Table of Contents

E90 Entertainment and Communication

Subject	Page

Entertainment and Communication

Model: E90

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Identify the different audio systems available

- Access service mode on the RAD2

- Know the TCU variant offered as optional equipment

- Understand what systems can play back MP3/MWA files

Introduction to Information & Communication Technology

Information and Communication Technology refers to various systems in the vehicle that that inform or entertain the driver and passengers.

Depending on the equipment configuration (BMW Assist), the IKT also serves the purpose of making available servicing-relevant data and sending messages in the case of emergency.

For the first time in this vehicle class, a fibre optics-based bus is used for data transmission in information and communication applications (IKT). This bus is the so-called MOST (Media Orientated Systems Transport) bus as already used on the E65, E60 and E63/4.

In this section you will be informed about the information and communication technology available in the new BMW3 Series (E90). It deals with the following topics:

- Audio systems
- Navigation systems
- Telephone systems
- Voice recognition systems

Audio Systems

Two audio sources are offered on the E90. Both are on the MOST bus and have CD playing capabilities.

The base version utilizes a single cd drive and a dual LCD line readout and is referred to as the RAD2 ('Professional' radio). This audio system can be ordered as a HiFi system with 180 Watt capability or upgraded to Top-HiFi Logic7 with 420 Watts of power.

The second audio source is the familiar Car Communication Computer (CCC or Navigation system, Professional). Because the CCC does not have an LCD readout, it utilized the CID as a visual monitor. A vehicle equipped with CCC will always come with the Top-HiFi Logic7 system with 420 Watts of power as standard.

The following new features have been introduced:

- New 'Professional' radio with MOST capabilities (RAD2 and CCC)
- Additional audio input for external devices
- Playback of MP3 files (RAD2 Directly / CCC with CD Changer)

System Components and Features

Radios Overview

	'Professional' radio	'Professional' navigation system
	SA663	SA609
Designation	CD-73, MD-73	CCC
Display	Two-line	CID 8.8"
Manufacturer	Alpine	Siemens VDO
Bus connection	K-CAN, MOST	K-CAN, MOST
AM tuner range	Single LW,MW	Single LW,MW,SW
FM tuner (RDS)	Single	Double
FM diversity	Yes	Yes
CD	Yes	Yes
MD (instead of CD)	---	---
DVD	---	Yes
MP3 playback	Yes	Planned
Audio jack		Yes
AUX level matching	Yes	---
Top-HiFi operation	Yes	Yes
Telephone operation	Yes	Yes
CD changer operation	Yes	Yes

The E90 is equipped with RAD2 ('Professional' Radio) as standard equipment.

'Professional' Radio (Rad2)

The 'Professional' radio is a new radio for the MOST system network.

The radio combines the following features:

- Player for CD/MP3/WMA files
- Most bus gateway to the K-CAN
- Board computer readout
- Built in single radio tuner
- Liquid crystal display
- Personal profile management

The MP3 directory structure is the same as that of a PC. Up to 8 directory levels can be represented. A maximum of 255 directories and a total of 999 music tracks per CD can be managed.

Navigation System, Professional

The 'Professional' navigation system is based on the CCC (car communication computer), the functions of which are already familiar from the E60 and E63/4.

The CCC combines the following control units in one housing:

- Navigation computer/GPS module; Map display and/or arrow view on CID (split screen)
- RDS double tuner
- Audio system controller (ASK)
- MOST gateway
- Interface to control display (LVDS)
- DVD player
- CD player

When the navigation system is not in use, its DVD drive can be used to play audio CDs.

Together with the controller and CID, the CCC forms the iDrive system.

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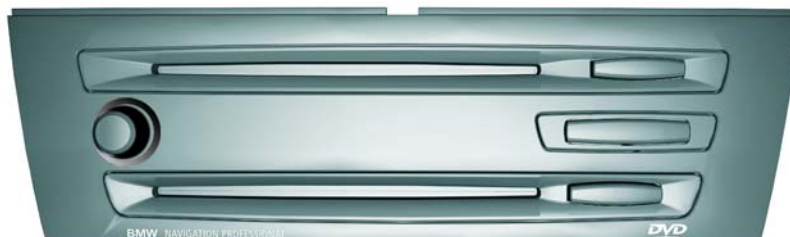
Amplifiers and Speakers

The audio systems in the E90 offers two choices:

- HiFi system -10 speakers w/separate amplifier
- Top-HiFi system (Logic7) - 13 speakers w/Logic7 amplifier

In addition to the higher achievable sound pressure, the audio systems are also distin-guished by the improved system fidelity. For the customer, the additional features such as the 7-band graphic equalizer and the spatial sound (Logic7) provide both visible as well as audible added value.

The central basses are located under the front seats. They are coupled to the side sills, thus enlarging the resonance volume necessary for bass reproduction.

The stereo, HiFi and Top-HiFi systems exhibit different performance features in terms of symmetry of the sound field, sound pressure and fidelity of the frequency response.

	HiFi	Top-HiFi
Rad2	Standard audio system	Optional
CCC	----	Standard audio system
Output	*180 Watts total:* 2 x 40W (2Ω) Bass 4 x 25W (2Ω)	*420 Watts total:* 2 x 70W (4Ω) Bass 7 x 40W (2Ω)
Max Sound Pressure	104 dB as from 50 Hz	110 dB as from 40 Hz
Bandwidth	40 Hz to 20 kHz	30 Hz to 20 kHz
Fidelity	± 3 dB	± 1.5 dB
Tweeter Manufacturer	26mm (medium) Harman/Becker	26mm (high) Harman/Becker
Mid-Rang Speaker Manufacturer	100 mm (medium) Harman/Becker	100 mm (high) Harman/Becker
Central Base Speaker Manufacturer	217 mm (medium) Harman/Becker	217 mm (medium) Harman/Becker

Note: Even though the diameters of the speakers in the HiFi and Top-HiFi sys-tems are the same, there are differences in the output of the speakers. This is achieved by the use of different materials for the diaphragms, coils, magnets etc.

To distinguish between them, the designations Medium and High are used in the table above.

■ HiFi System

The analogue 6-channel 'HiFi' amplifier has the same technical specifications as the one fitted in the E83. In the E90, however, it features settings specific to the E90 (diplexers, equalizing).

The HiFi amplifier is located behind the rear left side panel trim in the luggage compartment.

The audio signals are transmitted in analog form from the radios or navigation systems to the HiFi amplifier. This amplifier amplifies the signals and transfers them to the speakers.

A total of 10 speakers are driven by 6 audio channels:

- A high-range and mid-range speaker in each front door
- A tweeter and a mid-range speaker on each side of the rear shelf
- A central bass speaker under each front seat

HiFi System Layout

Index	Explanation	Index	Explanation
1	Rad2	5	Tweeter, front
2	Mid-range speakers, front	6	Tweeter, rear
3	Central woofers	7	HiFi amplifier
4	Mid-range speakers, rear		

HiFi System Circuit Diagram
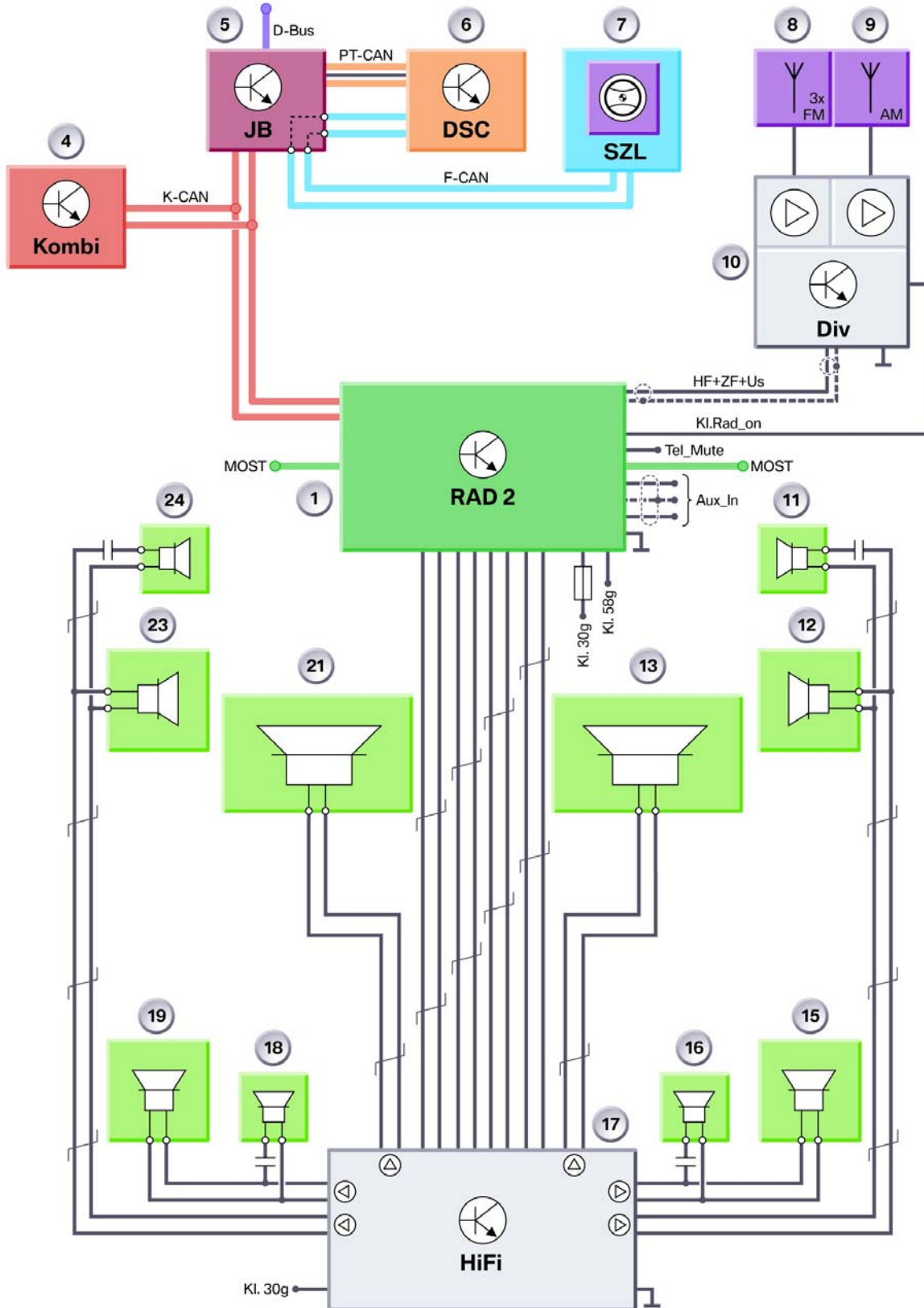
Legend for HiFi System Circuit Diagram

Index	Explanation	Index	Explanation
1	'Professional' radio (RAD 2)	16	Tweeter, rear right
4	Instrument cluster	17	HIFi Amplifier
5	Junction box control unit	18	Tweeter, rear left
6	Dynamic stability control	19	Mid-range speaker, rear left
7	Steering column switch cluster	21	Central base speaker, left
8	FM1, FM2 and FM3 aerials	23	Mid-range speaker, front left
9	AM aerial	24	Tweeter, front left
10	Antenna amplifier with diversity module	MOST	Media Orientated System Transport
11	Tweeter, front right	HF	High frequency signal
12	Mid-range speaker, front right	ZF	Intermediate frequency signal
13	Central base speaker, right	Us	Changeover voltage, AM/FM antenna diversity mode
15	Mid-range speaker, rear right	Aux_In	Audio input for additional audio sources
KL Rad_on	Control signal or power supply	Tel_ Mute	Radio muting during telephone operation

■ Top-HiFi System

The digital 'Top-HiFi' amplifier with Logic7 (Surround Sound) is of identical design to that used in the E60 and the E63/4. This amplifier is a MOST bus node and can be operated only with radios or navigation systems with MOST capabilities.

The audio signals are sent in digital form via the fibre-optic cable (MOST bus) from the radio or navigation systems to the 'Top-HiFi' amplifier. The amplifier converts the digital signals to analogue signals, amplifies them and routes them to the speakers.

The sound adjustment (7-band equalizer, spatial sound, fader etc.) takes place prior to the analogue conversion in the digital signal processor (DSP) of the amplifier. The Top-HiFi amplifier is installed in the same location as the HiFi amplifier.

Top-HiFi Amplifier Mounting Location

Index	Explanation
1	Logic7 amplifier

A total of 13 speakers are driven by 9 audio channels:

- A high-range and mid-range speaker in each front door
- A tweeter and a mid-range speaker on each side of the rear shelf
- A mid-range speaker in each rear door
- A mid-range speaker in the dashboard (Surround Sound)
- A central bass speaker under each front seat

Top-HiFi System Layout

Index	Explanation	Index	Explanation
1	CCC	6	Tweeter, rear
2	Mid-range speakers, front	7	Top-HiFi amplifier
3	Central Woofers	8	CID
4	Mid-range speakers, rear	9	Mid-range speaker, front center
5	Tweeter, front	10	Mid-range speakers, rear doors

Top-HiFi System Circuit Diagram
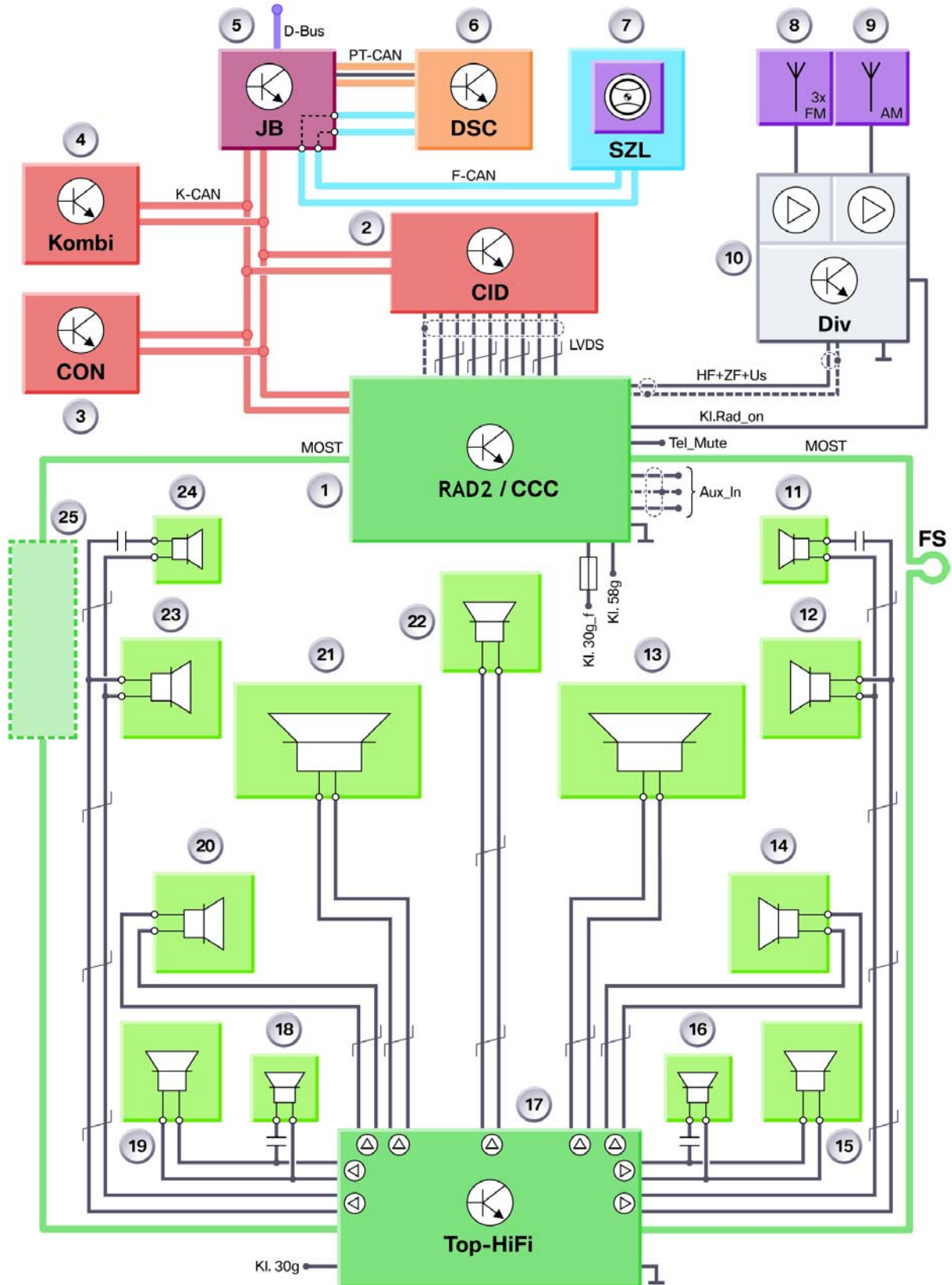
Legend for Top–HiFi System Circuit Diagram

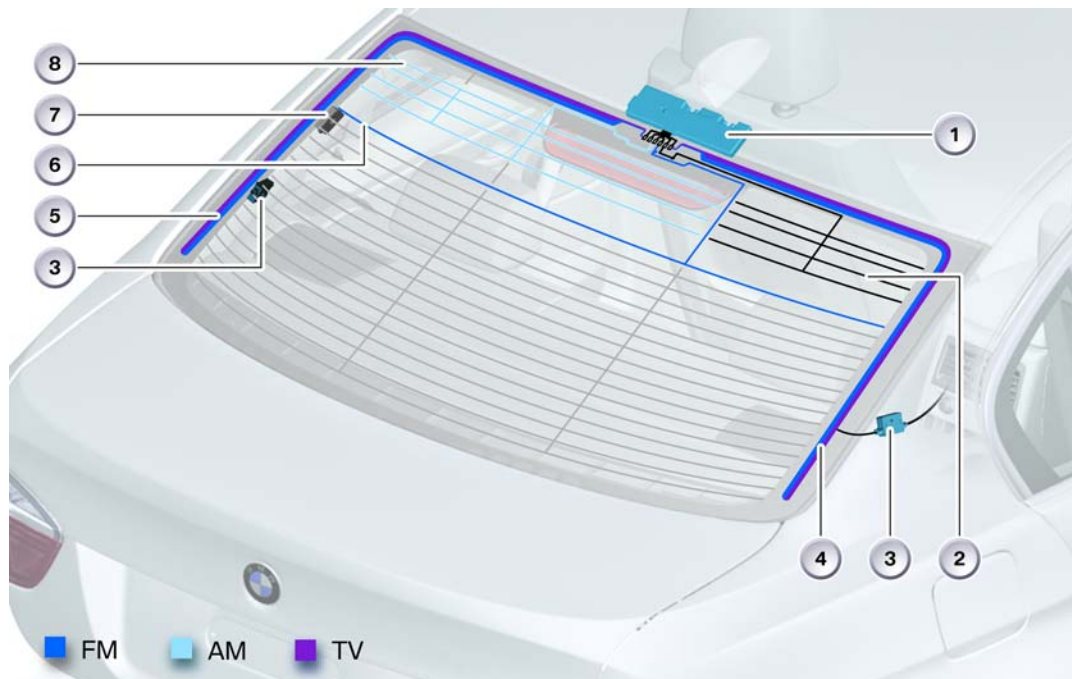| Index	Explanation	Index	Explanation
1	Rad2 or CCC	16	Tweeter, rear right
2	CID	17	Top HiFi (Logic7) Amplifier
3	Controller	18	Tweeter, rear left
4	Instrument cluster	19	Mid-range speaker, rear left
5	Junction box control unit	20	Mid-range speaker, rear left (door)
6	Dynamic stability control	21	Central base speaker, left
7	Steering column switch cluster	22	Center speaker
8	FM1, FM2 and FM3 aerials	23	Mid-range speaker, front left
9	AM aerial	24	Tweeter, front left
10	Antenna amplifier with diversity module	25	Other MOST bus consumers
11	Tweeter, front right	MOST	Media Orientated System Transport
12	Mid-range speaker, front right	HF	High frequency signal
13	Central base speaker, right	ZF	Intermediate frequency signal
14	Mid-range speaker, rear right (door)	Us	Changeover voltage, AM/FM antenna diversity mode
15	Mid-range speaker, rear right	Aux_In	Audio input for additional audio sources
KL Rad_on	Control signal or power supply	Tel_Mute	Radio muting during telephone operation
LVDS	Low voltage differential signaling (digital)	FS	Most direct access (loop)

Antennas

The E90 can have up to 5 aerial systems depending on the optional equipment fitted:

- FM/AM radio (rear-window aerials)
- Digital radio (roof antenna)
- Navigation system (roof antenna)
- TV (rear-window aerials) - not for US
- Telephone (roof antenna) additionally:
  - Bluetooth antenna in steering column trim panel for mobile telephone connection
  - Emergency aerial in left rear wheel arch (only if premium package or option SA639)

In addition to those, there is also:

- Aerial for the remote control services (FBD)
- 6 aerials for the Comfort Access system (from 9/2005 option 322)

Antenna Locations

Index	Explanation	Index	Explanation
1	Antenna amplifier with diversity module	5	FM2 and TV2 aerial
2	FBD Aerial	6	FM1 antenna
3	Lockout circuit (filter)	7	Third brake light (HBL) filter
4	FM3 and TV1 aerial	8	AM aerial

Note: An HBL filter is fitted suppresses interference from the third brake light.

Radio Antennas

The high-frequency signals from the radio transmitters are received via the rear-window aerials (FM1, FM2, FM3 and AM).

The aerial amplifiers are in the Diversity module. There are separate ones for AM and FM.

The combined aerial amplifier and Diversity module is located on the headliner above the rear window, concealed behind a cover.

Both aerial amplifiers are supplied with direct current when the radio is switched on (via terminal Rad_On).

The high-frequency signals from the AM and FM aerials are passed via a ribbon cable from the rear window to the combined aerial amplifier and Diversity module.
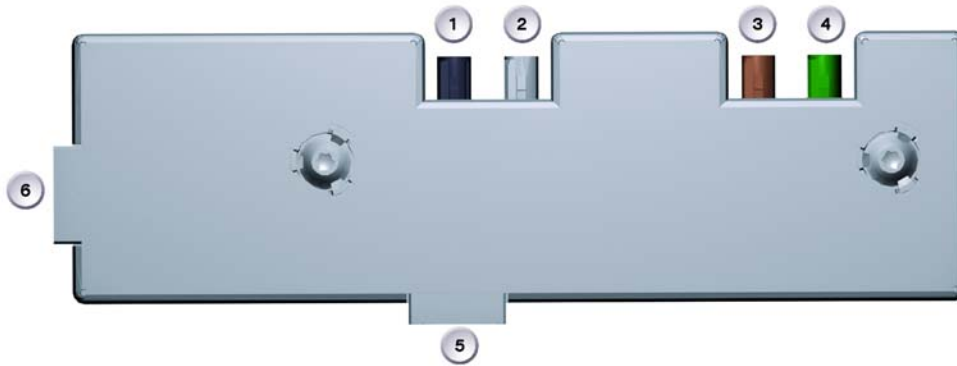
Aerial Amplifier and Diversity Module

Index	Explanation	Index	Explanation
1	AM/FM tuner signal connector (black)	4	TV1 signal (green) not for US
2	not for US	5	6-pin rear window aerial antenna
3	TV2 signal (brown) not for US	6	6-pin power supply and FBD connector

■ FM Antenna Diversity

A quadruple FM aerial diversity system is fitted as standard on the E90.

FM antenna diversity comprises:

- FM1, FM2 and FM3 aerials
- FM4 aerial, formed by combining the signals from the FM1 and FM2 aerials
- FM antenna amplifier with antenna diversity module

For reasons of space, the rear window of the E90 can accommodate only three FM aerials. The FM4 aerial is not a physical component. To improve FM reception, the FM4 aerial is created by overlaying the HF signals from the FM1 and FM2 aerials.

The signal quality of the currently selected FM antenna (FM1 to FM4) is evaluated and assessed in the diversity module. The next FM antenna is selected if the signal quality of the received radio station deteriorates in connection with the active antenna. The changeover takes place such that no interruption can be heard.

The high-frequency signal from the active FM aerial at any particular time is fed by the aerial amplifier and Diversity module via a co-axial cable to the tuner in the radio or navigation system. The signal is demodulated in the tuner and output in the form of an audio signal through the speakers.

The radio or navigation system detects that a diversity module is installed and generates the changeover voltage Us and the intermediate frequency signal (ZF) necessary for diversity operation. The ZF signal is analyzed by the electronic circuitry in the diversity module and is a copy of the currently selected radio station transmission on a fixed frequency of 10.7 MHz.

The changeover between AM reception, FM diversity mode and diagnosis mode is effected by means of the DC voltage signal Us. This voltage is generated by the radio and used in the diversity module for evaluation purposes.

Diversity mode is active at Us = 2.5 V. AM mode is active at Us = 0 V, i.e. the FM1 antenna is selected. Diagnosis mode is active at Us = 5 V.

In total, up to three signals are therefore applied on the coaxial cable simultaneously.

- HF signal (e.g. 87.5-108 MHz) from diversity module to radio
- Control DC voltage Us from the radio to the diversity module
- Intermediate frequency (f_{IF} = 10.7 MHz) from the radio to the diversity module as the basis for evaluating the quality of the RF signal.

Diversity Module Internal Schematic
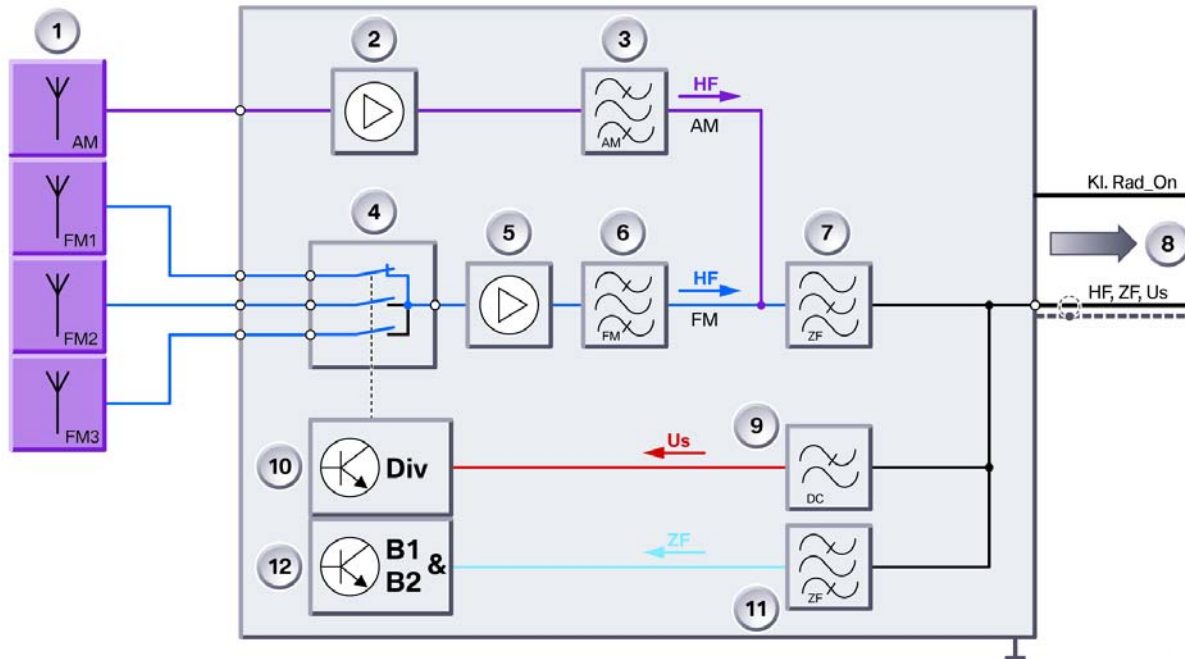
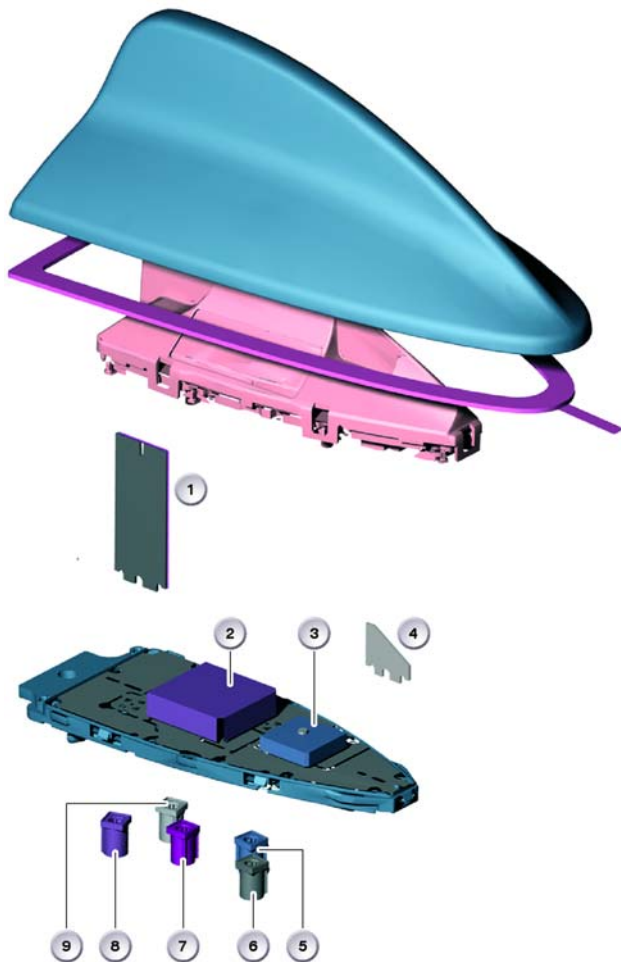| Index	Explanation	Index	Explanation
1	Rear-window aerials FM1, FM2, FM3 and AM	7	Band-block filter for IF signal
2	AM aerial amplifier	8	Coaxial line to radio
3	Band-pass filter for AM signal	9	DC filter
4	Aerial changeover switch for FM aerials	10	Diversity electronics
5	FM aerial amplifier	11	Band-pass filter for IF signal
6	Band-pass filter for FM signal	12	Demodulator with signal evaluation based on level and noise component
KL Rad_on	Control signal or switched voltage supply from radio	HF	RF signal to radio
Us	Antenna diversity changeover voltage from radio	ZF	IF signal from radio

■ Roof Aerial

There are two different variants of roof antenna for the E90:

- Vehicle equipped with TCU - GPS antenna needed for telematic feature
- Vehicle equipped with SDARS (Satellite Digital Radio Service - Sirius)

The roof aerial for SDARS reception has a larger housing compared with the version without satellite radio capability.

Specifically, the roof aerial for all possible equipment options on the US version comprises:

- Mobile phone aerials
- Telematic Control Unit (TCU) telephone aerials
- GPS antenna
- SDARS aerial for satellite reception
- SDARS aerial for terrestrial reception

Index	Explanation
1	Telephone aerials for mobile phone and Telematic Control Unit (TCU)
2	SDARS aerial for satellite reception
3	GPS antenna
4	SDARS aerial for terrestrial reception
5	GPS signal connector color code: blue
6	SDARS signal, terrestrial
7	Telephone signal: connector color code: Bordeaux violet
8	SDARS signal, satellite
9	Telephone signal: connector color code: Grey

SDARS Roof Aerial

SDARS Satellite Tuner

The SDARS satellite radio is the same as the satellite tuner fitted on the E60, E61, E63 and E64.

It enables reception of digital radio signals. These are of a higher quality that analog transmissions.

Advantages of digital satellite radio:

- Reception of same radio station across the entire US mainland (excluding Alaska)
- Digital reception of music, news and talk stations
- Wide choice of available music genres
- No commercial breaks
- Digital signal transmission provides greater immunity to external interference

Only the SDARS system developed by Sirius Satellite Radio is supported. This uses three satellites which follow an elliptical orbit around the Earth. Because of the arrangement of the orbits, there are always two satellites over the reception area.

In large urban areas where there are obstructions (e.g. tower blocks, tunnels) or in situations where there are topographical features (e.g. mountains) that block the satellite signals, terrestrial transmitters are used to relay the signals.

The separate satellite tuner is necessary because the signals are transmitted in the gigahertz band (microwave band).

The satellite tuner is located in the trunk above the recess, on the left (when viewed from the rear) next to the Telematic Control Unit (TCU).

Location of SDARS Tuner and TCU

CD Changer

All E90 vehicles come pre-wired for CD changer.

The option SA672 for the E90 is a new "CD changer for 6 CDs" (CDC). The CD changer is a MOST network node and differs from the MOST-compatible CD changer on the E60 and E63/4 by virtue of its support for MP3 files and WMA files.

The CD changer is located behind a flap on the left in the luggage compartment.

If the vehicle is equipped with the HiFi audio system, the digital data of the CD is sent via the MOST bus to the radio or navigation system. Here they are converted to analog data and output via the amplifier and the speakers.

If a 'Top-HiFi' system (Logic7) is installed, the audio data is transmitted in digital form via the MOST bus from the CD changer directly to the Top-HiFi amplifier, from where it is output. This direct transmission bypassing the radio and the navigation system is possible as data conversion and sound adjustment take place exclusively in the Top-HiFi amplifier.

The CD changer supports playback of MP3 CDs. The MP3 files are decoded in the CD changer.

Note: Because MP3s are compressed audio files, it can take the player up to 20 seconds to decompress and read the information from a CD before audio is heard.

The fibre optic conductors for connecting the CD changer are arranged at the fiber optics connector in the luggage compartment such that they are not incorporated in the MOST ring. After retrofitting a CD changer, the fibre optics conductors for the CD changer preparation are unplugged at the fibre optics connector and connected to the MOST ring. Coding of the system will be necessary.

Audio Jack

The audio jack (AUX-In) is used to connect an external audio source such as MP3, cassette, or CD playback devices. It is a standard feature with both the RAD2 and CCC.

It is located below the center armrest. A 12 V socket outlet is located in the immediate vicinity of the audio jack. Connection of the external audio source is provided by means of a 3.5 mm latch connector.

Fine adjustment of the playback volume is possible with the RAD2 radio. The purpose of the adjustment is to prevent volume differences that can occur when switching between different audio sources. The CCC does not have the line volume balancing option.
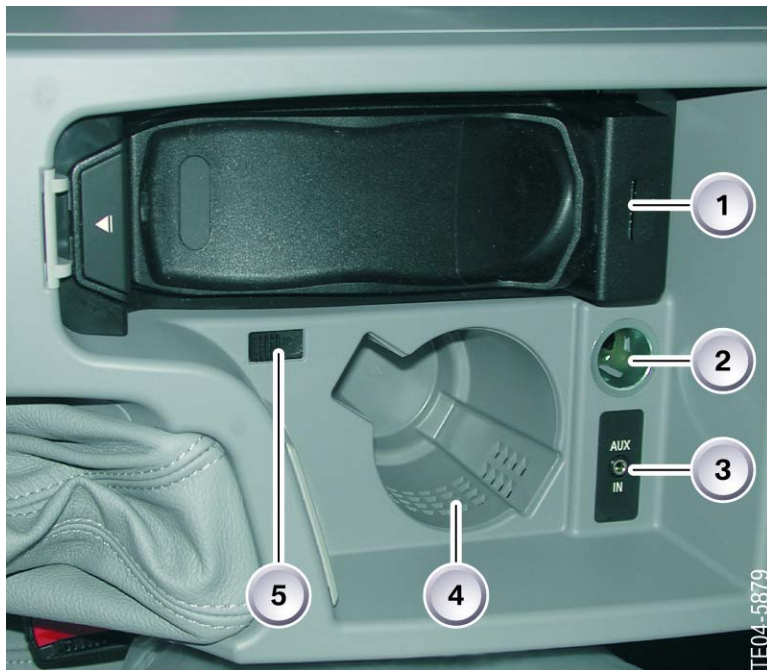
Audio Jack Location

Index	Explanation	Index	Explanation
1	Eject box	4	Drink/electronics cooler
2	12V DC socket	5	Switch for cooler
3	Audio jack		

Service Information

Radio Service Mode

In the case of customer complaint or malfunctions, certain important functions can be checked directly at the radio with the aid of service mode. This service mode can also be used to implement settings that are not intended for the customer. For this purpose, it is first necessary to enter service mode. This procedure differs for the RAD2 and CCC.

■ Accessing Service Mode - Rad2

- Switch on radio

- Within 8 s, press and hold the "m" button for at least 8 s

- The various menus can be selected in service mode
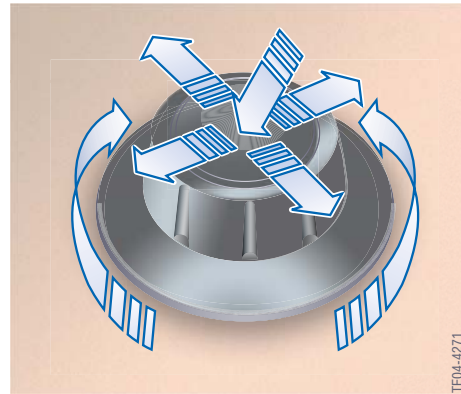
- Switch off the radio to exit service mode

■ Information Available

Menu	Display content (example)	Explanation
Serial number	AL87013SPL0122	Serial number of device
Type	MC57CD72	Radio type
SW Ver	H8S 00-0000 4.25.1 ST10 18-3203 4.40.4	Device software status
Revision index	02	Revision index
GAL	3	Set level of speed-dependent volume control
ANT	AUTO	Aerial selection: ANT1 = FM1 aerial ANT2 = FM2 aerial ANT3 = FM3 aerial ANT4 = FM1 and FM2 aerials AUTO = Automatic selection of FM aerial with best reception
F/Q	FM1 1 89.3 5 11	Current FM memory Current memory location Current frequency Field strength of current station Signal quality of current station
DSP/Volume	DSP 1 V4	DSP 0 = No DSP installed DSP 1 = DSP installed V = Volume setting increment
TP-V	0	Traffic information setting, minimum volume Setting range: -9 to +9
Display check		Display check
Area	ECE	Country-specific version: ECE = Europe USA = United States JPN = Japan OCE = Oceania
AF	Auto	RDS and alternative frequency tracking: RDS Off = RDS function not available as soft-key button. AF Off = RDS function available, alternative frequency tracking off AF Man = RDS function available, alternative frequency tracking only active in mute pauses (e.g. station selection via station buttons, frequency band change, telephone muting) AF Auto = RDS function and automatic alternative frequency tracking active
Key memory	ON	To switch car and key functions on and off

■ Accessing Service Mode - CCC

The only information available in the CCC are software, hardware, and system status numbers. The information is primarily intended for equipment development purposes. More is planned for the future.

- Open Start menu
- Press and hold Controller for at least 10 s
- Move Controller 3 stops to the right
- Move Controller 3 stops to the left
- Move Controller 1 stop to the right
- Move Controller 1 stop to the left
- Move Controller 1 stop to the right
- Press Controller once

To exit Service mode press the Menu button.

Reset

The RAD2 can only be reset by the following procedures:

- Switch system ON/OFF
- Disconnect from vehicle electrical system
- BMW diagnosis system

There is no button or key combination on the device for performing a reset.

The 'Professional' navigation system (CCC) can be reset by simultaneously pressing and holding the eject buttons on the DVD and CD player and the rotary push-button for approximately 10 s. The CID becomes blank. The CCC is then restarted.

3 The MOST gateway ('Professional' radio, M-ASK or CCC) is muted for 2 s when resetting a MOST control unit. 1

Interference in Radio Reception

Check the following in the event of interference in radio reception:

- Power supply terminal Rad_On for the antenna amplifiers in the diversity module.
- Antenna connector at diversity module
- Antenna connector at radio or navigation system

Note: Care must be taken as the antenna plug connection may be damaged due to the restricted package space behind the CCC.

Service Concept

The following are replaced as complete units:

- 'Business CD' radio
- 'Professional' radio
- 'Business' navigation system (M-ASK)

The service concept of the CCC permits replacement of individual assemblies. It is based on the concept implemented on the E60. The following assemblies can be replaced:

- Fan
- CD and DVD player
- Front panel
- HIP, gyro sensor
- Tuner/audio board

Observe the electro-static discharge (ESD) guidelines when replacing components.

MP3/WMA Playback

Note: The information provided in the following is of a general nature and not specific to BMW.

MP3 stands for MPEG Layer 3 and is a compression method for audio data which achieves very high compression ratios. MP3 makes use of a phenomenon that is associated with psychoacoustics: Human beings do not hear everything that theoretically could be heard - in any case not consciously. Based on the characteristics of human hearing, the MP3 inventors at the German Fraunhofer Institute have developed perception-adapted audio coding whereby part of the digital sound information normally found on the CD is simply omitted. These are sounds that most people do not consciously perceive, e.g. very high or very low sounds. In addition, components of the sound signals are omitted that are of no significance with regard to the sound impression but enabling the very high compression values.

MPEG is the abbreviation for Moving Picture Experts Group. The experts group is an organization that has created standards for the compression of film data. The standards for audio compression were later added.

MPEG layer 1 and layer 2 are the predecessors of MP3. They achieve compression rates which, however, do not approach those of Layer 3. Layer 1, for example, is used in connection with digital music cassettes and Layer 2 for DAB (Digital Audio Broadcast). All three compression methods (Codecs, see below) are downward compatible, i.e. a Layer-3 decoder will also play files that are coded in accordance with Layer 1 or Layer 2.

The computing power for MPEG Layer 1 to 3 is to a high degree asymmetric. This means that the computing power for MP3encoding is substantially higher than for MP3 decoding.

Since all the values achieved during the coding procedure are stored in the MP3 file, the work of the decoder is restricted to interpreting these values. All three layers support the following sample rates: 32 kHz, 44.1 kHz or 48 kHz. As part of MPEG audio coding, a filter array converts the audio signal to be encoded from the time range to the frequency range. During this procedure it is initially subdivided into 32 frequency ranges (subbands). Prior to MPEG Layer 2, all 32 sub-bands had the same width of 625 Hz. Only with the advent of Layer 3 have the sub-bands been adapted to the characteristics of the human ear (psychoacoustic model). The audio signal subdivided into frequency ranges provides the algorithm with distinctly more working area or depth for data reduction than the uniform audio signal.

The MP3 encoder examines each sub-band individually and removes frequencies that are deemed dispensable based on the fundamental psychoacoustic model and compresses the remaining audio data.

◼ Bit Rate

Compression of audio data using the MP3 method reduces the data volume corresponding to the selected target quality to a fraction of the original volume. A decisive factor governing the music quality of an MP3 file is the data transmission rate - referred to as the bit rate. In connection with MP3, the bit rate is measured in kiloBits per second. The higher the bit rate, the higher the quality of the result. However, this also increases the size of the data volume to be stored.

Overview of MP3 quality stages

Sound quality	Mode	Bit rate	Compression ratio
Telephone	Mono	8 kBit/s	96:1
Better than SW radio	Mono	16 kBit/s	48:1
Better than MW radio	Mono	32 kBit/s	24:1
Similar to UHF radio	Stereo	56 to 64 kBit/s	26:1 to 24:1
Approaching CD quality	Stereo	96 to 112 kBit/s	16:1 to 14:1
CD quality	Stereo	128 to 192 kBit/s	12:1 to 8:1

There are both fixed and variable bit rates which, however, are not supported by all MP3 players. The traditional method of audio coding CBR (Constant Bit Rate) maintains a constant bit rate during the entire recording. In connection with the variable bit rate method (VBR), the bit rate drops to a lower level when a section in a song contains little sound information. As a result, the bit rate is frequently reduced to 32 kBit/s or less. In sections with large quantities of sound information, the bit rate increases to a specified maximum which is normally at 128 or 192 kBit/s. The advantage of the variable bit rate is an overall better sound quality with reduced file sizes.

While MP3 is better suited for coding at higher bit rates, the WMA format (Windows Media Audio) is appropriate for lower bit rates. When using WMA format, even recordings with a bit rate of only 64 kBit/s sound acceptable. The data loss at a constant bit rate is less noticeable than in an MP3 file. However, outstanding bass reproduction at 64 kBit/s cannot be achieved in any format. WMA is much better suited than MP3 for ultralow bit rates (e.g. 16 kBit/s).

Navigation System

The 'Professional' navigation system is based on the CCC (already familiar from the E60 to E63/4) and features the following range of functions:

- Navigation with map and arrow mode

- Display on 8.8" color CID

- Split-screen view

- Perspective map presentation

- Input via controller with electrically controlled feedback, optionally controlled by voice commands (SVS)

- The navigation DVD from the E60 to E63/4 can be used in this system also.

The higher-grade V-Info Plus (Vehicle Information Plus) service can be activated. It can only be used if a Telematic Control Unit is fitted and BMW Assist is enabled.

Navigation Map with Arrow Display   **Navigation Map Perspective View**

System Circuit Diagram
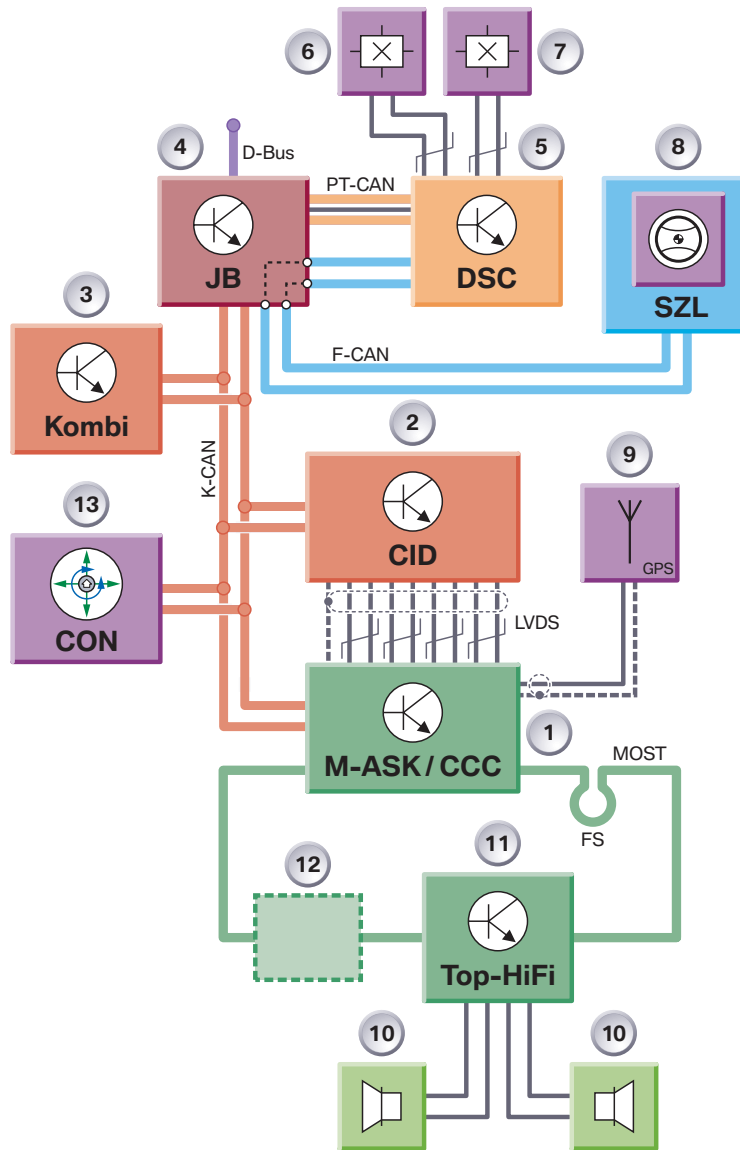
Index	Explanation	Index	Explanation
1	CCC	7	Wheel speed sensor, rear right
2	Central information display	8	Steering column switch cluster
3	Controller	9	GPS antenna
4	Junction box control unit	10	Audio speaker
5	Dynamic stability control	11	Audio amplifier
6	Wheel speed sensor, rear left	12	MOST components (optional)
LVDS	Low voltage differential signal	MOST	Sliding element
FS	MOST direct access		

System Components and Features

This section describes the two navigation systems available on the E90. With few exceptions, with regard to function, display and operation, these navigation systems correspond to the navigation systems used in the E60.
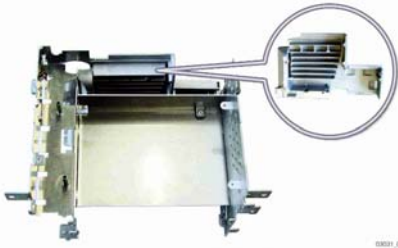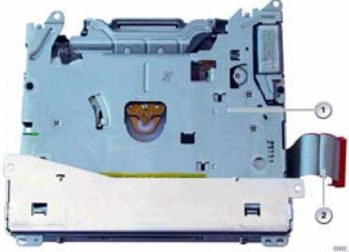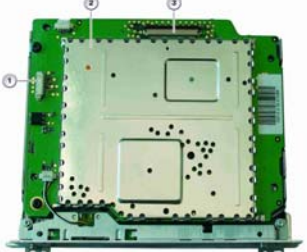
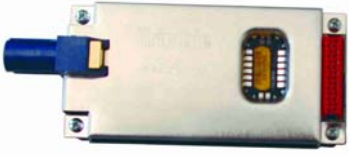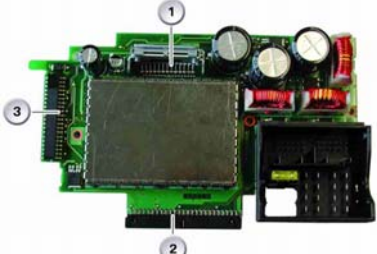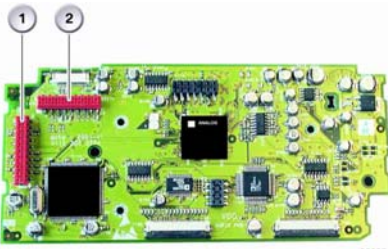The navigation systems is made up of the following components:

- Navigation computer with GPS receiver and yaw rate sensor in the M-ASK or CCC control unit
- GPS antenna
- Double tuner (radio/TMC data)
- DVD-Drive with Navigation DVD

Additional information:

- Wheel speed sensor information from DSC control unit (bus message)
- Reverse gear signal from footwell module (bus message)

CCC

|		
▨ **Housing**		The car communication computer is accommodated in an aluminium casing. The size of the car communication computer corresponds to two radio DIN casings.
▨ **Audio CD Drive**		The following types of CD can be played on the CD-ROM drive: - Audio CD
▨ **DVD Drive**		When the navigation system is not in use, the DVD drive can also be used to play audio CDs or audio CD-ROMs with MP3 files.

■ **HIP-Module (Host Independence Positioning Module)**		The HIP module contains the GPS receiver that has the task of converting and decoding the signals received from the GPS aerial.:
■ **Gyro Sensor**	03050_02	The gyro sensor is a separate module that is connected via plug contacts to the main board and is secured by a screw.
■ **Central Processing Unit**		In addition to the CPU (Central Processing Unit) further processors and main memories are mounted on the main board. The main board also contains plug-in slots for expansion boards.
■ **Power Board**	03034_02	The power board is located at the rear of the car communication computer. The FAKRA main connector for the power supply and the MOST connector are secured on the power board. The main connector provides the interface to the vehicle electrical system.
■ **Audio Board (ASK)**	03036_02	The ASK functions are located on the audio board. Two digital sound processors facilitate simultaneous conditioning of the audio signals and operation of the voice control system.

Back View of CCC
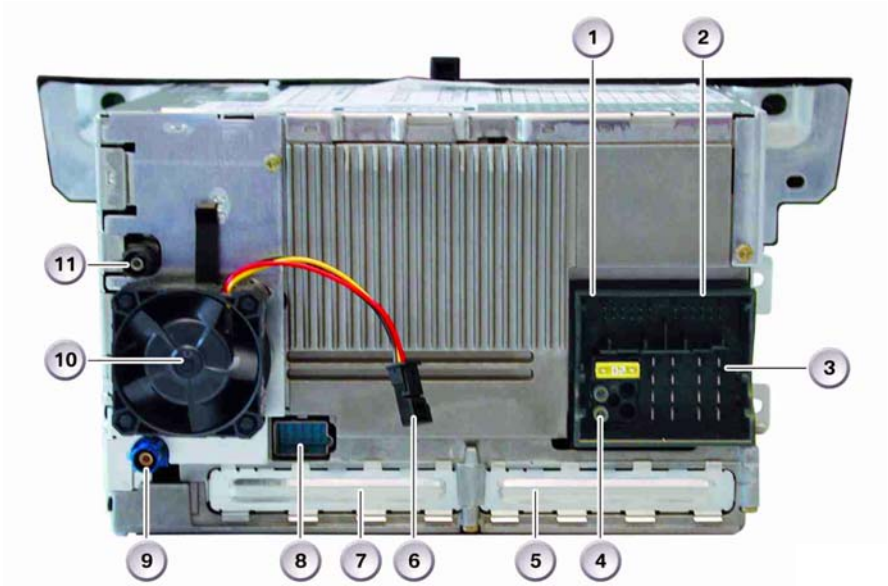
Index	Explanation	Index	Explanation
1	12-pin, left (AUX signal, fan)	7	Cover for expansion card
2	12-pin, right (not for US)	8	LVDS connection
3	16-pin	9	GPS antenna
4	MOST interface	10	Fan motor
5	Cover for expansion card	11	AM, FM antenna
6	Fan motor connection		

Inside Components of CCC
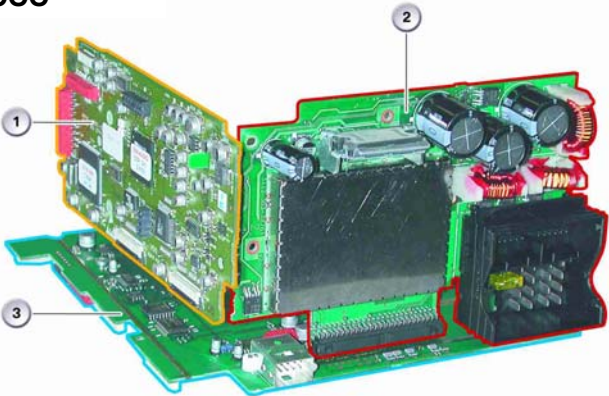
Index	Explanation
1	Audio board
2	Power board
3	Main board

Principles of Operation

Each satellite transmits messages with the following (simplified) information:

- Number of the satellite
- Current position of the satellite
- Message time

The satellite additionally broadcasts so-called orbit (path) and almanac data. These orbit and almanac data are stored in the navigation system and used for subsequent calculations to enable fast acquisition of the currently available satellites. Almanac data contain information on the orbits of all satellites, time correction factors and atmospheric delay parameters.

To determine the position, the GPS data are received by the GPS antenna in the antenna base and routed via a coaxial cable to the navigation computer (CCC). The GPS data are decoded.

To determine the location, the navigation system compares the time at which the signal was sent with the time at which the signal was received. The distance of the satellite can be calculated from this time difference. The time calculations are based on a highly accurate atomic clock (UTC: Universal Time Coordinated).

The current position can now be determined by adding measurements from other satellites. The GPS receiver can determine its position on the earth's surface with the aid of at least three satellites. This process is known as "2D position fix". Two dimensional because the receiver must assume that it is located directly on the earth's surface. The absolute spatial position can be determined with the aid of four or more satellites ("3D position fix"). The altitude is necessary, for example, on multi-tier road junctions and intersections.

Note: A clear view of the sky is necessary for the reception of GPS data. Rain or snow normally do not interfere with reception. However, a very dense cover of wet leaves or shadow areas such as high-sided buildings, rows of trees may impair reception.

In addition, depending on the time of day, there may be fluctuations in satellite reception at one location during a 24 hour period (example: Munich 5-10 satellites). This is due to the orbits of the satellites.

From these satellite signals, the navigation system calculates

- longitude
- latitude
- altitude from the satellite data.

Based on repeated measurements, the direction of movement and speed can also be calculated by way of GPS.

Navigation Mode

The present position is known at the start of the journey as it is either still stored or is checked/established at the time. When the vehicle is being driven, the navigation system receives the "distance covered" information from the DSC control unit via the bus (PT-CAN/junction box control unit/K-CAN).

The travel data from the wheel speed sensors is transmitted as a bus message. It is broadcast on the PT-CAN by the DSC. From there it is transferred to the K-CAN by the junction box control unit and passed to the navigation system.

The rear left wheel speed sensor supplies the information necessary for this purpose to the DSC control unit. If that wheel speed sensor fails, the rear right wheel speed sensors takes over.

The gyro sensor determines any changes in direction such as when cornering. Changes in altitude are not detected by the two dimensional gyro sensor. The current position can be determined by combined evaluation of the "distance covered" and "driving direction". The position calculated in this way is compared to the navigation data stored on the DVD.

If considerable deviations occur (incorrect calculations due to inaccurate sensor data, out-dated map data), priority is given to the current position determined by the GPS. During normal operation, the position is therefore determined during navigation operation based on correspondingly processing the wheel speed and yaw rate sensor information.

The footwell module makes available the "reversing" information in the form of a bus message to the navigation system and this information is taken into account in the position calculation.

On manual transmission vehicles, the reverse gear switch is located on the manual gearbox.

On automatic transmission vehicles, the reverse gear information is provided by the transmission control unit that detects the status of the selector lever position switch.

After the navigation computer has been disconnected from the power supply, it can take up to 10 minutes before the navigation system determines the current position as an update of the almanac data and the received satellite data is necessary in this case.

Delayed positioning can also occur after longer parking periods (e.g. holidays). The following aids are available for route guidance purposes:

- Display of current position on the screen
- Direction arrows as orientation for further road routing
- Distance information up to the next change in direction (turn off)
- Voice announcements for further route guidance
- Distance to destination
- Route list and destination list
- Calculated route indicated by a white line to the destination in the map presentation

Service Information

DVD
The navigation DVD of the 'Professional' navigation system (CCC) are compatible with other vehicles (e.g. E60) with the same equipment (CCC).

Note: If the navigation DVD is not recognized although the correct DVD is loaded in the player, the DVD should be removed and reinserted.

Media Ejection
If the navigation DVD is not ejected during normal operation by pressing the Eject button, carry out the following procedure:

- Reset CCC
- Press the Eject button several times during start-up

Alternatively, the system reset can be activated by means of the BMW diagnosis system (control unit functions).

Note: If a DVD does not want to eject from the CCC, Do NOT FORCE it out. No mechanical emergency release is provided on the DVD player to remove media.

Start-Up
After disconnecting the battery, due to the necessary data transmission, it may take up to 10 minutes before the navigation system correctly displays the current position.

Telephone

The E90 is equipped with the same TCU that is found in the E60 and E63/4 vehicles only if option code SA639 (Assist or Premium Package) is ordered.

The range of functions offered are as follows:

- The Telematic Control Unit is fitted as standard in order to provide the Telematic functions Emergency call (E-call) and Breakdown call (B-call)

- Dual band 800 MHz and 1900 MHz

- Combined NAD (network access device) transceiver module for the:
  - analog AMPS (American Mobile Phone Standard)
  - digital CDMA (Code Division Multiplex Algorithm) standard

Two different equipment levels are offered for the American market:

- Telematic Control Unit with Telematic functions Emergency call (E-Call) and Breakdown call (B-Call) without base plate or snap-in adapter.

- Telematic Control Unit with Telematic functions Emergency call (E-Call) and Breakdown call (B-Call) with base plate and snap-in adapter for a supported Bluetooth compatible mobile phone.

The telematic control unit is factory-programmed as "active" for Bluetooth. Consequently, any **supported** mobile phone can be linked to the vehicle.

The customer also has the facility for charging the mobile phone in the vehicle and making calls via the external aerial. The external aerial reduces the radiation exposure inside the vehicle.

There are optional components available for the TCU:

- Base plate
- Snap-in adapter for Bluetooth-compatible mobile phone
- Compensator (optional)

Location of SDARS Tuner and TCU

The Telematic Control Unit supports

- Telematic
- TeleService
- BMW Assist

The TCU has an embedded phone that can call out for these services as long as the vehicle is in an area with cellular phone coverage.

The Telematic option provides the following:

- Emergency-call button with emergency-call indicator lamp
- SOS speaker
- SOS antenna

The telephone aerials for TCU and mobile phone are integrated in the roof aerial. There is an emergency backup antenna on the rear parcel shelf.

The Bluetooth antenna is located behind the steering column trim panel.

The hands-free microphone for telephone calls and voice control of the telephone is in the roof function module (FZD) which is located on the driver's side.

TCU IPO
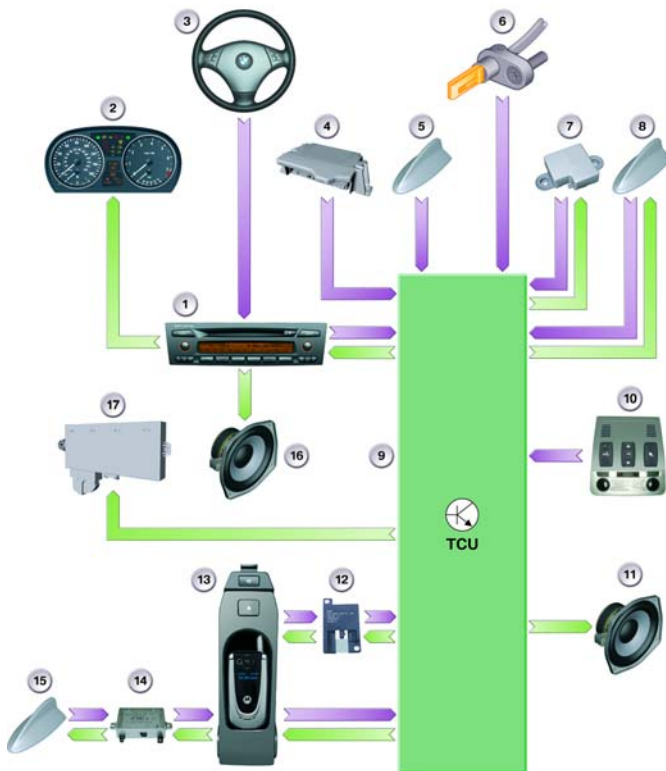
Index	Explanation
1	RAD2
2	Instrument cluster
3	MFL
4	MRS 5
5	Roof aerial (GPS)
6	Wheel speed sensors (x2)
7	SOS Antenna
8	Roof aerial (TCU)
9	TCU
10	FZD
11	SOS speaker
12	Bluetooth antenna
13	Snap in adapter with mobile phone
14	line compensator(optional)
15	Roof aerial (telephone cradle)
16	Audio speaker
17	CAS2

System Circuit Diagram
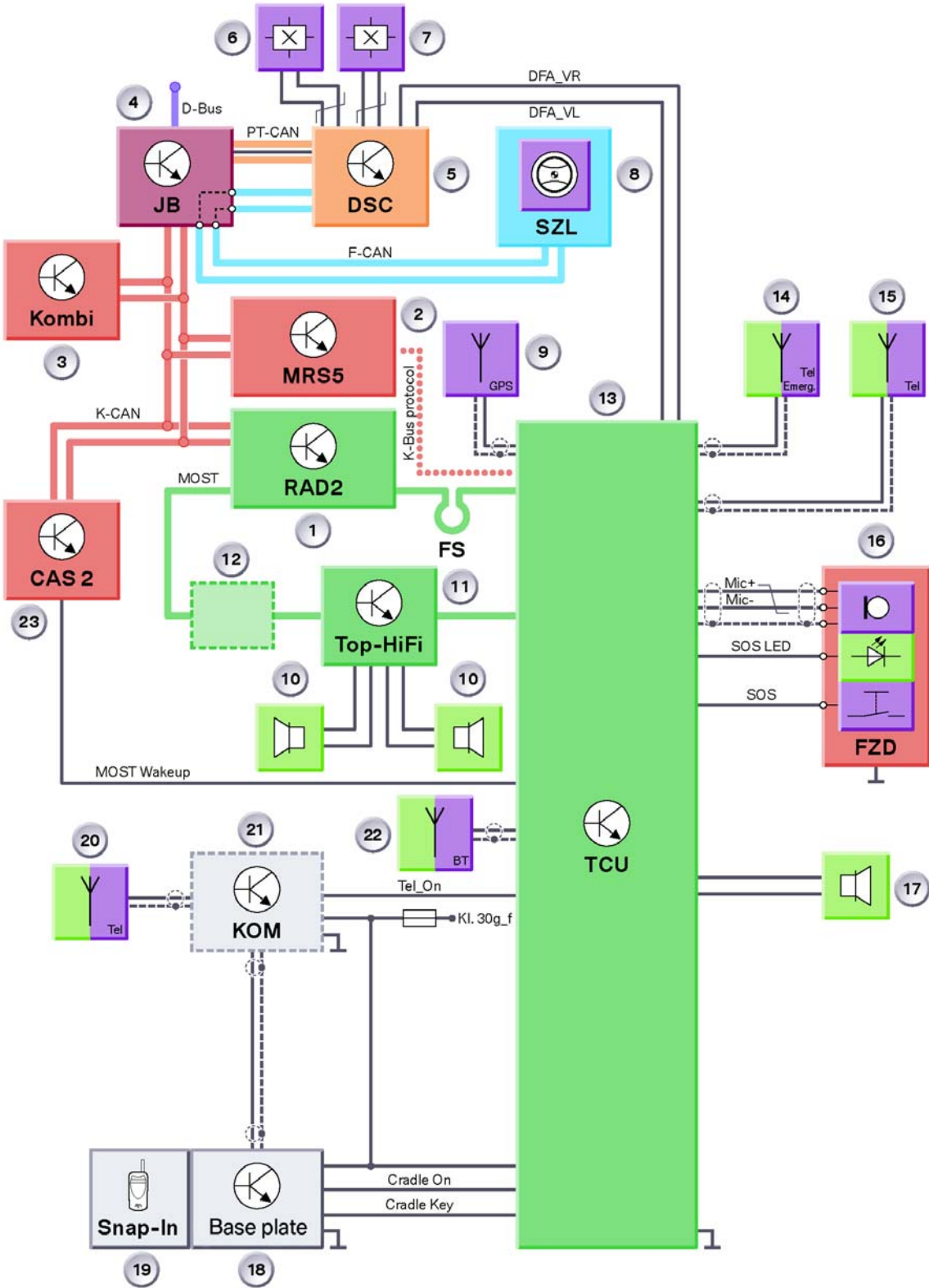
Legend for System Circuit Diagram

Index	Explanation	Index	Explanation
1	RAD2	13	Telematic control unit
2	Multiple restraint system 5	14	SOS antenna
3	Instrument cluster	15	Telephone aerial (TCU)
4	Junction box control unit	16	Roof function module (driver's-side microphone, emergency-call button with emergency-call indicator lamp)
5	Dynamic stability control	17	SOS speaker
6	Wheel speed sensor, left	18	Base plate
7	Wheel speed sensor, right	19	Snap-in adapter with mobile phone
8	Steering column switch cluster	20	Telephone aerial (mobile phone)
9	GPS antenna	21	Line compensator (optional)
10	Audio speaker	22	Bluetooth antenna
11	Audio amplifier	23	Car access system 2
12	MOST components (optional)	MOST	Media Orientated System Transport
13	Vehicle wake-up signal	FS	Service port MOST bus loop
DFA_VL	Wheel speed signal, front left	DFA_VR	Wheel speed signal, front right
Mic+	Microphone, positive	Mic-	Microphone, negative
SOS LED	Emergency-call indicator lamp	SOS	Emergency call signal
Cradle On	ON signal for the charger electronics in the snap-in adapter	Cradle Key	Call accept/transfer/pairing button
Tel_On	Telephone ON signal for compensator		

Service Information

Compatible Telephones
A list of all compatible bluetooth phones can be found in www.bmwcenternet.com.

Select Menu => BMW => BMW Assist => Bluetooth Handsets
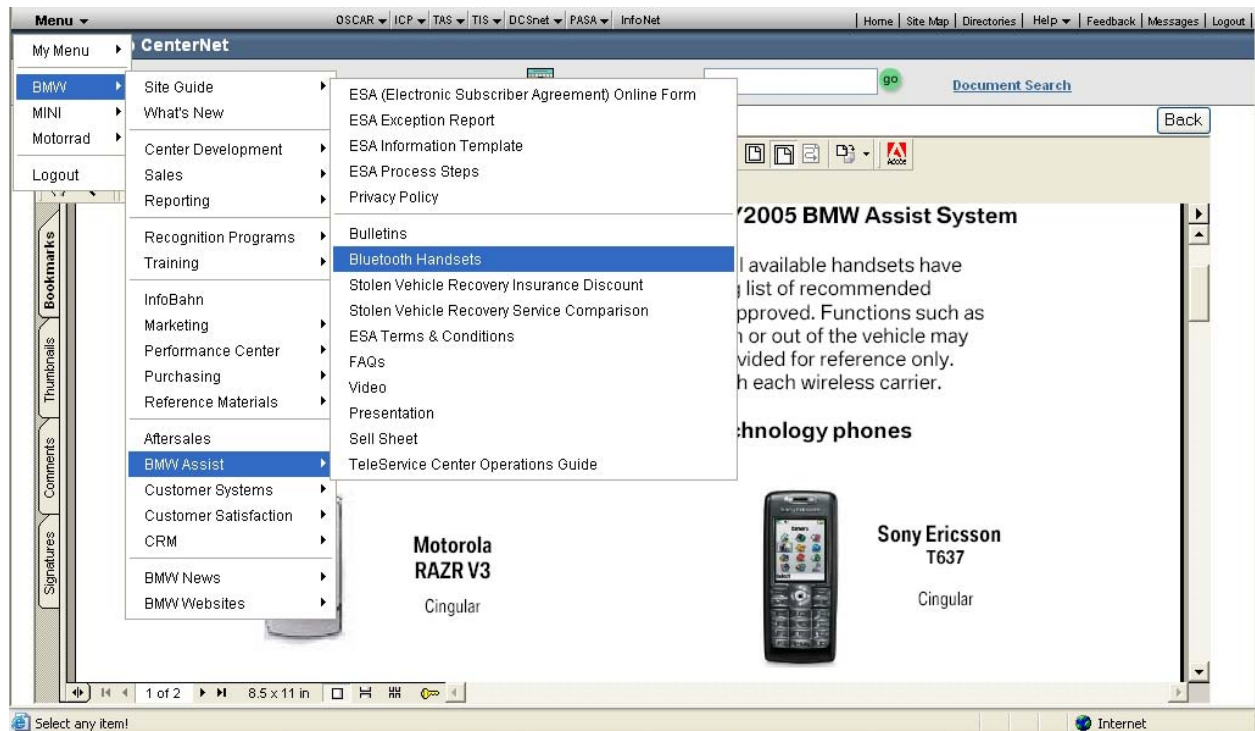
Pairing a Handset
A variable passkey that must have at least one character is used for the purpose of coupling Bluetooth mobile phones. A predefined key is no longer necessary.

v60i Phones
v60i phones will no longer be compatible on the E90.

Voice Recognition System

The E90 has two different variants of voice control:

- Internal of the TCU
- Internal of the CCC

TCU

Voice control for telephone functions comes as standard with all telephone systems. The voice control capability is achieved by means of software on the telephone control unit.

Voice control comprises the telephone function and a voice-controlled phone book that is separate from the address book on the mobile phone. Up to 50 names and telephone numbers can be stored.

The telephone book managed by means of voice control cannot be transferred to the mobile phone.

Note: The notepad function previously available with the ULF is not available on the E90.

The microphone for voice control of the telephone is located in the roof functions center on the driver's side. It is connected to the telephone control unit.

CCC

A more comprehensive voice recognition system is available with the option SA609 ('Professional' navigation system) as the voice recognition system is realized as software in the CCC.

Many of the functions that are otherwise selected via the controller in the CID can be operated by means of voice commands.

The microphone is located in the roof functions center on the passenger's side and is connected directly to the CCC.

The language of the voice recognition system cannot be changed in the CID. The language that can be selected in the CID (one of three languages) refers only to the display text and the announcement language for the navigation system.

During the CCC programming procedure, the language of the voice recognition system is programmed corresponding to the vehicle order (country assignment). The language cannot be easily changed over as for the display language due to the size of the software package.