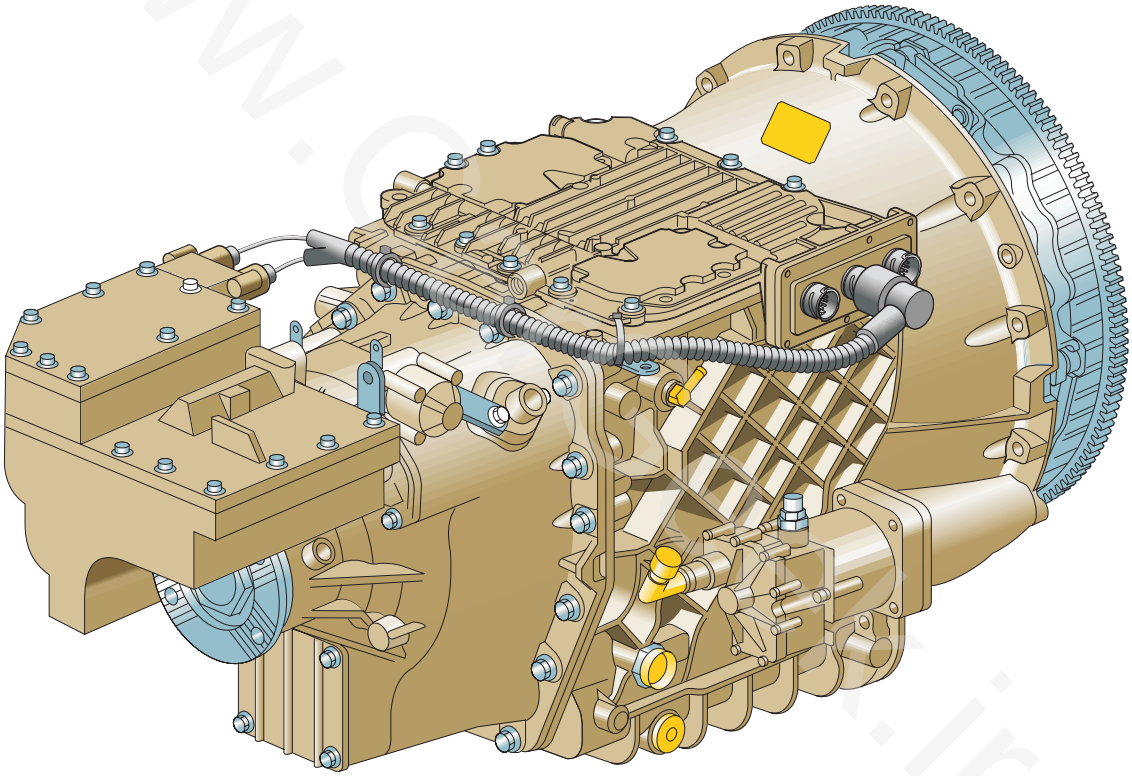
Gearbox VT2412B

Design and function

Student booklet



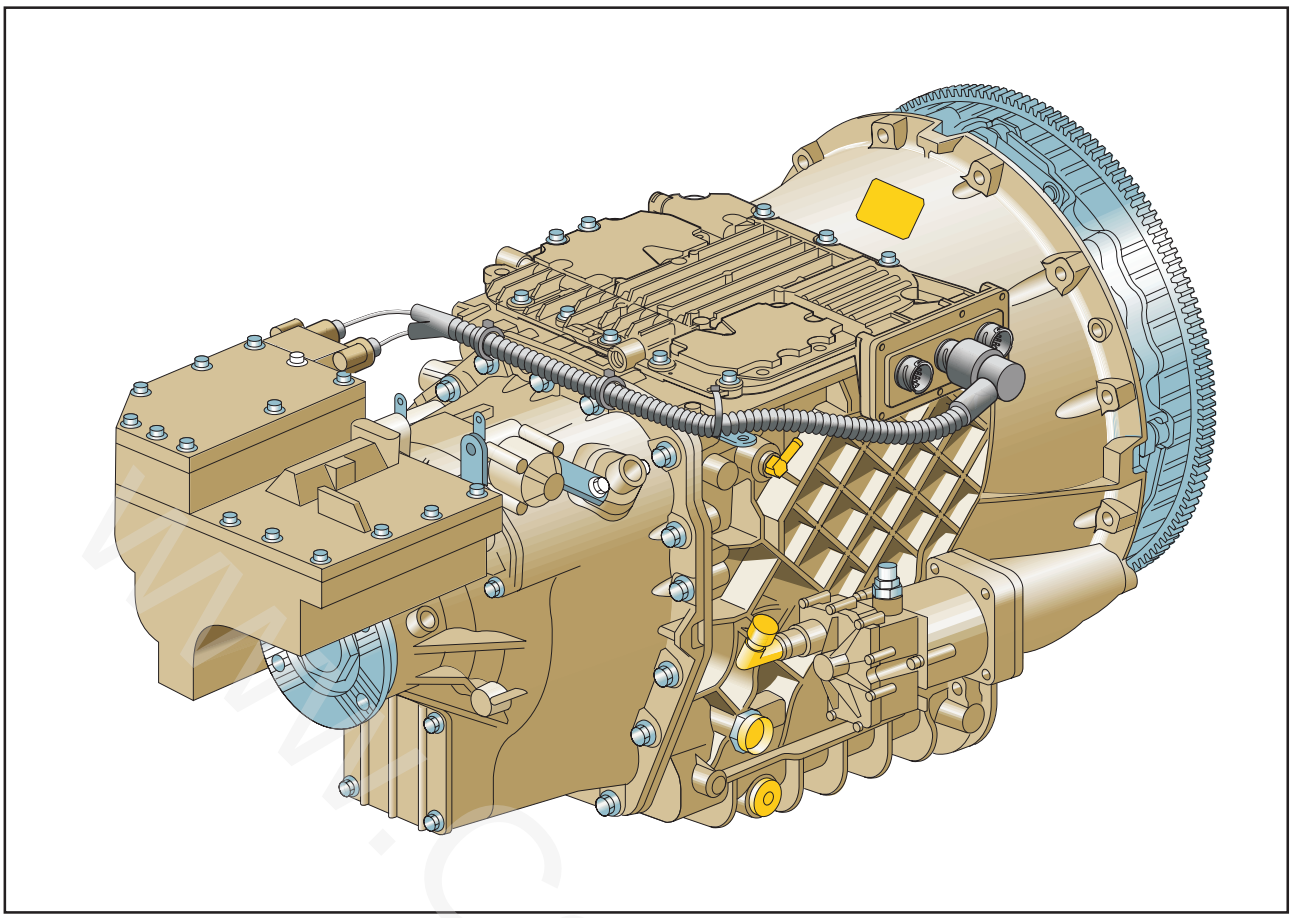
VOLVO

Preface

This training package describes the Volvo VT2412B gearbox that is available as gearbox options for trucks and buses. Automatic gear changing on the VT2412B is electronically controlled but the driver can still change up or down manually if necessary. As an alternative, gear changes can be made completely manually by the driver. The clutch plate is a single dry plate with full automatic control, which means there is no clutch pedal.

Both variants are covered in the training package, so certain pictures and comments may require modification depending on the variant being described.

Contents



1 Introduction

VT2421B with product designation I-shift = Intelligent shift has a 3-speed non-synchromesh basic gearbox without crawl gear. Together with a synchromesh splitter gear in the front of the gearbox and a range gear at the back, this gives a total of 12 forward gears and four reverse.

The gearbox lubrication system has an oil capacity of 13 litres and weighs 272 kg. It is 150 mm shorter and 70 kg lighter than previous gearbox variants.

Automatic gear changing is electronically controlled but the driver can still change up or down if necessary. As an alternative, gear changes can be made completely manually by the driver. The clutch plate is a single dry plate with full automatic control, which means there is no clutch pedal.

The gearbox contributes to a higher degree of safety as the driver is able to concentrate on driving, comfort is also heightened as changing is smoother and without jerkiness while economy is improved as the gearbox provides optimum fuel consumption.

The gearbox is built to withstand a maximum torque of 2400 Nm and is available in two models, with or without retarder. The model with retarder combines the gearbox with a VR3250 compact retarder integrated in the range housing.

The synchromesh range gearbox situated at the back of the basic gearbox contains a planetary gear with two gear ratios, low range and high range.

The splitter gear is synchromesh and situated in the front of the gearbox. It is a gear transmission that splits the forward and reverse gear in the basic gearbox into two. This means that the basic gearbox's three individual gears are split into six. The range and splitter gears cannot be operated separately; gear changing is achieved in steps depending on the gear chosen by the system.

The gearbox is declutched automatically by an electro-pneumatic clutch cylinder controlled with solenoid valves. These solenoid valves control the compressed air to the clutch cylinder, which controls the release bearing. The clutch cylinder is mounted on the clutch housing.

The gear control is not mechanically linked to the gearbox but is controlled electro-pneumatically and is stepped up or down with a pushbutton on the gear control or automatically in automatic mode.

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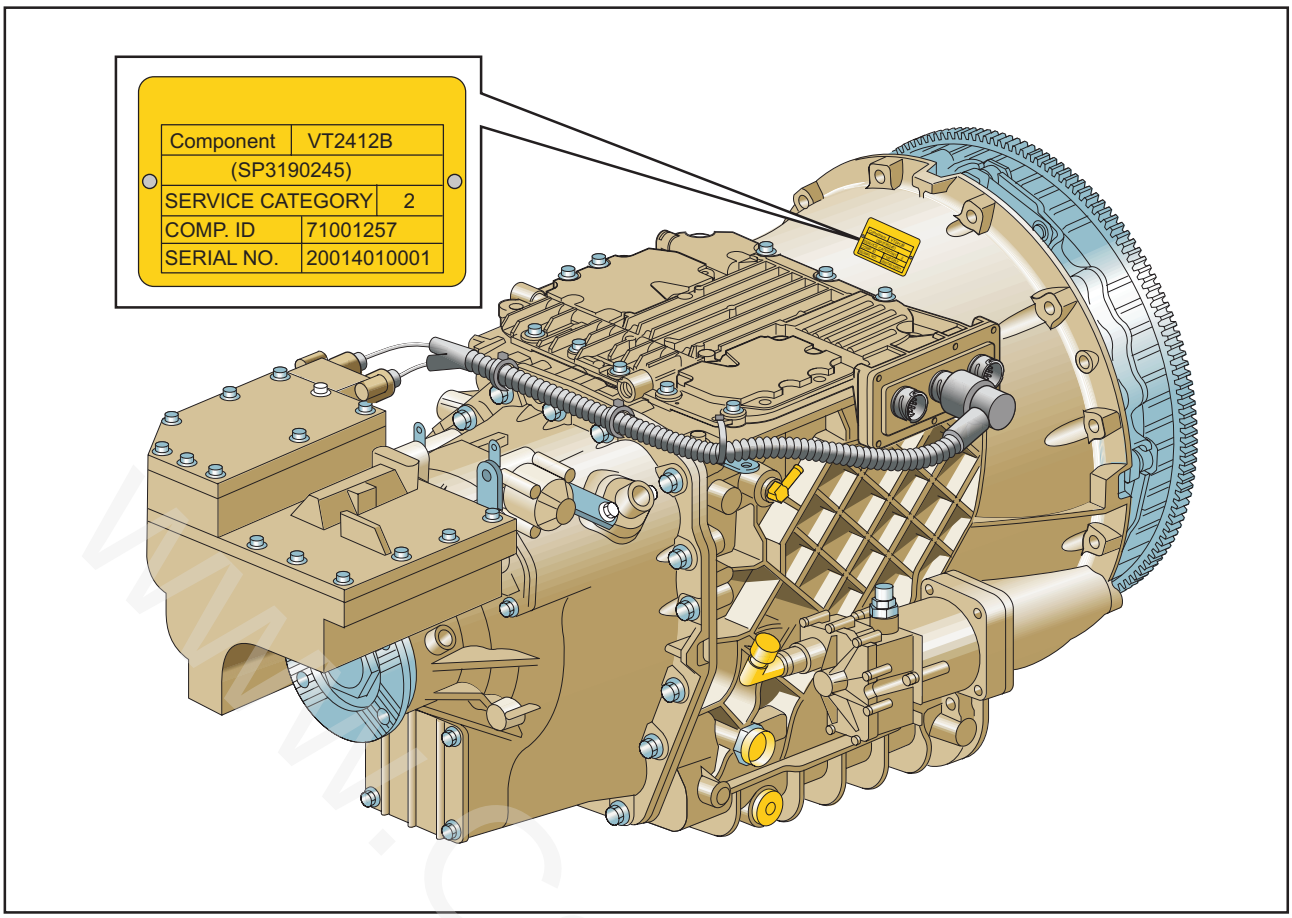

2 Type plate

VT2412B is the model designation and the type plate contains the following information:

Component	component designation VT2412B.
(SP3190245)	spare part number.
V	Volvo
T	Transmission
24	Max. torque 2400 Nm
12	forward gears
B	model.
Service category	(see service information).
Comp. id	factory part number.
Serial number	20014010001
2001	year of manufacture/week 40/day 1/0001 consecutive number.

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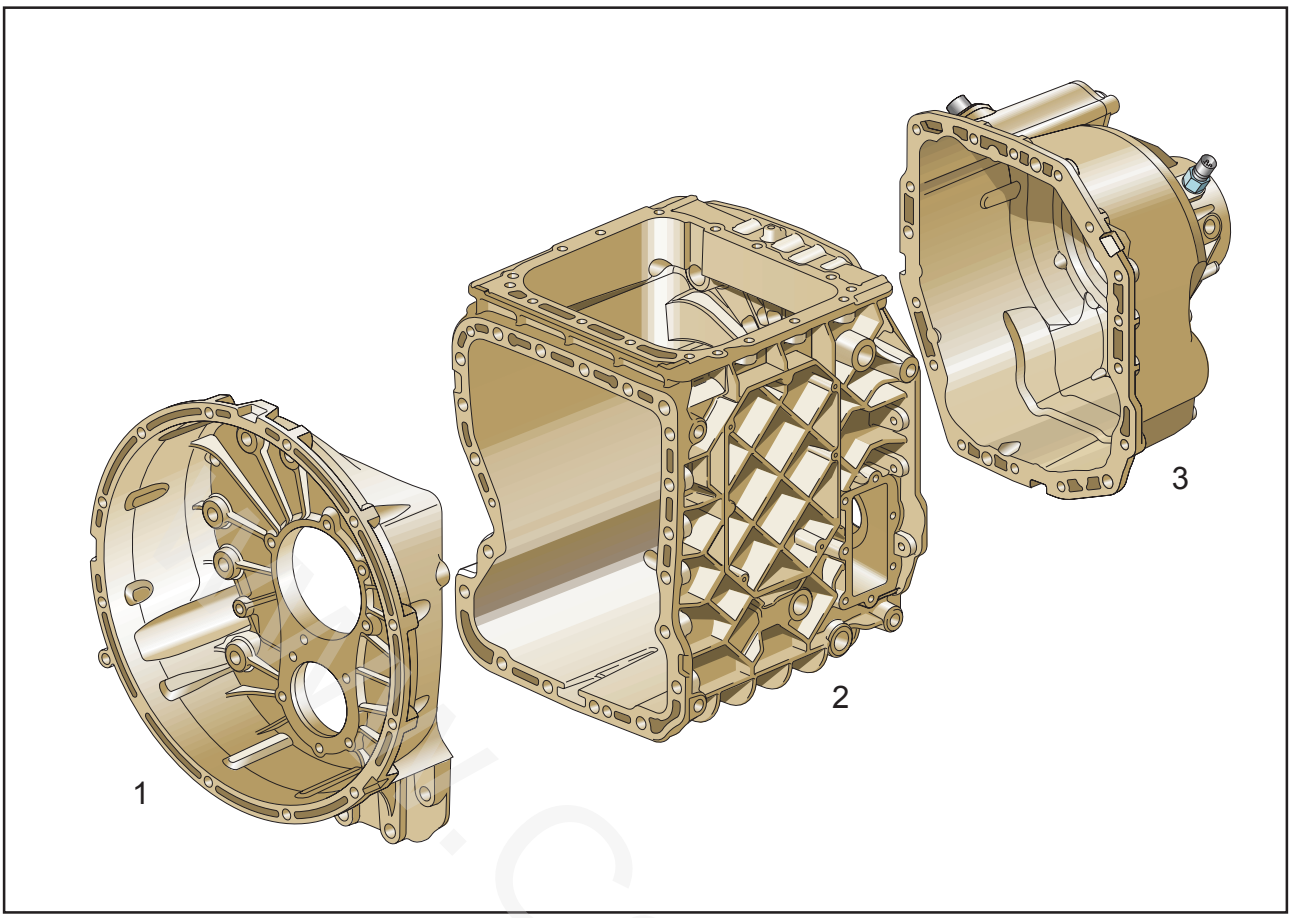

3 Gearbox housing

1 Clutch housing 2 Base housing 3 Range housing

The gearbox is constructed of three housings, all manufactured in aluminium to save weight. The clutch housing (1) is the front end of the gearbox and optimized for one single clutch plate.

The base housing (2) contains the mainshaft, countershaft and reverse shaft as well as the selector unit integrated in the control housing where the splitter gear fork is also contained. The cast transverse ribs on the housing are used for rigidity and to reduce the noise level.

The range housing (3) contains the planetary gear, selector fork and output shaft.

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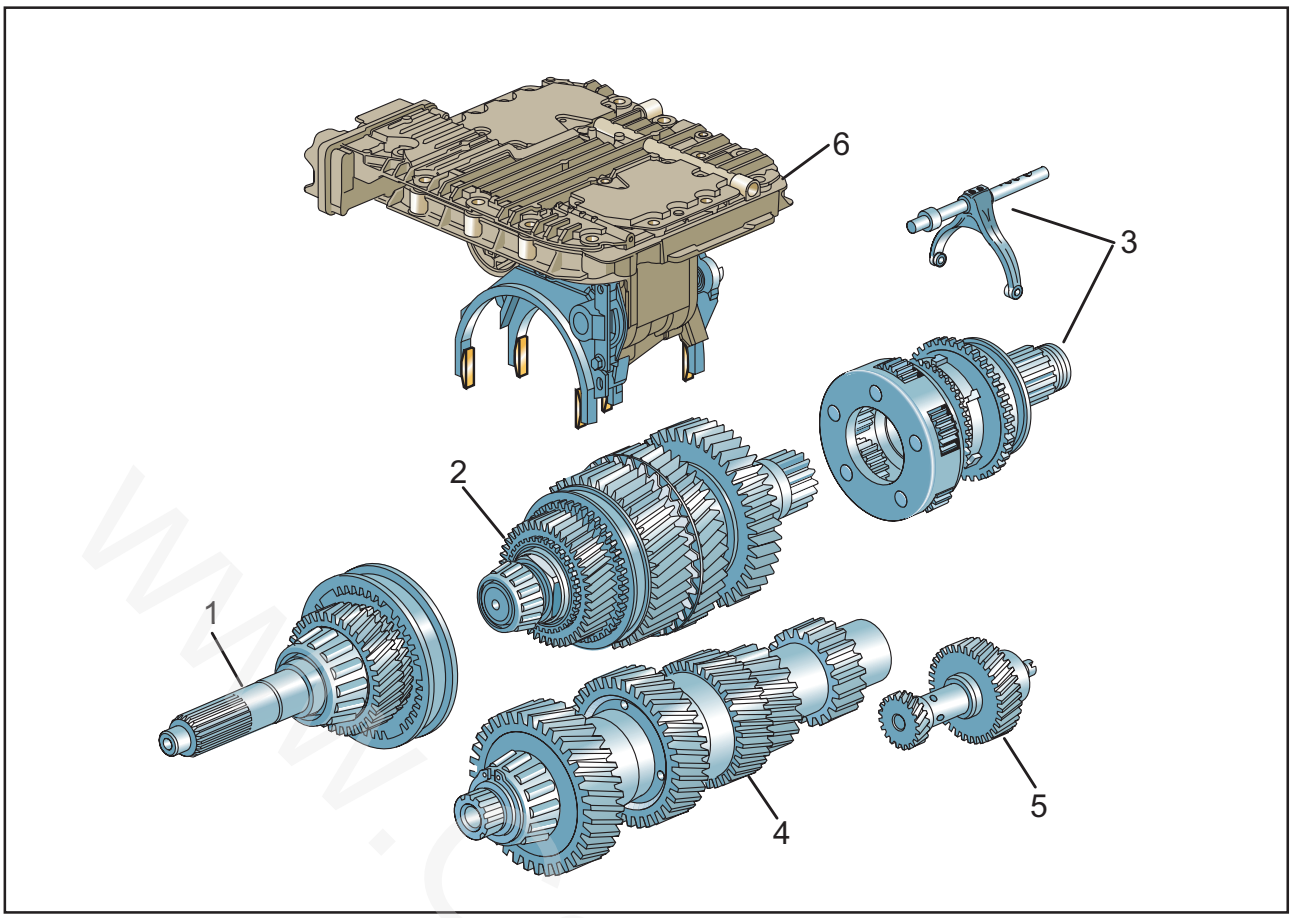

4 Main components

1 Input shaft
2 Mainshaft
3 Range gear with selector unit
4 Countershaft
5 Reverse shaft with oil pump drive shaft
6 Control housing with selector unit

The input shaft has involute splines that are not lubricated when assembling the gearbox.

Reverse and base gear wheels are located on the mainshaft, where the range sun gear is also located. Between the first and third gears on the mainshaft there is a toothed wheel used to measure the mainshaft rpm.

The countershaft gears are fixed, two of the gears press-fitted, splines at the front end where the countershaft brake is mounted.

The range gear comprises a planetary gear integrated with the output shaft. The reverse gear is integrated with the oil pump shaft.

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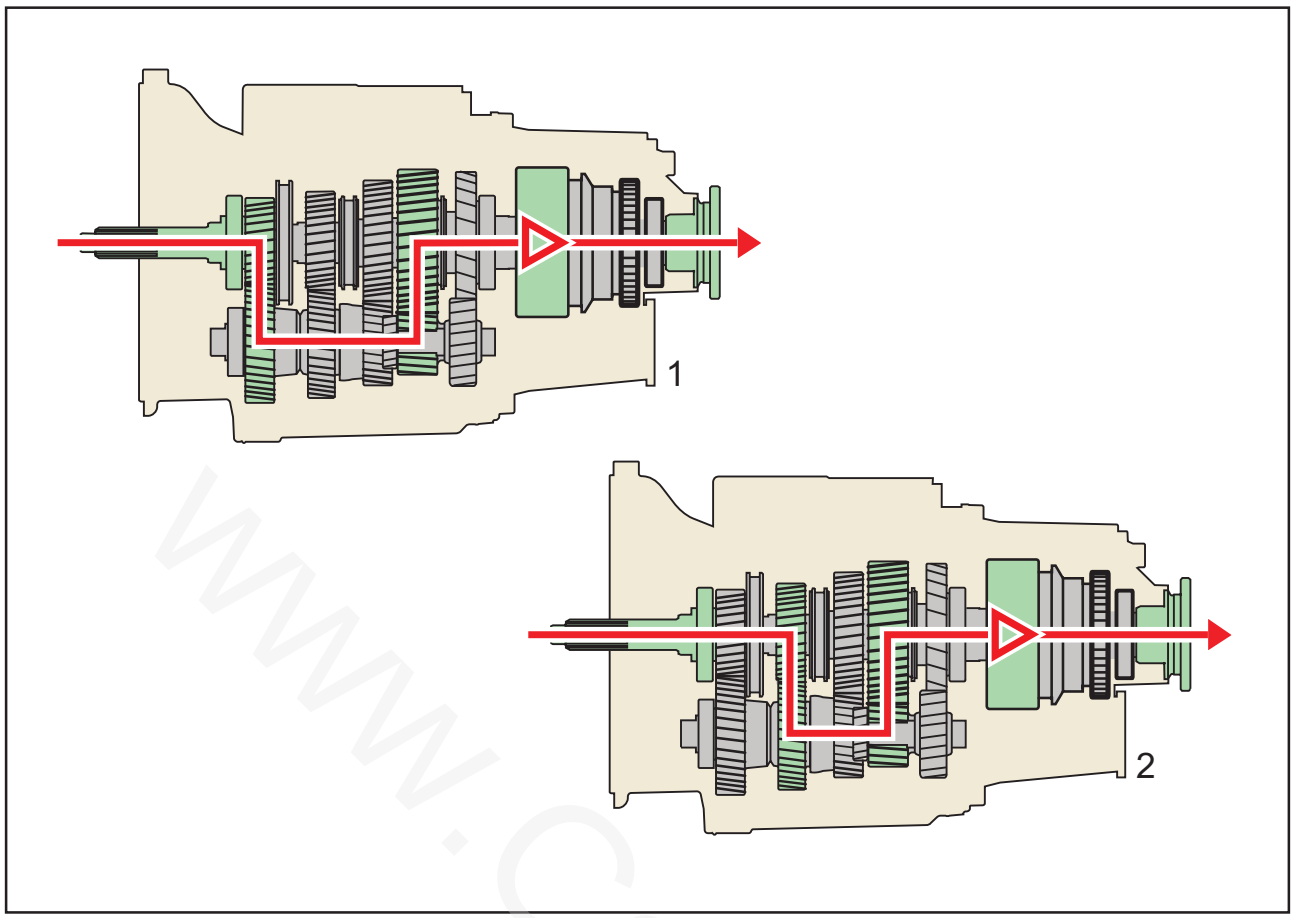

5 Gears 1 and 2

1 Low split/LP gear wheel

2 High split/HP gear wheel

The splitter gear is located at the front of the gearbox and divides the basic gearbox's three gears. This means that each gear in the basic gearbox has two positions: high or low split. This process, however, cannot be controlled separately but is integrated in the normal linear gear changing in the system, i.e. forward gears 1-12 and reverse 1-4. The splitter gear is controlled by a gear selector cylinder mounted in the control housing. This gear selector cylinder is controlled by the HS (High Split) and LS (Low Split) solenoid valves. Both solenoid valves are located in the control housing cover and are controlled with signals from the transmission control unit (TECU).

NOTE. The splitter gear is monitored by a position sensor located in the splitter gear selector cylinder.

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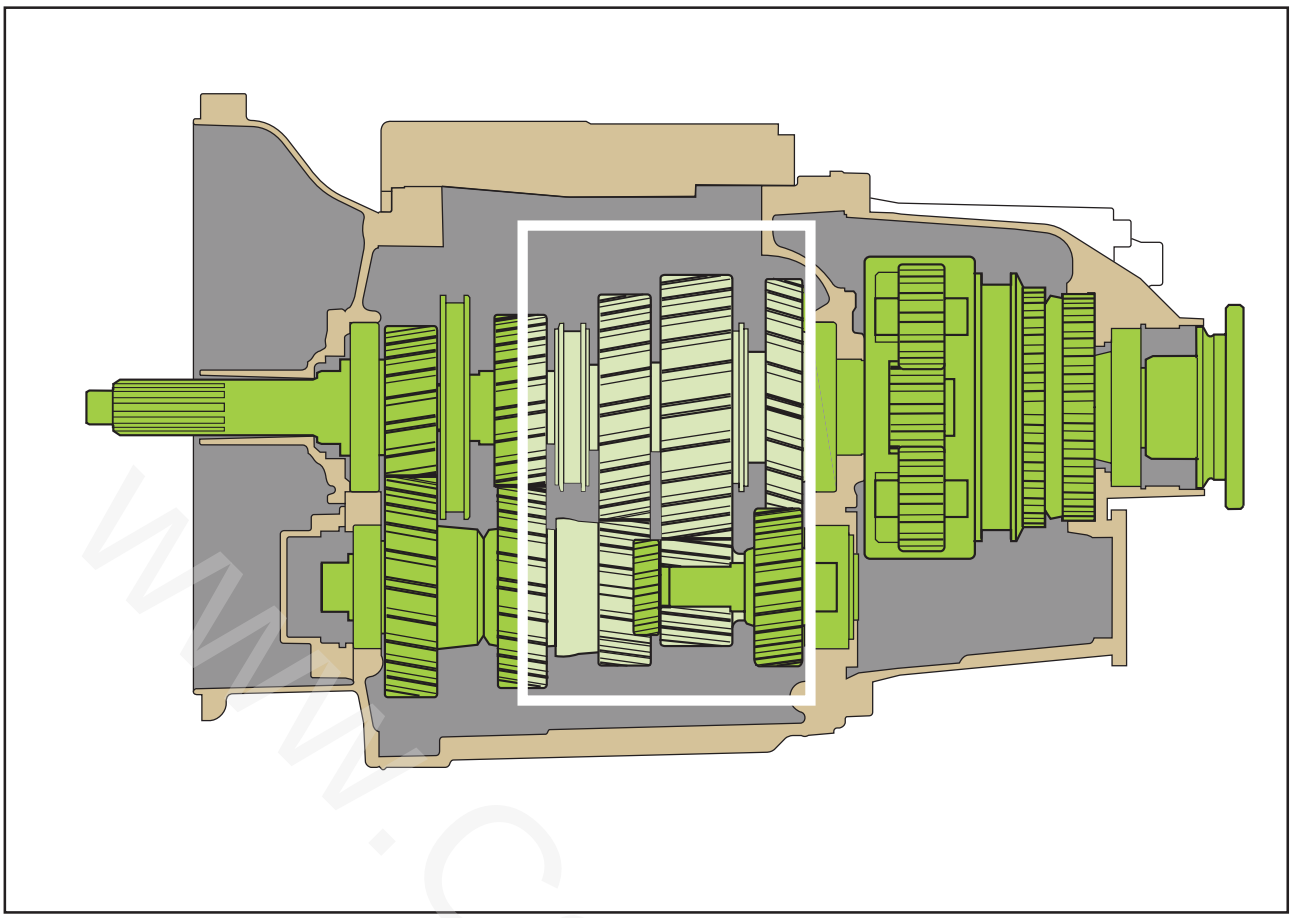

6 Basic gearbox

The basic gearbox has three non-synchromesh gears. This gives lower total weight, shorter overall length and a reduced number of moving wearing parts such as synchromesh components.

Gear changing in the basic gearbox is controlled by two gear selector cylinders located in the control housing, 1/R for first and reverse and 2/3 for second and third gears. These gear selector cylinders are controlled by four solenoid valves. The four solenoid valves are located in the control housing cover and are controlled with signals from the transmission control unit (TECU).

To eliminate wear, noise and scraping during gear changes in the basic gearbox, the engine and basic gearbox must be rotating synchronously. This is achieved by the transmission control unit requesting a synchronous rpm from the engine control unit (EECU) before changing gear. A further explanation will be given later.

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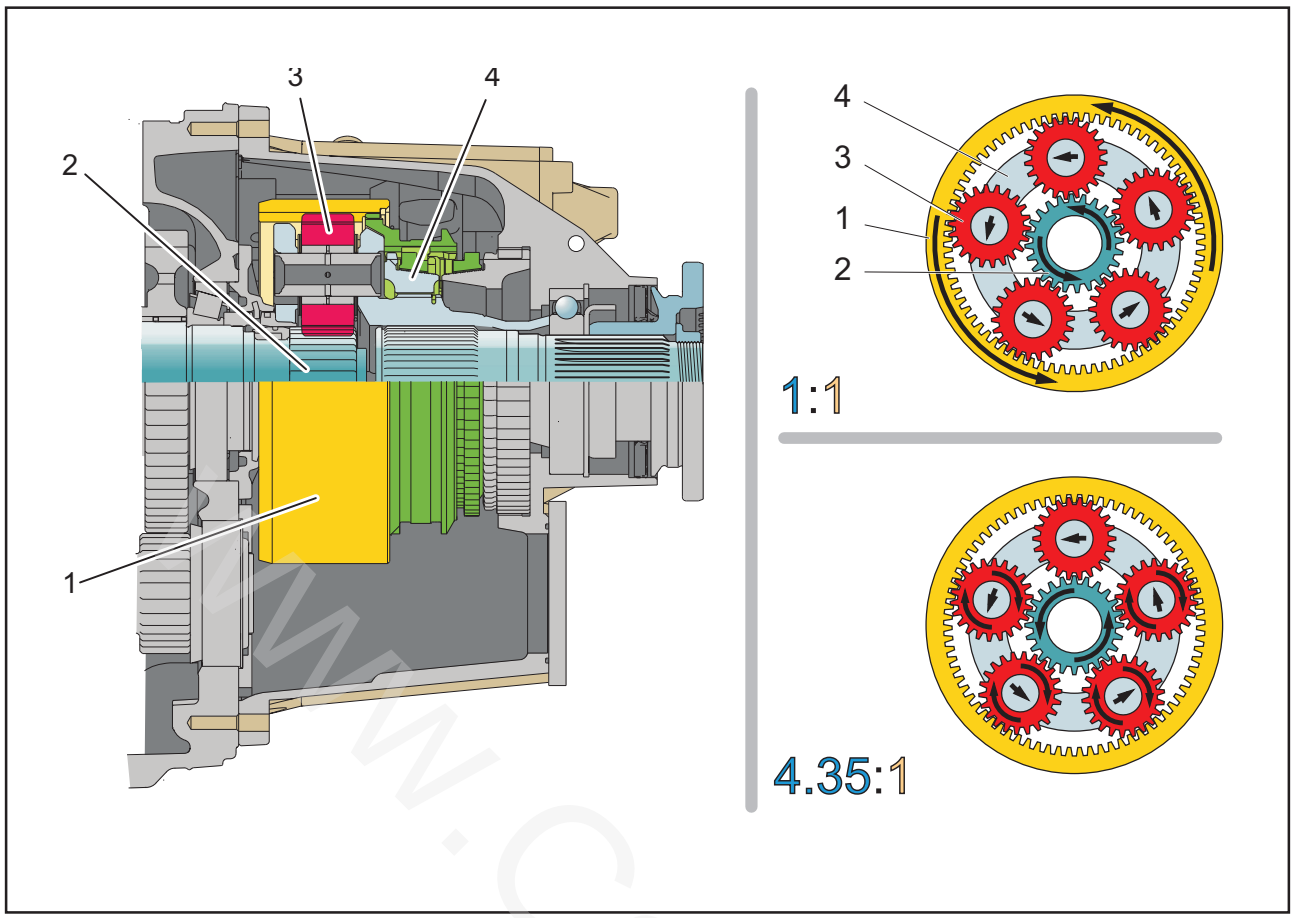


7 Range

1 Ring gear
2 Sun gear
3 Planet gear
4 Carrier

The range gearbox contains a synchromesh planetary gear with two gear ratios, low range and high range. The planetary gear comprises five gear wheels, so-called planet gears, which are meshed with the sun gear integrated on the mainshaft. The planet gears are supported in the planet gear carrier. The planet gears are also meshed with the outer ring gear which is finally linked to the clutch sleeve. The planet gear carrier and the output shaft are joined together with splines. The output shaft is supported in ball bearings in the rear end of the range housing.

The planetary gear is engaged and disengaged using a gear selector cylinder located in the control housing. In high range, the ring gear is free from the range gear housing. The planet gear is locked to the planet gear carrier and the entire planetary gear rotates as one unit. The mainshaft and the output shaft then rotate at the same speed, gear ratio 1:1.

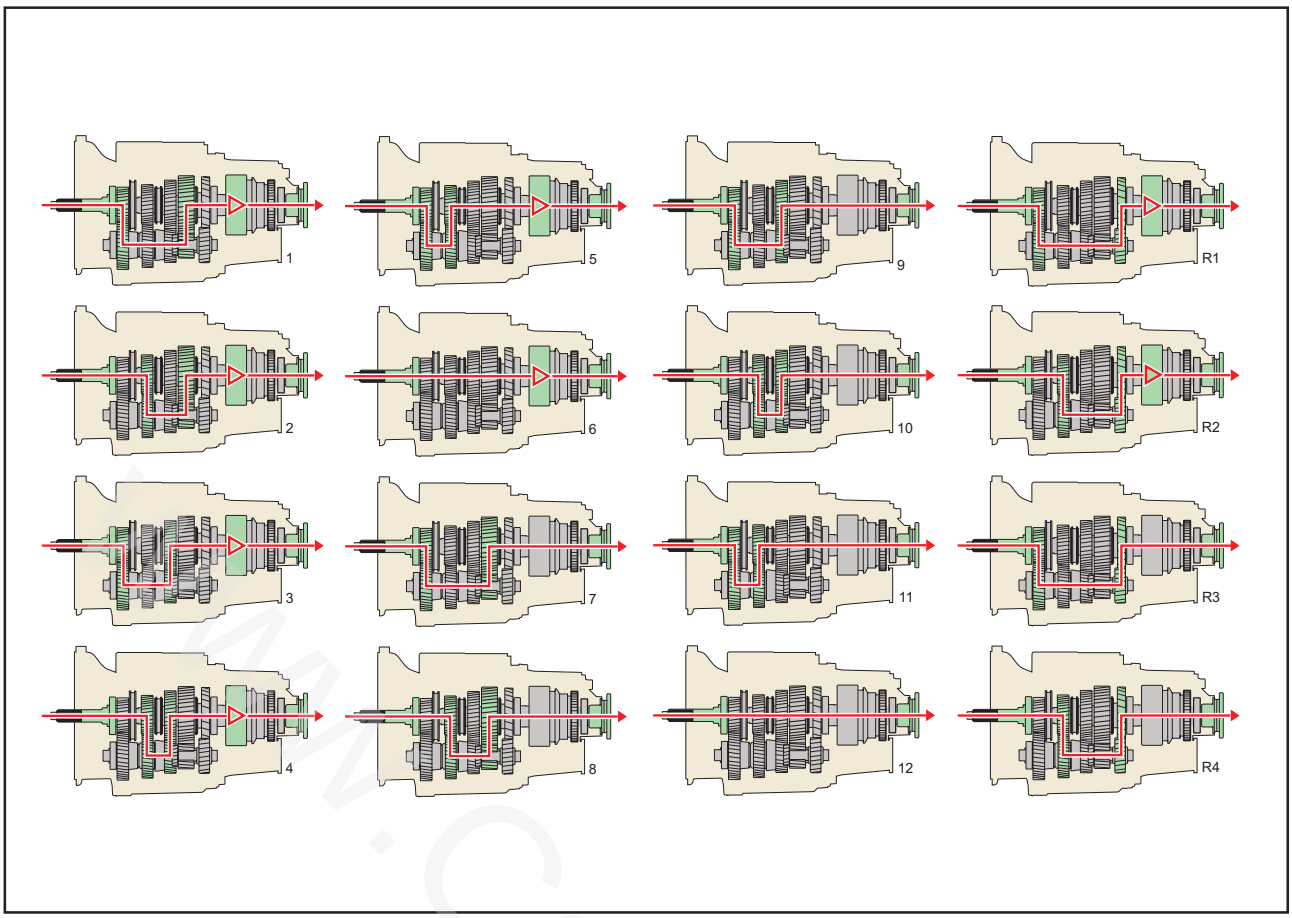
In low range, the ring gear is locked to the range gear housing and the planet gear is forced to rotate with the sun gear. The output shaft will then rotate slower than the mainshaft, giving a gear ratio of 4.35:1 on the output shaft.

The range gear is monitored by the range position sensor located in the gear selector cylinder.

The gear selector cylinder is controlled by the LR (Low Range) and HR (High Range) solenoid valves, which are located in the control housing cover and are controlled by signals from the transmission control unit (TECU).

The range gear, however, cannot be controlled separately but is integrated in the normal linear gear changing in the system, i.e. forward gears 1-12 and reverse 1-4.

Forward gears 1-6 forward and R1, R2 are in low range, forward gears 7-12 and R3, R4 are in high range. Gears 7-12, i.e. high range, cannot be engaged while the vehicle is stationary.



8 The power flow

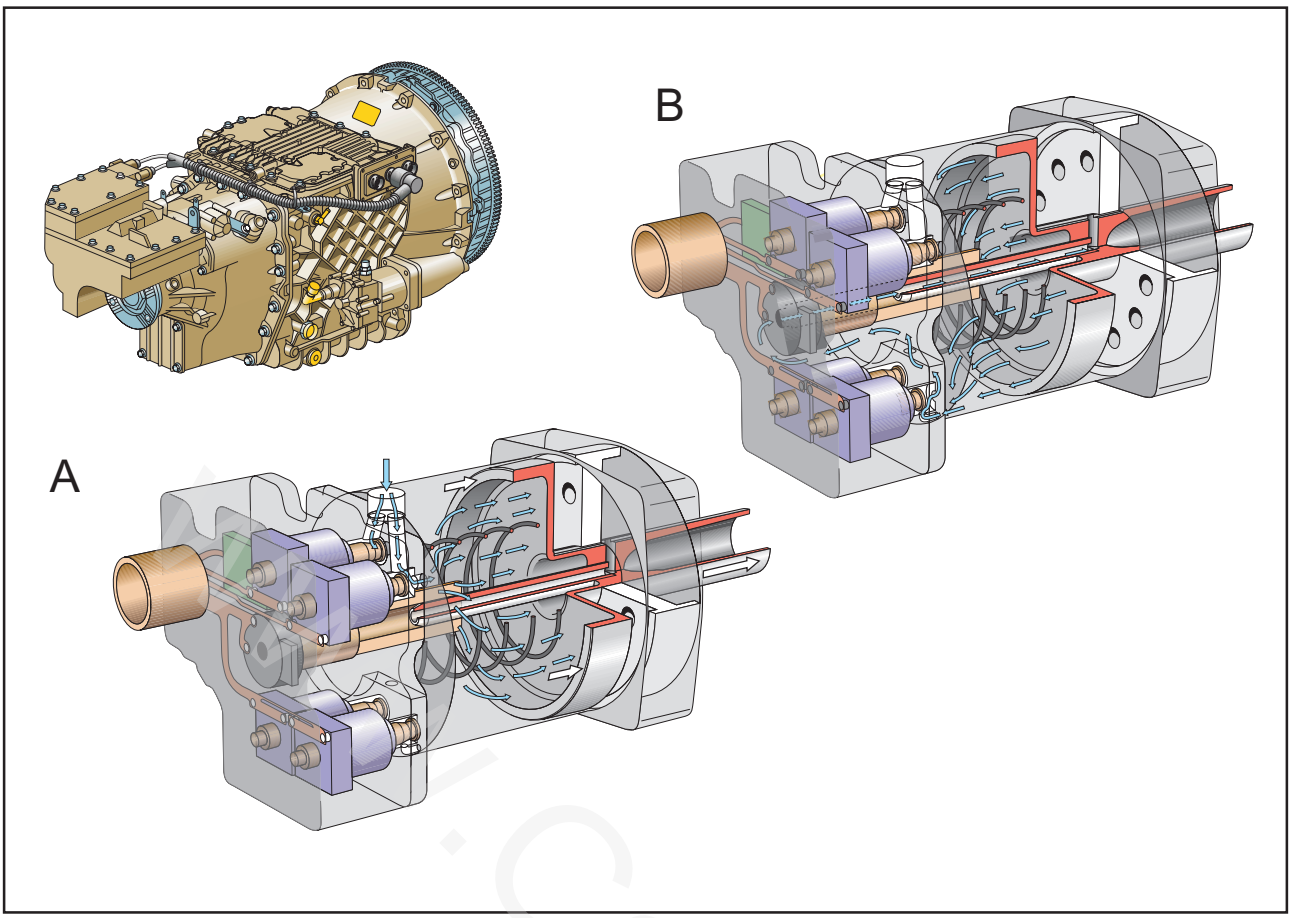
1st	14.94:1	7th	3.44:1	Reverse gear R1	17.48:1
2nd	11.73:1	8th	2.70:1	Reverse gear R2	13.73:1
3rd	9.04:1	9th	2.08:1	Reverse gear R3	4.02:1
4th	7.09:1	10th	1.63:1	Reverse gear R4	3.16:1
5th	5.54:1	11th	1.27:1		
6th	4.35:1	12th	1.00:1		

Power is conveyed by the input shaft via the LP gear to the countershaft for gears 1, 3, 5, 7, 9, 11, R1 and R3.

For gears 2, 4, 8, 10, R2 and R4, power is conveyed directly to the HP gear wheel on the mainshaft to the countershaft and on to the gear wheel on the mainshaft engaged by the gear selector cylinder's selector fork when the system automatically selects gear or the driver does it manually.

When the first base gear and the splitter gear are to be engaged, the selector fork for 1/R gear will lock the first gear on the mainshaft. The power is then conveyed from the input shaft via the LP gear wheel to the countershaft via the splitter gear and from there to the first gear on the mainshaft. Since the 1st gear wheel is locked, it will transfer this power to the mainshaft. The power is conveyed through the planetary gear to the output shaft. Gear reduction in the range gear is done in gears 1-6 and R1, R2.

The reverse gear is in continuous mesh between the reverse gear wheel on the mainshaft and the corresponding gear wheel on the countershaft. When the reverse gear is engaged on the mainshaft with synchromesh, the reverse pinion will change the direction of the mainshaft. The mainshaft will now rotate anticlockwise (viewed from the front) and the power will go via the companion flange to the drive shaft and the vehicle will reverse.



9 Clutch

A Clutch released

B Clutch engaged

The clutch is a pull type single plate clutch. Remember to hold the vehicle still with the parking brake when starting on a hill with the gear lever in automatic. Otherwise, there is a risk of overheating the clutch, whereby the information lamp will come on together with the overheated clutch symbol on the display. This would otherwise cause much wear on the clutch plate.

The pneumatic cylinder has wear compensation using the clutch control unit (TECU) and therefore no manual adjustment of the clutch is necessary.

When the clutch plate is to be changed it will be indicated on the display. Programs basic, fuel and economy do not have this function.

When changing the clutch plate, clutch cylinder or after reprogramming the control unit, these three calibrations must be performed in the following order:

40084-2	Clutch stroke length and wear.
40104-2	Gearbox, calibration. ·
40053-2	Clutch point of engagement, calibration.

The clutch cylinder is controlled electro-pneumatically and the position of the piston in the cylinder is regulated using four PWM controlled (Pulse Width Modulation) solenoid valves located inside the CCU and controlled by the transmission control unit (TECU). Different speeds of engagement and release of the clutch are achieved with PWM control of the solenoid valves.

Two solenoid valves are used for engagement:

PWM valve, rapid engagement (VAFE = Valve Fast Engagement). PWM valve, slow engagement (VASE = Valve Slow Engagement).

Two solenoid valves are used for release:

PWM valve, rapid release (VAFD = Valve Fast Disengagement). PWM valve, slow release (VASD = Valve Slow Disengagement).

The clutch is normally engaged and can be released under several different conditions:

- Before changing gear
- If the engine speed is too low (below 600 rpm)
- If the engine speed drops too quickly
- When the wheels lock

Engagement can take place in three stages, for example:

- Manoeuvring the clutch as fast as possible to the point of engagement. This is done by activating the two PWM valves, fast engagement (VAFE) and slow engagement (VASE).
- Synchronising the speed across the clutch. This is done by activating the PWM valve slow engagement (VASE) to give the vehicle constant acceleration.
- Completing the engagement as fast as possible by activating the two PWM valves, fast engagement (VAFE) and slow engagement (VASE).

This means that the clutch is engaged as quickly as possible after a gear change without impairing driving comfort.

The clutch cylinder also has an inductive position sensor that monitors the actual position of the clutch cylinder.

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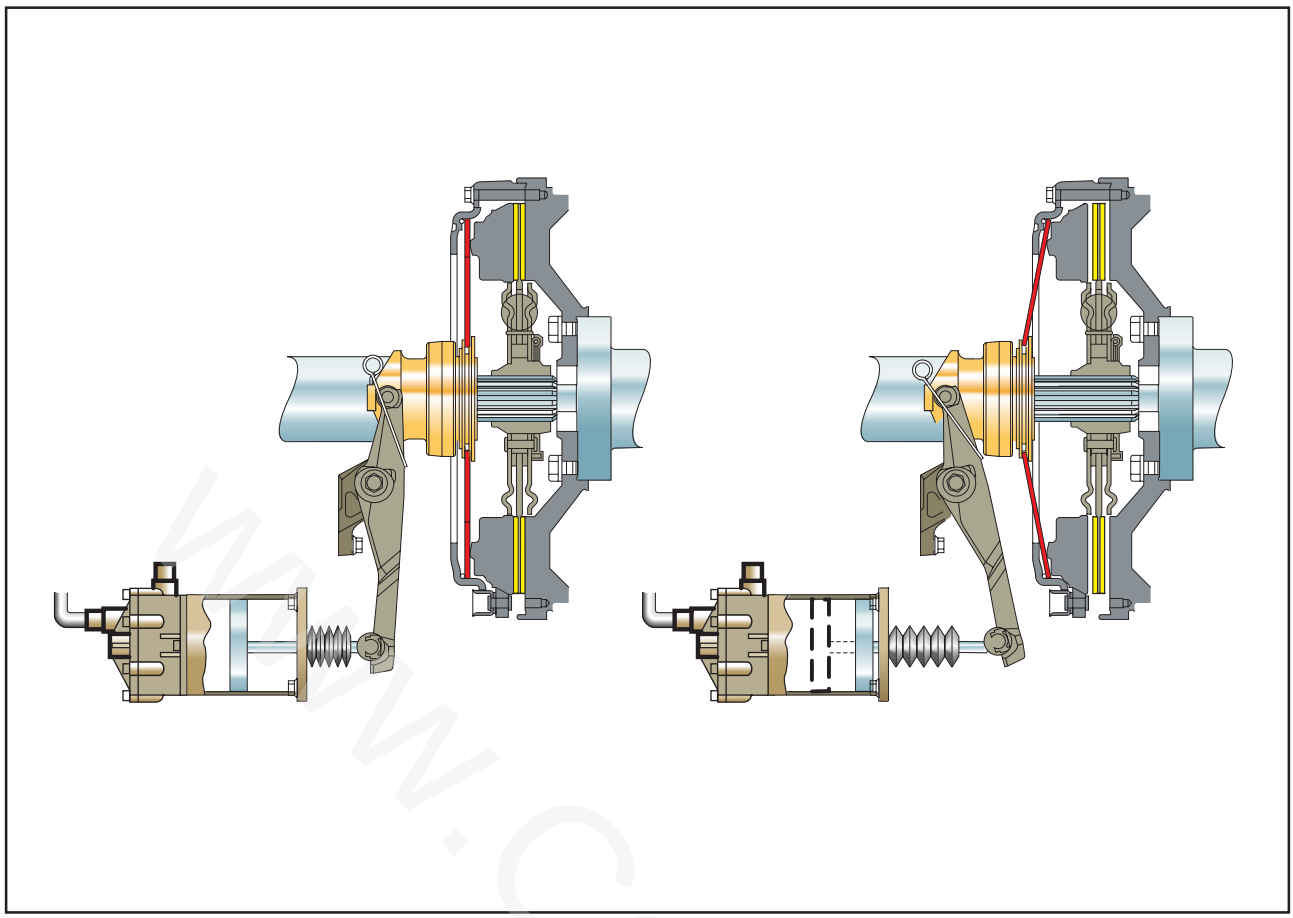

10 Stroke

The stroke of the clutch cylinder is the distance the lever/piston moves from its engaged position to its released position. The picture on the left shows the engaged position when the clutch is unaffected, the pressure plate, driven plate and flywheel are joined together.

The picture on the right shows the released position where the piston in the clutch cylinder has been moved by the air pressure acting on it. The lever pulls the release bearing to the left of the picture, which separates the pressure plate, driven plate and flywheel from each other.

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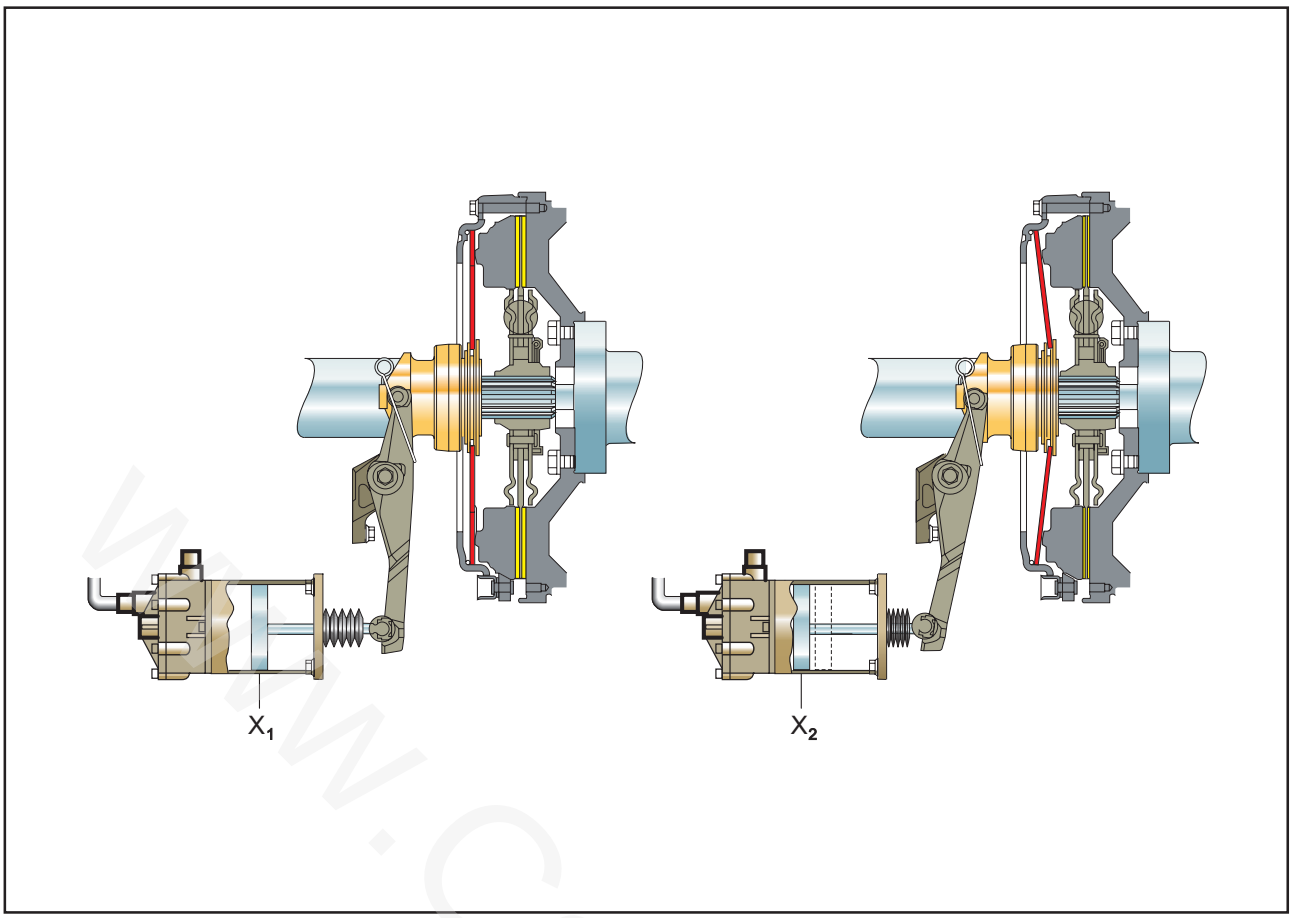

11 X1-X2 value

Test 40084-2 “clutch stroke length and wear” in VCADS Pro is used to follow the movement of the clutch cylinder and estimate the wear on the clutch plate. On new vehicles or changed plates, the measured value X1 should be noted on a label. The wear is regularly followed up with new test values X2 (suitably during service).

It is essential that the results of each test are noted. Value X2, wear Y and date D are to be noted on the label.

When the difference reaches a certain value Y, the clutch plate must be changed.

After changing the clutch plate, a new test is carried out and new values noted.

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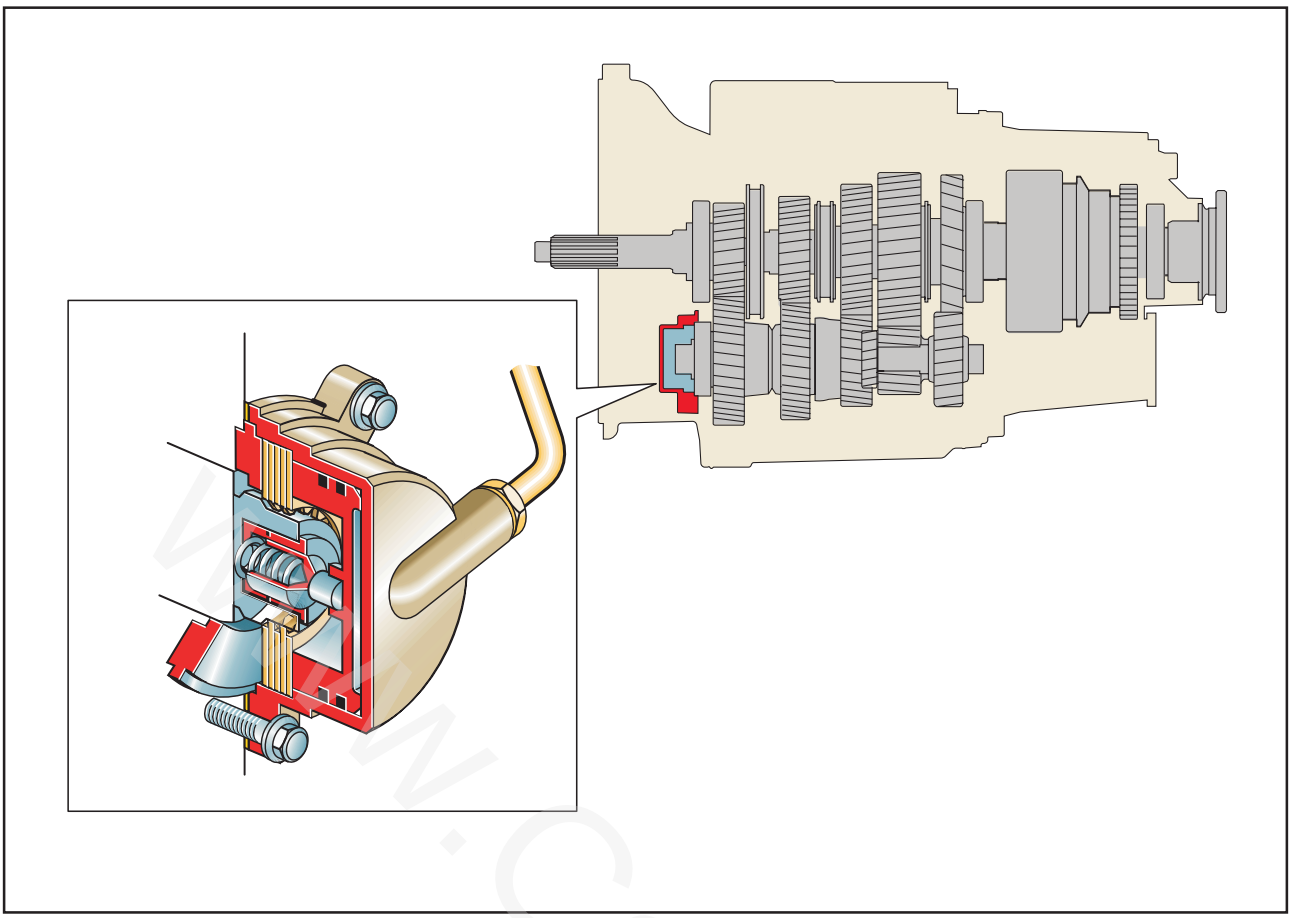

12 Countershaft brake

The VT2412B is equipped with integrated countershaft brake located on the front of the countershaft and front-mounted in the clutch housing. It is used to slow down the rotation of the parts in the gearbox when the vehicle is stationary and a starting gear is to be engaged. This eliminates wear, noise and grinding in the gearbox. The countershaft brake is used to slow down the input shaft to obtain synchronous speed when changing up*.

The countershaft brake comprises a cylinder containing a multi-disc brake (2 friction discs, 3 steel discs) that is activated with compressed air.

In turn, the pneumatic cylinder is operated by a solenoid valve located in the control housing cover and controlled by TECU.

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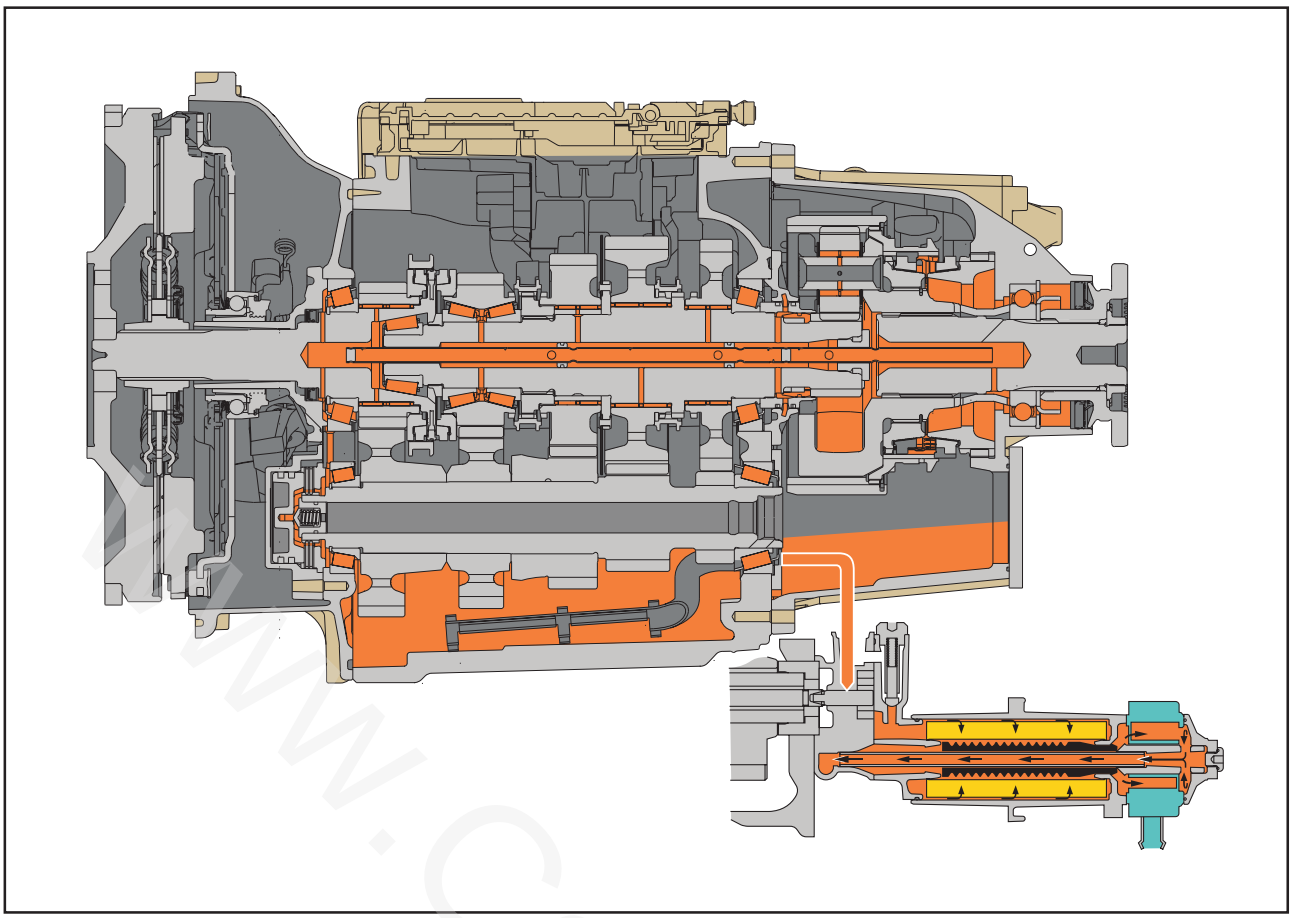

13 Lubricating system

The gearbox is lubricated through a combination of forced and splash lubrication.

The oil is drawn up from the bottom of the gearbox through a strainer to the oil pump; the oil is cleaned in the oil filter. The oil is subsequently forced into the mainshaft rear cover. The oil is forced out into the oil distributor pipe, which has a number of holes through which the oil is forced out to bearings on the input shaft, mainshaft and to the range gear.

Passages then lead the oil to bearings and synchronizers. The oil is distributed approx. 30% to the mainshaft and 70% to the range gear.

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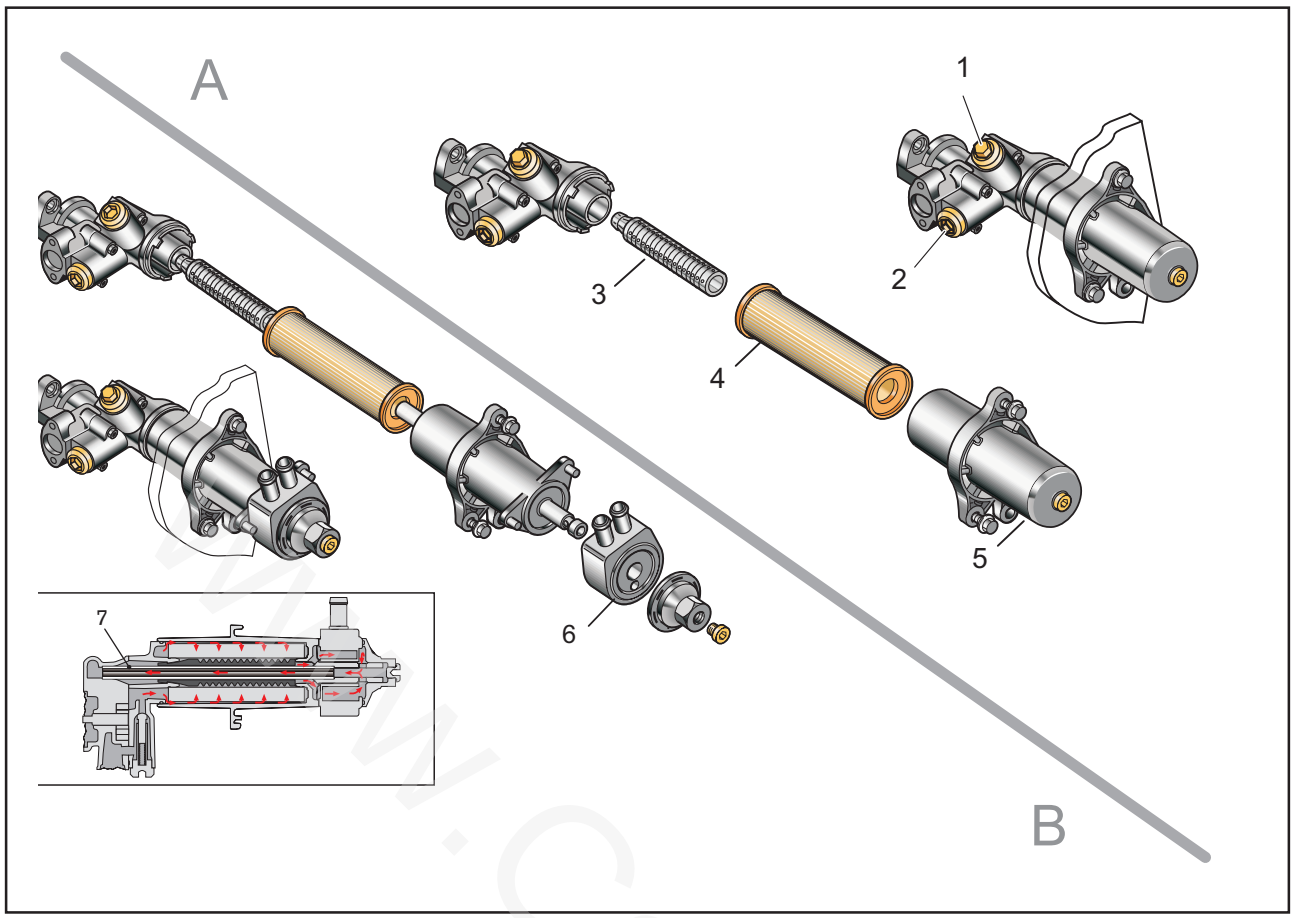


14 Oil pump and filter

1 Overflow valve, blocked filter
2 Overflow valve, high pressure, cold start
3 Stay tube
4 Insert filter
5 Oil filter cover
6 Oil cooler
7 Oil cooler in cross section

A. The oil pump is an eccentric pump that is driven by the countershaft via a gear and a drive shaft running through the reverse gear. The drive shaft is mounted in two needle bearings in the reverse shaft.

There are two overflow valves on the oil pump. One of them (1) is used to ensure the gearbox is lubricated in case the filter is blocked and the other (2) will open if the oil pressure rises too high in the system, when cold starting for example. These valves are mounted in the pump housing and comprise a compression spring and valve peg.

On the pressure side of the pump there is a full flow insert filter (4).

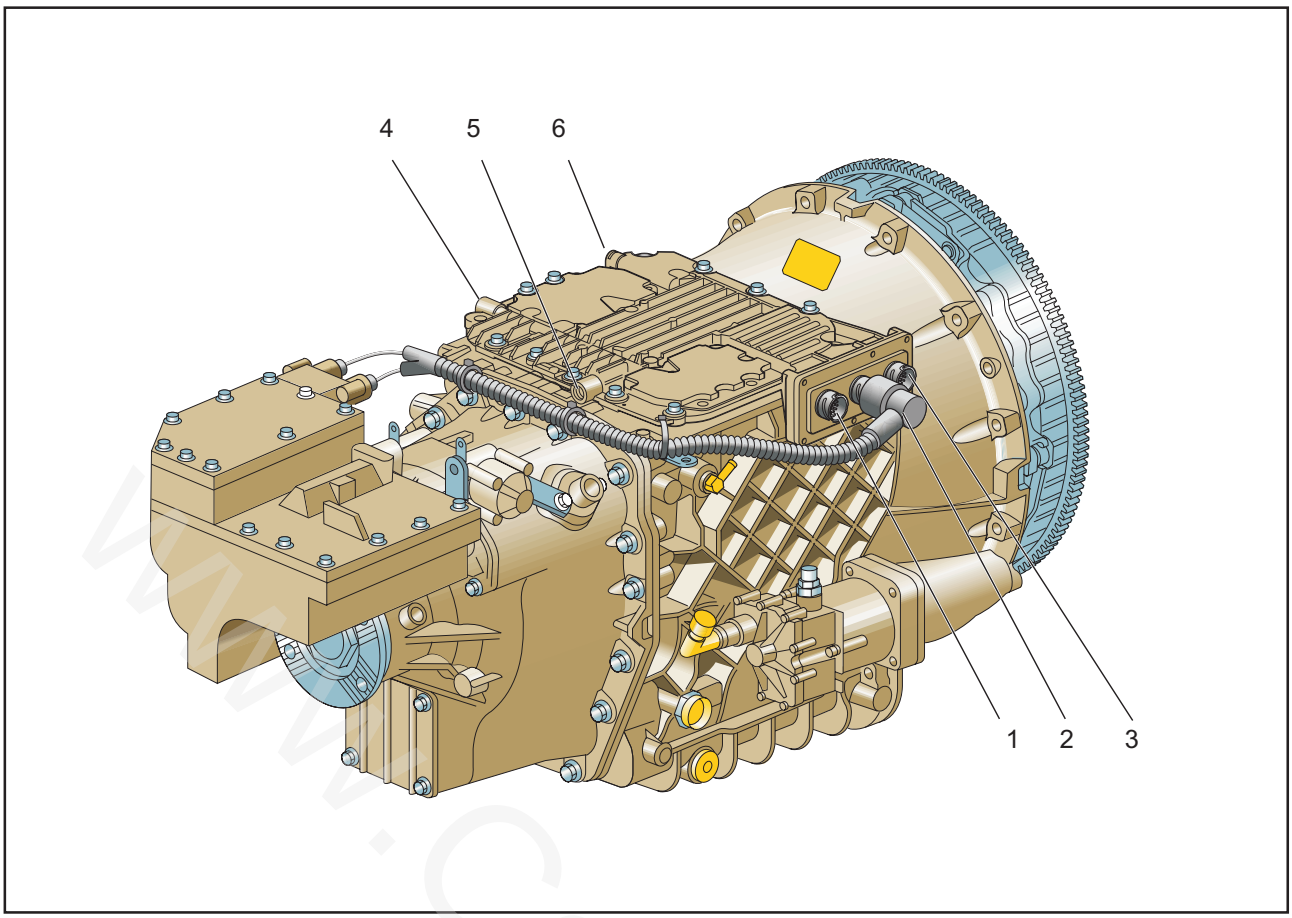
It is located in a holder on the pump housing and is accessible from outside. The filter is protected by a cover (5) on the range housing. In the oil filter is a plastic pipe (3) that prevents the filter from collapsing.

The gearbox oil temperature can be read on the display (option).

B. These gearboxes can be equipped with oil cooler mounted on the gearbox.

Another oil filter cover is used that the oil cooler is screwed onto.

Oil is pumped first through the filter then through the oil cooler and subsequently out to the gearbox oil passages via the pipe (7). Coolant passes from the engine cooling system to the oil cooler heat exchanger via pipes and hoses. If necessary, there is a larger oil cooler available as an alternative where the oil cooler is replaced with an adapter to lead the oil to this cooler.



15 Electric and pneumatic connections

1 Connection to vehicle communication
2 Connection to retarder
3 Connection to clutch cylinder
4 Inlet compressed air
5 Compressed air to clutch cylinder
6 Compressed air to countershaft brake

The gearbox has three external compressed air connections. Inlet connection (4) goes from the vehicle's compressed air tank to the control housing. In the control housing, the compressed air is then distributed to the solenoid valves, via pipes to the clutch cylinder (5) and to the countershaft brake (6) via passages in the control housing, the base housing a pipe inside the clutch housing.

I-shift has three electric connections in the control housing cover.

1 Electric connection to speedometer and chassis wiring

2 Electric connection to retarder

3 Electric connection to clutch cylinder

In cases where the vehicle is not fitted with retarder, there will not be any wiring connected to connection 2.

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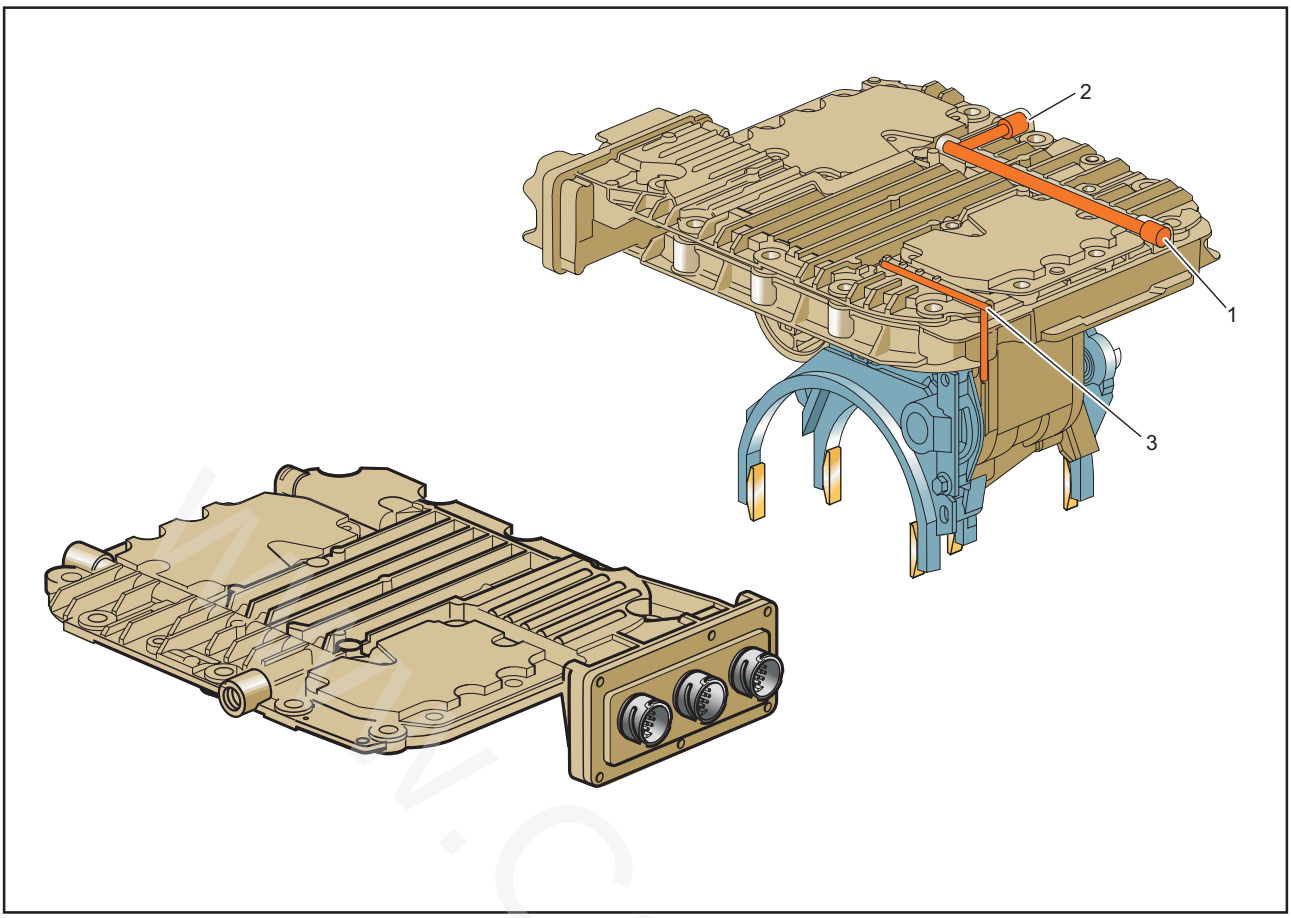

16 Control housing (GCU)

1 Inlet air pressure 2 Compressed air to clutch cylinder 3 Compressed air to countershaft brake

The following parts can be found in the gearbox control housing (GCU).

- Transmission control unit with integrated angle sensor and temperature sensor.
- Four parallel gear selector cylinders
- Four inductive position sensors
- Nine solenoid valves
- Air pressure sensor for service air
- Two speed sensors, one each for the mainshaft and the countershaft
- Temperature sensor for gearbox oil
- Selector forks for splitter gear and basic gears
- Compressed air connections
- Electrical connections

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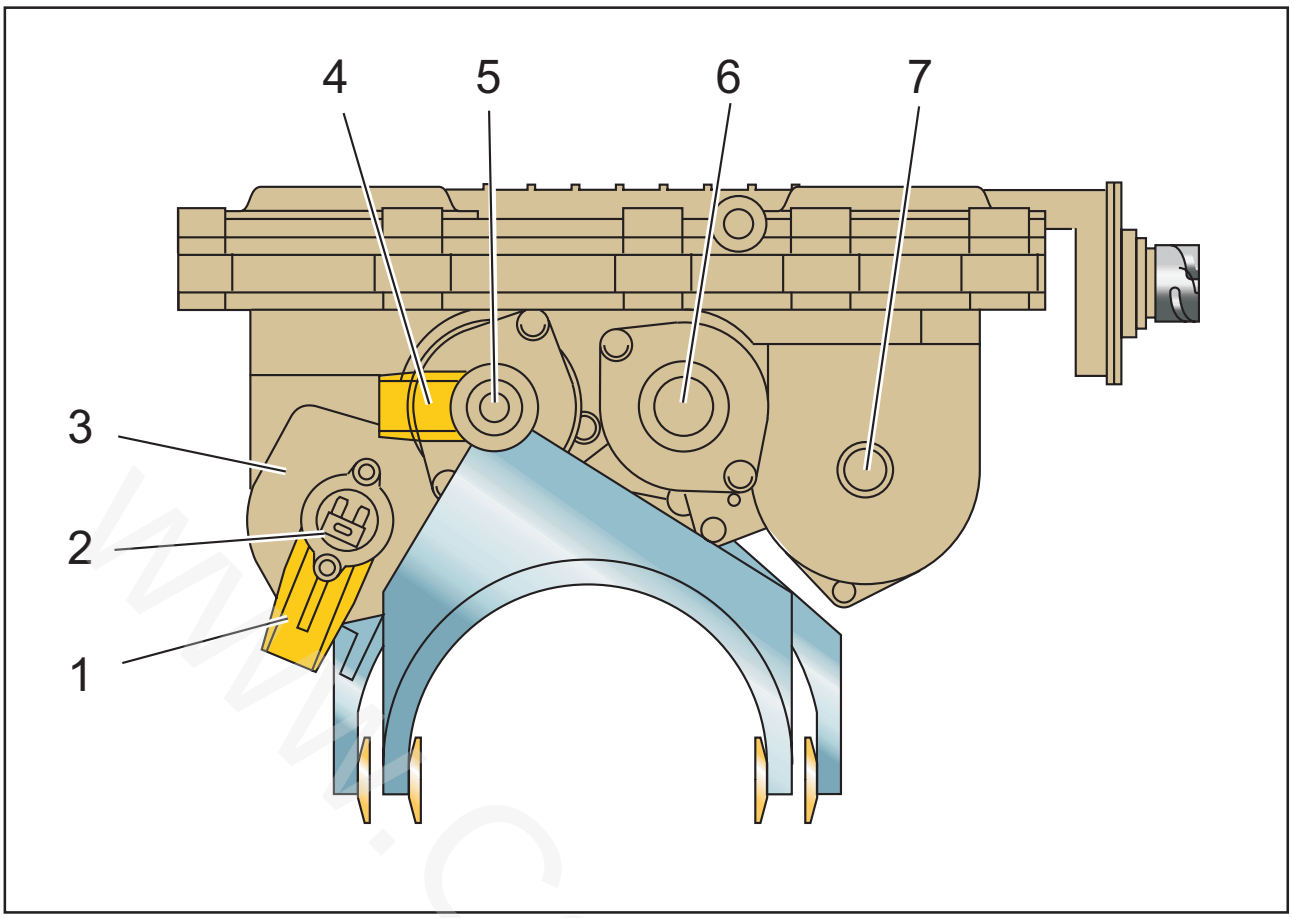

17 Gear selector cylinders

1 Inhibitor, splitter gear selector cylinder
2 Position sensor, splitter gear selector cylinder
3 Splitter gear selector cylinder
4 Inhibitor, 1/R gear selector cylinder
5 1/R gear selector cylinder
6 2/3 gear selector cylinder
7 Range gear selector cylinder

The gear selector cylinders are used to convey the motion with compressed air to the selector forks and engage the selected gear. The range cylinder (7) is a two-position cylinder, high-low range; the others have three positions, e.g. cylinder (5) that controls the first gear position, neutral position and reverse gear position.

The position sensor is an inductive sensor.

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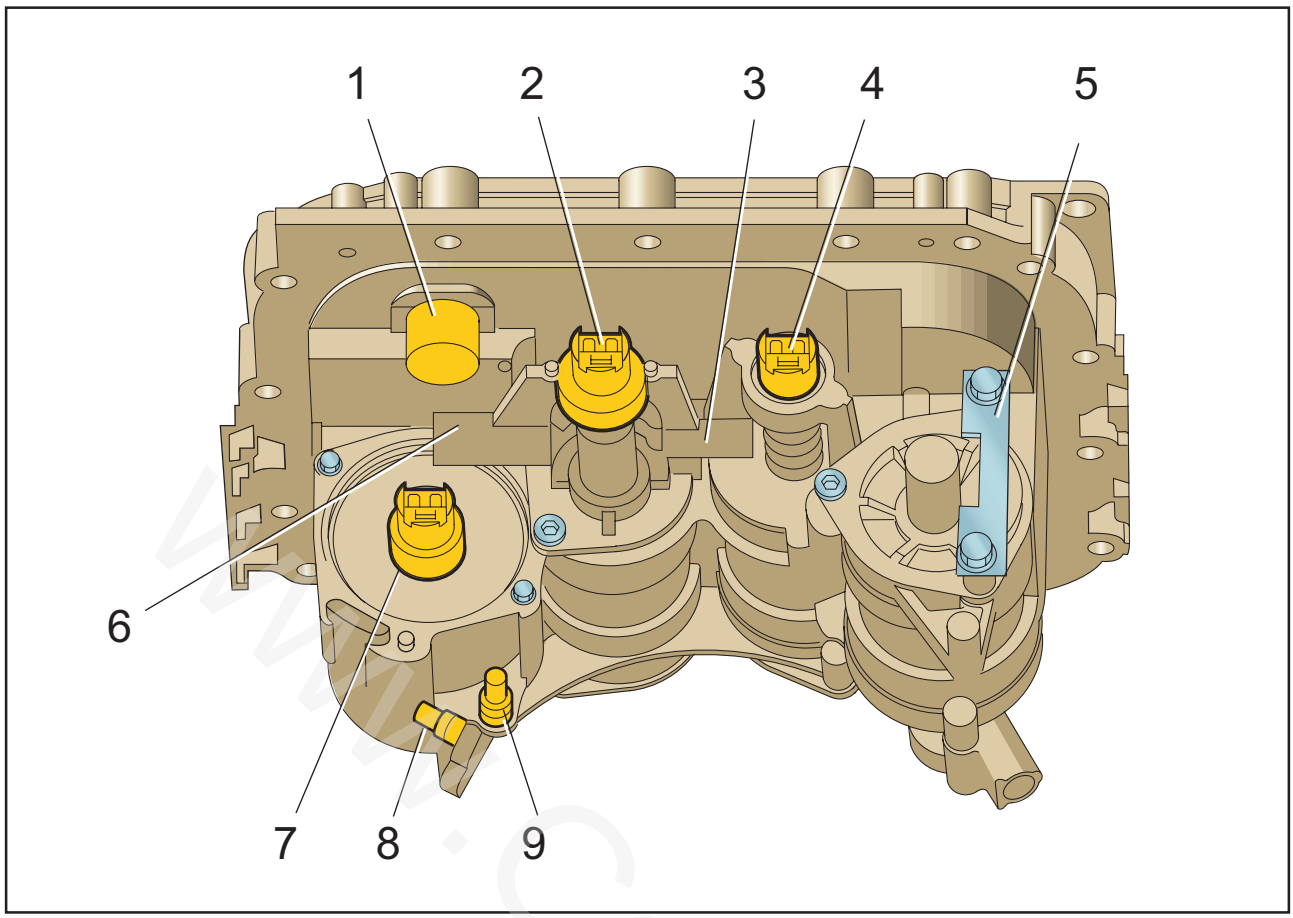

18 Gear change inhibitors and sensors

1 Oil temperature sensor
2 Position sensor, 2/3 gear selector cylinder
3 Inhibitor, only 1 gear selected
4 Position sensor, 1/R gear selector cylinder
5 Plate limiting splitter cylinder stroke
6 Inhibitor, 2/3 gear selector cylinder
7 Position sensor, range gear selector cylinder
8 Countershaft speed sensor
9 Mainshaft speed sensor

After turning the control housing through 180° we can see the gear change inhibitors, speed sensors and position sensors.

The inhibitors comprise a spring-loaded ball with grooves in each gear selector cylinder for securing the piston rod, a fixed position to ensure the gear is kept engaged. All position sensors are inductive. The speed sensors measure the rotational speed of both shafts, sensor (9) measures the mainshaft speed and sensor (8), although measuring the mainshaft, calculates the speed of the countershaft thanks to the control unit knowing the gear ratio between the gears on the two shafts.

The oil temperature sensor is fixed in the wire entry into the upper cover.

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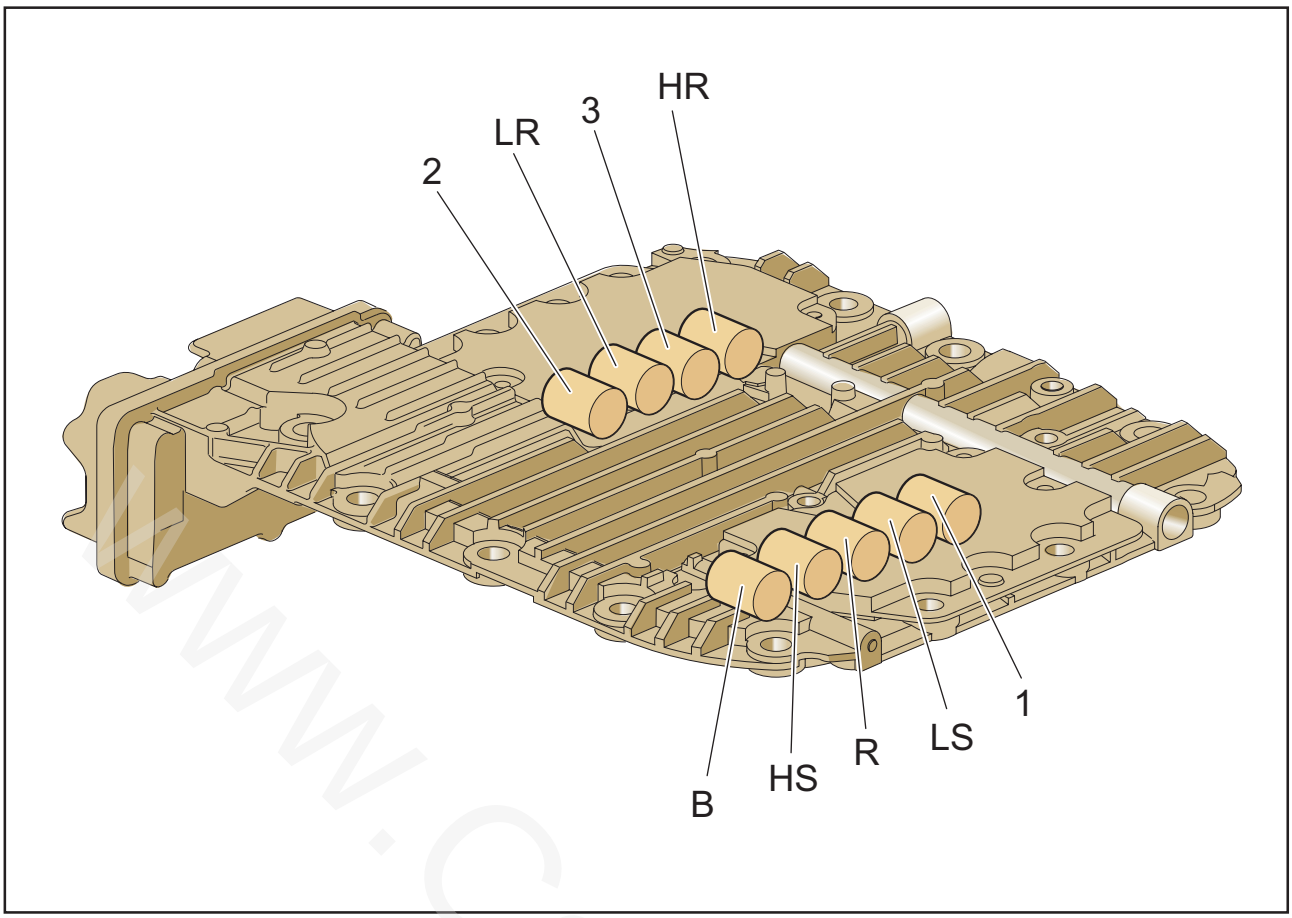

19 Solenoid valves

1 First gear solenoid valve
2 2nd gear solenoid valve
3 3rd gear solenoid valve

LS Low split solenoid valve
HS High split solenoid valve
R Reverse gear solenoid valve
LR Low range solenoid valve
B Countershaft brake solenoid valve
HR High range solenoid valve

All nine solenoid valves are located in the control housing cover. System pressure is 8.5 bar for trucks while for buses it is 7.5 bar and the operating pressure is about 4-10 bar. Voltage range is 18-32V DC.

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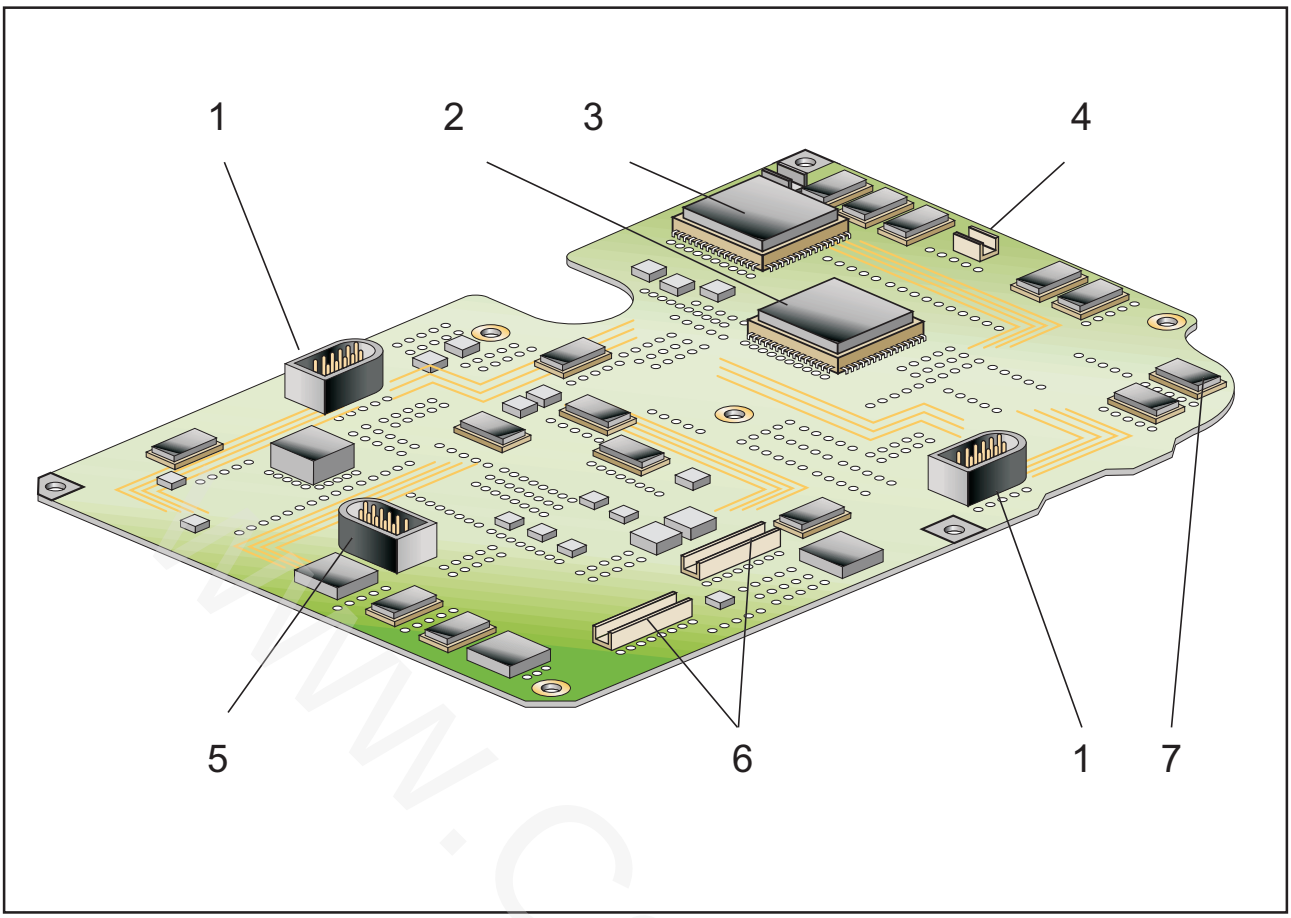

20 Circuit board

1 Connector for solenoid valves
2 Processor, executing unit, controls gearchange/clutch
3 Processor, software
4 Connector for air pressure sensor
5 To gearbox sensor
6 To 20-pin connector
7 Angle sensor

The control housing must not be opened; the figure is for information only to show what the circuit board looks like.

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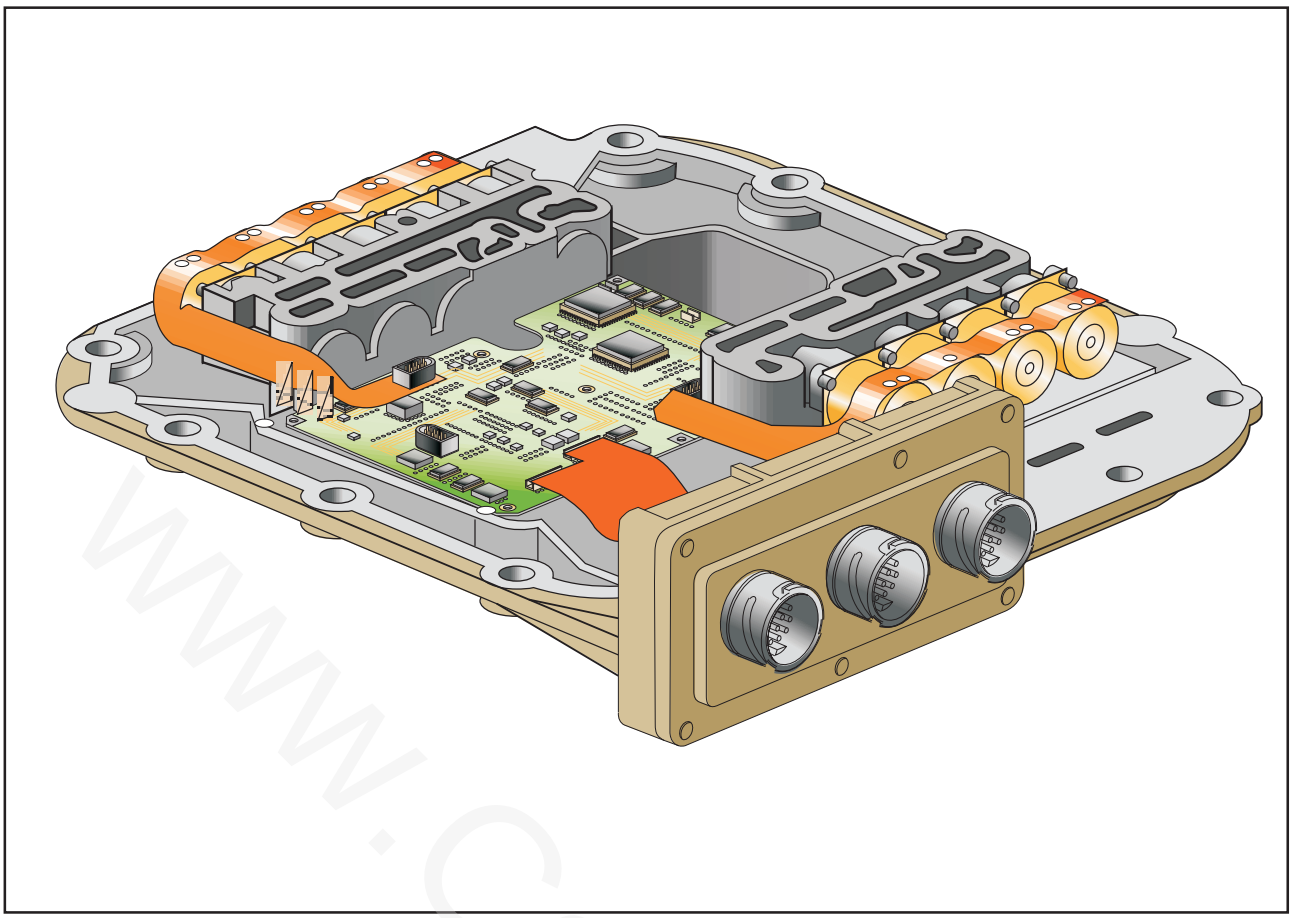

21 Control unit

The control housing (GCU), which is located on top of the gearbox, contains the transmission control unit (TECU). TECU is connected to the gear changing unit (GECU), which is located in the gear selector control inside the vehicle. TECU is integrated with the vehicle's TEA/BEA system and communicates with the other control units in the vehicle via the CAN link J1939 and the information link J1708. TECU is therefore able to retrieve all the information contained on the network in order to carry out optimum gear changes.

There are various programs giving the gearbox different characteristics and functions.

B=Basic

- This is the simplest alternative covering basic functions such as standard gear change program and
  standard "power" program.

C=Comfort

- This variant has a kick-down function.
- Automatic starting gear selection
- System takes into account several variables when selecting gear.
- The braking program uses the auxiliary brakes more efficiently and is deactivated in low gears and
  at low engine speeds.
- Information on oil temperature in the gearbox and when it is time to change clutch.
- Intelligent use of Volvo Compression Brake (VCB), countershaft brake and clutch cylinder for changing up.
- Silenced range shifting.

FE = Fuel and Economy

- This variant is optimised for low fuel consumption. Amongst other things, it has a freewheel function
  that is activated when neither braking force nor engine power is being applied.
- System takes into account several variables when selecting gear.
- Automatic starting gear selection
- The braking program uses the auxiliary brakes more efficiently and is deactivated in low gears and at low engine speeds.
- Smart cruise control that deactivates the auxiliary brakes in certain situations.
- Intelligent use of Volvo Compression Brake (VCB), countershaft brake and clutch cylinder for changing up.

FEC = Fuel and Economy & Comfort

- This variant is simply the two programs Fuel and Economy plus Comfort combined together. - This variant has a kick-down function.
- System takes into account several variables when selecting gear.
- Automatic starting gear selection.
- The braking program uses the auxiliary brakes more efficiently and is deactivated in low gears and at low engine speeds.
- Information on oil temperature in the gearbox and when it is time to change clutch. - Smart cruise control that deactivates the auxiliary brakes in certain situations.
- Smart cruise control that deactivates the auxiliary brakes in certain conditions.
- Intelligent use of Volvo Compression Brake (VCB), countershaft brake and clutch cylinder for changing up.
- Silenced range shifting.

EP= Economy Power

This program contains all the functions of the other programs plus the following.

- Increased torque in high gear, direct gear.
- Smart cruise control that deactivates the auxiliary brakes in certain conditions.
- Intelligent use of Volvo Compression Brake (VCB), countershaft brake and clutch cylinder for changing up.
- Silenced range shifting.

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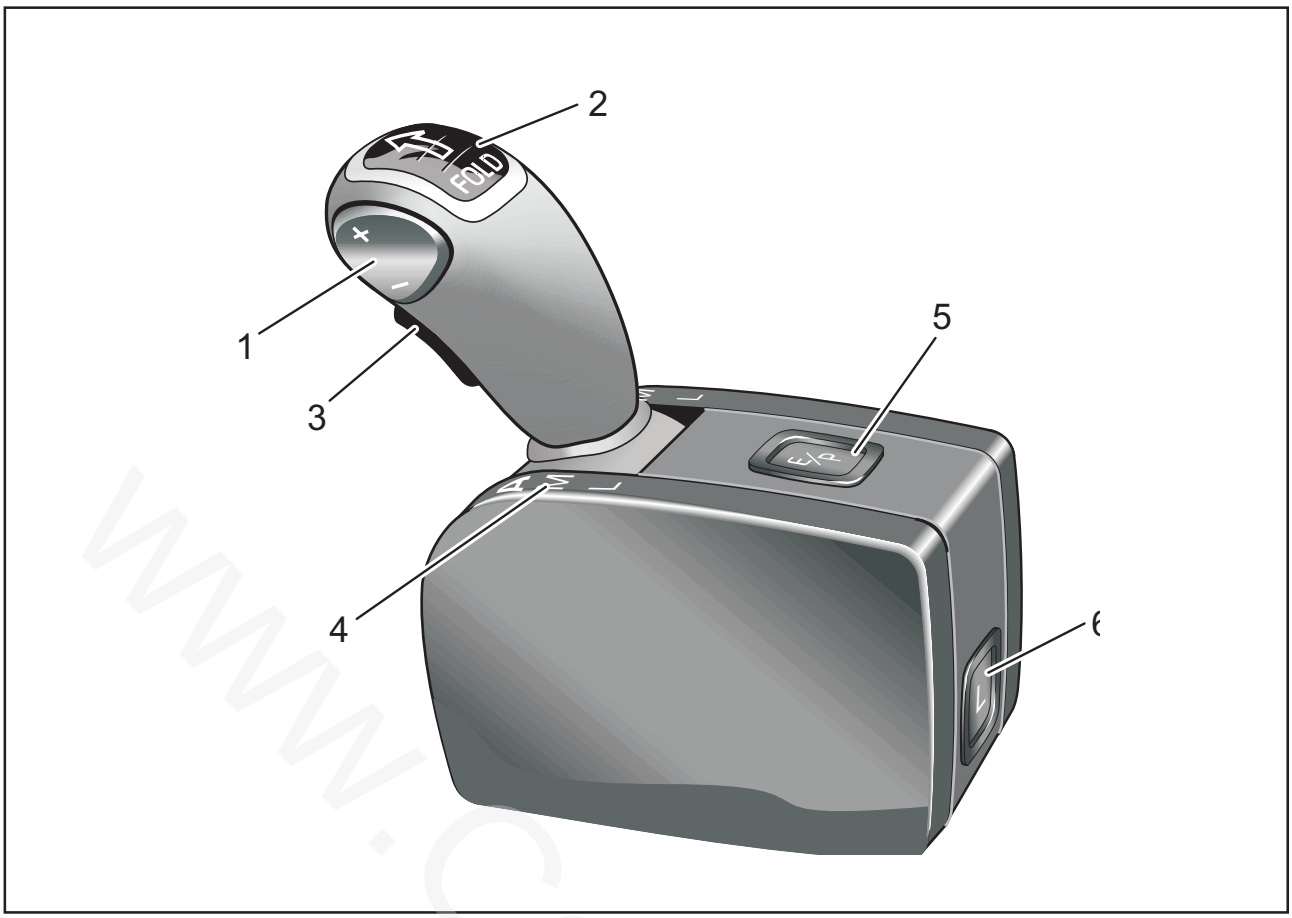


22 Gear selector

1 Gear step button
2 Lever fold button
3 Gear selector lock button
4 Gear selector positions
5 Economy/Power button
6 Limp home button

The gear changing unit (GECU) is located inside the gear selector (GLU), which is fixed to the driver's seat and can be folded to facilitate access for the driver. The gear lever can be folded forwards using the fold button (2). This can be done only when the lever is in neutral.

The gear step button (1) is spring-loaded and has two options, up and down. The button is used to step up or down through the gears. The gear selector lock (3) prevents inadvertent gear selector engagement.

There are different gear positions:

R = reverse gear

N = Neutral.

A = Automatic

M = Manual.

L = Low gear D12 = gear 4, D9 = gear 2 (on trucks only).

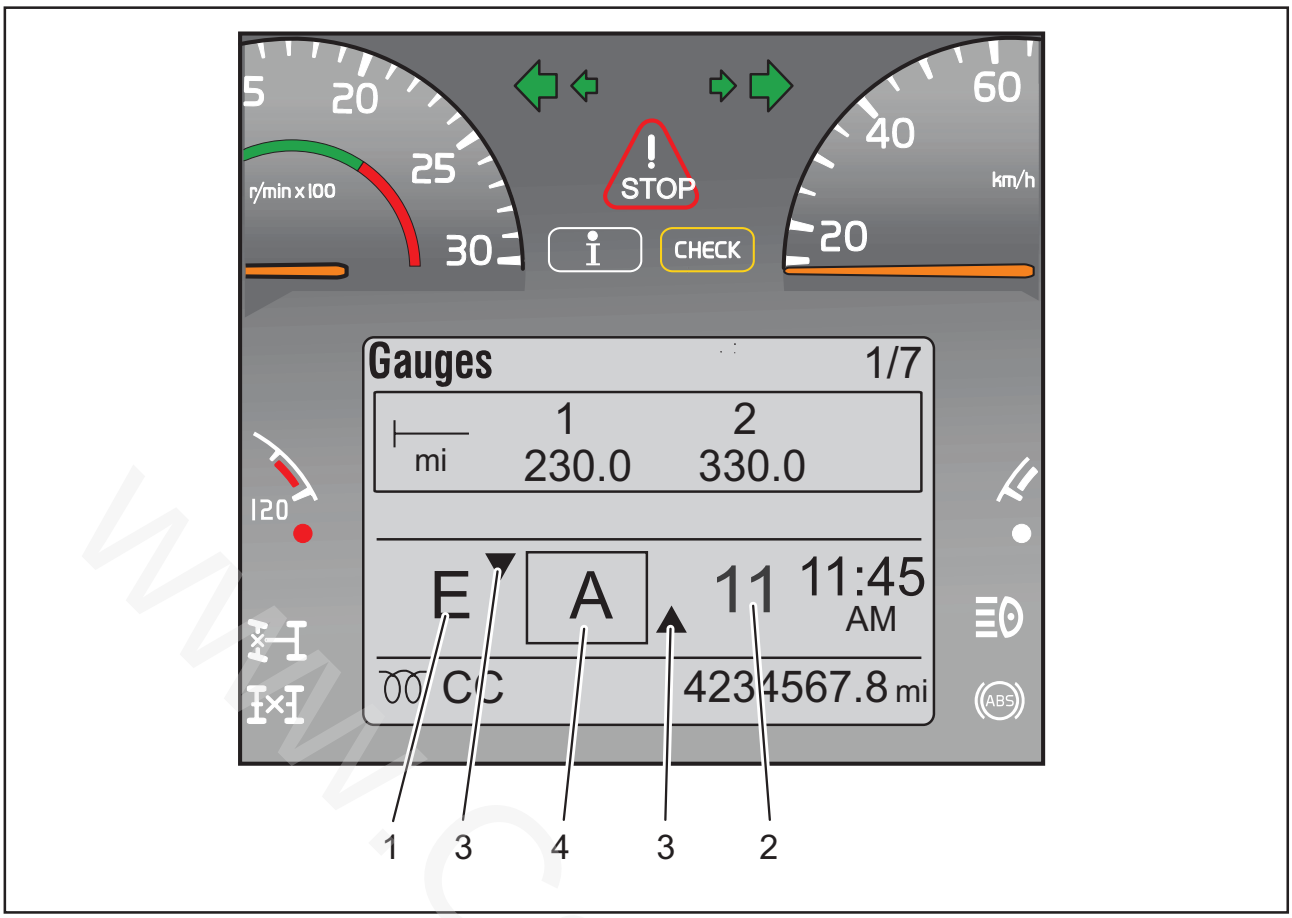
The E/P (Economy/Power) button (5) is used in cases where higher engine speeds between gear changes are needed. The system switches back to economy when power is no longer needed.

The L (limp home) button (6) is an emergency mode that can be engaged if a fault has occurred in the gearbox that prevents the vehicle from being driven in automatic, manual or reverse modes and should only be used for moving short distances.

Activating and changing can only be done while the vehicle is stationary.

The function is engaged by pressing the L button while moving the gear lever to A position. In forward position, first, third and fifth plus reverse R1 can be engaged. When driving with limp home engaged, it is not possible to change gears. The L button does not need to be pressed when changing from forward to reverse.

Notes



23 Display, trucks

1 Driving programs E, E+, P, B, L
2 Selected gear
3 Available gears (up/down)
4 Lever position

The display gives information on the current driving program,

E = Economy
E+ = freewheel possible
P = Power,
B = Brake,
L = Limp home

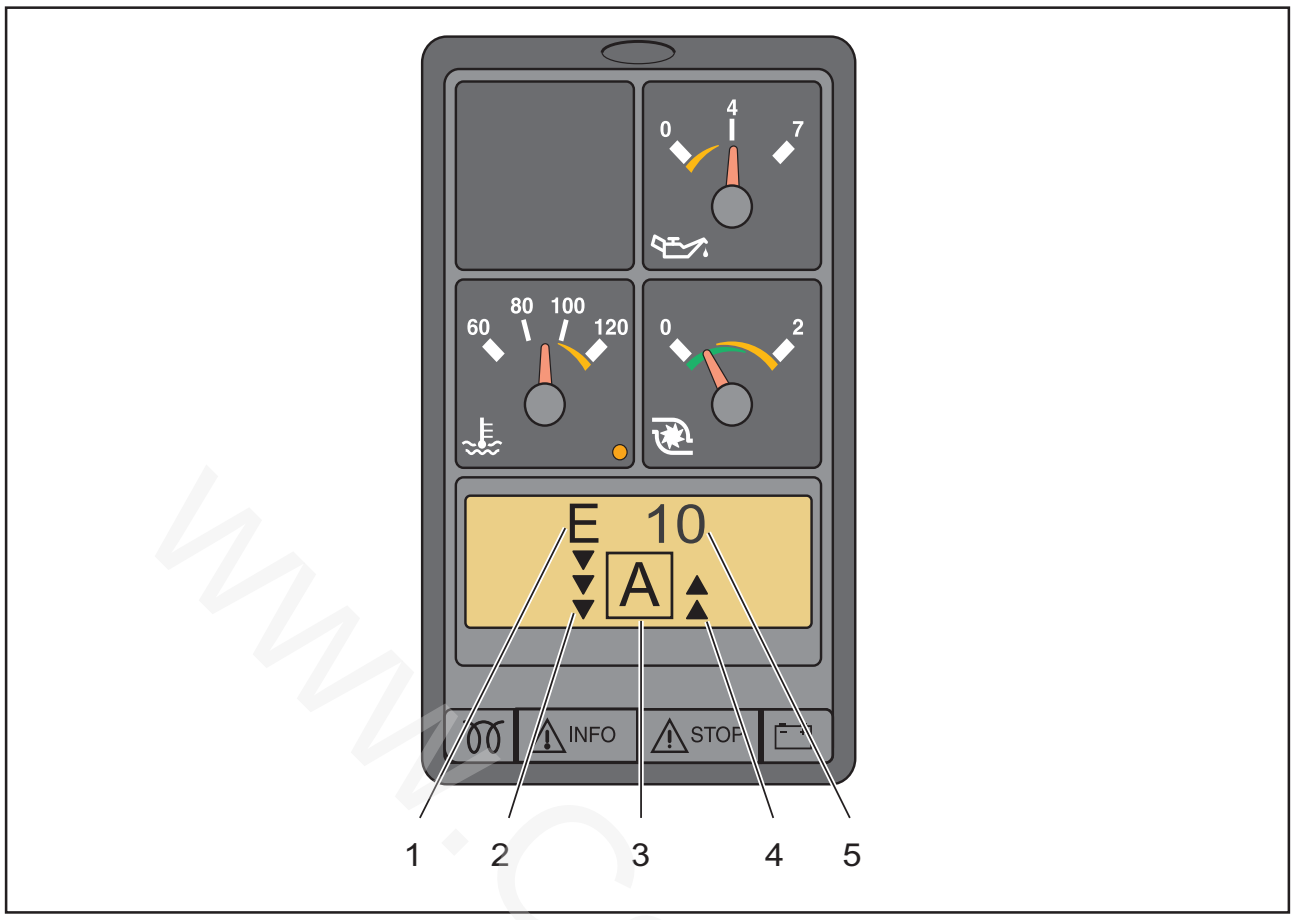
Selected gear (2) shows the gear 1-12, N = Neutral, R = Reverse gear.

Available gears position (3) are shown with max 3 arrows by the side of the gear selector position symbols on the display.

Gear selector position (4) shows the position of the lever:

R = Reverse
N = Neutral
A = Automatic
M = Manual
L = Low gear

When the lever is folded, the display shows the programs that are installed in the control unit (TECU). B, C, FE, FEC or EP.



24 Display, buses

1 Driving programs E, P, B, L
2 Available gears (down)
3 Lever position
4 Available gears (up/down)
5 Selected gear

The display gives information on the current driving program,

E = Economy

P = Power,

B = Brake,

L = Limp home

Selected gear (5) shows the gear 1-12, N = Neutral, R = Reverse gear.

Available gears selector position (2, 4) are shown with max 3 arrows by the side of the gear position symbols on the display.

Gear selector position (3) shows the position of the lever:

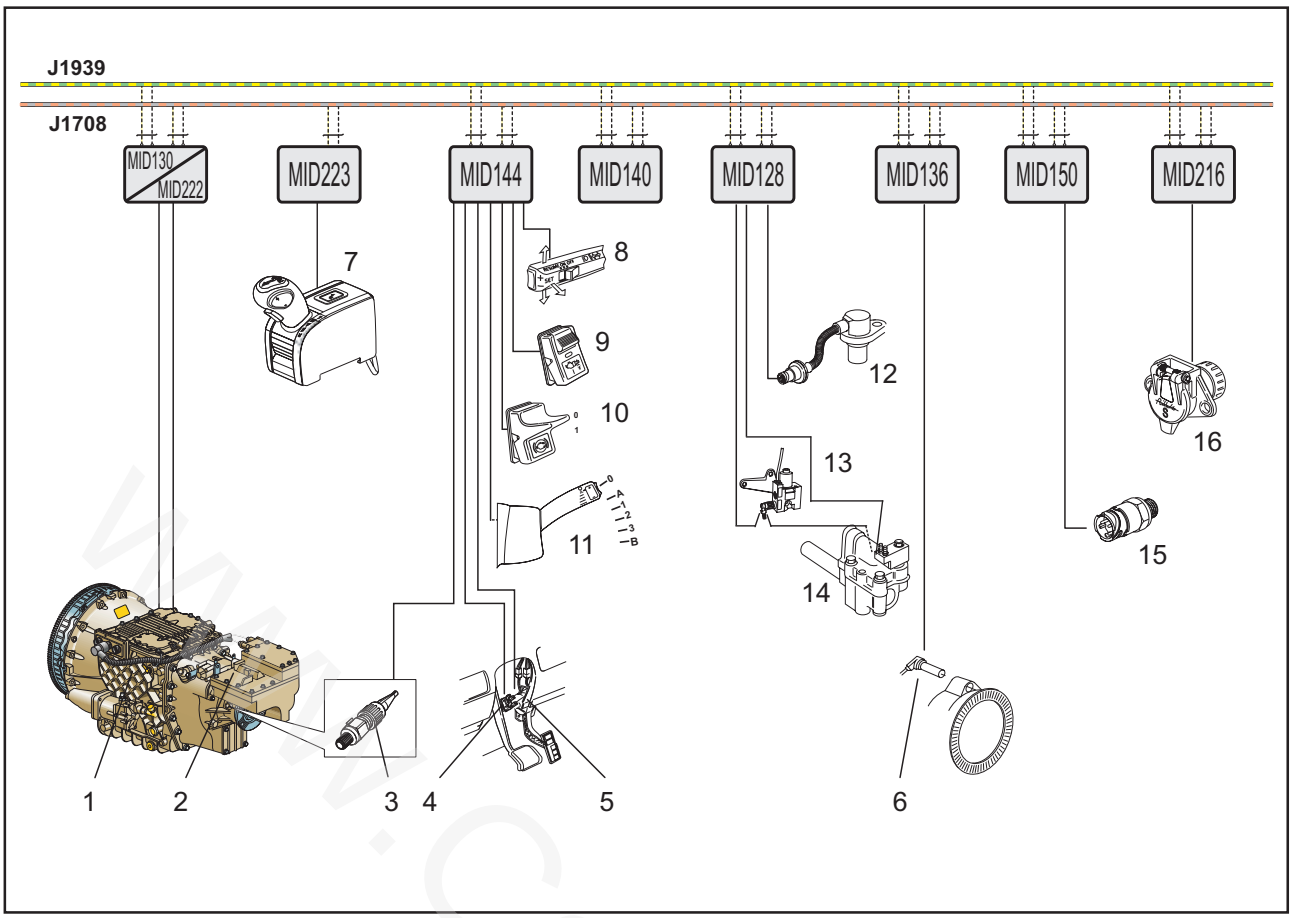
R = Reverse

N = Neutral

A = Automatic

M = Manual

When the lever is folded, the display shows the programs that are installed in the control unit (TECU).



25 Signal summary, trucks

MID130 Transmission control unit TECU
MID222 Retarder control unit RECU
MID223 Gear selector control unit, GECU
MID144 Vehicle control unit, VECU
MID140 Central instrument control unit
MID128 EMS, engine control unit
MID136 EBS/ABS/ASR control unit
MID150 ECS control unit
MID216 LCM control unit
1 Gearbox
2 Retarder
3 Speed sensor for tachograph/speedometer
4 Position switch, brake pedal
5 Sensor, accelerator pedal
6 Wheel speed sensor
7 Gear selector with control unit GECU
8 Cruise control switch
9 Power take-off switch
10 Engine brake switch
11 Auxiliary brake lever, retarder
12 Engine speed sensor, crankshaft
13 Solenoid valve block, engine brake/EPG
14 Solenoid valve, Volvo Engine Brake VEB
15 Air suspension pressure sensor
16 Trailer connection, 7-pin

VT2412B communicates with a number of different control units in order to obtain information that is required for the system (TECU) to choose the most suitable gear with regard to driving comfort. Below are examples of signals/information that the gearbox retrieves: Via EBS/ABS/ASR control unit MID 136, signal from wheel speed sensors (6) for determining vehicle speed. In case of wheel spin, ABS system active, ESP active the system will not change gear.

Via engine control unit MID 128, Sensor, engine speed crankshaft (12) to determine engine speed, torque, etc. Solenoid valve block and VEB/VCB solenoid valve (14) to brake the engine when changing gear.

Via vehicle control unit MID 144.

Position of switch for cruise control (8), PTO switch (9) and engine brake (10). Auxiliary brake lever, retarder (11) to activate intelligent braking program, etc.

Brake pedal position switch (4) to determine when the vehicle brakes are applied. The accelerator pedal sensor (5) to determine its position.

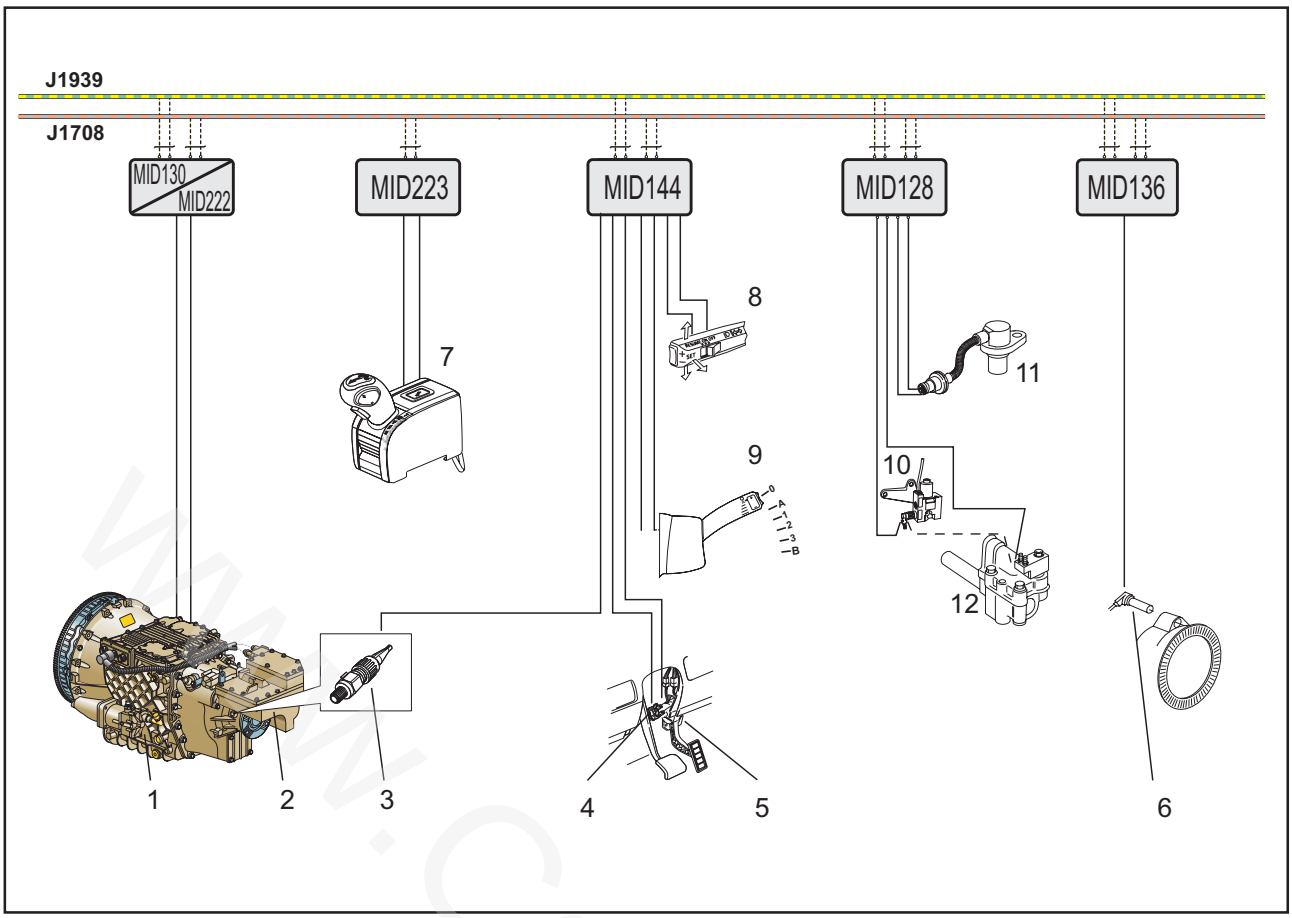
Speed sensor for tachograph/speedometer (3) to determine the gearbox rpm when changing gear, etc.

Via central instrument MID 140, gear selector position, selected gear, possible gears, driving program E/P, time/date for diagnosis.

Via ECS control unit MID 150, air suspension pressure sensor (15), information on bellows pressure, for calculating total weight of vehicle.

Via LCM control unit MID 216, trailer connection (16) gives a signal if a trailer is coupled.

Notes



26 Signal summary, buses

MID130 Transmission control unit TECU
MID222 Retarder control unit RECU
MID223 Gear selector control unit GECU
MID144 Vehicle control unit VECU
MID128 Engine control unit EECU
MID136 EBS/ABS/ASR electronic control unit
1 Gearbox
2 Retarder
3 Gearbox output shaft speed sensor
4 Brake pressure switch
5 Accelerator pedal position sensor
6 Wheel speed sensor
7 Gear selector with control unit GECU
8 Cruise control switch
9 Hand control, engine/retarder brake
10 Exhaust pressure governor solenoid valve
11 Crankshaft position sensor
12 Solenoid valve, Volvo Engine Brake

VT2412B communicates with a number of different control units in order to obtain information that is required for the system (TECU) to choose the most suitable gear with regard to riding comfort.

Wheel speed sensors (6) via brake control unit MID 136 to determine vehicle speed.

Crankshaft position sensor (11) via engine control unit MID 128 to determine engine speed, torque, etc.

Solenoid valve to VEB/VCB (12) via engine control unit MID 128 used to brake the engine while changing gear.

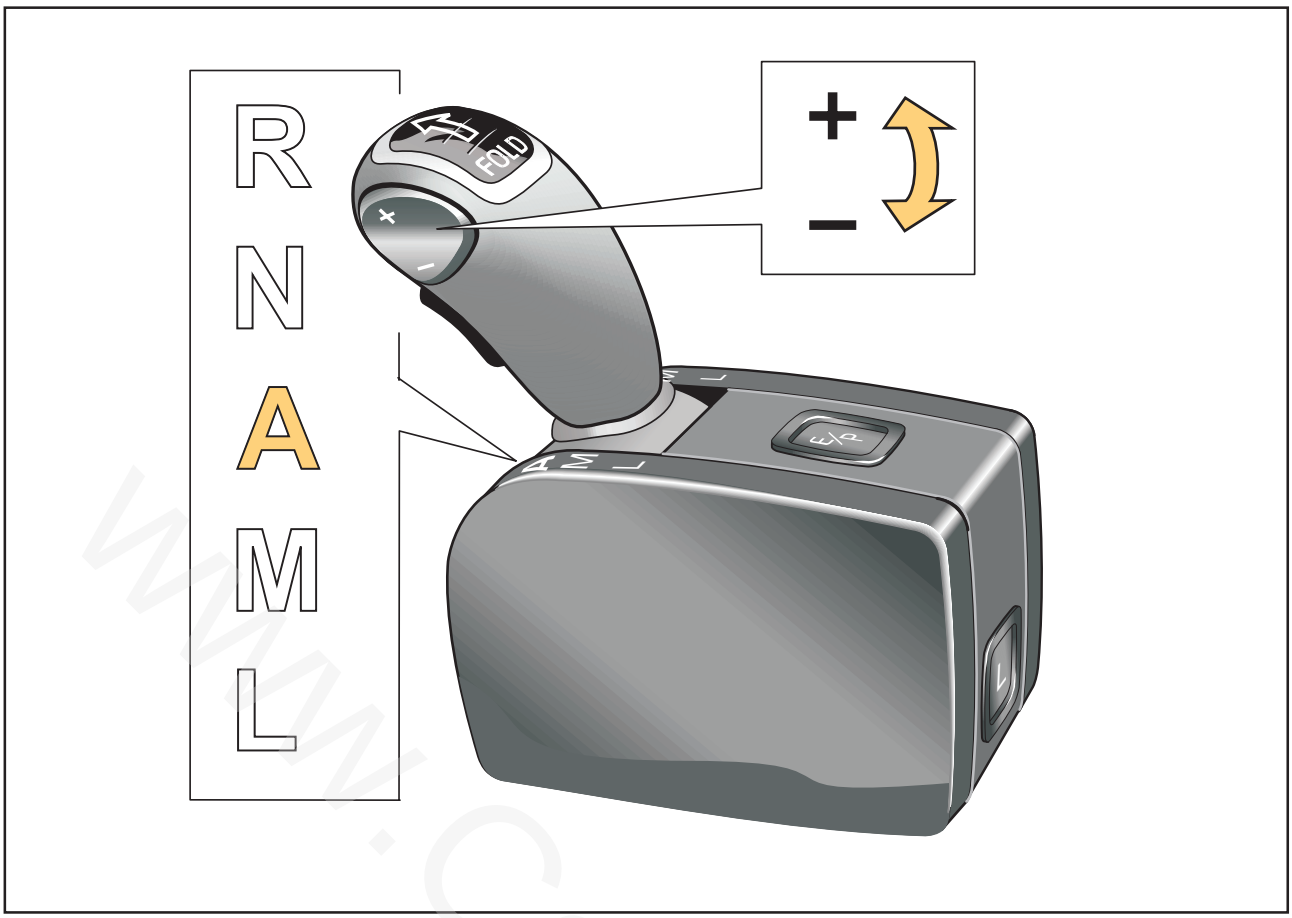
Exhaust pressure governor solenoid valve (10), via engine control unit MID 128 for activating EPG. Cruise control switch (8) via vehicle control unit MID 144.

Hand control, engine/retarder brake (9) via vehicle control unit MID 144 for activating intelligent brake program, etc.

Brake pressure switch (4) via vehicle control unit MID 144 to determine when the brakes on the vehicle are applied. The accelerator pedal sensor (5) via the vehicle control unit MID 144 to determine its position.

Engine speed sensor for gearbox output shaft (3) via MID 144 to determine the gearbox rpm when changing gear, etc.

Notes



27 Gear changing

The simplest way to drive the vehicle is to use the automatic programme (position A). Gear changing takes place automatically and the driver can concentrate on the actual driving.

There are different ways of changing gear in automatic, of which the following is one example:

Once the correct engine speed, torque and vehicle speed for changing gear has been attained, the transmission control module (TECU) will request a lower engine torque from the engine control unit (EECU). Declutching will occur once the lower engine torque has been attained and the basic gear will be changed to neutral. In cases where the range or splitter gear is not changed, the clutch will engage.

If splitter and/or range gear is changed, the clutch will be engaged after that. TECU then calculates the information from the mainshaft and countershaft speed sensors and requests a synchronous engine speed from EECU and once the correct speed has been attained, the basic gearbox will change gear. The engine output can then be raised to full power again and the changing procedure is completed.

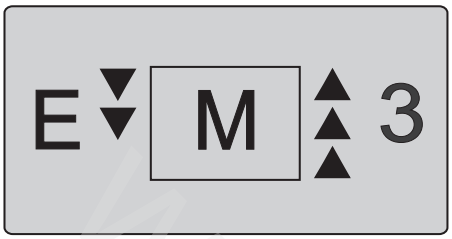
All changes are monitored by position sensors located in the gear selector cylinders.

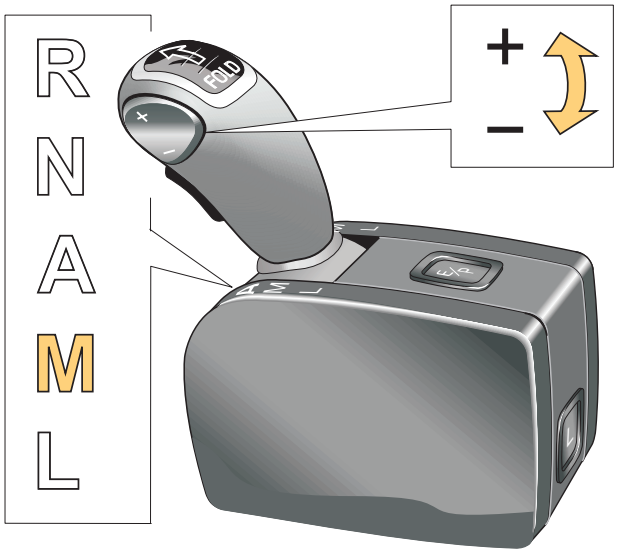
In automatic, the driver can also change up or down manually to adjust the braking force from the engine brake when the accelerator pedal is not depressed.

In manual, it is possible to change up or down while driving without releasing the accelerator pedal.

When it is not necessary to change gear, the lever is moved from A to M. Further gear changing will not take place and the selected gear will be maintained until the lever is moved back to A.

VT2412B has four reverse gears. When the gear selector is moved to reverse, the system will select R1 for trucks and R2 for buses. But it is still possible to change to another gear and choose between R1 and R2 for reversing. If starting in R3 it is possible to change between R3 and R4.





28 Starting gear

In automatic, the starting gear is selected depending on the vehicle weight and road surface gradient. The parameters for the starting gear is calculated differently for trucks and buses.

The system obtains the parameters by calculating the weight after measuring the torque and acceleration.

TECU obtains truck parameters partly from the air suspension MID150 and the vehicle's angle sensor, which is integrated in TECU.

In manual, the driver selects the starting gear and it is then important not to select too high a gear as this will cause clutch slip and eventual wear and heat in the clutch.

If too high a starting gear is selected the clutch will slip and block the system. The clutch is released and a warning shown on the display, overheated clutch. First gear must be engaged in order to start the vehicle. After moving the lever to M, a gear can be selected with the rocker switch on the side of the lever. The button is also used to change up or down while driving.

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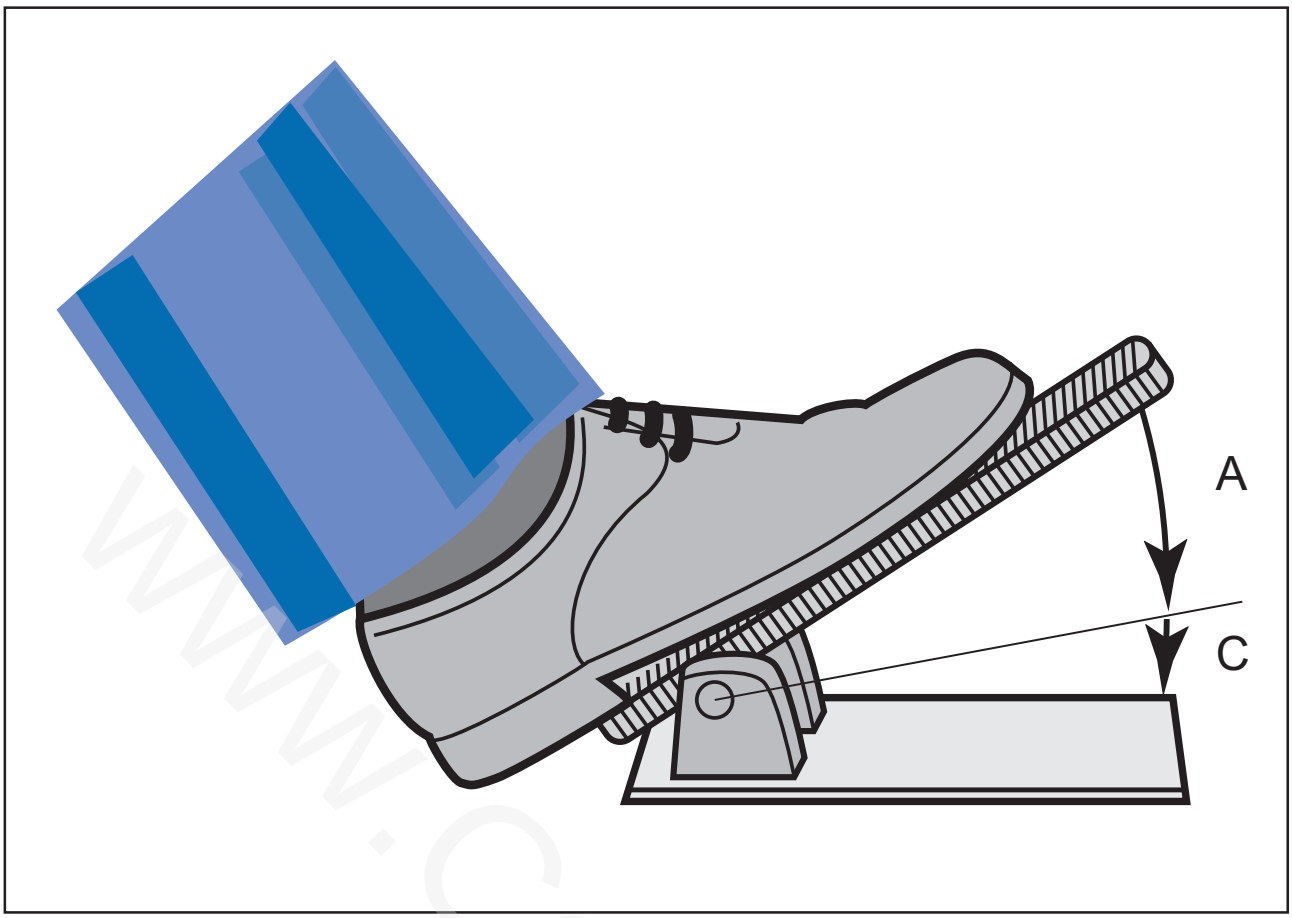

29 Kick-down

A Acceleration C Kick down

The kick down function is available for certain programs only.

Kick down in automatic is obtained by pressing the accelerator pedal all the way down. The kick-down program optimises gear selection/throttle for maximum acceleration.

This is possible in both economy and power program but not in manual position.

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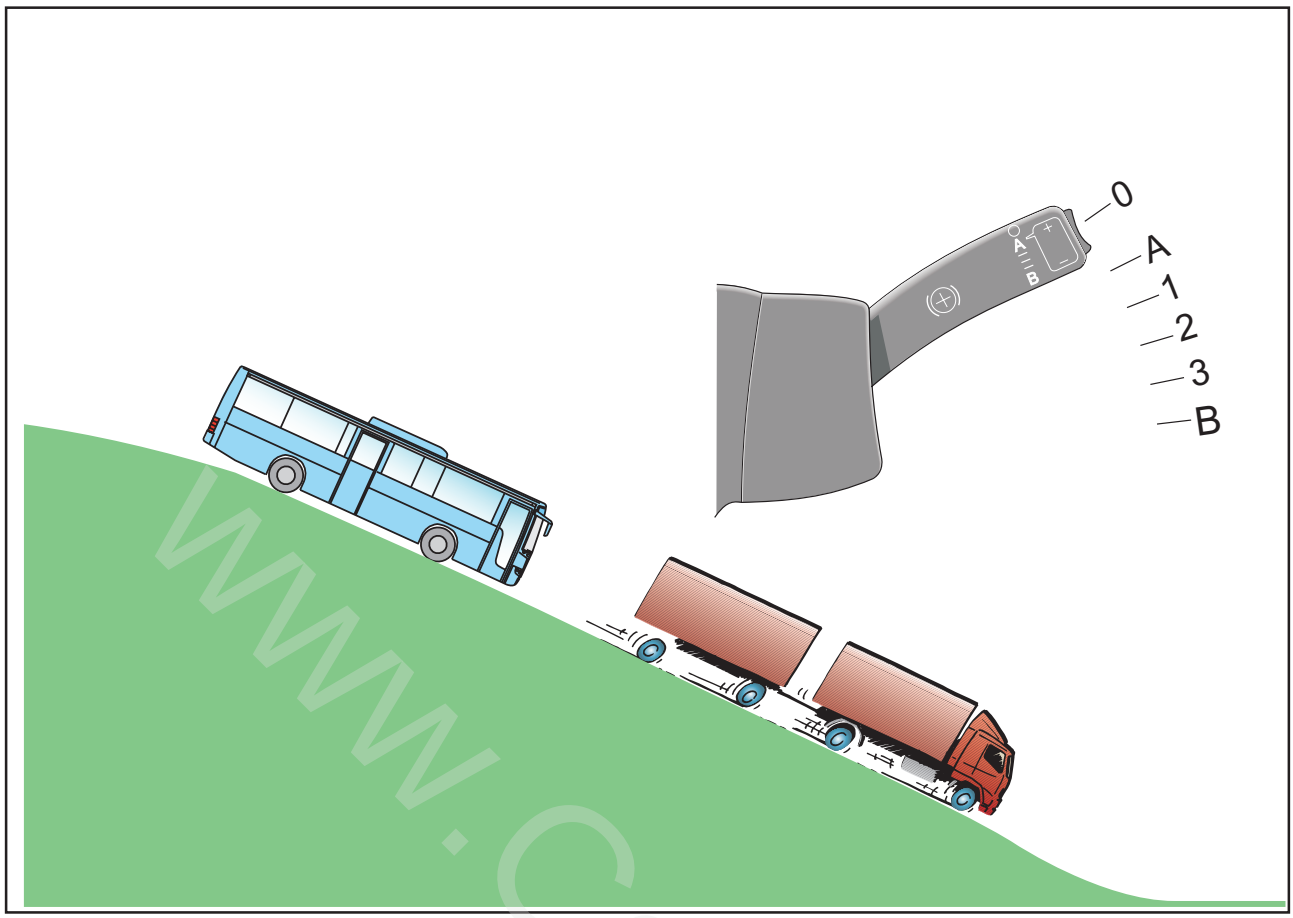

30 Auxiliary brakes

0 Disengaged
A Automatic auxiliary brake via foot brake
1-3 Auxiliary brakes, engine brake + retarder
B Braking program

When descending steep hills and a higher braking force is required, the gearbox's braking program can be engaged by pulling the auxiliary brake lever to B and then releasing it. The gearbox will be changed down and a higher engine speed is obtained. The system now optimises the auxiliary braking force for VEB, Retarder, exhaust brake (EPG) fully automatically.

Buses with low total weight have chosen not to use VEB in combination with retarder. The display shows a B when the braking program is engaged.

To adapt the braking force, the lever is moved to position 1, 2 or 3 after activating the braking program (position B).

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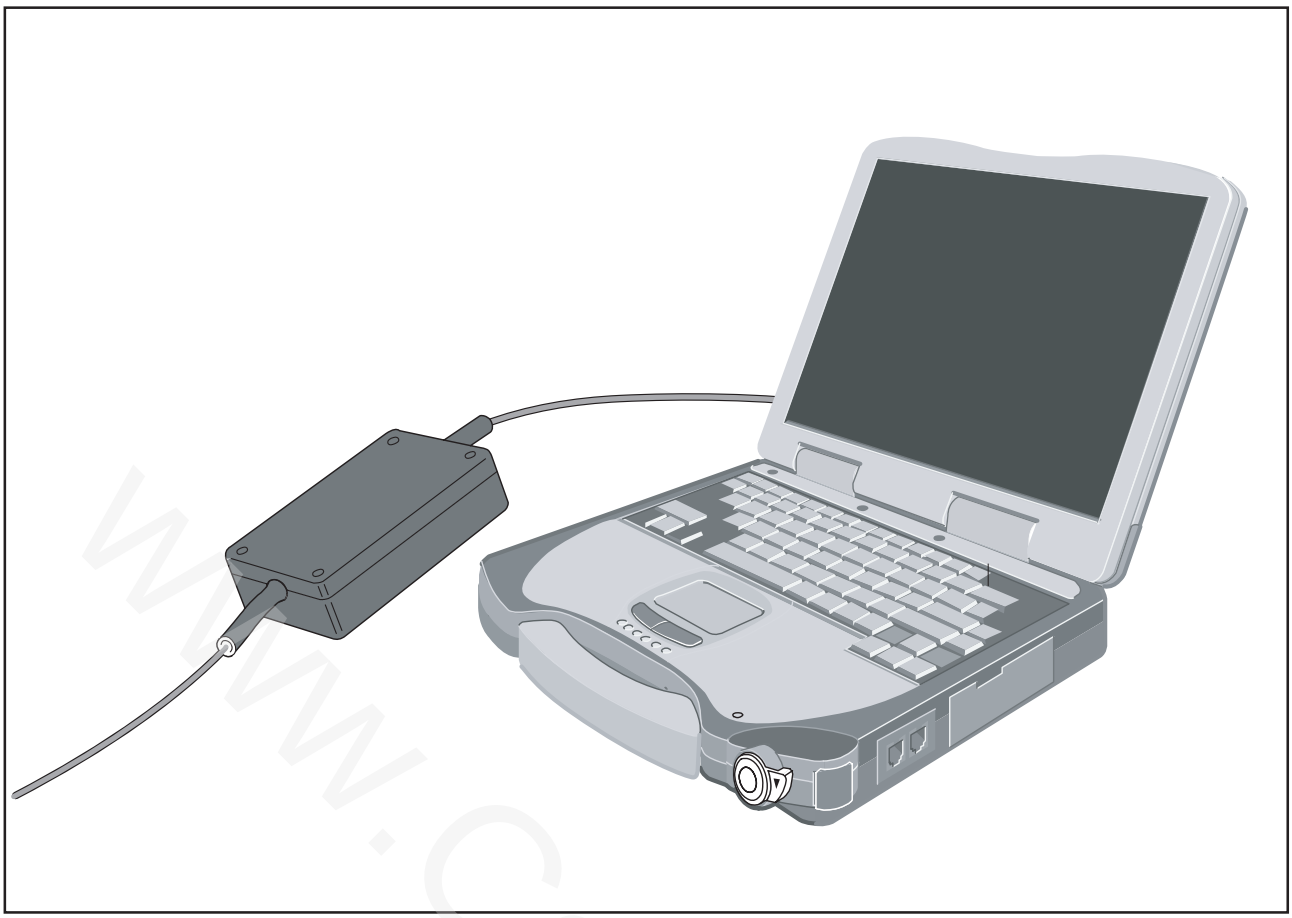

31 Diagnostics

At present, there are 17 different diagnostic tests and 4 different calibrations that are carried out with VCADS Pro.

Tests:

40010-2 Clutch cylinder, test
40012-2 Gear selector position sensor, test
40015-2 Range cylinder, test
40016-2 Splitter cylinder, test
40020-2 Gears, test
40023-2 Tachometer sensor, test
40024-2 Oil sensor signals, test
40083-2 PWM valves, test
40087-2 Pressure sensor, test
40117-8 Gear selector switch, test
40135-2 Starter inhibitor relay, test
43121-2 Gear selector cylinder 1/reverse gear, test
43122-2 Gear selector cylinder 2/3, test
43126-2 Sol. valve brake countershaft, test
43127-2 Gear selector cylinders, test*
43773-2 Angle sensor, test
43116-4 Gears, test. Gearbox removed

Calibrations:
(The three top calibrations in the vehicle must be carried out in the following order)

40084-2 Clutch stroke length and wear, calibration.
40104-2 Gearbox, calibration
40053-2 Clutch tension position, calibration.
40105-4 Gearbox, calibration. Gearbox removed

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