

Electrically operated trailer coupling

E60, E61, E90, E91, E92, E93



Introduction

> E60, E61 from 03/2007

The BMW 5 Series can be equipped with a **fully automatic trailer coupling**(option 3AC "trailer coupling with electrically pivoted ball head").

The fully automatic trailer coupling (system supplier Westfalia) is operated by a button in the luggage compartment. Briefly pressing the button prompts the ball head to pivot out or in as far as each limit position entirely automatically. The system has a control unit that is not directly connected to the vehicle's bus system.

[System overview...]

> E90, E91, E92, E93

The BMW 3 Series can be equipped with an **electrically released trailer coupling**(option 3AC "trailer coupling with pivoted ball head").

The trailer coupling is released by a button in the luggage compartment.

The trailer coupling has a pivoted ball head. The trailer coupling release can be operated when the ball head is folded in or out. The ball head then moves down to an intermediate position.

The trailer coupling must be manually locked, and heard to lock, in both end positions.

The system has a control unit without a direct connection to the vehicle's bus system.

[system overview ...]

Modifications from 09/2005:

From 09/2005, the E91 is available with option 3AC. Since this time, a separate Check Control symbol has been provided for the system. In the event of a system error, the trailer module will generate a Check Control message. The Check Control message appears in the instrument cluster.

The separate loudspeaker is discontinued.

Modifications from 03/2007:

To coincide with the new model appearing in 03/2007, the E60, E61 is equipped with option 3AC "trailer coupling with

electrically pivoted ball head"). Since this time, a separate Check Control symbol has been provided for the system. In the event of a system error, the trailer module will generate a Check Control message. The instrument cluster displays the Check Control message.

Brief description of components

The following components supply signals for the electric trailer coupling release or fully automatic trailer coupling:

- **Button for the trailer coupling release**

> E90, E91, E92, E93

Pressing the button operates the trailer coupling release.

The ball head moves from the locked position to an intermediate position.

Two coloured LEDs are integrated into the button (green and red). The indicator lamp shows the system status.

While the ball head is not locked, the indicator lamp in the button will light up red.

[more ...]

- **Button for the electrically pivoted trailer coupling**

> E60, E61

Pressing the button prompts the ball head to pivot out or in as far as each limit position.

Two coloured LEDs are integrated into the button (green and red). The indicator lamp shows the system status.

While the ball head is not locked, the indicator lamp in the button will flash red.

[more ...]

- **Rear-lid contact switch**

The rear lid must be open when the trailer coupling is operated. The rear lid contact switch in the rear lid lock transmits the signal to the control unit for the trailer coupling release (E90, E91, E92) or for the electrically pivoted trailer coupling (E60, E61).

At the same time, the luggage compartment lights are switched on by this contact.

- **Microswitch in drive for trailer coupling release**

> E90, E91, E92, E93

The microswitch is a switch with 3 connections. The microswitch recognises whether the ball head is locked in one of its two end positions (folded out or folded in). The microswitch transmits the signal to the trailer coupling release control unit.

[more ...]

- **Microswitch for trailer detection**

E60, E61

The microswitch for trailer detection is built into the trailer socket. If the trailer connector is inserted in the trailer socket, the ball head cannot be pivoted in.

[more ...]

- **Hall-effect sensor in drive system for the electrically pivoted trailer coupling**

E60, E61

The Hall-effect sensor is integrated into the drive system. The entire pivoting travel of the ball head is monitored with the aid of the Hall-effect sensor.

The drive system's rotary movement is transmitted by the Hall-effect sensor to the control unit for the electrically pivoted trailer coupling in the form of a Hall-effect sensor signal.

In parallel to the Hall-effect sensor signals, the control unit measures the current required for the pivoting movement.

If the permissible current consumption of the DC motor is exceeded during fully automatic pivoting out or in, or no Hall-effect sensor signals are emitted, the ball head's pivoting movement is halted. The ball head is pivoted back a short way in the opposite direction (reversed).

- **Loudspeakers**

> E90 up to 09/2005

The loudspeaker is located on the left under the rear window shelf. An acoustic signal is emitted when the ball

head is unlocked.

The loudspeaker indicates a Check Control message with a continuous tone.

The loudspeaker is actuated by the trailer coupling release control unit.

Several control units are involved in the trailer coupling release:

- **Control unit for the trailer coupling release or electrically pivoted trailer coupling**

> E60, E61: Control unit for the electrically pivoted trailer coupling

> E90, E91, E92, E93: Trailer coupling release control unit

The control unit energises the drive system's direct current motor. The control unit is not directly connected to the bus system. The control unit is not capable of self-diagnosis, nor can it be programmed.

> E60, E61

[more ...]

> E90, E91, E92, E93

[more ...]

- **CAS: Car access system**

The CAS control unit supplies the input signal for the status of terminal 15 at the control unit for the trailer coupling release (E90, E91, E92, E93) or for the electrically pivoted trailer coupling (E60, E61).

With terminal 15 ON, the trailer coupling cannot be released or pivoted out or in.

- **AHM: Trailer module**

The trailer module is directly connected to the control unit for the trailer coupling release (E90, E91, E92, E93) or to the control unit for the electrically pivoted trailer coupling (E60, E61). In the event of a system error, the trailer module will generate a Check Control message.

The trailer module furthermore serves as a trailer detector. The trailer module identifies a trailer as connected if at least 2 loads (cold measurement) are detected at the lighting output terminals. The trailer module then transmits the message "Trailer connected" along the K CAN.

This message is translated by several control units in the towing vehicle. For instance, the ultrasonic sensors at the rear of the towing vehicle are deactivated via Park Distance Control. The footwell module (E90, E91, E92, E93) or lights module (E60, E61) deactivate the rear fog light and reversing light on the towing vehicle.

Other components:

- **Power distributor in junction box**

> E90, E91, E92, E93

The electrical distribution center in the junction box supplies power to the trailer coupling release control unit (terminal 30g).

The junction box consists of the junction box electronics (JBE) and electrical distributor.

- **Front and rear electrical distributors**

> E60, E61

The front electrical distributor supplies the control unit for the electrically pivoted trailer coupling with power (terminal 30).

The control unit for the electrically pivoted trailer coupling receives the input signal "terminal 30g" from the rear electrical distributor.

The following components are controlled:

- **Drive system for the electrically pivoted trailer coupling**

> E60, E61

The drive system pivots the ball head out and in fully automatically as far as each limit position .

[more ...]

- **Trailer coupling release drive**

> E90, E91, E92, E93

The drive mechanically releases the trailer coupling ball head. This is done by a DC motor being actuated, which drives the trailer coupling release unit.

[more ...]

- **Light-emitting diode in the button for the electrically pivoted trailer coupling and for the trailer coupling release**

The indicator lamp shows the system status.

- **Instrument cluster**

The instrument cluster is actuated in the event of a Check Control message from the trailer module (AHM).

System functions

The following system functions of the trailer coupling release and electrically pivoted trailer coupling are described:

- Releasing the trailer coupling (E90, E91, E92, E93)
- Pivoting the electrically pivoted trailer coupling out and in (E60, E61)
- Monitoring of terminal 15 and Check Control message
- Undervoltage and overvoltage
- Overheating protection for the drive system (E90, E91, E92, E93)
- Adjusting the trailer coupling (E60, E61)
- Emergency function (E60, E61)
- Emergency operation (E90, E91, E92, E93)

Trailer coupling release

> E90, E91, E92, E93

The trailer coupling can be released from terminal 30g ON. The following signal conditions must be satisfied to allow the coupling to be released:

- Terminal 30g: high signal
- Button: low signal
- Terminal 15: low signal
- Rear lid contact switch: low signal
- Microswitch output 1: low signal
- Microswitch output 2: high signal

The control unit for the trailer coupling release uses the signal conditions to check whether the release procedure can be started. The DC motor is actuated. During release, the outputs at the microswitch change the signal conditions. The indicator lamp lights up red.

While the trailer coupling is released, the loudspeaker emits a continuous tone (E90 to 09/2005) or an acoustic signal is given for a limited time (E90 from 09/2005, E91, E92, E93).

When the trailer coupling is locked in the end position (manually), the outputs at the microswitch change the signal condition again. The indicator lamp lights up green. The loudspeaker is deactivated (E90 up to 09/2005).

Pivoting out and in of the electrically pivoted trailer coupling

> E60, E61

The trailer coupling can be pivoted electrically from terminal 30g ON. The following signal conditions must be satisfied to allow the coupling to be pivoted electrically:

- Terminal 30g: high signal
- Button: low signal
- Terminal 15: low signal
- Rear lid contact switch: low signal
- Microswitch for trailer detection: high signal

The control unit for the electrically pivoted trailer coupling uses the signal conditions to check whether the pivoting movement can be started.

If the activation conditions are met, the following procedures can be performed by pressing the button for the electrically pivoted trailer coupling:

- Automatic pivoting out or in (single brief press of button)
- Pivoting out or in by continuous operation of button

Automatic pivoting out and in

Briefly pressing the button (for less than 1 second) pivots the ball head fully automatically from one limit position to the other.

Fully automatic pivoting out or in can be halted at any time by briefly pressing the button a further time.

Fully automatic pivoting out or in can only be started if the ball head is in one of the two limit positions or fully automatic pivoting out or in has been halted by pressing the button.

Reversing the pivoting movement

If the permissible current consumption of the DC motor is exceeded during fully automatic pivoting out or in (e.g. as a result of an obstruction, stiff movement or low ambient temperatures), the control unit for the electrically pivoted trailer coupling triggers reversing. The ball head's pivoting movement is halted. The ball head is pivoted back a short way in the opposite direction (reversed).

It can now only be moved by continuous operation of the button (manual operation).

Reversing is suppressed close to either limit position and a higher current consumption is permitted. This allows the ball head to be pivoted out of each limit position with more force (e.g. to release the ball head if stuck).

Pivoting out or in by continuous operation of the button

This mode is entered by pressing the button for the electrically pivoted trailer coupling for longer than 1 second.

The ball head is only pivoted for as long as the button is pressed. If the button is held pressed, the ball head is pivoted in the opposite of its previous direction of pivoting. The ball head's pivoting movement stops when the button is released. A further pivoting movement can only be performed in this mode.

Increased current consumption by the DC motor is permissible in the continuous button-operated mode. If the current consumption permissible in this mode is exceeded, the ball head's pivoting movement stops. The ball head does **not** pivot in the opposite direction to its previous direction of pivoting (no reversing in this mode).

Only if a limit position is reached in this mode is automatic pivoting out or in possible again

Monitoring of terminal 15 and Check Control message

> E60, E61

The CAS transmits a status signal for terminal 15 to the control unit for the

electrically pivoted trailer coupling. The control unit transmits the status signal and the operating statuses of the trailer coupling to the trailer module (AHM).

The CAS also transmits the status signal for terminal 15 to the trailer module via the K CAN. The plausibility of both signals is checked in the trailer module.

Signals from the control unit for the electrically pivoted trailer coupling to the AHM:

- Status signal of terminal 15 OFF: low signal
- Status signal of terminal 15 ON and pivoting ball head in limit position: PWM signal (pulse-width-modulated signal) 450 ms low -> 50 ms high -> 450 ms low -> etc.
- Status signal of terminal 15 ON and ball head pivoting or halted in intermediate position: high signal

The trailer module generates a Check Control message. The Check Control message is sent via the K CAN. The Check Control message is only indicated after the engine is restarted by a Check Control symbol (red) in the instrument cluster and by an acoustic signal of limited duration (E90 up to 09/2005: continuous signal).

Check Control message:

- Trailer coupling locked

or

- Trailer coupling electrics

Further information is provided in the Central Information Display (CID).

> E90, E91, E92, E93

Terminal 15 is monitored by a live signal as follows:

- Terminal 15 ON and trailer coupling locked:
The trailer coupling release control unit transmits the live signal to the trailer module (AHM). To do this, the control unit activates the output to the AHM every 450 ms.

The trailer module detects a system error by the absence of the live signal.

> E90 up to 09/2005

A yellow Check Control symbol in the instrument cluster indicates the Check Control message: Vehicle on lifting platform. The loudspeaker simultaneously emits a continuous signal.

If the trailer coupling is released with terminal 15 ON, a Check Control message is likewise generated. The loudspeaker is switched on for 30 seconds.

The output to the AHM has a high resistance when terminal 15 is OFF.

> E90/E91 from 09/2005 and E92, E93:

From 09/2005, a separate, unambiguous Check Control symbol has been provided for the trailer coupling release.

Undervoltage and overvoltage

> E60, E61

The electrically pivoted trailer coupling control unit detects undervoltage and overvoltage.

Undervoltage On-board supply voltage less than 9 volts

Overvoltage On-board supply voltage greater than 16 volts

If overvoltage or undervoltage is detected during fully automatic pivoting in or out of the ball head, the ball head still pivots as far as the limit position. The error is then indicated via the LED in the pushbutton.

If an overvoltage or undervoltage is detected during continuous operation of the button for the electrically pivoted trailer coupling, the ball head can still be pivoted into the limit position. The ball head's pivoting movement stops when the button is released. The DC motor can then no longer be energised while the overvoltage or undervoltage persists.

> E90, E91, E92, E93

The trailer coupling release control unit detects undervoltage and overvoltage.

Undervoltage On-board supply voltage less than 9 volts

Overvoltage On-board supply voltage greater than 15 volts

Outside this voltage range, the system is deactivated.

Overheating protection for drive

> E90, E91, E92, E93

The DC motor is actuated for a maximum of 4 seconds.

The control unit detects an excessively high current draw for the drive, e.g. due to blocking. The maximum current draw is 13 amps.

Adjusting the trailer coupling

> E60, E61

To ensure that the trailer coupling remains pivoted in the limit position, the DC motor is energised briefly in the direction of the limit stop every 60 seconds.

The control unit for the electrically pivoted trailer coupling activates adjustment in the following conditions:

- Terminal 15 ON
- Ball head pivoted out in limit position

Emergency function

> E60, E61

Cyclical readjustment of the pivoted-out ball head can result in the ball head becoming mechanically jammed in this limit position.

In this event, the ball head can be freed from the limit stop by the emergency function.

A defined pivoting movement must be achieved in the run-up phase to pivoting the ball head out or in. This pivoting movement corresponds to a defined number of Hall-effect pulses by the DC motor. The Hall-effect pulses are picked up by a Hall-effect sensor on the DC motor.

If a defined number of Hall-effect pulses is not reached, the control unit activates the emergency function.

In the emergency function, the DC motor is energised five times cyclically (each cycle comprises energising for 300 ms followed by a pause of 200 ms).

If the minimum number of Hall-effect pulses is not achieved, the ball head can then only be pivoted in or out by continuous operation of the button for the electrically pivoted trailer coupling.

The control unit for the electrically pivoted trailer coupling activates the emergency function in the following conditions:

- Briefly pressing (for less than 1 second) the button for the electrically pivoted trailer coupling (mode: fully automatic pivoting out or in)
- Trailer head is in the run-up phase to pivoting in or out
- Emergency function was not previously triggered
- Minimum number of Hall-effect pulses by the DC motor not achieved

Emergency operation

> E90, E91, E92, E93

If the power supply is interrupted during operation, various signal conditions could be lost.

When power is available again, the button must be pressed and held for 5 seconds. This will switch the drive on (emergency operation).

If the power supply is interrupted, the trailer coupling cannot be released.

Preconditions for activation

The following switch-on conditions for the trailer coupling release or electrically pivoted trailer coupling must be met:

- Terminal 15 OFF
- Rear lid open
- No overvoltage or undervoltage in the on-board supply voltage

> E60, E61 with ball head pivoted out:

- Trailer connector **not** inserted in trailer socket

Notes for service staff

The following information is available for service staff:

- General note: [more ...]
- Diagnosis: ---
- Encoding/programming: ---

Subject to change.