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# E65 Central Body Electronics

**Model: E65/E66**

**Production: All**

# OBJECTIVES

After completion of this module you will be able to:

- Understand the Operation of Body Electronics Systems
- Understand the Role of Bus Networks in Body Electronics Systems
- Locate and Identify Components used in Body Electronics Systems
- Diagnose Concerns in Body Electronic Systems

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## Introduction

The Central Body Electronics functions of the E65 are to a large extent identical to the ZKE III centralized system of the E38. To enhance convenience and safety, numerous technical modifications and innovations have been carried out. A large proportion of these improvements are executed in the background and are not immediately noticed by the customer.

A major difference to the E38 is the placement of software for a particular function. The software can be located in the associated control unit or distributed to several control units. On account of this distribution, each system is described below mainly in its capacity as a function.

The following functions are classified as "Central Body Electronics" of the E65:

- Central Locking and soft-close automatic doors
- Power windows
- Roller sun blinds
- Sun roof
- Front seat adjustment
- Steering-column adjustment
- Memory seats, door mirrors, steering column
- Windshield wipe-wash functions
- Automatic trunk lid lift

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## Central Locking and Soft Close Automatic Doors

The Central Locking system (ZV) of the E65 controls the:

- Door locks (optional soft-close).
- Trunk lid lock and soft close.
- Fuel tank filler flap locking.

Various improvements have been made to the system, however the greatest change from the previous model is that while the CAS contains the Central Locking Master functions, the output operations are de-centralized and carried out by several different modules.

The Central Locking may be operated from the following locations:

- Lock cylinder, driver's door.
- Remote Control (FZV function of FBD).
- Central locking button (CLB).
- Passenger compartment trunk lid release button (TOEHKI).
- Trunk-lid button, inside of trunk lid (TOEHKK, only if equipped with HKL).
- Outside trunk-lid button (TOEHK).
- Hotel switch in lockable compartment in center console (hotel).

Unlocking via the crash sensor and forced double unlocking via the "key-inserted signal" in the Car Access System (CAS) and the central locking button are possible.

The following central-locking functions can be controlled by way of the operating locations:

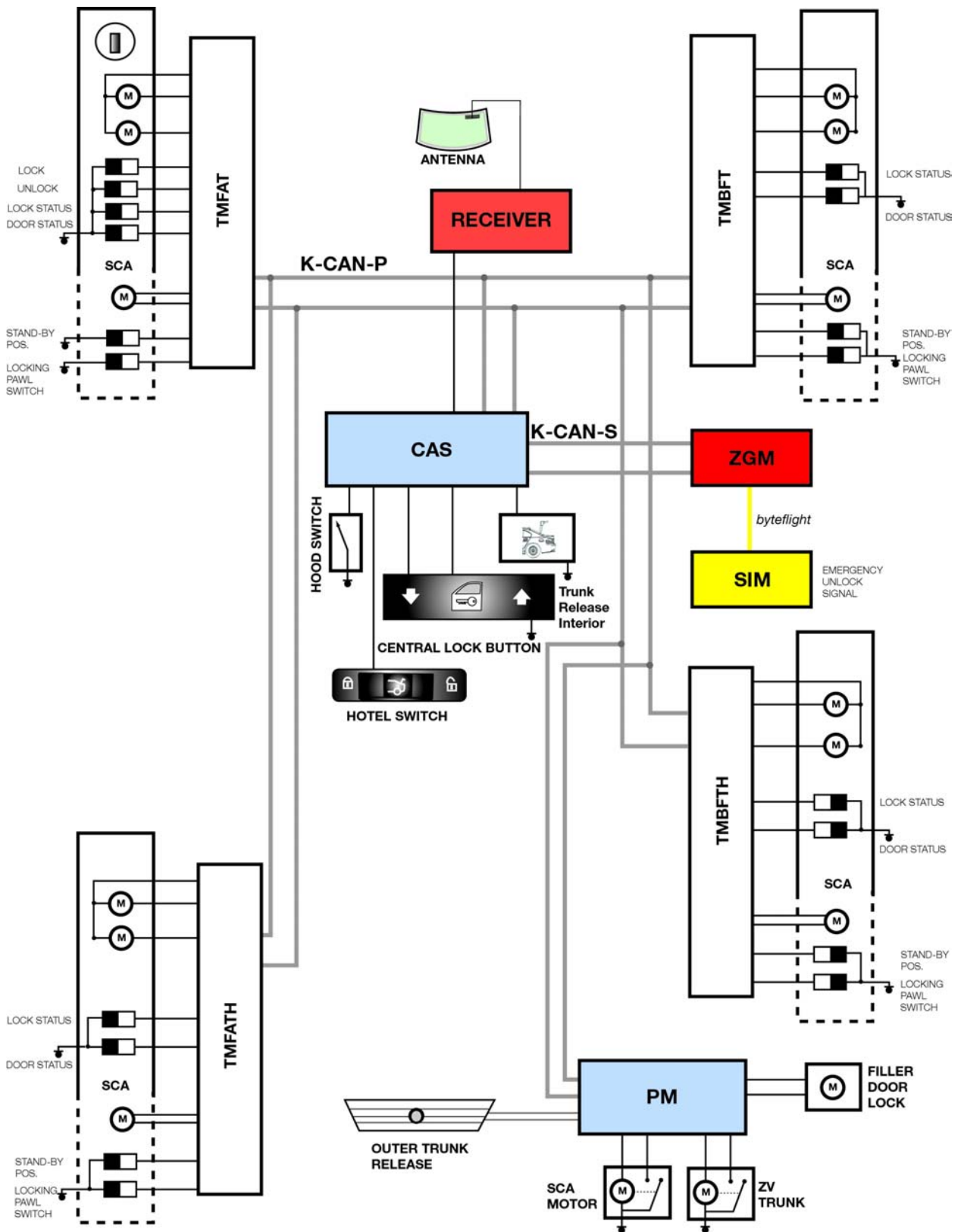
- Locking
- Double locking
- Selective unlocking
- Unlocking
- Soft close (optional for the doors)

In order to improve anti-theft security, the lock cylinder in the trunk lid is now only used for mechanical emergency unlocking.

The individual components communicate with each other via the K-CAN P and with the rest of the vehicle via the K-CAN S (e.g. anti-theft alarm system).

The FZV is connected by way of a separate unidirectional line to the CAS control unit.

# System Overview



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## Components

The Central Locking system of the E65 consists of the following components:

- Car Access System module (CAS).
- Door Modules (4).
- Power Module.
- Door lock assemblies.
- Trunk lock actuator and soft close drive assembly.
- Engine hood contact.
- Fuel tank filler door actuator.
- Central locking button (CLB).
- Passenger compartment trunk lid release button (TOEHKI).
- Trunk-lid button, inside of trunk lid (TOEHKK, only if equipped with HKL).
- Outside trunk lid release button (TOEHK).
- Hotel switch in lockable compartment of the center console (hotel).

### Car Access System (CAS)

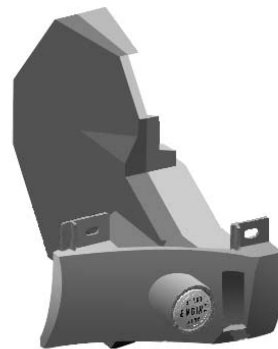
As Central Locking Master (ZV master), the CAS controls all the higher-level functions of the Central Locking system.

It centrally monitors the battery voltage of the ZV (lock actuators) assemblies.

The ZV assemblies function within a voltage range of 9 V to 16 V.

Activation of the ZV assemblies is controlled as follows:

- For safety reasons, the "crash unlocking" function is activated independently of the battery voltage.
- If the CAS determines a value less than 9 V or greater than 16 V, there is no forwarding or implementation of operator prompts by the CAS.
- The motors in the doors are blanked out based on the evaluation of the local voltage at the door modules (motors for Soft Close Automatic and motors for electric opening).





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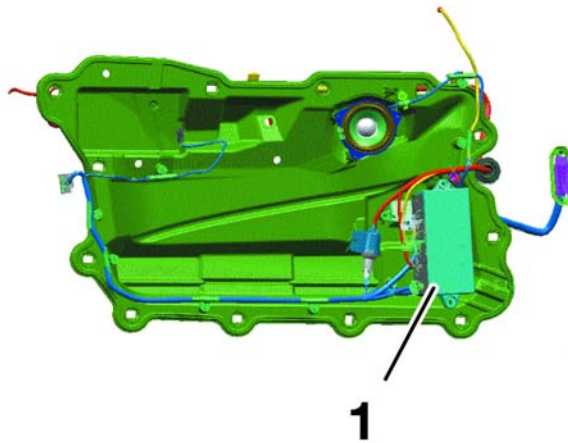
## Door Modules

Each door contains a door module (1) for the control of all functions contained or attached to the door. The door module is located inside of the door attached to the inner door carrier.

The door modules receive the signals for locking and un-locking requests from the CAS over the K-CAN-P.

The door modules are also responsible for interpreting the signals from the hall sensors in the door lock assemblies and providing them to the CAS.

The output for the ZV drives is controlled by internal final stages.



## Power Module

Within the Central Locking system the Power Module is responsible for the output control of the trunk lock actuator, soft close motor and the fuel filler flap actuator.

The Power module is also responsible for relaying the signals:

- Status of the trunk lid open/closed
- Status of the outside trunk lid button
- Status of timed-arrest for the trunk and filler flap ZV drives



## Door Lock Assemblies

The door lock and ZV drives consist of a single integrated unit. The door lock assembly contains two servo motors, the locking mechanism and hall sensors for position sensing. The hall sensors signal:

- Door contact (open or closed)
- Position of mechanical lock (locked/ unlocked)

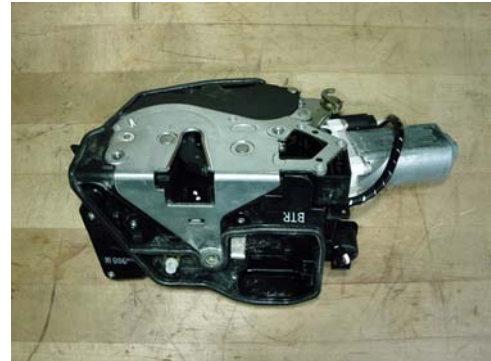
If the vehicle is equipped with the optional soft close doors there is an additional motor for pulling the door closed as well as two more hall sensors. The hall sensors signal:

- “Stand-by” position
- “Locking pawl switch” position

The Drivers lock assembly contains two hall sensors for the signalling of the position of the external lock cylinder in the drivers door. The hall sensors signal:

- Unlock request
- Lock request

The rear doors are equipped with child lock out switches preventing the rear doors from being opened from the inside.



## Trunk lock Actuator and Soft Close Drive Assembly

The trunk lock and trunk lock actuator are two separate components. The lock actuator is controlled by the PM and contains a micro-switch to signal the lock status of the trunk. This input is sent via the K-CAN-P to the CAS for the monitoring of the trunk (e.g. DWA, CC)

The signal is also an input to the PM to run the soft close motor and to control the trunk lights.

The soft close motor is carried over from the E38. It contains an internal micro-switch to signal the PM that the motor has completed 1800 of rotation.



## Engine-Hood Contact

The engine-hood contact is a simple ground (N/O) contact. This contact is closed when the hood is open and is monitored for the purposes of theft prevention and CC messages (Check Control). The status is distributed by the CAS to the vehicle electrical system.

## Fuel Tank Filler Door Actuator

The assembly for unlocking and locking the fuel tank filler door is operated by the Power Module. The commands for this purpose are controlled by the ZV master (CAS). The fuel-tank flap is only locked with ZV central double locking (ZS).

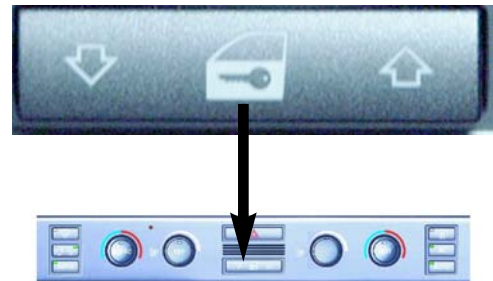
## Central Locking Button (CLB)

The Central Locking button is located in the iDrive Comfort Area as part of the IHKA control panel. However, the CLB is not processed by the IHKA, it has a direct connection to the CAS.

The button is a rocker switch that provides two separate signals; one for unlock and another for lock. The signal provided is a momentary ground.

The operation of the CLB remains the same as the previous E38:

- Central locking/unlocking of the doors (the fuel filler flap remains open).
- Removing a vehicle from double lock to central lock (emergency function)



## Passenger Compartment Trunk Lid Release Button (TOEHKI).

The interior trunk release button is located in the iDrive Driving Area to the left of the steering column. It provides a momentary ground signal to the CAS when pressed.

The signal is passed on to the PM over the K-CAN-P.

The button is active from KL R when the hotel setting is off and the vehicle speed is below 2mph.



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## Outside Trunk-Lid Release Button (TOEHK).

The outside trunk lid release button is a direct input to the Power Module. It provides a momentary ground when pressed.

The button is active when the vehicle is unlocked and the hotel setting is off.



## Hotel Switch

The Hotel switch is located inside of the lockable compartment of the center console. It is a direct input to the CAS as a ground signal when the switch is in the “lock” position.

Locking of the compartment is done using the mechanical key integrated into the Remote Control which the customers then takes with them. Only the “electronic key” is then handed over to the hotel valet.



When the setting is “locked”, the interior and outside trunk release button inputs are ignored.

The CAS sends the telegram over the bus that the hotel setting is engaged. This is used, for example, by the DWA to continue to monitor the trunk and the hood even though the vehicle is unlocked.

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## Principle of Operation

### Central Locking System Functions

#### Central Locking

Central locking is activated using the Central Locking button inside of the vehicle. Only the doors and trunk are locked, the fuel tank filler door remains open for access by gas station attendants. The locking pin in the door lock assembly is not disengaged, therefore the vehicle doors may be unlocked by pulling on the interior handle once.

#### Double Locking

When double locking is engaged, the locking pin in each door is disengaged from the lock by a mechanical coupling. It is no longer possible to unlock the vehicle from the inside using the handles or from the outside. The fuel-tank filler door is locked.

Double locking is only possible with terminal OFF and the subsequent opening of one of the front doors and with the driver's door closed. With the driver's door open, there is no action in response to the double locking operator request.

#### Selective Unlocking

Selective unlocking is activated by means of coding. With selective unlocking, only the driver's door is unlocked on the first unlocking command via the driver's door operating location or the remote control. The other doors move into the locked position. Only with the second unlocking attempt is the entire vehicle unlocked.

#### Double Unlocking with Valid Remote Control

With the vehicle double locked, the assemblies are moved from the "double locking" position to the "locked" position when a valid Remote Control is inserted in the CAS. The vehicle engine may only be started when the central locking has been double-unlocked.

The procedure is handled by the K-CAN messages for the central locking control system. If a driver has unintentionally locked himself inside his vehicle by means of the Remote-Control, forced double unlocking prevents him from driving off in the vehicle while it is double-locked and the anti-theft alarm system is armed.

#### Double Unlocking via Central Lock Button (CLB)

An occupant who has accidentally locked himself in is able to get out by operating the CLB. This action moves the ZV on a one-off basis from double locked to locked. It is then possible to open the door through double operation of the inside door handle.

The DWA is not disarmed in this process so that when a vehicle is opened in this way an alarm cycle is triggered when the door is opened.

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## **Electric Lock-Out Protection**

With electric lock-out protection, the electronics ensures that the central-locking assembly is unlocked again e.g. when the locking knob is pressed down with an open driver's door. This protects the driver against being inadvertently locked out. With the driver's door open, it is not possible to lock the vehicle with the central lock button. The remote control is likewise ineffective.

## **Crash Unlocking**

The crash message is transmitted from the Safety Information Module (SIM) via the ZGM to the K-CAN-S. The CAS receives the message and passes it on over the K-CAN-P.

The message is made available to the door modules and the Power Module. A priority "unlocking message" is simultaneously created by the ZV master in the CAS and forwarded to the door modules and the Power Module. This is to ensure that the system is unlocked in each case even if the crash message were to be delayed because of a currently active message. Unlocking of the Central Locking system in the event of a crash is only permitted under the following conditions:

- Terminal R ON
- Terminal 15 ON
- Vehicle is not in double-locked state (for theft protection).

## **Reactivation of Controls after Crash Unlocking**

The following component signals are disabled after crash unlocking to prevent unwanted re-locking due to crash-induced short-circuit faults or damage of the lock mechanism:

- Lock cylinder, driver's door
- CLB
- Remote Control

These components are re-activated by resetting the CAS-internal crash status. After terminal R "OFF", the following events can reset the crash status after 3 s:

- Reception of signals "status, crash severity" value 0 (light collision without airbag activation)
- Opening and closing of driver's door
- Unlocking command at lock cylinder in driver's door
- Unlocking command via Remote Control
- Deactivation and reactivation of terminal R

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## **Timed-Arrest**

An timed arrest circuit is provided because the assembly motors are always operated up to their stops. An internal counter is increased by a value of 1 each time it is actuated. This counter is reduced by a value of 1 after a specified period of time.

The timed arrest circuit engages if the counter exceeds a specified value on account of permanent actuation. All the operator prompts for the Central Locking are forwarded but no longer executed.

The door modules and the Power Module signal via the K-CAN P to the Central-Locking master in the CAS that an assembly is now in timed arrest status. The ZV master in the CAS then outputs an overall status "ZV assembly, timed arrest circuit" for all the users.

The timed arrest circuit is disengaged by the door modules and the Power Module when the signal "ZV assembly, timed arrest circuit" is removed. There is also an timed arrest circuit for trunk-lid unlocking. The anti-repeat circuit is ignored during the crash unlocking function.

## **Initiation of Convenience Closing/Opening**

The Central Locking system includes the convenience function for power windows and sliding sunroof. It is possible by means of the lock cylinder in the driver's door or by Remote Control to initiate sequential closing (only from drivers door) and opening of the windows and the sunroof as long as terminal R is off.

Convenience closing is initiated if a ZS (double-lock) command is held for an extended period. The sequence is aborted if the ZS command is cancelled during the closing operation. If a ZS command is entered again within a specific period since the cancellation, the sequence starts after a brief period.

Convenience opening is initiated if an ER (unlock) command is held for an extended period. The sequence is aborted if the ER command is cancelled. In the event of resumption, convenience opening follows the same process as convenience closing.

The Central Locking system forwards the operator prompts to controlling functions in the CAS (power-window master) and to the vehicle bus system.

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## **Signalling to Anti-Theft Alarm System (via CAN)**

The DWA is not part of the Central Locking system but it does require commands and signals from it. For this purpose, the DWA monitors the status of doors, hood, trunk and terminal status.

The DWA monitors the tilt sensor and the ultrasonic interior protection sensor by itself.

The DWA is armed by each valid locking (ZS) command. Optical feedback is provided by an LED, which signals the status of the DWA. The tilt and interior sensors are deactivated if a ZS command is initiated again within a specific period (10 s) after the first arming of the DWA.

The CAS forwards this information to the K-CAN P and K-CAN S. The DWA is disarmed by each double-unlocking command. The luggage compartment can also be accessed while the DWA is armed via remote control without the alarm being activated.

The alarm is activated if the trunk lid is opened mechanically using the emergency lock cylinder while the DWA is armed.

Scope of DWA monitoring from the Central Locking system:

- Door contacts
- Engine-hood contact
- Trunk-lid contact
- Tampering, driver's-door lock cylinder

## **Vehicle and Key Memory Individualization**

All the codable functions for Vehicle/Key Memory are activated within the framework of the E65 Coding, Individualization and Programming program (CIP).

These functions can be set using the coding software and are stored in the CAS. They only become active when the vehicle has been "double-locked".

The following central locking functions have been made possible for individualization (4 keys + 1 vehicle coding):

- Selective unlocking of driver's door.
- Automatic locking from a speed of 16 km/h (10mph).
- Automatic relocking if vehicle unlocked by remote control and no ensuing action in 2 minutes.



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## **Soft Close Automatic Doors (SCA)**

The Soft Close Automatic Doors are optional equipment (part of the convenience package). The drive assemblies are integrated into the door locks and are controlled by the individual door modules.

There are 2 additional hall sensor signals for the position detection of the SCA drive:

1) "Stand-by" position

2) "Locking pawl switch" position

- The control system always knows the position of the drive and can, if necessary, activate it in order to move it to a defined or "set" position.
- The "Locking pawl switch" position is set each time the drive is switched on and deleted again when switched off in a set position (stand-by or park). The "Stand-by" position" is set when the door is opened and deleted when the latch has reached the park position.
- When the door is opened, (recognized by the rotary-latch hall sensor), the SCA drive moves into the stand-by position so that it only needs to move half a turn into the park position the next time the door is pulled closed. If the door is moved into the main catch before the SCA is in operation (slamming shut), the SCA drive remains in the stand-by position. The SCA does not move the next time the door is opened.
- When the door is closed, the sensors identify the catch position from the locking-pawl signal and pull the door into the main catch. The SCA drive then remains in the park position.
- If the electronics fails to identify the reaching of the two defined positions, the control system assumes a timeout after 5 seconds and shuts down the SCA drive. An entry is also made in the fault memory of the respective door module.
- The stop conditions are checked every 23 ms while the SCA is in operation. The motor is shut down if the SCA is not stopped within 5 seconds. The motor is switched off when reaching the park position.

## **Timed Arrest Circuit**

The SCA doors have a timed arrest circuit to prevent the motors and final stages from overheating. Operation is staggered until the arrest counter in the door modules returns to zero.

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## Power Windows

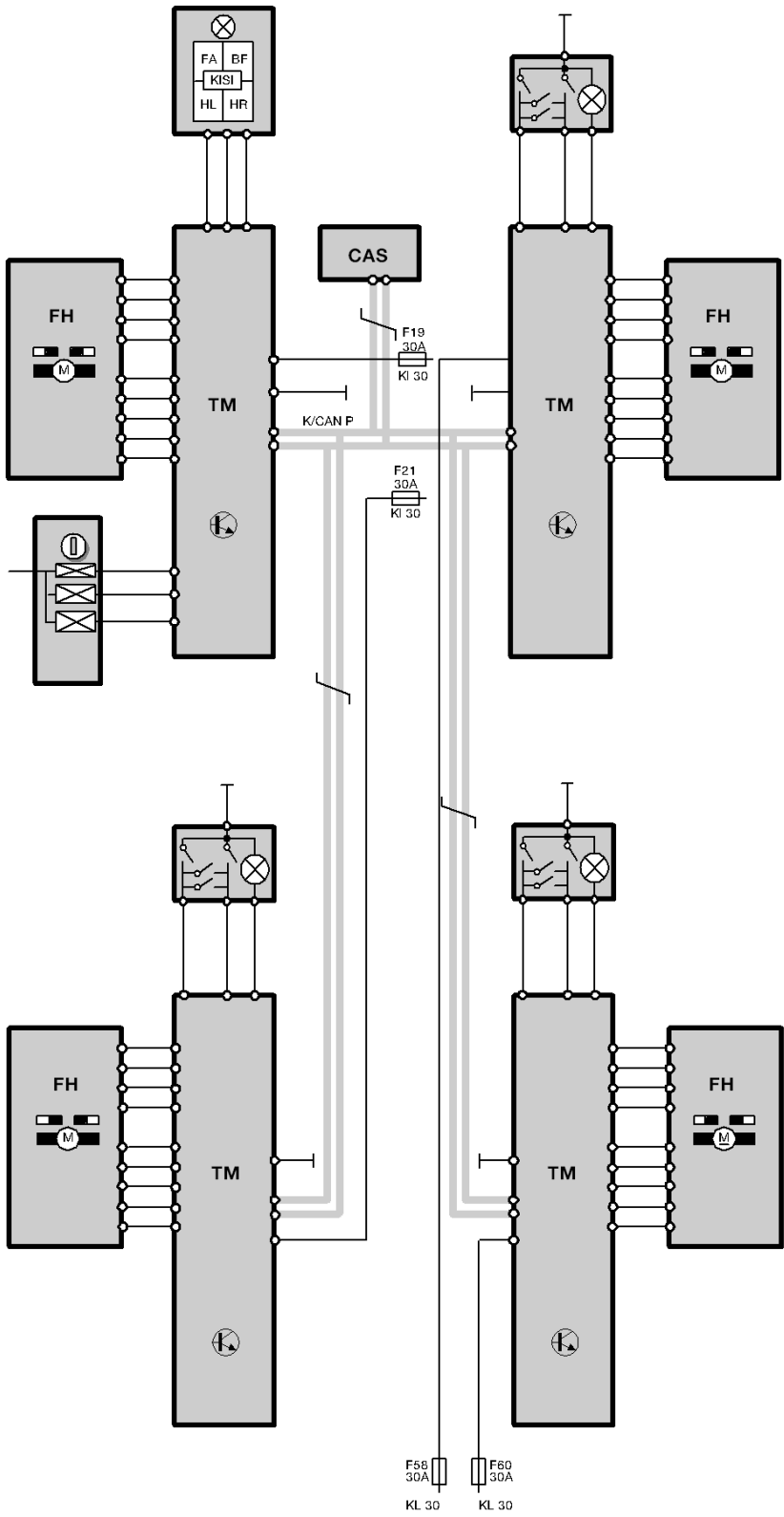
The power windows are controlled by the door modules, (i.e. one door module locally controls one power window). The CAS control unit controls the window functions as the power-window master.

The master controls the convenience functions and the Central locking (ZV) interface.

List of power window functions:

- Closing and opening of windows.
- Toll function (one-touch) in both directions on all 4 windows.
- Child lock-out.
- Emergency close.
- Convenience opening/closing.
- Timed arrest circuit.
- Excessive load cutout.
- Smooth rundown / smooth startup.
- Synchronous motor operation.
- Anti-trapping protection.

# System Overview



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## Components

### Car Access System (CAS)

The CAS contains the master functions of the power window system. It is also responsible for signalling the convenience open/closed requests.

### Electric Window Lift Assemblies

The electric window lift assemblies consist of an electric motor/module with integrated hall sensors for distance and speed sensing. The anti-trap strips in the door frame of the predecessor E38 have been deleted. The module integrated into the assembly receives the control requests from the door module via a PWM signal, it then provides the appropriate voltage to control the operation of the motor within an infinitely variable speed range up to full voltage. The window motor/modules must be initialized.

The window regulators are of the cable operated design as used in the E38.

### Door Modules

Each door contains a door module for the control of all functions contained or attached to the door. The door module is located inside of the door attached to the inner door carrier.

The door module receives the control requests from the window switches and carries out the allowed operation of the motor. The control is based on the status signalled from the CAS and the current condition of the window as detected by the hall sensors in the motor assembly.

### Window Switches

The window switches of the E65 are of the press/pull type as first seen on the E46. The drivers door switch block is a control unit that communicates with the door module via a local P-bus (single wire: 9.6kbps).

The drivers door module signals the status of all of the switches of the drivers switch block to the other door modules and the CAS over the K-CAN-P.

The single switches in the passenger doors are conventional ground switches that communicate 5 statuses over 2 wires as used on the predecessor E38.



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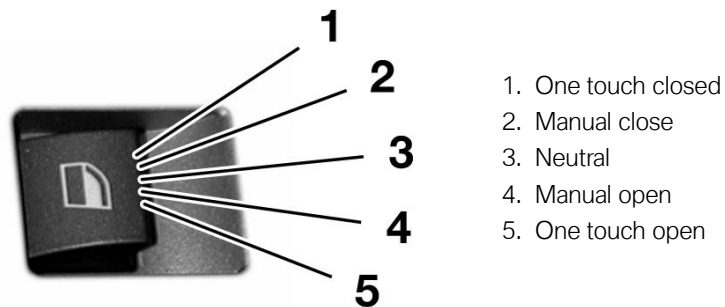
## Principle of Operation

### Operating the Windows

The power windows are enabled and disabled by the power-window master in the CAS. Enabling and disabling are dependent on coding and the status of the door contacts and the terminal status.

The power windows can be operated from "terminal R on" and are disabled in the crossover into "sleep mode".

The switch control logic, which was introduced for the first time in the E46, is also used in the E65. This prevents the windows from being closed by mistake.



Toll operation (one-touch) takes place in the closing or opening direction immediately after the switch position "one touch closed" or "one touch open" has been reached. The power windows are activated in the initial closed/open lock-in positions as long as the button is held in this position. Anti-trapping protection is active in both one-touch and manual operation.

The function with the highest priority that is started or selected first is executed. However, a one-touch function can be cancelled by the local switch.

In order to prevent damage to the motor, the window travel is subject to a maximum activation time of 10 s (exception: initialization run).

If the window glass moves to the upper stop, the drive is activated at full power for the blocking time of 0.5 s in order to ensure safe closing.

The following functions are available thanks to timed activation of the power-window drives by means of power final stages:

- Smooth startup
- Smooth rundown
- Speed control (2 speed stages)

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## **Emergency Close**

This function is used for deliberate closing of the windows without anti-trapping protection. Use of this function may be necessary for example in the event of an attack from an outside source or closing a window glass which has frozen solid.

The entire control sequence is divided into two phases:

### **Phase 1**

The emergency-close mode is activated after 0.5 s when the position "one-touch closed" is held. The window is closed at maximum speed and with modified anti-trapping protection. Releasing the button terminates emergency closing, (i.e. the window proceeds to be closed with full anti-trapping protection as with automatic operation).

Anti-trapping protection remains activated in modified form even during emergency closing. If trapping is detected, the window travels back only the short distance of 20 mm. This relieves strain on the mechanical system or gives the attacker the option of backing away.

### **Phase 2**

The button must now be released ("zero position") and then pressed again in the position "overpressed closed" within 4 s. The window is now closed without anti-trapping protection with full force. In the event of blocking, the window is powered until the motor thermal protection is activated or the window has moved to the upper stop.

Emergency closing is terminated when the button is released. For safety reasons, it is always possible to open the window independently of the thermal protection.

If there is no renewed activation of the emergency-close mode within 4 s (overpressing and holding), anti-trapping protection returns to its normal state. "Emergency close" is not operational from a vehicle speed of > 16 km/h (10mph).

When the child lock is engaged, the emergency-close function cannot be activated by the local switches in the rear doors but only only by the switch block in the driver's door.

An emergency-closing operation activated by the switch block in the driver's door cannot be interrupted by the local buttons in the front passenger door or the rear doors.

The emergency-close function can be completely deactivated by means of coding.

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## **Convenience Opening/Closing**

The convenience function enables the operator to close or open all the windows and the slide/tilt sunroof before entering or leaving the vehicle.

The convenience opening function can be triggered by means of the Remote Control key. Both convenience opening and closing can be operated by mechanical key operation in the driver's door lock.

The function is controlled by the power-window master in the CAS control unit. For this purpose, a K-CAN-P message is sent from the CAS to the four doors.

### **Closing**

The closing operation starts after a delay; for this purpose, the key must be held in the locking (VR) or double locking (ZS) position during the entire closing operation. The closing operation can be terminated at any time by turning the key back. The sequence begins again after 0.5 s if a ZS command is entered again within 3 s of the cancellation.

The individual windows and the sunroof are closed in the following sequence: rear power windows (PWs), front PWs and sunroof. The PWs are activated so that two PWs are always switched on simultaneously (starting with the rear). The front PWs are started after a 1 s delay. The sunroof is closed immediately when all 4 windows are closed or 3.5 s after the start of convenience closing.

### **Opening**

In the unlocking lock cylinder position (ER), it is possible to initiate convenience opening by holding the key in this position. With convenience opening, first the front PWs are opened, followed by the rear PWs after a delay of 1 s. The sunroof is opened immediately when all 4 windows are open or 3.5 s after the start of convenience opening.

The operation can be terminated at any time by turning the key back. The sequence begins again after 0.5 s if an ER command is entered again within 3 s of the cancellation.

Operation by Remote Control is performed in the same way as operation by lock cylinder.

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## **Child Lock-out**

Operation of the two rear power-window buttons is disabled by means of the child-lock button in the switch block in the driver's door. When the child lock is engaged, it is only possible to operate the rear power windows from the driver's switch block or via the convenience function. An LED in the button indicates the current status of the child lock.

The LED is activated by the power-window master in the CAS. No opening/closing function is triggered when the child lock is engaged.

In the event of a fault, the Check Control message "Child lock not functioning" in the instrument cluster is sent by the CAS.

It is only possible to deactivate the child lock in conjunction with a valid Remote Control in the ignition.

The child lock remains engaged after a CRASH telegram has been received.

## **Motor Protection (thermal protection)**

Each power-window motor is provided with its own thermal protection to prevent them from overheating. For this purpose, the motor running time is added up in a counter. The output value of the counter is influenced by the ambient temperature.

If the counter exceeds a threshold, new control requests are no longer accepted but a movement that is already in process is continued. The counter is reduced again if the motor is deactivated. Operator prompts are accepted again when the value drops below the threshold. Return window travel in the event of trapping is not obstructed by the thermal protection.

## **Load Deactivation**

In order to assist starting, the power windows are not operational with terminal 50 (starter motor). Each action, e.g. opening or one-touch function, is terminated immediately and the power windows are stopped. Following the starting sequence, the windows are fully operational again once they have been re-actuated.

## **Undervoltage Deactivation**

The supply voltage is monitored locally in the door modules. If the supply voltage is below 9 V, the power windows are disabled.

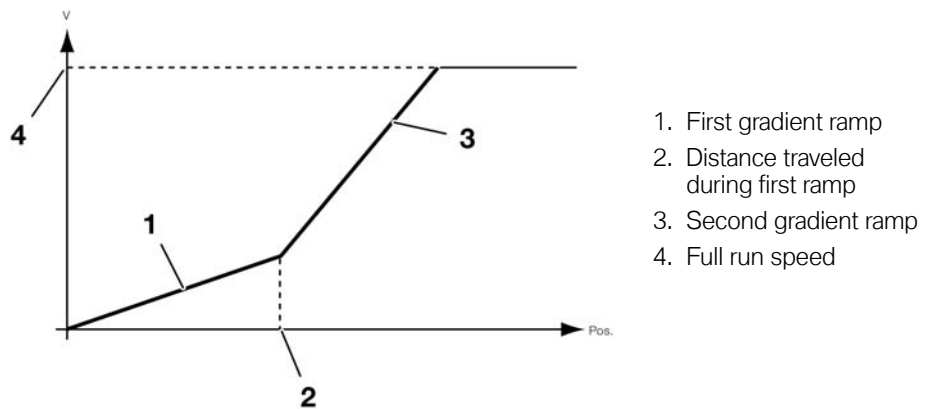


## Smooth Start-up

Smooth start-up describes a new feature of the E65 which starts the power windows with a linear increase in speed up to full speed. Smooth start-up takes place in both the closing and opening directions.

Clunking noises are avoided in the door due to the low speed as play in the window lift assembly is taken up.

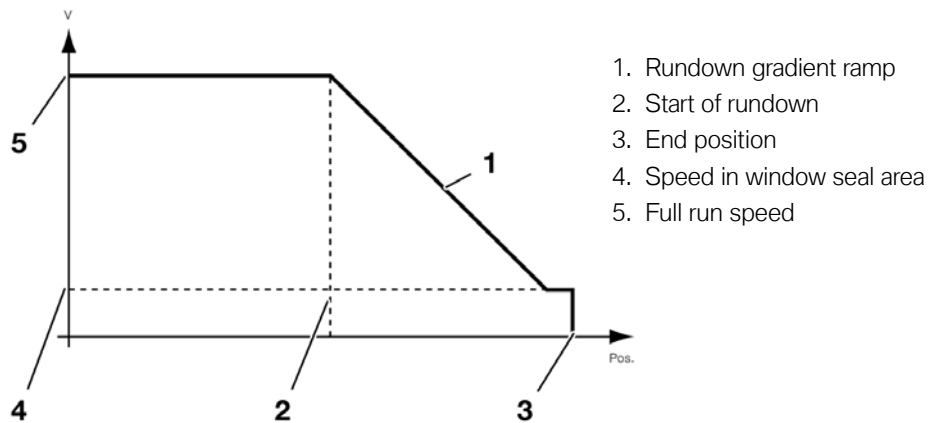
To ensure that the windows remain quiet during the entire service life of the vehicle, the gradient of the first ramp is less steep than that of the second ramp. The total window travel until the full desired speed is reached is approximately 5 mm.



## Smooth Rundown

Smooth rundown describes running down of the power windows with a linear decrease in the infinitely variable speed until the window is at a standstill. This function is used when approaching the end positions (in both automatic and manual operation) of the lower and upper stops.

The smooth-rundown travel is about 15 mm on the downward travel and about 30 mm on the upward travel.



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## **Synchronous Motor Operation**

The window speed is kept constant over a wide voltage range by timed activation (PWM) of the power windows.

## **Blocking Protection**

Blocking protection is based on monitoring of the Hall-sensor signals. With each signal change of the active sensor, a time measurement is restarted which triggers the blocking reaction when a defined period of time is exceeded (exception: emergency close).

If blocking protection takes place in an adjustment range protected by closing-force limitation, the window travels back when the closing-force limitation is exceeded. Outside this range, the window travels back for 1/4 turn in order to relieve the tension on the mechanical system.

## **Anti-Trapping Protection**

Anti-trapping protection restricts window closing force to a maximum permissible value (closing-force limitation). Any load in excess of this force causes the window to immediately stop and reverse.

The power windows require an initialization procedure during the initial startup.

The initialization procedure consists of:

- Standardization
- Learning of characteristic closing-force curve

When the window is standardized, the end positions of the window travel are determined by a blocking run in the upper window seal and on the lower window stop. When the closing force is being learned, it is measured over the entire closing travel and permanently stored.

Anti-trapping protection is active and one-touch closing is possible only after initialization has been completed.

Calibration of the triggering threshold begins with a closing force of approx. 500 N. This high starting value increases operational reliability so that the windows are closed even in the event of stiffness.


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## Manual Initialization

The power-window system must always be initialized after any repair work affecting the system has been carried out.

Operation sequence:

- Press the power window switch in the open direction for at least 15 seconds but no longer than 25 seconds.
- Release the switch and then pull it to the “one-touch” close position and hold it. Initialization begins (this step is part of the CAS logic to prevent a trigger of the initialization mode if the switch is jammed).
- Hold the switch in the “one-touch” close position until initialization is completed. The windows will open and then return to the closed position to confirm a successful initialization.
- A Check Control message is issued if any of the side-windows are not initialized. The message is retracted as soon as all windows are successfully initialized.

<b>Check Control message displayed in Kombi</b>	<b>Message displayed in Control Display</b>	<b>Cause</b>
Power window not initialized! 	“Power window not initialized!” Anti-trap protection deactivated. Please contact the nearest BMW center.	One or more windows have not been detected by the CAS as not initialized.

## Electric Roller Sun Blinds

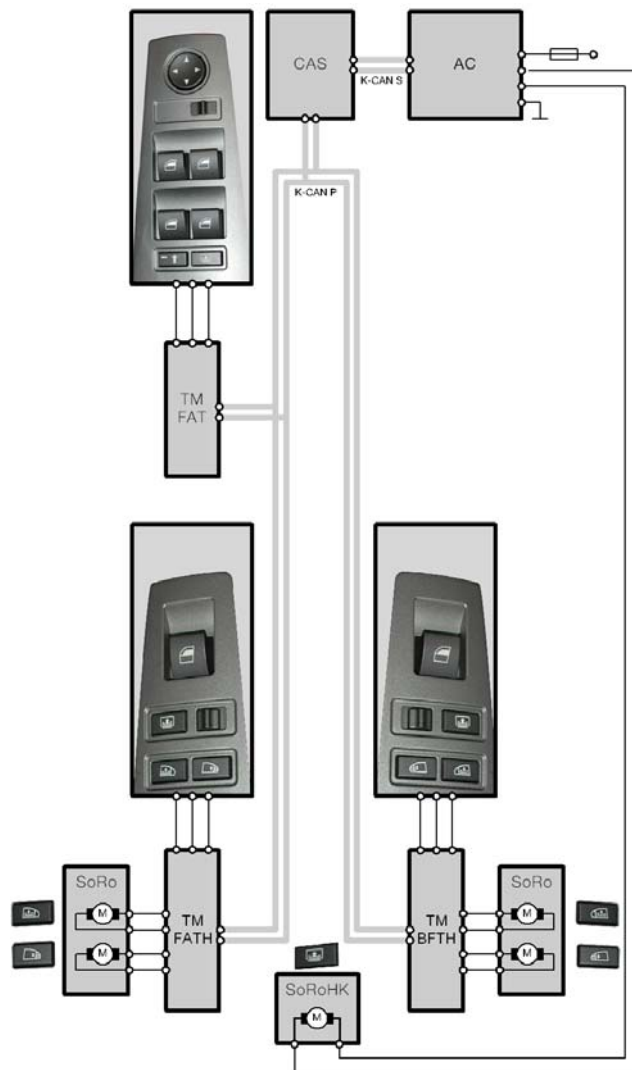
Rear electric roller sun blinds are optional equipment. They are only available in combination with the rear-window roller blind. Each door has two roller sun blinds: one for the side window and one for the quarter window.

The IHKA contains the master function and the rear-window roller blind control. The operating switches for the rear electric roller sun blinds are located in the driver's door switch block (module) and on the rear switch blocks (module).

There are buttons for the side-window sun blind, the quarter window sun blind, the rear-window roller blind and left/right rear door side selections on each door switch block .

Both rear door modules contain control outputs and master functions for the rear-compartment roller sun blinds.

## System Overview



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## Principle of Operation

To protect the customer against trapping, the side-window roller blinds can only be raised when the side window is closed. The system regards the side window as "closed" up to a maximum opening of 10 mm.

- It is always possible to lower the side window roller blinds, even when the window is open.
- It is always possible to lower the window glass, even when the side-window roller blind is up.



When the window is open and a command to raise the side-window roller blind is sent, the side-window roller blind starts up briefly and reverses. This indicates that an invalid operation has been attempted. The roller sun blind cannot be raised until the customer closes the window. It is always possible to operate the quarter roller blind, irrespective of the side window position.

Briefly pressing or holding down the control buttons for the side and rear-window roller blinds initiates an automatic movement of the roller sun blinds as far as the top or bottom stop.

The left/right slide switches on the rear switch blocks are used to select whether the roller sun blinds and the side window on the left or right hand side are to be operated.

Holding down the rear window roller blind switch activates a special function, which activates the rear-window roller blind immediately. After 750 ms, all rear-compartment roller sun blinds move in the same direction as the rear-window roller blind.

For example, when the rear-window roller blind is down, both the rear-window roller blind and the rear-compartment roller sun blinds move upwards when the button is held down.

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## **Undervoltage Protection**

The voltage supply is monitored locally in the door modules. Roller sun blind operation is stopped if the voltage is less than 9.0 V. The functions are not available again until the voltage exceeds 9.5 V.

Once a roller sun blind has been set in motion, the operation is completed regardless of the voltage level.

## **Blockage Detection**

To protect the motor and the control units, the door module has blockage detection which switches the motor off after it reaches the upper or lower end position. The deactivation criteria is calculated from the motor starting current. When 75% over the normal motor starting current is reached the control unit switches off the motor.

Motor activation is also time monitored. The system stops activating the motors after 11 s for the rear and side-window roller blinds and 6 s for the quarter window roller sun blind.

## **Timed Arrest**

To prevent playing children from overloading the motor by constantly sending commands (thermal cutout), a timed arrest feature used. If this counter exceeds a maximum running time of 90 seconds, then no new operating requests will be accepted. If running time of the motor exceeds 90 seconds, the motor operation pauses 270 seconds.

When timed arrest is active, it is possible to reverse the roller sun blind once downward.

## **Child Safety Lock**

The child safety lock function is engaged or released via a button in the driver's door switch block. When the child safety lock is engaged, it not possible to operate the rear compartment roller sun blinds and the rear-window roller blind from the rear switches.

An active roller sun blind function is not interrupted by engaging the child safety lock.

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## Sunroof (SHD)

### Introduction

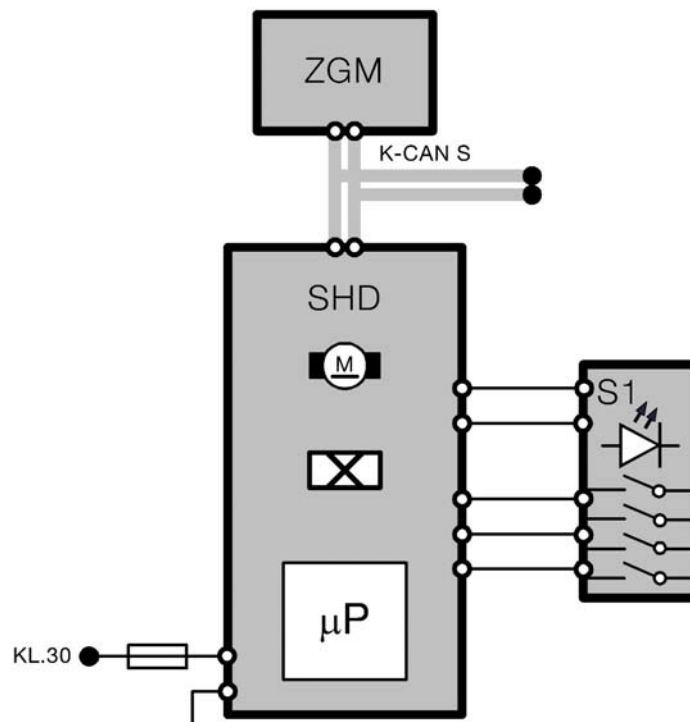
The SHD module controls the opening, closing, lifting and lowering of the glass sunroof in the E65.

The anti-trapping protection of the sunroof has been improved considerably.

The following functions are available for the sunroof:

- Manual operation
- One-touch operation
- Convenience opening and closing
- Panic close
- Anti-trapping protection
- Emergency operation
- Mechanical operation
- Generation of CC messages
- Diagnosis

### System Overview



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## Components

The sunroof consists of the following components:

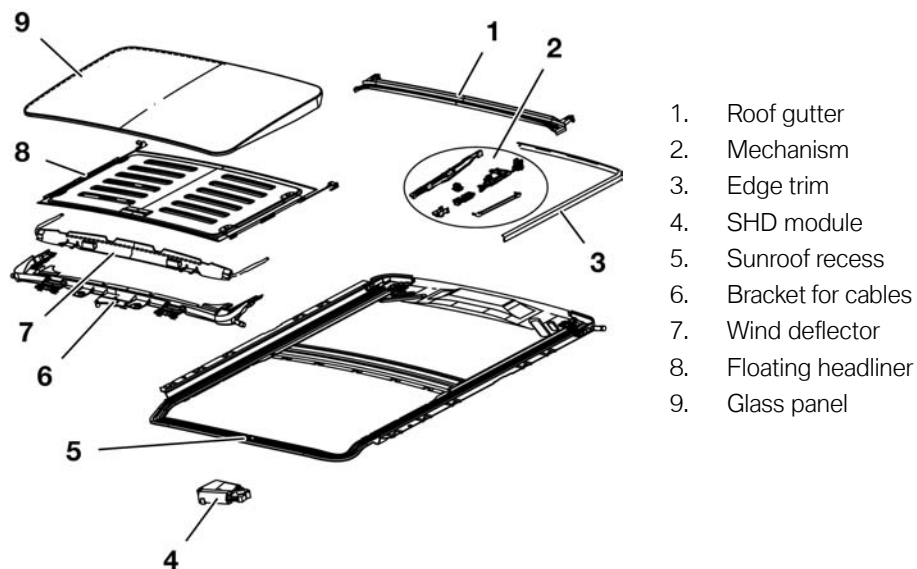
- Sunroof cassette
- SHD Control unit
- Sunroof switch
- Vehicle bus interface

### Sunroof Cassette

The structure of the sunroof cassette is similar to that of the E38/E39.

The parts that can be replaced with the cassette still installed in the vehicle are:

- Glass panel
- Floating headliner
- Wind deflector
- SHD module
- Roof gutter



The cables of the sunroof cassette cannot be serviced individually, if they are defective, the entire cassette must be replaced. If the sliding/tilt lever is damaged the cassette must also be replaced.

**Note: Be careful removing the rubber drain hoses from the cassette because they are bonded to the body and are not easily replaced.**



## SHD Control Unit

The sunroof module is located, as with other models, behind the rear view mirror in the center of the roof. It contains the following components:

- DC motor with attached gear reduction mechanism.
- 2 integrated Hall sensors for position and trap detection.
- Control unit

The DC motor is controlled with a PWM signal to provide a smooth-rundown feature similar to the window operation.

This module can only be replaced as a complete unit.



## Sunroof Switch

The switch is installed in the panel behind the interior light, beside the emergency call button.

Possible directions for movement:

1. Open
2. Close
3. Lift

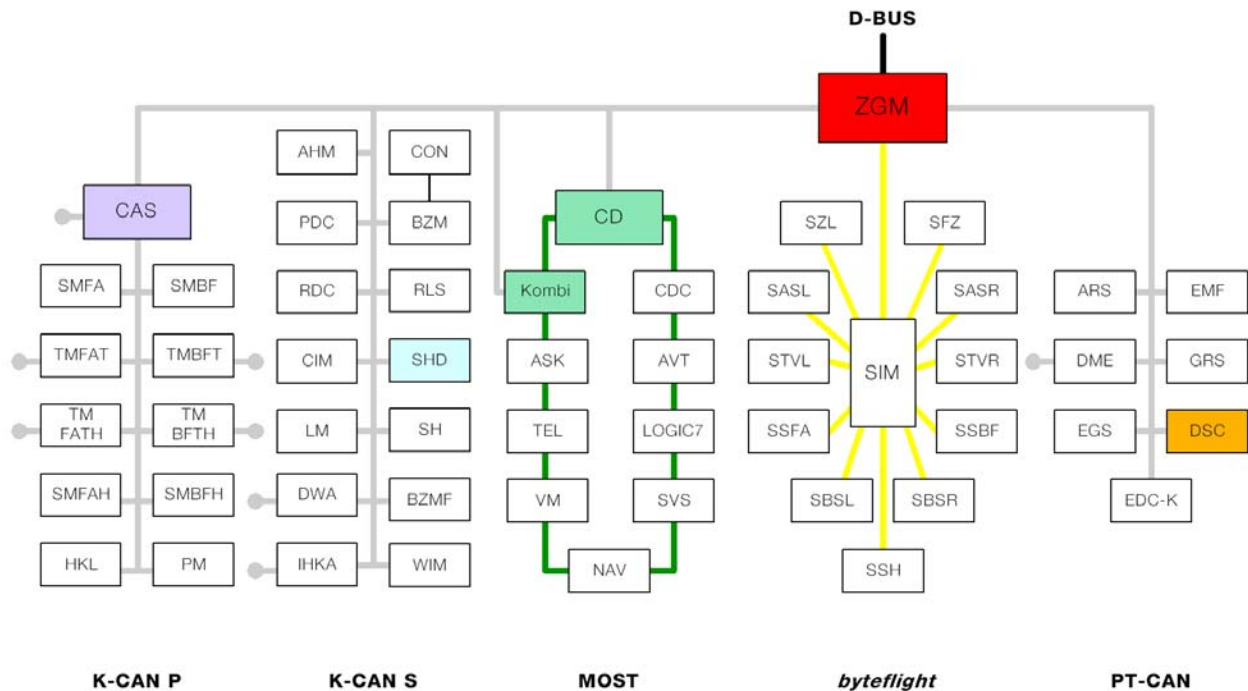


The operations available from the sunroof switch correspond to the previous E38.

The sunroof switch provides the SHD module with requests for sunroof operation as coded grounds over three wires. The ground supply for the switch is from the SHD control unit.

## Vehicle Bus Interface

The communication with the vehicle electronics is via the K-CAN-S connection.



### CAS

The convenience opening/closing commands and the terminal status are received from the CAS via the K-CAN S.

### Instrument Cluster

The instrument cluster serves as a display of Check Control (CC) messages for the SHD.

### Control Display CD

Extended CC messages are displayed in the CD.

### Dynamic Stability Control DSC

The DSC provides the speed signal over the bus system used for the panic mode and anti-trapping protection.

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## Principle of Operation

The manual, one-touch and convenience open/close features correspond to the previous models.

The following operations are new to the E65 SHD:

### Panic Close

This function is for deliberate closing of the sunroof without anti-trapping protection. It might be necessary to use this function, for example, in the event of an outside attack or if the roof is jammed.

The control procedure is divided into two phases:

#### Phase 1

Holding the switch position "one-touch CLOSE" activates the panic close mode after 0.5s. The sunroof is closed at maximum speed and with modified anti-trapping protection.

Releasing the button terminates the panic close, which means that the sunroof is closed with normal anti-trap.

Even in the case of panic closing, the anti-trapping protection remains activated in a modified form. If trapping is detected, the roof only moves back 20 mm. This relieves strain on the mechanical system or gives the attacker the option of backing away.

#### Phase 2

The sunroof switch must be released ("Position zero") and immediately pressed again within 1.5 seconds. The sunroof is now closed at maximum power without anti-trapping protection. The actuation time of the SHD motor is a maximum of 15 s. In the event of blocking, the SHD motor still receives current until the higher-level motor protection of 15s kicks in or the sunroof lid is moved into the end position.

For safety reasons, it must always be possible to open the sunroof. Releasing the button discontinues the panic close immediately.

If the sunroof is in the lift position, the panic close function cannot be triggered.

As of a vehicle speed of >16 km/h (10mph), panic close does not function.

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## Anti-trapping Protection

The SHD has anti-trapping protection for all closing functions. In order to detect trapping, hall sensors are integrated into the motor. The sensors provide direct measurement of the closing speed and end positions. They are also used for calculation of the sunroof closing power. The result of the calculations are stored in the control unit as the “characteristic curve”.

For each closing operation, the required closing power is determined. The characteristic curve is then calibrated to this value and as closing proceeds, the currently measured values are compared. If the measured force increases to a value above the characteristic curve by more than the triggering threshold, the sunroof is reversed.

In compliance with governmental regulations, the maximum closing power should not exceed 100 N in the range of 25 mm to 4 mm. The mass inertia of the moving parts makes it necessary to reduce the adjustment speed of the roof in this area. This is done by reduction of the voltage applied to the motor. The voltage is adjusted by pulse width modulation (smooth-rundown feature).

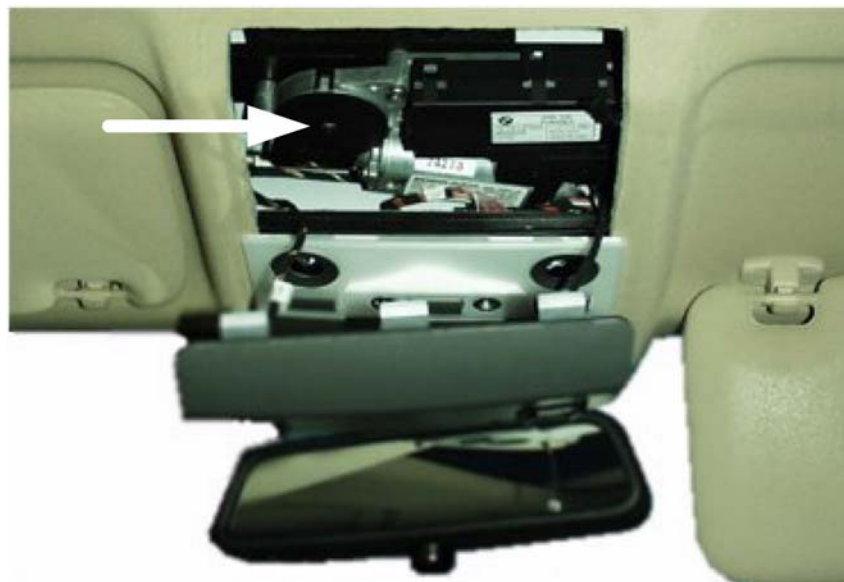
## Adjustment of Anti-trapping Protection to the Vehicle Speed

The air flow when driving produces a vacuum at the sunroof. This suction is particularly strong when the roof is closed from the lift position.

The SHD control unit is unable to distinguish this rise in force from trapping of an obstacle. For this reason, the speed signal is included in the anti-trap protection function. The speed signal is provided by the DSC and received by the SHD via the K-CAN-S.

## Emergency Mechanical Operation

In the event of an electrical defect, the sunroof can be moved by using the hexagon wrench from the on-board tool kit.



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## Workshop Hints

### Initialization

Initialization of the SHD control unit is necessary after:

- Intervention in the mechanical sequence, e.g. manual operation or roof position changed while module was removed.
- Interruption of power supply while the sunroof was moving.
- Replacement of SHD control unit or sunroof cassette.

Disconnection of the battery does not erase the stored positions in the control unit.

The initialization consists of 2 operations that are required for complete functioning of the sunroof:

1. Standardization: This is when the sunroof module measures and stores the mechanical end position of the sunroof in the end position "lift". This end position is used by the module to calculate the remaining positions.
2. Learning the characteristic curve: the sunroof module stores the required force to move the sunroof).

Initialization is performed as follows:

- Press the operating switch to the "Lift" position and hold it there.
- After 15 seconds, the sunroof drive runs towards "lift." The end position is saved in the module.
- In the position "Lift," the drive stops for 5 seconds and then runs towards "Close." The characteristic curve for "Close from Lift" is learned.
- The drive then moves to the "Open" end position, turns around and moves towards "Close." The characteristic curve for "Close" is learned.

The switch must remain pressed during the entire procedure. If the switch is released, the procedure must be repeated. The anti-trapping protection does not function during initialization.

A Check Control message is issued by the SHD until initialization is performed.



## Classroom Exercise - Review Questions

1. Which control module contains the master functions for central locking?

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2. What is the purpose of the “Hotel Switch”?

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3. List the bus signal path for crash unlocking:

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4. What bus connects the driver’s door switch block with the door module?

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5. What is the bus signal path for convenience opening from the remote control?

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## Classroom Exercise - Review Questions

6. What is meant by the “Smooth Startup” function of the power windows?

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7. How are the power windows initialized on the E65?

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8. What control module is responsible for the operation of the rear electric sun blind? Describe the bus path for this signal?

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Notes:

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