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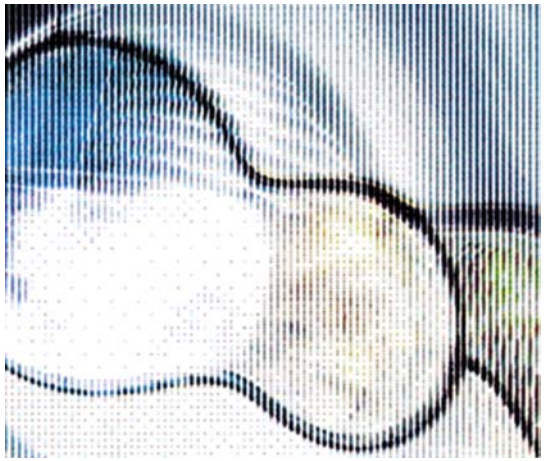

Trucks • Transmission
Telligent automatic transmission in ACTROS and ATEGO

Specialist training

As at 10/03

Global Training.

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Welcome

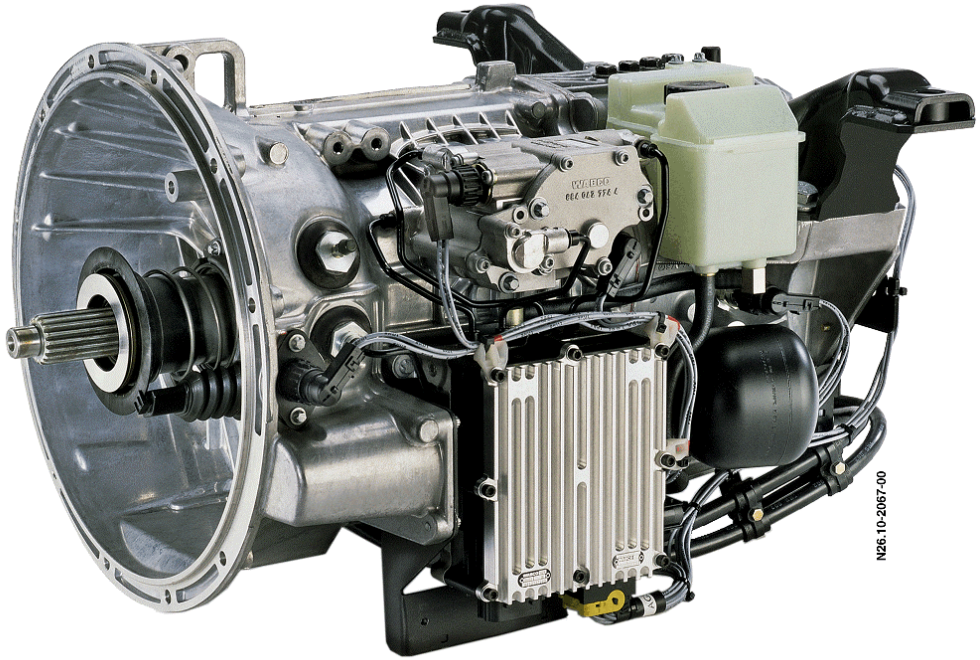
29.10.2003

Welcome to the NGAS training course. As the training course progresses, it will become evident how this subject is presented. While it was relatively easy to have an overview of the shift devices used with the LK and SK, one or two things have changed since the launch of the ***ACTROS, ATEGO*** and ***AXOR***. The first challenge has no doubt been dealing with the "networking" of the systems.

This will be just one of the hurdles you will have to overcome in the course of the NGAS training. It will soon become evident that, even with a good foundational training in electrics, you will only be able to do a proportion of the tasks set. The other tasks require a good understanding of transmission mechanics, wiring and different hydraulic systems.

If you have some experience and understanding in the areas of mechanics, hydraulics and electrics, this will be of great benefit and you will be able to follow the training course easily. If not, then you have quite some ground to cover, but we will be happy to help and support you in your efforts.
This is because those who understand the systems are also quick to make a confident diagnosis. While diagnostic aids, such as DAS and WIS, can certainly help you in your work, they will rarely actually make the decision for you as to what ultimately needs repairing.

During the training course you will work with all the named diagnostic aids so that you will be in a better position afterwards to make a diagnosis on the shift devices "at home", in your workshop.



N26.10-2067-00

Training sequence

Day 1

- Welcome
- Overview of gearshift systems and types of gearshift system
- Design and function of the Telligent automatic transmission II – EAS II gearshift system in the ACTROS
- Networking of the Telligent automatic transmission II – EAS II gearshift system in the ACTROS
- Teach-in processes of the Telligent automatic transmission II – EAS II gearshift system in the ACTROS
- DAS actual values of the GS II system and drive control
- Practical work on the ACTROS
- Troubleshooting aids based on customer complaints
- Presentation and feedback in plenary session
- Feedback from day 1

Day 2

- Design and function of the Telligent automatic transmission – AGS gearshift system in the ATEGO
- Networking of the Telligent automatic transmission – AGS gearshift system in the ATEGO
- Teach-in processes of the Telligent automatic transmission – AGS gearshift system in the ATEGO
- DAS actual values of the AGS system and drive control
- Practical work on the ATEGO
- Troubleshooting aids based on customer complaints
- Presentation and feedback in plenary session
- Final test
- Feedback and close of training session

	Training Course Description Code NGAS - MA253	29.10.2003

Training course description	ACTROS, ATEGO – Telligent® automatic transmission (EAS, AGS) • Specialist training
Target group	Mechanics, electricians
Requirements	The course participants are required to have passed the final test of the NGGG training or have worked through the preliminary training and passed the initial test. (The knowledge required for this can be acquired from the CBTs "Telligent gearshift system Parts 1 – 4", "Telligent automatic transmission Parts 1 – 2" and "Wiring diagrams Parts 1 + 3").
Performance level	3
Methodology	50% theory, 50% practical
Duration	2 days DCVD, 2-3 days Export
Objectives	The participant can: • independently prepare a diagnosis on the Telligent® automatic transmission (ACTROS - EAS; ATEGO - AGS) • perform testing, adjusting and repair work
Contents	• Design and function of the Telligent® automatic transmission vehicle networking • Drive control on pneumatic (EAS) and hydraulic (AGS) shifting systems • Diagnosis using current diagnosis systems and fault diagnosis based on case examples • Carrying out the necessary teach-in processes

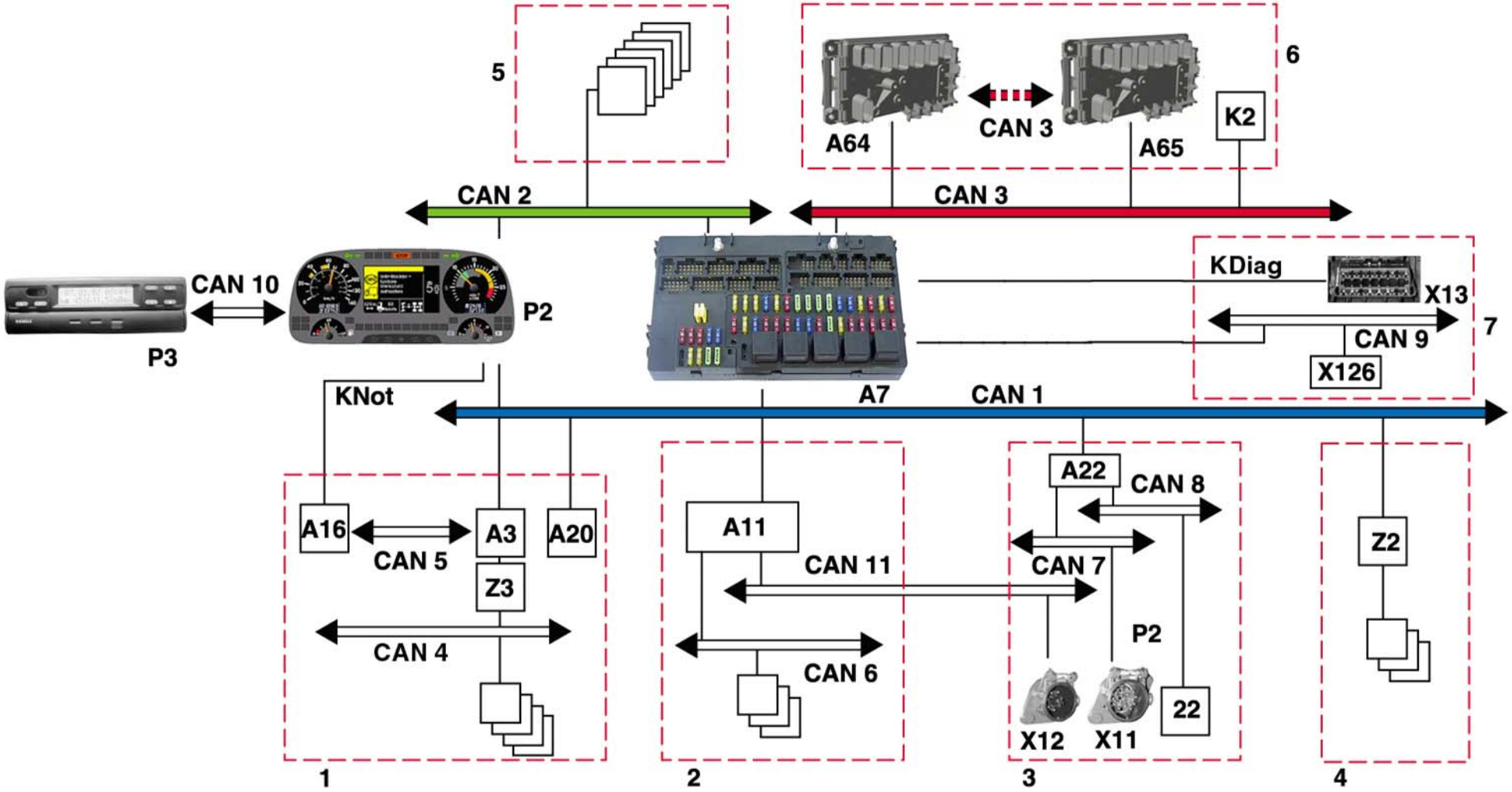
	Overview of shifting systems for ACTROS, AXOR and ATEGO	11.02.03

Since the launch of the ***ATEGO, AXOR*** and ***ACTROS***, various other shifting systems have been introduced in addition to the mechanical gearshift system, the MPS and the EPS, already familiar to us from the SK.
{0>Die verschiedenen Schaltungsarten werden über Verkaufscode dem jeweiligen Getriebetyp und Fahrzeug zugesteuert.<}100{>The various shifting types are assigned to the respective transmission type and vehicle by way of the sales code.
The respective sales code can be found on the data card.
While no completely new types of gearshift system were introduced with the refinement of the ***ACTROS*** model (MPII) in the spring of 2003, existing systems were nevertheless revised. As a result new sales codes have been issued for better differentiation.
The ***ATEGO*** model series is also earmarked for various innovations in 2003. These are also listed below.
The list differentiates between the following shifting systems in the current generation of vehicles:

ACTROS, *AXOR*, *ATEGO*	**Changes to *ACTROS* models 930 - 934**
Sales code GS 1: • Mechanical shift - MS • Mechanical-pneumatic shift – MPS • Mechanical-pneumatic shift with pneumatic shifting aid - MPS with PSH	
Sales code GS 3: • Hydraulic shift - HS • Hydraulic-pneumatic shift - HPS • Hydraulic-pneumatic shift with shift force assist – HPS with SKU	
Sales code GS 2: • Telligent gearshift system – EPS II	**Sales code GS 7:** • Telligent gearshift system II (GSII)
Sales code GE 1: • Telligent automatic transmission – EAS • Telligent automatic transmission – AGS	**Sales code GE 2:** • Telligent automatic transmission II – EAS II

Gearshift system types arranged according to vehicles and transmissions

			Mechanical shift			Hydraulic shift			Telligent gearshift syst.		Telligent aut. transmission	
			GS 1			GS 3			GS 2	GS 7	GE 1	GE 2
			MS	**MPS**	**MPS with PSH**	**HS**	**HPS**	**HPS with SKU**	**GS**	**GS II**	**EAS/AGS**	**EAS II**
ATEGO	ZF S 5-42	GF 1	☒									
	G 56 - 6	GC 4	☒								10/04	
(up to 15t)	G 60 - 6	GC 5	☒								AGS	
	G 85 - 6	GC 6	☒								AGS	
	G 100 - 12	GC 7			☒							
ATEGO	G 85 - 6	GC 6				☒					AGS	
(as of 18t)	G 100 - 12	GC 7						☒				
	G 131 - 9	GT 1						10/03				
	G 221 - 9	GD 5					☒					
	G 211 - 16	GD 3					☒		☒			
AXOR	G 211 - 16	GD 3							☒			
	G 221 - 9	GD 5		☒								
	G 240 - 16	GC 2		☒					☒			
ACTROS	G 210 - 16	GC 3		☒			☒		☒	☒	EAS	☒
	G 211 - 16	GD 3					☒		☒	☒	EAS	☒
	G 231 - 16	GH 6					☒		☒	☒	EAS	☒
	G 240 - 16	GC 2		☒			☒		☒	☒	EAS	☒
	G 260 - 16	GC 1		☒			☒		☒	☒	EAS	☒



W00.19-1011-79

1	*Power train components*
2	*Brake components*
3	*Trailer and body components*
4	*Vehicle components*
5	*Cab components*
6	*Frame components*
7	*Telematics / diagnosis*
22	*Body electronics*
A3	*Control unit, drive control (FR)*
A7	*Base module (GM)*
A11	*Control unit, brake control (BS)*
A16	*Control unit, gear control (GS)*
A20	*Control unit, retarder control (RS)*

A22	*Control unit, parameterizable special module (PSM)*
A64	*Front module (FM)*
A65	*Rear module (HM)*
CAN 1	*Vehicle CAN*
CAN 2	*Interior CAN*
CAN 3	*Frame CAN*
CAN 4	*Engine CAN*
CAN 5	*Transmission CAN*
CAN 6	*Brake CAN*
CAN 7	*Trailer CAN (PSM)*
CAN 8	*Body CAN*
CAN 9	*Telematics CAN*
CAN 10	*Speedometer CAN*
CAN 11	*Trailer CAN (BS)*

K2	*Battery disconnect switch*
K	*Diag K-line diagnosis*
K	*Emergency K-line, emergency running mode*
P2	*Instrument (INS)*
P3	*Modular tachograph (MTCO)*
X11	*15-pin trailer socket*
X12	*7-pin ABS trailer socket*
X13	*Diagnostic socket*
X126	*Telematics platform (FleetBoard)*
Z2	*CAN star point, cab dash support, additional*
Z3	*CAN star point, additional*

Note: For further information see GF 00.19-W-0002 MP "Extended vehicle network KontAct function"

This exercise is concerned with the new network in the ***ACTROS.*** Use the new network diagram to work through the following tasks.

Task

❍ Enter the CAN BUS designations.

CAN 3	Frame CAN BUS	*CAN 10*	Tachograph CAN BUS
CAN 1	Vehicle CAN BUS	*CAN 11*	Trailer CAN (BS)
CAN 5	Transmission CAN BUS	*CAN 7*	Trailer CAN (PSM)
CAN 6	Brakes CAN BUS	*CAN 9*	Telematics CAN BUS
CAN 4	Engine CAN BUS	*CAN 8*	Body CAN
CAN 2	Interior CAN BUS		

Task

❍ Which control units are part of the vehicle CAN BUS?

✍ *Base module (A7), control unit for drive control (A3), control unit for brake control (A11)*

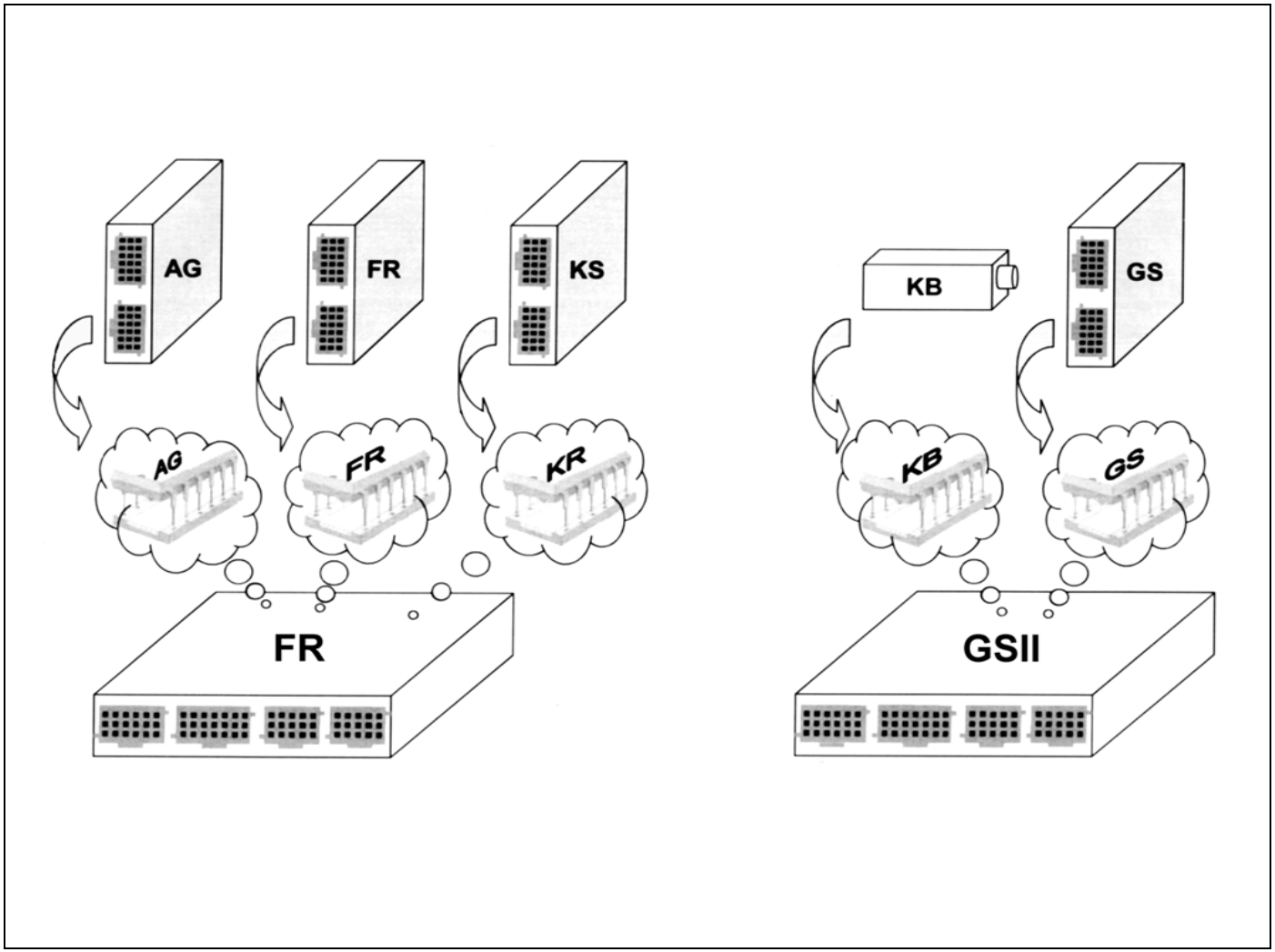
✍ *Control unit for retarder control (A20), Parameterizable special module control unit (A22)*

✍ *Instrument (P2), CAN star point cab dash support, additional (Z2)*

ACTROS, models 950 -954
Control units

ACTROS, models 930 - 934
Software modules

ACTROS, models 930 - 934
Control units



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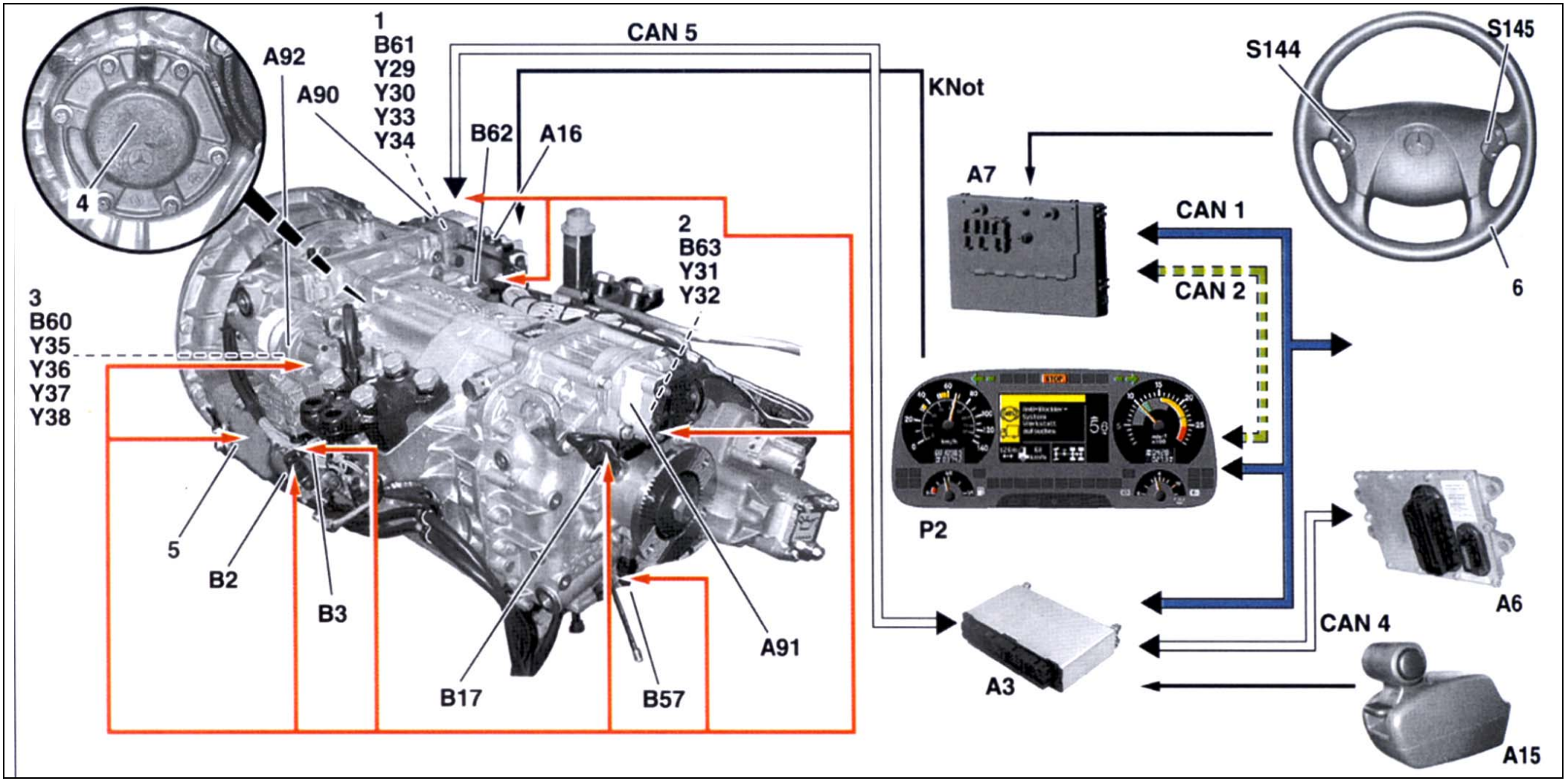
	EAS II - (Code GE2), function diagram	29.10.2003



GT_26_21_0002 (W26.21-1009-79)

1	Gate shift cylinder
2	Range shift cylinder
3	Gear cylindrical actuator
4	Splitter shift cylinder
5	Clutch actuator
6	Multifunction steering wheel
A3	Control unit for drive control (FR) with integrated drive control (FR) software module
A6	Control unit for engine control (MR)
A7	Base module (GM)
A15	Sensor unit for gear control (GS)
A16	Control unit for gear control (GS) with integrated gear control (GS) software module
A90	Gate module
A91	Range module
A92	Gear module
B2	Clutch travel sensor
B3	Countershaft speed sensor
B17	Speed sensor
B57	Transmission output speed sensor
B60	Gear sensor (SGG)
B61	Gate sensor (SGE)
B62	Splitter sensor (SSP)
B63	Range sensor (SRA)
CAN1	Vehicle CAN
CAN2	Interior CAN (redundant)
CAN4	Engine CAN
CAN5	Transmission CAN
KNot	K-line emergency running mode
P2	Instrument (INS)
S144	Button group on left of multifunction steering wheel
S145	Button group on right of multifunction steering wheel
Y29	Solenoid valve, split 1 (MS1)
Y30	Solenoid valve, split 2 (MS2)
Y31	Solenoid valve, range 1 (MR1)
Y32	Solenoid valve, range 2 (MR2)
Y33	Solenoid valve, gate 1 (MG1)
Y34	Solenoid valve, gate 2 (MG2)
Y35	Uneven gears air admission solenoid valve (MUB)
Y36	Even gears air admission solenoid valve (MGB)
Y37	Uneven gears air release solenoid valve (MUE)
Y38	Even gears air release solenoid valve (MUE)

General points:
Based on the gear control II (GS II) shifting system, the Telligent automatic transmission II (EAS II) is a special design with automated clutch.

The design of the Telligent automatic transmission II (EAS II) based on the gear control II (GS II) has been substantially simplified:
The entire clutch hydraulic system used in the first-generation EAS has been replaced by an electropneumatic clutch actuator. This clutch actuator directly operates the mechanical clutch system.
The old EAS, AG and KS control units are still there but only as virtual control units. The AG is integrated as a drive control software module. The KS control unit is integrated in the GS control unit as a clutch control software module.
This dispenses with the need for hydraulic lines and maintenance work.
Only the electrical and pneumatic lines are still connected to the clutch actuator.
With the fold-out emergency clutch pedal no longer required, only the accelerator and brake pedals remain.
The option of activating manual or automatic shift mode via a selector switch on the gear control sensor unit has been retained.
Ride comfort has been improved, e.g., the system changes independently from the normal drive mode to a maneuver mode if required. This makes maneuvering considerably easier.

The Telligent automatic transmission II (EAS II) can be operated in two modes:

- Automatic operation
- Manual operation

The electronic systems for the transmission and the on-board related functions are entirely separate.
Information is exchanged between the electronic systems in the form of CAN messages via the CAN connections

Vehicle CAN (CAN 1),
Interior CAN (CAN 2),
Engine CAN (CAN 4)
Transmission CAN (CAN 5)

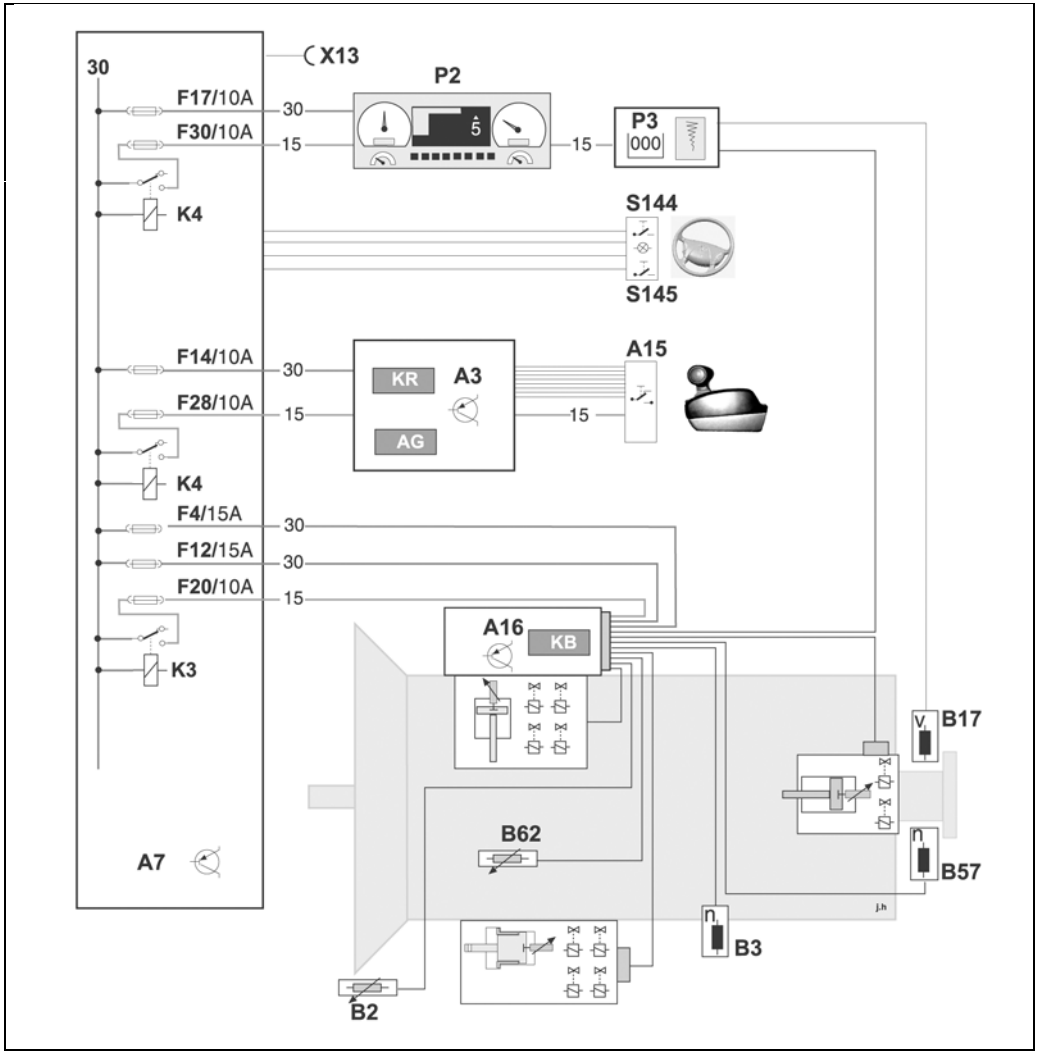
and via the

- K line emergency running mode (KNot), in backup drive mode

Task

Using the drawing opposite allocate the following components to the corresponding terminals, fuses and relays!

Component	Terminal	Fuse	Relay
P2	*30*	*F 17*	—
	15	F 30	K4
A3	*30*	*F 14*	—
	15	*F 28*	K4
A16	30	F 4	—
	30	*F 12*	—
	15	*F 20*	K3
A 15	*15*	*F 28*	K4



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Task

❍ Indicate the correct sequence of the signal path during a gear change on the Telligent® automatic transmission in "Manual mode".

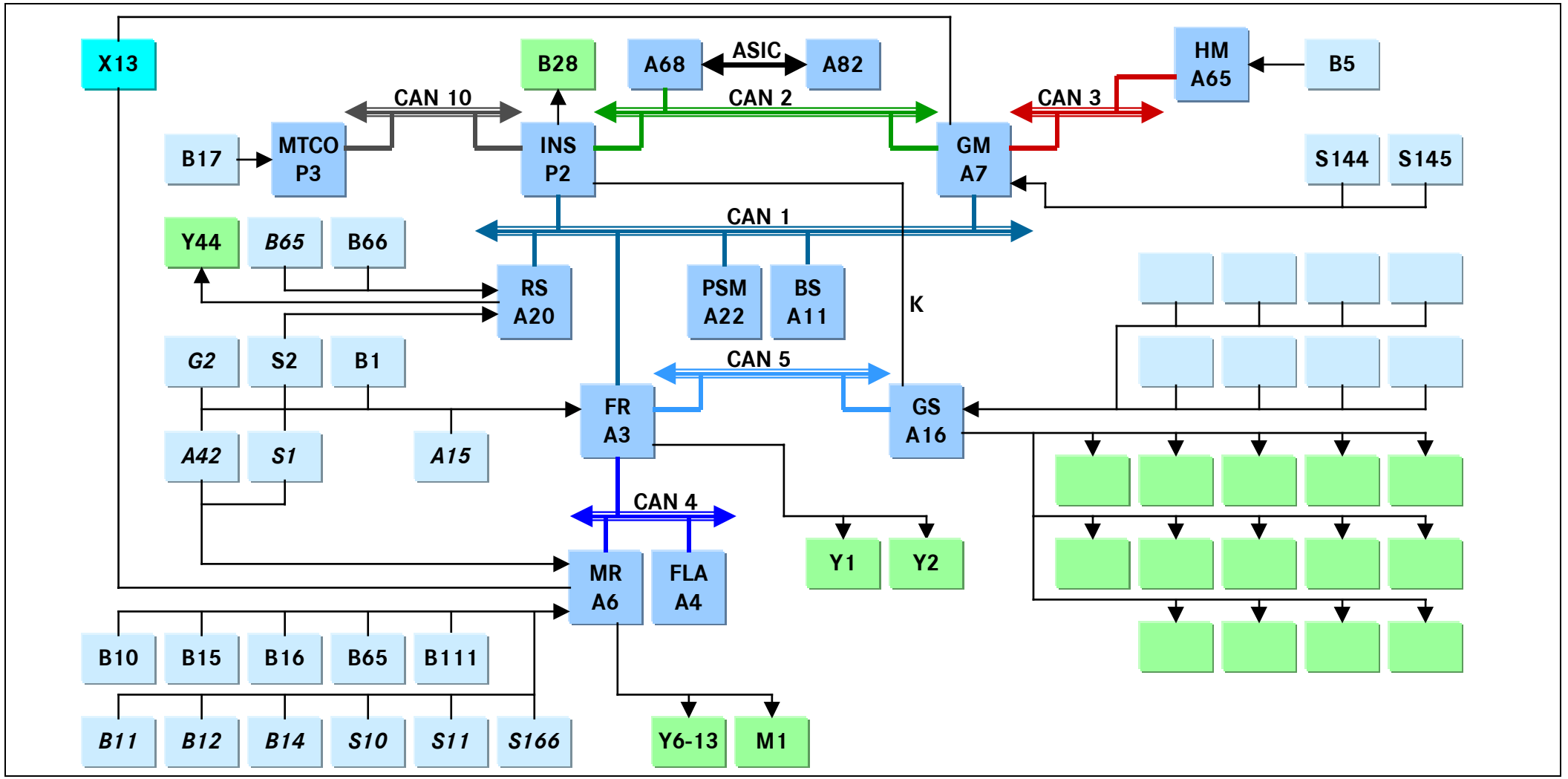
Note:
For further information, see GF 26.20-W-0001 MP "Gear control (GS) function" and circuit diagram.

3	GS control unit
2	FR control unit
1	Sensor unit
6	GS control unit
5	Gear, gate, range and splitter sensors
4	Gear, gate, range and splitter solenoid valves

Task

❍ The Telligent® automatic transmission communicates with other components and systems in different ways. Complete the table.

Component	Designation	Communication / Connection	Designation	Component
Sensor unit	A15	*Electrical line*	A3	FR control unit
FR control unit	A3	*CAN 5 (Transmission CAN)*	A16	GS control unit
GS control unit	A16	*Electrical line*		Connected components
Instrument	P2	*KNot/CAN1/CAN5*	A16	GS control unit
Instrument	P2	*CAN1 / CAN2*	A7	Base module
Multifunction steering wheel	S144/S145	*Electrical line*	A7	Base module
Modular tachograph	P3	*CAN 5 (Transmission CAN)*	A16	GS control unit



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Task

❍ The diagram shows an all-wheel drive vehicle with retarder control (RS) and EAS II.
Name the missing components.

The following questions may help you to solve the problem.

- How is the clutch actuated?
- Have you also considered clutch sensing?
- Have you thought about all the components required for engaging a gear?
- How is the corresponding gear position determined?
- Have you taken the splitter gearshift system components into consideration?
- How is a driver command transmitted?

Note: Further information on the Telligent automatic transmission II can be found in WIS under GF 26.21-W-0001 MP "Electronic drive control (EAS) operation".

✍ _____

✍ _____

✍ _____

✍ _____

✍ _____

Operation	Transmitter	Receiver	What is the reason and the purpose for the part action?
Evaluation of shift logic	FR	FR	Evaluation of CAN messages (influencing variables) Internal evaluation in the AGF software module
Select: open clutch	FR	GS	CAN 5 (transmission CAN)
Reduce engine torque	FR	MR	CAN 4 De-energized power train
Open clutch	GS	Y39.1/39.2	Energizing of corresponding solenoid valves Gear can only be changed when clutch open
Perform gear change	GS	Corresponding solenoid valves	Energizing of corresponding solenoid valves
Adjust engine speed	FR	MR	Change in unit pump actuation time and permanent brake actuation, levels 1+2 Reduction of clutch wear
Current gear position feedback	B60, B61, B62, B63	GS	Evaluation of displacement value sensor, energizing of corresponding solenoid valves, determination of current gear
Display shifted gear	GS	INS	CAN 5, CAN 1 Display of engaged gear
Close clutch	GS	Y39.3/39.4	Energizing of corresponding solenoid valves Establishment of power train frictional connection
Increase engine torque	FR	MR	CAN 4, change in unit pump actuation time Adjustment of specified engine torque setting on FR

Task

❍ You now know the gear change sequence involved in a gear change. Complete the table below by determining the detailed information contained in the data exchanged between transmitter and receiver. If possible, explain why the information is required.

Operation	Transmitter	Receiver	Relevant information	Reason
Evaluation of shift logic	FR	FR	Internal data exchange on AGF software module	Evaluation of relevant CAN messages (influencing variables)
Select: open clutch	FR	GS	*Open clutch request*	*Control of clutch actuator*
Reduce engine torque	FR	MR	*CAN message (change engine speed and engine torque)*	*De-energizing of power train*
Open clutch	GS	Y39.1/39.2	Energizing of clutch actuator solenoid valves, clutch position, electronic pulse	*Open clutch,* *Clutch position feedback*
Perform gear change	GS	Corresponding solenoid valves	*Electronic pulse*	
Adjust engine speed	MR, FR	Y6-Y13	*Change unit pump actuation time and engine brake actuation*	*Reduction of clutch wear*
Current gear position feedback	B60, B61, B62, B63	GS	*Position of sensors in gear, gate, splitter and range cylinders*	Evaluation takes place in GS control unit
Display shifted gear	GS	INS	*Shifted gear*	*Driver information*
Close clutch	GS	Y39.3/39.4	Energizing of clutch actuator solenoid valves, clutch position, electronic pulse	*Close clutch*
Increase engine torque	FR	MR	CAN message	*Adjust FR specified torque setting*

Task

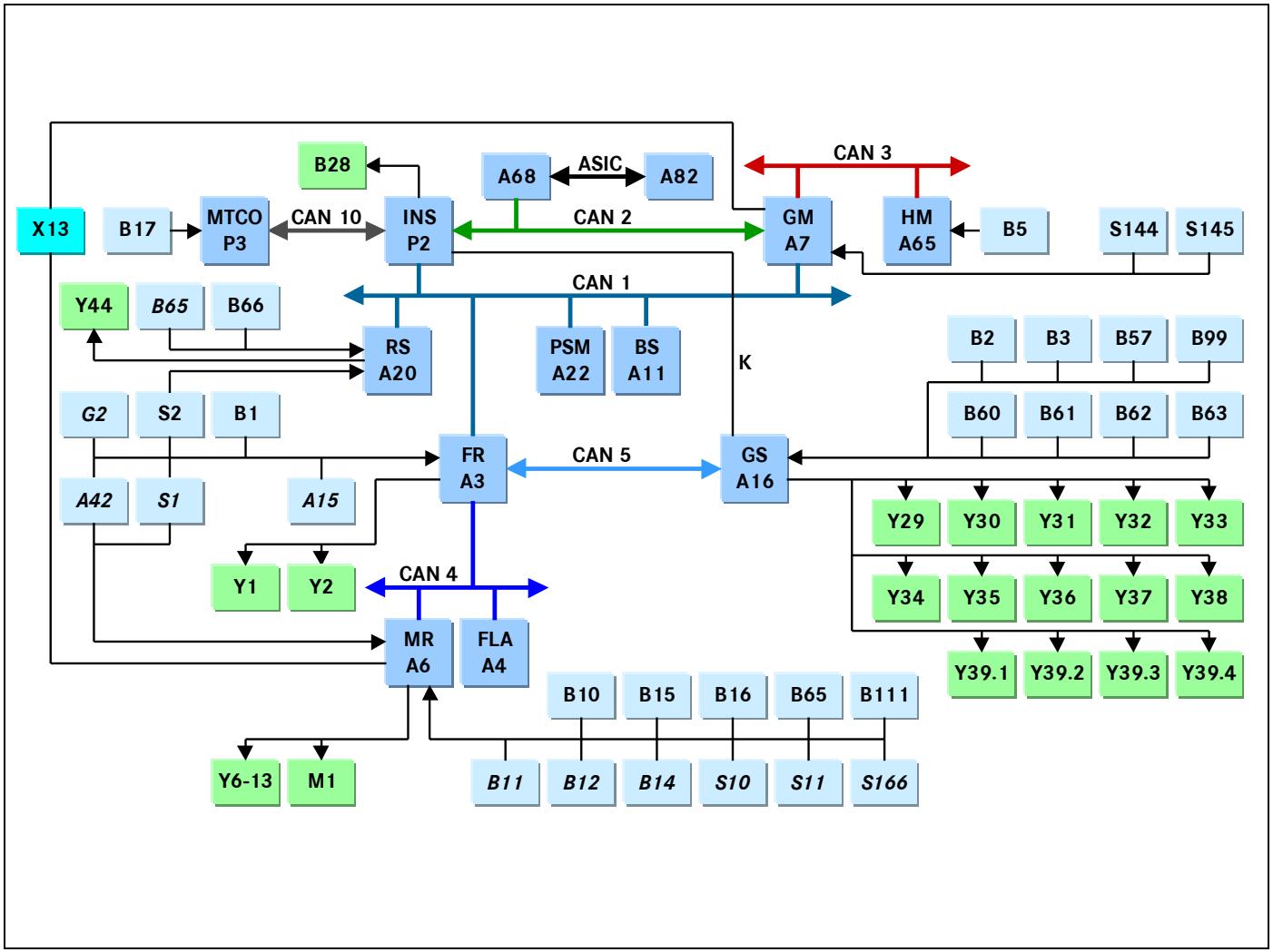
❍ You now know the information exchange when shifting gear. But how can you still test the pieces of information?
Complete the table below. Use the DAS simulation and the DAS to help you complete the corresponding actual values in the respective fields.

Operation	Transmitter	Actual values	Transmission	Receiver	Actual values
Evaluation of shift logic	FR	---	---	FR	*113, 114*
Select: open clutch	FR	*16, 82, 83, 86 96, 100, 114, 117*	---	GS	*157, 287, 307*
Reduce engine torque	FR	*14, 15*	---	MR	*01, 02*
Open clutch	GS	*039*	---	Y39.1/Y39.2 B2	*221, 223*
Perform gear change	GS	*288-297*	---	Corresponding solenoid valves	---
Adjust engine speed	MR	*004, 006, 034*	---	Y6-Y13	---
Current gear position feedback	B60, B61, B62, B63	---	---	GS	*35-39*
Display shifted gear	GS	*156*	*FR*	INS	---
Close clutch	GS	*287*	---	Y39.1/Y39.2 B2	---
Increase engine torque	FR	*14, 15*	---	MR	*004, 006*

The control units are networked together by a linear bus structure using the CAN bus network between the electronic systems of the engine control and the on-board systems (GS, INS, etc.). A control unit receives a measured value from a sensor, from which it generates a data telegram and puts in on the data bus, where it is available to all the control units connected to the CAN bus.

The control electronics control and monitor the entire GS system gear change sequence.
The control electronics receive information from the system's own sensors and switches (travel sensors and speed sensors) and also via the CAN interface of other vehicle systems.

The corresponding solenoid valves are actuated for shifting the gears. Data are exchanged with other electronic circuits via the CAN interface. The shifted and preselected gears and also the events and text messages are displayed to the operator in the instrument.



PPT

Task

- The diagram shows the GS electronic circuits and those components directly connected. The details are based on the given vehicle, an Actros with Telligent automatic transmission and all-wheel function.
  1. First complete the information exchanged and the direction of information between the relevant components.
  2. Secondly complete the actual value (IW) number that goes with the relevant information. Use GF 26.20-W-0007MP.

Module			IW	Information			Information	IW	Pin	Com-ponent	Module
					←		GS backup mode	308		P2	
A92	Y35	MUB	290	Actuation of uneven gear	←		V signal	037		P3	
	Y37	MUE	291	Actuation of uneven gear	←		Gate cylinder position	035		B61	
	Y36	MGB	292	Actuation of uneven gear	←		Split cylinder position			B62	
	Y38	MGE	293	Actuation of even gear	←	A16	Clutch position	039		B2	
	B60		036	Gear cylinder position	→		Transmission input speed	021		B3	
A90	Y29	MG1	294	Actuation of gate R	←	GS	Oil temperature			B47	
	Y30	MG2	295	Actuation of gate 3/4	←		Transmission output speed with transfer case	221		B99	
	Y33	MS1	288	Actuation of splitter L/H	→		Detection of direction of travel	281		B57	
	Y34	MS2	289	Actuation of splitter L/H	→		Open clutch - rapid	298	MKUB1	A39.1	A93
A91	Y31	MR2	297	Actuation range high	←		Open clutch - slow	298	MKUB2	A39.2	
	Y32	MR1	296	Actuation range low	←		Close clutch - rapid	298	MKUE1	A39.3	
	B63		038	Range cylinder position	→		Close clutch - slow	298	MKUE2	A39.4	

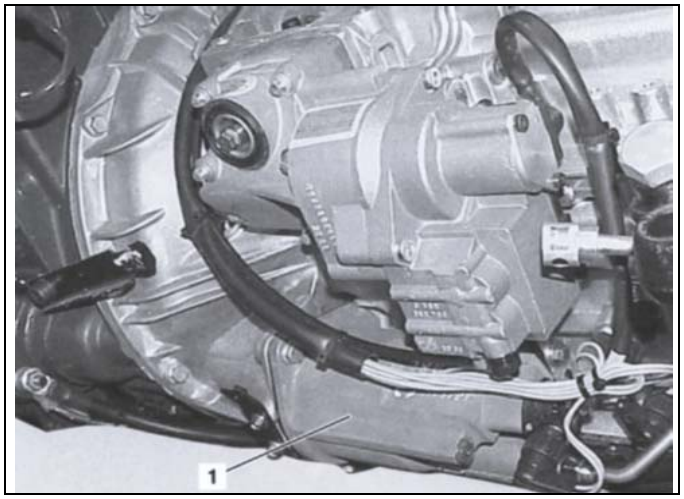
Clutch actuator

The tasks of the clutch actuator are as follows:

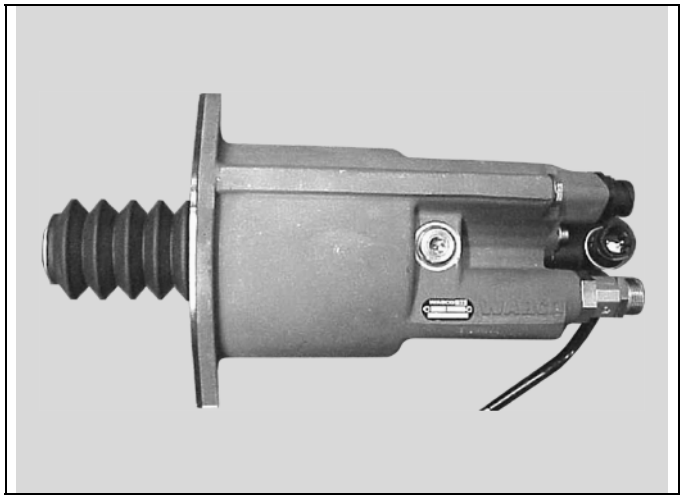
- To convert the electrical control signals in the pneumatic control of the actuator cylinder
- To record clutch travel and provide an electrical signal
- To operate the mechanical clutch system

The following components are integrated in the clutch actuator:

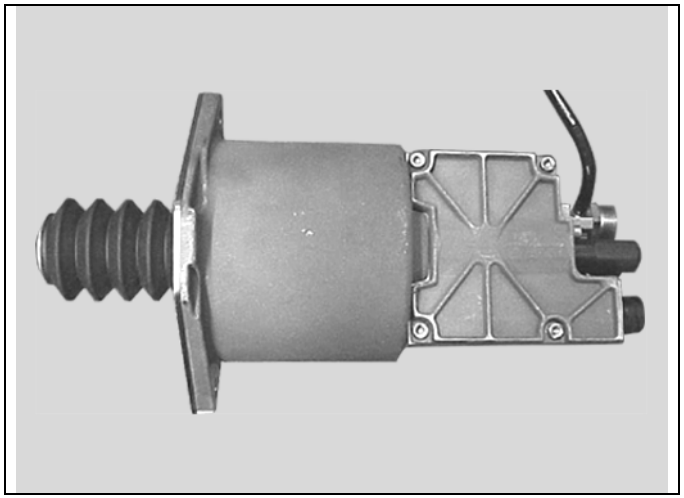
- Solenoid valves: Clutch aeration 1, Clutch aeration 2,
  Clutch bleeding 1, Clutch bleeding 2
- Clutch travel sensor (B2)
- Actuator cylinder



W25.20-1018-11 (GT_25_20_0010)



N25.20-2064-01



N25.20-2063-01

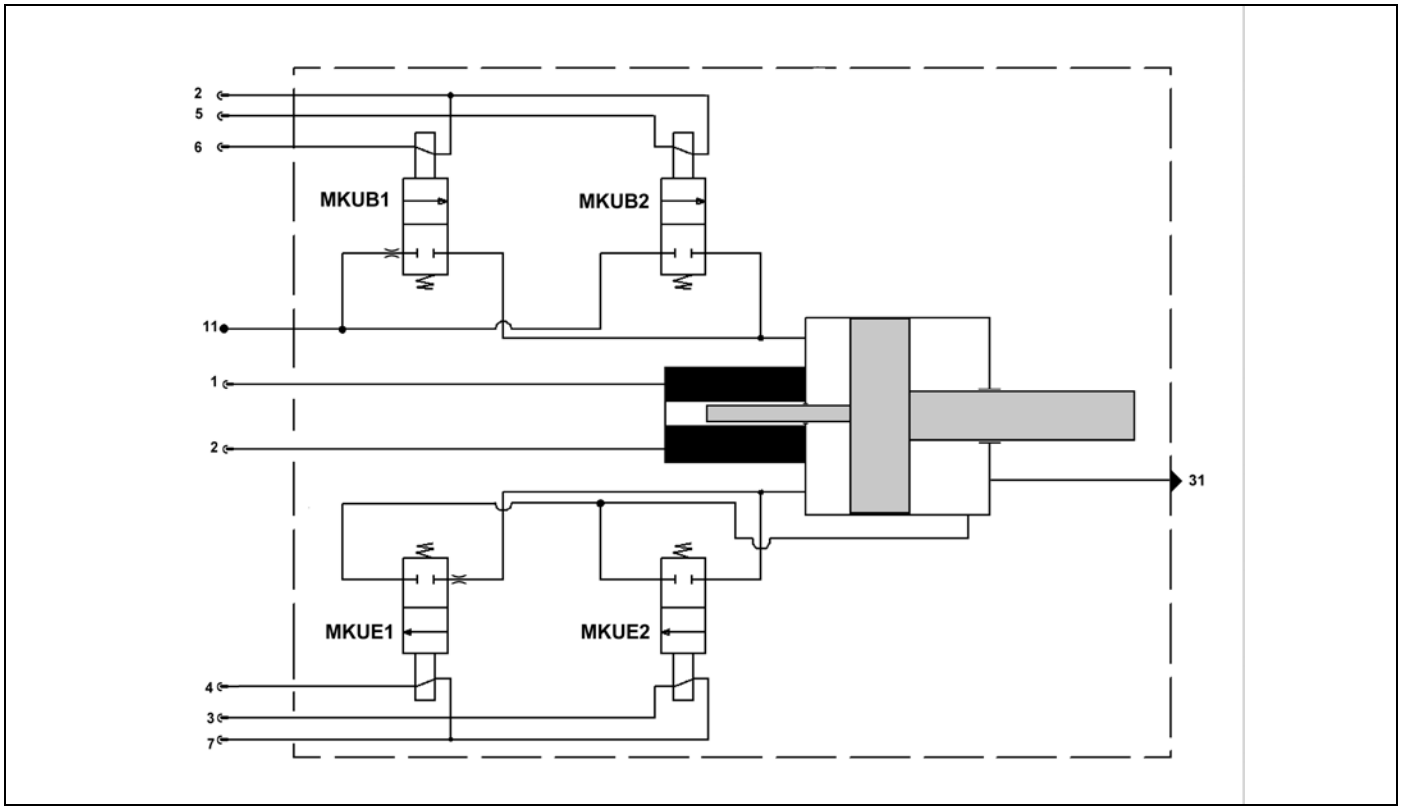
The clutch actuator directly operates the mechanical clutch system.

Each of the clutch positions can be moved to and retained by means of the four solenoid valves.

This basic principle applies:

Cylinder extended → Clutch open
Cylinder retracted → Clutch closed

The clutch travel sensor (B2) records the current position of the clutch actuator.



GT25_00_0001

Key:

MKUB1	Solenoid valve, aerate clutch with throttle
MKUB 2	Solenoid valve, aerate clutch
MKUE 1	Solenoid valve, bleed clutch with throttle
MKUE 2	Solenoid valve, bleed clutch

The **four solenoid valves** are necessary to properly control the inward and outward flow of compressed air used to move the cylinder.

MKUB2 and MKUE2 have a large air passage and are used to roughly regulate the clutch travel.

MKUB1 and MKUE1 work with a smaller flow area and are used for fine adaptation and very precise positioning during clutch actuation.

Transmission output speed sensor (B57, B99)

The task of the transmission output speed sensor is as follows:

- To record the transmission output rpm DZ1/DZ2

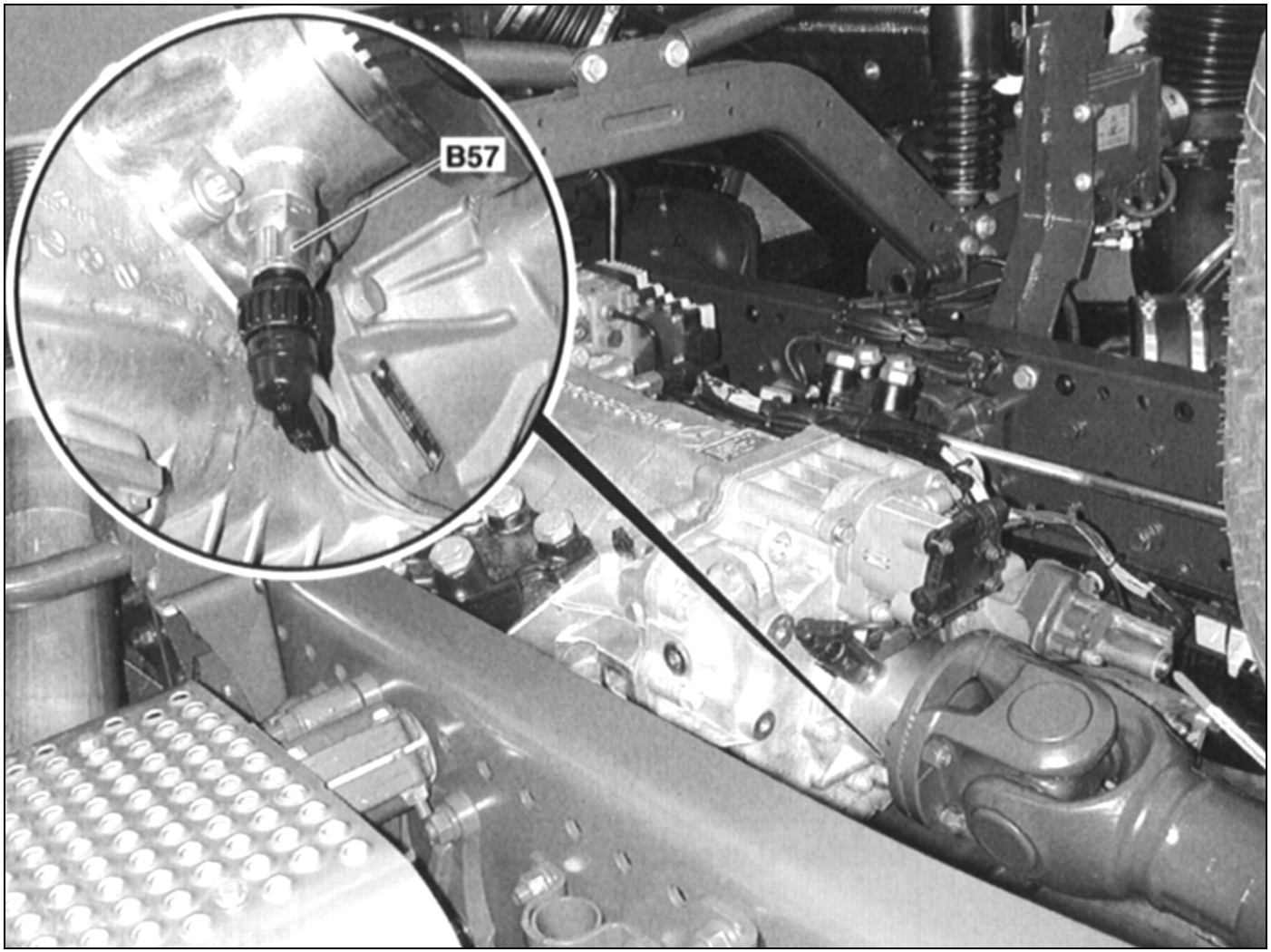
The additional recording of the transmission output rpm is needed to detect the direction of rotation.

The transmission output speed sensor (B57) is installed in all vehicles with Telligent automatic transmission II.

Vehicles with Telligent automatic transmission II require direct recording of the transmission output rpm.

This is because the speed sensor (B17) has been moved to the transfer case output.

For this reason the transmission output speed sensor (B99) is only additionally used on vehicles with Telligent automatic transmission II and all-wheel drive.



W26.19-1026-06 (GT_26_20_0019)

The basic functions and gear change sequences of the Telligent automatic transmission II can be represented as a simple control circuit.

The Telligent automatic transmisssion II control circuit consists of the system being controlled (transmission, clutch) and the FR control unit (A3), comprising automatic gear selection (AG software modules) and clutch control (KR software modules) based on the gear control (GS) and clutch operation (KB) (both software modules in the GSII control unit, A16).

The GS sensor unit (A15) provides the preselected gear in the form of a confirmation to the FR control unit (A3).
Vehicle-specific data are processed in the drive control (FR) software module in the FR control unit (A3). All the shift-related data are recorded and processed in the automatic gear selection (AG) software module, tasked with the ongoing calculation of possible target gears which correspond to the shift strategy. The clutch control (KR) records and processes all the data relating to the clutch control. The clutch operation (KB) in the GS II control unit (A16) converts these entries accordingly.

This information regarding the targeted gear to be shifted and regarding the clutch control is relayed to the GS control unit (A16) via the transmission CAN.
The entries for the targeted gear cannot be overwritten by the gear control II (A16). The gear control can only refuse to perform a gearshift in emergency situations (changed conditions suddenly brought about by influencing factors).

The gear control (GS) and clutch operation (KB) software modules convert the commands in the GS control unit (A16) accordingly and control the correct solenoid valves to open and close the clutch and shift the targeted gear.
The controlled system consists of the clutch and the transmission. The GS control unit compares the specified values (learned values) with the actual conditions and actual values.

The actual values represent the actual clutch and transmission operating conditions that are recorded via the different indicators and sensors. In the event that the comparison shows a difference between the actual values and the learned values, a shift abort might be introduced, for example, depending on the situation, or a corresponding event message displayed on the driver information system (FIS).
The learned values are entered in the GS II system during the "minor" and "major" teach-in processes. The response of the clutch operation is affected by the clutch characteristics in the FR control unit (A3).

If a gear change is to be completed in drive status, the gear to be shifted (targeted gear) is determined on the basis of several variables.

Task 1

❍ Complete the control circuit of the Telligent automatic transmission II in the ACTROS models 930-934 by entering the corresponding terms printed in bold opposite according to the description.

Gear selection

Factors influencing gear selection

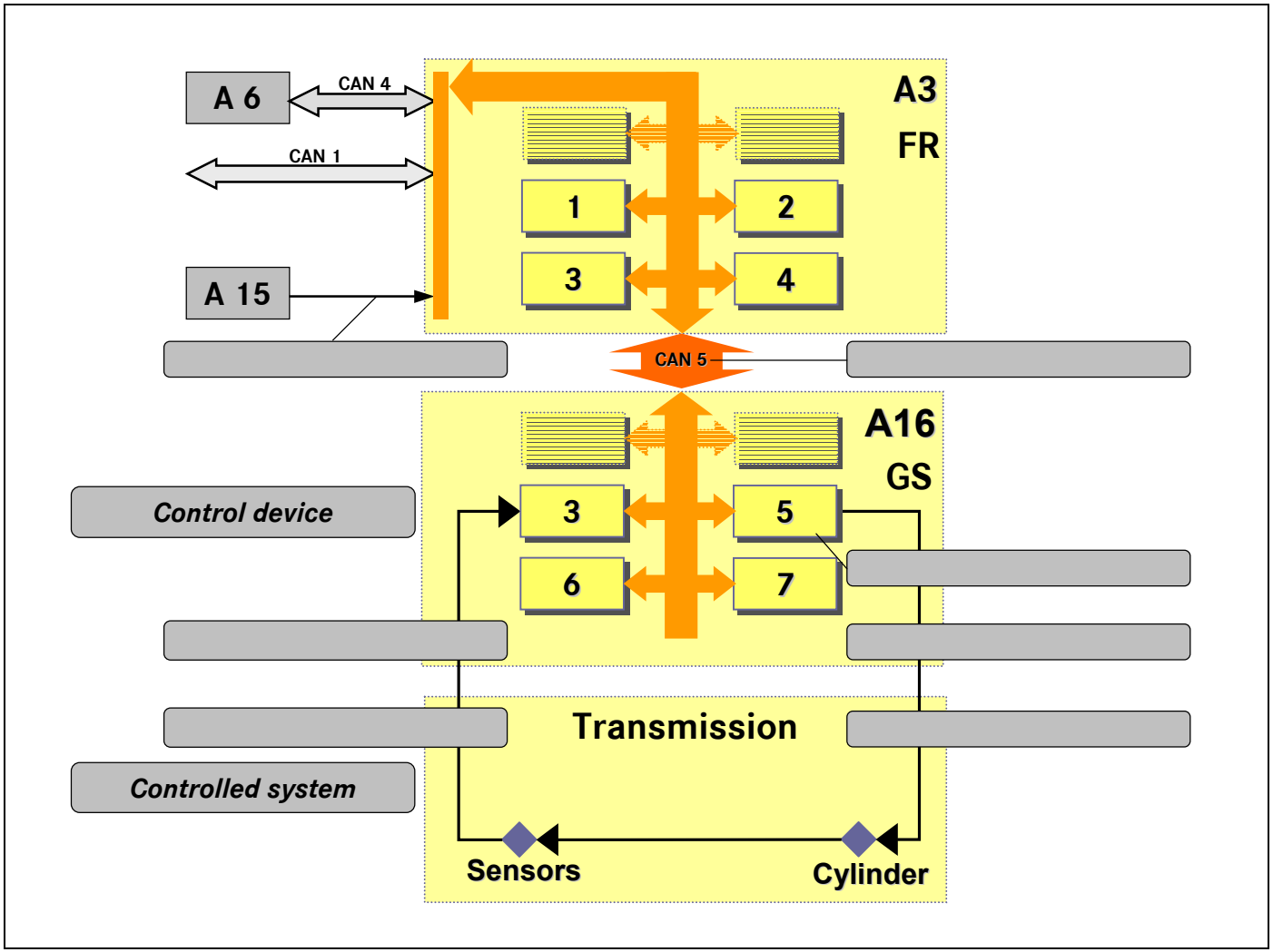
Actual gear

Current operating conditions

Preset gear

Actuation of solenoid valves

Calculation of gear differential



1	FR software module
2	AGF software module
3	Evaluation / comparator
4	KS software module
5	GS software module
6	Emergency computer
7	KR software module
A3	Control unit for drive control
A6	Control unit for engine control
A15	GS sensor unit
A16	Control unit for gear control
CAN1	Vehicle CAN
CAN2	Interior CAN
CAN4	Engine CAN
CAN5	Transmission CAN

Powerpoint Regelkreis GSII.ppt

EAS II - (Code GE2), clutch actuator adjustment, exercise

29.10.2003

In order to simplify the control system and, in so doing, to increase the positioning rate, the clutch actuator plunger tolerances must be kept as low as possible. Before installing the clutch actuator, the actuator plunger has to be properly adjusted.

Task

❍ When is it necessary to readjust the clutch actuator plunger?
For further information see WIS AR25.20-W-3000A

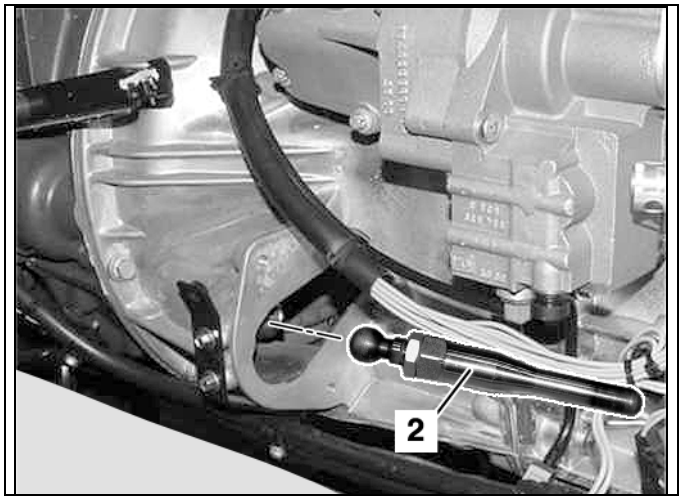
✍ *When replacing the clutch or clutch actuator plunger, when working on the clutch operation*

Task

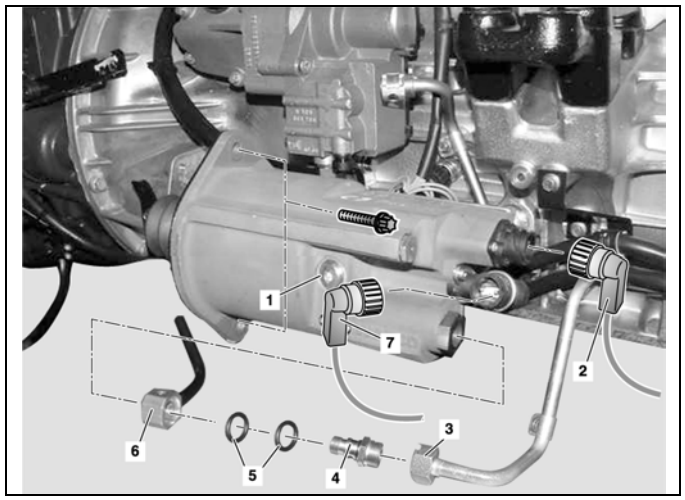
❍ How is the clutch actuator plunger adjusted?
For further information see WIS AR25.20-W-3000-01A

✍ *By mounting a special tool on the transmission housing*

✍ *By adapting the length of the plunger in line with the gauge*



W25.40-1076-01



W25.40-1077-01

Clutch actuator solenoid valves

Task

❍ The design and function of the clutch actuator are familiar. Which solenoid valves of the clutch actuator must be energized in order to elicit the preselected clutch response? Complete the table.

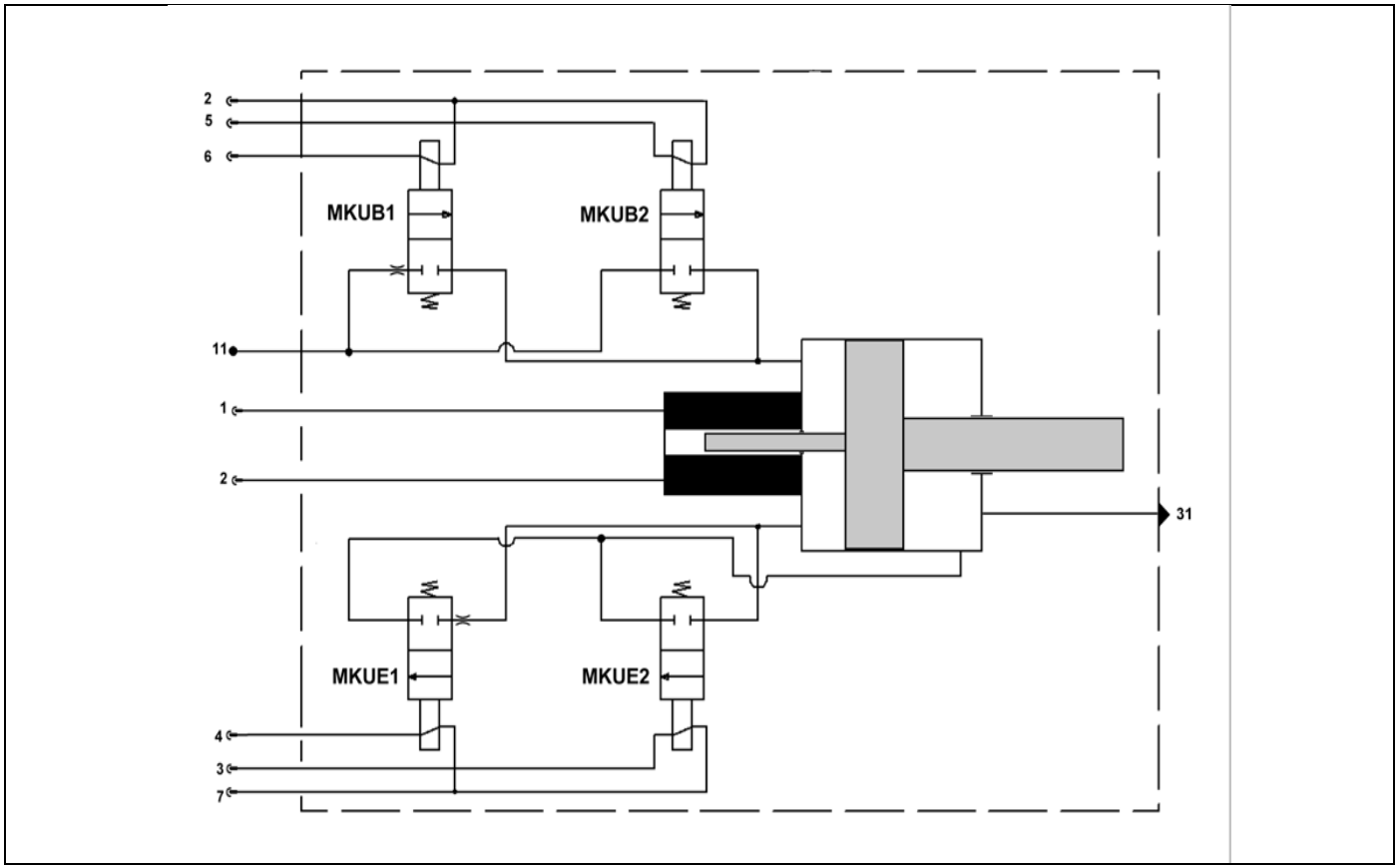
Clutch response	MKUB1	MKUB2	MKUE1	MKUE2
Open clutch slowly	X			
Open clutch rapidly	X	X		
Close clutch slowly			X	
Close clutch rapidly			X	X
Hold clutch around drag point	X		X	

Task

❍ What response is elicited if one of the clutch actuator solenoid valves fails or if the clutch actuator plunger is not correctly adjusted? Complete the table.

Failure of solenoid valve or plunger adjustment	Clutch response							
	Sluggish	Delayed	Rough	Sudden	No longer closes	No longer opens	Failure	Comfort loss
MKUB1			X	X				X
MKUB2	X	X						X
MKUE1			X	X				X
MKUE2	X	X						X
MKUB1+2						X	X	
MKUE1+2					X		X	
Adjustment dimension too low								X
Adjustment dimension too great								X

Clutch actuator design



GT25_00_0001

MKUB1 Solenoid valve, aerate clutch with throttle
MKUB2 Solenoid valve, aerate clutch
MKUE1 Solenoid valve, bleed clutch with throttle
MKUE2 Solenoid valve, bleed clutch

EAS II - (Code GE2), versions, exercise

29.10.2003

You are now conversant with the function diagram of the Telligent automatic transmission II and will no doubt have found some familiar components. The Telligent automatic transmission II builds on the Telligent gearshift system II.

Various components are dispensed with or added to depending on the vehicle version. These differences are dealt with in this chapter. The biggest differences are found in the all-wheel drive vehicles.

Task

❍ Complete the table adding the distinguishing features for the Telligent gearshift system II and for the Telligent automatic transmission II versions in the different possible vehicle configurations.
Note: For further information consult WIS GF26.21-W-0001MP "Electronic Drive Control (EAS) Function" and circuit diagram PE26.20-W-2001 "Gearshift System (GS)".

	Components dispensed with or located differently on the transmission for GS II	... replaced by GS II or additional when compared with GS II	... if already installed previously, located differently in EAS II
ACTROS models 930-934 with GE2	Clutch booster	✍ *Clutch actuator*	----
	----	✍ *Transmission output speed sensor (B57)*	✍ *Transmission output*
ACTROS models 930-934 with GE2 and all-wheel drive	Clutch booster	✍ *Clutch actuator*	----
	----	✍ *Transmission output speed sensor (B57)*	✍ *Transmission output*
	----	✍ *Transmission output speed sensor (B99)*	✍ *Transmission output*
	Speed sensor (B17)	----	✍ *Transfer case output*

EAS II - (Code GE2), teach-in process; exercise

29.10.2003

Task

❍ There are two different teach-in processes for vehicles with Telligent® automatic transmission II EAS II (Code GE2).
Find out which teach-in process should be performed for which operations.
Mark the respective teach-in process with a cross in the table!
Note: For further information see AR54.21-W-0009A and AR54.21-W-0007-01D/02D.

Circumstances	Teach-in process	
	Major	Minor
Transmission exchange identical		X
Transmission exchange not identical (different type)	X	
Gear module, gate module or range module replaced		X
Sensor, split or clutch replaced		X
Clutch replaced		X
Clutch actuator replaced		X
GS control unit replaced	X	
Non-identical engine replacement (different type, changed engine output)	X	
Identical engine replacement		X
Non-identical PLD control unit replacement	X	

EAS II - (Code GE2), teach-in process and teach-in faults; exercise

29.10.2003

During the "minor" and "major" teach-in process in the GS system various fault messages can be displayed by the GS control unit on the instrument display.

These fault messages on the display refer to teach-in and operating faults.

Task

❍ In which current service documentation can you read up on the corresponding teach-in and operating faults and then take appropriate remedial action?
Indicate the correct answer.

- [a] Diagnosis manual
- [b] Electrical wiring diagrams
- [c] Workshop Information System (WIS)
- [d] Vehicle operator's manual
- [☒] [e] Diagnosis Assistance System (DAS)

Task

❍ Which basic conditions have to be fulfilled so that the teach-in process can be performed properly?

- [☒] [a] Battery voltage > 24 V
- [☒] [b] Parking brake actuated
- [☒] [c] Reservoir pressure > 8.5 bar
- [d] Engine at idle speed

Task

❍ While you are performing the "major" teach-in process, GS II 28 comes up on the display and the teach-in process is cancelled.
What does this message mean and which sign did you fail to observe during the teach-in process?

✍ Teach-in fault, engine not started

✍ If the neutral display is flashing, then the engine must be started

✍ after no longer than 10 seconds if the major teach-in process is being carried out.

Task

❍ While you are performing the "minor" teach-in process, GS II 09 comes up on the display and the teach-in process is cancelled.
What does this message mean and which sign did you fail to observe during the teach-in process?

✍ Teach-in fault, neutral position

✍ The "Neutral position" adopted at the start has been

✍ abandoned without request at +/- 40 counts

Notes

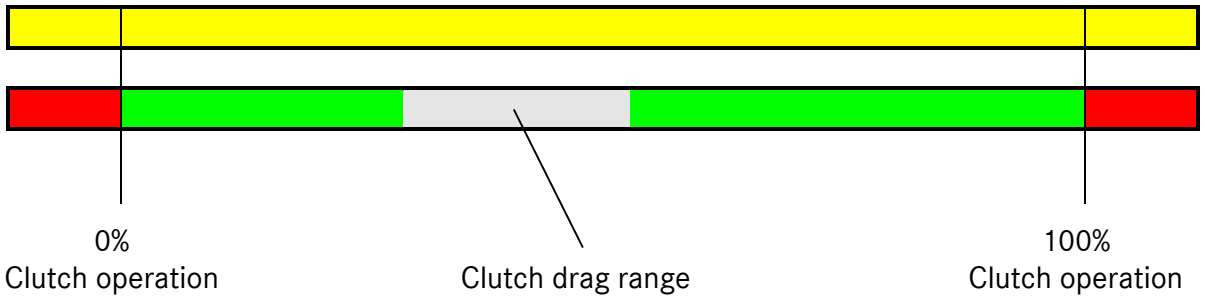
GS teach-in faults/text messages are located in the DAS simulation

under the appropriate menu

Clutch characteristics

Based on the clutch characteristics, the FR control unit detects the start or end position of the clutch drag point. The drag point has a short range in automated clutch operation.

The drag point of the clutch is defined as follows:
When "Close clutch" is selected transfer of the engine torque starts, and when "Open clutch" is selected, transfer of the engine torque ceases at this point. The drag point is at approximately 30 -50 % of the clutch operation.
Automated clutch operation attempts rapid overcoming of the "free travel" to the drag point.
Comfortable start-off, disengaging and maneuvering response should be guaranteed despite the "rapid" clutch operation.



Teaching in clutch characteristics

The clutch characteristics are continually teaching themselves in automatically while traveling.
The "adjustment" of the clutch characteristics does, however, become more sluggish as the length of operating time increases.
The clutch characteristics therefore need to be reset after the following work has been carried out:

- ⇒ FR control unit replaced
- ⇒ Engine or transmission removed or replaced
- ⇒ Work performed on clutch and clutch operation
- ⇒ Clutch actuator replaced
- ⇒ "Minor/major teach-in process" carried out in the GS

Resetting the clutch characteristics

The clutch characteristics are reset by means of DAS in the FR control unit. The resetting of the "clutch characteristics" is menu-assisted.

"Clutch characteristics" is one of the points listed in the "Actuations" menu. Confirm this menu option and follow the further instructions given by DAS.
The stored clutch characteristics are then deleted from the control unit. After some 6-7 shift operations the new clutch characteristics are identified in the FR control unit and stored. These serve as the new basis for adjusting the clutch response. The start-off and clutch response may seem rather awkward during the first 6-7 shift operations required for teaching in the new clutch characteristics.

GS backup mode in EAS II

The GS backup mode in the Telligent automatic transmission II is released, activated and operated in the same way as in the Telligent gearshift system II.

Special feature of GS backup mode in EAS II

The only difference in the backup mode relates to the sensor unit. In the Telligent automatic transmission II sensor unit, the selector switch is also integrated in the sensor unit.
When backup mode is operated, this can be used to select between manual or automatic backup mode.

There is no detectable difference between the "Manual" and "Automatic" operating modes.

1 Operating modes – selector
M Manual operation
A Automatic operation

EAS II sensor unit with selector switch N26.60-2205-31

EAS II - (Code GE2), drive control actual values and GS II, exercise

29.10.2003

Actual values are stored in the control unit for the drive control and GS II for a wide range of vehicle functions.

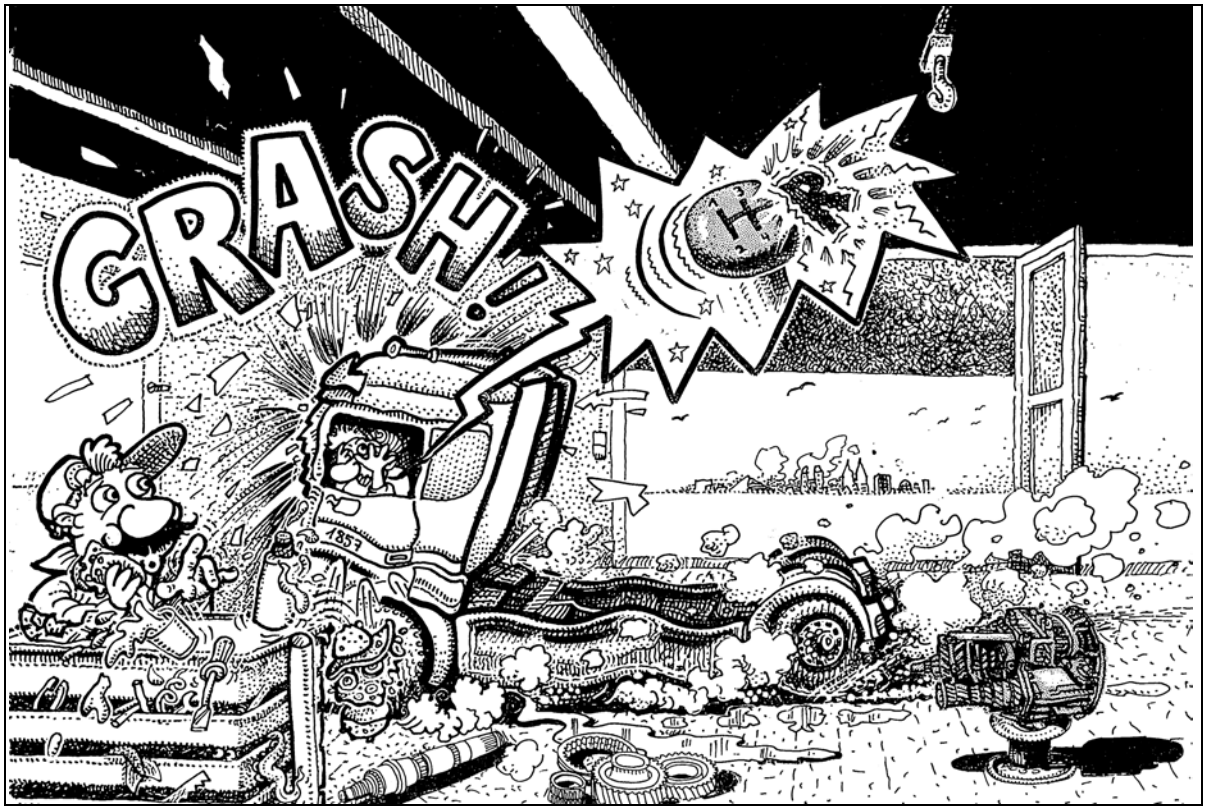
Our focus in this case is on the actual values connected with the Telligent automatic transmission II (EAS II).

In order to gain an initial overview, we will attempt to allocate the actual values to potential problem cases.

A large amount of current information on gear control and clutch operation can be read out from the "Drive control actual values and GS II" menu.

Many of these actual values can be referred to when diagnosing different customer complaints.

As you can see from the printouts you have been given showing current actual values for drive control and GS II, there is a large number of actual values.



N26.00-2023-09

Task

❍ Indicate which actual value groups for drive control and GS II may be of further help to you in diagnosing the reasons for the customer complaints on the following page.
Discuss possible solutions in groups.

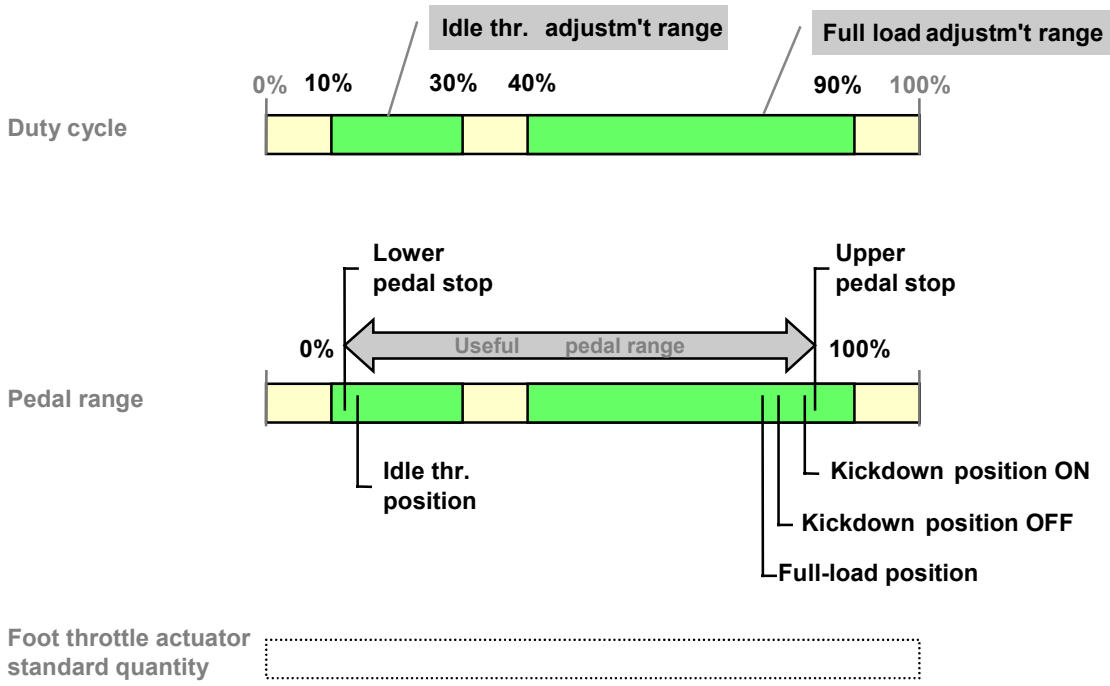
Customer complaint	GS II actual value group	Drive control actual value group
GS teach-in process incorrectly terminated (GS text message displayed)	• *Transmission / control unit version* • *Current vehicle status* • *Current and taught-in displacement and learned values* • *Number of shifting cancellations*	***Note:** Only the actual value group designations are stated as proposed solutions.*
Inoperability of, e.g., engine brake, permanent brake, cruise control, Temposet	• *Other ACTUAL values 1* • *Other ACTUAL values 2*	• *Engine brake* • *Clutch* • *Retarder* • *Cruise control* • *Clutch control Part 1* • *Clutch control Part 2*
Gear selection/preselection not possible/ Splitter gearshift system not available/ Reverse shifting not possible	• *Transmission / control unit version* • *Current vehicle status* • *Shifting times* • *Current and taught-in displacement and learned values*	• *Integrated automatic gear determination* • *GS sensor unit for gear control* • *Clutch control Part 1* • *Clutch control Part 2*
Shift abort	• *Shifting times* • *Current and taught-in displacement and learned values* • *Number of shifting cancellations* • *State of solenoid valves for shifting operations*	
Poor start-off and maneuvering response	• *Current and taught-in displacement and learned values*	• *Clutch* • *Clutch control Part 1* • *Clutch control Part 2*
Implausible gear selection	• *Transmission / control unit version* • *Current vehicle status* • *Other ACTUAL values 1* • *Other ACTUAL values 2*	

Task

The illustration shows a useful pedal range by way of an example.

In the field marked "Foot throttle actuator standard quantity" indicate the range of the minimum and maximum injection quantity which the driver can determine by using the foot throttle actuator.

Discuss in groups why the foot throttle actuator has to be taught in.



TM FFG 1_D.ppt

Requirement:
Activate the "Diagnosis" menu in the "Settings" menu (see operator's manual).

Teaching-in the foot throttle actuator:

- Select the "Diagnosis" menu
- Select the "Service info" submenu

Display	
FR LEARN	To start the teach-in process, select "Reset with reset button".
_ _ _ _	
A _ _ _	
+ _ _ _	Hold the accelerator in full-load position
+ _ _ A	
+ _ _ +	To conclude the teach-in process, select "Reset with reset button" again.
FR OK	

	Troubleshooting chart for GS II and EAS II shifting systems and notes on how to use it correctly	29.10.2003

- **After "Ignition On" wait for the sound speaker to extinguish (automatic system check).**

  If the ignition key is turned again straight away, a system check cannot be fully carried out. As a result a "CAN communication" fault code is set in the systems.

- **There must be a guaranteed voltage supply of 24 V and, when starting up in particular, the voltage level should not fall below 20 volts.**

  Otherwise undervoltage, CAN communication and implausible speed sensor fault codes are set in the systems.

- **Compressed air supply (8 bar) is very important for problem-free shifting.**

  Especially when starting at temperatures below +5 °C, an adequate supply of compressed air is required to open the drive clutch.

- **The foot throttle actuator setting should be checked in case of doubt and readjusted if necessary.**

  Shift speed and gear allocation can be insufficient if the settings are incorrect.

	Troubleshooting chart for GS II and EAS II, TIPS procedure and application	29.10.2003

In order to facilitate a standard procedure of detection and diagnosis with regard to current complaints, the Wörth plant customer service department has developed a troubleshooting chart for the Telligent automatic transmission II – GS II (Code GS7) and Telligent automatic transmission II – EAS II (Code GE2).

An important feature of the troubleshooting chart is its integration of current complaints communicated through TIPS.

How can I contact TIPS?

Intranet address: **http://tips-reader.daimlerchrysler.com**

Your provisional user name: _____ (request from MPC, country-specific)

Your provisional password: _____

Now you can search for a "TIPS" yourself.

Symptom: **Engine brake and cruise control not working**

Model: ***ACTROS*** 930-934 with Telligent automatic transmission II - EASII (Code GE2)

Have fun searching!

Shift system troubleshooting chart for the Telligent gearshift system II – GS II (Code GS7) and Telligent automatic transmission II – EAS II (Code GE2)

- Observe instructions for use in the operator's manual.
- "Observe" tips for problem-free use!
- Targeted questions regarding complaints at the time of vehicle acceptance.

Complaint in accordance with symptoms

Remedy according to "TIPS" design group 26

Crunching occurs
when shifting from 4th to 5th gear

discontinue clutch operation

Crunching occurs
when shifting from 4th to 5th gear

Complaint in accordance with current fault code displayed

Read out fault code in GS + FR control unit

Determine GS + FR control unit version

Read out parameterization in GS

Remedy according to DAS/WIS

Complaint in accordance with symptoms

Read out abnormal termination counter in GS control unit

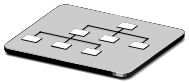
Assessment of abnormal termination counter

Mainly abnormal clutch terminations

- Hold down clutch pedal for longer when shifting gear
- Check compressed air line cross sections for restrictions
- Check compressed air system for leaks
- Check mechanical function of clutch components

Mainly abnormal transmission terminations

- Check cable set connection to sensor system / transmission
- Check cable set connection to solenoid valves / transmission
- Check cable set connection to engine cable set separation point
- Check ground points in transmission cable set
- Check cable set connection to GS control unit
- Check connectors visually for leaks

	Procedure	Sources of inf.	Logging
	The complaint or symptom is specified.	Order, data card, FDOK Driver, customer	List, table
	Sub-areas are defined for the affected functions. Faults are allocated to the sub-areas.	Own know-how, WIS (AF, AD and GF documents) Introductions to service manual	List, table, matrix
	A test strategy is developed. • Sub-areas prioritized • Information required for the function or system defined • Tests for sub-areas defined • Priorities set according to economic viability and probability • Teach-in processes taken into account A test strategy is implemented. • Test equipment stipulated with test modes and measuring points • Target results defined, actual results determined and compared with target • Components, media and settings evaluated or eliminated by testing	Own know-how, WIS (test documents), DAS, Introductions to service manual	Table, matrix, troubleshooting chart, decision tree, test sheets
	The causes are established.	Test results	List, description
	Repair is carried out. Operational check is carried out.	WIS (Repair documents)	

Log sheet

Complaint level

Mercedes-Benz

Repair order no.:

Vehicle
Ident. no.

Account no.

Date: ___. ___. 00

Location	**Registration number**			**Initial registration**		**Vehicle model**			**Engine no.**			**Mileage**
Location	**Brought in by**			**Accepted by**		**Time**	**Antifreeze in coolant** **°C changed to** **°C**					**Non-binding time** hours
Location	**Fam.:** **Model code:**				**Main inspection**	**Emissions inspection**	**§57 B**		**GW-V erf.:** **Dat. I. WD:**	**WD-GR.:**		**Change of date**
Listed	Item	**Rg. code**	**Operation no.**	WU	Oper. code	Proc. code	Type of operation					**DM**

Log sheet

Complaint level

Any further information?	Sources of information?	Notes

Log sheet

Sub-area and function level

Defined sub-areas	Defined functions	Prioritization	Notes

Log sheet

Test level

Function:

Basic conditions required / information required	What test / test equipment is being used?	In the .... system	What is being tested?	TARGET value	ACTUAL value	Notes / reference

Log sheet

Test level

Which test?	Which test equipment?	What is being tested?	Prior-itiza-tion	TARGET result	ACTUAL result	Reference

Log sheet for metaplan board

Test level

	Which test?	Which test equipment?	What is being tested?	TARGET result	ACTUAL result	Reference
1						
2						
3						
4						
5						
6						
7						

Customer complaint

❍ The customer complains that the engine brake and cruise control are not working on an ACTROS 2544 model 930-934 with Telligent automatic transmission II. A few days previously the customer replaced the clutch himself.
No event is being displayed in the instrument.
The Actros is fitted with the following major assemblies:

Chassis no.	WDB 930 203 .....
Engine	501 922 .....
Transmission	715 531 .....

Task

❍ The customer complaint is remedied following a teach-in process. You may now wonder what does a teach-in process have to do with the functioning of the engine brake and cruise control?

Enter your initial suppositions here

✍ *The engine brake and cruise control functions have something to do with the clutch sensing.*

✍ *This is because both functions can only be active when the clutch is closed.*

✍ *This is because the old taught-in value and the current value no longer agree in the "counts grid".*

✍ *Neither function is active.*

✍ *The values are resynchronized/updated by means of a teach-in process.*

Note

In case you still cannot see the connection between the functions and the clutch sensing, we aim to establish this connection in the following exercises.

Task

❍ In which operating conditions can the engine brake and cruise control be activated?
Discuss the demands made on the functions in groups and complete the table.

Function	Condition, minimum requirement in terms of ...		
	Engine speed	Speed	Clutch
Engine brake	*at least 900 rpm*	———	*closed*
Cruise control	———	*at least 30 km/h*	*closed*

Task

❍ Let us refer back to the above customer complaint.
Check the vehicle to see whether the clutch disengages fully. This can be done with the help of actual values in the GS II system and with the engine running.
Note down the respective actual values and complete the required values.

GS actual value	Actual value statement	Actual clutch value with at engine idle speed		Notes
		not activated	activated	
02	Countershaft speed	*600*	*0*	
034	Clutch displacement value in percentage	*0*	*100*	
039	Clutch displacement value	*945*	*475*	
051	Learned value "Clutch open"	*475*	*475*	
052	Learned value "Clutch closed"	*945*	*945*	
220	Engine speed	*600*	*600*	
223	Clutch status	*closed*	*open*	

Task

❍ You can control the clutch actuator via the submenu "Clutch operation control" in the "Actuations" menu in the drive control system.
For which customer complaints is it advisable to use the "Clutch operation control" menu?
Discuss possible options for use in groups and note them down.

✍ *Start-off and maneuvering response*

✍ *Clutch-related complaints*

✍ *Abnormal shift terminations on account of inadequate clutch operation*

✍ *Aaa*

✍ *Aaa*

Task

❍ Carry out the "Clutch operation solenoid valves" actuations menu taking into account the following task.
What causes may exist if you detect deviations in the clutch operation control loop with the help of the "Clutch operation solenoid valves" actuations menu?
Complete the table.

	Clutch opening is delayed	Clutch fails to reach max. value (as per standard)	Clutch closing is delayed	Clutch fails to return to starting position
The release bearing on the drive shaft is sluggish	X	X	X	X
Clutch operation components are wearing	X		X	
Mechanical operation of clutch actuator sluggish/faulty	X	X	X	X
Pneumatic reservoir pressure too low	X	X		
Pneumatic lines clogged/restricted	X		X	
Ventilation bores clogged/dirty			X	X

Customer complaint

❍ A customer complains that the driver's shift commands are occasionally not implemented in an ACTROS 2544 model 930-934 with Telligent automatic transmission II.
The Actros is fitted with the following major assemblies:

Chassis no.	WDB 930 203 1K .....
Engine	501 922 .....
Transmission	715 531 .....

Task

❍ Which electronic system(s) is (are) relevant for the diagnosis?

✍ *FR control unit*

✍ *Aaa*

Task

❍ In the event of which specific customer complaints is it advisable to check that the GS sensor unit is working correctly?
List them below.

✍ *Start-off and reverse gear cannot be engaged*

✍ *Neutral cannot be engaged*

✍ *Gears cannot be skipped*

✍ *Aaa*

Task

❍ Check the GS sensor unit on the vehicle with the help of STAR DIAGNOSIS.
Perform the relevant shift operations.
Note down the respective GS II actual values and complete the required values.

GS actual value	Actual value statement	Sensor unit		Notes
		activated	not activated	
105	"Shift up" selected on main lever of sensor unit	Yes	No	
106	"Shift down" selected on main lever of sensor unit	Yes	No	
107	"Shift up" selected on half-gear rocker of sensor unit	Yes	No	
108	"Shift down" selected on half-gear rocker of sensor unit	Yes	No	
109	Position of automatic system switch on gear control GS sensor unit	Manual	Automatic	
110	"Neutral" signal of gear control GS sensor unit	Yes	No	
111	Acknowledgement signal of gear control GS sensor unit	Yes	No	
112	Function button pressed on gear control GS sensor unit	Yes	No	

Notes

Customer complaint

❍ The customer complains of abnormal shift terminations on an ACTROS 2544 model 930-934 with Telligent automatic transmission II.
No event is being displayed in the instrument.
The Actros is fitted with the following major assemblies:

Chassis no.	WDB 930 203 .....
Engine	501 922 .....
Transmission	715 531 .....

Task

❍ What circumstances might cause a shift abort in the GS II or EAS II system?
Note down your findings/the special features.

Enter your initial suppositions

here

✍ *1. Difference between gate displacement values and learned values,*

✍ *Gear, splitter, range and clutch too large*

✍ *2. Shift times are exceeded*

✍ *3. Air admission and vent lines are clogged up or restricted*

✍ *4. Mechanical wear or sluggishness in transmission*

Task

❍ You have replaced the clutch actuator because your diagnosis revealed it to be the cause of the customer complaint. What teach-in process(es) do you still have to carry out in the GS II system?

✍ *Minor GS II teach-in process and reset clutch characteristics in the drive control*

Task

❍ Carry out a "minor teach-in process" in the GS II system.
Note down your findings/the special features.

✍ *Aaa*

✍ *Aaa.*

✍ *Aaa.*

Task

❍ Reset the "clutch characteristics" in the drive control system.
Note down your findings/the special features.

✍ *Aaa*

✍ *Aaa.*

✍ *Aaa.*

Do not forget to delete all fault codes in the individual systems!

The Telligent® automatic transmission (AGS, Automatic Gear Shift) combines the economic benefits of the conventional manual transmission with the high level of operational and ride comfort of an automatic transmission. Based on a 6-speed manual transmission, the system now boasts automated clutch and gearshift operation. The driver no longer requires the clutch pedal and conventional gearshift lever in the cab. The latter has been replaced by a so-called sensor unit with a gear selector lever which the driver moves forwards or backwards to generate shift commands.

The core of the Telligent® automatic transmission is the electronic drive control, FR, which processes the information from the controls, the drive conditions and vehicle load conditions, and converts them into clutch and shift operations. For this purpose the transmission is fitted with an independent hydraulic unit consisting of expansion reservoir, electrically operated hydraulic pump, pressure reservoir, transmission positioner and clutch actuator.

By taking into account all the signals simultaneously, the system can respond appropriately to a skilled driver.

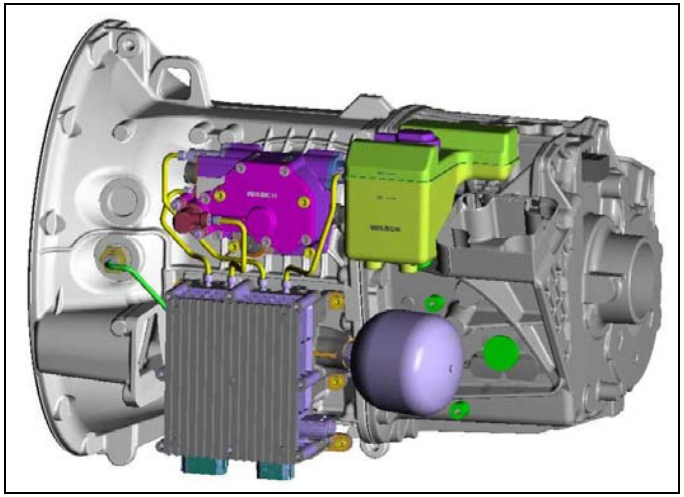
N00.00-2099-01

Having covered all the conditions that might occur while driving, the system offers the driver ease of operation, ride comfort and a high degree of driving safety.

The facts regarding the Telligent® automatic transmission speak for themselves:

- Relief for driver in shift-intensive delivery traffic. No manual shifting operations are required for start-offs in stop and go traffic.
- There is absolutely no need for force-intensive clutch operation.
- {Preservation of the drive train and reduction in wear and tear.
- Savings in fuel costs.
- Avoidance of operator errors such as overrevving the engine, overheating the clutch or shifting without clutch operation.

The sales code for the Telligent® automatic transmission (AGS) is GE1.



AGS transmission complete GT_26_00_0012

The Telligent® automatic transmission (AGS) is used in the following vehicles:

- ***ATEGO*** up to 15 t

- ***ATEGO*** from 18 t

N00.00-2038-01

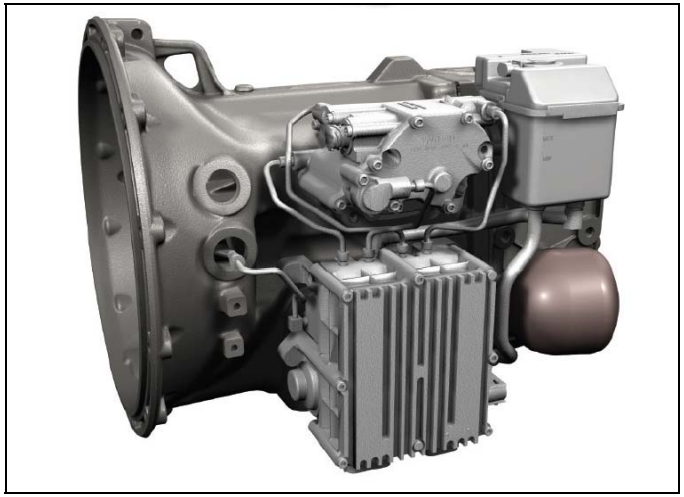
N00.002099-01

The Telligent® automatic transmission (AGS) is used in the ***ATEGO*** with the following transmissions:

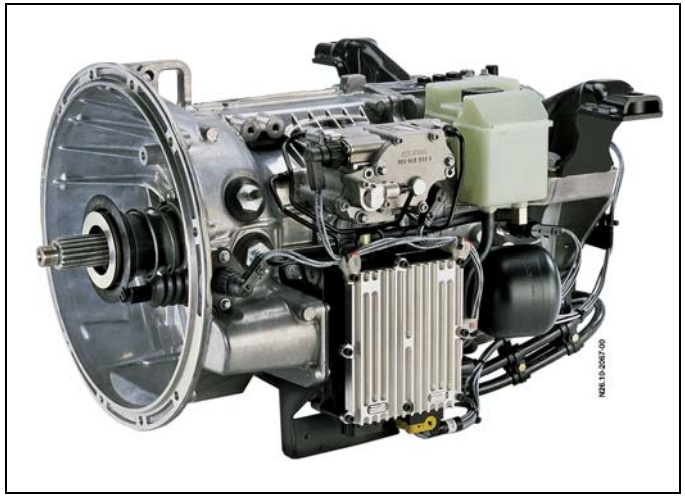
- G56-6/6,28-0,78 (GC4, from 10/04)

- G60-6/9,20-1,00 (GC5)

- G85-6/6,70-0,73 (GC6)



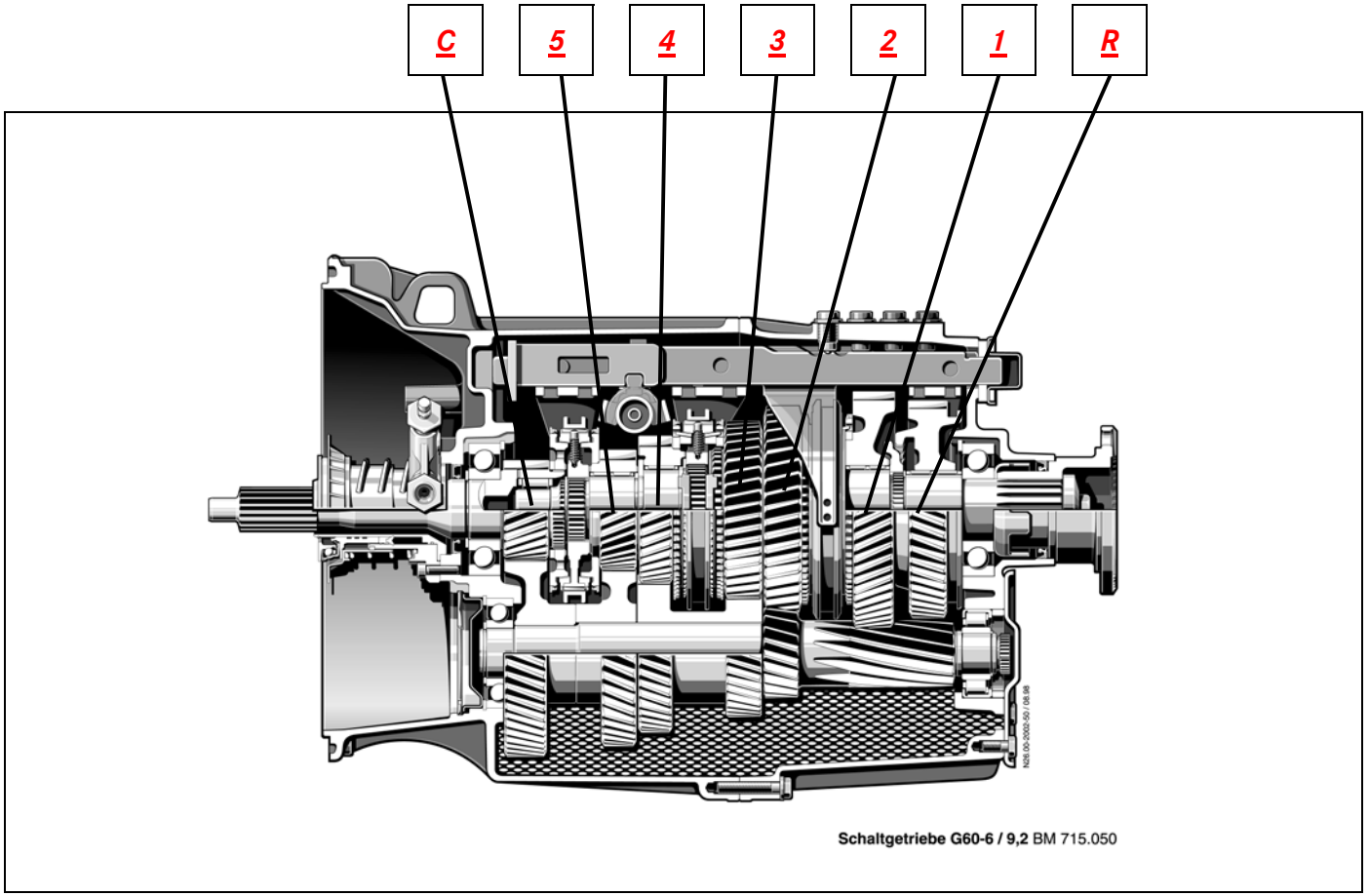
Transmission G 56 GT_26_00_0009



Transmission G 60 and G 85 N26.10-2067-00

Task

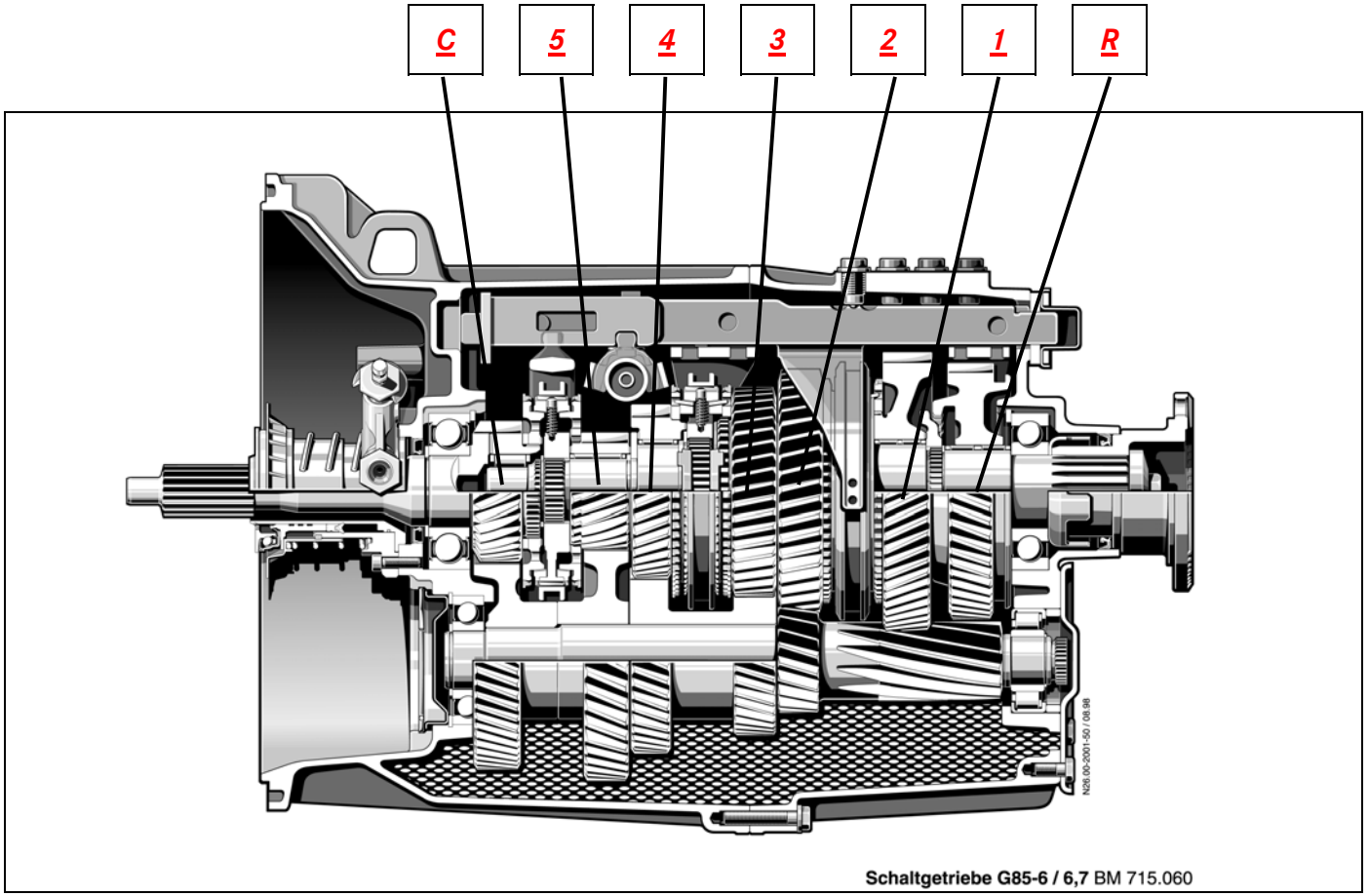
❍ On the G 60-6/9.2 transmission, mark the constant, the forward gears and the reverse gear.
Draw in the power progression in 5th gear on the G60 transmission.



N26.00-2002-09

Task

❍ On the G 85-6/6.7 transmission, mark the constant, the forward gears and the reverse gear. Draw in the power progression in 5th gear on the G85 transmission.



Schaltgetriebe G85-6 / 6,7 BM 715.060

N26.00-2001-09

Task

❍ Compare the 5th gear with the gearwheel of the constants.
Is the constant wheel on the drive shaft...

[a] larger than
[b] the same size as
☒ [c] smaller than ... the gearwheel of the 5th gear on the main shaft?

Task

❍ Explain why the transmission illustrated is a direct drive transmission.

[a] The diameter of the drive wheel on the drive shaft is smaller than the smallest wheel driven on the main shaft.
[b] The MB 6-speed transmissions are basically direct drive transmissions.
☒ [c] It is impossible to tell from the illustration.

Task

❍ Which of the following statements apply to the reverse gear?

☒ [a] It is always near 1st gear in a conventional transmission.
☒ [b] It is normally driven by the same countershaft gearwheel as 1st gear.
☒ [c] The reverse gear is not directly driven by the countershaft.
☒ [d] The reverse gear is not synchronized.
☒ [e] The gearwheel of the reverse gear is a sliding gear on the transmission illustrated.

G60/85 transmission transverse shift gate; exercise

29.10.2003

Task

❍ Arrange the components listed below in the correct position on the transverse shift gate illustrated.
(Transmission transverse shift gate viewed from behind – direction of travel)

1 Gate 1 - 2

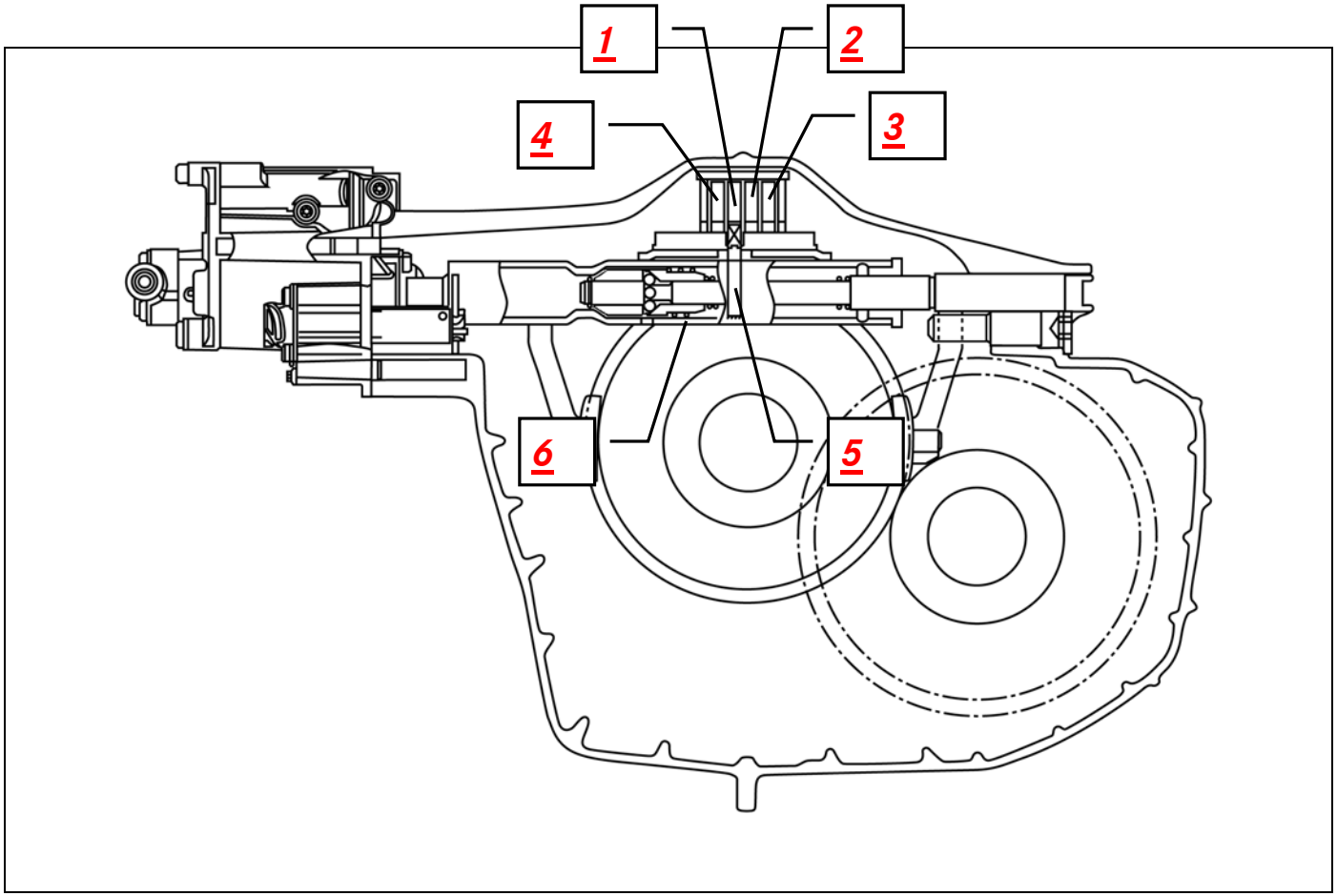
2 Gate 3-4

3 Gate 5-6

4 Gate R

5 Shift finger

6 Neutral position spring



N26.21-2015-06

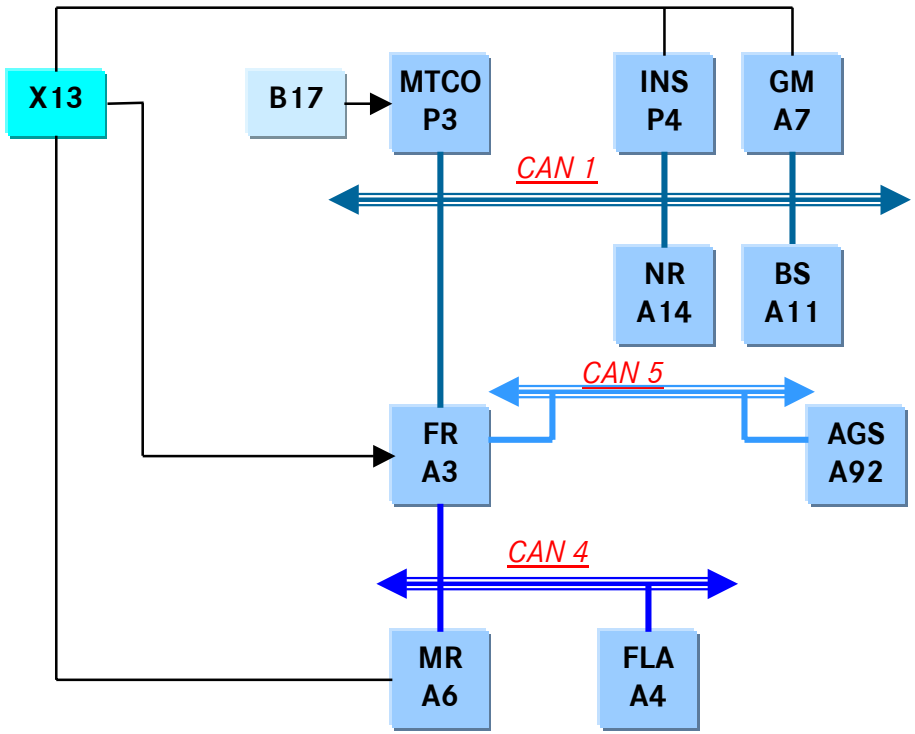
Task

The diagram shows an ATEGO with AGS, BS and NR.

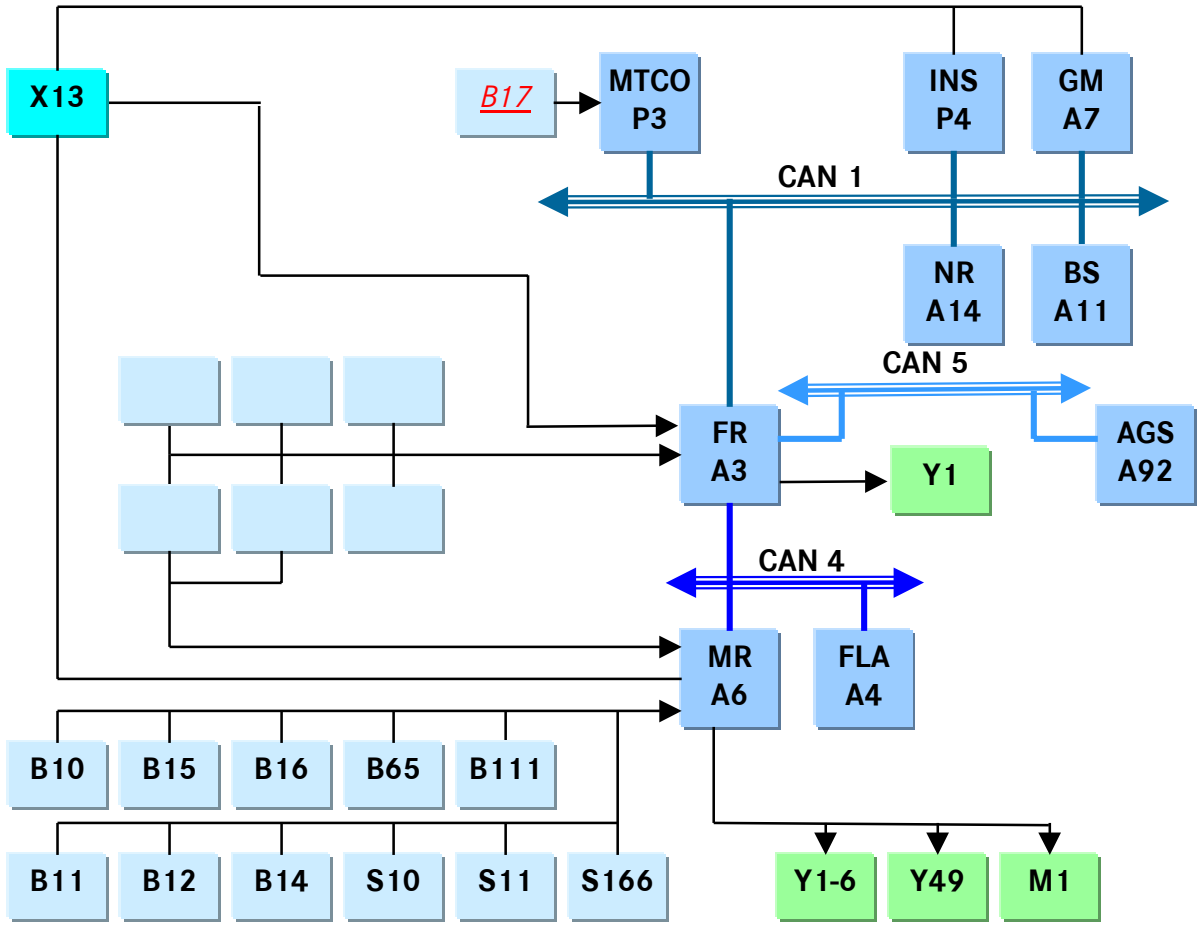
Name the BUS systems in the diagram.

Note:
Use the circuit diagram PE00.19-W-2150A "Extended vehicle network".

CAN 1	Vehicle CAN bus
CAN 4	Engine CAN BUS
CAN 5	Transmission CAN BUS
A3	Control unit, drive control (FR)
A4	Control unit, flame starting system (FLA)
A6	Control unit, engine control (MR)
A11	Control unit, brake control (BS)
A14	Control unit, level control (NR)
A92	Control unit, gear control (AGS)
P3	Modular tachograph (MTCO)
P4	Instrument (INS)
X13	Diagnostic socket



PPT


X13
B17
MTCO
P3
INS
P4
GM
A7
CAN 1
NR
A14
BS
A11
CAN 5
FR
A3
Y1
AGS
A92
CAN 4
MR
A6
FLA
A4
B10
B15
B16
B65
B111
B11
B12
B14
S10
S11
S166
Y1-6
Y49
M1

P

Task

❍ Name the components that are missing from the graphic!
Use the FR circuit diagram.

The following questions may help you to solve the problem.

- Is the generator integrated in the engine management?
- Where is the foot throttle actuator connected?
- How are the drive switch and the read-out electronics integrated?
- What determines the engine brake requirement and how is the engine brake activated?
- Where is the vehicle speed signal fed-in?
- Is the parking brake switch connected?
- How can information be displayed on the instrument display?

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

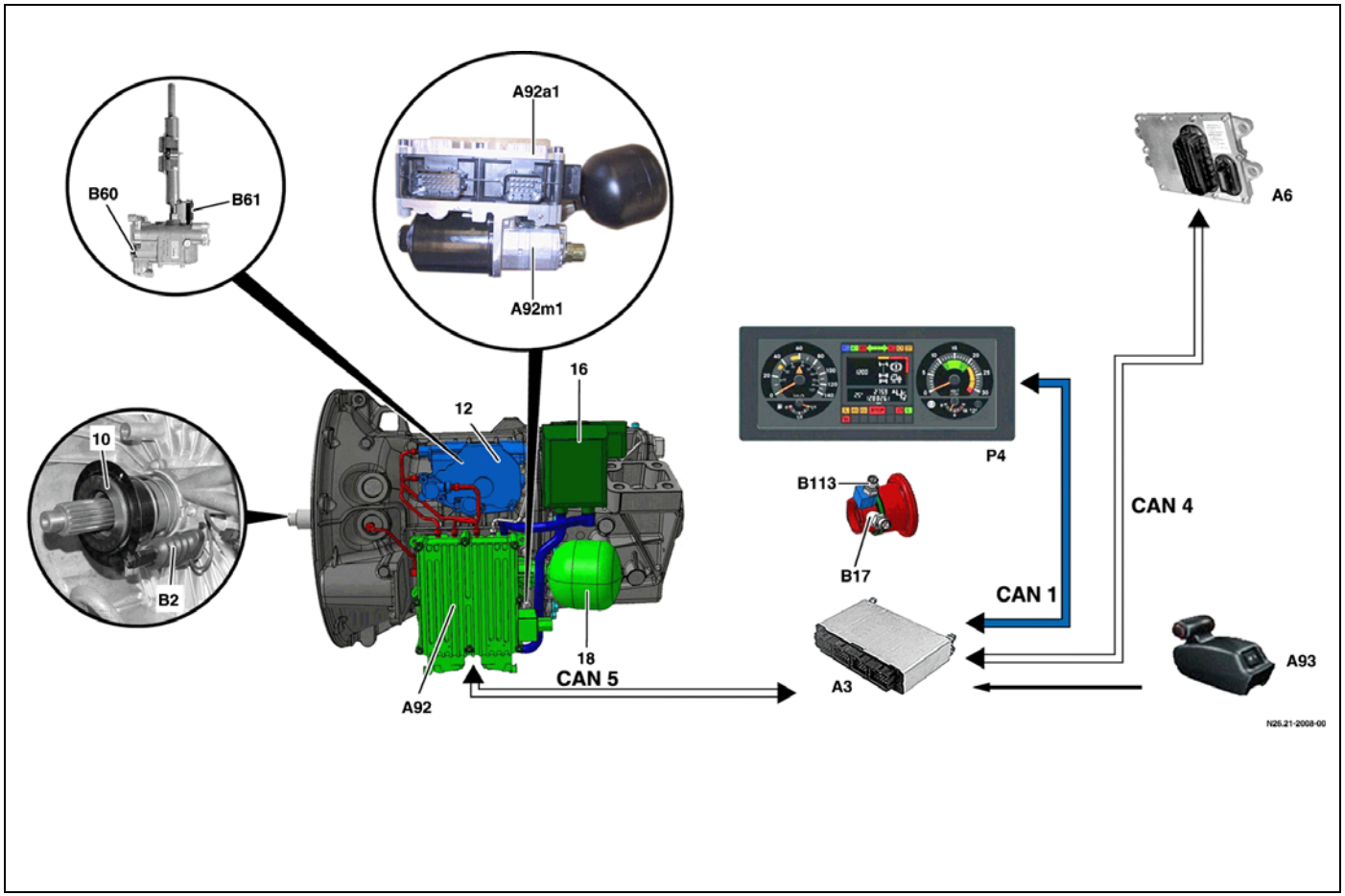
✍ *Aaa* _____

✍ *Aaa* _____

The electronic systems for the transmission and the on-board related functions are entirely separate. Information is exchanged between the electronic systems in the form of CAN messages via the following CAN connections:

- Vehicle CAN (CAN 1)
- Engine CAN (CAN 4)
- Transmission CAN (CAN 5)

10	Hydraulic central release bearing
12	Hydraulic transmission positioner
16	Hydraulic fluid container
18	Pressure reservoir
A3	Control unit, drive control (FR)
A6	MR/PLD control unit
A92	Automatic gear control (AGS) hydraulic control unit
A92a1	Automatic gear control (AGS) control unit
A92m1	Hydraulic pump
A93	Sensor unit, automatic gear control (AGS)
B2	Clutch travel sensor
B17	Speed sensor
B60	Gear sensor
B61	Gate sensor
B113	Transmission output speed sensor
CAN 1	Vehicle CAN
CAN 4	Engine CAN
CAN 5	Transmission CAN
P4	Instrument cluster 2000



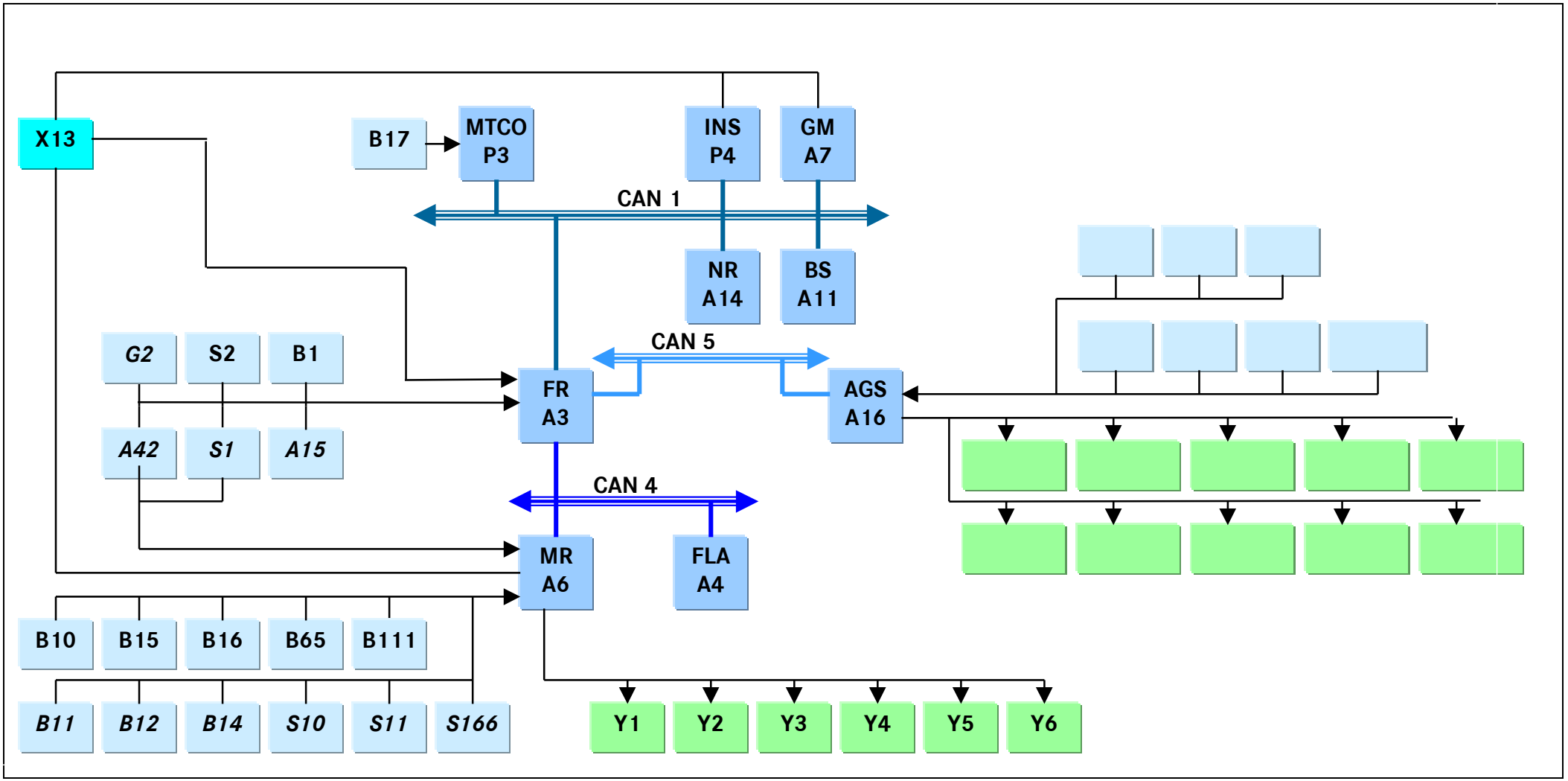
N26.21-2008-00

The shift commands of the sensor unit for the automatic gear control (AGS) (A93) are read in by the control unit for drive control (FR) (A3), compared with shift-related data of other control units and relayed as shift signals via the transmission CAN (CAN 5) to the control unit for automatic gear control (AGS) (A92a1).

The control unit for automatic gear control (AGS) (A92a1) then ensures that the clutch is opened and closed correctly and ensures actuation of the gear and gate solenoid valves.

During and after shifting, the control unit for automatic gear control (AGS) (A92a1) transmits CAN messages to the control unit for drive control (FR) (A3) with information for displaying the shift status and for emitting warning sounds via the transmission CAN (CAN 5).

The control unit for drive control (FR) (A3) in turn relays these to the instrument cluster 2000 (P4), which displays the shift status and, if necessary, emits warning sounds.


X13
B17
MTCO
P3
INS
P4
GM
A7
CAN 1
NR
A14
BS
A11
G2
S2
B1
CAN 5
FR
A3
AGS
A16
A42
S1
A15
CAN 4
MR
A6
FLA
A4
B10
B15
B16
B65
B111
B11
B12
B14
S10
S11
S166
Y1
Y2
Y3
Y4
Y5
Y6

P

Task

❍ The graphic shows an ATEGO with Telligent automatic transmission AGS (Code GE1).
Name the missing components.

The following questions may help you to solve the problem:

- How is the clutch actuated?
- Have you also considered clutch sensing?
- Have you thought about all the components required for engaging a gear?
- How is a driver command transmitted?

Note:
Further information on the Telligent automatic transmission II – AGS (Code GE1) can be found in WIS under GF26.21-W-0003A.

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

Entering shifting commands
The automatic gear control (AGS) is operated via the sensor unit for the automatic gear control (AGS) (A93).
In order to carry out the shift options, the shift commands are entered via various controls:

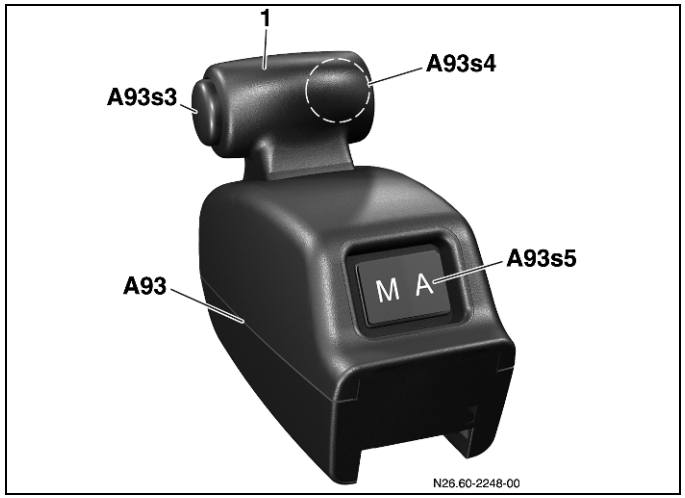
Main lever (1)
- Shifting up by moving the main lever forwards, main lever UP.
- Shifting down by moving the main lever backwards, main lever DOWN.

Function button (A93s3)
- Skipping of gears when the main lever is activated.
- Reverse gear shifting.

Neutral button (A93s4)
- Shifting into neutral.
  The neutral button (A93s4) is only evaluated if the main lever is in basic position.

AUTO/MAN switch (A93s5)
- Shifting in manual or automatic shift mode.

Transmitting shift commands
The sensor unit for automatic gear control (AGS) (A93) transmits the shift signals to the control unit for drive control (FR) (A3).



N26.60-2248-00

1	AGS sensor unit main lever
A93	AGS sensor unit
A93s3	Function button
A93s4	Neutral button
A93s5	AUTO/MAN switch

P

AGS (Code GE1), sensor unit operation; exercise

29.10.2003

Task

❍ What operations must be performed on the AGS sensor unit so that a forward starting gear can be engaged?
Use the aids and resources available.

[a] Move the main lever backwards
[b] Press and hold the neutral button and move the main lever forwards
[☒] [c] Press and hold the function button and move the main lever forwards
[d] Press and hold the function button and move the main lever backwards

Task

❍ Which forward starting gear is always automatically engaged in the transmission?
Use the aids and resources available.

[☒] [a] 1st gear
[b] 2nd gear
[c] 3rd gear
[d] 4th gear

Task

❍ How can a gear be skipped in the transmission with the aid of the AGS sensor unit?
Use the aids and resources available.

[a] Press and hold the neutral button and move the main lever forwards or backwards
[☒] [b] Press and hold the function button and move the main lever forwards or backwards
[c] Press the neutral button and the operating mode switch
[d] Gears cannot be skipped

Task

❍ How and when is a gear changed if the "*Automatic*" operating mode is selected on the AGS sensor unit?
Use the function description GF26.21-W-3102A (Sensor unit, automatic gear control AGS – location/task).

✍ *A gear change is effected after appropriate calculation by the AGS control unit*

✍ *The AGS control unit fully controls the sequence between*

✍ *clutch operation and engaging of the calculated gear*

✍

Task

❍ How and when is a gear changed if the "*Manual*" operating mode is selected on the AGS sensor unit?
Use the function description GF26.21-W-3102A (Sensor unit, automatic gear control AGS – location/task).

✍ *A gear change is effected after appropriate actuation of the AGS sensor unit by the*

✍ *driver*

✍ *Aaa*

✍

Task

❍ How can a rapid change of direction be effected with the help of the sensor unit?
Use the function description GF26.21-W-3102A (Sensor unit, automatic gear control AGS – location/task).

✍ *The reverse gear must first be engaged.*

✍ *By pressing the function button and*

✍ *moving the main lever forwards at the same time,*

✍ *the rapid change of direction can*

✍ *be effected. In order to return to*

✍ *reverse gear, the process must be carried out again*

✍ *in reverse order.*

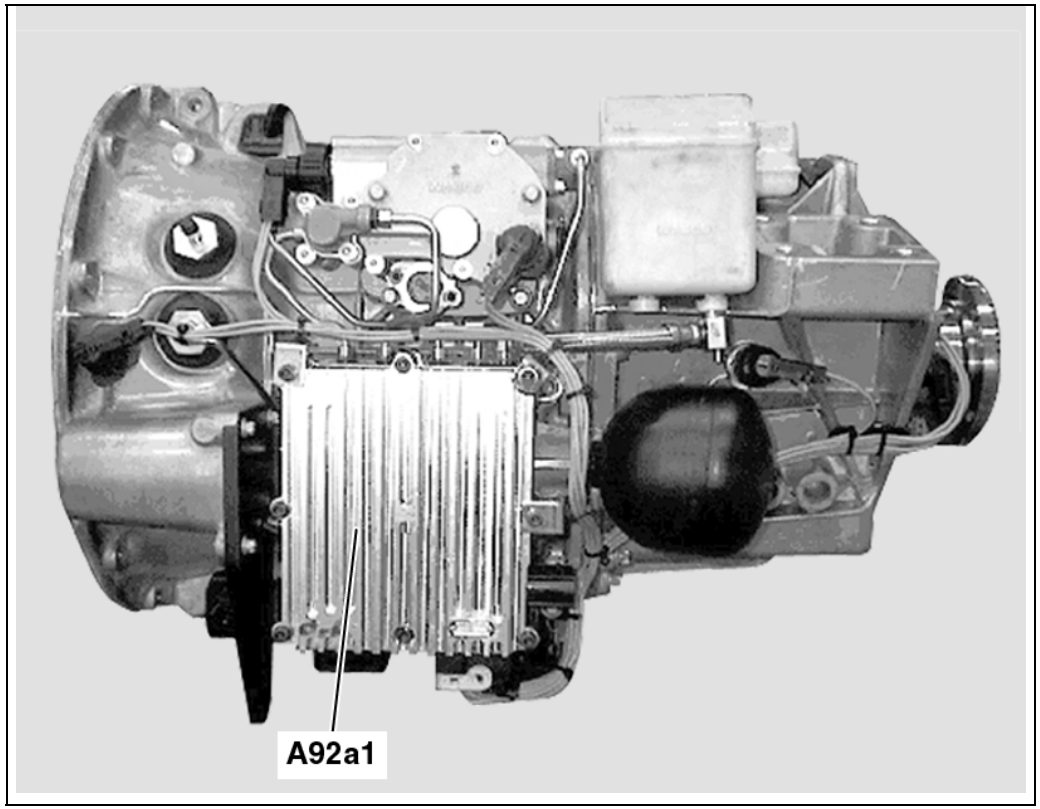
✍ *Repeat as often as necessary!*

Task

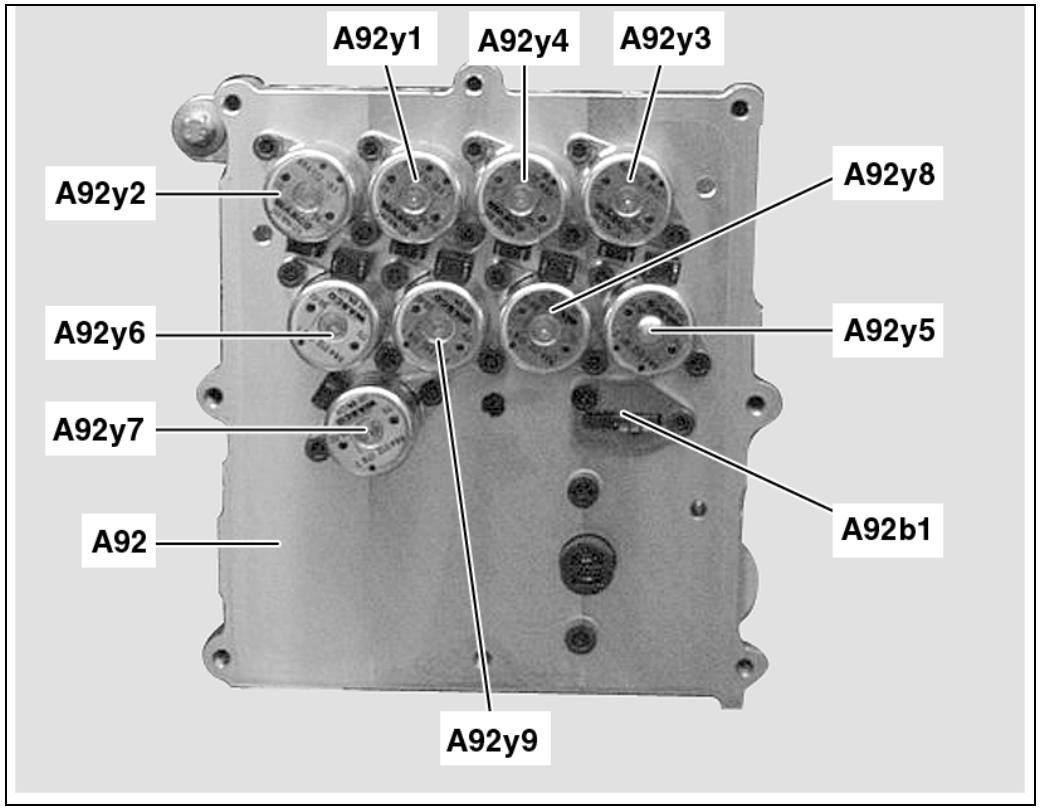
❍ To which control unit is the AGS sensor unit connected and is it possible to call up the relevant actual values?
Use the function description GF26.21-W-3102A (Sensor unit, automatic gear control AGS – location/task).

[a] AGS
[b] Base module
[☒] [c] FR
[d] GS

Control unit, automatic gear control (AGS)



W26.21-1030-11



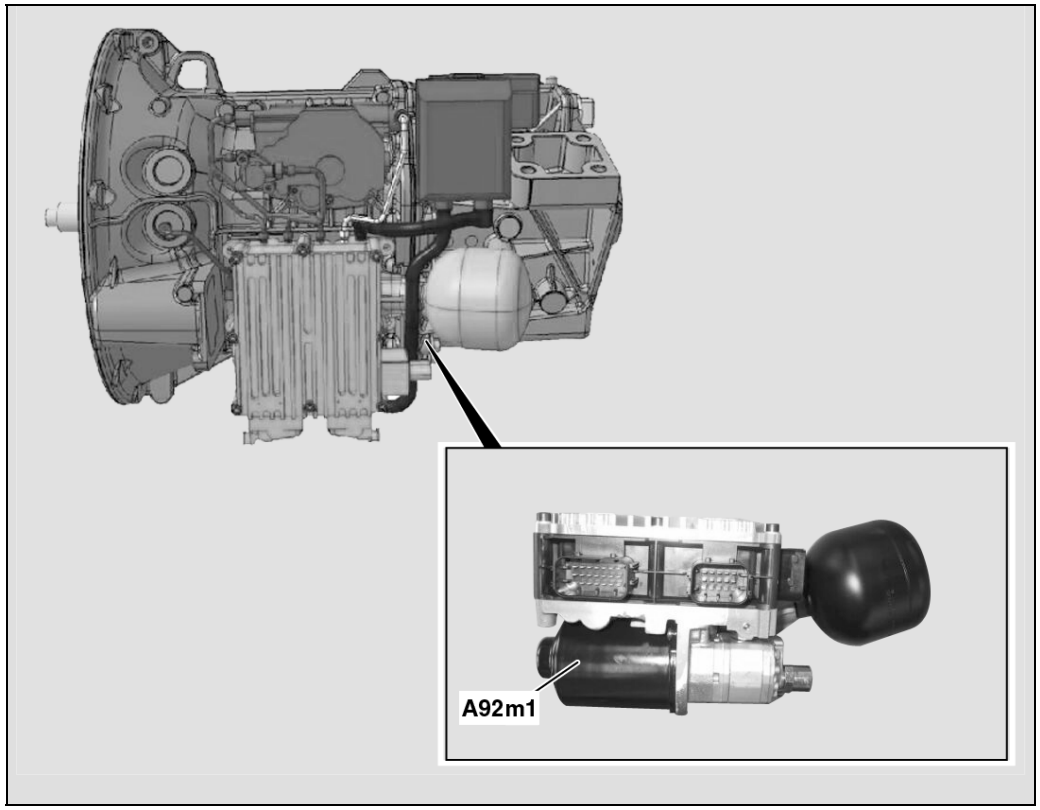
W26.21-1017-11

The control unit for the automatic gear control (AGS) is the central control electronics system for performing transmission-related functions.

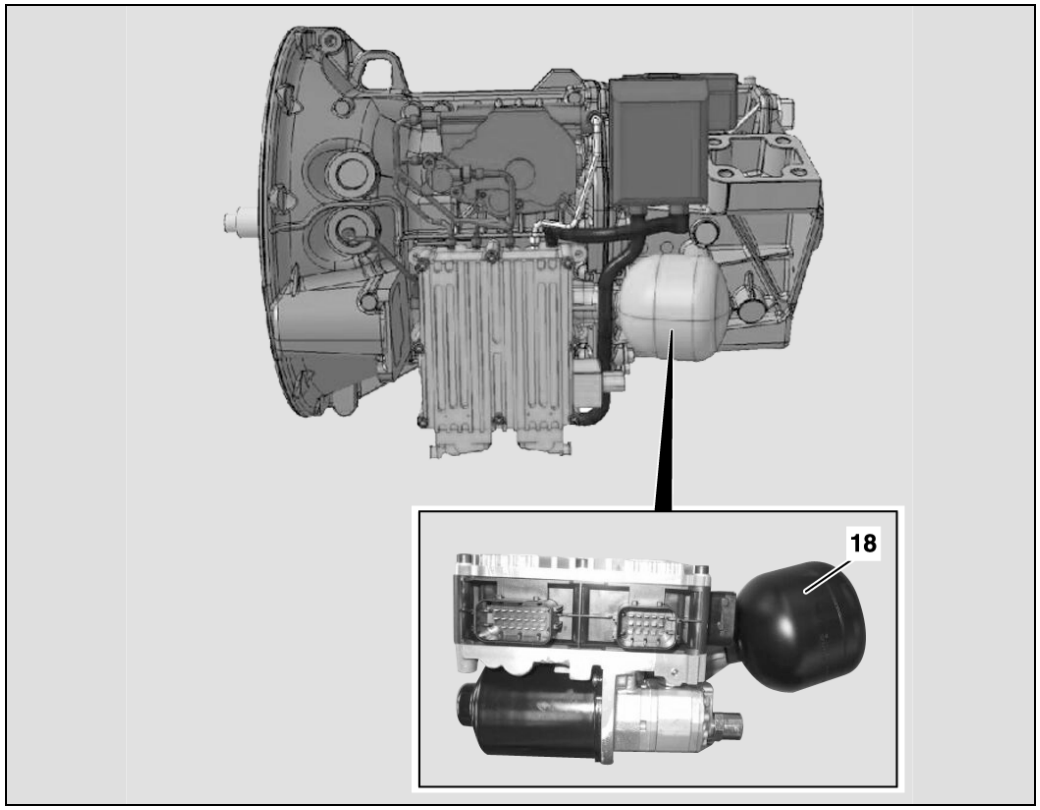
The respective solenoid valves are also arranged in the AGS control unit.

A92	AGS control unit
A92b1	Oil pressure sensor
A92y1	Gate solenoid valve, LOW
A92y2	Gate solenoid valve, HIGH
A92y3	Solenoid valve, even gear
A92y4	Solenoid valve, odd gear
A92y5	Pressure modulation solenoid valve
A92y6	Solenoid valve, open clutch 1
A92y7	Solenoid valve, open clutch 2
A92y8	Solenoid valve, close clutch 1
A92y9	Solenoid valve, close clutch 2

Hydraulic pump and hydraulic pressure reservoir



W26.21-112906



W26.21-112612

Aided by an electric motor, the hydraulic pump (A92ml) generates the hydraulic pressure required for shifting.

Cutoff pressure: over 85 bar

Cut-in pressure: below 60 bar

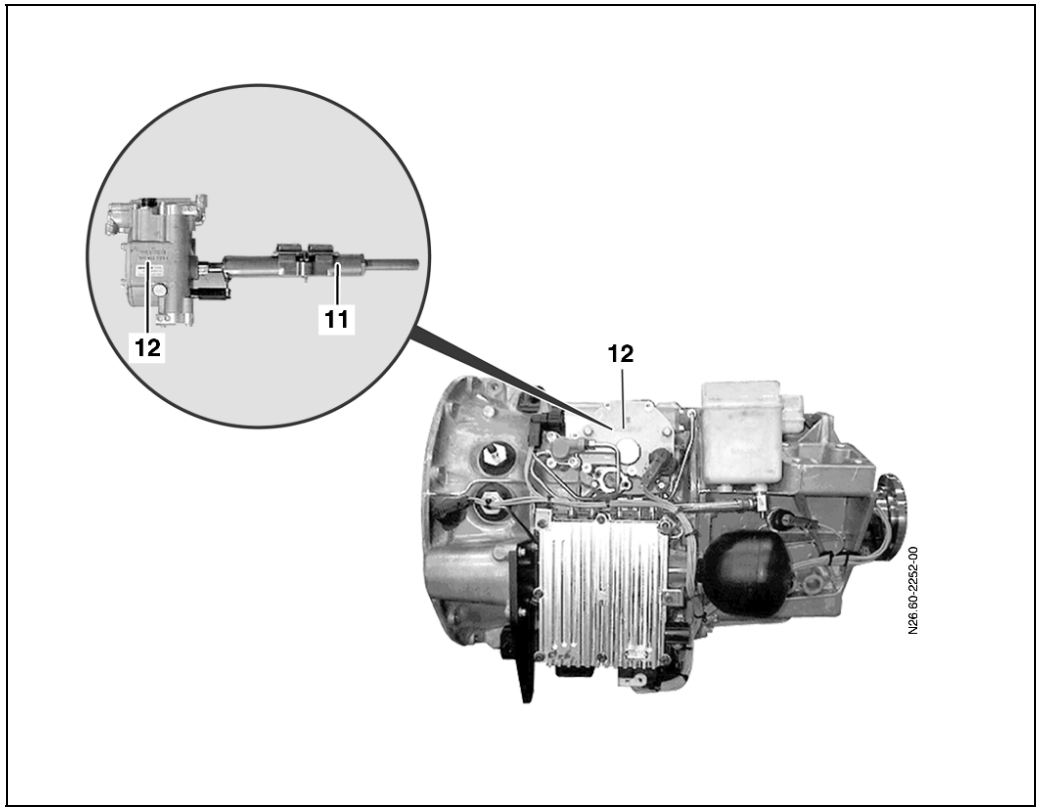
At "Ignition On" the hydraulic pump starts up and switches off after 8 seconds; if no pressure increase is detected in the system, a fault code is set.

The hydraulic pressure reservoir (18) reserves the pressure generated by the hydraulic pump (A92m1), makes it available to the automatic gear control (AGS) system and absorbs pressure fluctuations.

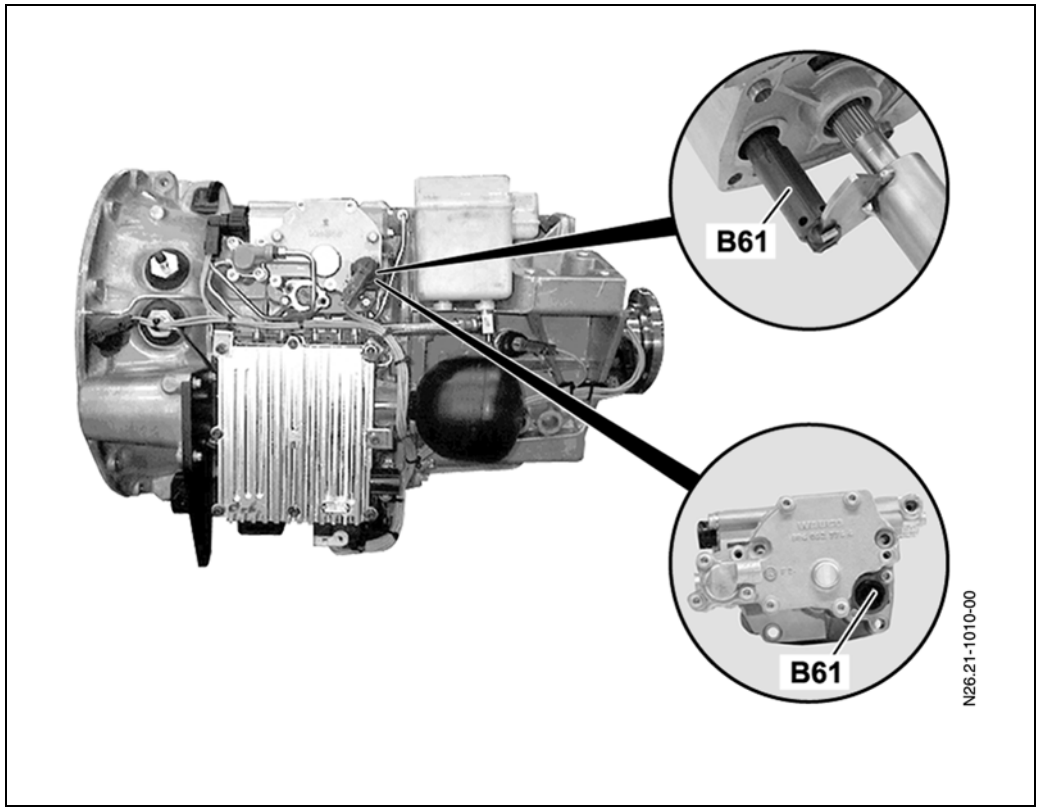
The hydraulic pressure reservoir is filled with a gas.

Supply for at least 4 shift operations in the event of hydraulic pump failure.

Hydraulic transmission positioner



N2660-2252-06



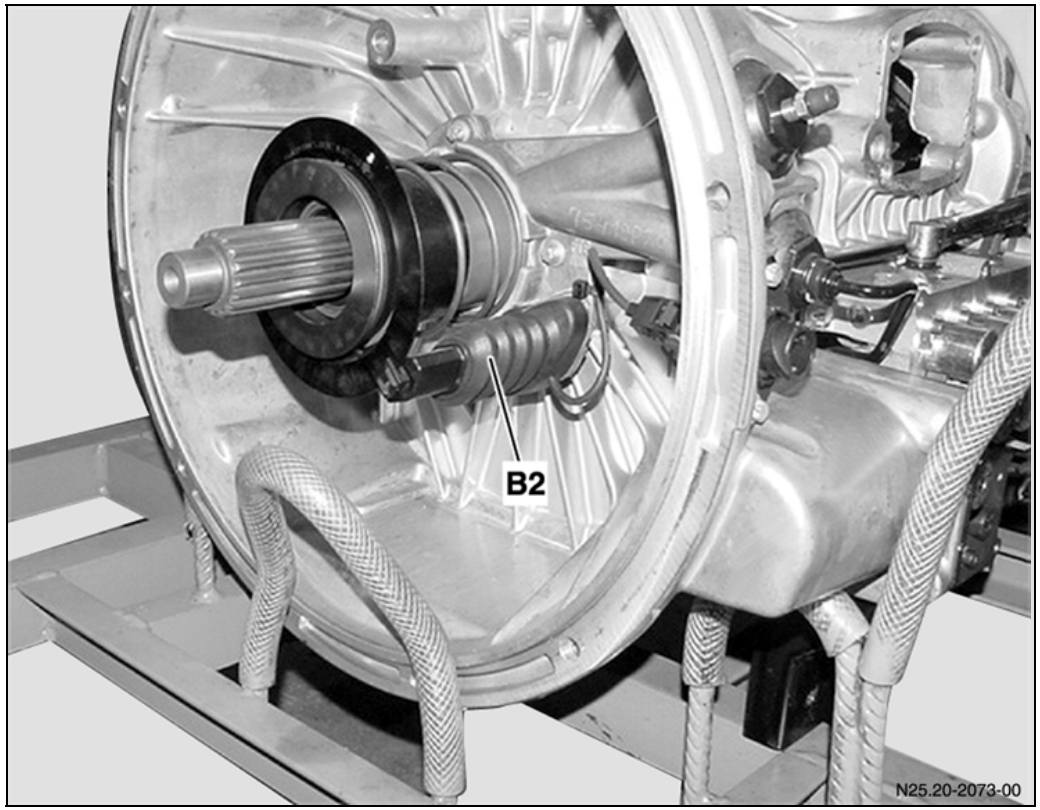
N26.21-2010-06

The hydraulic transmission positioner (12) is directly connected to the shift shaft (11) and shifts the gears and gates preselected by the control unit for the automatic gear control (AGS).

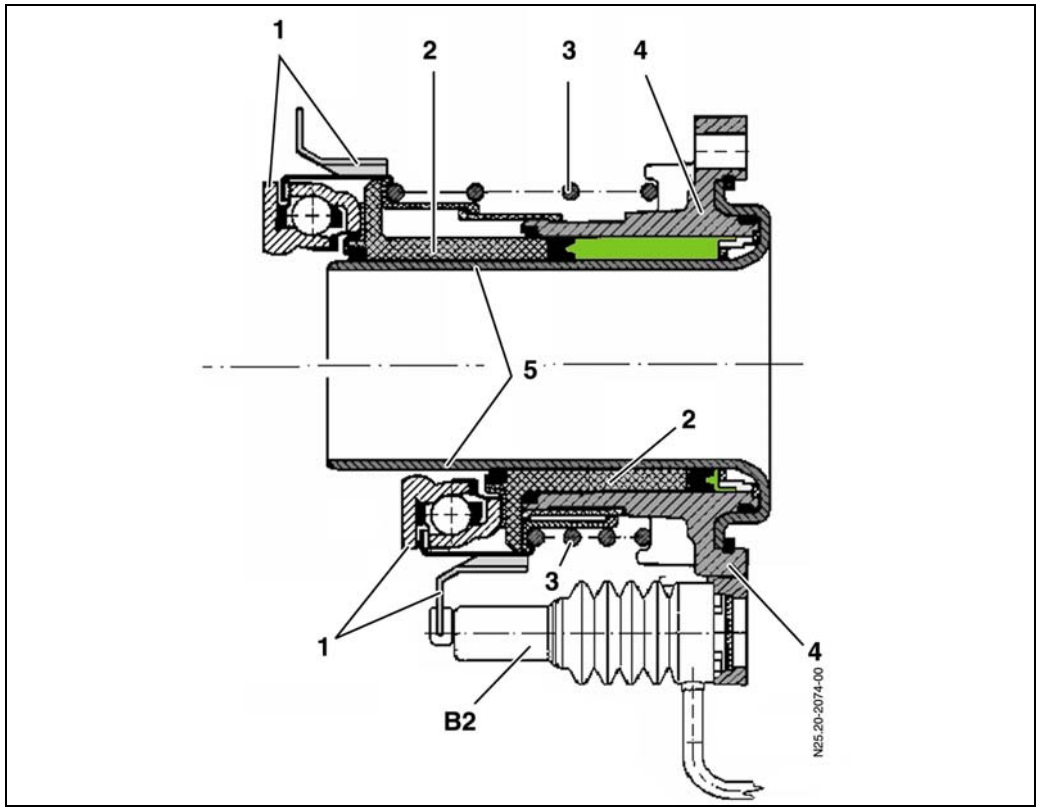
The hydraulic transmission positioner (12) also contains the gear and gate sensors (B61).

Depending on the rotary movement of the shift shaft, the sensors for gear (B60) and gate (B61) generate a variable electric signal which is evaluated by the control unit for the automatic gear control (AGS).

Hydraulic central release bearing and clutch travel sensor



N25.20-2073-02

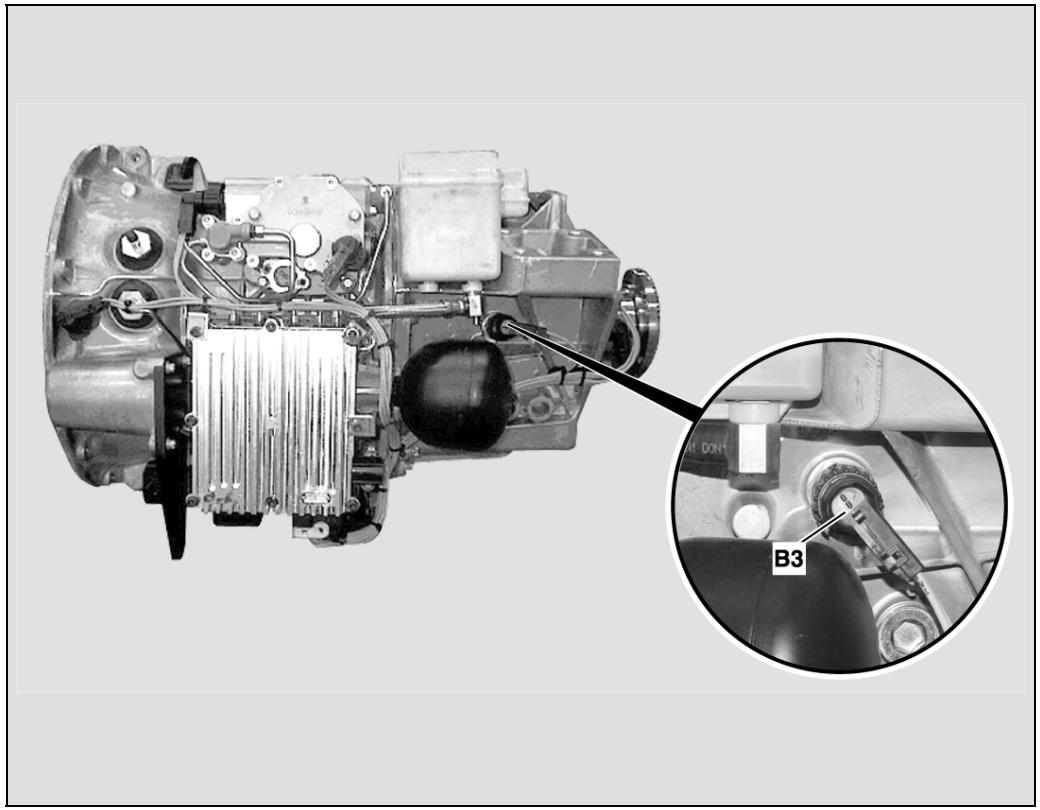


N25.20-2074-02

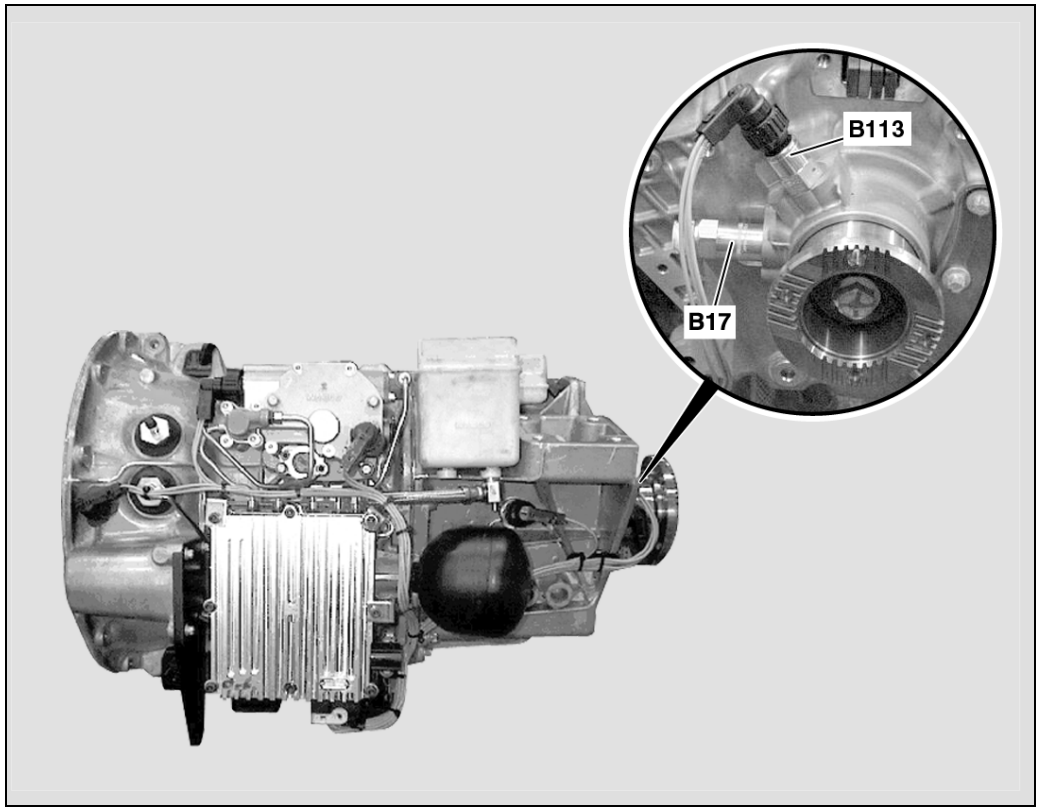
The hydraulic central release bearing (10) is located on the drive shaft of the manual transmission and is screwed firmly in place with the transmission bell. Task of the hydraulic central release bearing: The hydraulic central release bearing (10) operates the clutch pressure plate.

1	Release bearing	B2	Clutch travel sensor
2	Pressure piston	A	Basic position
3	Preload spring	B	Pressure position
4	Housing		
5	Transmission input shaft		

Countershaft speed sensor and transmission output speed sensor



W26.19-1034-05



W26.19-1033-05

The countershaft speed sensor (B3) inductively records the countershaft speed and provides the control unit for the automatic gear control (AGS) with the corresponding analog power signal.

The transmission output speed sensor (B113) inductively records the speed of the transmission output shaft and makes it available to the control unit for the automatic gear control (AGS) as a corresponding power signal.

In vehicles with all-wheel drive an additional transmission output speed sensor (B113.1) is installed in the place of the speed sensor (B17).

Hydraulic reservoir containing Pentosin CHF 11S

The hydraulic reservoir (16) is mounted on the rear left hand side of the transmission.

The hydraulic reservoir stocks a certain quantity of hydraulic fluid (Pentosin CHF 11 S) and ensures atmospheric pressure compensation.

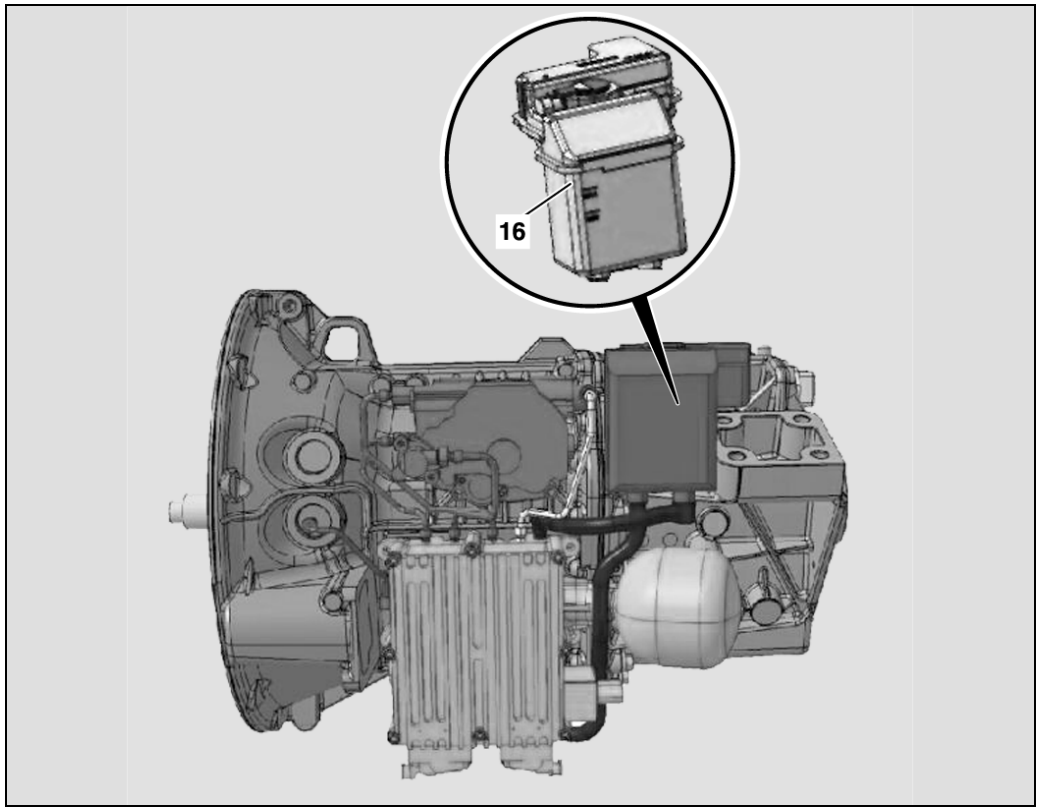
In unpressurized systems the hydraulic reservoir must be filled right to the top. If pressure is now built up in the system, the fluid level decreases rapidly.

Note:

Ensure the correct hydraulic fluid is used – **only use Pentosin!**

Ensure the hydraulic reservoir is filled to the correct level

- Unpressurized system – fill hydraulic reservoir up to top



W26.60-1128-12

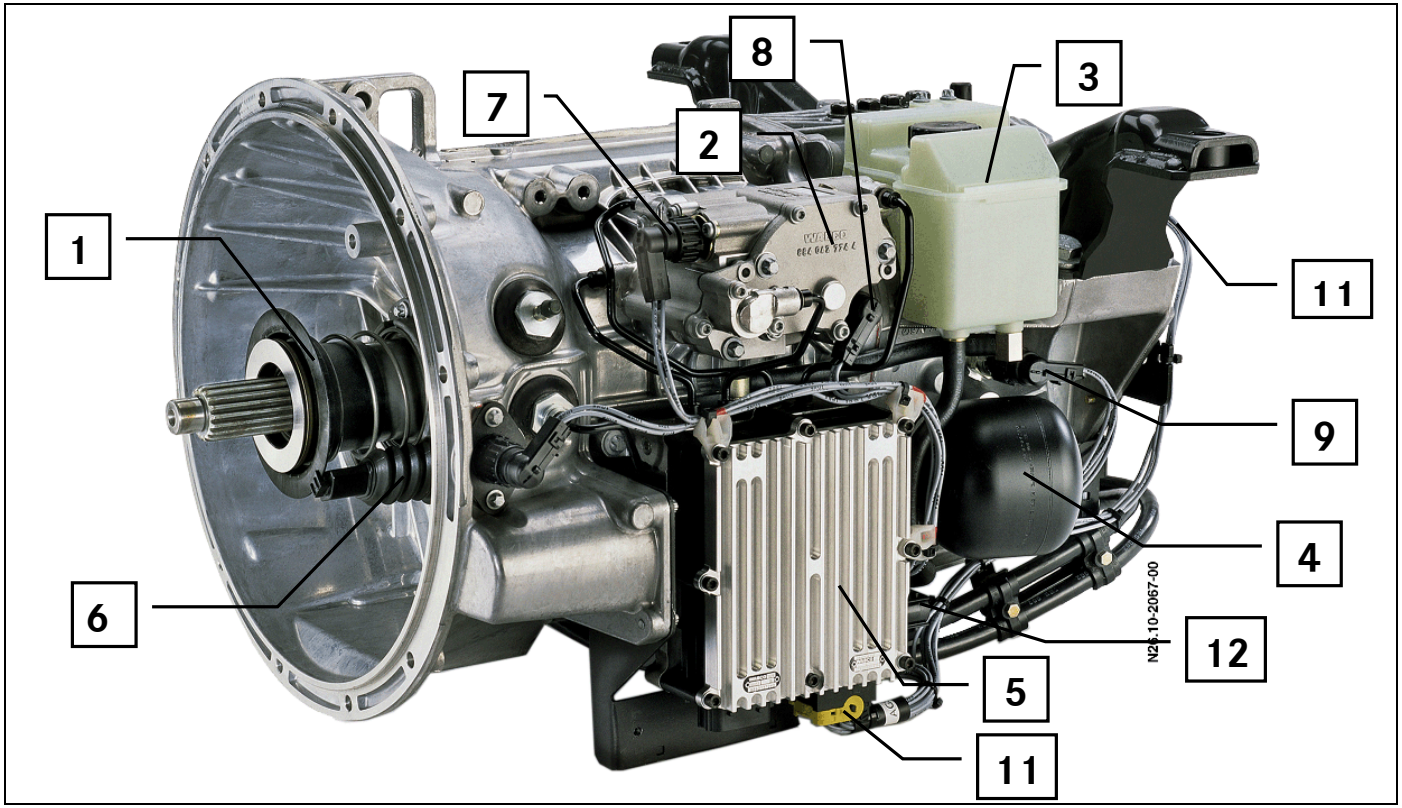
16 Hydraulic reservoir containing Pentosin CHF 11S

AGS (Code GE1), location of the AGS components on the transmission and their task; exercise

29.10.2003

Task

- dentify the numbered transmission components in the diagram and allocate them to the correct designation in the table below. Use the function description GF26.21-W-0003A (Automatic gear control AGS – function).



N26.10-2067-00

1	Hydraulic central release bearing	5	AGS control unit	9	Countershaft speed sensor
2	Hydraulic transmission positioner	6	Clutch travel sensor	10	Transmission output speed sensor
3	Hydraulic reservoir for Pentosin	7	Gear sensor	11	Electrical connection for transmission electrics
4	Pressure reservoir	8	Gate sensor	12	Electrical connection for hydraulic pump

Task

❍ Enter the correct component and its number in the table below according to the tasks described. Then decide whether the relevant component's information is only required by the AGS system or by other systems as well, and if so, state the name of the system(s).
Use the function description GF26.21-W-0003A (Automatic gear control AGS – function).

No.	Component	Task	AGS only	Systems
5	AGS control unit	... is the central control electronics system for performing transmission-related functions.		FR
1	Hydraulic central release bearing	... operates the clutch pressure plate.		FR
7	Gear sensor	... generates a variable electric signal, depending on the rotary movement of the shift shaft, and makes this available to the AGS control unit.	X	
4	Pressure reservoir	... reserves the pressure generated by the hydraulic pump, makes this available to the AGS system and absorbs pressure fluctuations.	X	
10	Transmission output speed sensor	... inductively records the speed of the transmission output shaft and makes it available to the AGS control unit.	X	
2	Hydraulic transmission positioner	... is directly connected to the shift shaft and shifts the gears and the gate preselected by the AGS control unit.	X	
7	Gate sensor	... records the axial movement of the shift shaft, generates an electric signal from this and makes it available to the AGS control unit.	X	
9	Countershaft speed sensor	... inductively records the countershaft speed and makes the corresponding analog power signal available to the AGS control unit.		FR
6	Clutch travel sensor	... records the clutch travel and makes a corresponding electrical signal available to the AGS control unit.		FR

	AGS (Code GE1), solenoid valves special features	29.10.2003

Further information follows concerning the operation of the solenoid valves:

- The design of the solenoid valves is 25% ED (operating time).
- These solenoid valves have two positions: energized – open and not energized – closed (basic position), special feature: pressure modulation solenoid valve (A92y4), energized-closed and not energized-open (basic position).
- The clutch solenoid valves are only energized for opening until such time as a "Minimum clutch learned value" differential value of approx. 315 counts is reached. Two solenoid valves are installed for opening and two for closing. This is in the interests of safety. In "normal" clutch operation only one solenoid valve is actuated alternately for opening and closing. If the clutch needs to be opened or closed rapidly, then both solenoid valves may be actuated accordingly.
- The High gate solenoid valves are energized for engaging the gate 3/4 to be shifted until such time as the gate position is set at a corresponding displacement value that has been stored as a learned gate value.
- The even and odd gear solenoid valves are energized for engaging the gear to be shifted until such time as the gear position is set at a corresponding displacement value which has been stored as a learned gear value. In addition, the pressure modulation solenoid valve (A92y5) must be co-actuated with every actuation of a gear solenoid valve (pulsed actuation). This serves to reduce pressure when engaging a gear. This in turn facilitates the synchronization work in the transmission (supports, no premature wear).
- When shifting reverse gear, the countershaft is braked by asynchronization of the 2^{nd} gear (avoidance of shift sounds) before the reverse gear is shifted.

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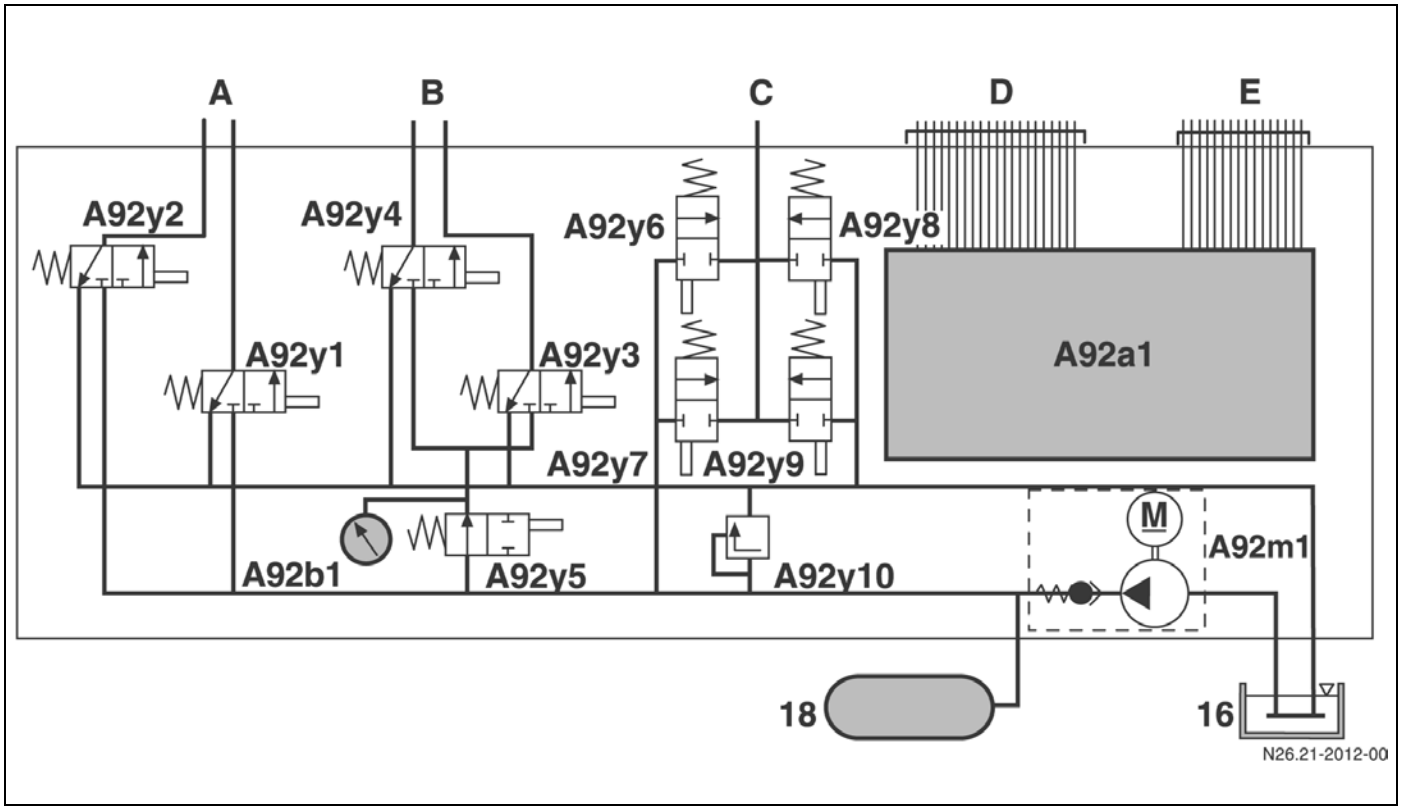
AGS (Code GE1), assignment and actuation of the solenoid valves; exercise

29.10.2003

The control unit for automatic gear control (AGS) (A92a1) ensures that the clutch is opened and closed correctly and ensures actuation of the gear and gate solenoid valves. Only a few solenoid valves are used to move to the different transmission positions. Which solenoid valve is required for which transmission position? This question should be explained below.
A total of 2 clutch positions, 4 gate positions and 3 gear positions must be moved to with the help of the solenoid valves.

A92a1	Control unit, automatic gear control (AGS)
A92b1	Oil pressure/termperature combination sensor
A92m1	Hydraulic pump
A92y1	Solenoid valve, gate low
A92y2	Solenoid valve, gate high
A92y3	Solenoid valve, even gear
A92y4	Solenoid valve, odd gear
A92y5	Pressure modulation solenoid valve
A92y6	Solenoid valve, open clutch 1
A92y7	Solenoid valve, open clutch 2
A92y8	Solenoid valve, close clutch 1
A92y9	Solenoid valve, close clutch 2
A92y10	Pressure relief valve
16	Fluid reservoir
18	Hydraulic pump
A	To gate cylinder hydraulic transmission positioner
B	To gear cylinder hydraulic transmission positioner
C	To hydraulic central release bearing
D	Electrical connection for vehicle electrics
E	Electrical connection for transmission electrics



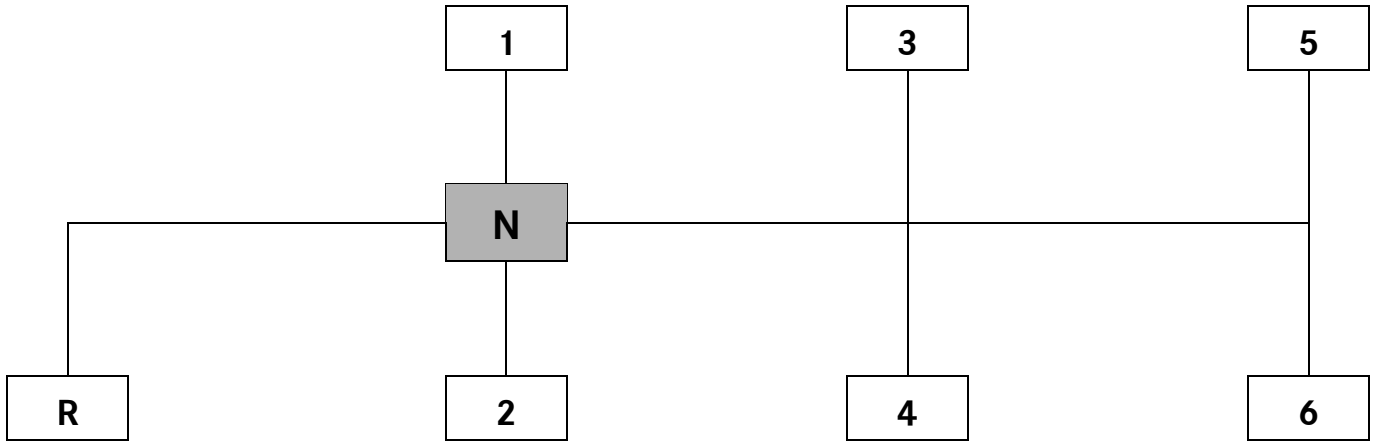
P

Task

❍ Which solenoid valves must be energized in order to shift the preselected gears on a G60? Complete the block diagram.
Note: Use the function description GF 26.21-W-3100-03A Control unit for automatic gear control AGS – location, task, design.

Solenoid valves:

Gear		*A92y4 / A92y5*	*A92y4 / A92y5*	*A92y4 / A92y5*
Gate		*Spring centered*	*A92y2*	*A92y2*



Gate	*A92y1*	*Spring centered*	*A92y2*	*A92y2*
Gear	*A92y3 / A92y5*	*A92y3 / A92y5*	*A92y3 / A92y5*	*A92y3 / A92y5*

Task

❍ Which solenoid valves must be energized in order to shift the preselected gears on a G60? Note also the order of the energization.

Caution: Starting position: Clutch closed

Note: Use the function description GF26.20-W-3007A - transmission, shifting, function.

	1						2						5						N						R					
	Sequence						Sequence						Sequence						Sequence						Sequence					
Solenoid valve, gate low	A92y1						A92y1						A92y1						A92y1						A92y1		X	X		
Solenoid valve, gate high	A92y2						A92y2						A92y2		X	X			A92y2		X	X			A92y2					
Solenoid valve, even gear	A92y3						A92y3		X				A92y3						A92y3			X			A92y3					
Solenoid valve, odd gear	A92y4		X				A92y4						A92y4			X			A92y4						A92y4			X		
Pressure modulation solenoid valve	A92y5		X				A92y5		X				A92y5			X			A92y5			X			A92y5			X		
Solenoid valve, open clutch 1	A92y6	X					A92y6	X					A92y6	X					A92y6	X					A92y6	X				
Solenoid valve, open clutch 2	A92y7						A92y7						A92y7						A92y7						A92y7					
Solenoid valve, close clutch 1	A92y8			X			A92y8			X			A92y8				X		A92y8				X		A92y8				X	
Solenoid valve, close clutch 2	A92y9						A92y9						A92y9						A92y9						A92y9					

Note:

Gear change sequence: Open clutch – gate – gear – close clutch

Interplay of AGS control unit, sensor and solenoid valves

The AGS control unit activates the solenoid valve. The control unit uses the sensors to detect whether the energizing of the solenoid valve has the desired effect, whether the hydraulic transmission positioner is moving in the correct direction and whether the shift is completed.
Furthermore, the sensor also measures the shifting speed and the duration of the shifting operation.

So how does the control unit know when a shifting operation is over?

In order for the control unit to be able to detect this, it is necessary for all the positions of a shifting operation to be “shown” to the control unit.
We call this the “teach-in process”.

During the teach-in process all the positions required for a shifting operation are moved to, checked for plausibility and then stored as learned values.
STAR DIAGNOSIS can be used to call up these learned values and to compare them with the current values.

Example:	Learned value "Odd gear"	144 counts
	Learned value "Neutral"	609 counts
	Learned value "Even gear"	956 counts

Task

❍ You have connected the STAR DIAGNOSIS on a stationary ***ATEGO*** and the gear display in the instrument is showing "1" in the display.
What number of counts do you read off for the gear displacement value?

✍ _____*144*_____ counts

On an ***ATEGO*** 1217 with a G 60 transmission you have read out the following learned values and actual values in the AGS system:

Learned values:	
Learned value "Odd gear" (sliding sleeve is in direction “Output switched”)	144 counts
Learned value "Neutral"	609 counts
Learned value "Even gear" (sliding sleeve is in direction “Drive switched”)	956 counts
Learned value "Reverse gate"	204 counts
Learned value "Gate cylinder position 1/2"	448 counts
Teach-in value "Gate cylinder position 3/4"	694 counts
Learned value "Gate cylinder position 5/6"	938 counts
Learned value, clutch minimum	611 counts
Current actual values:	
Gear displacement value	956 counts
Gate displacement value	452 counts
Clutch displacement value	613 counts

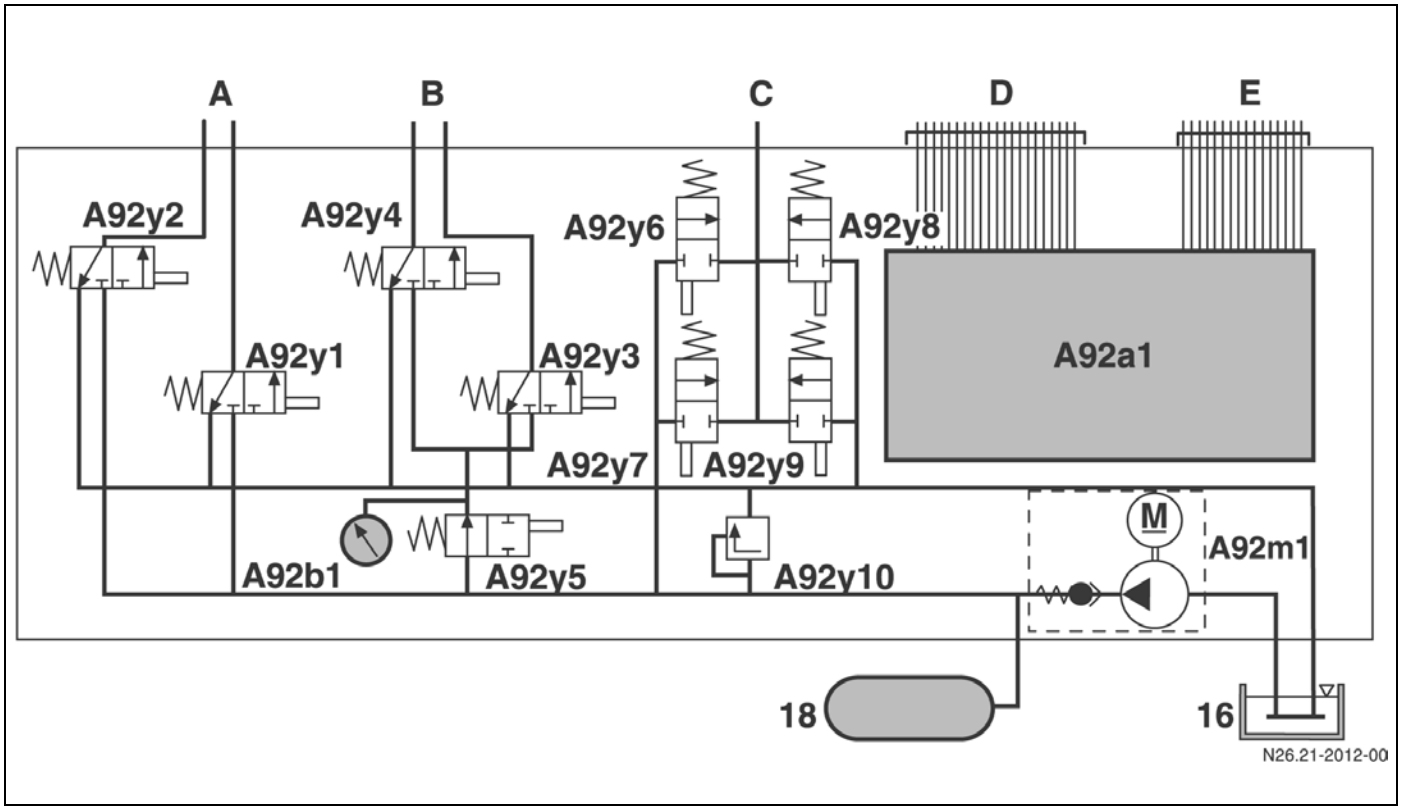
Task

❍ In which positions are the clutch and transmission located on the basis of the preset AGS learned values and displacement values?

Clutch: ✍ ***Closed***

Gear: ✍ ***2***

A92a1	Control unit, automatic gear control (AGS)
A92b1	Oil pressure/termperature combination sensor
A92m1	Hydraulic pump
A92y1	Solenoid valve, gate low
A92y2	Solenoid valve, gate high
A92y3	Solenoid valve, even gear
A92y4	Solenoid valve, odd gear
A92y5	Pressure modulation solenoid valve
A92y6	Solenoid valve, open clutch 1
A92y7	Solenoid valve, open clutch 2
A92y8	Solenoid valve, close clutch 1
A92y9	Solenoid valve, close clutch 2
A92y10	Pressure relief valve
16	Fluid reservoir
18	Hydraulic pump
A	To gate cylinder hydraulic transmission positioner
B	To gear cylinder hydraulic transmission positioner
C	To hydraulic central release bearing
D	Electrical connection for vehicle electrics
E	Electrical connection for transmission electrics



N26.21-2012-00

Task

❍ You want to shift the G 60 transmission out of neutral into 2nd gear with the engine running.
Which solenoid valve(s) must be energized?

[a]	[a]	A92y1	[b]	[b]	A92y2	[X]	[c]	A92y3
[d]	[d]	A92y4	[X]	[e]	A92y5	[X]	[f]	A92y6
[g]	[g]	A92y7	[h]	[h]	A92y8	[i]	[i]	A92y9

Task

❍ That was easy, now shift from the engaged 2nd gear into the reverse gear!
This can only be done in 4 steps.
Starting position: Vehicle running (only the gear change is being observed).

1st step:	**Open clutch**																				
		a	a	A92y1	b	b	A92y2	c	c	A92y3	d	d	A92y4	e	e	A92y5	X	f	A92y6	g	g	A92y8
2nd step:	**Neutral position**																				
		a	b	A92y1	b	b	A92y2	c	c	A92y3	X	d	A92y4	X	e	A92y5	f	f	A92y6	g	g	A92y8
3rd step:	**Gate selection**																				
		X	c	A92y1	b	b	A92y2	c	c	A92y3	d	d	A92y4	e	e	A92y5	f	f	A92y6	g	g	A92y8
4th step:	**Gear selection**																				
		X	d	A92y1	b	b	A92y2	X	c	A92y3	d	d	A92y4	X	e	A92y5	f	f	A92y6	g	g	A92y8

Note: If reverse and gears 3/4 and 5/6 are selected in the main transmission, then the corresponding solenoid valve for the gate only remains energized until such time as the respective gear is engaged.

Task

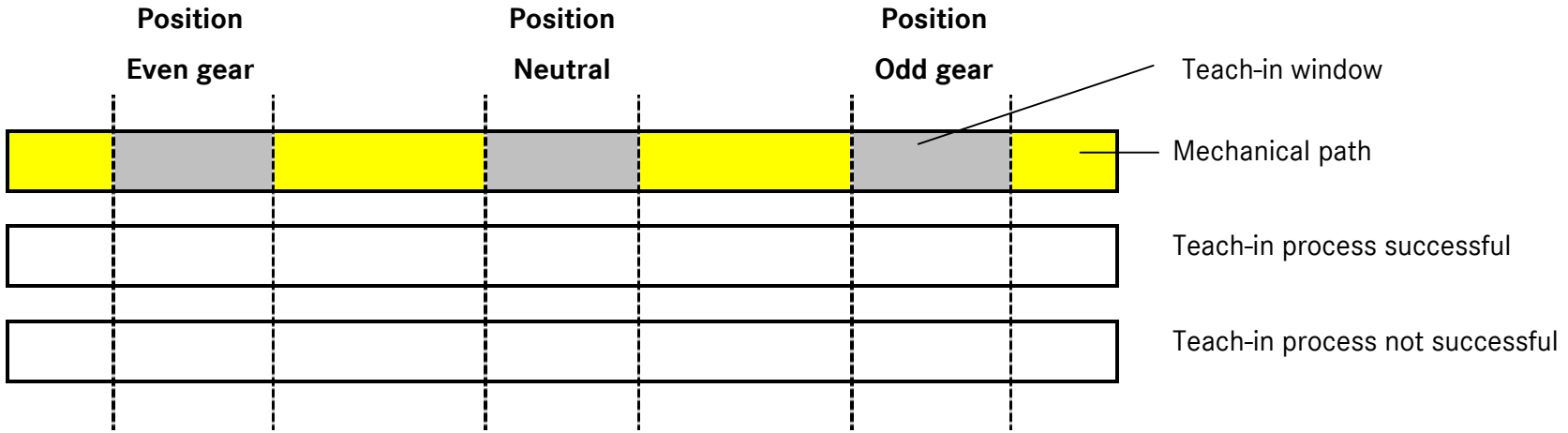
❍ Let's try it again! You are shifting from 2nd gear into reverse gear.
Starting position from previous task.
<u>Note:</u> The following can be assumed when working out the task: For clutch operation only solenoid valve 1 is always used for opening and closing.

Sensor values in 2nd gear:	Clutch displ. value *300* counts		Gear displ. value *956* counts		Gate displ. value *448* counts		
Open clutch:	[a] [e] A92y1	[b] [b] A92y2	[c] [c] A92y3	[d] [d] A92y4	[e] [e] A92y5	[X] [f] A92y6	[g] [g] A92y8
Sensor values open clutch:	Clutch displ. value *615* counts		Gear displ. value *956* counts		Gate displ. value *448* counts		
Shifting into neutral position:	[a] [f] A92y1	[b] [b] A92y2	[c] [c] A92y3	[X] [d] A92y4	[X] [e] A92y5	[f] [f] A92y6	[g] [g] A92y8
Sensor values in neutral position:	Clutch displ. value *300* counts		Gear displ. value *609* counts		Gate displ. value *448* counts		
Shifting gate selection R:	[X] [g] A92y1	[b] [b] A92y2	[c] [c] A92y3	[d] [d] A92y4	[e] [e] A92y5	[f] [f] A92y6	[g] [g] A92y8
Sensor values gate selection R:	Clutch displ. value *300* counts		Gear displ. value *609* counts		Gate displ. value *204* counts		
Shifting gear selection R:	[X] [h] A92y1	[b] [b] A92y2	[X] [c] A92y3	[d] [d] A92y4	[X] [e] A92y5	[f] [f] A92y6	[g] [g] A92y8
Sensor values gear selection R:	Clutch displ. value *300* counts		Gear displ. value *956* counts		Gate displ. value *204* counts		
Shift completed:	[a] [i] A92y1	[b] [b] A92y2	[c] [c] A92y3	[d] [d] A92y4	[e] [e] A92y5	[f] [f] A92y6	[g] [g] A92y8

The reason for carrying out the individual teach-in processes and the procedure for doing so is now sufficiently familiar.
Now let us turn our attention to the sequence of a teach-in process from the control unit's point of view with regard to the analysis of the position reached.

Task

❍ Complete the bar chart for evaluating the teach-in process using the example of the gear cylinder. Mark the bar chart fields for the shift position according to the criteria "Teach-in process successful" and "Teach-in process not successful".



Task

❍ How can you detect that the teach-in process was not successful?

✍ *Gear indicator remains dark and it is no longer possible to select and engage gears*

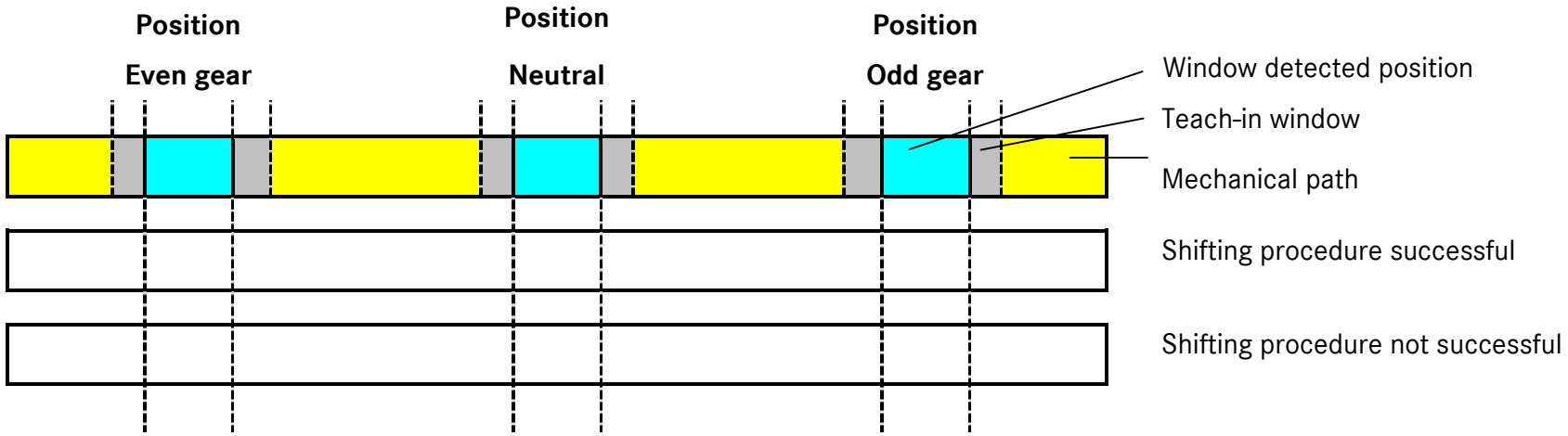
✍ *A text message appears on the display, e.g. "AGS 11"*

Sensor analysis during shifting procedure

Now let us turn our attention to the sequence of a shifting procedure from the control unit's point of view with regard to the analysis of the positions reached.

Task

❍ Complete the bar chart for evaluating the shifting procedure using the example of the gear cylinder. Mark the bar chart fields for the shift position according to the criteria "Shifting procedure successful" and "Shifting procedure not successful".



Task

❍ How can you detect that the shifting procedure was not successful?

✍ *Gear indicator shows "N" and it is no longer possible to select and engage gears*

✍ *No event indication is displayed.*

Description of the clutch and transmission teach-in process ("Minor, Major" teach-in process) in the AGS

In order for the automatic gear control to be able to work perfectly without malfunctions after various repair and maintenance tasks have been carried out on the clutch and transmission, it is necessary to initialize a "minor" or "major" teach-in process in the AGS system depending on the situation.

During the "minor" and "major" teach-in process, the following positions are moved to during the teach-in process:

1. Gear R
2. Gear 5 and 6
3. Open and close clutch 2x consecutively

All other positions for shifting the gear and gate are determinedby the AGS control unit on the basis of the positions "moved to" and are likewise stored as learned values.
During the "minor" teach-in process, the clutch learned value is not retransferred to the AGS control unit.

"Minor" teach-in process

Press and hold the neutral button on the AGS sensor unit
Ignition "On"
Teach-in process successfully completed if "N" appears in the gear display

"Major" teach-in process

Press and hold the function button and the neutral button on the AGS sensor unit
Ignition "On"
When "N" begins flashing in gear display, start engine
Teach-in process successfully completed if "N" appears in the gear display

Please note the visual displays during the teach-in process!

During a teach-in process the displacement values of the clutch, gear and gate travel sensors are recalculated and stored as learned values in the control unit for the automatic gear control AGS. These learned values are newly stored in every teach-in process.

Task

❍ There are two different teach-in processes for vehicles with Telligent automatic transmission AGS (GE1).
Find out which teach-in process should be carried out for which operations.
Mark the respective teach-in process with a cross in the table.
Note: For further information see the DAS simulation.

Circumstances	**Teach-in process**	
	Major	**Minor**
Transmission exchange identical	X	
Transmission exchange not identical (different type)	X	
Gear and gate sensor replaced		X
Clutch sensor replaced	X	
Clutch replaced	X	
Hydraulic central release bearing replaced	X	
Work done on hydraulic system (line renewal, transmission positioners a + e)	X	
Hydraulic system self-ventilated	X	
GS control unit replaced	X	
FR control unit replaced		
Non-identical engine replacement (different type, changed engine output)	X	
Identical engine replacement	X	

AGS teach-in faults

During the "minor" and "major" teach-in process in the AGS system, various fault messages can be displayed by the AGS control unit on the instrument display.

These fault messages on the display refer to teach-in and operating faults.

Task

❍ In which current service documentation can you read up on the corresponding teach-in and operating faults and then take appropriate remedial action?
Indicate the correct answer.

- [a] Diagnosis manual
- [b] Electrical wiring diagrams
- [c] Workshop Information System (WIS)
- [d] Vehicle operator's manual
- [☒] [e] Diagnosis Assistance System (DAS)

Task

❍ Which basic conditions have to be fulfilled so that the teach-in process (minor, major) can be performed properly?

- [☒] [a] Battery voltage > 24 V
- [☒] [b] Parking brake actuated
- [☒] [c] Hydraulic reservoir pressure > 60 bar
- [d] Engine at idle speed

Task

❍ While you are performing the "major" teach-in process, AGS 28 appears in the display and the teach-in process is cancelled.
What does this message mean and which sign did you fail to observe during the teach-in process?

✍ Teach-in fault, engine not started

✍ If the neutral display is flashing, then the engine must be started

✍ after no longer than 10 seconds if the major teach-in process is being carried out.

Task

❍ While you are performing the "minor" teach-in process, AGS 24 appears in the display and the teach-in process is cancelled.
What does this message mean and which sign did you fail to observe during the teach-in process?

✍ Teach-in fault, parking brake not activated

✍ Parking brake not activated or

✍ signal is incorrectly detected

Notes:

✍ *AGS teach-in faults/text messages are located*

✍ *in the DAS simulation under the corresponding*

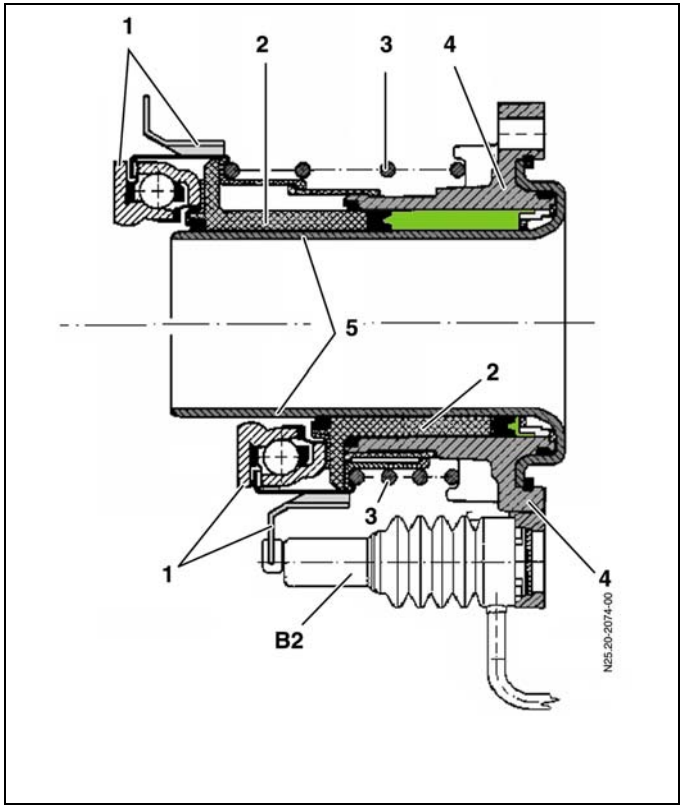
✍ *menu*

Basically the automatic gearshift system (AGS) is fitted with a clutch travel sensor. This sensor is connected to the AGS control unit.
The clutch travel sensor records the movement of the hydraulic central release bearing.

The measured sensor values are displayed in counts.
The control unit subdivides the range "Hydraulic central release bearing not activated" through to "Hydraulic central release bearing fully activated" into "Clutch open", "Intermediate position" and "Closed".
The pressure piston of the hydraulic central release bearing is moved in the direction of the clutch when the clutch is actuated. The sensor tappet moves away from the sensor. The sensor value increases. On account of the wear on the drive plate, the pressure piston travels towards the clutch, the clutch tappet is immersed in the sensor to a lesser extent and the sensor value increases.

The sensor value, zero point with a new clutch, is stored in the control unit and can be compared with the sensor value of the current zero point. The difference between these two values represents the wear.

The clutch travel is evaluated on an inductive basis and, as such, is contactless and wear-free.



N25.20-2074-02

1 Release bearing
2 Pressure piston
3 Preload spring
4 Housing
5 Transmission input shaft
B2 Clutch travel sensor
A Basic position
B Pressure position

AGS (Code GE1), FR and AGS actual values; exercise

29.10.2003

Actual values are stored in the control unit for the drive control and AGS for a wide range of vehicle functions.

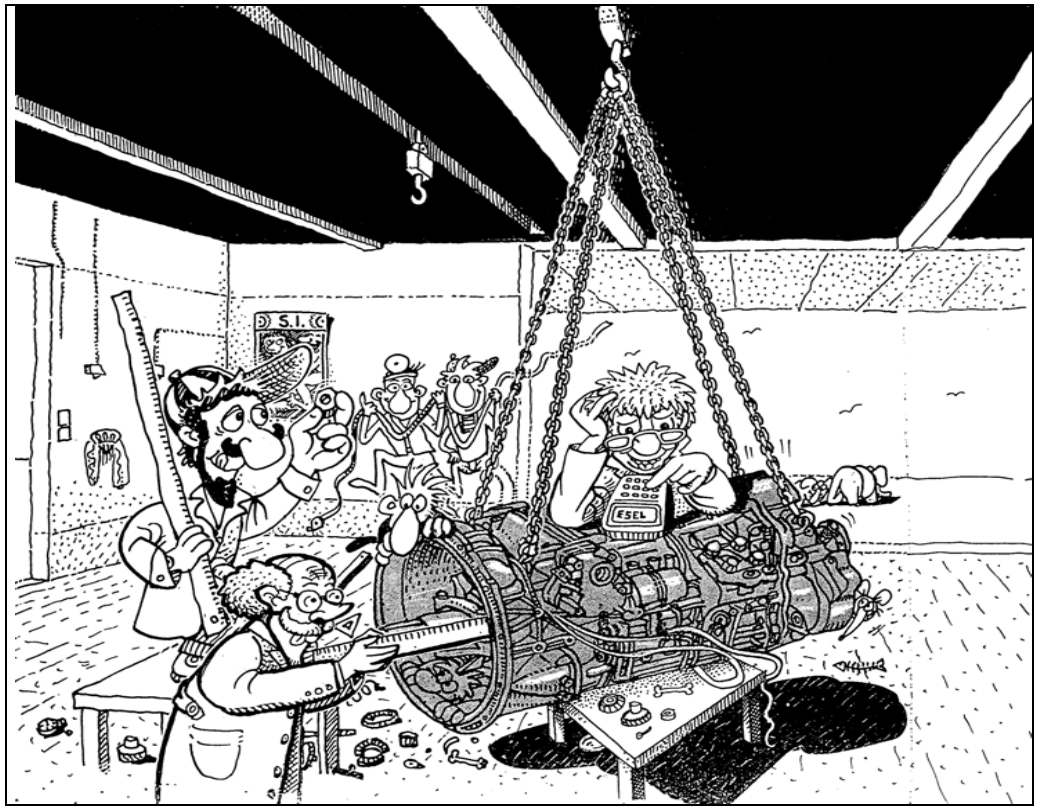
Our focus in this case is on the actual values connected with the Telligent automatic transmission AGS.

In order to gain an initial overview we will attempt to allocate the actual values to potential problem cases.

A large amount of current information on gear control and clutch operation can be read out from the "FR and AGS actual values" menu.

Many of these actual values can be referred to when diagnosing different customer complaints.

As you can see from the printouts you have been given showing current actual values for drive control and AGS, there is a large number of actual values.



N26.00-2026-09

Task

❍ Indicate which actual value groups for drive control and AGS may be of further help to you in diagnosing the reasons for the customer complaints on the following page.
Discuss possible solutions in groups.

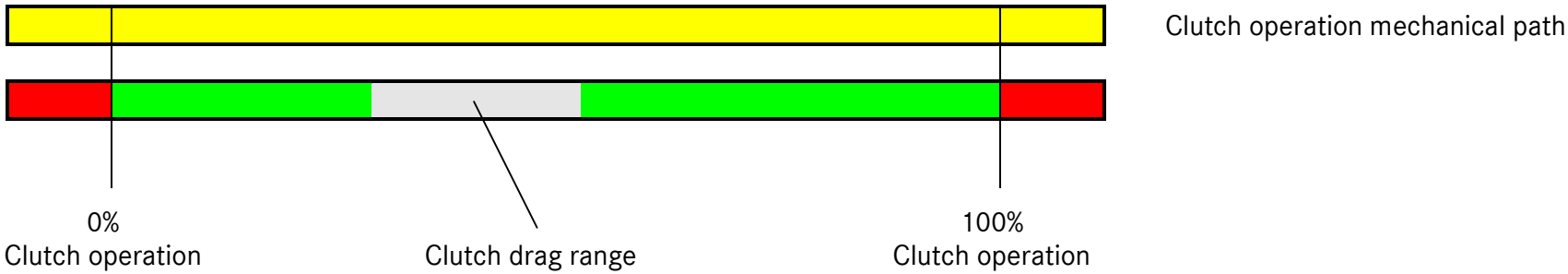
Customer complaint	AGS actual value group	FR actual values group
AGS teach-in process incorrectly terminated (AGS text message displayed)	• *Transmission / control unit version* • *Current vehicle status* • *Current and taught-in displacement values* • *Number of shifting cancellations* • *Hydraulic system*	***Note:** Only the actual value group designations are stated as proposed solutions.*
Inoperability of, e.g., engine brake, permanent brake, cruise control, Temposet	• *Current vehicle status*	• *Engine brake* • *Clutch* • *Retarder* • *Cruise control* • *Clutch control Part 1* • *Clutch control Part 2*
Gear selection/preselection not possible / Splitter gearshift system not available / Reverse shifting not possible	• *Transmission / control unit version* • *Current vehicle status* • *Shifting times* • *Current and taught-in displacement values*	• *Integrated automatic gear determination* • *GS sensor unit for gear control* • *Clutch control Part 1* • *Clutch control Part 2*
Shift abort	• *Shifting times* • *Current and taught-in displacement values* • *Number of shifting cancellations* • *State of solenoid valves for shifting operations* • *Hydraulic system*	
Poor start-off and maneuvering response	• *Current and taught-in displacement values*	• *Clutch* • *Clutch control Part 1* • *Clutch control Part 2*
Implausible gear selection	• *Transmission / control unit version* • *Current vehicle status* • *Other ACTUAL values*	

The AGS clutch balancing in the ATEGO corresponds to the clutch characteristics in the ACTROS models 930 - 934 with Telligent automatic transmission II. "Clutch balancing" in the ATEGO and "Clutch characteristics" in the ACTROS models 930 – 934 are inherently the same.

Clutch characteristics

Based on the clutch characteristics, the FR control unit detects the start or end position of the clutch drag point. The drag point has a short range in automated clutch operation.

The drag point of the clutch is defined as follows:
When "Close clutch" is selected, transferl of the engine torque starts, and when "Open clutch" is selected, transfer of the engine torque ceases at this point. The drag point is at approximately 30 -50 % of the clutch operation.
Automated clutch operation attempts rapid overcoming of the "free travel" to the drag point.
Comfortable start-off, disengaging and maneuvering response should be guaranteed despite the "rapid" clutch operation.



Teaching in clutch characteristics

The clutch characteristics are continually teaching themselves in automatically while traveling.
The "adjustment" of the clutch characteristics does, however, become more sluggish as the length of operating time increases.
The clutch characteristics therefore need to be reset after the following work has been carried out:

- ⇒ FR control unit replaced
- ⇒ Engine or transmission removed or replaced
- ⇒ Work performed on clutch and clutch operation
- ⇒ Hydraulic central release bearing replaced
- ⇒ "Minor/major teach-in process" carried out in the AGS

Clutch balancing procedure

The AGS clutch balancing resets the clutch characteristics in the FR control unit. The clutch balancing is triggered in the "Teach-in processes" menu option in the AGS control unit. The teaching-in procedure for the "clutch balancing" is menu-assisted.

Confirm this menu option and follow the further instructions given by DAS. The stored clutch characteristics are then deleted from the FR control unit. After some 6-7 shift operations the new clutch characteristics are identified in the FR control unit and stored. These serve as the new basis for adjusting the clutch response. The start-off and clutch response may seem rather awkward during the first 6-7 shift operations required for teaching in the new clutch characteristics.

⚠ **Instructions for testing and repair work on the AGS gearshift system:**

Please note:

- Gear and clutch actuations and manual gearshifts can cause damage if the transmission unit is removed.
- Work may only be carried out on the hydraulic system if the system has been depressurized.
- No measurements may be taken on the contacts on the inside of the automatic gear control AGS control unit.

Important:

- Switch engine off.
- Secure the vehicle against rolling away and apply the parking brake.

Depressurization (only hydraulic system operations):

- Prior to depressurization the hydraulic pump plug connection on the transmission must be disconnected.
- After depressurization the plug connection must remain disconnected, otherwise the pressure will build up again when the ignition is switched on.
- The mechanical pressure limiting valve should be undone by half a revolution.
- If the mechanical pressure limiting valve is opened too far, there is a risk of draining the hydraulic system.
- The actuation may lead to fault entries in the control unit. These should be deleted at the end of the test.

Depressurization (installation and removal of the unit):

- Follow the instructions of the menu item "Control system – depressurization"

AGS (Code GE1), emergency operation characteristics

29.10.2003

If a fault is detected in the AGS system by the control unit, then the event is displayed on the driver information system (FIS). The AGS system then shifts into emergency operation characteristics mode.

If the system is being operated in the emergency operation characteristics mode, then only the gears R – N – 1 – 2 can be shifted when stationary depending on the type of damage.
Depending on the type of damage, the clutch is opened when the vehicle is at a standstill but no longer closed.
Caution: As such, the vehicle can no longer be maneuvered without assistance!

Note:

Should a fault occur on the vehicle while traveling, do not stop the vehicle until you have found a suitable parking place / location! Observe the traffic situation!

If a pressure sensor in the control unit fails, then the pump will start up with every shifting operation. The pressure relief valve limits the pressure in the system to approx. 95 bar.

Note:

If the vehicle has to be towed away it is absolutely essential to detach the propeller shaft! (See operator's manual!)

	Transmission diagnosis, practical example template	29.10.2003

Order	Defined sub-areas / functions	Test strategy
Vehicle: **Complaint:**		• . . . . . . • . . . . . . • . . . . . . • . . . . . . • . . . . . . • . . . . . .

Notes:

Sub-area log sheet:

Functions	Condition	What test method is being used?	TARGET value	ACTUAL value	Notes / reference

Sub-area log sheet:

Functions	Condition	What test method is being used?	TARGET value	ACTUAL value	Notes / reference

Sub-area log sheet:

Functions	Condition	What test method is being used?	TARGET value	ACTUAL value	Notes / reference

AGS (Code GE1), practical 1; exercise

29.10.2003

Customer complaint

❍ The customer complains of abnormal shift terminations on an ATEGO 1317 with Telligent automatic transmission AGS. No event is being displayed in the instrument.
The ATEGO is fitted with the following major assemblies:

Chassis no.	WDB 970 065 1K 253854.....
Engine	904 917 .....
Transmission	715 050 .....

Task

❍ Check the learned values and displacement values on the basis of the AGS actual values provided by the STAR DIAGNOSIS. Complete the table below.
Note: Odd-numbered gear = 1st gear, even-numbered gear = 2nd gear

No.	Name	Actual value	Unit	No.	Name	Actual value	Unit	Difference	
17	Learned value "Even gear"	_____	Counts	14	Gear displacement value	_____	Counts	_____	Counts
18	Learned value "Neutral"	_____	Counts	14	Gear displacement value	_____	Counts	_____	Counts
19	Learned value "Odd gear"	_____	Counts	14	Gear displacement value	_____	Counts	_____	Counts
20	Learned value "Reverse gate"	_____	Counts	15	Gate displacement value	_____	Counts	_____	Counts
21	Learned value "Gate cylinder, position 1/2"	_____	Counts	15	Gate displacement value	_____	Counts	_____	Counts
24	Learned value, clutch minimum	_____	Counts	16	Gate displacement value	_____	Counts	_____	Counts

Gears 3-6 cannot be shifted when the vehicle is stationary!

Task

❍ Carry out a "minor teach-in process" in the AGS system.

Notes:

✍ *Aaa*

✍ *Aaa*

✍ *Aaa*

Task

❍ What changes can you detect in the AGS system after a "minor teach-in process" on the basis of the learned values and displacement values when compared with the actual values recorded prior to the "minor teach-in process"?

Notes:

✍ *Aaa*

✍ *Aaa*

✍ *Aaa*

AGS (Code GE1), practical 2; exercise

29.10.2003

Customer complaint

❍ The customer complains of occasional abnormal shift terminations on an ATEGO 1317 with Telligent automatic transmission AGS. An event is being displayed in the instrument.
The ATEGO is fitted with the following major assemblies:

Chassis no.	WDB 970 065 1K 253854
Engine	904 917 .....
Transmission	715 050 .....

Task

❍ Disconnect the electrical connection for the gear sensor on the hydraulic transmission positioner.
What reactions can you detect in the display or when actuating the AGS sensor unit?

Display:

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

Actuation of the AGS sensor unit:

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

Task

❍ Process the fault code with the help of STAR DIAGNOSIS.
Note down your procedure.

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

✍ *Aaa* _____

Notes

Reminder: Delete the fault code in the AGS system!

Customer complaint

The customer complains of abnormal shift terminations on an ATEGO 1317 with Telligent automatic transmission AGS. No event is being displayed in the instrument.
The ATEGO is fitted with the following major assemblies:

Chassis no.	WDB 970 065 1K 253854.....
Engine	904 917 .....
Transmission	715 050 .....

Task

❍ What could be the cause of an abnormal shift termination in the AGS system?
Note down your findings/the special features.

Enter your initial suppositions

here

✍ *1. Difference between gate and gear displacement and learned values too great*

✍ *2. Shift times are exceeded*

✍ *3. Air admission and vent lines are clogged up or restricted*

✍ *(Hydraulic pressure too low)*

✍ *4. Mechanical wear or sluggishness in transmission*

Task

❍ You have replaced the hydraulic clutch actuator because your diagnosis revealed it to be the cause of the customer complaint. Which teach-in process(es) do you still have to carry out in the AGS system?

✍ *Carry out AGS minor teach-in process and AGS clutch balancing*

Task 1

❍ Carry out a "major teach-in process" in the AGS system.
Note down your findings/the special features.

✍ *Aaa*

✍ *Aaa.*

✍ *Aaa.*

Task 2

❍ Carry out a "clutch balancing" procedure in the AGS system.
Note down your findings/the special features.

✍ *Aaa*

✍ *Aaa.*

✍ *Aaa.*

Reminder: Delete all fault codes in the individual systems!

» ... Die Mitarbeiter werden zukünftig in die Rolle persönlicher Wissensmanager hineinwachsen müssen, die aktiv die Verantwortung für ihre Qualifizierung übernehmen ... « Jürgen E. Schrempp

» ... Staff must in future assume the role of personal knowledge managers, who actively take responsibility for their own qualification ... « Jürgen E. Schrempp

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