VIN:	XXXXXXX	Vehicle:	7'/E66/SEDAN/750Li/N62/AUTO/USA/LL/2006/04
System Version:	3.45.30.12306	Data Version:	R3.45.30.12306

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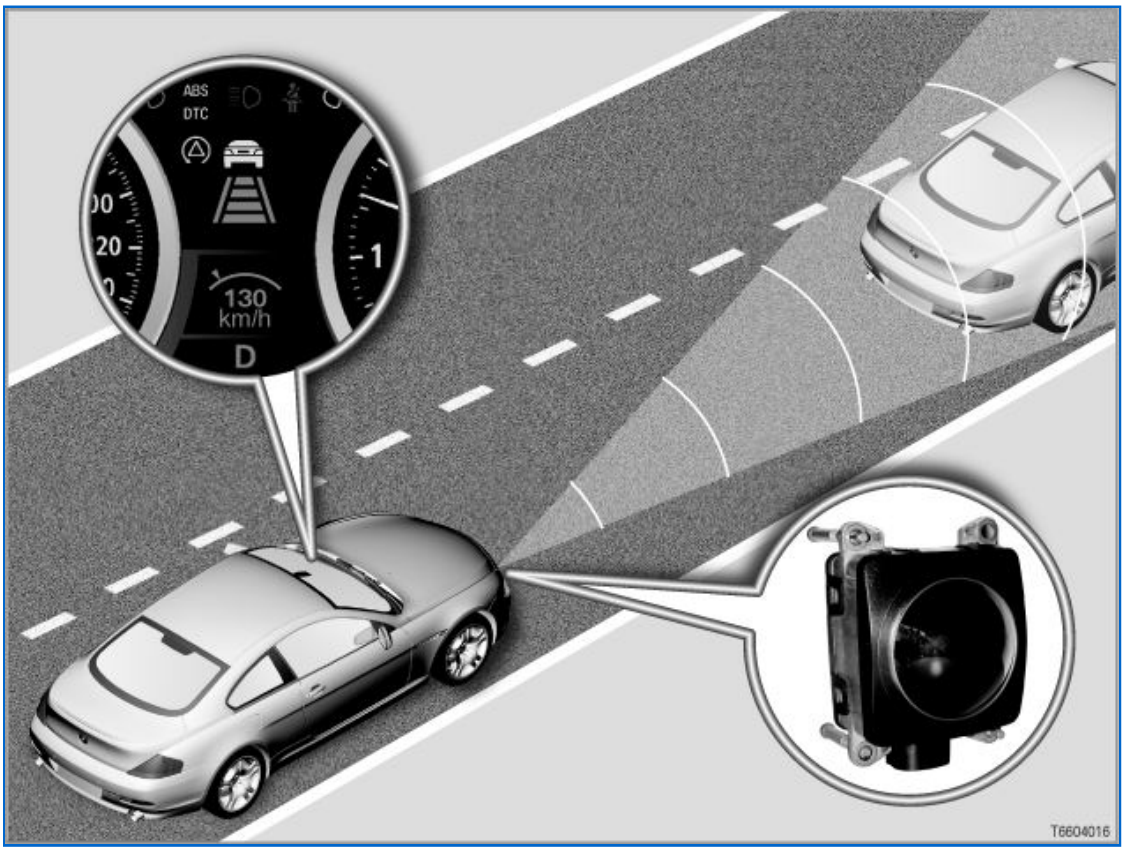
Active Cruise Control

E60, E61, E63, E64, E65, E66



Introduction

In 04/2000, active cruise control (system supplier: BOSCH) was installed for the first time in a BMW as special equipment for the E38.

Active cruise control is an extension of the conventional cruise-control system (FGR). A comfortable distance and cruise control has been added to this.
The distance from the vehicle ahead can be selected from 4 fixed timed separations. (EURO version: 1.0 - 1.5 - 2.0 - 2.5 seconds)
Thus the spatial distance from the vehicle in front changes with the speed.

With Active Cruise Control activated, a speed in the range from 30 km/h to 180 km/h can be preselected.

Important: Cruise control does not relieve the driver of his personal responsibility.

The Active Cruise Control option is a comfort system. Adjustments by the driver will always have a higher priority (= importance) than cruise control.
The driver should decide whether (and how) the system is used based on road and traffic conditions and visibility.

The 2nd generation (ACC 2) Active Cruise Control option 541 will be introduced for the first time in 09/2004 on the E63/E64. With the model year measures in March 2005, Active Cruise Control (ACC 2) will be introduced in more models: E60, E61, E65, E66.

> E60, E61, E63, E64 before 09/2005 [System overview ...]

> E60, E61, E63, E64 from 09/2005 [System overview ...]

> E65, E66 as from 03/2005 [System overview ...]

Changes to ACC 2 compared to ACC 1 (ACC 1 in E60, E61, E65 and E66 before 03/2005):

- Radar sensor now has 4 radar antenna instead of just 3

  This means the area covered by the radar sensor is widened from ±4° to ±8°.

- The system is approx. 60 % smaller.

With the model year measures, the following changes to the active cruise control option will be introduced in March 2005:
> E60, E61, E63, E64
Additional scope of operation in combination of car communication computer (CCC) with Professional navigation system option 609.
The dynamics of the Active Cruise Control change according to the characteristics of the roads. (The roads are split into road categories, e.g. motorways and highways. In addition, the general the number of bends on the route ahead is analysed, i.e. if there are a lot of bends ahead, or just a few, as well as the radii of the bends.)

The advantages:

In comparison with the previous ACC, ACC 2 offers the following advantages:

- more dynamic control behaviour
- The widened surveillance range of the radar sensor means that Active Cruise Control now works much better when cornering.
-
  - Vehicles in front are monitored earlier
  - Longer, more stable monitoring when following a vehicle (even in cases of tight bends)

Brief description of components

The Active Cruise Control option consists of the following components:

- **ACC sensor with control unit**

  The ACC sensor and control unit form a single unit.
  The ACC sensor monitors the distance, angle and relative speed of vehicles driving ahead. (Relative speed: The relative speed is the difference in speed between the two moving objects, i.e. relative to each other.)
  The ACC sensor is a radar sensor. The ACC sensor has a limited monitoring range (approximately 120 metres).

  [more ...]

- **Cruise-control system steering-column stalk**

  Cruise control is set and called up using the Active Cruise Control system steering-column stalk.

  [more ...]

- **2 brake pressure sensors**

  A brake pressure sensor is installed in each of the front and rear axle brake circuits. The signals from the brake pressure sensors are evaluated by the Dynamic Stability Control.
  If Active Cruise Control is in use, the vehicle will be braked as necessary by the Dynamic Stability Control (DSC) (not DSC intervention). The brake pressure sensors all the brake pressure, which is often only very slight, to be regulated to the front and rear axles

  - Vehicles with DSC 8Plus:

    The brake pressure sensors have been discontinued on vehicles with DSC 8Plus. DSC 8Plus is an advanced development of the familiar DSC 8.

In addition, the ACC control unit communicates with the following control units:

- **DME or DDE: Digital engine electronics or digital diesel electronics**

  The DME/DDE controls the engine intervention. The following data is transmitted by the ACC sensor to the DME or DDE:

  - Current torque request

  The following data are transmitted from the DME or DDE to the ACC sensor:

  - Driver's command (signals from accelerator pedal module)

- **SGM: Safety and gateway module**

  > E65, E66 as well as

  E60, E61, E63, E64 up to 09/2005:

  The SGM is the gateway (= data interface) between:

  - PT CAN
  - K-CAN
  - **Byteflight**

  The diagnosis lead is also connected at the SGM.

  > E60, E61, E63, E64 from 09/2005

  The body-gateway module replaces the safety and gateway module (SGM).

- **KGM: Body-gateway module**

  > E60, E61, E63, E64 from 09/2005

  The KGM is the gateway (= data interface) between:

  - PT CAN
  - K-CAN

  The diagnosis lead is also connected at the KGM.

- **DSC: Dynamic Stability Control**

  The current status of the vehicle is detected by the DSC, for example by evaluating the following sensor signals:

  - Rate of yaw (measure of movement of the car about its vertical axis)
  - Steering angle
  - Information on the brake pressure

- Circumferential wheel speed

DSC then transmits data about current operating conditions to the ACC sensor.

The following data are transmitted by the ACC sensor to the DSC:

- Request for vehicle deceleration:

  DSC receives the request for vehicle deceleration from the Active Cruise Control via the PT-CAN. DSC reduces the speed. To do this, DSC intervenes in the brake system. (goal: comfortable vehicle deceleration. No DSC intervention in the sense of enhanced operating stability.)

With automatic braking, the brake lights are actuated depending on the vehicle deceleration and the gradient of the road (legally prescribed).

- **FPM: Accelerator pedal module**

  The accelerator pedal module signals the driver's command. This signal is required to check the respective driving status. (evaluation via DME/DDE)

  By pressing the accelerator pedal, the speed setpoint of the Active Cruise Control can be overridden at any time.

- **Brake light switch**

  The brake light switch tells the active cruise control when the brake pedal has been pressed. Active Cruise Control is deactivated if braking actions are necessary.

- **Clutch mode** (manual transmission only)

  Clutch engagement/disengagement is recognised by the signal from the clutch module.

  During the clutch engagement/disengagement process, the engine speed is maintained at an optimal speed range by the DME or DDE.
  After the clutch has been reengaged, the DME/DDE will adjust back to the current torque request from the Active Cruise Control.

  If the engine speed is too high or too low, an audible signal and a check control message prompt the driver to change gear. The prompt to upshift when the engine speed is too high is only made during the warm-up phase of the engine.

  If no gearshift or change in engine speed is made within approx. 5 seconds of such a signal being given, active cruise control will be deactivated.

  If the clutch is disengaged for longer than about 6 seconds, Active Cruise Control (ACC) will be deactivated.

  Active cruise control cannot be activated in 1st gear.

  Active cruise control is automatically deactivated in the ”neutral gate” (i.e. no gear engaged and clutch not depressed).

Important: Only install prescribed rear differential unit.

Active Cruise Control has a variant coding which is co-ordinated with the differential ratio. If a different rear differential unit is installed, it may be the case that the Active Cruise Control will deactivate itself in manual transmissions, particularly in the higher gears. In this case, no fault is entered in the fault memory.

- **EGS and SMG: electronic transmission control and sequential manual transmission**

  - Electronic transmission control

    The electronic transmission control evaluates the data from the DME/DDE and ACC sensor.

    The adaptive transmission control (constituent component of electronic transmission control) adapts the shift characteristics of the driving programme to the driver's commands and the driving situation.

- Sequential manual gearbox

  No automatic upshift in manual mode.

  In order to prevent excessively high engine speeds, an audible signal and check control message prompt the driver to change gear. The prompt to upshift when the engine speed is too high is only made during the warm-up phase of the engine.

The following data are transmitted from the EGS or SMG to the ACC sensor:

- Gear engaged
- status information about gearshifts

The ACC sensor transmits the following data to the EGS/SMG:

- Current operating status
- Current torque request

- **LM: Light module**

When active cruise control is in operation, the brake lights are actuated during automatic braking (legal requirement). This requires a signal sent via the K-CAN to the light module.

Active cruise control uses the ”turn signals” signal from the light module for assistance when changing lanes. In other words, if a left turn signal is given before overtaking, the distance to the vehicle in front is reduced. The vehicle to be overtaken is “ignored” more easily. Conversely, when you move back into the right lane, vehicles being driven there will be monitored more quickly.

- **SZL: Steering column switch cluster**

The SZL processes all data from the cruise-control system steering-column stalk.

> E65, E66 as well as
> E60, E61, E63, E64 before 09/2005

The SZL is connected to the safety and gateway module (SGM) via the **byteflight**. The SGM creates the connection to the bus system.

> E60, E61, E63, E64 from 09/2005

The SZL is connected to the bus system via the PT-CAN.

- **Displays in the instrument cluster**

For Active Cruise Control, the following displays are available in the instrument cluster:

- Set speed via an indicator disc

  (Set speed = selected km/h of the cruise control system)

- Monitored vehicle

  (Display through lit up icon)

- Request for action to driver

  (Display through flashing icon. In addition, an audible warning is made.)

- Selected distance from vehicle driving ahead

  (Display via icon)

- The LC display briefly shows the newly selected set speed (approximately 6 seconds).

- Check control message in LC display

[more ...]

- **M-ASK or CCC and CID: Multi-audio system controller/Car Communication Computer and Central Information Display**

  > E60, E61, E63, E64 only

  For the instrument cluster, the M-ASK and CCC serve as an interface to the Central Information Display (CID).

  Amongst other things, the CID displays detailed information about the check control messages. To back up the check control message, the M-ASK / CCC emit acoustic warnings through the loudspeakers (depending on national version). The instrument cluster assumes control over these warnings via the K-CAN.

  - CCC with Professional navigation system option 609:

    Only in the combination of CCC with Professional navigation system option 609 are the additional scopes of operation possible for the dynamics control behaviour.

- **CD: Control display**

  > E65, E66 only

  The control display is the central display for the information and communication system.

  The control display is used as an interface between the MOST and K-CAN data buses. (MOST stands for “Media Oriented System Transport”; K-CAN stands for “Body Controller Area Network”.)

  Amongst other things, the control display displays detailed information about the check control messages. The instrument cluster controls these warnings by means of the K-CAN.

- **CAS: Car Access System**

  The CAS provides input signals relating to terminal status (e.g. terminal 15 ON).

- **HUD: Head-up display**

  > E60, E61, E63, E64 only

  The Head-up display (option 610) displays the following information:

  - Set speed
  - Object ahead monitored
  - Request for action to driver
  - Timed separation setting
  - Check-control messages

System functions

The system functions of the Active Cruise Control option are described below:

- Monitor object ahead
- Cruise control
- Lens heating
- Low-voltage cutout and high-voltage protection for ACC sensor
- Self-diagnosis and compensation for minor horizontal adjustments

- Influence on the dynamics in connection with a navigation system
- System limits

Monitor object ahead

Objects are all vehicles in the same lane. The vehicles on other lanes are of no interest for the Active Cruise Control option.

In the same lane, the vehicle immediately ahead is selected as the object.

With the calculated expected same lane, the lateral deviation of each monitored object to the same lane can be determined.

The radar waves received cannot distinguish between animals, vehicles and traffic signs. In order to prevent incorrect reactions, stationary objects and traffic in the other direction are ignored in the distance control.

Cruise control

The Active Cruise Control option differentiates between 2 driving conditions:

- **Cruise control with specified set speed**

  A selected set speed (in the range 30 km/h - 180 km/h) is automatically maintained on open roads without vehicles driving ahead.

- **Cruise control with speed adapted to that of vehicle driving ahead**

  If a slower vehicle is detected on the vehicle's own track, the vehicle's own speed will be adapted to that of the vehicle driving ahead

  At the same time, a distance from this vehicle preset by the driver is established (4 fixed, timed separations can be selected).

  The timed separation from a vehicle driving ahead is no less than 1 second under stationary conditions. In certain conditions (e.g. when a vehicle cuts in a short distance ahead), this timed separation may briefly be less than 1 second.

Lens heating

The lens of the ACC sensor is made of plastic. The built-in lens heating ensures better availability of the Active Cruise Control option in winter weather conditions.

The lens heating is activated by the ACC sensor. The heating is controlled via a pulse-width modulated signal (PWM signal). The heating coil is integrated into the lens of the ACC sensor

The lens heating is only activated within a certain ambient temperature range (approx. +5 °C to -5 °C). Reason: Only at temperatures around zero is snow wet or moist. At temperatures well below this, snow will be dry. To prevent snow from thawing on the lens and creating an artificial coating, the heating is switched off below a certain ambient temperature. The current ambient temperature value is transmitted by the instrument cluster.

- **Conditions for activation**

  - Engine ON
  - ACC ON
  - Ambient temperature between -5 °C and +5°C

- **Safety cutout**

  - Temperature in ACC sensor over 50 °C

    (measured by interior temperature sensor in ACC sensor control unit)

  - Voltage greater than 16 volts

  The safety cutout shuts down the lens heating. The Active Cruise Control option remains activated. (No fault memory entry)

- **Monitoring**

  The lens heating is monitored for open and short circuits in the heating coil.

  If the monitoring reports a fault, the Active Cruise Control option will be shut down. (Fault memory entry)

Low-voltage cutout and high-voltage protection for ACC sensor

The ACC sensor works with a supply voltage of 9 to 16 volts.

- **Low-voltage cutout**

  If the on-board supply voltage drops below about 9 volts, the ACC sensor will perform a low-voltage cutout and a fault memory entry will be stored.

  The ACC sensor will be reactivated when the on-board supply voltage exceeds 9.8 volts again.

- **Overvoltage protection**

  If the on-board supply voltage exceeds about 17.5 volts, the ACC sensor will perform a cutout with a fault memory entry.

  The ACC sensor will be reactivated when the on-board supply voltage drops below 17.0 volts again.

Self-diagnosis and compensation for minor horizontal adjustments

External forces may change the alignment of the ACC sensor. A horizontal change leads to function limitations. (Function limitations encountered are, e.g.: reaction to vehicles in the next lane or late reaction to vehicles in the same lane).

Self-diagnosis allows the ACC sensor to compensate for minor horizontal adjustments of up to 1°.

If a horizontal adjustment of more than 1° is detected, the Active Cruise Control option will be deactivated and a fault will be stored in the fault memory. A check control message will be issued.

Influence on the dynamics in conjunction with a navigation system

If the Active Cruise Control is coupled with a navigation system, this may have an influence on the dynamics. (Only possible in combination of CCC with the Professional navigation system option 609.)

Navigation systems provide additional information, such as the course of the road and the road category.

The road category is split up as follows:

- Motorways and well finished fast roads
  (faster acceleration)
- Main roads and highways
  (average acceleration)
- Urban driving

  (reduced acceleration)

On motorways and well finished fast roads, Active Cruise Control is expected to be highly dynamic. In other words, faster acceleration if the driving mode changes from following a car ahead to clear road ahead. The set speed is adjusted quickly.

On main roads and highways, Active Cruise Control is expected to be averagely dynamic. In other words, comfortable acceleration if the driving mode changes from following a car ahead to clear road ahead. The set speed is adjusted with an average acceleration behaviour.

During urban driving, a reserved dynamic is expected of the Active Cruise Control. In other words, reduced acceleration

behaviour if the driving mode changes from following a car ahead to clear road ahead. The set speed is adjusted moderately.

The often difficult traffic situations during urban driving make reduced acceleration behaviour necessary.

In addition, the number of bends on the road ahead is analysed and the dynamic of the Active Cruise Control adjusted accordingly.

System limits

If the limit of the functional range is reached, the driver is prompted to act (brake or swerve).

During operation, the following system functions requiring explanation (for the driver) can occur due to the limits of the functional range:

- **Limited range and deceleration:**

  - The range of the ACC sensor is limited (approximately 120 metres).

    Rain, snow and fog absorb radar waves.

    This will significantly reduce the range of the ACC sensor.

  - The Active Cruise Control option is only able to effect limited deceleration via the DSC (dynamic stability control) (a maximum of 2.5 m/s^2; E65, E66: a maximum of 2.0 $m/s^{2)}$. This means that cruise control is only able to compensate for a limited relative speed.

  Operation of the Active Cruise Control is only possible in flowing traffic in a road speed range from 30 km/h to 180 km/h.

- **Lateral monitoring range**

  The lateral monitoring range of the ACC sensor is limited, meaning that a monitored vehicle ahead could be lost due to a tight bend.

  In such cases, cruise control will not accelerate to the set speed for approximately 2 seconds. This will prevent the vehicle from accelerating too close to the vehicle ahead, which is possibly only briefly not being monitored.

  When driving straight ahead, this can cause a delayed reaction to another vehicle cutting in close in front. The vehicle cutting in will not be monitored by the cruise control until it is clearly in the same lane as the vehicle with the Active Cruise Control option.

- **Display for monitored vehicle does not light up, the vehicle remains below the set speed and does not accelerate furth**

  Causes:

  - On sharp bends, the vehicle's speed will be controlled in such a way that lateral acceleration does not exceed a maximum of 4.0 m/s^2 to maintain driving comfort.

- **Timed separation less than 1 second**

  The timed separation from a vehicle driving ahead is no less than 1 second in the adjusted status. In certain conditions (e.g. when a vehicle cuts in a short distance ahead), this timed separation may briefly be less than 1 second.
  If the deceleration induced by the cruise control is not sufficient, the driver will have to intervene directly.

- **ACC sensor blind**

  If the ACC sensor is blinded, the Active Cruise Control option shuts down. (Blinding, e.g. due to extremely heavy snowfall, through a layer of ice on the sensor or through dirt)

  Cruise control can be reactivated after the ACC sensor has been cleaned.

- **Bends cannot be detected in an anticipatory manner**

  The cruise control is unable to work in an anticipatory manner when the vehicle is cornering. It is only able to react to existing lateral acceleration when it is already on the bend. For this reason, the driver is responsible for ensuring that an

appropriate speed is being driven as the vehicle enters the bend.

- **Active Cruise Control deactivated after DSC intervention or brake application by the driver**

  Cruise control will be deactivated following DSC intervention or a brake application by the driver. (DSC intervention in the sense of enhanced operating stability.)

  Cruise control will then have to be reactivated at the cruise control steering-column stalk.

Operation

Operation of the Active Cruise Control option is described in the Owner's Handbook.

Notes for service staff

Service staff should note the following points:

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

National versions

US and CDN national versions

Different timed separations encoded for following mode (1.5 - 1.8 - 2.2 - 2.5 seconds)

US and GB national versions

Active cruise control is effective in the speed range 20 mph to 110 mph.
Speed can be selected in steps of 1 mph and 5 mph.

Subject to change.