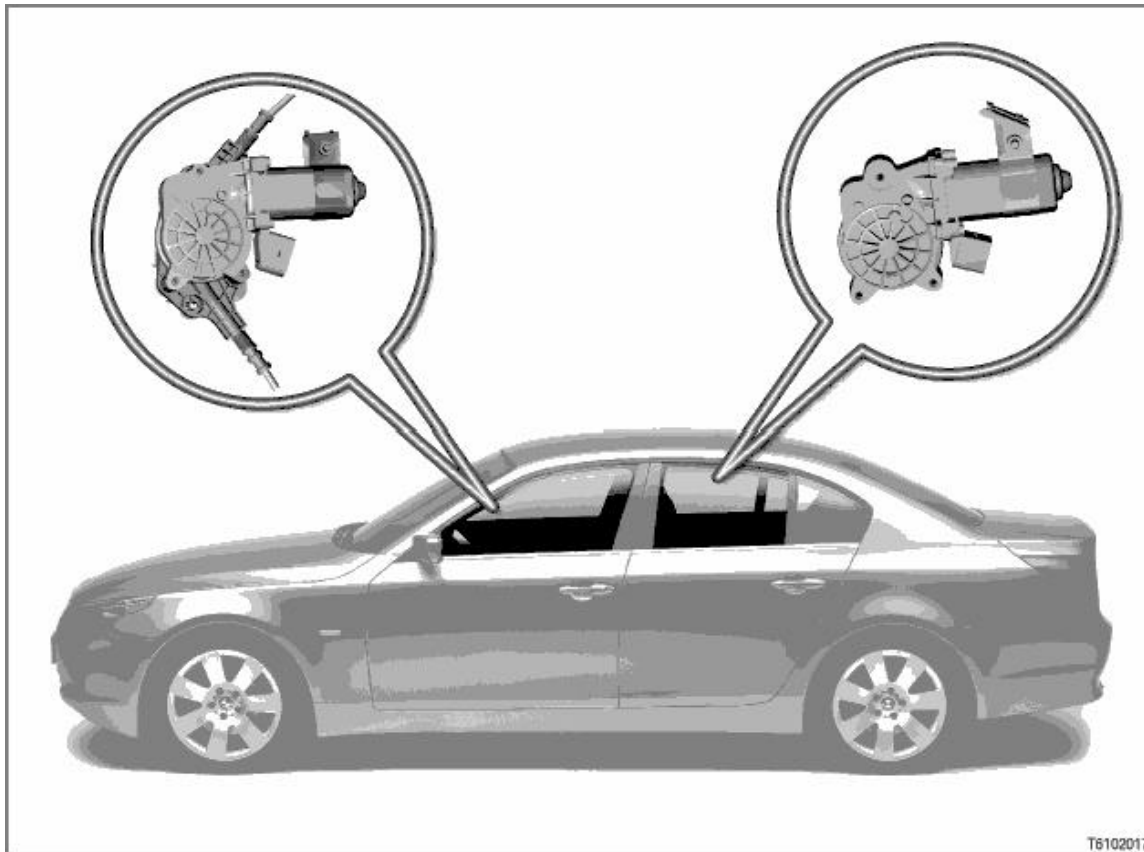# Power windows

E60

Introduction

The power windows for raising and lowering the side windows are designed as a cable lift drive.
The power windows for the front doors are controlled by the door modules (driver's door module TMFA and front-passenger door module TMBF). The power windows for the rear doors are activated by the body basic module KBM.
The Car Access System CAS controls the release and inhibition of power-window operation, depending on:

- Terminal status

- Status of door contacts

- Country-specific coding

In addition the convenience operation of the power windows (convenience opening/closing) is controlled by the CAS.

Brief description of components

The following components supply an input signal for the power windows function:

- **Switch block in the driver's door**

   All the power windows can be operated via the switch block in the driver's door. The switch block is connected via a LIN bus on the driver's door module TMFA (LIN = Local Interconnect Netwerk). [more ...]

- **Power-window switch in the front-passenger door, power-window switch in the rear doors**

The front-passenger door and the rear doors are equipped with separate power-window switches.

- **Door contacts of all doors**

  The door contacts are analysed to detect the status of the doors (OPEN or CLOSED). In the event of a faulty door contact, a closed door is assumed.

- **Hall sensors in the power-window motors**

  Two Hall sensors are built into the power-window motor. The direction of rotation, speed and position can be determined through these.

The following control units are involved in the operation of the power windows:

- **CAS Car Access System**

  The Car Access System is the power-window master for the operation of the power windows.

  The commands are transmitted via the K CAN.

- **Safety and gateway module SGM**

  The safety and gateway module forms the gateway between K CAN and **byteflight**.

- **Driver's door module TMFA and front-passenger door module TMBF**

  The door contacts are components of the ASE passive safety system (= Advanced Safety Electronics). The door modules control the power windows for the front doors. [more ...]

- **KBM body basic module**

  The KBM body basic module controls the power windows for the rear doors. The body basic module is connected to the safety and gateway module SGM and the Car Access System CAS via the K CAN. [more ...]

The following actuators are controlled for the operation of the power windows:

- **power-window motors**

  There is a DC motor in each door which drives the power windows.

  The power-window motors for the front doors are controlled by the door modules. The power-window motors for the rear doors are controlled by the KBM body basic module. [more ...]

System functions

The power windows incorporate the following functions:

- Opening and closing
- Convenience opening and closing
- Emergency closing and panic mode
- Child-proof locks
- Repeat lock
- Indirect anti-trapping mechanism
- Load cut-off

Opening and closing

The power windows may be operated from terminal R ON. The power windows can be operated for 1 minute after terminal R has been switched OFF (coded in the CAS for switching off the off-load current).

The power windows cannot be operated if one of the front doors is open (dependent on coding).

The side windows can be opened and closed using the following control units:

- Switch block in the driver's door
- Power-window switch in the front-passenger door and in the rear doors

- Remote control
- Driver's door lock cylinder

All the power-window switches have two switch levels in either operating direction.

At the first switch level, the side window is opened or closed all the while the switch is pressed.

At the second switch level, the side window is opened or closed fully even after the switch has been released (one-touch opening and closing).

The power-window drive runs at higher speed during one-touch opening or closing.

One-touch opening/closing is only possible with the anti-trapping function activated.

To ensure that the side windows are securely closed, the power-window motors are briefly moved to the locked position (mechanical final stop) end in the upper stop.

Convenience opening and closing

This convenience function is controlled by the CAS Car Access System CAS via the door modules and the KBM body basic module.
Convenience opening and closing can be triggered by the remote control or by the driver's door lock cylinder. Convenience closing is activated when:

- the remote control button remains pressed and held after locking/securing,
- the mechanical key is kept in the "Lock" door lock position.

Convenience opening is similarly activated via the unlocking button on the remote control or using the mechanical key in the "Unlock" door lock position.

Convenience opening is performed in the following order:

- both front power windows
- both rear power windows after a time delay
- sliding/tilting sunroof after a time delay

Convenience closing is performed in the following order:

- both rear power windows
- both front power windows after a time delay
- sliding/tilting sunroof after a time delay

The convenience function is stopped if the command is interrupted.

Emergency closing and panic mode

Emergency closing:

Emergency closing is for intentional closing of the side windows **with** the anti-trapping mechanism. To do this, the power-window switch must be pressed and held. It may be necessary to use this function in the event of an attack from outside or if the side windows are frozen.
Emergency closing can be activated up to a speed of 16 km/h.

If something becomes trapped in the window, the selected side window opens just a few millimetres (unlike the normal procedure when something is trapped in the window; see indirect anti-trapping function).

Panic mode:

The panic mode can only be triggered after emergency closing has been performed.

If the user releases and then presses and holds the power-window switch within 4 seconds, the side window is closed **without** the anti-trapping function. The side window is then closed with maximum force and speed. If something becomes trapped, the power-window motor runs until the thermal protection cuts in.
It is always possible to open the side windows irrespective of thermal protection.

Releasing the held power-window switch interrupts the emergency closing or panic mode function.

When the child-proof locks are applied, emergency closing for the rear side doors can only be triggered via the switch block in the driver's door.

If emergency closing for one of the side windows is triggered via the switch block in the driver's door, the closing procedure can be stopped by the other power-window switches as long as the child-proof locks are not applied.

Child-proof locks

The child-proof locks inhibit the function of the rear power-window switch. The child-proof locks are enabled/disabled through a switch on the switch block in the driver's door.

When the child-proof locks are enabled, the function LED in the button is switched on.

No opening or closing is triggered when the child-proof locks are enabled. An opening or closing operation which is already taking place (e.g. one-touch closing) is interrupted.
The child-proof locks are disabled in crash mode.

Safety functions with the child-proof locks enabled and automatic closing function of the rear power windows in progress:

• The closing operation can be stopped by the relevant local power-window switch.

• The child-proof locks can only be disabled if the key is engaged in the ignition lock.

Repeat lock (thermal protection)

A repeat lock is provided for each motor to prevent the power-window motors from overheating. The running time for the power-window motor is limited. The motor is switched off for a defined time.

The repeat lock allows at least 5 complete window movements (OPEN/CLOSED).
 The last movement possible is always a closing operation.

In the event of entrapment, opening is not hindered by the repeat lock
The anti-trapping function is always able to reverse the window movement.
The repeat lock is integrated in the door modules and in the body basic module.

Indirect anti-trapping mechanism

The anti-trapping function is active during the entire window movement in the closing direction. The indirect anti-trapping function does not prevent all entrapment, but limits the maximum permissible entrapment force (closing force limit to maximum of 100 Newtons).

The anti-trapping function is only enabled once the power windows have been successfully initialised and automatic closing (one-touch closing) is possible.

Initialisation of front power windows:

During the first operation, only the upper stop on the side window has to be learnt during initialisation. To do this, the side window must be moved to the upper stop. No characteristic curve is learnt for the front power windows. The window does not need to move to the lower stop.

Initialisation of rear power windows:

During first operation, the characteristic curve must be standardised and learnt during initialisation. During standardisation, the zero position of the window movement is determined at the upper and lower stops. In addition, during initialisation the development of the closing force is measured over the entire closing movement and permanently stored (= learning the characteristic curve).

The mechanical forces for the closing procedure vary according to the ambient temperature and ageing. Therefore the closing force is relearnt with each closing procedure and the anti-trapping mechanism is adapted accordingly.
 With each further closing procedure, the closing force currently required is recorded and compared with the

stored value. If the difference between the two force values is over the predefined trigger threshold, the side window opens immediately. The opening procedure can be coded so that it is country-specific.

The anti-trapping function can be disabled in the panic mode (see emergency closing and panic mode).

If the anti-trapping function fails (e.g. faulty Hall sensors), automatic closing is not possible (one-touch closing).

Load cut-off

To protect the battery, the power windows will not operate while the engine is being started (terminal 50). Any current power-window operation (e.g. one-touch opening) is stopped.

If the battery voltage falls below 9 volts, the power-window motors are switched off.

Notes for service staff

Service staff should note the following points:

- General information: ---

- Diagnostics: ---

- Encoding/programming: ---

- Car and Key Memory: ---

National versions

The following national versions are possible:

- Finland national version

    Operation of the power window and sliding/tilting sunroof is allowed when the driver's or front-passenger door is open. The power windows and the sliding/tilting sunroof are disabled once the two front doors have been closed.

- USA/Canada/Australia national version

    Operation of the power windows and the sliding/tilting sunroof is inhibited if the driver's or front-passenger door is opened. Furthermore, convenience closing is not possible.

- United Kingdom national version

    The reversal opening of the side window when the anti-trapping function is activated is greater than in the EU national version.

Subject to amendment arising from misprints, errors and technical modifications.

E60 Switch block in the driver's door

Installation location

The switch block in the driver's door is installed on the inside door handle.

Construction

Key	Description	Key	Description
1	Door mirror adjustment	2	Switches between the door mirrors
3	Front-passenger door power-window switch	4	Passenger-side rear door power-window switch
5	Roller sunblind button in rear window	6	Child-proof locks for the rear power windows
7	Driver's side rear door power-window switch	8	Driver's door power-window switch
9	Button for folding the door mirrors in/out		

The switch block in the driver's door is firstly connected via a LIN bus (LIN = Local Interconnect Network) to the driver's door module TMFA.
 The switch block in the driver's door is the central operating point for the power windows. Operation of the door mirrors and the roller sunblind for the rear window is also provided.

How it works

The power-window switches have 2 functional stages for pushing and pulling:

- **Functional stage 1: Switch as far as the pressure point**

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Page - 1 -

The power-window motors are activated until the switch is released. The power window stops immediately the switch is released. The power-window motor switches off in the end positions. As soon as the window reaches the end position, the power-window motor is no longer powered.

- **Functional stage 2: Switch beyond the pressure point**

   The position beyond the pressure point is also known as the one-touch function. The power-window motors are automatically run to the end position once the button has been pressed beyond the pressure point. This automatic movement of the power windows may be halted by pressing the power-window switch again.

The signals between the switch block in the driver's door and the driver's door module TMFA are transferred on the LIN bus (LIN = Local Interconnect Network).
The LIN bus is a serial single-wire bus standardised for the automotive industry.
The data transfer rate for the LIN bus can reach 19.2 kBaud.

Example of a signal: opening the driver's door side window using the switch block in the driver's door
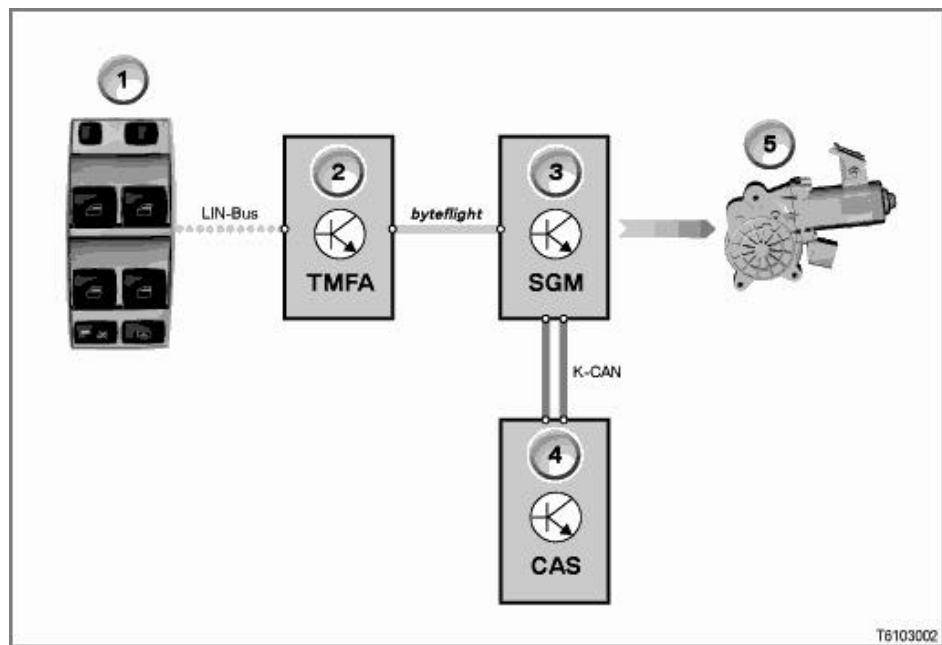
Key	Description	Key	Description
1	Switch block in the driver's door	2	Driver's door module TMFA
3	Safety and gateway module SGM	4	Car Access System CAS
5	Power-window motor in the driver's door		

Operation of the power-window switch is signalled via the LIN bus to the driver's door module TMFA. The driver's door module TMFA sends the signal via the **byteflight** to the Safety and gateway module SGM. The safety and gateway module translates the signal and sends it on the K CAN to the Car Access System CAS (= master control unit for the power windows). The Car Access System receives the signal and analyses it. The CAS sends a command on the K CAN to the safety and gateway module. This transfers the command via the **byteflight** to the driver's door module TMFA. The driver's door module activates the power-window motor in the driver's door. The driver's door module TMFA calculates the following from the Hall sensor signals in the power-window motor:
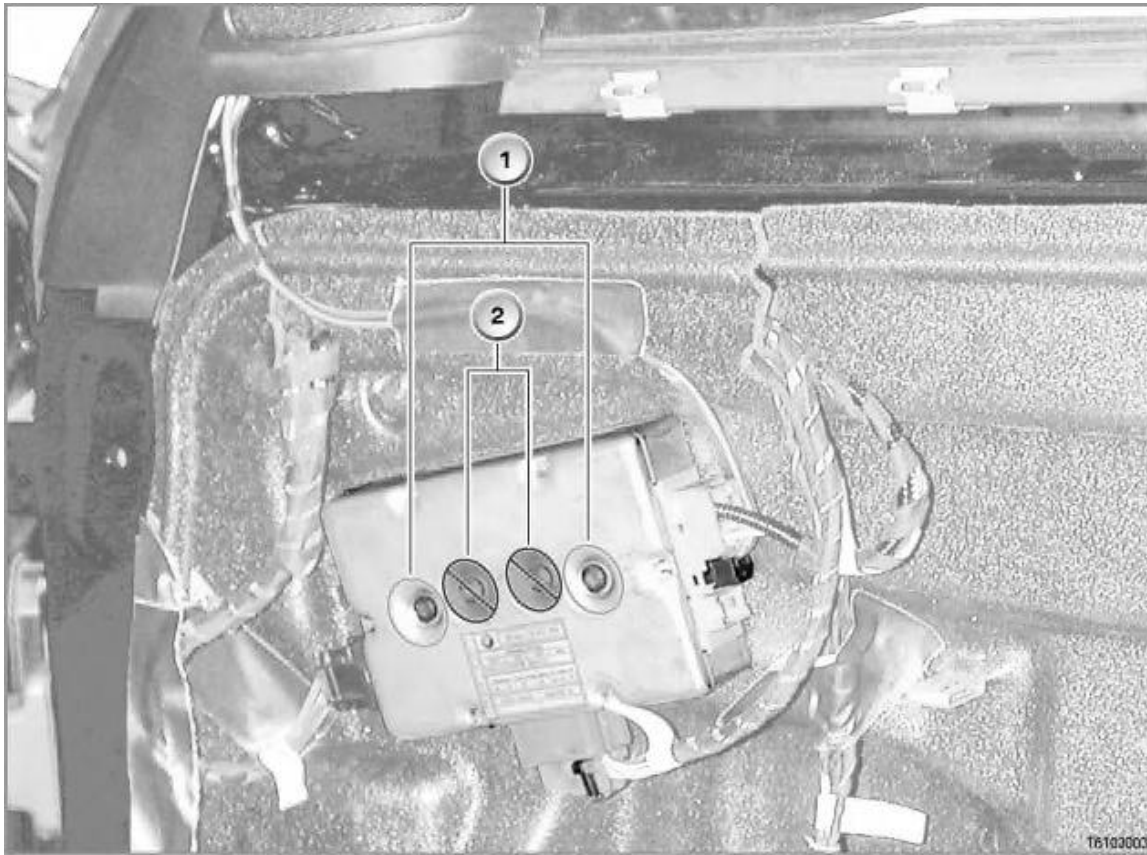
- Direction of rotation

- Speed

- Position

If necessary, the anti-trapping function is enabled.

E60 Door modules

Installation location

The driver's/front-passenger door modules are secured to the inner door panel above the door handle.

Key	Description	Key	Description
1	Screws to remove the door module (front-passenger door illustrated)	2	**Important. Do not undo the screws** The inner screws hold the housing together and ensure that the pressure sensor is sealed.

Construction

The door module is a combination of the following:

- Control unit for various functions of the body electronics, such as the front power windows or the door mirrors

- Satellite of the passive safety system ASE (ASE = Advanced Safety Electronics)

There is a pressure sensor in the driver's and front-passenger door module. The pressure sensor allows the ASE to activate the side airbag as early as possible.

Note: connector colours vary
> The driver's/front-passenger door modules can be distinguished by the colour of the lower connector (18-pin).
> Driver's door module = black connector
> Front-passenger door module = green connector

There are a total of 5 connectors on the door module (example of the driver's door).

Pin assignment X1129, 5-pin (black)

Pin	Type	Description
1	V	Power supply, terminal 30 (central locking system, power windows, door mirrors, lighting)
2	M	Earth, terminal 31, (power windows)
3	M	Earth, terminal 31 (central locking system, door mirrors, lighting)
4	A	Driver's door power-window motor (+)
5	A	Driver's door power-window motor (-)
	A = Output M = Earth V = Supply Please refer to the BMW diagnosis system for current information regarding pin assignment	

Pin assignment X10667, 18-pin (driver's door green, front-passenger door black)

Pin	Type	Description
1	A	Signal for locking the driver's door
2	---	---
3	A	Earth for the Hall sensors (power windows) in the driver's door
4	E	Signal from the Hall sensor (door contact) in the driver's door
5	---	---
6	---	---
7	---	---
8	A	Ambient light in the handle recess (terminal 58g)
9	A	Ambient light in the storage compartment (terminal 58g)
10	A	Signal for securing the driver's door
11	A	Door entry lighting
12	A	Signal for unlocking the driver's door
13	E	Signal for unlocking the lock cylinder (Hall sensor) in the driver's door
14	E	Signal for locking the lock cylinder (Hall sensor) in the driver's door
15	A	Power supply for the Hall sensors (power windows) in the driver's door
16	A	Earth for the Hall sensors (lock cylinder) in the driver's door
17	E	Signal 1 from the Hall sensor (power windows) in the driver's door
18	E	Signal 2 from the Hall sensor (power windows) in the driver's door
	A = Output E = Input M = Earth V = Supply Please refer to the BMW diagnosis system for current information regarding pin assignment	

Pin assignment X1128, 5-pin (yellow)

Pin	Type	Description
1	E/A	**byteflight** to the safety and gateway module SGM
2	V	Power supply for the ASE function in the door module (ASE = Advanced Safety Electronics)
3	M	Earth to the driver's door module
4	A	Igniter pellet for the side airbag (+)
5	A	Igniter pellet for the side airbag (-)
	A = Output E/A = Input/output M = Earth V = Supply Please refer to the BMW diagnosis system for current information regarding pin assignment	

Pin assignment X01050, 6-pin (yellow)

Pin	Type	Description
1	A	Door mirror adjustment, horizontal
2	A	Earth for door mirror adjustment, for folding in the mirrors and mirror heating
3	A	Courtesy lighting
4	A	Door mirror adjustment, vertical
5	A	Power supply for mirror heating
6	A	Motor control folding in the mirrors
	A = Output Please refer to the BMW diagnosis system for current information regarding pin assignment	

Pin assignment X01172, 6-pin (yellow)

Pin	Type	Description
1	A	Earth to door mirror (potentiometer for identifying the position)
2	E	Signal from potentiometer for identifying the position, vertical
3	A	Power supply to the door mirror (potentiometer for identifying the position)
4	---	---
5	---	---
6	E	Signal from potentiometer for identifying the position, horizontal
	A = Output E = Input Please refer to the BMW diagnosis system for current information regarding pin assignment	

Pin assignment 10725, 8-pin (black)

Pin	Type	Description

SBT E60 Door modules

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Page - 3 -

1	A	Power supply for the switch block in the driver's door
2	A	Earth for the switch block in the driver's door
3	E	Signals via LIN from the switch block in the driver's door (LIN = Local Interconnect Network)
4	---	(CLOSED signal on the passenger side from the power-window switch)
5	---	(OPEN signal on the passenger side from the power-window switch)
6	---	---
7	---	---
8	E	Signal from potentiometer for identifying the position, vertical
	A = Output E = Input Please refer to the BMW diagnosis system for current information regarding pin assignment	

How it works

The front power windows are controlled by the driver's door module TMFA or the front-passenger door module TMBF.
The rear power windows are controlled by the body basic module KBM.

The door module represents the interface to:

- Switch block in the driver's door via LIN bus or front-passenger power-window switch

- Power-window motor with Hall sensors

- Door contact

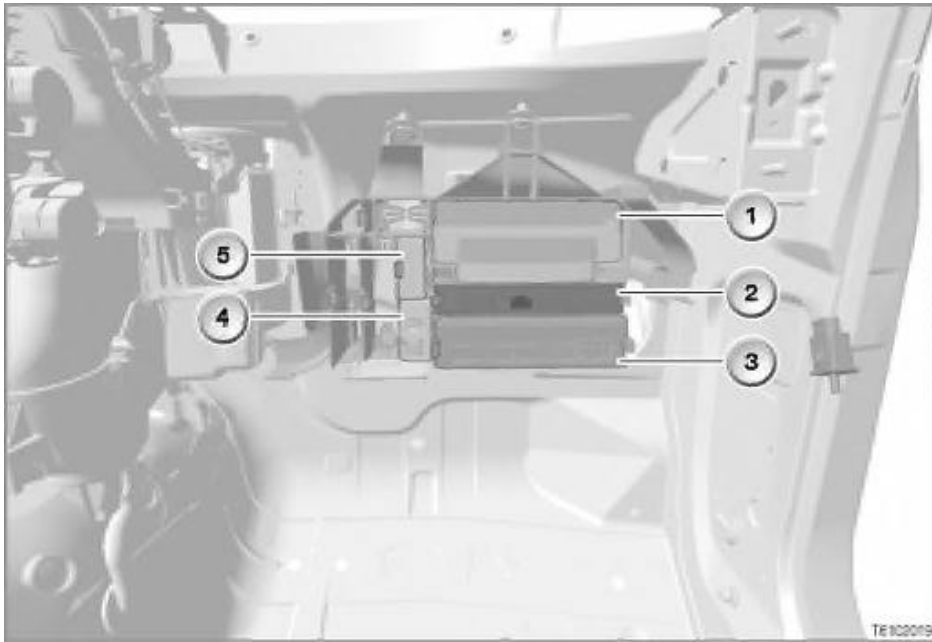- Safety and gateway module SGM via **byteflight**

In addition to the power-window functions in the front doors, the door module controls:

- Door mirror adjustment

- Mirror heating for the door mirrors

- Ambient light for the handle recess and the storage compartment in the front doors

- Front door entry lighting

- Courtesy lighting (light conductor in the door mirror)

- Side airbag (ASE satellite)

E60 Body basic module KBM

Installation location

The body basic module KBM is integrated with the other control units in the rack behind the glove compartment .

Key	Description	Key	Description
1	Control unit for the CD changer (CDC control unit)	2	Body basic module KBM
3	Safety and gateway module SGM	4	Control unit for the adaptive cornering lights (AHL control unit)
5	Control unit for the tyre pressure monitor (RDC control unit)		

Construction

The body basic module KBM has a terminal strip with four connectors.

Pin assignment X13252, 52-pin

Pin	Type	Description
1	A	Control of the washer pump for the headlight cleaning system SRA
2	---	---
3	E	Signal 1 from the Hall sensor (power windows) in the rear door on the passenger side
4	---	---
5	E	Signal from the interior light button
6	---	---
7	---	---
8	---	---

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02.08.2005 08:19
Page - 1 -

9	A	Power supply for the Hall sensors (power windows) in the rear door on the passenger side
10	E	Signal from the reset contact in the wiper motor
11	---	---
12	E	Signal from the Hall sensor (door contact) in the rear door on the driver's side
13	---	---
14	E	Signal from the power-window switch in the rear door on the passenger side (OPEN)
15	E	Signal from the power-window switch in the rear door on the driver's side (OPEN)
16	---	---
17	---	---
18	A	Control of the wiper motor (via dual relay module)
19	---	---
20	E	Signal 2 from the Hall sensor (power windows) in the rear door on the driver's side
21	E	Signal 2 from the Hall sensor (power windows) in the rear door on the passenger side
22	E	Signal 1 from the Hall sensor (power windows) in the rear door on the driver's side
23	---	---
24	---	---
25	---	---
26	A	Power supply for the Hall sensors (power windows) in the rear door on the driver's side
27	---	---
28	E	Signal from the Hall sensor (door contact) in the rear door on the driver's side
29	---	---
30	---	---
31	---	---
32	E	Signal from the power-window switch in the rear door on the driver's side (CLOSE)
33	E	Signal from the external boot lid pushbutton
34	A	Control of the door entry lighting for the front-passenger door
35	A	Control of the door entry lighting for the driver's door
36	A	Control of the washer pump (windscreen)
37	E	Terminal 15 signal
38	E/A	K CAN High connection
39	E/A	K CAN Low connection
40	---	---
41	---	---
42	---	---

43	---	---
44	---	---
45	---	---
46	---	---
47	A	Earth for the Hall sensors (power windows) in the rear door on the driver's side
48	A	Earth for the Hall sensors (power windows) in the rear door on the passenger side
49	---	---
50	E	Signal from the power-window switch in the rear door on the passenger side (CLOSE)
51	A	Control of the wiper motor (via dual relay module)
52	A	Control of interior lighting in the headlining
53	A	Control of the footwell light for the front-passenger door
54	A	Control of the footwell light for the driver's door
	A = Output E = Input E/A = Input and output Please refer to the BMW diagnosis system for current information regarding pin assignment	

X13542, 3 pin

Pin	Type	Description
1	A	Consumer shutdown for the interior lighting
2	A	Consumer shutdown for other consumers
3	V	Power supply with terminal 30 (electronics)
	A = Output V = Supply Please refer to the BMW diagnosis system for current information regarding pin assignment	

X13253, 13-pin

Pin	Type	Description
1	M	Terminal 31 (load 1)
2	V	Power supply with terminal 30 (load)
3	A	Boot lid central locking drive
4	A	Signal for deadlocking the rear door on the driver's side
5	A	Signal for locking the fuel filler flap
6	---	---
7	A	Signal for unlocking the rear door on the driver's side
8	A	Signal for locking the rear door on the driver's side
9	A	Signal for deadlocking the rear door on the passenger side
10	---	---

Pin	Type	Description
11	A	Signal for unlocking the rear door on the passenger side
12	A	Signal for unlocking the fuel filler flap
13	A	Signal for locking the rear door on the passenger side
	A = Output M = Earth V = Supply Please refer to the BMW diagnosis system for current information regarding pin assignment	

X13255, 6-pin

Pin	Type	Description
1	V	Power supply with terminal 30 (load 2)
2	A	Control of the power windows for the rear door on the passenger side OPEN
3	A	Control of the power windows for the rear door on the passenger side CLOSE
4	V	Power supply with terminal 30 (load 3)
5	A	Control of the power windows for the rear door on the driver's side OPEN
6	A	Control of the power windows for the rear door on the driver's side CLOSE
	A = Output V = Supply Please refer to the BMW diagnosis system for current information regarding pin assignment	

How it works

The body basic module KBM is integrated into the bus network via the K CAN (body CAN).

The body basic module controls the following functions:

- Power windows for the rear doors
- Central locking of the rear doors, the boot lid and fuel filler flap
- Wipe/wash system
- Interior lighting with door entry lighting on the rear doors
- Consumer shutdown

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Page - 4 -
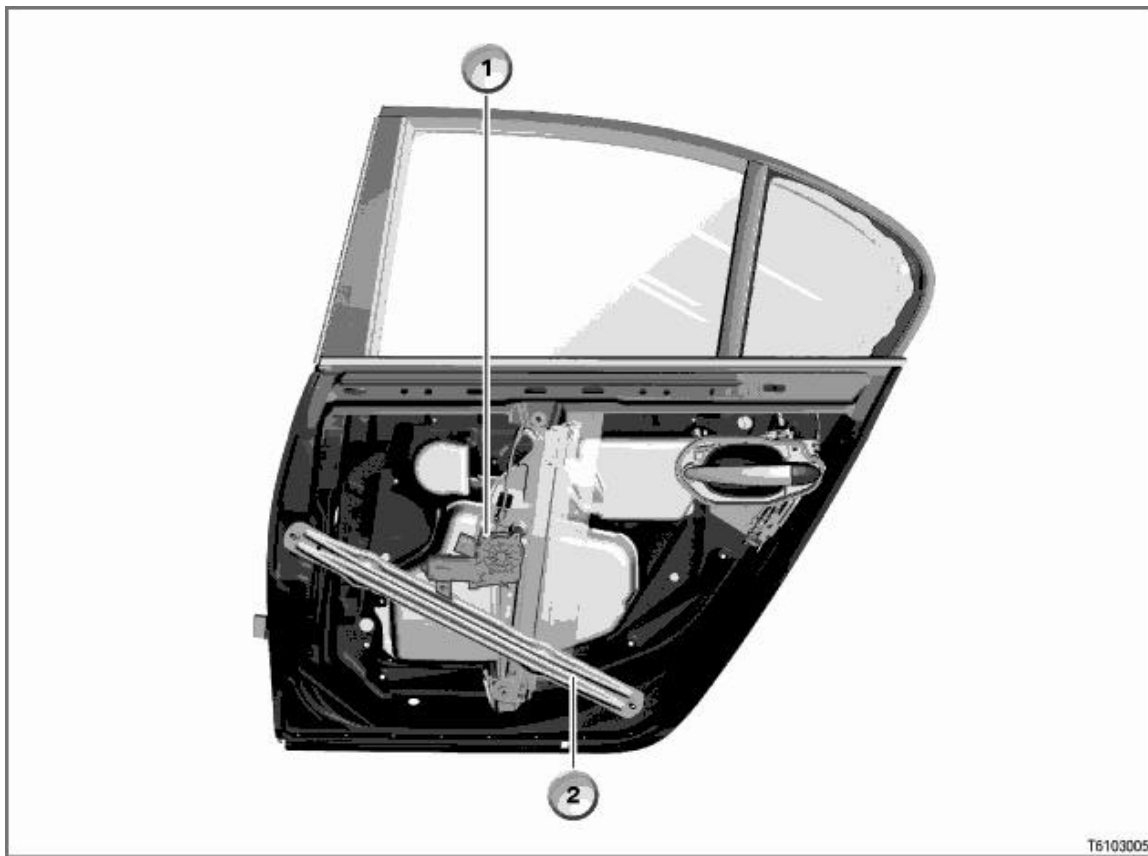
E60 Power-window motors

Installation location

The power-window motors in the front and rear are each mounted by the door reinforcement stiffener.
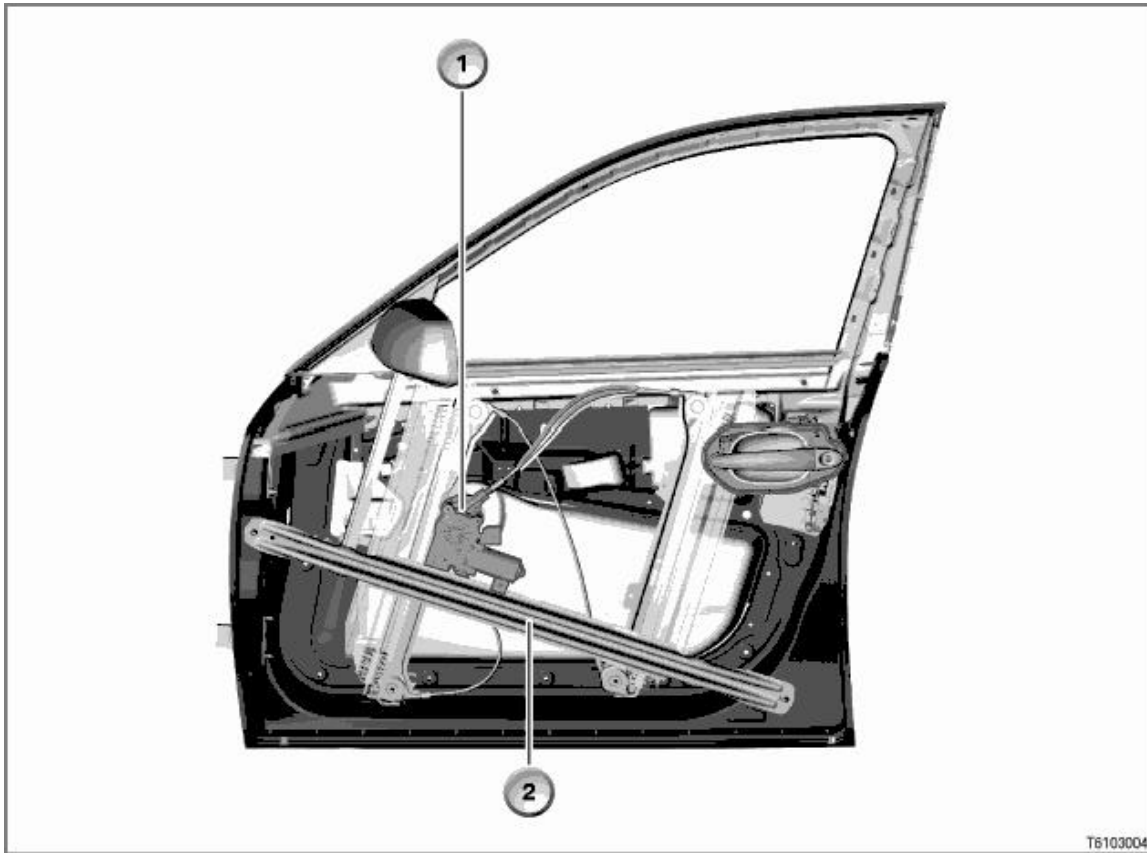
Key	Description	Key	Description
1	Power-window motor in the driver's door	2	Door stiffener

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Page - 1 -

Key	Description	Key	Description
1	Power-window motor in the rear door on the driver's side	2	Door stiffener

Construction

The power-window drive is designed as a cable lift drive.
The power-window motor essentially comprises:

- DC motor with 2 Hall sensors

- Step-down gearing

- Electronics unit

Two Hall sensors are built into the DC motor which are addressed by a magnetic disc mounted on the armature shaft. The magnetic disc is divided into several pole pairs.

How it works

The door modules and the body basic module calculate the following for the power-window motors from the Hall sensor signals:

- Direction of rotation

- Speed

- Position

In addition, trapping or blocking of the power windows is also detected.

The power windows are operated at various speeds:

- Reduced speed at the upper and lower side window stop to reduce noise (soft starting and stopping of power-window motor)

- Normal speed when opening/closing without automatic operation

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Page - 2 -

- Increased speed with automatic opening/closing (one-touch opening/closing)

Important. Initialisation after repair work

Initialisation is required after repair work to ensure that the position of the power windows is determined.

Initialisation is different for the front and rear power windows (see notes for service staff).

No initialisation is required after disconnecting and then reconnecting the vehicle battery.