StarTuned®

Information for the Independent Mercedes-Benz Service Professional

December 2016
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Inside:

Preventing Electrostatic Discharge Damage
The Intelligent Servo Module
Wiring & Function Diagrams & Descriptions
Careful Adjustments Keep Special Tops Working Great

Mercedes-Benz

Who's Your *Part*ner in Success? Mercedes-Benz's PartsPro

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StarTuned®

December 2016

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, on-line 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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Visit us at our web site MBWholesaleParts.com to view this issue and past issues of *StarTuned*®, along with a wealth of information on Genuine Mercedes-Benz Parts.

Visit mbusa.com to locate a Mercedes-Benz dealer near you.

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Zap!

Preventing Electrostatic Discharge Damage

You've seen the big sparks rubbing your feet on a carpet can cause. All that voltage can perforate delicate – and expensive! – electronics. How to ground it out.

Electrostatic Discharge (ESD) is rarely a concern in most shops, but it should be. Even as recently as 20 years ago, most car parts weren't sensitive to ESD, but that's dramatically different today. It's actually very easy (and cheap!) to prevent ESD problems, while the consequences of not doing so can cost you thousands in damaged parts and even more in lost trust with your customers.

So what is ESD anyway? Well, the human body is a big capacitor, and, as we know from basic electronics classes, a capacitor stores voltage in an electrical field. When we knock electrons off of a surface, they can build up on us, and when we come into contact with an electrical conductor, we short out our "capacitance" and discharge all those electrons literally in a flash. Ever walk across a carpet in winter when the air is dry and get zapped by a "static electricity" spark when you touched, say, a door knob, or some other metal object? That's ESD in action.

Thousands of volts

These harmless sparks are just a small nuisance to us because even though they comprise thousands (!) of volts, the amount of electrical current (which is the part that's deadly to humans) is very, very small. But get down to the tiny scale of a semiconductor used in a transistor or integrated circuit and those thousands of volts, even at a microampere of current, is cause for alarm since damage is almost guaranteed.

Those of us in the northern regions of the country, particularly during cold, dry winter weather, know all about static electricity – that little sting is an annoyance. But let's face it, the folks in Florida, Texas, Louisiana and other southern states with heavy humidity, particularly in the summer, have absolutely nothing to fear from static electricity since the moisture in the air shorts out our internal capacitor, rendering us ESD-safe. Unless, of course, we remove the humidity with air conditioning (something few shops have).

We all know what static electricity is, and that the spark created when we touch a conductor is what we mean when we say Electrostatic Discharge. But why is this a problem for auto repair shops? The simple answer is that auto makers – Mercedes-Benz included – have used ever more powerful electronics in their cars in recent years. Semiconductor manufacturers, in their efforts to make faster and more powerful, yet less expensive, components, have made the microscopic features of their parts smaller than ever before.

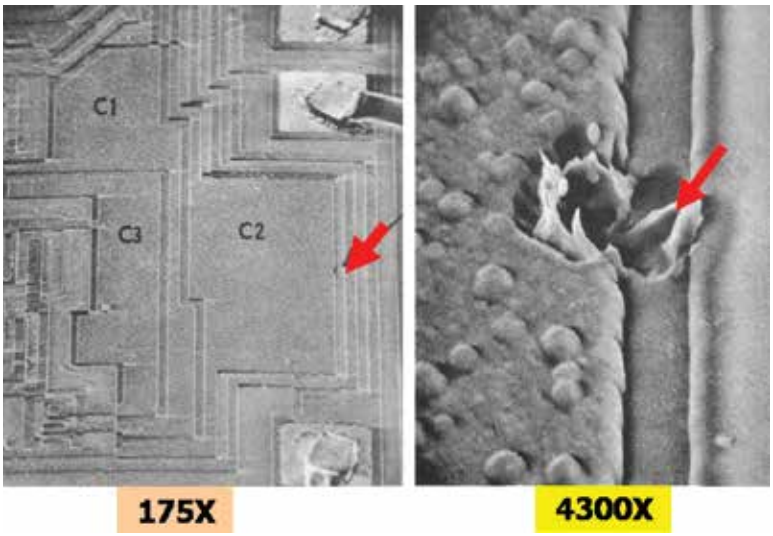
In the semiconductor industry, smaller means more efficient and faster, and the state of the semiconductor art has us seeing features on a scale of about 14 nanometers (0.00000055 inches), or about the width of 90 Silicon atoms. Parts with features this small – and even those many times larger – are extremely sensitive to high voltages. So, letting these voltages come into contact with the electronic control units we so commonly see in cars today is a recipe for disaster.

In some cases, when we let a spark jump from our finger onto a control unit, we kill the control unit instantly. You plug it in, but it either doesn't work at all, or many of the functions are simply dead. It's hard to tell why, but you just know that it's not working. But even ESD you can't see or feel – just a few hundred volts – still causes problems.

Walking wounded

In most cases of ESD damage, we create what is known in the industry as the "walking wounded." This is where the component has been damaged, but not enough (yet) to prevent something from working. What happens is that, over a short time, the damage gets stressed and becomes worse and worse until the part finally fails completely. These faults are the most challenging for repair shops because we not only don't know why the part failed, but we can expect a hit on our reputation as "the part we just replaced" fails. And, as we all know, without a good reputation, you're out of business.

Take a look at the image of the damaged semiconductor: The damage doesn't go completely through the chip's "wiring," but with a chunk like that taken out we can easily understand that it won't be long before the whole thing fails. The folks at NASA and JPL (Jet Propulsion Laboratory) take this stuff seriously since retrieving a $500 million satellite for repairs isn't practical. For us as ISPs (Independent Service Providers), it's not quite as serious, but thankfully it's easy to make sure we're handling the expensive, high-tech components of our customers' cars safely.



These images show the damage to an integrated circuit caused by Electrostatic Discharge (ESD). At a magnification of 4,300 times, the "crater" in the silicon is plainly visible. ESD damage can let the circuit keep working for a while, but it will eventually fail. A simple wrist strap can easily prevent this. (Courtesy JPL.)

Studious avoidance

If it's humid, say above 50% relative humidity, we generally won't see or feel ESD sparks. But nobody should rely on high humidity to prevent ESD damage because even then it is possible to build up enough of a charge to cause trouble if the conditions are just wrong. So that means you techs down on the gulf coast, say, need to heed these precautions just as much as those up in the cold, dry north.

Okay, so we know what ESD is and how it causes damage. What can we do about it? There are few things you can do, and the good news is that none of them is expensive, inconvenient, or difficult.

Whether labeled or not, treat any components that arrive in ESD-safe packaging the same: Only open the packaging on an ESD-safe mat after you've donned your ESD wrist strap.

The first step towards eliminating ESD damage is to handle electronics properly. Never touch the connector pins, even on the wiring harness side since that wire might lead to a pin on another control unit. After disconnecting a connector, only touch the outside of the control unit's housing.

A second step is to discharge yourself any time you're working near electronics that might be sensitive. To do this, simply touch a larger piece of metal (but not metallized plastic!). The inherent conductance of the metal will equalize your body's voltage and remove the residual charge. By "larger" we're not talking about your keys, but something a little more substantial, like the car body or even just the door handle.

One step that does NOT work against ESD is a metal work surface: Covering the top of a workbench with aluminum or galvanized sheet metal is not "ESD-safe." Instead of safely bleeding off the charge gradually, it instead conducts the ESD voltage more efficiently to the sensitive component, just making the danger zone for ESD larger. The same effect comes from wrapping a part in aluminum foil – that's worse than nothing. That's why you see some parts arrive in special ESD packaging: That special grid or coating on those silvery or pink bags has

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some resistance, which bleeds off the voltage instead of conducting it right to where you don't want it.

Ground strap

These two steps can get you though 98% of a typical day, mostly because you're not often working directly on ESD-sensitive parts. For the other 2% of the time, there's one more step you should take: an ESD strap. That is, a small "bracelet" made of stretchy (and electrically-conductive) cloth, with a means of attachinb a wire. The wire goes to either the building ground (through a grounded electrical outlet or cold water pipe, for example), or the vehicle ground, depending on which is more convenient for you. You attach an alligator clip to your ground point, and the extensible cord keeps things comfortable. You should be reminded to use it any time you get a spare part that has ESD packaging around it – put on the strap before opening the package.

The strap does conduct electricity, but not very well. ESD straps generally have a built-in resistance of several thousand Ohms. Wearing a home-made metal strap, for example, is a very bad idea because this sets you up for a dangerous electrocution risk. Even if the electricity conducted by an all-metal strap doesn't kill you (and it can!), the metal can get very hot and cause serious burns if enough current passes through it. The bottom line: Use only a purchased dedicated ESD strap, and never one that does not have built-in resistance.

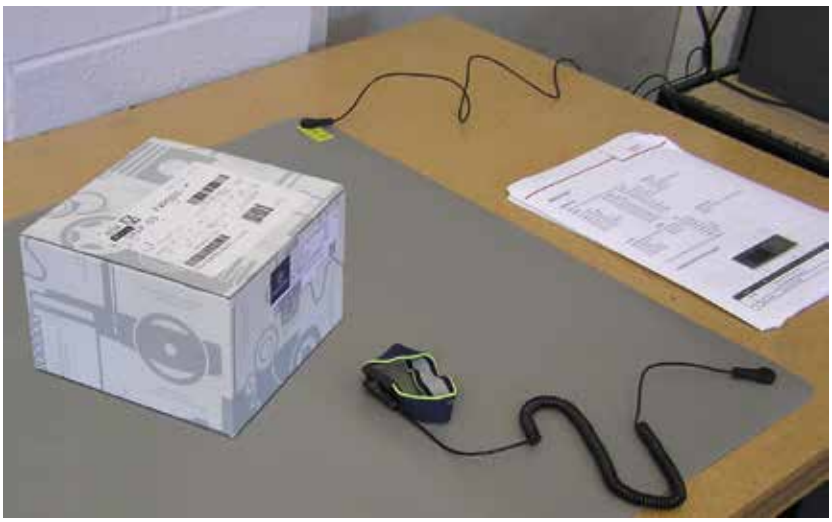
We work with our hands, so a strap might get in the way. No problem, just wear it on your ankle! It works just as well, and we've found that it stays out of the way.

A good ESD strap can be had for less than the cost of a Starbucks coffee, and if you shop carefully you can get one for less than the cost of a newspaper. So price is no excuse for not purchasing this essential piece of gear. Sure, when you were working on 124s nobody needed an ESD wrist strap, but let's face it: A new 222 S-Class has more computing capacity than the space shuttle (!), so it should be clear that times have changed.

Mercedes-Benz offers a complete ESD Kit under Part Number W000 589 52 98 00, which you can get from your local dealer. The kit includes not only a high-quality wrist strap, but an ESD mat for your workbench and some convenient grounding options. Similar kits are also available commercially, since ESD safety is not limited to the automobile industry.

As we work on newer and newer cars, we automotive technicians must take action to prevent Electrostatic Discharge from causing damage. The damage isn't visible since it's hidden inside the semiconductors, and it also isn't always obvious right away. If we don't do anything about it, we can expect customer complaints and comebacks, with the inevitable dent in our reputation, along with the costs for fixing what we broke. Yet, it is easy and inexpensive to be 100% protected against ESD damage with a wrist strap, along with some common sense. So, there's no excuse not to add ESD protection to your toolbox today.

Don't ignore these labels: They are there for your own protection. No sense installing a pre-damaged part. Protect your customer's car and your reputation by following the simple and inexpensive ESD safety procedures.



The Mercedes-Benz ESD protection kit includes a high-quality ESD wrist strap, a durable ESD mat for the top of your workbench, and cables to easily connect these elements together and to a source of earth ground. Using this kit helps minimize the risk of damage from ESD to sensitive electronic components.

Now comes the best part.

Along with a total commitment to customer satisfaction, a PartsPro dealership can offer:

- Access to over 300,000 readily available Genuine Mercedes-Benz Parts
- A dedicated, factory-certified wholesale team
- Multiple daily deliveries and hot-shot deliveries where available
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Plus, a complimentary consultation to help streamline ordering and avoid costly delays.

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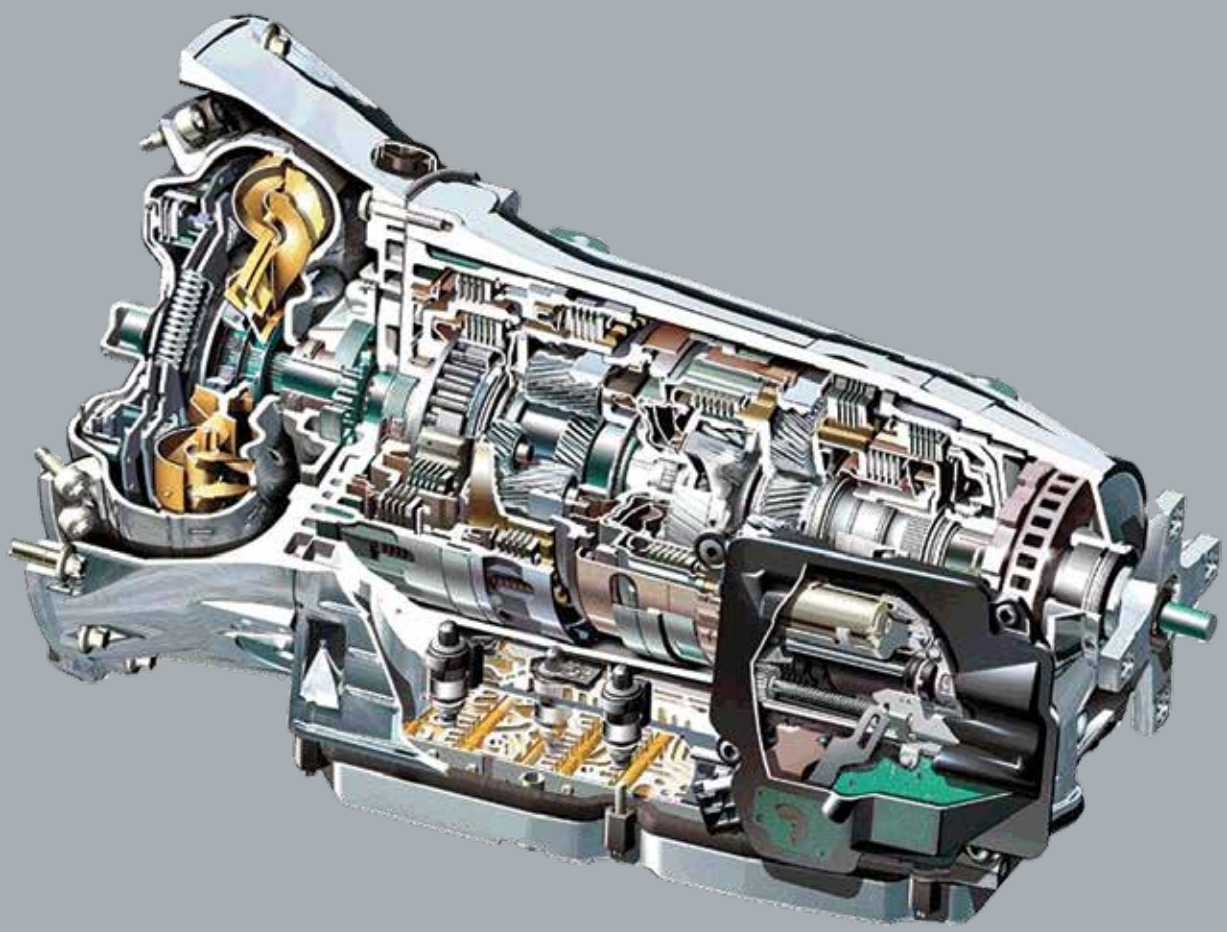
The Intelligent Servo Module



The 722.9 New Automatic Gearbox 2 (NAG2) automatic transmission replaced the shifting linkage in some versions with an Intelligent Servo Module, or ISM.

Back in the day, selecting the auto trans gear was a mostly mechanical affair: a gear shift lever attached to a linkage, moving an arm on the side of the transmission. Just after the turn of the century, Mercedes-Benz came out with its 722.9 New Automatic Gearbox 2 (NAG2) automatic transmission, and replaced the shifting linkage in some versions with an Intelligent Servo Module, or ISM. In a future edition of StarTuned, we plan to talk about the care and feeding of the 722.9 transmission, but for today we're going to focus on the ISM. These cars are most certainly showing up at your shop, so here's what you need to know about this new technology.

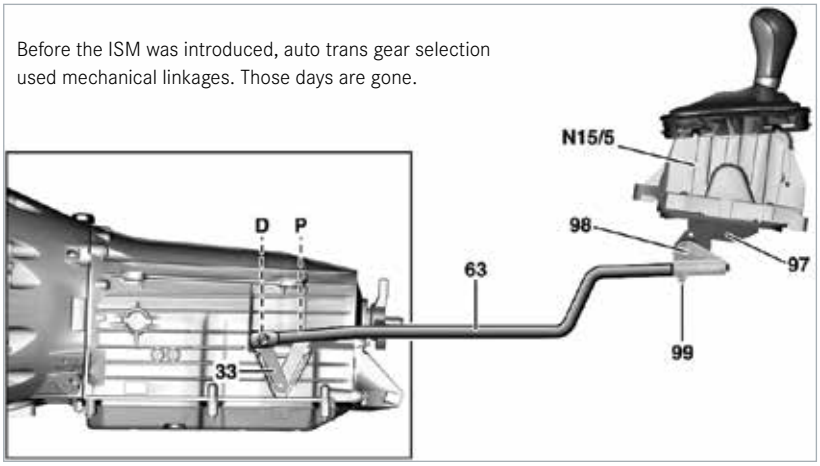
Even in models from just a few years ago, the shift lever and linkage arrangement served us well. Sure, you sometimes had to replace those plastic bushings on the linkage, and the shift-lock adjustment could get a bit fiddly, but for the most part things were good. As almost purely mechanical systems, they were also fairly easy to troubleshoot, repair, and replace.

But the stylists were just itching to get rid of that gear shift level taking up valuable real estate in the center console, and the engineers were looking for something that not only used fewer mechanical parts, but increased vehicle security as well. Thus the ISM was born, in support of the DIRECT SELECT system.

Little lever tip-off

You can spot a car equipped with DIRECT SELECT by the shift lever mounted to the side of the steering column. Unlike the column-shift levers of the past, this is an electrical switch: Tap once down for Drive, and once up for Reverse, and press the push-button on the end to put the trans into Park. (Some models have a conventional-looking shift lever – if there's a button for Park, you know it uses DIRECT SELECT as well).

Before the ISM was introduced, auto trans gear selection used mechanical linkages. Those days are gone.



From a few feet away, the task of the ISM is remarkably simple: It moves a lever on the side of the transmission in response to the driver's gear selection. Although it sounds like they just replaced the mechanical linkage rod with a small motor, there's more to it that that. If we dissect the name Intelligent Servo Module, we can better understand what it's doing. Module just means that it's a control unit that is self-contained. Servo is the function of moving the transmission's shift lever, and keeping track of the position. Intelligent means that this isn't just a motor and sensor, but an integrated system for selecting a gear range.

The primary piece of intelligence is the theft protection system. As a component of the Drive Authorization System (DAS), the ISM needs to be unlocked by an encrypted message from the vehicle's SmartKey. With DAS, the key (A8/1) first confirms with the Electronic Ignition Switch (N73) that it is the correct key for the vehicle. If it passes this test, the Electronic Ignition Switch sends out encrypted messages to each of the other DAS components: The ME-SFI engine control module (N3/10), the ISM (A80), and the Electronic Transmission Control module (Y3/8). All of these need to respond correctly with their own encrypted response before they'll function.

Stuck in Park

While this makes it really difficult to steal a Mercedes-Benz if you don't

have a key, it can also bring a few headaches for the Independent Service Provider – you. The typical situation you might encounter is that the car comes in on the hook (hopefully a flatbed), with the transmission stuck in Park. In an emergency situation – say, an under-voltage in the electrical system, or communication with the ISM is faulty – a small motor in the ISM puts the transmission into Park, and you cannot shift out of park until the problem is fixed.

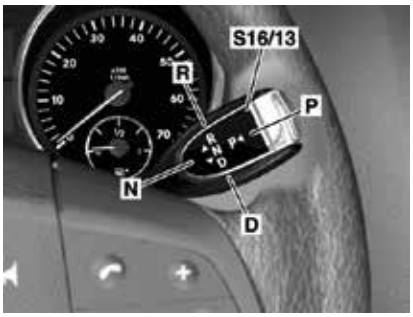
In normal operation, the main motor is controlled by the ISM's internal electronics in response to data signals from the DIRECT SELECT lever. The motor drives a screw shaft through a toothed belt and pulley system (earlier versions used gears). A slide nut, driven by the screw shaft, physically moves the transmission shifter level to the desired position, and a sensor tells the system where the lever actually is. Easy enough, right?

If there's a problem, the ISM needs to guarantee that it can put the trans into Park, so when a problem is detected, the Electronic Ignition Switch (EIS) can trigger the so-called Emergency-P Function. The EIS verifies that it is safe to put the transmission into Park, and then supplies power directly to the ISM on the Emergency-P pin, which drives the emergency motor in the ISM. The emergency motor slowly rotates an eccentric shaft, which pushes down on a button on the top of the sliding nut. When the eccentric pushes this button all the way down, the sliding nut de-couples from the screw shaft and the nut with the shifting lever are pushed by a spring into the Park position. There is no way to reverse the emergency motor from outside the ISM (and opening it is a disaster in the making), so the only way to make everything right again is to find and fix whatever sent the ISM into emergency-P mode in the first place.

Mini-batt

More recently produced cars can set the Emergency-P mode using the vehicle's main battery, even if it is partly discharged. Earlier models had a separate emergency battery, about the size of two packs of cigarettes, mounted somewhere in the car. In models with ECO Start/Stop, the somewhat larger secondary battery used for that system serves as the emergency battery.

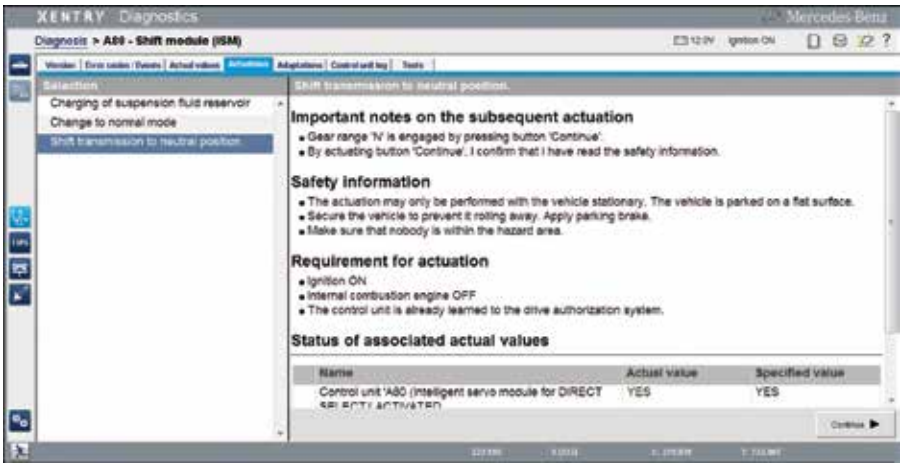
So, if we have a car stuck in Park, we need to figure out if whatever triggered Emergency-P can be reversed. Almost every time, it's been a dead (or nearly so) battery triggering the system, so simply restoring system voltage usually brings the ISM out of Emergency-P mode. There is also a way to use XENTRY to bring the car out of Park and into Neutral, which might be handy for moving the car into a service bay.



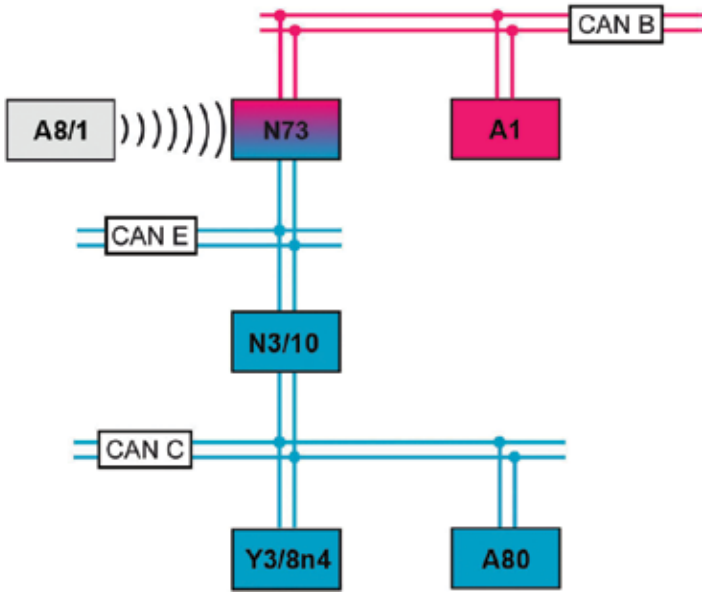
Any car with a shift stalk like this one has DIRECT SELECT, which means it uses the Intelligent Servo Module (ISM) to shift the transmission's gear. ranges.

Inside an ISM. In normal use, the main motor (1) drives the screw shaft (4) via a timing belt (9) to move the shift lever (6) into the various gear ranges. If Emergency-P mode is required, emergency motor (2) drives the eccentric shaft (5) to push down the release (11) on the shuttle nut (3). Spring pressure then forces the shuttle nut and shift lever down the screw shaft into Park.

This tiny 1.2 Ah battery installed in some models is used exclusively to ensure the ISM can put the transmission in Park if the main vehicle electrical system has low voltage.



Undervoltage can put the ISM into Emergency-P mode. If restoring power doesn't reset the ISM, it may be possible to use XENTRY to put the trans into Neutral so the vehicle can be moved more easily.



This shows the CAN Bus networks involved in a typical Drive Authorization System (DAS4). CAN C is the engine CAN, through which the ISM (A80) gets all its data. Measure the DC voltage across the CAN wires for a quick check of the Bus.

Every so often we see codes in the XENTRY Diagnostics system for faulty communication to or from the ISM (A80) and one or more of the other control units. These need to be followed through and checked. Wiring concerns are at the top of the check list, but we use both the wiring and function diagrams from WIS or Star Wiring to develop a list of "players" (possible causes) for our diagnosis.

CAN-C

After supply voltage, our biggest player when it comes to ISM communications problems is the Engine CAN Bus (CAN-C), so we start by taking a voltmeter measurement between the two CAN Bus wires. We expect to see a DC voltage (measured to ground) of about 2.4 or 2.6V in a normally-functioning Bus. If we see 0V, that wire of the bus is shorted to ground, while about 12V means that it is shorted to power. If both wires read exactly the same, we can suspect the wires are shorted together, while both reading 0 is probably an unplugged connector somewhere. Once you know what problem you're looking for, it becomes a matter of separating the CAN Bus at the voltage distributor (check the wiring diagram for each particular model) and measuring each wire separately.

It is rare, but if the CAN communications problem isn't related to the physical layer – wiring, connectors, and such – then it may be that some other control unit has gone crazy and is taking down the communications. We've seen this, but always connected to a bunch of other symptoms, the transmission staying in Park being the least of them.

XENTRY also has some tests for control module power supply, so check at the ISM electrical connector to see if there's battery voltage, and even if there is, be sure to repeat the test under load by measuring the supply voltage with the ISM connected. To do this, use the Mercedes-Benz electrical connector and test kit. Whatever you do, don't compromise the water-tightness of the wires or connector.

Theft-Relevant

In the worst case – and to be honest, we've never had this happen – the ISM needs to be replaced. That opens up a whole new can of worms, because the ISM is a Theft-Relevant Part, or TRP, and that means the dealer is not allowed to sell the part to you unless you are enrolled in the NASTF Vehicle Security Professional (VSP) Registry. If you're not already enrolled, and your

customer's car definitely needs an ISM (or any other TRP, for that matter), best send them off to the dealer right away, since enrollment takes some time, more than a few days in any case.

Way back in 2008, Mercedes-Benz updated its Theft-Relevant Parts policy to combat the rising trend of vehicle thefts using keys ordered from a dealer. For customers, the policy represents a bullet-proof assurance that nobody but they is going to get a key or other theft-relevant part for their car – after all, the value of a key is not what was paid, but the value of the car it can start. See the sidebar for a summary of the Mercedes-Benz TRP policy.

Just a short comment about the VSP Registry: If you are serious about servicing modern cars, you need to consider joining the VSP Registry. Originally intended to support locksmiths in getting vehicle key codes from manufacturers, the Registry has evolved into a general "circle of trust" between vehicle manufacturers and ISPs. Applicants to the Registry undergo a background check and agree to the terms and conditions, pay a fee for the initial two-year license, and, once accepted, can buy virtually all Theft-Relevant Parts from their dealer. Aside from Mercedes-Benz, many other manufacturers accept VSP Registry credentials for the purchase of restricted parts.

Specific VIN

Okay, let's say you have been on the VSP Registry since forever, and you have concluded you need a new ISM to fix your customer's car. Don't bother buying a used ISM: They are programmed to a specific VIN, and that programming can't be erased or changed. Instead, you need to complete the TRP form the dealer can provide (or download one from the STARTekInfo web site – no need to log in, just select the "Theft-Relevant Parts Info" link) and give them the proof they need: Proof of ownership, proof of identity (from the customer), and proof of your own identity (the form generated by the VSP registry). Once the part comes in, your dealer will want the old part so he or she can prove it has been destroyed, or at least your customer's signature that the part has been kept by him or her.

Putting in the ISM isn't as easy as bolting it on, though. You absolutely must have a XENTRY system and a valid XENTRY Flash account. The sale of the Theft-Relevant Part has been recorded by Daimler, and you need to log in to XENTRY Flash to activate and program the new part, as well as "marry" it to the specific vehicle. Unless you're fully equipped for this task, you may better serve yourself and your customer by letting the dealer handle it.

Oh, and the bolts: They're made of aluminum, and must be replaced each time they are loosened. Don't try to

The NASTF home page. This is where you go to get on the Vehicle Security Professional (VSP) Registry, which allows you to buy Theft-Relevant Parts from the dealer. Anyone seriously engaged in automotive service should enroll, since this is an industry-wide organization.

After installing a new ISM, you first need to perform the "initial startup" procedure, followed by the "calibration" procedure. It's a good idea to check whether the control unit has the latest software update installed too.

re-use them as you'll only end up breaking them and having to drill them out – after dropping the trans completely. Trust us, just buy the new bolts, and don't ask how we know. Replace the vent hose as well, because it will leak if re-used. Small cost for a high-quality repair. Both these requirements, and a complete procedure, are found in WIS under Group 27.19.

Process

Since so many ISPs are indeed equipped to handle this task, let's take a quick look at the process. If you are completely unable to communicate with the old ISM, you need to complete all of the tests in XENTRY to verify beyond all doubt that the ISM is indeed faulty and needs to be replaced. It's worth spending some time on this simply because replacing the ISM can be challenging (particularly if you are not in the VSP Registry) and expensive. Once we conclude the ISM needs to be replaced, we install the new part and, using XENTRY, complete the routine for "Initial start-up of already installed control unit," the first item on the Adaptations tab for A80. This is a multi-step procedure, but completely guided by XENTRY, so just follow the instructions on-screen. In this process, you'll release the anti-theft transport protection of the new part, then personalize, activate, and enable the module for the specific VIN.

The next step is to calibrate the ISM, again using the procedure defined in XENTRY. This is how the ISM learns the correct positions for each shifter setting. Finally, you should use your XENTRY Flash account to verify that the control unit has the latest version of software installed. If it's already up-to-date, the system will tell you, but if an update is needed, be sure you can guarantee the car's battery voltage by using an approved battery maintainer, and the XENTYRY system's power supply by making sure the batteries of both the Tab and the Connect are fully-charged. Although rare, it is possible to "brick" (render completely inoperative) a new control unit if the update process is interrupted at the wrong spot.

We're hoping it never gets that far, but perhaps with this bit of advice you'll get through the process with a successful repair and a happy customer. As we mentioned, the ISM is rarely faulty, so be sure to follow up on all other possibilities before heading down this trail.

Mercedes-Benz Theft-Relevant Parts Purchasing Policy

It's not a secret that Mercedes-Benz USA instituted a new Theft-Relevant Parts (TRP) policy about 8 years ago. But many independent workshops (just like yours) have decided to leave the game entirely, admitting that theft-relevant parts are simply not available to them.

Completely untrue. Virtually any part is available to you, with a 'catch': You need to be a registered VSP (Vehicle Security Professional). Let's take a closer look at MBUSA's current TRP policy and at the VSP Registry.

MBUSA's TRP policy is available for anyone to see and download at startekinfo.com, on the "Theft-Relevant Parts Info" link – you don't need to log in to access it. There, you'll find the MBUSA Policy (at the time of this writing it was dated March 2015) along with a handy guide for independent workshops.

MBUSA's policy states that "TRPs are parts that may be required to steal a vehicle and/or to give it a new identity". Of course, the vehicle owner has a specific interest in avoiding getting their car stolen, as does MBUSA and, indeed Daimler AG in Germany. For that reason, the sale of any TRP requires some documentation, generally from the vehicle owner, but this requirement is somewhat different if the vehicle is being serviced by a dealer as opposed to the parts being sold over the counter to an outsider, since authorized Mercedes-Benz dealers have a higher level of accountability as compared to someone walking in off the street.

Here's a list of typical TRPs:

- Vehicle keys (electronic and mechanical)
- Electronic steering locks
- Electronic ignition switches (and workshop key where needed for programming)
- Electronic selector levers
- Transmission control unit (722.6 and later)
- Integrated shift modules
- Engine control units
- Integrated starter-alternator used with DAS4
- High-voltage control units (Hybrid/electric vehicles)
- Complete mechanical lock sets
- VIN plates and related labels and components

Of these parts, the only ones not available except to an Authorized Mercedes-Benz Dealer are the last four. The starter-alternator and High Voltage components are restricted for safety reasons, complete mechanical lock sets for security reasons (although individual locks can be ordered keyed to the car), and VIN plates are simply not available to anyone (not even a dealer).

A comment on the High Voltage parts: Unless you have high-voltage training, just stay away. It's no longer a matter of profit and loss, but of life and death. Without the proper training and equipment for automotive high-voltage work, don't risk it. All HV parts are clearly identified, and we dare say it's worth your while to pay attention.

Anyway, we can see the majority of TRP are available to you, as long as you follow some common-sense rules:

- First, you must have the (written) agreement of the vehicle owner (kind of obvious).
- Second, you must be a registered VSP. More on that in a minute.
- Third, complete the on-line form at www.startekinfo.com under the Theft-Relevant Parts Info link. The form asks for information such as the VIN and customer info, which part you need, your VSP Registry credentials, and at which dealer you'd like to pick up the part. Remember, this is a transaction between you and the dealer you select: the form is just so the dealer can independently verify your VSP Registry info. (The dealer doesn't see your password: Instead, the VSP Registry sends them information to verify your credentials). You'll get a copy of the form by e-mail, which you bring to the dealer. You also hand over a so-called "D-1 form" (from NASTF) which the dealer completes and hands back to you for your records.
- Finally, you'll need to bring copies of the vehicle proof of ownership (registration or title) and your own personal identification (driver's license or passport), along with your shop's repair order.

These requirements are fairly solid at preventing theft, but not so difficult to comply with. Not to mention you're protected if your customer's car shows up stolen some time in the future. Plus, you have all this available to you already, except perhaps the VSP Registration. Let's see how to get it.

The National Automotive Service Task Force (NASTF), according to their website nastf.org is "...a not-for-profit organization established to facilitate the identification and correction of gaps in the availability and accessibility of automotive service information, service training, diagnostic tools and equipment, and communications for the benefit of automotive service professionals. NASTF is a cooperative effort among the automotive service industry, the equipment and tool industry and automotive manufacturers." This means it is a group of auto-industry suppliers and manufacturers dedicated to supporting you, the independent workshop. If you're not a member, you should consider joining (it's free).

If you want to become a Registered Vehicle Security Professional, which enables you to buy security-relevant parts from nearly every manufacturer, follow the link for "Locksmith/Vehicle Security" on the NASTF website. You'll need to complete a form (and get it notarized) with your personal details, agree to a background check, provide info on your business, insurance and bonding, and an application fee (currently $75). If you are granted a license, the cost is $300 for two years, hardly a burden if this is how you make your living.

The form can seem a little intimidating, so NASTF has quite a lot of information on both the application and parts ordering process. If you are even remotely interested, go visit their site and read up. They also have phone and e-mail contact info in case you have any questions their publications don't answer, but we found what they had pretty comprehensive.

Form D-1

National Automotive Service Task Force

AUTHORIZATION FOR AUTOMOTIVE KEY GENERATION and/or IMMOBILIZER SYSTEM/ANTI-THEFT SERVICES

Page 2 of 2

For every TRP order you need to complete a D-1 form from NASTF and hand it to the dealer. The dealer completes their part of the form, and you (the LSID holder) keeps the form securely on file as specified by the NASTF. The NASTF audits these randomly, so be sure to keep your records straight.

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- WIS-net (Workshop Information System)
- Wiring Diagrams
- Technical Bulletins
- Mercedes-Benz Special Tools
- Maintenance Sheets
- Star Diagnosis System (SDS)
- Mercedes-Benz Workshop Equipment

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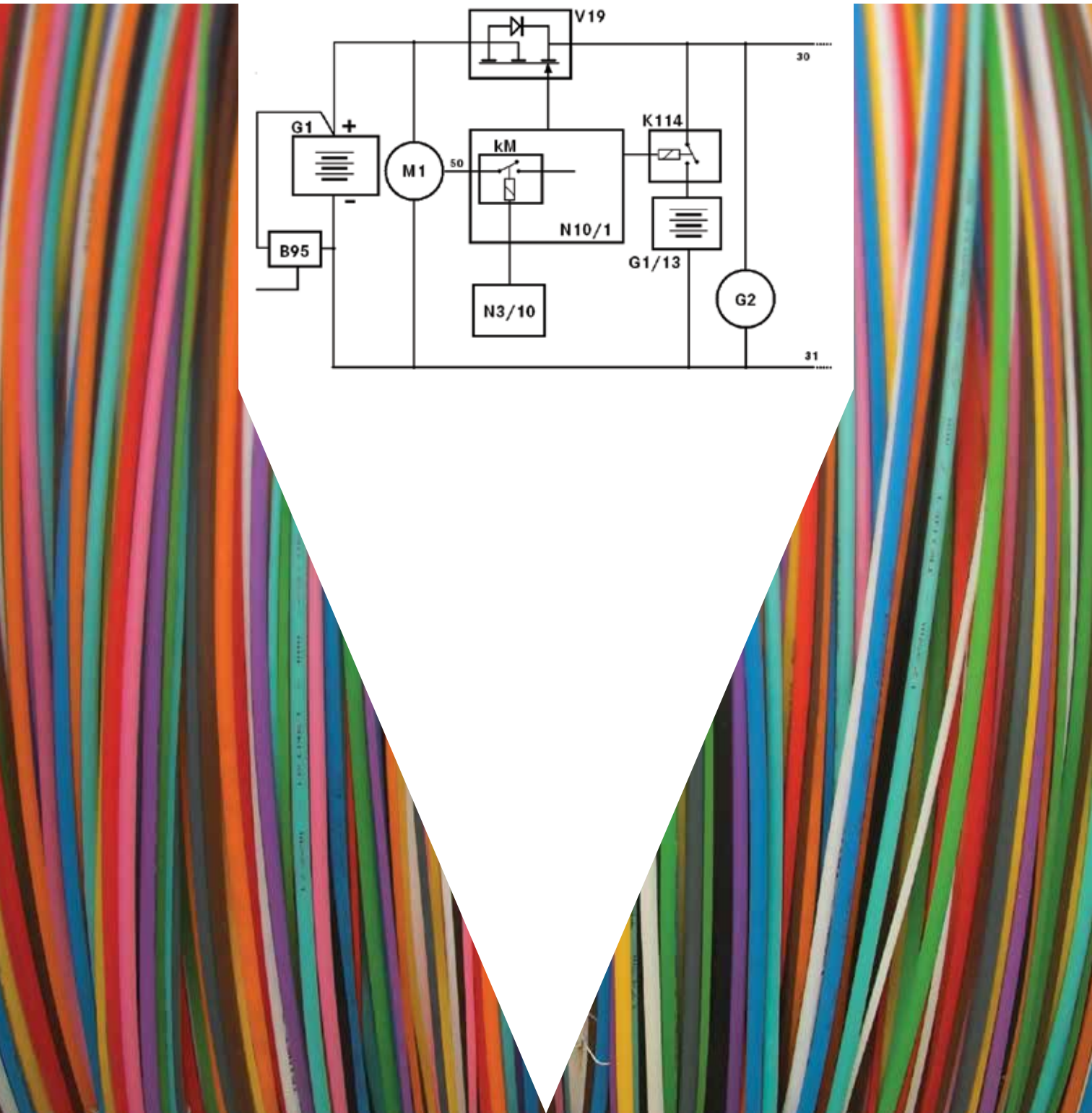
or learn more at www.mbwholesaleparts.com

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

Wiring & Function Diagrams & Descriptions

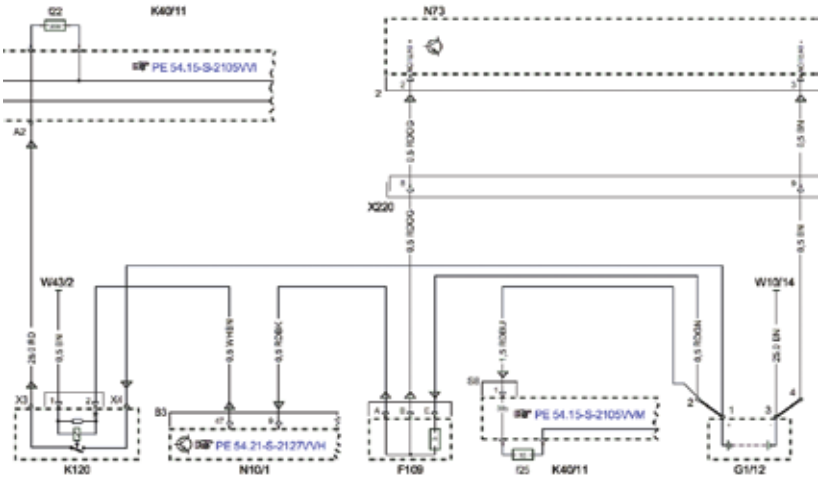


This focused tour of the Wiring and Function Diagrams, and Function Descriptions found in STAR Wiring and WIS will help you use this resource more effectively.

Unless you've been hiding under a rock, or you never see electrical problems in your shop (ha!), you're already familiar with the electrical wiring diagrams found on STAR TekInfo and in WIS. What might still be a mystery are those Function Diagrams found in the same place, which are just as important to a solid electrical diagnosis as the wiring diagrams. Today, we'll show you how these, along with the Function Description documents in WIS (the so-called GF documents) can help you perform a focused and professional electrical diagnosis.

Let's start by taking a quick look at wiring diagrams. As examples we'll use the ones found in STAR TekInfo, but the diagrams in WIS are nearly identical, the main difference being the way we can navigate inside these diagrams: In STAR TekInfo, we can use the mouse to drag the diagram to what we want to see, while in WIS we have to use the scroll bars at the edge of the window.

A wiring diagram is a two-dimensional representation of the physical wiring. We see the components and the wires that connect them, along with information about those wires and connections. For example, we might see a wire labeled as 0.75 GNBU, which means it has a cross-section of 0.75 mm2 (about 18 AWG) and has green insulation with a blue marking stripe. Note that this doesn't mean it is 0.75 mm in diameter – in fact, the copper wire is just over one mm in diameter – it is the cross sectional area of the wire.



This section of the wiring diagram for the ECO Start system in a new Metris van (Model type 447) shows the auxiliary battery (G1/12) that powers the vehicle for the brief moment that the main battery is running the starter. Relay K120 switches the auxiliary battery on-line for that instant. Only a small part of the wiring diagram is shown here.

If we look closely at the connections to a component (including a wiring connector such as X220), we can see that one side of the connection is shown as a pin (usually on the component side) and the other side is shown as a socket. This tells you whether the electrical contact is male or female, helpful when you're not sure which side of a connector you're looking at. Of course, you can also see the component designation for each component (such as N10/1), along with the connector number (B3 on N10/1) and pin number (Pin 47 on N10/1 for the control signal to K120) for each individual wire connection.

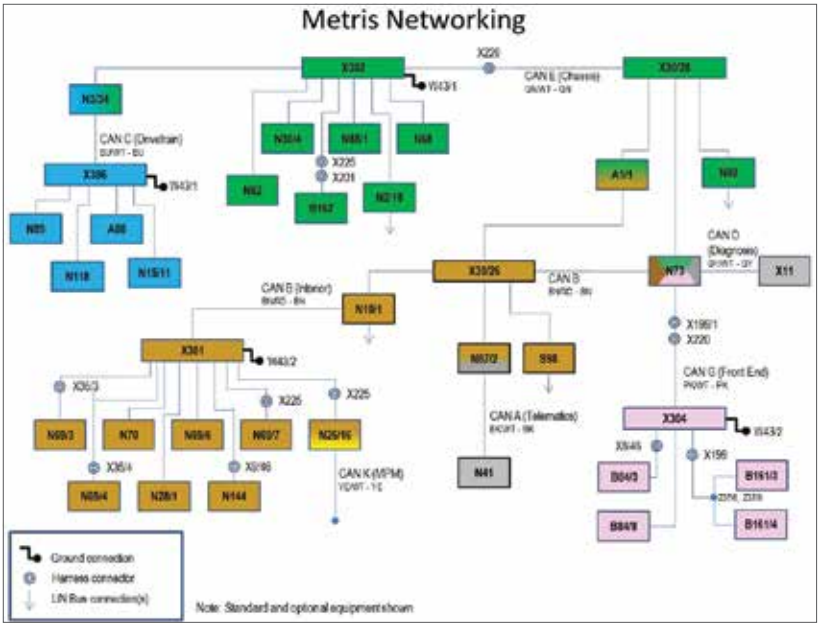
These symbols and features should be familiar, but some newer features in WIS and STAR Wiring are worth mentioning. In WIS, if you have a computer mouse with a wheel, you can use the wheel to scroll up and down in a document, zoom in or out by moving the wheel while holding the <Ctrl> key, or scroll horizontally by moving the wheel while holding the <Shift> key. This is especially handy in wiring diagrams. Also in WIS, if you're not sure which Service Group contains the wiring diagram for a particular system, you can now search by Option Code. So if you need the diagram for PARKTRONIC (Code 220), you can search by SA Code (one of the options in "additional" Search Mode).

In STAR Wiring, you'll find Signal Flow arrows. These don't show the direction that current goes,

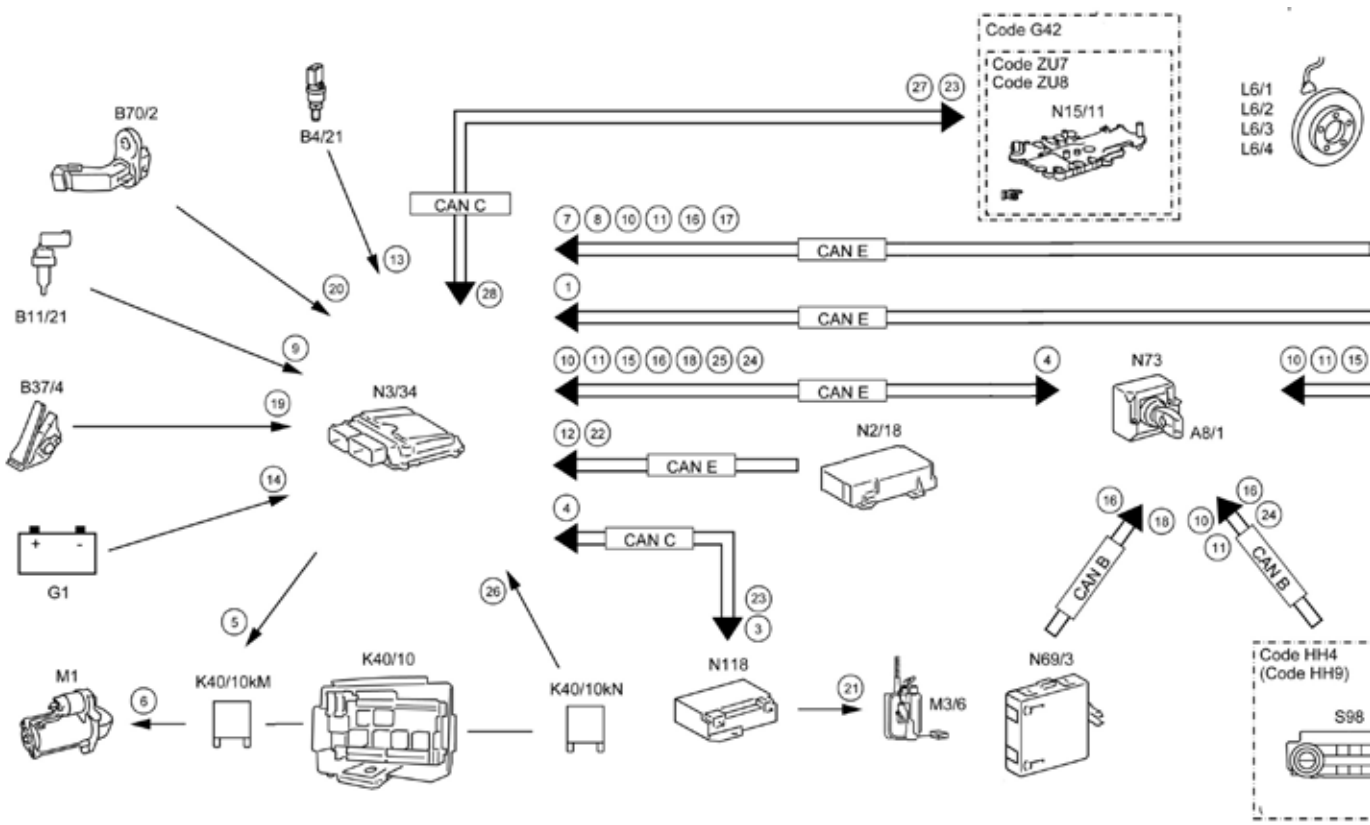
but the direction that the signal goes. In other words, whether it is an input or an output (or both!). Additionally, you can now find the General Function documents (we'll get to those in just a moment) on the System Information tab. These same documents can be found in WIS as document type "GF."

Back to our topic. We can clearly see that the wiring diagram is showing the physical wiring layout in the vehicle. It doesn't show how long the wires are, or where they are located (although STAR Finder shows component locations), so it is not a perfect physical representation of the wiring, but it is close. If we wanted to check a wire, we should have little trouble finding each end for testing.

Until the early 1990s, wiring diagrams were all there was, and, really, all we needed. But then came networking, where a single wire could carry a multitude of information, with the technician having no way to see or measure what exactly was on that wire. Oh sure, we can measure the voltage



The use of data networks such as CAN Bus in vehicles has definitely simplified wiring and reduced weight, but it made diagnosis using only a wiring diagram nearly impossible. This shows the CAN networking used in the new Metris van, a relatively simple vehicle. To understand how a signal gets from here to there, you need to use the Function Diagrams found right next to the wiring diagrams in STAR Wiring and WIS.



to see if the CAN Bus is working normally, but without some kind of specialized test equipment, we could not, for example, tell what outside temperature value the A/C module was getting off the CAN Bus. Indeed, we couldn't even know where the outside temperature signal was coming from.

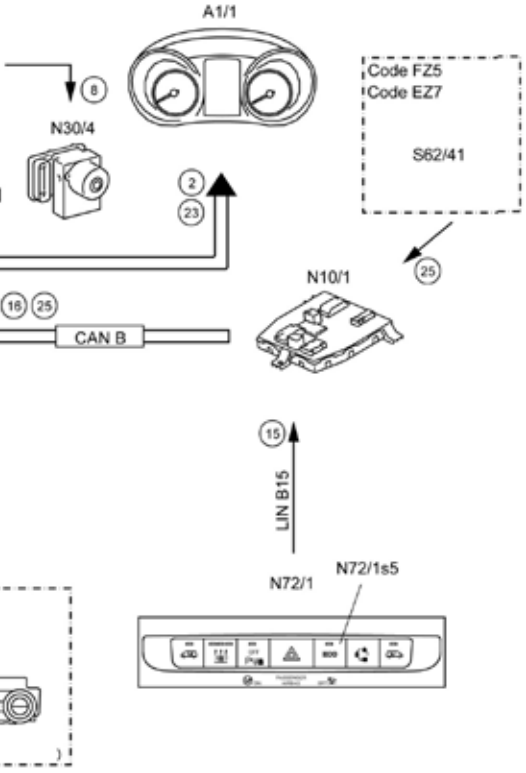
After Mercedes-Benz introduced the CAN Bus for its products in the mid-1990s, technicians quickly identified the need to understand all the CAN messages that were being sent and received by the various control modules. Mercedes-Benz responded by introducing the so-called Function Diagrams. Instead of a pure physical layout, these diagrams show the signal flow between and among components, particularly the signals on the CAN Buses (and other networks). If we want to understand where a particular signal starts from, or which signals are being received off the CAN Bus, we can turn to the electrical Function Diagram.

Taking this one step further, if we want to understand what a system is doing with these signals – in other words, information on how a system operates – we can then use the Function Diagram together with the General Function ("GF") document. In WIS, we need to search for the GF document as a separate document type, but in STAR Wiring there is a direct link to this function description.

We already know about wiring diagrams, so let's take a closer look at a Function Diagram. For this example, we'll use the ECO Start function from the new Metris mid-size van, chassis type 447, and follow two signals from their origin to their destination.

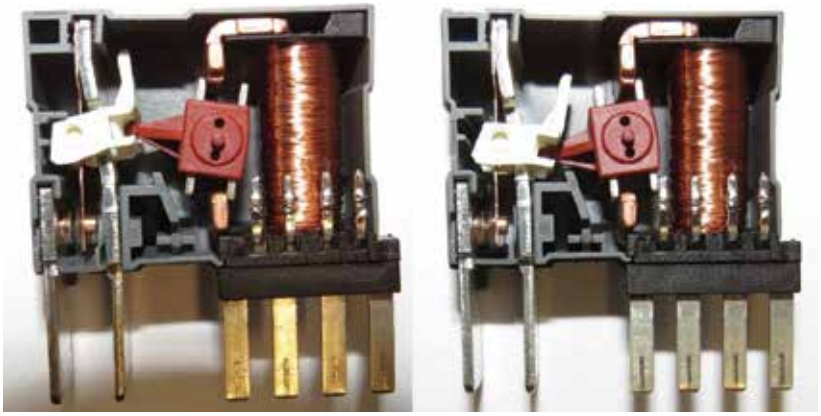
The first signal is the coolant temperature sensor, B11/21. Looking at the far left of the diagram, we see that B11/21 sends Signal #9 (Coolant temperature sensor, signal) on a directly-connected wire to the ME-SFI control unit (N3/34). We could also have seen this on the wiring diagram for N3/34, which would include physical details such as the wire size, color, and the specific connector and pin numbers, but would not tell us

Diagram below: This Function Diagram shows the components involved in the ECO Start system in a Metris van and how the many signals get from their origin to their destination. In this age of networking, a wiring diagram cannot show the information being delivered by the network. This diagram shows exactly that.



1	Vehicle speed, signal
2	Instrument cluster, message
3	Fuel pump, specified pressure request
4	Fuel pressure, status
5	Starter circuit 50 relay, actuation
6	Starter, actuation
7	Electronic Stability Program (ESP) control unit, status
8	Wheel speed, signal
9	Coolant temperature sensor, signal
10	Engine start, request
11	Engine stop enable, status
12	Crash, signal
13	Fuel temperature, signal
14	Circuit 30, status
15	ECO start/stop function button, status
16	Engine stop prohibited, request
17	Braking torque, signal
18	Door rotary tumbler switch, status
19	Accelerator pedal module, signal
20	Engine speed, signal
21	Fuel pump with fill level sensor, actuation
22	Seat belt buckle restraint system switch, status
23	Engine running, signal
24	Automatic air conditioning (AAC) control and operating unit, status
25	Engine hood contact switch, status
26	Circuit 87, status
27	Gear range, request
28	Gear range, status
A1/1	Instrument cluster (KI) control unit
A8/1	Transmitter key
B11/21	Coolant temperature sensor
B37/4	Accelerator pedal module
B4/21	Fuel tank pressure and temperature sensor
B70/2	Crankshaft Hall sensor

CAN B	Interior CAN
CAN C	Drive train CAN
CAN E	Chassis CAN
Code, EZ7	Active Parking Assist
Code, FZ5	ATA I, anti-theft alarm system
Code, G42	7G-TRONIC PLUS automatic transmission
Code, HH4	THERMOTRONIC automatic air conditioning
Code,HH9	TEMPMATIC semi-automatic air confditioning
Code ZU7	Canada version
Code ZU8	USA version
G1	On-board electrical system battery
K40/10	Engine compartment fuse and relay module
K40/10kM	Starter circuit 50 relay
K40/10kN	Circuit 87M relay
L6/1	Left front rpm sensor
L6/2	Right front rpm sensor
L6/3	Left rear rpm sensor
L6/4	Right rear rpm sensor
LIN B15	Battery sensor LIN
M1	Starter
M3/6	Fuel pump with fill level sensor
N10/1	SAM control unit
N118	Fuel system control unit (FSCU)
N15/11	Fully integrated transmission control (VGS) electric controller unit
N2/ 18	Supplemental restraint system (SRS) control unit
N3/ 34	ME-SFI [ME] control unit
N30/ 4	Electronic Stability Program (ESP) control unit
N69/ 3	Left front door control unit
N72/ 1	Upper control panel (UCP [OBF]) control unit
N72/ 1s5	ECO start/stop function button
N73	Electronic ignition lock (EZS) control unit
S62/ 41	Engine hood switch
S98	Air conditioning control and operating unit



This "bi-stable" relay is used to switch off power to some consumers when the vehicle is parked to help reduce parasitic battery current draw. A momentary pulse to the coil switches the relay from on to off and vice-versa without drawing any current continuously. At left, the contacts are open, and at right they are closed. You'd never have known this relay existed if you didn't look at the General Function (GF) document that describes the energy management system, just one simple example of the value of this information.

what the signal was. Of course, in this case the signal is obvious (the coolant temperature!), but the point is that the wiring diagram does not tell us that.

The second signal is from the engine hood switch, S62/41. If we look at the far right of the diagram, we see that S62/41 sends signal #25 (Engine hood contact switch, status) on a directly-connected wire to the SAM control unit (N10/1). If we look just to the left of N10/1, we see Signal #25 is sent over CAN B (the Interior CAN) to N73 (Electronic Ignition Switch). N73 then sends Signal #25 over CAN E to N3/34. If we look closely at the function diagram, we cannot find Signal #25 anywhere else, so we can be certain that no other control unit also receives Signal #25 for this particular vehicle function. From experience (and from the hint "Code FZ5" at S62/41), we can tell you that the hood switch signal is also used by the anti-theft alarm, but since ATA has nothing to do with ECO Start, that information is not shown on this diagram.

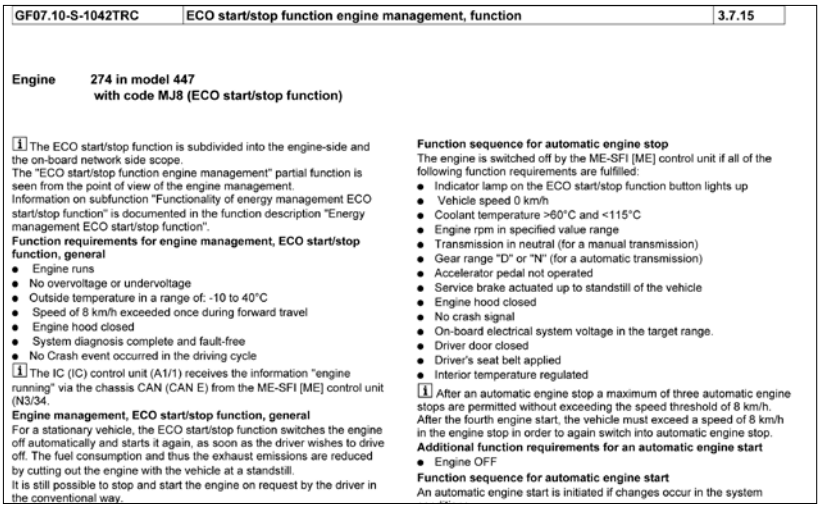
As a side note: Thin lines on a function diagram show a direct wired connection, while the wide "Bus" lines show signals carried over the CAN Bus. Dashed boxes tell us that the information only relates to vehicles with the option code or codes shown. And, as we saw, the numbers in circles are signals, and we can see where these signals go by following the numbers. These signals sometimes go to more than one place: Signal 23 (Engine running, signal) is sent by the ME-SFI control unit (N3/34) to both N118 (Fuel system, control unit) and N15/11 (Transmission control unit). Sometimes it takes a sharp eye to find all these, but the information is there for those who look.

Getting back to the basic idea for these: If we were trying to diagnose a problem with the ECO Start system, no matter how hard we looked at the wiring diagram for the ME-SFI control unit, we'd never figure out that the engine hood switch was being considered in the operation of this system. It would be just as hard to figure out exactly how the engine control unit was even getting that information. But a quick look at the function diagram, and Viola!, the mystery is solved in plain sight.

The ECO Start system is found in nearly every new model. Seeing the symbol (the "A" with the arrow around it) in the instrument cluster display or on a switch on the dash should alert you that the system is installed. If you read through the GF document carefully, you'll find that you should take extra safety precautions to ensure the engine doesn't start by itself while you're working on it.

So now we can see just how the signals needed by the ECO Start system get around, and we have an almost fighting chance to understand how the system works: If we start with Signal #1 and work our way down the list, we (almost) have a bunch of clues as to what the system is looking at to decide if the engine can be shut down or not. For example, we can see that the A/C system (S98) has something to do with it, as does the left front door control unit (N69/3) and the SRS control unit (N2/18). But what, exactly, are these signals used for in ECO Start?

From our knowledge of professional diagnosis, we know that in order to diagnose all but the simplest of problems, we need two things: one is an accurate idea of the symptoms, and the other a thorough understanding of the system and how it is supposed to operate – exactly how it does what it is supposed to do (its Function). We get the symptoms from customers (why would they be in your shop otherwise?) and from our own attempts to duplicate the complaint, while using our knowledge of how



GF07.10-S-1042TRC	ECO start/stop function engine management, function	3.7.15

Engine 274 in model 447 with code MJ8 (ECO start/stop function)

The ECO start/stop function is subdivided into the engine-side and the on-board network side scope.
The "ECO start/stop function engine management" partial function is seen from the point of view of the engine management.
Information on subfunction "Functionality of energy management ECO start/stop function" is documented in the function description "Energy management ECO start/stop function".

Function requirements for engine management, ECO start/stop function, general

- Engine runs
- No overvoltage or undervoltage
- Outside temperature in a range of: -10 to 40°C
- Speed of 8 km/h exceeded once during forward travel
- Engine hood closed
- System diagnosis complete and fault-free
- No Crash event occurred in the driving cycle

The IC (IC) control unit (A1/1) receives the information "engine running" via the chassis CAN (CAN E) from the ME-SFI [ME] control unit (N3/34.

Engine management, ECO start/stop function, general

For a stationary vehicle, the ECO start/stop function switches the engine off automatically and starts it again, as soon as the driver wishes to drive off. The fuel consumption and thus the exhaust emissions are reduced by cutting out the engine with the vehicle at a standstill.
It is still possible to stop and start the engine on request by the driver in the conventional way.

Function sequence for automatic engine stop

The engine is switched off by the ME-SFI [ME] control unit if all of the following function requirements are fulfilled:

- Indicator lamp on the ECO start/stop function button lights up
- Vehicle speed 0 km/h
- Coolant temperature >60°C and <115°C
- Engine rpm in specified value range
- Transmission in neutral (for a manual transmission)
- Gear range "D" or "N" (for a automatic transmission)
- Accelerator pedal not operated
- Service brake actuated up to standstill of the vehicle
- Engine hood closed
- No crash signal
- On-board electrical system voltage in the target range.
- Driver door closed
- Driver's seat belt applied
- Interior temperature regulated

After an automatic engine stop a maximum of three automatic engine stops are permitted without exceeding the speed threshold of 8 km/h. After the fourth engine start, the vehicle must exceed a speed of 8 km/h in the engine stop in order to again switch into automatic engine stop.

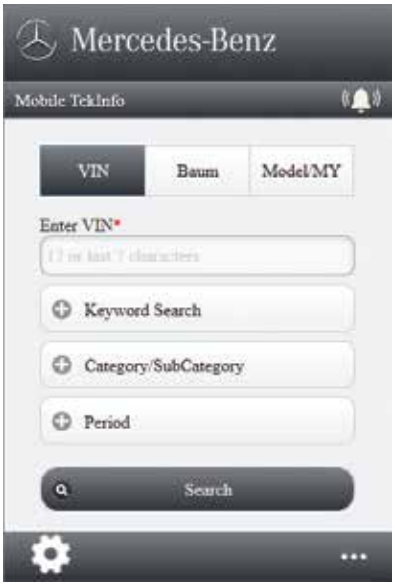
Additional function requirements for an automatic engine start

- Engine OFF

Function sequence for automatic engine start

An automatic engine start is initiated if changes occur in the system

This General Function document explains in detail how the system does what it does. See the text for details on how this document, when combined with the Function diagram, can help you better understand the system so you can perform a more professional diagnosis.



The new Mobile TekInfo website is ready for you and your smartphone or tablet. Access to bulletins, WebETM, manuals, WIS and much more are available on most any mobile device. Log in with your regular STAR TekInfo user ID and password.

the system is supposed to operate (gleaned from the operator's manual). But understanding how the system functions is a little more complicated. Even if training is available, who could possibly remember the tiny, intricate details of how each system functions in every car ever made since forever?

Even the best of the best can't remember everything. But all you need to remember is how to find the General Function document in WIS or STAR Wiring, and you have all the details right there in writing. If you use this document, along with the function diagram and the wiring diagram, and spend a few minutes studying the system, you will have all the information you need to thoroughly understand its function in great detail.

We've reprinted a portion of the General Function document GF07.10-S-1042TRC, which describes part of the ECO Start function as it applies to the M274 engine installed in USA-version Metris vans. Here, we can see that the engine is switched off by the ME-SFI control unit if all of the listed function requirements are met. One of these requirements is that the coolant temperature is between 60 and 115 degrees Celsius, and another is that the hood is closed. Looking closer, we can also see that the interior temperature must be in regulating phase – the A/C or heat has the temperature at or near where it's supposed to be – and that there must not be any Crash Signal received from the SRS control unit.

As you'll remember, we saw all four of those signals – engine coolant, hood switch, A/C unit, and SRS unit – on the function diagram, but didn't have any real information on what, exactly, they had to do with ECO Start. Now, using the GF document, together with the function diagram, we know what they do, and can consider what might happen (what symptoms we might see) if these were not working properly.

Which is the whole point: We want to fix the customer's car (or van) as quickly as possible, and we want to be certain that we really fixed the problem. This makes for happy customers, and we all know that happy customers come back when they need us again. So if we make the investment in Mercedes-Benz information systems, we know we're able to get the detailed information we need to really understand the system's function, make a professional diagnosis, and perform a permanent repair. For sure, we can get wiring diagrams from other sources, but Function Diagrams and General Function documents, especially from The Source, can prove more valuable than we realize.

Mercedes-Benz USA offers this information, which is exactly the same as what Authorized Mercedes-Benz Dealers get, to independent workshops like yours because the company recognizes that your customers are also its customers. No matter who services the vehicles, every Mercedes-Benz customer deserves only the very best, and, with the right tools, parts and information, you can deliver on that promise.

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 MB dealers
	BQ 1 09 0195	6/1 Quart Cases		
	BQ 1 09 0196	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.5 Specification SAE 5W-40	A0009898301USB6	12x1 Quart Cases	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A0009898301USB8	55 Gallon Drum		
	A0009898301USB9	Bulk - No Equipment		
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		
Genuine Mercedes-Benz Oil MB 229.52Specification SAE 5W-30	A0019893701USA9	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
	A0019893701USA6	6x1 Quart Cases		
	A0019893701USA8	55 Gallon Drum		
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
M-B Genuine ATF 134FE	A0019897703USA8	55 Gallon Drum		
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		
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

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Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
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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 15W40	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 After-treatment 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 10W30	BQ 1 09 0086	Bulk - No Equipment		
Mobil Delvac 1 5W40	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 80W90	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		

Careful Adjustments Keep Special Tops Working Great

Applying appropriate TLC to special tops on Mercedes-Benz vehicles can involve a few simple tweaks, or some real elbow grease, depending on any problems that may be present. In many instances, reinstalling a component will keep the top on an even keel, while other situations require testing, rerouting, or the installation of new parts. The time and effort will have been well spent to ensure driving satisfaction in a superior motor car equipped with extra pizazz.

What could be more rewarding than dropping the top and cruising some scenic route on a beautiful afternoon? Special roof treatments – soft tops, sun roofs, hard, panoramic, or Vario tops – are icing on the cake of driving a Mercedes-Benz, but every now and then they need adjustment or repair to function as they should and continue contributing to the pleasure of driving a fine car. The most visible culprits in the need for TLC are soft convertible tops or Vario tops with their "drawbridge" opening and closing mechanism.

A convertible or cabriolet is an automobile body style that can convert between an open-air mode and an enclosed one, varying in degree and means by model. While convertible tops normally operate flawlessly for many years, glitches can arise in the mechanical linkage, hydraulic or electric power units, or in the top itself.

Historically, a retractable roof consists of an articulated frame covered with a folding textile-based fabric similar to that on an open carriage. A detachable hardtop provides a more weatherproof and secure alternative, and as technology improved a retractable hardtop that can be removed and stowed in its own rigid roof in the trunk became available. A semi-convertible (also known as a Vario vehicle) has a retractable metallic top, which retains fully-framed windows on its doors and side glass.

The following sections are highlights of vehicle types Mercedes-Benz's Collision Center News identified that occasionally need adjustment or repair in soft top, sun roof, Vario roof, and panoramic roof models.

An acoustic fabric soft top reduces wind noise and includes a spoiler that rises from the windshield frame when the top is down, reducing turbulence and wind rush noise.

Opposite page: Mercedes-Benz is certainly no newcomer to the convertible concept. This majestic 1930 Maybach proves it.

Soft Tops:

Reattach Tension Cable to Soft Top Canvas

The tension cable seam can become detached at the soft top canvas. Use this procedure to reattach:

- Remove the rear window. Refer to WIS document AR67.20-P-5145QA.
- Expose the soft top at C-pillar by removing rivet and bolt from the retaining rail.
- Fold the plastic rail of the soft top canvas forward and remove the bolt and rivet, then guide the strap of the soft top canvas together with the narrow strap around the soft top bow and rivet it to the water pocket together with the wide strap.
- Unclip the guide with the tension cable, and slide the tension cable through the water pocket. Thread the guide together and lock it into position in the soft top bow.
- Repair/bond the fold seam using adhesive tape to mask off the area that is not to be bonded. Mix the adhesive from the repair kit, then remove the black plastic slide, spread the adhesive on the

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surfaces to be bonded, and allow a flash-off time of five minutes.
- Clamp the adhesive seam using spring clamps and a straight edge; after bonding, the adhesive seam must harden for at least five hours, then reassemble the soft top C- Pillar and install the rear window.
- If this condition occurs, the soft top canvas must be repaired by bonding the fold seam. *Do not replace the soft top canvas if the fold seam has become detached.*

Allow Soft Top to be Opened Hydraulically

If the soft top cannot be opened hydraulically after being released manually and after the header bow is pressed over the dead center position, this may be the result of the soft top switch in the rear soft top lock not being actuated by the operating lever due to excessive mechanical friction. The soft top control module detects an implausible status, causing a malfunction the next time the soft top is opened, and may show or store one of these codes: 996D (soft top position is implausible); 996E (status of the rear soft top lock is implausible); 996F (status of the front soft top locks is implausible).

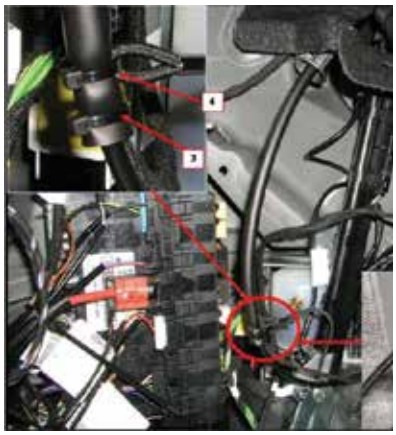
To resolve, move the lever several times in the lock or unlock direction and apply lubricant (A000 989 36 60) to the latch/operating lever. If the soft top is not in a confirmed end position – fully closed or open – the hydraulic system is depressurized after seven minutes, permitting the soft top to be manually lowered to the rear, and allowing accessibility to the soft top lock.

Cure Electrically-Powered Cabriolet Top Not Opening

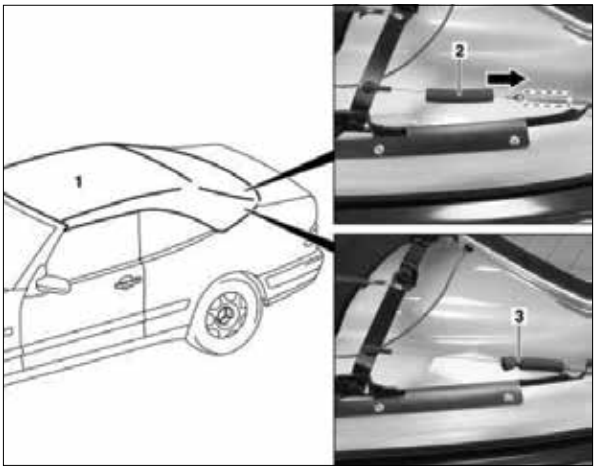
With thick sound insulation, an acoustic fabric soft top reduces wind noise and includes a spoiler that rises from the windshield frame when the top is down, reducing turbulence and noise. The fabric is so tough it is said to be almost impossible to cut through with a knife, and occasionally customers will complain the top will not open or close without the ignition switched on, which it will definitely not do. Make sure the SmartKey is in position in the ignition lock before exploring other functioning options.
- If the trunk lid is open, close the trunk lid, and if the trunk partition is not closed, close it.
- If the soft top has been opened and closed several times in a row the soft-top drive has been deactivated automatically for safety reasons, and the soft top cannot be opened or closed again until after ten minutes.
- To check, switch the ignition off, turn it back on, and repeat the opening or closing procedure. If none of this works and the top still will not open, the soft-top mechanism or control system is at fault.

Move the lever several times in the lock or unlock direction and apply lubricant to the latch/operating lever.

Apply lubricant (A000 989 36 60) to the lever.



Guide the tension cable through the water pocket, thread the guide together and lock it into position in the soft top bow.



Detach the soft top from the soft top bow and fold it upward, then anchor the sponge rubber hose in place using a cable tie.

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Fix Soft Top Canvas Pulling Out of Soft Top Bow Retaining Groove

If the soft top canvas pulls out of the retaining groove of the soft top bow, detach the soft top canvas from the soft top bow and fold it upward, move the sponge rubber hose to its intended position, anchor the sponge rubber hose in place using a cable tie, and cut off the excess tightened cable tie.

Replace the Hydraulic Pump if Supply Pressure is Less than Specified

Check supply pressure in vehicles equipped with a soft top hydraulic pump if the hydraulic system appears to be functioning sporadically – use the test and adjustment values for soft top hydraulics. Assemble the testing unit, including the pressure gauge, adapter and test line with connection M10x1 on both sides, and insert the rod-side hydraulic line into the adapter, making sure that the sealing ring is seated correctly.

- Lock the latch, fasten with a bolt, and actuate the soft top hydraulic pump with the diagnostic system.
- Remove the test equipment after testing, disassemble and read the supply pressure on the gauge – if it is less than the minimum acceptable supply pressure, replace the soft top hydraulic pump.
- Bleeding the hydraulic system as well as the soft top hydraulic pump is not required after pressure testing.

WARNING: If the soft top is not fully opened or closed, the soft-top hydraulics de-pressurize after a short time. This causes the soft top to lower unexpectedly and may cause the technician or others to be trapped. Always open or close the soft top completely.

Sun Roofs:

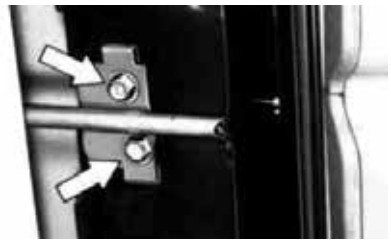
Adjust the Gap between the Roof and the Windshield Trim Strip

The gap between the roof and the windshield trim strip should be 5 to 6 mm, and not less than 5 mm. Otherwise, closing forces for the front catches will be too high. If high closing forces negatively affect locking and release operations, install spacers below the locking pins, then perform a rain test. If a replacement sun roof is installed, perform following work after adjustment:

- Unlock the roof, lift it at the front, support it with rubber mallet, and mark the position of the locking pins with a felt-tip pen.
- Loosen the screws and adjust the gap by moving the locking pin toward the rear to decrease the gap, or toward the front to increase the gap. Adjust the locking pins by moving them parallel to the side so that there is no gap between the covering on the front pillars and the roof at the left and right sides.
- Tighten the screws and lock the roof with the top switch, then check the opening and locking operations several times.

Adjust Tilting/Sliding Sun Roof Top Panel

To adjust the sun roof top panel, remove the sun roof headliner and loosen the fastening screws on the sliding angle pieces front left and right; push the sliding angle pieces inward until the sliding shoes are abutting laterally and the sun roof is located accurately in the center of the cutout.



Loosen the screws and adjust the gap by moving the locking pin toward the rear to decrease the gap, or toward the front to increase the gap.

- The sun roof frame has tolerances with regard to its total width, and lateral clearance must be checked at several points. Unscrew the control cable on the sliding carrier and move the sun roof top panel manually.
- Open the sun roof and loosen the fastening screws on the slide rails.
- Adjust the height adjusting screw at left and right so that the front edge of the closed sun roof is 0-1 mm deeper than the roof outer skin.
- Tighten the fastening screws of the sliding rails.

Adjust Rear Height, Remove Headliner

Create two centering pins and remove the sun roof headliner, then close the sliding roof and loosen the screws on the left and right retaining brackets.

- Plug the centering pin into the left and right centering bore.
- Adjust the sun roof top panel so it is flush with the roof, or up to 1 mm deeper. Starting from the slide position at the rear in the curved area, tighten the screws on the left and right retaining brackets.
- Pull out the centering pin and install the sun roof headliner.

Unique Vario Roofs:

The hydraulically operated, three-part folding Vario roof turns roadsters into

cars for all seasons, taking up a third of the available luggage compartment space when open and offering everyday practicality and quiet running as if the vehicle were a coupé or sedan. Three moving elements interconnected by a sophisticated pivoting mechanism make the Vario roof work, and include a magnesium/plastic/glass hybrid modular roof, two magnesium and plastic C-pillars, and a magnesium frame and single-pane safety glass pivoting rear window. Six electrically-operated hydraulic cylinders and one hydraulic pump actuate the folding system, opening or closing the Vario roof in about 16 seconds.

Adjust the Contour of a Vario Roof

(Use template P77.50-0327-06 for checking and adjusting the roof contour.)

- Remove the C-pillar cover on the Vario roof and the cover above the B-pillar.
- Unhook the return spring and push the slide up.
- Loosen the bolts on the main mount and move; when moving the main mount, do not lock the slide main mount toward the rear or front.
- Tighten the bolts on the main mount.
- Hook in the return spring, close the Vario roof, and check the contour with the template – position the template on the rails, ensuring that when hooking in the return spring the sleeve for the control cable is located in the bracket.
- Open and close the roof. When locking, avoid excessive downward pressure around the separation joint between the front and rear roof sections while the rear side window is not yet in contact with the roof seal, and check the stop buffer adjustment, the catch on the C-pillar, crank the windows, and the rear side windows.
- Install the cover above the B-pillar and C-pillar paneling of the Vario roof mechanical system.

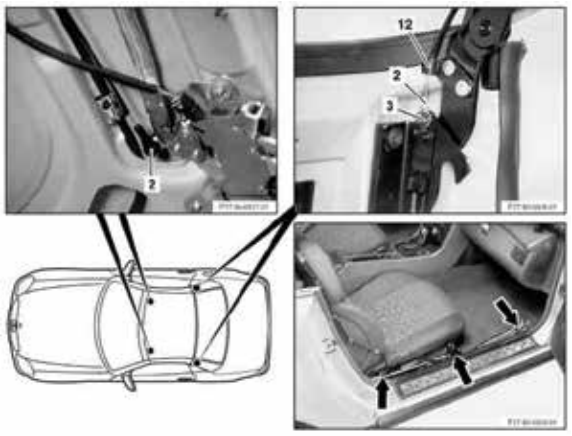
Adjust the Vario Roof Gap

Adjust the gap between the Vario roof and the crossmember above the windshield, checking the gap with a feeler gauge. A V-shaped gap of 1 mm is normal over the roof width:

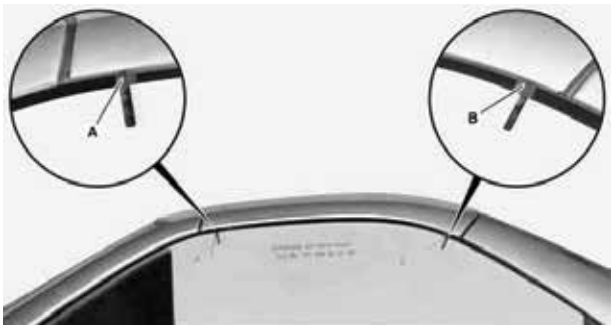
- Remove the paneling at the top of the windshield, loosen the two screws, and remove the intermediate, then tighten the screws slightly.
- Close the roof and align it laterally, adjusting the roof in relation to the crossmember above the windshield so that it is flush with the A-pillar.
- Open and close the roof – the rotary catch should engage in the center of the mount and not touch the mount at top or bottom when closing.
- Check the adjustment of the catch on the C-pillar and roof contour.
- Tighten the screws and install the paneling at the top of the windshield.

Adjust the Catch on the C-Pillar

- Remove the C-pillar paneling on the Vario roof and close the roof.
- Push the slide up (the interval between the pin and the oblong hole release in the slide is 2 to 3 mm), and loosen the screw
- Adjust the cam by turning it to the left or right to obtain an interval of 2 to 3 mm after releasing the slide.
- Open and close the roof several times. If the roof is subjected to excessive pressure downward in the area of the separation joint between the front section and the rear section of the roof when locking, adjust the stop roof buffer.
- Install the C-pillar paneling on the roof.



Adjust the gap between the Vario roof and cross member above the windshield, checking the gap with a feeler gauge.



Loosen the bolts on the main mount and move it; when moving the main mount, do not lock the slide main mount toward the rear or front.

Cure Noise from Panoramic Roof

Loose or missing bolts could cause noise from the panoramic roof area. To check and cure, if that is the problem:

- Remove the headliner (refer to WIS document AR68.30-P-4300SX).
- Check for loose or missing bolts at the body cross bracing, replace any missing bolts, and tighten all nine bolts to 7 Nm ±1 Nm.
- Check for loose or missing bolts at the panoramic roof frame.

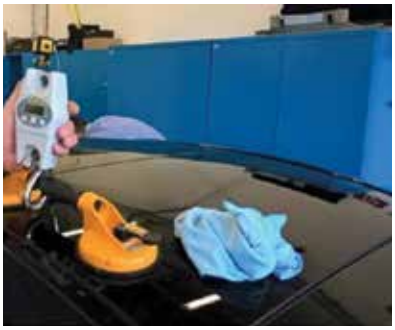
On vehicles with panoramic roof trim (R&R 68-1611):

- In addition to the headliner on vehicles equipped with the Parktronic system, replace (68-1698) with night vision assist (68-1714).
- Replace or adjust the panoramic roof frame hardware.

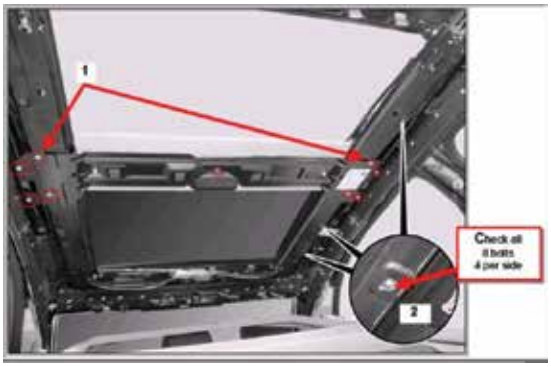
Correct Bonding of Rear, Fixed Part of the Panoramic Glass Roof

Bonding on certain Model 205 vehicles may be incorrect, and the rear fixed part of the glass roof could separate from the vehicle. If it does, the glass panel may need replacement. This is Recall #RC-2016020006, affecting only a few vehicles, but check the bonding of the rear glass panel to be sure, replacing the glass panel if needed after performing a recall campaign VMI check to determine if the vehicle is involved in the campaign and if it has been previously repaired. *Recall Campaigns do not expire and may also be performed on a vehicle with a vehicle status indicator.* Here are the repair procedures:

- Clean the rear fixed glass section and install the vacuum lifter, attaching a cable tie to the suction lifter handle.
- Hook theforce gauge onto the cable tie and pull it upwards with 25 kg or 50 lbs. of tractive force. The Panoramic glass sunroof must not detach from the vehicle. Do not lean you head over the roof when applying upward force to prevent the roof from separating from the vehicle when force is applied, and do not reuse the same cable tie on subsequent vehicles – use one new cable tie per vehicle.
- Repeat measurements and if the fixed glass section has not detached from the vehicle the checking procedure is complete and the glass is correctly attached.
- If needed, replace the rear fixed glass section for the Panoramic sliding sunroof using Roll-Out 2004 glass removal tool (SSEP Article # 521-900 589 046700). *If the fixed glass section for the Panoramic sliding sunroof detaches from the vehicle, the results of the check/test must be recorded on the repair order and kept with the vehicle's file.*
- Use special adhesive for this operation and ensure that the temperature of the special adhesive is >70 deg. F. to avoid difficulty in application, and use the dual caulking gun to apply the adhesive.



Hook a force gauge onto the cable tie and pull upwards with 25 kg or 50 lbs. of tractive force.



Replace any missing bolts, tightening all nine bolts to 5 Nm ±1 N.

Thoroughly clean the rear glass before any other operations are performed.

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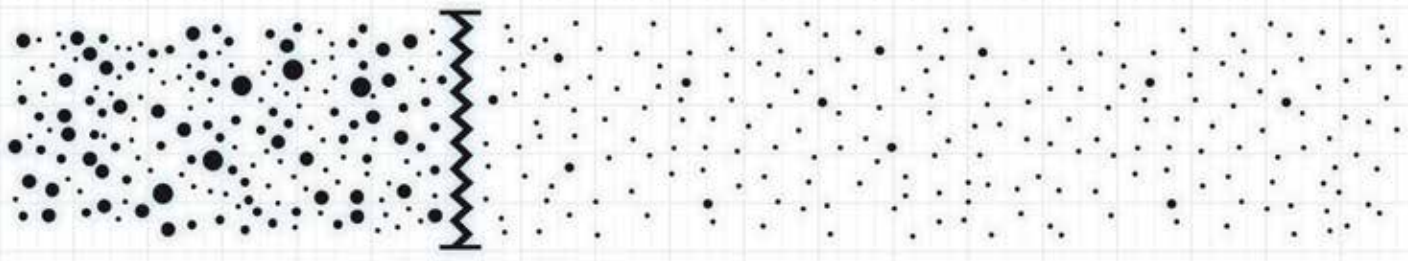

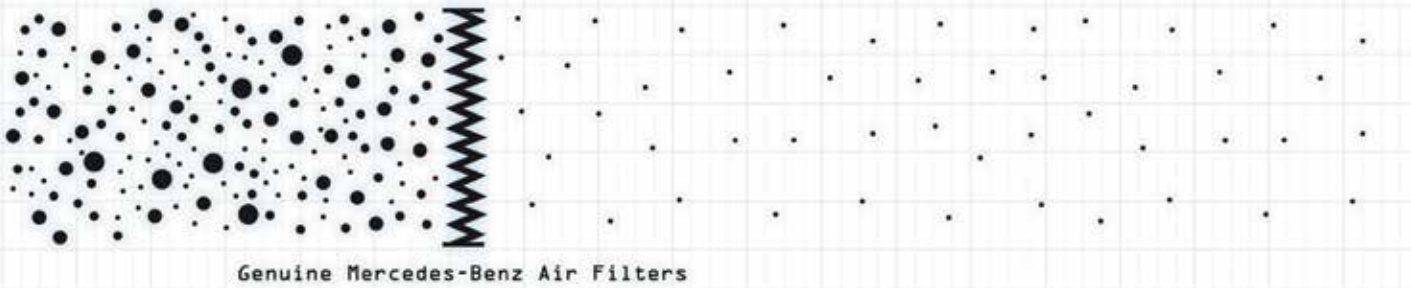

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*As compared to leading paper air filters and based on test #ISO 5011-2000, which measures filtration efficiency using diesel soot.

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