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01 Body	01 Shell	
>>smart City-Coupé	**Body In White**	

Task

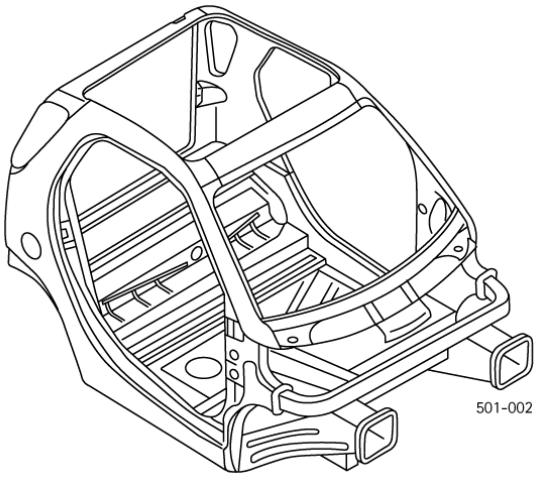
The body in white forms the Tridion safety cell and ensures optimal all-round protection, and with it the greatest possible passenger safety.

> Its longitudinal and cross members absorb impact energy at the front and rear.

> The most important units are housed in its underbody, preventing these from penetrating into the passenger compartment.

> Crashboxes mounted on it absorb the impact energy at the front and rear at speeds of up to 15 km/h.

> It holds the telescopic steering column via the cockpit cross member.



501-002

Design

The Tridion safety cell consist of approx. 30 % high-strength steel panels. Due to the production process used, these have a greater stiffness and strength than ordinary panels.

The high-strength sheet metal parts can be processed like ordinary sheet metal parts.

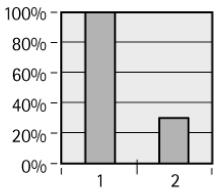
The advantages of the high-strength sheet metal parts of the Tridion are as follows:

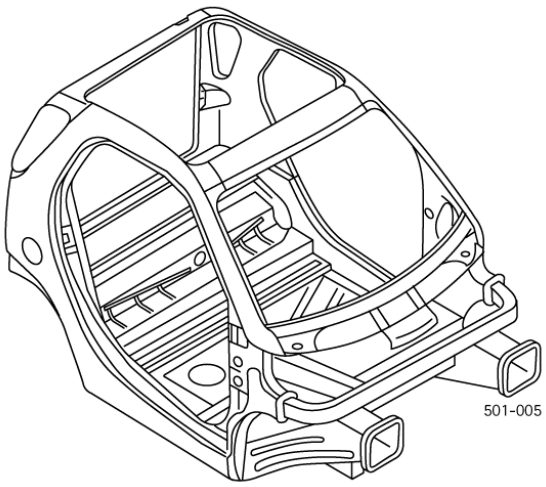
> Improved torsional stiffness,

> Optimised crash behaviour,

> Reduced sheet metal thickness,

> Decreased weight.



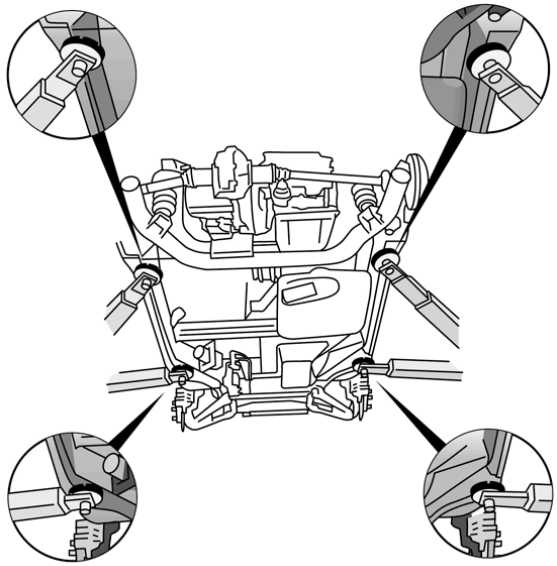


1 Total sheet-metal parts of Tridion (100 %)

2 High-strength sheet metal parts of Tridion (30 %)

501-005

The mounting points for the lifting platform are located behind the front and in front of the rear wheel houses on the longitudinal members.



501-003

501-003

Function

Frontal impact

> The crashbox and longitudinal members absorb any outside forces acting on the vehicle and pass them on.

> The front wheels also act as an energy-absorbing deformation zone ("crush zone") during a crash, whereby they are supported on the longitudinal members.

> The smart also uses the crash zone of the other vehicle involved in the accident (deformation compatibility) for passenger safety.

> The engine-gearbox unit (rear-axle drive module) is purposely pushed forward and provides for a compensation of the rebound force so that during collisions in the higher speed range the rebound is considerably reduced. As a result, no so-called rebound effect occurs with the smart following a collision.

517-643

Side impact

> In a side crash the other vehicle involved in the accident impacts at least one of the two axles due to the smart's short wheelbase. As a result, the wheel and wheel suspension can absorb some of the impact energy. The passenger cell remains stabile.

> The longitudinal members drawn up on the side and the sections in the door and door frame offer a high level of protection against intrusion (penetration of an object into the vehicle interior).

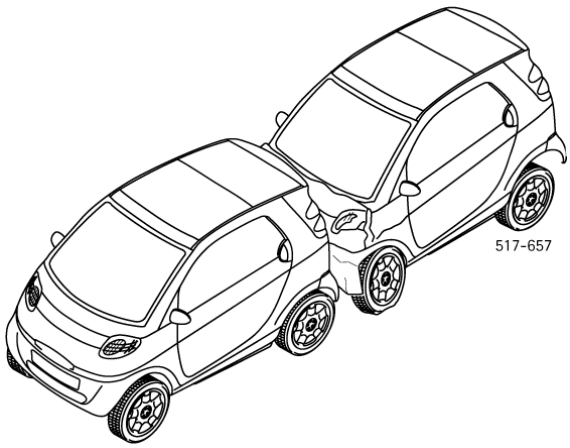
00130402

Rear impact

The front end and rear area of the smart are designed according to the same design concept.

> To prevent structural damage at impact speeds of up to approx. 15 km/h, an aluminium extruded section is installed in the rear of the vehicle as a crashbox (deformation element).

> The rear vehicle area is excellently protected against intrusion, i.e. against the penetration of an object into the vehicle interior, on two impact levels by the underfloor arrangement of the engine and the override protection.



517-657

Task

Up to an impact speed of approx. 15 km/h the impact forces are to be absorbed damage-free.

Location

The crashboxes are located at the front and rear under the CBS (Customised Body Panel System; see 01 02, Customised Body Panel System).

405-031

405-031

1 Front crashbox

2 Rear crashbox

Design

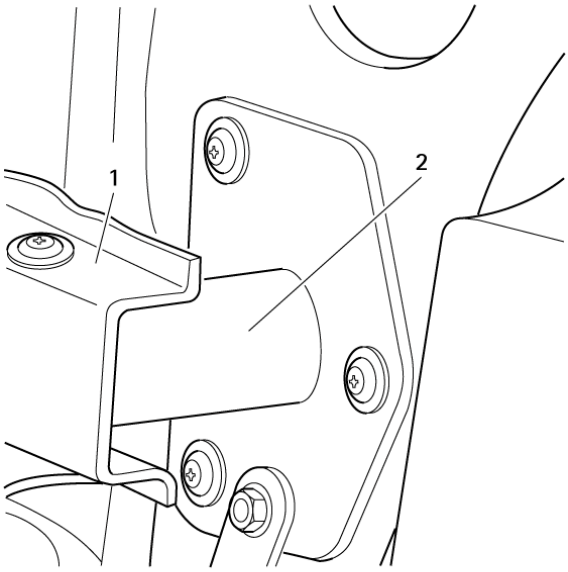
> An energy-absorbing part of plastic (Styrofoam®) is mounted on the upper cross member.

> The lower cross member consists of two stub pipes (2), the ends of which are interconnected with a member (1).

The front towing eye is also attached to the right front crashbox.

Function

During compression the stub pipes convert the kinetic energy (momentum) into deformation work. In the process they are compressed and the deformation is then maintained.



405-032

405-032

1 Member

2 Stub pipe

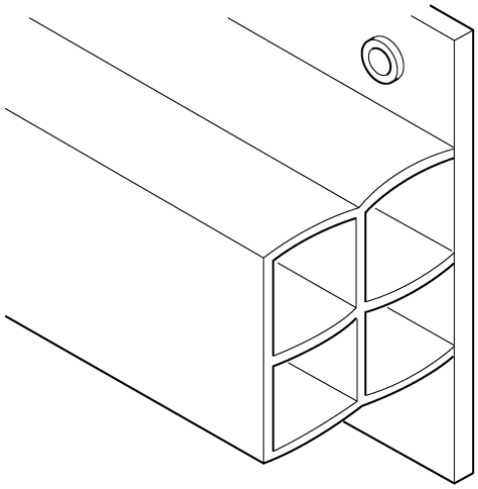
Design/Location

The rear crashbox is designed as an aluminium extruded section and mounted on the rear integral member.

The rear towing eye is also mounted on it.

Function

During a crash part of the impact energy (momentum of the vehicles involved) is absorbed by deformation



405-029

405-029

>>smart City-Coupé

Customised Body Panel System

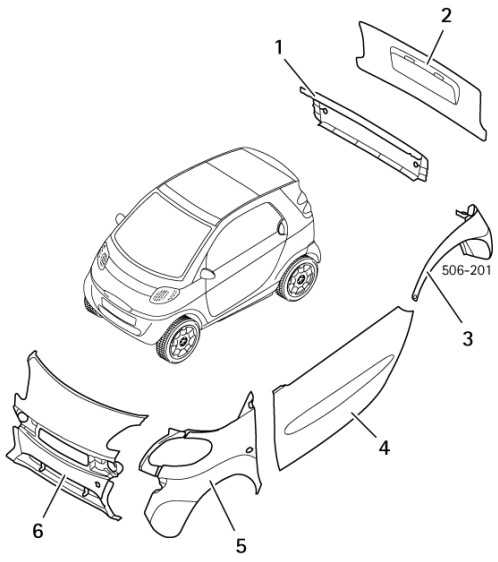
Design

The Customised Body Panel System (CBS) of the smart consists of nine parts.

They are manufactured from impact-resistant, recyclable plastic on a polycarbonate and polyester (PC/PBT) basis.

Characteristics of the plastic exterior parts:

> Rustproof
> Quick replaceability, and therefore also low costs following an accident
> Impact resistant
> Low weight
> Recyclable



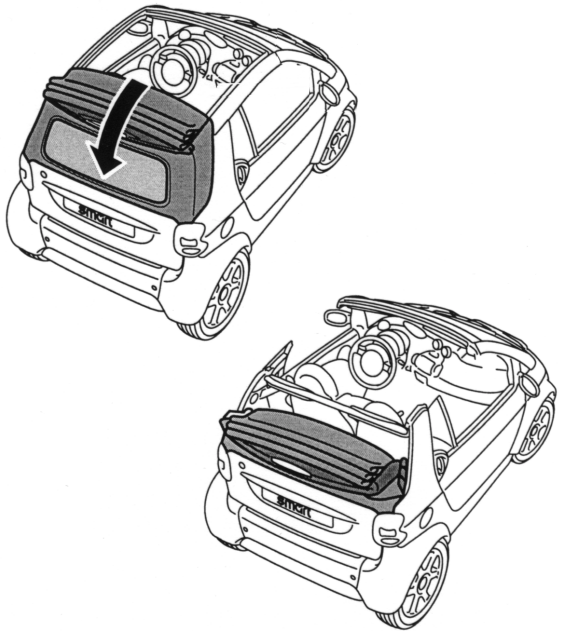
506-201

1 Rear centre section
2 Rear hatch panelling
3 Rear side section
4 Side door panelling
5 Wing
6 Front centre section

Design

The smart Cabrio is equipped with a fabric soft top that consists of a sliding folding roof driven by an electric motor and a manually operated rear top.

The convertible soft top is described in detail in a separate functional description.



00130204a

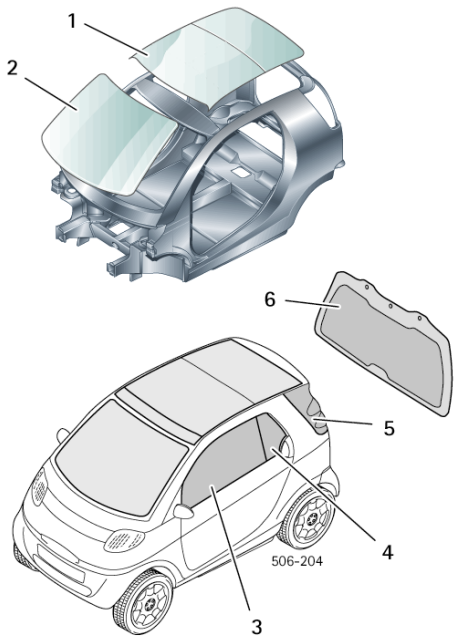
Design

The following windows are bonded:

1 Glass roof or solid roof
2 Windscreen

The following windows are screwed or clipped on:

3 Roll-down window, driver's and passenger door
4 Quarterlight, driver's and passenger door
5 C-pillar cover (window in the side panel)
6 Window in rear hatch



506-204a

Design

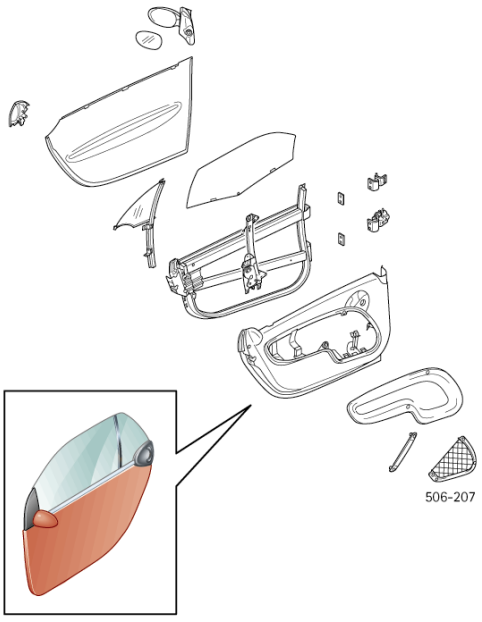
The doors of the smart are designed as a frame construction that contributes to passenger safety and have electric window lifts as standard equipment.

Interior trim panels

> The door pocket can be retrofitted in each case.

> The section of the interior trim panel covered with fabric can be replaced separately on each door.

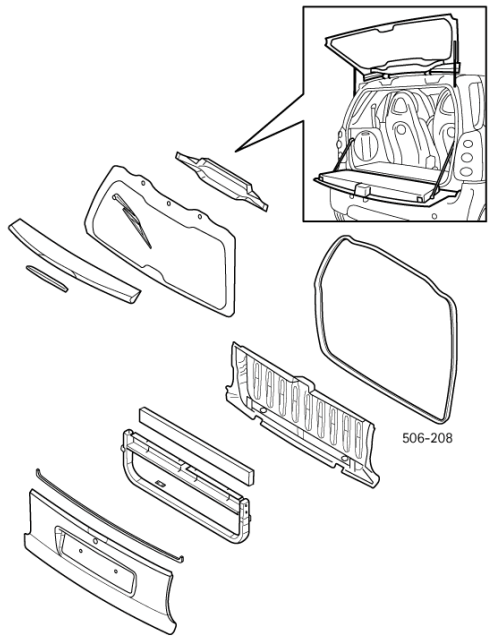
> The inside section (unupholstered plastic) cannot be replaced separately, but rather only in conjunction with the door shell.



506-207

Design

The rear hatch of the smart consists of two sections. The lower section can be folded open separately, and the upper section contains the rear window.



506-208

01 Body	06 Seats	
>>smart City-Coupé	**Driver's and Passenger Seat**	

Design

The smart seats are integral safety seats. With their stiff, modular metal structure and the integrated headrests, they are designed for maximum crash loads.

Location

The seats are mounted on seat consoles and are guided by these. They are arranged offset in the driving direction so that the driver and passenger will not strike each other in an accident if possible.

507-244

1 Headrest cushion
2 Backrest bead
3 Backrest bead
4 Lumbar cushions (reinforced cushion for improved back support)
5 Seat cushion

Task and Function

- Low danger of injury due to the relatively high seat position
- Maximum passenger safety due to specific back-rest deformation with good load distribution and limitation. As a result, the passengers can withstand vehicle accelerations up to twice those of conventional passenger cars.
- The seat surfaces are moulded to be energy-absorbing.
- A crash wedge prevents the passengers from "slipping through" under the lap belt.
- Conditional protection against the load in the luggage compartment by the sheet metal back-rests.

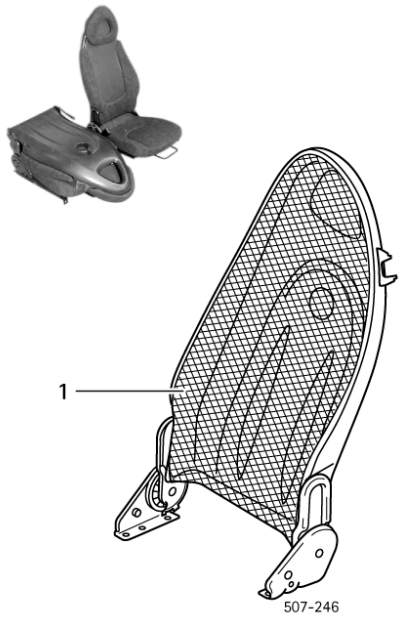
Design

The first smart generation is equipped with a backrest with a net and without filling.

Beginning with the second smart generation the backrest is also equipped with comfort pads that are clipped into the net of the backrest.

The backrest on the third smart generation is covered with a net-like upholstery material, behind which a breathing foam material is hidden.

If the backrest net is damaged, it must be completely replaced together with the backrest for safety reasons. As a result, it is not carried as an individual part in the product line.



507-246

1 Backrest with net

Task

In the smart children of all ages can ride on the passenger seat with appropriate restraint systems. The restraint systems that can be used in the smart offer the children sufficient safety while driving and protection in the case of an accident.

The restraint system must be suitable for the size of the child.

Babies: smart baby carrier
Smaller children: smart child's seat
Larger children: Child's booster seat

Location/Function

smart child's booster seat

The shoulder belt is routed through an eye on the backrest of the smart child's booster seat when securing it. With this child's booster seat it is permissible for a child to ride on the passenger seat.
When using the smart child's booster seat the belt tensioners and passenger airbag remain active.

295

smart child's booster seat

smart child's seat

The smart child's seat is secured on the passenger seat using the child's seat quick-fastener. With the smart child's seat it is permissible for a child to ride on the passenger seat.

When using the smart child's seat the passenger airbag and belt tensioner must be deactivated (see 02 01, Triggering unit). This is achieved by snap-locking the child's seat quick-fastener on the passenger seat, whereby a switch monitored by the triggering unit is automatically actuated.

The restraint system on the smart child's seat is a harness belt.

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smart child's seat

smart baby carrier

The baby lies in the smart baby carrier facing opposite the driving direction.

Therefore, the passenger airbag and belt tensioner must be deactivated (see 02 01, Triggering unit). This is achieved by snap-locking the child's seat quick-fastener on the passenger seat, whereby a switch monitored by the triggering unit is automatically actuated.

297

smart baby carrier

Task

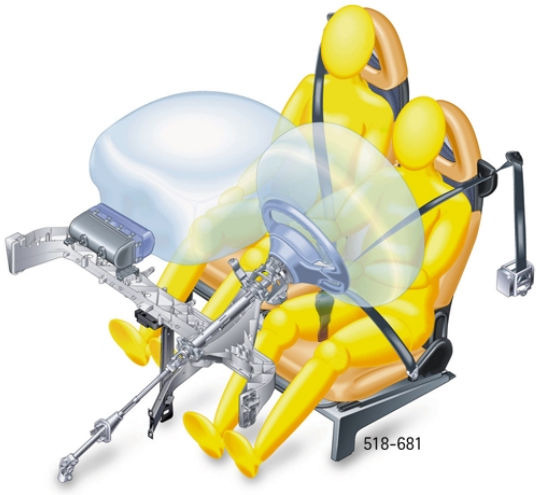
The restraint systems are used to protect the passengers from injuries to the greatest degree possible during a frontal collision by securing the total braking distance of the passengers. This consists of the usable length of the deformation zone and the distance that the passengers still cover in the vehicle following a crash.

Location and Design

The smart is equipped with the following restraint systems:

> Fill-size airbags on driver's and passenger side
> Side airbags (optional extra)
> Elastic steering wheel
> Telescopic steering column
> Energy-absorbing knee protection cushions
> Three-point automatic safety belts
  > Power belt tensioner
  > Belt-force limiter

The driver's and passenger airbag in the smart are full-size airbags. That means that their size corresponds to that specified in the standards valid in the US.



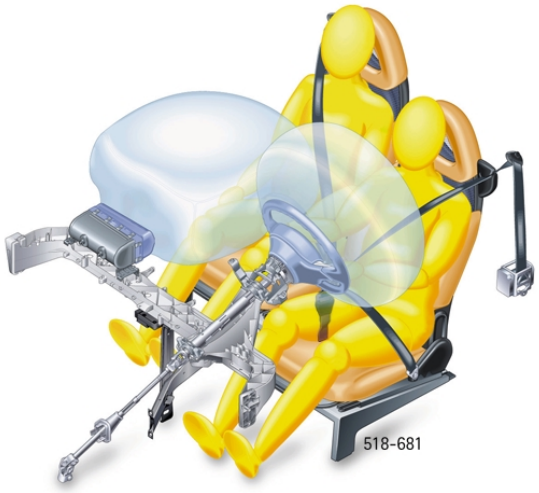
518-681

Design and Function

The airbag on the driver's side is integrated in the steering wheel, i.e. is not a separate module. The one-piece airbag cover is of plastic and has an invisible tear-open edge.

It has an inflated volume of 64 litres.

The airbag is electrically ignited by the triggering unit (see 02 01, Triggering Unit).



518-681

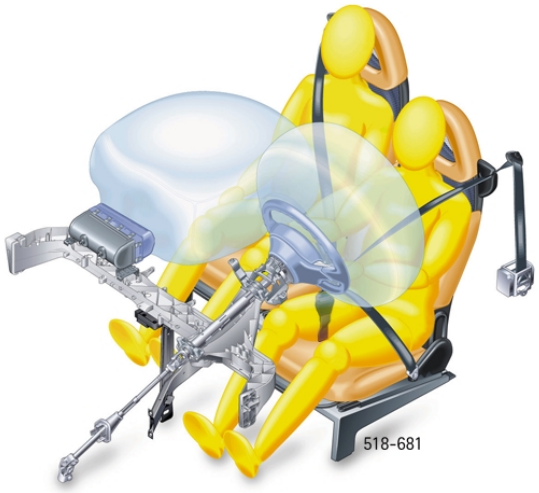
Design and Function

The airbag on the passenger side is installed as a separate, visible component in the cockpit between the instrument panel and cockpit cross member.

It has an inflated volume of 120 litres. The airbag does not rest on the windscreen with its volume, but instead on the instrument panel.

The passenger airbag is electrically ignited by the triggering unit (see 02 01, Triggering Unit).

When a smart child's seat or a smart baby carrier is properly installed with the quick fastener (see 01 06, Child's seats), the airbag on the passenger side is automatically deactivated.



518-681

Task

The side airbags (optional extra) are intended to protect the driver's and passenger's head and shoulders from being thrown against the roof pillar and the side window.

Design and Function

The side airbags are located in the backrests under the cover on the respective outer side.

The side airbags are electrically ignited by the triggering unit (see 02 01, Triggering Unit).

When a smart child's seat or a smart baby carrier is properly installed with the quick fastener (see 01 06, Child's seats), the side airbag on the passenger side is automatically deactivated.

00130414

Task

The gas generators are used to inflate the airbags and are electrically ignited by the triggering unit.

Function

The gas generators newly developed for the smart burn an acid-free solid fuel during inflation. This fuel has a high gas yield, enabling the use of gas generators with a compact, light design. During combustion very little gaseous pollutants are produced, and the solid combustion residues are non-toxic and water-soluble.

Design

The two safety belts in the smart are three-point automatic belts with the following components:

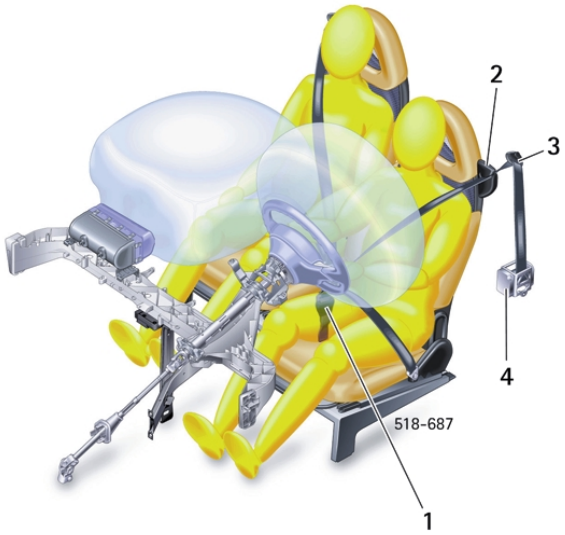
> Belt buckle (1) on seat

> Belt guide (2) on backrest

> Belt guide (3) on B-pillar

> Retractor (4) with integrated power belt tensioner

> Belt-force limiter in the form of a torsion rod, integrated in power belt tensioner



518-687

1 Belt buckle
2 Belt guide (on seat)
3 Belt guide (on pillar)
4 Retractor

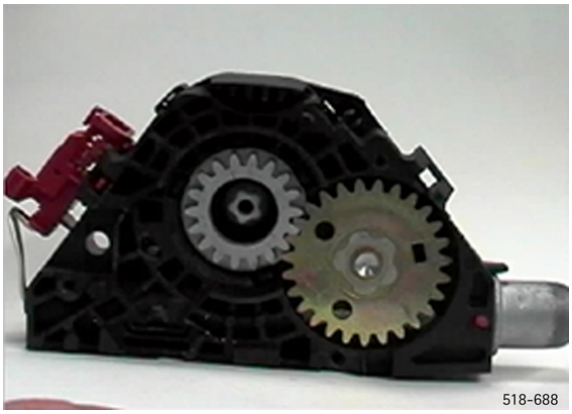
Task and Function

The passengers must take part in the vehicle deceleration as early as possible during a crash. This means that they may not be thrown forward and then abruptly caught by the belts during a crash. Serious injuries can result in the process, e.g. contusions in the belt area.

To catch the passengers early, the safety belt system of the smart is equipped with a newly developed power belt tensioner. Its tensioning distance is a maximum of 120 mm. This is the distance by which the belt is pulled back during a crash.

This reduces the belt slack, i.e. the "play" that a belt has before it holds the passenger in place. The greater the belt slack is, the less efficient the belt is.

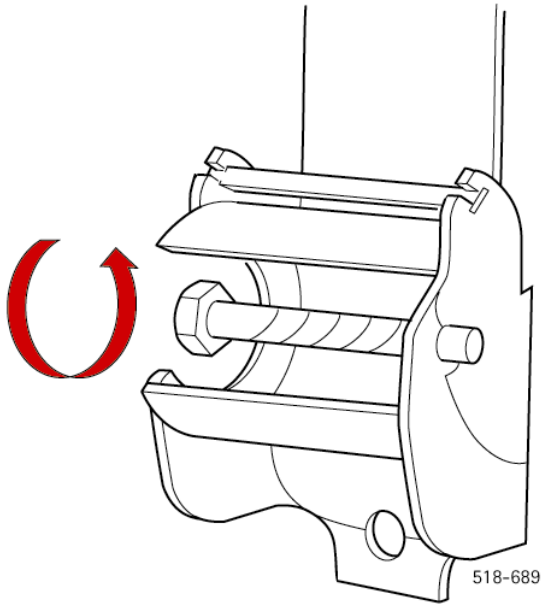
The power belt tensioner is electrically activated by the triggering unit (see 02 01, Triggering Unit).



518-688

Task and Function

The torsion rod in the power belt tensioner holds the belt force at a constant, low level of 2 kN, enabling the greatest possible passenger braking distance which, as already described, is secured by the belts and airbags.



518-689

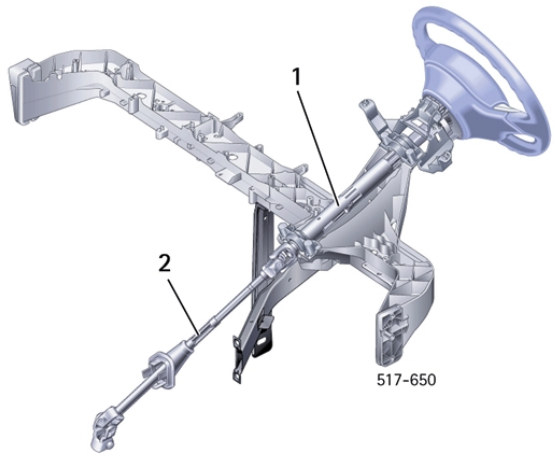
Design

The steering column has a deformable design so that impact energy is absorbed and the passenger braking distance is a large as possible during a crash.

Function

The steering column (1) is deformed in dependence on the seriousness of the crash and the weight of the driver. After the defined load threshold is exceeded, it compresses telescopically in accordance with the preset force-distance characteristic.

In the case of a very serious frontal impact, the lower section (2) of the steering column is also compressed.

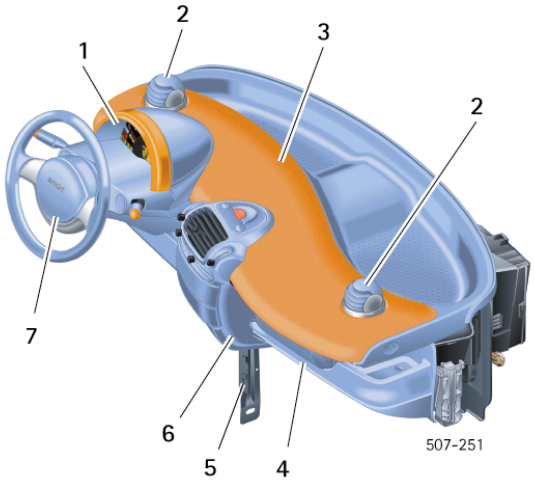


517-650

1 Steering column, upper section
2 Steering column, lower section

Design

1 Instrument cluster
2 Air-outlet side vents, left and right
3 Cockpit
4 Full-size airbag on passenger side (see 01 07, Airbags and Safety Belts, Passenger Airbag)
5 Vertical bracket
6 Centre console
7 Steering wheel with full-size airbag (see 01 07, Airbags and Safety Belts, Driver's Airbag).



507-251a

Task

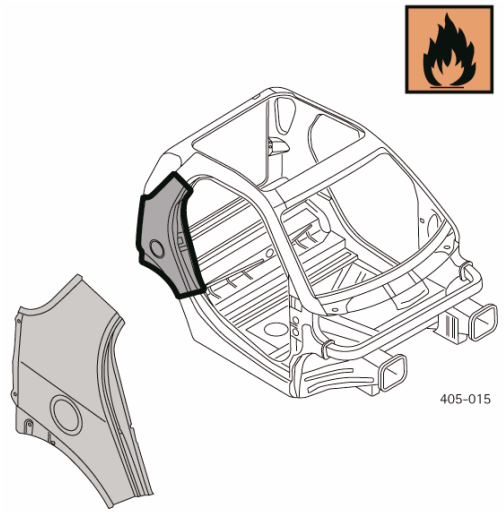
Repairs are to be carried out economically on the following body parts using the sub-parts:

> Front end,

> Side panel,

> Rear end.

The individual repair descriptions are contained in the TIS (Technical Information System).

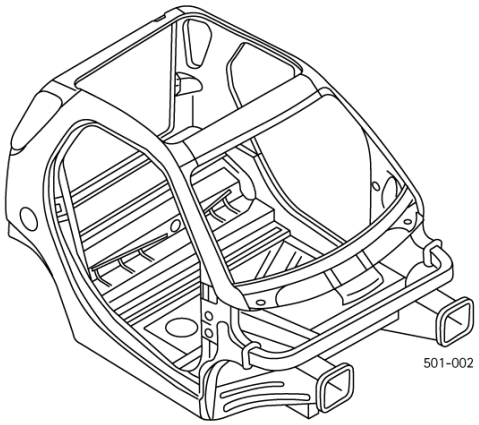


405-015

Design

All sheet-metal parts of the Tridion welded during production (see 01 01, Body in White) are also available as service parts.

The service parts have the same corrosion protection (galvanising or cathodic immersion painting) as the corresponding parts of the original body (see 01 11, Paint Structure of Body in White). In addition, all service parts are also provided with a special spare-part primer.



501-002

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Paint Structure of Body in White

Design

All parts of the Tridion (see 01 01, Body in White) are protected against corrosion with phosphatising and electrophoretic priming and coated with powder paint as standard.

The following colours are offered:

> Brilliant silver: 2-layer power paint finish with clear lacquer;
> Anthracite: 1-layer powder paint finish without clear lacquer.

The Tridion is powder-coated with a special process at the factory.

> In contrast to ordinary acrylic paint finishes (consisting of a base paint and clear lacquer), the surface of this powder paint finish is not high-gloss.

However, this special process of powder painting cannot be used when making repairs, but instead the usual acrylic painting method is used.

502-043

502-043

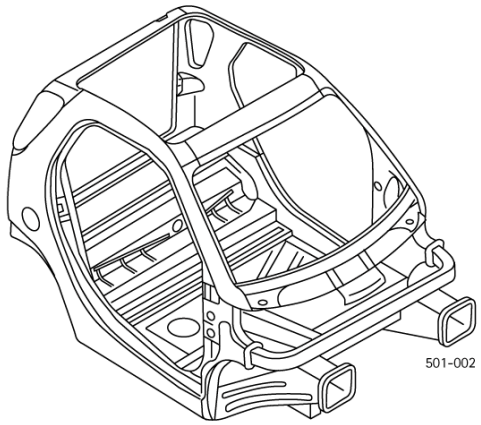
Task

The phosphatising and electrophoretic priming of the smart sheet-metal parts provides permanent corrosion protection.

During phosphatising a protective coating of zinc iron phosphate is produced on the steel parts that may be galvanised. This coating also ensures optimum adhesion of the paint layers to be applied subsequently.

Powder painting has the following advantages:

> Permanent coating;
> High surface quality due to high layer thickness;
> Low emissions during painting;
> No exhaust-air cleaning required;
> Small amount of paint sludge;
> Virtually no losses during coating;
> Low-energy system concepts.



501-002

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Paint Structure of Body in White

Powder Painting

Design

The table shows the layer structure of the factory powder paint finish compared to conventional 2-component painting with which the paint material is also mixed with hardener prior to application.

CIP stands for "cathodic immersion painting". It is the basis for permanent corrosion protection. During phosphatising a protective layer of zinc iron phosphate is produced on the steel parts, which may be galvanised. The body phosphatised in this way is lowered into an immersion basin containing primer. With immersion painting even hard-to-reach places, e.g. hollow cavities, and edges and corners are well-coated.

With conventional wet painting, no intermediate drying takes place between the application of the individual paint layers.

Powder Painting		**Conventional Wet Painting**	
Powder coating paint DL-P	approx. 70 µm	Clear lacquer DL-CC	30 µm
		2-comp. base paint DL-BC	25 µm
		Filler	20 µm
CIP phosphatising	20 µm	CIP phosphatising	20 µm
Pre-treatment	3 µm	Pre-treatment	3 µm

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Paint Structure of Body in White

Powder Painting

Process comparison:
Powder painting vs. conventional wet painting

In the table two processes are compared with regard to the current costs and the emissions.

The values are based in each case on the painting for one vehicle. With powder painting they apply to the SMB painting system (SMB = Safety Metal Body or Tridion) and with conventional wet painting for the version without stone-impact protection compound.

	Powder Painting	**Conventional Wet Painting**
Emissions	2 grams	36 grams
Energy costs	10 Euro	17 Euro
Waste	1.5 kilograms	3.8 kilograms
Waste water	35 litres	85 litres

Task

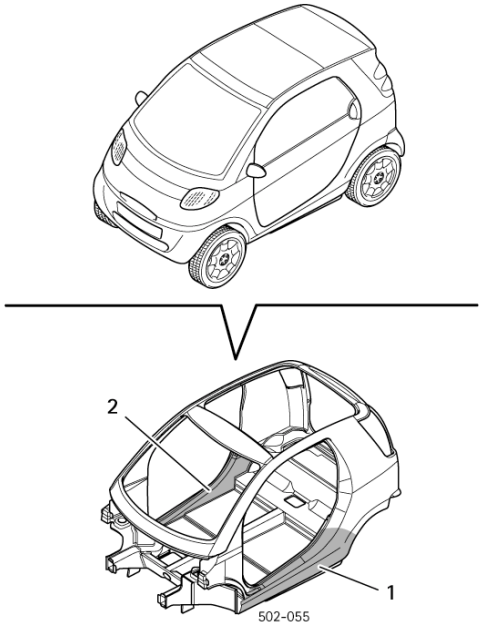
Hollow cavity sealing is used to protect against corrosion.

There is danger of corrosion from condensed water and penetrated moisture in the hollow cavities of the body.

Design

The inner surfaces of the hollow cavities and gaps and welded seams are coated evenly with wax by using waxes that are easy to distribute.

Hollow cavity sealing is carried out at the factory in the rocker panel areas 1 and 2 shown in the illustration.



502-055

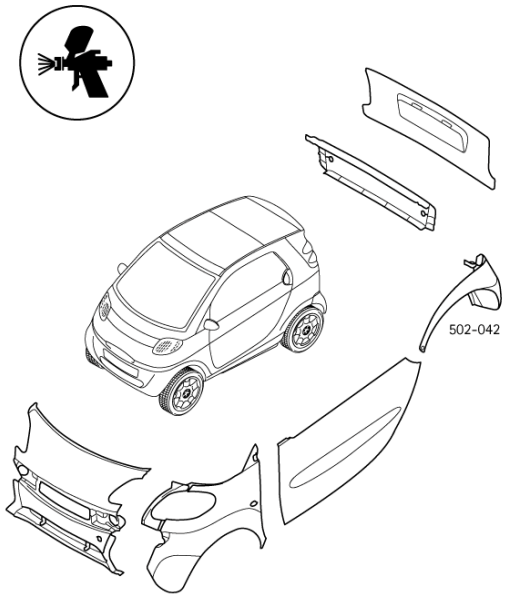
Design

The plastic external parts are manufactured according to three different coloration processes:

> Dying
(e.g. white, yellow, black and red)

> Painting
(e.g. True Blue, Bay Grey)

> Cubic Printing method
(e.g. Aqua-Green and Aqua-Vanilla)



502-042

Task

The protective paint

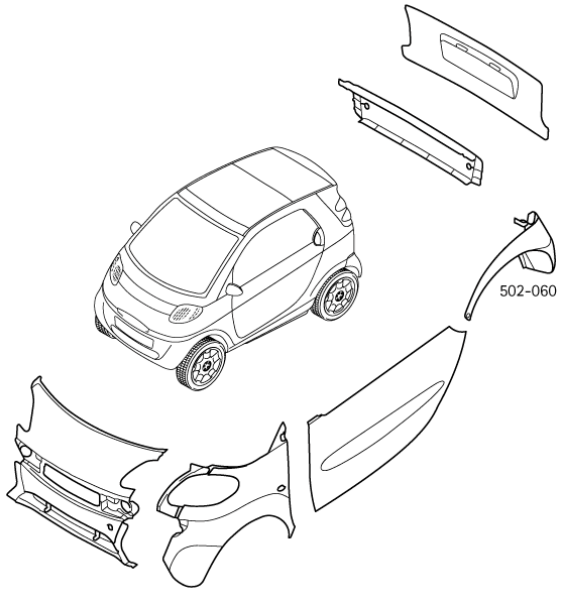
> protects the plastic against UV radiation in daylight;

> protects against mechanical influences and/or minor damage;

> increases the gloss of the part concerned.

Design

The dyed plastic parts are coated with a transparent protective paint at the factory.

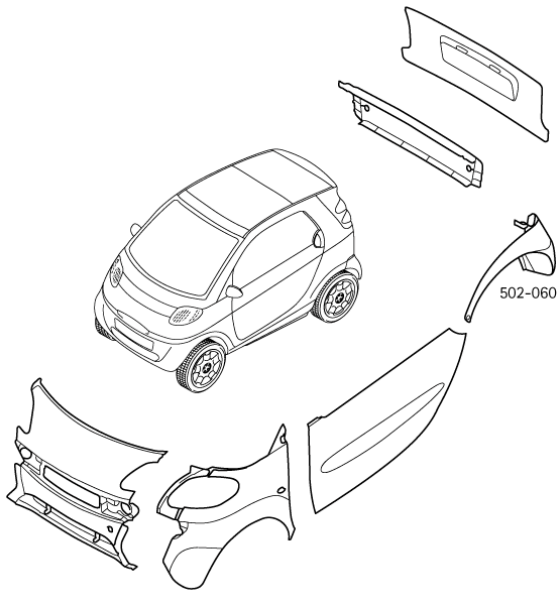


502-060

Design

The basis for the painted parts are dyed plastic parts. The plastic external colour is applied at the factory with an ordinary 2-component wet-in-wet painting process.

All coloured plastic external parts are coated at the factory with a high-gloss clear lacquer. This paint finish can be polished by hand or machine.



502-060

>>smart City-Coupé

Paint Structure of Attached Parts

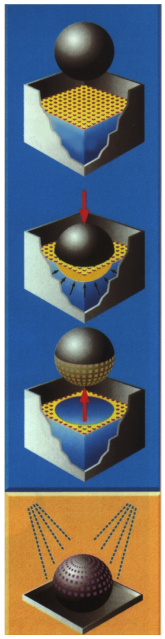
Cubic Printing

Design

The basis for the parts painted with this process are dyed plastic parts with the necessary base colour (e.g. yellow or white).

During painting the second colour (e.g. green or Vanilla) is applied to a water surface using a carrier foil. The carrier foil is water-soluble, and the paint floats on the surface of the water. The plastic parts are immersed in the water bath and pick up the paint. After drying the plastic parts have the characteristic two-colour marbling. Due to the production process used, each plastic part is unique.

These plastic parts cannot be repainted in the Service Department.



00130404

Process steps:

1. Application of paint film
2. Immersion of plastic part
3. Raising of plastic part with colour
4. Drying

Design

For each system there is a complete circuit diagram that can be displayed via the Technical Information System (TIS).

Additional information is contained in the circuit diagrams, e.g. the fitting locations of components and devices. This information can be displayed via so-called hot spots (stored in the graphic symbol of a device) by clicking on them with the mouse.

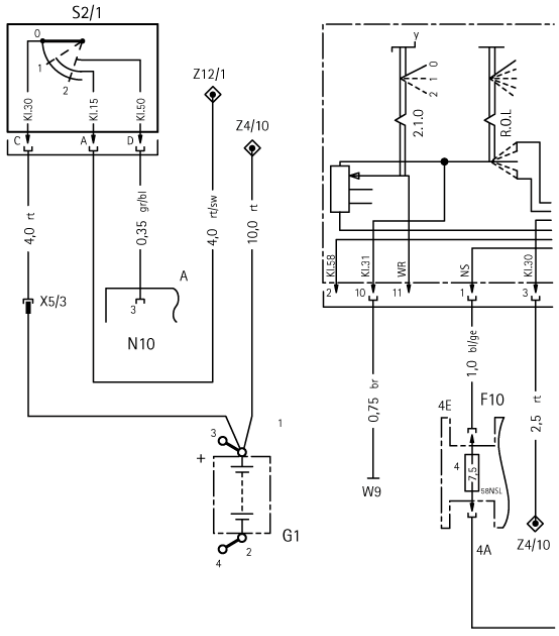
Device code

Each electrical device in a circuit diagram is provided with a device code. Here the code letter stands for the component, e.g. a wiring harness plug, followed by the number of the component concerned. All devices are handled according to this system. Here each device code is only assigned once.

Examples:

> The device code F10 stands for a fuse.

> The central electric system module (central electric/electronic system) is designated with N10 in the circuit diagram.



512-441

512-441

Design

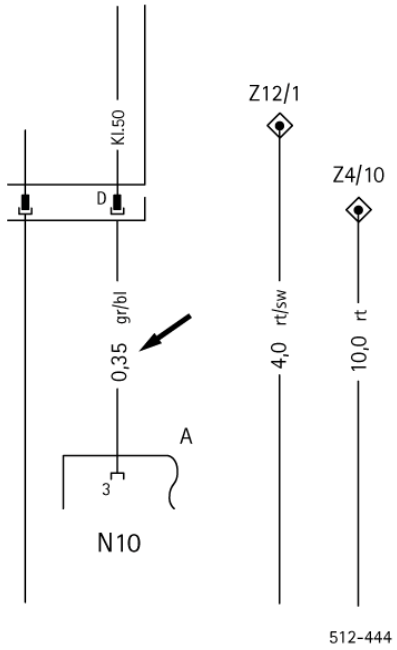
The wire numbers, wire cross-sections and colours are coded in the wiring connections of the circuit diagram.

Example: In the wire 0.35 gr/bl is shown.

0.35 Cross-section 0.35 mm^2

gr Base colour grey

bl Code colour blue



512-444

Design

Earth points and splices (wire connections) are also coded.

For example, Z81 (splice 81) is the soldered connection with the name "Soldered connection Ter. 58R".

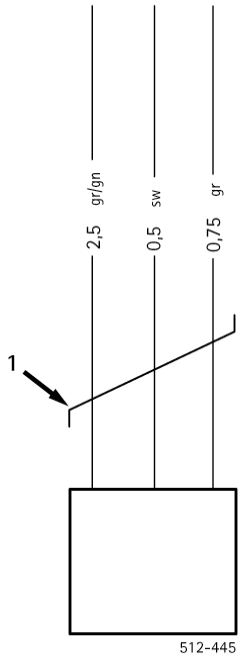
W10 (earth point 10) is the earth point with the name "Earth front left, near lamp unit".

Colour codes:

br	Brown	bl	Blue
ge	Yellow	gr	Grey
gn	Green	or	Orange
sw	Black	vi	Violet
ws	White		

Shielded cables/Wiring harnesses

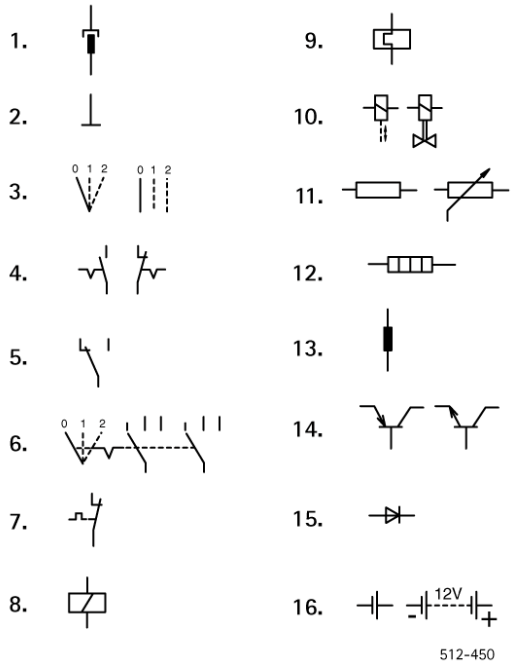
A check mark (1) over wires means that the wires are shielded.



512-445

Design

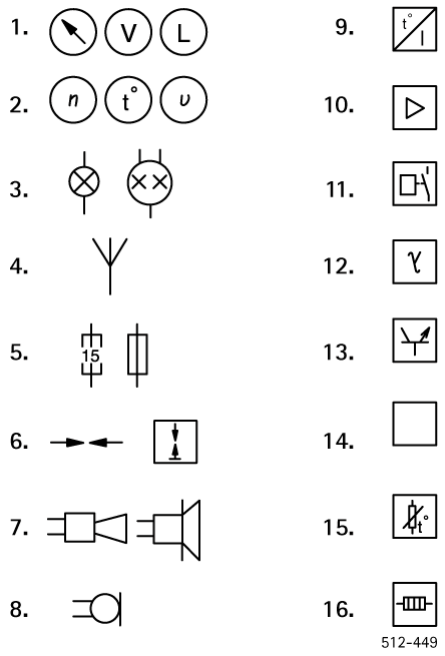
1	Connectors, plugs and sockets
2	Earth (housing earth, vehicle earth)
3	Switch positions (basic position: pulled-out line, dashed lines show the switch positions in the switched state)
4	Power controller (make contact element, break contact element)
5	Changeover contact
6	Multi-position switch
7	Thermal switch
8	Relay drive with one winding
9	Electrothermal drive
10	Electromagnetic drive, solenoid or solenoid valve
11	Resistor, potentiometer
12	Heating resistor
13	Inductance, winding
14	Transistor
15	Diode
16	Battery



512-450

Design

1 Display instrument, voltage meter, clock
2 Rev. counter, temperature gauge, speedometer
3 Bulbs with one and two filaments
4 Aerial
5 Fuse
6 Spark gap, spark plug
7 Horn or fanfare
8 Microphone
9 Transducer
10 Amplifier
11 Pressure switch
12 Lambda probe
13 Switching device, control unit
14 Device or contact element
15 Temperature switch
16 Glass pane (heated rear window)

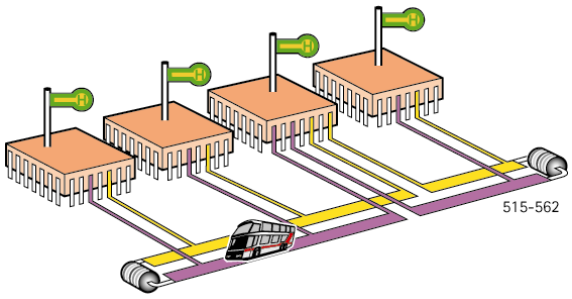


512-449

Task

CAN is the abbreviation for "Controller Area Network".
This means the CAN data bus (CAN bus for short) is a communications road between the control units.

The data received or output by the individual control units are transported from control unit to control unit as data blocks via the CAN bus. In the process, each control unit filters out only the data blocks that are important for it for further processing.



515-562

Design

In the smart four control units are interconnected with the CAN bus:

1 Instrument cluster (A1)

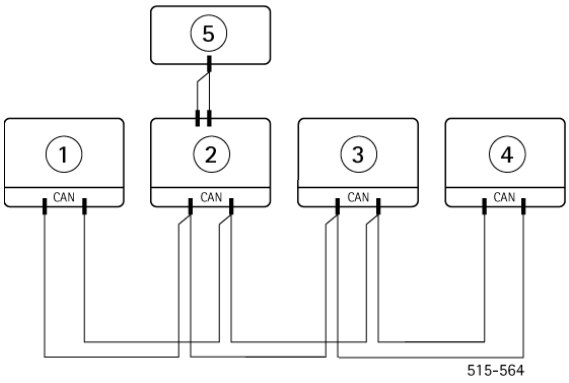
2 Central electric system module (central electric/electronic system) (N10)

3 Engine control unit MEG (N48)

4 Anti-Lock Brake System ABS (N47)

5 Airbag control unit (N2/2)

The airbag control unit (5) with the triggering unit for the airbag and safety belt is connected to the central electric/electronic system with conventional wiring.



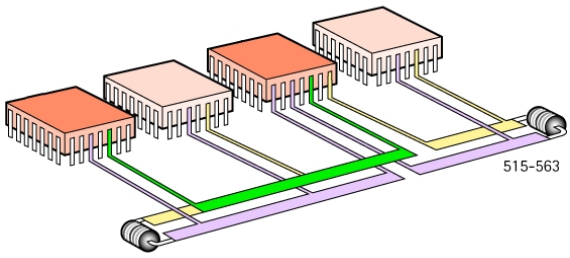
515-564a

Function

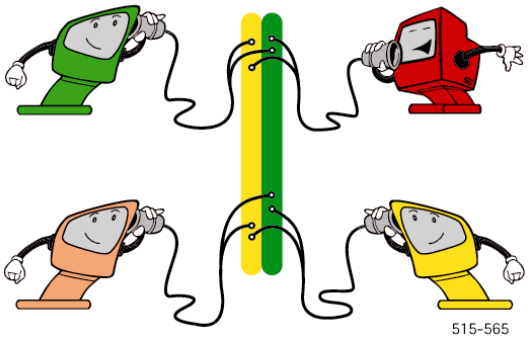
Four of the five control units in the smart are interconnected via CAN networking. As a result, data coming from a sensor can be processed by up to four control units with their respective control circuits.

The mode of operation is similar to that of a telephone conference. One subscriber (control unit) "speaks" into the network, and the others "listen" to the messages intended for them. If messages are transmitted simultaneously, their valuation determines which is transmitted first. This ensures that important messages have priority when transmission begins simultaneously.

For example, the distance signal of the ABS control unit has a higher priority than the handbrake signal, because it is more important for the display.



515-563a



515-565

The control units identify the data intended for them automatically and then route them from the bus into their working memory. This means the control units are not directly addressed, but instead recognise from the coding of the messages which messages are intended for them.

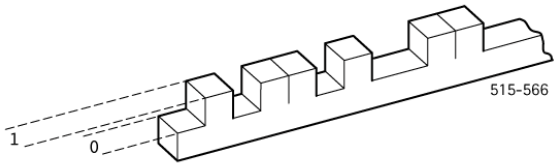
This method is called message-oriented addressing (of the messages).

Structure of a message

The data on the CAN bus consist of exactly defined sequences of bits. This means each message is a sequence of zeros and ones which include information on the origin, length and content of the signal.

Data transmission is serial, i.e. the bits are sent over the bus individually one after the other.

Each connected control unit cannot transmit data over the bus until it has not been occupied for a defined time, and is therefore enabled.



515-566

Signal paths

Data transmitted hard-wired, i.e. with a separate wire directly on the control unit, consist of analogue signals. For example, the sinusoidal voltage signal of a sensor is used for the direct control of an actuator.

Data transmitted via the CAN bus are digital. they have been converted to a sequence of bits (i.e. into a binary number) before transmission. The control units carry out calculations with these data and conduct the control of the actuators based on the results.

Networking of the control units

To show the relationship between the systems networked with the CAN bus, the following data are listed in the tables that follow here:

> Input variable of control unit X
> Transmission object of control unit X
> Reception object of control unit Y
> Output variables of control unit Y

Example:

> Input variable of central electric/electronic system control unit: Handbrake lever switch
> Transmission object of central electric/electronic system control unit: Parking brake
> Reception object of instrument-cluster control unit: Parking brake
> Output variables of instrument-cluster control unit: Control of ABS and brake indicator lamps

Data from central electric/electronic system to instrument cluster

Triggering Event	**Can Bus Signal**	**Effect of Signal**
Handbrake lever switch actuated	Parking brake	Control of indicator lamps for ABS and brake
Lever switch for turn indicators	Turn indicators	Control of turn-indicator indicator lamp
"Ignition On" (Ter. 15)	Safety belt	Control of safety-belt indicator lamp
"Ignition On" (Ter. 15)	Kilometre reading calibration	Kilometre reading in central electric/ electronic system is calibrated with kilometre reading in instrument cluster
Diagnosis interrogation by smart Tester.	Diagnosis data	Stored diagnosis data of instrument cluster read out of instrument cluster

>>smart City-Coupé

Wiring Harnesses

CAN Networking

Data from instrument cluster to central electric/electronic system

Triggering Event	Can Bus Signal	Effect of Signal
Wheel speeds from ABS control unit	Kilometre reading calibration	1. Calibrate kilometre reading in instrument cluster with kilometre reading in central electric/ electronic system 2. Transmit kilometre reading for environmental data of diagnosis error to engine control unit (via CAN)
Diagnosis interrogation by central electric/ electronic system	Diagnosis data	Output stored diagnosis data of instrument cluster to smart Tester

Data from central electric/electronic system to engine control unit

Triggering Event	Can Bus Signal	Effect of Signal
"Ignition On" (Ter. 15)	Querying of immobiliser data	Transmission of immobiliser data (via CAN)
Transmission of immobiliser data (via CAN)	Newly calculated immobiliser data	1. Enabling of fuel pump (software lock of engine control unit) 2. Enabling of starter (software lock of engine control unit) 3. Enabling of ignition (software lock of engine control unit)
Lock door switch lt/rt	Door contact	Transmission of immobiliser data (via CAN)
"Ignition On" (Ter. 15)	Querying of immobiliser data	Safety concept of automatic operation of manual gearbox
Handbrake lever switch	Parking brake	Safety concept of automatic operation of manual gearbox
Crash signal of triggering unit	Crash signal	Fuel pump shut-off

>>smart City-Coupé

Wiring Harnesses

CAN Networking

Data from central electric/electronic system to engine control unit

Triggering Event	Can Bus Signal	Effect of Signal
1. A/C button on safety island (two-stage) 2. Interior blower switch, speed 1	Air conditioner	1. Control of solenoid switch of A/C compressor (Normal: 2 or 3 °C; ECO: 11 or 12 °C evaporator temperature) 2. Control of entire air conditioner 3. Adjust idling control
Kilometre reading from instrument cluster (via CAN)	Kilometre reading	Save environmental data of diagnosis error with kilometre reading (in engine control unit)
Ignition lock "On", start (Ter.50)	Ter. 50	Begin starting procedure
Interior blower switch, speed 1	Electric fan for interior blower	Adjust idling control
Rear window heating switch on safety island "On"	Rear window	Adjust idling control

Data from engine control unit to central electric/electronic system

Triggering Event	Can Bus Signal	Effect of Signal
Querying of immobiliser data from central electric/electronic system (via CAN)	Immobiliser data	Newly calculated immobiliser data (via CAN)
Water temperature sensor	Front fan	Connect front fan
A/C function (evaporator temperature/water temperature/ interior fan switch) (via CAN)	Front fan	Connect front fan
Engine speed sensor	Start-end	Connection of relay for rear window heating, interior blower, fan
"Gear engaged"; lock door switch lt/rt (via CAN)	Warning tone	Warning tone in central electric system

Data from engine control unit to instrument cluster

Triggering Event	Can Bus Signal	Effect of Signal
Engine speed sensor	Engine speed	Calculation and display of engine speed and passing on to tachometer
Fuel gauge sensor	Tank content	Calculation of tank content and display in in-strument cluster
Water temperature sensor	Engine temperature	Calculation of water temperature and display in instrument cluster
Gearbox incremental sensor and position of gear potentiometer	Gear indicator	Display of current gear in instrument cluster
Internal detec-tion of active immobiliser in engine control unit	X display	"X" display in instrument cluster
Water temperature sensor	Critical temperature	Control (flashing) of water-temperature indicator lamp in instrument cluster

Data from engine control unit to instrument cluster

Triggering Event	Can Bus Signal	Effect of Signal
Internal engine control unit boost balance calculation	Battery-charge indicator lamp	Control of battery-charge indicator lamp in instrument cluster
"Ignition On" (Ter. 15): Energising of glow plugs	Preheating	Control of preheating indicator lamp in instrument cluster
Oil-pressure switch signal	Oil pressure	Control of oil-pressure indicator lamp in instrument cluster
Internal engine control unit diagnosis (error state that endangers engine)	Engine Check	Control of Engine Check indicator lamp in instrument cluster
"Ignition Off" (Ter. 15)	Run-on	Calibration of tank characteristic with "calmed" tank content

Data from engine control unit to ABS control unit

Triggering Event	Can Bus Signal	Effect of Signal
Calculation of engine torque of engine control unit	Engine torque	ABS control parameters

Data from ABS to engine control unit

Triggering Event	Can Bus Signal	Effect of Signal
Wheel speeds from engine speed sensors	Wheel speeds	1. Automatic function: Gear change at corresponding speed 2. Downshifting during coasting
Stop lamp switch	Brake pedal	Engaging of reversing gear only when brake pedal is actuated
Wheel speeds from speed sensors	ABS controlled braking	Opening of module coupling so that engine is not "killed"

Data from ABS control unit to instrument cluster

Triggering Event	Can Bus Signal	Effect of Signal
Wheel speeds from speed sensors	Wheel speeds	1. Calculation of speed and display in instrument cluster 2. Calculation of kilometre reading and display in instrument cluster
ABS failure with EBV failure	Lamp control	Control of ABS and brake indicator lamps in instrument cluster
ABS emergency running	Lamp control	Control of yellow ABS indicator lamp
Brake-fluid level sensor	Lamp control	Control of red brake indicator lamp

Location

1 Central-electric system module (central electric/electronic system) (N10), in which the central electric system (F10) are installed; see 02 01, Central Electric System, Central Electric System Module

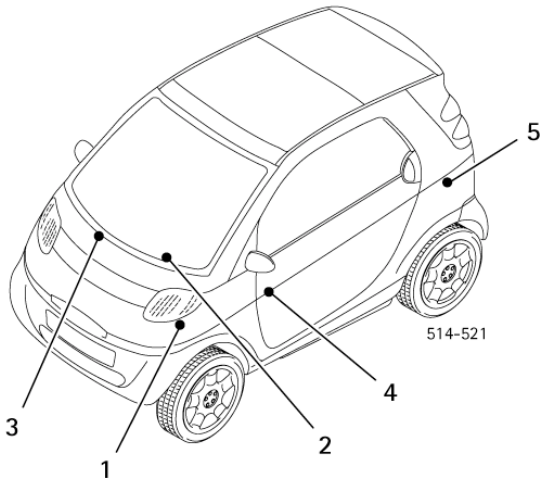
2 Instrument cluster (A1); see 02 01, Instrument Cluster

3 Triggering unit for airbag/belt tensioner (N2/2); see 02 01, Airbag, Triggering Unit

4 ABS control unit (N47); see 02-04, Anti-Lock Brake System, ABS Control Unit

5 Engine E-Gas Gearbox Control Unit MEG (N48); see 02 03, Engine Control, Propulsion Management

All control units are diagnosis-capable; see 08 02, Diagnosis Functions.



514-521

Task

The triggering unit detects collisions and triggers the belt tensioners, airbags and the side airbags (optional extra) if necessary.

Location

The triggering unit is installed in the centre on the cockpit cross member. The triggering unit is mounted suspended.

Function

The triggering unit only triggers the airbags in the case of a major deceleration within an angular range relative to the longitudinal vehicle axis, i.e. in the case of a frontal collision. The angular range is larger the greater the deceleration is.

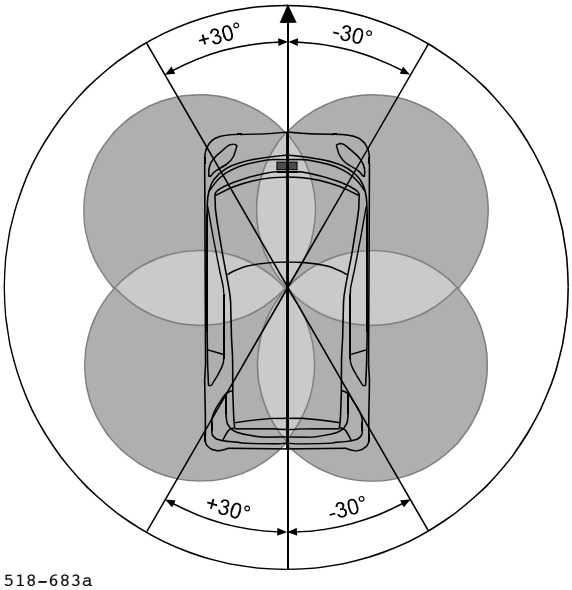
The same applies to the triggering of the side airbags in the case of a side impact.

In both cases the belt tensioners are also activated.

In the case of a rear-end crash only the belt tensioners are activated.

When a child's seat is installed, the right-hand airbag and the right-hand side airbag (optional extra) are deactivated.

For additional information, see 01 07, Restraint Systems.



518-683a

Task

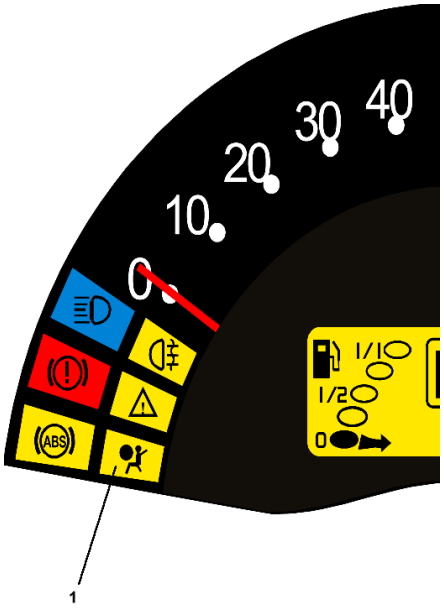
The airbag indicator lamp in the instrument cluster is used to monitor the operation of the restraint system.

Function

The Airbag indicator lamp (1) must light up when the ignition is switched on and then go out after a short time (maximum of 4 seconds).

If the lamp does not go out or only goes out briefly and then lights up again immediately, or if it lights up during driving, an error has occurred.

The error may have occurred in the power belt tensioner, in the airbag system or in the child's seat detection.



518-684a

1 Airbag indicator lamp

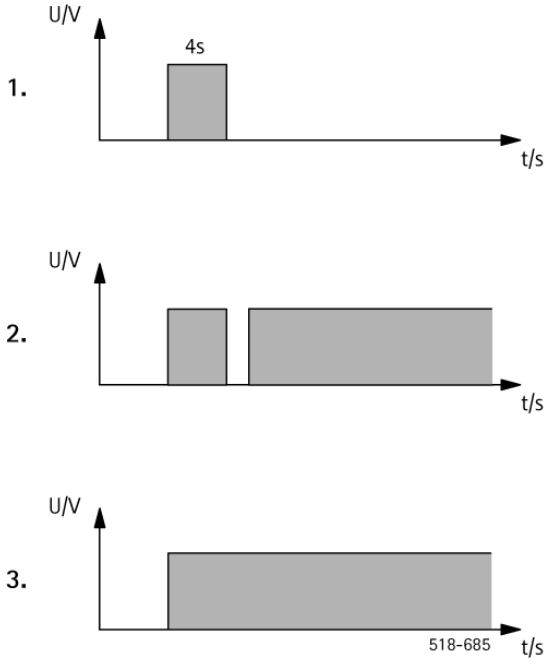
Flash codes

1 Indicator lamp on 4 seconds, then off:
System OK

Error detection

2 Indicator lamp on 4 seconds, then off and on again:
Triggering unit detects error in system

3 Indicator lamp on:
Error in triggering unit



518-685

Radio equipment:

> RDS tuner (RDS means "Radio Data System" and is a Europe-wide service of the radio stations. Here a data telegram is transmitted, e.g. for station identification.)

> 12 station presets, programmed with 6 dual-assigned station buttons

> Auto-store: Assignment of the station keys with the strongest stations

> Full-logic cassette player with Dolby-B noise suppression (full-logic means that the cassette player is controlled fully automatically.)

> Output: 2 x 21 watts at 4 ohms

> Digital tone control and loudness (in contrast to ordinary tone control via potentiometers, digital tone control is wear-free, and therefore virtually invulnerable to errors.)

> Clock

41_0135b

> Anti-theft protection with numeric code (after disconnection of the battery, the code must be entered. After an incorrect entry of the radio code, the waiting time until the next possible code entry is doubled each time.)
> Two bass reflex loudspeakers with a volume of 4 litres each are located in the cockpit below the storage shelf.

The radio is available with or without a cassette player. It is possible to connect a 6x CD changer to both models.

The picture shows the right-hand bass loudspeaker.

520-761

Design

1 Treble loudspeaker
Fitting location: Near the left and right air outlet nozzle

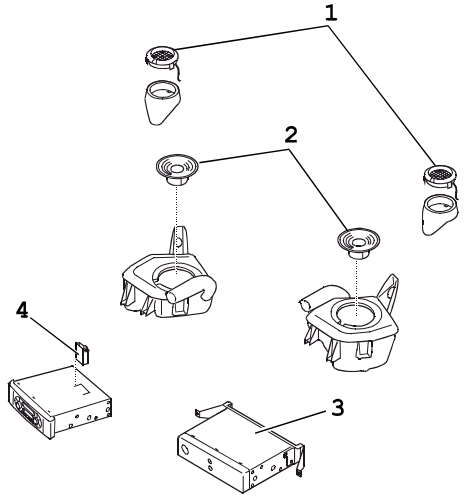
2 Bass reflex loudspeaker
Fitting location: In the cockpit below the storage shelf

3 6x CD changer
Fitting location: Below the passenger seat

4 Additional amplifier module

Hands-free use of the telephone via the radio loudspeaker: Installation kits are available for retrofitting.

The work steps to be carried out during installation are contained in the TIS.



520-763a

>>smart City-Coupé

Central Electric System

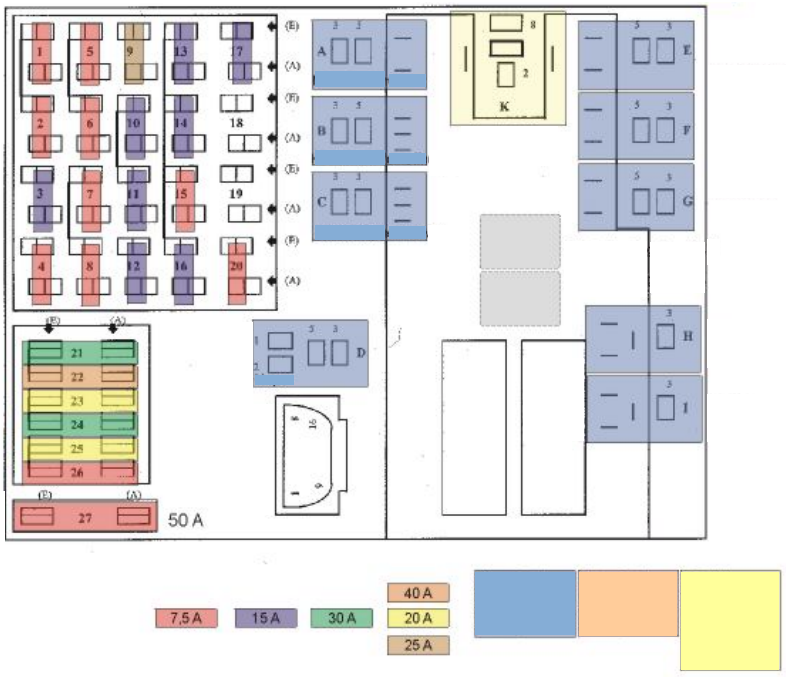
Task

The central electric system contains the fuses and the relays of the driving authorisation system, the body electronics and the comfort electronics, as well as the related control unit, the central electric system module (central electric/electronic system).

Design

The central electric system is shown in three versions on the following pages, in each case with the legend on the following page.

smart City-Coupé MCC B01/02 from production date 15/11/1999



00130410

>>smart City-Coupé

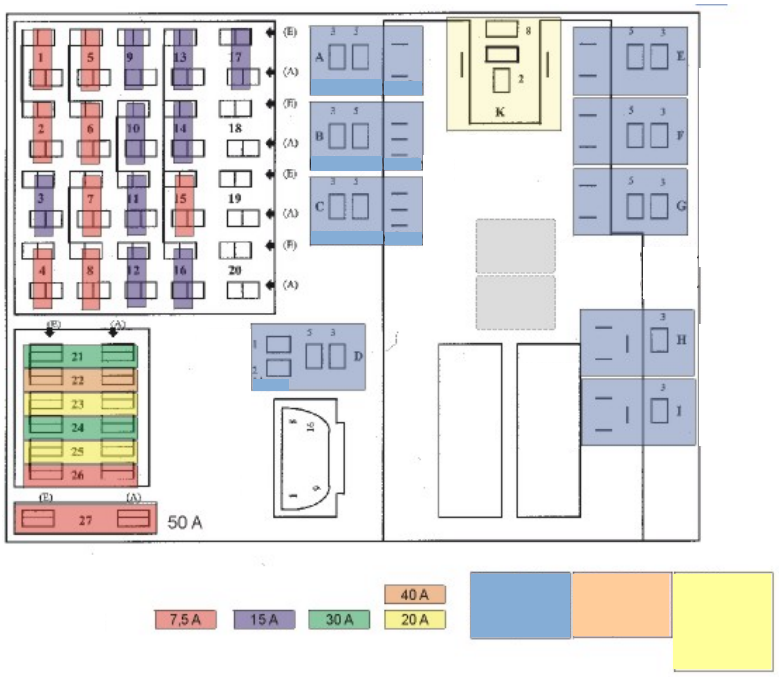
Central Electric System

smart City-Coupé MCC B01/02
from production date 15/11/1999

1 Parking and rear lamp, right, Ter. 58 for the central electric/electronic system, Instrument lighting, number plate lamp, radio lighting
2 Parking and rear lamp, left
3 Front fog lamps
4 Rear fog lamp
5 Dipped beam, left, with HRC
6 Dipped beam, right, with HRC
7 Main beam, left, main beam indicator
8 Main beam, right
9 Ter. 15 in relay box (starter)
10 Brake lamps, turn indicators
11 Ter. 15 (radio, mobility box, CD changer, instrument cluster, tachometer, reversing lamp, PTC heater switch, diagnosis socket)
12 Electrical outlet
13 Rear interior lamp, diagnosis socket
14 Ter. 30, (radio, mobility box, CD changer)
15 Control unit for instrument cluster, central electric/electronic system, receiver for central-locking remote control, front interior lamp
16 Central-locking control motors, safety island, clock, horn, HDF
17 Rear wiper motor
18 not in use
19 not in use
20 Engine control unit
21 Rear window heating, front engine fan
22 Ter. 30 in relay box
23 Heater blower
24 Power window, left, right
25 Front wiper, washer pump, rear wiper control circuit
26 Control unit for ABS, central electric/electronic system, airbag
27 ABS control unit

A Front fog-lamp relay
B Rear-hatch remote unlocking relay
C Rear wiper interval relay
D Horn relay
E Relief relay for ignition switch, heater blower, power windows, electrical outlet
F Rear-window heating relay
G Engine fan relay
H Left turn indicator relay
I Right turn indicator relay
K Front wiper interval relay

smart MCC D 01 (cdi)



00130411

>>smart City-Coupé

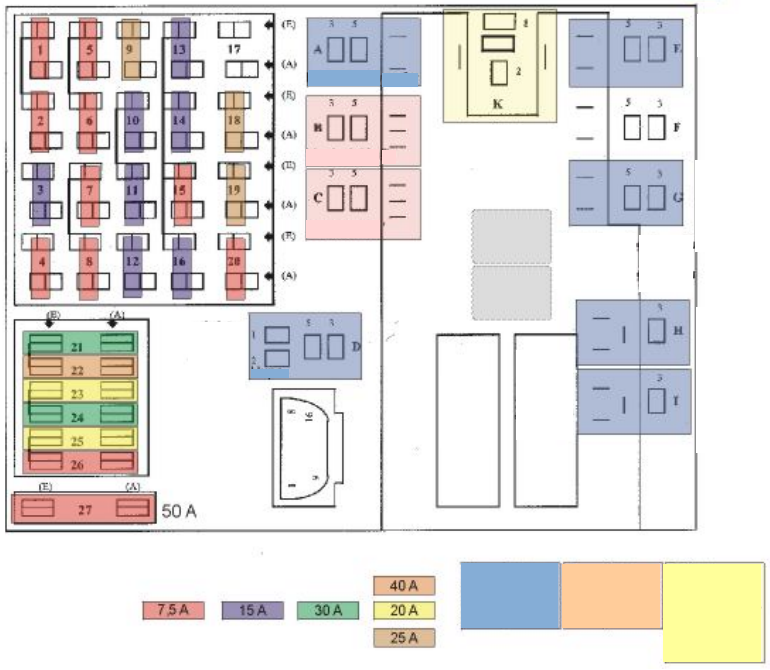
Central Electric System

smart MCC D 01 (cdi)

1 Parking and rear lamp, right, Ter. 58 for the central electric/electronic system, Instrument lighting, number plate lamp, radio lighting
2 Parking and rear lamp, left
3 Front fog lamps
4 Rear fog lamp
5 Dipped beam, left, with HRC
6 Dipped beam, right, with HRC
7 Main beam, left, main beam indicator
8 Main beam, right
9 Ter. 15 in relay box (starter)
10 Brake lamps, turn indicators
11 Ter. 15 (radio, mobility box, CD changer, instrument cluster, tachometer, reversing lamp, PTC heater switch, diagnosis socket)
12 Electrical outlet
13 Rear interior lamp, diagnosis socket
14 Ter. 30, (radio, mobility box, CD changer)
15 Control unit for instrument cluster, central electric/electronic system, receiver for central-locking remote control, front interior lamp
16 Central-locking control motors, safety island, clock, horn, HDF
17 Rear wiper motor
18 not in use
19 not in use
20 not in use
21 Rear window heating, front engine fan
22 Ter. 30 in relay box
23 Heater blower
24 Power window, left, right
25 Front wiper, washer pump, rear wiper control circuit
26 Control unit for ABS, central electric/electronic system, airbag
27 ABS control unit

A Front fog-lamp relay
B Rear-hatch remote unlocking relay
C Rear wiper interval relay
D Horn relay
E Relief relay for ignition switch, heater blower, power windows, electrical outlet
F Rear-window heating relay
G Engine fan relay
H Left turn indicator relay
I Right turn indicator relay
K Front wiper interval relay

smart MCO B 01 (cabrio)



00130412

>>smart City-Coupé

Central Electric System

smart MCO B 01 (cabrio)

1 Parking and rear lamp, right, Ter. 58 for the central electric/electronic system, Instrument lighting, number plate lamp, radio lighting
2 Parking and rear lamp, left
3 Front fog lamps
4 Rear fog lamp
5 Dipped beam, left, with HRC
6 Dipped beam, right, with HRC
7 Main beam, left, main beam indicator
8 Main beam, right
9 Ter. 15 in relay box (starter)
10 Brake lamps, turn indicators
11 Ter. 15 (radio, mobility box, CD changer, instrument cluster, tachometer, reversing lamp, seat occupation, diagnosis socket)
12 Electrical outlet
13 Rear interior lamp, diagnosis socket
14 Radio, mobility box, CD changer
15 Control unit for instrument cluster, central electric/electronic system, receiver for central-locking remote control
16 Central-locking control motors, safety island, clock, horn, HDF
17 not in use
18 Soft top motor
19 Soft top motor
20 Engine control unit
21 Rear window heating, front engine fan
22 Ter. 30 in relay box
23 Heater blower
24 Power window, left, right
25 Front wiper, washer pump, rear wiper control circuit
26 Control unit for ABS, central electric/electronic system, airbag
27 ABS control unit

A Front fog-lamp relay
B Soft top "Open" relay
C Soft top "Close" relay
D Horn relay
E Relief relay for ignition switch, heater blower, power windows, electrical outlet
F -
G Engine fan relay
H Left turn indicator relay
I Right turn indicator relay
K Front wiper interval relay

Task

The central electric system module (central electric/electronic system) (N10) controls functions of the driving authorisation system and of the body and comfort electronics. In addition, it also provides signals on the CAN bus that are evaluated by the other control units.

General functions

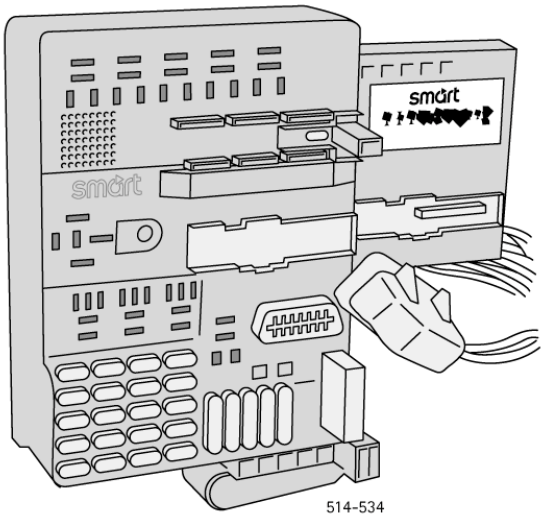
> Turn indicators/hazard warning signal
> Heated rear window
> Interior light control

Additional functions

> Position of rotary latch
> Position of heater blower switch
> Signal from terminal 58: Light ON
> Signal from terminal 50: Starter ON
> Relief relay for ignition/starter switch
> Front fog lamps
> CAN bus connection
> Kilometrage storage
> A/C control ON/OFF
> Fan control for radiator
> Crash sensor input

Complex functions

> Central locking
> Immobiliser
> Burglar alarm



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514-534

Location

The central electric system module (central electric/electronic system) (N10) is integrated in the central electric system.

Function

Turn indicators

This function is only active with the ignition ON. The contacts of the lever switch lead to the central electric system module. The central electric/electronic system controls one relay each for the right and the left turn indicators. If one of the front or rear turn indicators fails, the flashing frequency doubles. The same applies when several turn indicators fail. The function is displayed in the instrument cluster. A signal is sent to the instrument cluster from the central electric/electronic system via the CAN bus for this purpose.

Hazard warning signal

This function is also active with the ignition OFF. It has priority over turn indicator flashing. Both turn indicator relays are controlled simultaneously. The function is displayed with one LED each in the hazard warning switch and in the instrument cluster, however only with the ignition ON, as the CAN bus is only active with the ignition ON.

Heated rear window

This function is only active with the ignition ON. When the rear window heating button is pressed, the heated rear window is switched on for 10 minutes. If the button is pressed again during this time, the rear window heating is switched off.

The relay is controlled by the central electric/electronic system, and the load is switched via a relay in the central electric system (central electric system, slot F). An LED in the button displays the function. When the lighting is ON, the function display is dimmed.

Interior light control

> The interior light is switched on with the driver's or passenger door open (rotary latch signal), or when the central locking is unlocked (by radio remote control).

> After the doors are closed, the interior light is dimmed and switched off with a time delay.

> If the vehicle is locked with the radio remote control with the doors closed, then the interior light is dimmed and switched off without a time delay.

> When the ignition is switched on, the interior light is dimmed and switched off without a time delay. If the driver's door and/or the passenger door remain(s) open when the ignition is switched on, then the interior light remains lit.

> With the vehicle switched off and the doors open, the interior light is switched off after 10 minutes without dimming, regardless of whether the ignition is ON or OFF.

> If the interior light has been switched on via the interior light switch, the central electric/electronic system (N10) has not switch-off function. The interior light remains switched on until the switch is switched over to the door contact position again.

Additional functions

Position of rotary latch (switches against earth)

The position of the rotary latch of the driver's of passenger door is detected and evaluated by the central electric system module. With a door open, the central electric/electronic system detects a "low" signal (i.e. approx. 0 volts).

The signal is required for central locking control, interior light control and safety functions (warning buzzer). The rotary latch position is made available on the CAN bus.

Position of heater blower switch

With the heater blower switched off, the switch outputs a "low" signal. The position of the heater blower switch is used by the central electric/electronic system to enable the A/C function on the CAN bus. This will be discussed in greater detail in the air conditioner module.

Handbrake lever switch

With the handbrake set a "low" signal is detected by the central electric/electronic system. With the ignition ON the information is placed on the CAN bus and displayed by the instrument cluster.

Signal at terminal 58: Light ON

With the parking lights switched on a "high" signal is present at terminal 58 (i.e. battery voltage). The central electric/electronic system (N10) reads this information and uses it for the "Light on" warning with the driver's door open and for dimming the switch LEDs for central locking, rear window heating, air conditioner and instrument cluster.

Signal at terminal 50: Starter ON

The signal of the ignition/starter switch for actuating the starter is evaluated by the central electric/electronic system (N10) and made available on the CAN bus.

Relief relay for ignition/starter switch

To avoid overloading the electrical contacts of the ignition/starter switch, part of the electrical consumers (heater blower, electrical outlet and window lifts) are switched via a relay (slot E in the central electric system).

The relay receives the signal from terminal 50 (starter control) during starting and is switched off with a short time delay.

To prevent brief pick-up and drop-out of the relay during fast turning of the ignition key to the start position, the relay is not actuated until after a debouncing time.

Front fog lamps

Front fog lamps can be installed in the vehicle as an optional extra. They are switched on ("low" signal) and off with a button.
This function is only active with the lighting ON and the ignition ON. When the ignition is switched off, the front fog lamps are also switched off. When the ignition ON signal is output again, they are switched on again.

The front fog lamps are switched via a load relay (slot A in the central electric system).
Operation is indicated with an LED in the switch.

CAN bus connection

See 02 00, Wiring Harnesses, CAN Networking

Distance storage

A plausibility check of the km reading is constantly carrier out between the instrument cluster (A1) and the central electric system (F10). If differences occur, the highest value is used as the current value (see 02 01, Instrument Cluster).

A/C control ON/OFF

This function is only active with the ignition EIN and the insider blower ON. When the button in the safety island is pressed, a "low" signal is sent to the central electric/electronic system (N10).

The receipt of this signal has a toggle function, i.e. pressing the button repeatedly cycles through (toggles) all three states ECO A/C [MIN], A/C ON [MAX] and A/C OFF, and makes them available to the CAN bus. Operation is displayed with two LEDs in the button.

> ECO A/C (button pressed 1x): An LED lights up

> A/C ON (button pressed 2x): Two LEDs light up

> A/C OFF (button pressed 3x): Both LEDs off

With the ignition Off or the blower switch OFF, the function is set to A/C OFF. The last state of the A/C control is stored and the LEDs are switched off. When the ignition or blower switch is switched on again, the A/C control returns to the stored state.

Radiator fan control

The control signal for the fan is made available to the central electric/electronic system by the engine control unit via the CAN bus. The central electric/electronic system evaluates this signal and controls the load relay (slot G of the central electric system) as long as the signal for the fan is present on the CAN bus.

Crash sensor input

After the ignition is switched on, the crash sensor input is checked for short-circuit to earth. If there is a short-circuit, then the signal is not evaluated and a error is entered in the error memory.

Complex functions of the central electric/electronic system

> Central locking (see 02 02, Central Locking)

> Immobiliser (see 02 02, Immobiliser)

> Burglar alarm (see 02 01, Burglar Alarm)

Task

The instrument cluster (A1) is a control unit that is responsible for the combined display of the most important vehicle operating data and for control of the indicator lamps.

Design

1 Speed display (pointer display)

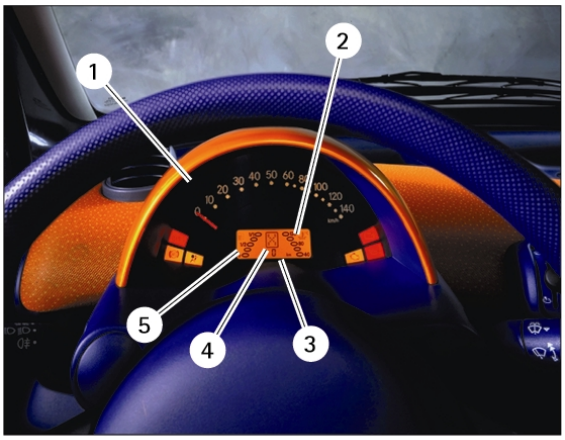
Displays in the LC display:

2 Coolant temperature

3 Kilometre/trip kilometrage/outside temperature display (only with air conditioner)/reserve fuel display (from production date 15/11/1999)

4 Gear indicator or immobiliser active

5 Fuel level

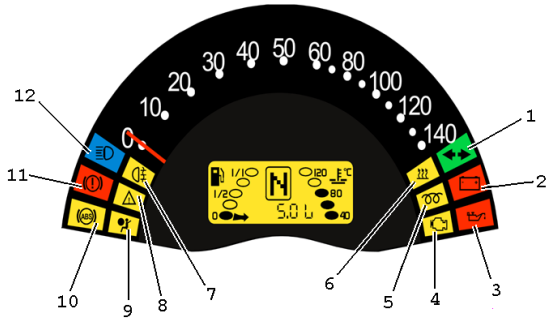


514-526

514-526

Indicator lamps

1 Left/right turn indicators, hazard warning indicator (via button on safety island)
2 Battery change
3 Oil pressure
4 Check Engine
5 Preheating (diesel only)
6 Auxiliary heater
7 Rear fog lamp (rear fog lamp ON)
8 Trust-Plus lamp
9 Airbag
10 ABS
11 Brake
12 Main beams (main beams ON)



514-527a

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Instrument Cluster

Function

Speed display

The speed display is calculated from the kilometrage signal and displayed by the instrument cluster (A1). The kilometrage signal is a mean value calculated by the ABS control unit (N47) from the signals of the wheel speed sensors (L6).

Middle digital display for kilometres, trip kilometrage, outside temperature and residual fuel display (from production date 15/11/1999)

It is possible to switch between the various displays by pressing the button located on the left next to the instrument cluster. The display does not go out when the computer run-on is ended with the ignition OFF. As a result, either the kilometrage display, the trip odometer or the outside temperature display remains visible.

To ensure that no instrument cluster with a kilometre reading lower than the actual kilometre reading of the vehicle is installed during repairs, the instrument cluster (A1) carries out a kilometre reading calibration with the central electric system module (N10) via the CAN bus.

The outside temperature display is only available when an air conditioner is installed.

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Instrument Cluster

Digital display for tank content and coolant temperature, as well as gear indicator

This information are placed on the CAN bus by the engine control unit (N48) and read out, processed and digitally displayed by the instrument cluster (A1). When the immobiliser is activated, an "X" or a key symbol (from production date 15/11/1999) appears in the gear indicator.

> The recommendation that the driver shift into the next-highest/next-lowest gear is given with an arrow in the gear indicator.
> If Softouch is activated, an "A" is displayed.
> Three bars in the gear indicator indicate an error in the CAN bus.
> When five litres of fuel remain in the tank, the display in the instrument cluster switches over to the display of the remaining fuel quantity. The remaining litres are displayed in 0.5-litre steps (from production date 15/11/1999).

Indicator lamps

The display of the indicator lamps is requested by other control units via the CAN bus.

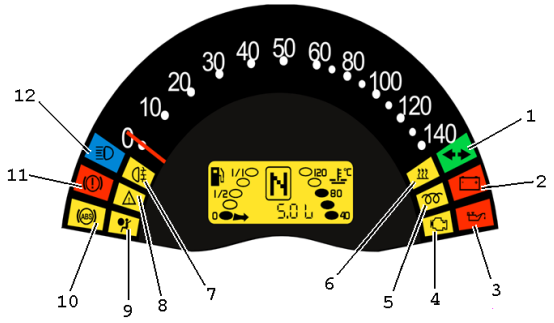
CAN bus error

In the case of a CAN bus error the indicator lamps for the brakes (8) and turn indicators (2) may light up continuously, or three bars appear in the display.

Lighting adjustment

The lighting of the instrument cluster (A1) can be adjusted with the smart Tester. Day and night lighting can be adjusted for the LC display. The scale lighting is also adjustable.

1 Left/right turn indicators, hazard warning display (via button on safety island)
2 Battery charge
3 Oil pressure
4 Check Engine
5 Preheating (diesel only)
6 Auxiliary heater
7 Rear fog lamp (rear fog lamp ON)
8 Trust-Plus lamp
9 Airbag
10 ABS
11 Brake
12 Main beams (main beams ON)



514-527a

Design

There are different alternators and batteries for vehicles with and without air conditioning.

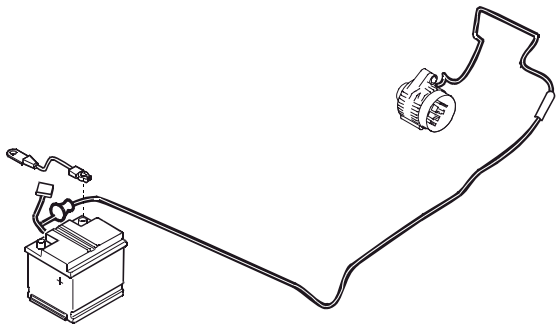
Vehicles with air conditioning have a stronger alternator and a higher-capacity battery.

Location

The battery is located in the passenger footwell.

Function

The alternator is driven by the crankshaft gear via a V-belt.



513-490a

Task

The burglar alarm monitors the unauthorised entry into the vehicle via the doors and lids, the vehicle interior and also the change in the vehicle tilt (towing protection) if desired). In the case of an alarm it outputs an optical and acoustic alarm.

The burglar alarm is integrated in the driving authorisation system (remote control of central locking, unlocking and locking of the doors and lids, immobiliser).

Design

Own components of the burglar alarm:

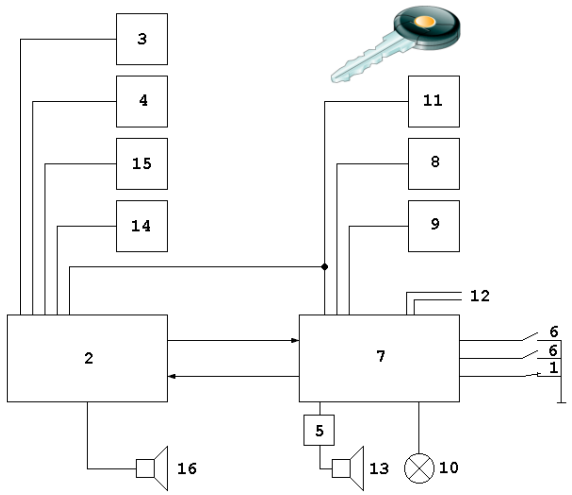
1 Microswitch of rear hatch
2 Interior monitoring device with
3 Two integrated front ultrasonic sensors
4 Two rear ultrasonic sensors as an option (Cabrio)
5 Intelligent horn relay (IHR – up to 15/11/1999)

Components that work together with the burglar alarm:

6 Rotary latch switch on the doors
7 Central electric/electronic system
8 Radio receiver
9 Panic button
10 Turn indicators
11 Microswitch of Cabrio soft top
12 Central locking
13 Alarm horn

Components of the Burglar Alarm Plus:

14 Tilt sensor (towing protection)
15 Two front microwave sensors (Cabrio)
16 Alarm siren, sabotage-proof between floor panel and underbody cover



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Burglar Alarm

Function

Activating

The burglar alarm is activated by locking the vehicle using the remote control. After a brief delay, all alarm sensors are monitored.

Feedback

> The turn indicators flash three times.
> The lamps only flash when all doors and the rear hatch are closed. This points out any door not closed to the operator. To give an additional acoustic signal, the door locks are locked once and then unlocked again (from production date 15/11/1999).
> The burglar alarm is not activated when a door or lid is not closed.

The interior protection is not activated:

> During fan operation of an auxiliary heater,
> On the Cabrio with the soft top open; however, if the Cabrio is equipped with the Burglar Alarm Plus, the interior is also monitored with the soft top open using microwave sensors.

The optional towing protection can be deactivated, e.g. when the vehicle is to be loaded. To do this:

> Open the door with the ignition switched on,
> Press the panic button in the centre console,
> Switch off the ignition,
> Close the door
> Lock the vehicle.

The next time the vehicle is locked, the towing protection will be activated again normally.

In the country model for Belgium, the burglar alarm is automatically activated (like the immobiliser), even when the vehicle is not locked.

Deactivating

The burglar alarm is deactivated by unlocking the vehicle using the remote control.

Feedback

> The turn indicators flash once.

Triggering alarm

With the burglar alarm activated the alarm will be triggered in the following cases:

> Opening of a door, the rear window of the City-Coupé or the rear hatch of the Cabrio,
> Movement in the vehicle interior,
> A change in the tilt of the vehicle (if equipped with towing protection of the Burglar Alarm Plus),
> Sabotage to the siren of the Burglar Alarm Plus; the siren is equipped with a control unit and battery for this purpose.

Alarm

The alarm is indicated by:

> The turn indicators flashing,
> The alarm horn or siren sounding.

The type and duration of the alarm are country-dependent.

Ending alarm

The alarm is ended by opening the vehicle with the remote control, i.e. by using an authorised transmitter key.

The sabotage alarm can only be ended when triggered by restoring the wiring connection.

Function

The ultrasonic sensors function according to the same principle as a bat uses for orientation. They transmit and receive sound waves above the frequency range audible for human beings.

After the burglar alarm sensors have been switched on, they radiate the entire vehicle and receive the reflected sound waves. Any movement in the vehicle is then detected from the change in the received signal and the alarm is triggered.

Function

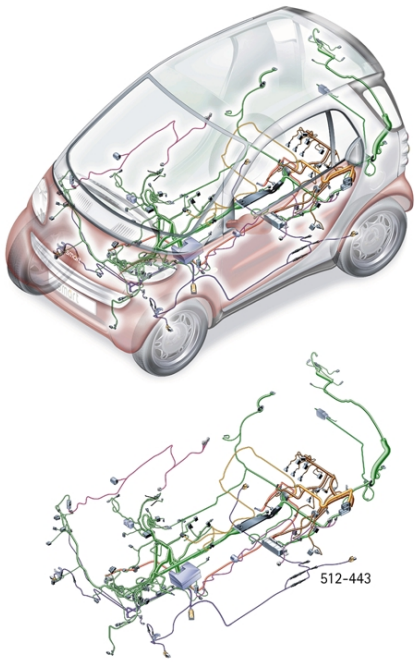
The microwave sensors transmit and receive radio waves.

After the burglar alarm sensors have been switched on, the transmitter in the sensor transmits radio waves that are reflected by all parts of the vehicle interior and are registered by the receiver in the sensor. As long as the reflecting parts in the vehicle maintain their positions, the reflected waves have the same frequency as the transmitted waves. If a part in the vehicle interior moves, the frequency of the waves reflected by it shifts. It becomes larger when the part moves toward the sensor and smaller when it moves away from it (Doppler effect). The interior monitoring detects the frequency change and the alarm is triggered.

Compared to ultrasonic sensors, microwave sensors have the advantage that the spreading of the waves can be relatively clearly limited. Therefore, microwave sensors can also be used in convertibles with the soft top open.

Task

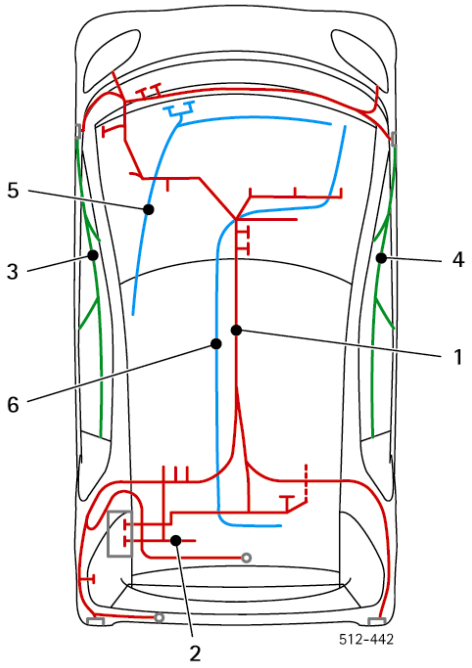
The wiring harnesses are used to provide the individual systems and their components with information and power.



512-443

Location

1 Main wiring harness
2 Engine wiring harness
3 Side door wiring harness
4 Side door wiring harness
5 ABS wiring harness
6 Battery wiring harness



512-442

Design

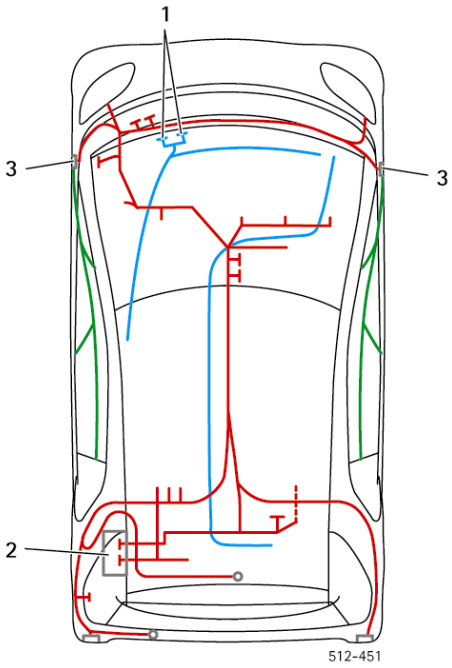
The wiring harnesses consist of wiring looms that consist of grouped individual wires.

Connection points of wiring harnesses

1 Main wiring harness to ABS wiring harness, via two wiring harness connectors on outer left-hand side of bulkhead

2 Main wiring harness to engine wiring harness, via engine control unit interface and relay box

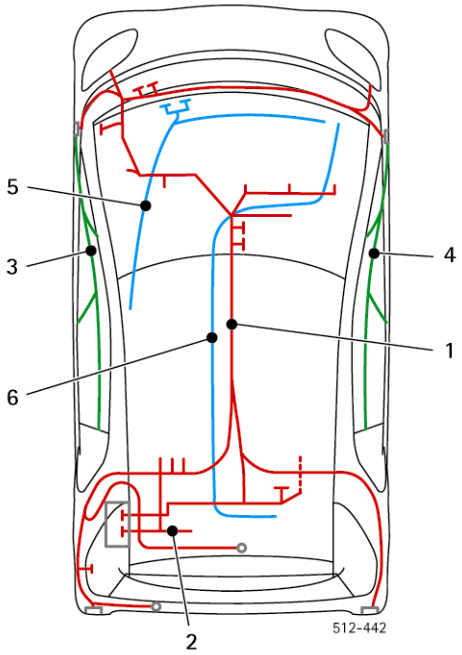
3 Main wiring harness to door wiring harnesses, via one wiring harness connector each on outer left-hand or right-hand side of A-pillar



512-451

1 Main wiring harness

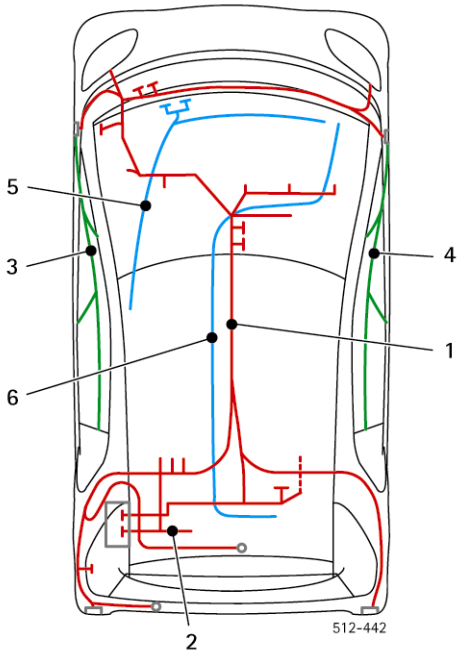
> Interior and exterior lighting system, turn indicators, speed sensors
> Airbags and safety belt system
> CAN bus
> Central electric system, central electric system module
> Instruments
> Radio preparation
> Relay box/relay box for A/C
> Fuel tank
> Window (heated rear window)
> Blower motor (ventilation)
> Radio receiver
> Battery connection
> Fanfare
> Radiator fan
> Wiper system, wash-water hose
> Safety island
> Sedrive unit



512-442

2 Engine wiring harness

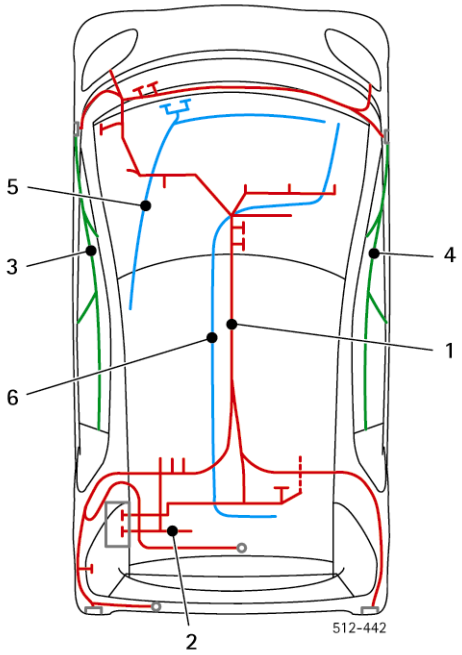
> Engine sensors, gearbox sensors
> Air conditioner/solenoid clutch
> Engine control unit
> Gearbox
> Dual ignition coils
> Intercooler
> Lambda probe
> Injectors



512-442

3/4 Side door wiring harnesses

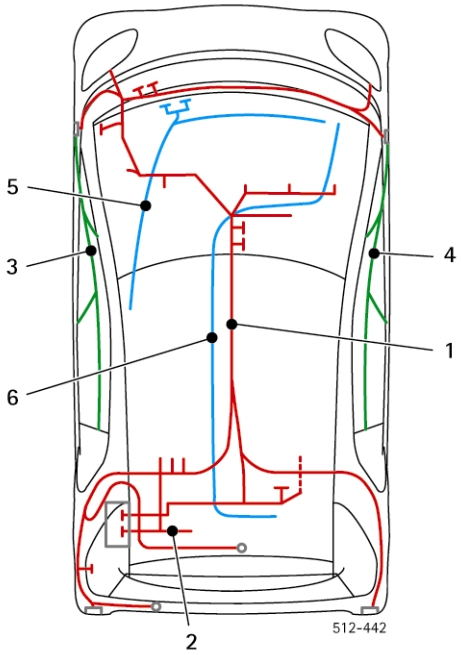
> Driver's and passenger door
> Rotary latch
> Actuator (servomotor for central locking)



512-442

5 ABS wiring harness

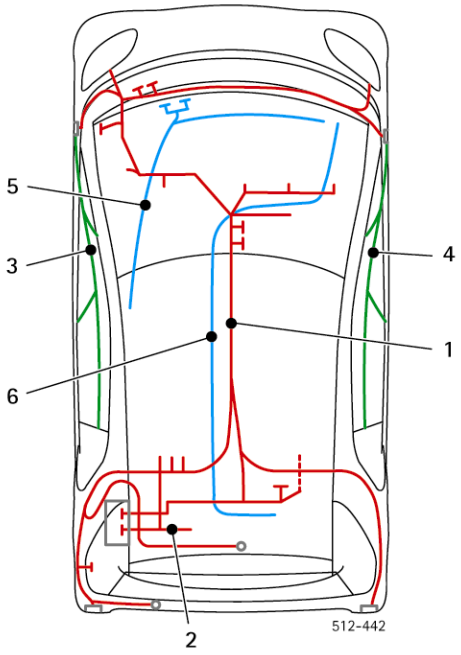
> Wheel speed sensor
> Stop lamp switch
> Power supply Positive (+), Negative (–)
> CAN bus
> Brake-fluid level sensor



512-442

6 Battery wiring harness

> Alternator
> Starter
> Battery



512-442

Task

CAN networking enables communication between the control units.

Location

The CAN-Bus is part of the main wiring harness.

Function

For detailed information, see 02 00, Wiring Harnesses, CAN Networking.

Design

> Parking lamps, dipped beams, main beams and turn indicators are combined in the headlamps.

The headlamps are equipped with an integrated headlight range control. The height is controlled with a three-stage rotary switch (positions 0, 1 and 2) behind the left-hand lever switch.

The lens is made of plastic.

The headlamps and turn indicators are operated via the left-hand steering column lever.

The headlamps can only be replaced as a complete unit.

> Side turn indicator lamps

> Taillamps with integrated reversing lamp on the right and rear fog lamp on the left. Operation with the rotary switch on the left-hand lever switch.

> The third stop lamp is located in the spoiler (rear).

> Front fog lamps are available as an option. They are operated with the switch on the left next to the footwell lighting.

513-487

513-487

Design

The interior lamp in the rear and the footwell lamp integrated in the interior light switch are used for interior lighting.

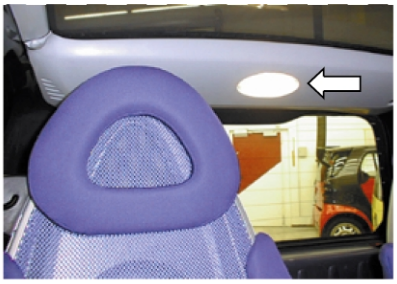
Function

The interior light switch has two positions:

> Position 1: Footwell lighting and interior lamp in the rear light up with a door open. After 10 minutes the lighting switches off automatically. If the doors are closed, both lamps are dimmed and then go out.

> Position 2: Footwell lighting and interior lamp in the rear light up continuously.

For details, see 02 01, Central Electric System, Central Electric System Module.



513-488

513-488

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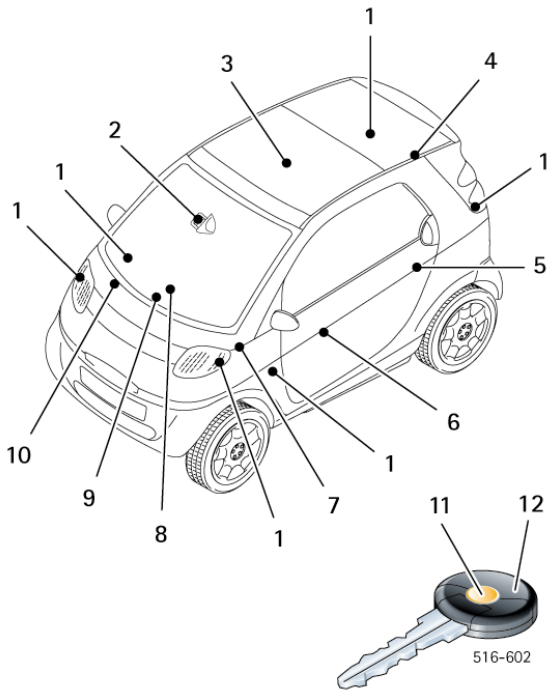
Central Locking

Design

1 Turn indicators
2 Right inside door handle
3 Door lock actuator for passenger door
4 Servomotor for central locking of rear hatch (in lower rear hatch)
5 Door lock actuator for driver's door
6 Left inside door handle
7 Central locking controller in the central electric/electronic system
8 Central locking inside button (panic button, on safety island)
9 Central locking status display (on safety island)
10 Radio receiver for central locking (under cockpit cross member, right)
11 Transmission button
12 Radio transmitter for central locking (remote control)



516-602

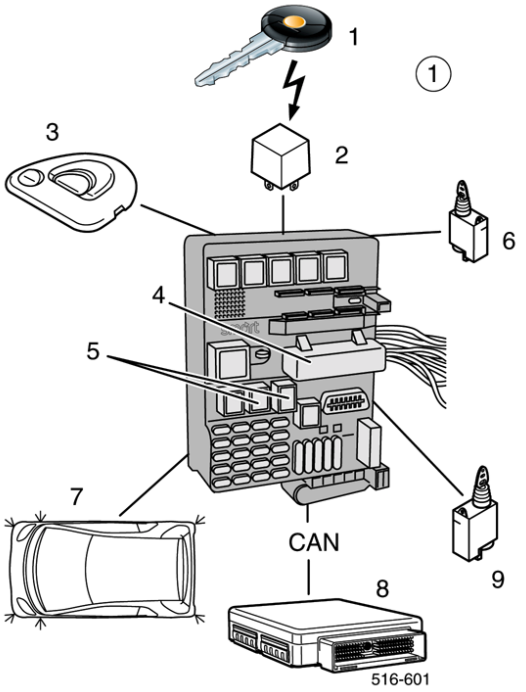
Central locking system

1 Radio remote-control status change (open/close)
2 Radio receiver
  Fitting location: under cockpit cross member, right
3 Central-locking inside button (panic button)
4 Central electric system module (Central electric/electronic system)
5 Two micro-relays for central locking (Ter. 30)
6 Remote control for rear hatch
7 Front and rear turn indicators, left and right side lamps
8 Engine control unit: Activate/deactivate immobiliser
9 Actuators for locking/unlocking central locking and feedback

Function

The smart is locked and unlocked with the transmission button in the radio remote control. With the panic button only locking can be carried out; in this case, locking is carried out with the inside door handles.

The central locking functions are controlled via the central electric system module (central electric/electronic system).



516-601

The current state of the central locking is displayed in the central-locking status display.

> Display flashes: locked

> Display does not light up: unlocked

> Display light up continuously, ignition is "ON": locked with panic button

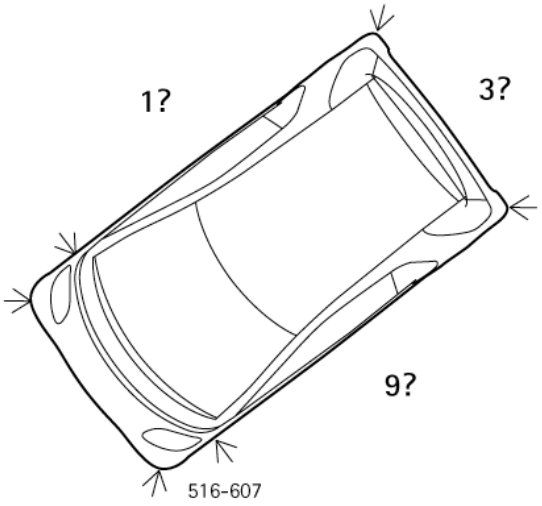
> Display flashes, ignition is "OFF": locked with panic button

If the vehicle is unlocked or locked, the respective action carried out is confirmed with the flashing lamps.

> Flashing lamps flash once: Vehicle is unlocked and immobiliser is deactivated

> Flashing lamps flash 3 times: Vehicle is locked and immobiliser is activated

> Flashing lamps flash rapidly 9 times: Transmitter battery low or transmitter defective. If battery is low, the transmitter can still be actuated approx. 100 times.



516-607

>>smart City-Coupé

Central Locking

Crash Opening

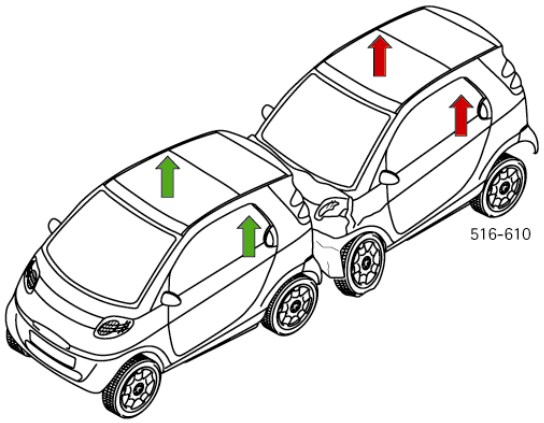
If a crash situation occurs, this is detected by the airbag triggering unit and reported to the central electric/electronic system via a directly wired signal.

The central locking immediately unlocks the doors. The servomotors of the doors are energised to OPEN, regardless of the previous locking state.

If a crash has been detected, all attempts to lock the smart with the panic button will be ignored. The normal operating mode will not be restored until

> Ignition OFF – Lock – Unlock (each with the radio remote control)

has been carried out.



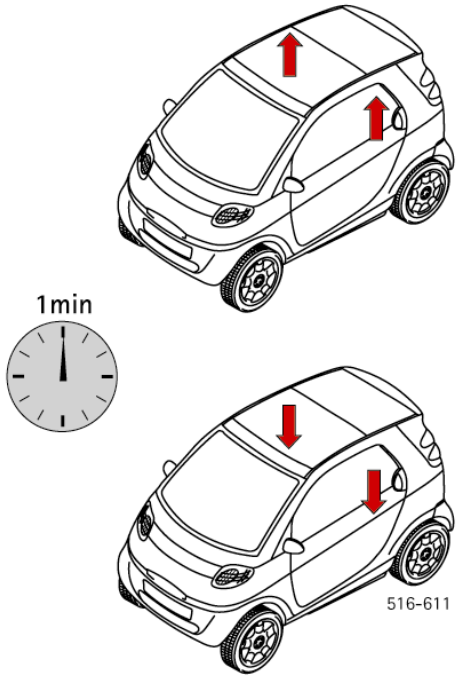
516-610

The auto-relock function becomes active when no door is opened within one minute of unlocking with the radio remote control.

The door contacts are monitored by the central electric/electronic system for this purpose. If no signal comes from the door for one minute, then relocking is carried out.

This function is intended to prevent the smart from being left unlocked due to accidental unlocking.
In this case an open rear lid is not locked.

On vehicles with a burglar alarm, the burglar alarm is also rearmed.



516-611

Task

The immobiliser prevents the engine from being started by unauthorised persons by deactivating the starter and injection system until the smart is unlocked with a valid key. It is also not possible to move the gearshift lever when the immobiliser is active.

Function

The immobiliser controller is integrated in the central electric system module. The activation of the immobiliser is confirmed by the central electric/electronic system with a triple beep. The blocked state is displayed in the instrument cluster with the "X" symbol or a key symbol (from production date 15/11/1999).

As long as the immobiliser is active, a signal is transmitted from the central electric/electronic system to the engine control unit via the CAN bus which orders the starter not to function.

516-613

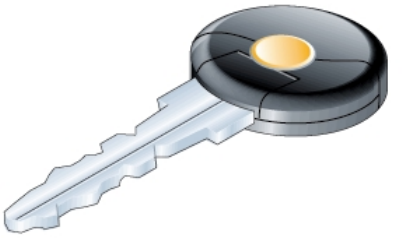
516-613

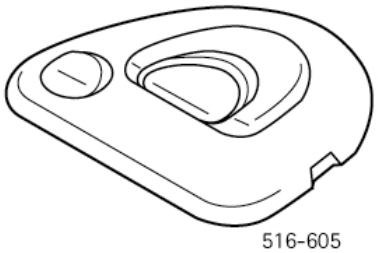
As soon as the vehicle is unlocked with a valid key, the controller switches into the "immobiliser free" state for 5 minutes (1 minute from production date 15/11/1999). If the ignition is switched on within this time, the engine control unit is deactivated via the CAN bus.

For legal reasons (ECE 95/56), the immobiliser is automatically activated after 5 minutes (1 minute) if the ignition has not been switched on within this time.

The immobiliser is deactivated simultaneously with the unlocking of the door locks or activated with the locking of the door locks.

Here locking can be carried out with the radio remote control or the panic button.





516-605

Deactivating immobiliser after self-arming

Automatic self-arming occurs if the ignition has not been switched on within 5 minutes (1 minute from production date 15/11/1999) after unlocking the vehicle.
This is indicated with an "X" (key symbol from production date 15/11/1999) in the instrument cluster with the ignition switched on.

To deactivate the immobiliser the ignition must be switched off again and the transmission button pressed once. The key need not be pulled removed to do this.

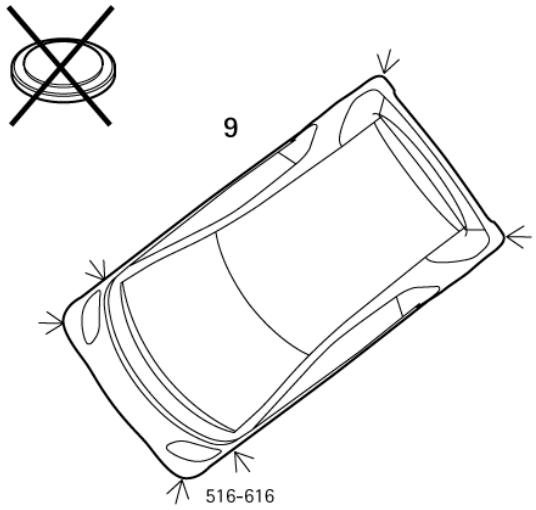
The central electric/electronic system then signals with a single beep that the immobiliser has been deactivated. After switching on the ignition again, the gear position appears in the instrument cluster.

516-614

Diagnosis

If the flashing lamps flash rapidly 9 times, the radio transmitter battery is low and must be replaced. After the first warning the transmitter can still be actuated approx. 100 times.

The batteries, which are sufficient for approx. 7,000 actuations of the radio remote control, should always be replaced every two years, as their charge also decreases when they are not used.



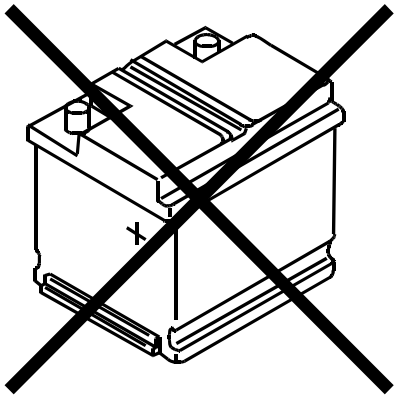
516-616

When the vehicle battery is drained, the doors cannot be unlocked electronically.

To get the smart operating again, first the rear hatch must be mechanically unlocked. Then one of the doors can be manually opened from the inside. Following this the battery in the passenger footwell is supplied with power via a charging cable or jumper cable.

By locking and unlocking the vehicle once with the radio remote control, the immobiliser can then be deactivated and the vehicle can be started again.

Ensure proper polarity! An incorrectly poled jumper cable can damage components in the vehicle.



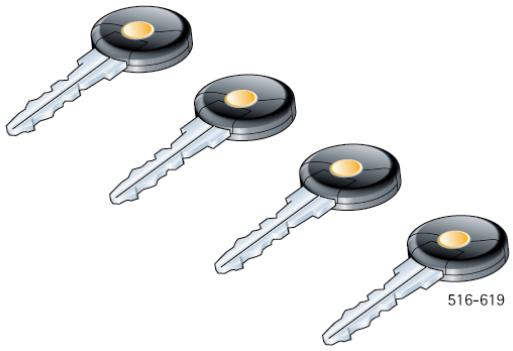
516-617a

The smart is provided with two main keys with an integrated transmitter (from production date 6/4/1999).

Additional main keys are available as an accessory.

In the case of replacement or addition, the customer must come to the smart Centre with the vehicle and all keys so that a new key can be learned. Here an identity check is carried out based on the chassis number to ensure that only the vehicle owner obtains a spare key.

A maximum of four keys can be learned.



516-619

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Engine Management

Propulsion Management

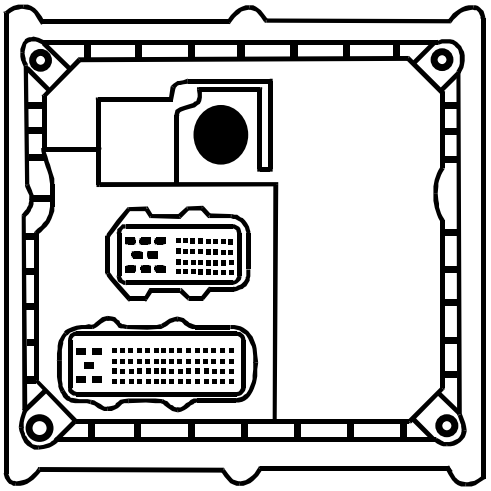
Task

The propulsion management is the combination of all drive controllers in one control unit - the engine control unit.

The engine control unit (N48) encompasses all functions for

> ignition
> injection
> air control (E-gas actuator)
> clutch control
> gearbox control
> A/C control
> special functions
> diagnosis

This minimises the number of interfaces and reduces the error possibilities.



00130410

Propulsion management controls all functions of the clutch and gearbox electrically. The mechanical clutch is electrically actuated. Although the gearbox is shifted by hand (= manually), the gears are engaged with an electric motor (Softip). This means the gearbox is automated.

On vehicles with Softouch it is possible to switch between Softip and Softouch. In the Softouch mode shifting is automatic.

Design

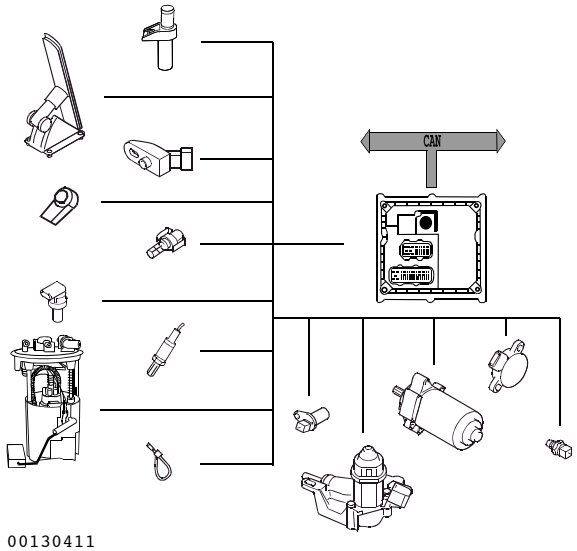
Sensors/Inputs

> Battery voltmeter
> Terminal 15
> Engine speed sensor (L8)
> Accelerator pedal module (B37/1)
> Intake-manifold pressure sensor (B28)
> Knock control sensor (A16)
> Intake-air temperature sensor (B17)
> Water temperature sensor (B45)
> Lambda probe (B13/1)
> Fuel gauge sensor
> Evaporator sensor
> CAN bus
> All gearbox control sensors

CAN inputs

CAN networking interconnects four of the five vehicle control units. The engine control unit receives the following signals via the CAN bus:

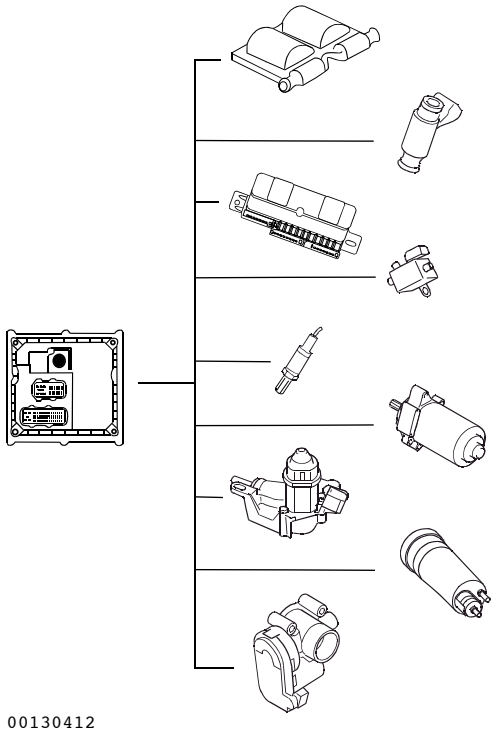
> Wheel speed
> Immobiliser
> Door contact
> Stop lamp switch
> Terminal 50
> A/C switch



00130411

Engine control unit outputs

> Waste-gate cycle valve (Y77)
> Ignition coils (T1)
> Injectors (Y3)
> Tank vent valve
> Lambda probe heater
> Relay box (K7) and various relays depending on equipment
> E-gas actuator (Y22)
> Clutch actuator (M18)
> Shift actuator (M17)



00130412

Additional components, systems and operating elements of the propulsion management

Components/Systems:

> Three-cylinder turbocharged engine
> Mechanical clutch
> Six-speed gearbox
> Engine control unit
> E-gas actuator
> Clutch and shift actuator

Operating elements:

> Sedrive Unit
> Accelerator pedal module
> Ignition/starter switch
> Stop lamp switch
> Door contact

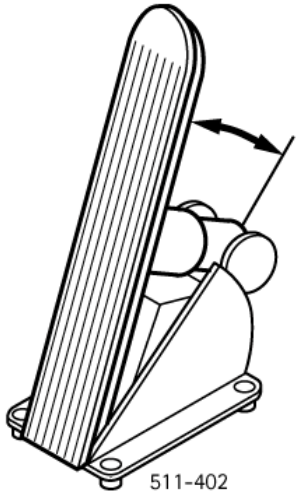
Function

Acceleration control

The engine control unit (N48) detects that the driver wishes to accelerate based on the change speed of the accelerator pedal position. The E-gas actuator is controlled in dependence on how rapidly the driver wishes to accelerate.

> Slow angular change: Slow acceleration

> Fast angular change: Rapid acceleration, by downshifting with Softouch if necessary.



511-402

Top speed limitation

The engine control unit (N48) detects when the maximum speed (135 km/h) would be exceeded based on the speed signal of the wheel speed sensors (L6), and then decreases the speed via the throttle valve position. If necessary, the boost pressure of the turbocharger is decreased.

Catalyst control

During cold starting the engine control unit (N48) increases the idling speed to achieve rapid warm-up and optimum catalyst efficiency.

As soon as a gear is engaged, this function is deactivated. So that the Lambda probe reaches its operating temperature more quickly, it is heated with the Lambda probe heater.

For details on the operation of the Lambda probe, see 02 03, Engine Sensors, Lambda Probe.

Emergency functions of engine control unit

If an error occurs during driving, the engine control unit (N48) has various ways of reacting.

If signals fail, substitute values are used that enable continued driving, although with a loss of comfort.

In the case of serious errors, the system switches into the emergency and protective function. This is indicated to the driver in the display with three bars or the Check Engine lamp.

Error memory of engine control unit

To simplify troubleshooting, signal failures are stored in an interrogatable error memory.

Space for a maximum of 10 errors is provided in the error memory. The environmental data and the frequency of occurrence are stored together with each of these errors.

Environmental data may be: Engine speed, clutch status etc.

With the other control units only the errors are stored in the error memory.

Task

TRUST is the **Tr**action and **St**ability program of the smart. TRUST is intended to prevent unstable driving situations in curves.

Function

A lateral acceleration sensor measures the lateral acceleration of the smart in curves.

In conjunction with the signals of the wheels speed sensors, the engine control unit (N48) detects critical driving situations and makes a correction by controlling the throttle valve and clutch.

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Engine Management

Trust-Plus

Task

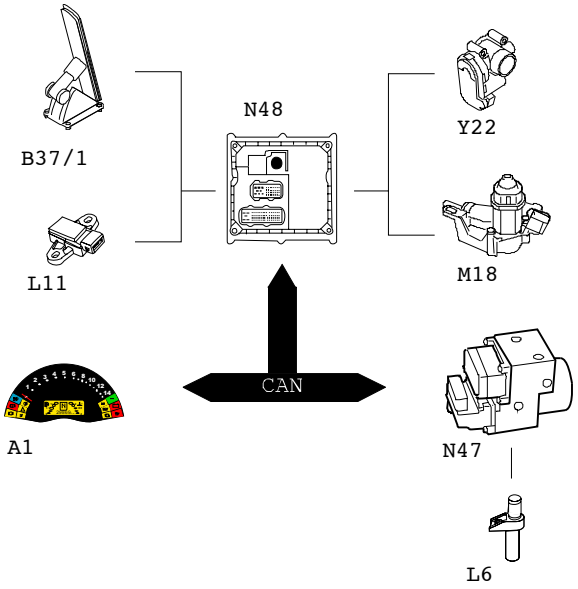
Trust-Plus is an extended function of the Trust (traction and stability) dynamic driving system.

In addition to the traction and stability control of Trust, Trust-Plus also influences the engine and clutch during acceleration.

Design

Trust-Plus consists of the following components:

N48	Engine control unit
Y 22	E-gas actuator
M18	Clutch actuator
B37/1	Accelerator pedal module
L11	Lateral acceleration sensor (fitting location: on underbody in centre of vehicle)
A1	Instrument cluster Trust-Plus active indicator lamp
N47	ABS control unit
L6	Wheel speed sensors



00130413

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Engine Management

Trust-Plus

Function

1. The engine control unit detects critical driving situations based on the lateral acceleration and by comparing the four wheel speeds.
   Variables such as the gearbox speed, engine speed etc. that are available for the engine management are also taken into account in the engine control unit as calculation variables.

The lateral acceleration is detected by a lateral acceleration sensor and calculated via the wheel speeds.

If the measured and calculated values indicate a critical situation, the engine control unit controls the throttle valve and opens the clutch if necessary until the driving situation is stabile again.

2. If the wheel torque is too high on a surface with a low friction coefficient, the driven wheels tend to spin. Due to the reduced static friction of the rear wheels, the engine torque cannot be transmitted to the road surface.

Spinning wheels cannot transmit cornering forces (comparable to lock wheels), and the vehicle becomes unstable.

The wheel speeds are detected by the wheel speed sensors. This information is transmitted to the engine control unit via the CAN bus.

When spinning wheels are detected, the throttle valve is controlled accordingly and the clutch opened if necessary until the rear wheels can transmit torque again.

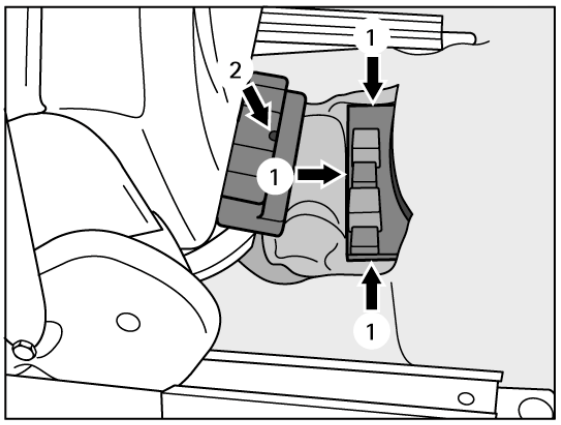
An indicator lamp in the instrument cluster warns the driver during the transition to a critical driving situation.

Location

The relay box is installed at the rear left behind the driver's seat under the floor covering.

Design

There are two types of relay boxes (relay box and A/C relay box), which differ in their equipment. Vehicles with air conditioning also have an A/C relay.



513-484

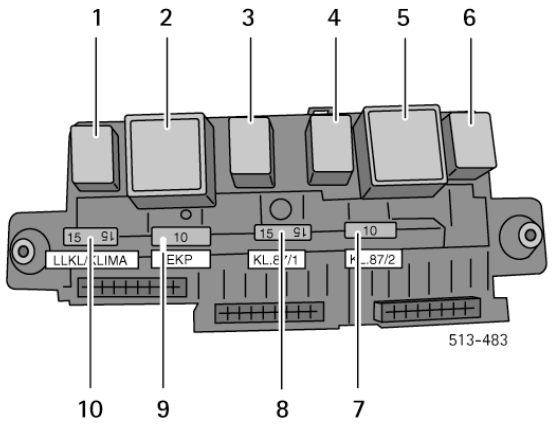
513-484

1 Relay
2 Relay box cover

Fuse and relay assignment of relay box

The relay box is shown without its cover.

1 Electronic fuel pump relay
2 Power supply relay for the H bridge (controls left/right running of the shift actuator of the automated gearbox)
3 Main relay for supply voltage of engine control unit
4 Relay for electric-fan intercooler (LLK)
5 Solenoid starter switch relay
6 A/C compressor magnet clutch relay
7 Fuse for tank vent valve, Lambda probe, waste gate cycle valve, A/C relay, power supply
8 Fusing for injectors and engine control unit
9 Fusing for electric fuel pump
10 Fusing for electric-fan intercooler (LLK) and A/C compressor magnetic clutch



513-483

Task

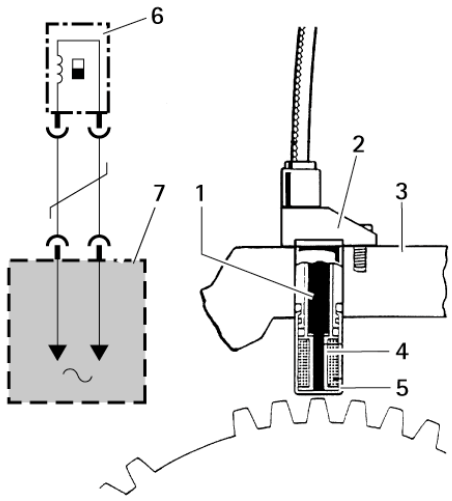
The engine speed sensor (L8) detects the crankshaft position and the engine speed.

Location

The engine speed sensor (L8) is located above the gearbox bell.

Design

The engine speed sensor (L8) is and inductive sensor. It consists of a permanent magnet and a soft iron core with a copper winding.



1 Permanent magnet
2 Connector plug of engine speed sensor (L8)
3 Gearbox bell
4 Soft iron core
5 Copper winding
6 Engine speed sensor (L8)
7 Engine control unit (N48)

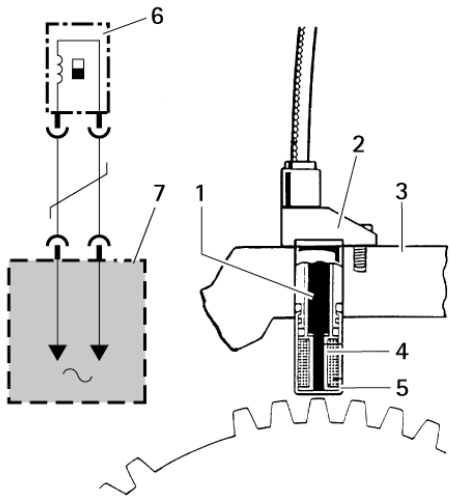
401-007

401-007

Function

When the teeth of the incremental ring run past the speed sensor, the magnetic flow changes, inducing an alternating current in the sensor.
The wide gap in the incremental ring marks the TDC point of Cylinder 1.

The engine control unit (N48) calculates the engine speed and the ignition point from this information.



1 Permanent magnet
2 Connector plug of engine speed sensor (L8)
3 Gearbox bell
4 Soft iron core
5 Copper winding
6 Engine speed sensor (L8)
7 Engine control unit (N48)

401-007

401-007

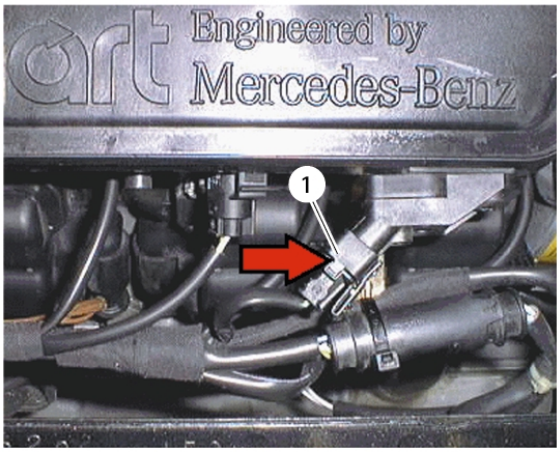
Task

The intake-manifold pressure sensor (B28) measures the pressure present in the intake manifold.

The intake manifold pressure is a measure of the engine load and the most important variable for calculating the air mass flow. The injection duration is calculated by the engine control unit based on the air mass flowing in per time unit.

Location

The intake-manifold pressure sensor is located on the engine intake manifold.



510-364

510-364

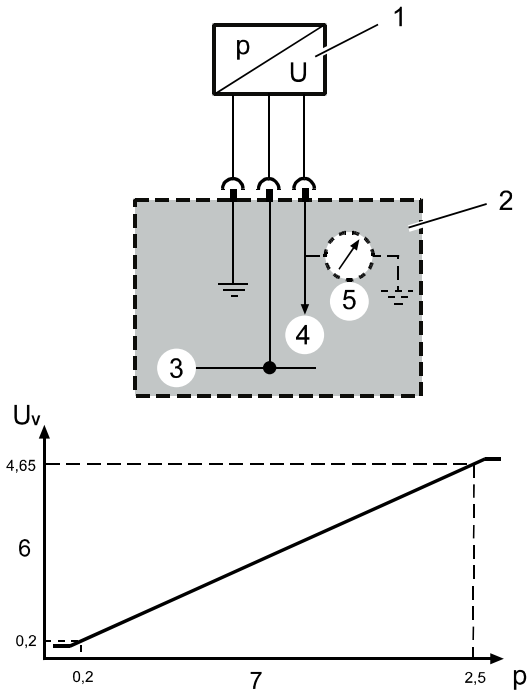
1 Intake-manifold pressure sensor (B28)

Function

The intake-manifold pressure sensor (B28) is supplied with a voltage of 5 volts. It generates a voltage signal in dependence on the intake manifold pressure.

When the ignition is switched on, the intake-manifold pressure sensor (B28) measures the ambient pressure to detect the altitude.

When the altitude of the location increases (e.g. when driving in mountainous areas), the air pressure decreases, as does the mass of the air volume aspirated by the engine. In this case the engine control unit (N48) adjusts the mixture.



401-012a

1 Intake-manifold pressure sensor (B28)
2 Engine control unit (N48)
3 Supply voltage
4 Signal for engine control unit
5 Voltage measurement
6 Signal voltage in volts
7 Absolute pressure in bar

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Engine Sensors

Knock Control Sensor

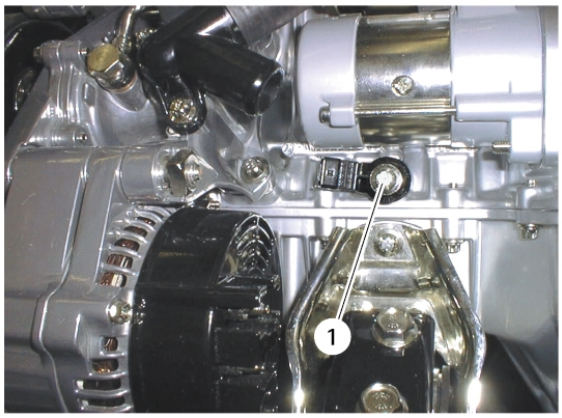
Task

The engine control unit (N48) detects knocking combustion from the voltage signals of the knock control sensor (A16).

Location

The knock control sensor (1) is screwed onto the engine block.

Observe the correct tightening torque of the knock control sensor, as otherwise its operation will be impaired.



509-323

509-323

1 Knock control sensor (A16)

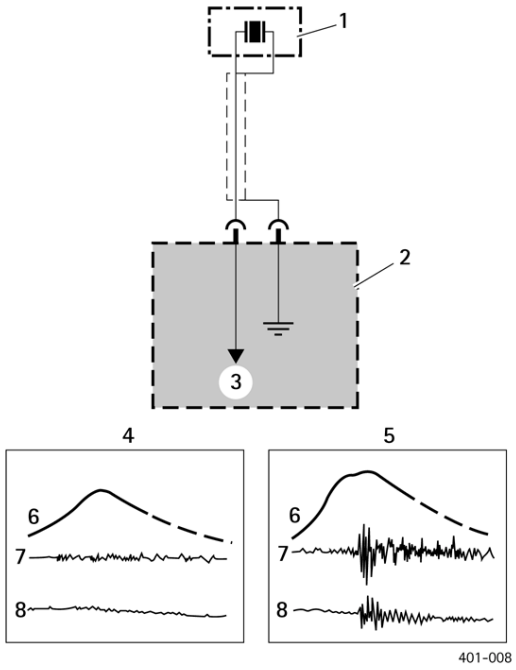
Function

When the mixture still unburned burns unchecked and suddenly through self-ignition, this is referred to as knocking combustion. The knock limit is dependent on the fuel quality, the engine state and the operating conditions.

Knocking can lead to considerable engine damage!

Knocking is demonstrated as vibrations on the engine block. These vibrations are transferred as electrical signals to the engine control unit (N48) by the knock control sensor (A16). The engine control unit detects the knocking cylinder based on the firing order.

As a counter-measure the engine control unit moves the firing angle in the "retarded" direction and reduces the boost pressure in the turbocharger and the enrichment of the fuel mixture.



401-008

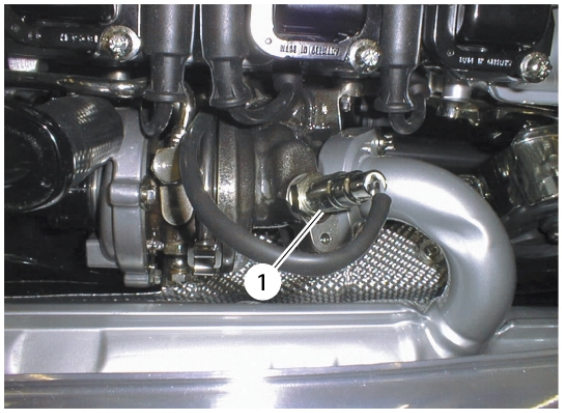
1 Knock control sensor (A16)
2 Engine control unit (N48)
3 Signal for engine control unit
4 Combustion without knocking
5 Combustion with knocking
6 Pressure curve in cylinder
7 Signal of knock control sensor
8 Signal for engine control unit

Task

The Lambda probe (B13/1) detects the residual oxygen content in the exhaust gas stream. The engine control unit (N48) calculates the Lambda air/fuel ratio from the probe signal and adjusts the injection quantity accordingly.

Location

The Lambda probe (B13/1) is screwed into the turbocharger-exhaust manifold unit.



510-366

510-366

Function

The Lambda air/fuel ratio indicates the ratio between the air quantity fed in and the air that would be theoretically required for complete combustion of the fuel.

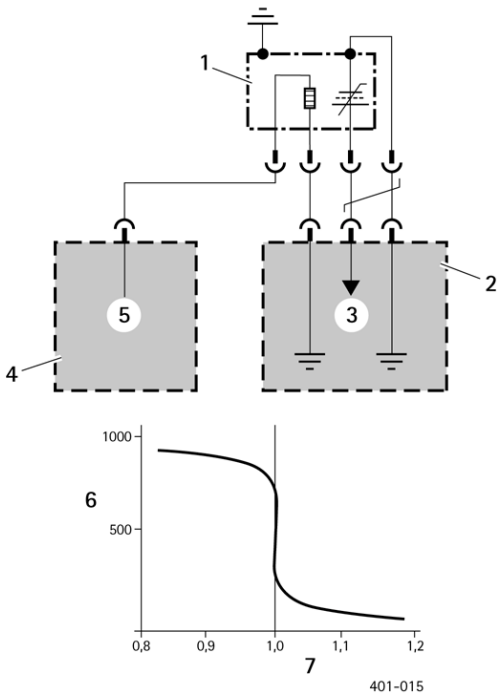
lean mixture (Lambda > 1): high residual oxygen

rich mixture (Lambda < 1): low residual oxygen

With Lambda approx. 1 the probe supplies a signal between 450 and 500 mV. At the transition to the rich mixture range the voltage increases, and at the transition to the lean range it decreases.

The operation of the Lambda probe (B13/1) is highly temperature-dependent. So that the Lambda probe (B13/1) reaches its operating temperature quickly after the engine is started and the Lambda control can be used, the probe is heated.

The power supply of the Lambda probe heater is 12 volts.



401-015

1 Lambda probe (B13/1)
2 Engine control unit (N48)
3 Signal for engine control unit
4 Relay box
5 Power supply for main relay
6 Probe voltage in mV
7 Lambda air/fuel ratio

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Engine Management

Intake-Air Temperature Sensor

Task

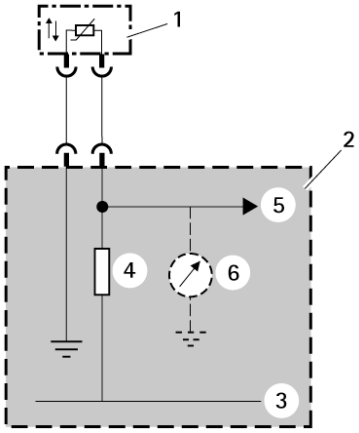
The intake-air temperature sensor (B17) detects the temperature of the aspirated air and transmits it to the engine control unit (N48). This signal is used by the engine control unit to calculate the air mass.

Location

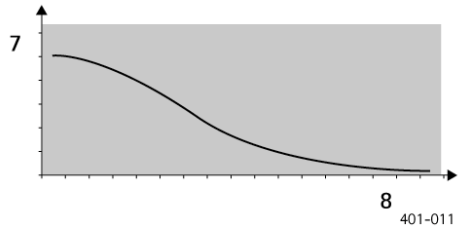
The intake-air temperature sensor (B17) is located on the engine intake manifold.

Design

The intake-air temperature sensor (B17) is an NTC resistor with a resistance value that decreases as the intake air temperature increases.



1 Intake-air temperature sensor (B17)
2 Engine control unit (N48)
3 Supply voltage
4 Series resistor for protecting control unit (in control unit)
5 Signal for engine control unit
6 Voltage drop
7 Voltage
8 Intake air temperature



401-011

Function

The intake-air temperature sensor (B17) is operated with a supply voltage of 5 volts. The engine control unit determines the temperature of the aspirated air based on the voltage drop on the resistor.

Task

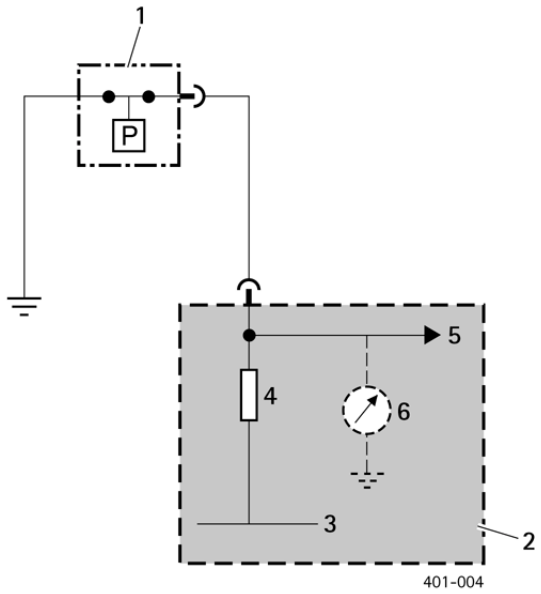
The oil pressure switch (S41/1) is used to check whether the oil pressure of the lubrication system is sufficiently high.

Location

The oil pressure switch is located on the oil filter housing.

Design

The oil pressure switch (S41/1) is a single-pin switch.



401-004

1 Oil pressure switch (S41/1)
2 Engine control unit (N48)
3 Supply voltage
4 Series resistor, for protecting control unit (in control unit)
5 Signal for engine control unit
6 Voltage drop

Function

The oil pressure switch (S41/1) is operated with a supply voltage of 5 volts. Once the necessary oil pressure is reached, the switched is opened.
The engine control unit (N48) monitors the voltage signal of the oil pressure switch (S41/1) and then switches off the oil-pressure warning lamp. if the oil pressure is too low, the switch closes and the engine control unit causes the oil-pressure warning lamp to light up.

Task

The water temperature sensor (B45) detects the coolant temperature and transmits it to the engine control unit (N48).

Location

The water temperature sensor (B45) is inserted in the thermostat housing.

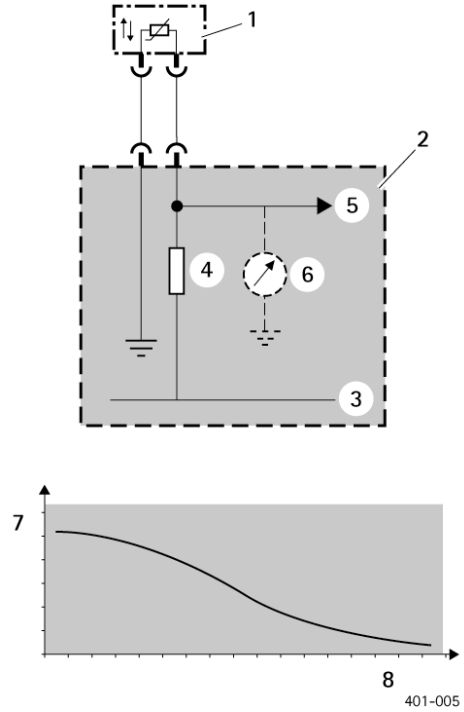
Design

The water temperature sensor (B45) is an NTC resistor with a resistance value that decreases as the coolant temperature increases.

1 Water temperature sensor (B45)
2 Engine control unit (N48)
3 Supply voltage
4 Series resistor for protecting control unit (in control unit)
5 Signal for engine control unit
6 Voltage drop
7 Voltage
8 Water temperature

Function

The water temperature sensor (B45) is operated with a supply voltage of 5 volts. The engine control unit determines the coolant temperature from the voltage drop at the NTC resistor.



401-005

Task

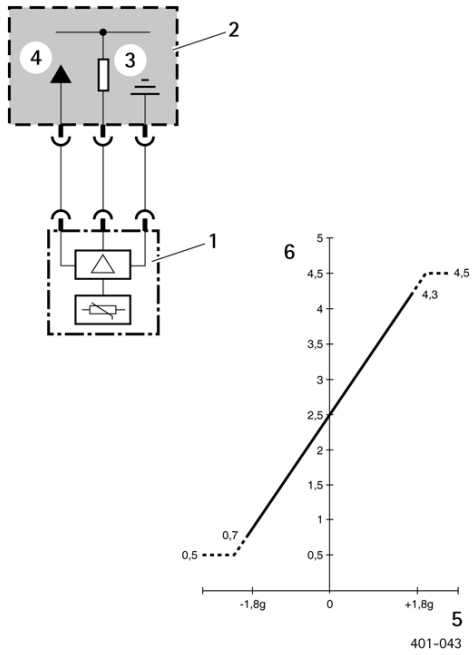
The lateral acceleration sensor (L11) detects the lateral acceleration of the vehicle. Its signal is required for the Trust or Trust-Plus program.

Location

The sensor is located in the centre below the vehicle.

Design

The sensor consists of a differential capacitor that changes its capacitance in dependence on the lateral acceleration.



401-043

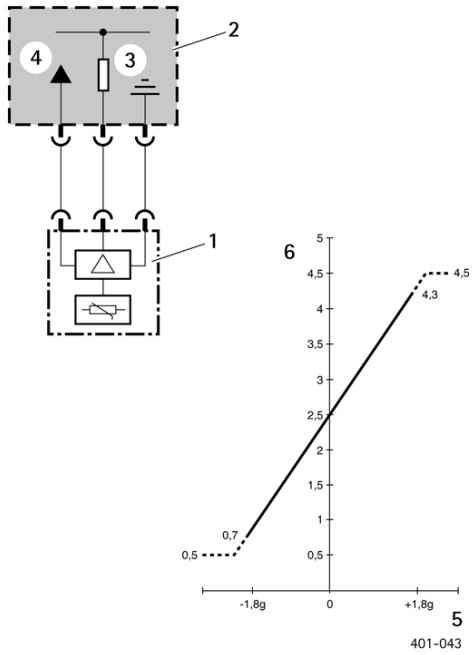
1 Lateral acceleration sensor (L11)
2 Engine control unit (N48)
3 Series resistor (in control unit)
4 Signal for engine control unit
5 Acceleration (in multiples of g)
6 Output signal in volts

Function

The lateral acceleration sensor (L11) is operated with a supply voltage of 5 volts. Due to the special design of the differential capacitor, its capacitance, and with it the voltage between the capacitor plates, change when lateral acceleration occur. The signal is directly proportional to the lateral acceleration. The engine control unit (N48) calculates the adjustment of the throttle valve angle in dependence on the output signal of the sensor and the signals of the ABS control unit (N47).

Diagnosis

The sensor can be checked with an operating test or with measurements on the component. Following an accident or after replacement of the lateral acceleration sensors (L11) or the engine control unit (N48), a zero-point calibration of the sensor must be conducted. This prevents the lateral acceleration sensor (L11) from already sending a voltage signal to the engine control unit in the zero position.



401-043

1 Lateral acceleration sensor (L11)
2 Engine control unit (N48)
3 Series resistor (in control unit)
4 Signal for engine control unit
5 Acceleration (in multiples of g)
6 Output signal in volts

Task

The gearbox speed sensor (B40) detects the gearbox input speed.

Location

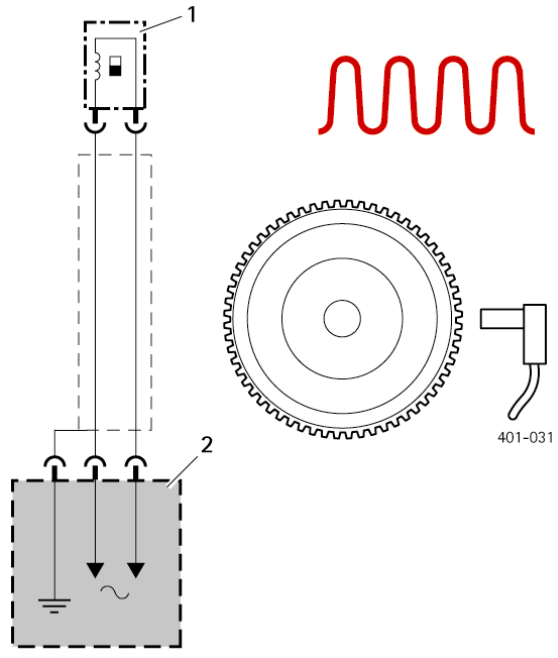
The gearbox speed sensor (B40) is located below the shift actuator on the gearbox housing.

Design

The gearbox speed sensor (B40) is an inductive sensor. It consists of a permanent magnet and a soft iron core with a copper winding.

Function

When the teeth of the incremental ring run past the speed sensor, the magnetic flow changes, inducing an alternating current in the sensor.
A gearwheel on the gearbox input shaft is used as the incremental ring.



1 Gearbox speed sensor (B40)
2 Engine control unit (N48)

401-031

Task

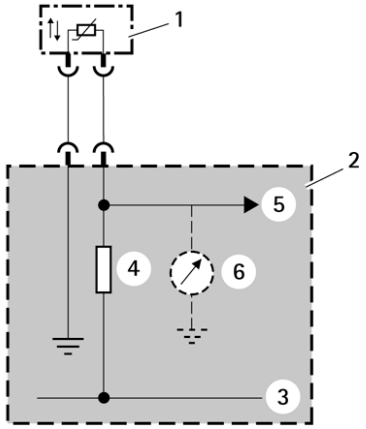
The gearbox temperature sensor (B41) detects the gearbox oil temperature. This is an influencing variable for the switching current of the shift actuator.

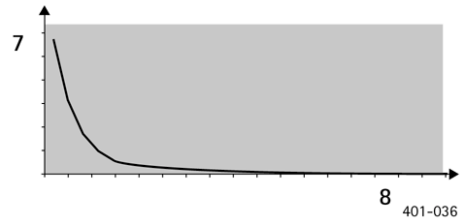
Location

The gearbox temperature sensor (B41) is located next to the clutch actuator on the gearbox housing.

Design

The gearbox temperature sensor (B41) contains an NTC resistor with a resistance value that decreases as the gearbox oil temperature increases.





401-036

1 Gearbox temperature sensor (B41)
2 Engine control unit (N48)
3 Supply voltage (in control unit)
4 Series resistor for protecting control unit
5 Signal for engine control unit
6 Voltage drop
7 Voltage
8 Gearbox oil temperature

Function

The gearbox temperature sensor (B41) is operated with a supply voltage of 5 volts. The engine control unit (N48) determines the temperature of the gearbox oil based on the voltage decreasing at the resistor.

Task

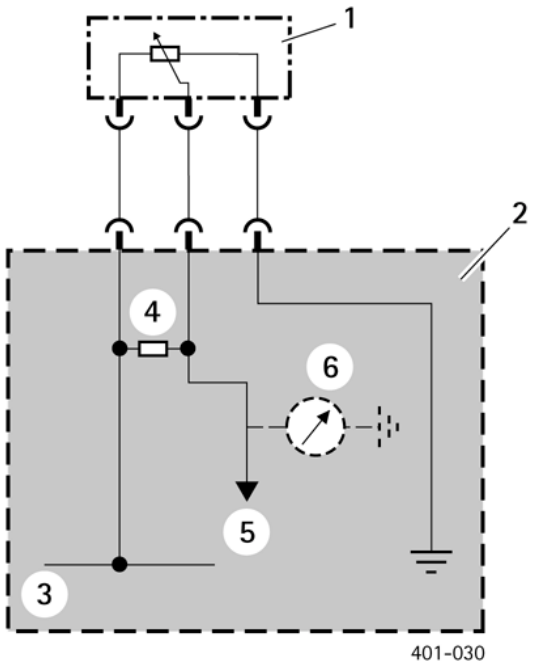
The position of the gear selector drum is detected with the angle sensor (B43).

Location

The angle sensor (B43) is located on the shaft of the gear selector drum.

Design

The angle sensor (B43) consists of a potentiometer (rotary rheostat). This means that the voltage decrease on it is dependent on the gear selector drum position.



401-030

1 Angle sensor (B43)
2 Engine control unit (N48)
3 Supply voltage
4 Pull-up resistor
5 Signal for engine control unit
6 Voltage measurement

Function

The angle sensor (B43) is operated with a supply voltage of 5 volts.

For safety reasons, the same information is also detected on the incremental sensor in the shift actuator.

The pull-up resistor in the engine control unit ensures that a signal is passed on, even when there is no longer any contact between the wiper and the wiper track of the potentiometer. The engine control unit (N48) compares the signal with the value calculated via the incremental sensor and detects the occurrence of errors from this.

Task

The ignition system must supply the spark plugs with ignition voltage at the proper time in the respectively correct cylinder.

Design

1 Engine control unit (N48)

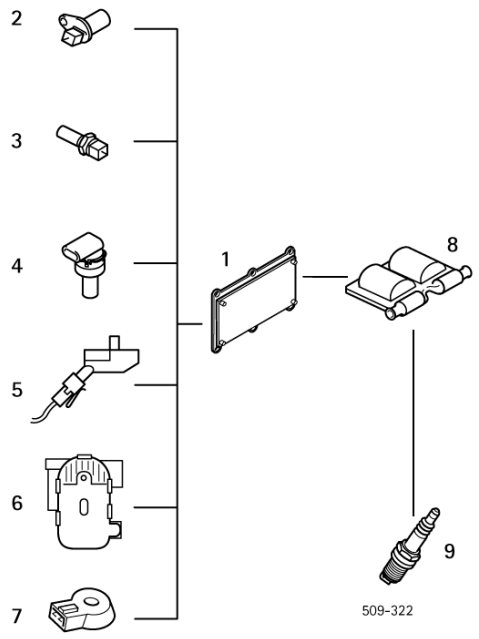
Sensors:

2 Engine speed sensor (L8)
3 Intake-air temperature sensor (B17)
4 Water temperature sensor (B45)
5 Intake-manifold pressure sensor (B28)
6 Throttle valve potentiometer, integrated in E-gas actuator
7 Knock control sensor (A16)

Actuators:

8 Dual ignition coils (T1)
9 Spark plugs

There are three dual ignition coils (T1/1 - T1/3), i.e. one ignition coil pair and one spark plug pair per cylinder that ignite simultaneously.



509-322a

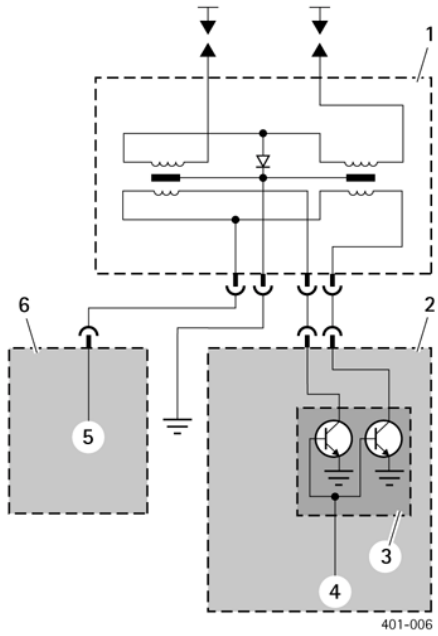
Function

The ignition system has a resting voltage distribution, i.e. there is no distributor, and therefore no rotating components.

The engine control unit (N48) switches the primary current in each ignition coil on and offer via the ignition output stages. If the power supply is interrupted, a sudden voltage drop occurs in the primarily coil, causing high voltage to result in the secondary coil.

The secondary coil, the spark plugs and the engine earth form a closed circuit via which this high voltage is discharged, resulting in the ignition sparks in the spark plugs.

The ignition output stage limits both the primary voltage and the primary current. At the moment of ignition the voltage in the primary coil is approx. 200 - 400 volts. The voltage in the secondary coil is approx. 32,000 volts.



401-006

1 Dual ignition coil
2 Engine control unit
3 Ignition output stage
4 Signal for engine control unit
5 Power supply from main relay
6 Relay box

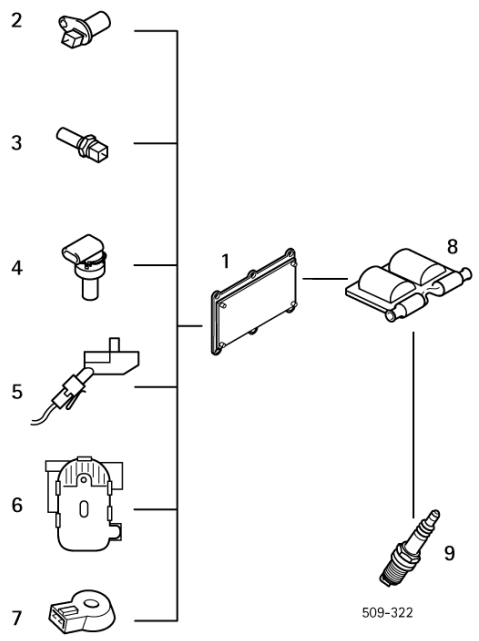
Determining ignition point

The ignition map in the engine control unit (N48) determines the ignition point in dependence on the engine load and engine speed.

The information of the other sensors is used for the fine correction of the firing angle.

If the engine control unit (N48) detects knocking combusting in one of the cylinders based on the signal of the knock control sensor (A16), it reduces the firing angle of this cylinder step by step until no further knocking occurs (see 02 03, Engine Sensors, Knock Control Sensor).

While the engine is being started, the engine control unit (N48) detects when Cylinder 1 must be ignited based on the speed changes characteristic for the three-cylinder engine.



509-322

509-322a

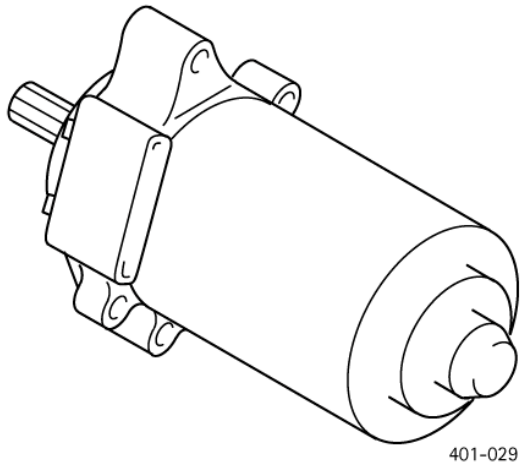
1 Engine control unit (N48)
2 Engine speed sensor (L8)
3 Intake-air temperature sensor (B17)
4 Water temperature sensor (B45)
5 Intake-manifold pressure sensor (B28)
6 Throttle valve potentiometer, integrated in E-gas actuator
7 Knock control sensor (A16)
8 Dual ignition coils (T1)
9 Spark plugs

Task

By controlling the shift actuator (M17), the engine control unit (N48) shifts the gearbox into the next-highest or next-lowest gear.

Design

The shift actuator is an electric motor with two integrated incremental sensors.



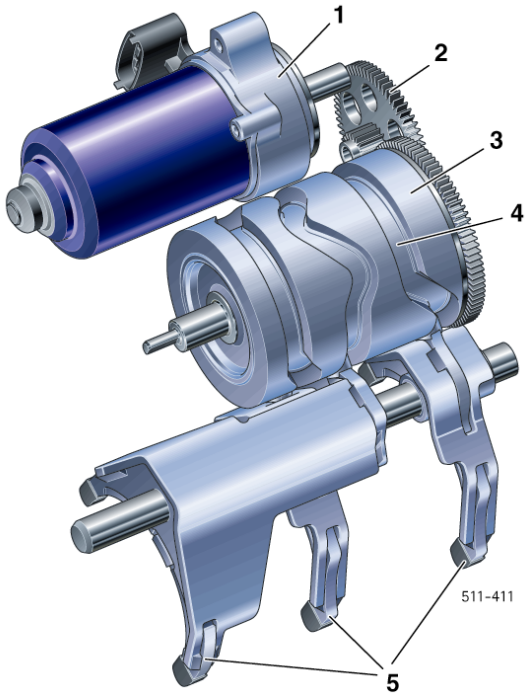
401-029

Function

The shift actuator (M17) has two rotating directions. Depending on the gear desired (upshift or downshift) it rotates to the right or left.

When the shift actuator (M17) is controlled, it drives the gear selector drum via spur gears. The gear selector drum moves the shifting fork via the curved paths. As a result, the shifting forks move the sliding sleeves, and the gearbox is synchronised. In the end position the power flow via the shift toothing and sliding sleeve up to the gearbox shaft.

Two incremental sensors are integrated in the electric motor of the shift actuator (M17) which detect the number of rotations and the rotating direction of the electric motor. The engine control unit (N48) calculates the position of the gear selector drum from this information. The mode of operation of the incremental sensors is described in the section on the clutch actuator.



1 Shift actuator (M17)
2 Spur gear
3 Gear selector drum
4 Curved path
5 Shifting fork

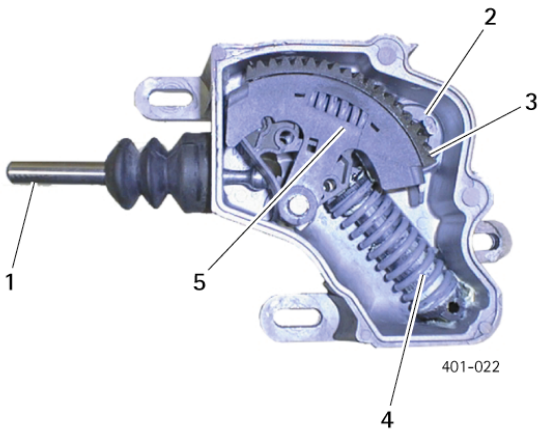
511-411

Task

By controlling the clutch actuator (M18) the engine control unit (N48) opens or closes the clutch and interrupts or produces the power flow between the engine and gearbox.

Design

The clutch actuator (M18) is an electric motor with two integrated incremental sensors.



401-022

1 Actuating plunger
2 Electric motor with angled splined shaft
3 Segment with helical toothing
4 Compensation spring
5 Stop damping

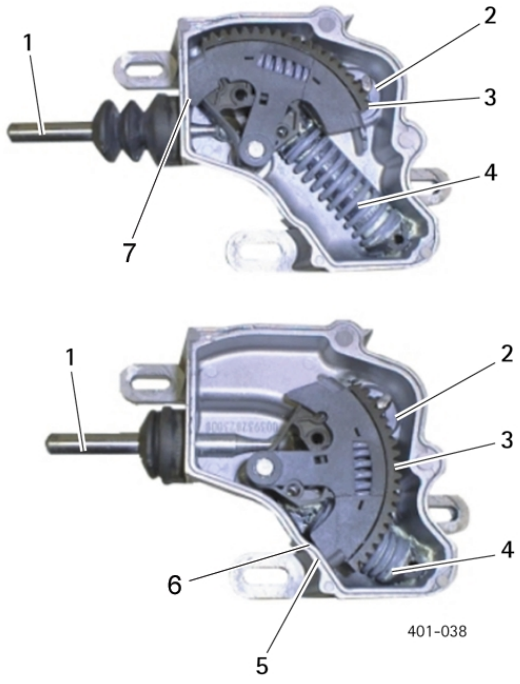
Function

Declutching

The electric motor (2) drives the segment with helical toothing (3) via the splined shaft. This presses the actuating plunger (1) outward against the limit stop (6) and opens the clutch. This movement is supported by the compensation spring (4).

Clutching

The electric motor (2) changes the rotating direction and moves the actuating plunger (1) back in to the other limit stop (7). Closing of the clutch is supported by the disc spring of the clutch module.



401-038a

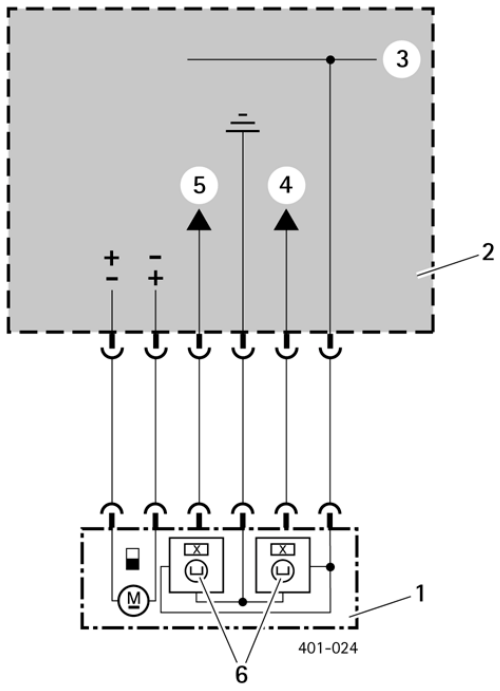
1 Actuating plunger
2 Electric motor with angled splined shaft
3 Segment with helical toothing
4 Compensation spring
5 Stop damping
6,7 Limit stops

Task

The two incremental sensors integrated in the electric motor of the clutch actuator detect the number of rotations and the rotating direction of the electric motor. The engine control unit (N48) then calculates the position of the plunger rod from the signals of the incremental sensors.

Design

1 Clutch actuator (M18)
2 Engine control unit
3 Supply voltage
4,5 Signals for engine control unit
6 Incremental sensors



401-024

Function

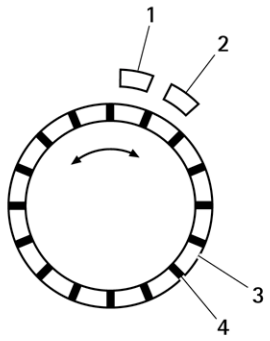
The incremental sensors are connected to a 5 volt supply voltage.

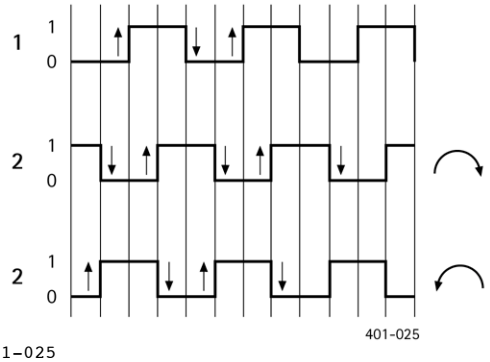
The incremental ring is seated on the shaft of the electric motor and rotates with it. The incremental ring consists of individual permanent magnets - the so-called increments.

The incremental sensors are designed as Hall sensors. When the increments pass by, voltage signals are generated in the sensors.

The engine control unit (N48) detects the rotating direction of the incremental ring from the time difference between these voltage signals. This is then used to determine the rotating direction of the electric motor.

At the same time, the engine control unit counts the increments and calculates the clutch position from them (EK/AK).





401-025

1,2 Incremental sensor
3 Incremental ring
4 Permanent magnet

Task

The E-gas actuator (Y22) is comparable to the throttle valve position in other vehicles.

With it the position of the throttle valve, and therefore the air mass flow, is controlled in dependence on an ignition map by the engine control unit (N48) based on the driver's wishes.

Location

The E-gas actuator (Y22) is located on the engine intake manifold.

Design

The E-gas actuator (Y22) consists of a
> throttle valve,
> electric motor and
> two potentiometers.

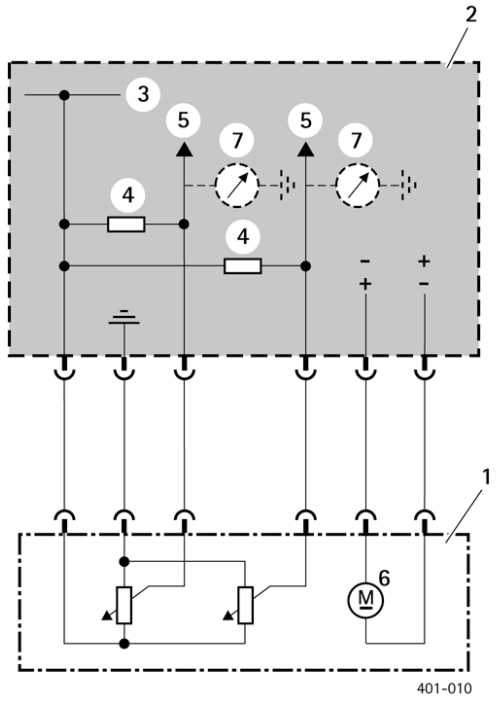
511-401

Function

The engine control unit (N48) detects the drivers wish based on the signal of the accelerator pedal module (B37/1) and controls the electric motor of the E-gas actuator (Y22).

The two potentiometers in the E-gas actuator have opposing resistance values and detect the throttle valve angle. As a result, the engine control unit is informed of the current throttle valve position and uses this output signal as the basis when changing the angle.

The throttle valve is adjusted exclusively with the electric motor in the idling control range and over the entire adjustment range.



401-010

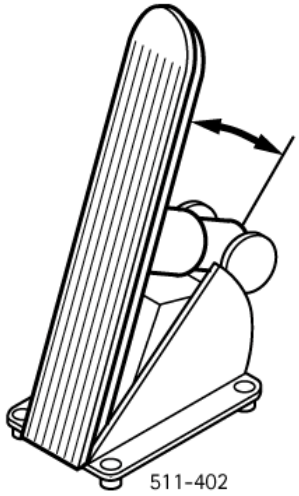
1 E-gas actuator (Y22)
2 Engine control unit (N48)
3 Supply voltage of 5 V
4 Pull-up resistor (in control unit)
5 Signal for engine control unit
6 Electric motor
7 Voltage measurement

Task

The accelerator pedal module (B37/1) detects the driver's wish via the pedal position and transmits a corresponding voltage signal to the engine control unit (N48). The signals of the accelerator pedal module are required by the engine control unit for controlling the E-gas actuator (Y22).

Design

Two potentiometers are integrated in the accelerator pedal module (B37/1).

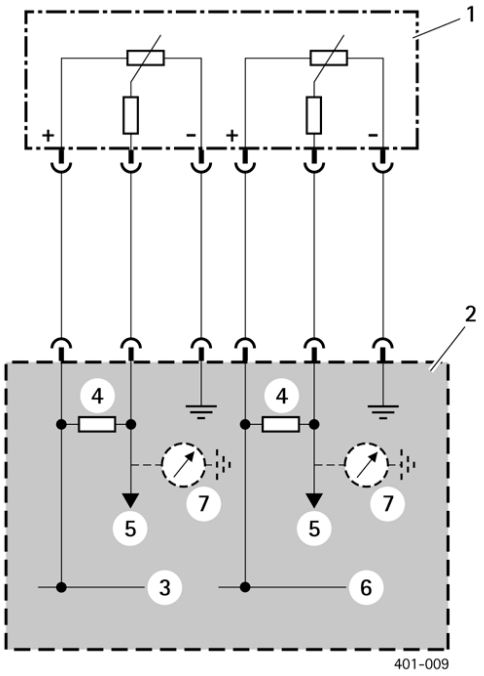


511-402

Function

The accelerator pedal module (B37/1) detects the pedal position via two potentiometers. The first potentiometer is operated with a stabilised supply voltage. It supplies a voltage signal to the engine control unit (N48) in dependence on the pedal position.

The second potentiometer is supplied with a non-stabilised supply voltage. With it the engine control unit checks the pedal position for plausibility and switches over to emergency program in the case of a deviant signal.



401-009

1 Accelerator pedal module (B37/1)
2 Engine control unit (N48)
3 Potentiometer supply voltage (stabilised)
4 Pull-up resistor (in control unit)
5 Signal for engine control unit
6 Potentiometer supply voltage (non-stabilised)
7 Voltage measurement

Task

The gearbox controller receives the driver's wish and carries out shifting and clutching automatically based on it.

> Engine control unit (N48)

Sensors:

> Sedrive unit (N3)
> Stop lamp switch (S9/1)
> Door contact
> Pedal value sensor
> Incremental sensor in clutch actuator
> Incremental sensor in shift actuator
> Angle sensor (B43) on gear selector drum
> Gearbox speed sensor (B40)
> Engine speed sensor (L8)
> Wheel speed sensors (L6) via CAN bus
> Water temperature sensor (B45) for engine temperature
> Gearbox-oil temperature sensor (B41)

Actuators:

> Clutch actuator (M18)
> Shift actuator (M17)
> E-gas actuator (Y22)

Function

Manual shifting is carried out via the Sedrive unit. The driver actuates the gearshift lever and specifies a desired gear with it. The gearshift lever passes on the shifting movement to the sensors without touching them. These then route the signals to the engine control unit.

The engine control unit carried out the following steps:

> The engine control unit has the E-gas actuator close the throttle valve. This enables shifting without changing the accelerator pedal position.
> The clutch is opened via the clutch actuator.
> The selected gear is engaged by controlling the shift actuator.
> The clutch is closed via the clutch actuator.
> The engine control unit opens the throttle valve again in accordance with the accelerator pedal position.

The shifting times are dependent on the oil temperature.

Clutch overload protection

The engine control unit (N48) indicates clutch overloading to the driver with clutch chatter. The clutch slip point is moved to for this purpose. The actuator begins to pulse at the slip point. As a last protective function, the engine control unit closes the clutch, stalling the engine in the process.

Emergency programs

The gearbox controller is provided with different emergency programs with different detection signs.

> Incremental sensor of clutch actuator defective: The comfort when starting off and shifting is noticeably reduced. Shifts take longer.

> Failure of gearbox-oil temperature sensor: Shifts take longer when the oil is cold.

> Sedrive unit defective: Three horizontal bars appear in the display and an acoustic signal sounds. the gear may be disengaged or blocked by the engine control unit.

> Mechanical damage in gearbox: It is not possible to shift into certain gears. If lower gears are concerned, a downshift attempt will be carried out with high actuator forces after the vehicle comes to a stop.

> Gear jumps: Gear shifting is repeated. A short interruption in the traction force can be perceived.

> In the case of a total failure of the CAN bus and ABS control unit, it is not possible to engage any gear.

> All errors which occur are stored in the engine control unit.

Task

The Sedrive unit is used for gear selection and transmission of the driver's wish to the engine control unit.

Design

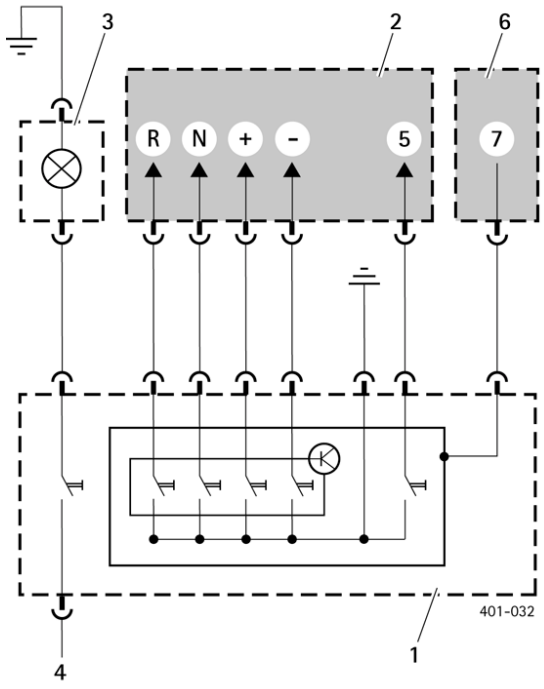
The gear selector lever and the sensors that transmit the lever position are combined in the Sedrive unit.

The ignition/starter switch is also integrated in the Sedrive unit.

511-403

Function

The Sedrive unit contains five Hall sensors, each of which supplies a voltage signal dependent on the position of the gearshift lever. These five contactlessly transmitted signals result in a bit pattern, which is then passed on to the engine control unit. The driver's wish is conveyed in this way.



401-032

1 Sedrive unit
2 Engine control unit
3 Reversing lamp
4 Terminal 15
5 Automatic function (optional extra)
6 Relay box
7 Voltage supply from ASG relay (automatic manual gearbox relay for power supply for shift and clutch actuator)

Shifting possibilities

> Double shifts:
  Double shifts are possible by actuating the gearshift lever repeatedly. Under certain conditions shifting will not be carried out:
  > If the target speed is too low, upshifting is not carried out.
  > Downshifts are only carried out when the target speed is the selected gear does not exceed a certain threshold value.

> Automatic downshifts:
  If the smart rolls and a certain speed limit is dropped below, the engine control unit shifts into the next-lowest gear. This makes it possible, for example, to roll up to a traffic light and continue driving in a lower gear at any time. The speed of the selected gear may be very low.

> Gear disengagement:
  If the driver's door is opened with the engine running, a warning sounds and after a certain time the gear is disengaged. The brake and the accelerator pedal module may not be actuated in the process. A zero appears in the display.

Display in instrument cluster

The engaged gear is shown in the display. In the case of double shifting, the desired gear selected is not displayed, but instead the gear currently engaged. A shift recommendation is displayed with arrows at a certain engine speed. The 0 in the display indicates that the clutch is open or no gear is engaged.

If an X is shown in the display (a key symbol from production date 15/11/1999), then the immobiliser is activated. Actuating the door locking function on the ignition key deactivates the immobiliser; see 02 02, Immobiliser.

Task

In the Softouch mode shifting is automatic.

Function

On vehicles with Softouch it is possible to switch between the Softip and Softouch modes with a button on the side of the gearshift lever of the Sedrive unit.

Tapping the gearshift lever in the plus or minus direction while in the Softouch mode switches into the Softip mode and simultaneously carries out an upshift or downshift.

The shifting points of the Softouch are not identical to the shifting recommendations of the Softip (appearance of arrows), but are instead designed for comfortable shifting.

In the Softouch mode the letter A appears in the display of the instrument cluster.

Task

The task o the injection system lies in feeding, filtering and pressurising the fuel. The proper fuel quantity is injected in the firing sequence before the inlet valves.

Design

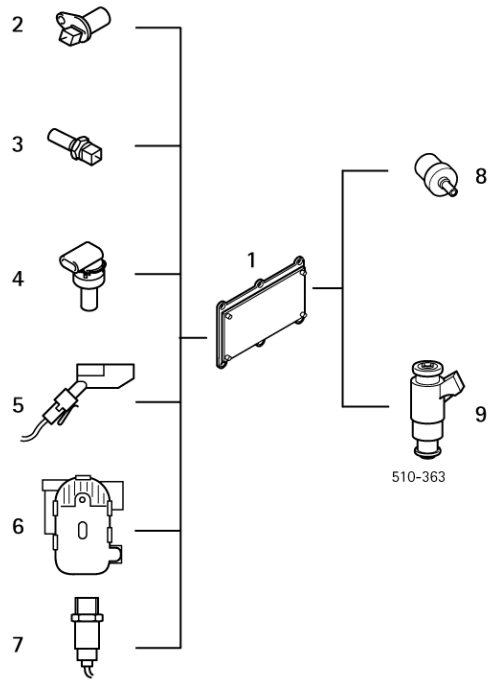
1 Engine control unit (N48)

Sensors:

2 Engine speed sensor (L8)
3 Intake-air temperature sensor (B17)
4 Water temperature sensor (B45)
5 Intake-manifold pressure sensor (B28)
6 Throttle valve potentiometer, integrated in E- gas actuator
7 Lambda probe (B13/1)

Actuators:

8 Regeneration valve (Y58)
9 Five-hole injector (Y3)



510-363

Function

> After the ignition is switched on, the enable signal for switching on the electric fuel pump is output by the engine control unit (N48).

> If the engine control unit does not receive a speed signal from the engine within a specified time, then the power supply is switched off to prevent fuel from being injected without the engine running.

> The power supply is not switched on again until a speed signal is received from the engine.

In the case of a frontal crash (detected by the airbag triggering unit), the fuel pump is switched off for safety reasons.

Quantity control

The MEG control unit determines the total injection quantity based on the operating state (engine speed, intake manifold pressure and corrections for intake air temperature etc.) while taking any limitations (top speed, TRUST-Plus, gearbox, clutch) into account.

The injection quantity is controlled by the engine control unit via the opening times of the injectors and via the injection pressure.

The fuel is injected sequentially, i.e. in dependence on the firing order.

Based on a map for the engine load and engine speed, the engine control unit then specifies the ignition point.

Idling control

For idling control the engine control unit compares the signal of the engine speed sensor with the setpoint for the idling speed.

If the actual value differs from the setpoint, the engine control unit corrects the throttle valve position via the E-gas actuator.

Task

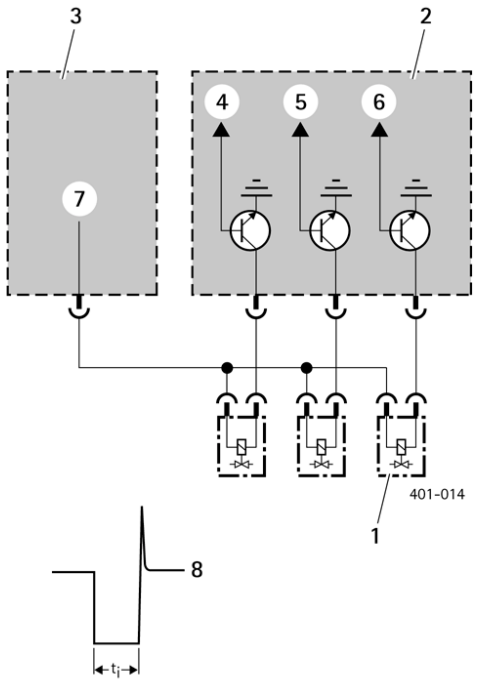
The injectors (Y3) are responsible for injecting the fuel before the inlet valves.

Design/Location

The injectors are connected to the fuel rail and mounted on the intake manifold.

Function

The injectors (Y3) are individually controlled by the engine control unit (N48) and inject the fuel directly before the inlet valves. The injection pump is dependent on the opening duration of the valves, the so-called pulse time, and on the fuel pressure, which is controlled in dependence on the intake manifold pressure.



401-014

1 Injector (Y3)
2 Engine control unit (N48)
3 Relay box (K7)
4 Control for Injector 1
5 Control for Injector 2
6 Control for Injector 3
7 Power supply from main relay
8 Pulse time

>>smart City-Coupé

Anti-Lock Brake System (ABS)

Task

The anti-lock brake system ensures that the braked wheels do not lock up and the vehicle remains steerable in critical driving situations.
This makes it possible, for example, to brake and avoid obstacles at the same time.

The braking pressure is controlled so that the braking distance is as short as possible.
ABS does not necessarily shorten the braking distance in every situation. On snow a locked wheel would brake better than an ABS-braked, non-locked wheel. The locking wheel pushes a wedge of show in front of it that acts like a braking wedge. However, steerability is lost or is not given without ABS.

ABS cannot cancel out the laws of physics while driving and, for example, improve the road adhesion of a rolling tyre. It can neither compensate for an unadjusted speed nor replace a driver's impaired (e.g. by alcohol) reaction time. ABS is an aid and cannot work miracles. It does not relieve the drive of his/her responsibility!

505-162

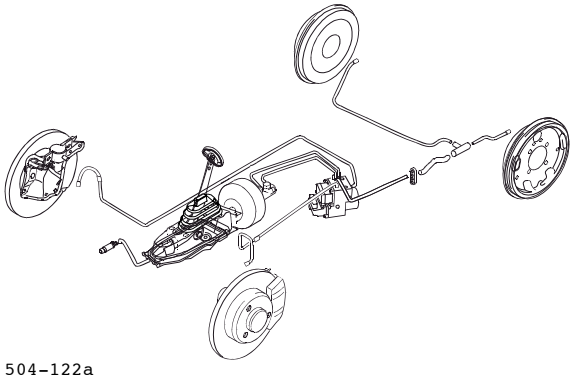
505-162

Design

The smart ABS is designed as a 3-channel ABS. This means that one line runs from the ABS hydraulic unit to each of the front wheels and a shared line to the rear axle with a distribution piece.

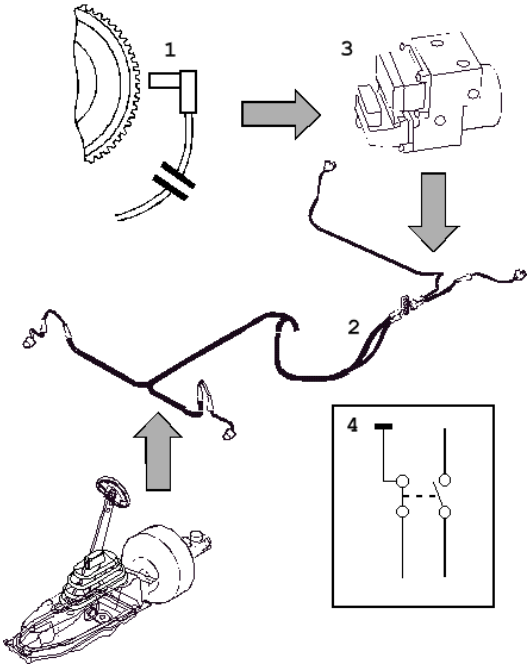
> Disc brakes on front wheels
> Drum brakes with parking brake on rear wheels
> Brake pedal module, consisting of brake pedal with brake master cylinder and brake servo unit, located below brake pedal
> ABS unit, consisting of ABS control unit and ABS hydraulic unit

For information on the ABS wiring harness, see 02 01, Wiring Harnesses, ABS Wiring Harness.



504-122a

1 Four speed sensors (L6) and toothed rings on wheel hubs
2 Cables between speed sensors and ABS control unit
3 ABS control unit (N47) on ABS hydraulic unit with cable to engine control unit (N48)
4 Stop lamp switch (S9/1)



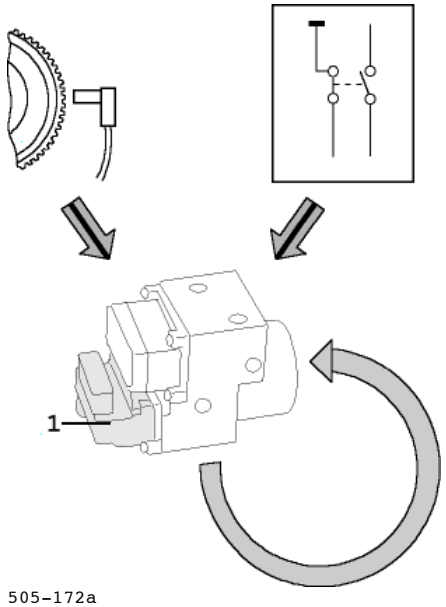
505-170a

Function

During full braking the full pressure is built up in the brake master cylinder. The ABS control unit (N47) receives the signal "the vehicle is being braked" from the stop lamp switch (S9/1).

The ABS control unit (N47) compares the speed signals of the individual speed sensors (L6) and calculates the reference speed (average wheel speed). By comparing the actual speed with the determined reference speed, the ABS control unit detects the tendency of a wheel to lock up.

If the speed of a wheel differs from the reference speed by more than an amount reasonable for the driving situation, the ABS control unit (N47) sends a signal to the ABS hydraulic unit.



505-172a

1 ABS control unit

Task

The hydraulic unit reduces the pressure in the respective wheel brake cylinder via the ABS phases

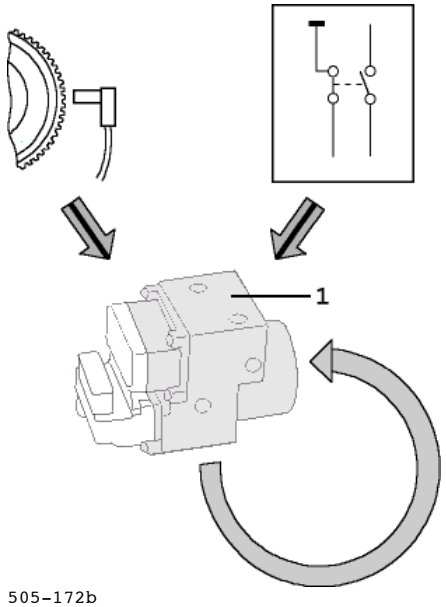
> "reduce pressure",

> "hold pressure"

> "build up pressure again".

The wheel can turn freely again with good road adhesion and cornering forces. It is braked again during each ABS cycle until braking is completed.

As with 3-channel ABS the pressure of the rear-axle brake line is distributed to both rear wheels. these are also jointly controlled. On the other hand, the front wheels are controlled individually.



505-172b

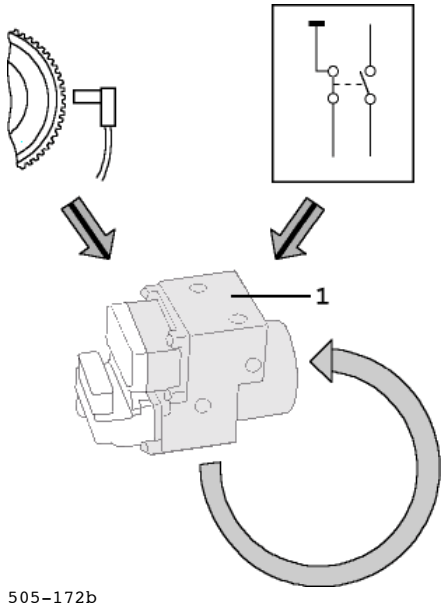
1 Hydraulic unit

Function

The brake pressure in the lines is controlled by opening and closing the solenoid valves in the hydraulic unit. The solenoid valves and the return pump in the ABS hydraulic unit are controlled in cycles by the ABS control unit (N47).

In the ABS phase "reduce pressure" the brake fluid is pumped back into the line to the brake master cylinder by the ABS hydraulic unit against the brake pedal and against the force of the driver's foot.

This prevents the wheel from locking up. The return feed of the brake fluid can be felt on the brake pedal as pulsing.



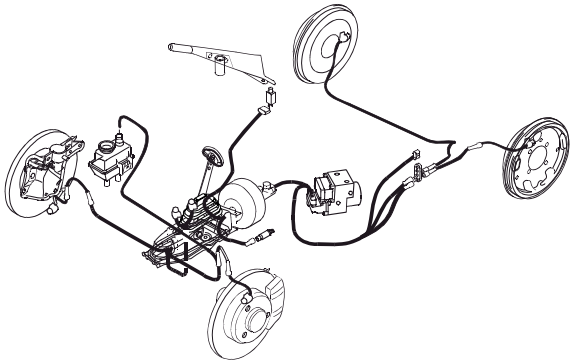
505-172b

1 Hydraulic unit

Task

The electronic brake force distribution controls the brake pressure to rear wheels in the hydraulic unit each time vehicle is braked.

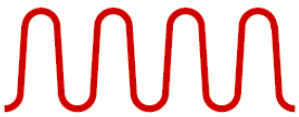
As a result, the EBP is not only effective when the brakes have a tendency to lock up.



505-175a

Task

Each of the four wheel speed sensors transmits an alternating current signal to the ABS control unit (N47) in dependence on the respective speed. This information is also passed on to the engine control unit (N48) and to the instrument cluster (A1) via the CAN bus.

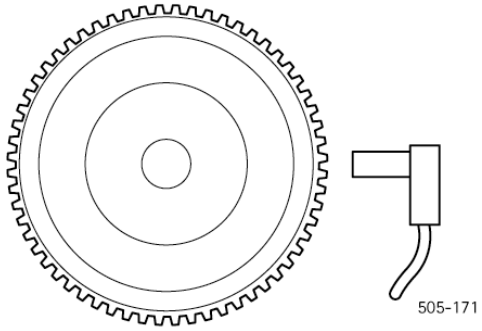


Design

The speed sensor is an inductive sensor. It consists of a permanent magnet and a soft iron core with a copper winding.

Function

A toothed ring is mounted on each wheel, the so-called incremental ring. When the wheel rolls, the toothed ring turns past the speed sensor. When the teeth of the incremental ring run past the sensor, the magnetic flow changes, inducing an alternating current in the sensor.



505-171

Task

The stop lamp switch switches on the stop lamps when the brakes are actuated and sends a brake signal to the ABS (N47) and engine (N48) control units.

In the ABS control unit (N47) the brake signal triggers the monitoring and control of the wheel slip.

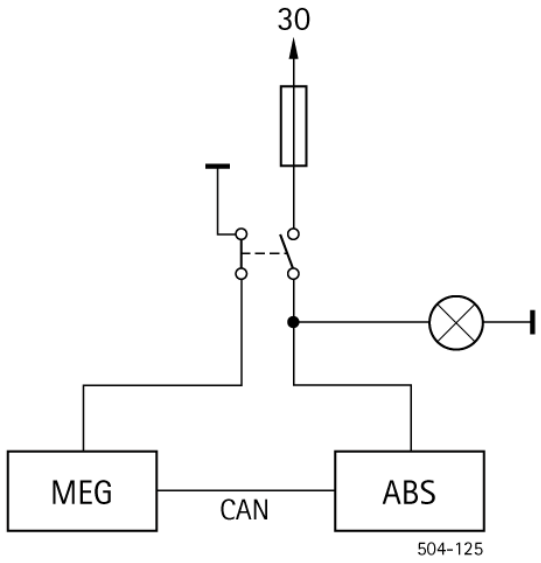
The engine control unit (N48) opens the module coupling in the case of ABS braking.

Design

The stop lamp switch is equipped with a make-contact element and a break-contact element. The make-contact element switches the stop lamps on and generates a signal for the ABS control unit (N47). The break-contact element generates a signal for the engine control unit (N48).

Function/Diagnosis

Both control units are interconnected via the CAN bus and compare the signals. The failure of one of the two contacts is detected in this way.



504-125

Location

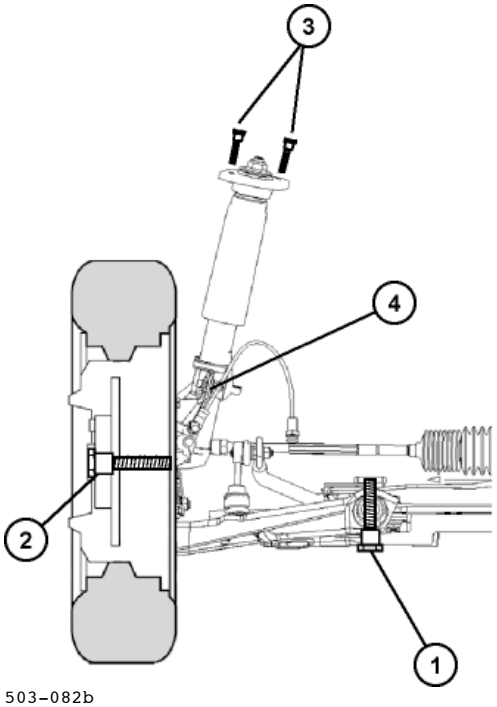
Mounting:

> Four self-moulding bolts (1) on frame

> One central bolt (2) through wheel bearing and swivel bearing (4) in single-tube shock absorber

> Mounting tab between swivel bearing (4) and single-tube shock absorber

> Single-tube shock absorber is bolted onto frame on upper end with two bolts (3).



503-082b

Design

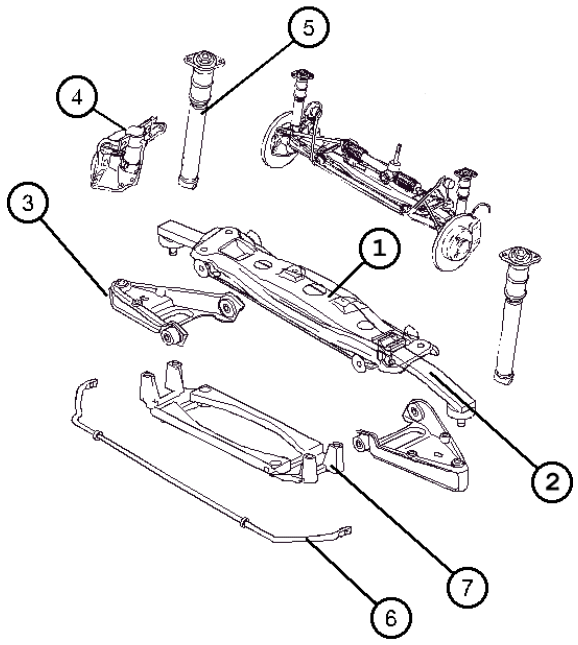
1 Front-axle cross member
2 Plastic transverse leaf spring
3 Steel plate wishbone, left and right, on cross member
4 Steel-plate swivel bearing, left and right, with supporting joints for wheel suspension
5 Two single-tube shock absorbers
6 Stabiliser bar
7 Trim weight, bolted onto front axle from below (on models up to production date of 15/11/1999)

Function

The transverse leaf spring is loaded to bending. Its advantage lies in the fact that only the light ends follow the unevenness of the road surface. The heavy middle section is already part of the sprung weight.

Note

The front axle was produced in various tuning configurations (transverse leaf spring, stabiliser bar, trim weight).



503-081b

Function

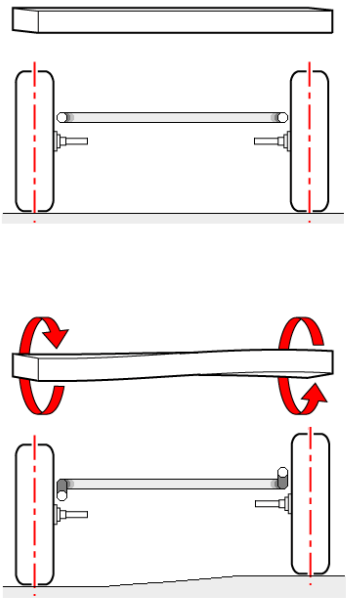
The stabiliser bar on the smart front axle is loaded when twisted. It is a torsion stabiliser bar. Its advantages are its low weight, the small space required and its maintenance-free design.

The stabiliser bar acts as a lateral stabiliser during wheel compression and rebound:

> The wheel in the outside of a curve compresses and twists the stabiliser bar.

> As a result, the otherwise unloaded wheel on the inside of the curve is also loaded.

This counteracts the tilting of the vehicle to the side.

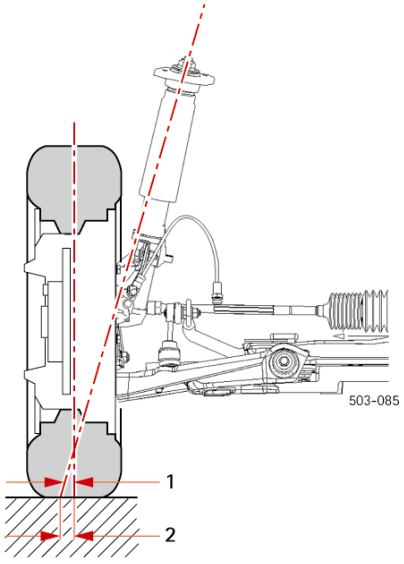


503-083

503-083

Task

To increase driving stability during braking, the front wheels of the smart have a negative steering offset.



503-085

1 Steering-axis inclination

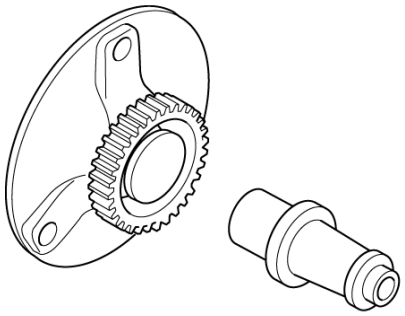
2 Steering offset

Design

The wheel hub is the outer ring of the wheel bearing. The ball races in the hub are surface-hardened.

The wheel bearing is secured on the swivel bearing with the central bolt and need not be adjusted.

The teeth of the pulse ring generate electric signals in the speed sensors (L6) from which the ABS control unit (N47) determines the wheel speed (see 02 04, Anti-Lock Brake System (ABS), Wheel Speed Sensor).



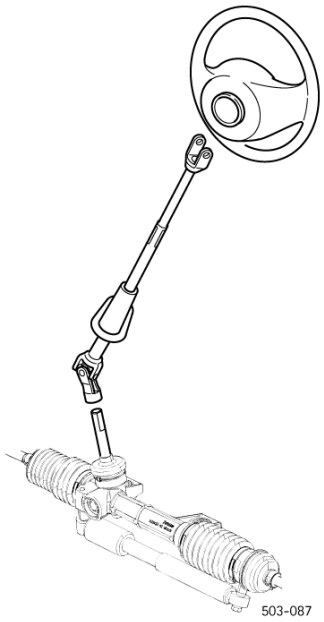
503-086

Design

The steering of the smart is a conventional rack-and-pinion steering.

Function

The steering operates linearly, i.e. the steer angle matches the angle of rotation of the steering wheel.



503-087

Location

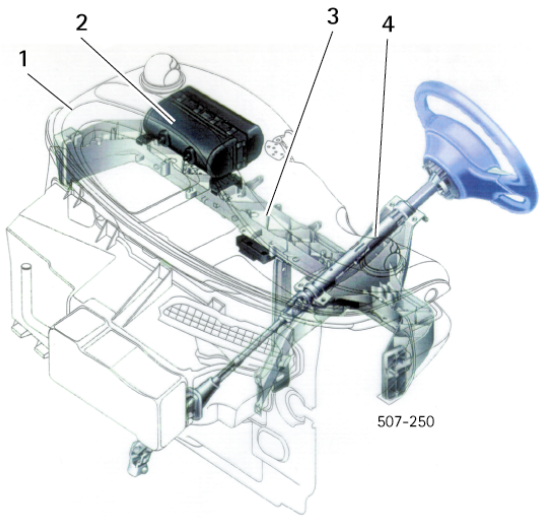
The steering column is mounted on the cockpit cross member.

Function

The steering column is offset and has two telescopic sections that are pushed into each other during an accident. This enables

> the steering wheel to remain in its position during an accident,

> the driver's airbag to unfold in the intended direction and to be completely effective.



507-250

1 Cockpit
2 Passenger airbag
3 Cockpit cross member
4 Steering column with steering wheel

>>smart City-Coupé

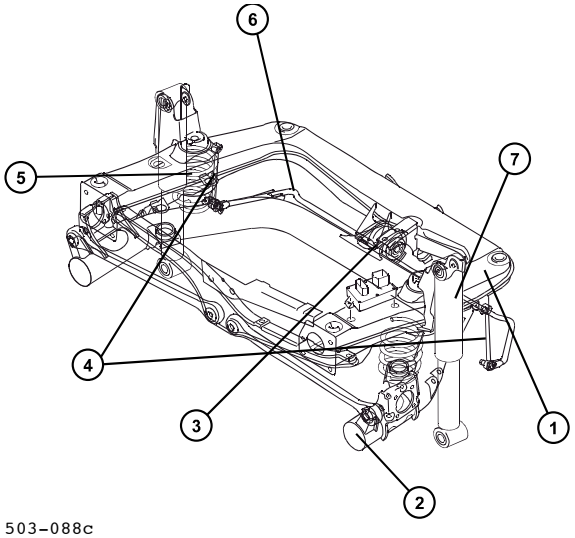
Chassis Subframe

Task

The chassis subframe holds the rear drive module and carries the rear axle.

Design

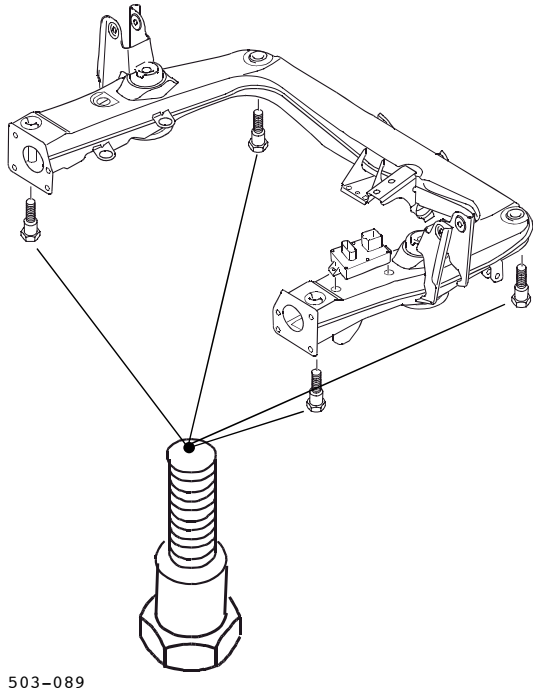
1 Integral carrier
2 Axle tube
3 Central bearing
4 Two control arms secured with a lock washer so that they do not tear off with worn rubber mounting
5 Coil springs between integral carrier and axle tube
6 Stabiliser bar on axle tube
7 Single-tube shock absorber



503-088c

Location

The integral carrier is mounted on the frame with four self-moulding bolts and can be removed completely with the rear drive.

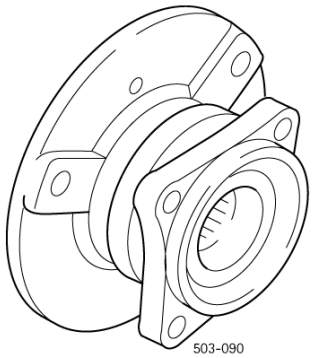


503-089

Location

The rear wheel bearing is mounted on the axle tube with 4 bolts and forms a component with the hub.

The axle shaft is mounted on the wheel bearing with the central bolt.



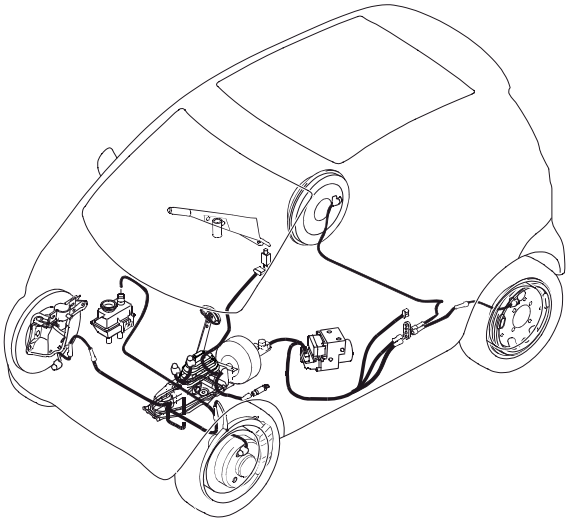
503-090

Task

The brake system is responsible for braking the vehicle and bringing it to a complete stop.

Technically (and legally) a distinction is made between the following brake systems:

> Service brake - Braking during driving
> Parking brake - Securing while at a stop



504-121a

Task

The service brake is the brake with which the vehicle is braked during driving.

Design

Components of the service brake:

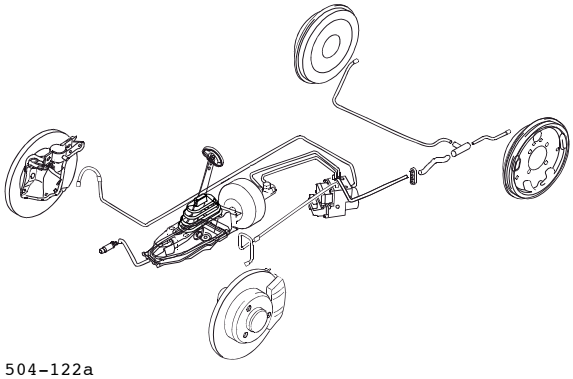
> Disc brakes on front wheels

> Drum brakes with parking brake on rear wheels

> Brake pedal module, consisting of brake pedal with stop lamp switch, brake master cylinder and brake servo unit

> ABS unit, consisting of ABS control unit (see 02 04) and ABS hydraulic unit

One lie each leads from the ABS hydraulic unit to the front wheels and a shared line with a distribution piece to the rear axle.



504-122a

Function

The service brake is a hydraulic 2-circuit brake system.

The braking action is optimally adjusted to the driving situation with ABS (anti-lock brake system) and EBP (Electronic Brake Proportioning); see 02-04, Anti-Lock Brake System (ABS), Electronic Brake Proportioning.

Task

In the brake master cylinder the foot force coming from the brake pedal is converted to hydraulic pressure in the two brake circuits.

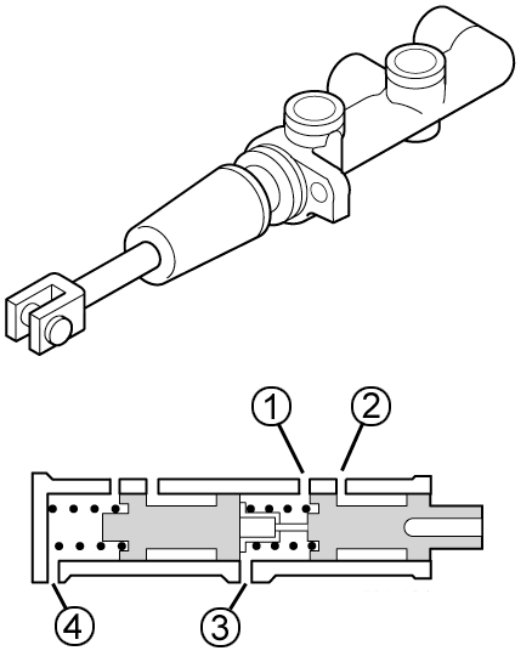
Design

The brake master cylinder is a tandem brake master cylinder with two sequentially arranged pistons.

Function

The first piston is actuated directly by the pressure rod of the brake pedal. This so-called "pressure rod circuit" is responsible for braking the front axis (ABS hydraulic unit inlet F).

The second piston is hydraulically actuated indirectly by the first piston via the pressure in the brake fluid. This so-called "floating circuit" brakes the rear wheels (ABS hydraulic unit inlet R).



504-124a

1 Compensation bore
2 Return bore
3 To ABS hydraulic unit inlet F
4 To ABS hydraulic unit inlet R

Task

The parking brake is a purely mechanical brake that spreads the shoes at the brake drums via the handbrake lever, handbrake cable and adjustment lever so that the vehicle is secured against rolling.

Design

The handbrake lever and handbrake cable are mounted self-adjusting via a toothed part.

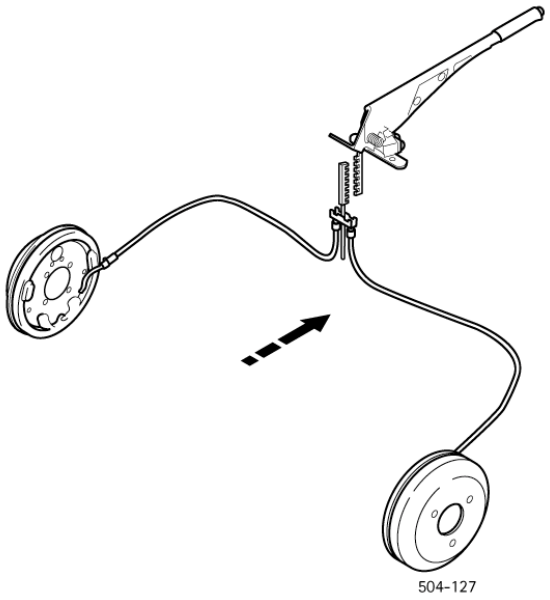
Function

when the handbrake lever is set, the toothing on the handbrake lever and handbrake cable intermesh like two sabre saw blades.

Advantages:

> Simple design of rear-axle drive module: The rear-axle drive module can be removed completely with the parking brake without having to unscrew or unhook the handbrake cable.

> The travel of the handbrake lever remains constant: When the handbrake lever is completely released, the toothing of the lever and handbrake cable are released. The toothing of both parts continue to intermesh, and the handbrake cable is automatically adjusted.



504-127

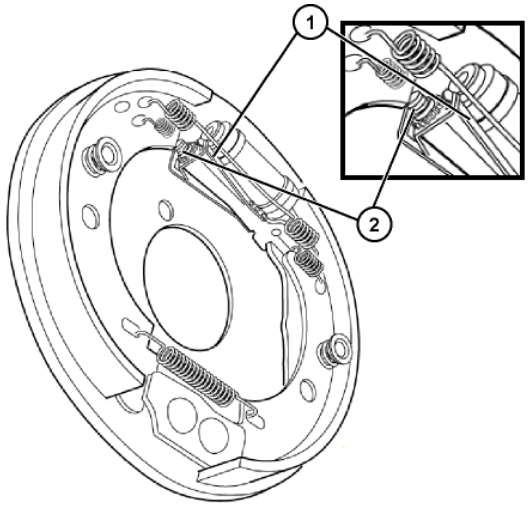
Task

The drum brake on the rear are automatically adjusted via a spring plate.

Function

When the shoes are pressed outward (hydraulically by the service brake), the spring plate adjusts the gearwheel of the adjustment mechanism by one tooth.

A bi-metal disc (1) is mounted parallel to the spring. This locks the adjustment device (2) when the brake heats up so that the thermal expansion of the brake drum does not lead to an unsuitable adjustment that would result in the brake locking after cooling.



504-128a

>>smart City-Coupé

Wheel-and-Tyre Assemblies

Task

The wheel-and-tyre assemblies of the smart contribute to compliance with the upper limit for carbon dioxide emissions and improve driving safety.

Design

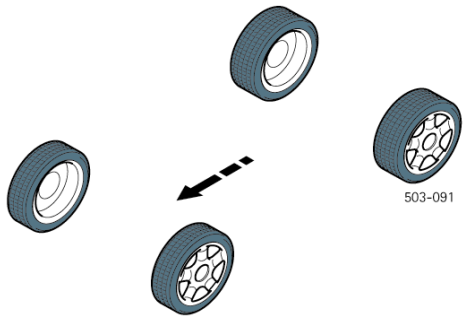
The specified tyres have a reduced rolling resistance (so-called eco tyres).

Different tyres and disc wheels are used on the front and rear of the smart.

Function

The rolling resistance and air resistance of the wheel-and-tyre assemblies have a considerable influence on the overall driving resistance of the vehicle. The eco tyres reduce the rolling resistance. The front wheels of the smart are narrow to reduce the air resistance. Both contributes to reducing the fuel consumption, and therefore to decreasing carbon dioxide emissions.

The wider rear wheels can build up a larger cornering force than the narrower front wheels. This gives the smart a tendency to understeer.



503-091

>>smart City-Coupé

Drive Unit

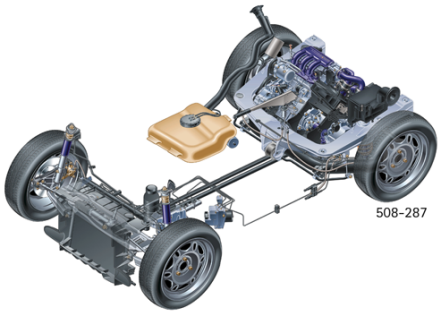
Location

The drive unit, i.e. the engine, clutch and gearbox, is located in the rear of the vehicle. It is mounted laterally and tilted at a 45° angle on three rubber-metal mounts.

Design

Two petrol engines with different output levels and one diesel engine with common-rail direct injection are used. The diesel engine is documented in a separate operating description.

The gear ratio of the gearbox final drive is adapted to the different speed and torque characteristic of the petrol and diesel engines.



508-287

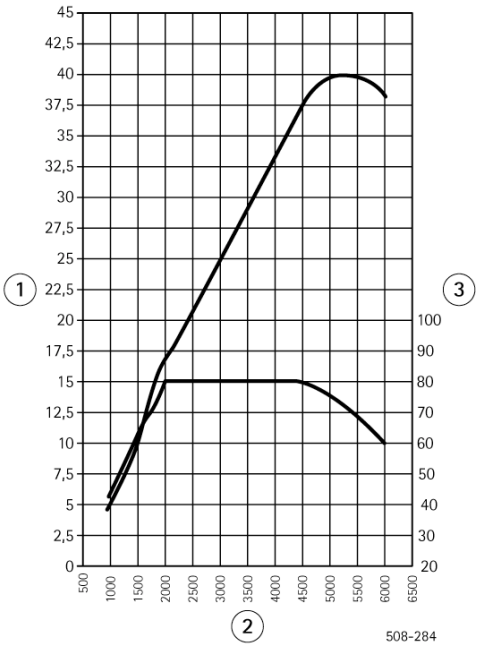
>>smart City-Coupé

Petrol Engine

Task

Despite the limited installation space available, the smart petrol engines provide sufficient power with low fuel consumption and low weight.

> Displacement: 599 cm^3
> Compression ratio: 9.5:1
> Turbocharger with intercooling and boost pressure control
> Output: 33 kW with mechanically controlled boost pressure (max. 0.4 bar) or 40 kW with electronically controlled boost pressure (max. 0.75 bar)
> Overboost function on 40-kW engine. During acceleration (see 02 03, Engine Management, Propulsion Management) the boost pressure is briefly increased to 0.9 bar.
> Torque: 80 Nm at 2,000 to 4,500 rpm
> Engine is operated with unleaded super petrol (RON 95).
> At 135 km/h the engine is automatically controlled so that this is the top speed.
> Engine weight: 59 kg (the entire rear module weighs just 120 kg)



508-284

Output and torque of the 40-kW engine:

1 Output in kW (upper curve)
2 Engine speed in rpm
3 Torque in Nm (lower curve)

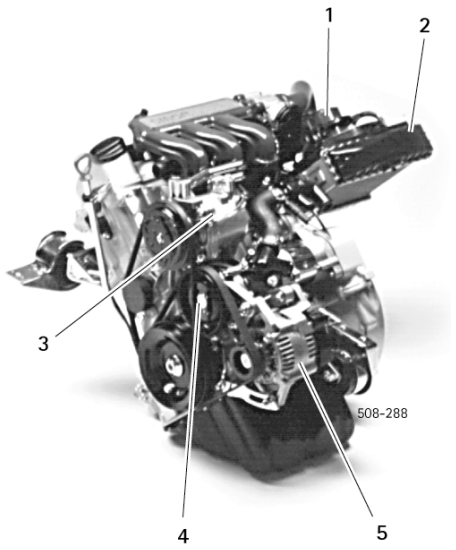
Design

> 3-cylinder, 4-stroke petrol engine with turbocharger and intercooling.
> Two valves per cylinder
> Crankcase and cylinder head of special aluminium alloys
> Cylinder sleeves of grey cast iron
> Piston cooling by spraying of piston crown with engine oil
> Valves driven with roller rocker fingers
> Automatic valve clearance compensation with hydraulic elements
> Dual ignition system with one dual ignition coil and two spark plugs per cylinder
> Injection system with variable pre-pressure dependent on intake manifold pressure
> Electric accelerator pedal module (B37/1): A potentiometer is integrated in the accelerator pedal. The pedal position determined with it is transmitted to the engine control unit (MEG; N48). Therefore, the smart has neither a throttle cable nor a throttle linkage.

508-281

Location of units:

1 Intercooler blower (M7)
2 Intercooler
3 A/C compressor
4 Water pump
5 Alternator (G2)



508-288

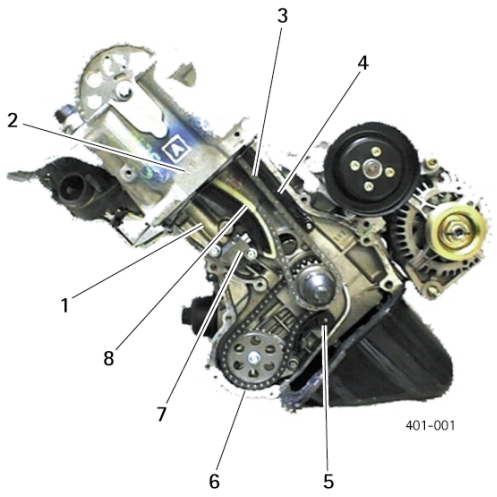
Interior design:

1 Crankcase (with integrated oil pump):
- > Crankshaft
- > Connecting rods
- > Pistons
- > Oil filter housing

2 Cylinder head:
- > Camshaft
- > Valves
- > Valve shaft seals
- > Roller rocker fingers
- > Hydraulic elements

Timing drive:

3 Camshaft timing chain
4 Slide rail
5 Chain tensioner for oil pump drive
6 Oil-pump timing chain
7 Timing chain tensioner
8 Clamping rail

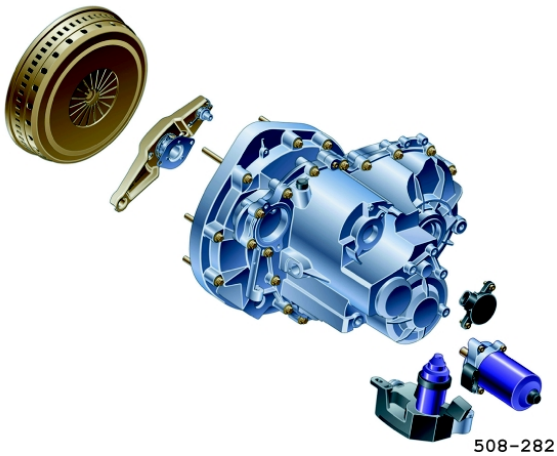


401-001

Task

The gearbox of the smart is a sequential six-speed gearbox with an auxiliary-section shift mechanism and automated clutch and shift management.

> Sequential shifting:
  All gears are shifted in sequence so that no gears can be skipped.
> Group shifting 3 x 2:
  Three-speed, two-shaft gearbox with two different ratios to the differential. This design principle enables a compact design.
> Automated clutch and shift management: Tapping the gearshift lever carries out a complete shift, i.e. reduce throttle, declutch, shift, clutch and apply throttle again.

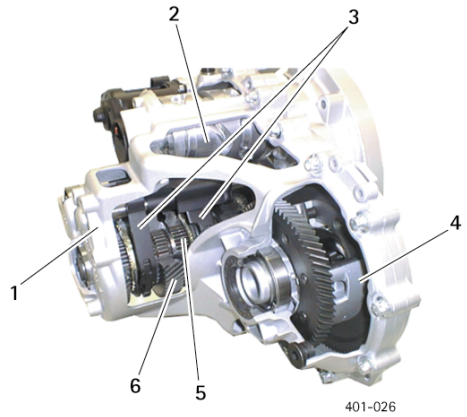


508-282

508-282a

Design

1 Gearbox housing
2 Gear selector drum
3 Shifting fork
4 Differential with two gear rings
5 Needle bearing
6 Shift gears



401-026

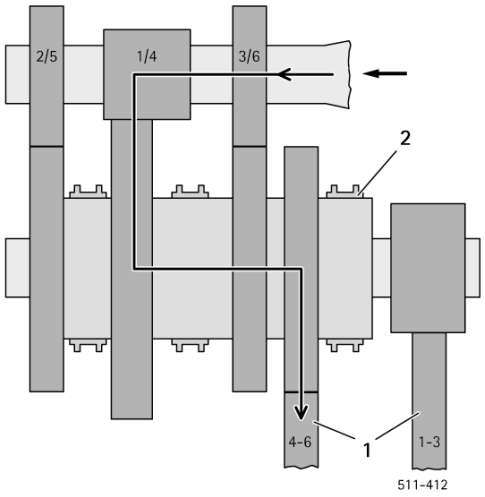
Function

The variable-speed gearbox has three ratio steps. An auxiliary-section shift mechanism with two gearwheel pairs is connected after the variable-speed gearbox.

> All gearwheels are constantly meshed. The adhesion is produced with sliding sleeves.

> The gear pairs 1 and 4, 2 and 5 and 3 and 6 each use the same gearwheels.

> The 6th gear is designed as an eco gear with a long ratio. It permits lower engine speeds, and therefore reduces fuel consumption.



511-412

1 Auxiliary-section shift mechanism

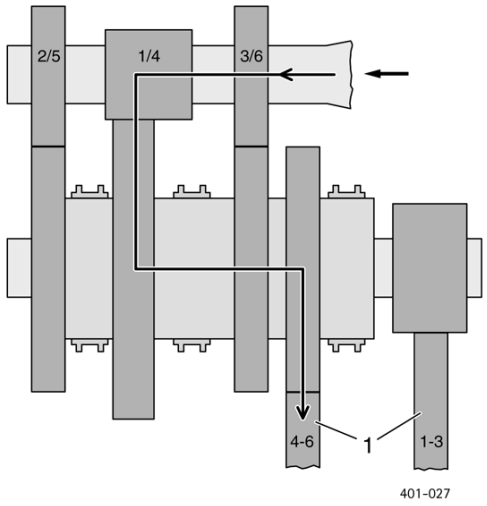
2 Sliding sleeves

Shifting:

The gears are shifted sequentially in virtually the same period of time.
Exception: Between the 3rd and 4th gear shifting takes slightly longer due to the auxiliary-section shift mechanism.
First the power flux in the variable-speed gearbox is shifted, and then the auxiliary-section shift mechanism shifts into the higher or lower gear group.

Advantages of auxiliary-section shift mechanism:

- Low weight
- Small installation space
- Low differential speed in basic gearbox, and therefore low friction
- Economical driving style with geometrical gear stepping



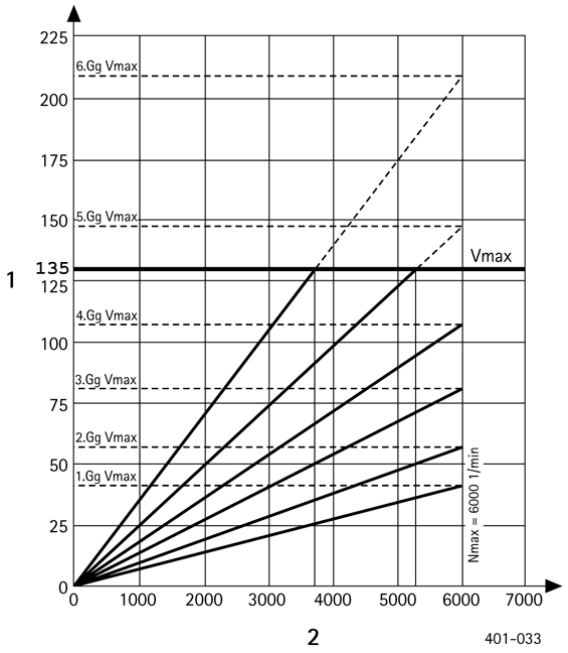
401-027

1 Auxiliary-section shift mechanism

Speed-rpm graph

This graph indicates the following:

> The ratio between the vehicle speed and the engine speed in the individual gears;
> The vehicle speed actually achieved or that would be computationally achieved in each case at maximum engine speed;
> Which gears are not shifted into from a certain engine speed so that the minimum and maximum permissible engine speed is not dropped below or exceeded;
> At which vehicle speed automatic downshifting is carried out so that the motor does not stall;
> The top speed Vmax of 135 km/h which is electronically controlled.



401-033

1 Vehicle speed in km/h
2 Engine speed in rpm

Task

The shift actuator shifts the gears.

Design

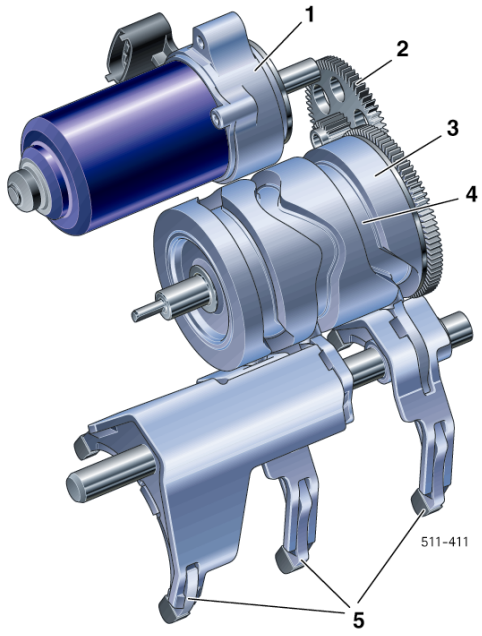
The shift actuator is an electric motor with two integrated incremental sensors (see Chap. 02-03).

Function

> The shift actuator (1; M17) drives the gear selector drum (3) via the spur gears (2).

> The gear selector drum (3) moves the shifting fork (5) via the curved paths (4). One of the three shifting forks moves depending on the curved path.

> The shifting forks (5) move the sliding sleeves, resulting in synchronisation.



511-411

1 Shift actuator
2 Spur gears
3 Gear selector drum
4 Curved paths
5 Shifting forks

Task

The gearbox adaptation is the determination and learning of the different position values in the gearbox.

Due to the production tolerances for gearboxes and angle sensors, individual position values of the individual gears result for each gearbox.

Function

The position values are stored in the MEG (engine/E-gas/gearbox control unit; N48).

Procedure

A gearbox adaptation is required:

> For the first time at the end of the production line; all components are new and must be learned;

> During repairs and troubleshooting.

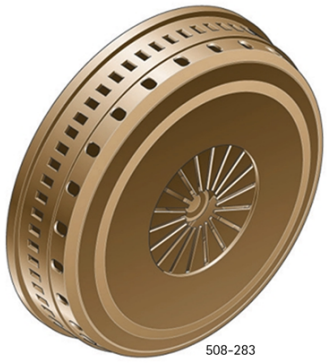
The gearbox adaptation is carried out with the smart Tester, as described in the ERM (Electronic Repair Manual).

For instructions on the design and use of the smart Tester, see 08 01 and 08 02.

521-801

Task

The single-disc dry clutch connects the gearbox to the engine.



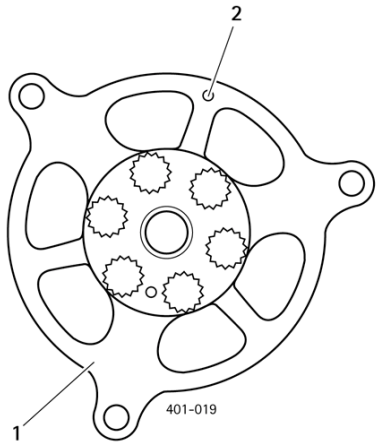
508-283

Location

The clutch housing is pressed onto the flywheel. It is bolted onto the crankshaft via the flex plate.

The clutch can only be completely replaced, as it represents a component.

The clutch module can only be bolted on in one position. Here the pin specifies the installation position which is also decisive for the ignition point.



401-019

1 Steel flex plate

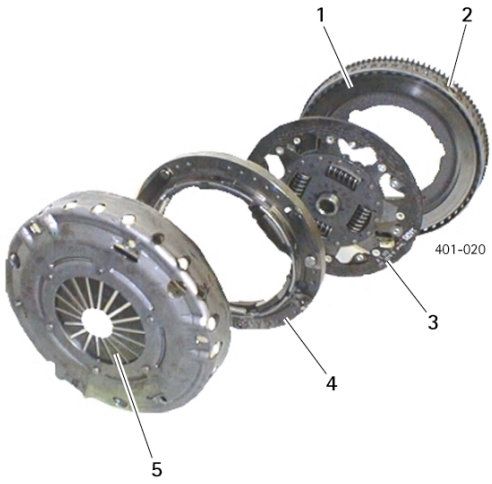
2 Pin

Design

The clutch with a large drive plate is provided with a mechanical wear adjustment (see next section).

Function

The incremental ring is used in conjunction with the speed sensor (L8) as a sensor for the crankshaft position and the engine speed.



401-020

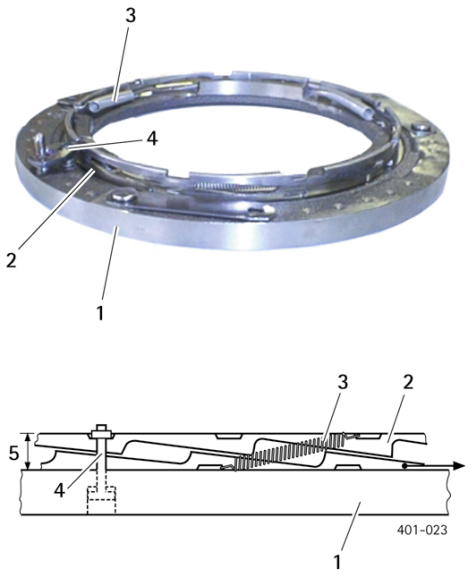
1 Flywheel
2 Incremental ring
3 Drive plate
4 Pressure plate with wear adjustment
5 Diaphragm spring

Task

The adjustment is used to maintain a constant force and distance during clutch actuation.

Function

Due to wearing of the clutch drive plate the diaphragm spring position changes so that the pressure of the diaphragm spring on the ramp-shaped setting rings decreases. The locking pin causes the setting rings to turn due to the tension of the springs. This compensates the play between the diaphragm spring and the pressure plate. The diaphragm spring is thus returned to the starting position.



401-023

1 Pressure plate
2 Setting rings
3 Springs
4 Locking pin
5 Wear compensation

Task

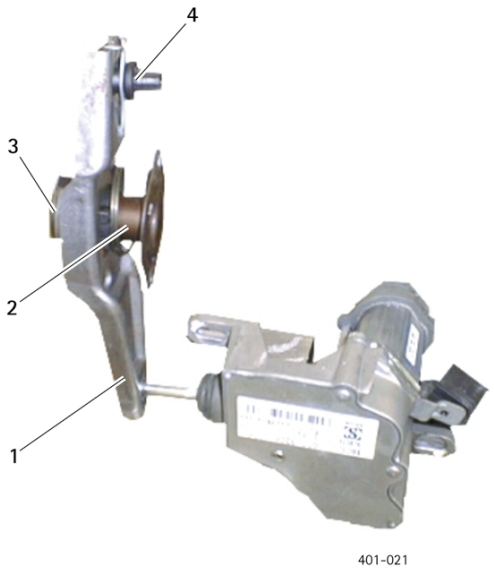
The release system enables clutch actuation with an electric motor.

Design

The release system is a module and can only be completely replaced.

Function

The actuating lever is controlled by the clutch actuator, see Chap. 02-03.



401-021

1 Actuating lever
2 Guide tube
3 Clutch operator
4 Pressure button

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Cooling System

Design

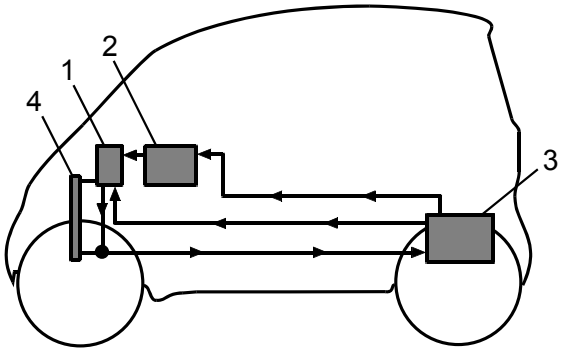
The coolant circuit is used to cool the engine and heat the passenger compartment.

Location

The radiator and the fan for cooling are located in the front of the vehicle under the front trim.

The coolant lines run in the tunnel between the front end and the rear drive module with the drive unit.

The heat exchanger is supplied directly from the engine, and the radiator return line is used for the return.



00130011

1 Expansion tank
2 Heater heat exchanger
3 Engine
4 Radiator

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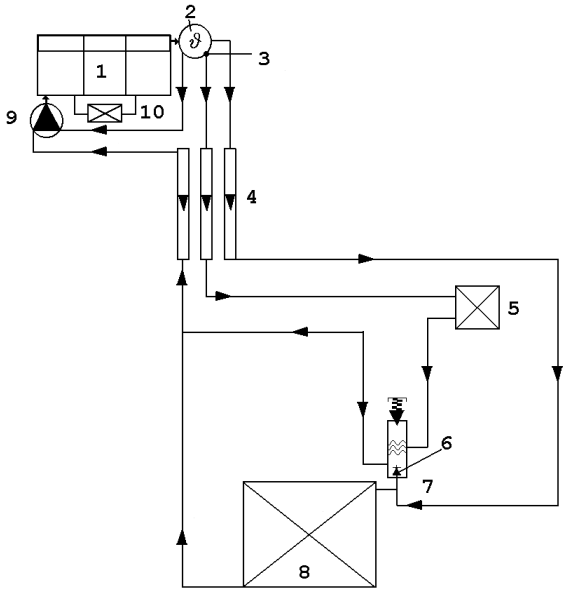
Cooling System

Design

The cooling circuit contains three sub-circuits, which are connected depending on the coolant temperature.

On the smart cdi from the start of production and on the other vehicles from January 2000, the expansion tank with the non-return valve shown in the illustration is used.



00130012

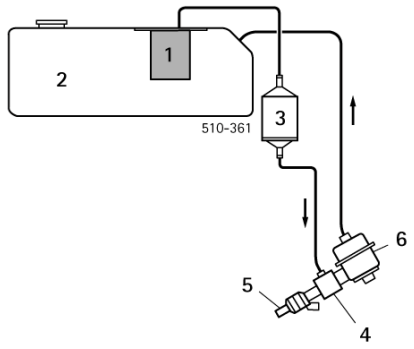
1 Engine
2 Thermostat
3 Thermostat valve
4 Coolant pipe bundle
5 Heater heat exchanger
6 Non-return valve
7 Expansion tank
8 Radiator
9 Water pump
10 Oil-water heat exchanger

Design and Function

The fuel is fed by the electric fuel pump (1) in the fuel tank (2).

> Via the fuel filter (3) the fuel reaches the fuel rail (4), and from there the injectors (5).

> The fuel return line runs through the pressure regulator (6) back into the fuel tank (2).



510-361

1 Fuel pump (M15/1)
2 Fuel tank
3 Fuel filter
4 Fuel rail
5 Injectors (Y1/3 - Y3/3)
6 Pressure regulator

Location

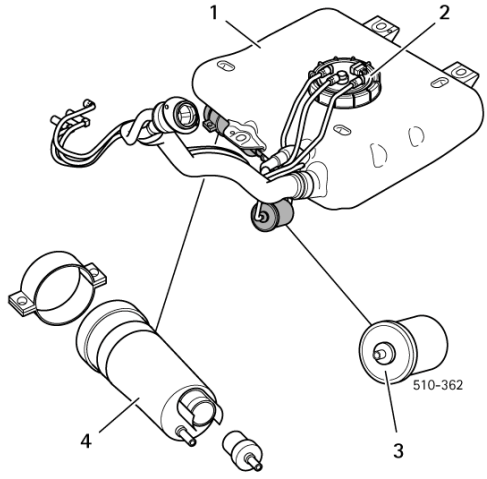
The fuel tank module is located in the right vehicle half under the passenger seat. The fuel tank is plastic and has a capacity of approx. 22 litres.

Design

The components of the fuel tank module are shown in the illustration.

This module contains the fuel pump module (2), which consists of the fuel pump and sensor for the fuel gauge.

The fuel filter (3) and the activated charcoal filter (4; see section "Fuel Regeneration") are mounted outside on the fuel tank.



510-362

1 Fuel tank
2 Fuel pump module (M15/1)
3 Fuel filter
4 Activated charcoal filter

Task

The fuel pump must build up the required fuel pressure and feed a sufficient fuel quantity.

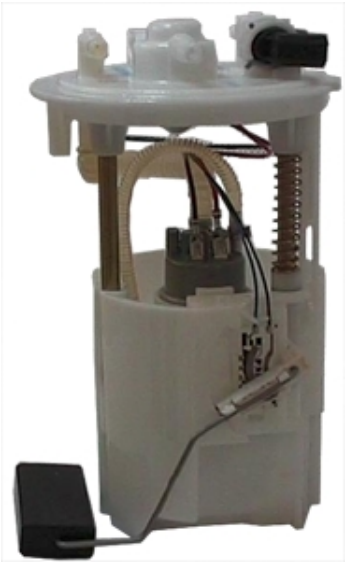
Location

The fuel pump is located in the fuel tank (in-tank pump).

The fuel pump housing also carries the potentiometer and the float of the fuel gauge.

Function

The fuel pump is electrically driven. An electric cut-off valve is therefore not required.



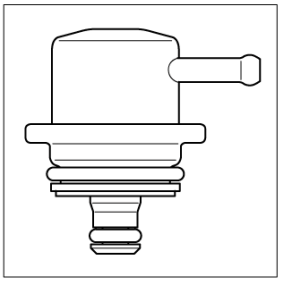
00130408

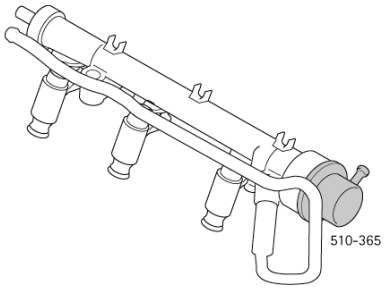
Task

The pressure regulator regulates the injection pressure in the fuel rail in dependence on the intake manifold pressure.

Location

The fuel pressure regulator is located on the face of the fuel rail. It is connected to the return line.





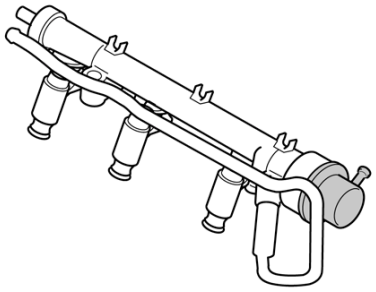
510-365

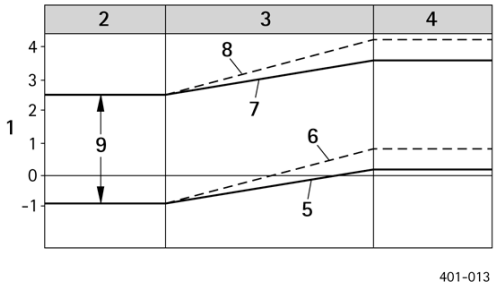
Function

> The fuel pump generates a feed pressure, which is always higher than the injection pressure.

> The pressure regulator regulates the injection pressure in the fuel rail in dependence on the intake manifold pressure.
As a result, the pressure difference between the intake manifold pressure and the fuel pressure is constant. If the intake manifold pressure increases (e.g. due to an increase in the engine speed), the fuel pressure also increases.

> The excess fuel continuously flows back to the fuel tank via the pressure regulator. In the process the fuel is also cooled.





401-013

401-013

1 Pressure in bar
2 Idling
3 Partial load
4 Full load
5 Intake manifold pressure in bar, without boost pressure
6 Intake manifold pressure in bar, with boost pressure
7 Fuel pressure in bar, without boost pressure
8 Fuel pressure in bar, with boost pressure
9 Pressure difference

Task

The fuel regeneration is intended to prevent environmentally harmful hydrocarbons from escaping into the environment. To do this, the fuel vapour that would escape during the pressure compensation is routed via the activated charcoal filter. This filter bonds it to the large surface of the activated charcoal particles.

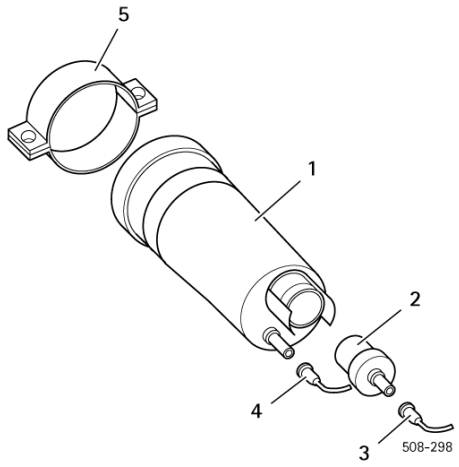
Design and Function

The components of the fuel regeneration system are shown in the illustration.

> The activated charcoal filter (1) holds back the fuel vapour. it can absorb approx. 30 g of saturated fuel vapour and approx. 10 g of liquid fuel.

> The regeneration valve (2) controls the return of the fuel vapours to the engine.

> The non-return valves are located in the lines to the engine. They both block the lines against the boost pressure of the turbocharger in the direction of the regeneration system and prevent overflowing from the air line before the turbocharger to the intake manifold.

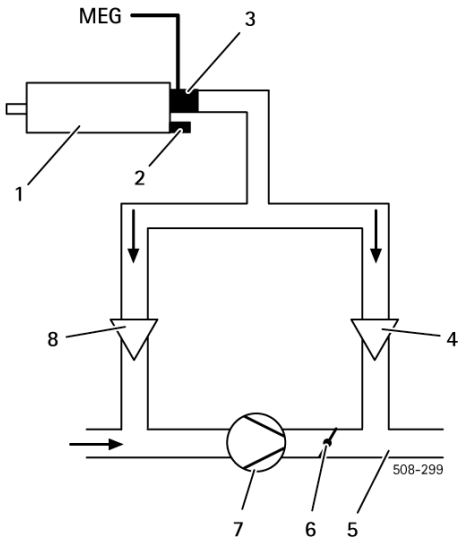


508-298

1 Activated charcoal filter
2 Regeneration valve (Y58)
3 Engine connection
4 Fuel tank connection
5 Bracket for activated charcoal filter

Function during driving:

> At idle the intake manifold pressure is very low, and a vacuum is produced. The fuel vapour is sucked out of the activated charcoal filter (1) into the intake manifold (5).
> At a higher engine load the intake manifold pressure increases due to the increasing boost pressure.
> The non-return valve (4) closes the line. At the same time a valve (8) in the second regeneration line is opened.
> The vapour then flows into the air line before the turbocharger.
> Depending on the pressure gradient, this results in either the first or the second line being closed.



508-299

1 Activated charcoal filter
2 From fuel tank
3 Regeneration valve (Y58)
4 Non-return valve
5 Intake manifold
6 Throttle valve
7 Turbocharger
8 Non-return valve

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Fuel Regeneration

Controller:

Fuel regeneration system is carried out by the MEG (engine/E-gas/gearbox control unit; N48) in dependence on various parameters:

> The MEG controls the regeneration valve (Y58).

> The regeneration valve is cycled; this means it is controlled by the MEG with defined current pulses of a corresponding frequency.

> The regeneration valve activates the return of the hydrocarbons from the activated charcoal filter.

Influence of fuel regeneration on mixture composition:

The MEG (engine/E-gas/gearbox control unit; N48) changes the mixture composition while the regeneration of the activated charcoal filter is being carried out in dependence on the loading state of the activated charcoal filter.

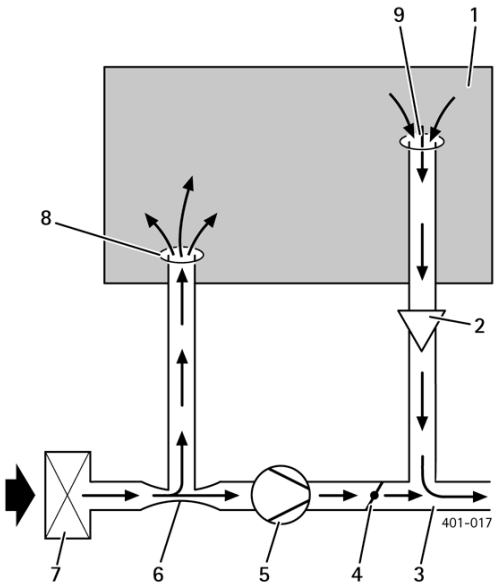
Function

Partial-load range:

At partial load a vacuum prevails in the intake manifold (3). Due to this pressure gradient the crankcase is supplied with fresh air via the full load ventilation.

The blow-by gases are returned to the engine via the opened non-return valve (2). Blow-by gases are gases that escape between the pistons and piston rings, and can thus contaminate the engine oil with combustion residues.

In the venturi tube (6) the flow speed increases due to the cross-sectional constriction. This produces a vacuum at the constriction.



401-017

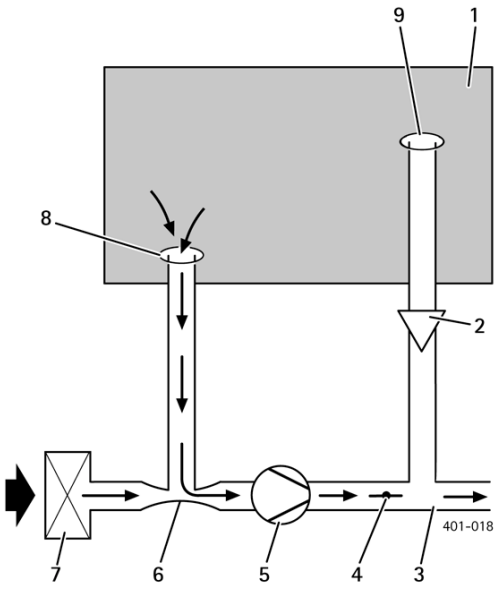
1 Engine
2 Non-return valve
3 Intake manifold
4 Throttle valve
5 Turbocharger
6 Venturi tube
7 Air cleaner
8 Valve cover connection
9 Crankcase connection

Full-load range:

At full load a vacuum prevails at the connection of the venturi tube (6) before the turbocharger compressor.

The blow-by gases are fed to the combustion process from the valve cover via the turbocharger.

Due to the pressure increases in the intake manifold (3), the non-return valve (2) for the partial-load ventilation is closed.



401-018

1 Engine
2 Non-return valve
3 Intake manifold
4 Throttle valve
5 Turbocharger
6 Venturi tube
7 Air cleaner
8 Valve cover connection
9 Crankcase connection

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Intercooler

Task

The compressed intake air from the turbocharger is cooled in the intercooler. In the process its density increases and the degree of cylinder filling becomes greater.

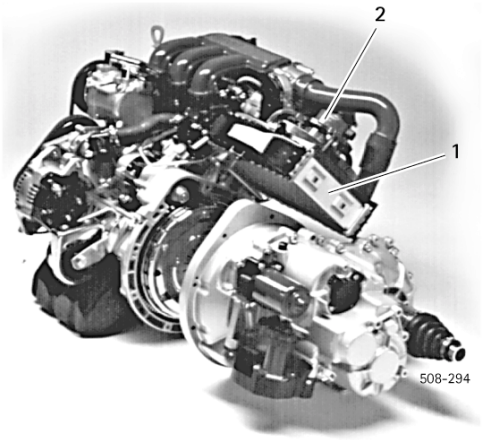
Location

The intercooler is located above the gearbox.

Function

Due to the compression in the turbocharger, the air heats up. In the process, its density decreases accordingly. The intercooler cools the air again so that its density increases again.

From a certain intake air temperature the electric fan is switched on. It supports cooling of the intake air.



508-294

1 Intercooler
2 Fan (M7)

Location

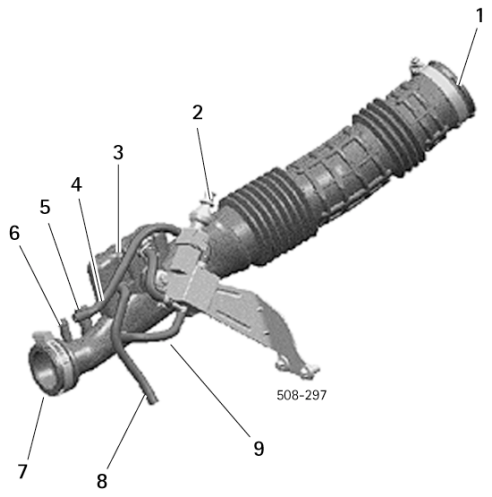
The air line is located between the filter box and the turbocharger.

Design

The illustration shows the connections of the air line.

Function

The damping volume reduces pressure jolts at the waste-gate diaphragm pot.



508-297

1 From air cleaner
2 Electrical connection to MEG (engine/ E-gas/gearbox control unit; N48)
3 Damping volume
4 To compressor connection piece
5 Full-load engine ventilation
6 Full-load regeneration
7 To compressor
8 To waste-gate diaphragm pot
9 Ventilation

Design

The brake system consists of two main components:

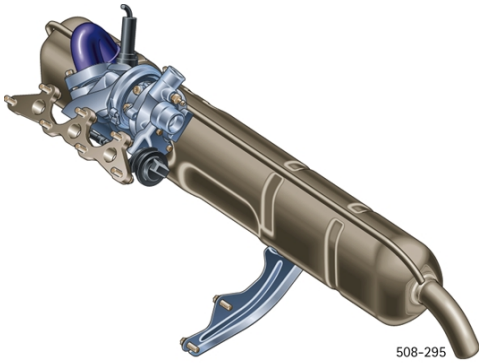
> Exhaust manifold and turbocharger, which form one unit;

> Silencer, which contains the catalyst.

Location

The silencer is rigidly bolted to the gearbox and connected to the turbocharger via a ball flange. This consists of two half-balls that can be fit together exactly.

Here two heat-resistant bolts are used that (as the name suggests) consist of a particularly heat-resistant alloy.



508-295

Function

The catalyst causes the pollutants in the exhaust gas to be largely transformed. In the process harmless substances are formed. The catalyst itself does not change in the process.

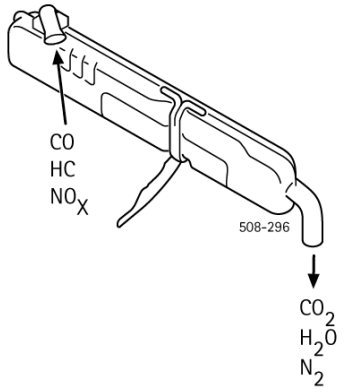
The chemical reactions in the catalyst are basically the following:

> Carbon monoxide (CO) and hydrocarbons (here abbreviated with HC) are oxidised to form carbon dioxide (CO_2) and water (H_2O).

  Oxidation in this context is a chemical reaction during which oxygen is absorbed.

> Nitrogen oxides (NO_X, e.g. NO_2 or NO) are reduced to nitrogen (N_2), whereby oxygen (O_2) is also formed. These two gases are the main components of air.

  A reduction in this context is a chemical reaction during which oxygen is given off.



508-296

Task

The turbocharger is used to increase the torque, and with it the output of the engine. In this way a relatively high output is also achieved on engines with a comparatively small displacement.

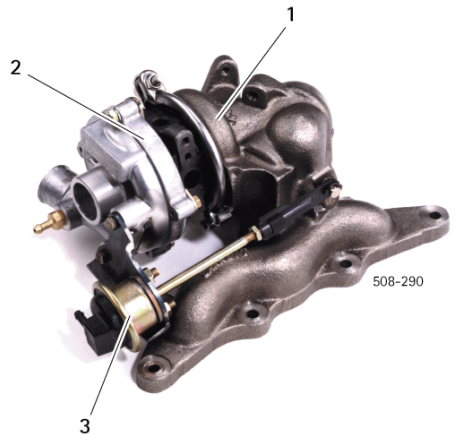
The respective output level of the smart engine (33 kW or 40 kW) is dependent on the boost pressure of the turbocharger; see 04 01, Petrol Engine.

On the 33-kW model the mechanically controlled boost pressure is a maximum of 0.4 bar.

The 40-kW model has an electronically controlled, higher boost pressure, which is up to 0.75 bar, and with the overboost function during acceleration even up to 0.9 bar.

Location

The turbocharger forms a unit together with the exhaust manifold.



508-290

1 Exhaust turbine
2 Compressor
3 Boost-pressure control valve

Design

The turbocharger has a water-cooled bearing housing that protects it against overheating. Overheating could lead to coking of the oil in the turbocharger bearing.

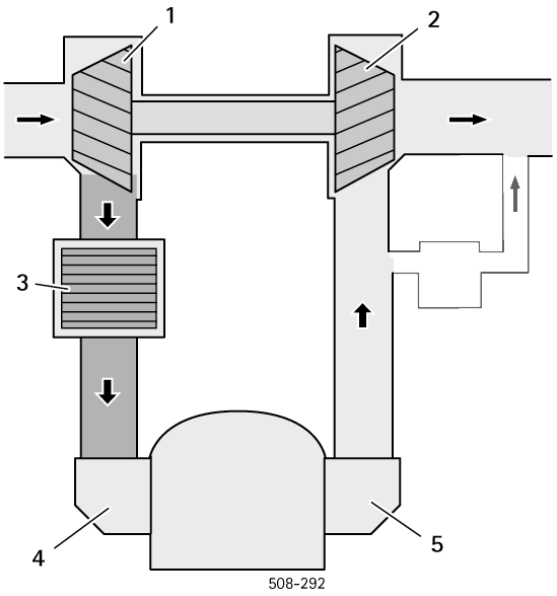
The water cooling system is designed so that a so-called thermosyphon effect occurs after the engine is switched off, and with it the water pump. This effect is based on the fact that hot water has a lower density than cold water, and therefore rises upward. In the process, the cold water is forced to flow in from below, resulting in a cooling effect.

Function

The exhaust turbine (2) drives the compressor (1), which compresses the aspirated air and presses it into the intake system(4).

The energy for driving the turbocharger is gained from the flow energy of the exhaust gases.

The compressed intake air is cooled in the intercooler (3; see Chap. 04-05). In the process, its density is increased and the degree of cylinder filling is also greater.



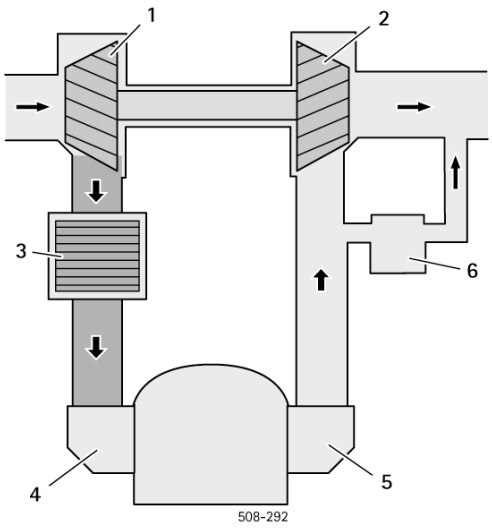
508-292a

1 Compressor
2 Exhaust turbine
3 Intercooler
4 Intake system
5 Exhaust manifold

Task

With a large exhaust flow the turbocharger turbine reaches a very high speed.

To prevent the boost pressure of the compressor from exceeding the specified value, part of the exhaust flow is routed past the turbocharger in the so-called bypass (6).



508-292

1 Compressor
2 Exhaust turbine
3 Intercooler (M7)
4 Intake manifold
5 Exhaust manifold
6 Bypass

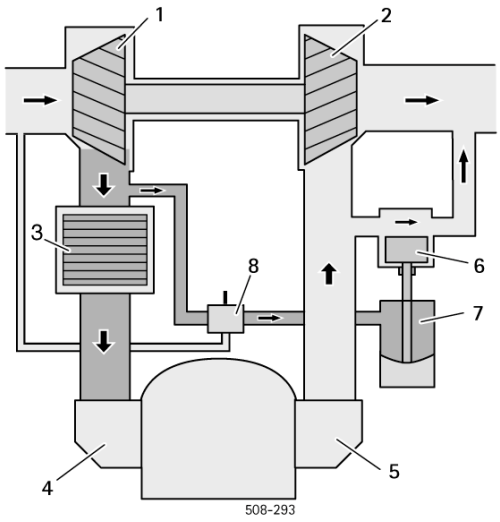
Function

The boost pressure of the turbocharger in the 33-kW engine is adjusted to a specified value.

The boost pressure of the turbocharger in the 40-kW engine is adjusted according to a specified engine map.

For this purpose the waste-gage cycle valve (8) receives electric signals from the MEG (engine/E-gas/gearbox control unit; N48).

The waste-gate cycle valve (8) ventilates the diaphragm pot (7) according to the signals received, which in turn opens and closes the bypass valve (6).



508-29

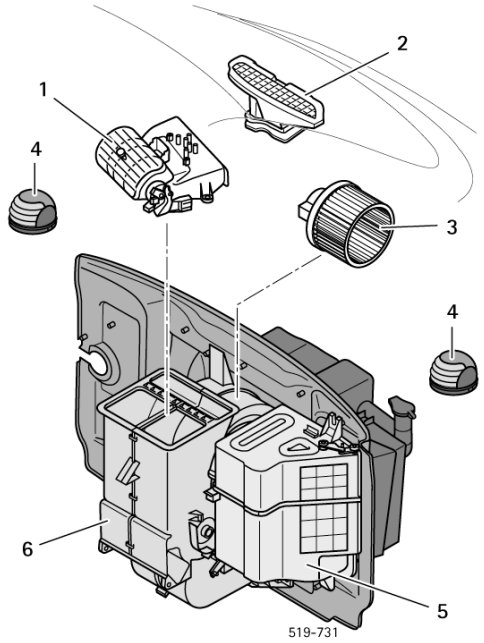
1 Compressor
2 Exhaust turbine
3 Intercooler (M7)
4 Intake manifold
5 Exhaust manifold
6 Bypass valve
7 Diaphragm pot
8 Waste-gate cycle valve (Y77)

Location

The heater heat exchanger is located in the air-distributor box (6).

Function

The heat exchanger is supply directly by the engine via a line and uses the radiator return line as its return.



519-731

1 Centre-nozzle air outlet
2 Windscreen air outlet
3 Electric fan for interior blower
4 Side-nozzle air outlets
5 Recirculation box
6 Air-distributor box with heat exchanger

Task

The air distribution switch enables five settings for the air flow:

> To centre and side nozzles,

> To centre and side nozzles and to footwell,

> To footwell,

> To footwell and windows,

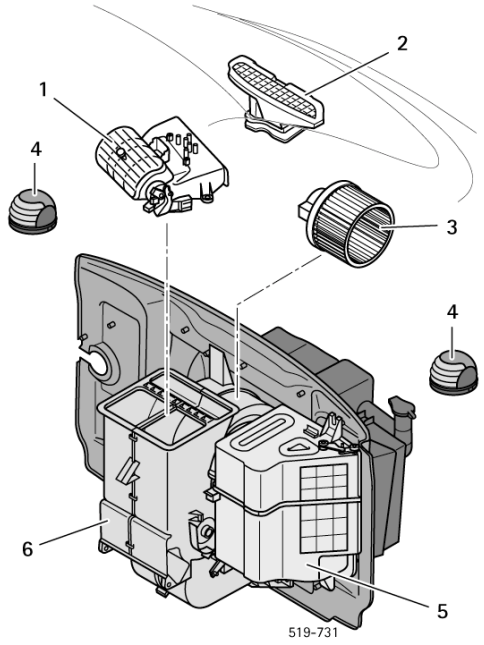
> To windows.

Function

The air for the upper air outlet nozzles floes from the air-distributor box through the instrument panel.

The outlet direction of the centre and side nozzles can be adjusted vertically and horizontally.

The fresh-air blower supplies the air quantity for the passenger compartment.



519-731

1 Centre-nozzle air outlet
2 Windscreen air outlet
3 Electric fan for interior blower
4 Side-nozzle air outlets
5 Recirculation box
6 Air-distributor box (with heater heat exchanger)

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Recirculation Mode

Task

In the recirculation mode the recirculated air flap is closed. This prevents the entry of uncleaned outside air, e.g. with diesel exhaust.

Location

The recirculation switch (1) is located on the left next to the centre nozzle.

Function

In the recirculation mode no fresh air is supplied, but instead the interior air is recirculated.

During long operation in the recirculation mode there is a danger of the windows fogging up, leading to impaired vision.

11_0029a

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Air Conditioner

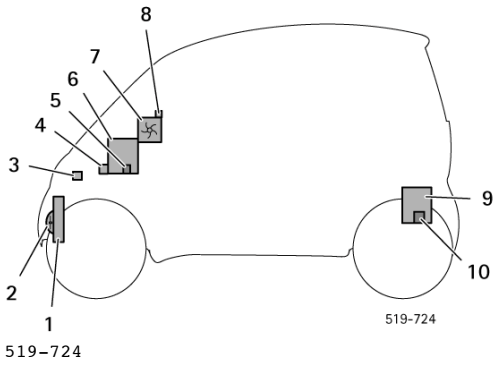
Task

The air conditioner increases driving comfort at high outside temperatures by cooling the air in the passenger compartment.

In addition, the air is dried and an air filter cleans the air flowing into the vehicle.

Location

The illustration shows the location of the air conditioner components.



519-724

1 Condenser with integrated dryer for refrigerant
2 A/C fan
3 Pressure switch
4 Expansion valve
5 Evaporator sensor
6 Evaporator
7 Electric fan of interior blower
8 A/C switch
9 A/C compressor (M4/3)
10 Temperature switch in A/C compressor

>>smart City-Coupé

Air Conditioner

Design

1 MEG (N48; see 02 03, Engine Management)

Sensors:

2 A/C switch
3 Pressure switch in pressure line
4 Temperature switch on A/C compressor
5 Evaporator sensor
6 Water temperature sensor

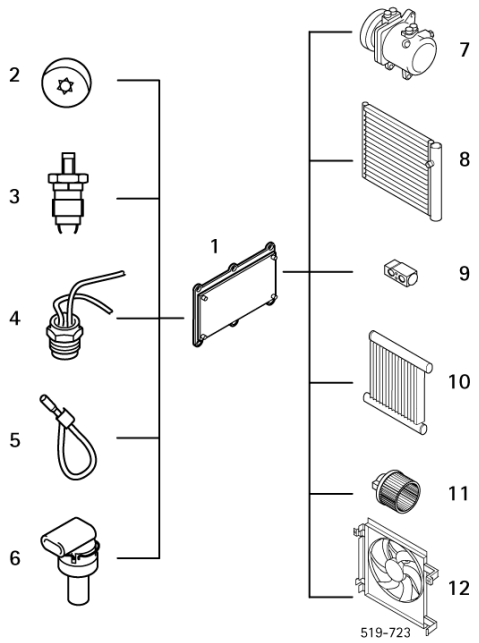
Actuators:

7 A/C compressor (M4/3)
8 Condenser with integrated dryer
9 Expansion valve
10 Evaporator
11 Electric fan on interior blower
12 A/C fan

Function

In the refrigerant circuit heat is extracted from the air flowing past the evaporator. This heat is absorbed by the refrigerant, transported to the condenser and given off there to the outside air.

At a high humidity some water condenses when the outside air flowing in cools so that the air entering the vehicle is drier.

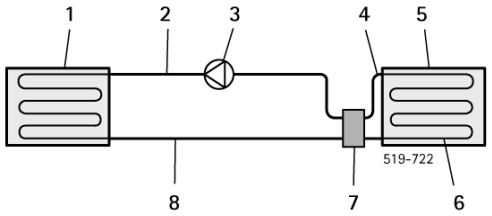


519-723

>>smart City-Coupé

Air Conditioner

> The A/C compressor (3) driven by the engine sucks in the gaseous refrigerant and compresses it to approx. 15 bar.
> On the output side (2) of the compressor this causes the refrigerant temperature to increase to approx. 70 °C.
> Then the refrigerant flows through the condenser (1), giving off heat in the process. Below 62 °C it liquefies.
> The refrigerant flows through the dryer surface integrated in the condenser, in which it is cleaned by a filter. In addition, moisture is also extracted from the refrigerant here.
> Through the expansion valve (7) it reaches the low-pressure area. In the process is vaporises again (6). This cools it to the same degree that it was heated in the compressor.
> As the refrigerant has already been cooled in the condenser, its temperature now drops below the ambient temperature.
> It flows through the evaporator (5), via which it extracts heat from the air flowing by.
> Then the refrigerant flows back to the compressor.



519-722

The unit states of the refrigerant in the refrigerant circuit:

High-pressure, gaseous, hot (2)

High-pressure, liquid, warm (8)

Low-pressure, liquid, cool (6)

Low-pressure, gaseous, warm (4)

In the smart air conditioner only the refrigerant R134a is used.

It has the following properties:

> Free of fluorinated hydrocarbons,

> Gaseous at normal pressure,

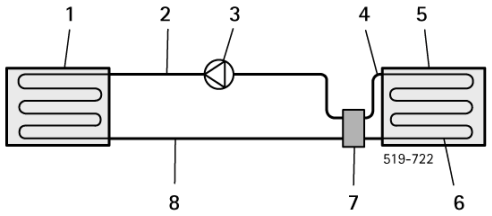
> Liquid under high pressure,

> Odourless,

> Non-flammable and not explosive,

> Easily absorbs moisture,

> Non-toxic in small concentrations.



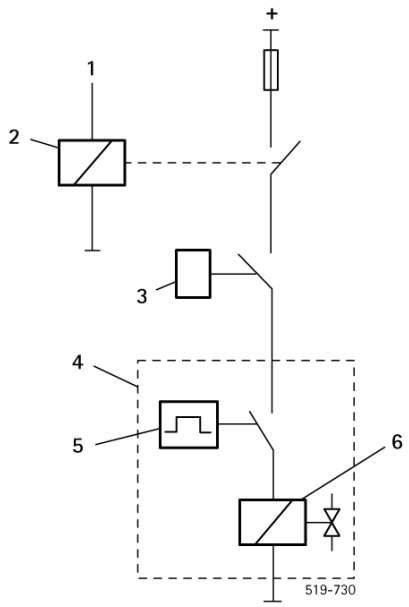
519-722

After the air conditioner switch is actuated, the signal from the central electric system module (central electric/electronic system; N10; see 02 01, Central Electric System) is read in and passed on to the engine/E-gas/gearbox control unit (MEG; N48; see 02 03, Engine Management) via the CAN bus (see 02 00, Engine Management).

Functions of the MEG

- Evaluation of the sensor signals in accordance with their map
- Output of corresponding signals to the magnetic clutch relay (2), with which the A/C compressor (4) is switched on or off
- Increase the engine speed after the air conditioner is switched on
- Monitor the input signals of the sensors and the output signals of the actuators

Any errors are stored in the error memory with specification of the error type.



519-730

1 Signal from MEG (engine/E-gas/gearbox control unit; N48)
2 Magnetic clutch relay
3 Pressure switch in pressure line
4 A/C compressor (M4/3)
5 Temperature switch in A/C compressor
6 Magnetic clutch

>>smart City-Coupé

Air Conditioner

Air-conditioner temperature control

> The evaporator sensor measures the air temperature behind the evaporator.

> In the ECO mode a higher nozzle blow-out temperature is set. This is the temperature of the air that flows out of the nozzle into the vehicle (see TIS for values).

> In the normal mode the nozzle blow-out temperature is lower; see TIS for values.

> The MEG (N48; see 02 03, Engine Management) controls the magnetic clutch of the A/C compressor. This clutch is switched on or off at certain temperature limits.

Blower motor control

The blower motor, which is located behind the condenser and the engine radiator, is switched on or off in dependence on the coolant temperature.

It is also switched on when the air conditioner is switched on.

Task

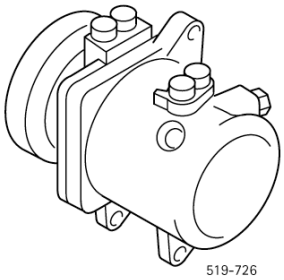
The A/C compressor suck in the gaseous refrigerant and compresses it.

Function

It can only compress gaseous substances.

The compressor is driven by the crankshaft via the integrated magnetic clutch and a flat belt. The A/C compressor cannot be controlled and has no cooling.

The A/C compressor has its own oil supply. The oil partially mixes with the refrigerant.



519-726

Task

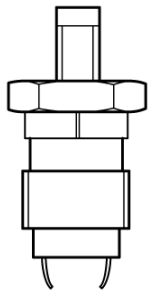
The pressure switch protects the A/C compressor

> against excessively high pressure:
  The system is switched off when the pressure becomes too high due to overfilling, overloading or a defect (see TIS for values);

> against insufficient pressure:
  The system is switched off when, for example, a minimum value is dropped below due to a leaky line, an insufficient fill level or an insufficient ambient temperature (see TIS for values).

Location

The pressure switch is located on the output side (pressure side) of the A/C compressor.



519-725

Task

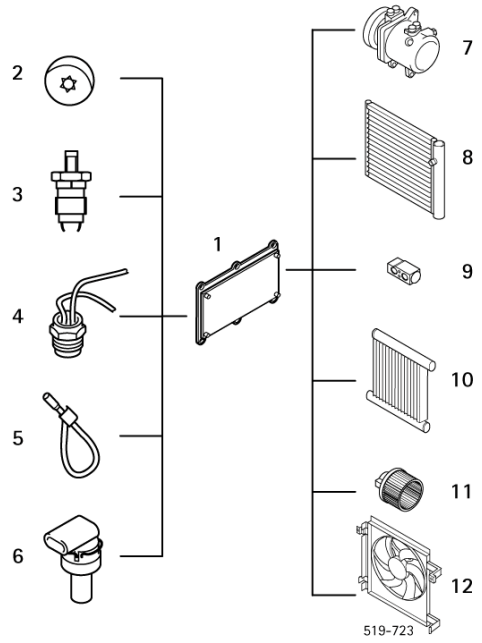
The temperature switch protects the A/C compressor from overheating.

Location

The temperature switch (4) is located on the A/C compressor (7).

Function

If the refrigerant temperature is too high (see TIS for values), then the A/C compressor is switched off.



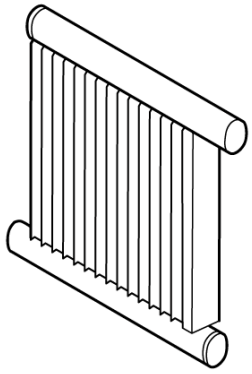
519-723

Task

The evaporator cools the air that flows into the vehicle interior.

Function

The evaporator acts like a heat exchanger. The refrigerant metered by the expansion valve is sprayed into the evaporator as liquid at low pressure. Here it evaporates into the cooling coils and extracts heat from the air flowing by in the process, i.e. cools it down.



519-729

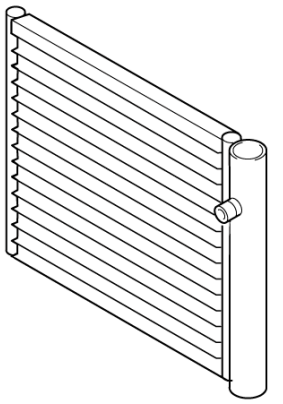
Task

In the condenser the gaseous refrigerant is liquefied by cooling.

The refrigerant dryer integrated in the condenser, which is also equipped with a filter, is simultaneously used as a reservoir for the liquid refrigerant.

Location

The condenser is located in the front of the vehicle, in front of the radiator.



519-727

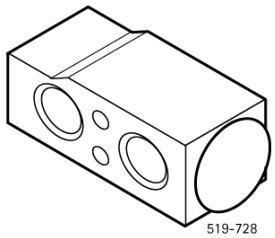
519-727

Task

The expansion valve controls the refrigerant flow into the evaporator.

Location

The expansion valve is located on the high-pressure side between the condenser and the evaporator, on which it is also mounted.



519-728

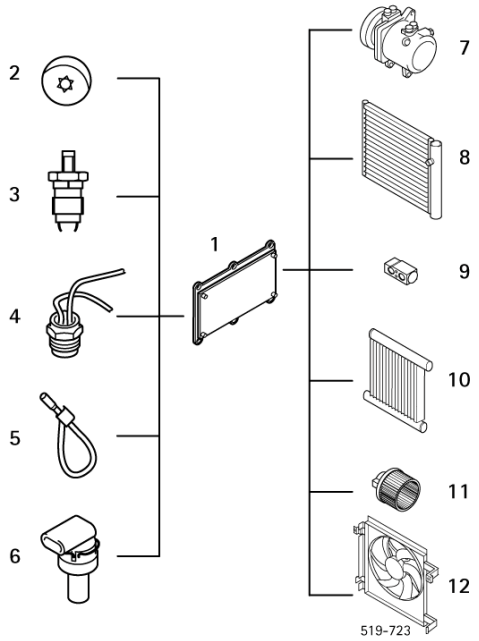
Task

The evaporator sensor controls the air exit temperature in the ECO and normal modes. In addition, the evaporator sensor protects the evaporator from icing up. This can occur at temperatures below 3 degrees centigrade, blocking the air flow through the evaporator. Therefore, the air conditioner is switched off at this limit value.

In addition, the evaporator sensor controls the temperature in both temperature states in the refrigerant circuit.

Location

The evaporator sensor (5) is located in the evaporator housing (10).



519-723

>>smart

smart Tester

Task

The smart Tester supports the Service personnel when performing maintenance, diagnosis and repairs on the electronic systems of the smart.

In addition, it offers repair and special functions and also permits the measurement of electric variables (see 08 01, Measuring Technology).

Design

The smart Tester is designed as a laptop PC (486/Pentium) with the operating system Windows NT.

521-801

Design

1 Indicator LED: smart Tester switched on or off

2 Indicator LED: External power supply (mains connection)

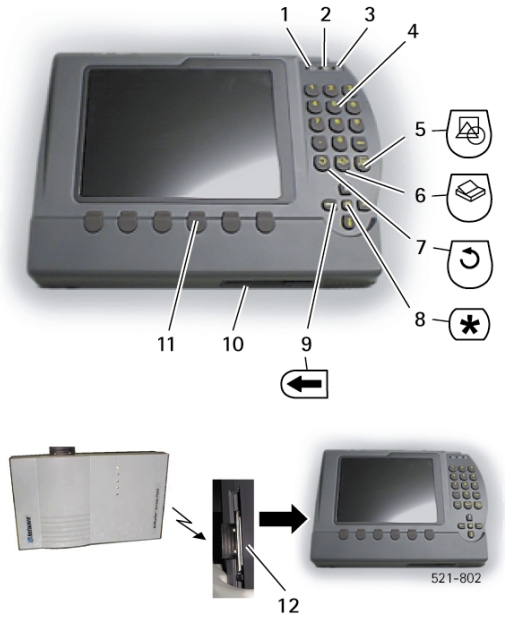
3 Indicator LED: Charging state of internal battery
green: Battery is being charged
red: Battery is drained
no display: Battery fully charged

4 Number pad for number entry

5 Integration key <F9>:
Menu bar (toolbar) with various buttons of the individual programs (DMS, FIND IT, ERM, EPC, Osci, Multi) appears at top of screen

6 Print <F8>: Printing on a network printer

7 Jump back with <F7> (round arrow) after selection from the menu:
> back to last menu
> back to main menu
> vehicle change
> end FIND IT



521-802

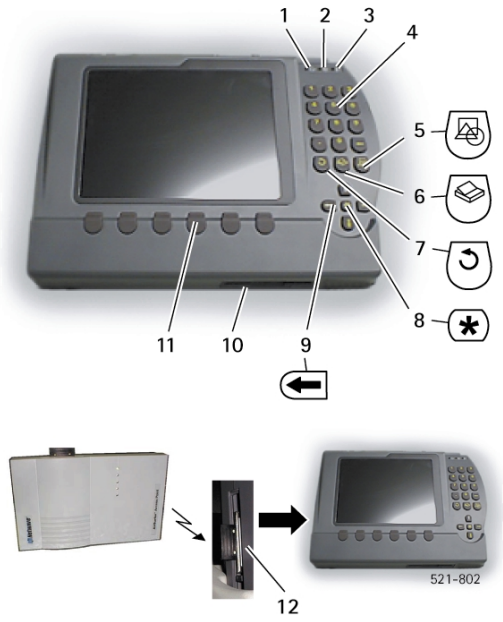
8 Enter key (marked with an *) for confirming and for running menu options after selection with the cursor keys

9 Cursor keys for selecting of menu options

10 Floppy disk drive, 3.5 inch
on smart Tester 486;
CD-ROM drive on smart Tester Pentium

11 Function keys <F1> to <F6>:
for running functions during diagnosis, e.g. navigation forward and back, delete error memory, yes/no queries or running the online help

12 Radio LAN: Wireless network connection to the server in the smart Centre



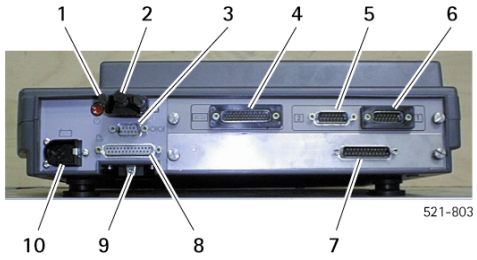
521-802

Design

1 On/Off switch: To switch off, press and hold the button briefly

2 smart Tester 486: Video connection for an external monitor. If no monitor is connected here, then the contacts are bridged with a plug (dongle) and the LC display is operated with a resolution of 800 x 600 pixels.
smart Tester Pentium: Connection for a fixed network card (Ethernet). If a wireless connection to the server in the smart Centre is not possible, the Tester can be connected to the network here with a cable after connecting an adapter included in the delivery scope.

3 Serial port: Interface for a mouse



521-803

4 Measuring cable connection (currently not in use)

5 Plug II: Measuring cable connection (current measurement)

6 Plug I: Measuring cable connection (voltage/ resistance measurement)

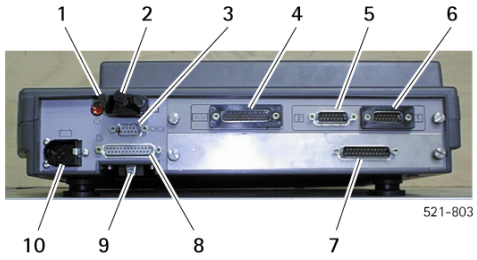
7 Communication card for communication of the FIND IT application with the control units

8 Parallel port, e.g. for a printer

9 Connection to the smart Tester console

10 Connection for 12-volt power supply

For diagnosis the smart Tester is connected to the central electric system (Central electric system; F10) with a diagnosis cable.



521-803

Design

> Connection to the 220-volt power system via the console (see 08 01, smart Tester, LEDs and Keys; Item 9) with the supply and data cable:
The internal battery of the smart Tester is only charged when the plug of the supply and data cable is inserted in the smart Tester and the console is not separated from the 220-volt V-power supply. When the smart Tester is being charged, the three indicator LEDs light up brightly. When the battery is fully charged, the right indicator LED goes out.
If the battery is drained, the right indicator lamp lights up red; it flashes briefly before the Tester switches off.

> Via the communication cable from the vehicle:
The battery of the smart Testers is not charged; only the two left indicator LEDs light up brightly.

> From internal battery:
Only the left indicator LED lights up brightly.

When the supply and data cable is connected, the vehicle battery can discharge.

The internal battery of the smart Tester can supply the necessary voltage for approximately 30 minutes of operation.

521-807

Design

The console of the smart Tester has the following functions:

> Serves as a support for the smart Tester
> Storage surface for the mouse
> External power supply for the smart Tester (220-volt power system)
> Routing out of several external connections (keyboard, printer etc.)
> Storage possibilities (compartment with lid, free slot)

521-805

Design

1 Connection to the 12-volt power supply

2 Serial port, not in use

3 Serial port for the connection of a mouse

4 Connection for a PC keyboard

5 Power supply, 220 V/50 Hz via mains cable

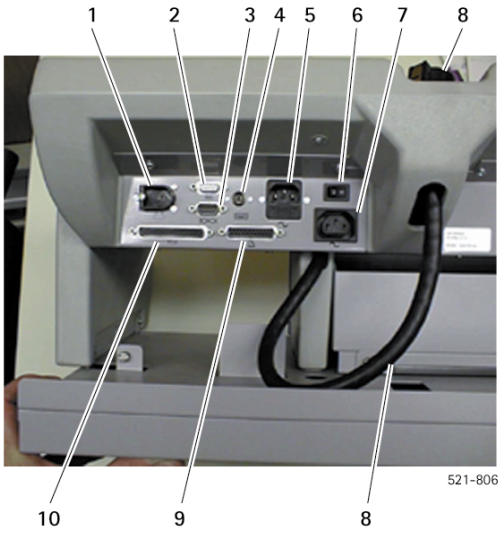
6 Power supply switch:
"1" = ON, "0" = OFF
If the switch is set to "0" = Off, then the smart Tester is disconnected from the mains and the battery is not being charged.

7 Electrical outlet, e.g. for an external monitor

8 Combined power supply and data cable for the external supply of the smart Tester via the 220-volt power system and the routing out of the external connections (mouse. keyboard etc.) via the console, and for charging the internal battery of the smart Tester

9 Parallel port for printer, not in use

10 Connection for a CD-ROM drive, not in use



521-806

>>smart

smart Tester

Starting smart Tester

Function

Without a mains connection for use locally, proceed as follows:

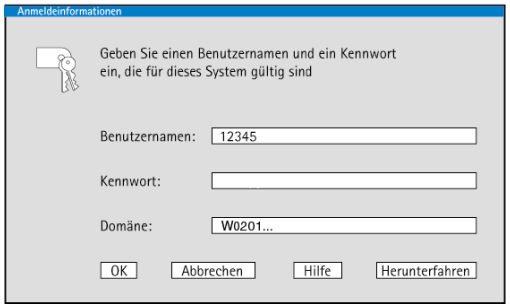
After switching on the smart Tester the login dialog box appears. The cursor is located in the "User name" field. Here you enter the numeric code for the user or accept the preset code.

Note:
When using the Tester locally, there is no mouse or PC keyboard connected.

> Activate the number block (via the Num key above the number block of the keypad) before disconnecting the plug of the supply and data cable.

Otherwise it is not possible to enter the password.

> In the case of a local logon, there is no connection to the NT server: Control unit programming, learning of vehicle keys and enabling of the Softouch mode are not possible. On the other hand, order processing in the DMS is possible.



521-808a

521-808a

>>smart

smart Tester

Starting smart Tester

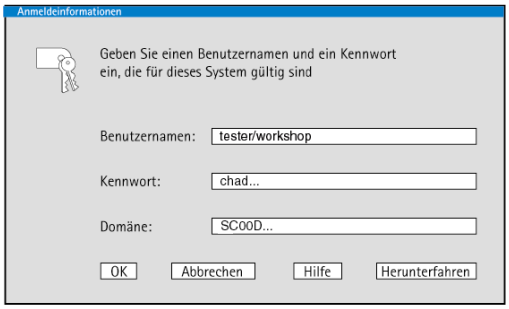
Login

Always log in as "Tester" or "Workshop".

The "Password" field can be reached as follows:

> Press the Enter key <*> on the smart Tester.
> The login process stops with an error message and can be skipped wit the Enter key <*>. The login dialog box appears again and the cursor is positioned in the "Password" field.
> Enter the password in the "Password" field.
> Press the Enter key <*>. Now the login process continues.

Make sure that the correct domain has been selected.



521-809a

521-809a

Notes on changing between the menus and programs

> Programs must always be closed in the reverse order in which thy were opened.
> A program change may only be carried out via the toolbar.
>
> The toolbar appears at the top of the screen when the integration key <F9> is pressed.

Example

You change from the DMS (Dealer Management System) to FIND IT and proceed from there to the ERM (Electronic Repair Manual).

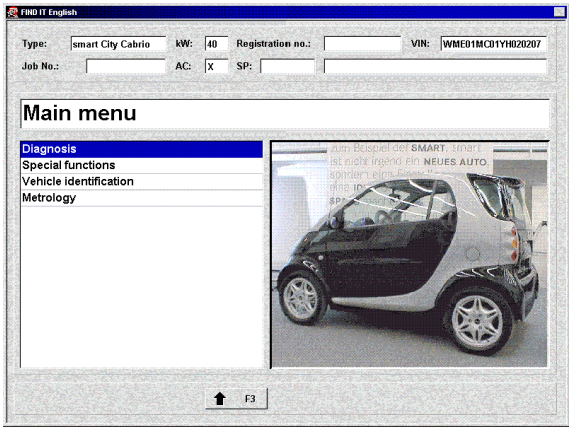
Then you must first change from the ERM to FIND IT again and then from there to the DMS. It is vital that this sequence be followed exactly and it may not be bypassed with other Windows function keys (taskbar).

If you change from FIND IT to ERM/EPC (Electronic Repair Manual/Electronic Parts Catalogue), you obtain information there on the respective diagnosis step and on the repair instructions and spare parts.

00130500

Functions

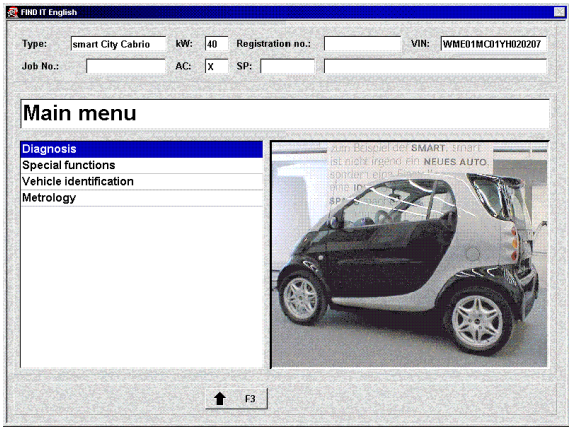
> Diagnosis
  > Short test (see 08 02, Diagnosis Functions, Short Test)
  > Assembly
  > Symptoms (see 08 03, Diagnosis Functions)
  > Systems (see 08 02, Diagnosis Functions)
> Special functions
  > Programming control units, e.g. flashing of MEG/EDT
  > Electronic immobiliser, e.g. learning vehicle keys (see 08 02, Special Functions, Electronic Immobiliser)
  > Repair functions, e.g. replacing control unit
  > Enabling Softouch
  > Installing speedometer
  > Enabling child's-seat lock detection
  > Resetting child's-seat lock detection



00130501

The illustration contains the header with the vehicle data they have been adopted from the vehicle identification by the control unit.

> Vehicle identification
(see 08 01, Vehicle Identification)
  > Identification by control unit
  > Manual identification
  > Identification by DMS (automatic identification)
> Measuring technology (see 08 01, Measuring Technology)
  > Multimeter
  > Oscilloscope



00130501

>>smart

Vehicle Identification

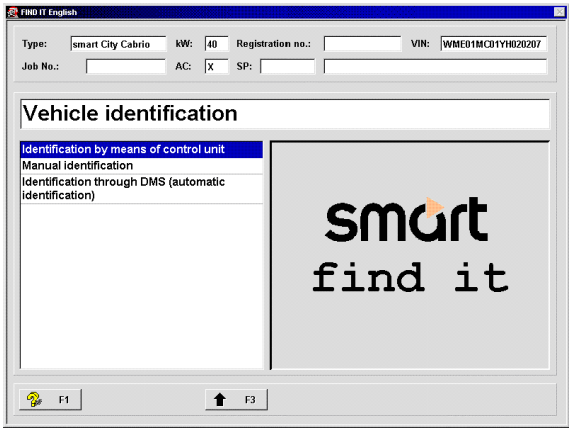
Task

The vehicle identification provides certain information on the vehicle required by the program of the smart Tester for a diagnosis.

Design

The following information is absolutely necessary for a clear identification:

> Vehicle model: smart City-Coupé, smart City Cabrio, smart City-Coupé cdi
> Engine output: 30 kW, 33 kW or 40 kW
> Chassis number (VIN, Vehicle Identification Number), for all communication with the vehicle
> SP (Service Package), for certain services
> Order number (WIP), for certain services



00130502

>>smart

Vehicle Identification

The three types of identification

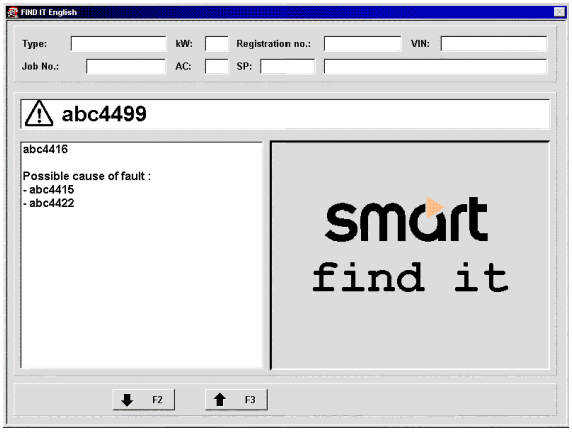
> Identification by control unit

> Manual identification
  The user must enter the required data in a mask of the smart Tester.

> Automatic identification (identification by DMS)
  The data are adopted in the FIND IT application from a vehicle database at the smart Centre.

If the vehicle data are not complete when changing from the FIND IT input screen to the main menu, an error message points this out and requests identification by the control unit or manually.

As a result, navigation in the main menu without complete vehicle data is not possible with the current version 2.2.



00130503

>>smart

Vehicle Identification

Identification with Control Unit

Function

In this case the vehicle model, engine output, chassis number (VIN, Vehicle Identification Number) and, if necessary, the presence of the air conditioner (AC, Air Conditioner) is read out of the central electronics system (Central electric system; F10).

These data are then displayed in the corresponding fields of the header.

Following the vehicle identification the program automatically changes to the main menu.

00130504

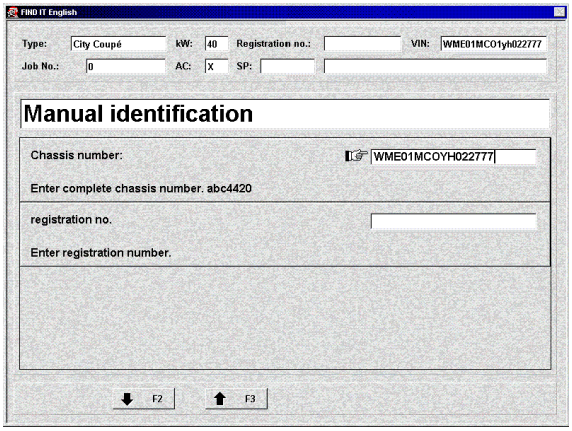
Function

In this case you will be guided through dialog boxes asking for the vehicle information. Confirm the input fields with the <F2> key or the selection from a list with the Enter key <*>.

The information is requested in the following sequence:

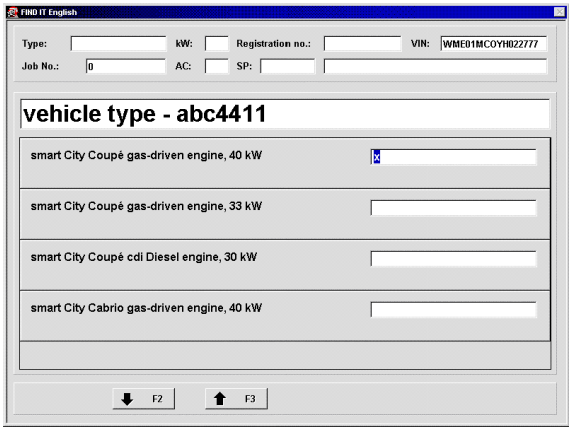
> Chassis number (entry is mandatory)

> Registration number (entry is not mandatory)



00130505

> Vehicle model
  Any character can be entered for the model concerned. Then confirm the entry with the <F2> key.

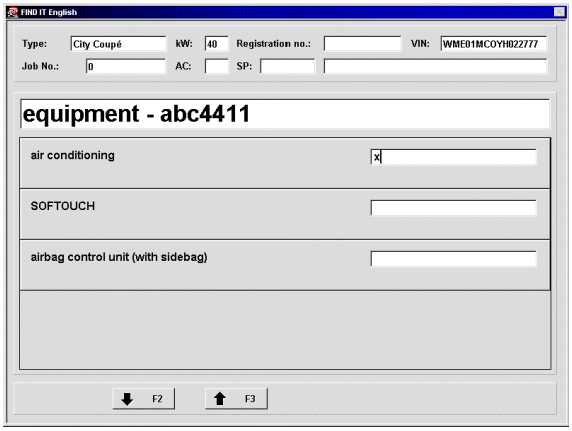


00130506

> Equipment (air conditioner, Softouch, airbag control unit, with side airbag if applicable). Any character can be entered for the applicable equipment. Then confirm the entry with the <F2> key.

The entered or selected data are displayed in the corresponding fields of the header.

Following complete manual identification the program automatically changes to the main menu.



00130507

Function

In this case the saved vehicle data for the vehicle concerned are read out of the DMS (Dealer Management System) and displayed in the corresponding fields of the header.

Without order in the DMS

> Connect the smart Tester to the diagnosis plug on the central electronics system (Central electric system; F10) with the connection cable and switch on the ignition.

> Press the <F2> key on the initial FIND IT screen to change to the main menu.

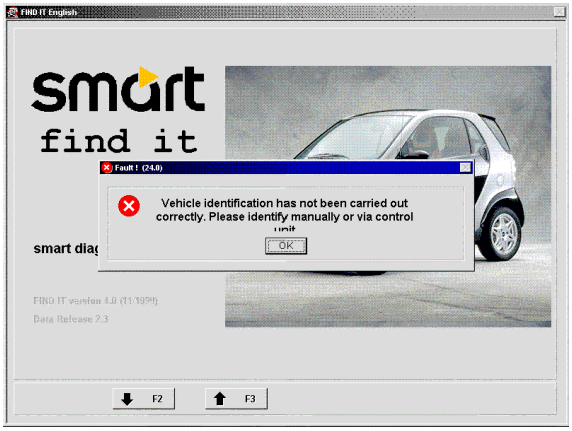
> A warning appears that the diagnosis-relevant vehicle date are missing and a vehicle identification must be carried out manually or via the control unit.

> Make a selection with the cursor keys and confirm the selection with the Enter key <*>.

Function keys

<F2> Navigate forward

<F3> Jump back one menu (general)



00130508

With order in the DMS

Before you change to the FIND IT diagnosis function via the toolbar, you have created an order or opened an existing one in the DMS. It contains all diagnosis-relevant vehicle data.

> Move the cursor in the DMS to the upper edge of the screen. The "Toolbar (Framework)" bar is opened. Select FIND IT.

> Connect the smart Tester to the diagnosis plug on the central electronics system (Central electric system; F10) with the connection cable and switch on the ignition.

> Press the <F2> key on the initial FIND IT screen.

> The diagnosis-relevant vehicle data are now automatically adopted from the DMS and the header is filled in accordingly. A log file is automatically created which logs the entire diagnosis sequence. The main menu is displayed.

00130500

>>smart

Vehicle Identification

Automatic Identification

> After completing diagnosis on this vehicle you must return to the initial FIND IT screen. To do this, press the <F7> key (round arrow) on the smart Tester and select the menu item "Vehicle change". Back in the initial FIND IT screen, press the integration key <F9> and select "DMS" in the toolbar.
> Create an order in the DMS or open an existing order.
> If you now return to the initial FIND IT screen from the DMS via the toolbar and change to the main menu again, the new, diagnosis-relevant vehicle data are automatically adopted from the DMS, and the header is filled in accordingly. In addition, a new log file is also created.

00130509

<F7> key (round arrow)

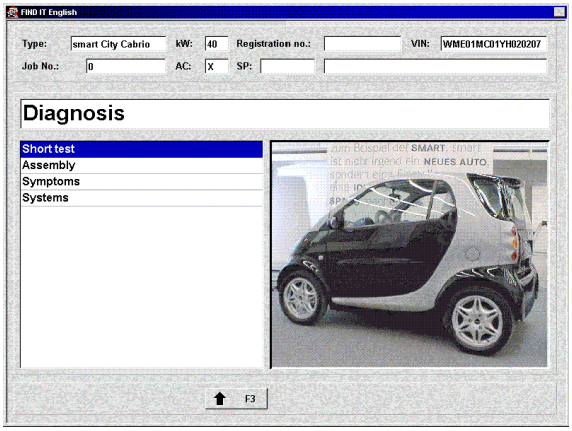
<F9> key (integration key)

>>smart

Diagnosis Functions of smart Tester

The smart Tester is equipped with the following diagnosis functions:

> Short test (see 08 02, Diagnosis Functions, Short Test):
  Interrogation of the control units
> Assembly
  Specific access to a component
> Symptoms (see 08 03, Diagnosis Functions):
  Entry via symptoms, customer complaint
> Systems (see 08 02, Diagnosis Functions, Systems):
  Specific access to a control unit



00130510

>>smart

Diagnosis Functions of smart Tester

During a diagnosis the smart Tester also evaluates the following information on the vehicle:

> Order No.,

> Registration number,

> SP: Service Package number and designation.

The chassis number is stamped into the floor panel next to the battery (upper illustration).

In addition, it is also indicated on the adhesive label on the right-hand B-pillar (lower illustration) or on the adhesive label in the centre near the service opening for the rear module.

522-842

522-842

>>smart

Diagnosis Functions of smart Tester

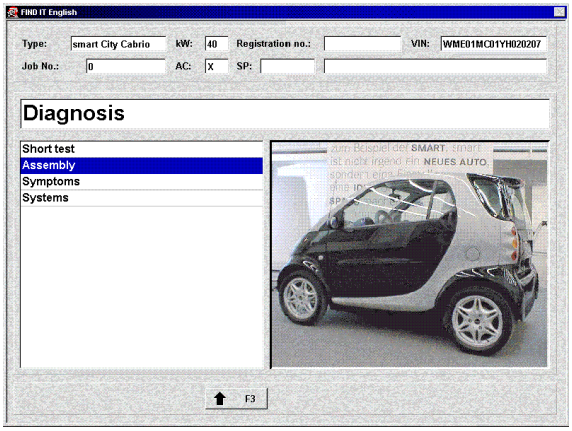
Assembly

Design

The "Assembly" function of the smart Tester contains the troubleshooting lists for those assemblies which are electrically controlled or are part of the power supply.

There are troubleshooting lists for:

> Assemblies,
> Components,
> Accessories,
> Optional extras.



00130511

>>smart

Diagnosis Functions of smart Tester

Assembly

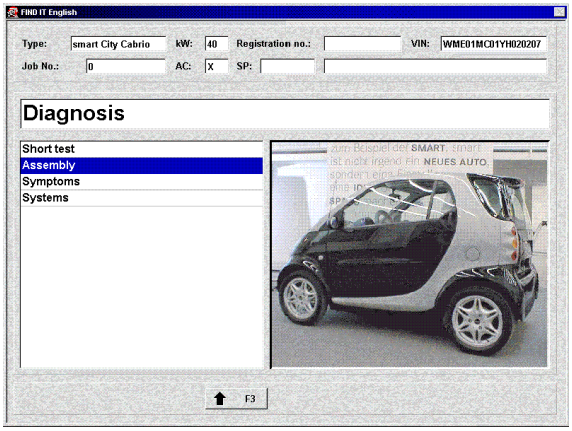
Running the function

> Change from the initial FIND IT screen to the main menu with the <F2> key.

> If you have not already done so, conduct a vehicle identification with the DMS (Dealer Management System), control unit or manually.

> Select the "Diagnosis" function in the main menu with the cursor keys and confirm the selection with the Enter key <*>.

> Select the "Assembly" function in the diagnosis menu with the cursor keys (see previous illustration) and confirm the selection with the Enter key <*>.



00130511

>>smart

Diagnosis Functions of smart Tester

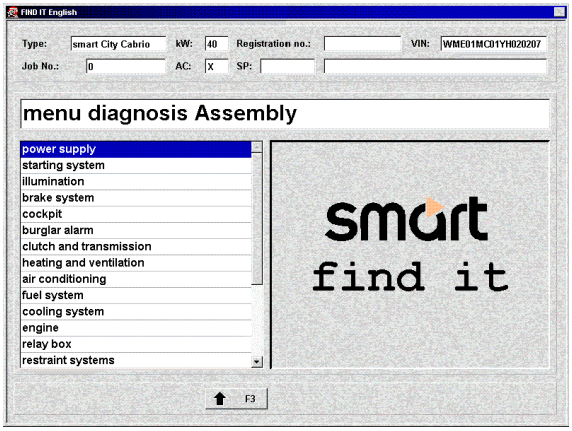
Assembly

In the menu that now appears you will find all components or assemblies that are electrically controlled or belong to the power supply, plus accessories and optional extras.

> Now select the desired entry with the cursor keys.

> Confirm the selection with the Enter key <*>.

This brings you to the troubleshooting list for the selected component or the assembly concerned.



00130512

Troubleshooting lists

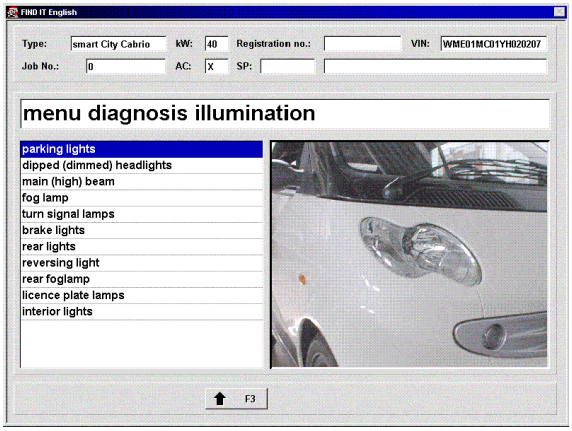
A troubleshooting list can be displayed for each component and assembly. The procedure will be explained here using the example of the lighting.

You have selected the entry "Lighting" with the cursor keys in the "Assembly" menu shown beforehand and have confirmed this selection with the Enter key <*>.

A list of all parts of the lighting system appears.

> Select the desired or defective component with the cursor keys and confirm the selection with the Enter key <*>.

> Now follow the instructions that guide you through the troubleshooting list until the fault is found.



00130513

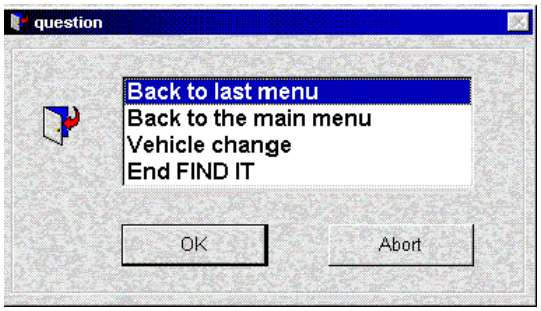
Returning from the lowest level of the troubleshooting list

> Press the <F7> key (round arrow).

A selection window appears.

> Select "Return to last menu" and confirm the selection with the Enter key <*>.

The previous menu opens.



00130509

>>smart

Measuring Technology

Measuring and Test Tools

Design

> smart Tester for diagnosis
(see 08 01, Diagnosis Functions and 08 02, Diagnosis Functions and 08 03, Diagnosis Functions)

> Multimeter function
  > Voltmeter
  > Ammeter
  > Ohmmeter
  > Diode measurement
  > Continuity tester

  Special measuring cables and a current measuring clip are available as accessories for this purpose.

> Oscilloscope function
  > Visualisation of signal curves
  > Voltage measurement
  > Current measurement
  > Frequency measurement

The use of the smart Tester as a Multimeter and as an oscilloscope is described in the following.

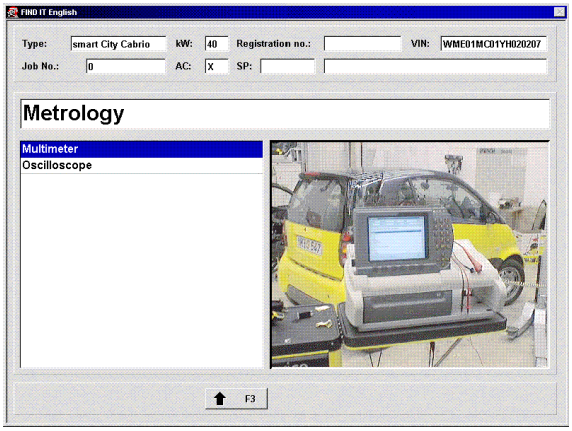
Before this the pairs of terms

> analogue and digital

and

> control and regulation

will be explained briefly.



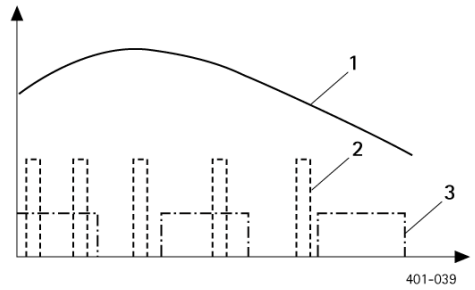
00130514

Analogue and digital

> An analogue signal (1) corresponds to a continuously changeable variable, e.g. to a voltage.
> On the other hand, a digital signal (2) can only take on certain values, i.e. cannot change continuously.
> A binary signal (3) can only assume to different values.

An analogue-digital converter converts an analogue signal, e.g. the voltage resulting at an NTC resistor, to a digital voltage signal, which can be fed to a digital computer or memory or a digital display. "NTC" means "negative temperature coefficient", i.e. as the temperature increases, the resistance decreases, and the voltage drops at it.

The sensor that measures the coolant temperature in the smart is an NTC resistor.



401-039

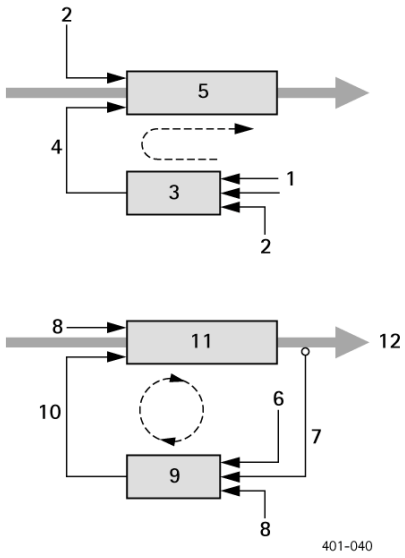
Open and closed-loop control

With open-loop control one or several input variables (1) influence the manipulated variable (4) in the system concerned with the actuator (3), which than acts on the system to be controlled (5). Any influencing quantities (2) present are not taken into account by the actuator and its control unit (3).

This kind of open functional circuit is characteristic for open-loop control.

With closed-loop control one of the controlled variables in the system concerned, an actual value (7), is continuously acquired and compared to the related setpoint, the reference variable (6). Differences between these two and possible influencing quantities (8) result via the actuator and its control unit (9) in new manipulated variables (10), and with them to new outputs (12) of the system to be regulated (11).

Characteristic for a regulation is the presence of a feedback, i.e. of a closed circuit, which is therefore called a closed-loop control circuit.



401-040

Function

The "Multimeter" function of the smart Tester can be used as follows:

> as a voltmeter,

> as an ammeter,

> as an ohmmeter or continuity tester,

> for diode measurement.

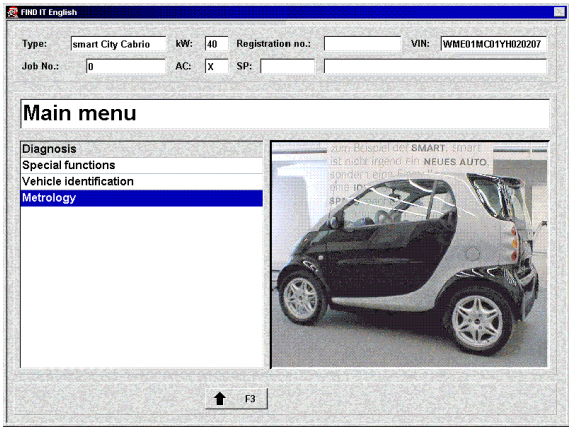
During diagnosis and troubleshooting the following fault causes can be examined in greater detail or localised:

> Defects in electrical components,

> Open circuits,

> Short circuits,

> Contact resistances, e.g. in connectors.



00130515

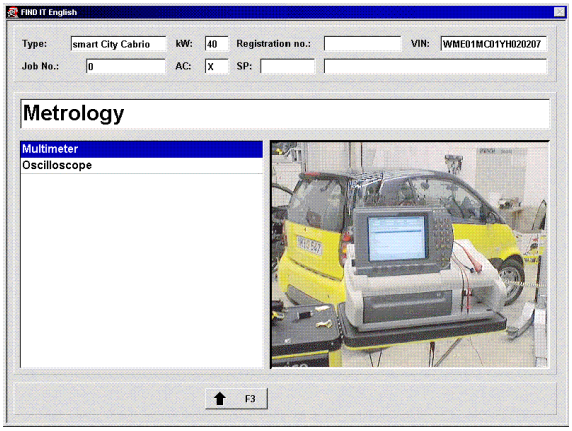
Running the function

> Press the integration key <F9> and select "Multi" in the toolbar with the cursor keys. Note: If you want to run the Multimeter function via the menu, a corresponding message will appear on the toolbar.

> Confirm the selection with the Enter key <*>.

> Connect the measuring cable on the back of the smart Tester (see 08 01, smart Tester, Connections; Plug I, Item 6).

> Confirm the selection with the Enter key <*>.



00130516

Now the "Multimeter" function is active.

Key functions

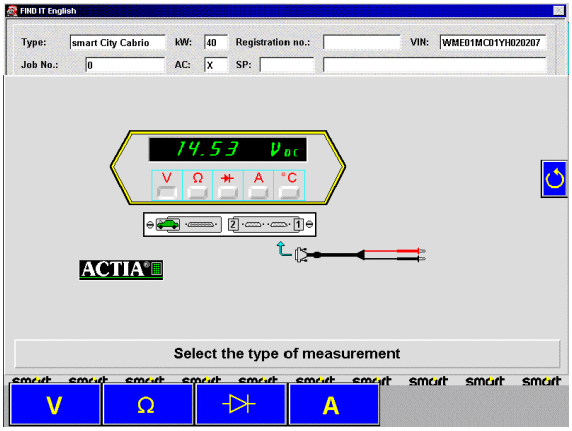
V Voltmeter (<F1>)

Ω Ohmmeter (<F2>)

⊣▷⊢ Diode measurement (<F3>)

A Ammeter (<F4>)

 <F7> key (round arrow)
Return to initial screen
"Measuring Technology"



525-007

Measuring direct voltage

Press the "V" key (<F1>) for the "Voltmeter" function on the screen shown previously.

As soon as the test tips of the measuring cable make contact with the measuring points, the measured voltage is displayed.

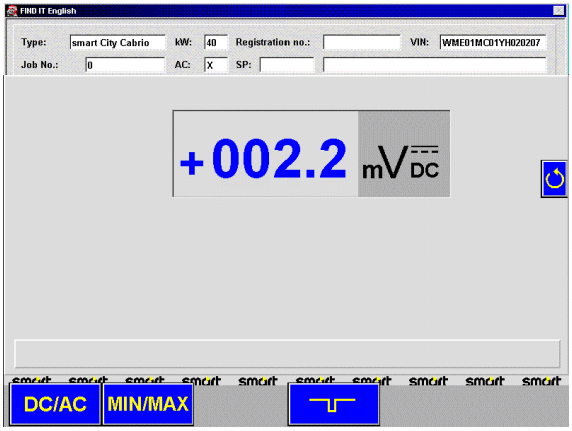
Technical data of voltmeters

In measuring channel 1 two measuring ranges are possible, between which the system changes automatically:

> 0 V to +/-40 V
  > Resolution: 10 mV
  > Accuracy: +/-2 percent
> +/-40 V to +/-400 V
  > Resolution: 0,1 V
  > Accuracy: +/-5 percent

Key functions

DC/AC	Change between direct voltage (DC) and alternating voltage (AC) measurement (<F1>)
MIN/MAX	Display maximum and minimum value during a measurement (<F2>)
⌐⊔⌐	Continuity test for battery voltage (<F4>)
	<F7> key (round arrow) Return to initial screen "Measuring Technology"



525-008

Working with the MIN/MAX display

Press the MIN/MAX key (<F2>).

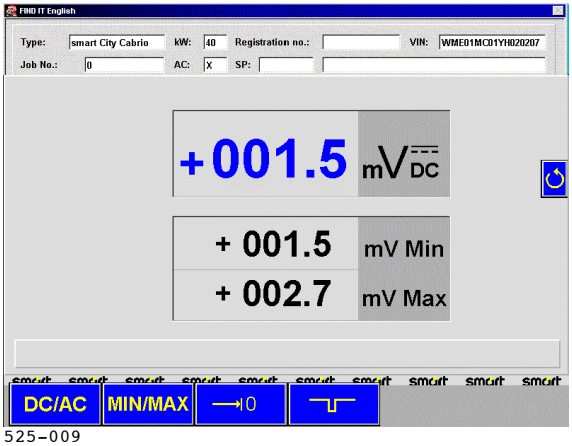
The following is displayed below the current measured value:

> the lowest measured value (Min),

> the highest measured value (Max).

With the "→0" key (<F3>) you can reset the MIN/MAX display.

Pressing the MIN/MAX key again returns to the "Voltage measurement" function.



525-009

Continuity test for battery voltage

This function is only available with the direct voltage measurement. With it brief open circuits (loose contacts) can be detected.

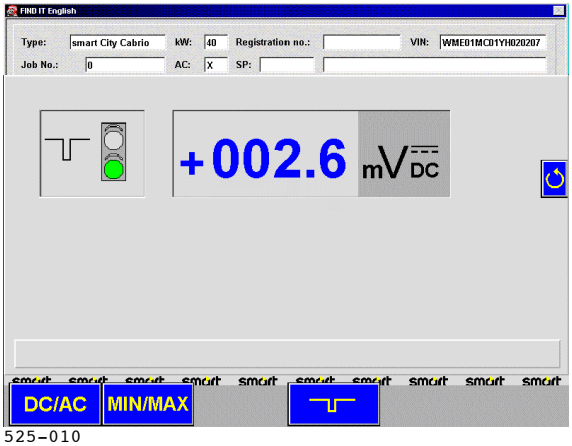
> Press the rectangular button (<F4>).

> Connect the test tips to a consumer and to the battery voltage.

If there is a conductive connection, then the voltage present will be displayed and the traffic signal lights up.

In the case of a brief open circuit, the voltage drops to zero and the ample lights up red.

> With the <F7> key (round arrow) you return to the initial screen "Multimeter".



525-010

Measuring alternating voltage

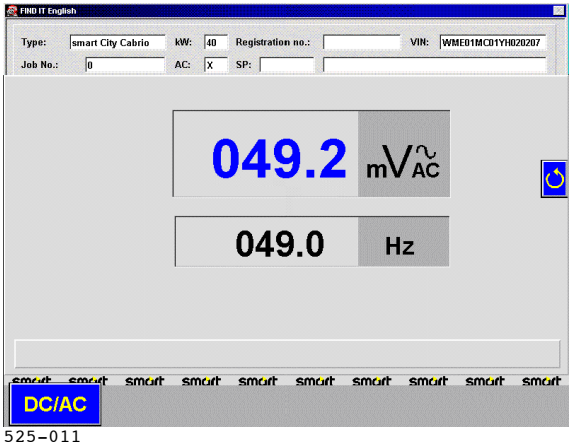
> Press the DC/AC key (<F1>) in the "Voltage measurement" function.

> Connect the measuring cable to the component to be checked.

The alternating voltage connected and its frequency will be shown on the screen.

The measuring range is automatically set so that it is always optimal.

> With the <F7> key (round arrow) you return to the initial screen "Multimeter".



525-011

Current measurement

Press the "A" key (<F4>) in the "Multimeter" function for the "Ammeter" function.

Always use a current measuring clip for this measurement. Connect it on the back of the smart Testers (see 08 01, smart Tester, Connections; Plug II, Item 5).

The measured alternating current is displayed on the screen in ampere.

> Calibrate the current measuring clip before each current measurement, as otherwise the measurement is unreliable.

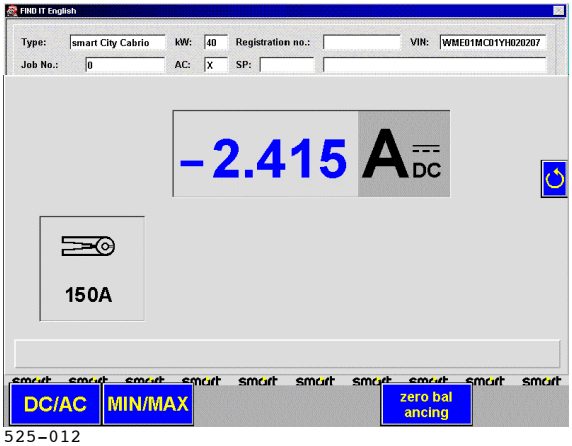
Key functions

DC/AC Change between direct current (DC) and alternating current (AC) measurement (<F1>)

MIN/MAX Display maximum and minimum value during a direct current measurement (<F2>)

Calibration
Calibration of the current measuring clip (<F4>)


<F7> key (round arrow)
Return to "Multimeter" function



525-012

Working with the MIN/MAX display

Press the MIN/MAX key (<F2>).

The following is displayed below the current measured value:

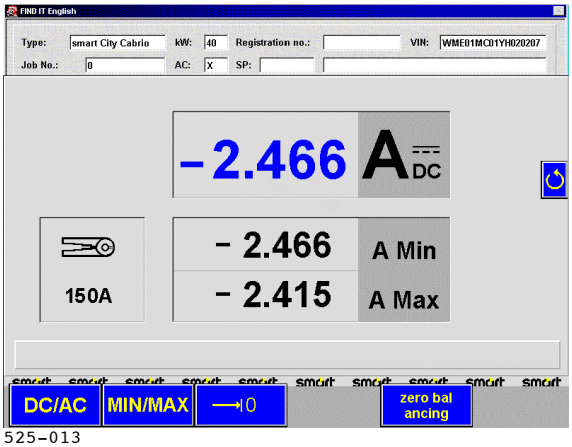
> the lowest measured value (Min),

> the highest measured value (Max).

If the values are exceeded or dropped below, they will be updated.

With the "→0" (<F3>) key you can reset the MIN/MAX display.

With the MIN/MAX key you return to the "Direct current measurement" function.



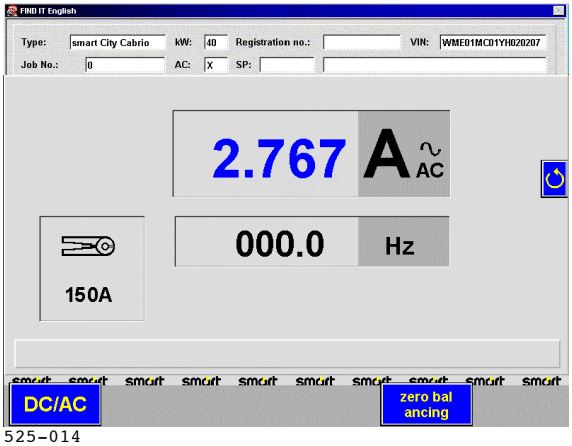
525-013

Alternating current measurement

> Press the DC/AC key (<F1>) in the "Direct current measurement" function.

The alternating current and its frequency are shown on the screen in ampere (A) or in Hertz (Hz).

> With the <F7> key (round arrow) you return to the "Alternating current measurement" function.



525-014

Resistance measurement

> Press the "Ω" key (<F2>) in the "Multimeter" function for the "Ohmmeter" function.

> Connect the measuring cable on the back of the smart Tester (see 08 01, smart Tester, Connections; Plug I, Item 6).

As soon as the test tips of the measuring cable contact the measuring points, the measured resistance is displayed.

Technical data of ohmmeters

The entire measuring range in measuring channel 1 or 2 is divided into two measuring ranges, between which the system changes automatically:

> Measuring range 0 to 20 kΩ
  > Accuracy: +/-2 percent

> Measuring range 20 kΩ to 1 MΩ
  > Accuracy: +/-5 percent

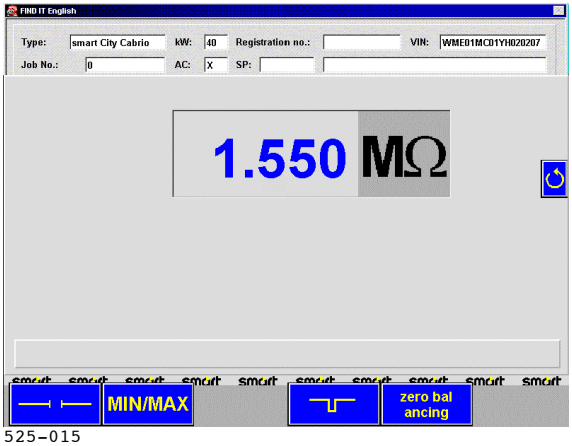
The resistances of the measuring cable are not compensated.

Key functions

MIN/MAX Display maximum and minimum value during a resistance measurement (<F2>)

Change to continuity test (<F4>)

<F7> key (round arrow)
Return to selection of measuring type



525-015

Working with the MIN/MAX display

Press the MIN/MAX key (<F2>).

The following is displayed below the current measured value:

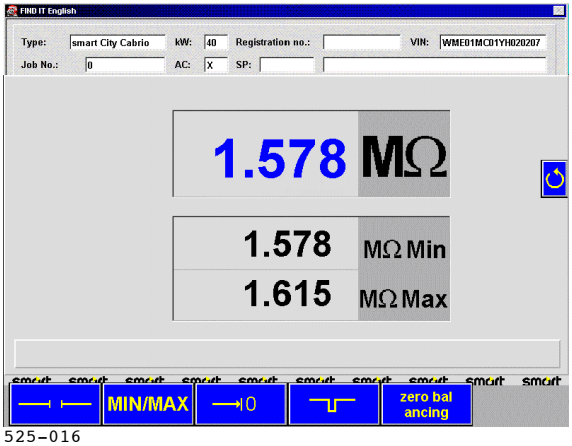
> the lowest measured value (Min),

> the highest measured value (Max).

If the values are exceeded or dropped below, they will be updated.

With the "→|0" (<F3>) key you can reset the MIN/MAX display.

Pressing the MIN/MAX key again returns you to the "Resistance measurement" function.



525-016

Continuity test

With the continuity test brief open circuits (loose contacts) can be detected. It can be conducted both during the MIN/MAX measurement and during the simple resistance measurement.

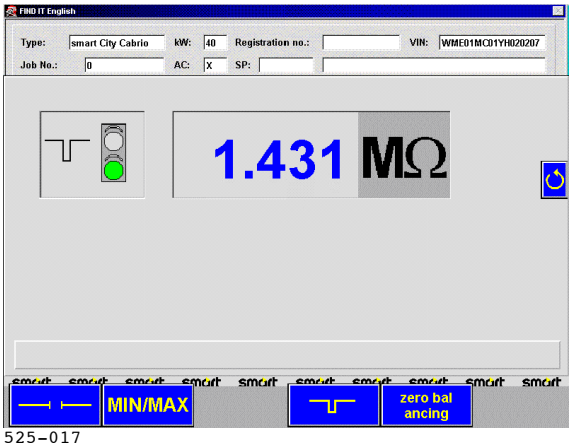
It is shown here using the example of a simple resistance measurement.

> Press the rectangular key (<F4>) in the "Resistance measurement" function.

If there is a conductive connection between the test tips of the measuring cable, then approx. 0 ohms is displayed and the traffic light lights up green.

In the case of a brief line break (loose contact), the displayed measured value increases and the traffic light lights up red.

> With the <F7> key (round arrow) you return to the initial screen "Multimeter".



525-017

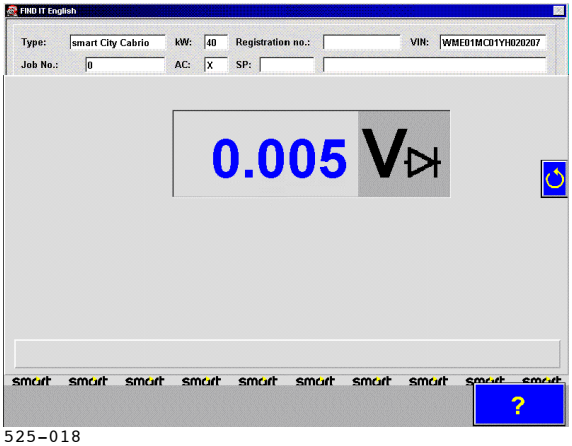
Diode measurement

> Press the diode key (<F3>) in the "Multimeter" function.

> Connect the measuring cable on the back of the smart Tester (see 08 01, smart Tester, Connections; Plug I, Item 6).

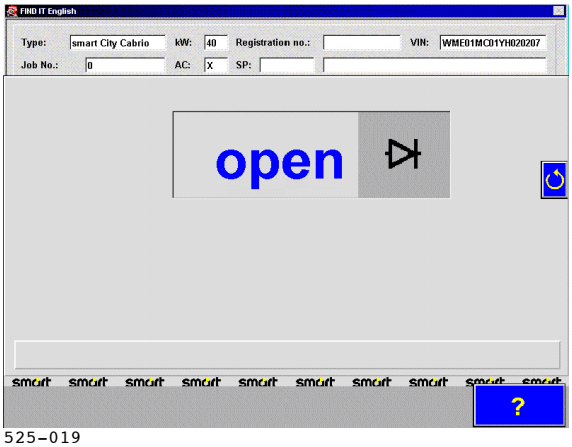
The forward voltage of the diode (approx. 0.6 V) is shown on the screen when the diode is located between the test tips in the forward or conducting direction.

> With the "?" key (<F6>) you can run the help function for diode measurement.



525-018

If the diode lies between the test tips in the reverse or non-conducting direction, then the word "open" open appears next to the diode symbol, as with an open circuit.



525-019

>>smart

Measuring Technology

smart Tester: Oscilloscope

Function

The smart Tester can also be operated as a 2-channel oscilloscope, which can display two signals simultaneously.

This makes the following possible:

> Visualisation of signal curves,

> Voltage measurement,

> Frequency measurement.

In addition to the signal transmission paths, the following components can also be examined in greater detail during diagnosis and troubleshooting:

> Electric motors,

> Inductive sensors,

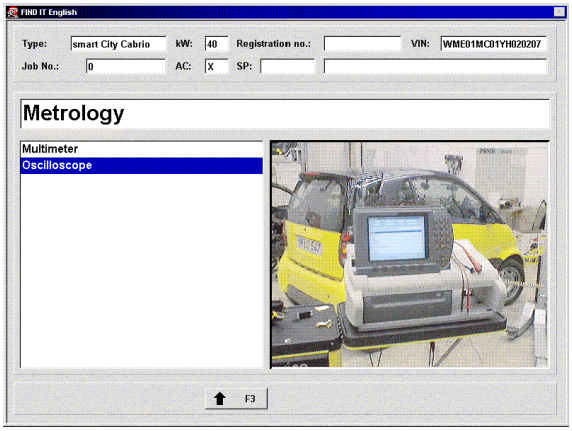
> Incremental sensors.

And the following signals can also be checked,

> those that result in synchronisation with the engine running (e.g. the pulse time in the engine/E-gas/gearbox control unit for the injectors),

or

> those that result non-synchronised with the engine running (e.g. for gearbox shifting).



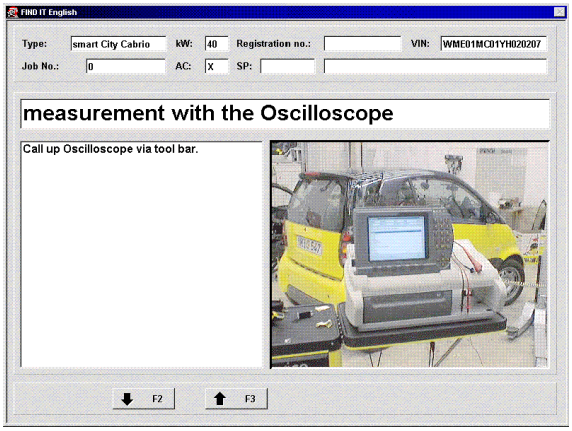
00130517

Running the function

> Press the integration key <F9> and select "Osci" in the toolbar with the cursor keys.

  Note: If you want to run the Oscilloscope function via the menu, a corresponding message will appear on the toolbar.

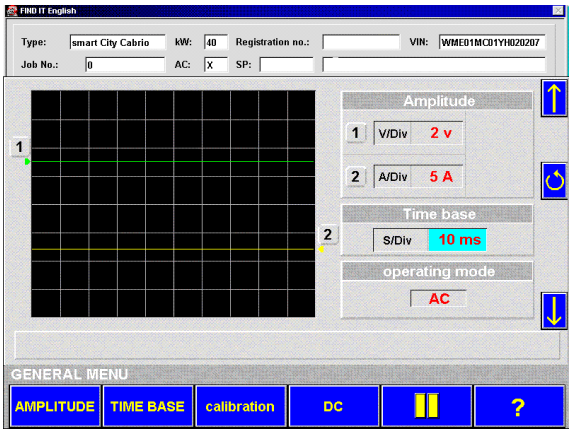
> Confirm the selection with the Enter key <*>.



00130518

Structure of screen

left	Oscilloscope and active measuring channel (1 and/or 2), depending on connected measuring cable
upper right	currently set amplitude per graduation mark (V/Div)
centre right	currently set time base per graduation mark (s/Div)
lower right	currently set operating mode direct current/alternating current (DC/AC)
bottom	Text field with information for user, e.g. connection to Plug I
very bottom	Menu buttons for operating the oscilloscope



00130519

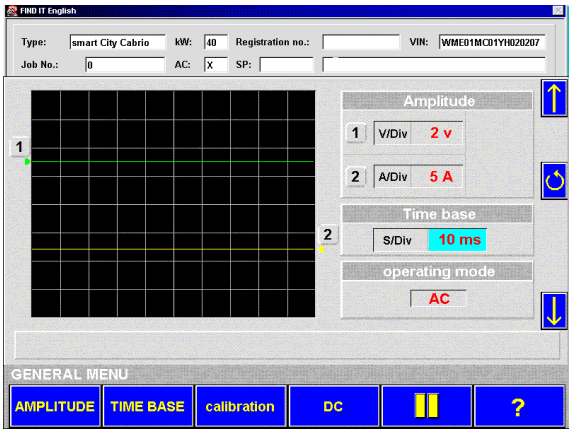
>>smart

Measuring Technology

smart Tester: Oscilloscope

Menu button functions

Amplitude	Change to setting of amplitude per increment (<F1>)
Time base	Change to setting of time base per increment (<F2>)
Calibration	Measuring cable calibration (<F3>)
DC/AC	Change between direct voltage (DC) and alternating voltage measurement (AC) (<F4>)
II (Pause)	Stop write process of oscilloscope (<F5>)
?	Run help for oscilloscope (<F6>)
	<F7> key (round arrow) Return to the "Measuring Technology" menu



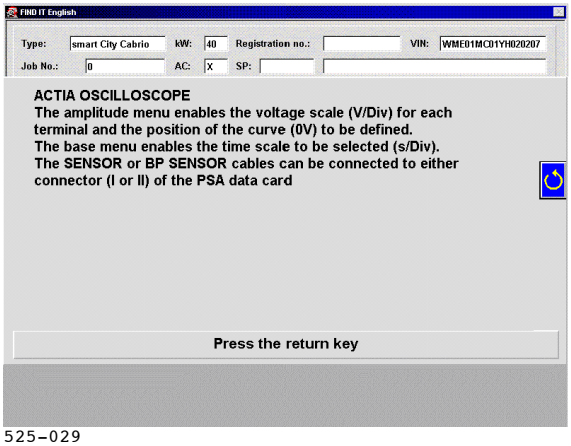
00130519

Help function

> Press the "?" key (<F6>) in the "Oscilloscope" initial screen.

The screen view changes to the Help menu. Here you can display brief descriptions on all buttons of the main menu.

> With the <F7> key (round arrow) you return to the initial screen "Multimeter".



525-029

Settings

> Press the "Amplitude" (<F1>) key in the "Oscilloscope" initial screen.

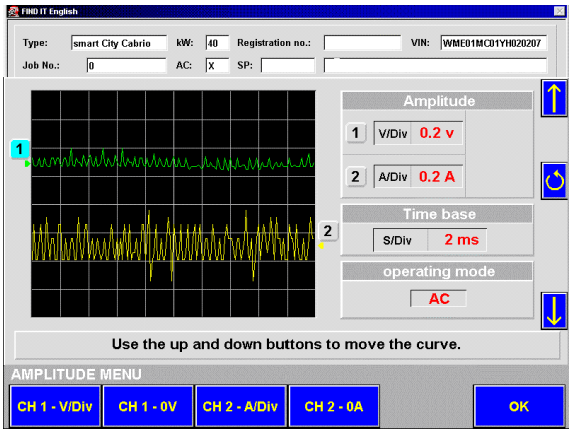
The following settings can be made on the screen that now appears:

> Voltage ranges (20 mV to 100 V)

> Position of zero line.

Key functions

CH 1 - V/Div	Set voltage range for measuring channel 1 (<F1>)
CH 1 - 0V	Move zero line for measuring channel 1 (<F2>)
CH 2 - V/Div	Set voltage range for measuring channel 2 (<F3>)
CH 2 - 0V	Move zero line for measuring channel 2 (<F4>)
OK	Return to "Oscilloscope" main menu (<F6>)



00130541

Setting the amplitudes

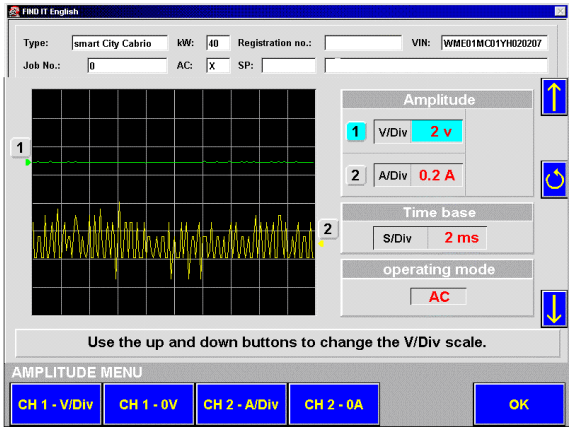
> Press the "CH 1 - V/Div" key (<F1>).

The amplitude of measuring channel 1 is displayed on a coloured background.

> Select the desired measuring range with the cursor keys (up/down) on the smart Tester.

> Measuring channel 2 is set in the same manner after pressing the "CH 2 - V/Div" key (<F3>).

> Apply the values with OK (<F6>).



00130542

Setting the zero lines

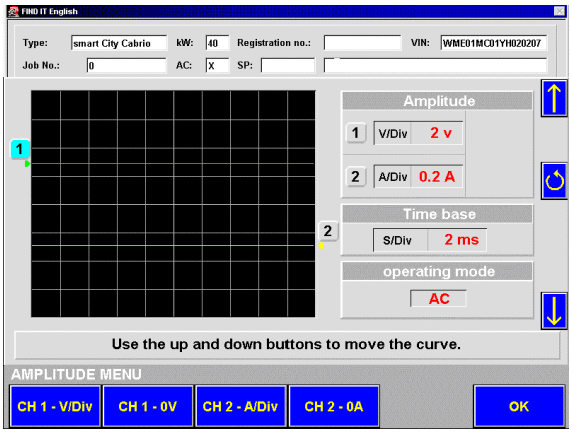
> Press the "CH 1 - 0V" key (<F2>)

The selected measuring channel 1 is displayed on a coloured background.

> Select the desired position of the zero line with the cursor keys (up/down) on the smart Tester.

> The zero line for measuring channel 2 is set in the same manner after pressing the "CH 2 - 0V" key (<F4>).

> Apply the values with OK (<F6>).



00130543

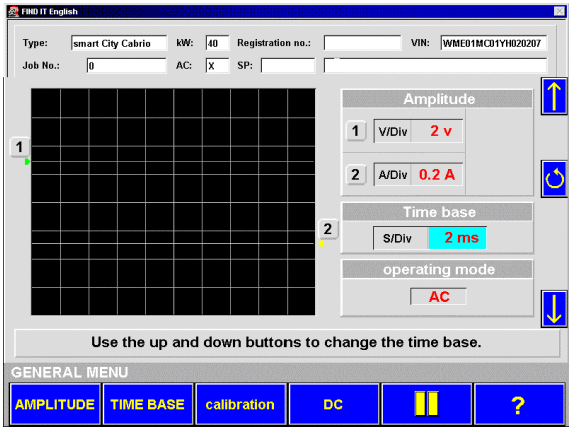
Setting the time base

> Press the "Time base" key (<F2>).

The time base currently set is displayed on a coloured background.

> Select the desired time base with the cursor keys (up/down) on the smart Tester.

> Apply the values with OK (<F6>).



00130544

Calibrating the measuring cable

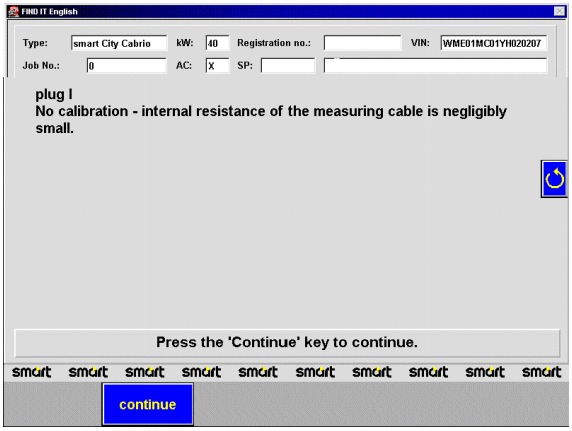
> Press the "Calibration" key (<F3>) in the main menu.

The calibration for Plug I is displayed on the screen.

> Press the Continue key <F2>.

If another measuring cable is connected to Plug II, then the calibration for Plug II is displayed.

> Press the Continue key <F2> to return to the main menu.



00130545

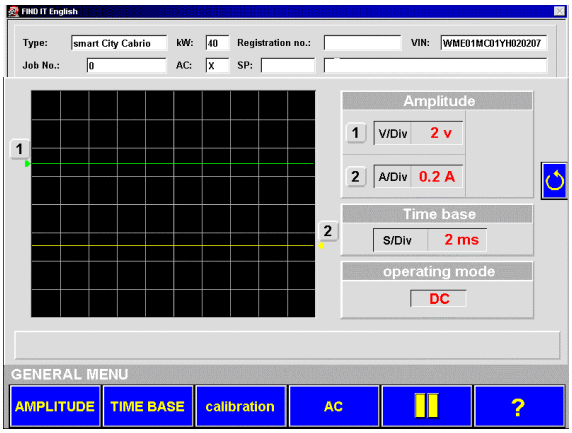
Operating mode

> Press the "DC" key (<F4>) in the "Oscilloscope" main menu.

The operating mode is changed from alternating voltage (AC) to direct voltage (DC) in the screen.

When changing the operating mode the display of the <F4> key at the bottom of the screen also changes.

> Press the "AC" key (<F4>) to return to the original operating mode.

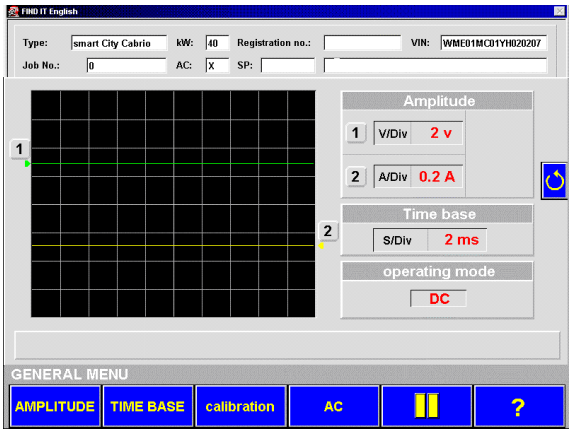


00130546

Stopping the write process (image memory)

> Press the Pause key "II" (<F5>) in the "Oscilloscope" main menu.

The write process of the oscilloscope is stopped (image memory) and you have sufficient time to view the display.



00130546

After stopping the write process, a printer symbol appears at the right-hand edge of the screen.

> With the Printer key (<F8>) of the smart Tester you can now print out the current display.

Continuing the write process

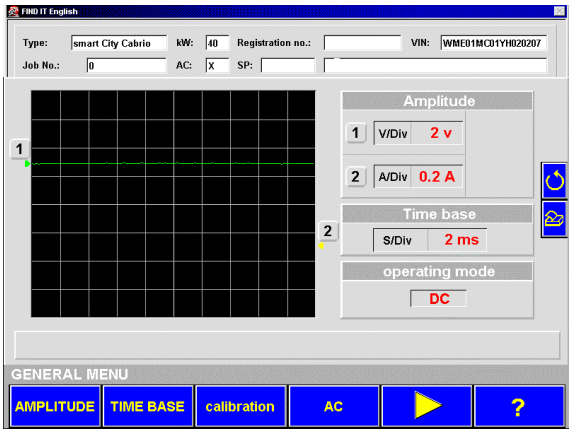
When the write process is stopped, the Pause key (<F5>) at the bottom of the screen changes: It now shows a right arrow.

> Press the arrow key (<F5>) to continue the write process.

Following this the Pause key "II" appears again and the printer symbol on the right-hand side of the screen disappears.

> To exit the Oscilloscope function, press the integration key <F9> and change to FIND IT with the toolbar.

> To end the Oscilloscope function, press the <F7> key and change to FIND IT with the toolbar.



00130547

>>smart

Functions of smart Tester

This chapter contains the control-unit-related diagnosis functions "Short Test" and "Systems", as well as the section "Special Functions".

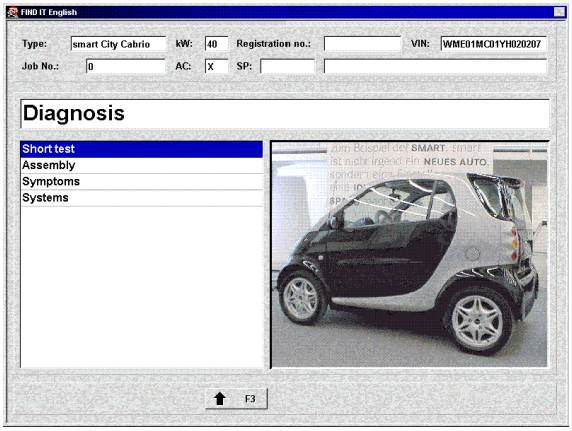
Overview of diagnosis functions

> Short test
  Interrogation of control units
  With this function you can only read out or delete the error memories of all control units.

> Assembly
  (see 08 01, Diagnosis Functions of smart Tester, Assembly)
  Specific access to individual components

> Symptoms
  (see 08 03, Diagnosis Functions, Symptoms)
  Entry via symptoms which, for example, are described by the customer

> Systems
  Access to individual control units
  With this function you can specifically select a control unit and read out the error memory concerned. In addition, you can control actuators and display actual values with this function, which is not possible with the "Short Test" function.



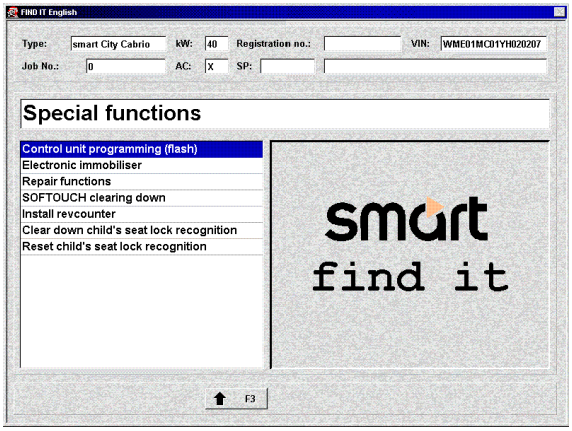
00130510

>>smart

Functions of smart Tester

Overview of special functions

> Programming control unit, e.g. flashing of MEG/EDT
> Electronic immobiliser, e.g. learning vehicle keys (see 08 02, Special Functions, Electronic Immobiliser)
> Repair functions, e.g. replace control unit
> Enabling Softouch
> Installing tachometer
> Enabling child's-seat lock detection
> Resetting child's-seat lock detection



00130520

>>smart

Diagnosis Functions

Short Test

Task

The short test is used for quick diagnosis of all control units in the vehicle. It tests the following control units for error entries in the error memory:

> MEG engine control unit or EDT control unit

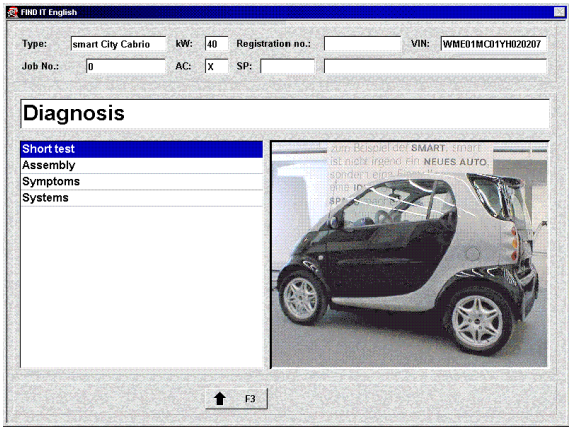
> ZEE central electric/electronic system control unit

> ABS control unit

> Airbag control unit (with side airbags if applicable)

> Instrument cluster

In contrast to the "Systems" function, here only the error memory of all control units can be addressed.



00130510

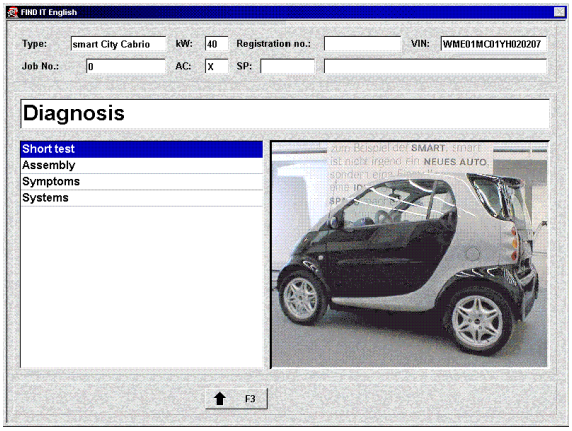
Running the function

> Switch on ignition
> Connect connection cable to diagnosis plug on central electric system
> Carry out vehicle identification, if not already carried out automatically
> Select the "Diagnosis" function with the cursor keys (see previous illustration) and confirm the selection with the Enter key <*>.

The "Diagnosis" menu appears.

> Select the "Short Test" function in the "Diagnosis" menu with the cursor keys and confirm the selection with the Enter key <*>.

The smart Tester establishes communication with the vehicle.



00130510

> Now press the <F5> key.

The smart Tester establishes communication with the vehicle and checks the following five control units for error entries:

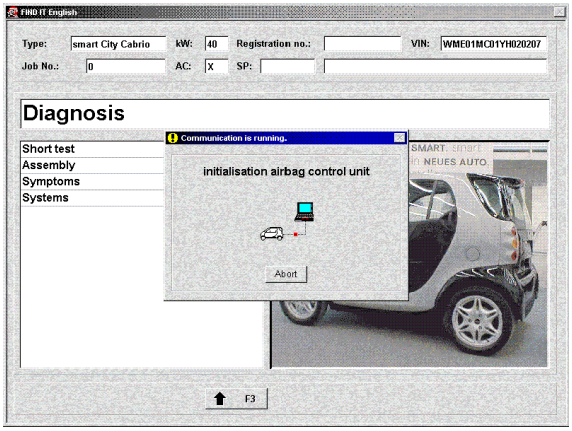
> MEG engine control unit (N48) or EDT control unit (N51)

> ZEE central electric/electronic system control unit (N10)

> ABS control unit (N47)

> Airbag control unit(N2/2), without/with side airbags

> Instrument cluster (A1)



00130521

>>smart

Diagnosis Functions

Short Test

When this check is completed, then the screen shown at the right appears.

Symbols and information

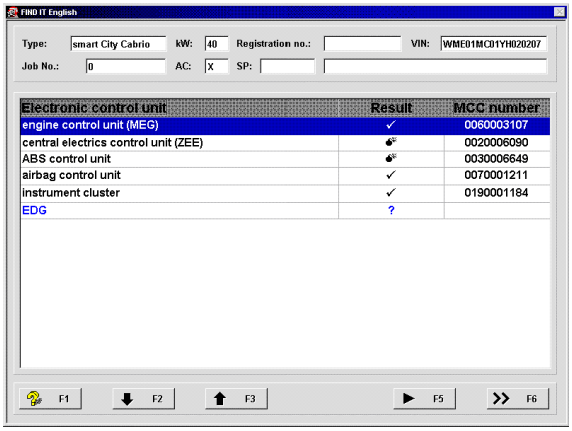
"Bomb" At least one entry in the error memory of this control unit

"Check" No entry in the error memory of this control unit

"Question mark" in blue
Communication to this control unit could not be established (diagnosis cable defective or not properly connected) or control unit not installed.

> "Result" column
Here one of the symbols "Check", "Bomb" or "Question mark" is shown in each case.

> "MCC Number" column
The MCC number consists of the part version number (specifies in which version the component is installed, e.g. 006) and the part number (specifies under which number the component can be ordered, e.g. 0003107).



00130522

>>smart

Diagnosis Functions

Short Test

Function keys

<F1> key Help

<F2> key Continue

<F3> key Back

<F4> key Change between first and last short test

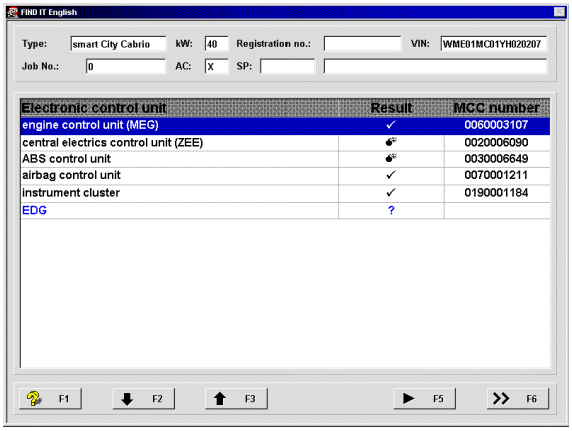
<F5> key Start tests
(this also applies to all following screen views)

<F6> key Switch over to the second function key bar

After the <F6> key is pressed, the following function keys appear at the bottom of the screen:

<F2> key Magnifying glass
Display of errors in the selected control unit

<F3> key Delete error codes of all control units



00130522

>>smart

Diagnosis Functions

Short Test/Read Out Error Memory

Displaying error entry of a control unit

The short test has, for example, shown that error entries are present; indicated by the "Bomb" symbol.

> Select one of the control units marked in this way with the cursor keys and confirm the selection with the Enter key <*>.

The error memory of the selected control unit is now read out and displayed on the screen. If several error entries are present, the entries are listed below each other.

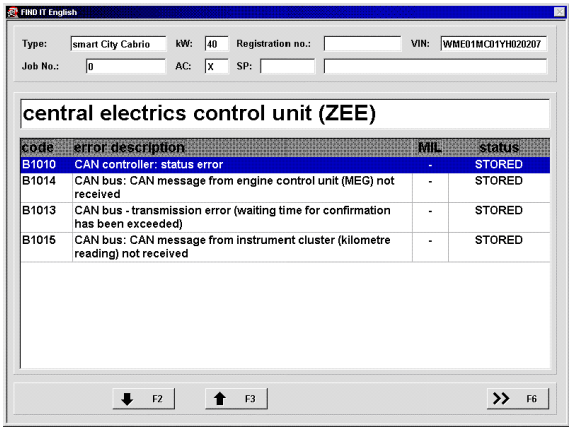
The information on this screen has the following meaning:

Code — Error number of error entry, e.g. here B1010

Error description — The defective component

MIL — (= Malfunction Indicating Lamp) Status for the control of the indicator lamp in the instrument cluster:
"-" No control
"+" Control

Status — Display of the current error status
STORED:
The error occurred several kilometres ago and was stored
CURRENT:
The error is currently present



00130523

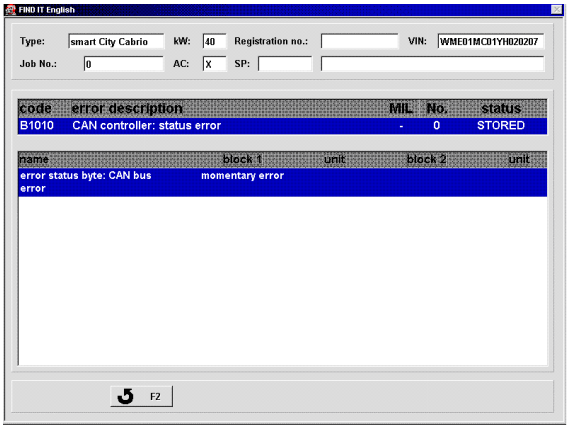
Reading environmental data

> Press the <F6> key to switch over to the second level of the function key bar.

> To read out the environmental data, press the <F2> key.

Block 1 contains the environmental data present the first time the error occurred.

Block 2 contains the environmental data present the last time the error occurred.



00130524

Processing error causes

An error cause is higher up in the list the faster it must be checked.

During the plausibility test the component and the error entry are checked again first.

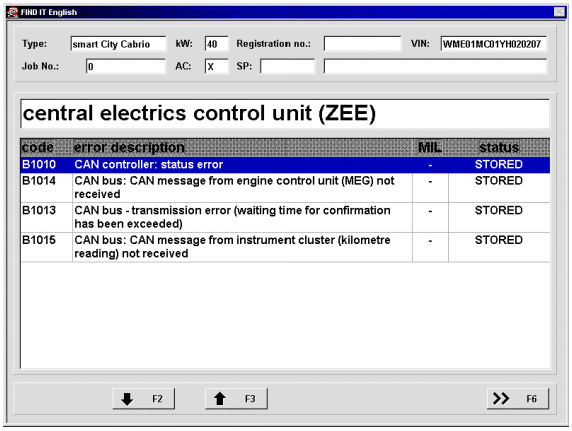
> Select the fault causes to be processed consecutively with the cursor keys and confirm each selection with the Enter key <*>.

Follow the instructions in the applicable error list when processing each error cause. You continue within the diagnosis with the <F2> key.

Processed menu items are displayed with a grey background.

If the error has been found and eliminated, you return to the screen with the error entries of the control unit concerned with the <F3> key.

Now you can delete the error entries as described in the following.



00130523

Deleting processed error entries

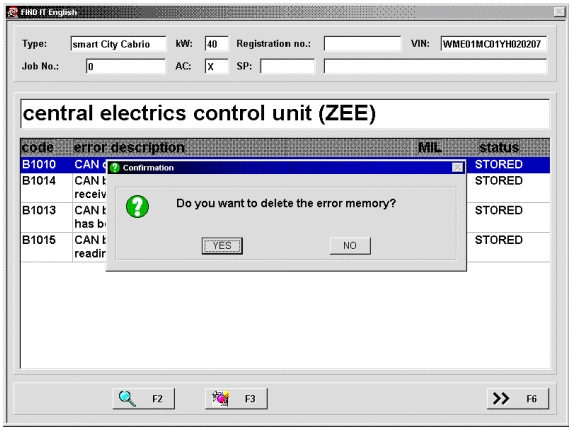
All error entries must be processed before the error memory can be deleted. It is not possible to delete a specific error, but instead the entire error memory of a control unit must always be deleted.

> Select the menu with the error entries of the control unit concerned with the cursor keys.

> Switch over the function of the <F3> key from "Navigation" to "Delete error" with the <F6> key.

> Press the <F3> key. On the screen you will be asked if you want to delete the error memory.

> Select "YES" with the cursor keys and confirm the selection with the Enter key <*>.



00130525

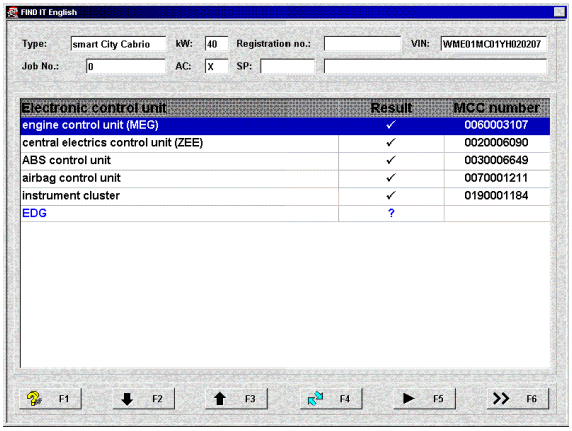
> Follow the instructions on the screen.

> To check whether the eliminated error has been deleted from the memory, press the <F6> key and then the <F3> key. This returns you to the "Short test" menu.

> Start the short test with the <F5> key.

If processing of the troubleshooting list has led to the elimination of the error, the "Check" symbol now appears, as no further errors are present.

> With the <F4> key you change between the results of the first and the last short test.



00130526

Exiting the function

You return to the initial FIND IT screen for all control units in the same way.

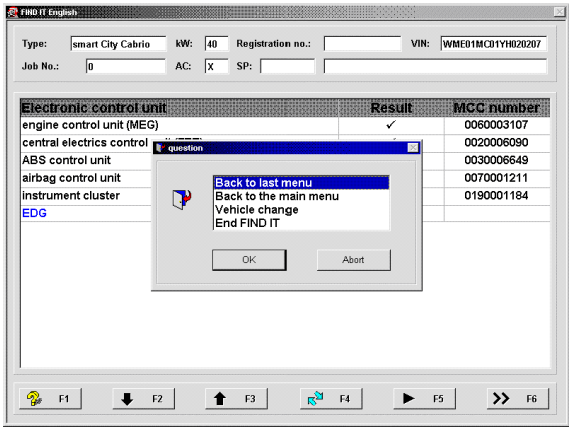
> Press the <F7> key (round arrow).

A selection window appears.

> Select "Vehicle change" if you want to conduct a diagnosis on another vehicle.

> Confirm the selection with the Enter key <*>.

The initial FIND IT window appears.



00130527

Task

In contrast to the "Short Test" function, you can check the control units in the vehicle separately and address the error memories of the control units separately with the "Systems" function:

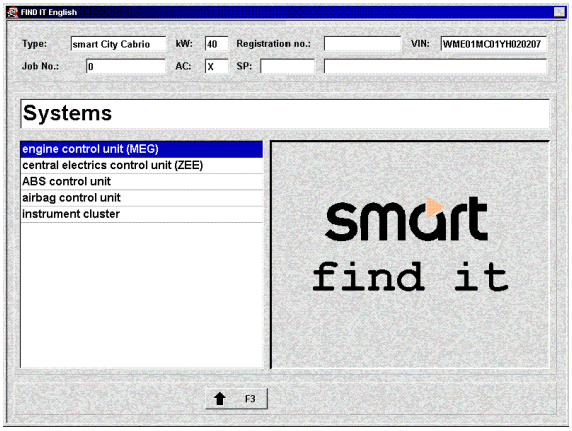
> MEG engine control unit (N48) or EDT control unit (N51)

> ZEE central electric/electronic system control unit (N10)

> ABS control unit (N47)

> Airbag control unit with or without side airbags (A1)

> Instrument cluster (N2/2)



00130528

Running the function

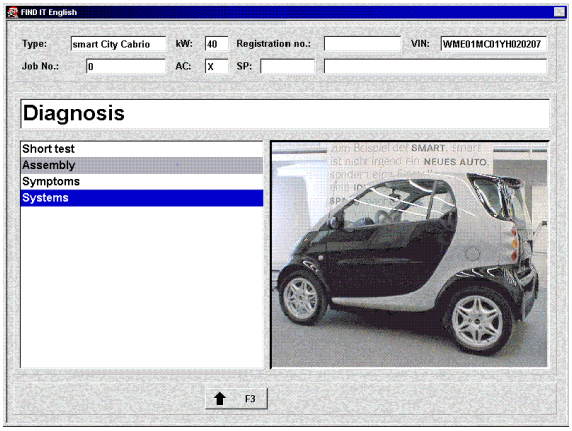
> Open the main menu in the initial FIND IT screen with the <F2> key.

> If it has not already been done, conduct a vehicle identification (see 08 01, Vehicle Identification).

> Select the "Diagnosis" function with the cursor keys and confirm the selection with the Enter key <*>.

> Select the "Systems" function with the cursor keys and confirm the selection with the Enter key <*>.

> Select the control unit you want to process with the cursor keys (e.g. "MEG engine control unit") and confirm the selection with the Enter key <*>.



00130529

Options for each control unit

> Read out fault memory

> Display actual values
With this function actual values are displayed, such as engine and gearbox speed or battery voltage. This enables the signals to be checked that are transmitted from actuators, sensors etc. to the control unit. As a result, the signal inputs on the control unit can be checked quickly and easily.

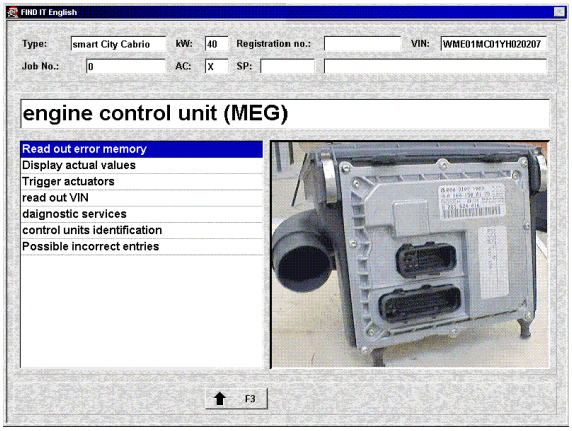
> Control actuators
With this function actuators etc. (e.g. shift gears or control fuel pump) can be specifically controlled. This enables a simple functional check of certain actuators, and checking of the control-unit signal outputs.

> Read out VIN
With this function the chassis number of the vehicle is read out (not on ABS control unit)

> Diagnosis services (see next page)

> Control unit identification
With this function the MCC part number with the version number, hardware and software versions and the diagnosis status can be read out of the respective control unit.

> Possible error entries
With this function all possible error entries of the selected control unit are displayed.

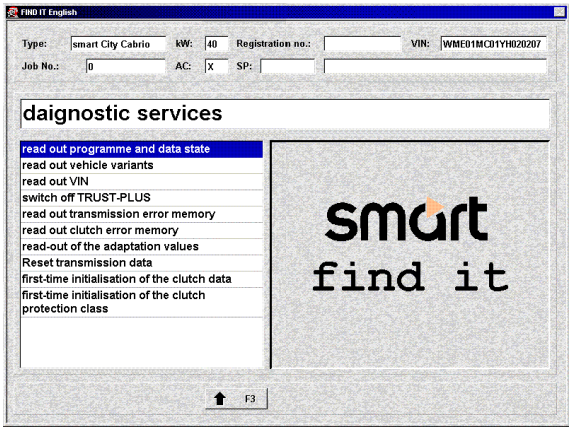


00130530

Option for MEG/EDT control unit

The Diagnosis services option
(additionally on MEG or EDT control unit)

> Read out program and data version
> Read out vehicle variant
> Read out VIN
> Switch off TRUST-PLUS
> Read out gearbox error memory (MEG only)
> Read out clutch error memory (MEG only)
> Read out adaptation values
> Reset gearbox data
> Original initialisation of clutch data
> Original initialisation of clutch protection class



00130531

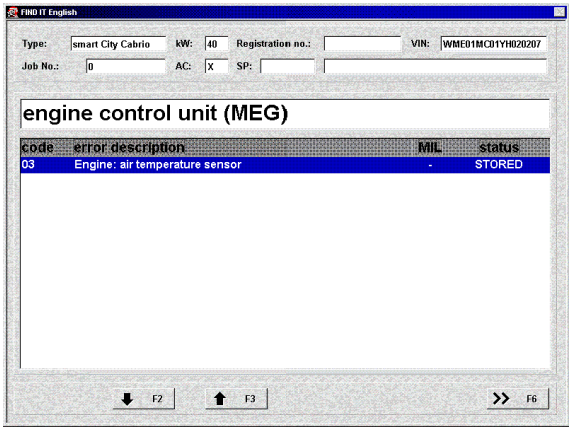
Reading out error memory

> Select the "Read out error memory" function with the cursor keys and confirm the selection with the Enter key <*>.

The connection to the control unit is established and the error entries of the selected control unit appear on the screen.

> With more than one error entry, select the error you want to process with the cursor keys and confirm the selection with the Enter key <*>.

Errors already processed are shown on a grey background.



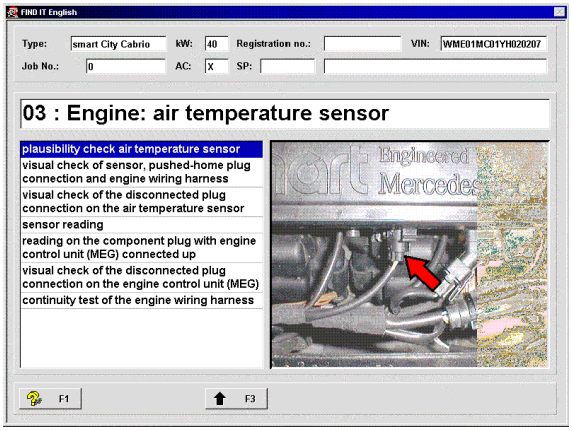
00130548

Now the troubleshooting list for the selected error entry appears.

Follow the instructions in the troubleshooting list in each case.

> With the <F2> key you continue within the troubleshooting list.

> Select the respective error possibility with the cursor keys and confirm the selection with the Enter key <*>.



00130549

Deleting error memory

After you have found the error and eliminated it, you can delete the error memory.

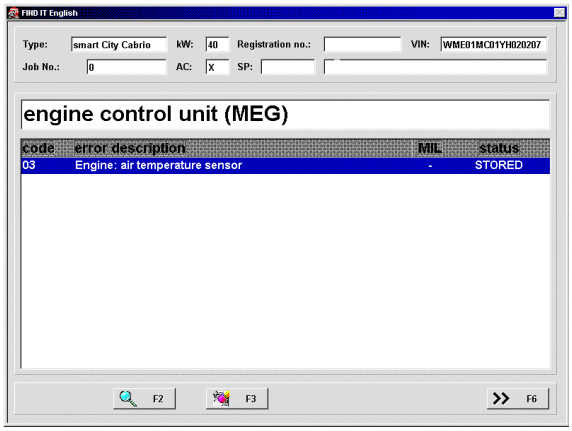
> To do this, press the <F3> key until the menu with the error entries appears.

> Press the <F6> key to switch over to the second function key bar.

> Press the <F3> key. A window with the question "Delete error memory - YES or NO?" is displayed.

> Select "YES" with the cursor keys and confirm the selection with the Enter key <*> if you want to delete the error.

> Follow the further instructions on the screen.



00130550

Exiting the troubleshooting list

> Press the <F7> key (round arrow).

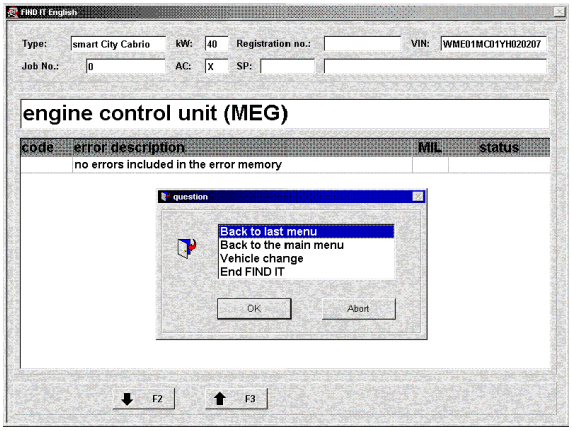
A selection window appears.

> Select "Return to last menu" if you still want to carry out other checks with the smart Tester.

> Confirm the selection with the Enter key <*>.

The previous menu appears.

> Select "Vehicle change" if you want to carry out a diagnosis on another vehicle.



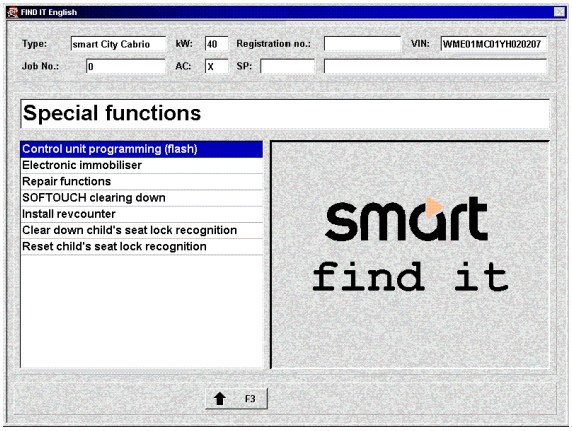
00130532

>>smart

Special Functions

The special functions of the smart Tester are:

> Programming control units, e.g. flashing MEG/EDT
> Electronic immobiliser, e.g. learning vehicle keys
> Repair functions, e.g. replacing control unit
> Enabling Softouch
> Installing tachometer
> Enabling child's-seat lock detection
> Resetting child's-seat lock detection



00130520

>>smart

Special Functions

Running the function

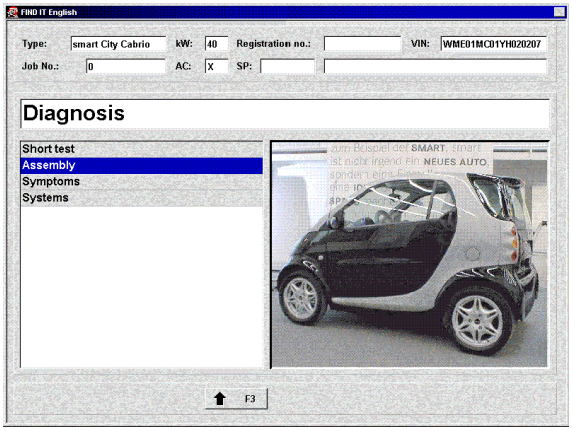
> Make sure the ignition is switched on and the diagnosis cable is connected to the central electric system (Central electric system; F10).

> Press the <F2> key on the initial FIND IT screen.

> If it has not already been done, conduct a vehicle identification.

> Select the "Special Functions" function in the main menu with the cursor keys.

> Confirm the selection with the Enter key <*>.



00130551

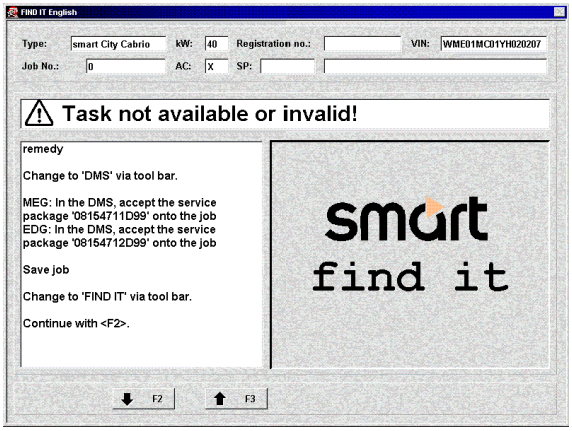
Function

> Select the "Programming Control Units (Flash)" function in the "Special Functions" menu with the cursor keys.

> Confirm the selection with the Enter key <*>.

A valid entry must be present in the DMS for flash programming.

If this is not the case, a corresponding message will appear on the screen.



00130533

>>smart

Special Functions

Electronic Immobiliser

Function

All data in the header must be filled in (order number and service package) for the function to be carried out.

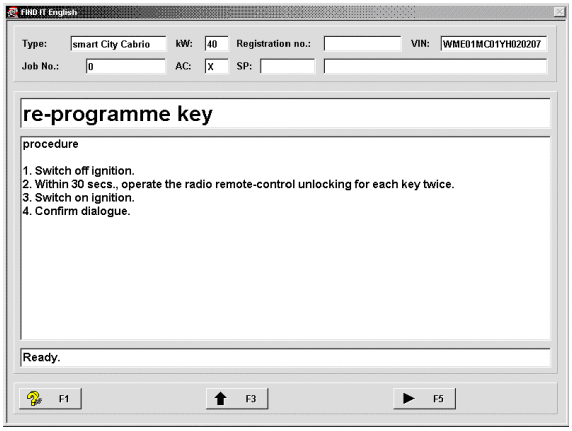
You must have opened an existing order or created a new one in the DMS.

Up to 4 keys can be learned per vehicle, however only directly consecutively during a "marriage mode".

> Call up the "Special Functions" menu as described previously and run the "Electronic Immobiliser" function there. It can only be carried out within range of the wireless LAN (the wireless network connection to the server at the smart Centre).

> Select the "Electronic Immobiliser" function with the cursor keys and confirm the selection with the Enter key <*>.

> Start the "Learn New Key" function with the <F5> key. Now the central electric/electronic system exchanges data with the vehicle key and the MEG engine control unit.



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Special Functions

Electronic Immobiliser

> The indicator lamp of the inside locking button on the safety island indicates with rapid flickering that the central electric/electronic system is in the "marriage mode".

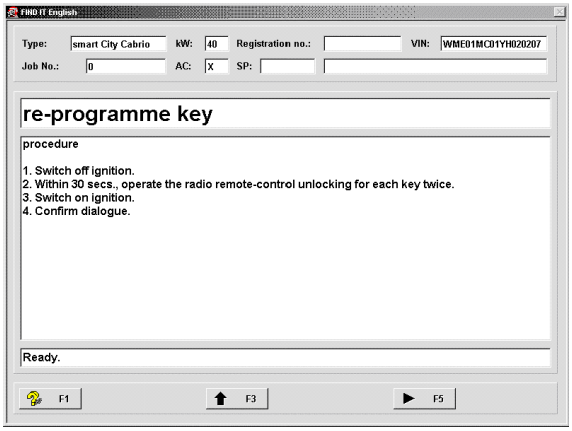
> Switch off the ignition and then press the radio remote control twice on the vehicle key to be learned.

> The indicator lamp of the inside locking button indicates that the vehicle key has been learned by going out for one second and then flickering again.

> The other keys for the vehicle are learned in the same way.

> After learning the last key, the ignition can be switched on again.

> Then confirm the dialog box with the Enter key <*>.



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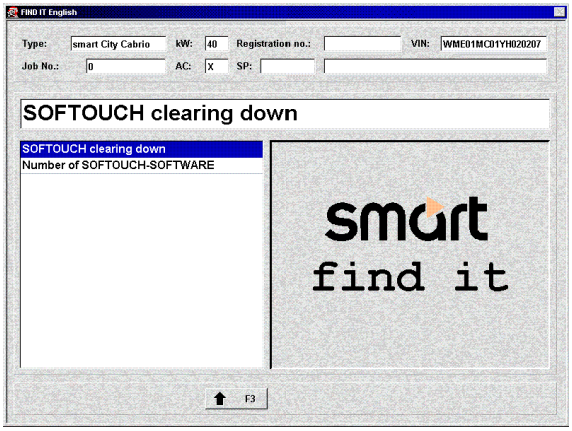
Function

> Select the "Enable Softouch" function in the "Special Functions" with the cursor keys.

> Confirm the selection with the Enter key <*>.

To enable the Softouch function a valid order must be present in the DMS.

If this is not the case, a corresponding message will appear on the screen.



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Diagnosis Functions

Symptoms

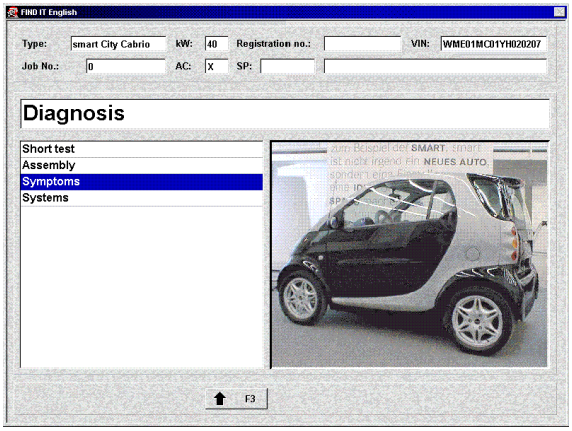
In this section the customer-related "Symptoms" diagnosis function is described.

Task

When errors occur, the customer describes the symptoms to you during direct acceptance at the smart Centre.

With the customer's statement you can locate the corresponding fault causes with the "Symptoms" function.

Example:
A customer vehicle starts poorly. After this statement you can go through the possible fault causes with the "Symptoms" function.



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Diagnosis Functions

Symptoms

Running the function

> Open the main menu in the initial FIND IT screen with the <F2> key.

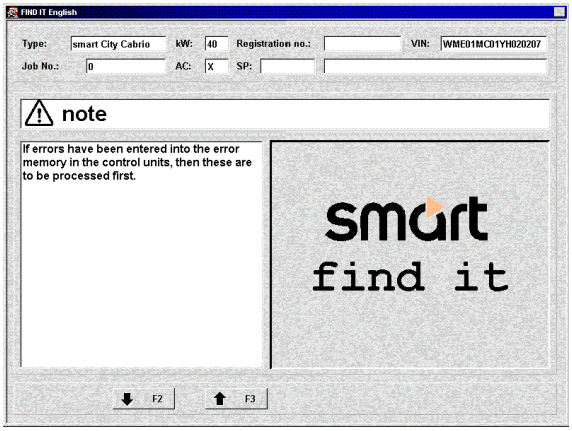
> If it has not yet been done, conduct a vehicle identification (see 08 01, Vehicle Identification).

> Select the "Diagnosis" function in the main menu with the cursor keys (see previous illustration) and confirm the selection with the Enter key <*>.

> Select the "Symptoms" function in the "Diagnosis" menu with the cursor keys and confirm the selection with the Enter key <*>.

A message appears stating that errors in the error memory must be processed first.

> Press the <F2> key to continue.



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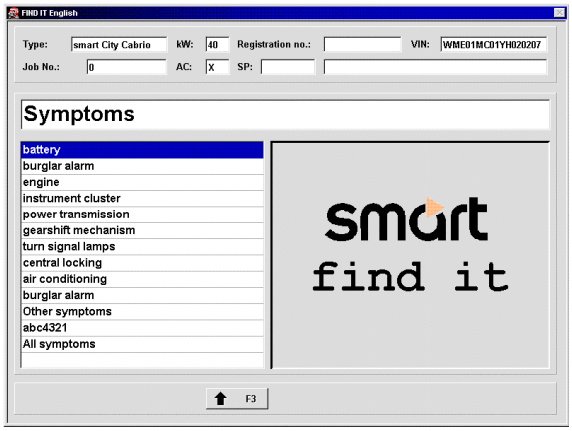
Now a selection of symptoms appears.

Other possibility:
The "All Symptoms" option lists all existing symptoms in a menu.

> Select the assembly concerned with the cursor keys and confirm the selection with the Enter key <*>.



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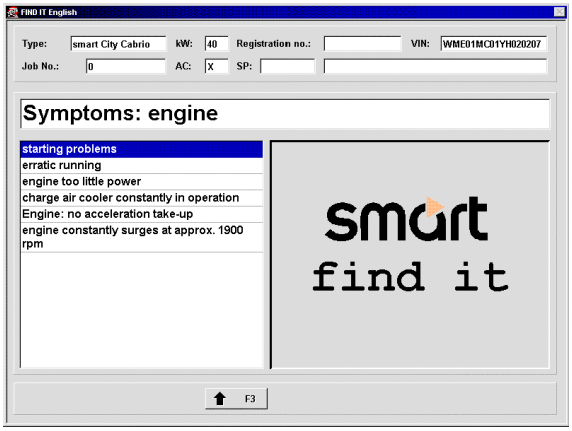
Processing the troubleshooting list

Possible symptom types at the symptom location concerned are displayed.

> Select the symptom that best matches the customer's statement with the cursor keys and confirm the selection with the Enter key <*>.



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Following this a screen appears with error lists for the possible error causes of the selected symptom.

> Follow the instructions in the respective error list.

> Work through all error possibilities until you have found the error.

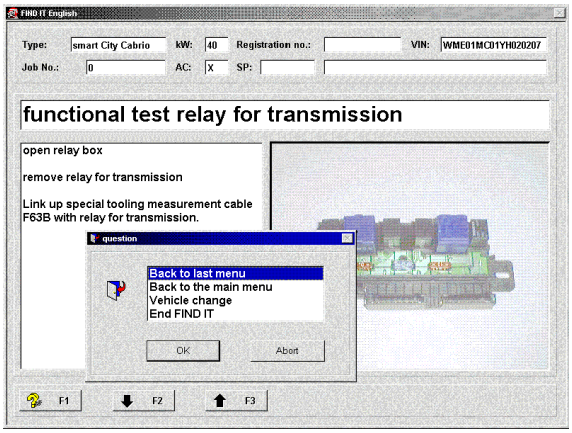
Exit the error list from the lowest level

> Press the <F7> key (round arrow).

A selection window appears.

> to exit the "Symptoms" function select "Return to last menu" and confirm the selection with the Enter key <*>.

The previous menu opens.



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