Mk-3 Navigation System

On-Board Monitor with Widescreen Display

Seminar Working Material

Status of information:

06/2000

BMW

Service Training

Contents Page

1. Navigation system

1.1 Intro-
duction

An increasing vehicle stock and the resulting road congestion means it is necessary for the driver to receive additional traffic information during his journey.

BMW has therefore been offering a navigation system since 1994. This system allows the driver to plan his route from A to B. An alternative route can easily be obtained during the journey (e.g. if there is a traffic jam).

The system has been under constant development. In addition, radio stations and special traffic information providers have since become available. These can be utilised by the navigation system.

The public radio stations have been broadcasting TMC (Traffic Message Channel) information since 1997. Since 03.98 BMW navigation systems have been processing this information and displaying it to the driver.

The German Institution for Traffic Information (DDG - Deutsche Gesellschaft für Verkehrsdaten) has been providing traffic information since 1999. This information is automatically updated, for a fee, by providers (e.g. Mannesmann Passo).

The navigation principle

Entry of various criteria (e.g. quickest route, major or secondary roads), enables the navigation system to plan a point-to-point route. To plan a route, the current location of the vehicle must be known and the vehicle must be equipped with an electronic map and a control/output unit.

The destination and the various other criteria are entered using the control panel.

The driver is informed of the planned route, both visually and audibly, by the output unit.

The current location of the vehicle is determined by dead reckoning. The current vehicle location is calculated using the GPS data, distance travelled/direction alteration and an electronic map (CD) and then displayed.

Advantages of the navigation system

- Automatic route planning

- Destination guidance via the navigation system
  - this allows the driver to concentrate better on road and traffic conditions

- No more map reading
  - up to date, digitally formatted street maps are available on CD

- The additional information improves road safety

- The possibility of using telematics/RDS (Radio Data System) TMC

- More relaxed driving

- Reduced fuel consumption
  - resulting in less environmental pollution

Navigation systems development
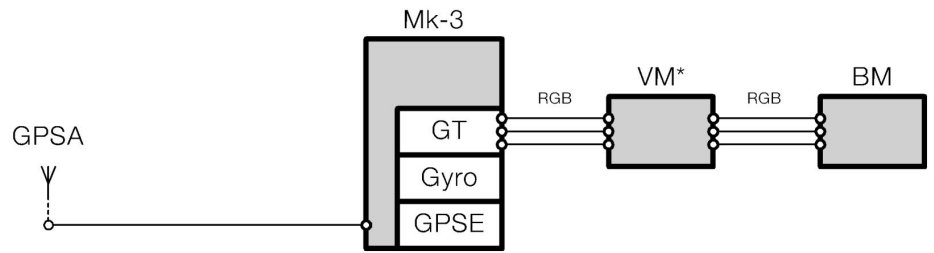
Fig. 1: Mk-1 navigation system
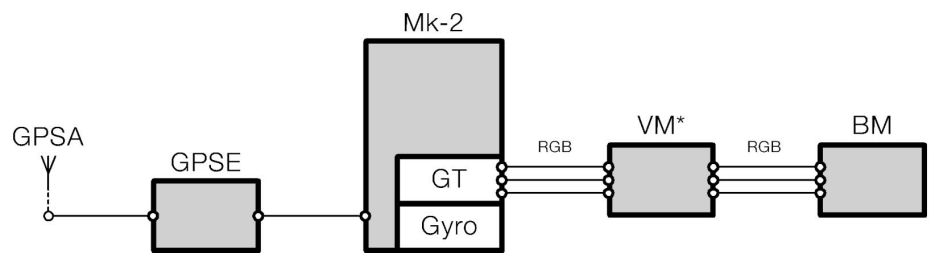
Fig. 2: Mk-2 navigation system (technical developments)

Index	Explanation
BM	On-board monitor
GPSA	GPS aerial
GPSE	GPS receiver
GT	Graphics stage
Gyro	Gyro sensor
Mk-1	First generation navigation computer
Mk-2	Second generation navigation computer
MAFS	Magnetic field sensor
RGB	RGB signals
VM	Video module
VM*	Not available in the USA

1.2 Mk-3 navigation system

Differences over Mk-2

- GPS receiver integrated in the navigation computer
- The same hardware variants for top and radio navigation computers
- More user-friendly
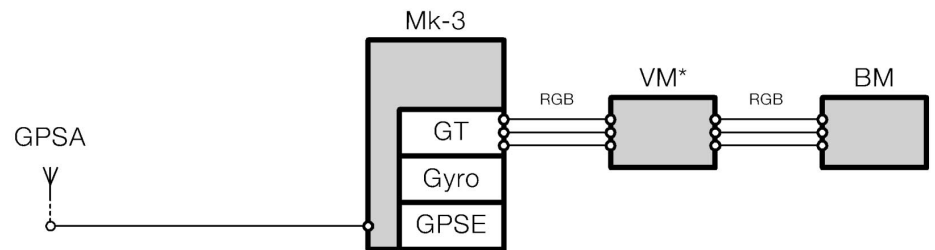
KT 5838

Fig. 3: Mk-3 navigation system (technical developments)

Index	Explanation
BM	On-board monitor
GPSA	GPS aerial
GPSE	GPS receiver
GT	Graphics stage
Gyro	Gyro sensor
Mk-3	Third generation navigation computer
RGB	RGB signals
VM*	Not available in the USA

1.3 BMW navigation systems

Series	Navigation system								
	Mk-1		Mk-2			Mk-3			
	PB	BM	PB	BM	RN	PB	BM	RN	WS
E38	09.94	X	09.97	X	-	09.00*	X	-	X
E39	09.95	X	09.97	X	-	09.00*	X	-	X
E46	-	-	09.97	X	X	06.00*	X	X	-
E52	-	-	01.00	-	X	09.00*	-	X	-
E53	-	-	01.00	X	-	09.00*	X	-	X

BM On-board monitor
RN Radio navigation
WS Widescreen monitor
 * Expected date of introduction

1.4 Mk-3 system

- Navigation computer incl. GPS receiver and CD drive

- GPS aerial

- Distance travelled and reverse motion sensors

- Digital road maps

- On-board monitor (widescreen monitor from 09.00)

- Interfaces

2. Mk-3 function description

2.1 Mk-3 navigation computer

- GPS receiver integrated in the navigation computer
- Two hardware variants (two part numbers)
  - for horizontal and vertical navigation computer installation
- Configuration for radio navigation or on-board monitor variants
- Coding process as for Mk-2
- Specially configured software for the widescreen monitor

Software

New software has been implemented for the introduction of Mk-3. Software CD version 15 will be used for the E46 (06.00) and software CD version 16 for the E38/E39 (09.00). The software implemented for PB 00 is functionally identical to the software previously used. However, the software is configured for the specific LC display to prevent picture distortions.

All the software variants (Mk-1 to Mk-3) are on one CD.

2.2 GPS aerial

The function of the GPS aerial remains unchanged. It is directly connected to the navigation computer. Installation locations remain unchanged.

Series	Installation point
E38	under the rear shelf
E39	under the rear shelf
E39 touring	on the left next to the front passenger airbag
E46	under the rear shelf
E46 touring	under the rear spoiler
E46 Convertible	behind the instrument cluster
E52	A pillar, front left under the dashboard
E53	under the rear spoiler

2.3 Speed sensors

An ABS wheel speed signal is analysed for more accurate location determination.

E38/E39/E52/E53 series

The front left wheel sensor supplies the signal. This signal is processed and then transmitted to the navigation computer via the ABS/ASC/DSC control unit.

E46 series

The rear left wheel sensor supplies the signal. This signal is processed and then transmitted to the navigation computer via the ABS/ASC/DSC control unit.

2.4 Reversing sensors

E38/E39/E52/E53 series

On manual gearbox cars, the signal is tapped from the manual transmission reverse gear selector. This signal is transmitted to the navigation computer via the light check module.
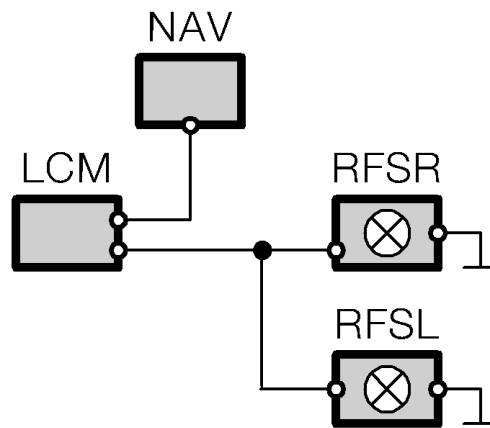
KT 5825

Fig. 4: E38/E39/E52/E53 reverse gear sensors (manual transmission)

Index	Explanation
LCM	Light check module
NAV	Navigation computer
RFSL	Left-hand reversing light
RFSR	Right-hand reversing light

On automatic transmission cars, the signal is tapped from the transmission position selector.

E46 series

On manual gearbox cars, the signal is tapped from the manual transmission reverse gear selector.
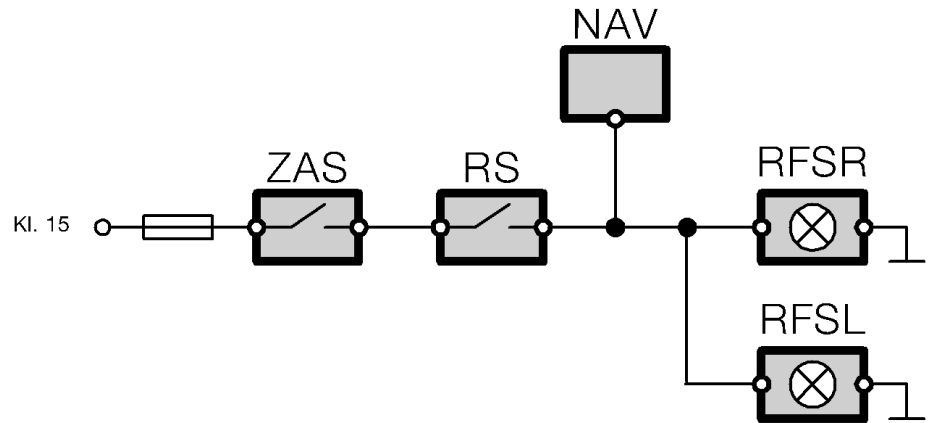
Fig. 5: E46 reverse gear sensor (manual transmission)

Index	Explanation
LCM	Light check module
NAV	Navigation computer
RFSL	Left-hand reversing light
Kl. 15	Terminal 15
RFSL	Right-hand reversing light
RS	Reverse gear selector
ZAS	Ignition switch

On automatic transmission cars, the signal is tapped from the transmission position selector.

2.5 Interfaces

Information/body bus

The navigation computer is integrated into the on-board network via the information bus or the body bus.

The following signals are available on the information bus and the body bus:

- Device status
- Navigation data
- TMC data
- Coding data
- Telematics data
- Display values from other control units
- Operating actions

RGB (Top navigation)

The entire composition of the screen is controlled through the RGB lead. The information is fed to the on-board monitor from the navigation computer via the video module.

A video module is not fitted on the US variants. The signals are thus fed directly to the on-board monitor.

NAV bus (MIR radio navigation)

In the case of radio navigation, the information on the display is sent from the navigation computer to the display unit via the navigation bus (NAV bus).

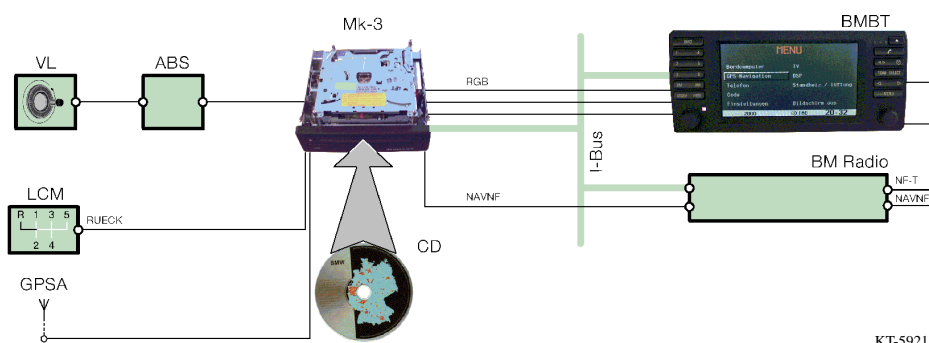The navigation bus is a single-core cable.

2.6 On-board monitor

The on-board monitor will be described in the "On-board monitor with widescreen display" section.
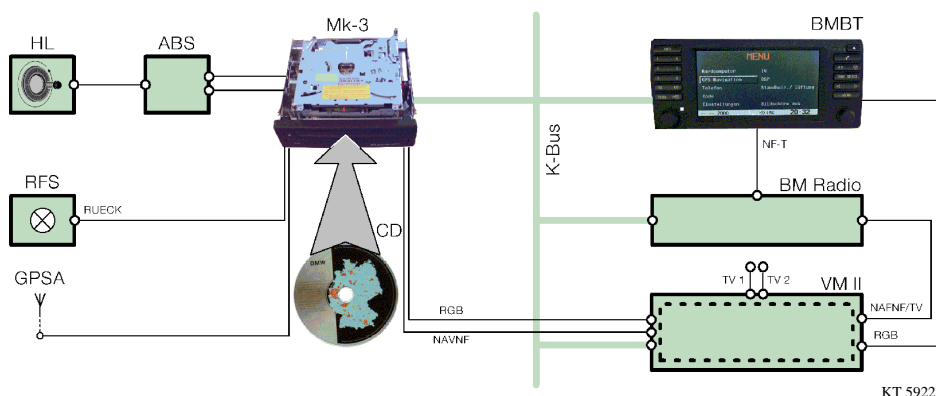
2.7 Mk-3 system overview

Mk-3 navigation system overviews

The Mk-3 navigation system overviews show which components have been fitted.

Fig. 6: Mk-3 system overview with on-board monitor control unit (E38/E39)

Fig. 7: Mk-3 system overview with on-board monitor control unit (E46)

Index	Explanation	Index	Explanation
ABS	ABS/ASC control unit	NAVNF/TV	Navigation/TV audio signal
BMBT	On-board monitor control panel	NF	Audio signal
BM Radio	On-board monitor radio	NF-T	Audio signal cassette
Mk-3	Navigation computer with GPS receiver	RFS	Reversing light
		RGB	LC screen signals
CD	Map CD	RUECK	Reverse gear signal
GPSA	GPS aerial	S-ANT	Rear window antenna (aerial)
HL	Rear left ABS sensor signal	TV1	Right-hand TV aerial signal
		TV2	Left-hand TV aerial signal
I-Bus	Information bus	VL	Front left ABS sensor
K-Bus	Body bus	VM II	Video module 2
LCM	Light check module		
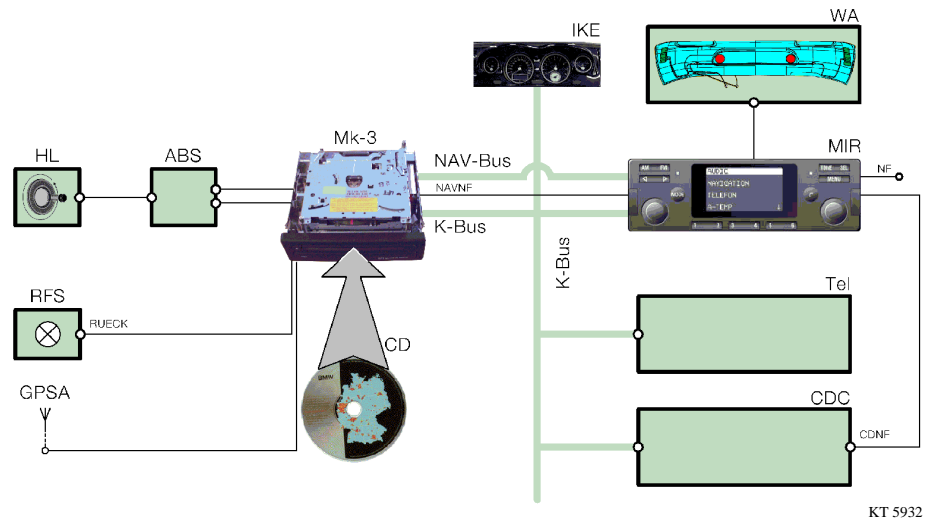
Fig. 8: Mk-3 system overview (E52 radio navigation display and control panel)

Index	Explanation
ABS	ABS/ASC control unit
BMBT	On-board monitor control panel
Mk-3	Navigation computer with GPS receiver
CD	Map CD
CDNF	Audio signal CD
GPSA	GPS aerial
HL	Rear left ABS sensor signal
IKE	Instrument cluster
K-Bus	Body bus
MIR	Multi information radio
NAV-bus	Navigation bus
NAVNF	Audio signal navigation
NF	Audio signal
RFS	Reversing light
RUECK	Reverse gear signal
TEL	Telephone
WA	Probe aerial

3. Mk-3 service notes

3.1 Navigation computer installation

When installing the navigation computer, note whether the hardware variant requires the navigation computer to be installed horizontally or vertically (two part numbers).

The ignition lock should be turned to position 0 during removal and installation of the navigation computer. After installation, close all doors and flaps on the car. The "information bus/body bus reset" will be carried out within approximately two minutes. Resetting guarantees problem-free calibration of the gyro sensor.

The navigation computer LED goes out once the system has been reset.

The car must be stationary during resetting.

For further information please refer to the function description in DIS.

The coding procedure for replacing a navigation computer within the HO (dealership organisation) is unchanged. The coding programm has been modified.

In contrast to Mk-2 navigation computers, Mk-3 navigation computers must be

1. reconfigured (new addition),

2. and the software must be loaded and

3. coded.

The current ICDs should be noted when carrying out the "configuration", "loading the software" and "coding" processes.

3.2 Configuration

Configuration reduces the number of variants.

It is carried out using DIS.

The necessary data is read from the central encoding key. The navigation computer is then configured accordingly.

Configuration data

The configuration data is stored in the central encoding key. Among other things, the encoding key contains

- model

- navigation sytem (Mk-x)

- country variant

- optional equipment

- date

- LC display type (monochrome or colour display)

    - the monochrome or colour display are distinguished by having their own "telegrams"

3.3 Loading the software

The current software must be loaded according to the configuration. All current software variants can be found on the CD.

The navigation computer automatically downloads the necessary software from the CD inserted.

The software update procedure is detailed on the CD cover and in the function description in the DIS.

Software

The software to be installed in 06.00 and 09.00 (version 15 and version 16) performs the same function as the software previously used. However, the software is configured for the specific LC display to prevent picture distortions.

Starting around 03.01, the software will gradually be explanded to include new functions. This will make split screen display possible on a widescreen monitor.

The introduction of NG (New Generation) radios will also make split screen display a possibility in the radio function.

Software update

The operating software is updated via the navigation computer's CD drive.

3.4 Coding

The coding process involves coding customer-specific information, e.g. delivery data, vehicle identification number, speed limit, vehicle model and telematics services.

3.5 Mk-3 service mode

Diagnostics may be carried out using the service mode as in Mk-2.

Service mode functions

Test functions can be called up from the "Set" display (menu item).

- Radio terminal (terminal 15) on

- Select the "Set" menu item

- Confirm the "Set" menu item using the "Navigation" rotary button

- Press and hold the "MENU" button for eight seconds

- Select the desired menu item from the list displayed

- Confirm the menu item selected using the "Navigation" rotary button

The test mode is quit when the radio terminal is switched off and the "MENU" button is pressed.

Example of menu structure:

Menu	Submenu	Display	
Navigation/ graphic element		SW-status	17
		HW-status	10
		Diag-index	03
		Bus-index	08
		Coding index	01
		Supplier	0103708
GPS	Version	Receiver	7.52
		SW date	10.01.98
	Status	Latitude	48° 11' 32"
		Longitude	11° 34' 30"
		Altitude	550 m
		Date	18.01.98
		Time	11:28
		G speed	22.3 m/s
		Heading	147 degrees
		Rec-Stat	POS
		Pos-Src	5
		PDOP	1.8
		HDOP	1.4
		VDOP	2.2
	Tracking info	CH	1
		PRN	07
		S/N	5.1
		Visible sat	08
		Almanac	yes
Video module		SW-status	17
		HW-status	10
		Diag-index	03
		Bus-index	08
		Coding index	01
		Supplier	0103708
Sensor check		Wheel	835 rear left navi
			835 rear right navi
		Satellites	05
		GPS status	09
		Gyro	2500
		Dir	Forward
Telematics		VIN	AB 12345
		Vehicle type	E38 Saloon
		Colour	Other
		Reg. number	M-XXXX
		SMS code number	+49 172 XXXX
		D1	+49 171 XXXX
		BMW information	on
		Automatic emergency call	on
		Initialization	on
		Sign-off	off

Explanation of menu example

Menu	Display	Explanation
GPS/Status	G speed Heading Rec-Stat Pos-Src PDOP HDOP VDOP	Relative vehicle speed over the ground Direction of travel Search/track/position receiver status Number of satellites available for analysis Accuracy of the calculated position < 8 sufficient determinations of position < 4 very good determinations of position
GPS/Tracking info	CH PRN S/N Visible sat Almanac	Channel Satellite detection The better the reception the higher the value The number of visible satellites, signals receivable, depends on time of day and constellation Satellite database, automatically loaded after 15 minutes
Sensor check	Wheel Satellites GPS status Gyro Dir	ABS sensors, pulses/minute, neg. when reversing Number of satellites currently received **07:** 3 Sat, position possible; **11:** 2D position determined; **12:** 3D position determined +- 400; mV setpoint value, halted or driving straight ahead, > right-hand, < left-hand curve Reverse gear signal detection Backward: reverse gear selected
Telematics	VIN Colour D1 BMW information Automatic emergency call Initialization Sign-off	Vehicle identification number Colour code or "Other" text Telephone network/contract number Customer-specific informationen Status on/off Telematics services status on/off Log out of the telematics service

PDOP	Position Dilution of Precision
HDOP	Horizontal Dilution of Precision
VDOP	Vertical Dilution of Precision
S/N	Signal/noise ratio
Gyro	Piezo Gyro sensor (in navigation computer)
Dir	Direction of travel

4. On-board monitor with widescreen display

4.1 Intro-
duction

The 5.5" LC display of the E38/E39 series will be replaced by a 6.5" LC display by in model year 2001. The widescreen display has an aspect ratio of 16:9.

On the E46 and E53 models, the 5" LC display will be replaced at a later date by the widescreen display.

These measures result in a further reduction in variants.
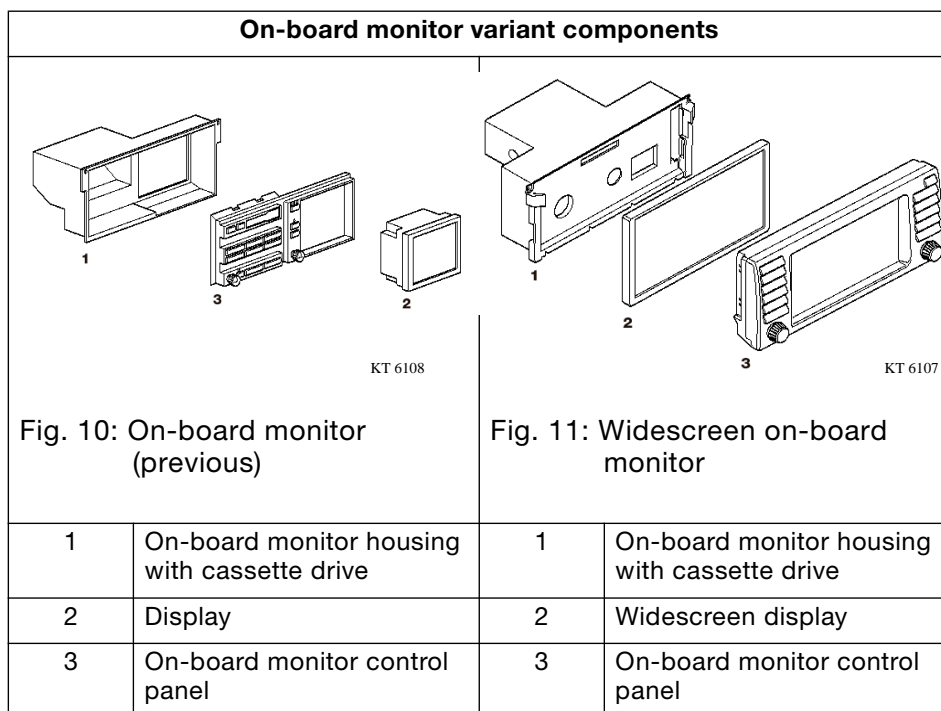

KT 5722

Fig. 9: Widescreen monitor

Some of the benefits provided by the larger LC display are:

● Better legibility

● Font size can be enlarged

The layout of controls on the left and the right of the LC display means that the system is just as suitable for left-hand drive cars as for right-hand drive cars.

4.2 On-board monitor

The on-board monitor consists of the on-board monitor control panel (BMBT) with buttons/rotary buttons, LC display and cassette drive.

On-board monitor variant components					
KT 6108			KT 6107		
Fig. 10: On-board monitor (previous)			Fig. 11: Widescreen on-board monitor		
1	On-board monitor housing with cassette drive		1	On-board monitor housing with cassette drive	
2	Display		2	Widescreen display	
3	On-board monitor control panel		3	On-board monitor control panel	

The cassette drive is located behind the on-board monitor when the wide screen monitor is used.

The on-board monitor control panel can be removed to the front and downwards by pressing the eject button. The cassette drive can now be accessed.
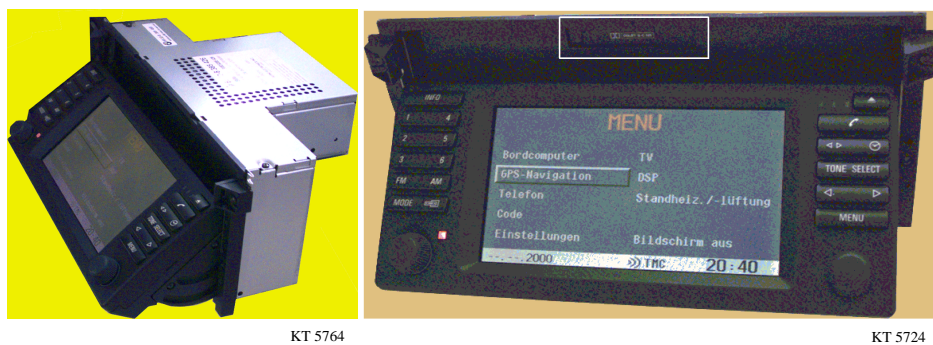

KT 5764

KT 5724

Fig. 12: On-board monitor control panel brought out to reveal cassette drive

4.3 On-board monitor control panel

Buttons/rotary knobs

Button and rotary knob actions are relayed to the radio, DSP, navigation computer and telephone units via the body bus.

The "INFO" button is new. The functions of the "TONE/SELECT" and "EJECT" buttons have been modified or expanded.

The exact functions of all the buttons are listed in the Operating Instructions.

On-board monitor control panel keypad

Abbreviation	Explanation	Abbreviation	Explanation
	"INFO" button "Radio/CDC" station key "Radio/CDC" station key "Radio/CDC" station key "FM/AM" button "MODE/Display" button Radio LED (on/off) "Radio" fine tuner KT 5745		Telephone LED/"EJECT" button "Telephone" button "Tape reverse/clock" button "Tone/Select" button "Fast forward/Rewind" button "Menu" button "Navigation" rotary button KT 5746

"INFO" button

The "INFO" button reduces the number of variants. Traffic information can be called up using the "INFO" button. The country-specific functions will be activated or deactivated depending on the country variant set.

"TONE/SELECT" button

Dolby switchover (Dolby B/C) is integrated in the "TONE/SELECT" button. The Dolby function will be set directly when the "SELECT" button is pressed. The Dolby function is only available when playing a cassette.

If there is a cassette in the cassette drive, it will be ejected when the on-board monitor control panel is out. If the cassette is not removed from the cassette drive, the on-board monitor control panel will remain out.

"EJECT" button

The on-board monitor control panel is brought out when the "EJECT" button is pressed. If the "EJECT" button is pressed again the on-board monitor control panel goes back in. If the button is pressed while the on-board monitor is in the out position, the on-board monitor control panel will automatically go back in after approximately 15 seconds.

When the on-board monitor control panel is out, the cassette may also be ejected by pressing the "Fast forward/Rewind" buttons.

The on-board monitor has a built-in entrapment safeguard. If the on-board monitor electronics detect that something has become trapped, the on-board monitor control panel will move back in the opposite direction.

"MODE/Display" button

The "DISPLAY" button can be used to alternate between the Radio menu display and the other displays available (BC/TEL/NAVI).

5. Mk-3 control panel with widescreen display

5.1 Introduction

The Mk-3 navigation system will be introduced in model year 2001. The E46 5" and E38/E39 6.5" (widescreen) on-board monitor variants will be installed in conjuntion with the Mk-3.

The widescreen display will be gradually introduced in other model series.

The software has been modified for the larger 6.5" widescreen monitor LC display to reduce image distortions.

The widescreen on-board monitor control panel is the same as the previous control panel.

Parallel to the introduction of the widescreen display, the control panel will gradually be expanded to include new functions.

Split screen displays will be introduced in all on board monitor variants by 09.01.

6. On-board monitor service notes

6.1 Service mode
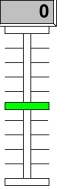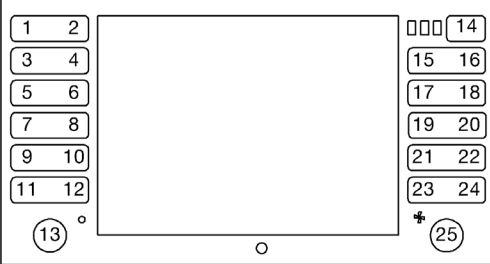
Diagnostics can be carried out via the service mode

Service mode functions

Test functions can be called up from the display ("Set" menu item).

● Radio terminal on

● Select the "Set" menu item

● Confirm the "Set" menu item using the "Navigation" rotary button

● Press and hold the "MENU" button for eight seconds

● Select the desired menu item from the list displayed

● Confirm the menu item selected using the "Navigation" rotary button

The test mode is quit when the radio terminal is switched off and the "MENU" button is pressed.

Example of menu structure:

Menu	Submenu	Display
On-board monitor	Version	SW-master 37 HW-status 31 Diag-index 21 Bus-index 08 Coding index 00 Supplier 16
	Brightness contr.	Automatic KT 5968
	Function of keys	Key FFH Contr. button 00 Radio control 00 KT 5747 Fig. 13: Allocation of numbers to buttons

Brightness control

The brightness control is set to "0" at the works. The brightness control display is shown above the control bar as a figure and as a green bar in the middle of the control display.

Brightness can be set anywhere between -10 (figures in red) and +10 (figures in green).

Function of keys

When testing the buttons, the cursor will automatically return to the Function of keys menu after a pause of about 5 seconds in the testing procedure.

7. Appendix/Glossary

7.1 Key

Index	Explanation
ABS	Anti-lock braking system/automatic stability control control unit
Ad-TFT	Advanced Thin Film Transistor
ASC	Automatic stability control
ARC-NET	ARC network
BC	On-board computer
BM	On-board monitor
BMBT	On-board monitor control panel
BM Radio	On-board monitor radio
CC-93/CC96	Navigation computer
CD	Map CD
CDNF	Audio signal CD
CH 1	Channel 1 magnetic field sensor
CH 2	Channel 2 magnetic field sensor
DDK	Rotary button
DIS	Diagnosis and Information System
DSC	Dynamic stability control
GPSA	GPS aerial
GPSE	GPS receiver
GT	Graphics stage
Gyro	Piezogyro sensor
HHS	Rear window signal
HL	Rear left ABS sensor signal
HW	Hardware
I-Bus	Information bus
IDC	Information Diagnosis Encoding
JPN	Japan
K-Bus	Body bus
Kl. R	Terminal R
LC-Display	Liquid crystal display
LCM	Light check module
MAFS	Magnetic field sensor
Mk-1/Mk-2/Mk-3	Navigation system designation
Mk-3	Navigation computer with GPS receiver
MIR	Multi-information radio
NAV	Navigation computer
NAV-Bus	Navigation bus
NAVI	Navigation function
NAVNF/TV	Navigation/TV audio signal
NF	Audio signal

Index	Explanation
NF-T	Audio signal cassette
OCN	Oceania
RDS	Radio Data System
RFS	Reversing light
RFSL	Left-hand reversing light
RFSR	Right-hand reversing light
RGB	LC screen signals
RGB US	US LC screen signals
RN	Radio - Navigation System
RN ABE	Radio navigation display and control panel
RS	Reverse gear selector
RUECK	Reverse gear signal
SW	Software
S1	LC screen toggle switch
TFT	Thin Film Transistor
TMC	Traffic Message Channel
TV1	Right-hand TV aerial signal
TV2	Left-hand TV aerial signal
VL	Front left ABS sensor signal
VM I	Video module 1
VM II	Video module 2
VR	Front right ABS sensor signal
WA	Probe aerial
WS	Widescreen
ZAS	Ignition switch