have much horsepower, torque or even much of a suspension, and the ride of the vehicle certainly was not of much concern, although better than the horse and buckboards. As cars developed much more powerful engines the need for isolation became evident.

The Need for Improvement

The obstacles that engineers are faced with solving are described in physical terms as:

1. Low frequency (1-50Hz) and high amplitude (1-2mm) vibration from shock excitations. Shock excitations are caused from driving on uneven roads, or from sudden vehicle acceleration or deceleration.
2. High frequency (30-250Hz) and low amplitude (0.005-0.5mm) vibration from unbalanced engine forces. Unbalanced engine forces are caused from the firing pulses, and from any mass imbalance that exists in the rotating and reciprocating engine parts (e.g. in the piston, connecting rod, crank, etc.).

To solve this problem, Mercedes-Benz engineers began to use hydraulic, or oil filled, motor mounts. To isolate the chassis from the unbalanced engine forces, the mount must be soft and lightly damped in the high frequency range, but to prevent the engine from bouncing under shock excitation the mount must be stiff enough and highly damped in the low frequency range. If the engine bounces with large amplitude under a shock, the engine components and surrounding vehicle structure can be damaged.

Since these two requirements are in conflict with one another, the dynamic stiffness and damping of the engine mount needs to be frequency-dependent. Hydraulic engine mounts can be highly tuned to approach an ideal stiffness which satisfies these two requirements. These mounts are much more effective than conventional elastomeric mounts whose dynamic stiffness does not readily change or adapt to the frequencies described above.

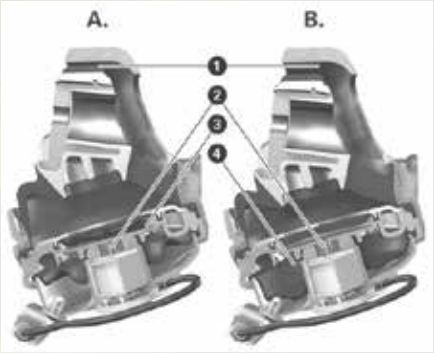
Genuine Mercedes-Benz motor mounts have been engineered to a specification that conforms to the optimal stiffness and vibration coefficient in order to give your customers the smoothest ride characteristics. Dozens of Mercedes-Benz engineers spend a not-so-small fortune testing motor mounts to ensure they are the very best possible. Cheap aftermarket mounts may look the same, but their manufacturers often cut corners and their product will fail to meet the rigid performance and longevity specifications that Mercedes-Benz demands.

Symptoms of Faulty Hydraulic Mounts

When diagnosing hydraulic mounts there is really only one obvious difference to solid mounts: the hydraulic fluid. Symptoms of faulty or failing mounts are:

1. Excessive vibration. The customer may have a complaint that they are feeling more vibration than normal, especially at idle. Some may say that the engine is running rough. Sit in the driver's seat at idle, change the engine speed a little, and engage drive or reverse to note changes in frequency or harshness of the vibration. Sometimes the passenger feels it more.
2. Noise. Excess noise such as knocking or clanking sounds from the engine compartment may be an indication that a mount or mounts are broken.

Note the clear signs of a leaking motor mount.



Functionality of the switchable engine mount

A. In the comfort position, the valve (2) is open and, as a result, permits the motion of the air suspension (3). The results is a soft range of spring (1).	B. In the driving dyamic position, the valve (2) is closed and, as a result, permits the motion of the hydraulic area (4). The result is a dynamically hard range of spring (1).

Cross section of an active hydraulic motor mount. Courtesy Lemforder.

3. Misalignment. As described above, part of the mount's job is not only to fasten, but to also align the engine and drivetrain in the vehicle at proper angles for optimum performance. An engine that is not level, or tilted at odd angles, is a giveaway that something is awry.
4. Broken or stressed hoses. Since we talked about how an engine mount aligns the power plant with the chassis, a broken or failed mount can lead to excess stretch of certain hoses. Too much strain can tear the hose, disconnect it or break off an attachment point.
5. Fluid leaking. Lastly, the main difference as we mentioned is the hydraulic mount has internal fluid. Oil residue on the engine below the mounts or dripping on the ground can be a symptom of a failed mount.

Active mounts

The "fixed tuning" of a typical motor mount is a compromise, to balance noise, vibration and harshness across a wide range of operating conditions. But when

Bulletin LI28.00-P-060078

Complaint

Humming/howling/droning noise from drivetrain.

Cause

Overlaid vibrations excited by the engine, suspension and drivetrain.

Remedy

Release stress in drivetrain. When relieving the stress in the drivetrain, make sure that the vehicle is standing with all four wheels on the ground.

Front engine mounts

1. Visual inspection of positions of the front engine mounts. They must be correctly seated in the engine support.
2. Unscrew the engine mount bolts. The thread in the engine mount must line up with the hole in the integral carrier. If this is not the case, lift the engine-transmission assembly approx. 10 mm and lower it again.
3. If the bolt is crooked, slacken the upper threaded connection of the engine mount on the engine support and position both engine mounts so that the thread in the engine mount lines up with the hole in the integral carrier.
4. Tighten the lower mounting bolts to the specified torque, lower the engine onto the engine mounts and tighten the upper bolts to the specified torque.

Unstressing the rear engine mount

1. Unscrew bolted connection between the rear engine mount and engine support.
2. Detach exhaust system transmission bracket at exhaust system pipe and in the area of the engine support, and look for stresses (e.g. exhaust system slipping upwards).
3. Raise engine-transmission assembly at the transmission so that the rear engine mount lifts off the support. Then lower the rear engine mount onto the support. The threads in the engine mount must line up with the holes in the engine support (as with the front engine mounts). If this is not the case, continue with step 4.
4. Unscrew the rear engine support mounting bolts on the body and align the rear engine support in the longitudinal and transverse directions so that the holes in the engine support and engine mount line up. Then tighten the bolts.

technology presents a new solution to a problem, Mercedes-Benz is at the forefront. Enter the active motor mount.

Electronically switchable motor mounts increase the possibilities of conventional hydraulic motor mounts. If you take a conventional hydraulic motor mount and add to it an actuator valve, some sensors and a control unit, it can be actively controlled, perfectly adaptable to any situation.

Depending on the motor excitation frequency, the motor mount dampens either hydraulically, passively or actively. The isolation characteristic is calculated by the control unit and converted by the actuator so that virtually no vibration is transmitted to the chassis of the car.

The advantages of active hydraulic dampening are:

- Improved vibrational comfort
- Improved high frequency behavior
- Customizable set-up of the mounts in terms of rigidity, damping positions, and neutral position behavior

Mounts Continue to Evolve

Further along on the technology scale are the second-generation magneto-rheological engine mounts used in the Mercedes-AMG C 63 S, for example. Unlike conventional hydraulic mounts which provide peak damping at a single frequency and amplitude, or the complexity found in actuator-valve motor mounts, the Magneto-Rheological (MR) Powertrain Mounts can provide high damping over a much broader frequency and amplitude range.

Using a special magneto-rheological (MR) fluid to change the damping rate in real time, these powertrain mounts may be “firmed up” with high levels of lateral acceleration for more direct cornering, or “softened” for maximum comfort during straight-ahead driving. Furthermore, the combination of precise control of powertrain motion with substantial elimination of noise and vibration simultaneously improves vehicle stability and interior comfort.

The mount contains an electromagnetic coil that can generate a variable magnetic flux across the fluid passages. When the coil current is turned off, the MR fluid is not magnetized, the iron particles are randomly dispersed within the fluid, and the fluid behaves like conventional hydraulic oil. When the coil is energized, the magnetic field causes the particles to align into fibrous structures in the direction of the magnetic flux. The strength of the bond between the particles in the structures is proportional to the strength of the applied magnetic field, so changing the current provides real-time variable damping with a very large range of force variation.

Testing – Diagnosis – Repair

After verifying your customer’s concern you can begin the process of repair and replacement of faulty components. Remember, no matter what type of mount you have, start with the basics: Most failures are going to be mechanical in nature. Torn elastic and leaking fluid will be the top culprits.

Begin with a visual inspection: Is the motor level and sitting at the right height? Raise the vehicle and look for signs of stress in the mounts or uneven spacing. Inspect the mount thoroughly for leaks and torn rubber. Some mounts may have obvious active leaks, but you may have one that has leaked for some time and now is empty. Check for staining around and below the mount for evidence.

1. Remove lower front and middle engine covers.
2. Remove 3 bolts (arrows) then remove right motor mount heat shield.

Note: Be careful not to contact alternator when removing heat shield.

Use care to ensure the original heat shield is in good condition. Otherwise replace it with a new one.

The second-generation MR powertrain mount installed on the AMG C 63 S.

Use a pry bar or lever and check to see if you can lift up one side or the other of the mounts. Use care in this procedure to not damage any other components. Don't forget the rear mount at the transmission.

Have an assistant power-brake the engine slightly, and look for excessive movement or lifting of the engine. Active motor mounts can set a code in the control unit, so perform a XENTRY Diagnostics quick test. You may find codes for circuit faults, short to positive, short to negative, and internal electrical faults as well as others.

An example is DTC P0AB649: *Actuation for engine mount B has an electrical fault or open circuit*. XENTRY would then guide you to identify the exact fault by testing the circuit, wiring, motor mount, and related components.

Replacing motor mounts is generally straightforward. Follow the work instructions in the Mercedes-Benz Workshop Information System, even if you think it's just a bolt-on part. Some of these newer motor mounts have special needs and procedures. Also be sure to have proper equipment to support the engine as you remove the mounts. A screw or transmission jack can be helpful in this repair.

Some models require the removal of components to provide clearance. In some cases on a 4MATIC you have to drop down the front axle. It is always a good idea to check STAR TekInfo for any possible updates or bulletins addressing the customer's concern on the vehicle. Sometimes you may have a complaint of a vibration or noise but the mounts appear perfectly normal. This can be due to the actual alignment of the mounts in the vehicle. The following is a service bulletin with exactly this problem and the solution is a simple adjustment of the mount.

When repairing or replacing mounts you will almost always find a heat shield of some sort protecting the mount. Invariably engine mounts are often in the vicinity of the exhaust system or other hot components and need to be protected. Be sure to examine these closely to be sure they are in good shape. If not, order up a new one to protect that new mount.

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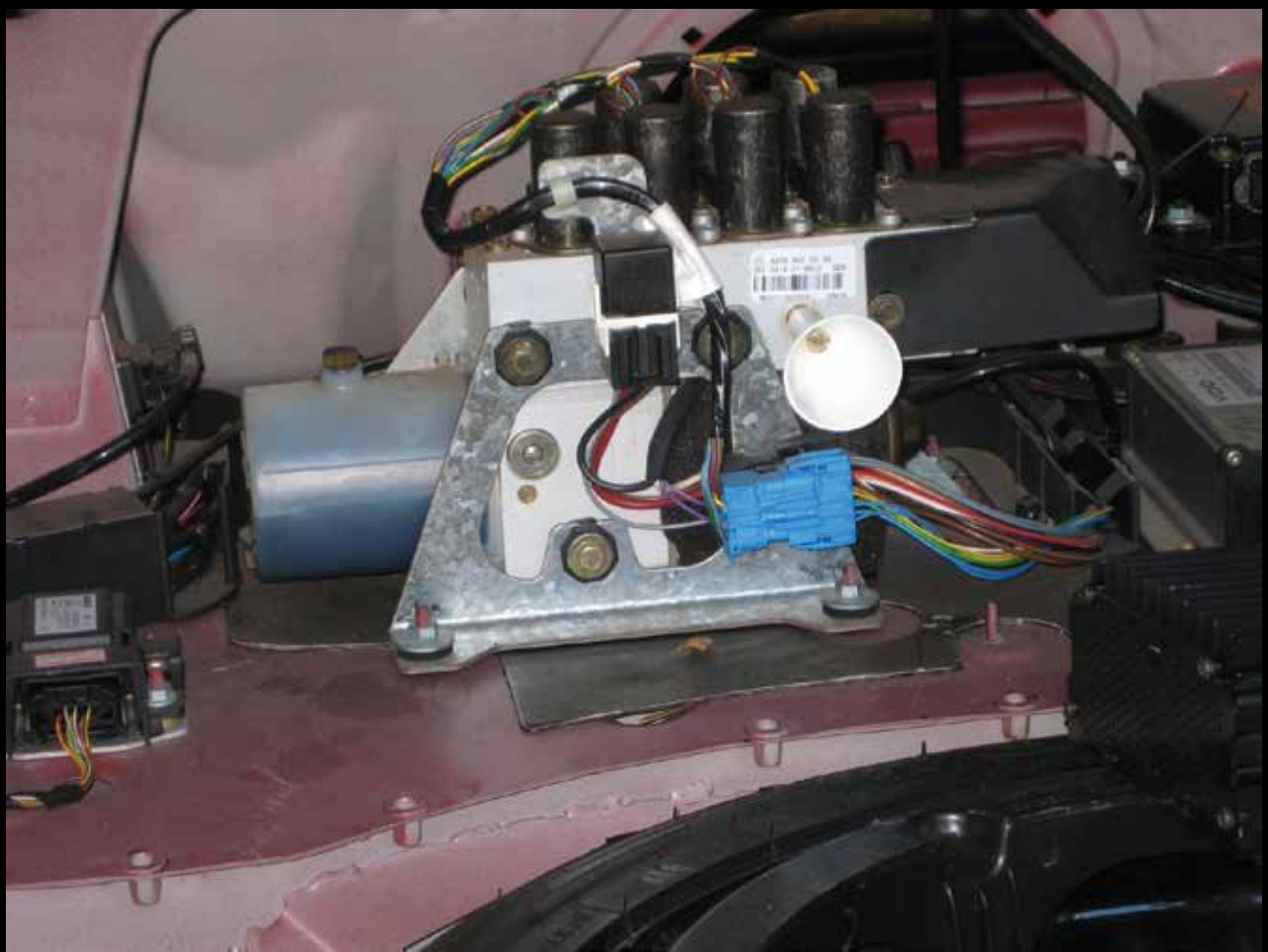
One remanufactured engine pulls the plug on climate-damaging CO_2 and saves 447 days of power for one laptop.

Soft Tops

How They Work and How to Troubleshoot Them

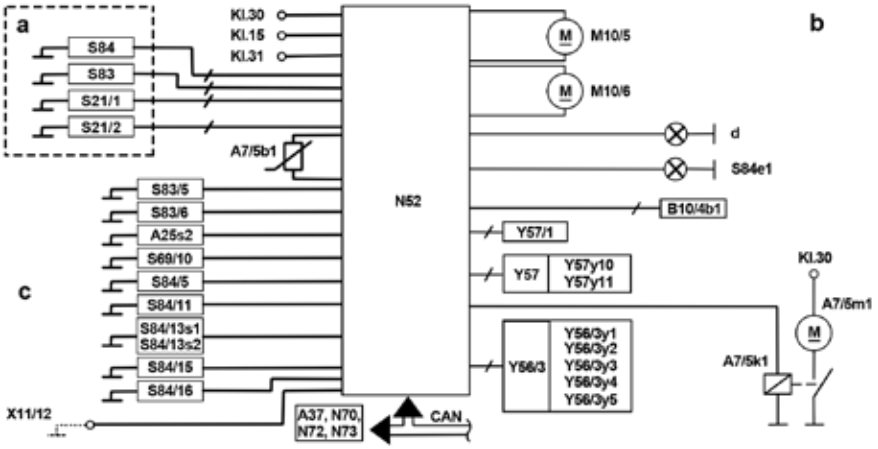
Cabriolets have always represented a challenge in car bodies.



The CLK Model 208 soft top hydraulic pump assembly in trunk. Note the plug on top of reservoir for adding fluid – torque spec is just 2 Nm, about finger-tight.

A beautiful sunny day, not too hot, temperature just right, cruising the countryside with the top down. There's nothing like it and that remains the reason convertibles and retractable hardtops are popular among driving enthusiasts. But does the lack of a roof structure mean they are flimsy? Well, no, because engineers recognize this and beef up the structure to keep them safe and dependable. According to Autobytel, the Mercedes-Benz C and E Class models are among the safest convertibles in the world. What it does mean is that there are some structural differences in car bodies when a soft top is involved.

Since a cabriolet has no fixed roof, a car loses a major part of its structural support system. Even though reinforcements are added, convertibles might not always make up for the loss of the roof. Even with the top up they tend to be noisier. Leaks can also be a concern for a soft top. Roof materials have improved considerably but as a vehicle ages, rain and heavy snow can still find their way in. There is also the issue of compromised security: A cabriolet is much easier to break into, a quick slash of the top and you're in. Exposure is also a concern: Interiors, seats, dashboards and trim can become sun damaged and cracked over time. Still, convertibles remain a popular concept and you will continue to see them in the shop, so it's important to understand how they work and how to service and repair them.



A7/5b1	Overload protection thermocouple	S69/10	Luggage compartment cover closed limit switch	Y56/3y2	Soft top open and soft top compartment cover closed
A7/5k1	Relays				
A7/5m1	Engine	S83	Roll bar manual operation switch	Y56/3y3	Soft top bow lock open and soft top bow open
A25s2	Soft top compartment cover locked limit switch	S83/5	Roll bar (RB) retracted limit switch	Y56/3y4	Soft top bow closed
		S83/6	Roll bar (RB) extended limit switch	Y56/3y5	Soft top compartment cover lock open and soft top compartment cover open
A37	Pneumatic control module (combined)	S84	Soft top operation switch		
		S84/5	Soft top compartment cover open limit switch	Y57	Roll bar (RB) valve block
B10/4b1	Temperature sensor (air conditioning)	S84/11	Soft top locked limit switch, left	Y57/1	Roll bar (RB) deployment solenoid
M10/5	Left rear power window motor	S84/13s1	Soft top closed limit switch	Y57y10	Rod-side valve
M10/6	Right rear power window motor	S84/13s2	Soft top opened limit switch	Y57y11	Piston-side valve
N52	Rollover bar (RB) / soft top operation control module	S84/15	Soft top bow bottom/top limit switch		
		S84/16	Soft top bow locked limit switch		
N70	Overhead control panel control module	S84e1	Soft top operation indicator lamp and status display	a	Inputs
				b	Outputs
N72	Lower control panel control module	X11/12	Test connector for soft top control system (for performing actuations with the hand-held tester)	c	Limit switch
N73	Electronic ignition / starter switch control module			d	Warning lamp in roll manual operation switch (S83)
S21/1	Left front power window switch (front center console)	Y56/3	Soft top operation valve block (5 connections)		
S21/2	Front right power window switch, front of center console	Y56/3y1	Soft top closed and soft top compartment cover closed		

The latest function diagrams, such as this one showing the CLK Model 208 soft top system, are a must when diagnosing convertibles. Each model is different, so always get an original from WIS.

Theory and Operation

Any analysis of the soft top or retractable hard top (vario-roof) operation of Mercedes-Benz vehicles will be futile at best without access to the latest function and wiring diagrams. Engineers are continuously improving upon the function and ease of use in the convertible top function, so it's important to consult the most current data and workshop information. Here is a rundown of a 208 CLK chassis with a soft top. Others may be similar but again, changes and improvements are constantly being made.

Opening the soft top consists of an 11 stage operation. The following stages are adapted from WIS document GF77.30-P-2002KA:

Stage 1

Pull down and turn the release lever at the windshield header to the clockwise and gently push up the front of the soft top about 8 inches. Return the release lever to its stowed position. The indicator lamp in the soft top operation switch (S84), located on the center console, lights.

Note: If the indicator lamp flashes slowly, there is a malfunction. If it flashes rapidly, the trunk lid and/or luggage cover may be open and needs to be closed. Remote trunk release is not possible until the soft top is completely open.

Pull and hold the symbol side of the soft top switch. For safety reasons the opening procedure is interrupted immediately at any time if the switch is released.

Stage 2

The side windows at the front and rear are opened electrically. The roll bar is lowered hydraulically if it is up.

Stage 3

The soft top bow is unlocked hydraulically.

Stage 4

The soft top bow is pivoted hydraulically until in an approximately 90 degree position.

Stage 5

The soft top compartment cover is unlocked hydraulically.

Stage 6

The soft top compartment cover is pivoted upward hydraulically.

Stage 7

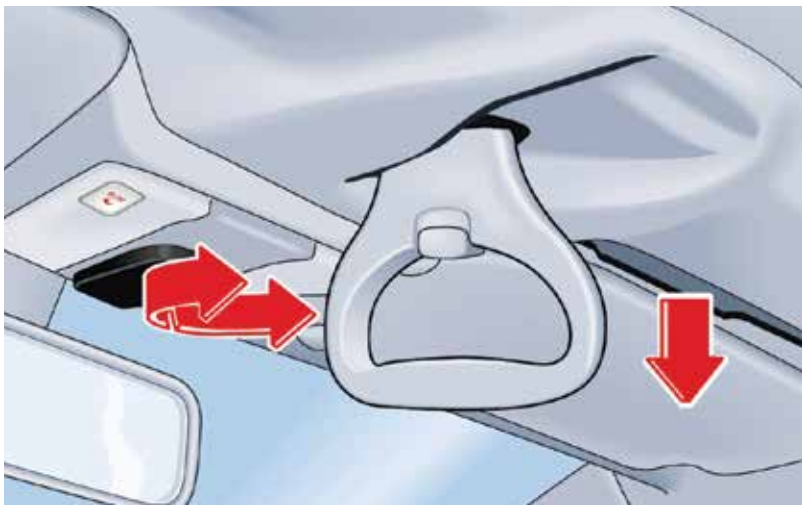
The soft top bow is moved hydraulically into the soft top compartment.

Stage 8

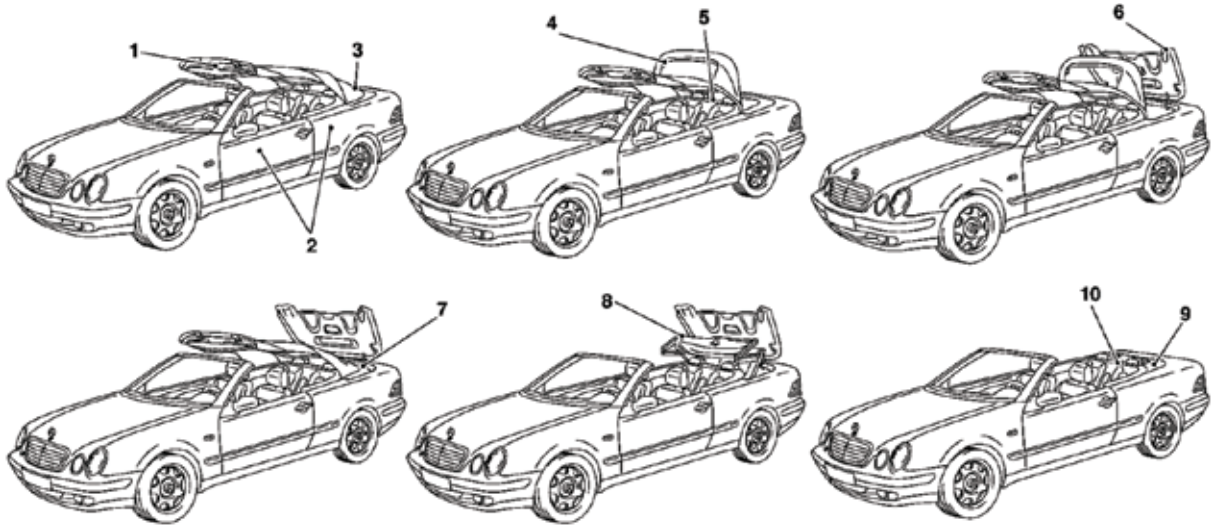
The soft top is moved hydraulically into the soft top compartment. The temperature sensor (B10/4b1) for the air conditioning is automatically switched to ground by the roll bar/soft top operation control module (N52).

Stage 9

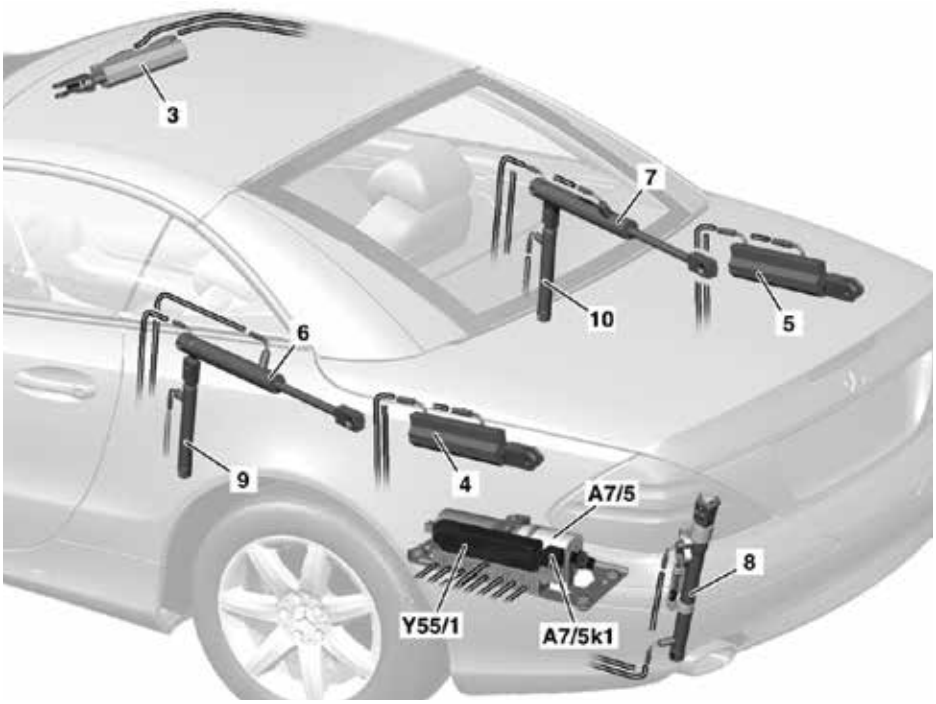
The soft top compartment cover is pivoted downward hydraulically.



The release lever at the windshield header starts the top opening sequence in CLK, Model 208.



Understand what is supposed to happen during the soft top operating sequence is critical to troubleshooting.



w	Hydraulic cylinder, front Vario roof latch
4	Hydraulic cylinder, left tubular frame latch
5	Hydraulic cylinder, right tubular frame latch
6	Left Vario roof hydraulic cylinder (opening/closing)
7	Right Vario roof hydraulic cylinder (opening/closing)
8	Trunk lid hydraulic cylinder
9	Left load assist hydraulic cylinder (lift/lower)
10	Right load assist hydraulic cylinder (lift/lower)
A7/5	RVC [UVS] hydraulic unit
A7/5k1	Relay
Y55/1	RVC [UVS] valve block

Typical vario roof components. Become familiar with the model you are working on and the components of the system to ease troubleshooting and repair work.

Myriad hydraulic lines offer greater opportunities for leaks. The foam cover is needed to dampen pump noise.

Stage 10

A signal sounds from the overhead control panel control module (N70) confirming the correct operation. The indicator lamp in the switch switches off.

Stage 11

If the switch is held, or released and lifted again within 2 seconds, the side windows at front and rear are closed and the roll bar raises if it was initially raised.

It is important to note the even after the individual limit switch positions have been reached, the corresponding hydraulic cylinder still remains actuated for a short time to compensate for tolerances of the limit switch switching points. The closing operation is basically the reverse of the opening procedure, with safety and pinch protection built in.

Troubleshooting

Understanding each stage of operation can be of great help in diagnosing and troubleshooting soft top failures. Very often the customer's concern is going to be a failure of the top to open or close, or a stopped operation somewhere in between. A careful analysis of

the stage where an operation fails, combined with an understanding of which components are involved at that stage, will greatly aid in diagnosing faults.

When confronted with a customer complaint, the first step is to find what isn't working. Try to operate the top using the switch. If it works, but stops at a certain point, you need to first identify which limit switch is supposed to be signaling the top's position, and find out why it isn't doing its job. Easily said, but it can be time-consuming in practice. Again, the information in WIS is essential to understand what is supposed to happen and when.

If completely inoperative, check the obvious first: Are the trunk and luggage cover closed and engaged in the limit switch? Operation switch OK? Fuses OK? Power & ground to the hydraulic pump OK? Don't neglect the limit switches that are needed at the end points (open or closed).

With a Mercedes-Benz XENTRY Diagnosis tool, all these tasks are greatly simplified, since XENTRY displays not only the actual values of all the switches and circuits, but contains excellent diagnostic trees and supplemental information to make this a breeze.

Electro-Hydraulic Operation

The Mercedes-Benz Workshop Information System (WIS) documents show how each stage of operation is governed by electric or hydraulic (or both) systems. Determining which of the two are at fault, while still considering a mechanical fault (bent or broken component), is your first step in diagnosing a customer's concern.

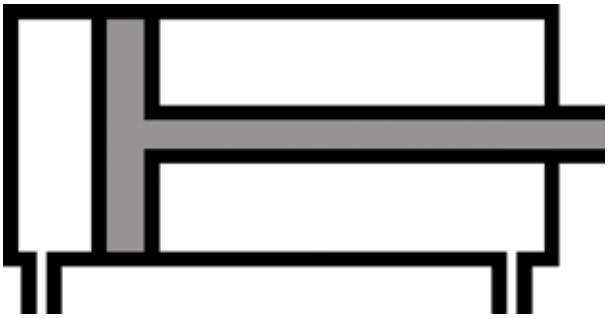
One of the most common failures in the field where there is a complaint of no or limited soft top operation is that the hydraulic fluid is low, thereby impairing the operation of all the hydraulic rams.

If you have a XENTRY Diagnostics system perform a quick test for any fault codes. Make sure vehicle system voltage is sufficient, as low voltage can have an effect. Then verify that the hydraulic fluid reservoir is sufficiently full.

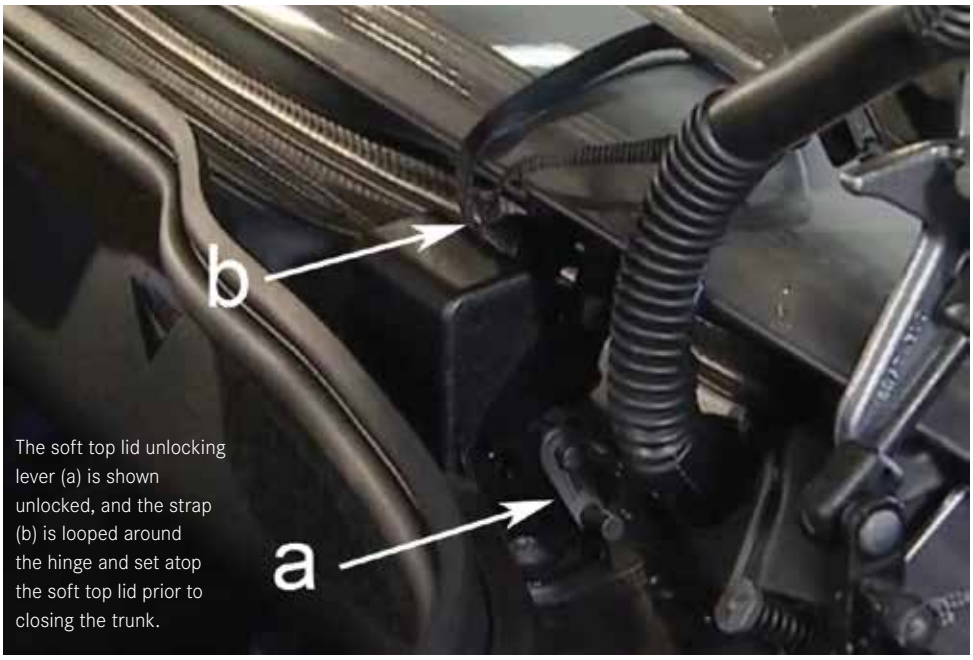
In Model 208, the pump is found forward in the trunk compartment. Visually check the fluid level and top up if necessary. Note that the torque spec on the plug is just 2 Nm, which is just barely finger-tight. Be sure to use the correct fluid, MB specification 343.0 or higher, corresponding to part # A000 989 91 03 10.

In other models, follow the WIS instructions, since the top may need to be open or closed when checking the fluid level.

Bleeding the system after topping up or making repairs is necessary. Most top systems are self-bleeding. With



A schematic diagram of a dual action hydraulic cylinder. Pressurized fluid enters one end, pushing the piston and rod towards the other end.



The soft top lid unlocking lever (a) is shown unlocked, and the strap (b) is looped around the hinge and set atop the soft top lid prior to closing the trunk.

the engine running to ensure sufficient system voltage, operate the roof four complete open-close cycles to fully bleed the system. Some noise is normal as the pump aerates in the process.

The hydraulic system is a closed system, so if you find you have had to add fluid then there must be a leak. Probable components are the lines, hydraulic cylinders, and the pump itself. Carefully inspect all of the items and replace as necessary using the correct WIS repair information. The lines are plastic and susceptible to damage over time, particularly in vehicles exposed to inclement weather and harsh conditions.

Hydraulic Cylinders

All hydraulic cylinders operate on the same principle: Push pressurized fluid in, and the piston on the cylinder is moved, as long as the outlet isn't blocked. So, fluid behind the piston extends the rod, and fluid in front of the piston retracts it. Because the area of the rod subtracts a small amount from the piston's effective area, a cylinder pressurized equally on both sides will extend: With the same number of pounds per square inch, the piston end has a little more square inches, so more pounds of force result.

Manual Operation of the Soft Top

When the top is completely inoperative, you will need to manually operate the top to inspect components or make repairs and adjustments. The following applies to a model 207 E Class cabriolet, and assumes the top is retracted, but as previously mentioned always consult the workshop information for the procedure used in a specific model.

Apply the parking brake and remove the key. Lower the head restraints automatically or manually. Open the side windows and get the 6mm Allen wrench from the owner manual packet. Also get the two black straps from the vehicle tool kit.

Open the cover in the trunk on the left-hand side to get to the pump, and move the foam covering aside. Open the brass valve screw for the hydraulic unit using the Allen wrench by turning it one turn counterclockwise. The hydraulic system is now unpressurized.

Next, open the perforated trim on both sides in the trunk – you may have to cut the trim with a knife. Pull out the black lock knob on the lid cylinders, up to the end stop, and then turn the lock 90° counterclockwise. Make sure that the lock is not pulled back in again. The soft top compartment lid is now unlocked.

On each soft top compartment hinge is a lever – flip these levers down. Take the straps and pass them behind the top of the hinge and through the resulting loop so you can pull on them. Lay the straps onto the soft top compartment lid - do not pull on the straps while the trunk lid is still open. Where applicable, remove the Allen wrench and the vehicle key from the trunk. Close the trunk lid.

Caution: Keep the trunk lid closed, or there may be damage to it or the top lid. Two people are absolutely required for these next steps, or the top will get twisted from uneven force!

Using the straps, pull the rear of the soft top lid to the rear and upwards. Lift the front of the soft top compartment lid until it is vertical. Hold it there.

Each person needs to reach deep into the soft top compartment, under the top, and lift the top from the compartment until it unfolds and rests gently on the windshield header. Move slowly.

Pull off the roof lock cover behind the overhead control panel. Open the lock by turning the Allen wrench clockwise up to the end stop. Press the top down gently into the latches, and turn the Allen wrench counterclockwise to the end stop. The soft top is now preliminarily latched at the windshield frame.

Move the soft top tensioning frame (rear bow) to a vertical position and lower the soft top compartment lid. Then apply a flat hand to press the soft top tensioning frame downwards, until it makes contact with the base of the soft top compartment lid. Push the soft top tensioning frame forwards/down until it engages in the guide. Then lock the roof lock on the front of the windshield frame by turning the Allen wrench counterclockwise up to the end stop. The roof is now closed.

Care and Maintenance

Care of the soft top material is primarily the responsibility of the vehicle owner. Keeping the material clean and cared for will extend the life of the top. Your Mercedes-Benz parts department can help your customers choose the right products for the job.

Keeping the fluid up and inspection for leaks, proper fit and smooth operation are the primary maintenance items.

Typical concerns to be addressed are going to be wind noise, leaks, rattles, and rough operation. When dealing with noise concerns, especially rattles, ensure that the customer removes all personal belongings from the vehicle before the vehicle analysis. It is extremely helpful to have the customer accompany you on the test drive to demonstrate the complaints.

Although discontinued, individual components of the Mercedes-Benz Noise Damping Service Kit are available, each used for various kinds of noises and materials.

Dry and dirty seals are the most common cause for creaking, cracking and ripping noises while driving. Clean the seals thoroughly with a cloth and mild detergent, then apply the special antifriction agent A000 989 36 60 (liquid) with a clean cloth.

Rattling noises, particularly on rough roads, from the windshield header could be caused by mis-adjusted latches or worn components. The trick is to drive the car to reproduce the condition, while a passenger listens to locate the source. A paper towel tube is an effective way to focus your hearing to a specific location.

Air and water leaks need to be localized. Temporarily cover suspected leak areas or cracks making wind noise with masking tape. In the vehicle, use a passenger to cover suspected areas with a cloth to see if wind noises change or disappear. While the top itself has few adjustments, the doors and windows have several, and a problem with any of them means a noise or leak.

These are examples of just a few areas where noises can develop over time. There are dozens of pivot points and adjoining areas where you may have noise complaints.

A good idea for dealing with all retractable roof systems roof systems is to develop a maintenance package that consists of cleaning, lubricating and adjusting all moving parts and pivot areas.

Tools such as this can aid the technician in finding those pesky squeaks and rattles. Photo courtesy Steelman.

Mercedes-Benz recommends the use of the Betasonic 1000M ultrasonic noise kit: Ultrasound is transmitted inside the closed vehicle while a special receiver is used. Even the smallest crack will allow the tiny ultrasonic sound through, making localization of leaks fast and easy. A remote microphone system like ‘Chassis Ears’ is also a potentially useful tool for noises originating outside the passenger compartment.

Working on convertible tops can appear daunting with all the various hydraulics, control units and complicated pivoting and locking systems in place. Start with the basics, get a complete and accurate description of the concern from the customer and take the maintenance and repair in stages.

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On occasion we all need a helping hand. Your PartsPro dealer is there to assist. Whether it means providing diagnostic assistance, information on supplies or special tools, or anything else you may need, your PartsPro dealer is there to assist you in repairing your customers' Mercedes-Benz vehicles and getting them back on the road as fast as possible.

Only those dealerships that meet the stringent certification requirements earn the right to display the "PartsPro" logo. Additionally, they receive ongoing consultation and training to ensure that they are consistently providing the very best support to you, the ISP customer.

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Mercedes-Benz Mobil 1

Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil 1 Formula M 5W-40	BQ 1 09 0197	Bulk - No Equipment	Fully synthetic formulas designed specifically for gasoline passenger cars	Low SPAsh. Available at most M-B dealers
	BQ 1 09 0195	6/1 Quart Cases		
	BQ 1 09 0196	55 Gallon Drum		
Mercedes-Benz GEO 229.5 5W-40	A000989790211BIFU	Liter	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A000989790217BIFU	208 Liter		
	A000989790219BIFU	Bulk - No Equipment		
Mercedes-Benz High Performance EO 229.5 0W-40	A000989810211BIBU	Liter 5KG	Fully Synthetic formula specifically designed for Mercedes-Benz AMG engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A000989810217BIBU	208 Liter 15KG		
Mercedes-Benz GEO 229.6 5W-30	A000989820211BJEU	Liter 40KG	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.6 Specification	Mercedes-Benz Engines that require 229.6 Specification Oil
	A000989800217BJEU	208 Liter 20KG		
Mercedes-Benz GEO 229.71 0W-20	A000989830211BNXU	Liter 35KG	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.71 Specification	Mercedes-Benz Engines that require 229.71 Specification Oil
	A000989830217BNXU	208 Liter 15KG		
Mobil 1 0W-40	BQ 1 09 0010	Bulk - No Equipment	Fully synthetic formulation designed to meet the requirements of many European vehicles	Porsche A40. Many European vehicles. HT/TS applications.
	BQ 1 09 0015	6/1 Quart Cases		
	BQ 1 09 0016	55 Gallon Drum		
Mobil 1 ESP X1 0W-30	BQ 1 09 0184	Bulk - No Equipment	Advanced full synthetic formulas designed specifically for diesel passenger cars that have particulate filters	Low SPAsh. Available at most MB dealers
	BQ 1 09 0182	6/1 Quart Cases		
	BQ 1 09 0183	55 Gallon Drum		
Mercedes-Benz GEO 229.52 5W30	A000989800219BMEU	Bulk - No Equipment	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.51 and 229.52 Specification requirements	Mercedes-Benz Engines that require 229.51 Specification Oil
	A000989800211BMEU	Liter 170KG		
	A000989800217BMEU	208 Liter 50KG		
Mobil 1 5W-50	BQ 1 09 0133	16 Gallon Keg	Higher viscosity, advanced full synthetic formula designed for performance vehicles	Porsche A40. HT/HS applications.
	BQ 1 09 0194	6/1 Quart Cases		
Mobil ATF 134	BQ 1 09 0166	55 Gallon Drum	Extra high performance automatic transmission fluid formulated with selected HVI base oils	Recommended for use in Mercedes-Benz automatic gearboxes
Mobil 1 ESP Formula MB 5W-30	BQ 1 09 0165	12x1 Liter Cases	Advanced full synthetic formulas designed specifically for passenger car diesels that have particulate filters	Low SPAsh. Available at most MB dealers.
AdBlue® ½ Gal.	A 000 583 0107	1/2 Gallon Bottle	Non-toxic solution that transforms harmful Nitrogen Oxide (NOx) emissions from diesel-powered vehicles into harmless water vapor and nitrogen	Recommended for use in Mercedes-Benz, Volkswagen + BMW AdBlue® (DEF) applications
Diesel Exhaust Fluid 55 Gal	BQ 1 47 0002	55 Gallon Drum		
Mobil 1 5W-30	BQ 1 09 0017	6/1 Quart Cases	Advanced full synthetic formulation designed to meet the requirements of many domestic, including GM, and imported vehicles	Vehicles that require 5W-30. Corvette approved.
	BQ 1 09 0018	55 Gallon Drum		
Mobil 1 10W-30	BQ 1 09 0019	6/1 Quart Cases	Advanced full synthetic formula designed for domestics and imports	Vehicles that require 5W-30 or 10W-30
	BQ 1 09 0020	16 Gallon Keg		
	BQ 1 09 0021	55 Gallon Drum		
Mobil 1 5W-20	BQ 1 09 0083	6/1 Quart Cases	Advanced full synthetic formulation designed to meet the requirements of many newer vehicles including Hondas, Fords, Chryslers, and newer Toyotas	Vehicles that require 5W-20
	BQ 1 09 0084	55 Gallon Drum		
Mobil 1 0W-20 AFE	BQ 1 09 0169	6/1 Quart Cases	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 0W-20 (newer Toyotas and Hondas), 5W-20 and certain hybrids
	BQ 1 09 0168	55 Gallon Drum		
Mobil 1 0W-30 AFE	BQ 1 09 0174	6/1 Quart Cases	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 5W-30 or 10W-30
Mobil 1 Synthetic ATF	BQ 1 09 0164	6/1 Quart Cases	Multi-vehicle, fully synthetic fluid designed to meet the demanding requirements of modern passenger vehicles	Vehicles that require Dexron III, Ford Mercon and Mercon V performance levels
	BQ 1 09 0163	55 Gallon Drum		

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Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil 1 15W-50	BQ 1 09 0023	55 Gallon Drum	Boosted, higher viscosity, advanced full synthetic formula designed for performance vehicles	HT/HS applications. Racing and Flat tappet applications
	BQ 1 09 0022	6/1 Quart Cases		
Mobil 1 Gear Oil (Mobil 1 Gear Lube 75W-90)	BQ 1 09 0085	12/1 Quart Cases	Exceeds the most severe service requirements in both conventional and limited slip applications	SUITABLE for use in modern high performance automobiles like SUV's, Vans and Light duty trucks requiring API GL-5 level performance
Mobil Special 5W-30	BQ 1 09 002464	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0171	12/1 Quart Cases		
	BQ 1 09 003064	55 Gallon Drum		
Mobil Special 10W-30	BQ 1 09 003164	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0172	12/1 Quart Cases		
	BQ 1 09 003764	55 Gallon Drum		
Mobil Special 10W-40	BQ 1 09 003864	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN/SMSL/SJ oil is preferred or recommended
	BQ 1 09 0173	12/1 Quart Cases		
	BQ 1 09 004464	55 Gallon Drum		
Mobil Special 5W-20	BQ 1 09 012464	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0170	12/1 Quart Cases		
	BQ 1 09 013264	55 Gallon Drum		
Mobil Special 20W-50	BQ 1 09 004664	55 Gallon Drum	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN/SMSL/SJ oil is preferred or recommended
Mobil Delvac 1300 Super 15W-40	BQ 1 09 0053	Bulk - No Equipment	Extra high performance diesel engine oils that help extend engine life in the most severe on and off-highway applications while delivering outstanding performance in modern, high-output, low-emission engines including those with Exhaust Gas Recirculation (EGR) and Aftertreatment Systems with Diesel Particulate Filters (DPFs) and Diesel Oxidation Catalysts (DOCs)	Specifically recommended for the latest low-emissions, high performance diesel applications equipped with aftertreatment systems using Diesel Particulate Filter (DPF) and Diesel Oxidation Catalyst (DOC) technologies
	BQ 1 09 0058	12/1 Quart Cases		
	BQ 1 09 0059	4/1 Gallon Cases		
	BQ 1 09 0060	55 Gallon Drum		
	BQ 1 09 0179	6/1 Quart Cases		
Mobil Delvac 1300 Super 10W-30	BQ 1 09 0086	Bulk - No Equipment		
Mobil Delvac 1 5W-40	BQ 1 09 0051	4/1 Gallon Cases	Fully synthetic supreme performance heavy duty diesel engine oil that helps extend engine life while providing long drain capability and fuel economy for modern diesel engines operating in severe applications	Recommended for use in all super high performance diesel applications, including modern low emission engine designs with Exhaust Gas Recirculation (EGR)
	BQ 1 09 0052	55 Gallon Drum		
Mobil Grease XHP 222	BQ 1 09 0078	60/14 oz Cartridge	Formulated to provide excellent high temperature performance with superb adhesion, structural stability and resistance to water contamination	Recommended for industrial and marine applications, chassis components and farm equipment
	BQ 1 09 0079	120 lb Keg		
	BQ 1 09 0080	400 lb Drum		
	BQ 1 09 0098	40/14 oz Cartridge		
Mobil Lube HD Plus 80W-90	BQ 1 09 0096	120 lb Keg	Extra high performance, automotive lubricant formulated from select base oils and an advanced additive system specifically for limited-slip differentials	Recommended for use in limited-slip differentials, axles, and final drives requiring API GL-5 level performance
	BQ 1 09 0097	400 lb Drum		

Mercedes-Benz Power Window Tips

Normalization solves many power window problems, and is as easy as pressing and holding a button.

Mercedes-Benz power window issues can result from something as simple as a temporary interruption of power supply to a window motor or other component in the system, and are easily repaired. Shown here is the 2019 E450 Sedan.

Some power window problems are hardware related, solved by repairing or replacing damaged cables or connectors, cleaning or substituting new for corroded components, or lubricating moving parts. In the unlikely event of failure of a computerized control unit, replacement is the solution.

More often than not however, Mercedes-Benz power window issues are simply the result of an interruption of power supply to a window switch, motor or control unit. Automatic functions such as one-touch opening and closing of windows, anti-pinch and other features require the door control unit to determine the current location of the window relative to a stored reference point. Power loss erases stored data that tells the controller where the window is in relation to the desired position.

The driver or passenger may still operate the window manually, but can no longer effectively use one-touch automated functions. Without the correct location data the controller may still operate the power window motor, but one-touch automated actuation may move the window to an unintended spot.

Normalization

When window location data is wiped out the power window motor is said to be denormalized. The solution to denormalization is to help the computer relearn the location of the open and closed positions of the window, and it does not require a wrench or much labor time. You pull or press the window adjustment switch to move the window through its full range of up or down motion, and hold the switch for about a second at its end stop.

This teaches the door control unit the location of the power window's full open and closed positions, and stores the data as reference points in the door control unit database. The process of setting the reference points for power windows (and other movable components, such as sunroof and seats) is called normalization.

Once the reference points are reset, the window is again normalized. You can perform normalization manually or using the Mercedes-Benz vehicle diagnostic system. Similar procedures apply to normalization of the seats, sunroof and roller blinds, if equipped.

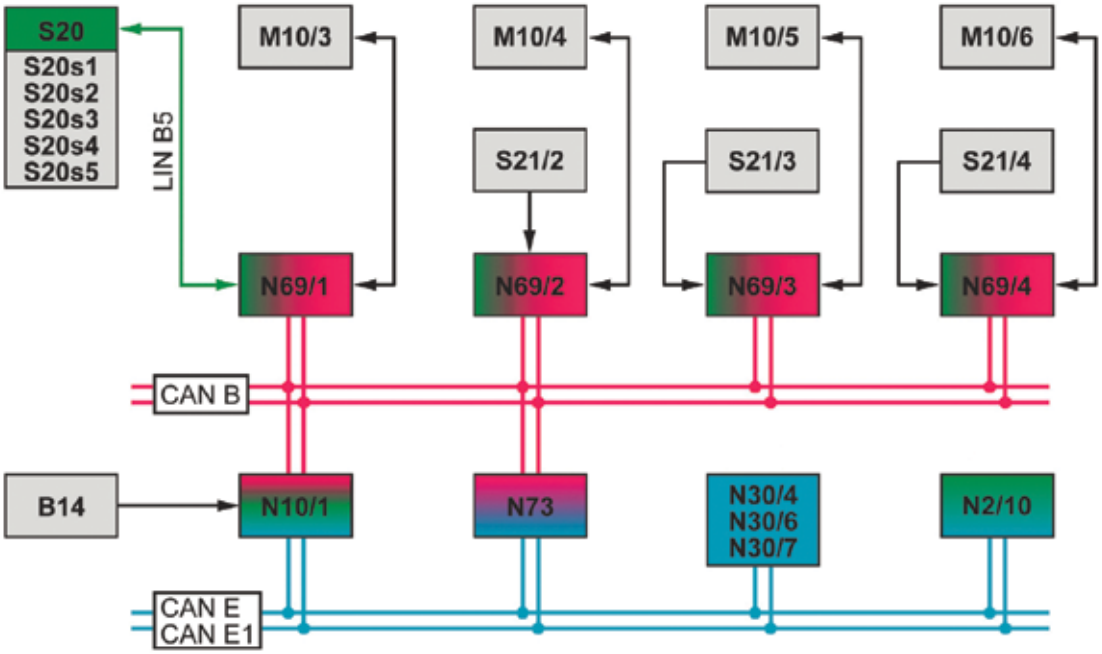
You must perform normalization after any situation that causes the control unit to lose its stored reference point value for the window. Loss of reference point data can occur due to collision impact or other damage to the power window wiring or connectors, or simply from disconnecting the power supply to the circuit.

Hall sensor signals

The window closed position is the reference, or zero point for Mercedes-Benz power side windows. Movement from closed to fully open and back establishes the range of adjustment possible for the window.

Once the reference point value is set, the door control unit determines the actual position of the window using signals from the Hall sensor in the power window motor. Algorithms in the door control unit translate the number and speed of rotations of the power window motor armature into a numerical value for each possible location of the window relative to the closed (reference point) position. This location counter uses the window reference point as its zero value. The location count increases as the window is opening and decreases when it is closing.

When the location counter value exceeds the maximum amount the window can travel when opening, or goes below zero when closing, the control unit interprets the data as an indication that something is wrong. The power window is denormalized and the control unit ceases any automated window functions. Similarly, if the control unit receives no Hall sensor signals when a given power window motor is actuated, it shuts down automated functions for that window. The cause of the fault is stored in the door control unit.



This diagram shows the motors, switches, control units, network connections and wiring that enable Mercedes-Benz power windows on the 2018 E350 4MATIC to function. Component designations that begin with the letter "M" indicate a motor, "S" a switch, and "N" a control unit. Understand the connections between the various components and you are better prepared to diagnose potential problems.

Electric motors raise or lower a mechanical lifter to close or open a power side window. Each motor is connected to a control unit at each door, e.g., the left front (LF) power window motor (M10/3 in the power window circuit diagram above) connects to the LF door control unit (N69/1). The control unit receives signals from a power window switch located in the door panel (S20) and actuates the power motor to raise or lower the window depending on which direction the switch was pushed.

There is an individual power window switch at each door (S20s1, S21/2, S21/3, and S21/4). To allow the driver control of all windows, there are also power window switches for each of the four doors in the driver-side door (power window switch group - S20). The driver's door controls overrule commands from any of the other door control units. There's also a rear door cutoff switch (S20s5) that, when actuated, prevents the switches in the rear doors from operating the rear windows, part of the child safety system.

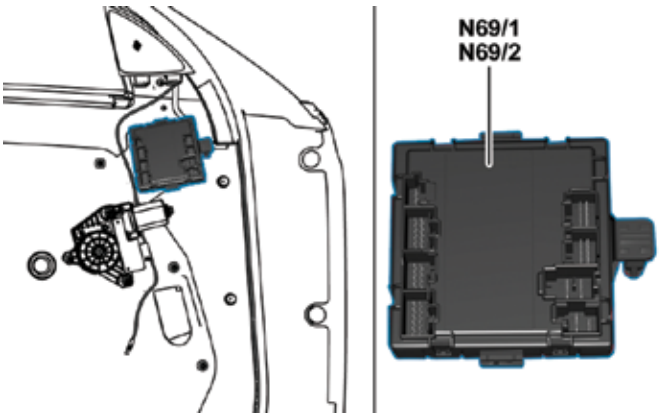
Each door control unit allows manual (hold the switch until the window has moved to the desired position) or automated operation (pull or press the switch for a fraction of a second to actuate automatic operation) of that door's window. A Convenience feature (for vehicles

Power window control switches in the door armrest (shown on the 2017 E-Class Sedan) feature one-touch automated or press-and-hold manual operation.

so equipped) enables actuation of all windows and the sunroof simultaneously.

In the Model 212 E-Class, all door control units connect to the front SAM control unit (N10/1), which includes the fuse and relay module, through CAN cabling (CAN B) that services interior devices. If the power window does not work at all, check the fuse for the appropriate door control unit. If the fuse is ok, check connectors and wiring between the fuse, the relay module, and the power window switches for faults.

A faulty power window switch can cause problems. Using XENTRY Diagnostics simplifies checking the switches, using the Actual Values menu. If you don't have a XENTRY machine, then check Mercedes-Benz STAR Wiring for the correct input and output voltages at each switch. Note that in some models, the switch may be networked instead of voltage-coded. If the switch is functioning properly, there are other components in the system that may contribute to power window faults.



The front door control units actuate the power windows. On the 2013 and newer Mercedes-Benz E350 4MATIC (212 model) the door control units (N69/1, N69/2) and power window motors are located in the door module behind the door trim.

Technicians normalize the side windows, sunroof (shown here on the 2017 E-Class Sedan), and roller blinds (if equipped) by simply pressing and holding the appropriate actuation switch for a short time at its start and end points.

Door control units interact with control units for the electronic stability program (N30/4, N30/7) and if so equipped, regenerative braking system (N30/6) as well as the SRS control unit (N2/10). The controllers connect to each other through the chassis CAN (CAN E or E1). If the electronic stability program detects an impending impact or rollover event, the ESP control unit, as part of the PRE-SAFE® function, actuates the power window motors to raise the windows to help prevent passenger ejection or injury. Check CAN lines between the power window motor, its switch, and the ESP and regenerative braking control units for wiring or connector damage.

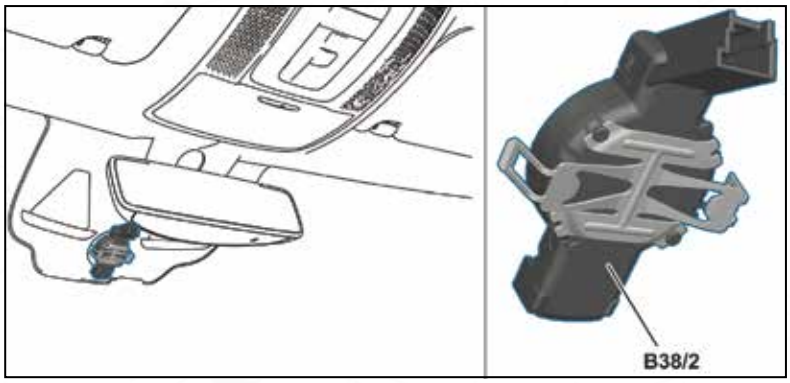
Normalization of the power window motor is quick and easy. It involves raising the window to its end stop, holding the control button for at least three-tenths of a second (300 milliseconds) longer, then releasing it. This sets the location counter to zero for that closed position, and end point normalization is complete. Note that these normalization instructions apply to the 2018 E350 4MATIC. The hold time or other procedural steps may differ for other Mercedes-Benz models or different build years – check the owner's manual.

Relearn for each automated device

You must set the end or reversal point for each automated component that has become denormalized. Window-related automated features on Mercedes-Benz models include controls for the side windows, sunroof, and roller blinds. Each can become denormalized if damaged or after loss of power, and require a reset (normalization) to restore automated function.

For each component the objective is the same. Move the window, sunroof, or roller blind to its end or reversal point and hold it for the specified amount of time for the control unit to store the location information in its memory. Refer to the vehicle owner's manual or repair information in the Mercedes-Benz Workshop Information System (WIS) for specific device normalization procedures.

This end point relearn allows the control unit to capture the Hall sensor signal output that represents the exact number and speed of motor armature rotations for each different automated power window position. The control unit stores the data in location counter numeric values. Window movement down increases the count, up decreases it.



The Rain and Light Sensor (B38/2) checks for moisture outside the vehicle, and sends signals when appropriate to close or partially close power windows and the sunroof. It is located on the inside of the windshield near the inside rearview mirror.

Once the controller learns the end point for each automated device, it uses the number and speed of motor armature rotations to determine where the component is in its potential travel range. This allows the technician to set only the end point, and not have to set every location or stop in that device. The controller calculates the number of motor armature rotations and speed necessary to move the window, sunroof, or roller blind to the pre-set location requested by the one-touch (automatic) button or lever.

Signals that appear to be outside the specified range for a given device cause the control unit to cancel automated function of that component. For example, when the rear window roller sun blind is actuated for more than 15 seconds, the sun blind is denormalized. If the voltage of the on-board electrical system is too low, the roller sun blind is also denormalized.

The control unit calculations enable movement to the correct positions for all automated devices. This includes ability to close the sunroof and all windows simultaneously (convenience closing function), full or partial window and sunroof closing when it rains, PRE-SAFE closing in potential collision situations, opening windows for post-crash ventilation, and anti-pinch, which backs the glass a slight distance from a hand or other blockage it detects in its path.

Following are examples from the 2013 E350 4MATIC of automated power component functions that are enabled by normalization.

Rain closing

When it rains, the rain/light sensor (B38/2) signals to the door control units to close side windows either completely or until only a small gap remains open. It also sends signals to an open sliding or panoramic sliding sunroof (if so equipped) to close and raise to the tilt position, or if it is a heavy rain, to close completely.

The rain and light sensor assembly includes, among other things, technology to detect the presence of moisture on the windshield.

A transmitter beams infrared light at a specific angle to the exterior of the windshield. When the outside of the windshield is dry, the infrared light is almost completely reflected back to the rain sensor. If there are water droplets outside on the windshield, a portion of the light is diverted. The lower the light intensity received back to the sensor, the higher the degree of wetting it measures on the windshield exterior. Refer to WIS for information on diagnosing rain sensor input and output issues.

PRE-SAFE (if equipped)

When the Mercedes-Benz electronic stability program or regenerative brake system detects a collision or otherwise unstable vehicle status, the ESP or brake control unit requests initiation of PRE-SAFE. Included in PRE-SAFE are commands to the door control units to raise the side windows, to reduce passenger ejection risk and minimize injury. On the E350 4MATIC, this automatically raises the side windows to within 4 mm of the end point (upper stop). Refer to the Mercedes-Benz Workshop Information System (WIS) for application-specific instructions to set and normalize automated power window functions on PRE-SAFE equipped Mercedes-Benz models.

The ESP and regenerative brake system control units transmit their requests for PRE-SAFE window actuation via chassis CAN (for models built up to February 28, 2013), chassis CAN 1 (models built as of March 1, 2013),

front SAM control unit, and interior CAN to the front and rear door control units. The front and rear door control units then directly actuate the power window motors. Refer to the wiring diagram to see where to test on PRE-SAFE equipped Mercedes-Benz models whether or not signals are getting transmitted from the chassis CAN or chassis CAN 1, front SAM control unit, and interior CAN to the front and rear door control units.

Crash deflation

Triggering of air bags, seat belt pretensioners, and other pyrotechnical restraint equipment releases smoke particles in the vehicle interior. The side windows then open automatically, creating a slight gap to allow smoke to quickly disperse.

The Supplemental Restraint System (SRS) control unit (N2/10) transmits the collision signal to the front and rear door control units, which then actuate the power window motors. The signals travel to the door control units in the same way as with PRE-SAFE, explained above.

Anti-Pinch Function

Movable components such as the windows, sunroof and roller blind are equipped with an anti-pinch function. This systems helps prevent injury or damage if a window, for example, meets an obstruction while automatically closing, such as if your dog sticks her head out the window at the wrong time.

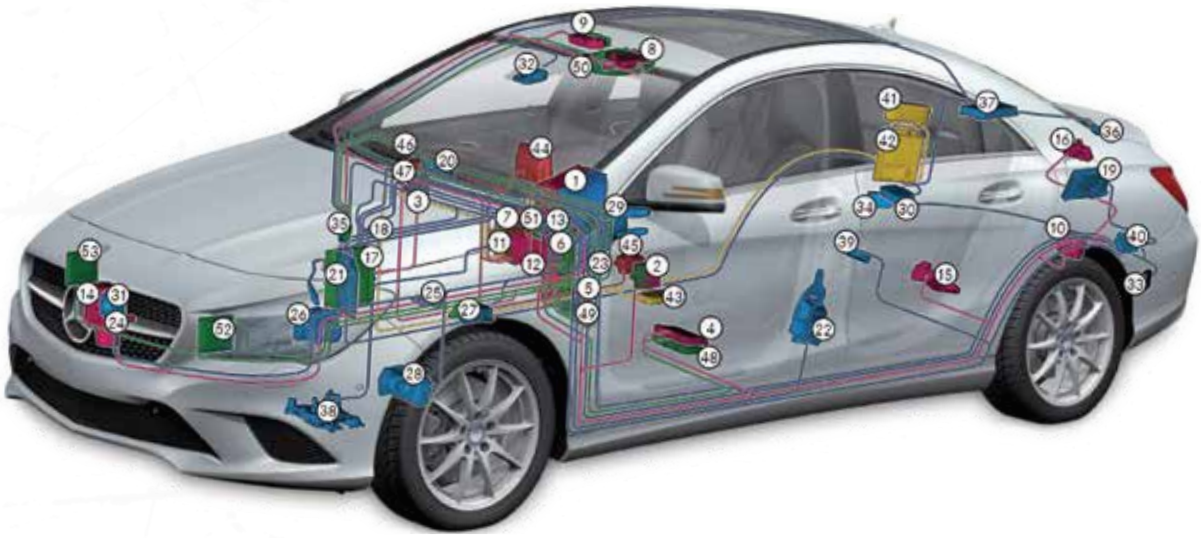
The control unit monitors the motor speed by examining the pulses from the Hall sensor and, if the motor slows more than a certain threshold, the automatic operation stops and the window (or other device) reverses slightly. However, conditions such as wear and dirt, moisture or ice in the mechanical components can create forces that slightly impede movement.

If these forces are not large enough to engage the anti-pinch function, the movement characteristics are learned and stored in the control unit, to prevent inadvertent triggering of the anti-pinch function.

In severe cases, it may be necessary to clean or adjust the guide rails or window glass to allow for smooth operation. Frameless doors, such as those found in roadsters and convertibles, have several possible adjustments, any of which can cause problems if incorrect. Check WIS for the adjustment possibilities for your specific vehicle. To find any binding points, remove the motor and carefully operate the system by hand.

The motors themselves either contain a thermal fuse, which temporarily disables the motor when it overheats, or the control unit calculates the motor temperature based on operating time. In the latter system, overheating protection is canceled for the reversing action of the anti-pinch feature.

Mercedes-Benz window, sunroof, and roller blind technology is far more sophisticated than that of just a decade ago. But when you understand the system's operation, use and repair is still as easy as pressing a button.



Modern Mercedes-Benz models use extensive networking to enable innovative functions. Wiring diagrams show physical connections, but only the Function Diagrams show the information that passes through the network. Without this information, diagnosis can end up as an exercise in tail chasing. Here, the networks found in a model 117 CLA-Class.

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