

**MODEL 164.1**

as of Model Year 09 /Modification Year 08 model refinement package  
with CODE (489) AIRmatic (air suspension with level adjustment and adaptive damping system ADS )

**MODEL 164.8 as of Model Year 09 /Modification Year 08****MODEL 251.0 /1**

as of Model Year 09 /Modification Year 08  
with CODE (489) AIRmatic (air suspension with level adjustment and adaptive damping system ADS )

**Function requirements, general**

- No overvoltage or undervoltage
- Circuit 30

**AIRmatic system, general**

With the AIRmatic system, the vehicle body suspension operates by means of air springs located at each wheel. The objective is to keep the vehicle level as constant as possible.

There are two variants of the system:

- AIRmatic without adaptive damping system (ADS) (on model 164.8)
- AIRmatic with ADS (with code (489) AIRmatic (air suspension with level adjustment and adaptive damping system (ADS)))

When the ignition is switched on, the last selected vehicle level and the last damping program setting are active.

The AIRmatic system is comprised of the following component functions:

- **Function sequence for starting AIRmatic system**
- **Compressed air supply function sequence**
- **Level control function sequence**
- **Level adjustment function sequence**
- **Lock position function sequence**
- **Function sequence for damper adjustment (model 164.1, 251.0/1 or for model 164.8 with code (214) Adaptive damping system (ADS) with skyhook and level control)**
- **Trailer operation function sequence (with code (550) Trailer hitch)**
- **System and warning messages function sequence**

**Additional function requirements for compressed air supply**

- Engine running (circuit 61 ON)  $n > 300$  rpm

**Compressed air supply function sequence**

Under normal operating conditions, the AIRmatic system operates with different pressures depending on the load.

Compressed air is supplied by the AIRmatic compressor unit. Any surplus compressed air which is generated is stored in the AIRmatic central reservoir. This allows large quantities of compressed air to be made available quickly. This increases the adjustment speed when raising the vehicle and makes control possible when the engine is not running.

If the system detects insufficient pressure in the AIRmatic central reservoir during driving operation, the AIRmatic compressor unit and the AIRmatic central reservoir charge valve (Y36y5) are actuated by the AIRmatic control unit and compressed air is supplied to the central reservoir.

The function is active as of a speed of  $v > 40$  km/h (during acceleration) and up to a speed of  $v > 20$  km/h (during braking).

The AIRmatic valve unit is comprised of the following components:

- AIRmatic pressure sensor
- Left front level control valve (Y36y1)
- Right front level control valve (Y36y2)
- Left rear level control valve (Y36y3)
- Right rear level control valve (Y36y4)
- AIRmatic central reservoir charge valve

**Additional function requirements for level control**

The AIRmatic system with ADS combines air suspension with automatic damper adjustment.

Automatic damper adjustment allows the suspension to be adjusted to the prevailing driving situation.

The direction of movement of the vehicle body is used to determine the suitable level of damping force. Damper adjustment operates based on the principle of the skyhook algorithm i.e. when the vehicle body moves upwards, the damper must be adjusted to provide a hard rebound stage and a soft compression stage. Conversely, a soft rebound stage and a hard compression stage is required when the vehicle body moves downwards.

**Function sequence for starting AIRmatic system**

The AIRmatic system is started when bus idle is canceled. This takes place when the central locking (CL) is unlocked using the transmitter key (A8/1) and a vehicle door is then opened, whereby the rear-end door also counts as a vehicle door. The rear SAM control unit (N10/8) sends the corresponding status for the front doors, rear doors and the rear-end door to the interior CAN. The front SAM control unit (N10) reads in this information, evaluates it and actuates the AIRmatic control unit (N51) (model 164.1/8) or AIRmatic with ADS control unit (N51) (model 251.0/1) via a direct line. Once the AIRmatic control unit has been woken, the current vehicle level is checked and corrected if necessary. Level control is performed in wake-up mode, e.g. when the vehicle is being loaded and unloaded, without the AIRmatic compressor unit (A9/1) being activated. Activation of the AIRmatic control unit starts an initialization period which is used to correct the vehicle level if necessary.

This in turn shortens the waiting time for the level correction.

The upper shutoff pressure for central reservoir charging depends on the following information:

- Atmospheric pressure and intake air temperature, from the CDI control unit (N3/9) (for diesel engine) or from the ME-SFI control unit (N3/10) (for gasoline engine) as provided on the engine compartment CAN
- Ambient air temperature, from the AAC [KLA] control and operating unit (N22) (without code (581) Comfort automatic air conditioning) or from the comfort AAC control and operating unit (N22/7) (with code (581) Comfort automatic air conditioning) as provided on the interior CAN and forwarded by the central gateway control unit (N93) over the engine compartment CAN to the AIRmatic control unit

The pressure in the AIRmatic central reservoir is monitored by the AIRmatic pressure sensor (Y36b1). The compressed air is distributed to the spring bellows of the suspension struts via the AIRmatic valve unit (Y36).

The signals from the following components are read directly by the AIRmatic control unit to calculate the vehicle level:

- Left rear level sensor (B22/7)
- Left front level sensor (B22/8)
- Right front level sensor (B22/9)
- Right rear level sensor (B22/10)

When compressed air is admitted to a bellows, the vehicle level increases at the wheel concerned. Conversely, the vehicle level

- Engine running (circuit 61 ON)  $n > 300$  rpm

### Level control function sequence

Level control is realized by means of four suspension struts with integral bellows. The AIRmatic control unit calculates the current vehicle level and actuates the level control valves in the AIRmatic valve unit accordingly.

The aim of the level control system is to keep the vehicle level almost constant regardless of the load condition.

On vehicles with code (430) Off-road package, the vehicle level can be raised and lowered in several stages. On model 164.1, this is performed by actuating the level control HIGH switch (N72s32) or the level control LOW switch (N72s33) and on model 164.8 by turning the level control selector wheel (N72s35) in the corresponding direction.

The respective request is then implemented by the system depending on the vehicle speed and the status of the Comfort/Sport switch (ADS) (N72/1s31) (on model 164.1, 251.0/1 or on model 164.8 with code (214) Adaptive damping system (ADS) with skyhook and level control).

The damping programs Auto, Comfort and Sport can be selected via the Comfort/Sport switch. The corresponding status of the level control switch and the Comfort/Sport switch is read-in by the upper control panel control unit (N72/1) and made available on the interior CAN. The central gateway control unit forwards the status of each switch over the engine compartment CAN to the AIRmatic control unit.

**i** The "higher level" corresponds to off-road level 2 on vehicles with code (430) Off-road package. The off-road levels are selected by repeatedly pressing the level control HIGH switch or level control LOW switch.

The following transient conditions apply to vehicles without code (430) Off-road package depending on the vehicle speed and the damping program setting:

- From raised level into highway level
  - $v > 70$  km/h for  $t \geq 20$  s or
  - $v \geq 90$  km/h

**i** In the Sport damping program, the system switches immediately from raised level to the high speed level.

The high speed level remains set as long as no level change is requested and implemented.

- From off-road level 1 into highway level
  - $v > 100$  km/h for  $t \geq 20$  s or
  - $v \geq 115$  km/h

**i** In damping program Sport, the system switches immediately from off-road level 1 to the high speed level. The high speed level remains set as long as no level change is requested and implemented.

- From highway level into high speed level
  - $v > 120$  km/h for  $t \geq 20$  s or
  - $v \geq 140$  km/h

**i** In damping program Comfort, the system only changes to high speed level as of a vehicle speed of  $v > 160$  km/h for  $t \geq 20$  s or at  $v \geq 180$  km/h.

- From high speed level into highway level
  - $v < 40$  km/h

decreases if compressed air is released via the corresponding level control valve or via the AIRmatic pressure reduction valve (A9/1y1).

### Additional function requirements for level adjustment

- Engine running (circuit 61 ON)  $n > 300$  rpm

### Level adjustment function sequence

On vehicles without code (430) Off-road package, the vehicle level can be raised manually by actuating the level control switch (N72/1s2).

Information on wheel speeds and wheel rotation directions, as an indicator of vehicle speed, is received by the AIRmatic control unit over the engine compartment CAN from the ESP control unit (N47-5). The AIRmatic control unit evaluates all relevant information and adjusts the vehicle to the corresponding level by actuating the level control valves or the AIRmatic pressure reduction valve (A9/1y1).

The following vehicle level setting are possible:

- Higher level +50 mm
- Highway level -30 mm
- High speed level -45 mm

The following vehicle levels can be selected additionally on vehicles with code (430) Off-road package:

- Off-road level 3 +80 mm
- Off-road level 2 +50 mm
- Off-road level 1  $\pm 0$  mm

- From highway level into high speed level
  - $v > 120$  km/h for  $t \geq 20$  s or
  - $v \geq 140$  km/h

**i** In damping program Comfort, the system only changes to high speed level as of a vehicle speed of  $v > 160$  km/h for  $t \geq 20$  s or at  $v \geq 180$  km/h.

- From high speed level into highway level
  - $v < 40$  km/h

The following transient conditions apply to vehicles with code (430) Off-road package:

- From off-road level 3 into off-road level 2
  - $v > 30$  km/h
- From off-road level 2 into off-road level 1
  - $v > 70$  km/h for  $t \geq 20$  s or
  - $v \geq 90$  km/h

### Lock position function sequence

To ensure that compressed air is not continuously drained out of the bellows in order to lower the vehicle when the vehicle is raised intentionally, e.g. with a jack, this reduction in the load on the wheels must be automatically detected and a lock position must be activated accordingly. The lock position is purely a software function which prevents actuation of the level valves (drain process). If the AIRmatic control unit detects the lock position, nothing is displayed in the instrument cluster (A1) and no errors are saved. As soon as the ESP control unit provides wheel speed information for the front wheels, the AIRmatic control unit cancels the lock position and level control starts.

Actuation of the output stages by the AIRmatic control unit via the diagnosis function is performed irrespective of the lock position status, i.e. actuation is always possible.

### Additional function requirements for damper adjustment

- Engine running (circuit 61 ON)  $n > 300$  rpm

### Damper adjustment function sequence

The system is equipped with an automatic damper adjustment system which operates based on the skyhook algorithm. All driving status data is collected and evaluated in the AIRmatic control unit and used to generate the actuation signals for damper adjustment.

The AIRmatic control unit reads the signals from the following components directly to determine the direction of movement of the vehicle body:

- Left front body lateral acceleration sensor (B24/3)
- Right front body acceleration sensor (B24/4)
- Right rear body lateral acceleration sensor (B24/6)

The following information is made available to the AIRmatic control unit to evaluate the driving status:

- Status of service brake wheel speeds and wheel rotation directions of front wheels as well as information on tire pressure, as provided by ESP control unit

Soft damping is selected individually for each wheel (where permitted by the vehicle condition). If the vehicle excitation exceeds a certain level, skyhook damping is activated for the corresponding wheel. If another threshold is exceeded, hard damping is activated. If the vehicle excitation has diminished, soft damping is reactivated. At vehicle standstill, damping at all 4 wheels is set to hard.

The control response of the damper adjustment can be influenced by the driver by actuating the Comfort/Sport switch. The status of the Comfort/Sport switch (ADS) is output to the interior CAN by the upper control panel control unit. The instrument cluster stores the corresponding program selection. The status of the Comfort/Sport switch (ADS) is made available to the AIRmatic control unit by the central gateway control unit on the engine compartment CAN. When the engine is restarted, the previously stored program selection is activated.

The central gateway control unit sends it over the engine compartment CAN to the AIRmatic control unit.

The AIRmatic control unit reads the status "Trailer detected" via the engine compartment CAN and switches to highway level once a vehicle speed of  $v \geq 8$  km/h is reached, irrespective of which vehicle level was previously selected.

### System and warning messages function sequence

System and fault messages with instructions for the driver can be output via the multifunction display (A1p13) in the instrument cluster. To output the messages, the AIRmatic control unit sends the corresponding information to the instrument cluster via the engine compartment CAN.

- Engine torque, as provided by CDI control unit or from ME-SFI control unit
- Steering wheel angle and steering angle rate of change, recorded by steering angle sensor (N49) and provided by steering column tube module (N80)

The AIRmatic control unit calculates the required damping force individually for each wheel based on the incoming information.

There are three different damper operating modes:

- soft damping (valve energized)
- skyhook mode (valve regulated)
- Hard damping (valve not energized)

In accordance with the selected damping mode the

- Left front axle damping valve unit (Y51)
- Right front axle damping valve unit (Y52)
- Left rear axle damping valve unit (Y53)
- Right rear axle damping valve unit (Y54)

are directly actuated.

**i** The initial phase of a braking or acceleration operation also causes the shock absorber mode to shift toward "hard" in order to prevent the vehicle from pitching.

In the event of system component failure, the system automatically switches to the fallback level "hard" (deenergized valves).

In this case, the indicator lamp in the Comfort/Sport switch is actuated. It is then no longer possible to change the operating mode by actuating the Comfort/Sport switch.

### Additional function requirements for trailer operation

- Engine running (circuit 61 ON)  $n > 300$  rpm
- Trailer detected

### Trailer operation function sequence

The status "Trailer detected", is output by the rear SAM control unit on the interior CAN.


The fault/system messages are displayed according to priority.

Examples of display texts in instrument cluster are:

- "Service required", plus signal tone F1
- "Stop, vehicle too low" plus signal tone F2
- "Level selection not permissible", no signal tone M1
- "Level selection canceled", no signal tone M2

**i** Priority classes: F1 = high priority, M1 = low priority.

If several faults exist at the same time, several messages can be displayed.

	AIRmatic, location of components		GF32.22-P-0003-05GM
	Electrical function schematic for AIRmatic	Model 164.1. with code (489) AIRmatic (air suspension with level adjustment and adaptive damping system (ADS)) Model 164.8 with code (214) Adaptive damping system (ADS) with skyhook and level control Model 164.8 Model 251.0/1 with code (489) AIRmatic (air suspension with level adjustment and adaptive damping system (ADS))	PE32.32-P-2050-97MAA  PE32.32-P-2050-97MAB PE32.32-P-2050-97RAA
	AIRmatic, block diagram		GF32.22-P-0003-06GM
	Instrument cluster, component description	A1	GF54.30-P-6000GM
	Component description for CDI control unit	N3/9 With engine 629.9 in model 164	GF07.16-P-6000OAG

		For engine 642.8 with code (U42) BlueTec (SCR) diesel-exhaust gas cleaning with AdBlue®/DEF and with code (494) USA version With engine 642.9	GF07.16-P-6000OGU GF07.16-P-6000OHG
	ME-SFI [ME] control unit, component description	N3/10 With engine 156 in model 164 With engine 272 With engine 273	GF07.61-P-6000MAG GF07.61-P-6000MIG GF07.61-P-6000MLG
	Front SAM control unit, component description	N10	GF54.21-P-7010GM
	Rear SAM control unit, component description	N10/8	GF54.21-P-7030GM
	Automatic air conditioning control and operating unit, component description	N22 Without code (581) Comfort automatic air conditioning	GF83.40-P-3000GM
	Comfort automatic air conditioning control and operating unit, component description	N22/7 with code (581) Comfort automatic air conditioning	GF83.40-P-3010GM
	ESP control unit, component description	N47-5	GF42.45-P-5118GM
	AIRmatic with ADS control unit, component description	N51	GF32.22-P-5108GM
	Lower control panel control unit, component description	N72 On model 164.8 and on model 164.1 with code (430) Off-road package	GF54.21-P-6060GM
	Upper control panel control unit, component description	N72/1	GF54.21-P-6040GM
	Component description for the EZS control unit	N73	GF80.57-P-6003GM
	Component description for the steering column module control unit	N80	GF54.21-P-6051GM
	Central gateway control unit, component description	N93	GF54.21-P-4170GM