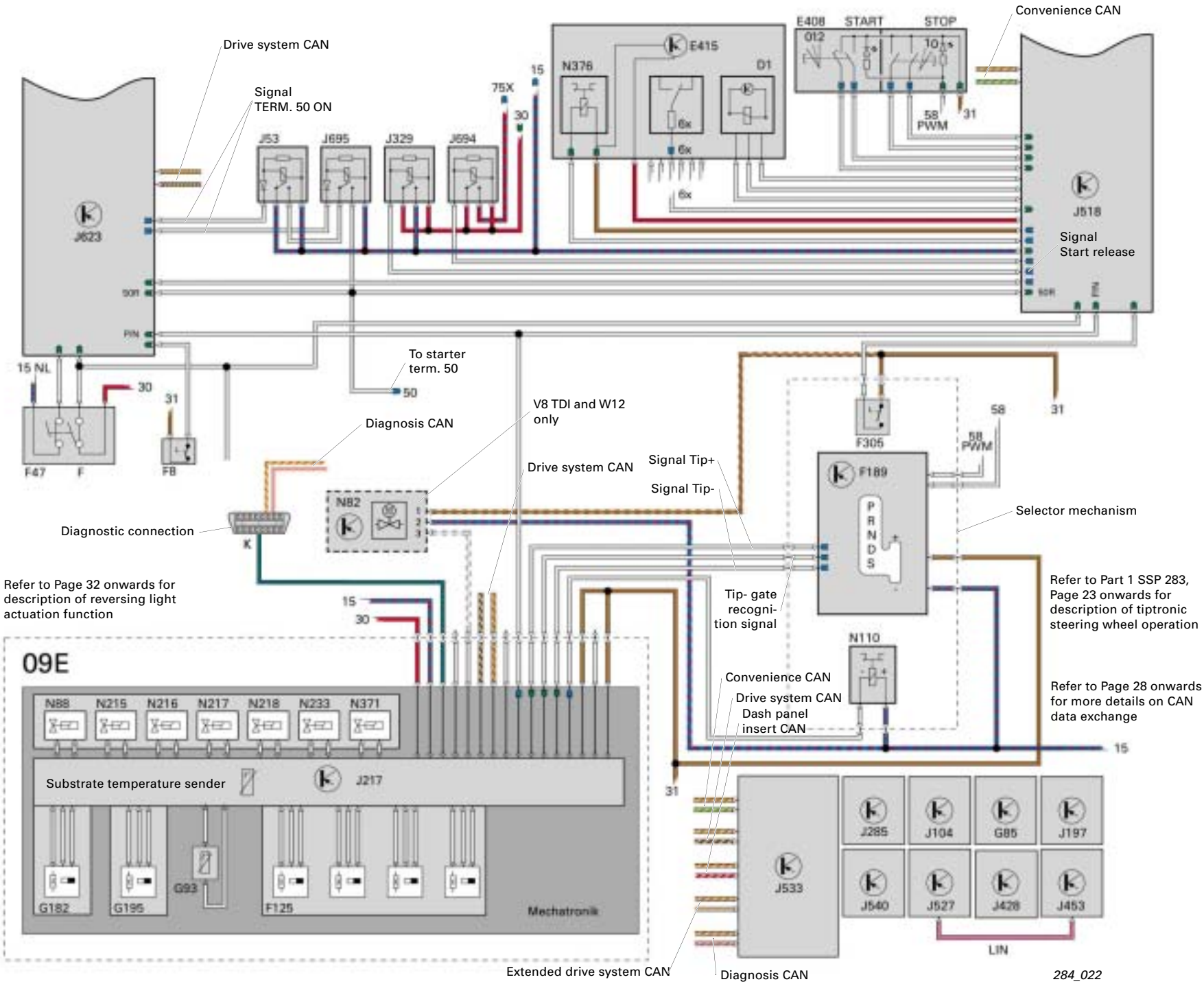
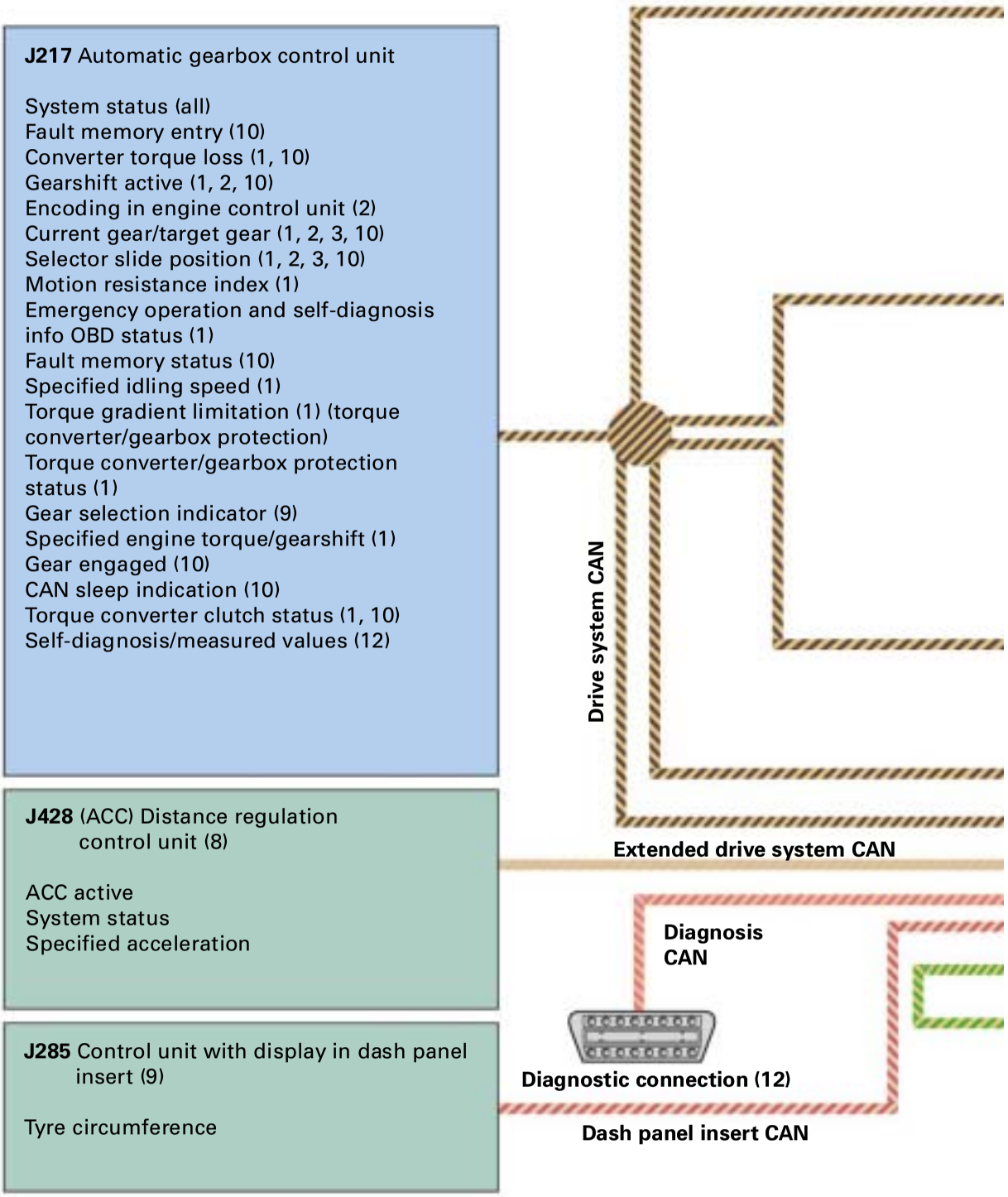
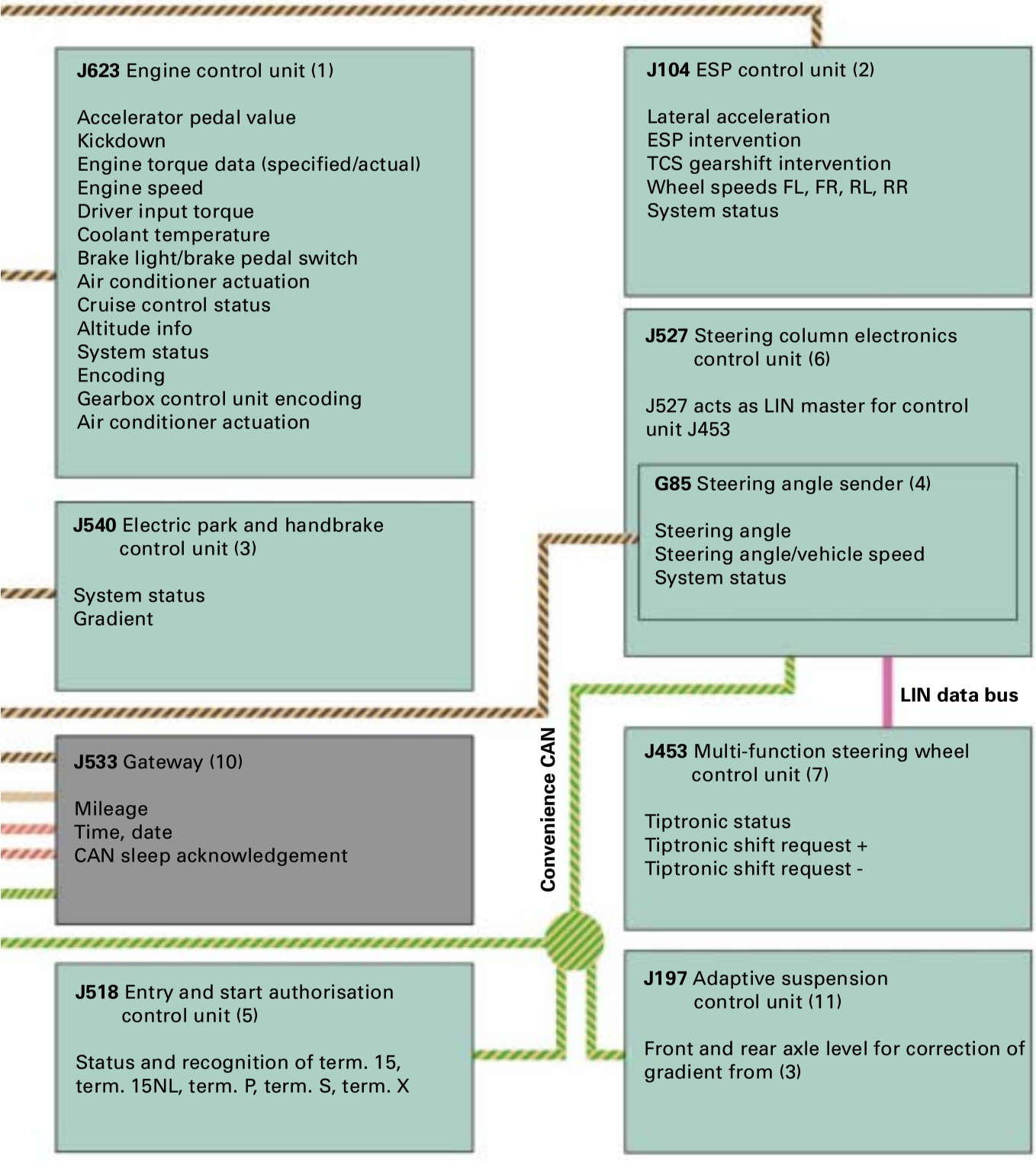

Drive system CAN
Signal
TERM. 50 ON
J623
J53
J695
J329
J694
75X
15
30
N376
E415
D1
6x
6x
6x
E408
START
STOP
012
10
58
PWM
31
Convenience CAN
J518
Signal
Start release
50R
CAN
50H
PIN
15 NL
30
31
F47
F
FB
To starter
term. 50
50
V8 TDI and W12
only
Diagnosis CAN
Drive system CAN
Signal Tip+
Signal Tip-
F306
58
58
PWM
31
F189
P
R
N
D
S
Selector mechanism
N82
Diagnostic connection
K
Refer to Page 32 onwards for
description of reversing light
actuation function
15
30
Tip- gate
recogni-
tion signal
N110
Refer to Part 1 SSP 283,
Page 23 onwards for
description of tiptronic
steering wheel operation
Refer to Page 28 onwards
for more details on CAN
data exchange
Convenience CAN
Drive system CAN
Dash panel
insert CAN
15
09E
N88
N215
N216
N217
N218
N233
N371
Substrate temperature sender
J217
31
J533
J285
J104
G85
J197
J540
J527
J428
J453
LIN
G182
G195
G93
F125
Mechatronik
Extended drive system CAN
Diagnosis CAN

284_022

# Gearbox Control

## CAN data exchange




**J623** Engine control unit (1)
Accelerator pedal value
Kickdown
Engine torque data (specified/actual)
Engine speed
Driver input torque
Coolant temperature
Brake light/brake pedal switch
Air conditioner actuation
Cruise control status
Altitude info
System status
Encoding
Gearbox control unit encoding
Air conditioner actuation
**J104** ESP control unit (2)
Lateral acceleration
ESP intervention
TCS gearshift intervention
Wheel speeds FL, FR, RL, RR
System status
**J527** Steering column electronics control unit (6)
J527 acts as LIN master for control unit J453
**G85** Steering angle sender (4)
Steering angle
Steering angle/vehicle speed
System status
**J540** Electric park and handbrake control unit (3)
System status
Gradient
LIN data bus
Convenience CAN
**J533** Gateway (10)
Mileage
Time, date
CAN sleep acknowledgement
**J453** Multi-function steering wheel control unit (7)
Tiptronic status
Tiptronic shift request +
Tiptronic shift request -
**J518** Entry and start authorisation control unit (5)
Status and recognition of term. 15, term. 15NL, term. P, term. S, term. X
**J197** Adaptive suspension control unit (11)
Front and rear axle level for correction of gradient from (3)

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# Gearbox Control

## Functions

**Stationary vehicle decoupling**

Stationary vehicle decoupling is a special feature of the 09E.

With the vehicle stationary (engine idling) and a gear engaged, the torque converter already transmits a certain torque level. With the brake released, this results in the vehicle "creeping forward". With the brake pressed, the torque transmitted represents a certain loss, as the idling speed has to be kept constant by adjusting the idling torque (further opening of throttle valve).

As well as increasing fuel consumption, constant brake application (a certain pedal force is required to hold the vehicle) results in a loss of comfort.

The stationary vehicle decoupling function reduces the torque converter power flow to the planetary gearbox with the vehicle stationary and **the brake applied** ("Brake pressed" info from F and F47) by regulating the clutch A.

In addition, stationary vehicle decoupling reduces the noise level with the engine idling as the engine load is lower.

Stationary vehicle decoupling is not activated in reverse gear.

With the current design philosophy, stationary vehicle decoupling is only activated at present in the ATF temperature range between approx. 15°C and 50°C.

**Functional description:**

Stationary vehicle decoupling is controlled by calculating the converter torque from engine and turbine speeds (speed difference). Further factors in the calculation are the ATF temperature and gradient.

**Stationary vehicle decoupling not active:**
Vehicle stationary, engine idling and turbine shaft not turning; 100 % speed difference/slip

**Stationary vehicle decoupling active:**
Vehicle stationary, engine idling and turbine shaft turning at a defined speed difference (approx. 120 rpm); slip approx. 20 %

To ensure immediate, smooth starting, the power flow is not completely interrupted. A low converter torque level is always transmitted, thus eliminating meshing cycles and improving clutch control action.

Stationary vehicle decoupling is deactivated immediately if a gearbox output speed (G195) is detected while the decoupling function is active. The power flow is established before the driver accelerates, thus largely preventing vehicle rollback on slopes.

Brake release ("Brake not pressed" info) also deactivates stationary vehicle decoupling irrespective of other parameters.

Exceeding a defined accelerator pedal value (with brake pressed) deactivates stationary vehicle decoupling.

This permits checking of the stall speed (stall test).

As of a gradient of approx. 5 %, stationary vehicle decoupling is no longer activated. The gradient is determined by the tilt sensor of the electric parking brake EPB, which is located in the electric park and handbrake control unit J540.

The gradient information is transmitted by way of the CAN bus (refer to CAN data exchange, Page 28 onwards).

J540 is located in the rear right side panel (refer to information given in SSP 285 Audi A8'03 Running Gear).

This has no influence on vehicle behaviour on gradients (possible rollback on releasing brake). Holding of the vehicle without the brake is still governed by idle converter torque, gradient and vehicle weight.

**Engine torque intervention**

In addition to the familiar engine torque reduction function during change-up (negative torque intervention), the 09E is the first gearbox to offer a "positive" torque intervention feature.

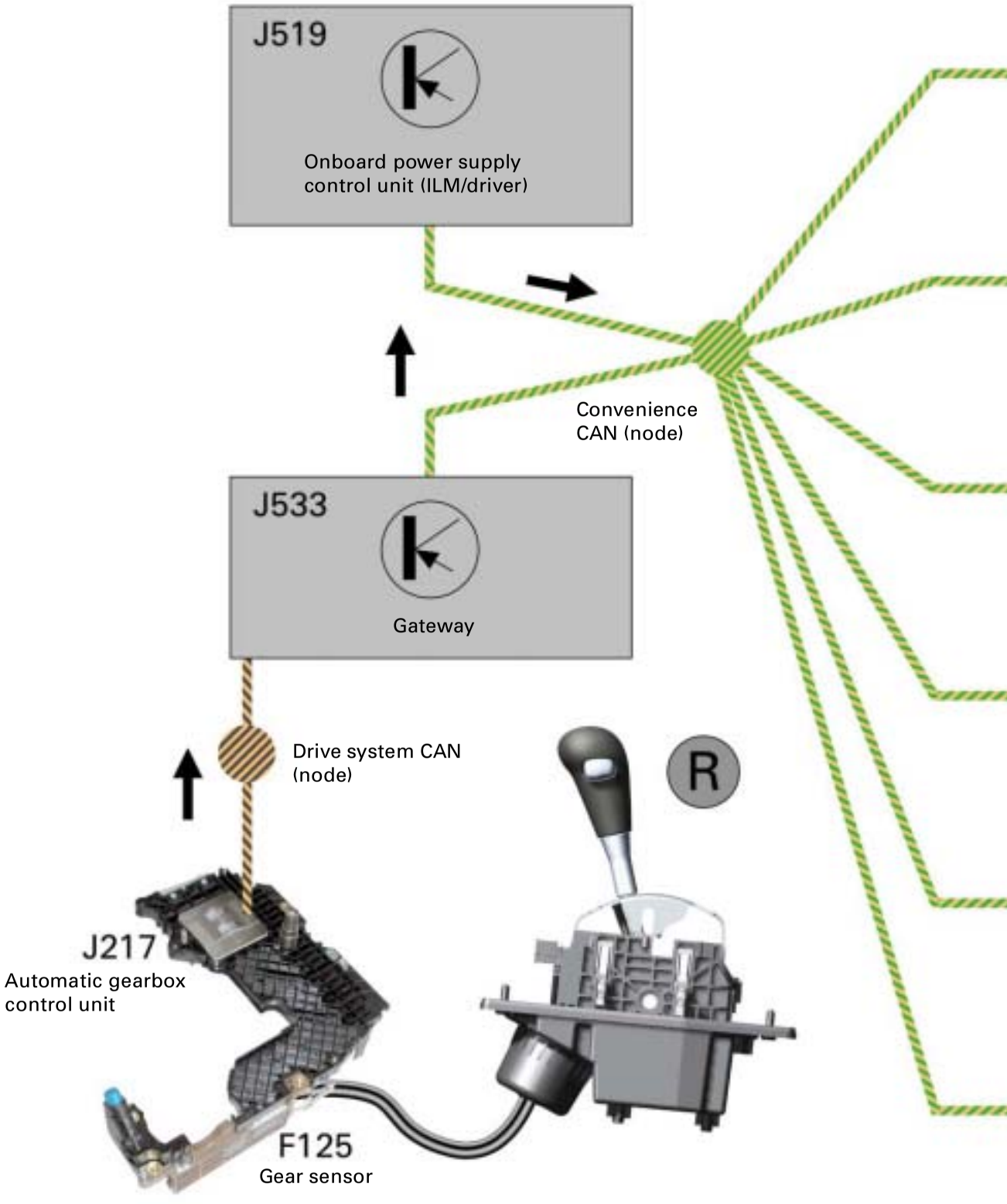
For greater gearshift comfort, the engine torque is increased on overrun change-down.

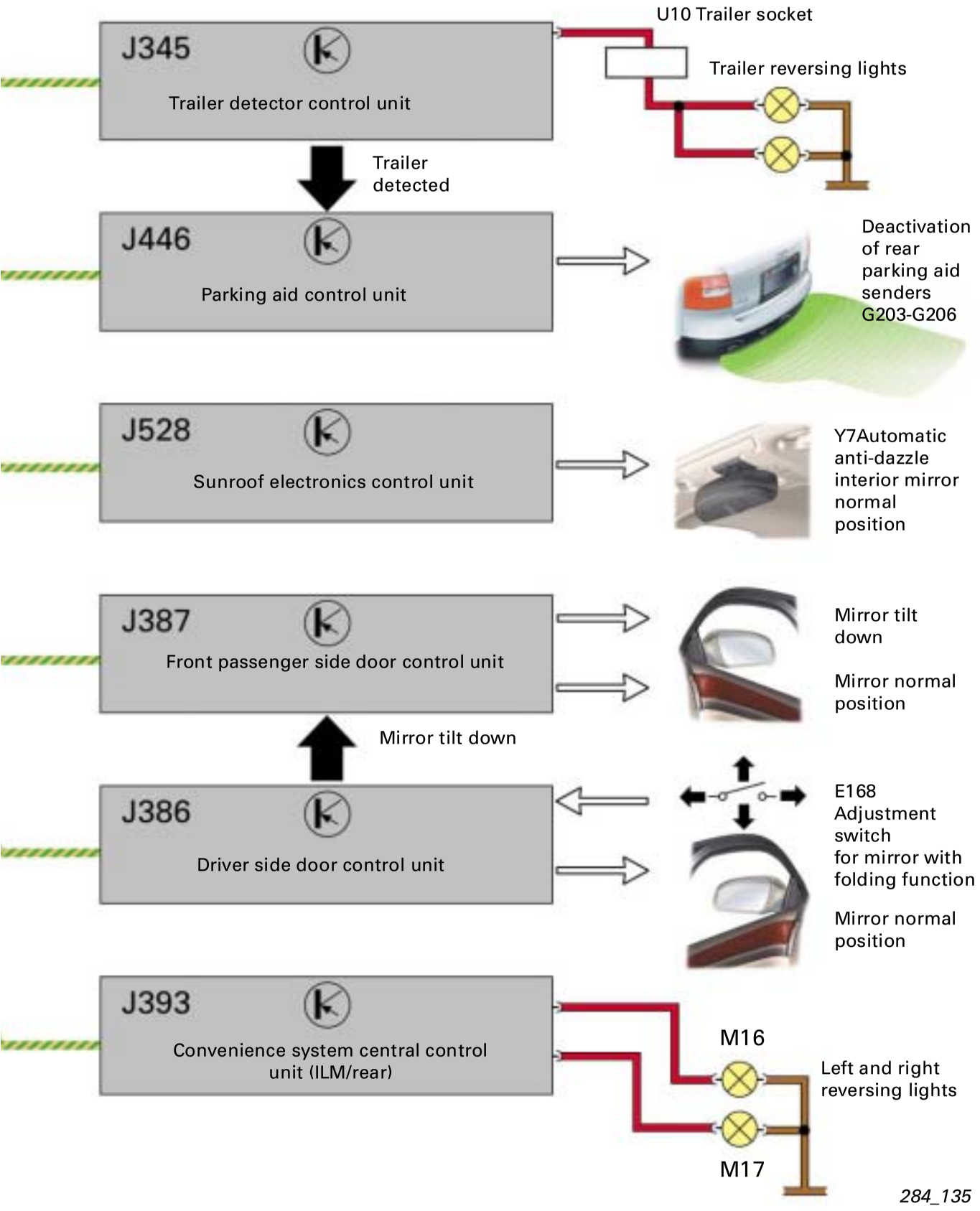
This function will not be available at the start of series production. It is due to be introduced with the control unit generation GS1904, scheduled for calendar week 02 / 03 onwards.

A precise description cannot be given at present, as the functions involved have still to be defined.

# Gearbox Control

**Reversing light**




J345
Trailer detector control unit
U10 Trailer socket
Trailer reversing lights
Trailer detected
J446
Parking aid control unit
Deactivation of rear parking aid senders G203-G206
J528
Sunroof electronics control unit
Y7Automatic anti-dazzle interior mirror normal position
J387
Front passenger side door control unit
Mirror tilt down
Mirror normal position
Mirror tilt down
J386
Driver side door control unit
E168 Adjustment switch for mirror with folding function
Mirror normal position
J393
Convenience system central control unit (ILM/rear)
M16
Left and right reversing lights
M17
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## Emergency programs

In the event of malfunctions, emergency programs enable the gearbox control unit J217 to prevent further gearbox damage and maintain vehicle mobility.

A distinction is made between substitute programs (emergency programs) and mechanical emergency running.

**Substitute programs**

In the event of failure of a system sensor for example, the gearbox control unit attempts to form a substitute signal from the incoming information of other sensors. If a substitute signal can be formed, use is made of so-called substitute programs to maintain the gearbox functions to the maximum possible extent.

If this is not possible or a safe operating status cannot be achieved, the gearbox switches to mechanical emergency running.

The effect of a substitute program on vehicle handling differs greatly depending on the fault involved (refer to Description of sensors/ information).

Gearbox functions may be restricted (e.g. no gearshift, no kick-down...) or implemented with fixed characteristic values (e.g. hard gearshift).

Depending on importance, a fault display appears in the gear selection indicator.

**Mechanical emergency running**

Mechanical emergency running is the term used to describe the situation when solenoid valves and pressure control valves are not actuated. The power flow is controlled on a purely hydraulic basis (as a function of the position of the selector slide and hydraulic system valves) and this function is thus often referred to as hydraulic emergency running.

A distinction is made between two types of mechanical emergency running:

A) Control unit still active

B) Control unit no longer active (total failure)

The following functions remain operative in the case of mechanical emergency running with an active control unit:

- Shiftlock
- Diagnosis
- CAN communication


Fault display

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**Description of mechanical emergency running function**

- In the event of faults/malfunctions resulting in mechanical emergency running, 3rd gear is always engaged if 3rd gear or lower had previously been selected. 5th gear is selected if the gearbox is already in 4th gear or higher.
- 5th gear remains engaged until either the selector lever is moved to neutral position or the engine is switched off.
- A mechanical switching valve is actuated in both cases on account of the drop in hydraulic pressure. On driving off again/ restarting engine, 3rd gear is selected.
- Reverse gear is available (reverse gear lock not active).
- The maximum system pressure is set, thus causing maximum shift pressure to be applied to the selector elements. Hard jolts occur on engaging gear.
- The torque converter clutch remains open.

**Gear monitoring with symptom recognition**

Switching to the emergency program should be avoided in the event of short-term faults during gearshift operations.

If irregularities indicating gearshift problems occur in the course of a gearshift operation (e.g. on account of contamination of the hydraulic control unit), the emergency program is not selected immediately, but rather the target gear is skipped or the current gear maintained depending on the situation.

The gearshift operation can be repeated several times before an entry is made in the fault memory and the emergency program thus selected.

Gearbox operation is maintained to the greatest possible extent. The driver may not even notice the symptom recognition process.

**Symptom recognition:**
In the case of monitoring functions with symptom recognition, once-only recording of a fault does not immediately lead to a fault memory entry. A fault has to be detected n times.

**Explanatory note:**
**Symptom** "Random event; temporary characteristic"

# Gearbox Control

## Dynamic Shift Program DSP

The DSP has been modified in the course of further development.

The principal parameters used for evaluation of driving situation and driving style are basically the same as for earlier DSP generations.

On account of the increasing degree of networking between gearbox control and other vehicle systems such as engine or ESP, a greater volume of data is now available to provide an even better definition of the current driving situation and driving style.

This is accompanied by the substantial refinement of data processing by the gearbox control unit. As well as enhanced gear and shift point selection, the gearbox control system is now capable of implementing additional functions.

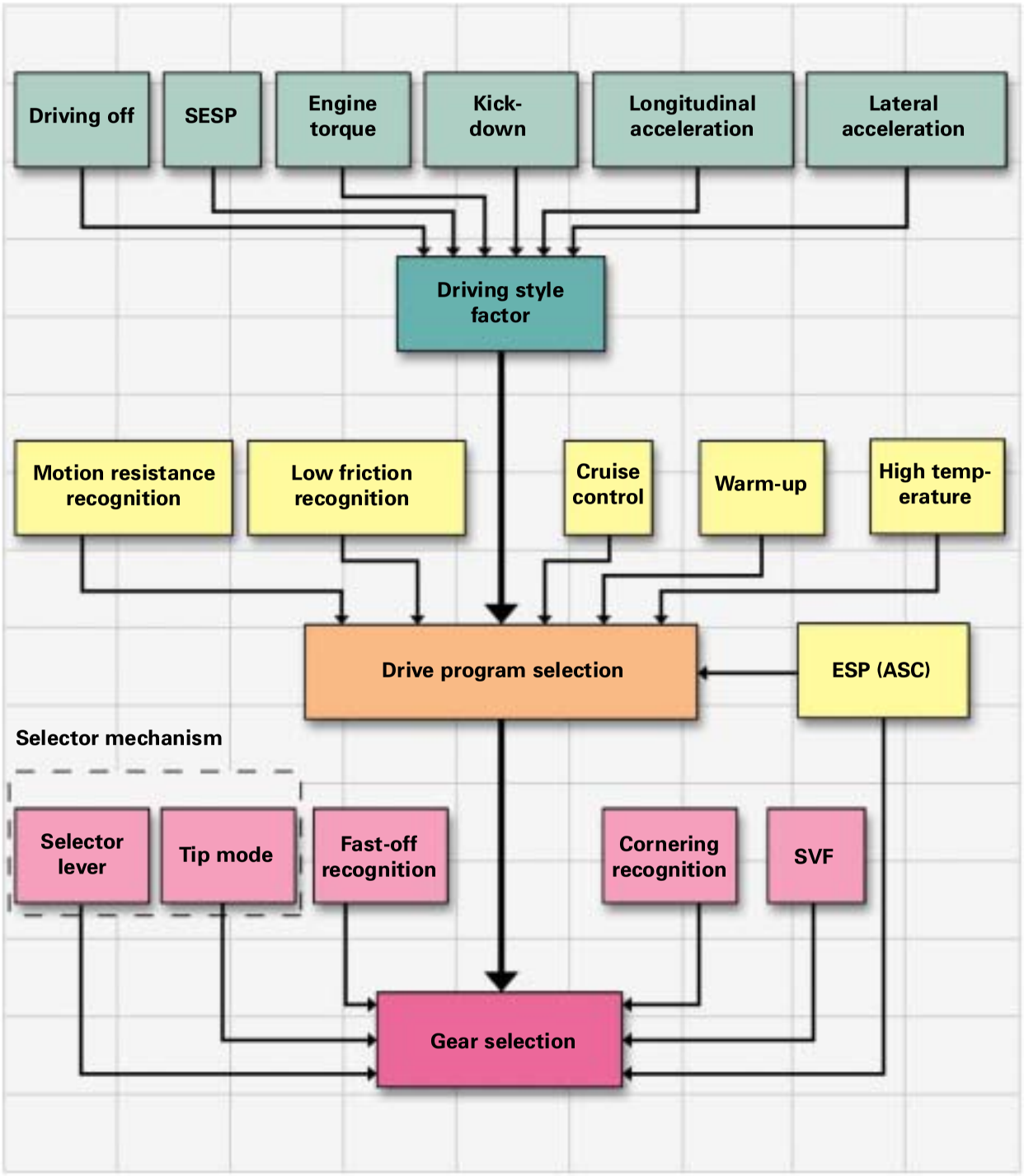
The operational structure of the DSP is basically organised in three groups:

– Driving style factor

– Situation-based drive program selection

– Gear selection

## Operational structure

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## Driving style factor

The DSP constantly evaluates the current driving style with a so-called sportiness rating from economical to sporty. Evaluation of the following influences the sportiness rating:

**Longitudinal acceleration**

Longitudinal acceleration refers to the rate at which the vehicle switches from its current speed to a different speed. This incorporates both positive (acceleration) and negative (deceleration) acceleration.

**Lateral acceleration**

Lateral acceleration is the force with which a vehicle is pressed outwards when cornering. The magnitude of the force is governed by vehicle speed and steering angle. The vehicle has to exceed a defined threshold value for the evaluation function to recognise and assess high-speed cornering. The weighting with regard to the sportiness rating depends on the maximum value occurring during cornering.

Evaluation of longitudinal and lateral acceleration takes place in the background and is always active (refer to Section on Gear selection, Page 42 onwards).

**Driving off**

On driving off, this function evaluates the situation by way of the maximum engine torque. Driving off from a standstill with high load application immediately results in allocation of a more sporty drive program.

**Kick-down**

If kick-down is constantly maintained, the sportiness rating is increased cyclically and this remains active for a certain period following termination of kick-down (depending on further driving style).

**Spontaneous increase in sportiness rating (SESP)**

Abrupt high acceleration (high positive accelerator pedal gradient) causes the counter to be set immediately to the maximum sportiness rating. Change-down takes place. The maximum value is only maintained for a few seconds and then returns to its initial level. Change-up takes place when acceleration is reduced.

At present, the sportiness rating is only determined for the drive program "S".

As part of conversion to the new gearbox control system it is planned to make use of the sportiness rating for drive program "D" as well.

# Situation-based drive program selection

**Motion resistance recognition**

Motion resistance recognition is one of the basic functions for drive program selection. This basic function commences as soon as the vehicle is driven off with an analysis of the equilibrium between drive power (engine torque) and the motion resistance at the drive wheels (analysis of vehicle speed and speed changes).

The following factors are incorporated:

- Vehicle weight (and inertia)
- Aerodynamics (drag)
- Climbing resistance
- Rolling resistance of tyres

The end product is a motion resistance index which defines the uphill, downhill and flat road drive program.

One of 15 drive programs is selected on the basis of the sportiness rating and motion resistance index.

In addition to this matrix, driving situations (e.g. warm-up, hot mode) or a vehicle system (e.g. cruise control CCS/ACC) may be definitive for the selection of a special drive program.

| | |
|---|---|
| 25 | ESP1/Flat road |
| 26 | ESP2/Hill |
| 27 | tiptronic mode |
| 28 | Hot mode/hill |
| 29 | Hot mode/flat road |
| 30 | Warm-up 1 |
| 31 | Warm-up 2 |
| 34 - 38 | As drive programs 4, 9, 14, 19, 24 |
| 39 | As drive program 28 |

**Drive programs**

| Motion resistance index | Selector lever position | | | Vehicle systems | |
|---|---|---|---|---|---|
| | "D" | "S" (S1 or S2 depending on driving style) | | ACC | CCS |
| Sportiness | S0 | S1 | S2 | S3 | S4 |
| Steep uphill | 20 | 21 | 22 | 23 | 38 (24) |
| Moderate uphill | 15 | 16 | 17 | 18 | 37 (19) |
| Slight uphill | 10 | 11 | 12 | 13 | 36 (14) |
| Flat road | 5 | 6 | 7 | 8 | 35 (9) |
| Downhill | 0 | 1 | 2 | 3 | 34 (4) |

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The current drive program can be read out using the diagnosis testers in measured value block 2, 1st display value.

CCS column:
For technical reasons the values displayed differ from the drive programs actually used (in parentheses).

# Gearbox Control

**Cruise control CCS or ACC mode**
(refer to matrix for drive programs)

The function of the CCS and ACC drive programs is to minimise the gearshift frequency in the respective system mode.

To further improve shift point selection in CCS/ACC mode, drive program selection was linked to the motion resistance recognition function (refer to matrix). 5 drive programs are available for each system.

This permits more precise definition of the appropriate shift point and prevents repeated shifting between two gears.

**Warm-up program**

(drive programs 30 and 31)
The purpose of the warm-up program is to reduce pollutant emissions after a cold start and in the warm-up phase.

The warm-up program is activated at engine temperatures below 30°C. It is a static drive program, i.e. neither motion resistance recognition nor driving style factor are incorporated. All shift points are moved to higher engine speeds.

**Petrol engines:**
With petrol engines, the higher speed level achieves rapid warm-up of the catalytic converters, thus considerably shortening the response time.

The warm-up program is currently not required for V8-5V engines and is therefore not implemented.

**Diesel engines:**
The higher speed level reduces the engine load and fewer pollutant emissions are produced.
The engine response behaviour is also improved.

At present the warm-up program is only used with diesel engines.

**Hot mode program**
(drive programs 28 and 29)

The hot mode program is activated at high gearbox temperatures. It is basically a gearbox protection program designed to return the gearbox to a sub-critical temperature range.

The significant factors governing shift point selection are temperature level and motion resistance recognition.

The hot mode program is characterised by shift points at higher engine speeds and early closing of the torque converter clutch. The associated decrease in torque converter slip results in reduced warming of the ATF. The higher engine speeds ensure a greater coolant throughput in the ATF cooler and thus better cooling of the ATF.

(For more details refer to Section on Temperature monitoring, Page 13)

**Electronic stability program intervention**
(drive programs 25 and 26)

The action involved with various electronic stability program functions (ABS, TCS, ESP) is assisted by way of special drive programs or by gearshift prevention. Impermissible engine speeds are prevented.

**Low friction recognition**
(not activated at present)

A basic function of the ESP is the constant determination of road surface friction. This data is now also used by the gearbox control system.

In the event of low road surface friction (e.g. ice/snow, rain or non-compacted surfaces), drive programs are selected which reduce the torque at the drive wheels by way of higher gears and early change-up. Change-down which could lead to wheel slip is largely avoided.

**Sports program**
(refer to matrix for drive programs)

In the sports program the driving style factor is one of the principal criteria affecting drive program selection. 10 sports programs are available depending on driving style factor and driving situation assessment (for further details on the sports program refer to Part 1 SSP 283, Page 16 onwards).

**tiptronic mode**
(drive program 27)

Information on this topic can be found in Part 1 SSP 283, Page 23 onwards.

## Gear selection

Selection of the required gear is always governed by the current drive program. Irrespective of this principle, the evaluation of sudden events or special short-term ambient conditions has a direct influence on gear selection.

This evaluation generally has the effect of suppressing undesirable change-up/change-down operations and prevents repeated shifting between two gears.

**Fast-off recognition**
(rapid load reduction)

This function is based on evaluation of the position and movement (highly negative pedal gradient) of the accelerator pedal and detects rapid load reduction by the driver.

Rapid load reduction is very often the result of a hazardous situation in which the driver abruptly releases the accelerator pedal (fast-off) to press the brake as quickly as possible.

Following detection of fast-off, change-up is suppressed until the driver presses the accelerator pedal again.

Fast-off from accelerator pedal positions close to full throttle always has this effect, whereas fast-off from a part throttle position does not automatically prevent change-up.

At present, fast-off recognition is only implemented in the "S program".

**Cornering recognition**

Releasing the accelerator pedal whilst cornering may lead to change-up in line with the drive program. Subsequent acceleration out of the bend then involves changing back down again (two undesirable/unnecessary gearshift operations).

The cornering recognition function suppresses such undesirable change-up operations when cornering at high speed.

The parameters governing this evaluation function are lateral acceleration, steering angle and wheel speed.

A bend is recognised if the instantaneous lateral acceleration exceeds a defined value. The threshold is defined such that only bends negotiated in a sporty manner or incorrectly judged bends are registered.

**Spontaneous vehicle deceleration (SVF)**

Spontaneous deceleration is recognised by way of brake pedal actuation and corresponding slowing of the vehicle (negative longitudinal acceleration).

If this is the case (only with great deceleration), the change-down point is shifted so as to implement change-down together with brake assistance at an early stage.

This takes the form of change-down being advanced in closed throttle position and taking place at a higher vehicle speed than usual.

This has the advantage that change-down is already in progress whilst the driver is still pressing the brake. The required gear is already engaged if the vehicle is then immediately to be accelerated again.

The effect of the SVF function is more pronounced on long downhill stretches. The brake then only has to be pressed gently to implement change-down.

The engine braking effect is put to better use by shifting the change-down points in the downhill drive program.

The change-up prevention function (HSV) remains active for the duration of brake actuation or closed throttle position. Only renewed acceleration cancels HSV and results in normal change-up in line with the current drive program.

**Self-diagnosis**

The automatic gearbox control unit J217 and the diagnosis tester communicate by means of the K-wire or by way of the CAN data bus interface.

Depending on the diagnosis tester generation used (VAG1551 or VAS 5051), data are transferred with the data log KWP 2000 on the K-wire (e.g. VAS 1551) or by means of the CAN transport protocol TP 2.0 with the data log KWP 2000 (VAG 5051).

Using the CAN data bus for the transfer of self-diagnosis data is far faster than via the conventional K-wire.

New, inter-system functions are now only available with CAN diagnosis.

**Snapshot memory**

The snapshot memory is used to store a wide range of gearbox control unit measured values (ambient conditions) applying at the time of the initial fault memory entry.

A new feature is that these ambient conditions can be read out in the measured value block function 08 (measured value blocks 40-48).

This considerably enhances the reproduction of faults and facilitates fault-finding, particularly in the case of sporadic faults (refer to "Assisted fault-finding").

The K-wire is still required for control units of relevance to OBD.

# Update programming

Integration of the electronic control unit into the gearbox (Mechatronik) has created the means to update the software version without replacing the control unit.

The control unit requires programs, characteristic curves and data (software) for the calculation of output signals. These are permanently stored in a so-called flash EPROM (erasable programmable read-only memory) and are thus always available to the control unit.

The EPROMs fitted to date could not be erased or programmed when installed.

To rectify problems requiring software modification, the control unit had to be replaced.

The Mechatronik control unit of the 09E features a so-called "Flash EPROM".

A flash EPROM can be re-programmed in situ. This process is known as "flash programming" or "update programming".

Flash programming requires the use of the diagnosis tester VAS 5051 equipped as follows:

- Tester software Basic CD V.02.00 or higher
- Audi CD as of version V.02.22
- Current flash CD

Programming is performed either by way of the diagnosis CAN interface (CAN transport protocol TP 2.0) or using the K-wire.

**Explanatory note:**

"In a flash" = "as quick as possible"

In terms of "flash programming" this means "high-speed programming".

The word "flash" is also used in a variety of terms relating to flash programming (e.g. flash CD).

"Update" = "Bring up to date, i.e. latest status"

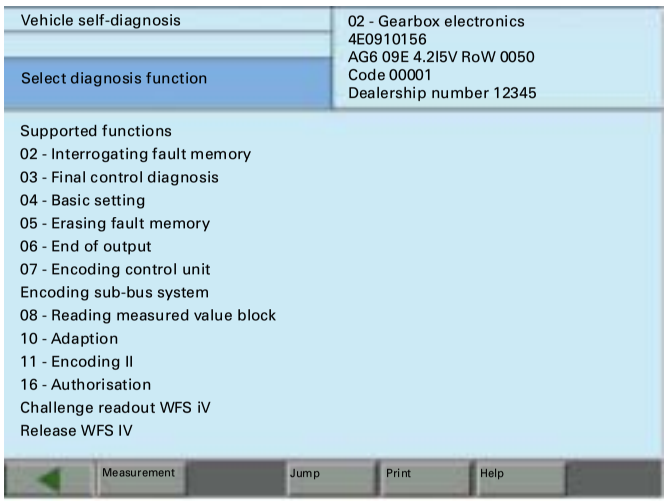
Flash programming is only necessary if problems can be rectified by means of software modification.

**Sequence of operations**

After inserting the current flash CD and entering into gearbox electronics diagnosis mode (address word 02), the VAS 5051 recognises whether the control unit can be programmed on the basis of the control unit identification.

VAS 5051 uses the flash CD data to determine whether a new software version is available for the gearbox control unit part number concerned.

If this is the case, "update programming" appears in the list of diagnosis functions. Programming commences after selecting the diagnosis function "update programming".

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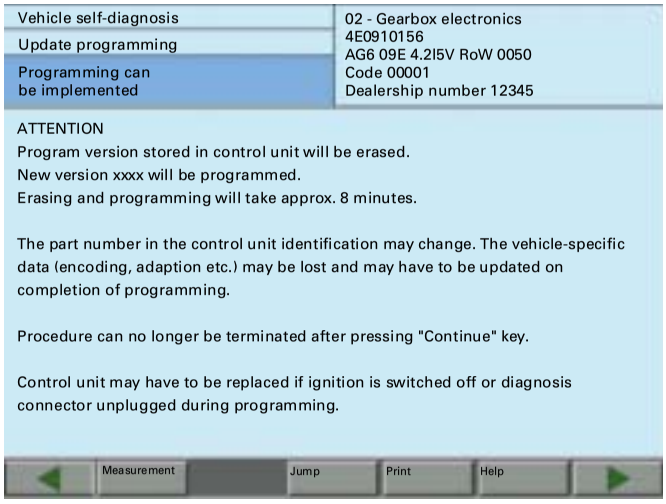


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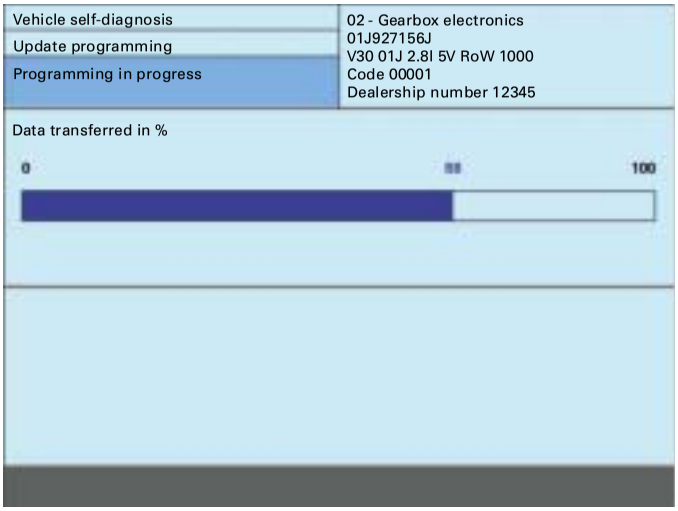
If the update programming function is not displayed, either the flash CD is not applicable to the vehicle or the current software version already corresponds to that of the flash CD.

Programming is controlled by the flash CD and takes place automatically.

The programming sequence is indicated on the display, provides information on the steps in progress and issues input prompts. Programming takes approx. 5-10 minutes.

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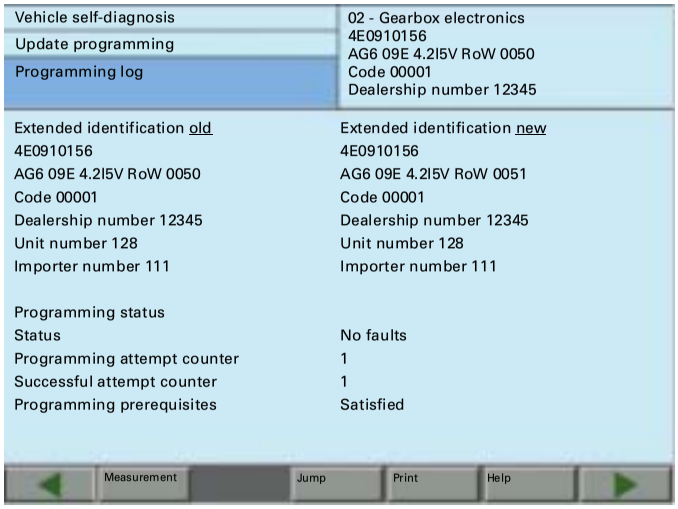
A programming log is displayed on completion of programming.

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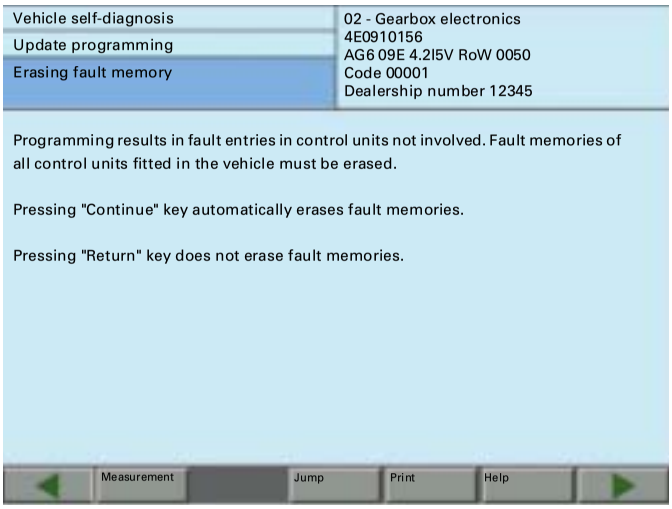
As CAN data exchange is interrupted during programming, faults are entered in the fault memories of the control units linked to the CAN.

After programming, the fault memories of **all** control units must be erased (last display).

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**Flash CD**

The flash CD contains the data and programs for the programming sequence and the "update versions" of new software versions.

Updates are issued at regular intervals for the flash CD. The flash CD also contains the update data for other programmable control units (future systems). This means that in future there will only be one flash CD for all systems (engine, gearbox, brakes, air conditioner etc. ...).


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Only new software versions can be programmed. "Programming back" to an older version is not possible.

Flash CDs are only supplied when new software versions are available.

## Special tools/workshop equipment

The following special tools/workshop equipment will initially be required for service work:

Thrust pad for radial shaft seal/selector lever
T10135

Thrust pad for radial shaft seal/flange shaft, RWD (2-part)
T10136

Thrust pad for torque converter/oil pump radial shaft seal
T10137

Thrust pad for differential flange shaft, right
T10138

Thrust pad for differential flange shaft, left (transverse shaft)
T10139

Carrier frame
3311 (attention: use new, longer bolt 3311/1)

Adapter/test box
VAG 1598/40

ATF filling system
V.A.G 1924


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## Towing

When the vehicle is towed, the oil pump is not driven and there is thus no lubrication of rotating components.

The following prerequisites must always be met so as to avoid serious gearbox damage:

- Selector lever must be set to position "N".
- Vehicle speed must not exceed 50 km/h.
- Vehicle must not be towed for more than 50 km.
- *On account of quattro drive, vehicle is not to be towed with front axle raised.

Tow-starting (e.g. inadequate battery charge) is not possible.

If battery is flat or has been disconnected, selector lever emergency release mechanism must be actuated to shift selector lever from "P" to "N" (refer to Part 1 SSP 283, Page 21 onwards).

*The transfer case (with Torsen differential) is lubricated by the transfer case oil pump. The oil pump is driven by the side shaft to the front axle. If the front axle is stationary, the oil pump is not driven and adequate transfer case lubrication is not guaranteed. This results in destruction of the Torsen differential.

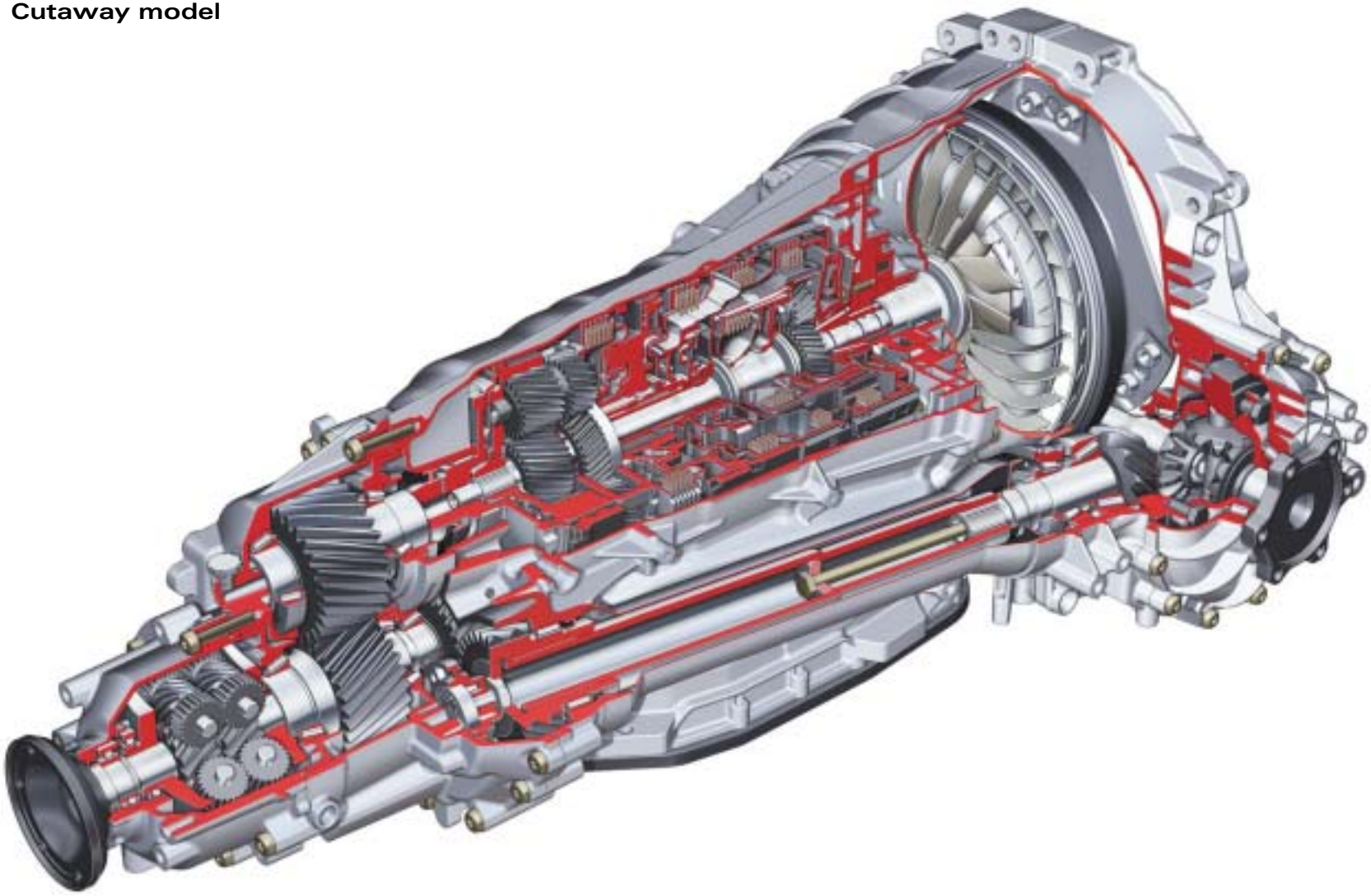
## Note on repair work

Jacking mode

On account of the air suspension, jacking mode must be selected before the vehicle is raised (no wheel load).

Refer to Workshop Manual.

## Cutaway model



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