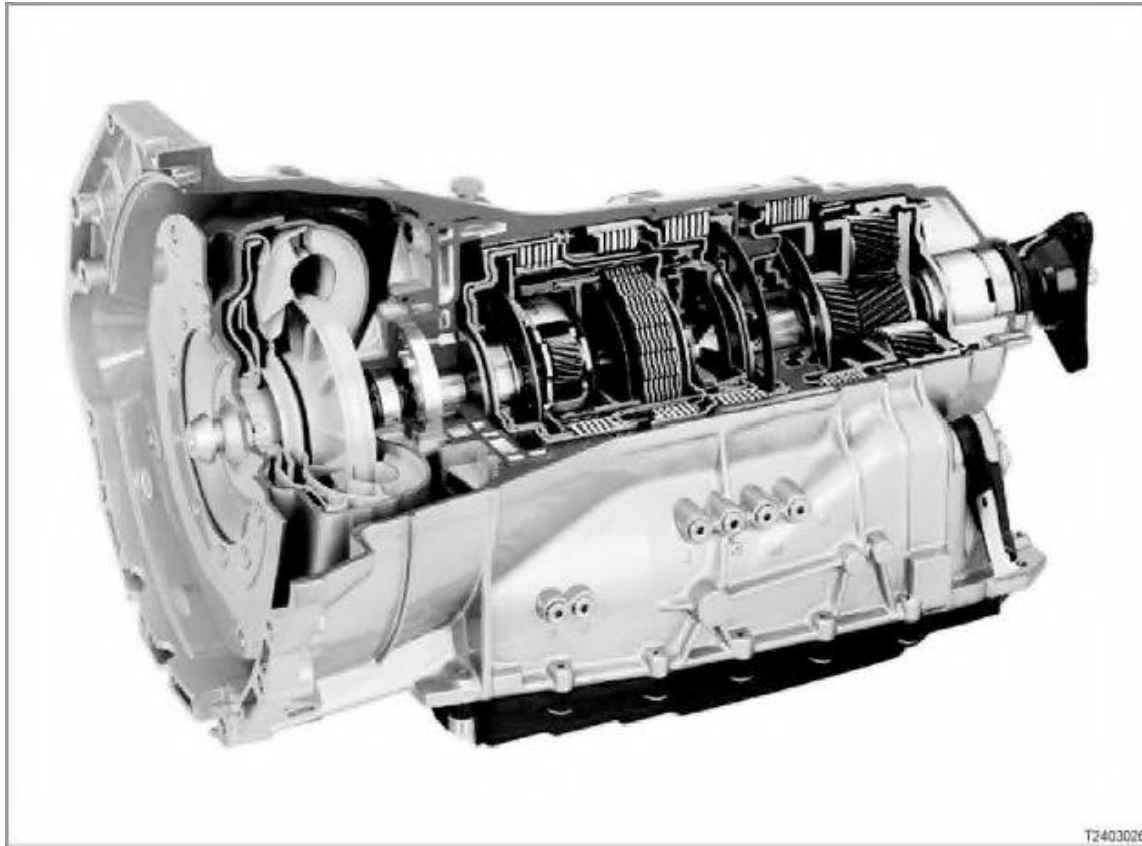


6-speed automatic transmission

E53, E60, E61, E63, E64, E65, E66, E83, E85, E87, E90, E91, E92



Introduction

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

- > E53, E83, E85 [system overview ...]
- > E60, E61, E63, E64 before 09/2005 [system overview ...]
- > E60, E61, E63, E64 from 09/2005 [system overview ...]
- > E65, E66 [system overview ...]
- > E87, E90, E91, E92 [system overview ...]

The automatic transmission is either standard or special equipment (option 205).

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

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

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

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

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

Brief description of components

The automatic transmission consists of the following components:

- **Mechatronics module**

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

The hydraulic control unit is the hydraulic part of the transmission control system.

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

[more ...]

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

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

The selector lever has the positions

P for Park

R for Reverse

N for Neutral

D for Drive (= automatic mode)

M/S M for manual mode = Steptronic, S for sport program = automatic mode with sporty map

The selector lever position display is located in the selector lever trim.

[more ...]

> E65, E66

The gear selector lever has the positions

P for Park

R for Reverse

N for Neutral

D for Drive (= automatic mode)

The selector lever position display is located in the instrument cluster.

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

> E65, E66

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

The steering wheel also houses the buttons for changing up and down in manual mode.

Program selection and control in manual mode are described in the Owner's Handbook.

- **Gearshift paddles**

>E85 from 01/2006

> E87 from 03/2006

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

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

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

- **Instrument cluster display**

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

- **CID: Central Information Display**

> E60, E61, E63, E64, E85, E87, E90, E91, E92

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

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

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

- **CD: Control display**

> E65, E66

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

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

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

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

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

- **Brake light switch**

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

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

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

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

- **DSC: Dynamic Stability Control**

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

- **Accelerator pedal module**

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

- **JBE: Junction box electronics**

> E87, E90, E91, E92

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

The junction box consists of the JBE and the power distributor.

The power distributor provides power, amongst other things, for the gate pattern diagram and the EGS control unit.

- **KGM: Body gateway module**

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

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

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

- **SGM: Safety and gateway module**

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

- > E65, E66

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

System functions

The automatic transmission has the following system functions:

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

Adaptive transmission control

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

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

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

- Comfort program in selector lever position "D"

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

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

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

The adaptive transmission control takes the following demands into account:

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

Adaptation to driver type

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

- Kick-fast

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

- Cornering detection

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

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

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

- Brake evaluation

The braking action is evaluated in a similar way to "kick-fast".

The braking deceleration is measured and compared with threshold values in the EGS control unit. The result of this comparison is the proposal of one of the two possible programs (XE or E in comfort program, S or XS in sport program).

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

Driving uphill or trailer towing

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

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

Driving downhill

If the EGS control unit detects downhill driving, it will automatically shift down a gear if the vehicle's speed picks up. This enhances the engine's braking effect. A downshift is only effected if the engine speed is below the maximum speed of the lower gear.

The EGS control unit detects downhill driving on the basis of signals from the throttle valve potentiometer (load), wheel speed sensor (road speed) and brake light switch (brake activation).

Braking deceleration and automatic upshift

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

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

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

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

Overlap control

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

Starter inhibitor

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

>E53, E83, E85

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

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

> E60, E61, E63, E64, E65, E66, E87, E90, E91, E92

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

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

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

Parking lock

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

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

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

> E65, E66

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

The parking lock is activated under the following conditions:

- Pressure on the button on the gear selector lever and roadspeed signal less than 2 km/h.
 - Remote control removed from the insert compartment and roadspeed signal 0 km/h.
 - Engine ON
- and
- Transmission position "D", "N" or "R"
- and
- Driver's door open
- and
- Driver's seat not occupied
- (roadspeed signal less than 2 km/h).

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

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

Example: A fault in the system prevents the parking brake from being moved from "Hold" to "Park". In this event, the EGS control unit will apply the parking lock after performing a plausibility check.

The locking conditions are as follows:

- Selector lever in position "N"
- Speed 0 km/h
- Engine OFF and ignition OFF

Warming-up program

The warming-up program is activated after each engine start with the engine temperature lower than approx. 60 °C. Up to a certain temperature, the automatic transmission remains in the output-orientated maps XE and XS during the warming-up program. Gear changes are only effected at higher engine speeds. This enables the engine and the catalytic converter to reach their operating temperatures more quickly.

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

Engine intervention

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

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

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

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

Downshift inhibitor

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

Reverse gear inhibitor

The reverse gear inhibitor electronically prevents reverse gear from being engaged when the vehicle is moving forwards at speeds over 5 km/h. When the specified speed is exceeded, the necessary solenoid valve are not actuated. This prevents multi-plate clutches B and D (for reverse gear) from being charged.

Selector lever lock (shiftlock)

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

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

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

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

Standstill decoupling

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

Interlock

- > E53, E83, E85 and

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

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

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

- > E65, E66

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

- > E87, E90, E91, E92 and

E60, E61, E63, E64 from 09/2005

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

- Interlock **without** convenience access

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

- Interlock **with** convenience access

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

Emergency program

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

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

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

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

A restart will be performed in 3rd gear.

Rock free from snow function

To rock the vehicle free from snow, it is possible to shift between selector lever positions "D" and "R" without the selector lever lock (effective in "N"). With the engine running, the gearshift must be completed within 0.5 seconds.

Operation

The different automatic transmission drive positions are selected with the selector lever.

When driving, there are the following possibilities:

- **D = Automatic mode**

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

- **Gearshift using gearshift paddles**

If the selector lever is in position "D" and a gearshift is initiated using the gearshift paddles, the automatic transmission will automatically change to manual mode.

If no gearshift is made and the vehicle does not accelerate significantly within 6 seconds, the automatic transmission will change back to automatic mode.

- **SD = Automatic mode, sport program**

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

- **M1 to M6 = Steptronic**

If the selector lever is in shift gate "M/S" and is briefly moved to "-" or "+", the electronic circuitry changes to Steptronic. Permanent manual mode is activated with the selector lever or gearshift paddles. The display in the instrument cluster changes from "SD" to "M1" to "M6".

In manual (Steptronic) mode, the transmission management will only execute upshifts or downshifts at appropriate engine and road speeds. Gearshifts that would result in an excessively high or low engine speed are suppressed.

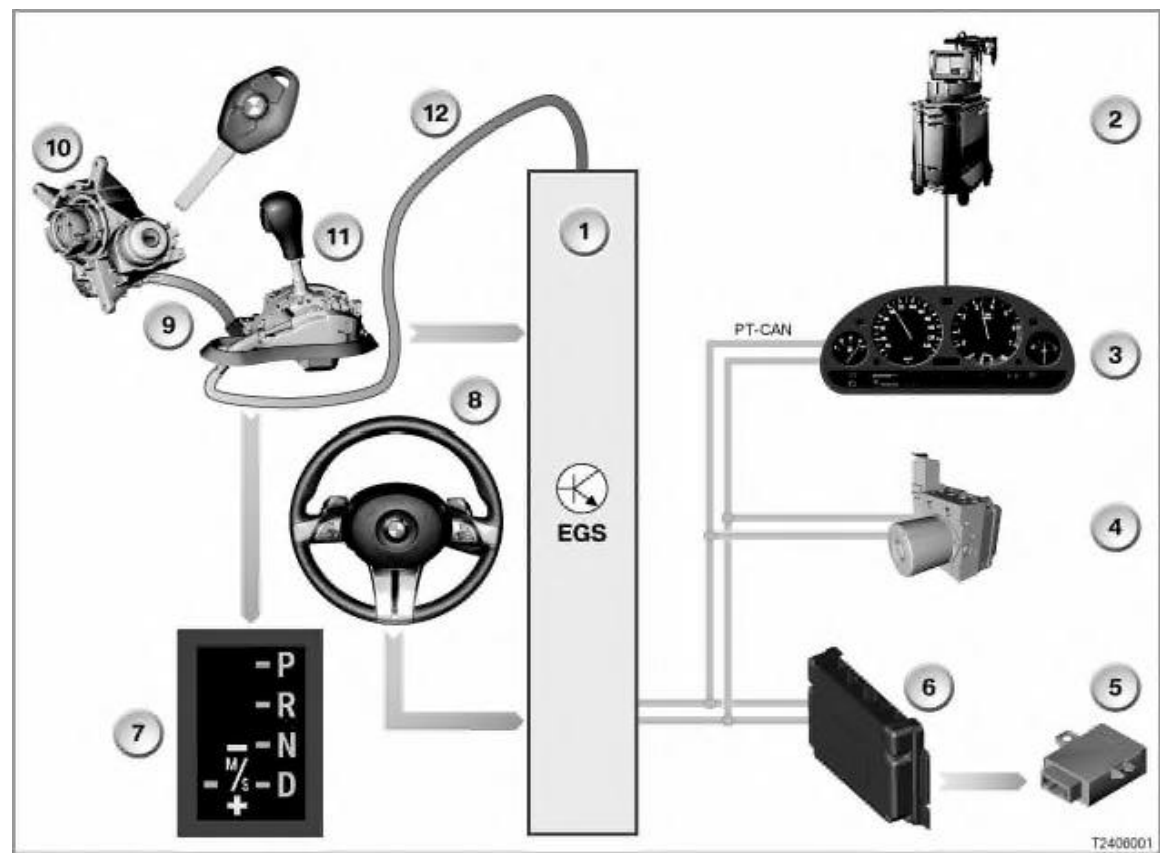
Notes for service staff

Service staff should note the following points:

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

Subject to change.

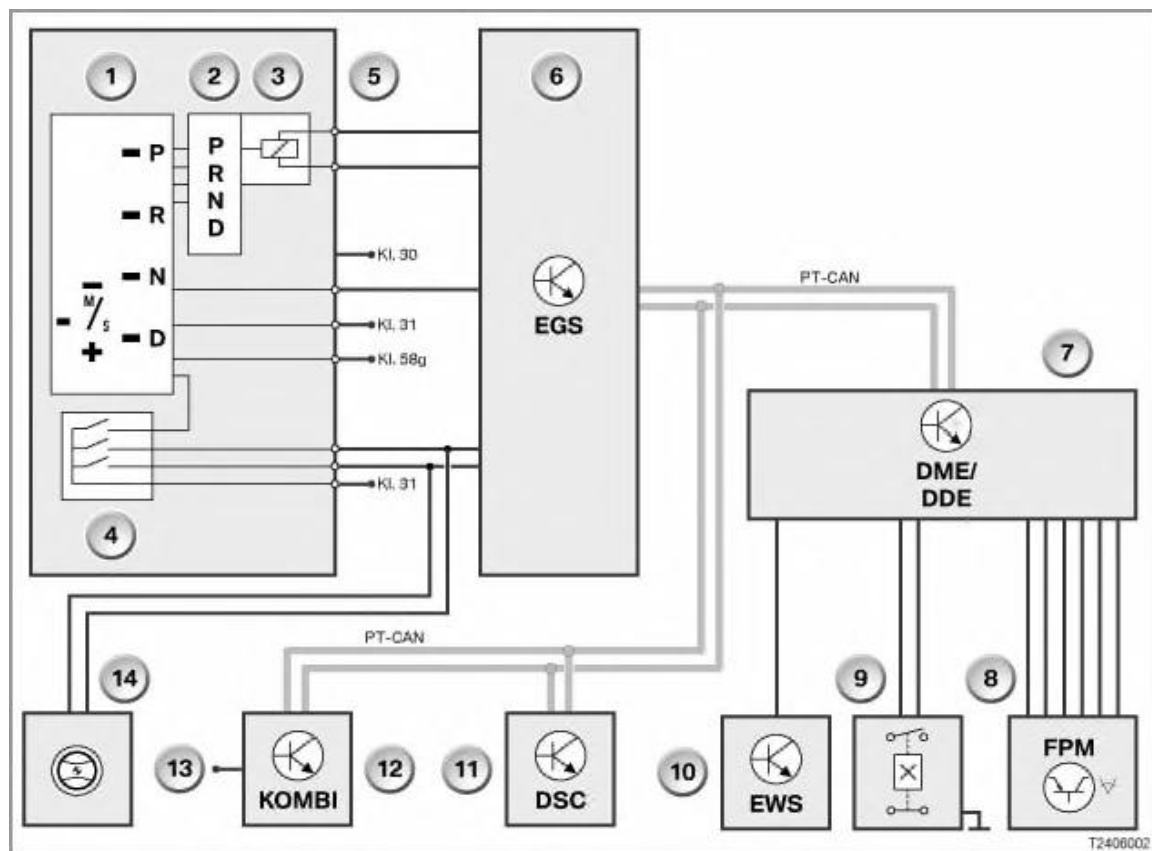
- Inputs/outputs



The illustration shows a simplified representation for the E53, E83 and E85.

| Item | Description | Item | Description |
|--------|--|------|--|
| 1 | EGS control unit integrated in mechatronics module | 2 | BMW diagnosis system |
| 3 | Instrument cluster | 4 | Dynamic Stability Control (DSC) |
| 5 | Electronic vehicle immobiliser (EWS) | 6 | Digital engine electronics (DME) or digital diesel electronics (DDE) |
| 7 | Selector lever position display with gate pattern diagram in selector lever trim | 8 | Steering wheel with gearshift paddles > E85 from 01/2006 only |
| 9 | Bowden cable for ignition lock interlock | 10 | Ignition lock with interlock |
| 11 | Selector lever | 12 | Bowden cable for the selector lever position switch and the parking lock |
| PT-CAN | Powertrain CAN | | |

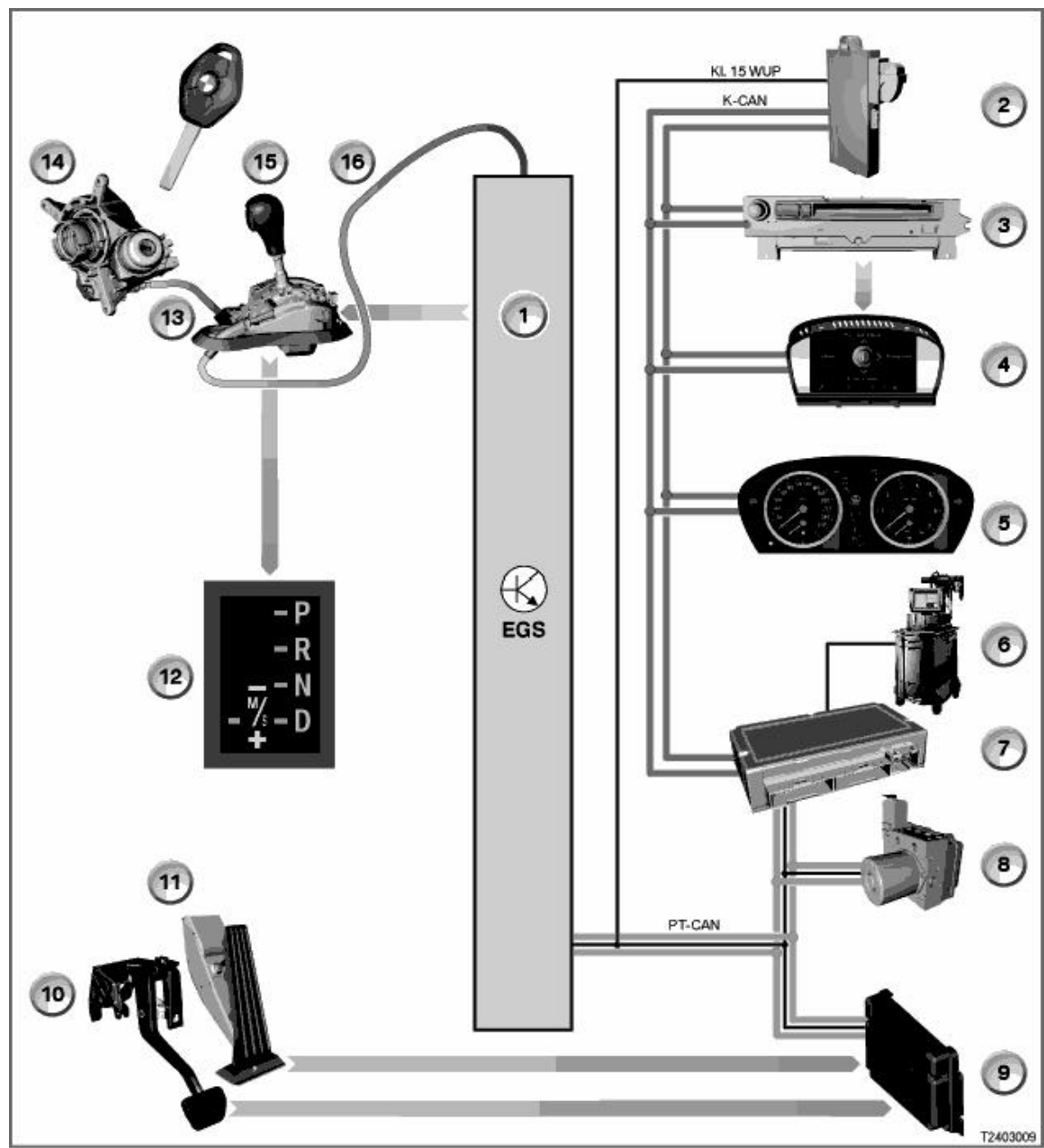
- System circuit diagram



The illustration shows a simplified representation for the E53, E83 and E85.

| Item | Description | Item | Description |
|---------|--|--------|---|
| 1 | Gate pattern diagram, illuminated drive position display | 2 | Sliding contact for gate pattern diagram illumination |
| 3 | Selector lever lock (shiftlock) | 4 | Steptronic switch |
| 5 | Gearshift mechanism | 6 | EGS control unit |
| 7 | Digital engine electronics (DME) or digital diesel electronics (DDE) | 8 | Accelerator pedal module (FPM) |
| 9 | Brake light switch | 10 | Electronic vehicle immobiliser (EWS) |
| 11 | Dynamic Stability Control (DSC) | 12 | Instrument cluster (KOMBI) |
| 13 | Diagnosis wire | 14 | Steering wheel with gearshift paddles > E85 from 01/2006 only |
| Kl. 30 | Terminal 30 (power supply) | Kl. 31 | Terminal 31 (earth) |
| Kl. 58g | Terminal 58g (locating light) | PT-CAN | Powertrain CAN |

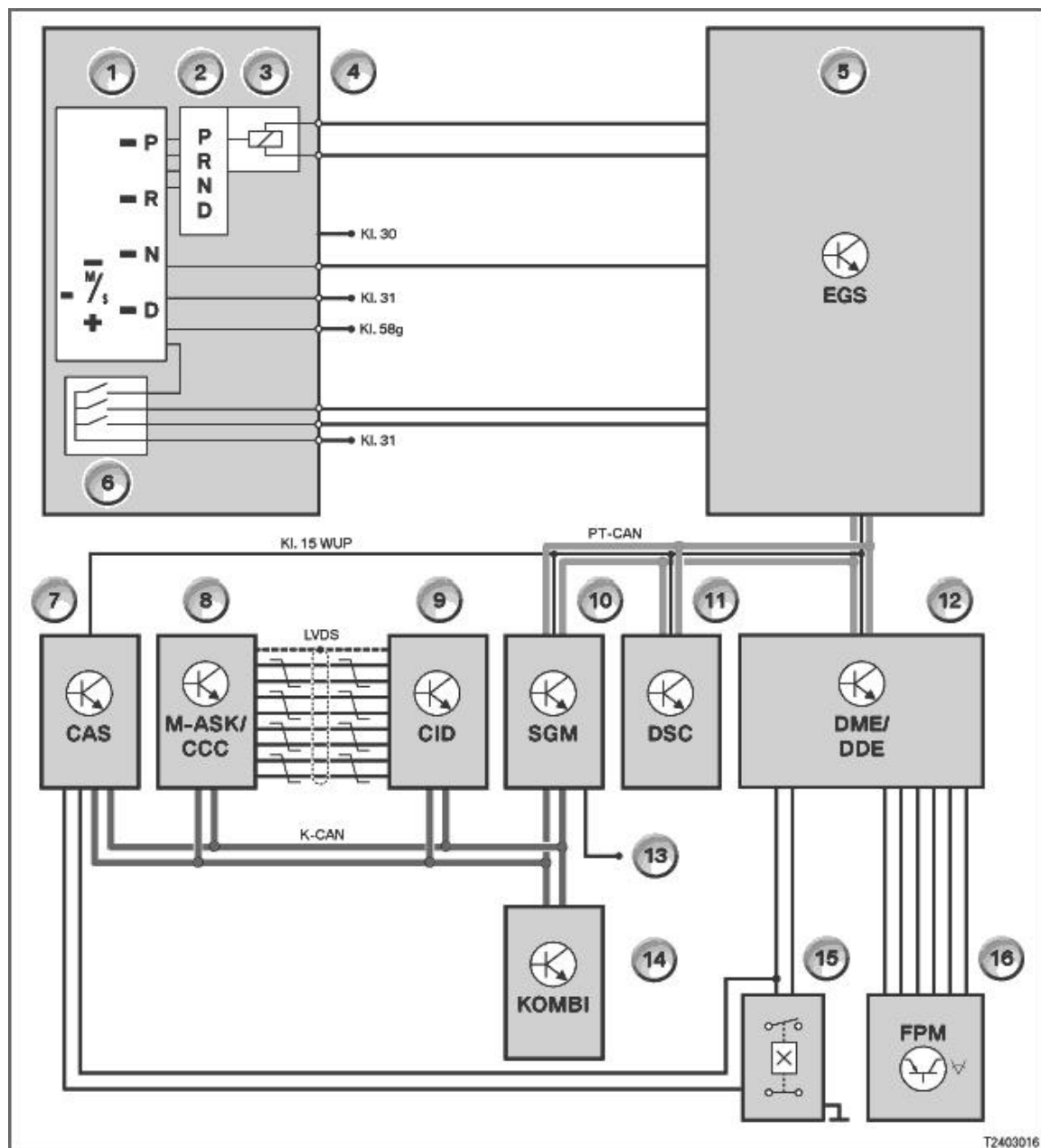
- Inputs/outputs



| Item | Description | Item | Description |
|------|--|------|--|
| 1 | EGS control unit integrated in mechatronics module | 2 | Car Access System (CAS) |
| 3 | Multi-audio system controller (M-ASK) | 4 | Central Information Display (CID) |
| 5 | Instrument cluster (KOMBI) | 6 | BMW diagnosis system |
| 7 | Safety and gateway module (SGM) | 8 | Dynamic Stability Control (DSC) |
| 9 | Digital engine electronics (DME) or digital diesel electronics (DDE) | 10 | Brake light switch |
| 11 | Accelerator pedal module (FPM) | 12 | Selector lever position display with gate pattern diagram in selector lever trim |

| | | | |
|------------|--|--------|--|
| 13 | Bowden cable for ignition lock interlock | 14 | Ignition lock with interlock |
| 15 | Selector lever | 16 | Bowden cable for the selector lever position switch and the parking lock |
| K-CAN | Body CAN | PT-CAN | Powertrain CAN |
| Kl. 15 WUP | Terminal 15 wake-up wire | | |

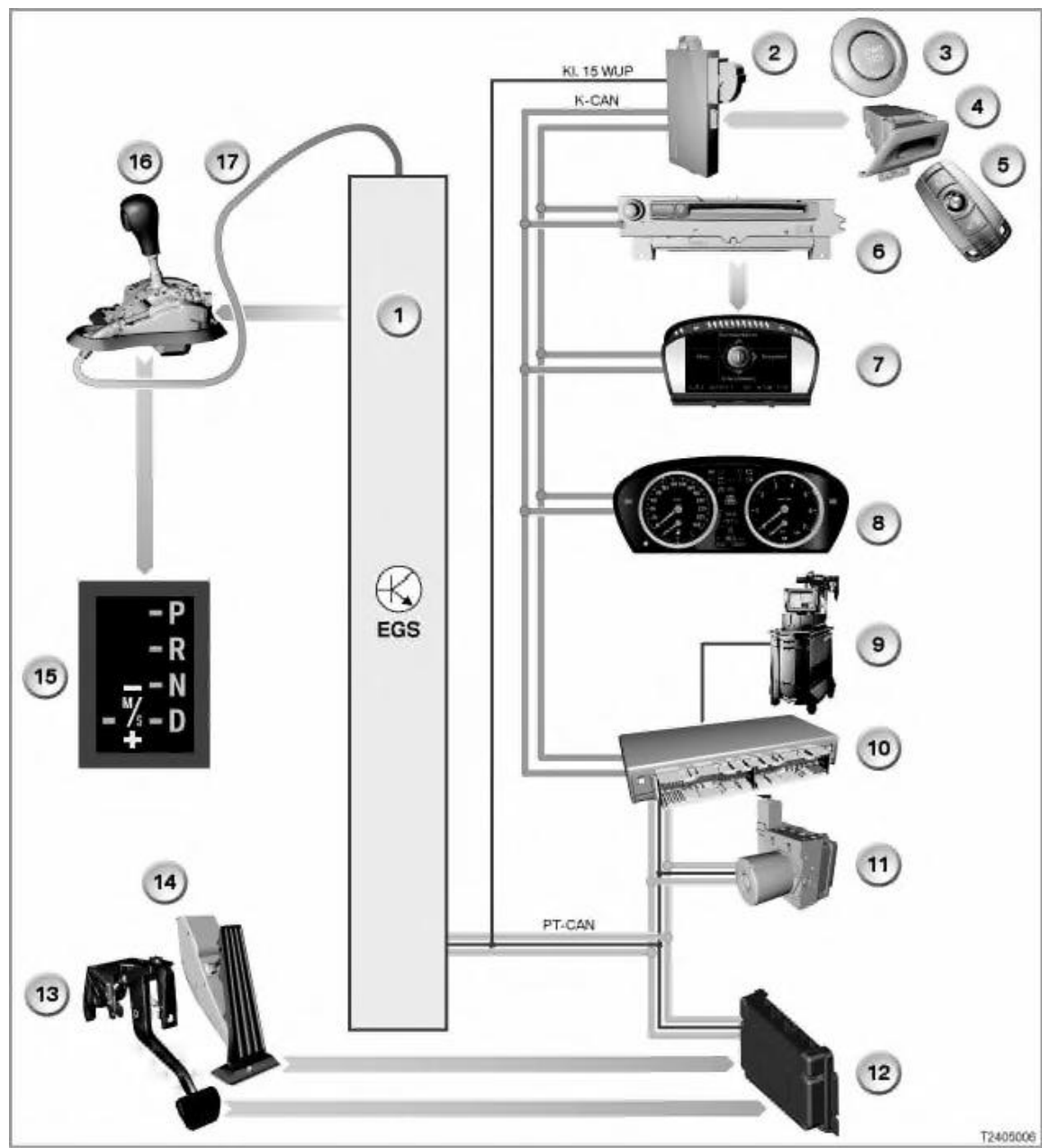
- System circuit diagram



| Item | Description | Item | Description |
|------|--|------|---|
| 1 | Gate pattern diagram, illuminated drive position display | 2 | Sliding contact for gate pattern diagram illumination |
| 3 | Selector lever lock (shiftlock) | 4 | Gearshift mechanism |
| 5 | EGS control unit | 6 | Steptronic switch |

| | | | |
|---------------|-----------------------------------|---------|---|
| 7 | Car Access System (CAS) | 8 | Multi-audio system controller (M-ASK) or Car Communication Computer (CCC) |
| 9 | Central Information Display (CID) | 10 | Safety and gateway module (SGM) |
| 11 | Dynamic Stability Control (DSC) | 12 | Digital engine electronics (DME) or digital diesel electronics (DDE) |
| 13 | Diagnosis wire | 14 | Instrument cluster (KOMBI) |
| 15 | Brake light switch | 16 | Accelerator pedal module (FPM) |
| Kl. 15 WUP | Terminal 15 wake-up wire | Kl. 30 | Terminal 30 (power supply) |
| Kl. 31 | Terminal 31 (earth) | Kl. 58g | Terminal 58g (locating light) |
| K-CAN | Body CAN | LVDS | LVDS (Low Voltage Differential Signalling) data wire |
| PT-CAN | Powertrain CAN | | |

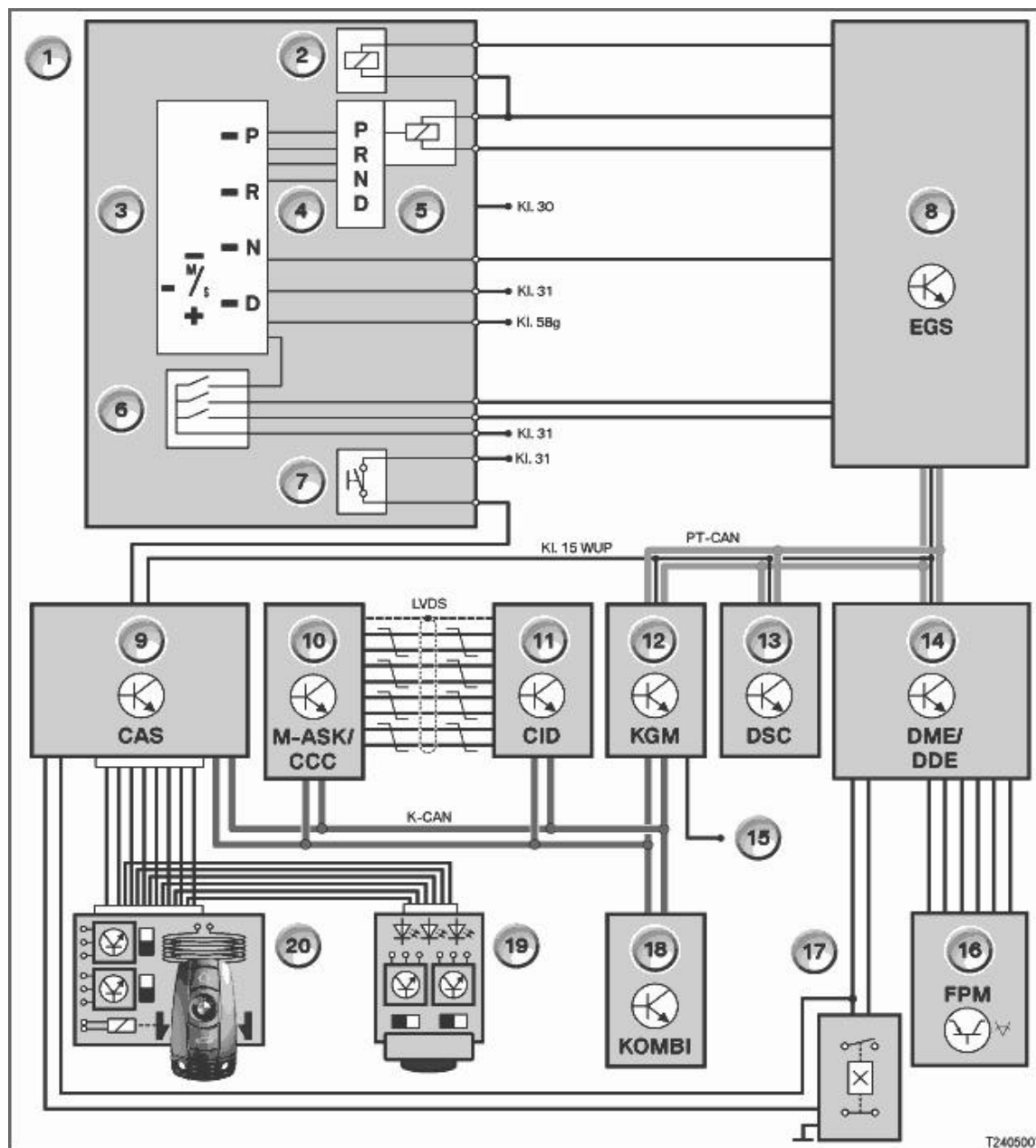
- Inputs/outputs



| Item | Description | Item | Description |
|------|--|------|--|
| 1 | EGS control unit integrated in mechatronics module | 2 | Car Access System (CAS) |
| 3 | START/STOP button | 4 | Insert compartment with interlock |
| 5 | Remote control | 6 | Multi-audio system controller (M-ASK) |
| 7 | Central Information Display (CID) | 8 | Instrument cluster (KOMBI) |
| 9 | BMW diagnosis system | 10 | Body gateway module (KGM) |
| 11 | Dynamic Stability Control (DSC) | 12 | Digital engine electronics (DME) or digital diesel electronics (DDE) |
| 13 | Brake light switch | 14 | Accelerator pedal module (FPM) |

| | | | |
|------------|--|--------|----------------|
| 15 | Selector lever position display with gate pattern diagram in selector lever trim | 16 | Selector lever |
| 17 | Bowden cable for the selector lever position switch and the parking lock | | |
| K-CAN | Body CAN | PT-CAN | Powertrain CAN |
| Kl. 15 WUP | Terminal 15 wake-up wire | | |

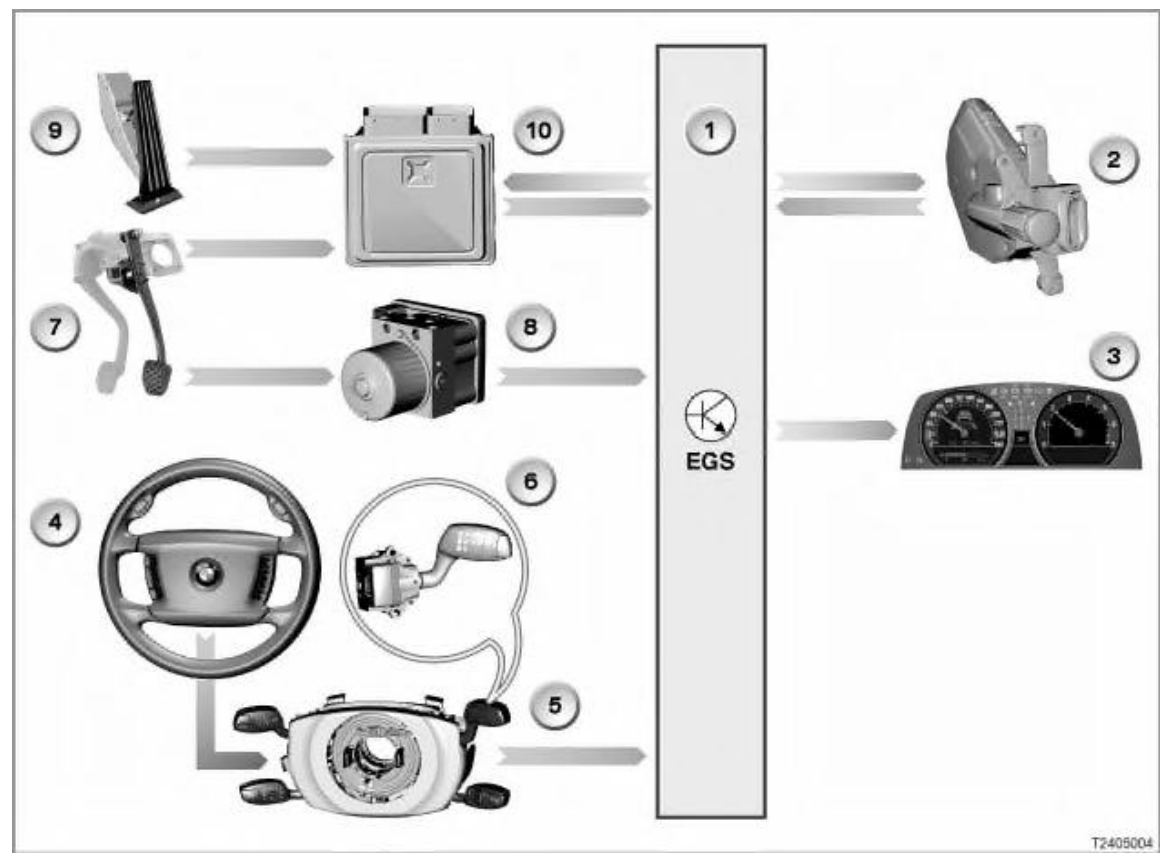
- System circuit diagram



| Item | Description | Item | Description |
|------|--|------|---|
| 1 | Gearshift mechanism | 2 | Interlock |
| 3 | Gate pattern diagram, illuminated drive position display | 4 | Sliding contact for gate pattern diagram illumination |
| 5 | Selector lever lock (shiftlock) | 6 | Steptronic switch |

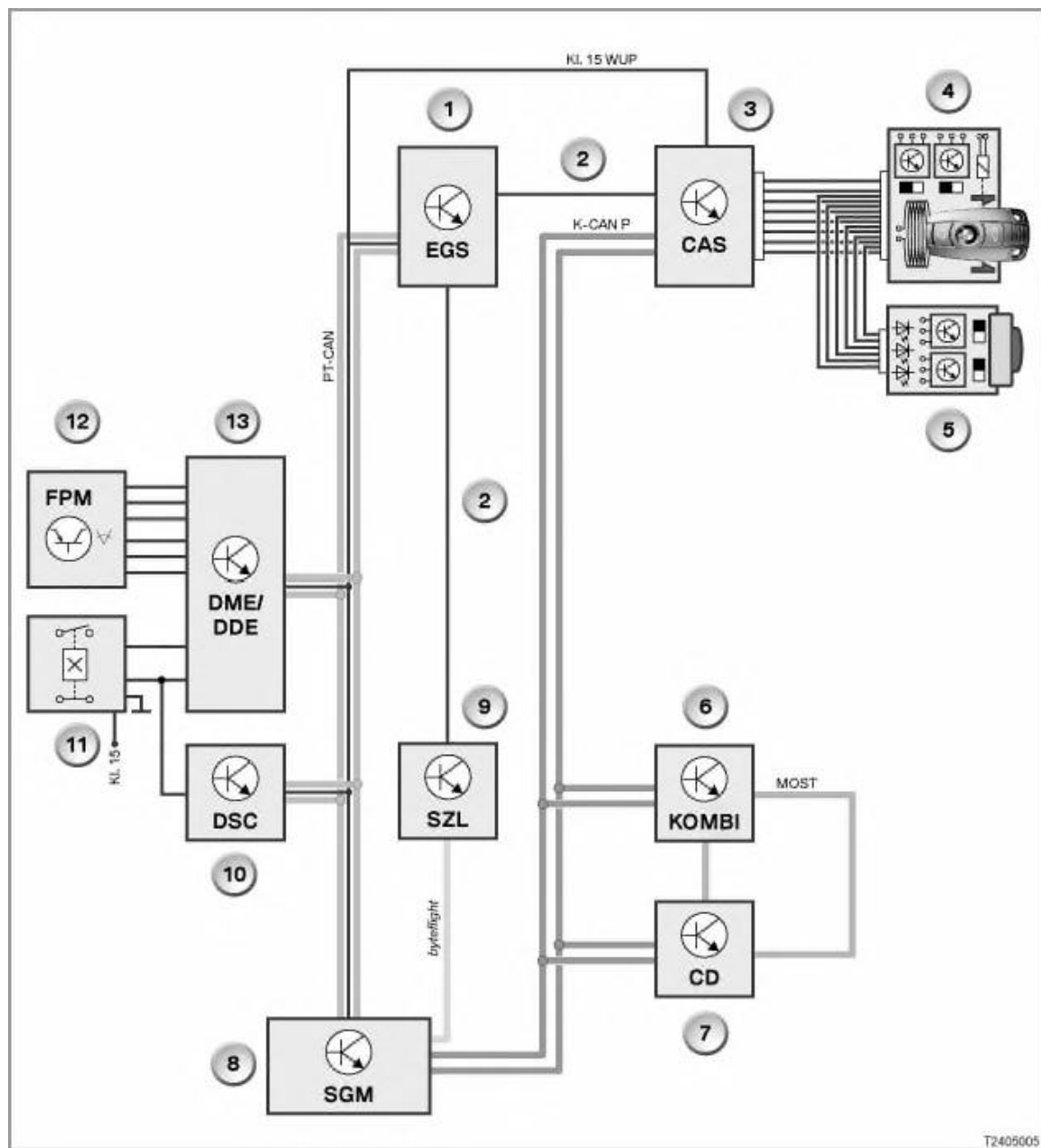
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|---------------|-----------------------------------|---------|---|
| | | | |
| 7 | Microswitch of the interlock | 8 | EGS control unit |
| 9 | Car Access System (CAS) | 10 | Multi-audio system controller (M-ASK) or Car Communication Computer (CCC) |
| 11 | Central Information Display (CID) | 12 | Body gateway module (KGM) |
| 13 | Dynamic Stability Control (DSC) | 14 | Digital engine electronics (DME) or digital diesel electronics (DDE) |
| 15 | Diagnosis wire | 16 | Accelerator pedal module (FPM) |
| 17 | Brake light switch | 18 | Instrument cluster (KOMBI) |
| 19 | START/STOP button | 20 | Insert compartment with interlock and remote control |
| Kl. 15 WUP | Terminal 15 wake-up wire | Kl. 30 | Terminal 30 (power supply) |
| Kl. 31 | Terminal 31 (earth) | Kl. 58g | Terminal 58g (locating light) |
| K-CAN | Body CAN | LVDS | LVDS (Low Voltage Differential Signalling) data wire |
| PT-CAN | Powertrain CAN | | |

- Inputs/outputs



| Item | Description | Item | Description |
|------|--|------|--|
| 1 | EGS control unit integrated in mechatronics module | 2 | Car Access System (CAS) |
| 3 | Instrument cluster (KOMBI) | 4 | Steering wheel with buttons for sport program and manual mode |
| 5 | Steering column switch cluster (SZL) | 6 | Gear selector lever |
| 7 | Brake light switch | 8 | Dynamic Stability Control (DSC) |
| 9 | Accelerator pedal module (FPM) | 10 | Digital engine electronics (DME) or digital diesel electronics (DDE) |

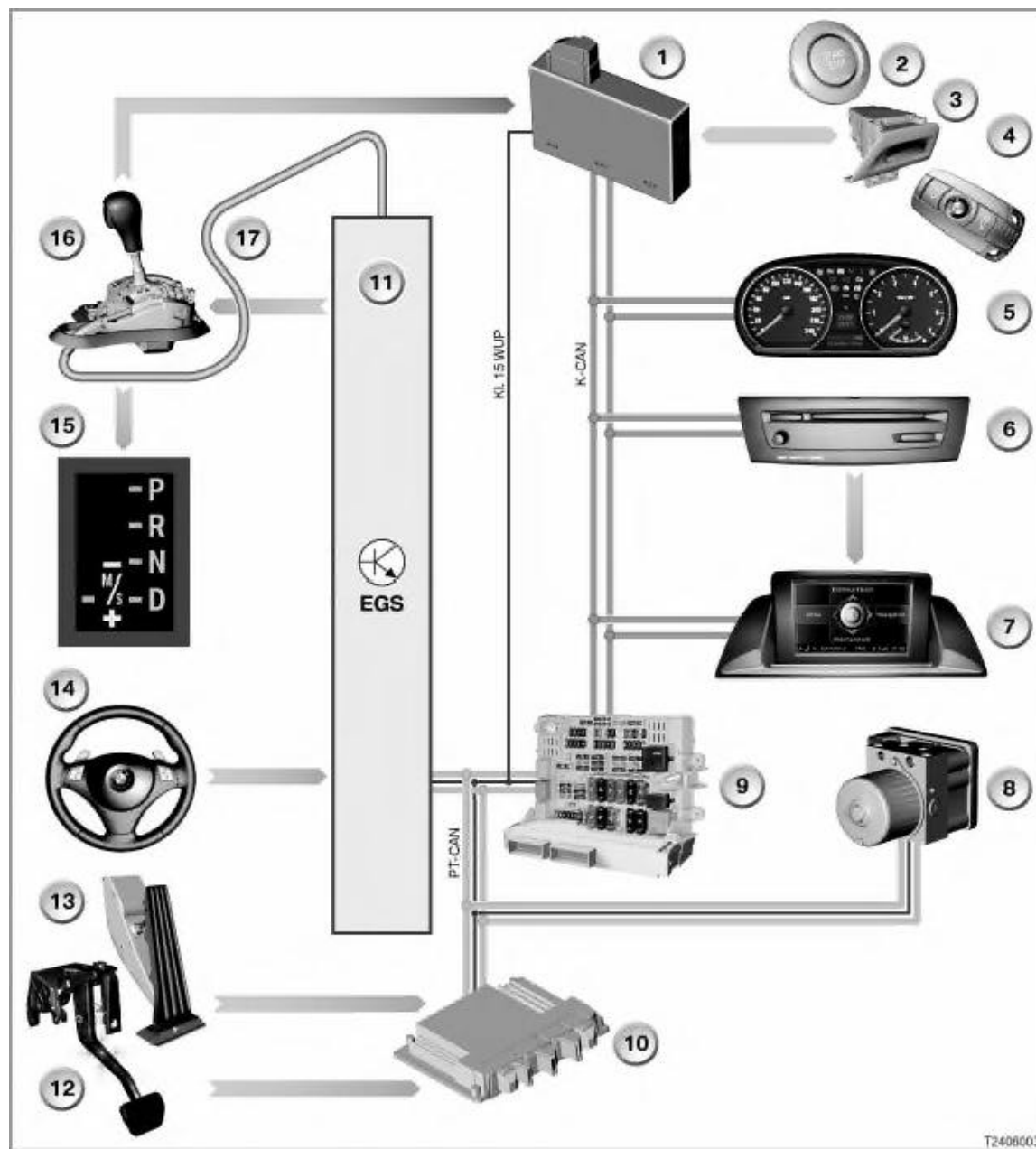
- System circuit diagram



| Item | Description | Item | Description |
|-----------|--|------------|--|
| 1 | EGS control unit | 2 | Direct wires |
| 3 | Car Access System (CAS) | 4 | Insert compartment with interlock and remote control |
| 5 | START/STOP button | 6 | Instrument cluster (KOMBI) |
| 7 | Control display (CD) | 8 | Safety and gateway module (SGM) |
| 9 | Steering column switch cluster (SZL) | 10 | Dynamic Stability Control (DSC) |
| 11 | Brake light switch | 12 | Accelerator pedal module (FPM) |
| 13 | Digital engine electronics (DME) or digital diesel electronics (DDE) | | |
| Kl. 15 | Terminal 15 | Kl. 15 WUP | Terminal 15 wake-up wire |
| bytflight | bytflight fibre optics | K-CAN P | Body CAN PERIPHERY |

| | | | |
|------|---------------------------------|--------|----------------|
| MOST | Media Oriented System Transport | PT-CAN | Powertrain CAN |
|------|---------------------------------|--------|----------------|

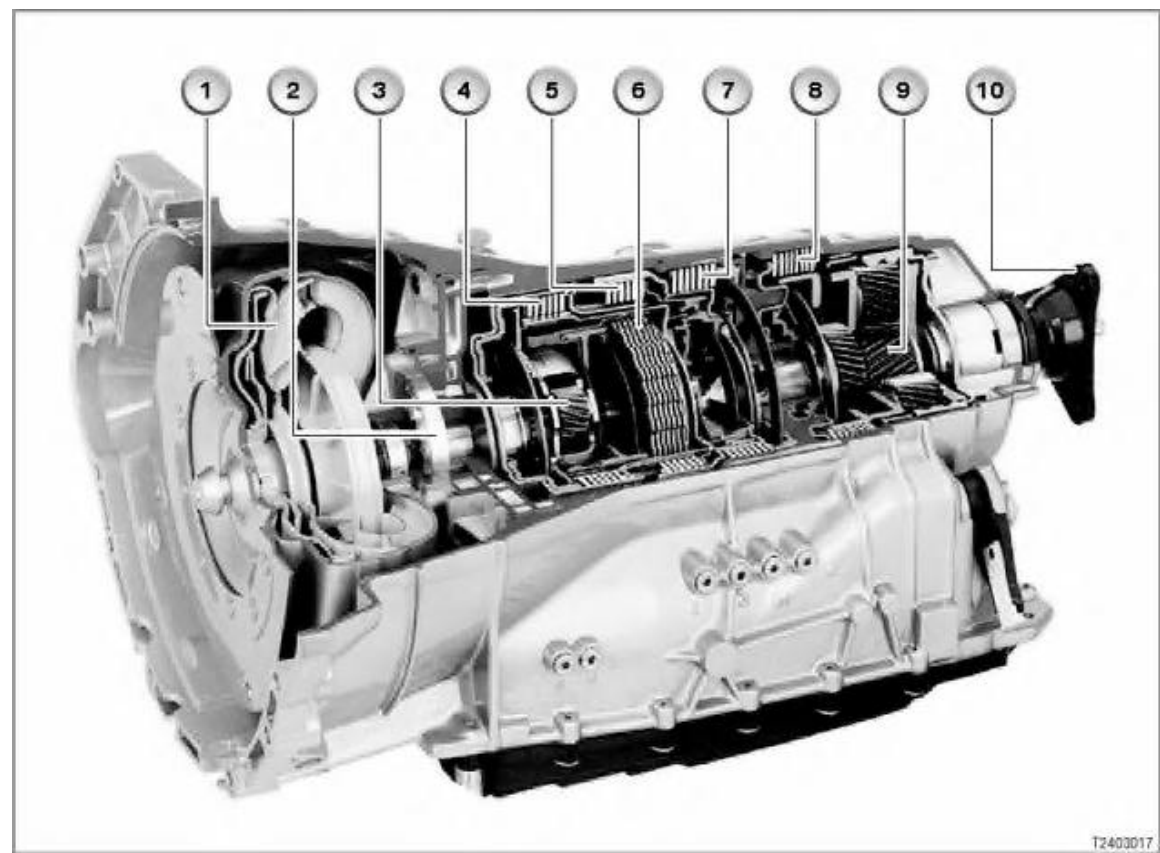
- Inputs/outputs



SBT 6-speed automatic transmission, system overview: E87, E90, E91, E92
Issue status (07/2006) Valid only until next DVD is issued

| | | | |
|------------|---|---------|---|
| 5 | Central Information Display (CID) | 6 | Multi-audio system controller (M-ASK) or Car Communication Computer (CCC) |
| 7 | Instrument cluster (KOMBI) | 8 | Brake light switch |
| 9 | Accelerator pedal module (FPM) | 10 | Digital engine electronics (DME) or digital diesel electronics (DDE) |
| 11 | Junction box electronics (JBE) | 12 | Steering wheel with gearshift paddles > E87 from 03/2006 only |
| 13 | Dynamic Stability Control (DSC) | 14 | EGS control unit integrated in mechatronics module |
| 15 | Steptronic switch | 16 | Gate pattern diagram, illuminated drive position display |
| 17 | Sliding contact for gate pattern diagram illumination | 18 | Selector lever lock (shiftlock) |
| 19 | Interlock | 20 | Microswitch of the interlock |
| Kl. 15 WUP | Terminal 15 wake-up wire | Kl. 30 | Terminal 30 (power supply) |
| Kl. 31 | Terminal 31 (earth) | Kl. 58g | Terminal 58g (locating light) |
| K-CAN | Body CAN | LVDS | LVDS (Low Voltage Differential Signalling) data wire |
| PT-CAN | Powertrain CAN | | |

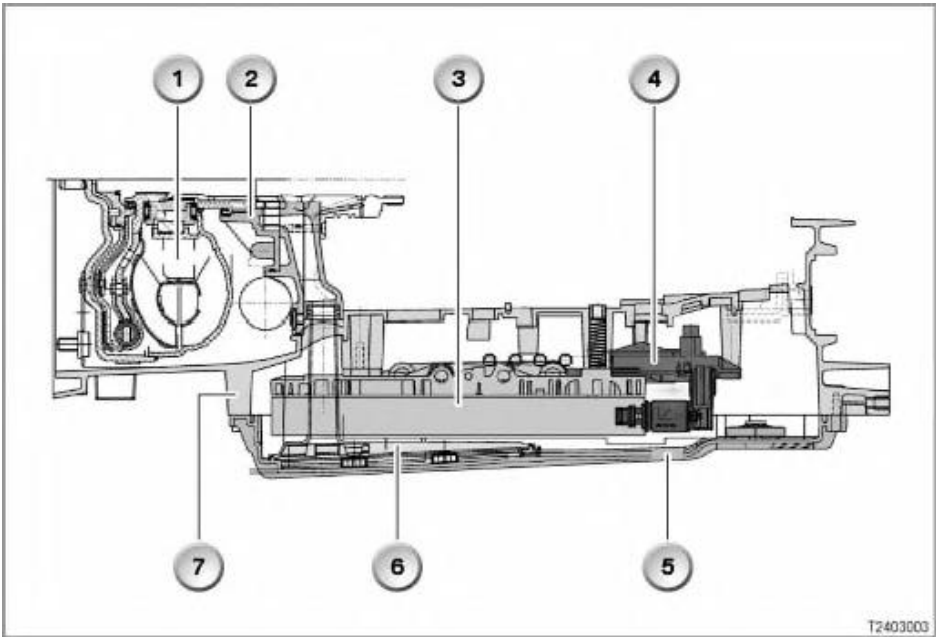
- Mechanical construction



| Item | Description | Item | Description |
|------|--|------|----------------|
| 1 | Torque converter with converter lockup clutch | 2 | Oil pump |
| 3 | Preceding single planetary gear set | 4 | Input clutch A |
| 5 | Input clutch B | 6 | Input clutch E |
| 7 | Brake clutch C | 8 | Brake clutch D |
| 9 | Secondary double planetary gear set (Ravigneaux set) | 10 | Output flange |

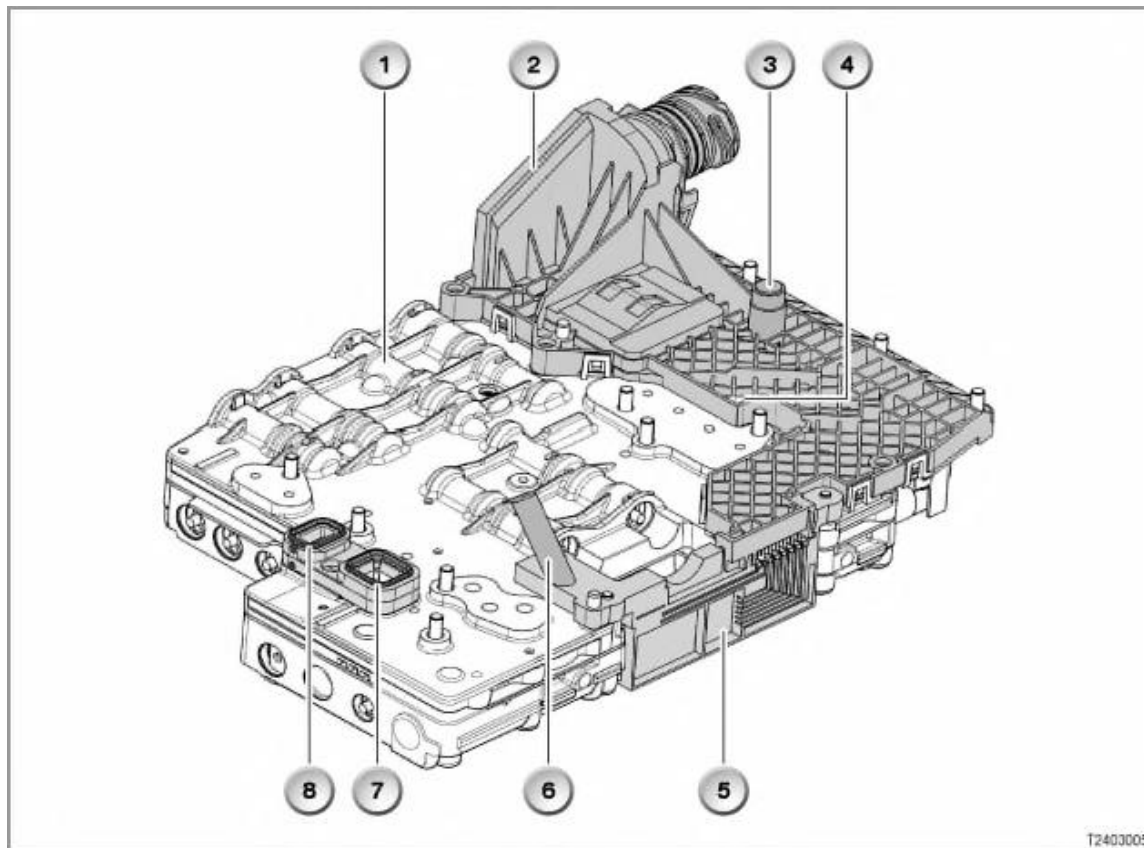
Installation location

The mechatronics module is a combination of hydraulic unit and electronics module. The mechatronics module is installed in the transmission oil pan.



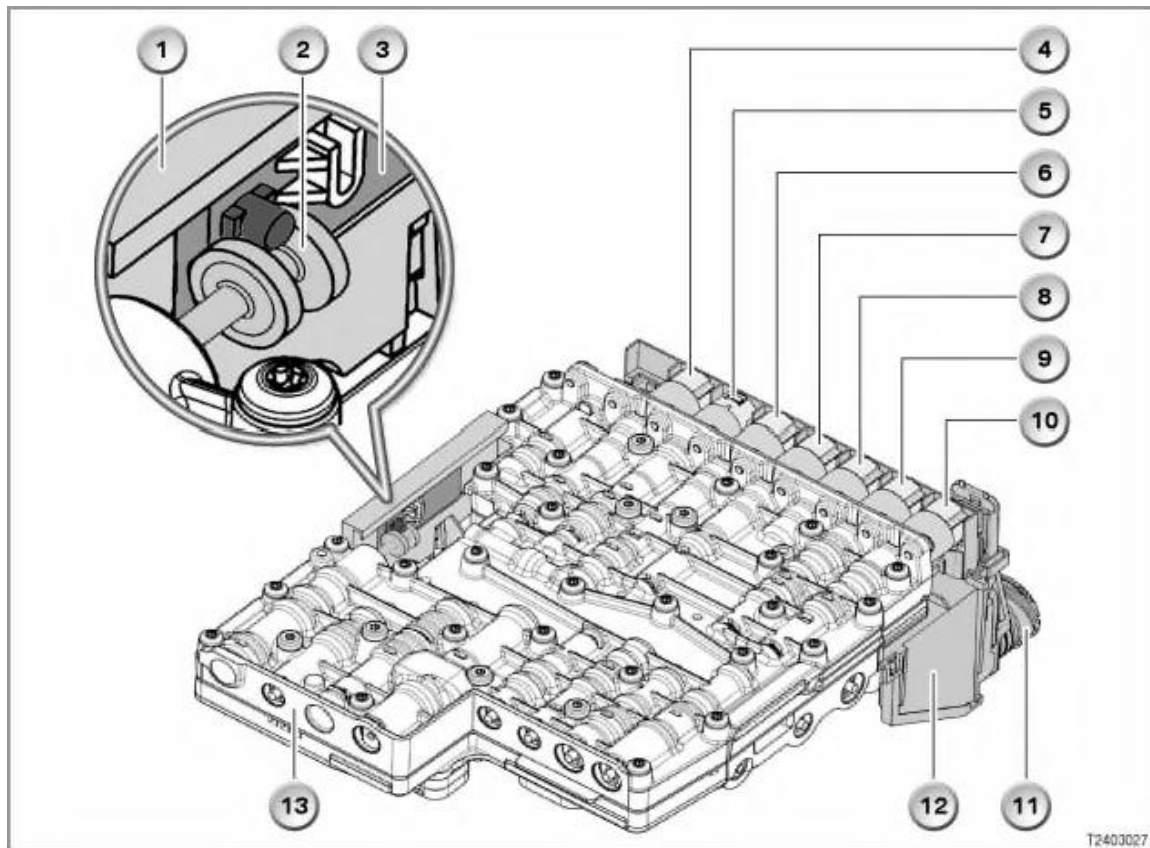
| Item | Description | Item | Description |
|------|------------------------|------|---|
| 1 | Torque converter | 2 | Oil pump |
| 3 | Hydraulic control unit | 4 | Electronics module |
| 5 | Transmission oil pan | 6 | Oil strainer with inlet pipe (integrated in transmission oil pan) |
| 7 | Transmission case | | |

Construction



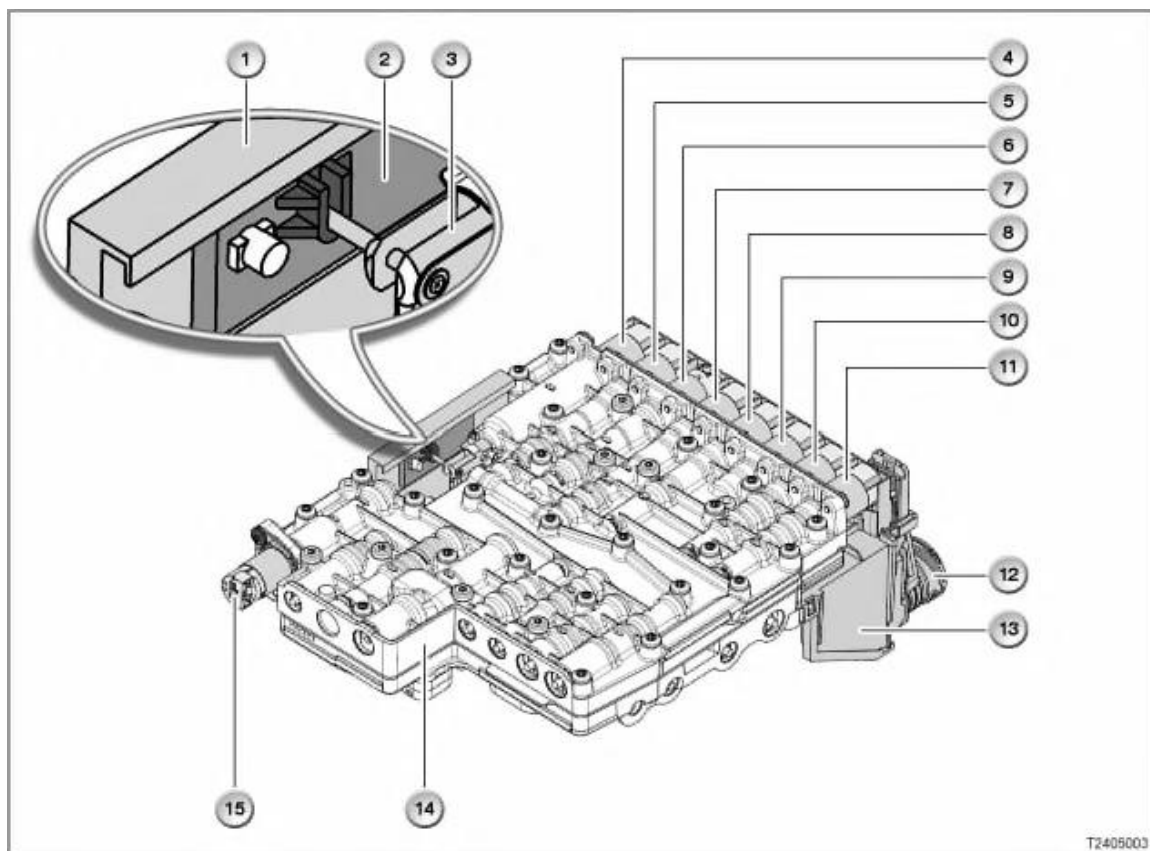
The illustration shows the top of the mechatronics module on the E53, E60, E61, E63, E64, E83, E85, E87, E90, E91, E92. The top of the mechatronics module on the E65, E66 is similar.

| Item | Description | Item | Description |
|------|--------------------------------------|------|-------------------------------------|
| 1 | Hydraulic control unit | 2 | Electronics module |
| 3 | Sensor for transmission output speed | 4 | ATF temperature sensor |
| 5 | Selector lever position switch | 6 | Sensor for transmission input speed |
| 7 | Oil channel, delivery end | 8 | Oil channel, inlet end |



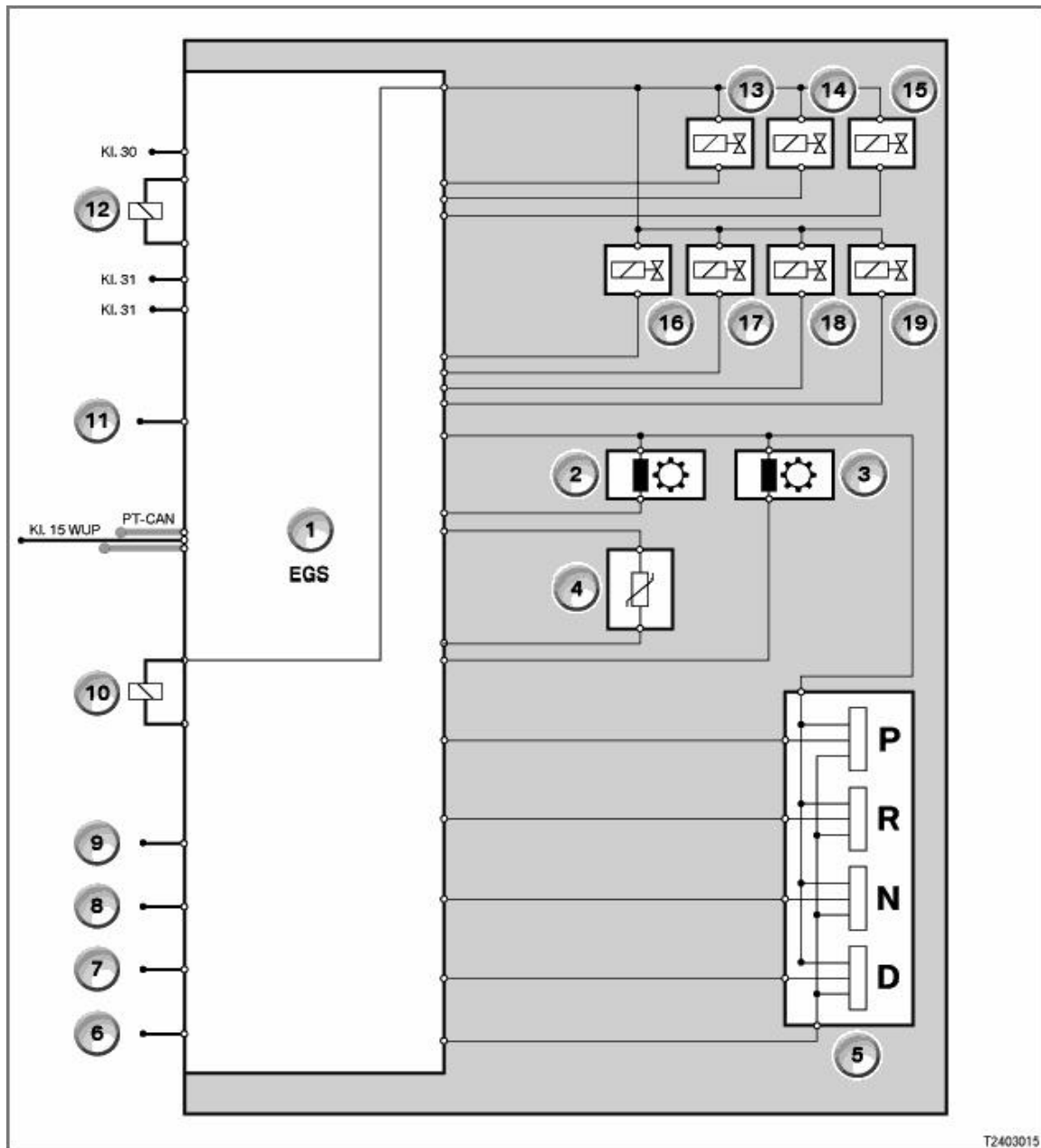
The illustration shows the underside of the mechatronics module on the E53, E60, E61, E63, E64, E83, E85, E87, E90, E91, E92.

| Item | Description | Item | Description |
|------|--|------|-------------------------------------|
| 1 | Selector lever position switch with 4 Hall sensors (for "P", "R", "N" and "D") | 2 | Hydraulic gear selector valve |
| 3 | Slide of the selector lever position switch, hooked in at the hydraulic selector valve | 4 | Electronic pressure control valve 6 |
| 5 | <ul style="list-style-type: none"> > E53, E60, E61, E63, E64, E83, E85, E87, E90, E91: Solenoid valve > E92: Electronic pressure control valve 7 | 6 | Electronic pressure control valve 4 |
| 7 | Electronic pressure control valve 5 | 8 | Electronic pressure control valve 3 |
| 9 | Electronic pressure control valve 2 | 10 | Electronic pressure control valve 1 |
| 11 | Transmission connector | 12 | Electronics module |
| 13 | Hydraulic control unit | | |



The following illustration shows the underside of the mechatronics module on the E65, E66:

| Item | Description | Item | Description |
|------|--|------|--|
| 1 | Selector lever position switch with 2 Hall sensors | 2 | Selector lever position switch slide, engaged on parking lock cylinder |
| 3 | Parking lock cylinder | 4 | Solenoid valve (locks the parking lock cylinder) |
| 5 | Electronic pressure control valve 6 | 6 | Solenoid valve |
| 7 | Electronic pressure control valve 4 | 8 | Electronic pressure control valve 5 |
| 9 | Electronic pressure control valve 3 | 10 | Electronic pressure control valve 2 |
| 11 | Electronic pressure control valve 1 | 12 | Transmission connector |
| 13 | Electronics module | 14 | Hydraulic control unit |
| 15 | Solenoid valve (actuates the parking lock valve) | | |

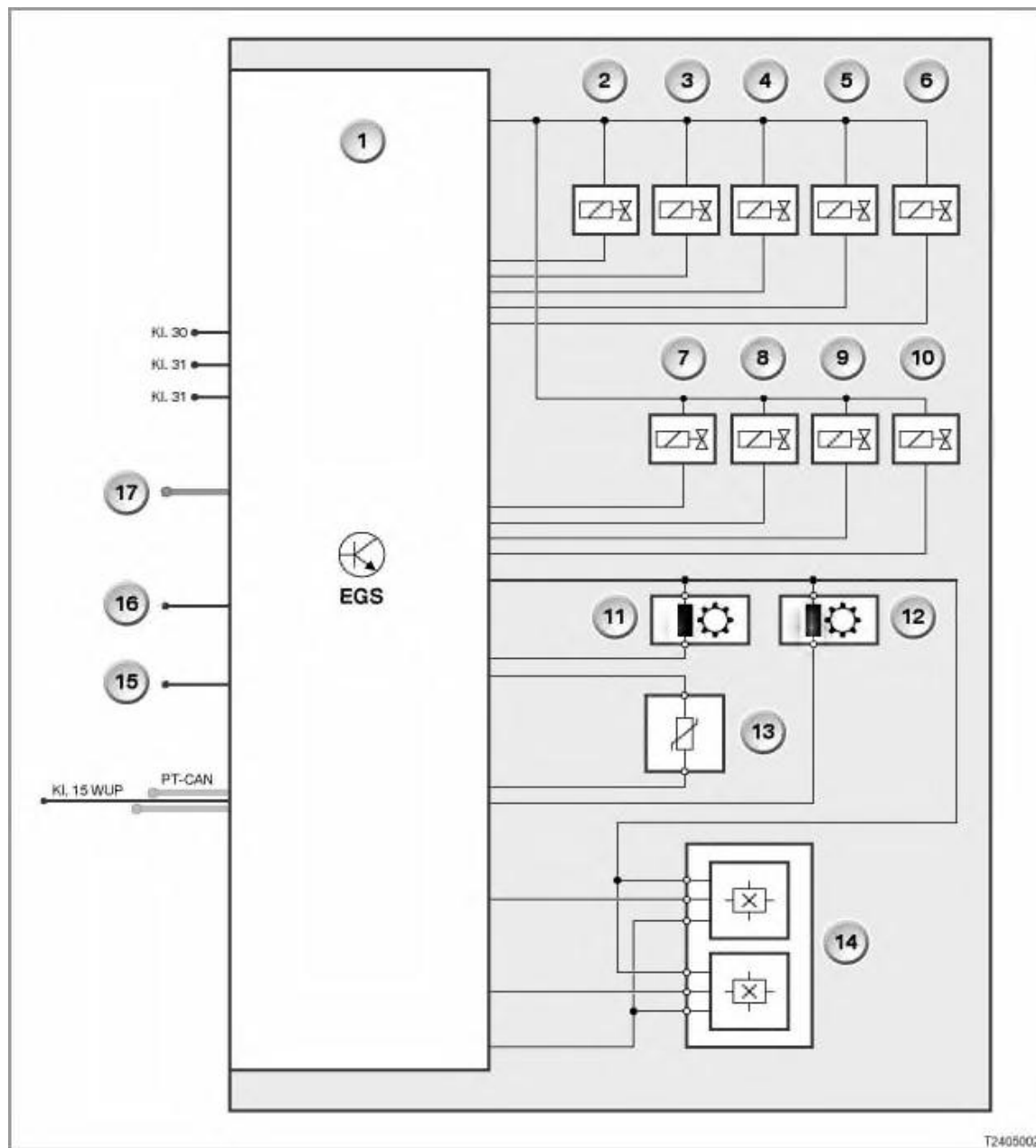


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The illustration shows the block diagram for the mechatronics module on the E53, E60, E61, E63, E64, E83, E85, E87, E90, E91, E92.

| Item | Description | Item | Description |
|------|--|------|--|
| 1 | EGS control unit | 2 | Sensor for transmission input speed |
| 3 | Sensor for transmission output speed | 4 | ATF temperature sensor |
| 5 | Selector lever position switch for the drive positions with 4 Hall sensors | 6 | One-touch function "Downshift" |
| 7 | One-touch function "Upshift" | 8 | Steptronic switch |
| 9 | Starter inhibitor | 10 | Selector lever lock |
| 11 | Diagnosis | 12 | Interlock (only E87, E90, E91 and E60, E61, E63, E64 from 09/2005) |

| | | | |
|------------|--|--------|-------------------------------------|
| | <ul style="list-style-type: none"> > E53, E60, E61, E63, E64, E83, E85, E87, E90, E91: Solenoid valve > E92: Electronic pressure control valve 7 | 14 | Electronic pressure control valve 2 |
| 15 | Electronic pressure control valve 4 | 16 | Electronic pressure control valve 1 |
| 17 | Electronic pressure control valve 3 | 18 | Electronic pressure control valve 5 |
| 19 | Electronic pressure control valve 6 | | |
| Kl. 15 WUP | Terminal 15 wake-up wire | Kl. 30 | Terminal 30 (power supply) |
| Kl. 31 | Terminal 31 (earth) | PT-CAN | Powertrain CAN |



The following illustration shows the block diagram for the mechatronics module on the E65, E66:

| Item | Description | Item | Description |
|------|------------------|------|----------------|
| 1 | EGS control unit | 2 | Solenoid valve |

| | | | |
|---------------|--|--------|--|
| 3 | Solenoid valve (actuates the parking lock valve) | 4 | Electronic pressure control valve 2 |
| 5 | Electronic pressure control valve 4 | 6 | Solenoid valve (locks the cylinder in "Park" position) |
| 7 | Electronic pressure control valve 1 | 8 | Electronic pressure control valve 3 |
| 9 | Electronic pressure control valve 5 | 10 | Electronic pressure control valve 6 for selector lever lock |
| 11 | Sensor for transmission input speed | 12 | Sensor for transmission output speed |
| 13 | ATF temperature sensor | 14 | Selector lever position switch for "Park" position with 2 Hall sensors |
| 15 | Starter inhibitor | 16 | to steering column switch cluster (SZL) |
| 17 | Diagnosis | | |
| Kl. 15 WUP | Terminal 15 wake-up wire | Kl. 30 | Terminal 30 (power supply) |
| Kl. 31 | Terminal 31 (earth) | PT-CAN | Powertrain CAN |

There are various other hydraulic valves within the hydraulic control unit in addition to the electronic pressure control valves and the solenoid valves listed (e.g. clutch valves, pressure reducing valves, etc.).

How it works

- EGS control unit
- Selector lever position switch
- Sensor for transmission input speed
- Sensor for transmission output speed
- Solenoid valve
- Electronic pressure control valve

EGS control unit

The EGS control unit is a component of the mechatronic module.

The data that the EGS control unit requires for shifting gears is sent on the powertrain CAN (PT-CAN) to the EGS control unit (e.g. injection period, engine speed, throttle valve angle, engine temperature and engine intervention).

Within the mechatronics module, the EGS control unit directly actuates the solenoid valve and the electronic pressure control valves.

Selector lever position switch

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

The selector lever position switch and the hydraulic selector valve are both actuated by the selector lever via the Bowden cable. The switching pulses from the Steptronic are transmitted by the selector lever to the mechatronics module. The selector lever position switch consists of a slide with permanent magnet and 4 Hall sensors for the drive positions

> E65, E66 only

The mechatronics module is electrically actuated by the selector lever ("shift-by-wire").

2 Hall sensors in the selector lever position switch allow the position of the parking lock cylinder to be registered. Only when the parking lock is released can the gears be changed.

Sensor for transmission input speed

The transmission input speed is measured at the transmission turbine wheel shaft (by a Hall sensor). The EGS control

unit compares the transmission input and output speeds and from this calculates the shift time of the clutches. The EGS control unit adapts piston pressures to the clutches as necessary to compensate for different altitudes and differences in friction padding.

Sensor for transmission output speed

The transmission output speed is directly proportional to the road speed and is measured by a Hall sensor on the transmission output flange.

The EGS control unit accepts the speed and uses this, together with the load signals, to calculate the necessary gear changes.

Solenoid valve

The solenoid valve in the hydraulic unit is actuated by the EGS control unit and has 2 functions (open and closed). The solenoid valve assigns the electronic pressure control valves to the corresponding release clutches, depending on the gear to be engaged.

> E65, E66 only

The parking lock is electrically actuated. Two additional solenoid valves are provided for the function of the parking lock. One solenoid valve actuates the parking lock valve, the other solenoid valve locks the parking lock cylinder.

>E92 only

The solenoid valve is no longer fitted. Instead, an electronically controlled pressure control valve is fitted (pressure control valve 7).

Pressure control valve 7 maintains constant system pressure throughout gearshifts. This allows shorter gearshift times.

Electronic pressure control valve

The electronic pressure control valves convert an electrical current defined by the EGS control unit into a proportional hydraulic pressure. The electronic pressure control valves actuate the valves belonging to the shift elements.

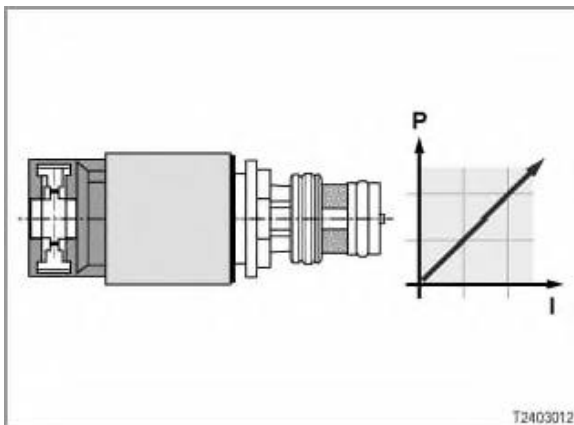
The electronic pressure control valves are assigned as follows to the individual shift elements:

| >E53, E60, E61, E63, E64, E65, E66, E83, E85, E87, E90, E91 | |
|---|----------------------------|
| <ul style="list-style-type: none"> - GA6HP19Z - GA6HP26Z - GA6HP32Z | |
| Electronic pressure control valve | Influence on shift element |
| 1 | Input clutch A |
| 2 | Input clutch B |
| 3 | Brake clutch C |
| 4 | Brake clutch D and E |
| 5 | System pressure |
| 6 | Converter lockup clutch |
| >E92 | |
| <ul style="list-style-type: none"> - GA6HP19Z TU (technical updates, e.g. of transmissions, are indicated with the letters "TU".) | |
| Electronic pressure control valve | Influence on shift element |
| 1 | Input clutch A |

| | |
|---|-------------------------|
| 2 | Converter lockup clutch |
| 3 | Input clutch B |
| 4 | Input clutch E |
| 5 | Brake clutch C |
| 6 | Brake clutch D |
| 7 | System pressure |

The following types of electronic pressure control valve are installed:

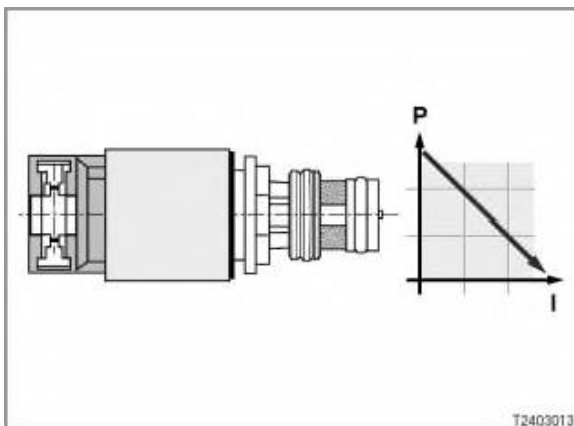
- Electronic pressure control valves with rising map
 - Electronic pressure control valves with falling map
- > **E53, E60, E61, E63, E64, E65, E66, E83, E85, E87, E90, E91**
- **GA6HP19Z**
 - **GA6HP26Z**
 - **GA6HP32Z**



Electronic pressure control valves 1, 3, 6:
green cap, closed without current, rising map

Technical data:

- Pressure range 0 to 4.6 bar
(0 mA = 0 bar /
700 mA = 4.6 bar)
- Power supply: 12 Volt
- Resistance of 5.05 ohms (at 20 °C)

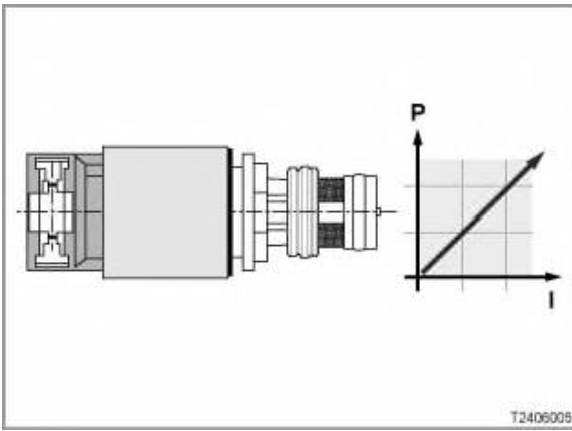


Electronic pressure control valves 2, 4, 5:
black cap, open without current, falling map

Technical data:

- Pressure range 4.6 to 0 bar
(700 mA = 0 bar /
0 mA = 4.6 bar)
- Power supply: 12 Volt
- Resistance of 5.05 ohms (at 20 °C)

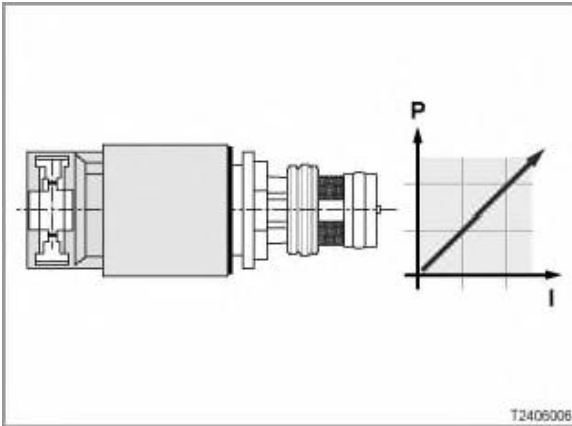
- > **E92**
- **GA6HP19Z TU**
(technical updates, e.g. of transmissions, are indicated with the letters "TU".)



Electronic pressure control valves 1, 2:
orange cap, closed without current, rising map

Technical data:

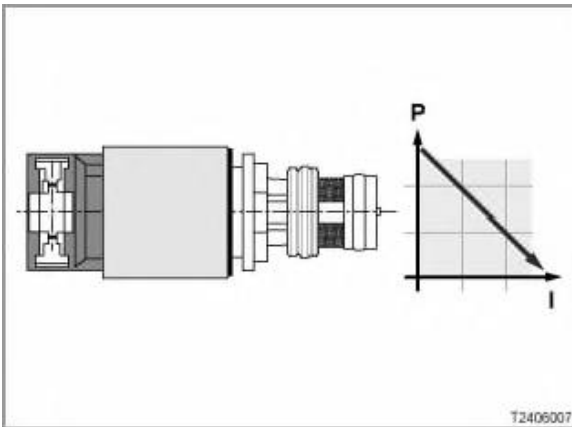
- Pressure range 0 to 4.7 bar
(0 mA = 0 bar /
700 mA = 4.7 bar)
- Power supply: 12 Volt
- Resistance of 5.05 ohms (at 20 °C)



Electronic pressure control valves 4, 5, 6:
yellow cap, closed without current, rising map

Technical data:

- Pressure range 0 to 4.6 bar
(0 mA = 0 bar /
700 mA = 4.6 bar)
- Power supply: 12 Volt
- Resistance of 5.05 ohms (at 20 °C)



Electronic pressure control valves 3, 7:
blue cap, open without current, falling map

Technical data:

- Pressure range 4.6 to 0 bar
(700 mA = 0 bar /
0 mA = 4.6 bar)
- Power supply: 12 Volt
- Resistance of 5.05 ohms (at 20 °C)

Selector lever, selector lever position display: E53, E60, E61, E63, E64, E83, E85, E87, E90, E91, E92

Installation location

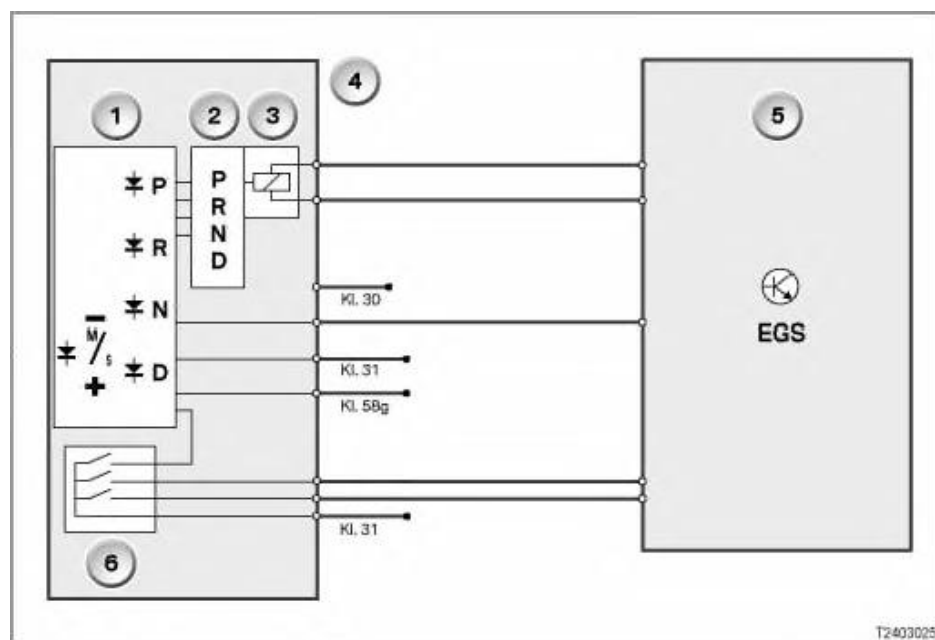
The selector lever is installed in the centre console. The selector lever trim holds the illuminated display for the selector lever position.

Construction

The gate pattern diagram is located in the selector lever trim. The drive position selected is illuminated in the gate pattern diagram. The background lighting is actuated by the sliding contact on the selector lever.

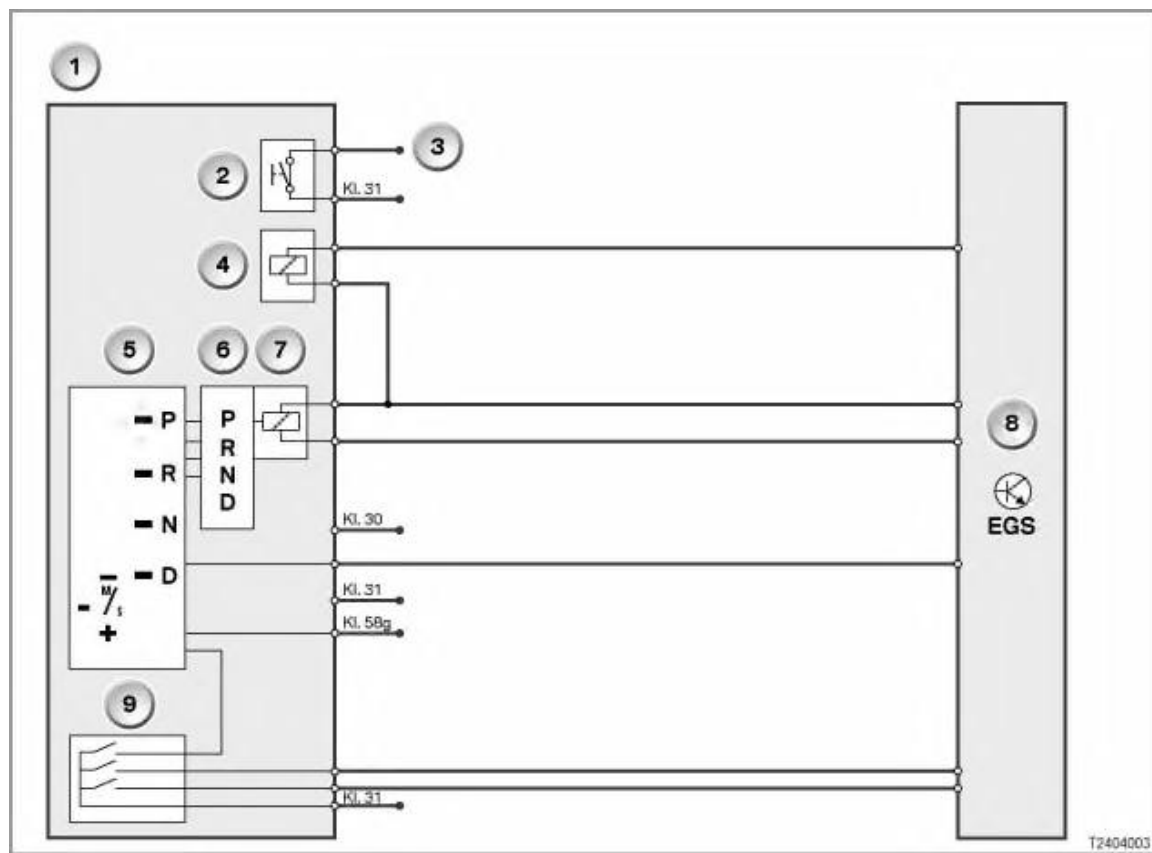
Using the Steptronic switch, gears can be shifted up and down manually.

- > E53, E83, E85 and
E60, E61, E63, E64 up to 09/2005



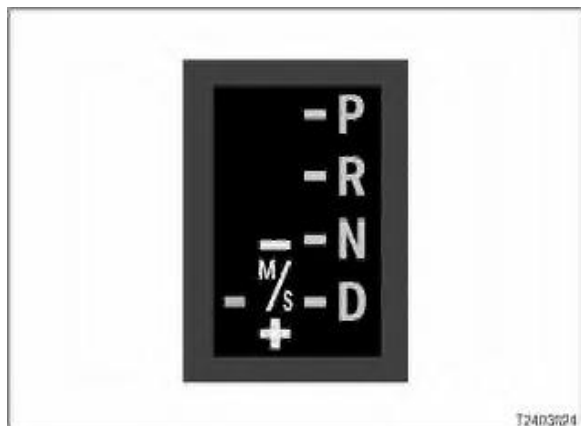
| Item | Description | Item | Description |
|---------|--|--------|---|
| 1 | Gate pattern diagram, illuminated drive position display | 2 | Sliding contact for gate pattern diagram illumination |
| 3 | Selector lever lock (shiftlock) | 4 | Gearshift mechanism |
| 5 | EGS control unit integrated in mechatronics module | 6 | Steptronic switch |
| Kl. 30 | Terminal 30 (power supply) | Kl. 31 | Terminal 31 (earth) |
| Kl. 58g | Terminal 58g (locating light) | | |

- > E87, E90, E91, E92 and
E60, E61, E63, E64 from 09/2005



| Item | Description | Item | Description |
|---------|--|--------|---|
| 1 | Gearshift mechanism | 2 | Microswitch of the interlock |
| 3 | Signal wire to CAS (Car Access System) | 4 | Interlock |
| 5 | Gate pattern diagram, illuminated drive position display | 6 | Sliding contact for gate pattern diagram illumination |
| 7 | Selector lever lock (shiftlock) | 8 | EGS control unit integrated in mechatronics module |
| 9 | Steptronic switch | | |
| Kl. 30 | Terminal 30 (power supply) | Kl. 31 | Terminal 31 (earth) |
| Kl. 58g | Terminal 58g (locating light) | | |

How it works



The following positions can be selected with the selector lever:

- P Park
- R Reverse gear
- N Neutral
- D Drive (= automatic mode)
- M/S Sport program or manual mode (Steptronic)
- Manual downshift
- + Manual upshift

A lock prevents the selector lever from being inadvertently moved to positions "R" and "P". To overcome the lock, the button on the front of the selector lever knob must be pressed.

Plausibility check

The selector lever can only be moved from position "D" to the "M/S" shift gate. For this shift to be carried out, the EGS control unit must detect the M/S shift gate and position D signals at the same time.

The signals "+" or "-" for upshift and downshift are only recognised in the manual shift gate.

General information for service staff about the 6-speed automatic transmission: E53, E60, E61, E63, E64, E65, E66, E83, E85, E87, E90, E91, E92

The following general information about the automatic transmission is provided for service staff:

- Oil change
- Interlock emergency release (E87, E90, E91, E92)
- Parking lock emergency release (E65, E66)

Oil change

Important: No oil change needed

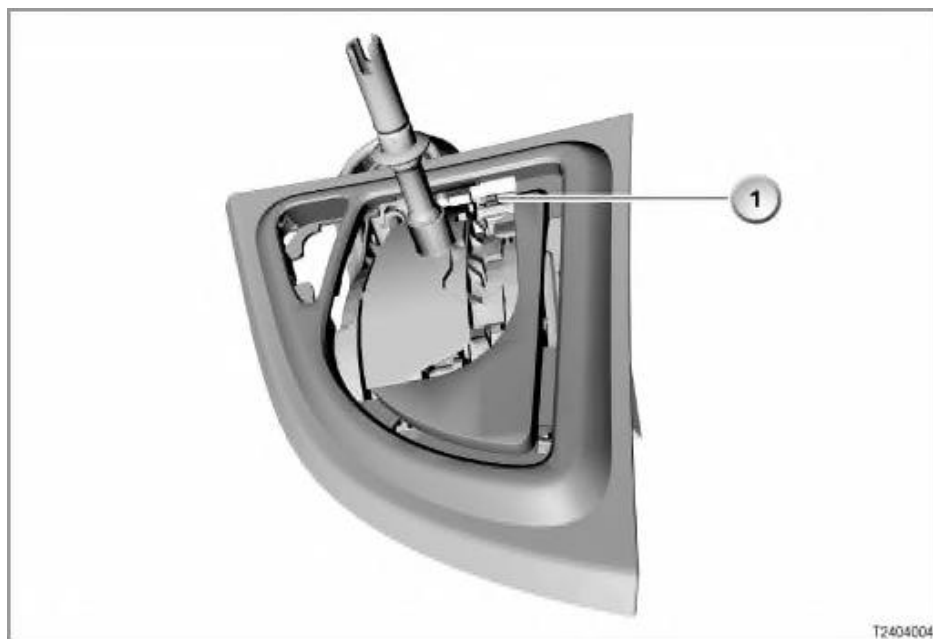
The automatic transmissions have a lifetime oil filling. The automatic transmissions do not need an oil change for their entire service life.

Interlock emergency release

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

> E87, E90, E91, E92

In an emergency, the selector lever can be moved by pressing the interlock locking pawl out of selector lever position "P". The selector lever cover must be removed for this emergency release.



| Item | Description | Item | Description |
|------|------------------------|------|-------------|
| 1 | Interlock locking pawl | | |

Parking lock emergency release

>E65, E66

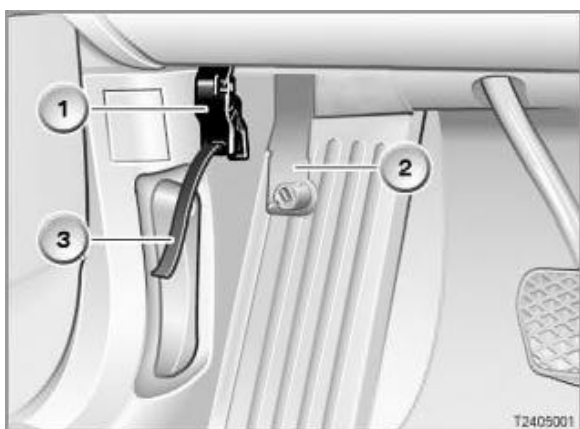
If the parking lock can no longer be released hydraulically, a mechanical emergency release device is still possible. This allows the vehicle to be pushed or pulled if necessary.

Important: Manually release the parking lock when towing the vehicle.

If the vehicle is to be pulled (towed) on all four wheels and the transmission is operational, the parking lock must be manually released with the emergency release. This prevents the drive wheels from locking.

Important: Reapply the parking lock after parking the vehicle.

The parking lock must be applied again when the vehicle is parked. If the parking lock is not applied, there is a risk of the vehicle moving unexpectedly.



How to release the parking lock is described in the Owner's Handbook.

- 1) Parking lock lever
- 2) Cover
- 3) Strap