

Adaptive transmission control

Control unit	Transmission	Engine
AGS-8.34	A4S 270R (GMPT R1)	M43, M44
AGS-8.34	A4S 360R (GM4)	M43
GS-20	A5S 360R (GM5)	M57
AGS-7.32	A5S 310Z (5HP-18)	M60B30
AGS-8.32	A5S 310Z (5HP-18)	M52
AGS-8.32	A5S 310Z (5HP-18)	M51
AGS-8.60.0	A5S 325Z (5HP19)	M52LEV
AGS-8.51	A5S 440Z (5HP-24)	M62
AGS-8.55	A5S 440Z (5HP-24)	M62
AGS-8.60.2	A5S 440Z (5HP-24)	M62LEV
AGS-9.22	A5S 560Z (5HP-30)	M60B40
AGS-9.22	A5S 560Z (5HP-30)	M62B44
AGS-9.22	A5S 560Z (5HP-30)	M73
AGS-8.60.3	A5S 560Z (5HP-30)	M73LEV

The task of the adaptive transmission control is to adapt gear selection to the driving characteristics of the driver as well as to the current driving situation. The main arguments for the use of adaptive transmission control are:

- Reduction in fuel consumption in conjunction with steady driving characteristics
- Avoidance of frequent gearshifts
- Optimisation of driving safety on slippery roads
- Reduction in amount of necessary driver interventions

The control unit transfers the shift pulses for upshifts and downshifts to the transmission selector unit (solenoid valves, pressure regulator) and decides when the torque converter lockup clutch is to be engaged, taking factors such as comfort and safety into consideration. For this purpose, it processes, in a computer program, input variables such as engine speed, output speed, turbine speed, injection signal, throttle (accelerator pedal) position, kick-down switch, drive program, selector lever position and oil sump temperature.

Note

The control unit is installed in the E-box in the engine compartment.

Driver type evaluation

The influencing factors which are used to classify the type of driver are described in the following. The result of driver type evaluation has an effect on the selection of the gearshift program.

Approach evaluation

The behaviour when approach driving (forced or more moderate) influences the selection of the gearshift program.

Kick-fast evaluation

A sporty, performance-oriented gearshift program is selected automatically from a low gearshift, consumption-oriented driving program by quickly depressing the accelerator pedal (kick-fast). This normally results in a downshift.

Driving evaluation

When driving with a constant accelerator pedal position, a consumption-oriented gearshift program is selected within a short space of time and the transmission shifts into a higher gear.

Kick-down evaluation

The sporty gearshift program is selected immediately by "kick-down". On completion of kick-down, the gear selection is still influenced for a certain period of time in the sporty direction.

Braking evaluation

Above average braking manoeuvres cause the system to change to the sports gearshift program with earlier downshifts.

Gearshift program selection

In addition to driver type evaluation, there are still further factors for selecting one of the four gearshift programs. These programs are classified from very comfort and consumption-oriented through to very sporty.

Program selection button

This button makes it possible for the driver to intervene in the driving program manually. Selection of the S-program (sports) leads directly and exclusively to the sports gearshift program. This program is not exited before the A-program (adaptive) is selected and the adaptive functions are activated once again. The A-program is always selected when the vehicle is started.

Uphill driving/trailer detection

A performance-oriented gearshift program is selected when negotiating extreme gradients or when driving with above-average load. This avoids frequent upshifts and downshifts.

Winter detection

The winter gearshift program is selected if the drive wheels slip through even at low acceleration. The program starts off in 2nd gear and ensures earlier upshifts. This driving situation is evaluated by way of the sensors of the antilock brake system (ABS). Different wheel speeds at the front and rear axle result in winter detection. The winter program is exited automatically as soon as a road surface with good grip in conjunction with high drive torque is detected for several seconds.

In addition to automatic gear selection in accordance with the above-specified criteria for gearshift program selection, four special functions are provided to ensure special driving situations are detected.

Downhill detection

Upshifts are suppressed when driving downhill without pressing the accelerator. If the driver presses the brake pedal, the transmission shifts down by one gear to provide extra assistance. This ensures the braking effect of the engine is utilised more effectively.

Fast-off detection

An upshift is prevented when the accelerator pedal is taken back rapidly. As a result the braking effect of the engine is utilised more effectively in these driving situations (fast changeover from accelerator pedal to brake pedal). This function considerably reduces the gearshift frequency when driving with a more sporty style.

Stop-and-go detection

In this driving situation there is no downshift into 1st gear. The car starts off automatically in 2nd gear. This increases driving comfort, reduces fuel consumption and reduces the crawling tendency when the car is stationary. By depressing the accelerator pedal more intensively, a downshift can be triggered in order to utilise the full power potential.

AGS interfaces

AGS inputs

The AGS control unit receives information from the following components via various interfaces:

Component	Information
Automatic transmission	Output speed, turbine speed, transmission oil temperature
Program button	Manual program selection
Selector lever	Gear selection, gear limit
Kick-down switch	Kick-down operation
Brakes	Brake pedal operation
Digital motor electronics DME	Engine speed, engine temperature, throttle angle
Speed control (cruise control)	Information concerning constant driving or acceleration, braking procedures
ABS/ASC	Current wheel speeds

AGS outputs

Information is supplied to the following components by the outputs of the AGS control unit:

Component	Information
Automatic transmission	Activation of solenoid valves and electronic pressure controller
Instrument cluster electronics IKE	Current driving program, selector lever position, if necessary "transmission emergency program" are

shown in the text display of the IKE.

Cruise control (Tempomat) interface

When the cruise control (GR) is selected, the AGS control unit switches over to a special transmission program for controlled driving. This gearshift program ensures that the available engine output can be utilised to the full extent in this driving situation. Frequent up and downshifts, i.e. frequent, fast successive gearshifts between two adjacent gears, are reduced to a minimum. A time delay is programmed to avoid abrupt gearshifts.

The information from the cruise control (GR) control unit to the transmission control unit flows via a serial interface. Data are transferred on the one-wire line at a rate of approx. 25 Baud.

The gearshift program takes into consideration the following driving situations:

Driving situation	Characteristics
Constant driving	Comfort-oriented, i.e. low engine speed level
Resume	Maximum tractive force
Acceleration procedures	Maximum tractive force
Deceleration procedure	Upshifts are avoided for optimum deceleration capacity

Instrument cluster interface

A serial data link leads from the AGS control unit to the instrument cluster electronics (IKE). The transmission control unit uses this data link to send the position of the selector lever, the active driving program (**A** daptive or **S** ports) and if necessary the signal "transmission emergency program" to the instrument cluster electronics.

Kick-down switch

The AGS control unit receives the transmit signal for kick-down gearshifts via a signal line and a switch to ground. The switch must be adjusted such that driving is possible under full load, i.e. accelerator pedal position 100%, and the kick-down shifts when the accelerator pedal is further depressed.

Selector lever switch

The AGS control unit detects the selector lever position by way of a switch on the transmission. This switch converts the current selector lever position into a code. This selector lever code is transferred via four lines (L1-L4) to the AGS control unit.

Selector lever position	L1 to L4 (0 = open, 1= U-batt)
P	L1 =1, L2 = 1, L3 = 0, L4 =1
R	L1 =1, L2 = 0, L3 = 0, L4 =0
N	L1 =1, L2 = 1, L3 = 1, L4 =0
D	L1 =0, L2 = 0, L3 = 1, L4 =0
4	L1 =0, L2 = 0, L3 = 0, L4 =1

3	L1 =0, L2 = 0, L3 = 1, L4 =1
2	L1 =1, L2 = 0, L3 = 1, L4 =1

CAN-bus

The CAN-bus (Controller Area Network) is a serial bus system, in which all connected stations are equally entitled, i.e. each control unit can both send as well as receive. In other words, the connected control units can "communicate" and exchange information via the lines.

Due to the linear structure of the network, the bus system is fully available for all other control units in the event of one control unit failing. The connection consists of two data links (CAN-L and CAN-H) which are interface-protected by means of shielding (CAN-S).

The control units AGS, ASC/DSC (M62 only) and digital motor electronics (DME) are currently interconnected with this system. Linking-in of further control units will follow. The following signals are exchanged between AGS, ASC/DSC and DME control units via the CAN-bus:

- Accelerator pedal position
- Load signal
- Engine speed
- Driver program
- Gear
- Engine intervention
- Wheel speeds (M62 only)

The connected control units must all have the same CAN status. The CAN status can be checked via the diagnosis interface. The CAN status (bus index) is specified in the identification of the relevant control unit connected to the CAN-bus.

Transmission oil temperature sensor

The transmission oil sump temperature is sensed by a temperature-dependent resistor which is soldered in the transmission wiring harness. Among other things, engagement of the torque converter lockup clutch is controlled dependent on the transmission oil temperature.

Wheel speeds

The ASC/ABS control unit supplies four processed signals relating to the wheel speeds from the ABS sensors. The speed information received by the AGS control unit is determined by frequency. Evaluation enables detection of cornering and winter operation.

Driving programs

Two driving programs can be selected on the E38 with the program switch.

Driver program	Function
A = Adaptive	From the four available gearshift programs, the adaptive control selects the most favourable program automatically. At the time the vehicle is started, the AGS control unit assumes the adaptive program.
S = Sports	After manual selection of this program, the transmission switches over directly and permanently to the sports gearshift program.

Adaptive gearshift characteristic curve control

When pulling a trailer or negotiating gradients, the changed acceleration capacity of the vehicle is evaluated by the control unit. For this purpose, the control unit selects (adapts) suitable gearshift programs in order to avoid frequent upshifts and downshifts.

Torque converter lockup clutch control

The torque converter lockup clutch is controlled dependent on the accelerator pedal position, transmission output speed, drive program, transmission oil temperature as well as the engaged gear (in 4th and 5th gear only).

Adaptive pressure control

Adaptive pressure control improves the gearshift quality over the life of the vehicle. During an upshift, the slip times are measured and compared to a nominal value range. The mean deviations are then stored. As soon as a programmed limit value is exceeded, the pressure is increased or reduced in steps of 0.1 bar. In this way, the control system corrects engine scatter, compensates for differences in the friction lining and adapts to altitude.

Steptronic

The Steptronic function makes it possible to shift all gears of the automatic transmission manually. The gear required by the driver is transmitted via three switches (to ground) in the manual gate to the AGS control unit: The "manual gate" switch is closed if the selector lever is moved out of the automatic gate into the manual gate. By pressing the selector lever forward or back, the "strike-up" or "strike-down" contact is additionally closed.

Note

After installing a new AGS control unit, the selector lever must be moved once into the "downshift" or "upshift" position with terminal 15 switched on in order for the control unit to detect that the Steptronic facility is installed.

P/N lock (shift-lock in Japan and US version up to 09/96, in all country-specific variants as from 09/96)

It is only possible to shift out of the positions "P" or "N" after evaluation of the signals:

- Brake (brake light switch or brake light test switch)
- Road speed
- Engine speed
- Time

The selector lever is locked when no brake signal is detected with the engine running and the vehicle stationary. A time delay function of approx. 0.5 s is used for operation under winter conditions. The brake light switch is designed as a normally-opened contact referred to 12 V and the brake light test switch as a normally-open contact referred to ground. The shift lever is locked by way of a solenoid on the selector lever switch.

Safety functions

By way of plausibility checks and checking the line connections for shorts or breaks, the control unit can detect and store defects. Manually engaged downshifts are not carried out at excessively high speeds. At a vehicle speed above approx. 8 km/h, the reverse lockout function prevents reverse being shifted hydraulically. In the event of failure of the transmission control or when defects are detected which lead to critical driving situations (e.g. impermissible downshifts), the mechanical emergency program is activated, i.e. the transmission control unit is switched off and the failure display activated. A self-test of the entire safety hardware is carried out during each new start.

Restricted driving of the vehicle is possible in the emergency program (4th gear). Various substitute programs are also made available depending on the type of defect which has occurred.