FTD-FTD-SBT2003-240103040 6-speed automatic transmission E53, E60, E61, E63, E64, E65, E66, E70, E81, E83, E85, E86, E87, E90, E91, E92, E93

VIN:	**P175318**	Vehicle:	**3'/E92/COUPE/335i/N54/AUTO/EUR/RL/2008/03**
System Version:	**3.50.10.14280**	Data Version:	**R3.50.10.14280**

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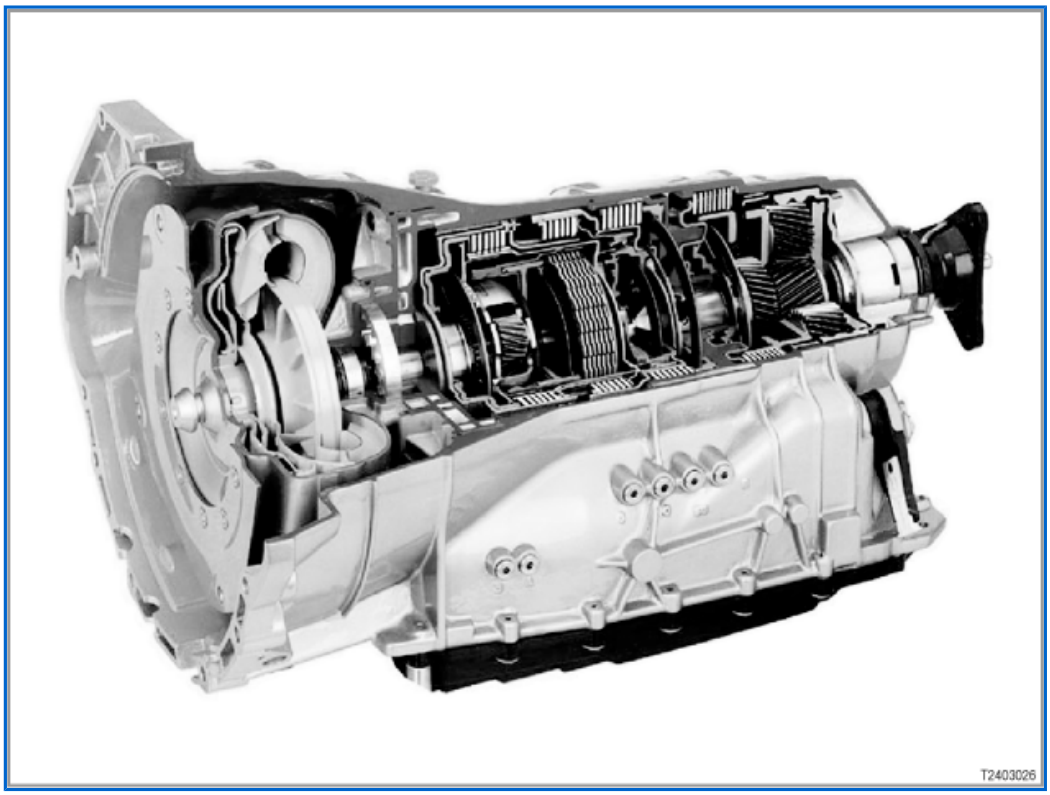
6-speed automatic transmission

E53, E60, E61, E63, E64, E65, E66, E70, E81, E83, E85, E86, E87, E90, E91, E92, E93



Introduction

The 6-speed automatic transmissions were jointly developed by BMW and ZF (Zahnradfabrik Friedrichshafen).

> E53, E83, E85, E86 [system overview ...]
> E60, E61, E63, E64 before 09/2005 [system overview ...]
> E60, E61 from 09/2005 until 03/2007 and
E63, E64 from 09/2005 until 09/2007 [system overview ...]
> E60, E61 from 03/2007
[system overview ...]
> E60, E61 from 06/2007 with sport automatic transmission and
E63, E64 from 09/2007 with sport automatic transmission [system overview ...]
> E65, E66 [system overview ...]
> E70 [system overview ...]
> E81, E87, E90, E91, E92, E93 [system overview ...]

Depending on the model concerned, the automatic transmission is either standard or special equipment (option 205).

> E60, E61 from 06/2007

From 06/2007, besides option 205 ”Automatic transmission”, option 2TB ”Sport automatic transmission” is also available.

The special equipment ”Sport automatic transmission” includes, amongst other features, gearshift paddles and a SPORT button.

> E63, E64 from 09/2007

Option 205 ”Automatic transmission” is discontinued.

On E63, E64 vehicles, only option 2TB ”Sport automatic transmission” is available. Depending on the model concerned, the ”sport automatic transmission” is either standard or special equipment.

The sport automatic transmission differs from the automatic transmission as follows:

- Gearshift paddles on steering wheel
- SPORT button in the selector lever trim
- Sport program also possible in selector lever position ”D”
- Separate gear selector switch (GWS)

So as to be compatible with the engines with higher torques, the automatic transmissions are designed with different strengths. The automatic transmissions thus differ, e.g. through different torque converters.

Depending on the engine fitted, the following 6-speed automatic transmissions are fitted:

- GA6HP19Z (designed for maximum torque of 400 Nm)
- GA6HP19Z TU (designed for maximum torque of 400 Nm)
- GA6HP26Z (designed for maximum torque of 600 Nm)
- GA6HP26Z TU (designed for maximum torque of 650 Nm)
- GA6HP32Z (designed for maximum torque of 750 Nm)

(technical updates, e.g. of transmissions, are indicated with the letters ”TU”.)

The automatic transmission requires 5 multi-plate clutches to shift between the 6 gears: 3 input clutches and 2 brake clutches. [system overview ...]

Electric steering lock discontinued:
On vehicles with automatic transmission, the electric steering lock is discontinued as follows:

- E90, E91, E92, E93 from 12/2006 (US version only)
- E60, E61 from 03/2007
- E63, E64 from 09/2007
- E70 from start of series production

Brief description of components

The automatic transmission consists of the following components:

- **Mechatronics module**

  The automatic transmission is controlled by the mechatronics module. The mechatronics module is a combination of hydraulic unit and electronics module.

  The hydraulic control unit is the hydraulic part of the transmission control system.
  The electronics module contains the EGS control unit, the sensors and the electrical connections within the transmission. (EGS is the abbreviation for electronic transmission control)

  [more ...]

- **Selector lever, selector lever position display**

  > E53, E81, E83, E85, E86, E87, E90, E91, E92, E93

  > E60, E61 until 03/2007

> E63, E64 until 09/2007

The selector lever has the following positions:

P for Park
R for Reverse
N for Neutral
D for Drive (= automatic mode)
M/S M for manual mode = Steptronic, S for sport program = automatic mode with sporty map
The selector lever position display is located in the selector lever trim.

[more ...]

> E65, E66

The selector lever is located on the steering column.

The selector lever has the following positions:

P for Park
R for Reverse
N for Neutral
D for Drive (= automatic mode)
The selector lever position display is located in the instrument cluster.

- **GWS: Gear selector switch**

  > E60, E61 from 03/2007

  > E63, E64 from 09/2007

  > E70

  The gear selector switch is configured as a control unit in its own right. With the gear selector switch, the transmission is no longer actuated mechanically, but rather electronically.

  [more ...]

- **SPORT button for Dynamic Driving Control**

  > E60, E61, E63, E64 with sport automatic transmission

  Dynamic Driving Control (FDC) is activated with the SPORT button: Gearshift times are shortened and the shift characteristics are made more sporty. The engine responds more spontaneously to movements of the accelerator pedal. The steering and holding forces of the steering tuned for a sportier feel - for Servotronic or active front steering (AFS). AFS includes Servotronic.
  > E70

  On the E70 with the option ”Adaptive Drive”, only the damping characteristics are changed (normal or sport).

- **Steering wheel with buttons for sport program and manual mode**

  > E65, E66

  The steering wheel has a button for selecting the program. The following drive programs can be selected in a predefined sequence: Sport program, manual mode or automatic mode.

  The steering wheel also houses the buttons for changing up and down in manual mode.
  Program selection and control in manual mode are described in the Owner's Handbook.

- **Gearshift paddles**

  Vehicles with gearshift paddles:

  In addition to the sequential gear selection with the selector lever, the gears can also be selected using the 2 gearshift paddles on the steering wheel.

  The shift pulse is transmitted electrically to the EGS control unit. With this gearshift method (”shift-by-wire”) there is no mechanical linkage between the gearshift paddles and the transmission.

  Pull one of the gearshift paddles briefly to change up a gear.

  Press one of the gearshift paddles briefly to change down a gear.

- **Instrument cluster display**

The drive ranges and drive program are displayed in the instrument cluster, the signal required for this is sent from the electronic transmission control.

- **CID: Central Information Display**

  > E60, E61, E63, E64, E70, E81, E85, E86, E87, E90, E91, E92, E93

  The CID displays detailed information about the Check-Control messages in the instrument cluster.

  The instrument cluster controls these messages on the K-CAN (body CAN).

  In addition to the visual display, the Check Control also alerts the driver with acoustic signals. Depending on the importance of the associated message, a single or double gong with varying volume and tone will sound. The instrument cluster controls these warnings by means of the K-CAN. Acoustic warnings are emitted by the M-ASK (multi-audio system controller) or CCC (Car Communication Computer).

- **CD: Control display**

  > E65, E66

  The control display is the central display for the information and communication system.

  The control display is used as an interface between the MOST and K-CAN data buses. (MOST = ”Media Oriented System Transport”; K-CAN = body controller area network”.)

  Amongst other things, detailed information about the Check-Control messages in the instrument cluster are displayed on the control display.

  The instrument cluster controls these messages on the K-CAN (body CAN).

The electronic transmission control requires signals from the following components (in alphabetical order):

- **Brake light switch**

  The signal from the brake light switch is needed for the function of the selector lever lock and the adaptive transmission control.

- **DME or DDE: Digital engine electronics or digital diesel electronics**

  The DME or DDE sends messages about the current operating status of the engine to the EGS (e.g. engine speed or torque).

  The EGS reports the current operating status of the transmission back to the DME or DDE.

- **DSC: Dynamic Stability Control**

  The DSC optimises both driving stability when pulling away or accelerating and traction. Within the limitations of the laws of physics, DSC compensates for driving conditions such as over/understeering. As part of this process, dynamic driving signals (e.g. wheel rotation speed, lateral acceleration) are sent to the DSC control unit. DSC transmits the processed signals regarding cornering, acceleration and winter detection to the EGS control unit.

- **Accelerator pedal module**

  The signal from the accelerator pedal module is needed for the adaptive transmission control.

- **JBE: Junction box electronics**

  > E70, E81, E87, E90, E91, E92, E93

  The JBE is the data interface (= gateway) between the K-CAN and the PT-CAN. Signals from the F-CAN are simply looped through. (K-CAN = body CAN; PT-CAN = powertrain CAN; F-CAN = chassis CAN.)

  The junction box consists of the JBE and the power distributor.
  The power distributor provides power, amongst other things, for the gate pattern diagram and the EGS control unit.

- **KGM: Body gateway module**

  > E60, E61, E63, E64 from 09/2005

  From 09/2005, the vehicle electrical system has been modified. The body gateway module (KGM) supersedes the SGM.

  The KGM is the data interface (= gateway) between the K-CAN and the PT-CAN. (K-CAN = body CAN; PT-CAN = powertrain CAN.) The diagnosis wire is connected to the KGM.

- **SGM: Safety and gateway module**

  > E60, E61, E63, E64 up to 09/2005

> E65, E66

The SGM is the data interface (= gateway) between the K-CAN, **byteflight** and the PT-CAN. (K-CAN = body CAN; PT-CAN = powertrain CAN.) The diagnosis wire is connected to the SGM.

System functions

The automatic transmission has the following system functions:

- Adaptive transmission control
- Overlap control
- Starter inhibitor
- Parking lock
- Warming-up program
- Engine intervention
- Downshift inhibitor
- Reverse gear inhibitor
- Selector lever lock (shiftlock)
- Standstill decoupling
- Interlock
- Emergency program

Adaptive transmission control

As with earlier automatic transmissions, the 6-speed automatic transmissions offer the choice between a comfort program and a sport program.

The adaptive transmission control (component of electronic transmission control) adapts the shift characteristics of the comfort program and sport program to the driver's wish and the driving situation.

In both programs, the adaptive transmission control changes from a basic map to a performance-orientated map, as required:

- Comfort program in selector lever position ”D”

  The comfort program is based on 2 maps: The XE map (extreme economy) and the E map (economy). The EGS control unit normally selects the economical XE map (= basic map). In case of particular demands (e.g. load requirements), the system will change to the performance-orientated E map. If the input signals change in favour of a more gentle driving style, the system will change back to the more economical XE map.

- Sport program in selector lever position ”M/S”

  The sport program effects dynamic, sporty shift characteristics. In the sport program, there is the basic S map (sport) and the performance-orientated XS map (extreme sport). If an extremely dynamic driving style is called for, the system will change from the S map to the performance-orientated XS map.

The adaptive transmission control takes the following demands into account:

- Adaptation to driver type
- Driving uphill or trailer towing
- Driving downhill
- Braking deceleration and automatic upshift
- Winter program

Adaptation to driver type

The adaptation to different driver types is done using the following values:

- Kick-fast

If the accelerator pedal is depressed rapidly, the shift program is changed accordingly. This is achieved by the detected accelerator-pedal value being compared with threshold values in the EGS control unit. The result of this comparison is the proposal of one of the two possible programs (XE or E in comfort program, S or XS in sport program).

- Cornering detection

  Cornering detection reacts to the vehicle's lateral acceleration with an indirect adaptation to the driver type.

  Lateral acceleration is considered an indirect statement of the preferred driving dynamics and does not cause an immediate gearshift response (shifts when cornering could adversely affect driving stability).

  Lateral acceleration is calculated from the signals from the wheel-speed sensors, from the yaw rate and road speed.

- Brake evaluation

  The braking action is evaluated in a similar way to ”kick-fast”.
  The braking deceleration is measured and compared with threshold values in the EGS control unit. The result of this comparison is the proposal of one of the two possible programs (XE or E in comfort program, S or XS in sport program).

The driver-type adaptation is restarted each time the vehicle pulls away from a standstill.

Driving uphill or trailer towing

These functions are based on a comparison of actual car acceleration with a nominal value. From the current engine operating situation, the acceleration with normal load on a level surface is calculated. If the actual acceleration is significantly below the theoretical value, the ”Driving uphill or trailer towing” function is activated.

The design of the corresponding shift characteristics allows a high-speed driving style. Undesirable upshifts and frequent up/downshifts are eliminated or greatly reduced.

Driving downhill

If the EGS control unit detects downhill driving, it will automatically shift down a gear if the vehicle's speed picks up. This enhances the engine's braking effect. A downshift is only effected if the engine speed is below the maximum speed of the lower gear.
The EGS control unit detects downhill driving on the basis of signals from the throttle valve potentiometer (load), wheel speed sensor (road speed) and brake light switch (brake activation).

Braking deceleration and automatic upshift

To decelerate the vehicle, the foot is taken off the gas and the brake depressed as necessary. The gearshift map triggers an upshift when the throttle is closed. These gearshifts are not necessary in conjunction with brake applications as they prevent the engine's braking effect from being exploited.

The intention to apply the brakes can often be anticipated from the accelerator pedal being rapidly released to the zero position. If such an action is detected, the upshift is suppressed for as long as the accelerator pedal is in the zero position and the vehicle is in overrun mode.

Winter program (only with selector lever in position ”D”)

The winter program is automatically activated if the drive wheels start to spin even at a low rate of acceleration. The winter program ensures better traction by not using 1st gear. Early upshifts reduced the reactions caused by load changes. The winter program is deactivated if the wheels do **not** spin for several seconds despite high drive torque.

Overlap control

Overlap control provides gentle shift characteristics as follows: With overlap control, several multi-plate clutches are in use at the same time. Here, pressure is reduced in the active multi-plate clutch and at the same time built up in the clutch that is about to be activated. The reduction and build-up of pressure is maintained until a synchronised speed is reached. At this point, the hydraulic pressure for the multi-plate clutch to be activated can be built up completely. Overlap control is active for all gearshifts from 1st to 6th gear and from 6th to 1st gear.

Starter inhibitor

It is only possible to start the engine when the selector lever is in position ”P” or ”N”.

> E53, E83, E85, E86

The EWS (electronic immobiliser) evaluates the following signal from the EGS (electronic transmission control) for the start:

- Selector lever position ”P” or ”N” as signal via the direct wire

> E60, E61 until 03/2007

> E63, E64 until 09/2007

> E81, E87, E90, E91, E92, E93

The CAS (Car Access System) evaluates the following signals from the EGS (electronic transmission control) for the start:

- Selector lever position ”P” or ”N” as CAN message via the powertrain CAN
- Selector lever position ”P” or ”N” as signal via the direct wire

> E60, E61 from 03/2007

> E63, E64 from 09/2007

> E65, E66, E70

The CAS (Car Access System) evaluates the following signals from the EGS (electronic transmission control) for the start:

- Selector lever position ”P” or ”N” as CAN message via the powertrain CAN
- Selector lever position ”P” as signal via the direct wire

In principle, the CAN message is used. If the message is incorrect or invalid, it switches to the signal from the direct wire.

Parking lock

The parking lock locks the transmission output shaft. The vehicle is prevented from rolling unexpectedly. The parking lock is designed to provide a reliable brake on gradients up to 32 %.

> E53, E81, E83, E85, E86, E87, E90, E91, E92, E93

> E60, E61 until 03/2007

> E63, E64 until 09/2007

When the vehicle is stationary, the parking lock is engaged purely mechanically via the selector lever (Bowden cable from selector lever to mechatronics module).

> E65, E66, E70

> E60, E61 from 03/2007

> E63, E64 from 09/2007

With the electric version of the parking lock, the parking lock is applied and electrically secured via a mechanical spring system in the transmission.

The parking lock is activated under the following conditions:

- E65, E66,
  - Pressure on the button on the selector lever and roadspeed signal less than 2 km/h.
  - Remote control removed from the slot and road speed signal 0 km/h.
  - Engine ON
    and
    Transmission position ”D” or ”R”
    and
    Driver's door open
    and
    Driver's seat not occupied
    (road speed signal less than 2 km/h).
  - By pressing the START/STOP button while the engine is ON (change status of terminal 15 to OFF)
    and
    Transmission position ”D” or ”R”
    and
    Road speed signal 0 km/h.
- E60, E61 E63, E64, E70

- Pressure on the button on the selector lever and roadspeed signal less than 2 km/h.
- Remote control removed from the slot and road speed signal 0 km/h.
- Engine ON

  and

  Transmission position ”D” or ”R”

  and

  Driver's door open

  and

  Driver's seat belt not fastened in belt buckle

  and

  Pedals not depressed

  (road speed signal less than 3 km/h).
- By pressing the START/STOP button while the engine is ON (change status of terminal 15 to OFF)

  and

  Transmission position ”D” or ”R”

  and

  Road speed signal 0 km/h.

The parking lock is only released when the engine is ON. Reason: Only when the engine is ON is there enough hydraulic pressure to open the parking lock (mechanical emergency release possible).

> E65, E66, E70

If the parking brake (EMF = ”electromechanical parking brake”) fails, the parking lock can still be applied.

Example: A fault in the system prevents the parking brake from being moved from ”Hold” to ”Park”. In this case, the EGS control unit will engage the parking lock after a prompt from the DSC (master control unit for the electromechanical parking brake) and after a plausibility check.

The locking conditions are as follows:

- E65, E66
  - Selector lever in position ”N”
  - Speed 0 km/h
  - Engine OFF and ignition OFF
- E70
  - Selector lever position ”D” or ”N” or ”R” engaged
  - Speed 0 km/h

Warming-up program

The warming-up program is activated after each engine start with the engine temperature lower than approx. 60 °C. In the warming-up program, the automatic transmission remains in the performance-orientated map E or XS up to a certain temperature. Gearshift are only executed at higher speeds. This enables the engine and the catalytic converter to reach their operating temperatures more quickly.

Up to a transmission oil temperature of approximately 35 °C, the converter lockup clutch is neither controlled nor closed.

Engine intervention

During the gearshift, the EGS control unit emits signals to influence the digital engine electronics (DME) or digital diesel electronics (DDE).

The DME then retards the ignition timing for a few milliseconds.

The DDE reduces the fuel quantity for a few milliseconds by reducing the injection period.

This action briefly reduces the torque, improves shift quality, reduces the load on the transmission and shortens the shifting time.

Downshift inhibitor

A downshift inhibitor prevents the transmission shifting to a lower gear until the engine speed is below the maximum speed for the next gear down. The engine speed signal is transmitted by the DME/DDE to the EGS control unit.
The downshift inhibitor prevents damage to the engine and transmission.

Reverse gear inhibitor

The reverse gear inhibitor electronically prevents reverse gear from being engaged when the vehicle is moving forwards at speeds above 5 km/h (3 mph). When this road speed is exceeded, the corresponding solenoid valves are no longer actuated. This prevents multi-plate clutches B and D (for reverse gear) from being charged.

Selector lever lock (shiftlock)

> E53, E60, E61, E63, E64, E81, E83, E85, E86, E87, E90, E91, E92, E93

The selector lever is locked in positions ”P” and ”N” by an electromagnet. The electromagnet is actuated by the EGS control unit. The selector lever lock is engaged when selector lever position ”P” or ”N” is detected and the ignition (terminal 15) is ON.

- Position change from selector lever position ”P” or ”N”:

  A position change is only possible at road speeds of less than 5 km/h and if the brake is applied at an engine speed of less than 2500 rpm.

Standstill decoupling (depends on national version)

The standstill decoupling of the torque converter decouples the torque converter from the drive when the vehicle is at a standstill. Thus only a minimum load remains, and fuel consumption is reduced. Decoupling is effected by a clutch regulation system (clutch A) within the transmission (depending on the load signal and output speed).

Interlock

> E53, E83, E85, E86 and

E60, E61, E63, E64 up to 09/2005

The ignition lock is mechanically linked to the selector lever by a Bowden cable (as on the E38). The interlock only allows the ignition key to be removed when the selector lever is in position P.

Conversely, the selector lever can only be moved from position ”P” when the ignition key is in the ignition lock and turned at least to ignition ON.

> E60, E61 from 03/2007 and

E63, E64 from 09/2007 and

E65, E66 and
E70

The remote control can only be removed when the CAS registers a roadspeed signal of less than 1 km/h.
If the remote control is removed from the slot after the engine has been switched OFF, the parking lock will automatically be applied.

> E81, E87, E90, E91, E92, E93 and

E60, E61 from 09/2005 until 03/2007 and

E63, E64 from 09/2005 until 09/2007

The selector lever is locked in position P by an electromagnet when terminal 15 is OFF. When the remote control is not in the slot, the selector lever is locked in position ”P”. When terminal 15 is activated, the EGS control unit applies current to the electromagnet and the selector lever is released. A microswitch registers the locking or unlocking of the selector lever. The microswitch transmits a signal to the CAS (Car Access System) to enable the remote control.

- Interlock **without** convenience access

  If the selector lever is not engaged in position ”P”, the remote control cannot be removed from the slot. The selector lever is locked when the selector lever is in position P and the ignition is OFF. The remote control can be removed.

- Interlock **with** convenience access

  The engine and terminal 15 (ignition) can only be switched off when the selector lever is in position ”P”.

Emergency program

The emergency program is activated if the transmission management should fail or detect a malfunction that could lead to critical driving conditions. In the emergency program, the vehicle remains operational, albeit with limitations.

If the electronic transmission control fails (without current), the following forward gears can be engaged:

Failure in 1st-3rd gear -> emergency 3rd gear

Failure in 4th-6th gear -> emergency 5th gear

A restart will be performed in 3rd gear.

Special situations (functions in EGS)

> E60, E61 from 03/2007
> E63, E64 from 09/2007
> E70

Direction change memory function
The driver wishes to change from selector lever position ”D” to selector lever position ”R” or from selector lever position ”R” to selector lever position ”D”.

- At v ≤ 5 km/h, the driver's wish is carried out by the electronic transmission control (EGS).
- At 5 ≤ v ≤ 10 km/h, selector lever position ”N” is engaged by the electronic transmission control, the display of the currently engaged gear range changes to the driver's desired selector lever position ”D” or selector lever position ”R”.

  The driver's wish is stored. If the vehicle's speed drops below 5 km/h within 1 second, the driver's wish for selector lever position ”D” or selector lever position ”R” is carried out by the electronic transmission control. If the speed stays above this threshold, selector lever position ”N” remains and the display changes to selector lever position ”N”.
- If v > 10 km/h, selector lever position ”N” is engaged by the electronic transmission control

Parking lock memory function
The driver wishes to engage selector lever position ”P” (parking lock)

- At v ≤ 2 km/h, selector lever position ”P” is engaged by the electronic transmission control (EGS).
- At 2 ≤ v ≤ 5 km/h, the current selector lever position remains, the driver's wish is stored. If the vehicle's speed drops below 2 km/h within a second, selector lever position ”P” is engaged by the electronic transmission control
- At v > 5 km/h, the driver's wish is not accepted. The current selector lever position remains and the Check-Control message ”Transmission position P only at standstill” is displayed

Position ”N” hold time
If v ≤ 2 km/h, the engine is OFF, selector lever position ”N” is engaged and the ID transmitter is inserted, the selector lever position ”N” hold time starts for 30 minutes.
During this time, information is transmitted by the electronic transmission control (EGS), the function display remains on and selector lever position ”N” lights up in the gate pattern diagram. At the end of selector lever position ”N” hold time, the display flashes and the electronic transmission control (EGS) engages selector lever position ”P” after 10 seconds.
If the selector lever is moved during position ”N” hold time, the 30 minutes selector lever position ”N” hold time start afresh.
Operation

The different automatic transmission drive positions are selected with the selector lever.
When driving, there are the following possibilities:

- **D = Automatic mode**

  When the selector lever is in position ”D”, gears are selected by the adaptive transmission control.

  - **Gearshift using gearshift paddles**

    If the selector lever is in position ”D” and a gearshift is initiated using the gearshift paddles, the automatic transmission will automatically change to manual mode.
    If no gearshift is made and the vehicle does not accelerate significantly within 6 seconds, the automatic transmission will change back to automatic mode.
- **SD = Automatic mode, sport program**

  When the selector lever is moved to the right from position ”D” into the shift gate ”M/S”, the automatic transmission's sport-shift program is activated. The display in the instrument cluster changes from ”D” to ”SD”.

- **M1 to M6 = Steptronic**

  If the selector lever is in shift gate ”M/S” and is briefly moved to ”-” or ”+”, the electronic circuitry changes to Steptronic. Permanent manual mode is activated with the selector lever or gearshift paddles. The display in the instrument cluster changes from ”SD” to ”M1” to”M6”.
  In manual mode (Steptronic), upshifts and downshifts are only executed by the transmission control if road speed and engine speed are suitable. Gearshifts that would result in an excessively high or low engine speed are suppressed.

- **Sport program via SPORT button**

  When the SPORT button is pressed, the electronics will change to the sport program regardless of the drive range engaged or the current selector lever position.

Notes for service staff

Service staff should note the following points:

- Service notes: [more ...]
- Diagnosis: ---
- Encoding/programming: ---

Subject to change.