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CAR ACCESS SYSTEM (CAS)

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Model: E65 - 745i

Production Date: 11/2001 - Start of Production

Objectives:

After completing this module you should be able to:

• Recognize the functions that are performed by the CAS.

• Describe how the CAS is responsible for the Terminal status of the vehicle.

• Identify the "keys" that should be delivered with the vehicle.

• Explain how the CAS accepts and ejects the remote control.

• Describe the EWS function of the CAS.

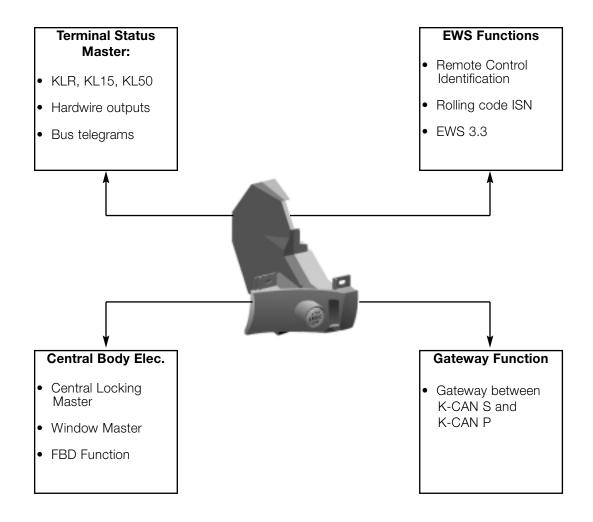• Understand the procedure required when replacing the CAS.

Purpose of the system

The Car Access System (CAS) controls access to the vehicle by controlling the master functions of the central locking system. It also controls the terminal statuses (KL R, KL 15, KL 50) via the ignition/starting button. The EWS functions are also integrated into the CAS which allows for starting of the engine.
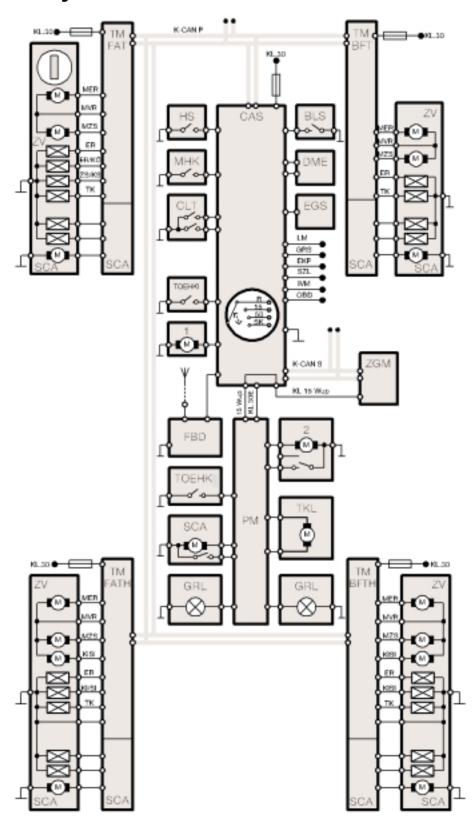
The CAS is a new development and combines the components previously installed in separate control units or systems:

- Ignition/starter switch

- Electronic vehicle immobilization (EWS)

- Functions of the central body electronics (ZKE).

The major development goals were increased convenience and a new operating concept.

Terminal Status Master:

- KLR, KL15, KL50

- Hardwire outputs

- Bus telegrams

EWS Functions

- Remote Control Identification

- Rolling code ISN

- EWS 3.3

Central Body Elec.

- Central Locking Master

- Window Master

- FBD Function

Gateway Function

- Gateway between K-CAN S and K-CAN P

Complete System Overview

KT-9416

Legend for Overview Diagram

Acronym	Description	Acronym	Description
M1	Starter	LM	Lamp Module
KL 15w	Terminal 15 Wake-up	MER	Unlock motor
KL 30	Terminal 30	MHK	Hood contact
KL 87	Terminal 87	MVR	Locking motor
BLS	Brake light switch	MZS	Central locking motor
CAS	Car Access System	OBD	On-Board Diagnosis
CLT	Central locking button	PM	Power Module
DME	Digital Motor Electronics	SCA	Soft close automatic system
ER	Unlocking	SZL	Steering Column Switch Center
EGS	Electronic Trans. Control	TK	Door contact
EKP	Electric fuel pump	TKL	Fuel filler door
ER	Unlocking	TMBFT	Door Module passenger side
FBD	Remote Control System	TMBFTH	Door Module passenger side rear
GRL	Trunk light	TMFAT	Door Module drivers side
GRS	Rotation rate sensor	TMFATH	Door Module drivers side rear
HS	Hotel switch	TOEHK	Trunk release button outside
IVM	Integrated Voltage Module	TOEHKI	Trunk release button inside
K-CAN-P	K-CAN Periphery	ZGM	Central Gateway Module
KiSi	Child proof door lock	ZV	Central Locking System

Components

Ignition/Starter Switch (ZAS)

The ignition/starter switch is the electromechanical part of the CAS and consists of:

- An ignition switch with an electromagnetic lock

- A start/stop button

- A coil for powering and communicating with the EWS transponder and for charging the battery in the remote controls.

1. **Start/Stop Button**

2. **Ignition Lock/ Remote Control receiver**

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The ignition lock/start button (ZAS) is located in the instrument panel between the instrument cluster and the control display at the level of the trim strips.

Light emitting diodes (LEDs) are integrated into the ignition/start button for illumination. The LEDs:

- Illuminate the start/stop button and the ignition lock/remote control receiver.

- Are switched on by the CAS from the "wake-up" signal.

- The LEDs are switched on as long as the bus is active
  (Useful for diagnosis of the bus sleep mode: when the LEDs light up, the bus is active).

Using the ignition/starter switch (ZAS) and the remote controls:

• The vehicle is started

• The different terminal statuses are selected (KL30, KL R, KL 15, KL 50).

Start/Stop Button

The various terminals are no longer actuated by turning an ignition key, but instead by touching the start/stop button. The vehicle is also started and shut-off with the start/stop button.
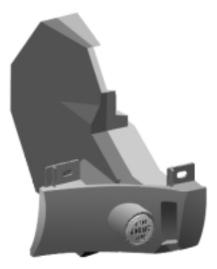

CAS Control Unit

The CAS control unit is the electronic part of the CAS/ZAS. The CAS is connected via the K-CAN Periphery with:

• The door modules

• The seat modules

• The Power Module

The higher-level connection to the entire vehicle is carried out via the K-CAN System.

All outputs from the CAS are designed

• With semiconductor technology

• Are short-circuit-proof to ground and B+

• Are fully diagnosis-capable.

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The CAS is the Gateway between the K-CAN System and K-CAN Periphery Bus.

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K-CAN P   K-CAN S   MOST   byteflight   PT-CAN

The CAS directly controls the functions:

- Radio remote control (FBD)

- Terminal control

- Electronic immobilizer (EWS)

- Starter-motor control

- Engine starting (ignition/starter switch)

The CAS control unit has the master functions for:

- The central locking system

- The window functions

The CAS has data storage functions:

- The mileage reading is stored in the instrument cluster (KOMBI) and in the CAS. When one of the two control units is replaced, the kilometer reading of the vehicle is transferred from the other control unit to the new control unit.

- Vehicle Order (successor to ZCS) is stored in the Lamp Module (LM) and the CAS.

"Ignition Key" (Remote Controls)

The "keys" are the component that represents the access and driving authorization for the vehicle.

All keys (with the exception of the key integrated in the remote control) contain the transponder for EWS.

The delivery specification of the vehicle are:

- 2 coded remote controls with integrated mechanical key.

- A reserve key (also individually coded) with an adapter for the ZAS (ignition lock).

Note: Since no ignition switch in the ordinary sense is installed, the term vehicle keys is also no longer used, but instead "remote controls")

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1.   **Remote Control**

2.   **Integrated mechanical key**

3.   **Release button for mechanical key**

4.   **Adapter for reserve key**

5.   **Reserve key**

Remote Controls

The power supply for the remote controls is provided by a non-replaceable re-chargeable battery.

- Charging: The battery is charged when the remote control is engaged in the ignition switch. Charging takes place via a 125-kHz interface in the ignition switch.

- Monitoring: The re-chargeable battery voltage is monitored by the remote control. At low voltage a Check Control message is output to the instrument cluster.

Each remote control is individually coded. As a result, different memory functions can be saved for each key: for example, seat adjustment, outside mirror adjustment, steering column adjustment etc.

The operating radio frequency of the remote controls in the U.S. is now 868.4Mhz.

No initialization procedure is required for the Remote Controls, once the CAS has recognized the key as valid it is automatically initialized.

Mechanical Key Integrated into the Remote Control

A key is pushed into the housing of the remote control. The key is purely mechanical and contains no transponder function for the EWS.

The key is used to emergency unlock the drivers door and trunk and also to lock and unlock the center storage box (hotel switch inside) and transmission emergency park release cable. To release the key, push the small button at the end of the remote control and slide the key out.

Reserve Key with Adapter

The delivery specification also includes a reserve key with an adapter for the ZAS. The reserve key is considerably smaller than the remote controls, enabling it to be easily carried in a wallet.

The reserve key consists of an integrated transponder and a mechanically cut plastic key. An adapter is required to push the narrow, flat reserve key into the slot and to engage it. The adapter should be stored in the vehicles tool kit.

A reserve key with the adapter has full access and driving authorization for the vehicle.

Key Management

The CAS control unit can manage a maximum of **10** valid vehicle keys. 3 keys are initialized during vehicle assembly, 2 remote controls and one reserve key.

The customer can order 7 additional keys if necessary.

Principle of Operation

Inserting, Locking and Releasing Remote Controls in Ignition Switch

The vehicle can be started with the remote controls or with the reserve key:

1. Inserting: push the remote control into the ignition switch.

2. Pressing the remote control: the sensor detects a user request to lock the remote control in the ignition switch.

3. Identification of the transponder by the CAS.

4. Locking the remote control in the ignition switch: when the remote control is recognized as authorized, the electromechanical removal lock is activated.

The remote control is mechanically fixed in place (locked). Locking of the remote control in the ignition switch is verified by a hall sensor in the CAS.

This ensures that the vehicle can be locked with the key in the case of a system failure.

5. Terminal R "on": after the remote control is locked in the ignition switch, terminal R is automatically switched on.

Automatic Ejection of a Remote Control
A remote control recognized as invalid cannot be locked (e.g. the key of another vehicle). If the transponder is invalid, the remote control will be pushed out.

Removing the Remote Control
The remote control can only be removed when the vehicle is stopped (below 1km/h) and the engine is switched off.

If these conditions are met, then the remote control can be removed in any terminal status by pressing the remote control. When pressed, the sensor in the CAS detects a request for release.
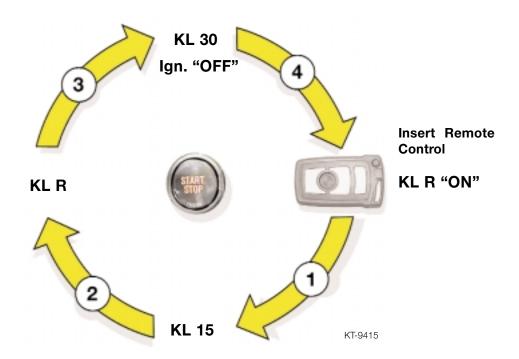
The CAS control unit actuates the electromechanical removal lock. The remote control is pushed out with spring force. After releasing the removal lock, the CAS is always in the position terminal R "off."

The remote control may also be "comfort released" by pressing the start/stop button for longer than 2 seconds after shutting off the engine.

Terminal Selection

The terminal statuses are selected when the brakes are not actuated by touching the start/stop button. A valid key must be locked in place. The terminal statuses are run through as follows:

Ignition "off" (terminal 30) → terminal R → terminal 15 → terminal R → ignition "off"

KL 30
Ign. "OFF"

Insert Remote Control

KL R "ON"

KL R

KL 15

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Starting the Engine
The vehicle engine can be started from all terminal statuses when

• A valid remote control is inserted and locked in the ignition switch

• The brake pedal is actuated.

If the brake-light switch is defective or disconnected, an actuation of the brakes is detected by the DSC control unit via the brake pressure sensor.

• The P or N position of the transmission is detected via the EGS (TCM).

Switching off the Engine

The vehicle engine is switched off when the vehicle is stopped and the start/stop button is pressed.

If the start/stop button is pressed for longer than 2 seconds, the vehicle engine is switched off and then the key is automatically released and pushed out with spring pressure ("convenience off").

After the vehicle engine is switched off, the CAS is in KL "R" (operational readiness for windscreen wipe, radio, airbag).

Incorrect Operation and "Emergency On"

To ensure the safety of the vehicle in the case of an accidental engine shutdown during driving, the "Emergency On" function is available.

An engine shutdown during driving can be caused by accidentally pressing the start/stop button (the start/stop button must be pressed for at least 1 second or 3 times consecutively).

The "Emergency On" function enables the starter to be actuated again without brake operation at a vehicle speed above 5 km/h (3mph). The "Emergency On" function also prevents terminal R from being switched off during driving.

Automatic Release with Missing Transponder

To protect against damage, tampering or incorrect operation, the remote control in the ignition switch is automatically released when:

• The transponder is no longer detected with terminal R "on"

• The vehicle is stopped

• The transmission is in the park position.

The authentication (validity test) of the transponder is carried out every 500 milliseconds within the first 10 seconds. Then the authentication takes place every 3 seconds.

Terminal control

The CAS generates the terminal statuses for the vehicle when the start/stop button is operated.

The terminals can only be connected when the remote control in the ignition switch is authenticated (recognized as valid) and the "key valid" signal is generated by the transponder in the CAS.

Terminal status in Vehicle Electrical System

The terminal status generated by the CAS for the vehicle is transmitted to the following buses every 100 milliseconds:

- K-CAN S

- K-CAN P

- PT-CAN

- MOST

- *byteflight*

The following statuses are output as telegrams:

- Status of terminal R

- Terminal 15 wake-up

- Status of terminal 15

- Status of terminal 50

- Valid key inserted

Hardware Redundancy

For safety reasons the terminal status of the terminal 15 outputs is redundant (via a hardware switch in the CAS).

Announcement of Terminal 15w "Wake-up"

The CAS and the ZGM (Central Gateway Module) are the only control units that can wake up the vehicle electrical system.

The control units on the K-CAN S, K-CAN P, *byteflight* and MOST are awakened by the network management (NWM) on the respective bus.

The control units on the PT-CAN are woken up via a high signal on the activation wire for terminal 15 wake-up. If a PT-CAN control unit receives the change in voltage "low-high" at the wake-up input, the control unit begins with reception and the evaluation of the messages from the PT-CAN.

Two modules (ZGM and the Power Module receive KL 15 wake-up as a hardwired input from the CAS in addition to the network management wake-up signal over the bus.

Announcement of Terminal 15 "ON"

For safety reasons certain control units and sensors are not only informed via the bus signal about terminal 15, but also have a direct hardwired output from the CAS.

The CAS provides ten KL 15 outputs for hardwire redundancies:

- Ignition coil relay: the output for the ignition coil relay is equipped with an overrun for maintaining OBD-relevant emission values (Emissions optimization).   When KL15 is switched "off" the ignition coils are not switched off until after a run-on time so that any fuel still injected is burned.

- GRS (Rotation/transverse acceleration rate sensor for DSC)

- LM/BLS (Lamp Module, brake-light switch)

- SBSR (Satellite B-pillar right, fuel pump)

- SZL (Steering Column Switching Center, selector lever transmission)

- OBD socket KL15 supply (On-Board Diagnosis)

- Rear seat heating (has no bus line)

- Three are reserved for future use
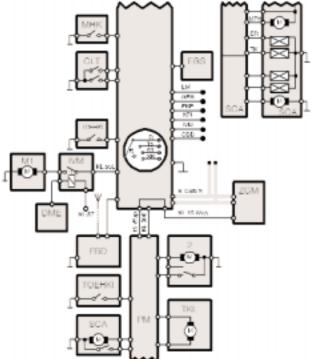
Terminal 50 (Engine Starting)

Terminal 50 is actuated by pressing the start/stop button.

Engine start-up and the related terminal change are carried out as soon as the start/stop button is pressed for at least 50 milliseconds.

The following conditions are needed to complete the start sequence:

• Remote control is valid and locked (transponder authentication).

• Brake operation: the brake is either detected via the direct wiring of the brake-light switch or redundantly via the CAN signal from the DSC . An incorrect brake signal from a defective or disconnected brake-light switch is detected as a "plausibility fault" as soon as the brake pressure is greater than 10 bar. If one of the two signals is missing, a Check Control message is sent. The engine start-up is permitted when the start/stop button is pressed again.

• Selector lever of automatic transmission in position P and N. The position of the selector lever is detected via the direct P signal or via a CAN signal. The engine can be started when at least one of these signal is present.

• No start-repeat lock present (start-repeat lock is activated at an engine speed above 1000 rpm).

If these conditions are not met, the starter-motor disabling circuit is activated. The engine cannot be started.

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Starter Motor Disabling

The starter disable circuit is used to protect the starter. The starter cannot be engaged with an already running engine.

The starter disable is carried out after the actuation of the starter solenoid has been ended.

The following situations will enable the starter disable function of the CAS:

- No "brakes actuated" signal: if no "brakes actuated" signal is output within a maximum of 200 milliseconds after the start/stop button is pressed, the engine start-up is aborted again. If only one of the two redundantly output brake operation signals is received, then the engine can be started.

- No continuous "brakes actuated" signal: if during the starting procedure the brakes are not continuously actuated, the engine start-up is aborted again.

- Time-out expired: the maximum operating period of the starter is 21 seconds.

- Selector lever in invalid position: outside P or N.

- The engine speed is greater than 1000 rpm. The DME (ECM) signals "status engine running."

- Short circuit/overloading detection of the starter by the CAS.

Actuation Time of Terminal 50

The monitored actuating times of terminal 50 protects the starter against overloading. The actuation times of terminal 50 are:

- A maximum of 21 seconds. A repetition is possible immediately.

- The actuation time is reduced for each repetition by 2 seconds until the minimum actuation time of 3 seconds is reached.

- If the start/stop button is pressed for longer than the preceding actuation time, the actuation time is increased by 2 seconds again (up to a maximum of 21 seconds).

Terminal 50 E (Electronics-Signal of Starting Request to the DME)
Terminal 50 E is provided to signal the starting request by the CAS to the DME.

Terminal 50 L (Load-Starter Solenoid)
Terminal 50 L is an input to the IVM to switch on the starter solenoid.

Auto-Park, Interlock and Shiftlock Functions

Auto-Park, Interlock and Shiftlock are safety functions.

Auto-Park and Interlock are CAS functions. Shiftlock is an EGS function.

- Auto-Park: When the remote control is removed from the ignition switch, the park position of the selector lever is automatically engaged. The "Auto-Park" function is programmed in the EGS.

- Interlock: The selector lever is locked in the park position until a valid remote control can be detected in the ignition switch.

- Shiftlock: the selector lever can only be moved out of the positions P or N with the brakes actuated.
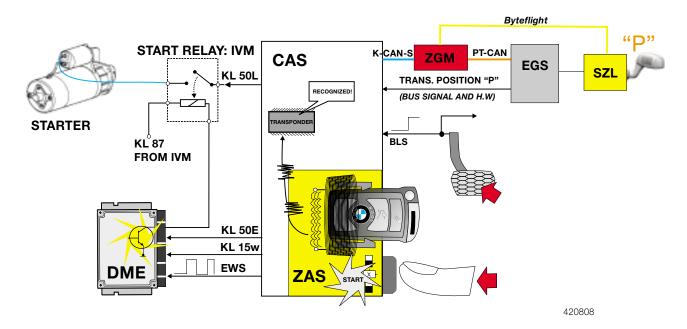
For safety reasons the EGS supplies the "transmission range and park position" signal redundantly. The EGS supplies two signals:

- The transmission position P via a direct, hard-wired cable (between the transmission and the CAS) for deactivation.

- The transmission range status via the message "gear status" as a redundancy (signal path: EGS - ZGM - CAS).

EWS Functions

The EWS function is also integrated into the CAS control unit. The transponder authentication is similar to the method used by EWS 3.3. The encoding process was changed compared to that of the previous versions (to increase security against tampering).

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After a start request from the start/stop button, starting may continue if the following conditions are met:

- Valid transponder detected

- Brakes actuated

- Selector lever in position P or N

The EWS sends a message (ISN) with a random code to the DME. To start the engine, the DME (ECM) enables the ignition and fuel injection. The fuel pump is actuated via the SBSR (satellite B-pillar right) as soon as a corresponding speed signal is sent on the bus by the DME (ECM).

The starter is actuated independently of the EWS ISN using the terminal 50 signal. If the starter turns and the engine fails to start, there may be a problem with communication between the DME (ECM) and EWS.

Central Body Electronics Master Functions

Central Locking System Master - CAS

The CAS contains all of the programmed logics for the Central Locking system.

Window Control System Master - CAS

The CAS contains all of the programmed logics for the window control system.

Remote Control Services (FBD)

The CAS is responsible for receiving the remote control request signals from the FBD receiver and placing requests for operation over the bus line.

Redundant Data Storage

The CAS is one of three control units in the E65 to store important vehicle specific data.

The CAS is responsible for storing:

- The full 17 digit VIN Number (Only the last 7 digits are stored in all codeable modules)
- Vehicle Order (FA)
- Total mileage
- CBS (Conditioned Based Service) Data

Redundantly, the full 17 digit VIN and the Vehicle Order (FA) are stored in the LM and the mileage is stored in the KOMBI. CBS data is stored in the Remote Controls

Vehicle Order

The Vehicle Order **(FA-***Fahzeugauftrag***)** replaces the central coding code **(ZCS)** used up until now. The Vehicle Order describes the current status of a vehicle (following production and in case of a change in the vehicle equipment).

The Vehicle Order is formed for each vehicle individually from the factory assembly order. The length of the vehicle order varies depending on the amount of vehicle equipment.

During first initialization at the factory, the Vehicle Order is entered into the CAS. It is also stored redundantly in the LM (Lamp Module). If the CAS is replaced or retrofitted in the workshop, the Vehicle Order must be re-entered or added to the CAS control unit.

Content of the Vehicle Order:

- Vehicle Identification Number (full 17 digit VIN)

- Series (E65)

- Model key (Digits 4-7 of the VIN)

- Time criterion (Production date: MM/YY)

- Paint code (4 digit paint code)

- Upholstery code (4 digit code)

- Assembly Number (ZusBau: prog. part # for powertrain)

- E word (Additions to the standard series not in the SA)

- HO word (center installed options using 3 digit option codes: not used yet)

- Special-equipment codes (3 digit SAs, up to 100 possible entries)

The FA may be read out and printed using the E65 programming software (CIP). Any options installed at the BMW center will be able to be registered and input using the FA editor function.
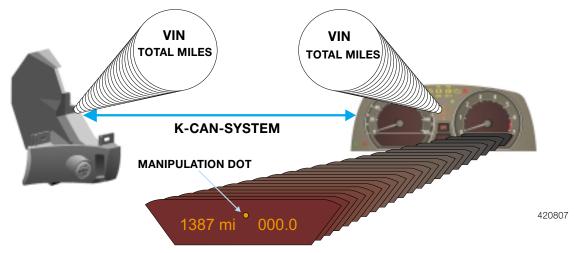
CBS (Condition Based Service) Data

The CBS (Condition Based Service) data are saved in:

- Remote controls (key)

- The EEPROM of the CAS

- Kombi

The CAS reads the data from the vehicle electrical system (DME (ECM), DSC, KOMBI etc.). If terminal 15 is switched off, the CAS saves the data into the remote control.

Vehicle Mileage Storage

To prevent the vehicle-specific data from being lost when the instrument cluster is replaced, they are stored redundantly in the CAS. Mileage is only transferred from the KOMBI to the CAS when the stored VINs match.

VIN
TOTAL MILES

VIN
TOTAL MILES

K-CAN-SYSTEM

MANIPULATION DOT

1387 mi   000.0

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Workshop Hints

Installation of a New CAS

A new CAS must ordered on a VIN-specific basis (key number, vehicle identification number, standard equipment) and installed in the relevant vehicle.

The new CAS must then be coded using the BMW DISplus, GT-1 or MoDiC III. Alignment of the CAS and DME (ECM) must also be carried out, only then can the engine be started.

Installation of a used CAS control unit is of limited use, as it will not be possible to open the vehicle using the original remote control or start the engine.

Replacement of Both CAS and Instrument Cluster (two new components)

Where possible, this should be avoided, as the current mileage reading and all the CBS data are irretrievably lost!

If both control units have to be replaced at one time, the following installation sequence is recommended:

1. Replacement of the instrument cluster
2. Coding of vehicle identification number
3. Terminal 15 OFF/ON (possible data transfer)
4. Replacement of the CAS
5. Coding of vehicle identification number
6. Terminal 15 OFF/ON

When terminal 15 is switched on again, the manipulation dot is extinguished. The communication between the instrument cluster and the CAS for redundant data storage is now available.

Remember, when replacing a CAS or KOMBI:

• The manipulation dot is set if the vehicle identification number in the CAS is different from the vehicle identification number in the instrument cluster.

• If the vehicle identification numbers are different, data exchange takes place in the working memory of the instrument cluster; however, no data is stored permanently.

• The instrument cluster adopts the data from the CAS if the CAS has a higher mileage reading than the instrument cluster and the vehicle identification numbers match.

• The CAS adopts the data from the instrument cluster if the instrument cluster has a higher mileage reading and the vehicle identification numbers match.

• The mileage is transferred from the instrument cluster to the CAS every 10 km (6 miles) of the trip. If at least 24 hours have elapsed between switching terminal 15 on and off, then another download is performed, regardless of the distance driven.

Diagnosis

Diagnosis of the various functions of the CAS are carried out using the Diagnosis Program of the DISplus, GT-1 or MoDiC. The Test Modules are automatically selected based on the faults stored or can be selected on the basis of a customer complaint.

The test modules are developed based on a specific function and may not deal exclusively with only the CAS.

"Expert Mode" diagnosis is available in the Control Unit Functions mask. The available functions are:
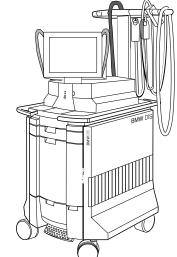
- Identification page
- Read fault memory
- Clear fault memory
- Diagnosis Requests
    - Transponder data
    - Programming data
    - Internal hall sensors
    - Inputs
    - Terminal Statuses
    - Remote Controls
    - Remote Control battery status

Blocking Remote Controls

If a Remote Control is lost, it can be blocked using the Test Module "Key Bar/Release" located under the "Service Functions" menu.

- Insert another valid and released remote control.

- Identify the lost Remote Control: To identify a lost Remote Control, it is necessary that all physically present remote controls are presented to the CAS.

- Read out the numbers of all Remote Controls via the CAS.

- Determine the number of the lost Remote Control from the available key numbers.

- Block the lost Remote Control with the Test Module

If the Remote Control is found again it can be enabled again in the same way.

Review Questions

1. What are the principle functions that the CAS is responsible for?_____

_____

_____

_____

_____

2. What is the ZAS? How can the ZAS be helpful in determining if the CAS is asleep?

_____

_____

3. Between which two Bus lines does the CAS act as a "Gateway"?_____

_____

4. What is required before the "wallet" key can be used in the ZAS?_____

_____

5. What is the frequency of the Remote Controls for the E65?_____

_____

6. How can the customer cycle between KL R and KL 15 without starting the engine?
   How are the different control modules aware that a terminal has changed state?

_____

_____

_____

7. What important vehicle data is stored in the CAS? Where else in the vehicle is this data
   stored redundantly?

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