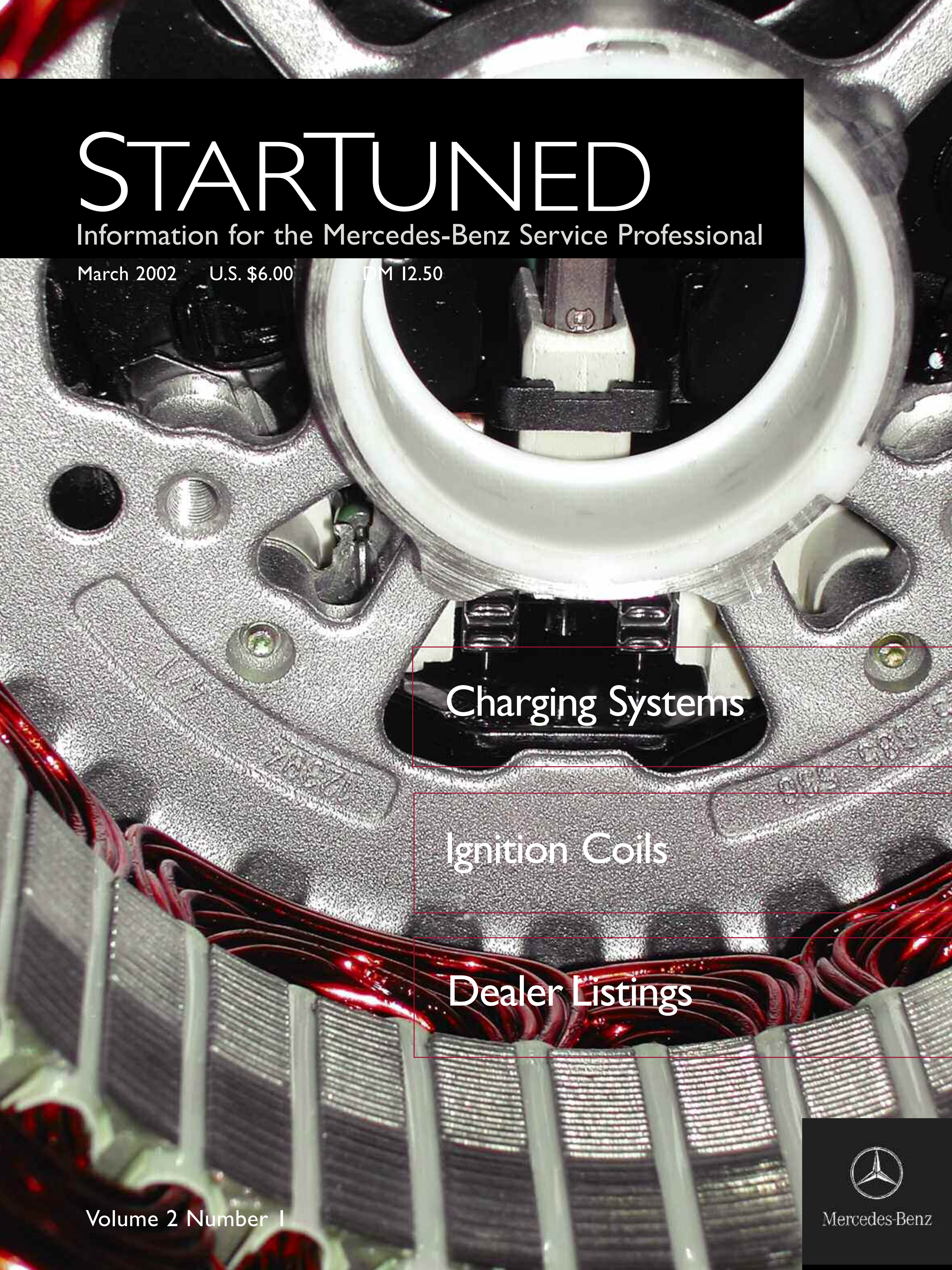


StarTuned

Information for the Mercedes-Benz Service Professional

March 2002 U.S. $6.00 DM 12.50

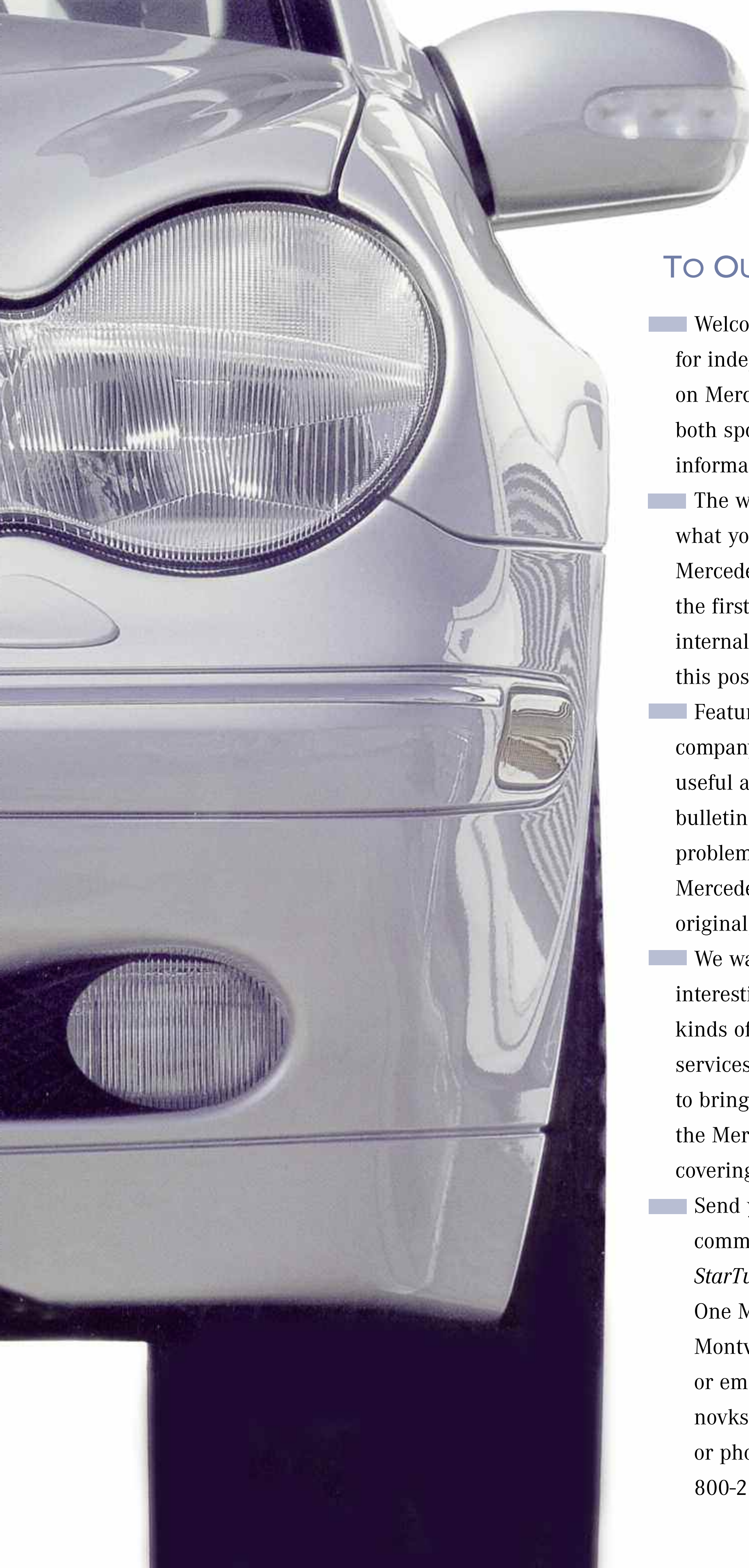
Charging Systems

Ignition Coils

Dealer Listings

Volume 2 Number 1

Mercedes-Benz



To Our Readers

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

The worldwide carmaker wants to present what you need to know to diagnose and repair Mercedes-Benz cars accurately, quickly and the first time. Text, graphic, on-line and other internal information sources combine to make this possible.

Feature articles, derived from official company information sources, focus on being useful and interesting. Our digest of service bulletins will help you solve unanticipated problems quickly and expertly. Our list of Mercedes-Benz dealers can help you find original, Mercedes-Benz factory parts.

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

Send your suggestions, questions or comments to us at:
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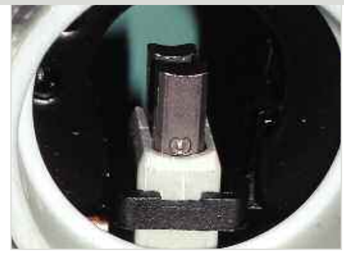
Feature Articles



Departments

Mercedes-Benz

Charge!

Whatever we say about charging systems, we're talking about electrons. Swarms of them, trillions, quintillions - zillions. Electrical current *is* electrons moving; static electricity *is* electrons swarming and damming in one place or on one surface, separated from another where they don't. When electrons move, you have electric current; when a lot of them move, you have a lot of current. When electrons pile up behind a resistance or an insulator, you have voltage; and a lot of them mean a lot of voltage.

The Electron, Positive or Negative?

The electron has the smallest unit of electric charge. It carries negative charge because Ben Franklin or one of the other pioneers of electricity had to guess which charge was which before the structure of the atom was known: Ben's odds were fifty-fifty. Maybe he was lucky in love. Most of the equations and diagrams in electrical textbooks were known in detail before the structure of the atom, too, so we still refer to the positive side of a direct current circuit as "power" even through the electrons always move from negative to positive. You could say, as some do, that 'electron holes,' places electrons could be but aren't (and thus have positive charge) move from positive to negative. This difference is clearer if you've ever heard the sound when a freight train starts up: The locomotive and cars head in one direction; the sound of the clanging gap pulled out of the couplers heads in the other. Like electrons and electron holes going in opposite directions in a wire. Well, sort of.

A charging system makes use of two properties of electrons: They are directly connected to magnetism, both as cause and as effect - we'll see more of this shortly - and they move freely through most metals. For all practical purposes, every electron in a chunk of metal can be an electron in any of the atoms of that same chunk. This ready capacity for electrons to move throughout it is, obviously, what makes metal electrically conductive. Materials that hold electrons more or less firmly locked in place in their individual atomic shells are insulators. A charging system uses each of these properties.

The charging system output arises in the output coils of the stator, built into the case. The armature spins inside this ring, turning its magnetic field as it spins. The energy delivered to the armature shaft from the crankshaft pulley provides the force needed to pull the magnetic fields through the coils and produce the current.

The connection between electricity and magnetism is the basis of the charging system. Just as a farmer might save a certain portion of this year's crop as seed for next year, the charging system uses a certain proportion of the available electric current to make more. It doesn't work by magic multiplication, of course; it isn't a 'perpetual-motion' or a 'free-energy' machine. Next year's farm crop derives most of its growth from the nutrients it draws from the soil. The next minute's electric current derives most of its power from the mechanical torque energy delivered from the crankshaft through the accessory drive belt, factored by the electromagnetism built by a small portion of this minute's electric current. Next year's crop will grow with sun, rain and soil. The next minute's electric current finally derives from the rendered dinosaur remains back in the tank, burning in the combustion chambers and driving the crankshaft.

Current Affairs

Depending on how alert or provident the car owner is, the first symptom of a charging system problem may be the indicator light on the dash, or it could be a dead battery preventing the starter from cranking the engine to work.

Current Mercedes-Benz charging systems are almost entirely internal to the alternator, which contains the regulator internally and which does not connect to the rest of the vehicle's electric system except as a source of power.

The alternators on Mercedes-Benz cars tend to last a long time before they need repair or replacement, and on some models removal is not a perfunctory task. If there is a charging problem, chances are at least even that the cause is something external to the alternator. So the first step in diagnosis of a charging system problem is to determine whether the problem lies with the alternator or elsewhere. You have the advantage that the charging systems on these cars are self-contained. They do not depend on the car's main computer to regulate the alternator's voltage output. The charging system is independent of the rest of the electrical system.

The strap on one side of the regulator serves both as the voltage sampling probe and the source of energy for the magnetic field. This current passes through the brushes and through the field coil, building or reducing the spinning magnetic field as needed.

On all Mercedes-Benz models for many years the voltage regulator is internal to the alternator (often called a *generator* in the service literature), but much older vehicles had external voltage regulators. Even longer back, Mercedes-Benz cars, like all others, used direct-current generators. With such older models, contact Mercedes-Benz USA for vintage car technical information. The company can provide service and mechanical detail on cars dating back over 50 years.

The regulator bolts to the alternator case. Its internal circuitry detects the difference between output voltage and the case, and its power transistor turns on and off to energize the field.

Generators and Alternators

Early charging systems used direct-current generators, which differed from present alternators in that the current was produced in the generator's spinning armature and collected from a slotted bank of collectors called the *commutator*. The direct-current generator had brushes, but they had to carry not the relatively small amperage of the current creating the magnetic field but the full output of the generator itself. The field coils received the 'seed' current from the voltage regulator to keep the output within a proper voltage range. But sparking and heat from the higher current and the mechanical abrasion of the slotted commutator meant shorter useful life for the brushes in the direct-current generator.

The diode, a solid-state, one-way 'valve' for electric current, allowed invention of the alternator. Now the electromagnetic field built by the return current from the voltage regulator could spin, generating current in the stationary stator windings, from which the output current flows. Of course, as a magnetic field spins, north and south magnetic poles follow one another in rapid succession, reversing polarity and thus the direction of electron flow. But the diodes work even more quickly and stop the flow of current when the voltage reverses.

A direct-current generator looks very much like an electric motor, like a starter (except that starter motors don't run long enough to require cooling air apertures). And, in fact, every such motor can become a generator and vice-versa. Something that looks much like an alternator is the industrial three-phase, alternating current electric motor, which does not even require small brushes for its armature because the current can be externally induced.

To make things more confusing, however, carmakers have chosen in the last few years to call everything that provides the power for the charging system a *generator,* whether it is the usual alternator or an old-fashioned direct-current generator. But don't get so confused you try to find a commutator in one of today's generators - oops! I mean alternators... no generators. Well, you get the point.

The Box of Volts

Batteries often have shorter useful lives than alternators, and they are always (well, almost always) easier to work on. Right after your overall visual inspection confirming the presence and condition of the accessory drive belt and the main electrical cables, gradually bring the battery to full charge. Once it cools from your recharge, check the specific gravity of the battery acid with a suitable tool and check the open-circuit, unloaded voltage, which should be just over 12 volts. Then run a battery load test with the proper equipment, to see whether it retains the minimum voltage under the equivalent of cranking. A battery that can't hold a charge is not only a problem itself; if it has an internal short, that can mean the alternator works at such a high output level that its useful life shortens, as well.

A reverse problem happens occasionally: If a voltage regulator overcharges the battery, not only should you replace the regulator (and for that matter, the entire alternator, as we'll see below), but the battery may have suffered internal damage, including warped or cracked plates. If an overcharge went on long enough to electrolyze battery acid below the tops of the plates, this has almost certainly occurred. Experience shows that in such cases, it is prudent to check the insulation on the alternator's output cable. If it shows signs of heat or even melting, replace it immediately along with the alternator and the battery.

Often people describe something as a charging system problem that actually results from a key-off current draw on the battery. This could be anything from a trunk light that fails to turn off when the lid is closed (climb in and look) or a closing-assist system that can't quite latch the door or trunk, to anything else that continues to pull current from the battery.

The test for this is no longer as simple as it once was. Of course, you disconnect the battery and measure how much current flows through a jumper. If your clamp-on ammeter doesn't register in the low ranges (well below one amp) needed for this test, coil your jumper wire in a circle ten times around. When you put the coil in your pickup clamp, it will multiply the tested current by ten, one for each winding of the wire.

The problem is, no modern car ever shuts everything off altogether. The engine management computer retains its electronic memory; the alarm system maintains its vigilance; the radio, seat adjustment and climate controls keep track of their settings; the central locking system stays awake, waiting for the owner's flashed infrared signal to pop up the locks. All of these systems together don't add up to even a consistent one-amp draw, or the car would be very hard to start after a few days unused, standing in the winter cold. The precise amount of the standby current draw is not an available specification because there are so many car models and accessory sets, but it's worth while checking a few cars at random just to get a sense of what range of draw to expect.

Assuming everything is working properly, this rest current, called the "parasitic draw," is much less than the internal current drain in a battery. Eddy currents form on and between the plates of a battery, currents which will inevitably discharge the battery over several weeks. There is really no method, other than fitting the car with a trickle-charger, which could prevent that. You can argue, of course, that if a person only needs to start his car every few weeks, he really doesn't need to start a car at all.

Even on an inline six-cylinder engine, it can be difficult to remove the alternator if there is a charging problem. V-form engines present even greater access challenges. It is thus good practice to determine as clearly as possible whether a charging problem comes from the alternator or some external source, like a defective battery, a parasitic draw or a high-resistance connection.

Resistances

If the battery is satisfactory and if the alternator is working properly, the charging system may still not work properly if there is resistance in the connections from the alternator to the battery and to the chassis ground. The most obvious of these connections is the output cable, going from the alternator output post to the battery terminal. But in electrical terms, it's also the least likely to have resistance problems. In fact, every connection in a circuit is equally important, including the connections between the battery posts and the cable clamps, including the connection between the alternator housing and its bracket to the engine ground. Resistance at any point is resistance to the circuit as a whole.

The best way to discover such a problem is with voltage-drop tests. For these tests, however, it is again critical to have a fully charged battery and to run your tests under normal current conditions. Absent these, there is no way to tell whether your results are significant or not.

The test points do not have to be at points just opposite the connection. For instance, to test the connection between the alternator bracket and the engine block, you need only touch the bracket with one multimeter probe wherever it's convenient. The other can touch the engine block anywhere at all. You may safely assume good electrical continuity through the block casting (otherwise there would be more serious, and more obvious, running problems than those involved with a charging system). Whether cranking, running or off, the voltage difference between the mounting bracket and the block at any point should be zero. The same should of course be true of the voltage between the alternator case itself and the block.

The voltage regulator, internal to the alternator in all remotely modern Mercedes-Benz cars, maintains

The Box of Amps

The alternator is a round steel and aluminum and copper box that uses some of the smallest and some of the largest things in the universe to push or pull electrons along the wires we want them to travel.

The smallest things are electrons – baffling physical objects, the unit-carriers of electrical charge. They have mass; they have North and South magnetic poles; they spin at a measurable rate. But their size is apparently really zero, no width, no height, no depth – except when they spread out to be in various different places at the same time!

The largest things are the magnetic fields – but I should really say The Magnetic Field, because there is only one, and it fills the universe and has local ripples of various kinds, including those in the alternator. I don't allude to these smallest and largest things idly: When we work on cars, we work on things that touch and use the fundamental laws of the world, right up to the point where we don't understand them anymore. This work is more than just "addressing customers' concerns." It deals with the basic laws of science. It deals with real, nonpsychological facts of the real world. Solving a real, objective problem comes first when 'addressing customers' concerns.'

Inside the alternator is the rotating armature, supported at either end by bearings, with a field coil powered through the slip rings and ferrous metal 'fingers' that focus the magnetic field produced by the field coil. The centrifugal fan draws cooling air through the alternator.

With the regulator and brushes removed, the slip rings are visible surrounded by the rectifier. The tab to the right provides output voltage to the regulator

the output voltage at a constant 13 to 14.5 volts between the output post and the alternator case, which it takes as vehicle ground. Any resistance on either the positive or negative side of the charging circuit reduces the effective charging voltage below this, the amount of the reduction depending on the resistance and the current flow. Check 'em.

Inside the Coils

What's going on in the alternator, with its zillions of electrons and single (but very complex) magnetic field, or complex wrinkle of The Magnetic Field?

There are three wound coils in the outer case of the alternator, joined through the rectifier or diode cluster to the output post and at the other end to ground. The geometry of these windings is such that if magnetic fields forcibly spin within them, electric voltage appears and thus current flows in the windings; and the diodes will convert them to a direct-current output with an output voltage ripple corresponding approximately to the system load.

The real source of the electrical energy the alternator produces comes from the mechanical energy the engine puts in, through the front pulley. Don't overlook drive pulley problems, therefore. A loose or glazed drive belt will not necessarily make noise. Check it for tension and for enough friction to grip the pulley. There have even been rare cases of pulleys that work themselves loose on the armature shaft, turning the alternator either very slowly or not at all but fooling someone who just tugs once or twice at the drivebelt to see whether it is tight.

The rectifier consists of the set of power diodes at the ends of the alternator stator windings that allow current to flow in the desired direction and block it when it reverses. These are solid-state devices with no mechanical internals. A defective rectifier, one with shorted or open diodes, means replacing the alternator.

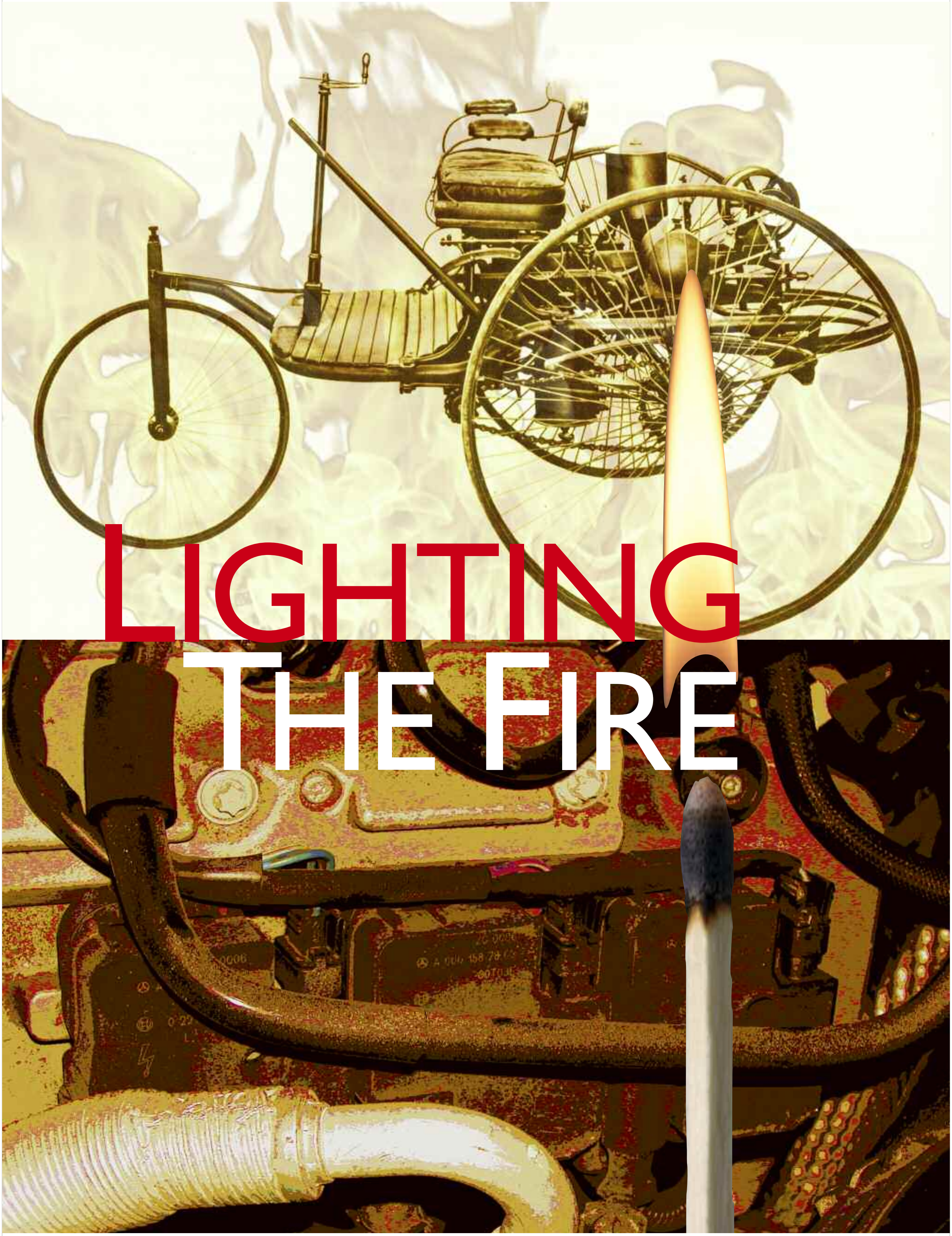
Inside the alternator is the armature, a special multiple-pole electromagnet consisting of the electric coil that energizes it, a shaft that constitutes the center of the magnet and two opposite poles with opposing fingers, making the lines of electromagnetic force. 'Seed' current from the voltage regulator flows through the armature's windings building magnetic fields of whatever strength is needed to keep the output voltage within the specified 13- to 14.5-volt range.

This current, the field current, enters and exits the armature through the two slip rings at one end of the shaft. Each ring is electrically connected to one end of the field coil around the armature shaft. You should, thus, always find continuity if you measure from one slip ring to the other, and you should never find continuity from a slip ring to the shaft itself, which grounds through the bearings to the case.

The amount of current through the field depends on what the voltage regulator senses is required to keep the charge high enough. Many factors, including the battery's state of charge, the number of electrical consumers like blowers and lights and even the ambient temperature, affect this. The regulator never goes to the extent of a once-popular diagnostic test: full-fielding. This meant running full system current through the alternator field to distinguish between an alternator and a regulator problem. It was more accurately an electrical-abuse test: If the alternator could survive full-fielding, it was probably OK at least in the short run. Most modern alternators are now designed to prevent full-fielding.

The regulator itself consists of a microprocessor/power transistor that converts input from ground and power to output through the field coils. The lower the output voltage, the higher the field current and vice-versa. This keeps the output voltage constant. The regulator is one unit with the carbon brushes that contact the armature's slip rings. These are items that wear out, eventually. It is possible to replace the regulator/brush unit individually rather than the alternator complete, but many dealers find that other wear elements of the alternator, such as the bearings on either end of the armature, have a similar useful life. They argue that replacement of the alternator complete not only reduces the chances of a comeback, but also turns out more economical over the useful life of the vehicle.

LIGHTING THE FIRE



Mercedes Benz Ignition Coils

When Karl Benz patented the first real car back in 1886, a three-wheeled conveyance he had built in stages over the previous couple of years, igniting the fuel/air mixture in an engine's combustion chamber was a very difficult problem, one that had taxed engine inventors for a long time. Benz's solution was to route a tube through the combustion chamber and sustain a flame inside that tube, a flame hot enough to light the fuel and air around the metal tube, just as the piston reached the top of each compression stroke. This hot-tube ignition worked like glowplugs on two-cycle model airplane engines, except that fuel constantly burned inside the hot tube to keep the temperature up. This hot tube had to stay hot from its internal flame; the very low-compression, slow turning engine didn't leave enough residual heat in the chamber to dependably fire the fuel mixture the next time.

Did it work? Well, yes and no. Over two years had passed since he'd first driven around his shop in his Motorwagen, but most people regarded it as a silly toy and its inventor as a harmless ninny. Laws as well as the painstaking inventor's sensible precautions meant not traveling on the ordinary horse roads, for fear of spooking the livestock and the locals. He just operated it near his shop experimentally, returning to tinker with it long hours every day.

This might have continued indefinitely, but early one day in August 1888 before Herr Benz was up and fiddling in his shop, Frau Bertha Benz, as practical as she was beautiful, took matters into her own hands and set out with her teen-aged boys, Richard and Eugen. They began the very first overland trip by car - without mentioning their purpose or itinerary to her husband, the reclusive inventor. The journey was from their home in Mannheim to her mother's house in Pforzheim, about 100 kilometers distant, over horse-trails through mountains. Before Karl Benz was awake and puttering, they rolled Motorwagen No. 3 out the door and down the road so they could start the engine without alerting him to their plans. In the course of their numerous stops along the way, Frau Benz would telegraph her husband about their progress. All the odds were against them: No one had ever done such a thing in a horseless carriage before.

Bertha Benz

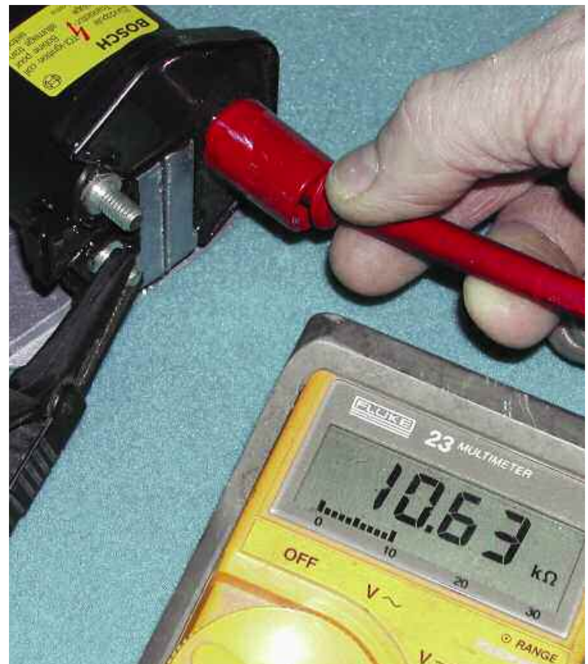
Nonetheless, the intrepid mother and her young sons set off anyway. For a cooling system, the one-cylinder engine just boiled off uncirculated water from its jacket as they drove along, but water was easy enough to collect from wells and streams. Fuel was a problem, though – gasoline hadn't been invented yet: The car ran on ligroin, a kind of drycleaning fluid, but Herr Benz had never driven his Motorwagen far enough to calculate fuel consumption, and the travelers hadn't thought about it at all until the tank first went dry. They were lucky: a local pharmacy sold ligroin by the flask. They could complete their trip provided they didn't drive past any more pharmacies without stopping for more of the stuff.

The three-HP, 1886 Motorwagen didn't have enough power or low enough gears to climb the steeper hills, so Frau Benz and her older son got out and pushed while the younger one steered. The brakes consisted of a leather strap rubbing against a small drum, and wore out quickly. Fortunately, resourceful German master shoemakers along the route helped out and did the first brake reline – on a machine they not only had never seen, but couldn't even have imagined. The drive chains, like a bicycle's, showed signs of rapid wear, but they held.

Late that same day they did arrive in Pforzheim. And, except when they ran short of ligroin and the fire went out, the hot-tube ignition system worked without fail the entire way. The reliability and usefulness of Karl Benz' invention was now clear, thanks to his confident Frau Benz and his boys. On the other hand, the hot tube was itself fragile and occupied precious space in the combustion chamber, reducing what was available for valves and the piston. What's more, there was no good way to control the point at which ignition occurred – it just lit off whenever the combination of compression, temperature and speed happened to cross the 'fire-now' threshold. On a slow, low-compression engine, that could and did work, at least as long as Frau Bertha's and her boys' luck held. But something better was needed.

Over its long history building cars, Mercedes-Benz has used just about every ignition system there is. On current V6 engines, there are individual coils for each cylinder, with two spark plugs apiece, both fired by the same coil.

It's been over 114 years since then, so we expect ignition systems to last longer than 100 kilometers, and they mostly do. Nonetheless, we still need something to reliably light the fuel/air flame to deliver the power to the crankshaft and the drivetrain, and that something has a much more precise job to do. That something, for the last 90 years or so since hot-tube ignition fell into disuse, is spark ignition from an ignition coil. A motorist is at fault if he or she runs out of fuel (ligroin, gasoline or whatever) or boils off all the water, but everyone expects the ignition system on any car will work better than that hot tube did for Frau Benz, and for much longer. Neither you nor I could start a Benz Motorwagen; if someone started it for us, we couldnít get it moving; if someone dropped it in gear, we couldn't steer; once moving, we couldn't stop it. She could and did all that. However, she was not only competent but also lucky. That's not enough for dependable ignition, so we turn to electricity.



The circuit ending in the high voltage tower begins at the low voltage primary circuit positive post. Because of the relatively high resistance of the secondary circuit and the relatively low resistance of the primary, it doesnít actually matter which primary terminal you choose to measure to the secondary tower ñ another ohm or two out of several thousand is below the measurement threshold of most multimeters.

Bolts From the Blue...
... Sparks in the Dark

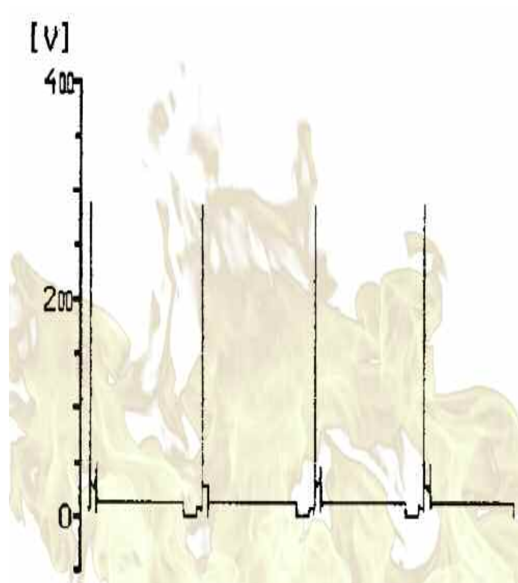
In the form of lightning, electricity can very easily start things burning. But lightning is not only dangerous but too intermittent and unpredictable to use. We don't really need the kind of power that can explode a tree into toothpicks to set a mixture of fuel and air burning, though. A very tiny lightning bolt in the combustion chamber – a spark in the dark – will do the trick just nicely.

The modern ignition coil generates a short, perfectly timed tiny bolt of lightning. The coil works by converting electric current to magnetism, and then by converting that magnetism it just built back into electricity. While charging and discharging the coil, building and then collapsing the magnetic field, is fast, the collapse is much faster than the buildup, as you can see from any ignition primary circuit pattern.

A coil that fires two plugs has a secondary circuit electrically independent of the primary circuit, except in the sense that when the coilś magnetic field collapses, it generates high voltage in both. You should measure from one high voltage tower to the other, comparing the result with your specifications book. There should be no continuity between either secondary tower terminal and either primary terminal or ground.

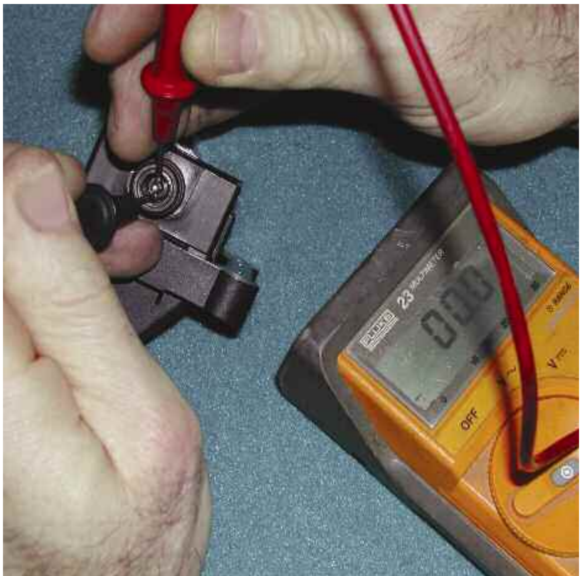
The conversion back to electricity trades current for voltage, much higher voltage – enough to jump the electrodes of the spark plug and start the combustion burn, even under the difficult conditions in the chamber at the top of the compression stroke. An ignition coil thus functions as a very-high voltage transformer. It's a little peculiar to speak of a transformer in the absence of alternating current, but the ignition coil uses pulsed current, which is just as good for transforming voltage.

Ordinarily, we speak of two kinds of ignition coil, those that fire one plug at a time and those that fire two. As we'll see, they are electrically similar. The standard, one-plug coil either fires one plug at a time through a rotor and distributor, eventually firing all the engine's plugs in sequence; or else the engine has a dedicated coil for each plug, a coil-on-plug system. Both primary and secondary circuits begin from battery positive and end at engine ground. For most one-plug ignition coils, you can measure resistance through each of the circuits and compare them with what you find in your specification book. The primary will always have much lower resistance than the secondary, and neither will have continuity to the coil housing or ground. To protect the system electronics from induced voltage spikes, many coil-on-plug systems use protective diodes that, incidentally, can prevent you from measuring resistance on one or the other circuit.



Scope patterns are similar for single or dual plug coils. Here is a normal primary circuit.

A two-plug ("waste-spark," "dual-spark," "twin-spark") coil fires two plugs almost simultaneously, one at each end of its secondary circuit, firing in opposite polarity. Its primary and secondary circuits are electrically separate: The primary goes from battery positive, through the coil windings to ground via the pulsed ignition module driver. The secondary goes from one plug's center electrode to another's, passing through the coil along the way. The two plugs could be in the same or different cylinders: If the same, the dual spark serves to promote more complete burning of the fuel/air mixture; if different, one



Both primary circuits end at the same connector on this Mercedes-Benz coil. Measure from the center terminal to the side, being careful not to let the probes touch (or you'll get a false reading). As with the secondary circuit, there should be no continuity from either of these terminals and either ground or the other (the high voltage) side of the coil.

of the sparks occurs in a cylinder at the top of its exhaust stroke, the so-called "waste-spark." Aircraft piston engines use a different kind of dual-spark, two completely independent magneto ignition systems, but such redundancy isn't needed in cars.

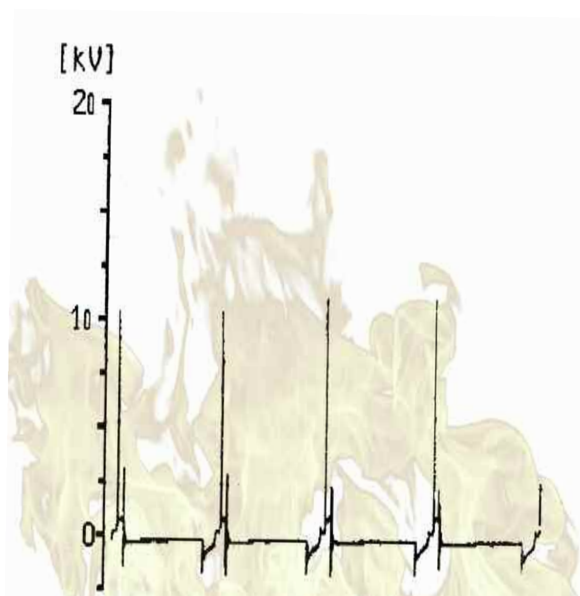
You can make similar resistance measurements for the two-plug coil as for the one-plug: There should be continuity (but different resistance) through the primary and secondary circuits individually and no continuity to ground. But unlike the one-plug coil, there should be no continuity between primary and secondary circuits.

The double spark is not as strange as it initially seems. In fact, a conventional distributor-type ignition system requires its coil to jump two spark gaps, also — one between the plug electrodes and the other between the distributor electrode and the rotor tip. A fast oscilloscope can show each gap-jump on its trace. Both those sparks have the same electrical polarity, of course. It does take more electrical energy to jump two sparkplug gaps than one, though, so you'll typically find lower primary resistance on two-plug coils. The lower resistance allows more current to flow.

Double Windings around a Magnet

Each ignition coil consists of two circuits of fine wire wrapped around a ferrous (thus electromagnetizable) core. The primary circuit conducts ordinary electrical system voltage through several hundred wraps of wire to form an electromagnet and build an electric field around the iron coil. This side of a coil circuit is called the primary circuit; it comes on first. When the ignition coil turns on, current starts to flow through the primary circuit windings.

On earlier vehicles, this occurred when the distributor's contact points closed, closing the ignition primary circuit. On modern vehicles, this occurs when the computer or the ignition module, working with information conveyed from the crankshaft and/or camshaft position sensors, signals the coil driver to close the primary circuit.



For each type ignition coil, a secondary pattern shows the high spark line followed by a burn line and the normal oscillations.

When a coil turns on, less current flows than you'd calculate from a stationary resistance measurement through the primary circuit. Instead, the current only gradually increases – 'ramps up' – because the lines of force in the growing electromagnetic field cut through or transect those same primary circuit windings as it grows. Move a wire through a magnetic field, and current flows in the wire. Grow a magnetic field through a coil of wire, and current also flows in the wire.

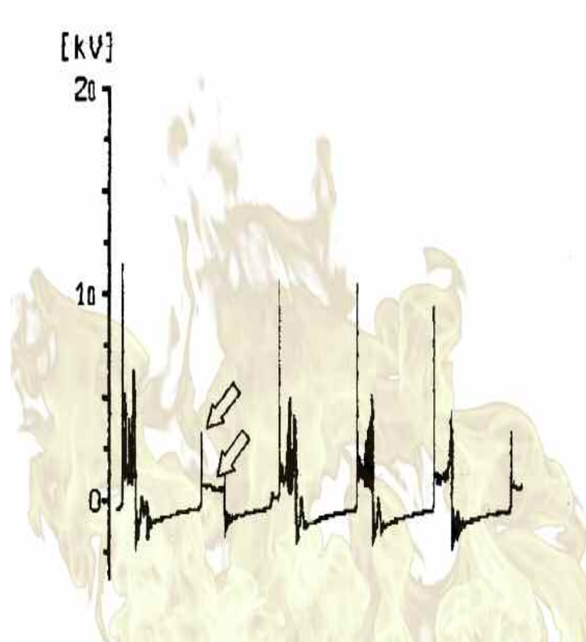
But this tries to induce a current in the opposite direction from the circuit, a phenomenon called reluctance, almost a kind of dynamic resistance. As the magnetic field nears full strength, the lines of force become stationary and no longer transect the wires, so the current reaches its maximum. On contact-point ignition, a spark occurs not at the low-current extreme when the points close and begin to saturate the coil, but when they open, when the primary circuit carries maximum amps. To be sure, there is additional induced current (and voltage) even in the ignition primary circuit as the magnetic field collapses. Contact-point ignition required a condenser to absorb this voltage surge; modern ignition systems can use Zener and other protective diodes that can withstand the spike.

Once the primary current stops, whether the contacts open in an old car or the transistor shuts off in a modern one, nothing holds the magnetic field up. It collapses almost instantaneously, and as it does, those same lines of magnetic force again transect the coil's wire windings in the opposite direction. In this stage, however, the excitement happens in the secondary windings. Because there are so many more of them, the voltage that forms is much higher than the voltage the primary circuit used to build the magnetic field in the first place.

One end of the secondary circuit in the one-plug ignition coil connects the battery-positive side of the primary circuit, through the thousands of windings of superthin secondary coil wrapping to the spark plug center electrode. The voltage-multiplication ratio of the coil, like that of any transformer, corresponds to the ratio of windings between the primary and secondary coils. Several hundred windings of primary circuit at twelve volts requires many thousands of windings of hair-thin secondary to achieve the 40,000 or more volts needed to ignite a lean fuel/air mixture under any and all throttle and engine speed conditions.

But it's not merely high voltage a coil must reach to generate a spark that can dependably light a compressed fuel/air mixture. It's also the duration of the spark, what we see in the extent of the spark line of a secondary ignition pattern. That energy comes from the additional energy stored in the magnetic field when the primary circuit builds it up before the spark.

Just as, if you're building a campfire, you have to hold the flame of the match to the tinder for a certain amount of time to get it to light, the spark in the combustion chamber has to do more than just jump across the electrode gap. The spark has to continue its electrical discharge across the gap for some time, long enough for the gasoline to start burning, for the combustion fireball to start growing. The amount of time required depends on engine temperature, fuel mixture, engine speed, throttle position, engine load and other factors.



When there is a problem, it will show up in the pattern. Here a spark plug gap that is too small on one plug reduces the spark line and (the energy has to appear some way) extends the burn time.

The voltage necessary to jump the electrode gap in the first place also varies, with similar factors. Before the spark jumps, the electrical voltage – that is, the electrons massing on one side of the gap – must *ionize* the fuel/air mixture in the gap. What that means is that the massed electrons drive electrons out of the gas mixture in the gap and the metal surface opposite, because electrical charges repel one another mutually. With the electrons driven out of the gap and the other side prepared for the spark to jump, that gas is now *ionized*, that is, richer in positive charge. When the combination of voltage and resistance hits the combination determined by Ohm's Law, the spark appears across the gap. Notice, it doesn't 'jump across.' The spark appears all the way across the gap simultaneously; it's a circuit phenomenon, not an electron-projectile.

Once it starts, it takes less energy to sustain the spark. We can see this in secondary discharge patterns. The spark line reaches relatively high voltage for a very brief time; the burn line runs at much lower voltage for a much longer period. There is a total amount of energy stored in the form of the electromagnetic field around the coil's core. When that collapses, it can take either the form of voltage – the spike that ionizes and jumps the gap – or current, duration – the burn line. There's only so much energy, and it can only take those two forms.

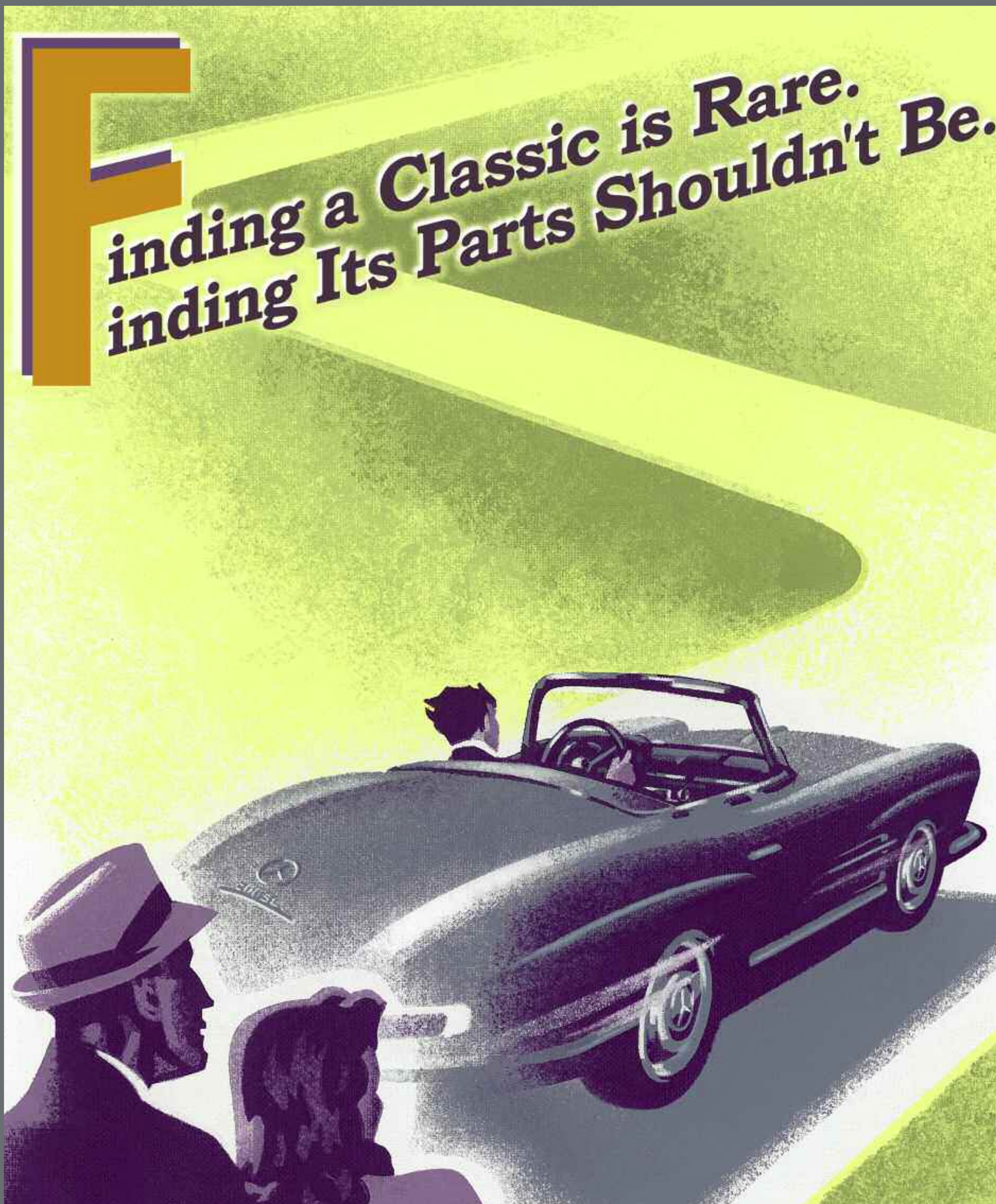
But you see what that means: If there is a problem anywhere in the circuit, like a high resistance secondary cable or bad insulation somewhere on the high voltage circuit, energy that should have gone into the spark must overcome the problem (raising the voltage to overpower resistance, as long as there's voltage to spare), or it leaks away to ground, frustrating the combustion burn. Ignition engineers try to maintain confidence the coil can always produce the required spark by designing them to be capable of much hotter and longer sparks than should really be required. But eventually conditions in the combustion chamber present greater demands; supply and delivery connections deteriorate, and wiring loses its integrity; finally the coil itself starts to lose capacity.

We'll just consider the factors internal to the coil here. The major reason why an ignition coil can't be an infinite-life component is the insulation. If you wrap a thin wire round and round as in both the primary and secondary circuits, the voltage difference between one winding and the next won't be very high at all. If the primary circuit had a mere 100 windings at 12 volts, that's only about 1/8 th of a volt per wiring turn. You don't need the stoutest insulation in the world to hold back 1/8 th of a volt. Traditional ignition coils just ran the thin copper wire through varnish before wrapping it into a coil. Today's insulation is much better than old varnish, but there's not much room for it to be much thicker. Eventually, heat will allow successive coil windings to touch at various points. This leads to minor internal shorts. There are probably a few in every brand new coil, but they don't effectively reduce the number of windings significantly until insulation breakdown becomes more widespread. Of course, as these mini-shorts increase in number, the coil's resistance goes down, its current draw goes up, and the internal heat increases, further damaging the insulation around the wires.

This tolerance for some insulation breakdown is one of the reasons why ignition coils typically have a range of acceptable resistance. Of course, modern primary circuits have such low resistance anyway that you can't measure them accurately with an ordinary ohmmeter – you'd have to rig up an elaborate Wheatstone Bridge measurement, and it would be simpler to just replace any suspect coil.

But the importance of the insulation also points to the importance of the quality of a replacement part, if it turns out one is needed. The ignition systems on these cars are quite durable, even though eventually coils and other components will have to be replaced. When you find one with a coil that has ended its useful life, take a look at the odometer to see how long that one was on the job. Given the improvements since that first car trip, get one that can rack up similar odometer numbers. Factoring in the 114 years since then, take the example of Bertha Benz and her Motorwagen's hot-tube ignition straight from the manufacturer. Get the best parts you can.

A conventional ignition coil, the type found on most Mercedes-Benz vehicles, uses primary and secondary circuits that share a connection at the battery-positive terminal. The primary circuit tested here builds an electromagnetic field around the iron core of the coil. Resistance through this and all other primary circuits is relatively low.



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Parts News

Alternator Or Regulator

Except for the indictor on the instrument panel, the charging system in a Mercedes-Benz is independent of the rest of the electrical system. As long as the engine is turning fast enough, the drive belt works and the battery can accept charge, the alternator should put out enough current to support all the loads and keep the battery charged.

If not, however, many dealership shops prefer to replace the alternator complete rather than just the regulator/brush unit. While most alternators function up to the point when the field brushes sliding against the slip rings begin to lose a secure electrical contact (they naturally wear with age, and the spring is only so long), these shops find the predictable useful life of the rest of the alternator is often comparable to that of the just-failed regulator/brush unit.

Alternators include bearings and diodes that don't last forever. Even the drive pulley is sometimes subject to wear or damage. Replacement of the charging unit complete guarantees against comebacks from any of these problems.

Still, there are a few occasions when you can be fairly confident in replacing the regulator/brush unit alone. If a battery develops an internal short and drives the system voltage down, with the consequence that the regulator toggles the alternator into full-capacity output for some time. Should inspection of the brushes flag wear and burning there but no detectable damage anywhere else in the unit, it might be a reasonable economy to replace the regulator/brush alone.

Ignition Coils

A good ignition coil will last a long time before it fails, and if you find one you need to replace, don't stop testing just at the coil itself. A failed coil is more often an effect than a cause, so check for excessively high resistance in any other parts of the secondary circuit, for poor connections at the primary circuit and for the condition of the spark plugs. Coil damage usually takes the form of internal insulation breakdown, but it can also appear as cracks in the case or as carbon tracks grounding the output spark. Misting water over the coil and other parts of the ignition secondary is still a good test for such problems, and it is a good idea to do coil and other secondary high voltage tests in enough shadow that you would be able to see sparks jumping to ground in unexpected places if that's what's going on.

Get a replacement coil by part number, not just by appearance. Just because an unidentified coil will bolt in place of its predecessor doesn't mean it is the right coil for the vehicle. Even different accessory packages can sometimes lead to specifying more than one different coil for very similar car models.

FACTORY SERVICE BULLETINS

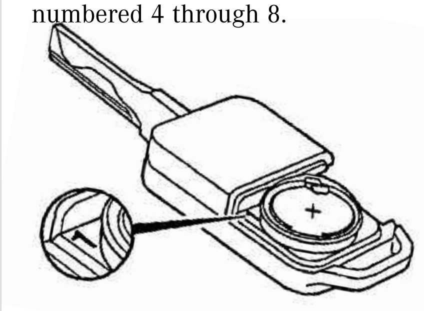
These suggestions and solutions for technical problems come from service bulletins published by Mercedes-Benz, selected and rewritten for independent repair shops. In keeping with this issue's electrical theme, most of our tech tips here cover various aspects of Mercedes-Benz electrical systems.

Infrared Remote Central Locking System

All Models beginning in 1996

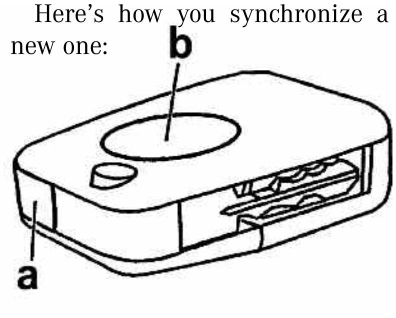
On each of these systems, it is critical to let your dealer have accurate information about the specific vehicle in question, not only its model year but any other information you may gather. Parts must follow the correct parts number, or the remote locking system will not function properly.

IR transmitters have an engraved numeral in the transmitter housing battery compartment. The transmitters that came with the car have numerals 1 and 2. Up to five additional IR transmitter ID's are available for each vehicle, numbered 4 through 8.



The remote locking system control module retains a memory for each individual transmitter used. This means that if a replacement transmitter had the same identification number as an existing one, the existing one would be automatically desynchronized from the control unit as soon as you synchronize the new one.

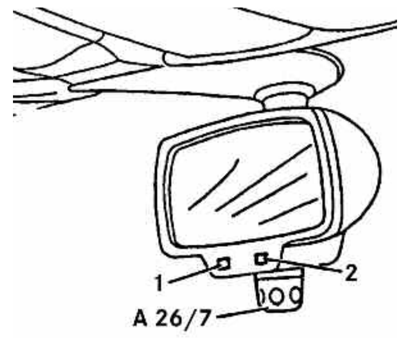
Here's how you synchronize a new one:



For 129's and 140's up to a build date of November 1993, point the transmitter window (a) toward an IR receiver and press the IR transmitter button (b). Then within 30 seconds, lock or unlock the vehicle using the mechanical key. Now the vehicle is synchronized to that transmitter.

For 129 and 140 from December 1993 to the beginning of 1995, point the IR transmitter window (a) at a receiver and press the button (b). Now within 30 seconds, switch on the ignition. Now that vehicle is synchronized to that transmitter.

As of model year 1996 for all models, point the transmitter window (a) toward the receiver (A26/7) at the bottom of the interior rearview mirror. Press the button twice. Then using the mechanical key, switch the ignition on within 30 seconds. Now that vehicle and transmitter are synchronized.



What can go wrong? Well, for one, the batteries in the transmitter may be dead or the contacts too resistant. Here's how to check that: Press and hold the transmitter button (b) for more than one second. An LED in the transmitter window (a) should light to show the batteries are functional. If not, replace the battery or clean the contacts.

That's not all, folks. You can also check to see whether the transmitter sends a signal using an IR Signal Indicator Card (like Radio Shack 276-0099). Follow the instructions that come with the card. The Mercedes-Benz Diagnostic Manual outlines the procedure to determine whether the vehicle then correctly reads the signal.

How can you determine the IR signal code? You can't, of course! That's the whole point of a central LOCKING system.

What if a transmitter is lost or stolen? Using the Mercedes-Benz Hand-Held Tester, you can irrevocably block a specific transmitter through the available menus. Do so only with the consent of the owner, obviously, and check all the transmitters he or she wants to retain, noting the numerals 1, 2 or 4 through 8 in those still on hand. Process of elimination tells you the numeral of the transmitter lost or stolen.

MBNA 80/22

Power Window Motor

Models 124 and 129

After the middle of July 1993, models 124 and 129 use the same power window motor, but when installing a replacement power window motor, be sure to use the three spacer sleeves and the related screws that come with the assembly. Left and right power window motors are mirror-image parts.

MBNA 72/12

Sliding/Pop-up Roof Drive Unit and Relay

Models 124, 126 and 201

The drive unit and a six-pole relay (the original was eight-pole) is available for these vehicles, and can serve as a retrofit in cars with the earlier version. The drives and relays of early and later versions are interchangeable, but once there has been substitution, the drive can only operate at one speed.

MBNA 77/16, 82/50

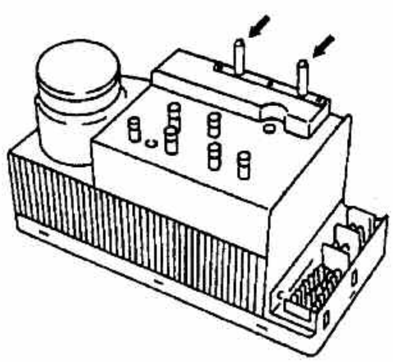
Fits-All Pneumatic Control Model 140

After August 1994 there is only one pneumatic system control module, with an improved type of pneumatic connectors and distribution manifolds. The new module can retrofit to earlier vehicles, as usual with such improvements.

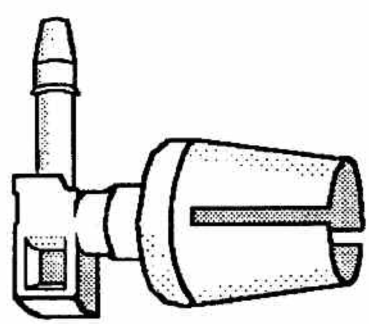
Here's how to replace the module: Remove the rear seat cushion to expose it, and disconnect all the pneumatic lines from the multiple connector using a 7-mm (1/4-inch) open-end wrench. Snip off the old plastic connector from each line.

You'll notice a lot of pneumatic lines, fortunately color-coded . The six yellow ones are for the central locking system; the two red ones are for backup assist; the one black line is for the retractable trunk lid grip; and the one clear (often faded to white) one is for manifold vacuum assist. Depending on the options built onto the car, there may also be three grey lines for the orthopedic seat backrest, and/or two white lines for the retractable rear head restraints.

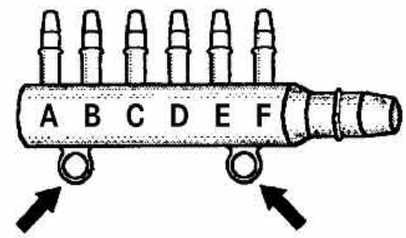
First remove the old and install the new PSE control module.



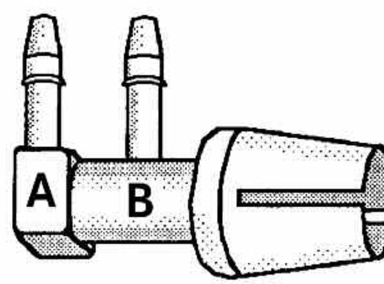
Then connect about 12 inches of pneumatic tubing to one of the sockets.



Attach the other end of the pneumatic line you just installed to the large end connector on a six-way manifold. Connect the six yellow central locking pneumatic tubes to the connections A to F on the six-way pneumatic manifold. Attach the socket and pneumatic line from the previous step to the connection on the PSE control module marked *ZV*.



Then slide the six-way pneumatic manifold over the two plastic split pins on the control module. Arrows indicate them on the line drawing above. Next connect the two red BA pneumatic lines to connections A and B on a two-way manifold. Attach the two way manifold to the connection on the pneumatic control module marked RH.



Connect the black RTG pneumatic tube to a single socket and attach the socket to the pneumatic control module at connection P- or Pu.

If the vehicle does not have pneumatic rear headrests, put a rubber cap over the FKS connection on the pneumatic control module. If it does, connect the two white pneumatic lines to connections A and B on a two-way manifold and attach that to the FKS connection on the control module.

If the vehicle does not have OSB, put a cap over the connection marked Pu or P+ on the control module. If it does, connect a 12-inch section of pneumatic tubing to a socket and attach the other end of the tube to the large end connector on the six-way manifold as shown above. Connect the three grey OSB pneumatic lines to connections A to C on the six-way manifold and put rubber caps over connections D to F. Attach the socket and the pneumatic tube to connection Pu or P+ on the pneumatic control module.

Fasten the six-way manifold in place by sliding the two rings of the distributor over the plastic split pins on the control module.

MBNA 80/5

Glass Grief

Models 129, 140 and 210 after 1996

Various Mercedes-Benz models can exhibit unexpected problems if someone applies a metallic tint to the glass of the vehicle. Model 210 has the radio antenna in the backlite glass and most 129's and 140's have a rain sensor in the windshield glass that determines how fast to run the windshield wipers. A metallic tint can block radio reception for the one car and can interfere with the amount of light transmitted through the glass on the others. Stick with the glass the factory chose.

MBNA 67/04

Can't Fill Tank?

If a motorist reports he or she can never get more than about three-quarters of a tank of fuel into his model 163, it's more likely that the sending unit resistor card has the wrong calibration than that the fuel won't go in. To see whether a particular vehicle falls into this category, check with your Mercedes-Benz dealer. T-SI-MBNA-47.20/05 includes all the vehicles affected and the relatively simple correction procedures.

MBNA 47.20/05

Electrical Connector Kit All Models

If you do a lot of electrical work on Mercedes-Benz vehicles, you might find the factory electrical connector kit very useful. This includes not only vehicle-specific connectors, but also test connectors for various voltage, current and resistance measurements. All terminal ends and connectors are, of course, exactly mated to those on Mercedes-Benz vehicles.

MBNA 58.20/109

Handmade Trouble-Code? All Models with ABS/ASR and/or Electronic Throttle

There are few things more frustrating than doing good work on a vehicle, only to find that somehow in the course of the work, you have set a trouble code that wasn't there before you started. On most Mercedes-Benz cars with electronic throttle controls, the system expects to see throttle movement *only* in response to the accelerator pedal on the floor in front of the driver. If you take a short cut while working under the hood and open the throttle with the cable or linkage when the ignition is on, this can set a fault code for the electronic throttle or other component.

MBNA 30/3

Reduced IR Range after 1993 Models 129 and 140

After January 1993, the infrared key was modified to reduce the operational range of the convenience features (closing the windows and sunroof). Locking and unlocking range remains unaffected at about 19 feet, but the other features fall to about 10 feet. As they say in the computer business, 'it's not a bug; it's a feature!'

MBNA 80/4

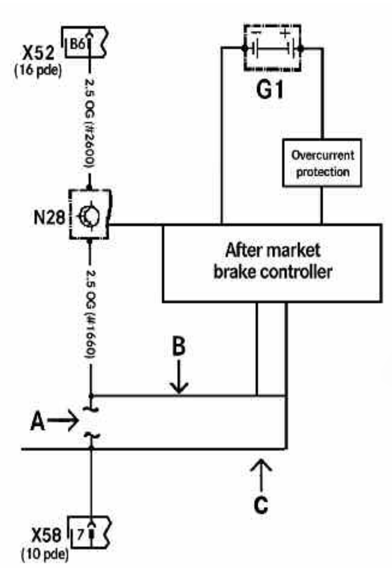
Overeager Park-Warning System Model 140

If a motorist reports implausible park-warning operation, showing seven or eight bars on the indicator and sounding the acoustic warning when the vehicle is distant from any obstacles, this may be caused by vibration of the sensors in the bumpers, a kind of 'tuning-fork' resonance. A silicone ring to dampen this movement was introduced into production in 1996, and it can work for vehicles manufactured at other times. Remove the spacer ring, spring washer and nut. Replace them with the grooved spacer ring, the damper ring and the toothed nut.

MBNA 54.65/47

Installing Brake Controllers Model 163

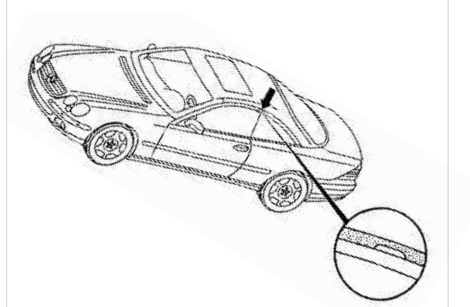
Few Mercedes-Benz cars tow trailers (and the company does not generally recommend it), but the model 163 sometimes does. While the manufacturer does not specifically recommend any brand of electric brake controller to actuate the electric brakes on a trailer, there is a recommended method for wiring the controller into the vehicle. Of course, your procedure should not only meet all the conditions of this procedure, but should be fully in accord with the instructions of the brake controller manufacturer, as well.



Locate the three- to two-wire connector (N28) built into the wiring harness that comes with the trailer hitch kit (p/n Q6 31 0002). Cut the orange wire (A, circuit 1660) after N28 but before the place where the harness exits the vehicle through its grommet. Connect the end of the orange wire from N28 to a new wire (B) and run it to the brake controller. This wire provides the brake light signal to the controller, and need not be a heavy current carrier. Run a second wire (C) from the brake controller output connector to the end of the orange wire leading to the trailer electrical connector (X58). This is the electric brake line, and you should use wire of whatever gauge the brake controller manufacturer specifies or heavier. Follow the brake controller manufacturer's instructions about connecting the power and ground circuits. Mercedes-Benz notes that most recommend using a circuit breaker and connecting the power and ground circuits directly at the battery. Perform all tests specified by the brake controller manufacturer and make certain the brake controller mounts within reach of the vehicle driver.

MBUSA 31.19/03

Battery Damages Roof Seal? Model 215



Yes, it can happen if the battery has been disconnected, perhaps for storage or shipping purposes. The roof seal extends over the side glass by about 4 mm as shown, so when the doors are opened or closed the glass can damage the seal.

SI 88.85/22

Limp-Home Transmission Model 163

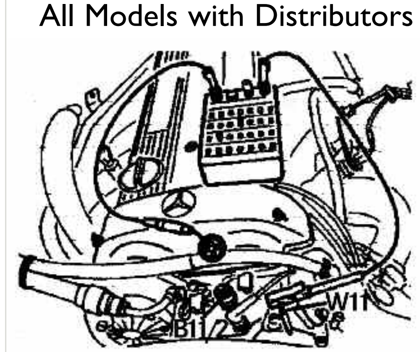
If the transfer case shift motor wiring sustains damage from coming into contact with the exhaust heat shield, this can trigger a transmission limp-home mode, in which the vehicle stays in the last selected gear, and the computer sets Diagnostic Trouble Code (DTC) P1831, flagging a transfer case position sensor or motor fault in the transfer case control module (N78). Check the transfer case shift motor wiring for damage.

If the wiring is severed, fold over the sheet metal at the point where it contacted the harness until there is at least 30-mm distance between them. Replace the transfer case shift motor. Erase the DTC using the Hand-Held Tester, and confirm the transfer case shifts properly.

If the wiring is not severed, bend the metal of the shield out of the way as described above, then remove the mounting bracket bolt to get access to the transfer case shift motor wiring. Repair the wiring with insulation damage using heat-shrink tubing. Reinstall everything where it belongs; erase the DTC and confirm proper operation of the transfer case shift motor.

MBNA 28.19/02

Checking Ignition Timing All Models with Distributors



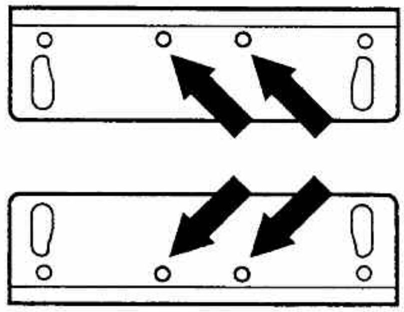
Before you can check the ignition timing on any engine with conventional ignition and a distributor, the engine coolant must be between 75 and 90 degrees C. Since that is not always convenient to measure at the same time you're doing other work, you can also substitute, as on the 102 engine in the illustration, a resistance of 320 ohms. Unplug the connector for the EZL coolant temperature sensor and put the specified resistance across the connector.

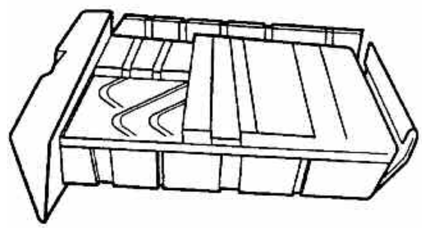
05.03.2002 CD-Ausgabe

Installing GPS Navigation Model 163

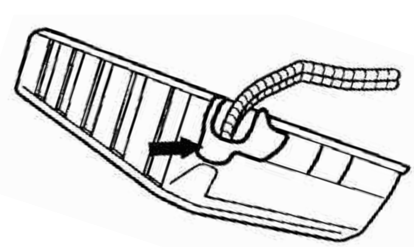
While you could bolt one of those domes they put on tractor-trailers on someone's 163, there are advantages to using factory equipment, even beyond the appearance. Here's how to install the version from Mercedes-Benz. Note the map data CD does not come with the hardware kit. The geographically appropriate CD can be ordered from MBUSA; the VIN has to be identified so the company can send the second disk to the customer later. The system is warranted only in the vehicle in which it was originally installed. Moving it to another car voids the guarantee. Mercedes-Benz also cautions that the components should remain in the positions designated in the instructions. A further preparatory note: Dark window tinting may adversely affect GPS reception and the system's function. Sometimes you have to choose between looking cool and knowing where you are.

There are specific installation instructions for most other models of Mercedes-Benz vehicles, which while functionally similar vary enough in detail that you should get them from your parts dealer before attempting the work. The carmaker also advises that on the 163, there must be a storage box under the passenger side seat, or else a new tray and storage box must be installed at additional cost. What's more, if the customer wants a cellular phone in the vehicle, this is the cost-effective time to install it.

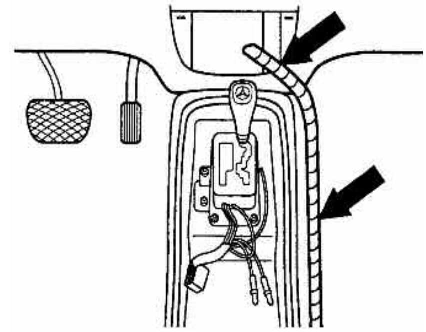




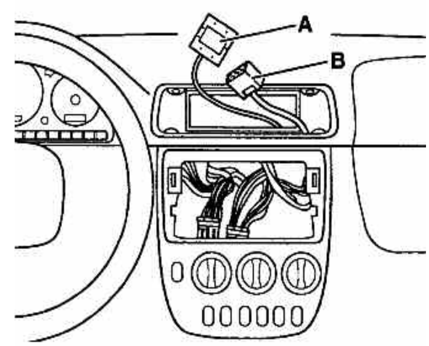
Use the navigation unit housing and its brackets as a template to mark the position for the two inner holes on each bracket. The back of the housing should be within an inch of the rear of the storage box, as shown. Drill 3.5-mm holes where you marked. Plug the 26-pin connector and grey GPS antenna connector into the back of the navigation unit, being careful not to kink either of the lines. Attach the navigation unit into the bracket from the bottom using the four M3 x 10 self-tapping screws in the kit.



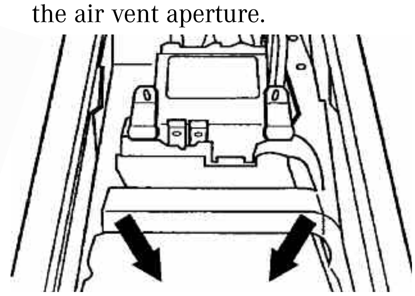
Cushion the back left corner of the storage box with felt to protect the harnesses from chafing against the metal edge. Since some 163 models are actually used off-road from time to time, this is an important step.



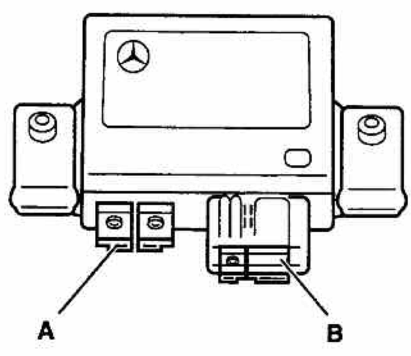
Run the harness along the right side of the console Leave the connector for the CAN-Bus adapter (the connector with the green and white wires) and the speaker connector in the center area of the console. Run the rest of the harness and the GPS antenna cable up the right side of the center console to the center of the dash.



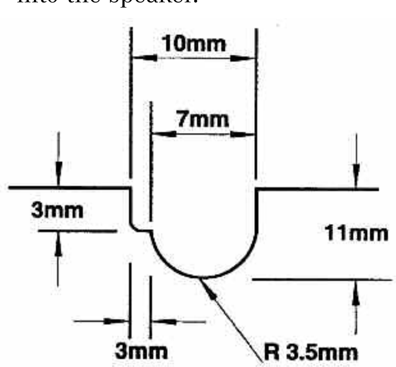
The connector with red, pink and brown wires will connect near the radio, but run the GPS antenna cable (A in the diagram) and the display unit cable (B) up and out the air vent aperture.



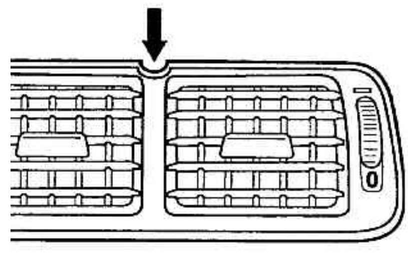
To install the CAN-Bus adapter, put the adapter with its bracket on the rear beam of the center console and mark the position of the two holes. The arrows show the direction of the front of the console. Drill 6.5-mm holes for the screws and secure the bracket and adapter with the screws in the kit. Attach the CAN-Bus adapter by driving the screws from the underside of the console into the bracket with the two M6 x 12 self-tapping screws.



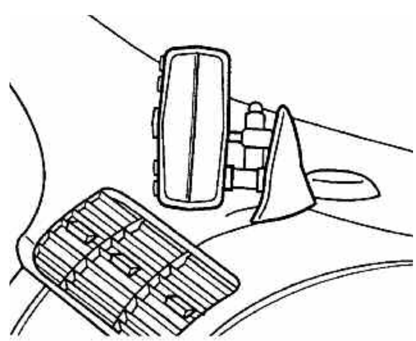
Plug the connector with the green and white wires into terminal A on the CAN-Bus adapter on the console. Notice the connector is keyed and will only fit into the left side of the two-port connector on the adapter. The other port is unused. Connect the black 18-pin connector to the CAN-Bus adapter at B. Plug the yellow connector into the speaker.



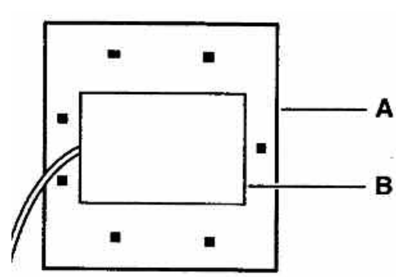
You'll have to modify the center air vent slightly to make everything fit. File a notch between the second and third vent from the left for the display unit and GPS antenna cables, following the pattern in the illustration.



To allow mounting the bracket, file one mm from the front top edge of the middle vent. Put the bracket on the vent lining up the two notches and use the width of the front metal part of the bracket to correctly size the notch you file.



Mount the display unit to the bracket with the M6 x12 screws and washers in the kit. Put the lock washer between the screw head and the flat washer. Plug the round 13-pin connector into the back of the display unit. Peel the tape from the back of the ground plane. Stick the GPS ground plane on the dashboard directly behind the display unit bracket with the single dot facing the windshield.



Put the GPS antenna on the ground plane, centered inside the dots. Be careful throughout this installation that you don't kink the GPS antenna cable anywhere, or there will be diminished satellite position information reception.

The unit can ordinarily calibrate vehicle speed automatically, but if during your test drive, the vehicle icon on the screen moves erratically, check the vehicle sped pulse. If the number on the display does not appear correct, you'll have to calibrate the vehicle pulse manually. In Diagnostics, select System Configuration and press enter. Select Calibrate Distance, and press enter. Highlight Start Calibration, when you're ready, press enter and drive *exactly* one mile. Then press enter to end calibration.

Enter 5280 feet using the arrow button and press enter. As long as the distance percent is between – 19.9 percent and 19.9 percent, the system can calibrate the distance. Press enter to accept the value and again to complete calibration.

Check that the system reads reverse. From the diagnostics menu, highlight Reverse and press enter. Shift the gear lever between reverse and neutral. The screen should reflect the gear accurately. Check the connection contact otherwise.

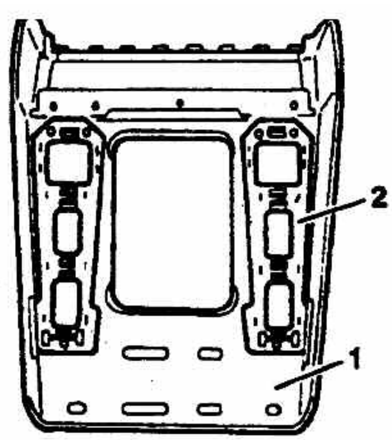
Confirm GPS satellite reception by parking in an area clear of large structures, wires and trees. Exit the diagnostic screen completely using the cancel button. At the caution screen press enter and then press the map button. When the GPS light at the bottom of the display turns green while the car is stationary, this confirms reception, but it can take as long as 15 minutes to confirm reception. GPS reception is impossible, of course, in tunnels, underground garages and other sorts of covered roadways.

Check the volume while you're waiting for confirmation of reception. Press the option button, scroll down to voice, choose volume setting 3 and press enter. To check the system once everything up to this point is complete, enter a destination. Highlight points of interest, then press enter. Choose a destination and press enter. Recall the system will save the destination you've chosen in its memory. After the system calculates a route, there should be a voice prompt, "Please proceed to the highlighted route." If you don't hear the voice, check the volume in the option screen and the speaker connection.

If the installation worked correctly, the car should track accurately on the display. Often on the initial operation of the system, the car and GPS system may require several minutes of driving time at about 30 mph with good GPS reception to correct any positioning errors.

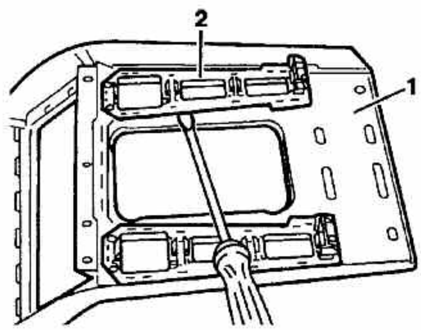
MBUSA 82.85/103A

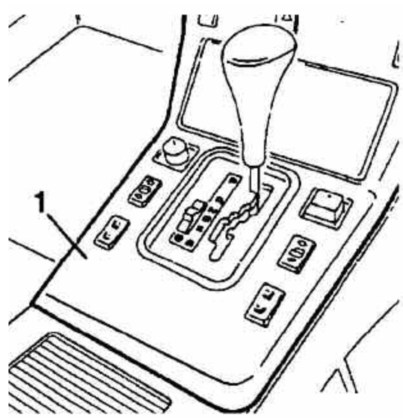
Loose Switches in Center Console Models 124, 129, 140 and 202



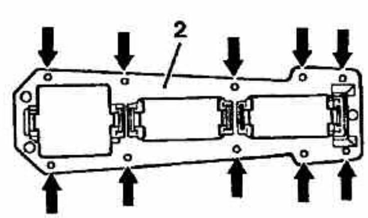
This is an alternative procedure to replacing some of the wood parts, which may be very hard to color match since each comes from different trees.

If the plastic frame (2 in the illustration) has separated from the wooden cover (1) or the tabs have broken, get a new plastic frame (part numbers vary by model) first remove the gearshift lever cover.

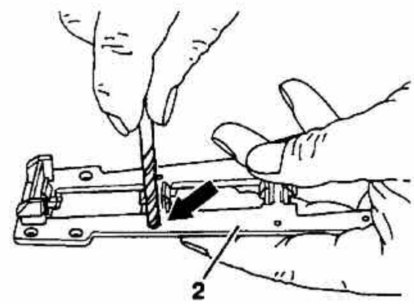




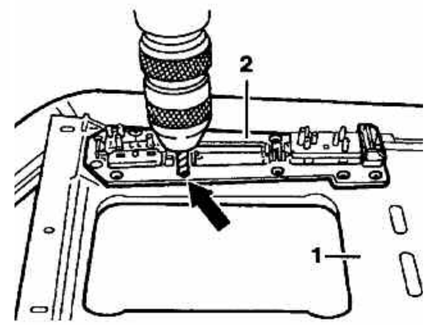
You can remove the old plastic frame (2 in the illustration) from the wood cover (1) by prying it off carefully with a screwdriver or other suitable tool. Keep in mind, it is the wood cover that is valuable, not the plastic!



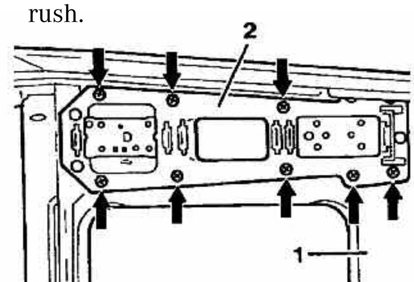
With a 2-mm drillbit, bore ten holes into the new plastic frame. The illustration shows where to drill the holes.



Using a 5-mm drillbit, hand countersink the holes in the plastic so the screws will be flush when finally mounted.



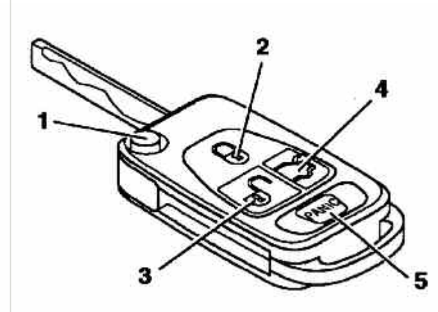
Put the plastic frame on the wood cover and align them exactly by installing the switches. With a 1.5-mm drillbit, drill holes for the screws in the wood cover, using the plastic frame as a template. It is critical to stop well short of drilling through the wood! Use a drill stop or depth gauge to insure you go no deeper than 3 mm or you could damage the wood cover. This is obviously not a step to rush.



Fasten the plastic frame on the wood cover with special screws, available for the purpose from your Mercedes-Benz dealer as part number 124 990 00 30. Then reinstall the switches and the wood cover.

MBNA 68/5A

Unlocking Options
Model 163

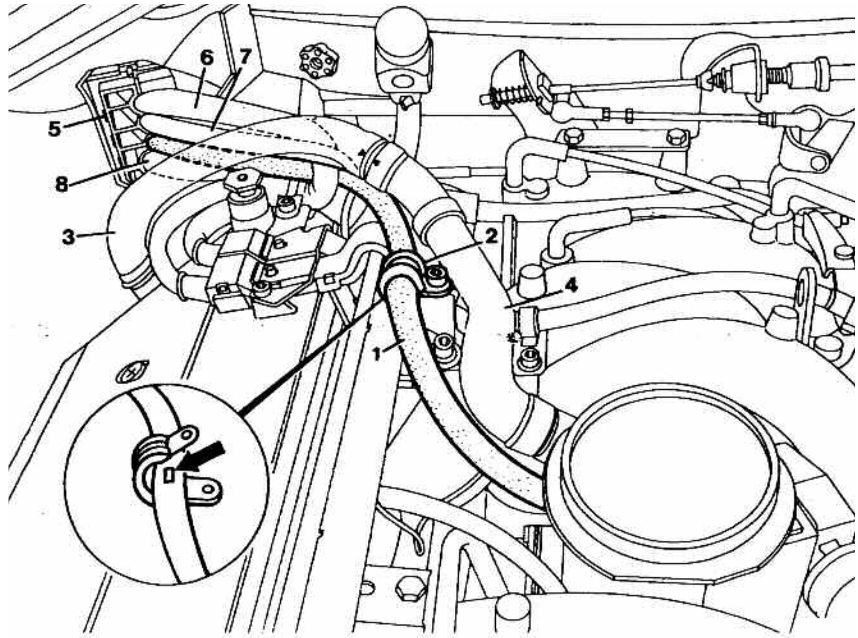


1. Mechanical key release
2. Lock
3. Unlock
4. Liftgate unlock
5. Panic

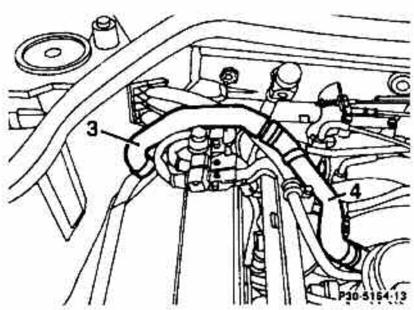
The locking systems on Mercedes-Benz vehicles have become more sophisticated in the last decade or so, and sometimes car owners don't know exactly how their vehicle system is supposed to work. On the model 163 the RF (radio frequency) key has these functions: Pressing the unlock button (3) once unlocks the driver's door and the fuel filler cap only. This is sometimes called "selective unlocking." Pressing the unlock button a second time shortly after the first unlocks all the other doors, the rear liftgate and the fuel filler flap. This is sometimes called "global unlocking." This is the way the system is supposed to work; it does not require or allow repair to change these functions.

MBNA 80.35/10

Proper Routing for EA/CC/ISC Harness
Model 124



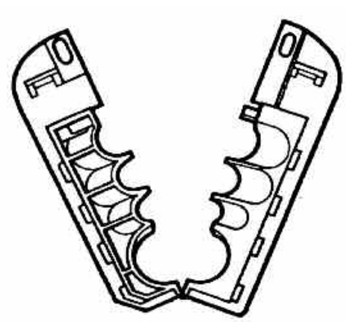
When removing or installing an air cleaner, be certain the EA/CC/ISC actuator harness (1) is not damaged or misrouted. It must lie under the formed hoses for crankcase ventilation (3 and 4) and then through the hinged grommet (5).

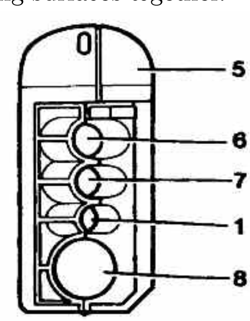


For engine serial numbers up to 001910, however, replace the formed crankcase ventilation hoses (3 and 4) and route by the figure below.

1 Electronic accelerator/cruise control/idle speed control actuator harness
2 Hinged grommet
3 Engine harness
4 Starter motor harness
5 Engine coolant return line from heater core

In each case, route electrical harnesses 1, 6 and 7) as well as the engine coolant return line for the heater core (8) through the corresponding holes (6, 7, 1 and 8) in the figure above. Reconnect the hinged grommet by pressing the parting surfaces together.





SI 30 11a

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Dothan
Rahal-Schmitz
334-794-6716

Hoover
Crown Automobile Company, Inc.
205-985-4200

Huntsville
Regal Auto Plaza
256-837-5752

Mobile
McConnell Automotive Corporation
334-476-4141

Montgomery
Jack Ingram Motors, Inc.
334-277-5700

Tuscaloosa
Leigh Automotive
205-556-1111

Alaska

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Mercedes-Benz of Anchorage
907-277-3383

Fairbanks
A & B Auto, Inc.
907-456-6161

Arizona

Phoenix
Phoenix Motor Company
602-264-4791

Scottsdale
Schumacher European
480-991-1155

Tucson
Mercedes-Benz of Tucson
520-886-1311

Arkansas

Fayetteville
Jones Motorcars, Inc.
501-521-7281

Little Rock
Riverside Motors, Inc.
501-666-9457

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Caliber Motors, Inc.
714-777-1900

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Mercedes-Benz of Bakersfield
661-836-3737

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Autobahn Motors
650-637-2333

Beverly Hills
Beverly Hills, Ltd.
310-659-2980

Buena Park
House of Imports
714-562-1100

Calabasas
Calabasas Motorcars, Inc.
818-591-2377

Carlsbad
Hoehn Motors, Inc.
760-438-4454

Chico
Courtesy Motors Auto Center, Inc.
530-893-1300

Encino
Auto Stiegler, Inc.
818-788-0234

Escondido
Mercedes-Benz of Escondido
760-745-5000

Fremont
Claridge's Ltd.
510-623-1111

Fresno
Herwaldt Motors
559-438-0300

Glendale
Calstar Motors, Inc.
818-246-1800

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Mercedes-Benz of Laguna Niguel
949-347-3700

La Jolla
Heinz Gietz Autohaus, Inc.
858-454-7137

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Mercedes-Benz of Long Beach
562-426-7301

Los Angeles
Downtown L.A. Motors
213-748-8951

Modesto
Modesto European
209-522-8100

Monterey
Stahl Motor Company, Inc.
831-375-2456

Newport Beach
Fletcher Jones Motor Cars, Inc.
949-718-3000

Oakland
Mercedes-Benz of Oakland
510-832-6030

Palm Springs
Mercedes-Benz of Palm Springs
760-328-6525

Palo Alto
Park Avenue Motors
650-494-0311

Pasadena
Rusnak/Pasadena
626-795-8004

Pleasanton
Mercedes-Benz of Pleasanton
925-463-2525

Riverside
Walter's Auto Sales & Service, Inc.
909-688-3332

Rocklin
Van Housen Motors
916-924-8000

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Mercedes-Benz of Sacramento
916-924-8000

San Diego
Mercedes-Benz of San Diego
858-279-7202

San Francisco
Mercedes-Benz of San Francisco
415-673-2000

San Jose
Smythe European, Inc.
408-983-5200

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Kimball Motor Company
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415-454-0582

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Cutter Motors
805-682-2000

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707-542-4810

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Berberian European Motors
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Walnut Creek
Stead Motors of Walnut Creek
925-937-1655

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Colorado Springs
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Murray Motor Imports Company
303-759-3400

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Mercedes-Benz of Littleton
303-738-7700

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Mercedes-Benz of Greenwich
203-869-2850

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New Country Motor Cars, Inc.
860-522-6134

New London
Carriage House of New London, Inc.
860-447-3361

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Mercedes-Benz of North Haven
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I.G. Burton & Company, Inc.
302-424-3042

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Wilmington Motor Cars, Inc.
302-995-2211

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Clearwater
Lokey Motor Company
727-530-1661

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Bill Ussery Motors, Inc.
305-445-8593

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Mercedes-Benz of Daytona Beach
386-274-4775

Ft. Lauderdale
Mercedes-Benz of Fort Lauderdale
954-462-4381

Ft. Myers
Mercedes-Benz of Fort Meyers
941-433-8300

Ft. Pierce
Coggin Motor Mall
561-466-7000

Ft. Walton Beach
Quality Imports, Inc.
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Kraft Motorcar Co., Inc.
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Brumos Motor Cars, Inc.
904-724-1080

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Robert G. Waters, Inc.
863-688-8111

Maitland
Mercedes-Benz of Orlando
407-645-4222

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Continental Motorcars, Inc.
321-956-0600

Miami
Mercedes-Benz of Miami
305-919-8000

Naples
Regency Autohaus, Inc.
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Centennial Imports, Inc.
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Autohaus Pompano
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Crown Eurocars, Inc.
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Tallahassee
Capital Eurocars, Inc.
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Mercedes-Benz of Tampa
813-870-0010

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Atkins Kroll, Inc.
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Mercedes-Benz of Athens
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Carriage House Imports, Inc.
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Atlanta
RBM of Atlanta, Inc.
770-390-0700

Augusta
Rader, Inc.
706-860-1111

Columbus
Columbus Motor Company
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Decatur
Atlanta Classic Cars, Inc.
404-296-1313

Macon
Jackson Automotive Group, Inc.
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Savannah
Critz, Inc.
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Hawaii

Honolulu
Theo Davies Euromotors, Ltd.
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Mark Motors, Inc.
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Napleton's Autowerks
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Sullivan-Parkhill Imports, Inc.
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312-944-0500

DeKalb
Sawyer Auto Imports, Inc.
815-758-5451

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Knauz Continental Autos, Inc.
847-234-1700

Lincolnwood
Loeber Motors, Inc.
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Loves Park
Napleton's Autowerks, Inc.
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Foley-Sweitzer Motor Sales, Inc.
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Sud's Motor Car Company, Inc.
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Mid/Town Imports Incorporated
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Laurel Motors, Inc.
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European Motorcars Des Moines
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Aristocrat Motors
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Sunflower Motors, Inc.
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Scholfield Auto Plaza, L.L.C.
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Moss Motors
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Holmes European Motors, Inc.
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Bangor
Quirk Auto Park of Bangor
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Falmouth
Performance Motors
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Euro Motorcars, Inc.
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Valley Motors, Inc.
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Mercedes-Benz of Hagerstown
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Herb Gordon Auto Group, Inc.
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Wagner Motor Sales
508-869-6766

Haverhill
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Flagship Motorcars
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Mercedes-Benz of Novi
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Williams Auto World
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Maplewood Imports
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Sears Imported Autos, Inc.
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Mississippi

Gulfport
Bert Allen Imports
228-864-6622

Jackson
Higginbotham Automobiles, L.L.C.
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Legend Automotive Group, Inc.
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Creve Coeur
Plaza Motor Company
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Ellisville
Tri-Star Imports, Inc.
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Joplin
Tri-State Import Cars, Inc.
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Springfield
Elite Automotive Group
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Montana

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DeMarois Olds-GMC Company
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Nebraska

Lincoln
Husker Auto Group. Inc.
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Omaha
Mercedes-Benz of Omaha
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Nevada

Las Vegas
Fletcher Jones Imports
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Reno
Streeter Imports
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Greenland
Dreher-Holloway, Inc.
603-431-8585

Manchester
Holloway Motor Cars
of Manchester, LLC
603-669-6788

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Bridgewater
Millennium Automotive Group
908-685-0800

Cherry Hill
Mercedes-Benz of Cherry Hill
856-663-3200

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Ray Catena Motor Car Corp.
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Benzel-Busch Motor Car Corp.
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Globe Motor Car Company
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Freehold
David Michael Motor Car Corp.
732-462-5300

Lawrenceville
Mercedes-Benz of Princeton
609-771-8040

Little Silver
Contemporary Motor Cars, Inc.
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Millville
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Morristown
Mercedes-Benz of Morristown
973-267-9200

Newton
Intercar, Inc.
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Paramus
Prestige Motors, Inc.
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Union
Ray Catena Motor Car Corp.
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W. Atlantic City
Precision Cars of Atlantic City Corp.
609-645-9000

New Mexico

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Premier Motorcars, L.P.
505-821-4000

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Helms Brothers, Inc.
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Binghamton
Feduke Motors, Inc.
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Brooklyn
Sovereign Motor Cars, Ltd.
718-258-5100

Fayetteville
Romano Motors, Ltd.
315-637-4500

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Estate Motors, Inc.
914-232-8122

Huntington
Mercedes-Benz of Huntington
613-549-2369

Latham
Keeler Motor Car Company
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Long Island City
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718-361-2332

Nanuet
Mercedes-Benz of Nanuet
845-623-1500

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Mercedes-Benz Manhattan, Inc.
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Rochester
Holtz House of Vehicles, Inc.
716-424-4740

Rockville Centre
Lakeview Auto Sales & Service
516-766-6900

Roslyn
Rallye Motors, L.L.C.
516-625-1600

Smithtown
Competition Imports, Inc.
631-265-2204

Southampton
Mercedes-Benz of Southampton
631-283-0888

Wappingers Falls
Friendly Motorcars
845-298-0600

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Mercedes-Benz of White Plains
914-949-4000

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Mercedes-Benz of Buffalo
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Ashevillle
Skyland Automotive, Inc.
828-667-5213

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Beck Imports of the Carolinas
704-535-6400

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Valley Motors, Inc.
910-487-0000

Greensboro
Mercedes-Benz of the Triad
336-856-1552

Hickory
Hendrick Motors
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