
Table of Contents

F01 Power Windows

Subject	Page
System Overview	5
System Circuit Diagram - Power Windows	6
Examples of the Signal Path	7
Driver's Door Switch Cluster	7
Power Window Switch, Front Passenger's Door	7
Power Window Switch, Rear Doors	7
Overview	8
Opening and Closing	8
Opening and Closing with Toll Function	8
Auto-remote Opening and Closing	10
Auto-remote opening with identification transmitter	10
Auto-remote closing with identification transmitter	10
Auto-remote opening and closing via the driver's door lock barrel	10
Auto-remote closing with Comfort Access	10
Indirect Pressure-sensitive Finger Guard	11
Panic Mode	12
Load shut-down, Terminal 50	12
Overheating Protection of Power Window Motors	12
Roller Sun Blind	13
System Circuit Diagram - Roller Sun Blind	16
Overview of Functional Principle	18
Pressure-sensitive Finger Guard for Side Window	18
Roller Sun Blind on Rear Window	18
Position of roller sun blinds unknown	19
Blocking detection	19
Child safety lock	20
Roller sun blind switches	20
System Components	22
Components Involved	22
Controls	23
Driver's door switch cluster	23
Signal evaluation of the power window switches	24

Subject	Page
Control Units24
Car Access System 424
Footwell module24
Junction box electronics24
Identification Transmitter24
Power Window Motors24
Service Information25
Initialization25
Initialization of Power Windows25
Initialization via the power window switches25
Initialization via the BMW diagnosis system25

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Power Windows

Model: F01/F02

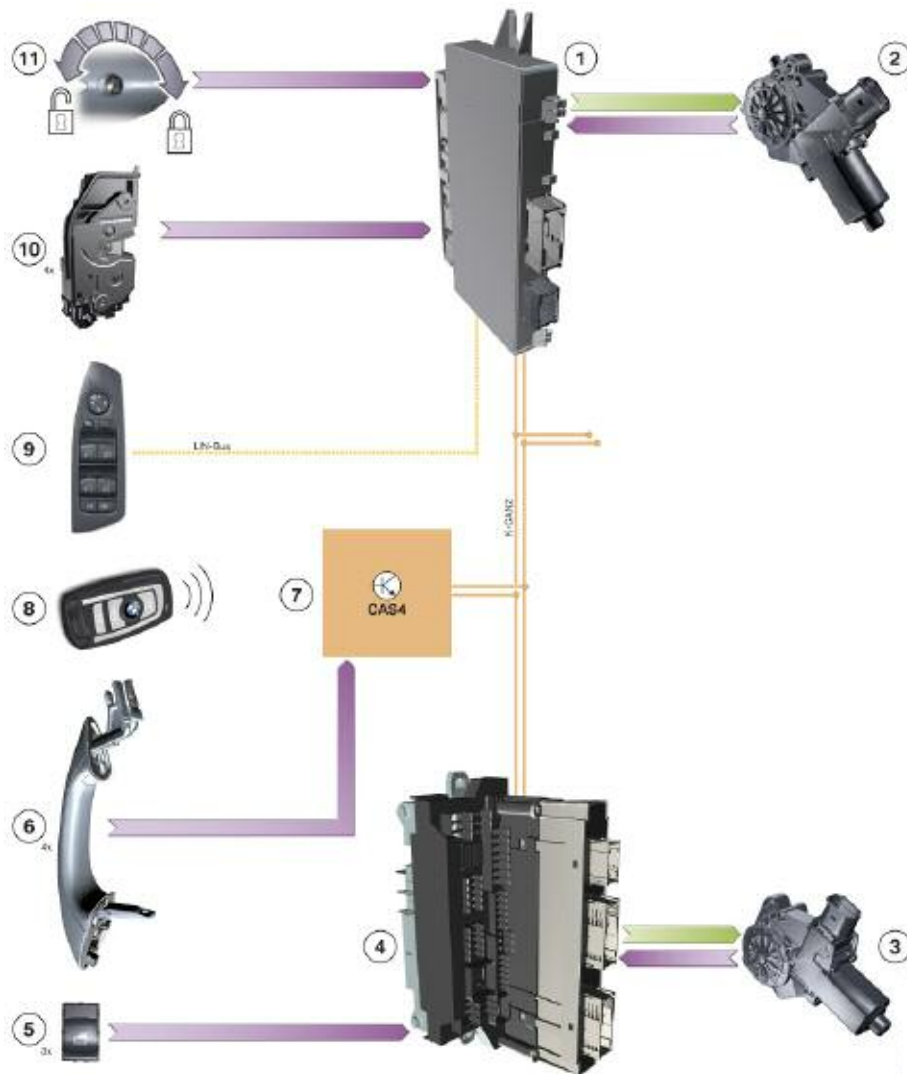
Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

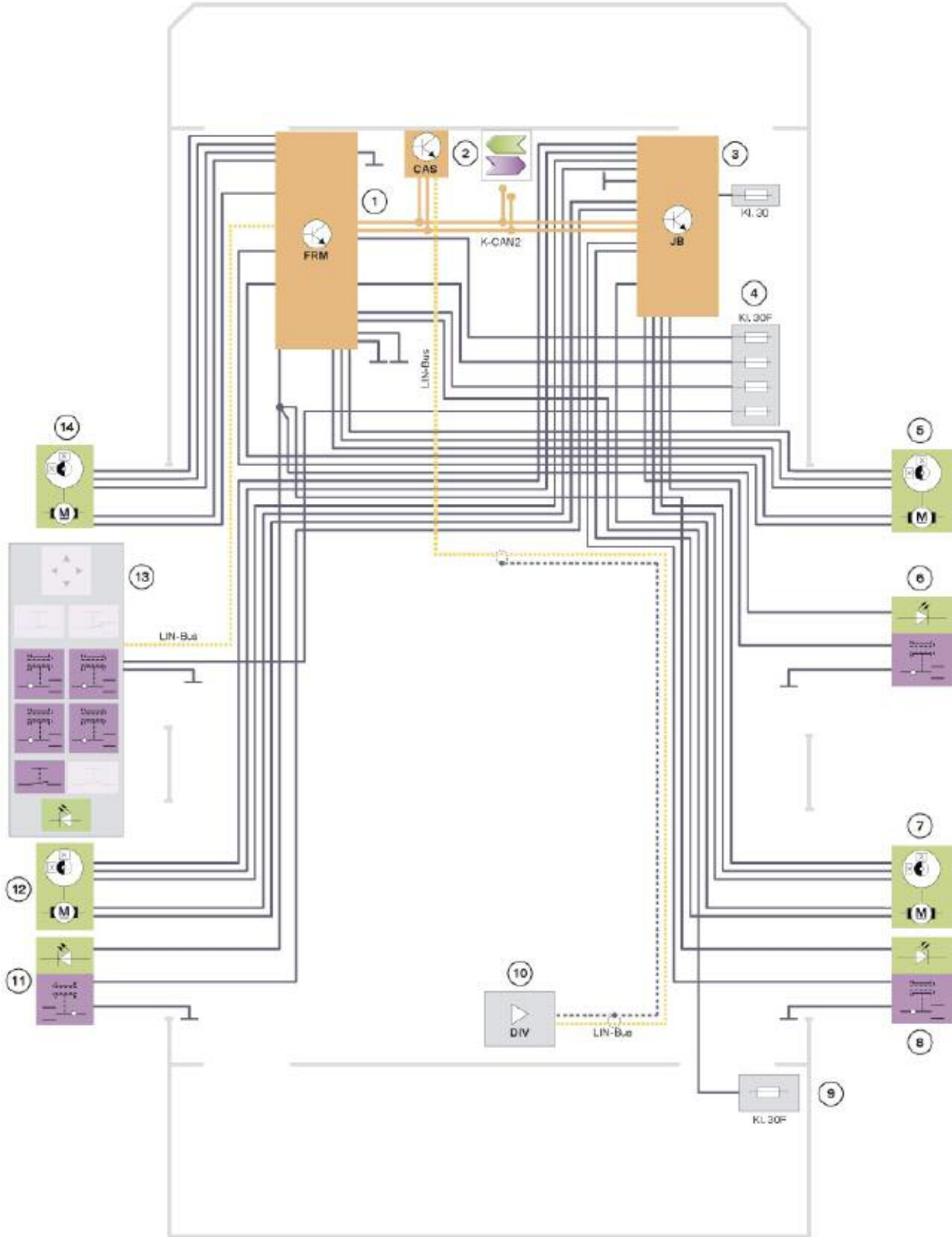
- Understand the operation of the power windows on the F01/F02
- Locate and identify power system components

System Overview



Index	Explanation	Index	Explanation
1	Footwell module	8	Identification transmitter
2	Power window motor, front	9	Driver's door switch cluster
3	Power window motor, rear	10	Lock with door contact
4	Junction box electronics	11	Lock cylinder, driver's door
5	Power window switch, driver's side rear passenger side front and rear	K-CAN	Body CAN
6	Outside door handle for Comfort Access	LIN	Local Interconnect Network bus
7	Car Access System 4		

System Circuit Diagram - Power Windows



Index	Explanation	Index	Explanation
1	Footwell module (FRM)	10	Remote control receiver in diversity module
2	Car Access System 4 (CAS 4)	11	Power window switch, driver's side rear
3	Junction box electronics (JB)	12	Power window motor with indirect pressure-sensitive finger guard on rear driver's side
4	Front power distribution box	13	Driver's door switch cluster
5	Power window motor with indirect pressure-sensitive finger guard on front passenger's side	14	Power window with indirect pressure-sensitive finger guard on driver's door
6	Power window switch, passenger side front	K-CAN2	Body-CAN2
7	Power window motor with indirect pressure-sensitive finger guard on rear passenger's side	LIN-Bus	Local Interconnect Network bus
8	Power window switch, passenger side rear	KI. 30	Terminal 30
9	Rear power distribution box	KI. 30F	Terminal 30, fault switched

The Car Access System (2) issues the enable to actuate the power window motors (5, 7, 12 and 14). If a power window switch is then activated, the footwell module (1) (front power window motor) or the junction box electronics (3) (rear power window motor) executes the request.

Examples of the Signal Path

The following examples of a signal path show the path taken by the signal before the power window motor opens or closes the window. A requirement is that the Car Access System 4 has issued the enable to operate the power windows.

Driver's Door Switch Cluster

When the power window switch for the window in the driver's door or front passenger's door is operated, the signal is routed via the LIN bus to the footwell module. The footwell module drives the corresponding power window motor.

The signal is routed from the driver's door switch cluster via the LIN bus to the footwell module when the power window switches for the windows in the rear doors are operated. The footwell module sends the signal via the K-CAN2 to the junction box electronics. The junction box electronics receives the signal and activates the corresponding power window motor.

Power Window Switch, Front Passenger's Door

The signal is routed to the junction box electronics when the power window switch in the front passenger's door is operated.

The junction box electronics sends the signal via the K-CAN2 to the footwell module. The footwell module drives the power window motor.

Power Window Switch, Rear Doors

When the power window switches in the rear doors are operated, the signal is routed to the JBE. The JBE drives the power window motor.

Overview

All four windows on the F01/F02 are electrically operated. The power windows are equipped with an indirect pressure-sensitive finger guard. The electric power windows have the following functions:

- Opening and closing
- Opening and closing with toll function
- Auto-remote opening and closing
- Indirect pressure-sensitive finger guard
- Panic mode
- Load shut-down at terminal 50
- Overheating protection of power window motors.

Opening and Closing

The Car Access System 4 has the central control function for electric opening and closing of the power windows.

This means that the Car Access System 4 issues the enable to open and close the power windows. The footwell module and the junction box electronics actuate the power window motors and monitor the motor speed of the respective power window motor. This means the footwell module or the junction box electronics can respond to the following operating situations:

- Trapping
- Overheating of the power window motor
- Blocking of power window motors.

The corresponding power window motor is activated in OPEN or CLOSE direction by pressing or pulling the power window switches to the first notch position. The power window motor remains active until the corresponding power window switch is released.

To ensure the power window is closed reliably, the power window motor is briefly driven to block status at the upper stop.

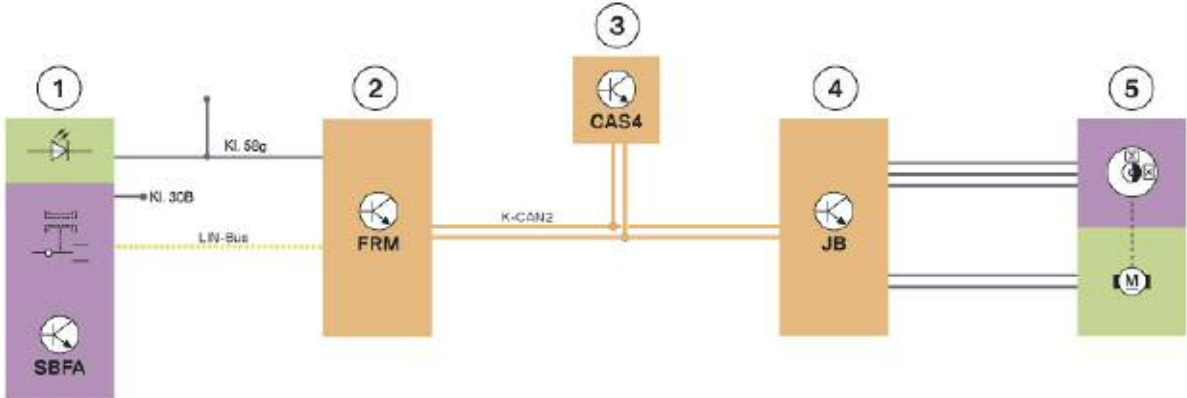
Opening and Closing with Toll Function

The toll function is implemented for all power windows. The corresponding power window motor is driven in the OPEN or CLOSE direction by pressing or pulling a power window switch beyond the limit stop.

The power window motor moves the window automatically until it is completely open or closed. Power window operation is stopped when the power window switch is pressed or pulled again.

By way of example, the opening and closing procedure for one of the rear windows is illustrated by the signal path in the following graphic. The opening or closing function is initiated from the driver's door switch cluster.

Example - Opening or closing the rear window in the F01/F02



Index	Explanation	Index	Explanation
1	SBFA power window switch in driver's door switch cluster	LIN-Bus	LIN-bus
2	Footwell module (FRM)	K-CAN2	Body-CAN2
3	Car Access System 4 (CAS 4)	KI. 30B	Terminal 30, basic operation
4	Junction box electronics (JB)	KL. 58g	Terminal 58g
5	Power window motor		

Auto-remote Opening and Closing

Auto-remote opening or closing can be performed with the identification transmitter via the door lock in the driver's door or the outside driver's/passenger's door handle.

■ Auto-remote opening with identification transmitter

The auto-remote opening function is initiated by unlocking the vehicle with the identification transmitter and keeping the button pressed for longer than 5 seconds.

Initially, the front windows are opened, followed after a short time delay by the rear windows and the panorama glass roof.

Note: If the fold-in/out exterior mirrors option is installed and the mirrors are folded in, the mirrors will be folded out at the same time as the rear windows are opened.

Only the version sold in Japan offers auto-remote closing or auto-remote opening for folding the exterior mirrors in or out.

The signal from the identification transmitter is picked up by the Car Access System 4 via the remote control receiver.

The Car Access System 4 issues the enable to operate the power windows and initiates the auto-remote opening function. The footwell module and the junction box electronics correspondingly activate the power window motors.

■ Auto-remote closing with identification transmitter

The auto-remote closing function is initiated after locking the vehicle with the identification transmitter and keeping the button pressed for longer than 5 seconds. Initially, the panorama glass roof is closed followed after a short time delay by the rear/front windows.

If the folding exterior mirrors option is installed, the mirrors are folded in simultaneously as the rear windows are closed.

■ Auto-remote opening and closing via the driver's door lock barrel

There are two Hall sensors installed in the door lock for the purpose of opening and closing the vehicle. The Hall sensors enable the footwell module to detect the position of the mechanical key or of the spare key in the lock barrel.

The key must be turned to the open or close position to initiate the auto-remote opening and closing function. The auto-remote opening or closing function is initiated when the key is held in this position.

The footwell module sends the request via the K-CAN. On conclusion of the corresponding check, the Car Access System 4 initiates the auto-remote opening or closing procedure.

■ Auto-remote closing with Comfort Access

In connection with Comfort Access, the auto-remote closing function is triggered via the driver's/passenger's outside door handle.

It is sufficient to touch the sensitive area of the outside door handle in order to trigger the auto-remote closing function via the door handle. Auto-remote closing is triggered if the sensitive area is touched for longer than 5 seconds. The ID transmitter must be within an approximate 2 m radius of the vehicle.

Note: Touching the outside door handle corresponds to pressing the lock button on the ID transmitter.

Indirect Pressure-sensitive Finger Guard

Essentially, the indirect pressure-sensitive finger guard does not prevent an object being trapped but rather it limits the trapping force to maximum 80 N. The power window motor is reversed on exceeding this trapping force.



The footwell module and the junction box electronics monitor the activated power window motors. The indirect pressure-sensitive finger guard for the front windows is activated by the footwell module. The indirect pressure-sensitive finger guard for the rear windows is activated by the junction box electronics.

The indirect pressure-sensitive finger guard in the E90 is based on the evaluation of the Hall pulses from the power window motors. The speed is derived from the Hall pulses of the power window motors. Speed fluctuations within certain ranges trigger the indirect pressure-sensitive finger guard so that the windows are opened. Operation of the power window switches is ineffective while the windows are in the process of opening.

If no operable pressure-sensitive finger guard is detected as the result of defective Hall sensors, the window can only be operated in jolts. The power window is in emergency mode and must be reinitialized.

Note: The initialization procedure is described in the Service Information.

The customer is shown a Check Control message.

Check Control message	Meaning	Information on the central information display
	Power window pressure-sensitive finger guard!	Power window pressure-sensitive finger guard deactivated.
	Power window pressure-sensitive finger guard!	Power window pressure-sensitive finger guard failed. Ask your nearest BMW Service to check this.

Panic Mode

Panic mode is triggered by overpulling releasing-overpulling (overpulling = pulling beyond limit stop) the power window switches.

It is necessary to release and overpull the switch again as the pressure-sensitive finger guard is still active the first time the switch is overpulled. Overpulling the power window switch the second time within 4 seconds closes the window with maximum force.

Note: The indirect pressure-sensitive finger guard is no longer active in this case. The window closes at the maximum closing force and does not reverse.

Load shut-down, Terminal 50

Car Access System 4 sends the “terminal 50 ON” status. The signal is received by the footwell module and junction box electronics via K-CAN.

The junction box electronics and the footwell module prevent operation of the power windows during the start procedure or interrupt current operation of the power windows. This protects the battery during the starting procedure.

The power window switches must be pressed again following an interruption in operation.

Operation of the power windows is not possible until the start procedure has been completed.

Overheating Protection of Power Window Motors

The footwell module and the junction box electronics monitor the motor temperature. The motor temperature is determined based on the outside temperature, motor running time and the time the motor is stationary (not operative). Each motor can be switched off individually to prevent the power window motors overheating during operation of the power windows. The motor is then deactivated for a defined period of time.

The overheating protection facility does not prevent the windows being opened in the case of trapping. Once started, a power window function is not interrupted by the overheating protection facility. In panic mode the window can still be closed even when the overheating protection function is active.

Roller Sun Blind

Roller sun blinds are available as an option for the rear window and rear side windows. The roller sun blinds can be raised and lowered electrically.

The switch for the roller sun blind on the rear window is located in the driver's door switch cluster. The footwell module detects the switch status via the LIN-bus. When the button is pressed, the footwell module issues the operational request via the K-CAN2. The complete control and function monitoring facility is integrated in the junction box electronics. The junction box electronics therefore executes the operational request.

Every time the roller sun blinds are operated, their positions are stored in the junction box electronics.

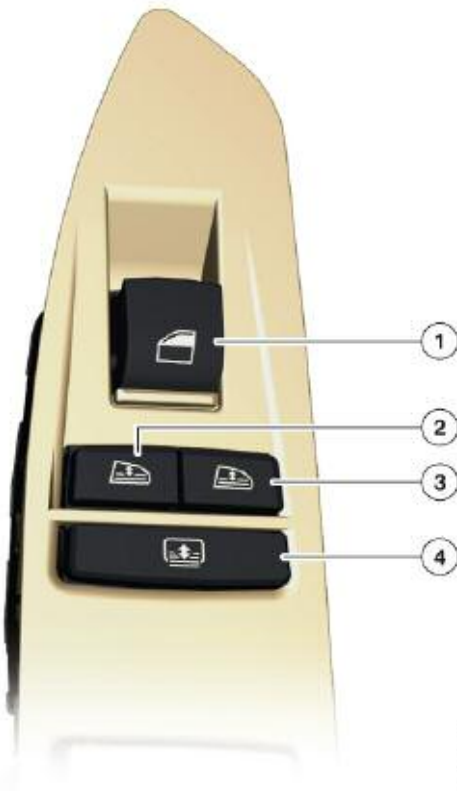
Other operating points are located in the armrests on the rear doors. The switches are located next to the switches for the power windows.

Three switches are provided in each armrest. The switches are:

- Switch for roller sun blind on rear window
- Switch for roller sun blind on left side window
- Switch for roller sun blind on right side window.

The roller sun blinds can be raised and lowered separately with the switches.

Switch cluster in driver's side armrest



Index	Explanation
1	Power window switch
2	Switch for roller sun blind on left side window
3	Switch for roller sun blind on right side window
4	Switch for roller sun blind on rear window

Each rear door has two roller sun blinds, one for the side window and one for the quarter light.

Both roller sun blinds are raised or lowered by means of an electric motor.

Note: The roller sun blinds are raised and lowered completely. They cannot be raised or lowered to an intermediate position.

If a new operational request is sent to the roller sun blinds during their actuation, they will reverse their direction of movement immediately.

The enable for operating the roller sun blinds on the rear doors is linked to the closed window position.

The Car Access System issues the enable for operating the roller sun blinds.

The roller sun blind of the corresponding side window is automatically lowered in response to an operational request to open the side window.

Operation of the roller sun blinds is restricted in the event of undervoltage.

By monitoring the outside temperature and interior temperature, the function “lower” roller sun blind is executed at an interior temperature $> 11^{\circ}\text{C}$ and outside temperature $< -16^{\circ}\text{C}$.

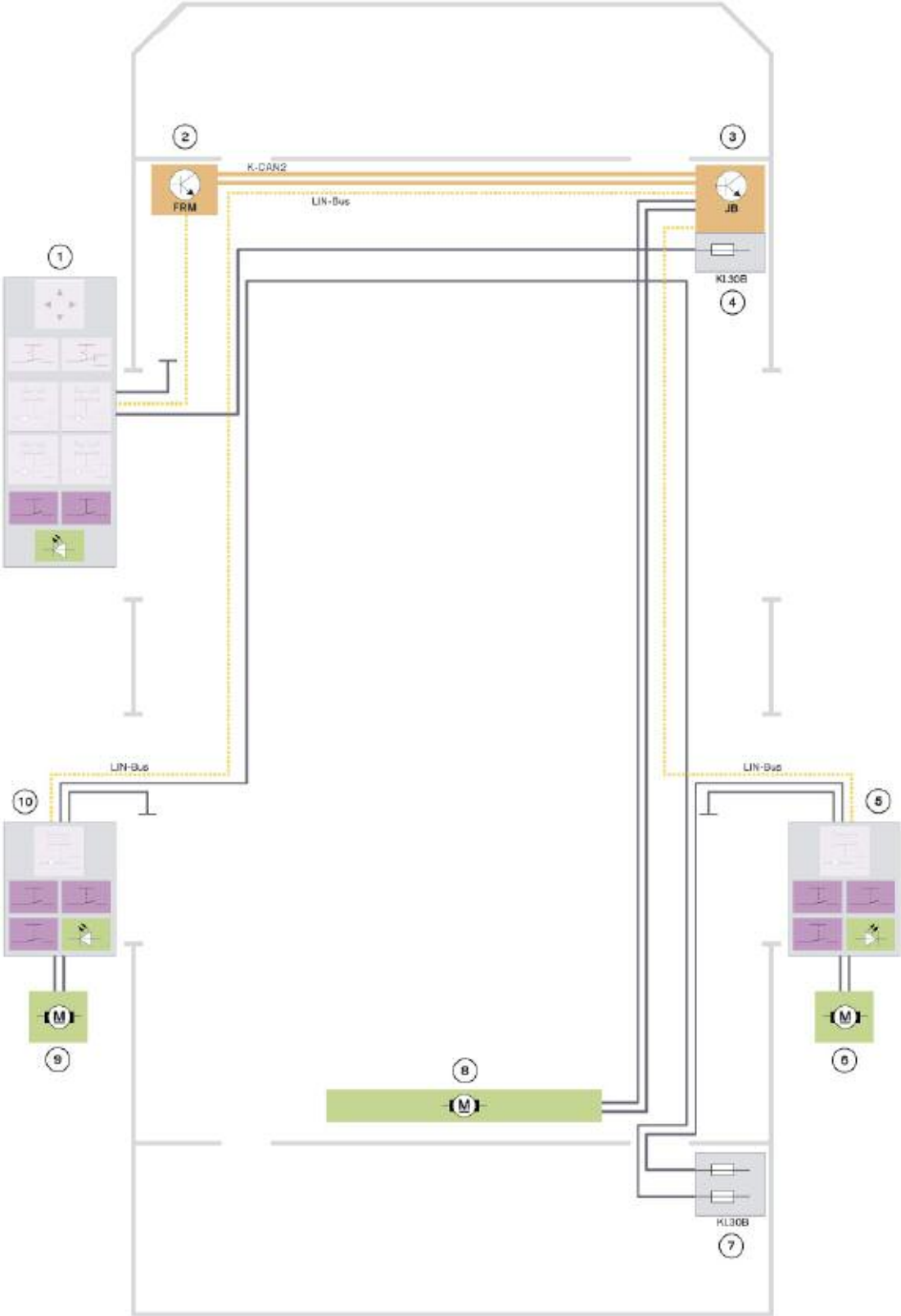
The roller sun blinds can be operated as from terminal 15N ON.

Note: Operation of the roller sun blinds is disabled when the child safety lock is activated.

NOTES

PAGE

System Circuit Diagram - Roller Sun Blind



Index	Explanation	Index	Explanation
1	Driver's door switch cluster	8	Motor for roller sun blind, rear window
2	Footwell module (FRM)	9	Switch cluster in rear driver's side door
3	Junction box electronics (JB)	10	Motor for roller sun blind, rear driver's side
4	Front power distribution box	K-CAN2	Body-CAN2
5	Switch cluster in rear passenger's side door	LIN-Bus	Local Interconnect Network bus
6	Motor for roller sun blind, rear passenger's side	KI. 30B	Terminal 30, basic operation
7	Rear power distribution box		

Overview of Functional Principle

The functional principle of the electrically operated roller sun blinds is described in the following.

Pressure-sensitive Finger Guard for Side Window

The roller sun blind has no electronic pressure-sensitive finger guard! The mechanism and drive units are designed such as to rule out any danger for the occupants posed by excessively high forces.

Nevertheless, to prevent trapping, the roller sun blinds can only be extended when the corresponding side window is closed. However should a trapping situation occur, movement of the roller sun blind will be stopped. The roller sun blind is then moved in the opposite direction in response to the next operational request. It is always possible to retract the roller sun blinds at the side windows.

The direction of roller sun blind movement that has already started can only be reversed 1.5 seconds after the button is pressed again.

Further button operation is ignored during the initial 1.5 seconds of roller sun blind movement. This function is intended to protect the operating mechanism of the roller sun blind.

Roller Sun Blind on Rear Window

The roller sun blind on the rear window can be operated by means of the roller sun blind switches. There are three operating points:

- Driver's door switch cluster
 - The junction box electronics receives the switch status via the K-CAN2.
- Switch cluster in rear driver's side armrest*
- Switch cluster in rear passenger's side armrest*.

*The junction box electronics cyclically evaluates the switches at the rear doors via the LIN-bus.

The roller sun blind for the rear window is raised or lowered by briefly pressing the switch.

A special function is activated when the switch for the rear window roller sun blind is pressed longer. This special function allows all three roller sun blinds to extend or retract to assume the same position.

In this function, the roller sun blind for the rear window is actuated and, if necessary, also the roller sun blinds for the side windows.

Every time the roller sun blinds are operated, their positions are stored in the junction box electronics.

The end stops are detected by the motors blocking, thus cancelling activation.

A repeat inhibit function is integrated in the system to prevent the motor overheating due to continuous operational requests initiated by children playing with the switch. The repeat inhibit blocks operation of the roller sun blind in the down position. Once started, movement of the roller sun blind is not interrupted by the repeat inhibit.

The renewed enable to raise the roller sun blind depends on the number of times the roller sun blind is operated and the intervals between operation.

Rear window roller sun blind F01/F02



■ Position of roller sun blinds unknown

The raised or lowered positions of the roller sun blinds are stored in the junction box electronics. An unknown position of the roller sun blind may occur, for example, as a result of a voltage reset. If the position is not known, the junction box electronics interprets the roller sun blind as being in the raised position. The roller sun blind is then initially lowered in response to the next operational request. The direction is reversed if the junction box electronics detects blocking directly after actuation. Blocking signals that the roller sun blind is at the lower end stop position.

■ Blocking detection

The junction box electronics is equipped with a blocking detection facility to protect the motor. This function serves the purpose of immediately switching off the motor on reaching the upper or lower end position.

Motor actuation is additionally subject to a time monitoring function. Consequently, actuation of the motors is terminated after a defined maximum period of time.

The roller sun blinds on the side windows also feature a blocking detection function. This function is integrated in the electronic circuitry of the switch cluster in the rear door armrest.

This blocking detection function serves the purpose of switching off the motor on reaching the upper or lower end position.

The end positions are detected by evaluating the current consumption of the motors, thus cancelling activation. After detecting a significant increase in current consumption, the motor is short-circuit braked in blocked position and the drive is briefly reversed to relief the strain on the mechanical system.

The actuation time of the motor for the roller sun blind is additionally monitored. The actuation time is limited to 15 seconds. Actuation is then terminated after this period of time has elapsed.

■ **Child safety lock**

The child safety lock function is switched on or off by means of the child safety lock switch in the switch cluster on the driver's side.

The roller sun blinds can no longer be operated with the rear switches when the child safety lock is switched on.

No request to raise or lower the roller sun blind is triggered when the child safety lock button is pressed. Current movement of the roller sun blind is not interrupted when the child safety lock is engaged.

■ **Roller sun blind switches**

All switches have a LIN-bus connection. The switches are connected to terminal 30B and a ground connection.

The motors for the roller sun blinds in the side windows are connected directly to the respective switch cluster. The motor for the roller sun blind on the rear window is connected to the junction box electronics.

The electronic circuitry for the LIN-bus and the power electronics for actuation of the motors are integrated in the switch cluster. The electronic circuitry monitors actuation and detects the end positions of the roller sun blind.

The junction box electronics receives information on the end positions from the LIN-bus.

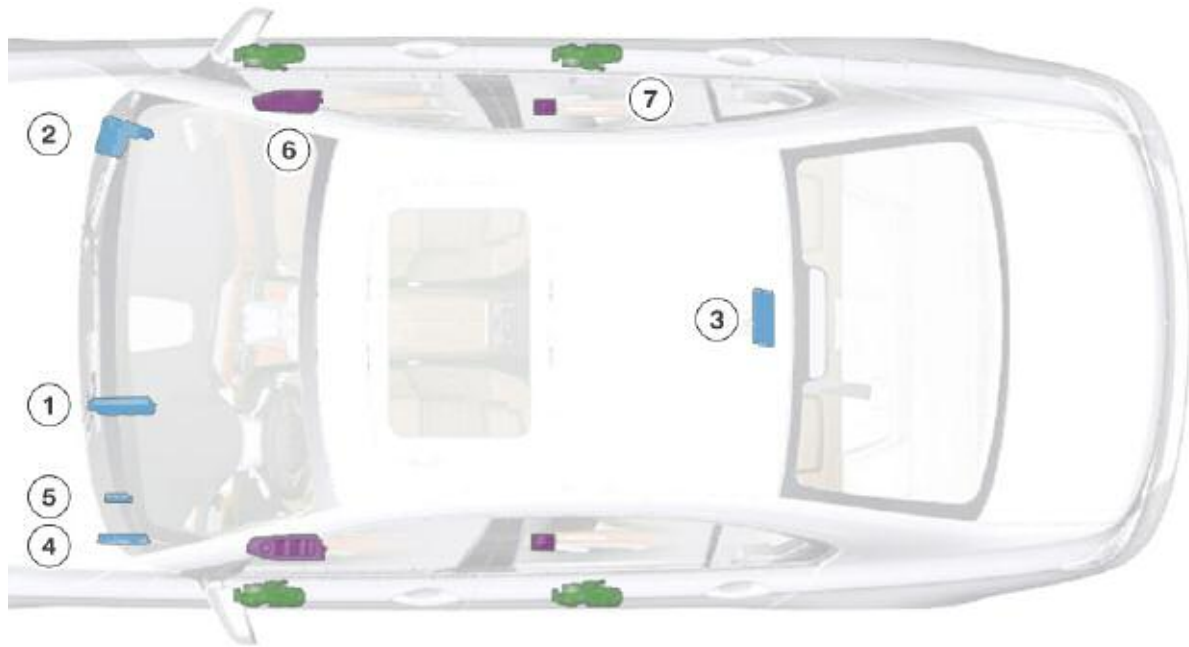
NOTES

PAGE

System Components

Components Involved

The following graphic shows all the components of the power window system together with the respective control units and control elements.



Index	Explanation	Index	Explanation
1	Car Access System 4	5	Central gateway module
2	Junction box electronics	6	Power window switch
3	Remote control receiver in diversity module	7	Power window motors
4	Footwell module		

The following components are described:

- Controls
- Control units
 - Car Access System 4
 - Footwell module
 - Junction box electronics
- Power window motor

Controls

■ Driver's door switch cluster

The driver's door switch cluster is connected via the LIN bus to the footwell module.

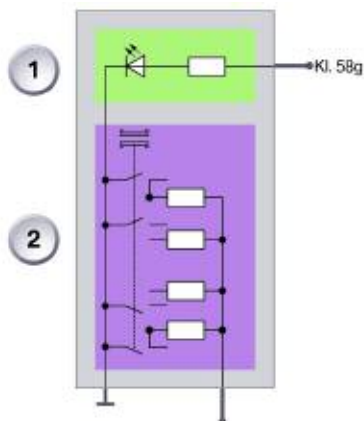


Index	Explanation
1	Outside mirror adjustment switch
2	Selector switch, outside mirror left/ right
3	Power window button, passenger's door
4	Power window button, rear right
5	Roller sun blind button
6	Child safety lock button
7	Power window button, rear left
8	Power window button, driver's door
9	Outside mirror fold-in button

For opening or closing, the power window switch has two notch positions. The first notch position is used for the manual power window function. The second notch position (press) is used for the toll function of the power windows.

The power window switches are resistance-coded and switched to ground. The following graphic shows the principle of a resistance-coded switch.

Resistance-coded switch F01/F02



Index	Explanation
1	Illumination of power window switch
2	Resistance-coded switch

■ **Signal evaluation of the power window switches**

The signals of the power window switch in the driver's door switch console are evaluated directly by the driver's door switch cluster and transferred to the footwell module via the LIN bus.

The signals from the power window switches in the front passenger's door as well as the power window switches of both rear doors are evaluated by the junction box electronics.

Control Units

■ **Car Access System 4**

The Car Access System 4 is the central control unit for opening and closing the windows. Therefore, it issues the enable to operate the power windows.

"Terminal 50 ON" status is sent while starting the engine. The junction box electronics and the footwell module prevent operation of the power windows during the start procedure or interrupt current operation of the power windows. This means more energy from the battery is available for the starter during engine start-up.

■ **Footwell module**

The relays for the power window motors for the front doors are installed in the footwell module.

The footwell module provides information on the status of the door contacts and the driver's door lock cylinder.

The footwell module also provides the power window switch and the driver's door switch console with information on the "Terminal 58g ON" status.

■ **Junction box electronics**

The relays for the power window motors for the rear doors are installed in the junction box electronics.

Identification Transmitter

The identification transmitter can initiate auto-remote opening/closing of the power windows.

The operating procedure is defined in the Owner's Handbook.

Power Window Motors

The power window motors are equipped with Hall sensors that generate signals during motor operation. These signals serve the purpose of monitoring motor operation and are evaluated for the pressure-sensitive finger guard.

The signals are evaluated in the footwell module and the junction box electronics.

Service Information

Initialization

Initialization of Power Windows

The front and rear power windows can be initialized via the power window switches or the BMW diagnosis system.

Note: The power windows can only be moved in jolts if not initialized.

■ Initialization via the power window switches

The following procedure must be performed to initialize the system:

- Completely close window by pulling the power window switch beyond the limit stop.
- Briefly interrupt pulling the power window switch and then pull the switch upwards again for approximately 1 second.

■ Initialization via the BMW diagnosis system

The power windows can be initialized as part of an initialization job using the diagnosis system. A detailed description of the initialization procedure is provided in the BMW diagnosis system.