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# Wipe/wash System

Model: E70

Production: From Start of Production

# OBJECTIVES

After completion of this module you will be able to:

- Fully understand and explain the wiper system on the E70 X5
- Locate the components and modules responsible for the wipers
- Properly identify the RLSS for a vehicle with HUD

# Introduction

The E70 is equipped with two Windshield wipers and one rear window wiper as standard.

The wiper function is possible in the following modes:

- Intermittent wipe
- Continuous wipe in Stage 1
- Continuous wipe in Stage 2
- Flick wipe

The E70 can be optionally equipped with headlight washer system option 502. It is equipped with rain/driving lights/solar sensor and heated nozzles as standard.

The wipe/wash system on the E70 is a conventional wiper/wash system. This means that the wiper motors are equipped with a reset contact.



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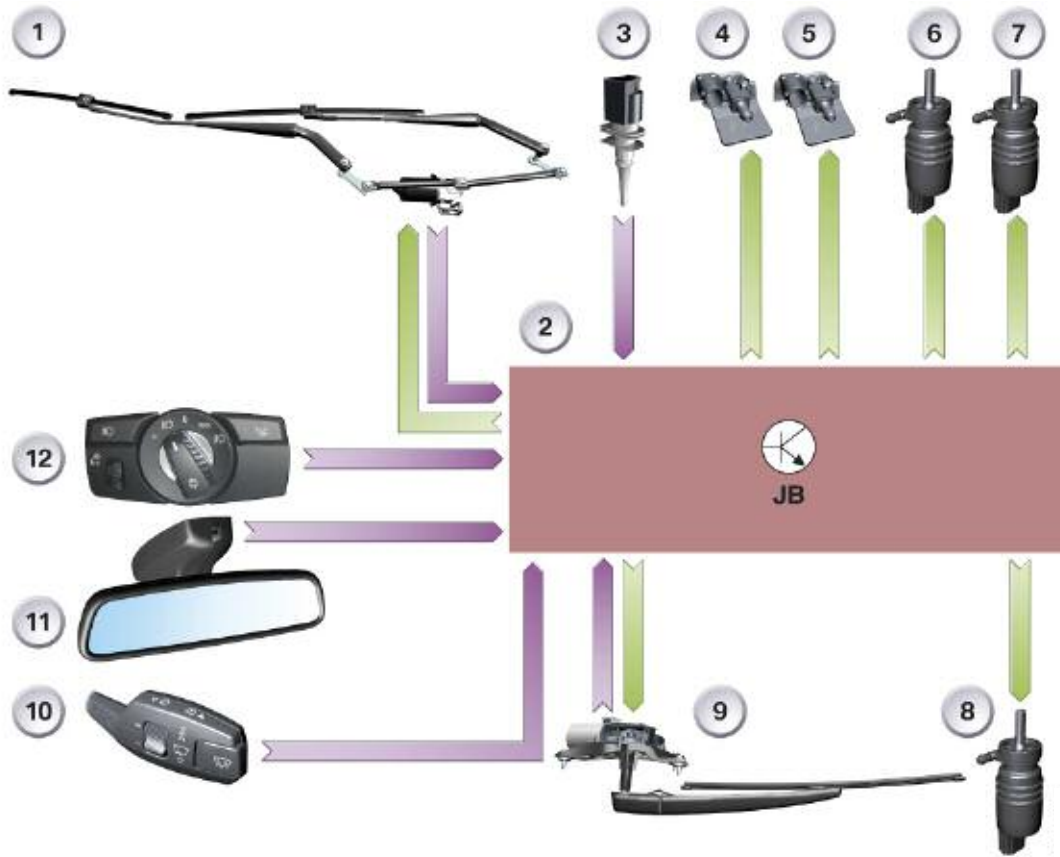
## Rain/Driving Lights/Solar Sensor

A new rain/driving lights/solar sensor is used on the E70. What is actually new is the fact that the solar sensor has been integrated in the rain/driving lights/solar sensor. The functionality of the rain sensor and of the driving lights sensor has been retained in full. This means the driver is still assisted in that the rain sensor automatically initiates the procedure for switching on the Windshield wipers.

The driving lights sensor supplies the ON signal for the driving lights control function. Under unfavorable light conditions such as twilight or when driving through a tunnel, the ON signal ensures the driving lights are switched on automatically. The solar sensor makes sure the automatic climate control system provides optimum air conditioning distribution in the vehicle.

# System Overview

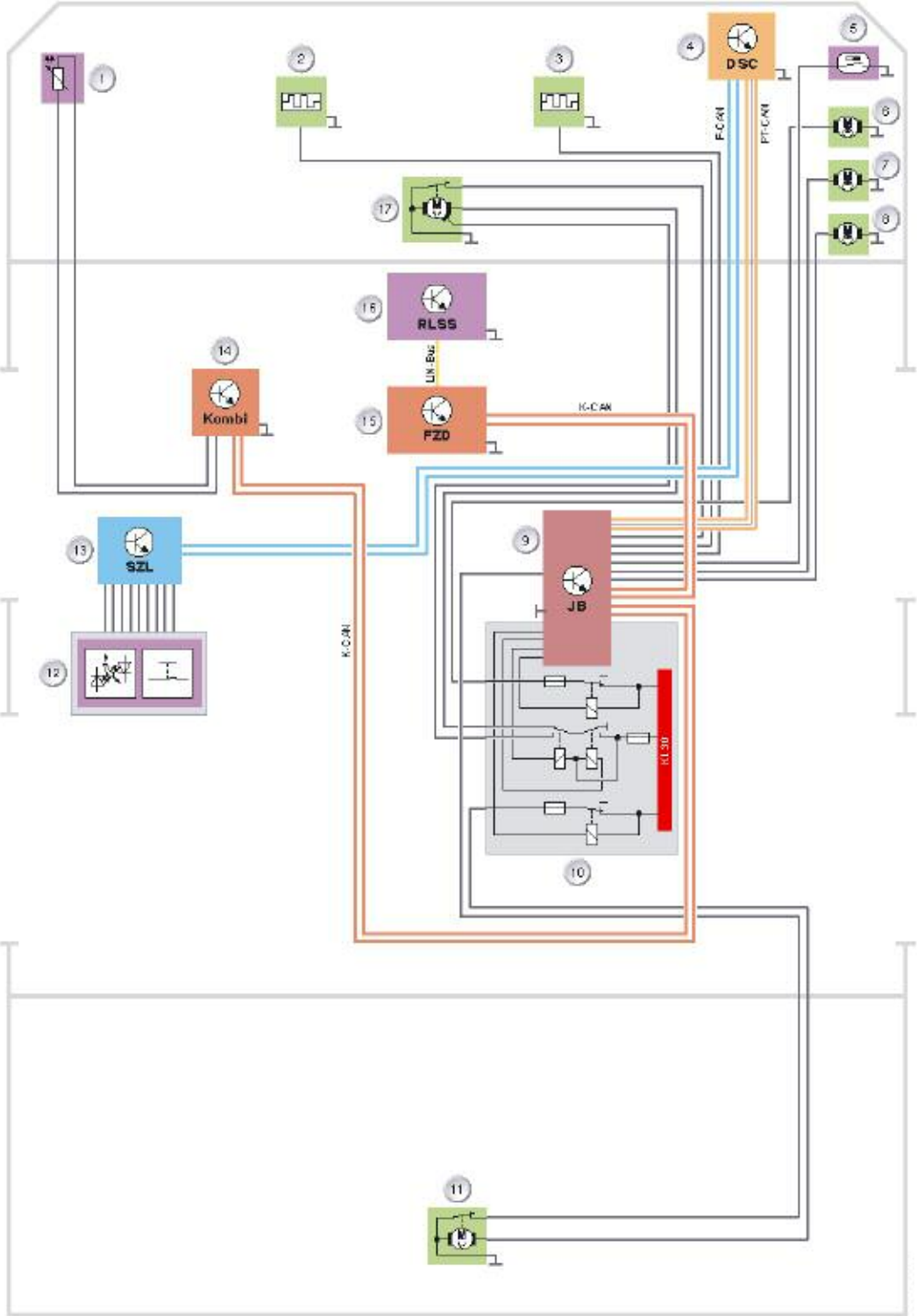
## Inputs/Outputs



Index	Explanation	Index	Explanation
1	Front wiper motor	7	Motor, headlight washer
2	Junction box control unit JB	8	Motor for washer fluid pump, rear
3	Outside temperature	9	Wiper motor, rear
4	Heated water jet, driver's side	10	Steering column switch, wipers
5	Heated water jet, front passenger's side	11	Rain/driving lights/solar sensor
6	Motor, washer fluid pump, front	12	Lights operating unit

The front wiper motor (1) or the rear wiper motor (9) is switched on or off by correspondingly operating the wiper switch on the steering column stalk (10). The junction box control unit (2) executes the functions of the wipe/wash system. The junction box control unit also switches the washer fluid pumps (6 or 7) on or off. On vehicles equipped with the driving lights control function, the junction box control unit receives the information to switch the wipe/wash system on and off from the rain/driving lights/solar sensor (11).

# System Circuit Diagram



## Legend for System Circuit Diagram

Index	Explanation	Index	Explanation
1	Outside temperature sensor	12	Steering column switch, wipers
2	Heated water jet, driver's side	13	Steering column switch cluster (SZL)
3	Heated water jet, front passenger's side	14	Instrument cluster
4	Dynamic Stability Control (DSC)	15	Roof functions center FZD
5	Washer fluid level sensor	16	Rain/driving lights/solar sensor
6	Motor, headlight washer	17	Front wiper motor
7	Motor, washer fluid pump, front	Kl. 30	Terminal 30
8	Motor for washer fluid pump, rear F-CAN	F-CAN	Chassis CAN
9	Junction box control unit JB	K-CAN	Body CAN
10	Relay in front power distribution box	PT-CAN	Powertrain CAN
11	Wiper motor, rear	LIN-Bus	LIN-bus

The signal produced when the wiper switch on the steering column stalk (12) is operated is sent from the steering column switch cluster SZL (13) via the chassis CAN to the dynamic stability control DSC (4). The dynamic stability control transfers the signal on to the PT-CAN. The junction box control unit (9) switches on the wiper motor (17), for instance, and monitors its operation.

The junction box control unit switches the washer fluid pumps (6 to 8) on or off.

On vehicles equipped with the driving lights control function, the rain-driving lights-solar sensor (16) sends, for example, the request to switch on the wiper motor (17) via the LIN bus. The roof functions center (15) makes the request available on the K-CAN. In this way, the junction box control unit receives the information to switch the wiper motor on or off.

The wipe function is dependent on the driving speed. The speed signal is made available by the dynamic stability control (4) via the PT-CAN.

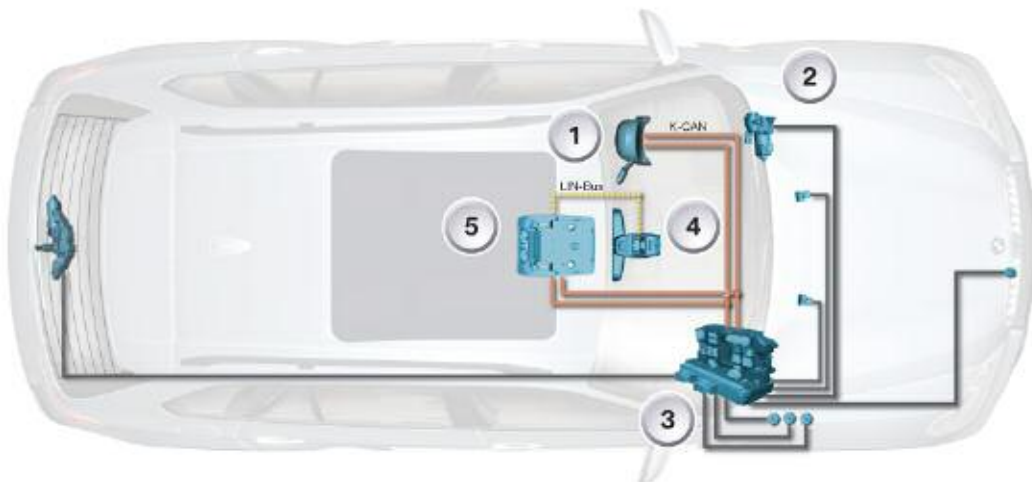


# System Components

## Involved components

The following components are involved in the wipe/wash system:

- Control units
  - Steering column switch cluster
  - Junction box control unit
  - Instrument cluster
  - Dynamic stability control
  - Roof functions center
  - Rain/driving lights/solar sensor
- Relays
  - Relays 1 and 2 for front wiper motor
  - Relay for headlight washer system
  - Relay for rear wiper motor
- Wiper motor
  - Front with reset contact
  - Rear with rest contact
- Pump for washer fluid, front and rear
- Pump for headlight washer system
- Heated water jets



Index	Explanation	Index	Explanation
1	Steering column switch cluster	4	Rain/driving lights/solar sensor
2	Front wiper motor	5	Roof functions center
3	Junction box control unit		

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## Control Units

### Junction Box

The junction box control unit is the master for all wiper functions.

The relays for the wipe/wash functions are integrated in the front power distribution box.

The relay for the continuous wipe function in Stage 1 is plugged in and the relay for Stage 2 soldered.

A relay each is installed in the power distribution box for wiping the rear window and for the headlight washer system.

### Roof Functions Center

The RLSS is connected to the K-CAN via the roof functions center.

### Dynamic Stability Control

The dynamic stability control makes available the driving speed signal and is the interface to the steering column switch cluster SZL.

### Rain/Driving Lights/Solar Sensor

The rain/driving lights/solar sensor consists of three sensors. These sensors are:

- Rain sensor - Signal for the wipe/wash system
- Driving lights sensor - Signal for switching driving lights on and off
- Solar sensor - Signal for the air conditioning system.



Index	Explanation
1	Rain/driving lights/solar sensor
2	High beam assistant
3	Condensation sensor
4	Mounting plate

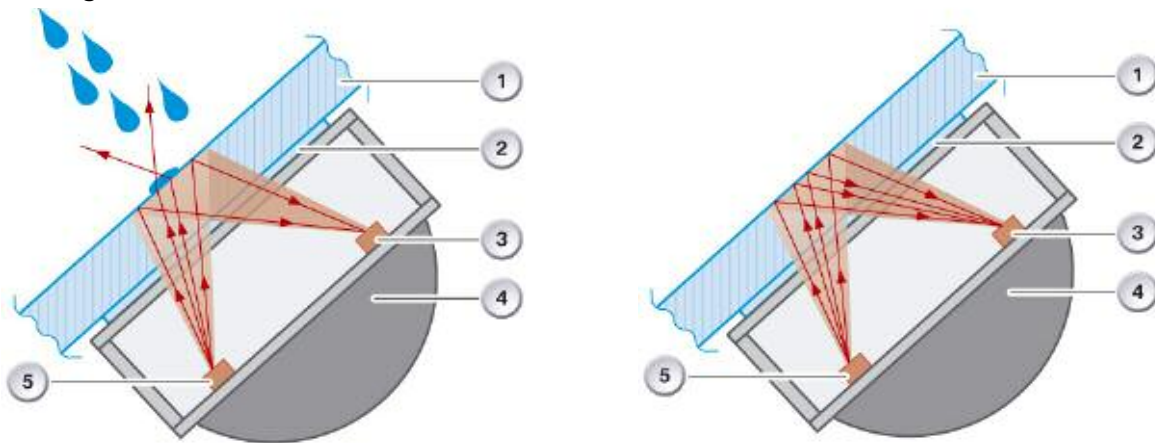
■ Rain Sensor

With the aid of three infrared transmit diodes and infrared receive diodes, the rain sensor evaluates the moisture level on the Windshield.

Three rain ranges are created by combining infrared transmit diodes and infrared receive diodes in pairs. The rain ranges are used to determine the rain intensity.

Rain detection is based on the reflection of the infrared light at the boundary surface from the glass of the Windshield to air. The reflection is dependent on the level of soiling and moisture on the Windshield.

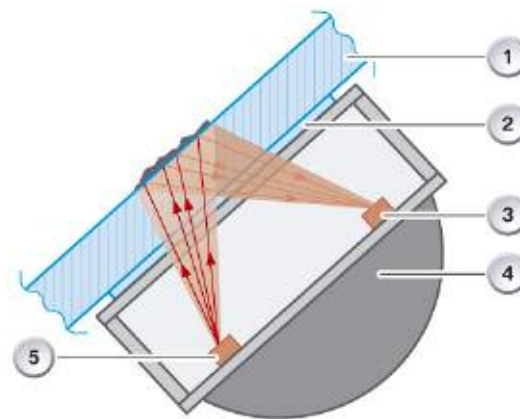
Rain range of rain sensor E70



The infrared light is reflected in full when the Windshield is clean and dry.

The reflection of the infrared light is reduced by dirt or rain water on the Windshield.

The rain sensor signals the detected rain situation to the roof functions center via the LIN-bus. In turn, the roof functions center transfers the information on the K-CAN. In this way, the junction box control unit receives the request to switch the Windshield wiper on or off.



The signals are:

- Sensor status
- Rain intensity
- Wiper speed
- Interval period

Index	Explanation
1	Windscreen
2	Adhesive layer
3	Infrared receive diode
4	Rain/driving lights/solar sensor
5	Infrared transmit diode

### ■ Driving Lights Sensor

The driving lights sensor registers the ambient light and the light levels in front of the vehicle (front end). A sensor for each of these areas is integrated in the rain/driving lights/solar sensor.

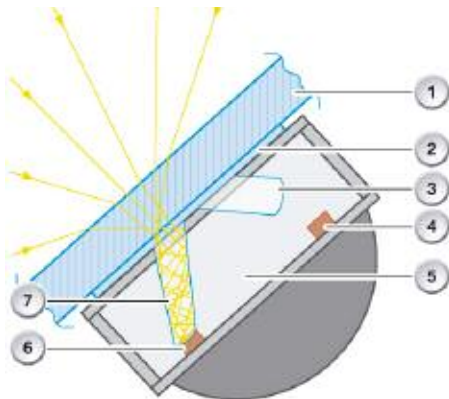
The rain/driving lights/solar sensor informs the roof functions center of the driving lights situation via the LIN-bus, i.e. driving lights on/off and reason for switching on.

The roof functions center packs the signals into the corresponding K-CAN telegram and sends it. In this way, the footwell module receives the request to switch the driving lights on or off (when the automatic driving lights function is active).

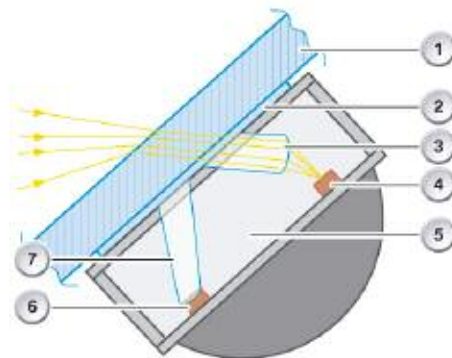
The signals are:

- Status of driving lights sensor
- Status of driving lights
- Ambient brightness level
- Reason for switching on.

Ambient Light Sensor



Front End Sensor



Index	Explanation	Index	Explanation
1	Windscreen	5	Rain/driving lights/solar sensor
2	Adhesive layer	6	Infrared transmit diode
3	Light optics, front end sensor	7	Receive diode, ambient light sensor
4	Receive diode, front end sensor		

### ■ Solar Sensor

The solar sensor is assigned purely to the scope of functions of the automatic heating and air conditioning system.

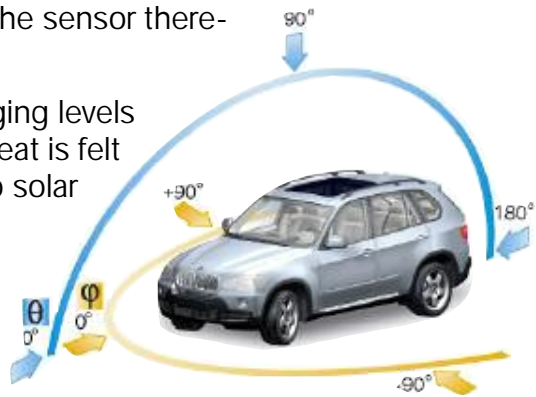
The solar sensor measures the angle of solar radiation (insolation) on to the vehicle. The solar radiation is measured separately on the driver's and front passenger's side.

At times the solar radiation comes from the front, from the side or sometimes from the rear due to the changes in direction while driving. The sensor therefore registers the solar radiation at all times.

Persons in the vehicle are subjected to these changing levels of solar radiation (insolation). Consequently, more heat is felt in the area of solar radiation than in the area with no solar radiation.

The solar sensor measures the solar radiation on to the vehicle depending on the position of the car with respect to the sun.

The values from the solar enable the integrated automatic heating and air conditioning system (climate control) to respond accordingly and create a pleasant climate in the vehicle. The roof functions center receives the values from the solar sensor via the LIN-bus and forwards the values on the K-CAN to the integrated automatic heating and air conditioning system (climate control).



Index	Explanation
$\theta$ (Theta)	Angle of incidence of solar radiation
$\varphi$ (Phi)	Course of the sun from sunrise to sunset

### ■ RLSS Variants

Two versions of the rain/driving lights/solar sensor are used in the E70. The version depends on whether a head-up display is installed in the vehicle or not. The optics in the front end light sensor that are pervious to infrared light are replaced by clear optics for the head-up display.

The front end light sensor is directed at the area of the road which is also used for the head-up display. The brightness level of the representation in the head-up display can thus be adapted to the light situation.

This is necessary for example when driving through a tunnel with the head-up display switched on.

Installation of the rain/driving lights/solar sensor in the E70 requires the installation of the roof functions center with maximum equipment configuration. Consequently, the maximum equipment configuration of the interior lighting system is also installed.

Note: The rain/driving lights/solar sensor can best be distinguished simply by looking at the Windshield. If the rain/driving lights/solar sensor has two clear lenses then it is for the head-up display.

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Three variants of the cover cap on the base of the interior rear-view mirror are possible.

- Cover without rain/driving lights/solar sensor
- Cover with rain/driving lights/solar sensor
- Cover with rain/driving lights/solar sensor and high beam assistant.

The optical element and the electronics of the rain/driving lights/solar sensor can be replaced separately.

Note: An exception is the rain/driving lights/solar sensor for the head-up display. This rain/driving lights/solar sensor can be replaced only as a complete unit. The reason for this is that the optical element and the electronics need to be matched (calibrated) in the sensor for the head-up display. This is currently possible only as part of the rain/driving lights/solar sensor manufacturing process.

The occurrence of small bubbles on the silicon gel layer (adhesive layer) is OK (permitted) when replacing the optical element. Please remember to initialize the rain/driving lights/solar sensor.

### Wiper Switch

The wiper switch with the following functions is located in the steering column switch cluster:

- Intermittent wipe
- Stage 1 and Stage 2
- Rear window wipe
- Windshield washer
- Rear window wash
- Switch for rain/driving lights/solar sensor
- Indicator for active rain/driving lights/solar sensor

The wiper switch is designed as an optical switch. The functions of the optical switch are described in the section entitled "Steering column switch cluster".

The interval switch is a four-stage switch.

Each stage switch produces different input values in the steering column switch cluster SZL. The input values are evaluated, for example, for setting the sensitivity of the rain/driving lights/solar sensor.

The button for the rain/driving lights/solar sensor is designed as a ground-switching button. It is required to switch on the rain/driving lights/solar sensor. The LED is illuminated when the rain/driving lights/solar sensor is activated.

### Front Wiper Motor

The front wiper motor is designed for two speed stages and has a reset contact.

### Rear Wiper Motor

The rear wiper motor also features a reset contact and has one speed stage.

The purpose of the reset contact is to detect the parked (rest) position of the wiper blade.

### Pump for Windshield Washer

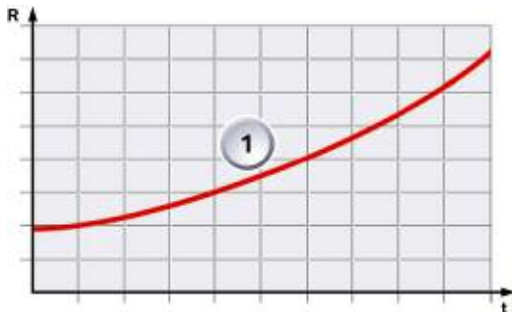
The washer fluid pumps for washing the Windshield and rear window are mounted on the washer fluid reservoir. These two pumps are driven directly by the junction box control unit.

### Pump for Headlight Washer

A high pressure pump is used for the headlight washer system. The pump is activated via a relay in the front power distribution box.

### Heated Water Jets

Two heated water jets are used for the Windshield washer. The water jets feature a PTC resistor that limits the current intake itself.



Characteristic of a PTC Resistor

Index	Explanation
1	Characteristic of a resistor
R	Resistance
t	Time

# Principles of Operation

The wiper/washer system is switched on and off with the wiper switch. The wiper switch is an integral part of the steering column switch cluster SZL.

## Wiper Switch

The following functions are switched on with the wiper switch:

- Intermittent wipe without the rain/driving lights/solar sensor
- Automatic wipe with rain/driving lights/solar sensor
- Continuous wipe, Stage 1
- Continuous wipe, Stage 2
- Flick wipe
- Wash Windshield
- Wipe rear window
- Wash rear window

The signals of the wipe switch are sent from the steering column switch cluster via the F-CAN to the dynamic stability control. The signal is then transferred from the dynamic stability control via the PT-CAN to the junction box control unit. The junction box control unit evaluates the signals and activates the wiper motor accordingly. The junction box control unit detects the rest position (park position) of the wiper by means of the reset contact in the wiper motor.

## Windshield Wipe Function

The following functions are available for wiping the Windshield:

- Intermittent wipe in stages
- Automatic intermittent wipe
- Continuous wipe, Stage 1
- Continuous wipe, Stage 2
- Flick wipe

### Intermittent Wipe

The interval can be set with the multi-stage switch. Four intermittent wipe stages are available. The time intervals depend on the set intermittent wipe stage and the vehicle speed. The junction box control unit calculates the time intervals and drives the wiper motor accordingly.



## Automatic Intermittent Wipe

The automatic wipe function is activated by pressing the axial button at "terminal R ON".

When active, the "automatic wipe" function is indicated by the LED on the wiper switch. A one-off wipe function (acknowledgement wipe) is additionally started. The acknowledgement wipe is also initiated when the wipe interval is increased by means of the wiper stage switch but not when the wipe interval is decreased.

The rain/driving lights/solar sensor makes available the wipe request corresponding to the rain intensity. The roof functions center evaluates the signal from the rain/driving lights/solar sensor within 20 ms, transfers the relevant signal values to the corresponding K-CAN telegram and send it cyclically (RLSS signal values unchanged) or event-controlled (RLSS signal values changed).

The junction box control unit evaluates the request K-CAN telegram (WIPER SPEED) and activates the wiper motor. In the automatic wipe function, the wipe speed depends on the information from the rain/driving lights/solar sensor, i.e. continuous wipe stage 1 or stage 2 may be initiated depending on the rain intensity.

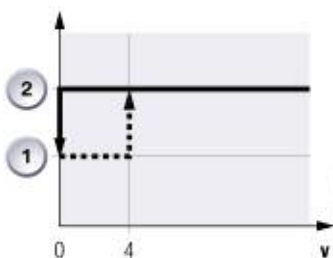
## Continuous Wipe, Stage 1

The wiper motor runs at normal speed when Stage 1 is switched on with the wiper switch. The wiper motor switches from continuous wipe in Stage 1 to intermittent wipe if the vehicle speed is reduced down to standstill.

The continuous wipe function in Stage 1 resumes as soon as the vehicle speed is higher than 4 km/h.

The reset (switch-back) of the wiper stage when the vehicle is stationary can be decoded.

In this case, the wiper blades operate in continuous wipe Stage 1 mode also when the vehicle is stationary.



Index	Explanation
1	Intermittent wipe
2	Continuous wipe, Stage 1
3	Vehicle speed km/h

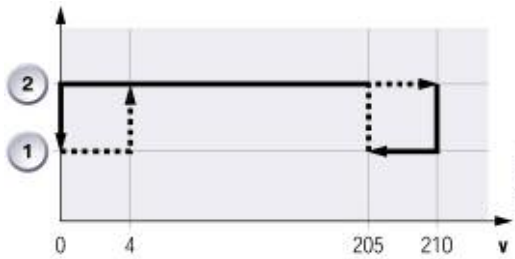
Decreasing Wiper Stage (continuous wipe stage 1)

### Continuous Wipe, Stage 2

The wiper blades are moved at double the speed in continuous wipe Stage 2. When the vehicle is stationary, continuous wipe Stage 2 automatically switched back to continuous wipe Stage 1. The wiper blades then move at normal speed. Stage 2 is resumed again at a speed in excess of 4 km/h.

The wipe function switches back to Stage 1 at a speed in excess of 210 km/h. Stage 2 is switched on again at a speed below 205 km/h.

The reset of the wiper stages when the vehicle is stationary can be decoded. In this case, continuous wipe Stage 2 is retained also when the vehicle is stationary.



Index	Explanation
1	Continuous wipe stage 1
2	Continuous wipe stage 2
3	Vehicle speed km/h

Decreasing Wiper Stage (continuous wipe stage 2)

### Single Wipe

By pressing down the wiper switch, the Single wipe function is triggered for as long as the switch is pressed. On releasing the wiper switch, the wiper movement is completed to the park position of the wiper blades.

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## Rear Window Wipe Function

The rear window wipe function is switched on with the wiper switch by pressing the stalk forward. The control of the rear window wiper is integrated in the junction box control unit.

The rear window wiper features the following functions:

- Intermittent wipe
- Continuous wipe

### Intermittent Wipe

The intermittent wipe function of the rear window wiper is started by pressing the wiper switch forward. The optical signal from the steering column switch is evaluated by the steering column switch cluster. The steering column switch cluster sends the signal on the F-CAN to the dynamic stability control.

From the dynamic stability control, the signal is made available on the PT-CAN. The junction box receives the signal and correspondingly activates the rear window wiper. The junction box control unit detects the rest position (park position) of the rear window wiper by means of the reset contact in the wiper motor.

### Continuous Wipe

The rear window wiper switches over to continuous wipe when reverse gear is engaged.

Operation of the rear window wiper is not stopped when the rear hatch is opened.

## Front and Rear Antiblocking Function

The Windshield wipers and the rear window wiper feature the antiblocking function which is integrated in the junction box control unit. If the signal is not sent from the reset contact while the wiper motor is running, this is interpreted as a blocking situation.

The junction box control unit evaluates the signal from the reset contact for the antiblocking function. The junction box control unit switches off the blocking motor. A further attempt can be made to switch on the wiper. If the wiper blocks again, it will no longer be operative for approximately 3 minutes. The wiper inhibit is cancelled by changing from "terminal R ON" to "terminal R OFF" and "terminal R ON". The wiper must then be switched on again.

## Wash Functions

The E70 has a wash function for the Windshield and the rear window. The function is operated via the wiper switch.

### Wash Windshield

On pulling the wiper switch, initially the washer fluid pump is switched on followed by the Windshield wiper. The washer fluid pump remains switched on for as long as the wiper switch is pulled.

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The signal is routed from the steering column switch cluster to the junction box control unit. The junction box control unit activates the washer fluid pump directly.

After the pump is switched off, the wipers continue to operate for several wipe cycles in order to wipe the Windshield dry. The wipe function set before the Windshield wash cycle is continued after the Windshield has been washed.

The junction box control unit will no longer drive the washer fluid pump if the fluid level in the washer fluid reservoir is too low. The junction box control unit receives the information necessary for this purpose from the washer fluid level sensor.

#### Washer Fluid Level Sensor

The junction box control unit monitors the washer fluid level sensor as from "terminal R ON". The washer fluid level sensor switches to ground.

The junction box control unit receives a low signal when the washer fluid reservoir is full. The switch opens when the fluid level in the washer fluid reservoir drops below a certain level. The low signal changes to a high signal. The junction box control unit consequently generates a message indicating the low level in the washer fluid reservoir.

#### Rear Window Wash Function

The rear window wash function is started by pressing the wiper switch forward. Initially, the washer fluid pump for the rear window is activated, followed by the rear window wiper switching on. The wipe function set before the start of the wash cycle and after the end of the wash function is continued again.

#### Terminal 50

The washer function is interrupted or not at all started while the vehicle is started.

If the Windshield washer function was interrupted, the started function is continued after the vehicle start procedure has been completed.

#### Headlight Washer System

The headlight washer system is switched on during the first wash cycle after "terminal R ON" and "lights ON". Activation is then suppressed for 7 minutes. The headlight washer system is activated if the Windshield washer system is operated 5 times within the 7 minutes.

In response to the request from the junction box control unit, the headlight washer system is switched on by means of a relay in the junction box.

The headlight washer system is no longer activated if the washer fluid level in the washer fluid reservoir is too low. The junction box control unit receives the corresponding signal from the washer fluid level sensor.

The headlight washer system is also not activated when blocking of the wipers is detected.

# Service Information

## Emergency Operating Functions

### SZL Failure

The wipers can no longer be operated in the event of the steering column switch cluster failing or a break in the bus connection. The junction box control unit switches to emergency operating mode and the Windshield wipers are switched on in Stage 1 setting.

### RLSS Failure

If there is a fault in the rain/driving lights/solar sensor or it fails completely, the junction box control unit takes over control of the wipe/wash system and assumes emergency operating mode. Emergency operating mode is an intermittent wipe function that is dependent on the vehicle speed.

## Replacing the RLSS

The following steps are necessary after replacing the sensor:

- Encode rain/driving lights/solar sensor
- Clear fault code memory
- Initialize rain/driving lights/solar sensor.