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E93 Retractable Hardtop

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Retractable Hardtop

Model: E93

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Explain the operation of the Retractable Hardtop on the E93
- Describe the distinguishing features of the Retractable Hardtop on the E93
- Identify the different components found on the E93 Retractable Hardtop
- Understand each component's function in the operation of the Retractable Hardtop

Introduction

Spring 2007 will see the market launch of the new BMW 3 Series E93 Convertible. It is the first to offer a retractable hardtop in lightweight steel construction. The three-part roof design with a fully automatic opening and closing mechanism allows the roof to be opened or closed in less than 25 seconds.

The retractable hardtop of the new BMW 3 Series Convertible provides good rear visibility, even when closed. The glass surface area of the rear window is significantly larger than that of the predecessor model. This makes driving maneuvers such as changing lanes, turning or parking considerably more pleasant.

Other advantages of the retractable hardtop are:

- Greater preservation of value
- Improved protection against damage and theft
- Optimized year-round suitability
- Sound insulation performance at high speeds (up to 270 km/h, 167mph) compared to that of a Coupe.

In addition, the folding height of the retractable hardtop (about 170cm/67in) is low enough to allow it to be opened and closed in garages.

The three steel roof section plates are engineered for optimum weight and rigidity. The trunk lid is also made of steel for rigidity reasons.

The movement sequence of the retractable hardtop is driven by a central hydraulic system with 8 hydraulic cylinders. The movement sequence is also supported by 6 gas pressure dampers. The hydraulic system is controlled via the Convertible Top Module (CTM) and is built into a recess in the luggage compartment floor.



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A central electric motor in the front roof panel locks the entire retractable hardtop system. It is locked at the cowl panel and the center roof panel by means of a linkage mechanism. The roof panels are interlocked using drive cables (similar to a sunroof drive) or flexible thrust cables.

The trunk lid is locked using the Soft Close Automatic (SCA) feature, which comes standard.

The retractable hardtop is opened and closed using the button in the middle of the center console. The retractable hardtop can also be opened using the remote control. The luggage compartment divider must be closed before the opening and closing process can be started.

The retractable hardtop can be stopped in any position during the opening/closing sequence. Pressing the operating button or remote control again continues the opening or closing process.

The retractable hardtop cannot be opened or closed while driving.

Weight:

- Roof module: about 98kg or 216lb (approx. 43kg or 95lb. more than soft top)
- Rear module: about 48 kg
- Complete scope of delivery with trunk lid attachments (lights, SCA etc.) approx. 147kg or 324lb

System Overview

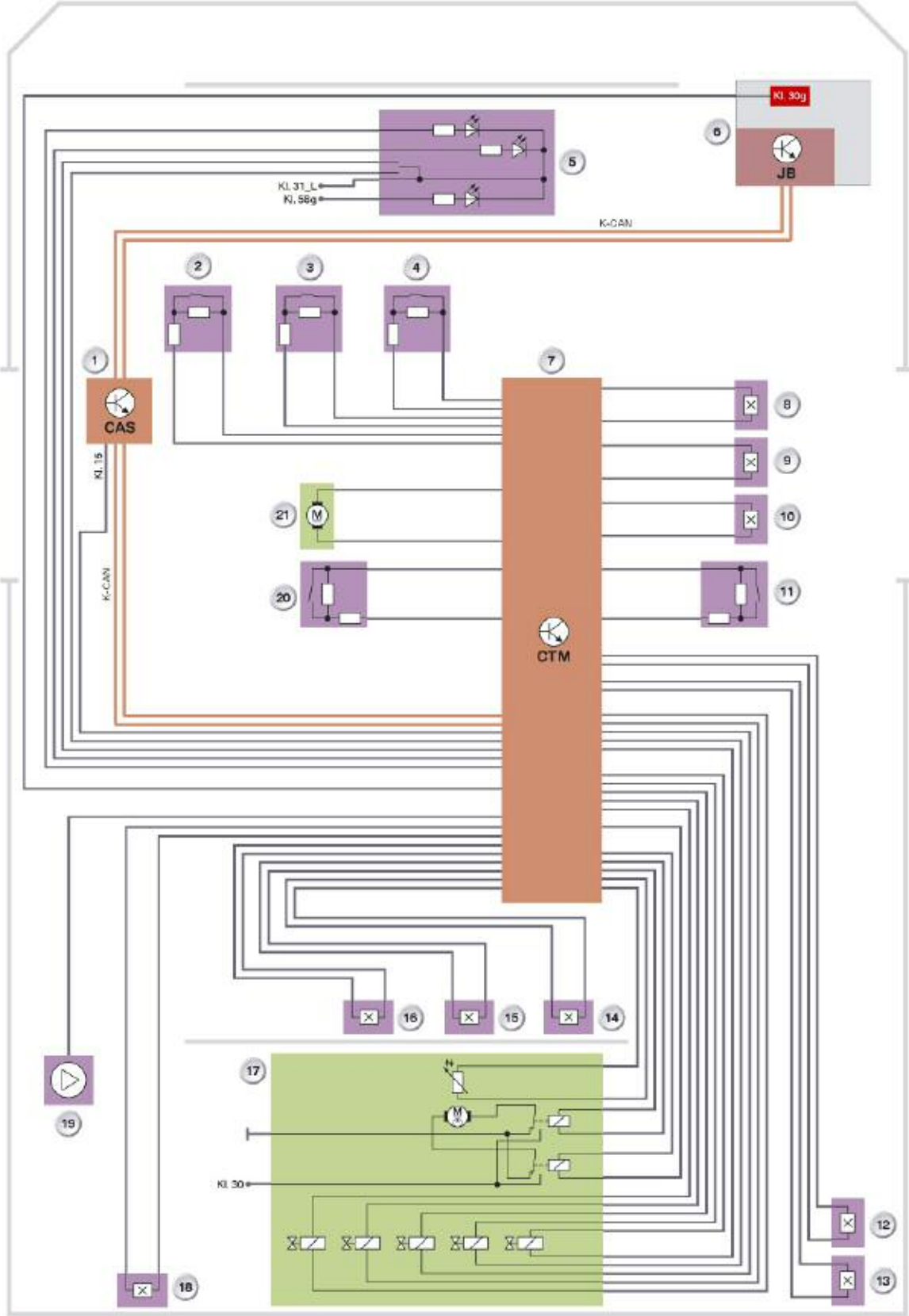
Conditions for Operation

The retractable hardtop can be opened and closed using the button in the center console only if the following conditions are met:

Important!!!

- Terminal R activated
- Outside temperature above -12°C (10°F)
- Trunk lid closed
- Vehicle not moving (driving speed 0 mph)
- Luggage compartment divider in lowest position
- Lateral inclination of the vehicle $< 8^{\circ}$
- Power windows initialized.
- Battery voltage $> 9.5\text{ V}$
- Fewer than five successive opening/closing operations
- Temperature of the hydraulic fluid
 - For opening: max. 90°C , 194°F
 - For closing: max. 105°C , 221°F

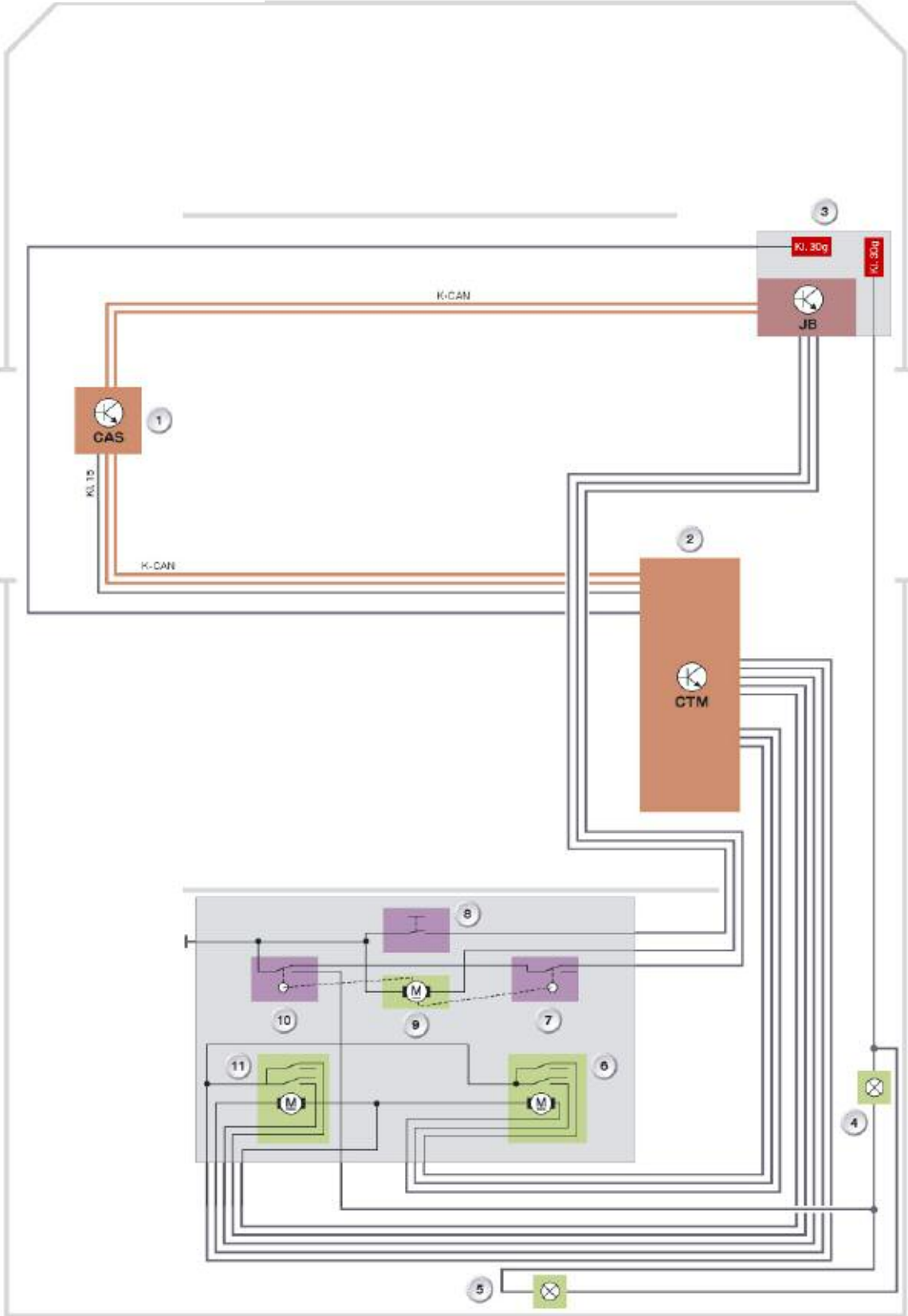
Convertible Top Module CTM



Convertible Top Module CTM Legend

index	Explanation	Index	Explanation
1	Car Access System (CAS)	12	"Rear module open" Hall sensor
2	"Cowl panel reached" microswitch	13	"Rear module almost closed" Hall sensor
3	"Catch hook locked" microswitch	14	"Roof package stowed" Hall sensor
4	"Catch hook unlocked" microswitch	15	"Rear module closed" Hall sensor
5	Operating button for retractable hardtop.	16	"Roof package extended" Hall sensor
6	Junction-box ECU	17	Hydraulic unit
7	Convertible top module (CTM)	18	"Luggage compartment divider" Hall sensor
8	"Open roof panels" Hall sensor	19	Diversity aerial
9	"Close roof panels" Hall sensor	20	"Left closure" microswitch
10	"Closure open" Hall sensor	21	Electric motor for fastener on cowl panel and interlocking of roof panels
11	"Right closure closed" microswitch		

Soft Close Automatic (SCA)



Soft Close Automatic (SCA) Legend

Index	Explanation	Index	Explanation
1	Car Access System (CAS)	7	Right Trunk lid lock
2	Convertible top module (CTM)	8	Rear hatch button
3	Junction box (JB)	9	"Trunk lid lock" electric motor
4	Trunk lid lamp	10	Left trunk lid lock
5	Luggage compartment light	11	Left Soft Close Automatic electric motor
6	Right Soft Close Automatic electric motor		

K-CAN Signals for the Convertible Top Module

In/out	Signal	Source	Function
In	Outside temperature	Instrument cluster	Hardtop cannot be operated at temperatures below -12 °C
In	Vehicle road speed	DSC wheel speed sensor	Hardtop cannot be operated at speeds > 0 km/h
In	Trunk lid position	Junction box	Hardtop cannot be operated with trunk lid open
In	Power window status	Footwell module	Hardtop cannot be operated if the power windows are not initialized
In	Vehicle tilt	DSC	Retractable hardtop cannot be operated if the vehicle tilt >8°.

Functions

Standard Operation



Index	Explanation
1	Green LED
2	Red LED
3	Button

The standard means of operating the retractable hardtop is by actuating the button in the center console. The movement of the hardtop is carried out as long as the button is actuated. The operating principle of the button is similar to that of the power windows.

- Pushing the button opens the hardtop; pulling the button closes it.
- The green LED in the button lights up while the hardtop is moving.
- If the button is released while the hardtop is moving, (the movement of the hardtop, the rear module or the side windows is immediately interrupted). The red LED then flashes in the button. The hardtop movement can be resumed by pressing the button again. The movement of the side windows can be resumed within 10 seconds.
- If one of the conditions is not met, the red LED is lit continuously.

Note: On early production E93 vehicles, the switch operation is different, Pushing the button closes the hardtop; pulling the button opens it.

Opening Sequence

When the button in the center console is pushed, the conditions for opening the hardtop are checked by the Convertible Top Module (CTM). After the check is successfully completed, the green LED on the switch goes on:

- The side windows are lowered.
- Then, the front roof panel is lowered and the roof sections are unlocked from each other.
- When the hydraulic system is activated, the lock fastener Mechanism "closure", (connecting the rear roof section and rear module to the body) is unlocked.
- The 3 roof sections are now positioned one on top of each other to form the "roof package"
- Then, the "rear module" is opened and the roof package is stowed in the trunk.
- The stowed roof module is then locked in place.
- The rear module is then closed and locked.
- Finally, the side windows move back up.



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Closing Sequence

The closing procedure of the hardtop is the reverse of the opening. When the button in the center console is pulled, the conditions for closing the hardtop are checked by the Convertible Top Module (CTM). After the check is successfully completed, the green LED lights up and:

- The side windows are lowered if necessary.
- The rear module is then unlocked and opened. Simultaneously, the roof package is unlocked.
- Once the rear module is opened all the way, it is held in this position while the roof package is extended.
- When the roof package has reached the end position, the rear module is closed, locked by the "closure", (to align all parts in closed position) then unlocked again.
- The roof sections are then moved apart until the front roof panel reaches the top of the cowl panel.
- The roof sections can now be interlocked as the front roof panel is locked to the cowl panel.
- Finally, the rear roof panel and rear module are locked to the body.
- The green LED in the button goes out.
- If the button remains pressed, the side windows are raised.

Convenience Functions

The retractable hardtop can also be operated using the remote control or using the mechanical key and door lock. For vehicles with the Comfort Access, the hardtop can be opened and closed using the ID sensor.



Convenience Opening Via Remote/ID Transmitter

The same pre-conditions apply for convenience opening of the hardtop using the remote control/ID Transmitter as for standard operation. The only difference is that terminal R does not need to be enabled and that the remote control/ID transmitter is within the reception range of the vehicle (4m or 13 ft)

The hardtop is opened by pressing and holding down the button on the remote control/ID Transmitter for unlocking the vehicle. If, during the opening process, a button of the second remote control/ID Transmitter is pressed, the opening process is immediately interrupted.



Convenience Closing Via Remote/ID Transmitter

Convenience closing of the hardtop via ID Transmitter is possible for vehicles with the Comfort Access.

The same pre-conditions apply for convenience closing of the hardtop using remote control/ID Transmitter as for standard operation.

The ID Transmitter must be within the reception range of the Comfort Access antenna (4m or 13ft). The hardtop is closed by pressing and holding down the button on the remote control/ID transmitter for locking the vehicle. If, during the closing operation, a button of the second remote control/ID Transmitter is pressed, the closing operation is immediately interrupted. If the ID Transmitter is in the slot, convenience closing is not possible.



Note: Convenience closing using the remote control is not possible on vehicles with out Comfort Access

Convenience Functions Via Door Lock

The hardtop can also be opened and closed using the mechanical key. During the opening or closing process, the vehicle user has all movements and hazardous situations in his or her field of vision. To do so, the mechanical key in the lock cylinder of the driver's door must be turned and held in the "unlock vehicle" or "lock vehicle" direction.

Mechanical key in the lock cylinder



Note: For vehicles with the Comfort Access, convenience closing via the outer door handle electronics is not possible

Convenience Loading/Unloading

The new convenience loading and unloading function allows quick access to the luggage compartment when the roof is open in order to load large items of luggage. The same pre-conditions apply for convenience loading and unloading as for operation via remote control/ID Transmitter.

The convenience loading and unloading function is activated as follows:

- Briefly press the trunk lid button.
- Then, press and hold down the trunk lid button (no more than one second may pass between when the trunk lid button is released and when it is pressed again)



Retractable hardtop and trunk lid in position for convenience loading



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-
- First, the rear module is unlocked and opened all the way.
 - Then, the roof pack is lifted from the luggage compartment to the intermediate position.
 - Next, the rear module is closed and locked.
 - Finally, the trunk lid is unlocked using the Soft Close Automatic feature and opened slightly.
 - The luggage compartment divider can be pivoted upward manually. This enlarges the access to the luggage compartment so that it can be loaded conveniently without the need to close the hardtop all the way.
 - After the luggage compartment is loaded, the hardtop can be opened using the remote control or opened or closed using the ID Transmitter (for vehicles with Comfort Access).

Note: "Open roof" , "Close roof" and "Convenience loading" via remote control/ID Transmitter are only possible with Comfort Access Option.

Soft Close Automatic (SCA)

For convenient closing of the trunk lid, the Soft Close Automatic is installed as standard. It consists of two Soft Close Automatic drives that lock the trunk lid to the rear module carrier on the left and right. This increases the stability of the trunk area.

Opening the Trunk Lid

When the trunk lid is opened using the trunk lid button, a microswitch is actuated and its status is read by the junction box JB. The JB sends a message to the CAS via K-CAN. After the check is successfully completed, the CAS sends the release and the JB triggers the drive for unlocking the trunk lid. The drive actuates the release catch; the left and right trunk lid locks are unlocked via the control cables.

The JB transmits the status of the trunk lid (unlocked) on K-CAN, and the CTM receives it. The CTM then triggers the start-up of the SCA drives, which then move to standby position and are available for a closing operation or to support a closing operation.

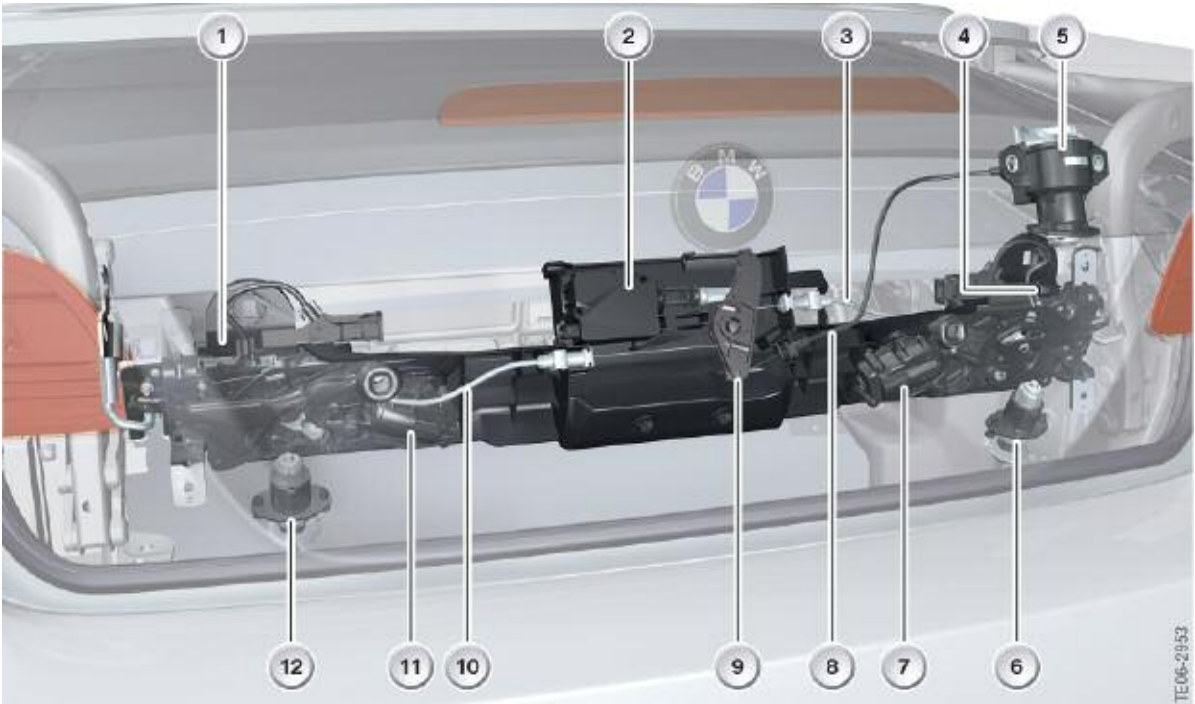
Closing the Trunk Lid

When the trunk lid is closed, the SCA drives are in standby position. When the left and right trunk lid locks have reached the locking clips, two microswitches are actuated and their status is read in by the CTM. The CTM then triggers both SCA drives (one on each SCA drive) until two other microswitches signal the "trunk lid locked" status to the CTM.

Manually closing the trunk lid would make closing via the Soft Close Automatic drive unnecessary. However, because it must be ensured that the trunk lid is really closed, the Soft Close Automatic drive is actuated nonetheless. The end position of the SCA drives in the "Unlocked" status is signalled to the CTM by two additional microswitches.

Non-repeat Lock

Each Soft Close Automatic drive has a non repeat lock to prevent overheating of the Soft Close Automatic drive. It allows up to 20 actuations of the Soft Close Automatic drive. Afterwards, the Soft Close Automatic drive is electrically disabled for approx. 2 minutes.



Index	Explanation	Index	Explanation
1	"Left trunk lid lock" microswitch	7	"Right Soft Close Automatic" drive
2	Drive for central locking of the trunk lid	8	Control cable for mechanical unlocking of the trunk lid
3	Control cable for unlocking the right trunk lid lock	9	Release lever
4	"Right trunk lid lock" microswitch	10	Control cable for unlocking the left trunk lid lock
5	Locking cylinder of the trunk lid	11	"Left Soft Close Automatic" drive
6	Right stop buffer	12	Left stop buffer

System Components

Mechanical Components

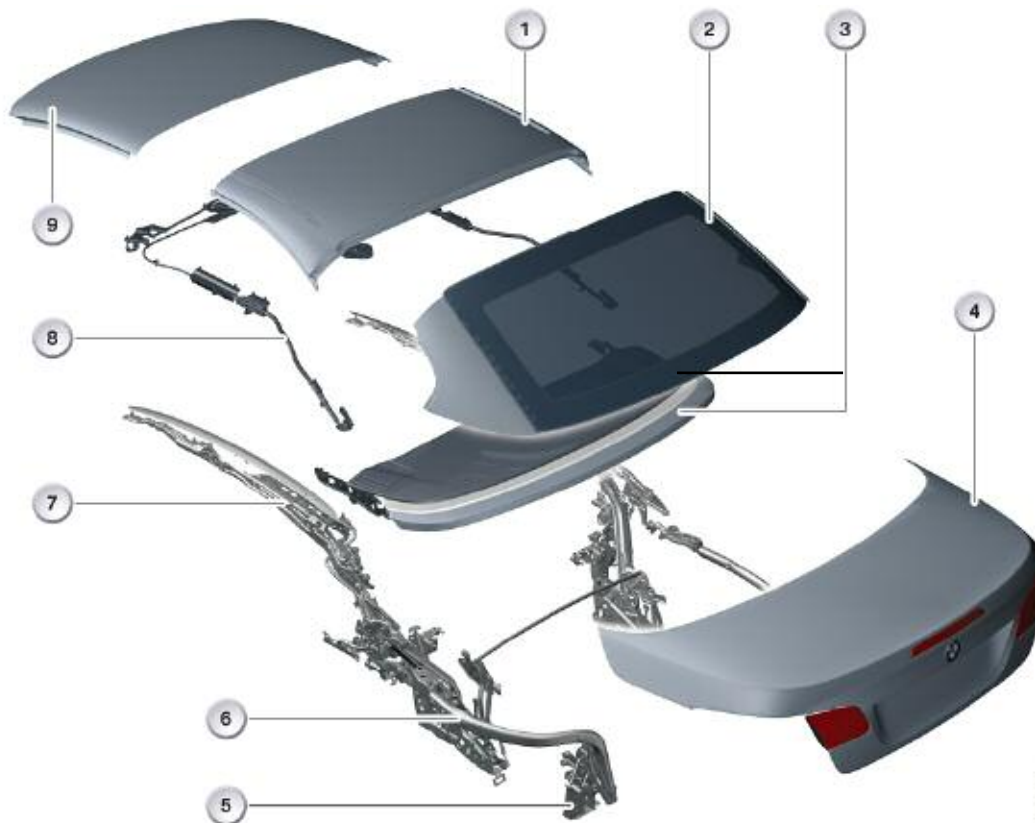
The retractable hardtop is a roof system in steel construction.

This system withstands speeds up to 270 km/h (167mph) and has a sophisticated water management system for draining remaining water when the roof is extended or retracted.

AM/FM antennas are integrated into the bonded rear window.

The retractable hardtop is designed as a three-part roof system. The hardtop roof panels are made of steel in a classic sandwich construction and are engineered for optimum weight and rigidity.

A central hydraulic system located in the luggage compartment floor operates the kinematic movement of 8 hydraulic cylinders in the overall system.



Index	Explanation	Index	Explanation
1	Center roof panel	6	Rear module linkage
2	Rear roof panel	7	Roof module linkage
3	Hardtop lid	8	Locking mechanism
4	Trunk lid	9	Front roof panel
5	Rear module mount		

- Fully automatic opening and closing is possible using the button in the center console or the mechanical door lock.
- The roof can also be operated (but only opened) using the remote control.
- For vehicles with the Comfort Access option, the retractable hardtop can be both opened and closed using the ID Transmitter.
- The hardtop can be operated only if the vehicle is not moving and the outside temperature is above -12°C (10°F).
- The opening/closing operation is completed in about 23 seconds.

Mechanism of the E93 retractable hardtop



Index	Explanation	Index	Explanation
1	Roof mechanism	4	Roof module main mount
2	Rear mechanism carrier bar	5	"Closure" locks the roof module, rear module and body together.
3	Rear module main mount		

Roof Module

The roof module consists of 3 roof sections, linkage, main mount and the hydraulics.

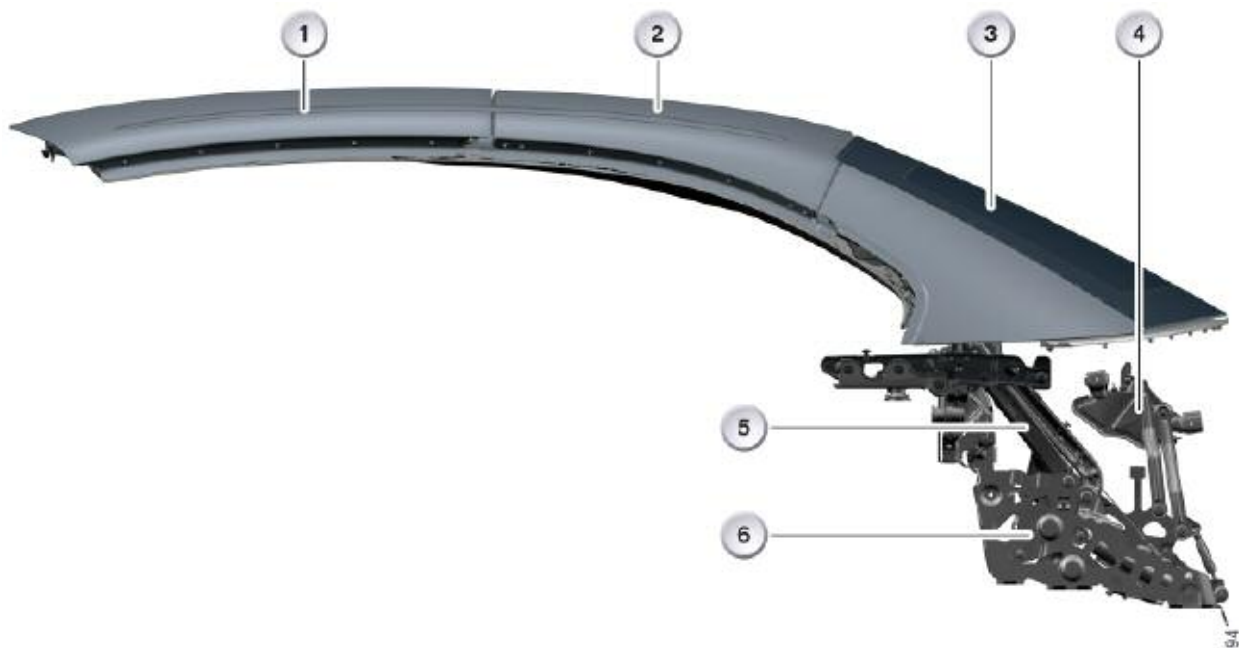
The movement sequence of the retractable hardtop is driven by a central hydraulic system with hydraulic 8-cylinder activation, with an additional 2 gas pressure dampers in the main mount.

A total of 8 hydraulic cylinders and 6 gas pressure dampers are used in the retractable hardtop. The hydraulic system is controlled via the Convertible Top Module (CTM) and is built into a multifunctional tray in the luggage compartment floor.

A central electric motor in the front roof section serves to lock the entire retractable hardtop system. The roof sections are interlocked using drive cable tubes, similar to a sunroof drive.

The roof module weighs about 98kg (216lb) (about 94lb more than a soft top)

E93 Roof Module

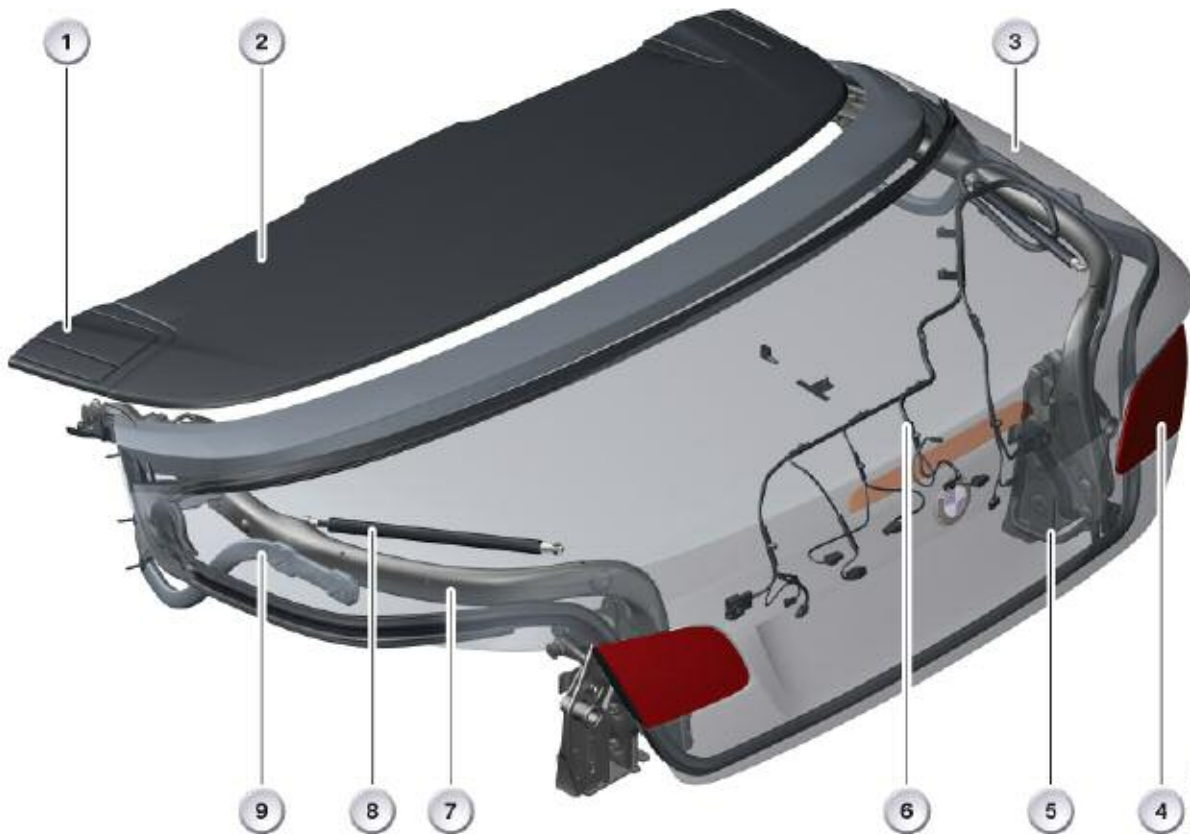


Index	Explanation	Index	Explanation
1	Front roof panel	4	Holder for luggage compartment divider
2	Center roof panel	5	Linkage
3	Rear roof panel	6	Main mount

Rear Module

The trunk lid and hardtop lid are integrated into the rear module. The rear module is fastened to the body using a supporting bar structure with main mount.

The rear module weighs about 48 kg. (106lb). The trunk lid is equipped with Soft Close Automatic.



Index	Explanation	Index	Explanation
1	Opening hinges for linkage (main pillars)	6	Wiring harness
2	Hardtop lid	7	Rear module linkage
3	Trunk lid	8	Trunk lid damper
4	Tail lights	9	Trunk lid linkage
5	Rear module main mount		

Water Management

The water flows from the roof channel into a water drain through a duct system with valve on the main guide bar.

When the retractable hardtop is stowed while wet, any remaining water droplets are collected in the side storage trays and the channel in the trunk sill panel, where they can evaporate. This provides items of luggage with maximum protection from remaining water.



Index	Explanation	Index	Explanation
1	Left storage tray	3	Right stowage tray
2	trunk sill panel channel		

Water Drains



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Index	Explanation	Index	Explanation
1	Water hose	3	Water drain
2	Water valve		

Electrical Components

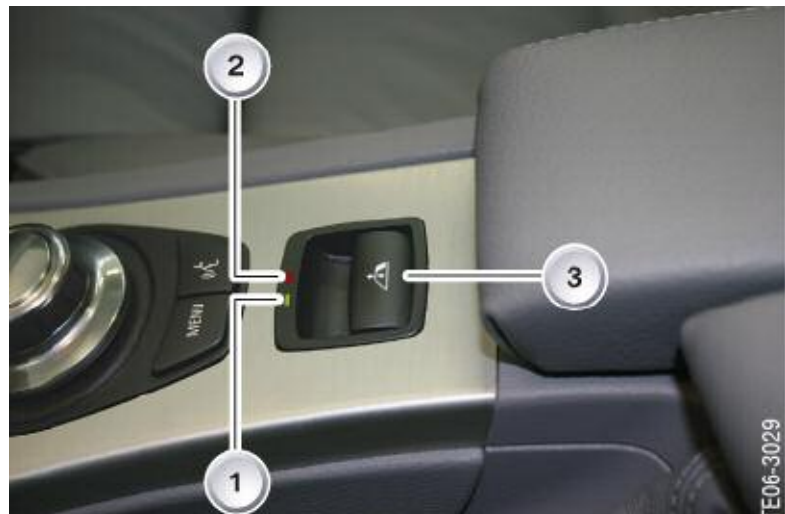
Button

The button is installed in the center console between the controller and armrest. It is secured by four screws in the console decor panel.

- The retractable hardtop and side windows are opened by pushing the button and holding it in that position.
- The retractable hardtop and side windows are closed by pulling the button and holding it down.

Note: On early production E93 vehicles, the switch operation is different, Pushing the button closes the hardtop; pulling the button opens it.

Index	Explanation
1	Green LED
2	Red LED
3	Button



If the button is released while the hardtop is moving, then the movement of the retractable hardtop, the rear module or the side windows is immediately interrupted. The hardtop movement can be resumed by actuating the switch again. It has two contacts that are switched to ground and that are closed alternatively. The function display on the button has two LEDs (red and green).

- The green LED in the button lights up during the opening/closing operation.
- The blinking red LED indicates that a system operation has been interrupted in mid movement, as the movement resumes the green LED lights up again until the operation is complete.
- The solid red LED signals incorrect operation or hazardous situations by one or more of the preconditions for operation have not been met. For example, the hardtop cannot be opened if the luggage compartment divider is not in the lower position or ambient temperature is below 10°F. In this case, the red LED is lit continuously. The CTM detects the status of the button.

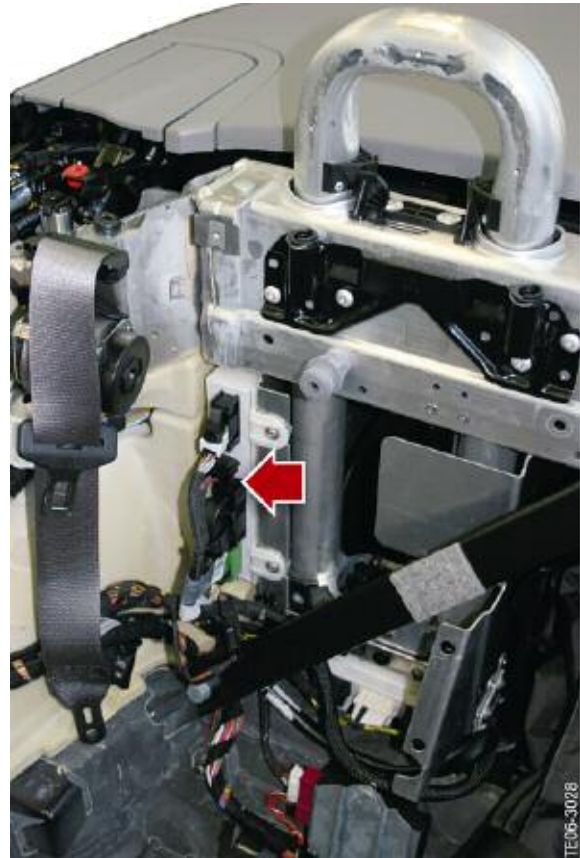
Convertible Top Module (CTM)

The (CTM) is the central electronic control module for all functions of the retractable hardtop. The location of the CTM is to the right of the compartment divider. The CTM controls the retractable hardtop, the rear module and the Soft Close Automatic feature.

Power is supplied to the CTM by the junction box with terminal 30g.

There is an additional power supply to the CTM via terminal 15 of the Car Access System (CAS) so that in certain cases of malfunction, such as an interrupted supply from the junction box, adequate diagnostics and communication with the diagnostic tester are possible.

The CTM controls the electric motor for the interlocking of the roof panels and of the front roof panel to the cowl panel. In addition, it controls the hydraulic pump and the 8 hydraulic cylinders via 5 valves in the hydraulic unit.



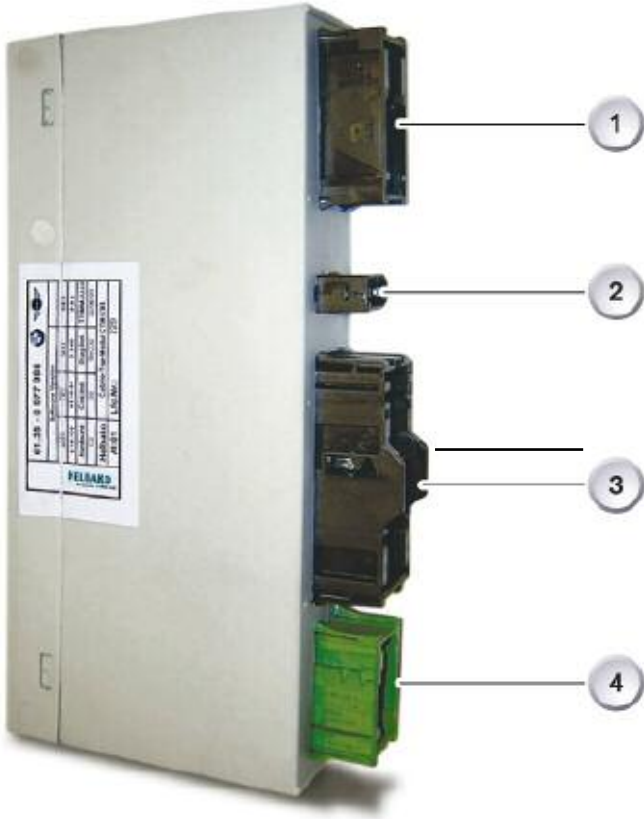
During the hardtop and rear module movements, the respective position is detected by 9 Hall sensors and 5 microswitches in the cowl panel, hardtop and rear module and forwarded to the CTM via the respective wiring harness. Each of them signals whether a certain status has been reached and whether the CTM can initiate the next phase. The current supply of the microswitches/Hall sensors is provided by the CTM. The CTM also reads in the status of the button.

The CTM is connected to other control modules via the K-CAN. For example, information about the outside temperature, driving speed and status of the trunk lid is received via K-CAN. When the hardtop is opened or closed, the CTM sends the request to lower the side windows to the FRM.

In certain critical situations, the CTM triggers introductions that are easily understandable to the customer in the instrument cluster as check control messages and text messages in the CID. A list of check control messages is provided in the "Service information" section of this Product Information.

Depending on whether the roof is closed or open, the CTM transmits a signal to the antenna diversity module for it to select best antenna to maintain proper reception.

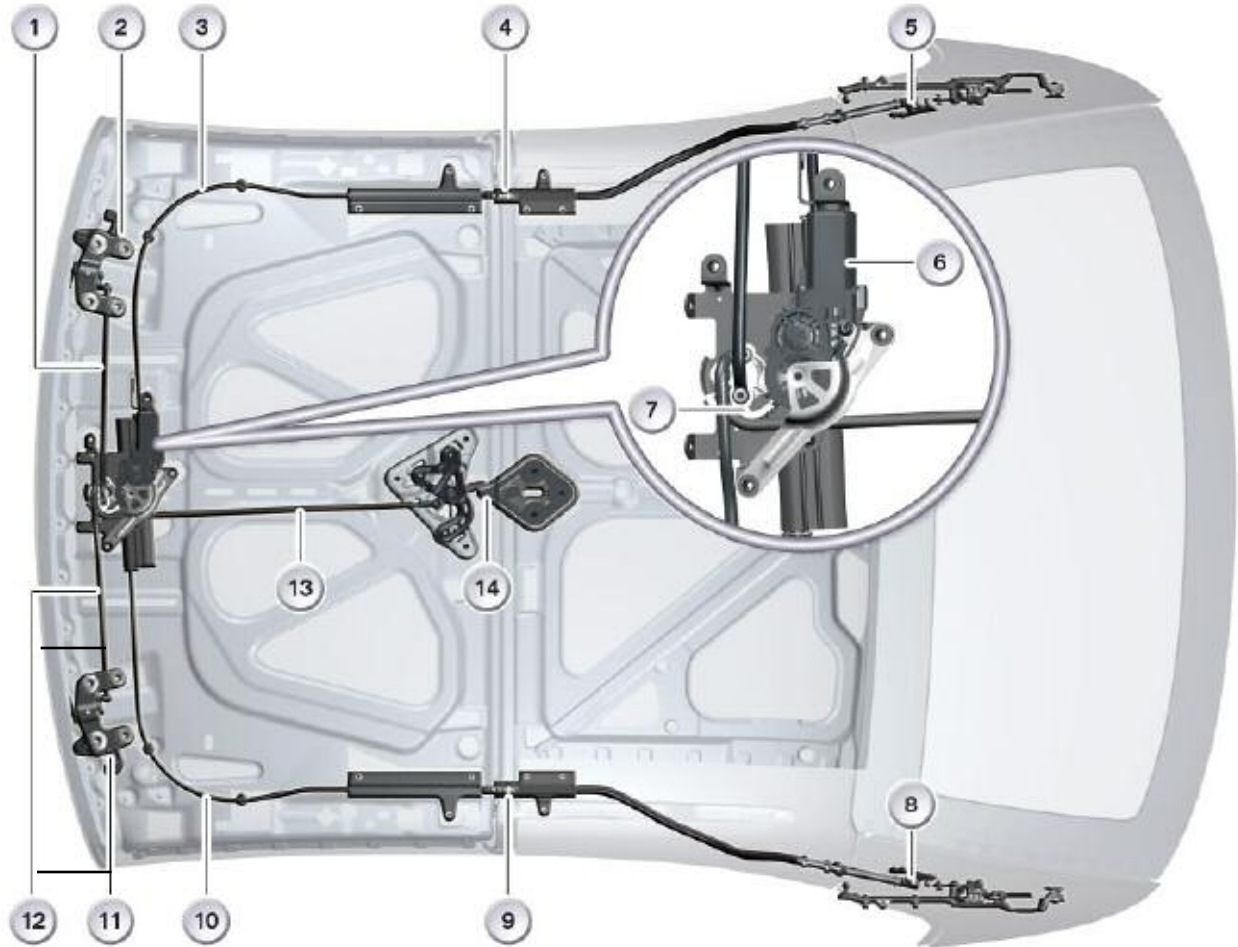
CTM Control Module



Index	Explanation
1	26-pin connector for Hall sensors and microswitches; 18-pin connector for hydraulic control module
2	2-pin connector for electric motor
3	41-pin connector for power supply, SCA, button, Hall sensors, microswitches and KCAN
4	18-pin connector for hydraulic control module

Hardtop Locking Mechanism

The roof sections of the hardtop are interlocked. In addition, the front roof panel is locked at the cowl panel via two catch hooks. The electric motor installed in the center of the front roof section serves as the drive. The electric motor is activated directly by the CTM.



Index	Explanation	Index	Explanation
1	Connecting rod for right catch hook	8	Locking bolt (pin) for center roof panel to rear left roof panel
2	Right catch hook	9	Locking bolt (pin) for front center roof panel to center left roof panel
3	Right drive cable	10	Left drive cable
4	Locking bolt (pin) for front center roof panel to center right roof panel	11	Left catch hook
5	Locking bolt (pin) for center roof panel to rear right roof panel	12	Connecting rod for left catch hook
6	Electric motor	13	Connecting rod for locking hook
7	Control disk	14	Locking hook

Roof Sections Locking Sequence

When the front roof panel has reached the cowl panel, the electric motor is activated. The left and right drive cables are driven via the gear on the electric motor (in a manner similar to the sliding/tilt sunroof). The ends of the drive cables have locking bolts (pins) that are pushed from the front roof panel into the center roof panel and thus lock these roof sections together. Simultaneously these locking bolts press against springloaded elements in the center roof panel then act on flexible rods, that push a second set of locking bolts (pins) to secure roof panels 2 and 3.

While the drive cables are operated, the connecting rods are simultaneously activated via the control disk. The force is transmitted from the gear wheel of the electric motor to the connecting rods via the splines on the control disk. The left and right connecting rods separate, and the front roof panel is locked to the cowl panel via the catch hooks. The locking hook, which locks the front roof panel to the center roof panel, is also driven via the center connecting rod.

The roof panels are unlocked by reversing this operation. The end positions of the electric motor are detected by two microswitches and forwarded to the CTM.

Locking of the Roof Package

To prevent damage to the roof package when stowed, such as when driving over pot-holes, etc., the front roof section is locked in the luggage compartment. Locking the front roof panel secures the entire roof package in place, which also prevents noises (such as squeaks, groaning or rattles).

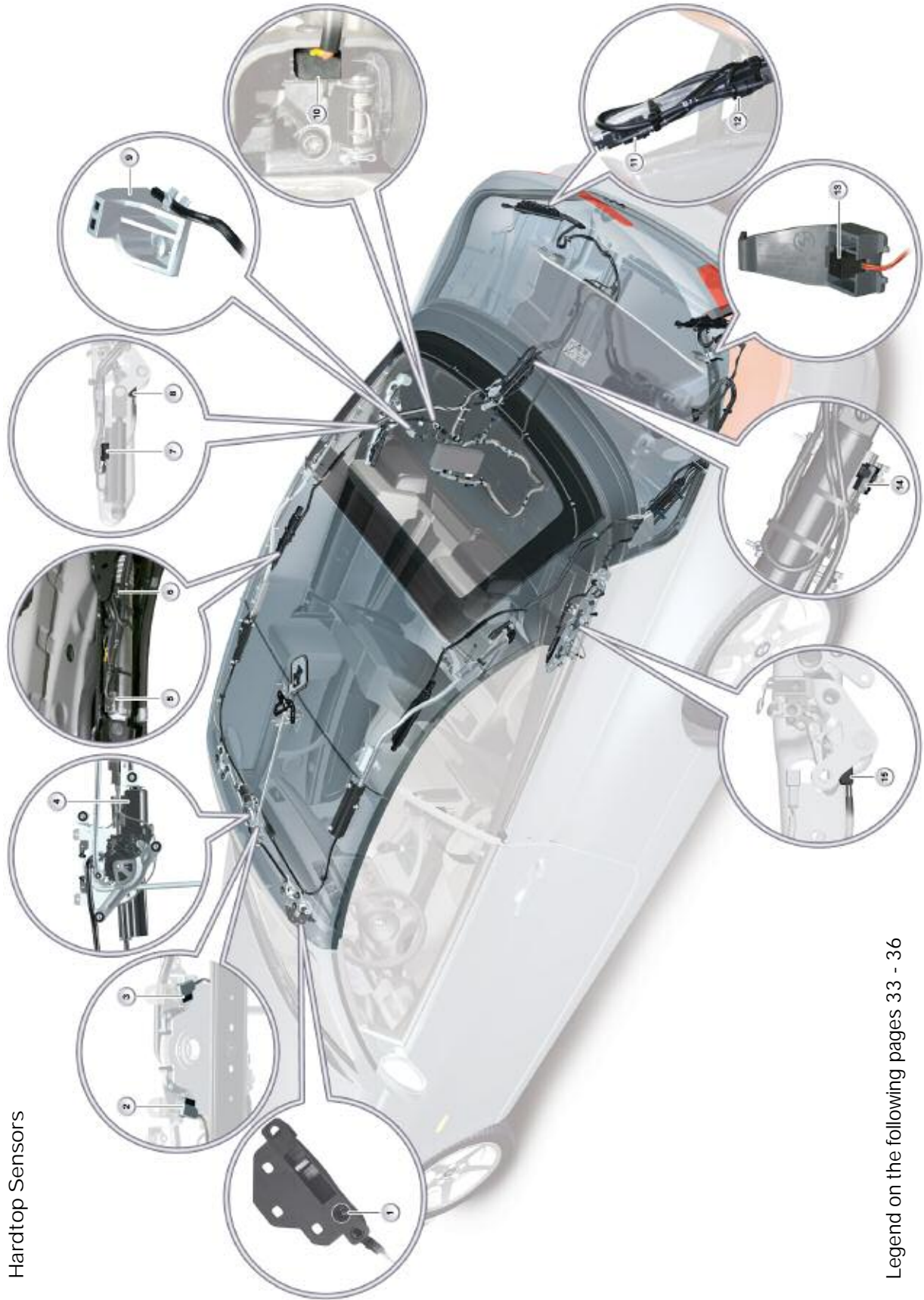
When the roof sections have been stowed in the luggage compartment, the electric motor is activated. The catch hooks are locked to the base plates via the catch hooks. In addition, the locking bolts (driven by the drive cables) move into the guides. Thus the front roof panel is securely locked in the luggage compartment.

Locking of the roof panels in the rear



Index	Explanation	Index	Explanation
1	Left catch hook	4	Right locking bolt(pin)
2	Right catch hook	5	Left locking bolt(pin)
3	Electric motor		

Overview of E93 Retractable
Hardtop Sensors



Legend on the following pages 33 - 36

Microswitches and Hall Sensors

The various positions of the retractable hardtop and the rear module are detected via 9 Hall sensors and 5 microswitches and sent to the CTM. All Hall sensors and microswitches are supplied with voltage by the CTM and are capable of diagnostics.

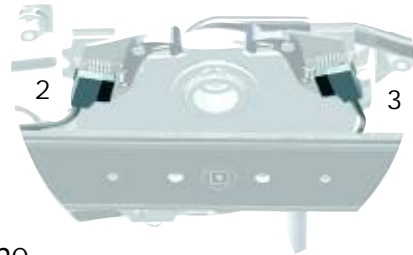
"Cowl panel reached" Microswitch (1)

- This microswitch is built into the left cowl panel on the vehicle. The CTM evaluates the signal of the microswitch. When the guide pin of the front roof panel has reached the cowl panel, the microswitch is closed. Beginning at this position, the electric motor is activated and the roof sections are locked.



"Catch hooks locked" Microswitch (2)

- This microswitch is installed on the left below the electric motor for hardtop locking mechanism. The contacts of the microswitch are opened if the catch hooks are locked all the way. The CTM reads in the status of the microswitch. The catch hooks can be locked both at the cowl panel and at the base plate in the luggage compartment. When the hardtop is closed all the way, the contacts of the microswitch are open. The CTM receives a "High" signal. When the hardtop is opened, the catch hooks are unlocked and the contacts of the microswitch are closed. After the roof package is stowed in the luggage compartment, the catch hooks at the base plate are locked and the contacts of the microswitch are opened.



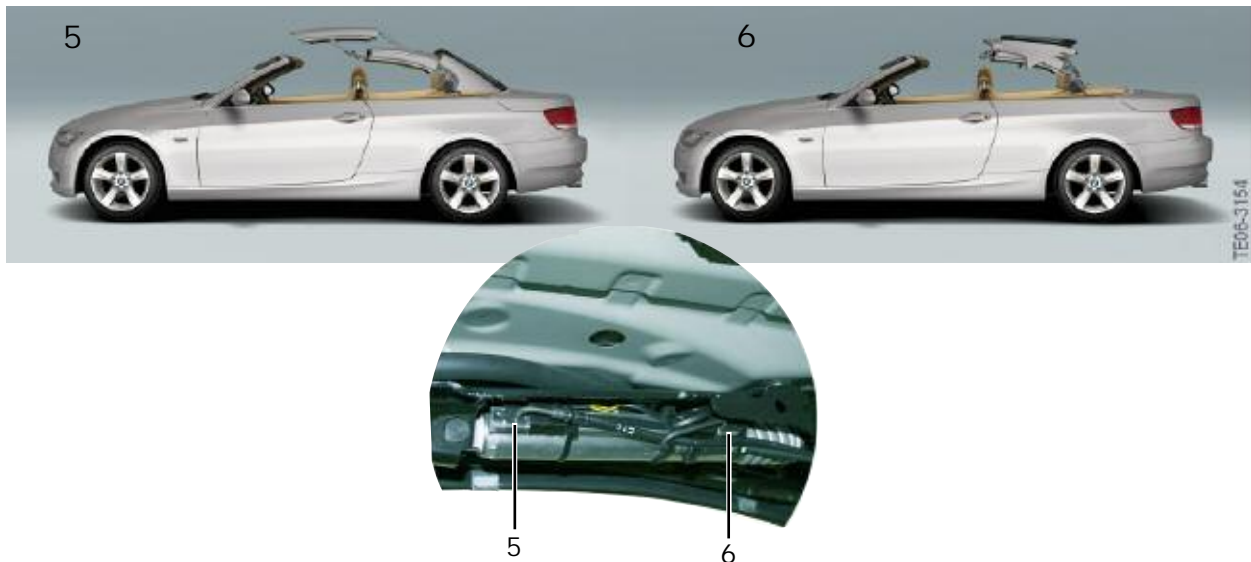
"Catch hooks unlocked" Microswitch (3)

- This microswitch is installed on the right below the electric motor for hardtop locking. The contacts of this microswitch are opened if the catch hooks at the cowl panel are locked all the way. The status of the microswitch is read in by the CTM. When a High signal is received by the CTM, the opening of the catch hooks of the hardtop is complete. Furthermore, the locking of the front roof panel to the center roof section and the interlocking of all three roof sections are separated. If the roof panels are subsequently lifted above each other and are stowed in the luggage compartment, the contacts of the microswitch remain open. Only when the catch hooks begin to lock are the contacts of the microswitch closed again.

"Roof panels partially open/partially closed" Hall Sensor (5-6)

Two Hall sensors are installed on the right roof panel cylinder and detect the movement of the piston in the roof panel cylinder. If the piston is extended, a signal is sent from the "Roof panels partially open" Hall sensor to the CTM. In this position, the roof sections are positioned completely above each other and can now be stowed in the luggage compartment. The "Roof panels partially closed" Hall sensor sends a signal to the CTM when the piston in the roof panel cylinder is almost completely retracted. From this position, the hardtop closes more slowly until it reaches the cowl panel (indirect pressure-sensitive finger guard system).

Left: Roof panels partially closed, right: Roof panels partially opened



"Right closure open" Hall Sensor (7)

This Hall sensor is located on the right closure cylinder. It transmits a signal to the CTM when the piston of the closure cylinder is fully extended. In this position, the lock of the rear module and the rear roof panel to the body is disengaged.



"Left/right closure closed" Microswitch (8 and 15)

One microswitch is on both the left and right closure cylinder. These microswitches transmit a signal to the CTM when the closure is locked.



"Rear module closed" Hall Sensor (9)

This Hall sensor is installed on the right of the divider module. It transmits a signal to the CTM when the rear module has reached the bottom position. The rear module has a bow that changes the voltage in the Hall sensor when it reaches the end position.



"Roof package stowed" Hall Sensor (10)

This Hall sensor is installed on the right base plate in the luggage compartment. It transmits a signal to the CTM when the guide pin of the front roof panel has reached the guide in the base plate. Beginning at this position, the drive for the hardtop lock can be activated and the rear module can be closed.



"Rear module opened/rear module almost closed" Hall Sensor (11-12)

Two Hall sensors are installed on the right rear module cylinder and detect the movement of the piston in the rear module cylinder. If the piston is extended, a signal is sent from the top "Rear module open" Hall sensor to the CTM. In this position, the rear module is completely open and the roof panel package can be stowed in or lifted out of the luggage compartment. The lower "Rear module almost closed" Hall sensor sends a signal to the CTM when the piston in the rear module cylinder is almost completely extended. From this position, the rear module closes more slowly until it reaches the end position.

Left: Rear module opened, right: Rear module almost closed



"Luggage compartment divider" Hall Sensor (13)

The Hall sensor for the luggage compartment divider signals that the luggage compartment divider is in the bottom position and thus that an important function condition is met. If this signal is missing, the hardtop cannot be actuated.

The Hall sensor is installed on the left rear module mount on the vehicle.

Index	Explanation
1	Luggage compartment divider
2	Installation location of the Hall sensor for the luggage compartment divider



"Roof package extended" Hall sensor (14)

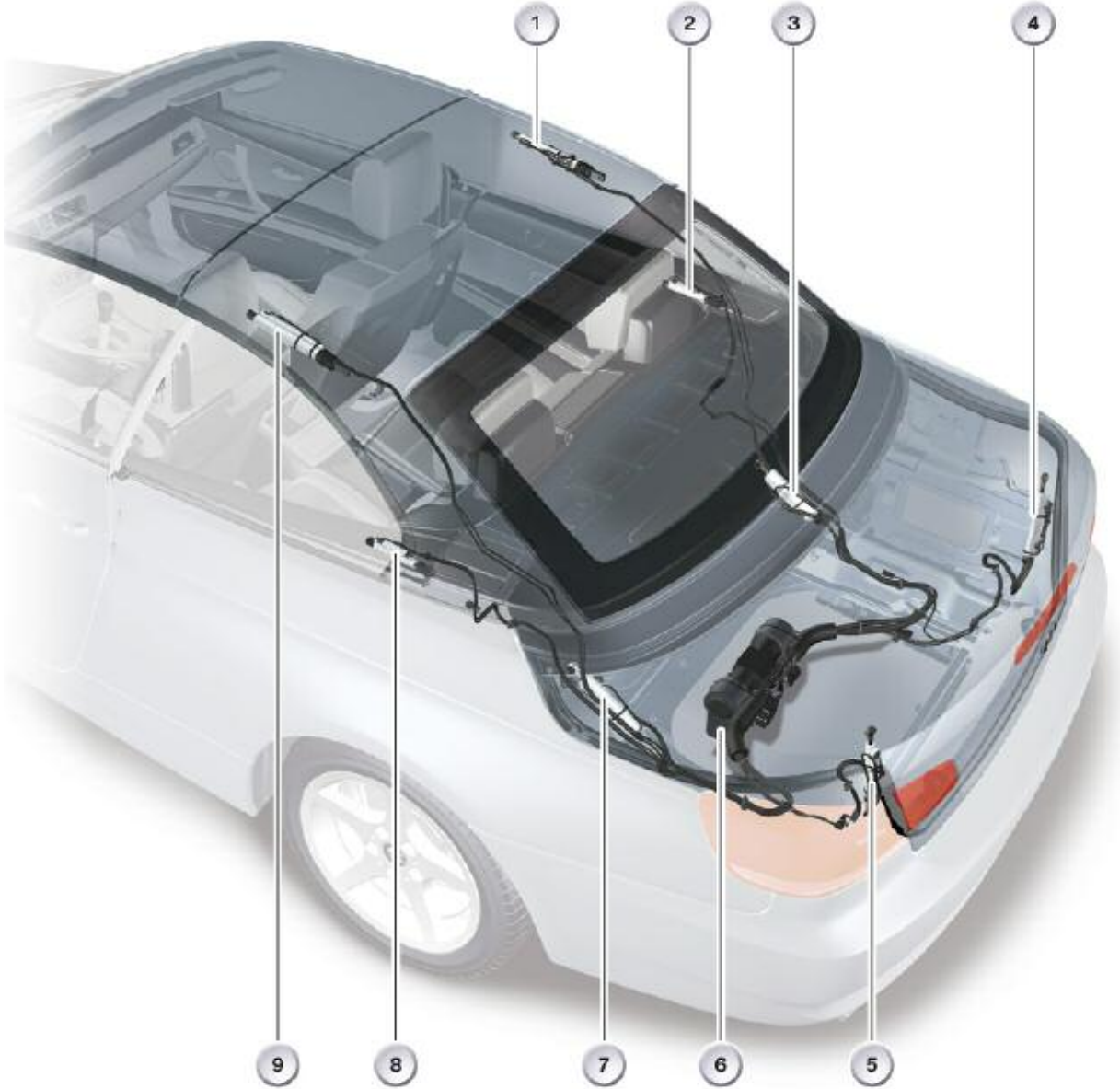
A Hall sensor is installed on the right rear pillar cylinder that sends a signal to the CTM when the piston in the rear pillar cylinder is extended. When the rear pillar cylinders are retracted, the roof panels are lifted.

Roof package extended



Hydraulic Components

Overview of the Hydraulic Components



Index	Explanation	Index	Explanation
1	Right roof panel cylinder	6	Hydraulic assembly
2	Right closure cylinder	7	Left main pillar cylinder
3	Right main pillar cylinder	8	Left closure cylinder
4	Right rear module cylinder	9	Left roof panel cylinder
5	Left rear module cylinder		

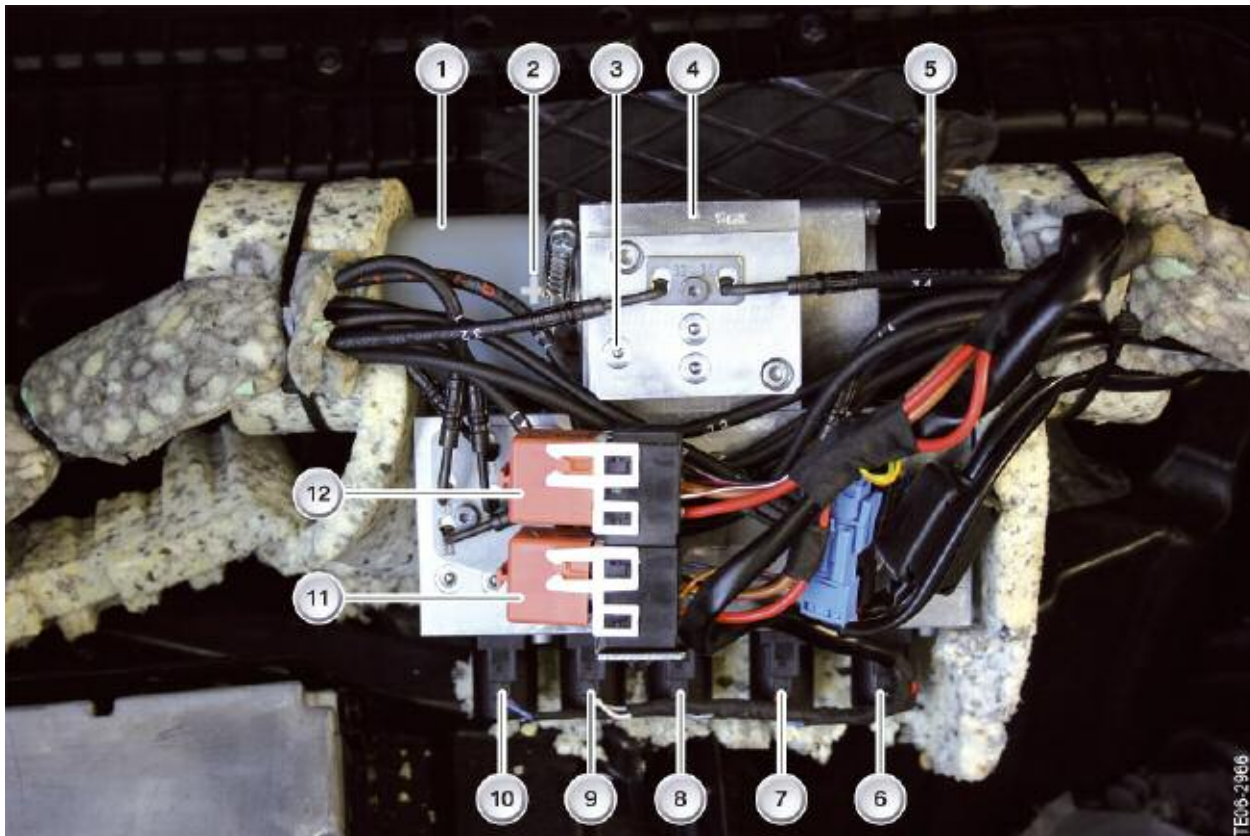
Hydraulic Overview

The retractable hardtop and the rear module are driven hydraulically. The hydraulic system consists of 8 hydraulic cylinders that are supplied with pressure by the hydraulic system via the hydraulic lines. The cylinders are always activated in pairs. The hydraulic assembly is installed in a recess in the luggage compartment floor. Four cylinders are required for the movement of the hardtop:

- Two roof panel cylinders and two rear pillar cylinders.
- The rear module is opened and closed by two rear module cylinders.
- Two closures are responsible for locking/unlocking the rear roof panel and the rear module.

Hydraulic Unit

Hydraulic Assembly in the Luggage Compartment Cavity



(See table on next page.)

Hydraulic Assembly Legend

Index	Explanation	Index	Explanation
1	Reservoir for hydraulic fluid	7	Valve 3
2	Fill level mark	8	Valve 5
3	Bleed screw for emergency actuation	9	Valve 4
4	Hydraulic pump	10	Valve 2
5	Pump motor	11	Relay for anticlockwise operation
6	Valve 1	12	Relay for clockwise operation

The movement direction of the hardtop and rear module are determined by corresponding valve positions and by reversing the direction of rotation of the pump. The hydraulic pump in the hydraulic unit is driven by an electric motor that operates in two directions of rotation. Both rotation directions are implemented with a relay switch.

The pump motor and the five hydraulic valves are activated by the CTM. The power consumption of the electric motor is about 40A (safeguarded by a 50A fuse). The hydraulic pump generates an operating pressure of 150 to 200bar.

To prevent the pump motor from overheating if the hardtop is operated frequently, the temperature of the pump motor is measured using an NTC resistor. The NTC resistor is connected to the CTM via two wires with a floating ground. An open circuit causes an entry in the fault code memory, but does not prevent the hardtop from moving. Two temperature values are particularly important. The lower of these is around 90°C (194°F) and serves as an "early warning". If this temperature is exceeded, any hardtop movement that has already begun is continued until it has safely come to an end. If the temperature reaches 105°C (221°F), the hardtop movement is stopped immediately. It cannot be resumed until the temperature falls back below 90°C.

- If the hardtop movement is interrupted, the hardtop remains in the hold position. The pressure in the hydraulic system is maintained at all times and is not shut off.
- In case of an emergency actuation of the hardtop, the bleed screw on the hydraulic pump must be released.
- The hydraulic fluid does not need to be changed (lifetime).
- If the hydraulic fluid needs to be refilled due to leaks ensure that the approved hydraulic fluid is used. Add hydraulic fluid only up to the mark on the reservoir.
- If a lot of noise is heard while the hardtop is actuated, the hardtop must be opened and closed a few times in succession to allow the system to bleed.
- The hydraulic system is automatically bled in the reservoir.

Closure Cylinders

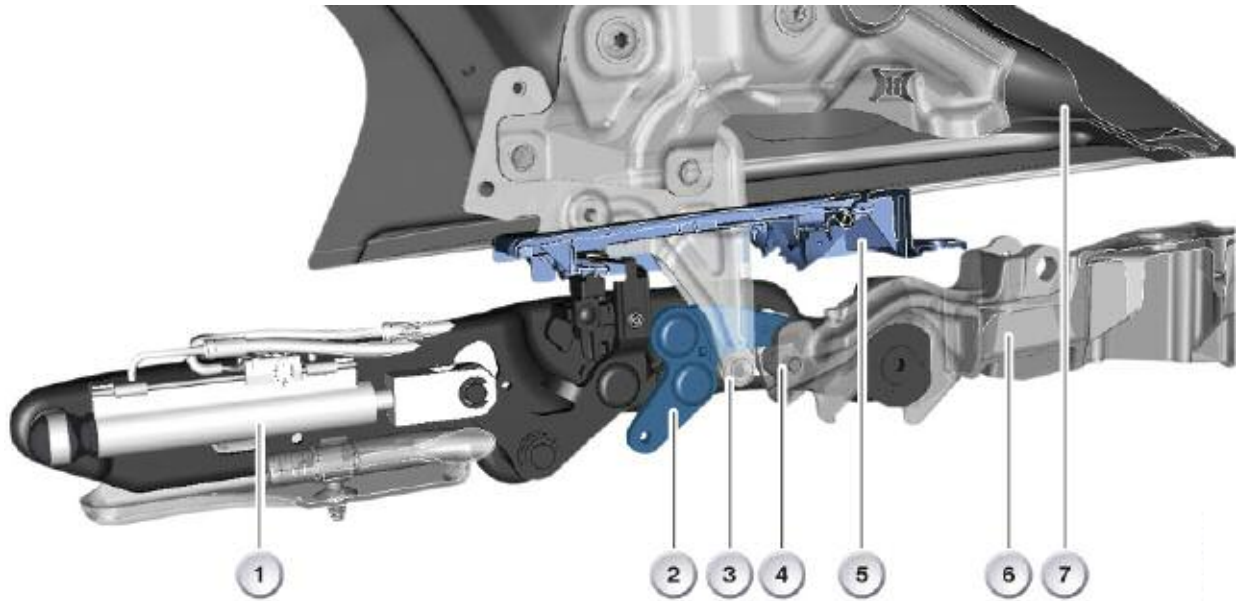
The closure cylinders lock the rear roof panel and rear module to the body. Before the hardtop can be opened, the rear roof panel must be unlocked. It is unlocked by extending the piston. A Hall sensor is installed on the right cylinder that detects the position of the extended piston. Since the cylinders are de-pressurized if the hydraulic pump is not activated, they are engaged while locked or activated via dead center.

The locking is signaled to the CTM by two microswitches (one on each of the two closure cylinders). When the hardtop is closed, after the roof package is extended and the rear module is closed, the closure cylinders are retracted in order to push the rear module all the way into the lower position. Then, the closures open and are not closed until the roof panels are interlocked and locked to the cowl panel. The rear roof panel and the rear module are locked to the body by closing the closures.



Index	Explanation
1	Closure cylinder
2	Lock hook

Closure



Index	Explanation	Index	Explanation
1	Closure cylinder	5	Outlet flaps for main pillars
2	Lock hook	6	Rear module mechanism
3	Rear roof panel locking roller	7	Rear roof panel
4	Rear module locking roller		

Roof Panel Cylinders

The movement of the roof sections is carried out using two roof panel cylinders. The actuation direction of the roof panel cylinders depends on the rotation direction of the hydraulic pump.

- When the pistons have retracted into the roof, the hardtop is closed.
- When the roof panel cylinders are pressurized on the piston side, the pistons are extended and move the roof panels above each other via the roof panel control arms.
- Two Hall sensors are installed on the right roof panel cylinder and detect the position of the piston.

- When the roof panel cylinders are pressurized on the rod side, the pistons are retracted and the roof panels separate.
- When the Hall sensor detects the position of the retracting piston, the pressure in the cylinder is reduced.

In addition, the spring on the roof panel cylinder acts counter to the movement direction. The reason for this is that the front roof panel moves into the front cowl very slowly, resulting in a harmonious hardtop movement. The slow movement also minimizes the risk of becoming trapped.

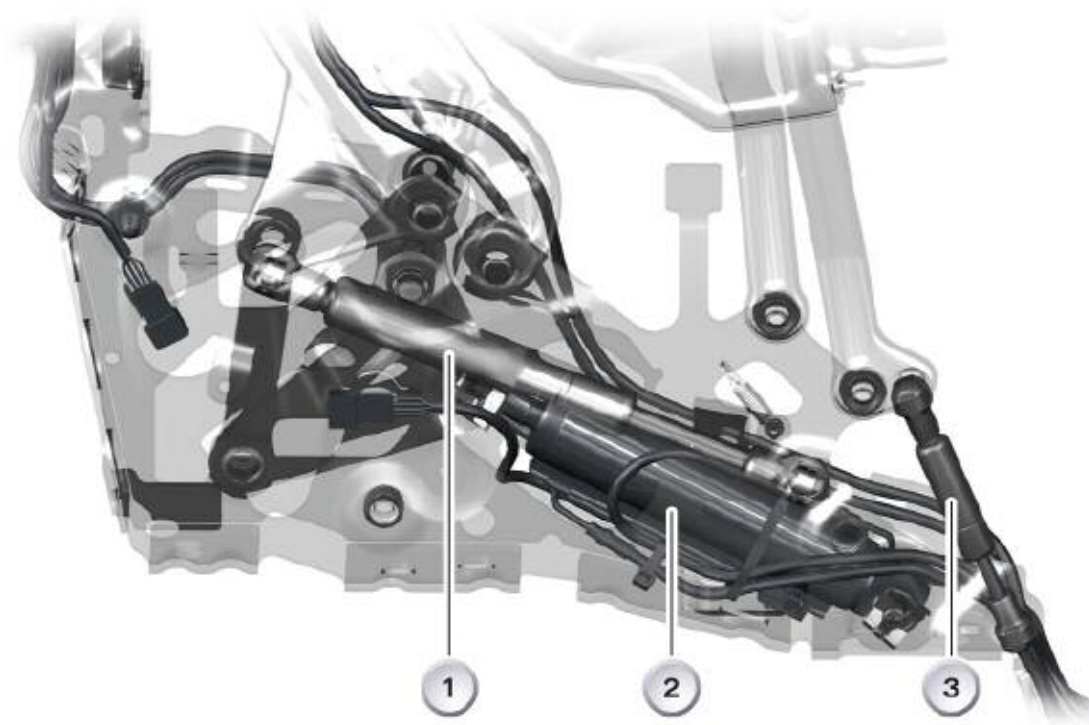
Left roof panel cylinder



Index	Explanation
1	Spring for mechanically damping the roof panel movement
2	Roof panel cylinder

Main Pillar Cylinders

The main pillar cylinders serve to stow the roof package in the luggage compartment and to lift it out of the luggage compartment. When the rear pillar cylinders are retracted, the roof package is lifted. The roof package is stowed by extending the main pillar cylinders. A Hall sensor is installed on the right main pillar cylinder that signals the "Roof panels extended" position to the CTM. The uniform movement of the roof package is supported by 2 gas pressure dampers in the main mount.



Index	Explanation	Index	Explanation
1	Gas pressure damper for main pillar	3	Gas pressure damper for luggage compartment divider
2	Main pillar cylinders		

Rear Module Cylinders

The rear module is opened and closed by the rear module cylinders. When the rear pillar cylinders are retracted, the rear module is closed. The rear module is opened by extending the pistons in the rear module cylinders. Two Hall sensors are installed on the right rear module cylinder. The upper Hall sensor detects the position of the opened rear module. The lower Hall sensor signals to the CTM that the rear module is almost closed. Beginning at this position, the pressure in the rear module cylinders is reduced and the rear module is slowly closed until it reaches the end position.

Rear module cylinders









Index	Explanation
1	Rear module cylinder
2	Rear module

Service Information

In certain situations, the hardtop cannot be opened or closed. To indicate these situations, corresponding messages are displayed in the instrument cluster as check control messages and as plain text in the Central Information Display. The check control messages are for support purposes and provide explanatory information for the red LED that lights up in the operating button in case of fault. As long as the CC messages are active, they are displayed every 5 seconds.

The following illustration provides an overview of possible messages

ID	Symbol	Cause/trigger	CC brief message	Additional text
401		Electrical/electronic defects (triggered when button is pressed)	Functional failure of roof system!	Roof system No roof movement possible. If the roof system is not locked, contact the nearest BMW Service.
416		Is triggered when the button is pressed.	Luggage compartment divider	Luggage compartment divider No roof movement possible. Move the luggage compartment divider into the required position; see the owner's handbook.
432			Roof hydraulic system too hot	Roof hydraulic system Roof hydraulic system too hot. Temporarily, only the closing function is available.
445		Roof movement is not allowed when vehicle is on an incline	Vehicle is on too much of an incline	Roof system Vehicle is on too much of an incline, no roof movement possible.
447		Safe end position was not detected (e. g. casing jammed, button released too soon, set in motion with roof not in end position)	Roof system not locked!	Roof system Locking not completed. Please check: Vehicle stationary? Roof movement locked? Then, press the button again.
19		Luggage compartment open	Luggage compartment open!	

Note: Due to the high current consumption of the retractable hardtop of up to 40A, the hardtop may be operated only when the battery charger is connected or the engine is running.

Adjusting the Retractable Hardtop

- When removing or installing the retractable hardtop, you must follow the repair instructions.
- Special tools and procedures to service the retractable hardtop are discussed in the Repair Instructions.
- Adjustment gauges are provided for the adjustment tasks during installation.

Service Shop Emergency Procedure

Emergency procedure for closing the hardtop in the case of a malfunction is only possible in the service shop by service employees (see Repair Instructions)

Note: An emergency procedure for operating the retractable hardtop by the customer is not provided nor possible.

Installing/removing the Retractable Hardtop

For installing/removing the retractable hardtop "Roof Package", a workpiece carrier is used as a special tool.

