Table of Contents

Mk-3 NAVIGATION SYSTEM

Mk-3 NAVIGATION SYSTEM

Models: E38, E39, E46, E52, E53

Production Date: E46 from 6/00, all others from 9/00

Objectives

After completing this module you should be able to:

- Recognize the changes to Mk-3 from the previous Mk-2 navigation system.
- Identify the components used in the system.
- Review the operating fundamentals of GPS navigation.
- Describe how to properly code and program the Mk-3 computer.

Purpose of the System

The Mk-3 navigation system is a factory installed navigation system that replaces the previous Mk-2 version. The purpose of the system remains the same as previous navigation systems: To provide the driver with navigation instructions to an entered destination based on the vehicles current position and the roads available selected from a digitized road map.

The principle differences of the Mk-3 system over the previous Mk-2 are:

- GPS receiver is integrated into the MK-3 computer.
- Optimized memory and faster processor resulting in faster start-up and operation.
- New split screen and magnifying feature when equipped with wide screen monitor. (software feature)
- Same navigation computer used for color board monitor or monochrome MIR display units.

System Components

Mk-3 Navigation Computer

The Mk-3 navigation computer is located in the left side of the vehicles trunk or cargo area. (In the case of the Z8 it is installed in the storage box behind the passenger seat.)

The navigation computer housing contains:

- Map CD drive
- Hardware for navigation function
- GPS receiver
- Gyro sensor
- Output for audio interface
- Output for visual display
- Cooling fan for unit

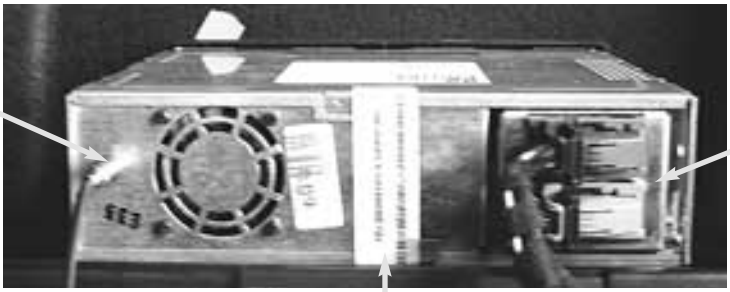
There are two different hardware versions available dependent on the angle of installation in the vehicle (horizontal or vertical). The Mk-3 is compatible with both board monitor or MIR display units. **(See workshop hints for configuration instructions)**

Identification of the Mk-3 computer over the previous versions is easy due to a change in the face plate design and the elimination of the “CD-IN” LED.

Mk-3 Navigation Computer

Mk-1 and Mk-2 Navigation Computer

Mk-3 computer



GPS (Global Positioning System) Receiver

The GPS receiver module of the previous Mk-2 system is integrated into the housing of the Mk-3 computer, further reducing the complexity and the number of components used in the system. The receiver is not serviceable.

The GPS receiver is responsible for receiving the satellite signals and providing the vehicle's position information to the navigation computer.

Information provided by the GPS receiver to the navigation computer can be displayed in the service mode **(see workshop hints)** but is not typically used in diagnosis.

Gyro (Rotation) Sensor

The navigation computer contains the electronic (piezo) Gyro sensor that detects rotation (yaw) of the vehicle as a confirmation that the vehicle is turning. The signal provided by the gyro is a mili-voltage that changes as the vehicle rotates. The navigation computer uses the input to track the vehicle along the digitized map and display the exact vehicle position.

The signal is available in the sensor test page of the service mode for diagnosis. The sensor is not a separately serviceable item and does not require calibration.

GPS Antenna

The GPS antenna is directly connected to the navigation computer via a coaxial cable. Locations of the antenna in the vehicles are as follows:

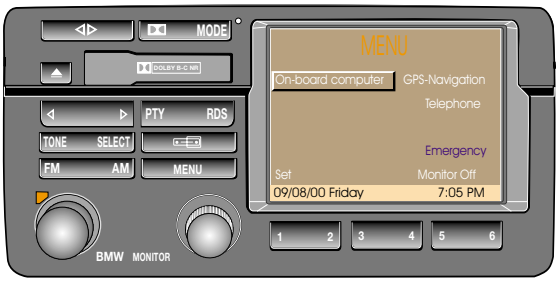
E38:	**Under the rear parcel shelf.**
E39 sedan:	**Under the rear parcel shelf.**
E39 Sport Wagon:	**Behind the dashboard on the left side.**
E46 sedan/coupe:	**Under the rear parcel shelf.**
E46 Sport Wagon:	**Above the rear glass under the spoiler.**
E46 Convertible:	**Behind the instrument cluster.**
E52:	**Left front corner behind the dashboard.**
E53:	**Above the rear glass under the spoiler.**

Display Units

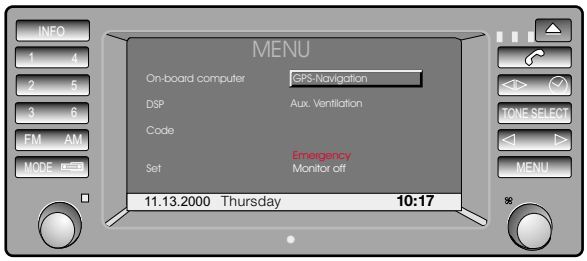
Based on the particular model, the factory installed Mk-3 system is displayed using a color board monitor or on a smaller monochromatic screen (MIR).

E52 MIR (Multi Information Radio)

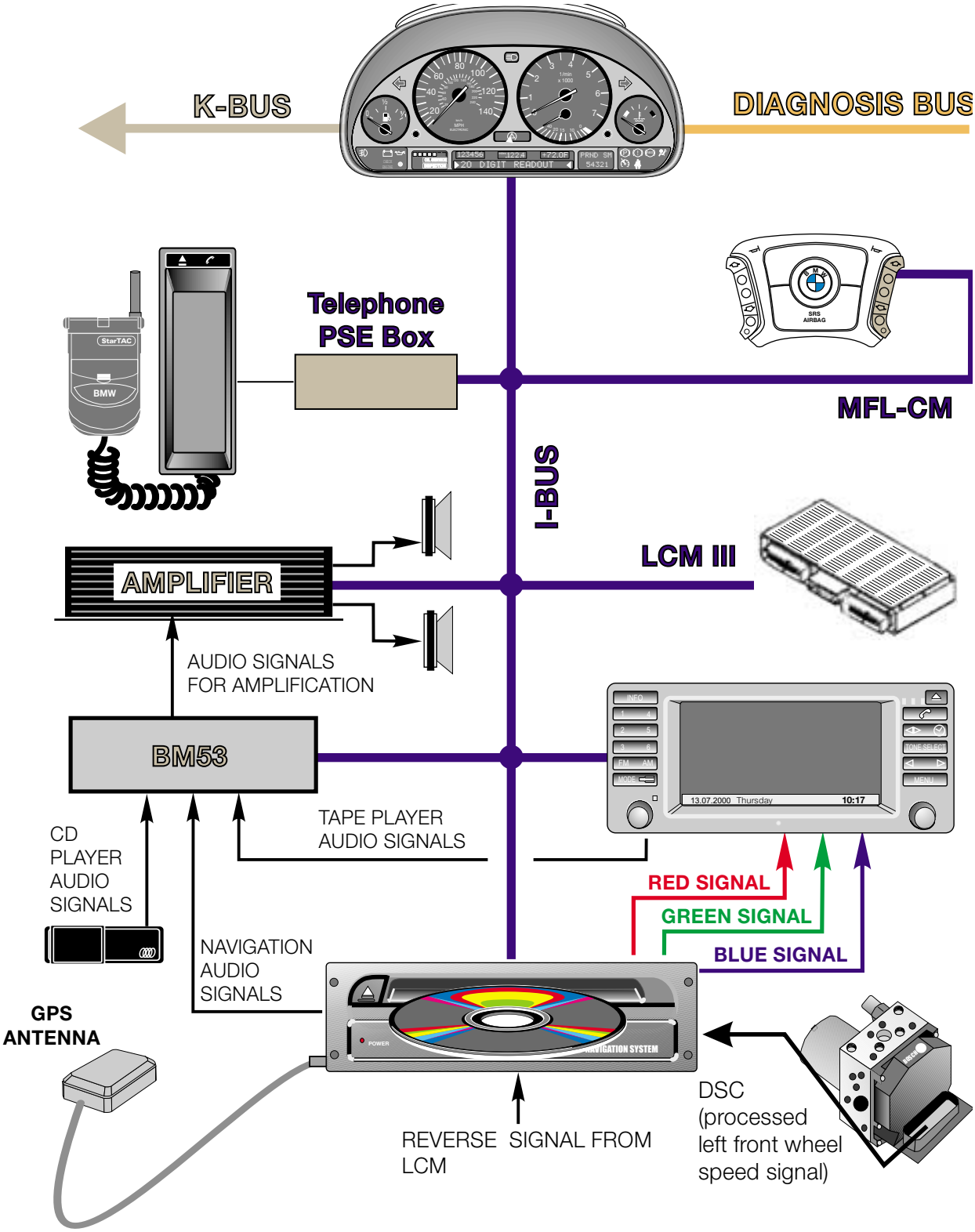
E46/E53 Color Board Monitor



E38/E39 Wide Screen Color Board Monitor (phased in for E53 1/01, E46 9/01)



Navigation System Interface



Example of E38/E39 with Mk-3 navigation

Information/body bus Interface

The navigation computer is integrated into the vehicle bus system as it's main communication link with the vehicle.

Communication occurs with the following modules:

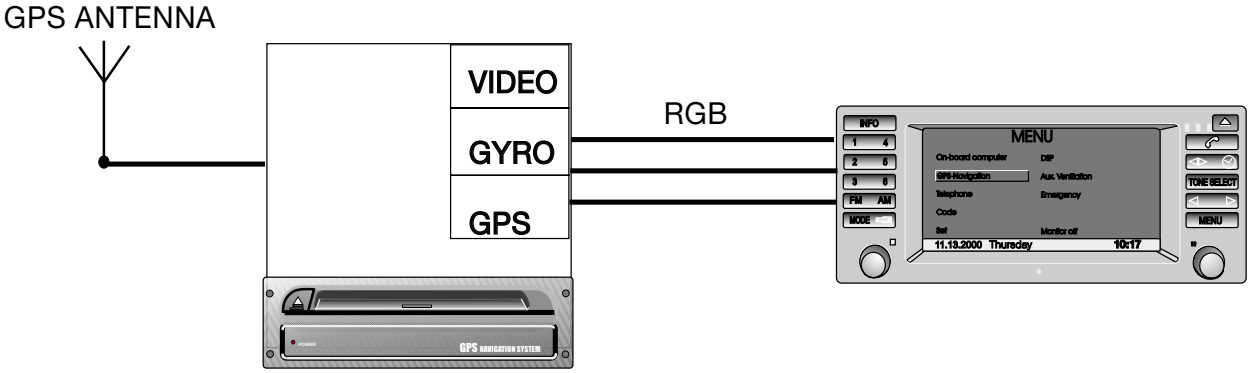
- **BMBT** - Control inputs
- **Radio** - Display data
- **GM** - Door open
- **IKE/Kombi** - On-board computer data
- **Telephone PSE Box** - Monitor display data, mayday function
- **DISplus** - Coding data

PSE = Portable Support Electronics

Video/Audio Signals

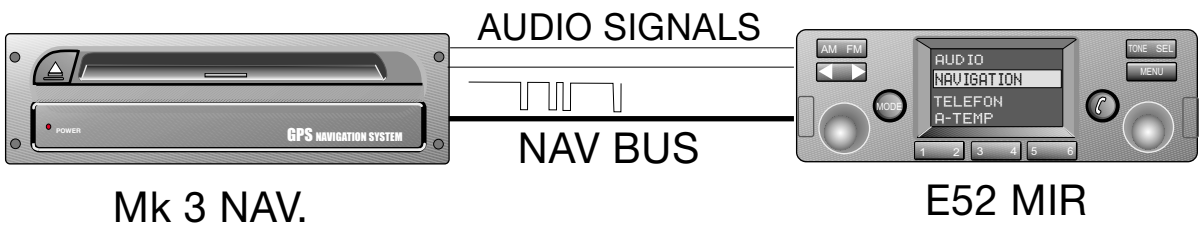
Board Monitor (Top Navigation)

The RGB video signal for all display functions of the board monitor are produced by the navigation computer graphics stage via three output signals. The Red-Green-Blue signals are direct inputs to the board monitor. The audio signals for navigation instructions to the radio are sent via two separate lines.



MIR (Radio Navigation)

Since a color display is not used for the MIR, the navigation information for the display is sent via a NAV bus. The NAV bus is a single dedicated line between the Mk-3 computer and the MIR. Audio signals for navigation instructions are sent to the radio via two separate lines.



Speed Signals

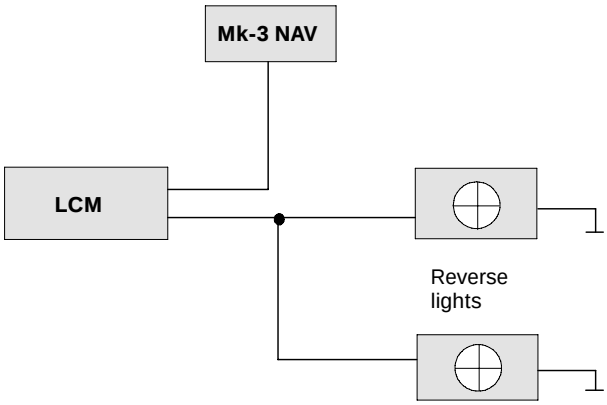
A speed signal is provided to the navigation computer for detection of distance traveled and vehicle speed to calculate the vehicles position on the digital map. The input is a processed signal provided by the vehicles DSC control unit.

- E46: The speed signal used is from the **left rear** wheel.
- E38/E39/E52/E53: The speed signal used is from the **left front** wheel.

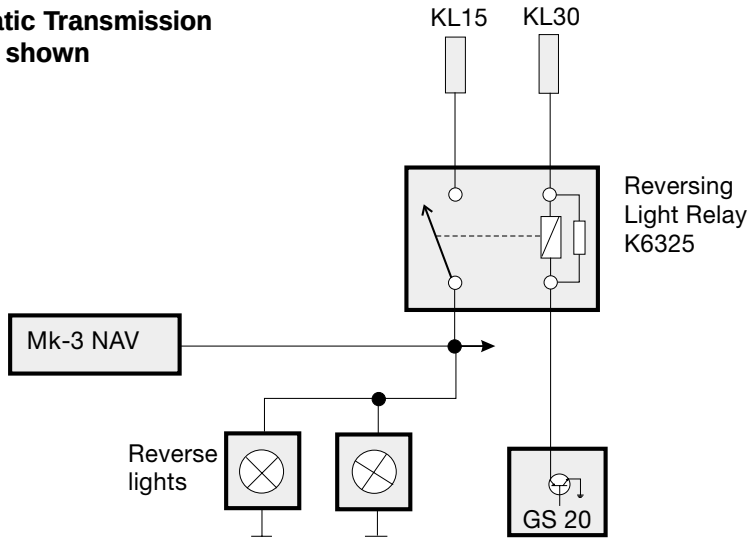
Reverse Gear Input

The reverse gear input is used by the navigation computer to distinguish between the vehicle backing up or turning around.

- E38/E39/E52/E53: The reverse input is a high signal produced by the LCM III.



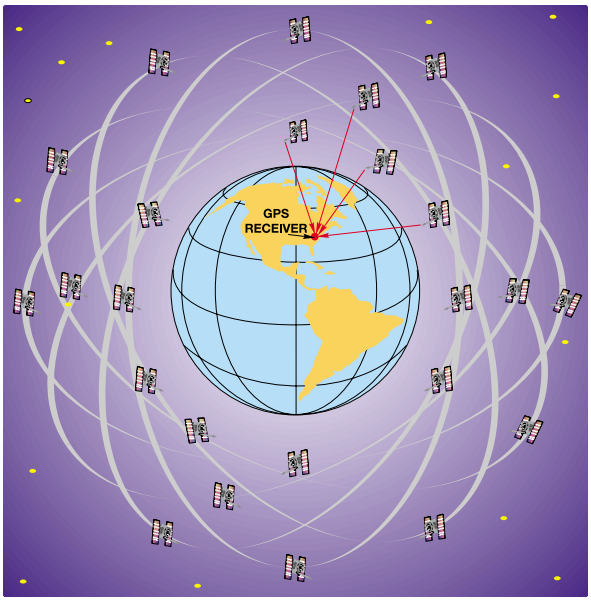
- E46: The reverse input is a high signal supplied by a splice from the back-up lights.



Principle of Operation

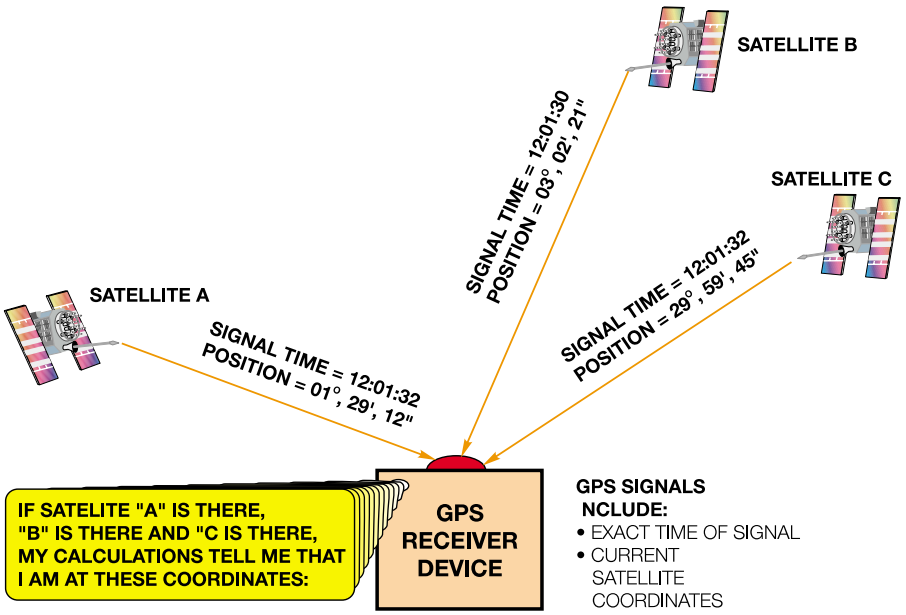
The Global Positioning System is a satellite based system developed by the US Department of Defense that provides both military and civilian users accurate information about location.

The GPS system uses 24 satellites in six orbits 12,550 miles above the Earth moving at 1.7mi per second. Usually 7 to 10 satellites are in view over any one point on the earth.



The GPS satellites are basically extremely accurate clocks that broadcast a coded signal representing time. The GPS receiver determines it's distance from the satellite by measuring the time it takes between satellite transmission of the signal and reception to the receiver. The receiver does this with at least 2 other satellites and uses the information to determine the vehicles latitude, longitude, and altitude. The accuracy of the system for civilian use is within 100m (300ft).

The vehicle must have an unobstructed view of the sky to receive the maximum amount of satellite signals. Trees, large buildings and excessive cloud cover can block the reception of the satellites' transmissions.



The GPS antenna passes the signal to the GPS receiver incorporated in the navigation computer. A CD with map data is loaded in the CD drive of the navigation computer. The navigation computer combines the vehicle position calculated by the GPS with this map data.

The current position of the vehicle can be shown on the on-board monitor by selecting “Emergency” from the main menu.

The driver can enter a destination. The navigation computer calculates a route from the current location to this destination based on selectable criteria (main use of highways, shortest distance, etc.). The calculated route is shown in the route display.

The navigation computer generates the RGB color video signal for all on-board monitor displays. These three signals are sent over separate shielded wires to the on-board monitor.

In the case of the E52 MIR (also referred as radio navigation) which does not have a color display, the visual display data is sent via one wire called the navigation bus. On both systems, color and monochrome display, the audio output from the navigation computer for voice directions is sent over two separate wires.

The driver has the choice of displays that utilize a color map with an icon of the vehicle being traced on the map or the use of arrow indicators and distance data shown on the on-board monitor display. Vehicles equipped with the wide screen board monitor have a split screen option that includes both display methods. The MIR only makes use of the arrows and distance display. With the assistance of voice prompts, the navigation computer indicates how and where to get into the correct lane or turn off.

The navigation computer calculates the distance traveled from the wheel speed signal delivered by the DSC control unit.

The gyro incorporated into the navigation computer housing informs the navigation computer when the vehicle is turning. An alternative route is re-calculated automatically if the driver does not follow the original route instructions.

Once the driver has reached their destination, the navigation computer is ready for another destination input.

Refer to the on-board monitor owners manual for instructions on using the navigation system software.

Workshop Hints

Replacing the Mk-3 navigation computer

When replacing the Mk-3 navigation computer be aware that there are two hardware variants depending on the installation position (vertical or horizontal).

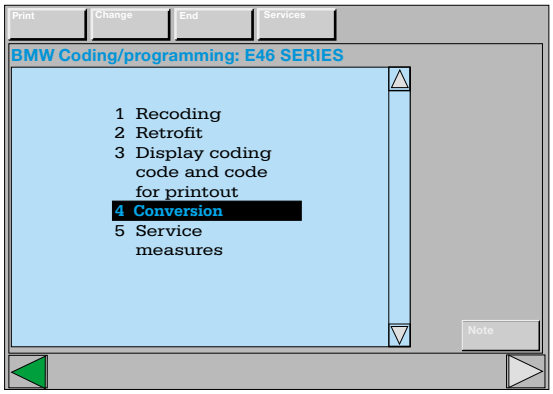
The ignition should be in position 0 during removal and replacement of the computer. After installing, close all doors, hood and trunk. A bus line reset will be carried out within two minutes. Resetting allows the gyro to perform a calibration run. Do not move the car during this reset period.

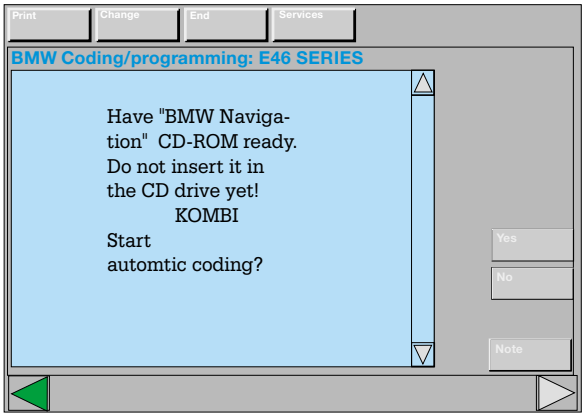
The coding sequence for the Mk-3 navigation computer has been changed from the previous Mk-2. There is now an additional step (configuration) that must be done before the software can be loaded.

After resetting, a configuration signal is needed to allow the computer to load the correct software for use with a board monitor or MIR. This is performed using the DIS coding program (CD 22.0 onward) and the Navigation System operating software (CD V15.0 onward).

Note: Vehicles using the wide screen BM require CD V16.1 onward.

1. **From the DIS/MoDiC Coding /Programming select “1 ZCS Coding”**
2. **Select the appropriate series (E46,E39,E38,E52,E53)**
3. **Select “4 Conversion”**
4. **Select “3 IKE?Kombi”**
5. **Select “2 language”**
6. **At the prompt “is the CD ROM present?” select yes , but do not install the operating software CD ROM yet.**
7. **First select the main language and then an additional language. (i.e. English-spanish)**
8. **Select the gender of the navigation audio voice.**
9. **Select “automatic coding-yes”**



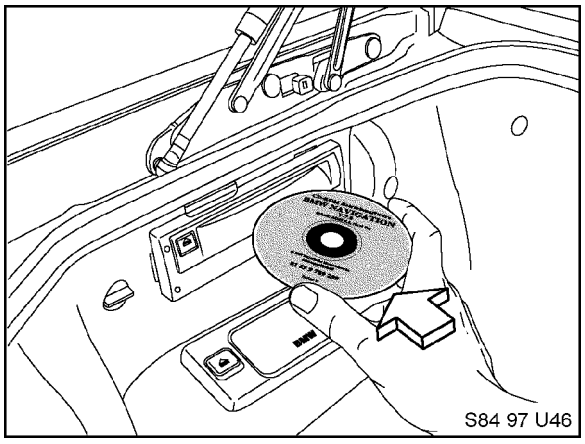


10. **After coding is done the DIS/MoDiC instructs you to follow the instructions on the monitor for the installation of the Navigation System CD ROM.**

11. **Place the navigation system software in the navigation computer CD drive.**

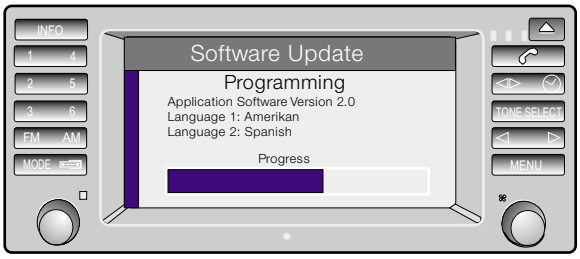
Important: Do not switch the ignition off during the software loading procedure. Do not use any software for the Mk-3 earlier than CD V15.0.

12. **Once loading has been completed, remove the CD and then confirm completion by pressing the rotary push-button on the monitor.**



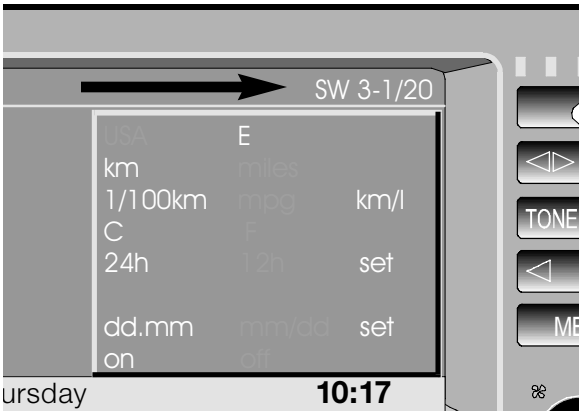
13. **Turn off the key for 10 seconds, then turn it back on and conduct a functional check.**

14. **After this step has been finished, encode the navigation computer using the "Recoding" path in ZCS Coding. The coding process involves coding vehicle specific data: VIN, Model, Telematics data etc.**



The software status can be confirmed from the "Set" screen for Mk-3 systems.

- **3** = Third generation system Mk-3.
- **1** = Device variant (1=Color screen, 2= MIR monochrome screen).
- **20** = Software version of the graphic component (Version 2.0).



After the navigation computer has been successfully programmed and coded the vehicle should be left in an area with a clear view of the sky with the key in KL R for at least 15 minutes to complete the calibration process.

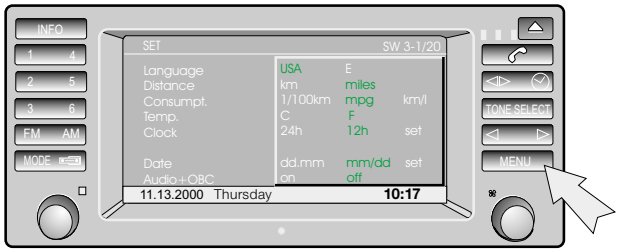
Service Mode

Just as Mk-2, Mk-3 provides an on-screen service mode for diagnosis. The service mode provides five different test screens:

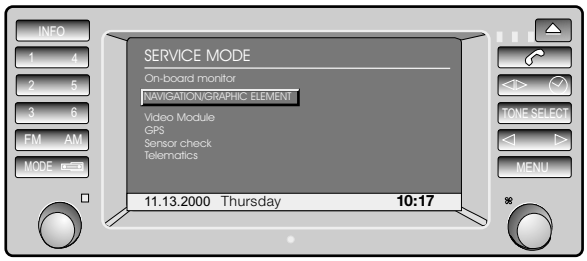
- On-board monitor
- Navigation/Graphic element
- GPS
- Sensor Check
- Telematics

To enter the Navigation Service Mode:

- Turn the ignition key to position 1 (KL R).
- From the Menu screen select “SET”.
- Once in the Set screen, press and hold the “MENU” button for 8 seconds.
- The Service Mode menu will appear on the display.
- Select from the Service Mode menu for navigation specific tests.



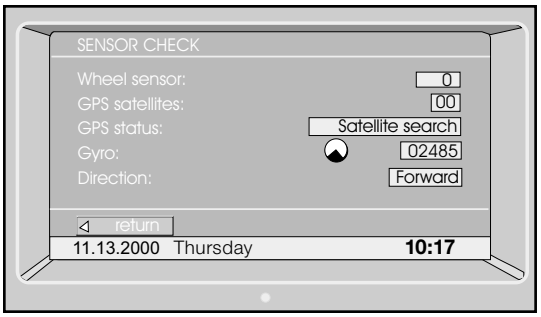
Press and hold for 8 seconds after entering the “Set” mode

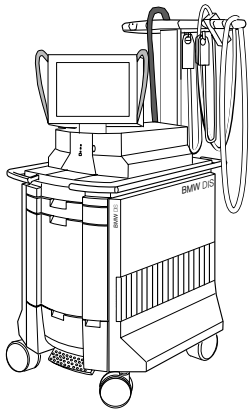


Service Mode main menu display

Diagnosis

Diagnosis is carried out using Test Modules in the Diagnosis Program as well as on-screen in the Service mode.The Sensor Check display is intended to be used while test driving the vehicle. The following pages contain charts with explanations of the Service Mode display.





STATUS DISPLAY	WHAT SHOULD BE DISPLAYED	WHAT TO DO IF NOT OK
Wheel Sensors:	As the vehicle is driven, the number should increase with an increase in vehicle speed.	Check fault codes in DSC system. If necessary carry out wheel speed sensor test.
GPS Satellites:	With unobstructed upward view of sky the display should be > 3	Check for interference of signals to GPS antenna, Check integrity of circuit from GPS antenna to nav computer.
GPS Status:	"See Legend below"	
Gyro:	Direction icon moves with vehicle turning movement. Milli voltage display value should be approx 2500 mV (+/- 400mV) when the vehicle is stationary or driven straight ahead. When the vehicle is turning, the signal voltage should increase on right hand turns and decrease on left hand turns.	Replace Navigation computer.
Direction:	Reverse is displayed when range selector is in reverse. Forward in any other range.	Check back up light signal input.

GPS Status Text Display	Description
1. "GPS fault"	Problem with GPS system. Swap nav computer and or antenna from know good vehicle after checking GPS status display information
2. "Reception Interference"	Problem with GPS system. Same as above.
3. "No Almanac"	No Data yet stored from satellites. The GPS almanac is a memory account of received satellite signals. If the vehicle battery has been disconnected or after replacing a nav computer it has an empty memory and requires satellite signals to become functional. After the nav computer receives battery voltage and ground, it must be left outside with an unobstructed sky above with the ignition switched to KL R for approximatly 15 minutes.
4. "Satellite search"	GPS is currently searching for satellite signals.
5. "Satellite contact"	At least one satellite is found
6. "Position known"	Vehicle's Latitude and Longitude known. Navigation is possible.

Menu	Display	Explanation
GPS/Status	G-speed	Relative speed over the ground
	Heading	Direction of travel
	Rec status	Search/track/position receiver status
	Pos-src	Number of satellites available for analysis
	PDOP	Accuracy of the calculated location
	HDOP	<8=sufficient determinations of location
	VDOP	<4=very good determinations of location
GPS/Tracking info	CH	Channel
	PRN	Satellite detection
	S/N	Better reception as the value increases
	Visible Sat	Number of visible satellites, receivable Signals, depending on time of day/configuration
	Almanac	Satellite database, loaded automatically after 15 minutes
Telematics	VIN	VIN (Automatically assigned during coding)
	Color	Color code or text
	GSM	Telephone network/contract number
	BMW info	Customer specific info
	Emergency call out	On/off status
	Initialization	Telematics services on/off status
	Logging off	Logging off telematics services

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

Review Questions

1. List the most signoficant changes made to the Mk-3 navigation computer over the previous Mk-2. _____

2. How can the signal provided by the gyro sensor to the navigation computer be checked? _____

3. Describe how the display signals are transmitted from the navigation computer to the MIR and board monitor. _____

4. What step is necessary before loading the navigation computer operating software CD on a newly replaced navigation computer? Where can the software status be confirmed after it has been loaded? _____

5. How is the VIN entered into the navigation computer? _____