Mk-3 Navigation System
On-Board Monitor with Widescreen Display

Course Contents/Background Material

Information status:

May 2000

BMW
Service Training

Contents

Navigation system

Introduction

Increasing vehicle numbers and the resulting congestion on the roads necessitate providing the driver with 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/changes of direction 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, digitized 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

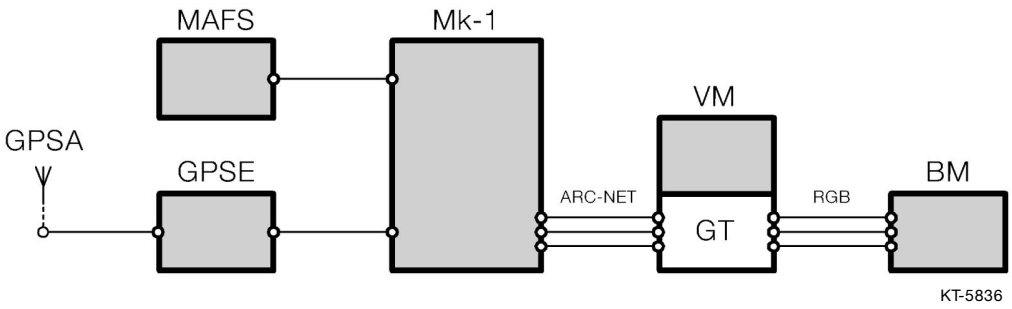

Fig. 1: Mk-1 navigation system

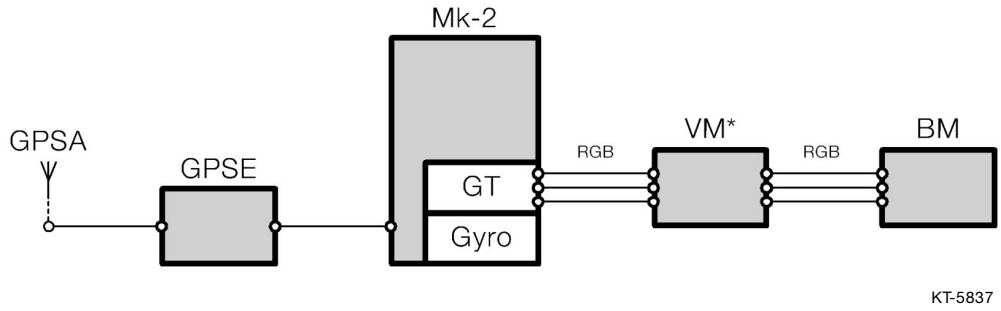

Fig. 2: Mk-2 navigation system (technical developments)

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

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

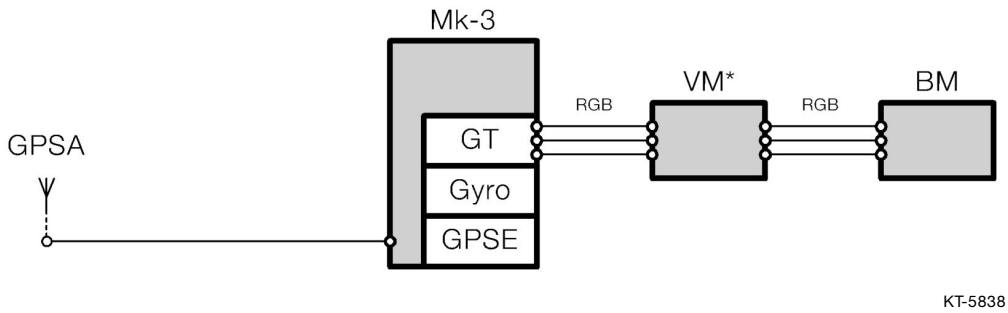

Fig. 3: Mk-3 navigation system (technical developments)

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

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

Mk-3 system

- Navigation computer including GPS receiver and CD drive
- GPS aerial
- Distance travelled and reversing sensors
- Digital road maps
- On-board monitor (widescreen monitor from 09.2000)
- Interfaces

Mk-3 function description

Mk-3 navigation computer

- GPS receiver integrated in the navigation computer
- Two hardware variants (two part numbers)
  - for horizontal and vertical installation of the navigation computer
- 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 (06.2000) and software CD version 16 for the E38/E39 (09.2000). 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 image distortion.

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

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

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.

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.

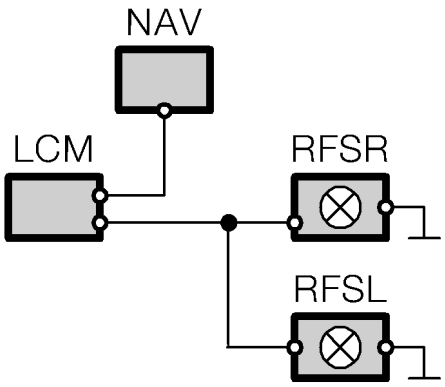

Fig. 4: E38/E39/E52/E53 reverse gear sensors (manual transmission)

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

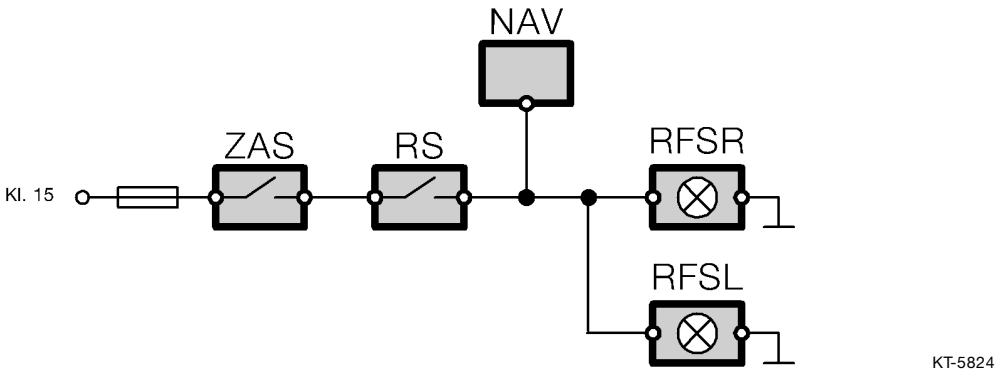

Fig. 1: E46 reverse gear sensor (manual transmission)

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

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

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:

- System 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 by the RGB lead. The information is fed to the on-board monitor from the navigation computer via the video module.

- R50 Red video signal
- RGB31_50 Red video signal earth
- G50 Blue video signal
- RGB31_50 Blue video signal earth
- B50 Green video signal
- RGB31_50 Green video signal earth

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.

On-board monitor

The on-board monitor will be described in the "On-board monitor with widescreen display" section.

Mk-1 to Mk-3 system overview

The system overview of the Mk-1 navigation system shows which components are fitted.

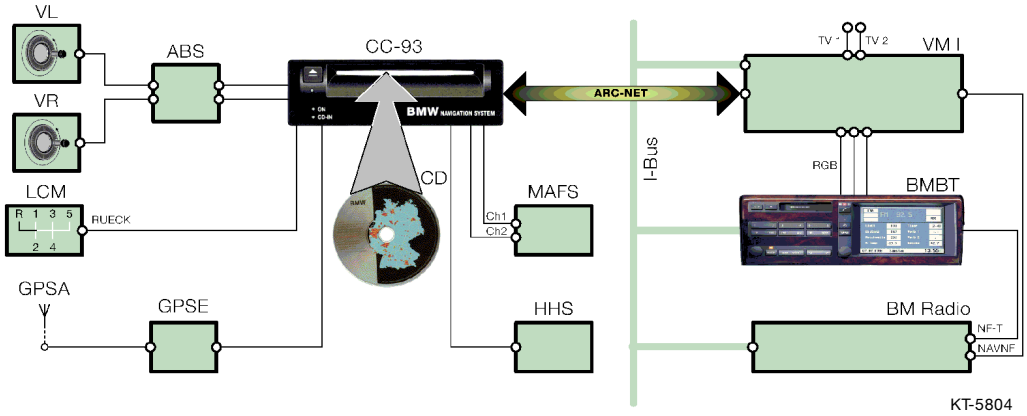

Fig. 2: Mk-1 system overview

Index	Explanation	Index	Explanation
ABS	ABS/ASC control unit	LCM	Light check module
ARC-NET	ARC network	MAFS	Magnetic field sensor
BMBT	On-board monitor control panel	NAVNF	Audio signal navigation
BM Radio	On-board monitor radio	NF-T	Audio signal cassette
CC-93	Mk-1 navigation computer	RGB	LC screen signals
CD	Map CD	RUECK	Reverse gear signal
CH 1	Channel 1 magnetic field sensor	TV1	Right-hand TV aerial signal
CH 2	Channel 2 magnetic field sensor	TV2	Left-hand TV aerial signal
GPSA	GPS aerial	VL	Front left ABS sensor signal
GPSE	GPS receiver	VM I	Video module 1
HHS	Rear window signal	VR	Front right ABS sensor signal
I-Bus	Information bus		

The system overview of the Mk-2 navigation system shows which components are fitted.

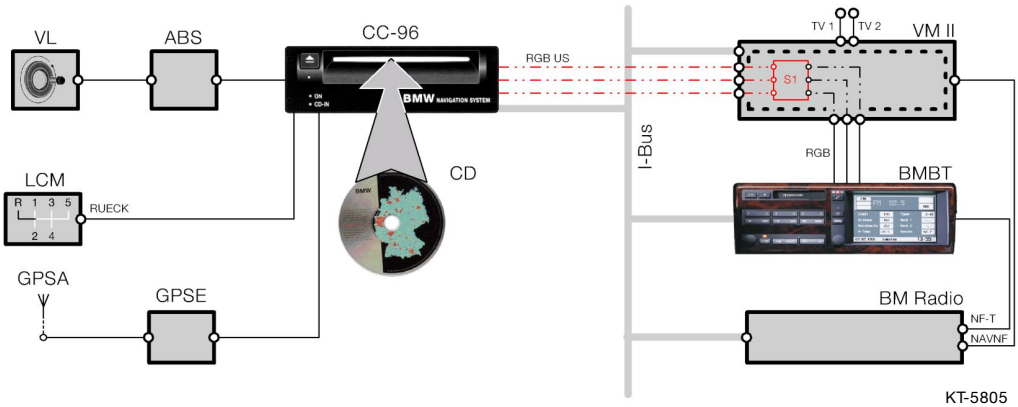

Fig. 3: Mk-2 (E38/E39) system overview

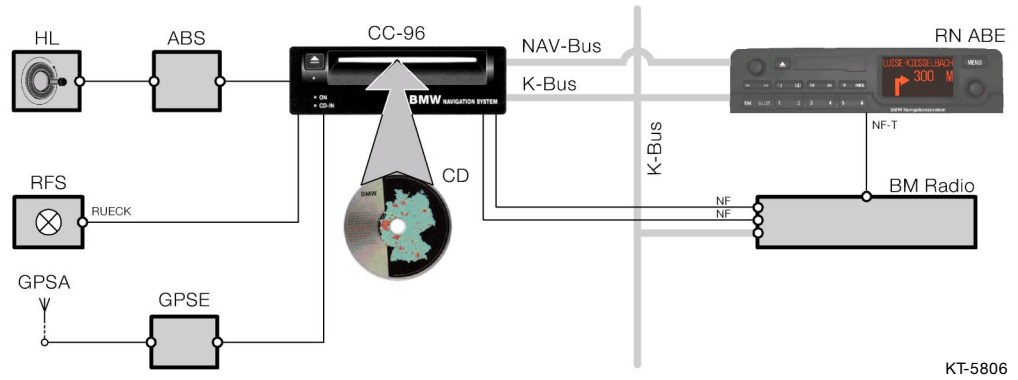

Fig. 4: Mk-2 (E46 radio navigation display and control panel) system overview

Index	Explanation	Index	Explanation
ABS	ABS/ASC control unit	NF	Audio signal
BMBT	On-board monitor control panel	NF-T	Cassette audio signal
BM Radio	Radio on-board monitor	RFS	Reversing light
Mk-2	Mk-2 navigation computer	RGB	LC screen signals
CD	Map CD	RGB US	US LC screen signals
GPSA	GPS aerial	RN ABE	Radio navigation display and control panel
GPSE	GPS receiver		
HL	Rear left ABS sensor signal (E46)	RUECK	Reverse gear signal
		S1	LC screen toggle switch
I-Bus	Information bus	TV1	Right-hand TV aerial signal
K-Bus	Body bus	TV2	Left-hand TV aerial signal
LCM	Light check module	VL	Front left ABS sensor signal
NAV-Bus	Navigation bus	VM II	Video module 2
NAVNF	Audio signal navigation		

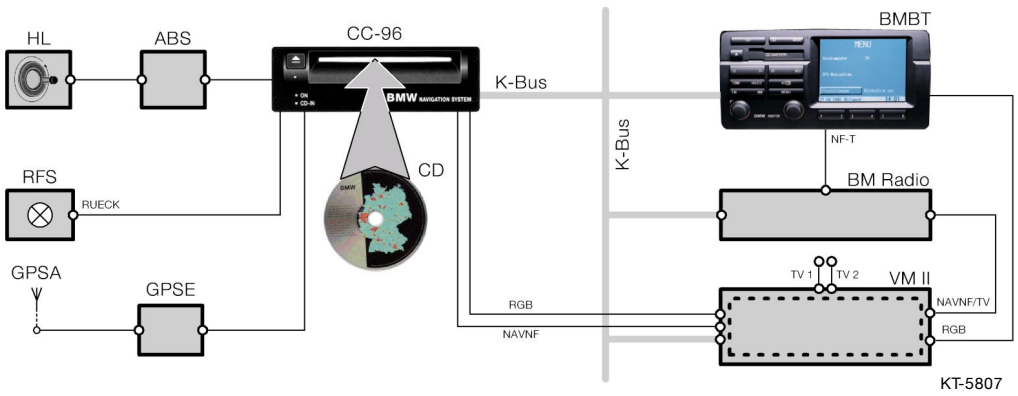

Fig. 5: Mk-2 system overview (E46 on-board monitor)

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	Radio on-board monitor	NF-T	Cassette audio signal
CC-96	Mk-2 navigation computer	RFS	Reversing light
CD	Map CD	RGB	LC screen signals
GPSA	GPS aerial	RUECK	Reverse gear signal
GPSE	GPS receiver	TV1	Right-hand TV aerial signal
HL	Rear left ABS sensor signal	TV2	Left-hand TV aerial signal
		VM II	Video module 2
K-Bus	Body bus		

The system overview of the Mk-3 navigation system shows which components are fitted.

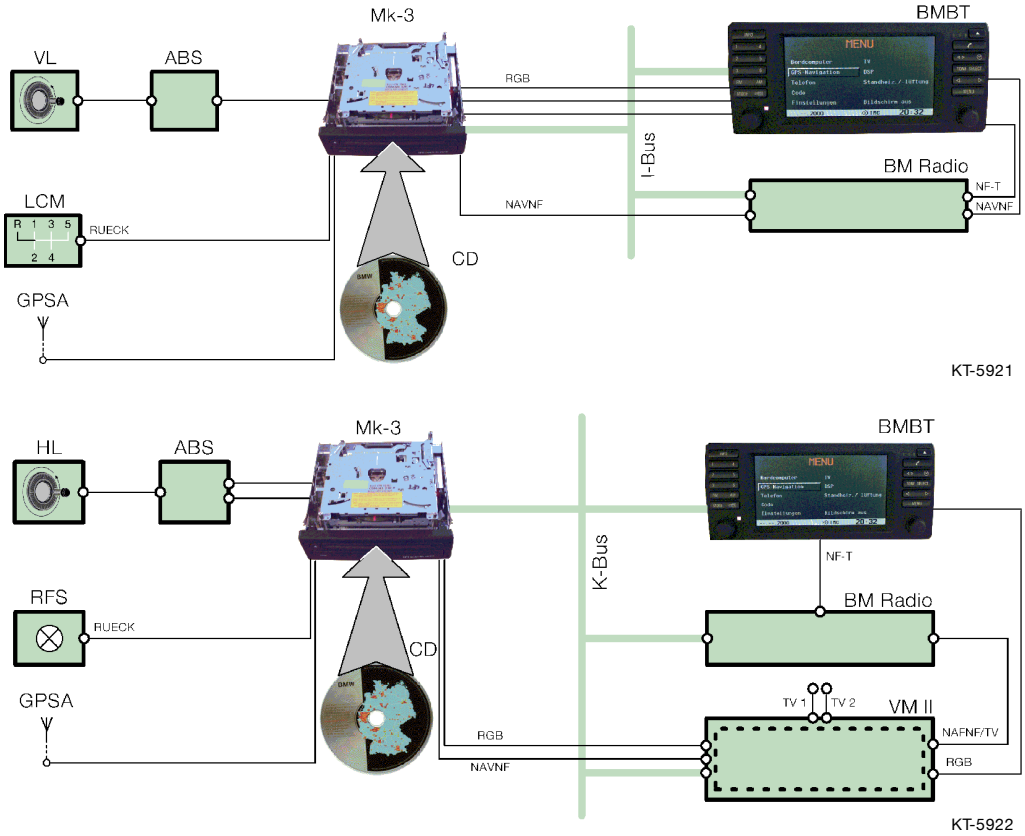

Fig. 6: System overview of the Mk-3 with on-board monitor control panel (E38/E39 and E46)

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	Radio on-board monitor	NF-T	Cassette audio signal
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
I-Bus	Information bus	TV2	Left-hand TV aerial signal
K-Bus	Body bus	VL	Front left ABS sensor
LCM	Light check module	VM II	Video module 2

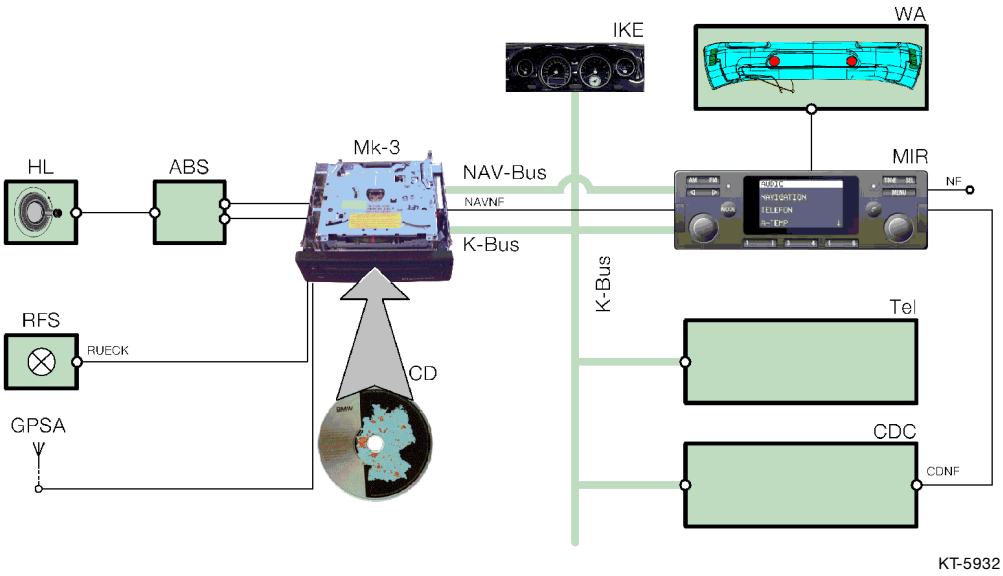

Fig. 7: Mk-3 system overview (E52 radio navigation display and control panel)

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

Mk-3 service notes

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 openings 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.

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 system (Mk-x)
- country variant
- optional equipment
- date
- LC display type (monochrome or colour display)
  - monchrome and coloured displays each have their own "message", for differentiation purposes

Loading the software

The current software must be loaded following 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 updating 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) is functionally identical to the software previously used. However, the software is configured for the specific LC display to prevent image distortion.

Starting around 03.01, the software will gradually be expanded 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.

Coding

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

Mk-3 service mode

Diagnostics can be carried out in the service mode, as with 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 with the "Navigation" rotary pushbutton
- 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 pushbutton

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

Example of menu structure:

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

Explanation of menu example

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

On-board monitor with widescreen display

Introduction

The 5.5" LC display of the E38/E39 series will be replaced by a 6.5" LC display 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 by the widescreen display at a later date.

These measures result in a further reduction in variants.

KT-5722

Fig. 8: Widescreen monitor

Among other benefits, the larger LC display has the following advantages:

- 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.

On-board monitor

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

On-board monitor variant components

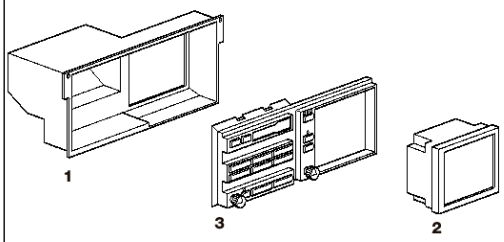

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Fig. 9: On-board monitor (previous)

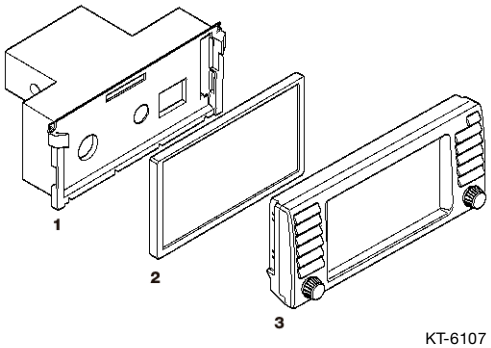

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Fig. 10: Widescreen on-board monitor

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 in the use of the wide screen monitor.

The on-board monitor control panel can be brought forwards at the bottom by pressing the EJECT button. The cassette drive can now be accessed.

KT-5764

KT-5724

Fig. 11: On-board monitor control panel brought forwards to reveal cassette drive

On-board monitor control panel

Buttons/rotary knobs

Button and rotary knob activities 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

Index	Explanation	Index	Explanation
 KT-5745	"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-5746	Telephone LED/"EJECT" button "Telephone" button "Tape reverse/clock" button "Tone/Select" button "Fast forward/Rewind" button "Menu" button "Navigation" rotary button

"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 brought forwards. If the cassette is not removed from the cassette drive, the on-board monitor control panel will remain forwards.

"EJECT" button

The on-board monitor control panel is brought forwards 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 oppossite 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).

LC display overview

E38/E39 series

- 5.5" display (diagonal dimension)
- 4:3 aspect ratio
- Resolution 320 x 240 triples (pixel)

E46 series

- 5" display (diagonal dimension)
- 4:3 aspect ratio
- Resolution 320 x 240 triples (pixel)

Widescreen display (Ad-TFT)

- 6.5" display (diagonal dimension)
- 16:9 aspect ratio
- Resolution 400 x 234 triples (pixel)

The widescreen display will be introduced on the E38/E39 models by 09.00 and at a later point on the other model series.

Switching the LC display on/off

Switch-on conditions

The LC display is switched on

- when the ignition key is in position 0; "Driver's door open" body bus signal
- if the radio terminal is on
- if the ignition key is in position 1
- if the "Clock" button is pressed
- if the "Telephone" button is pressed

- following overvoltage/undervoltage
  - U_B < 16 V U_B > 10 V LC display on
- following overheating T < 70 °C

Switch-off conditions

The LC display is switched off

- if the ignition key is in position 1; the video signal is off
- if the radio terminal is off
- if the ignition key is in position 0 and the "End of display" sign is showing (under preparation, e.g. time display for 8 seconds)

- if overheating occurs T > 76 °C
- if overvoltage/undervoltage occurs
  - U_B > 17 V U_B < 9 V LC display off

Mk-3 control panel with widescreen display

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 user interface is the same as the previous user interface.

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

Splitscreen display is expected to be introduced on all on-board monitor variants by 09.01.

Widescreen monitor introduction dates

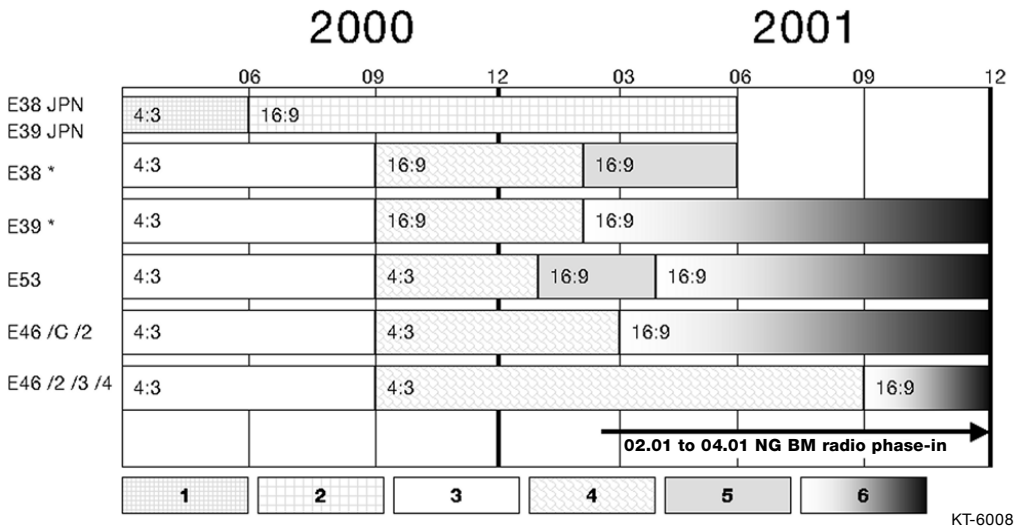


Fig. 12: Expected widescreen display phase-in

Index	Explanation	Index	Explanation
1	Japanese interface with 4:3 display	4	Mk-3 with 4:3/16:9 display Adapted old (4:3) interface
2	Japanese interface with 16:9 display	5	Mk-3 with 16:9 display Splitscreen navigation function
3	Mk-2 with 4:3 display Old interface	6	Mk-3 with 16:9 display Splitscreen navigation function, audio, on-board computer
*	Not installed on the Japanese version		

Overview of expanded functions in the user interface

Expanded functions to enhance user-friendliness include:

- A larger LC display
  - which facilitates the parallel (splitscreen) display of
    - destination guidance and map
    - destination guidance and on-board computer
    - destination guidance and audio
- Better legibility thanks to larger font (proportional font)
- New layout of display and background colours
- Points of Interest search facility
- Easier destination entry via zoom function and picklist
- New cursor and symbols
- "Highlighter" (visual display of where the cursor is positioned in a picklist)
- Permanent map scale display and direct selectability (planned)
- Brand-dependent start-up screen (planned)

Splitscreen

The splitscreen function allows for the parallel display of two functions.

The LC display is subdivided into two screen halves. A ratio of 9:7 (L:R) is used for this.

The "radio" splitscreen function is only possible with NG radios (BM53 and BM54 from 03.01).

The BM53 is the successor model to the C43 BM US, C43 BM JPN and C43 BM OCN radios.

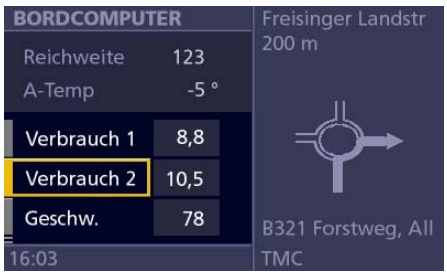
The BM54 is the successor model to the C24.

KT-5938

Fig. 13: Map/destination guidance navigation (splitscreen)

KT-5939

Fig. 14: Traffic information/destination guidance navigation (splitscreen)



KT-5981

Fig. 15: On-board computer/destination guidance navigation (splitscreen)

Font size

Legibility is improved by using a larger font.

Display and background colours

Background colour can be set in two colour sets.

POI (Point of Interest) search facility

This additional function will be integrated in the E53 as of 02.01. POIs of national significance can now be called up directly from a list. This list can be found under the "Information" menu item and the "Information about the country" submenu.

Simplified destination search

Entering the destination

As the first letter is entered, a list of places beginning with this letter appears on the LC display. As each subsequent letter is entered, the letter in the picklist turns white until the target destination has been fully entered or selected. The destination can also be selected and confirmed as the target directly from the list.

KT-5933

Fig. 16: Target destination selection and entry

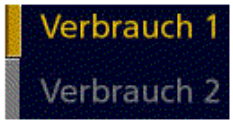
Zoom function

There is an additional zoom function when entering the target address during the navigation process. When the cursor is on a letter, this letter will be enlarged and shown in the upper LC display section.

KT-5950

Fig. 17: Zoom function

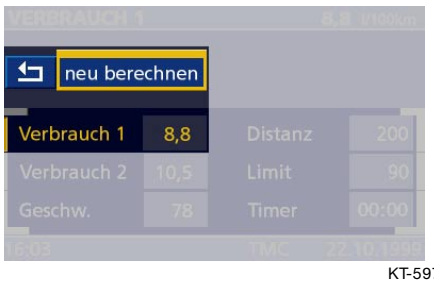
New cursor and symbols



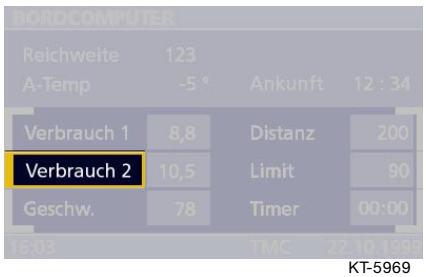
KT-5954

KT-5953

Fig. 18: Cursor and symbol examples



KT-5970



KT-5969

Fig. 19: Cursor on the "Verbrauch" (= "Consumption") topic

Last function memory (navigation)

This is a new function.

1. This makes it possible to return to the display before changing to another menu. The last main menu item accessed will be displayed.
2. The last screen shown before the radio terminal is switched off will be reinstated when the system is next switched on.

Example 1

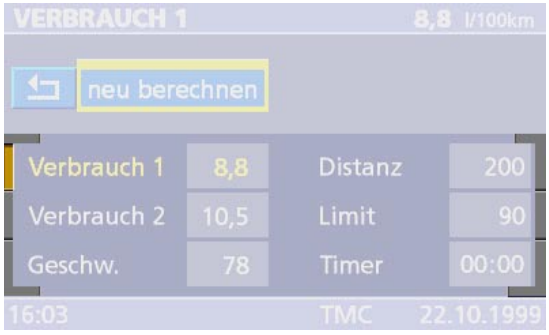
- Current display:
  - The destination guidance function is selected, a street name is entered, the zoom function, three letters are already selected
- Change menus:
  - Set the limit on the on-board computer
- Changing back to the previous menu:
  - Press the navigation rotary pushbutton,
    the street name entry menu item will be displayed
  - Confirm this menu item,
    street name entry and the zoom function are active again

Highlighter

The highlighter is situated on the right and/or left margin(s) of the widescreen display. It is a vertical bar with individual segments. It has a circular structure and serves to indicate the direction of rotation of the selection cursor.

A bar in the selection menu in the top and/or bottom margin(s) points to the centre of the screen. If the picklist is larger than can be displayed, this is shown by two closely spaced bar segments.

The highlighter will be visually emphasized when a selection is made from a list, for example.



KT-5955

Fig. 20: Bounded highlighter ("Verbrauch 1" (= "Consumption 1") selected)

KT-5956

Fig. 21: Unbounded highlighter (list is larger than the display area)

Scale display (planned)

Permanent map scale display during navigation is directly selectable.

The cursor jumps to the map when the rotary pushbutton is turned. Now select "Scale" and confirm using the rotary pushbutton. The scale can be altered and confirmed by further turning of the rotary pushbutton.

Brand-dependent start-up screen (planned)

A start screen will be displayed for approximately 15 seconds when the on-board monitor is switched on. During this time the current menu is building.

Examples of menus

The reworked and newly designed menus have been configured to suit the most frequently used functions, and have been redesigned in a more user friendly way.

Some examples of different menus and menu items follow.

KT-5934

Fig. 22: On-board computer ("Verbrauch 2" (= "Consumption 2") selected)

KT-5935

Fig. 23: On-board computer (recalculate consumption 1)

Rear monitor

The operating function of the rear display will remain the same as before.

Only the right side of the rear display splitscreen will be used when the widescreen display is operating in splitscreen mode.

The basics of LC displays

Light polarisation

Polarising direction of a light wave

Natural light consists of electrical and magnetic waves. A light wave "radiates" in one direction, known as the polarising direction. The light wave is simultaneously overlaid by many other light waves which all oscillate in the same axis. The alignment is such that the other light waves seem vertical to the propagation direction when viewed in the wave axis.

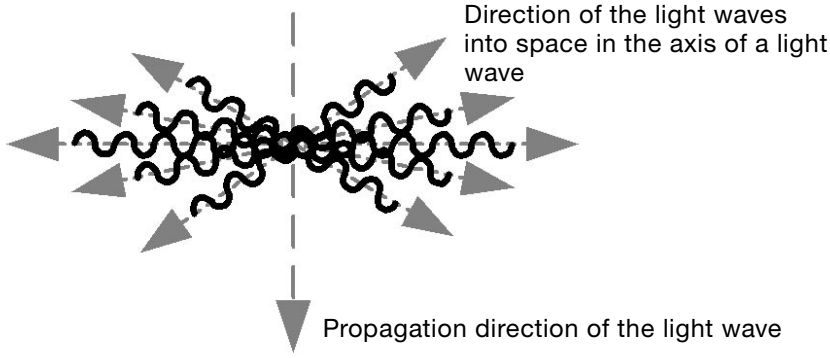


Fig. 1: Natural light

Polariser

The unpolarised light strikes the polariser (filter). The polariser filters out one light wave. A defined, polarised light is now available on the back of the polariser.

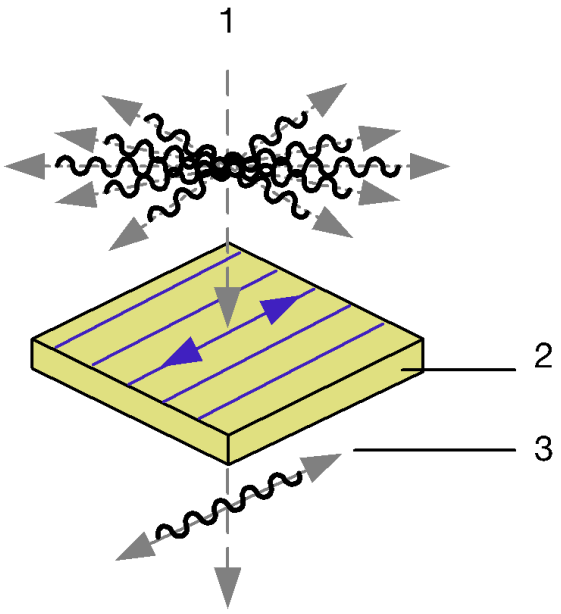
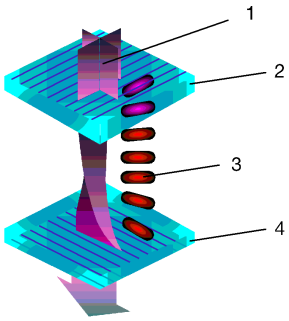


Fig. 2: The principle of a polariser

Index	Explanation
1	Unpolarised light
2	Polariser
3	Polarised light after passing through the polariser

De-energized polarisation

When there is no voltage applied, the individual liquid crystals are helically twisted through 90°. If the light strikes the polarisation foil, the light will be polarised in one direction. The polarised light electric field interacts with the LC molecule electrons. The polarisation of the light rotates according to the helical alignment of the LC molecules. The light can pass through. There is no electrical field strength to align the LC molecules.



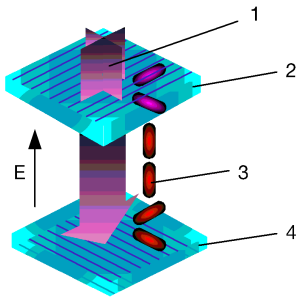
KT-5855

Fig. 3: De-energized polarisation of the light (electrical field)

Index	Explanation	Index	Explanation
1	Unpolarised light	3	Liquid crystals
2	Polariser with electrode	4	Polariser with electrode

Polarisation with a voltage applied

An electrical field is generated when a voltage is applied. The liquid crystals align themselves according to the electrical field. The polarisation of the light alters. The display goes dark.



KT-5856

Fig. 4: The light polarisation principle with a voltage applied (electrical field)

Index	Explanation	Index	Explanation
1	Unpolarised light	3	Liquid crystals
2	Polariser with electrode	4	Polariser with electrode
E	Electrical field		

The function principle of a TFT display

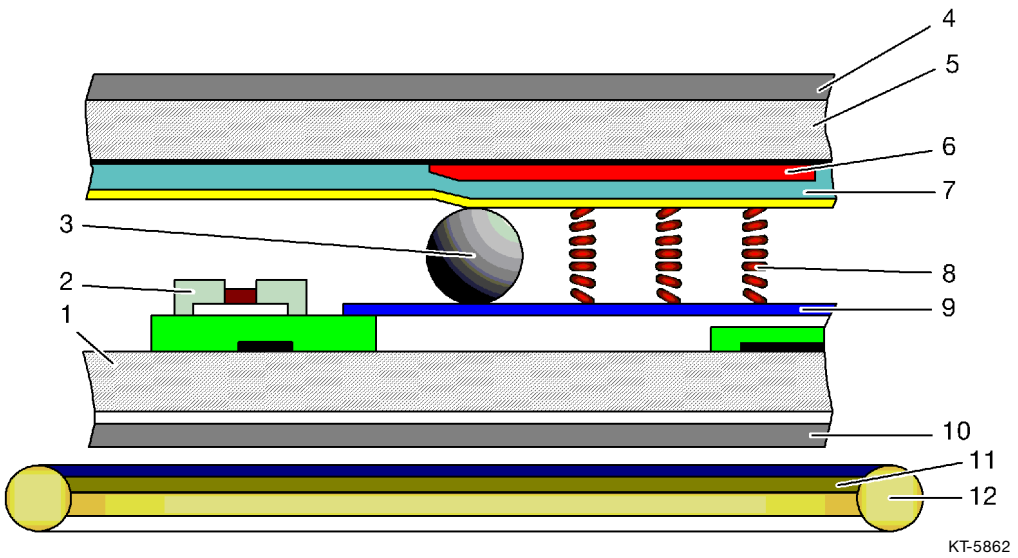


Fig. 5: LC display in TFT technology

Index	Explanation	Index	Explanation
1	Glass sheet	7	Electrode
2	Thin Film Transistor (TFT)	8	LC crystals
3	Spacer	9	Electrode
4	Polariser	10	Polariser
5	Glass sheet	11	Diffuser sheet
6	Colour filter	12	Fluorescent lamp

The light from the fluorescent lamp is distributed evenly via a diffuser sheet. This light is polarised by the polariser (10). The electric field between the electrodes (7 + 9) aligns the LC molecules. The light strikes the second polariser depending on transistor control via the "LC colour matrix". The "colour information" available here makes it possible to create an image. The sharpness of the image is dependent on the LC display type and its resolution (pixels), for example.

LC display pixel control

A pixel consists of the RGB colours (red, green, blue).

There are three transistors in a pixel, one responsible for each of red, green and blue. These transistors are controlled by an "LC colour matrix".

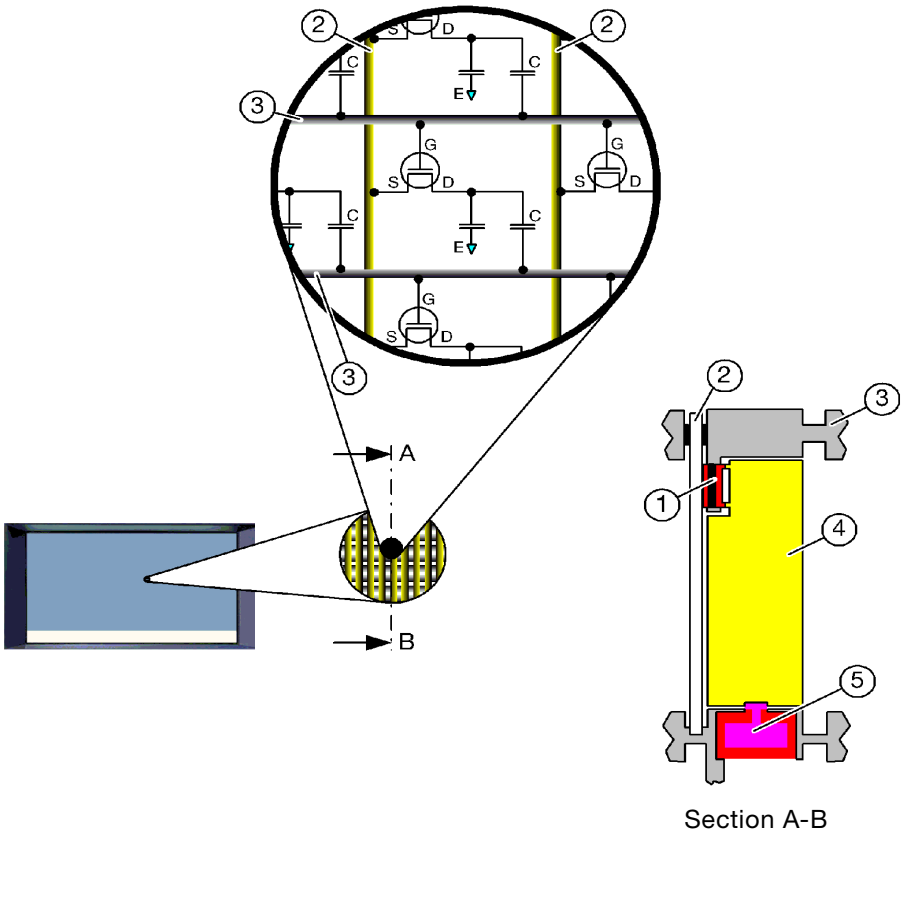


Fig. 6: Pixel control principle (one colour)

Index	Explanation	Index	Explanation
A-B	Section A-B	1	Thin Film Transistor (TFT)
C	Capacitor	2	Column
D	Drain connection	3	Row
E	Electrode connection	4	Pixel electrode
G	Gate connection	5	Capacitor
S	Source connection		

The function principle of an Ad-TFT display

The name Ad-TFT means Advanced Thin Film Transistor. An Ad-TFT display uses the light from internal and external light sources to display an image. This light is "controlled" so that the human eye can detect the colours on the display.

The significant differences (structural) compared to a TFT display are a delaying film and a microreflective layer.

Ad-TFT LC display technology

Two technologies are used for an Ad-TFT LC display. These technologies are

- LC display background lighting (transmission)
- Reflection of ambient light.

Near constant contrast under all ambient lighting conditions of up to 50000 lx is achieved by a combination of the two technologies (transflection). This light level corresponds to direct solar radiation.

The transmission principle

The transmission principle is used in LC displays which have been manufactured using TFT technology.

The LC display is illuminated from behind by a vacuum fluorescent lamp. The light from the fluorescent lamp is distributed uniformly using a diffuser sheet. It radiates through the polariser and the transparent electrodes to the RGB transistors. The RGB transistors are controlled by a "colour matrix". The corresponding image is displayed on the monitor interface according to RGB transistor control.

Backlight is always necessary to display an image.

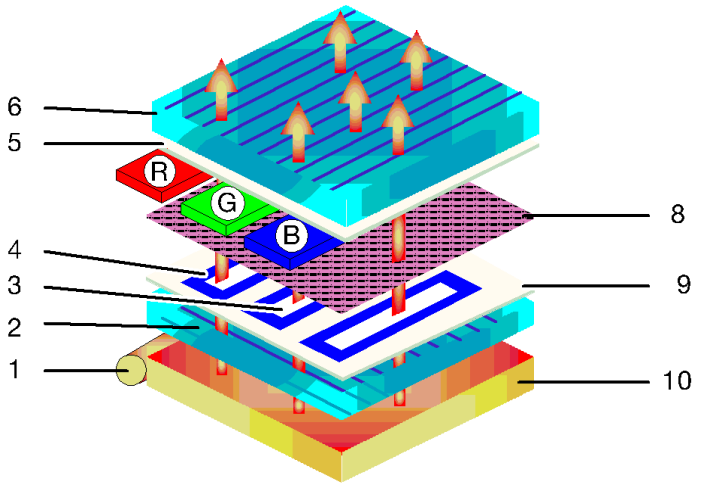


Fig. 1: The transmission principle with LC displays

Index	Explanation	Index	Explanation
1	Fluorescent lamp	8	Liquid crystal layer
2	Polariser	9	Delaying film
3	Transparent electrodes	10	Diffuser sheet
4	Microreflective electrodes	R	RGB colour filter, red
5	Delaying film	G	RGB colour filter, green
6	Polariser	B	RGB colour filter, blue

The reflection principle

The reflection principle is used along with the transflection principle for LC displays which have been manufactured in Ad-TFT technology.

Ambient light is reflected by the microreflective electrodes. This reflected light is used on the screen surface by controlling the RGB transistors using a "colour matrix". The corresponding image is displayed on the screen surface, according to RGB transistor control.

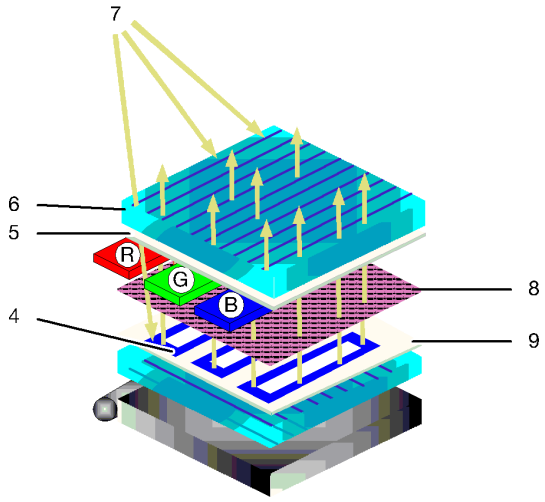


Fig. 2: The reflection principle with LC displays

Index	Explanation	Index	Explanation
4	Microreflective electrodes	9	Delaying film
5	Delaying film	R	RGB colour filter, red
6	Polariser	G	RGB colour filter, green
7	Ambient lighting	B	RGB colour filter, blue
8	Liquid crystal layer		

The transflection principle

The transflection principle is used along with the reflection principle for Ad-TFT displays which have been manufactured in Ad-TFT technology.

In transmissive (lighting) LC display operation, more contrast is achieved by using backlight. As the ambient light increases, the backlight is overlaid by the reflective portion of the ambient light. This leads to almost constant contrast.

The lighter the daylight, the more the luminosity of the backlight is increased.

If the daylight decreases (e.g. in a tunnel, on night-time journeys) the luminosity of the backlight is reduced.

The backlight is always in operation. It is controlled by the photosensor according to the ambient light.

Fig. 1: On-board monitor control panel photosensor circled in white

The RGB transistors are controlled by a "colour matrix". The corresponding image is displayed on the screen surface, according to RGB transistor control.

The reflective layer consists of microreflective electrodes and transparent electrodes.

The delaying film evens out colour shifts which occur as a result of differences in speed of the light.

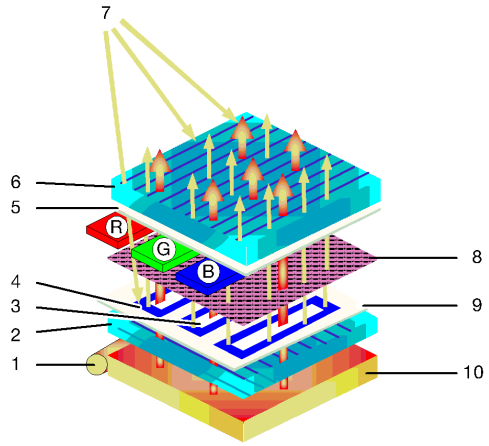


Fig. 2: The transflection principle with LC displays

Index	Explanation	Index	Explanation
1	Fluorescent lamp	8	Liquid crystals layer
2	Polariser	9	Delaying film
3	Transparent electrodes	10	Diffuser sheet
4	Microreflective electrodes	R	RGB colour filter, red
5	Delaying film	G	RGB colour filter, green
6	Polariser	B	RGB colour filter, blue
7	Ambient lighting		

Note

The Ad-TFT display cannot be compared to the Ad-TFT display on mobile phones.

Most mobile phones are front-illuminated (frontlight).

The Ad-TFT display in BMW cars is backlit. This display was jointly developed by BMW and Sharp.

On-board monitor service notes

Service mode

Diagnostics can be carried out via the service mode

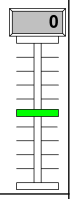
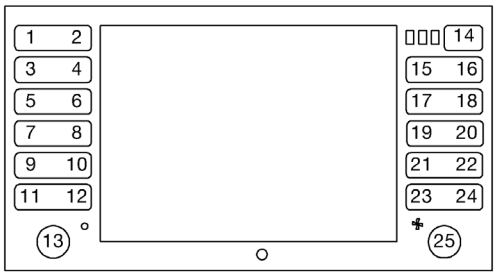
Service mode functions

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

- Radio terminal on
- Select the "Set" menu item
- Confirm the "Set" menu item using the "Navigation" rotary pushbutton
- 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 pushbutton

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. 1: 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 contrast 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.

List of abbreviations

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	CD audio signal
CH 1	Channel 1 magnetic field sensor
CH 2	Channel 2 magnetic field sensor
DDK	Rotary pushbutton
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

Index	Explanation
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
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	LC screen signals US
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

BMW documents about navigation

Document	Title
Operating Instructions	On-board monitor with navigation and TV (E38/E39/E46)
	On-board monitor with navigation (E53)
	Radio navigation (E46)
	Multi information radio (E52)
	Language administration (E38/E39)
Brochure	Comfort and communications electronics
	On-board monitor and GPS navigation
	Test mode 1
	Model year 1999 E46 on-board monitor navigation L7 rear
Trainer's Guide	E38 750i comfort and communications electronics On-board monitor system
	E39 On-board electronics
	E46 On-board monitor navigation