

SSP 31-001

**The Self-Study Programme is not a  
Workshop Manual.**



**Note**

# At a glance



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# What is where?



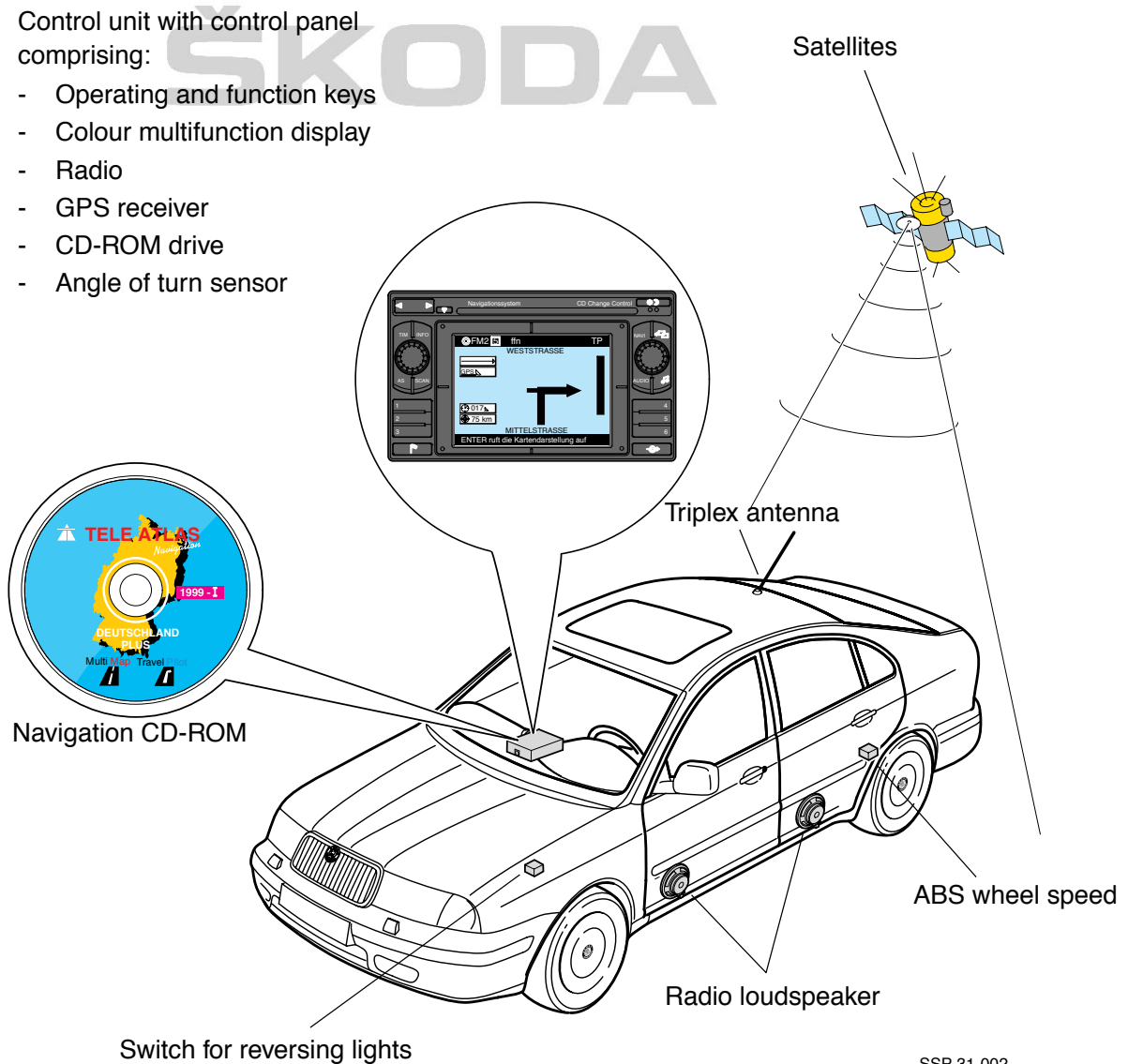
To provide you with a quick overview, all the component parts of the Volkswagen and Audi Radio Navigation Systems are shown on this double page.

You will find a description of the design and function of the system components on the following pages.

## Radio Navigation System

Control unit with control panel comprising:

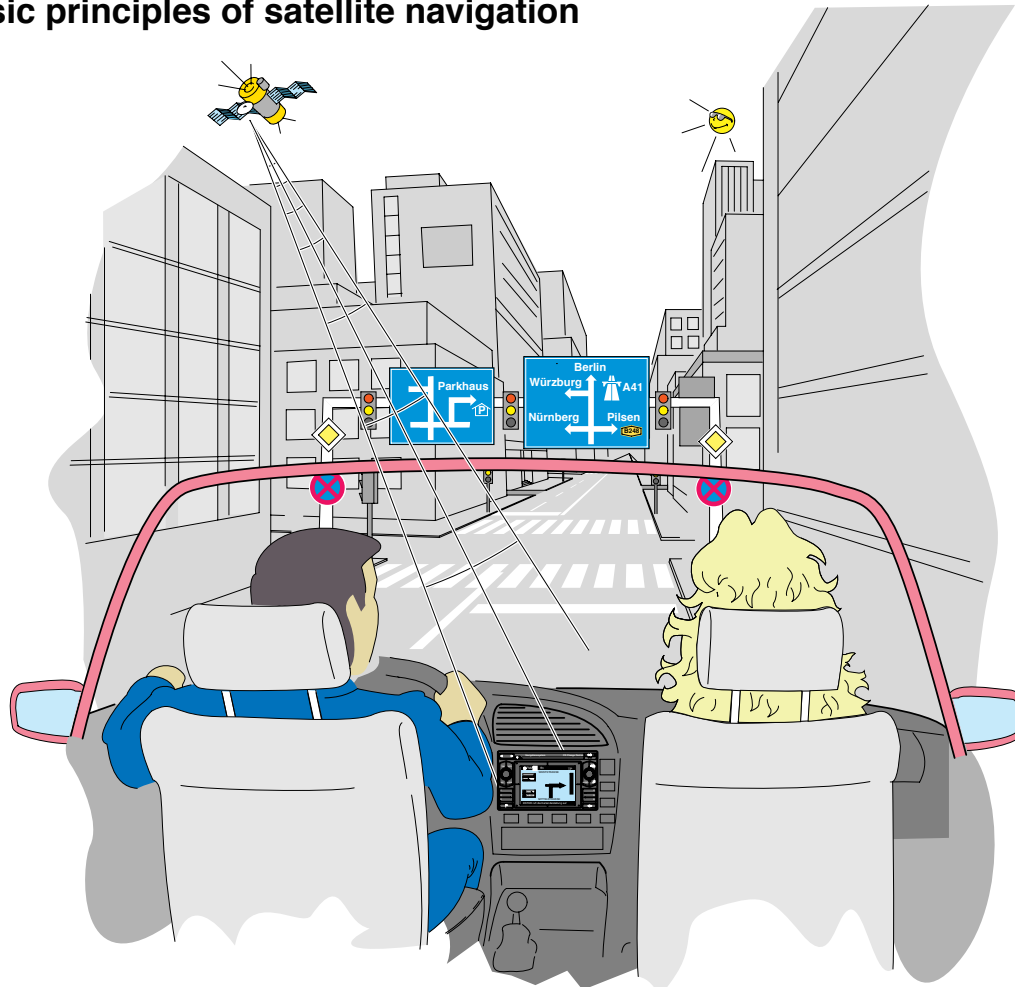
- Operating and function keys
- Colour multifunction display
- Radio
- GPS receiver
- CD-ROM drive
- Angle of turn sensor



SSP 31-002

## Part 1

### Basic principles of satellite navigation



SSP 31-003

#### What does navigation mean?

Every car driver is familiar with the following situation:

A journey to a holiday destination, driving into a unfamiliar town or city and a weekend trip in the immediate vicinity.

Before you set off, you study the route on a map or street plan.

During the journey, you find your bearings by reading traffic signs and noticing striking features of the landscape.

The front passenger may also be helpful. For various reasons, however, he or she may not always be able to help you out.

We all know what it means to get lost.

Navigation involves locating the position of a vehicle, as well as determining the direction and distance of your destination and taking the necessary steps to reach your destination.

Satellite-aided navigation enables you to travel from your starting point to your destination quickly, safely and comfortably without having to read maps.

# Basic principles

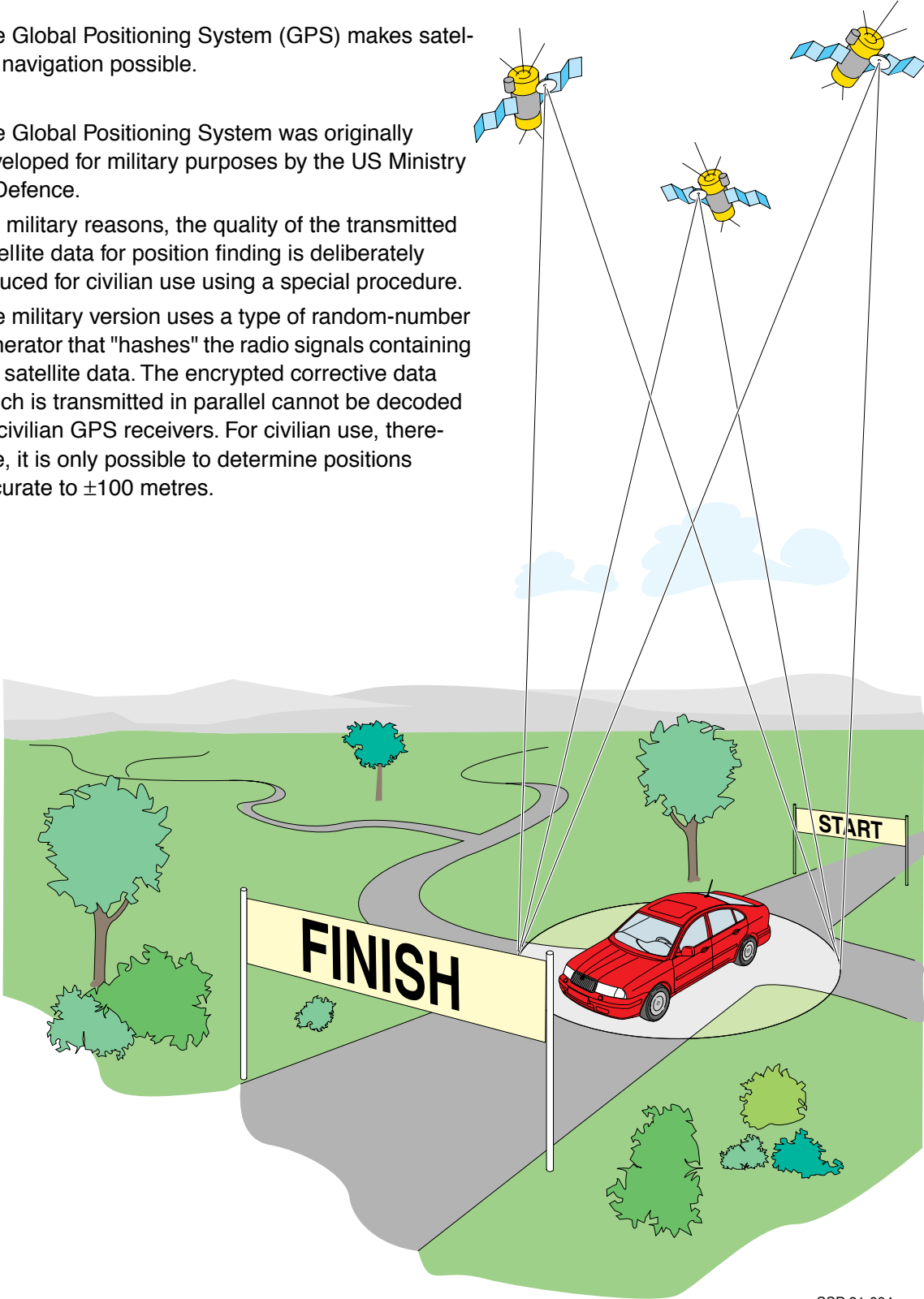
## The Global Positioning System

The Global Positioning System (GPS) makes satellite navigation possible.

The Global Positioning System was originally developed for military purposes by the US Ministry of Defence.

For military reasons, the quality of the transmitted satellite data for position finding is deliberately reduced for civilian use using a special procedure.

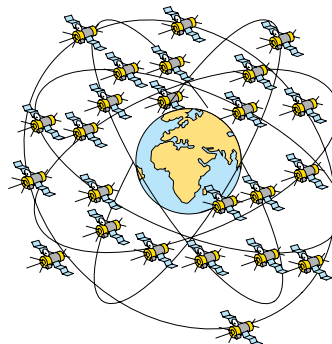
The military version uses a type of random-number generator that "hashes" the radio signals containing the satellite data. The encrypted corrective data which is transmitted in parallel cannot be decoded by civilian GPS receivers. For civilian use, therefore, it is only possible to determine positions accurate to  $\pm 100$  metres.



## Global Positioning System (GPS)

The Global Positioning System (GPS) currently comprises a total of 24 satellites which are evenly distributed over six orbits at an altitude of approximately 20,000 kilometres. They each circle the earth once every 12 hours.

With this arrangement, every point on the earth theoretically has radio contact to at least four satellites.



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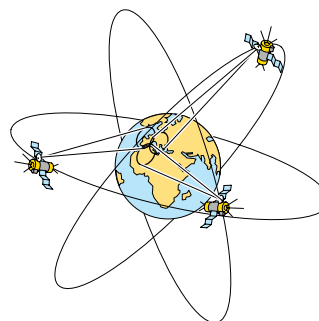


## Position calculation

Each time it is switched on, the Radio Navigation System attempts to receive the signals sent by the satellites.

Reception from at least three satellites is necessary for an accurate position fixing.

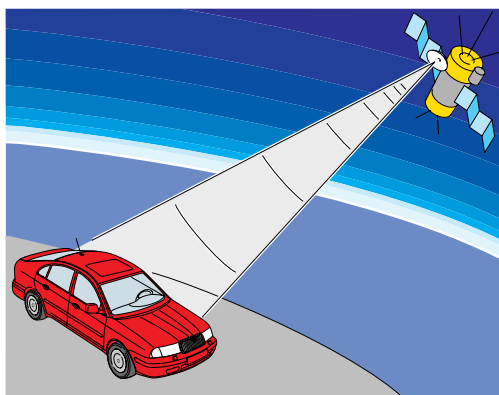
Only then can the position of the receiver be calculated at any point on the earth's surface.



SSP 31-006

# ŠKODA

## Radio traffic



SSP 199-011

The satellites radio an ID code, their position and a high-precision timing signal earthwards at intervals of one millisecond.

The GPS receiver in the Radio Navigation System receives the satellite data and calculates how long the data transmission took by comparing the timing signal with its internal high-precision clock.

If the navigation computer receives data from at least three satellites, it is able to calculate the vehicle's position.

# Basic principles

## Reception interference of satellite signals

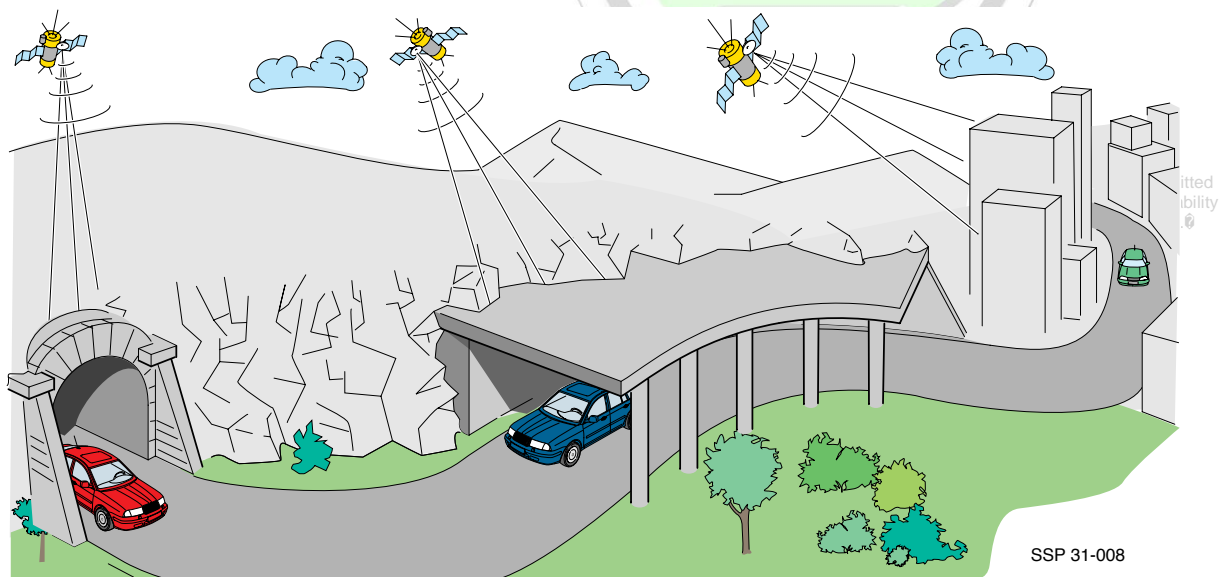
Reception interference may occur if the satellite transmitter does not have line-of-sight contact with the receiver of the Radio Navigation System or if the satellite signal is reflected off buildings, mountains, etc.

In the following situations, the radio link with the satellite may be interrupted or faulty:

In

- Street canyons
- Valleys
- Tunnels
- Multi-storey car parks

This may lead to an inaccurate position fixing or render the system unable to locate the vehicle.



Although the Global Positioning System is the primary source of information for the Radio Navigation System, the system is able to make allowance for short periods of reception interference.

For this purpose, the direction of travel and distance travelled are only calculated using the information provided by the angle of turn sensor and the wheel speed pulses generated by the ABS wheel sensor.

Comparison with GPS signals is not possible, and position fixings are less accurate when reception is disturbed.

As soon as GPS signals can again be received, the previously calculated position is corrected.

## Dead-reckoning navigation

The system components of the Radio Navigation System increase the accuracy of position fixing.

The navigation control unit calculates the route profile from the signal supplied by the angle of turn sensor for determining changes in the direction of travel to the left/right and the pulses generated by the ABS wheel speed sensor for calculating the distance travelled.

Dead-reckoning navigation is the result of the interplay between these two sensors.

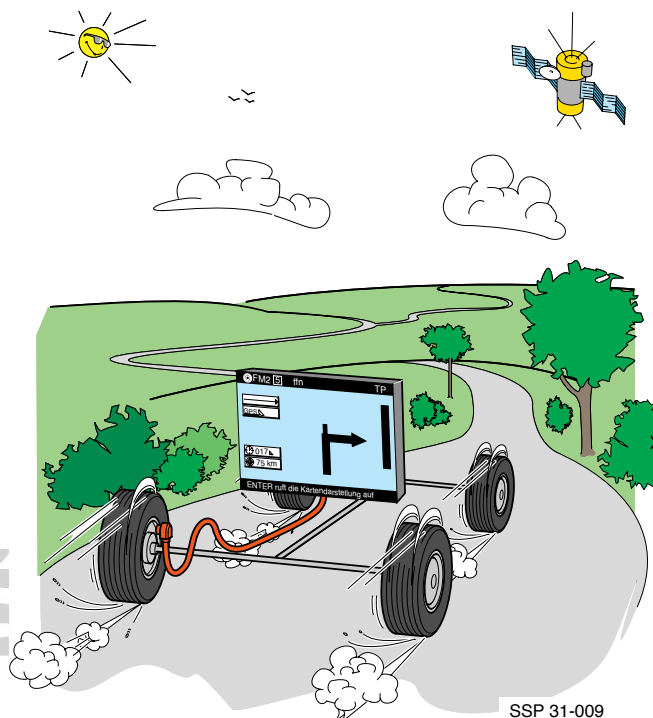
The navigation control unit compares the route profile with the street map stored on the CD-ROM several times per second.

This comparison process is known as “**map matching**”.

The accuracy of position fixing can thus be increased to  $\pm 5\text{m}$  in urban areas and  $\pm 50\text{m}$  on long, straight country roads or motorways.

If the vehicle is located on a road which is not stored on the CD-ROM, the message “OFF-ROAD” appears on the display.

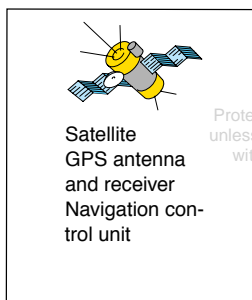
“Map matching” cannot be performed then. Therefore, only the straight line distance and the direction to the destination are displayed.



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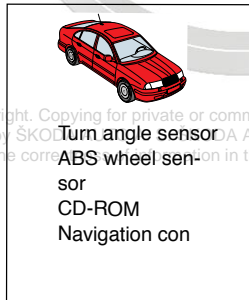
Vehicle navigation is the overall result of the interplay between satellite navigation and dead-reckoning navigation.

### Satellite navigation



+

### Dead-reckoning



=



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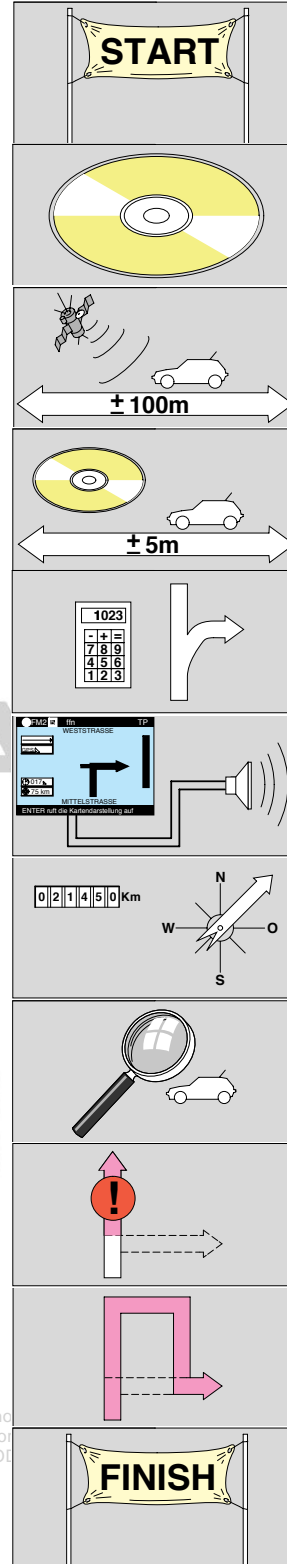
SSP 31-010



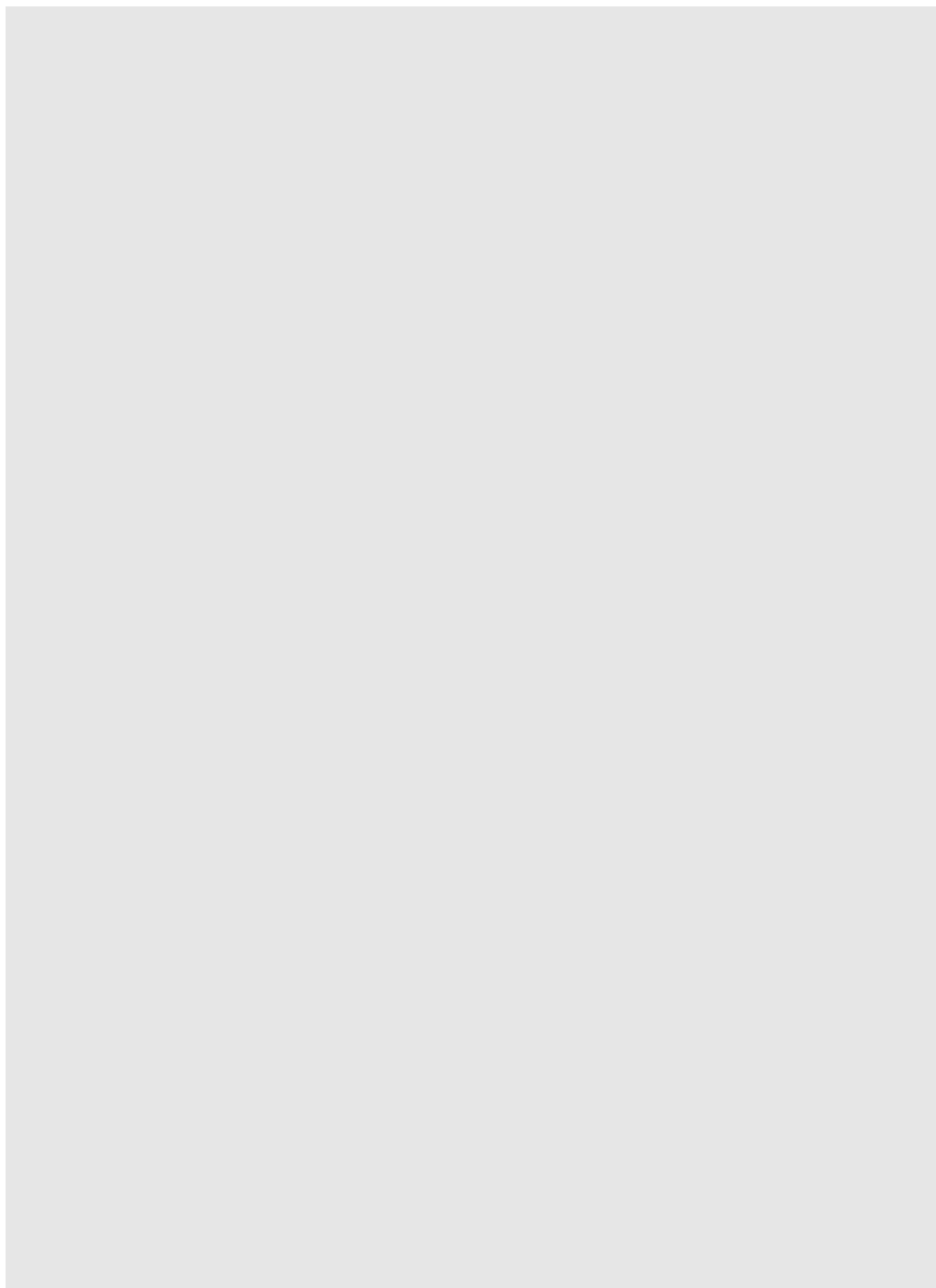
# Basic principles

## How vehicle navigation works

1. The driver enters the desired destination using the operating and function keys.
2. The position of the destination is determined using the street map on the CD-ROM.
3. The navigation control unit calculates the current vehicle position accurate to approx.  $\pm 100$  m using the satellite data it receives.
4. The vehicle position is determined by dead-reckoning navigation accurate to  $\pm 5$  m and by comparison with the digital map data stored on the
5. The navigation control unit calculates the distance, the direction of travel, the change of direction of
6. Route recommendations are then output in the form of visual and audible messages.
7. During the trip, the distance travelled is measured on the basis of the wheel speed pulses generated by the ABS wheel speed sensor and changes of direction sensed by the angle of turn sensor.
8. The system continuously monitors whether the driver follows the route recommendations.
9. The system tells the driver when he has deviated from the recommended route.
10. If the driver stays on this route, the system recalculates the distance to the destination.
11. When you reach your destination, the driver hears the message "You have reached your destination".



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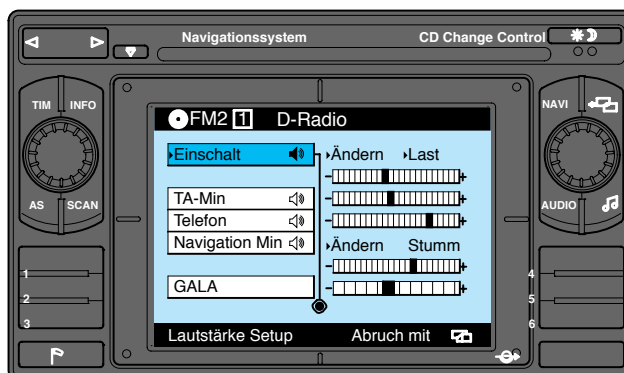


# Basic principles

## System components

### Control unit with control panel

The following components are integrated in the control unit with control panel:



SSP 31-012

Component	Function
Operator buttons and function keys	Various functions can be controlled with the operating and function keys, depending on whether the system is in Radio mode, Audio CD mode or Navigation mode.
Colour multifunction display	The colour multifunction display can be adjusted horizontally and vertically. The display can also be switched over to night illumination. This makes the display easier to read at night.
Radio	Radio stations for FM (VHF = very high frequency) and AM (medium wave) can be received.
GPS receiver	The GPS receiver automatically receives signals from the available GPS satellites via the navigation antenna.
CD-ROM drive	The CD-ROM drive plays back navigation CDs. Playback of audio CDs is not possible.
Angle of turn sensor	An angle of turn sensor records changes in the direction of travel. It replaces the magnetic field sender previously used.



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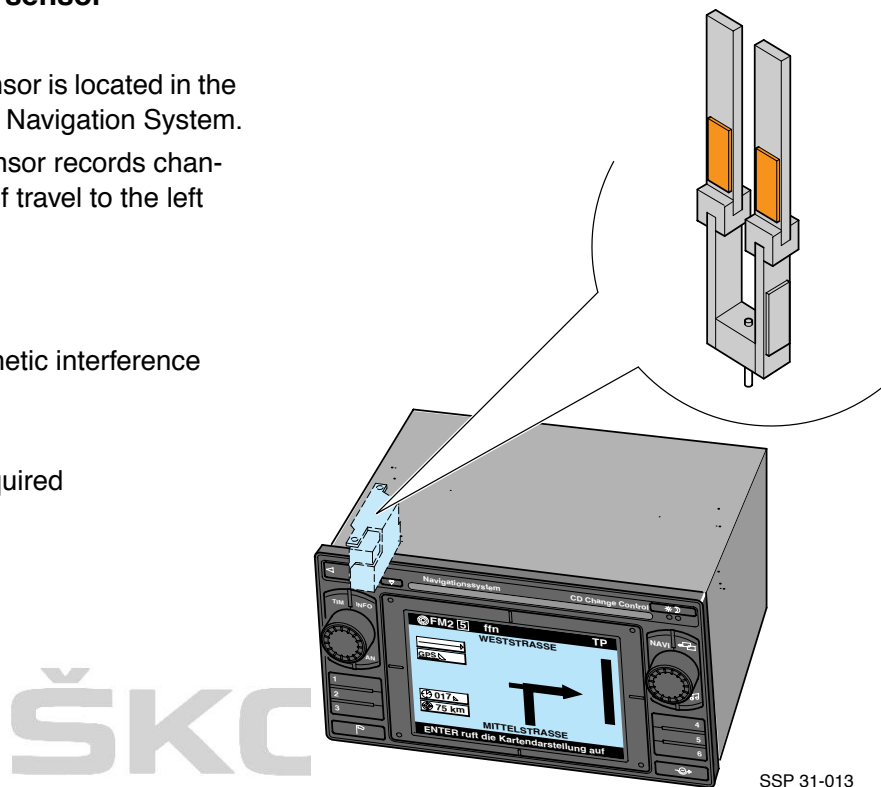
## The angle of turn sensor

The angle of turn sensor is located in the housing of the Radio Navigation System.

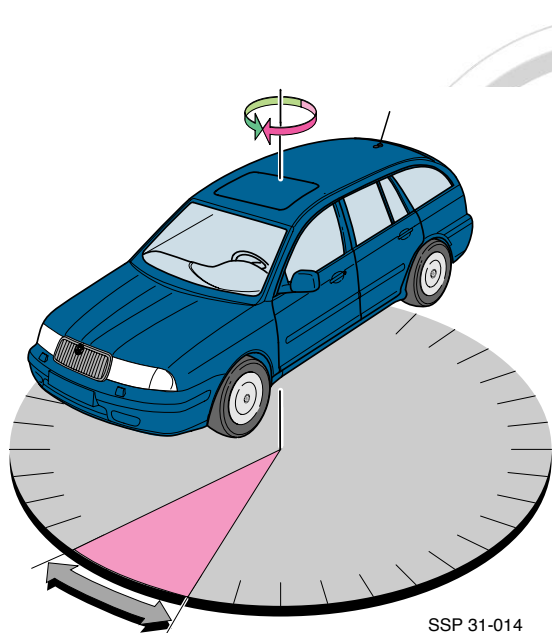
The angle of turn sensor records changes in the direction of travel to the left and right.

The advantages are:

- Immunity to magnetic interference
- Compact size
- Greater accuracy
- No calibration required



SSP 31-013



SSP 31-014

When the vehicle changes its direction of travel, it rotates about its vertical axis.

The angle of turn sensor detects this rotational movement and informs the navigation control unit. The navigation control unit then calculates the angle of the direction change.

In order to distinguish between forward and reverse movement, the control unit receives a signal from the reversing light switch.

The distance travelled is still required in order to calculate the curve radius.

This is determined with the aid of the wheel speed pulses of an ABS wheel speed sensor.

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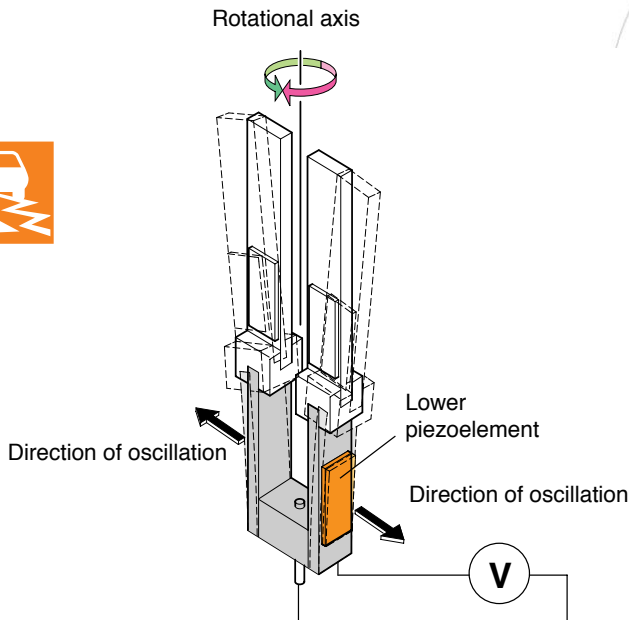
## Function of the angle of turn sensor

The angle of turn sensor is shaped like a tuning fork.

The two legs of this element are designed as oscillating bodies.

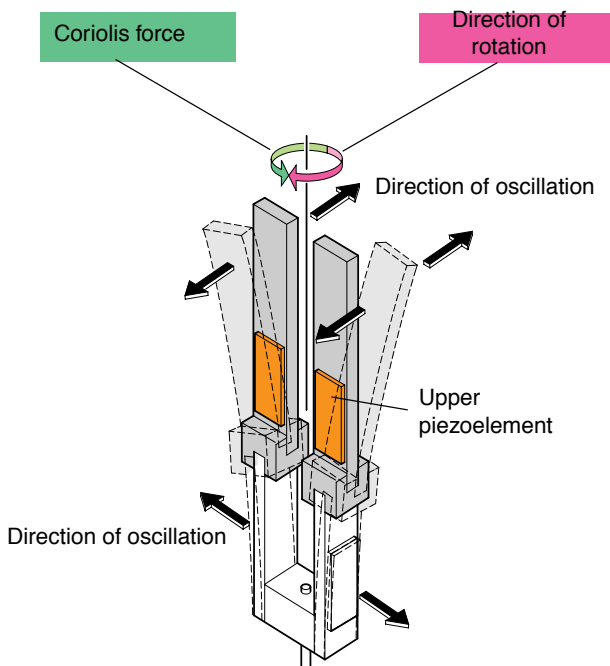
When the ignition is turned on, voltage is applied to the lower piezoelements. They then begin to oscillate.

The oscillations are transmitted to both limbs.



SSP 31-015

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When the vehicle changes direction (e.g. when cornering), the so-called Coriolis force acts on the oscillating legs of the sensor.

This Coriolis force acts against the direction in which the vehicle is rotating about its vertical axis.

The upper parts of the legs, which is already oscillating sideways, bend as a result.

The flexure of the legs is transmitted to the upper piezoelements, thereby generating a voltage in the piezoelement.

The navigation control unit can calculate the change in direction of travel from the level of this voltage.

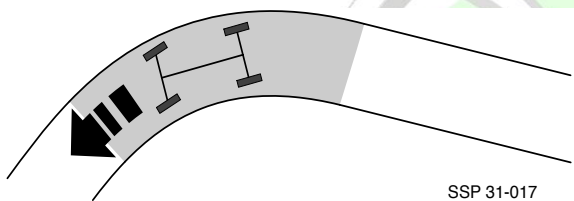
## Cornering

When the vehicle is cornering, the upper sections of the legs are bent by the Coriolis force for as long as the vehicle takes to negotiate the corner.

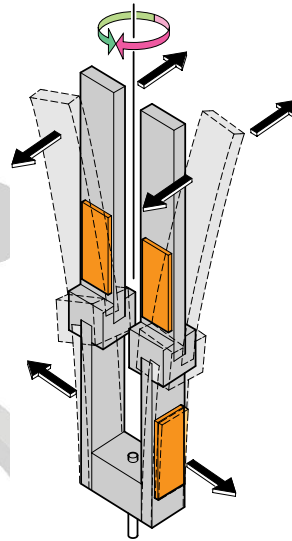
A voltage is produced in the upper piezoelements of the angle of turn sensor.

The level of this voltage is dependent on the change in direction of travel.

When negotiating a corner from left to right, for example, the sign before the voltage changes.



SSP 31-017

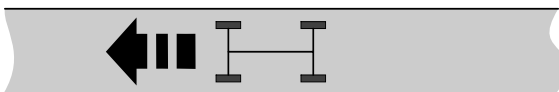


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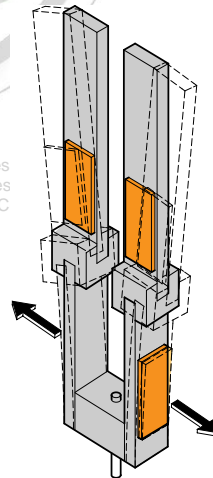
## Straight-line travel

No Coriolis force occurs when the vehicle is driving in a straight line.

The upper parts of the legs are not bent and no voltage is generated in the piezoelements.



SSP 31-019



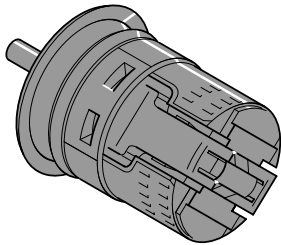
SSP 31-020



The angle of turn sensor only detects the angle of a single change of direction. The vehicle must be moving before a curve radius can be calculated. Only then is the navigation control unit able to calculate the curve radius and perform map matching using the data produced by the angle of turn sensor and the ABS wheel speed sensor.



# Basic principles



SSP 31-021

## ABS wheel speed sensor

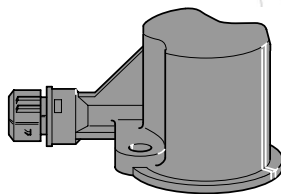
The wheel speed pulses produced by one of the ABS wheel speed sensors at the rear axle is used for measuring the distance travelled by the vehicle. The navigation control unit receives this data from the ABS control unit.

### Effect of signal failure

The navigation system cannot be started.

### Self-diagnosis

The connection to the ABS control unit is monitored.



SSP 31-022

## Switch for reversing lights

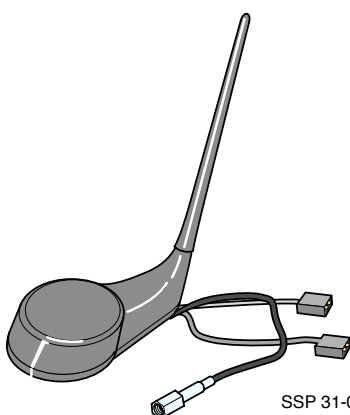
The navigation control unit obtains a signal from the switch for the tail-lights when reverse gear is engaged.

This enables the control unit to distinguish whether the vehicle is moving forwards or backwards.

### Effect of signal failure

The navigation control unit does not recognise when the vehicle is reversing.

### Self-diagnosis



SSP 31-023

## Roof antenna for radio, car phone and navigation system

Integrated in the roof antenna (Triplex) are the antennas for radio mode, car phone mode and navigation mode (GPS).

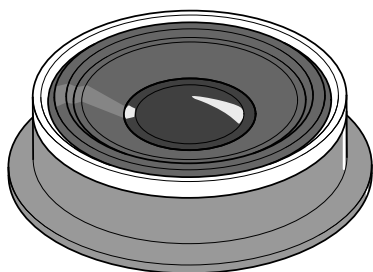
In some Audi vehicles the antennas are positioned separately.

In these vehicles, the antenna for the navigation system is located on the bootlid; the antenna for radio reception is integrated in the rear window and the stub antenna for the car phone is in the rear left body side panel.

### Self-diagnosis

Fault type: Open circuit, short circuit to earth

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### Radio loudspeakers

Audible route recommendations are played back over the radio loudspeakers.



SSP 31-025

### Navigation CD-ROM

The street map and the operating software are stored on the navigation CD-ROM.

The CD-ROMs are updated twice a year. These CDs can be purchased through Volkswagen/ Audi dealers.

### Service

The operator panel software of the Radio Navigation System can be adapted with a special CD-ROM.

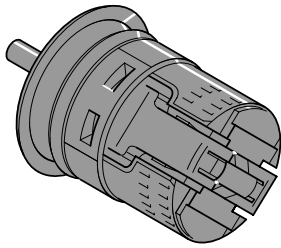
For example: Map colours, menu guidance and screen contents.

In this case, the Customer Service will provide you with information about the scope of adaptation and procedure.

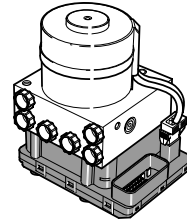


# Basic principles

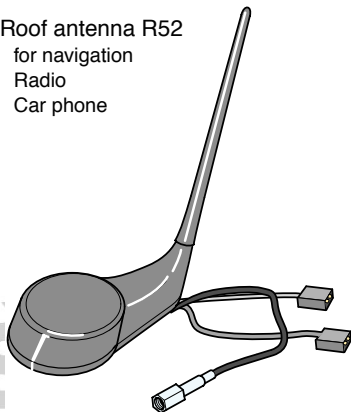
## System overview



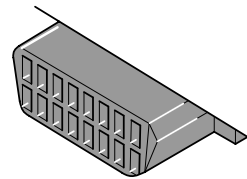
ABS wheel speed sensor G46



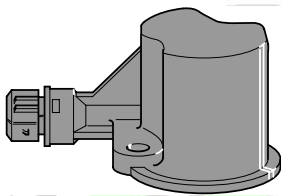
ABS control unit J104



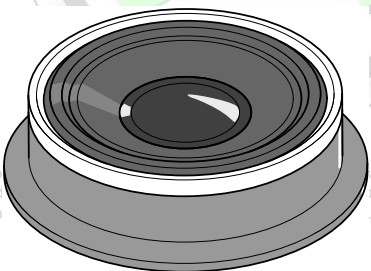
Roof antenna R52  
for navigation  
Radio  
Car phone



Diagnosis plug T16



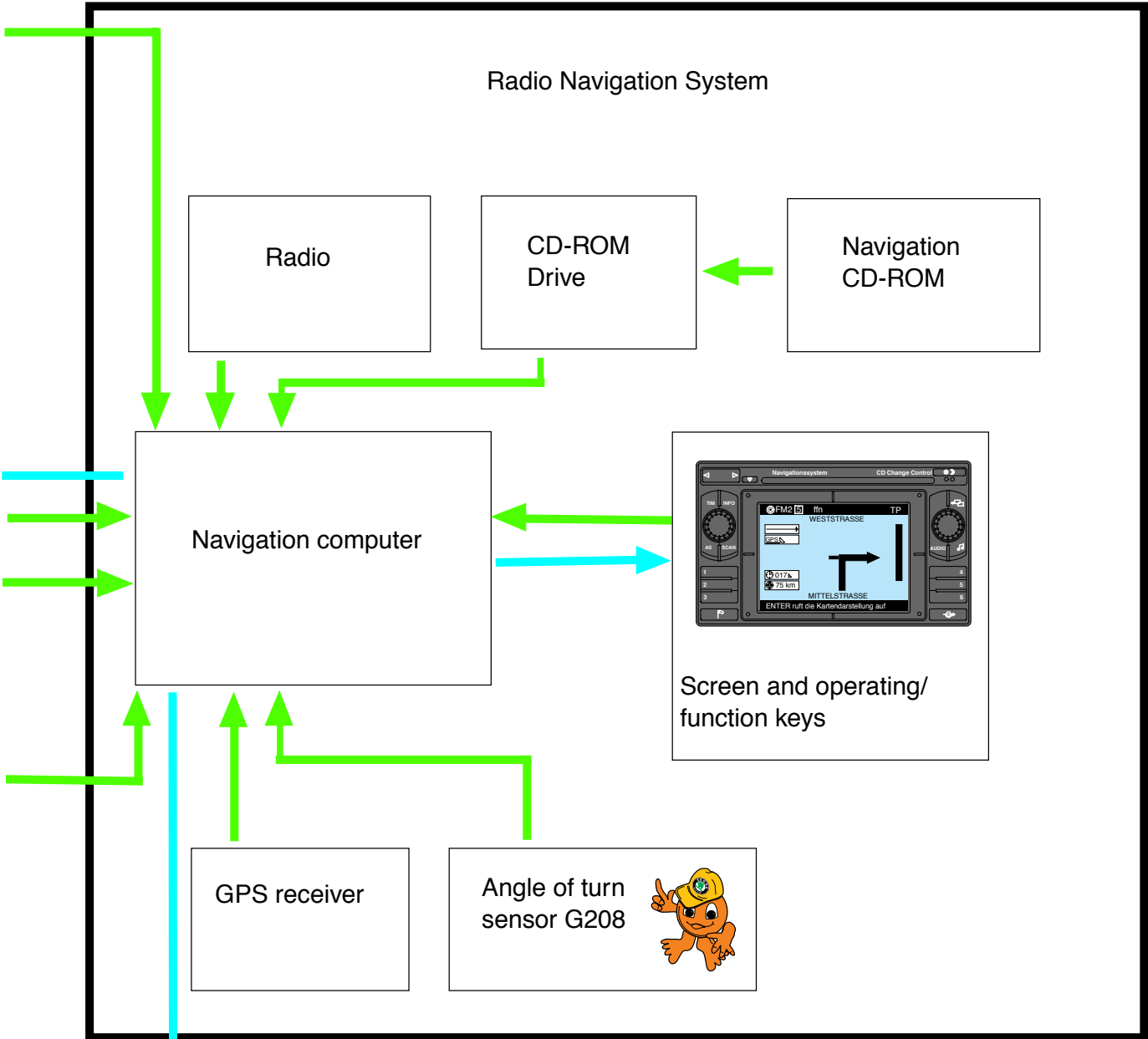
Switch for reversing lights



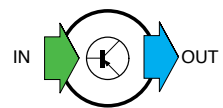
Radio loudspeakers



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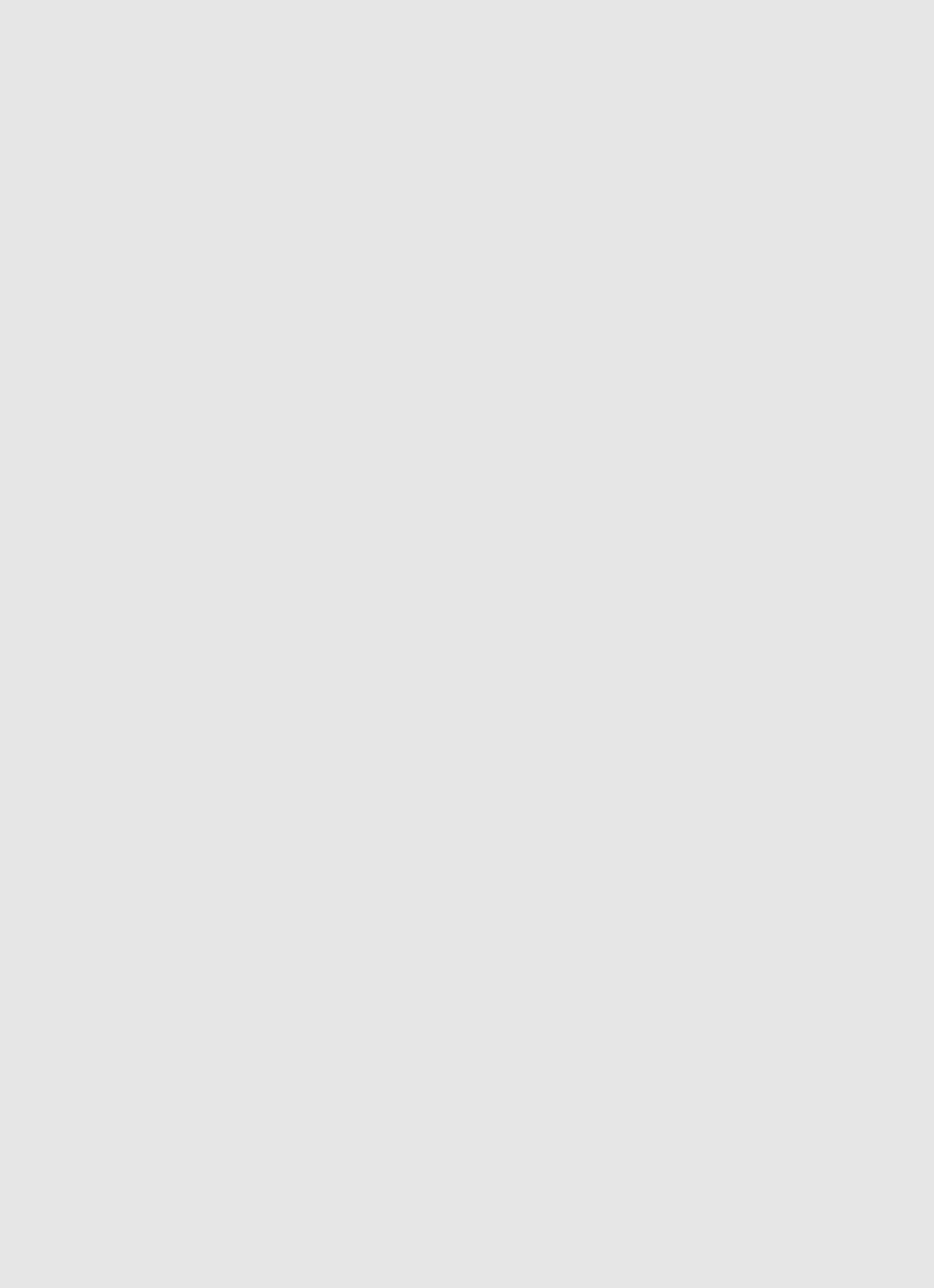


SSP 31-026



# Notes

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## Part 2

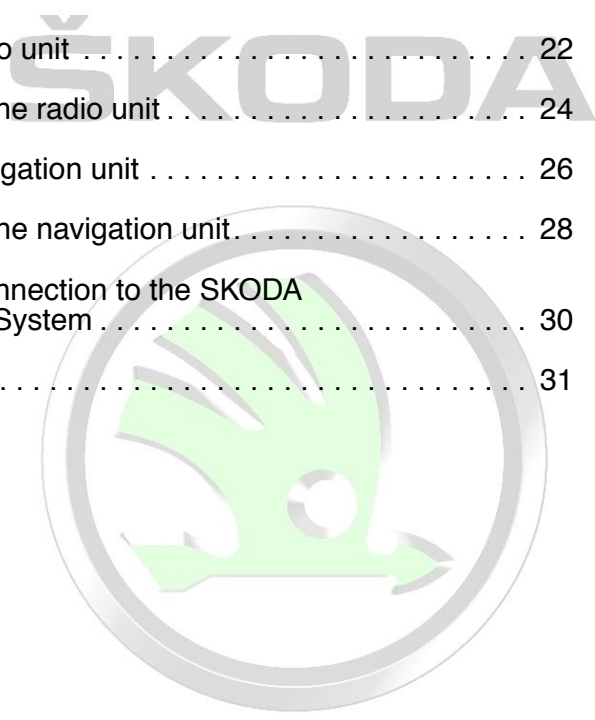
### Operation and function of the SKODA Radio Navigation Systems

The operation and functions of the SKODA Radio Navigation System is described on the following pages.

You will also find information about self-diagnosis, test functions and service.

#### List of contents

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# Operation and function

## Operation of the radio



### TIM button for retrieval of stored traffic announcements.

- New traffic announcements up to 4 minutes in length can be stored. When the system is switched on, each traffic announcement of the pre-set traffic radio station (TP Traffic Programme) is recorded. When you switch off the system, you can activate the Record mode for 24 hours by pressing the TIM button (press for longer than 2 sec.). In both cases, traffic announcement playback is started by pressing the TIM button. To start random track play, press the rocker button. To cancel playback, press the TIM button again.

### Rocker button

- In Radio mode, pressing this rocker button to start automatic local station seek in the direction you are travelling.

### Rotary push-button on left

- Press button to switch ON/OFF
- Turn switch to control volume

### AS/ CD mix button

- In Radio mode, you can store the 6 stations with the strongest signals using this button. The stations are saved to the station keys on the set waveband - TP, FM or AM. The memory locations are allocated automatically and exclusively on memory levels FM2, AM2 and TP2.

- In Audio CD mode, you can play tracks at random by pressing this button.

If a CD changer is connected, you shuffle-play the CDs by pressing this button.



### Scan button

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In Radio mode, all the station pre-sets can be played briefly by pressing this button. To pre-set a station, press this button again while the station is playing.

- In Audio CD mode, you can briefly play all the tracks on a CD by pressing this button. To select a track, press this button again while the track is playing.

## Multifunction display

- Can be swivelled horizontally and vertically

### Button for changing over to night display mode

When you switch the low beam headlight on or off, the display automatically changes between daytime and night display modes.

You can switch over to the other display mode by pressing this button.

A photocell which is located below the button controls display brightness.

### Flashing diode of anti-theft device

After entering the four-digit code number, the diode flashes if the ignition key has been removed from the ignition lock.



### Button

- Select preceding menu or basic menu

### Right-hand rotary push-button

- Turn: to select the menu fields and change the setting scales.
- Press: to confirm the menu fields.

### SOUND button

For selecting the sound menu for the settings for bass and treble, the sound field (Balance and Fader) and the Volume Setup menu (basic settings for switch-on volume, traffic announcements (TIM), car phone, navigation and GALA).

### AUDIO button

For selecting the basic audio menu.

Tone source selection: Audio CD (CD changer); Traffic radio TP1 and TP2; VHF FM1 and FM2; Medium Wave MW1 and MW2; Long Wave LW1 and LW2; other tone sources AUX; Radio mute

## Station keys 1-6

- In radio mode, a single station can be assigned to each button from the six wavebands TP, FM, AM at memory levels 1 and 2.  
Storing a station: Select the station using the rocker button. To store a station, keep one of the station keys pressed until the programme switches to mute and a signal tone sounds. To select a station, press the corresponding button briefly.
- In Audio CD mode, select the CD in the tray by pressing this button. Buttons 1-6 correspond to the order of the CDs in the autochanger tray.



# Operation and function

## Self-diagnosis of the radio unit module



The address word for the radio unit is 56.

The following functions can be selected:

Interrogate navigation system version

01- Interrogate radio version

02- Interrogate fault memory

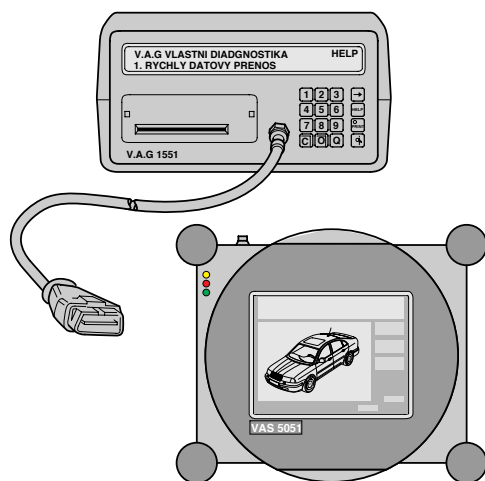
03- Actuator diagnosis

05- Erase fault memory

06- End of output

07- Encode radio functions

08- Read measured value block



SSP 31-028

### 02 - Interrogate fault memory

Faults in the Radio Navigation System are saved to the fault memory by the self-diagnosis.

These faults can be displayed on the monitor of the V.A.G 1551/52 or diagnosis system VAS 5051:



Source of fault	Fault message	Possible effect
Vehicle power supply, terminal 30 NO contact at ignition switch -D-	Signal too low Open circuit	Poor or no function No automatic switch-on after turning ignition off and on again
Front loudspeaker	Open circuit/ short circuit	Loudspeaker not functioning
Rear loudspeaker	Open circuit short circuit	Loudspeaker not functioning
Radio display output, dash panel insert	No communication	Display NOK
Connection to CD changer	No communication	CD changer function NOK
Radio antenna	Open circuit Short circuit	No or poor reception
Control unit	Wrongly encoded	Radio functions or sound NOK
Control unit	Defective	No radio operation possible



**The Workshop Manuals are updated after technical modifications are made. Please use the vehicle-specific Workshop Manuals as an aid to carrying out self-diagnosis.**

Rapid data transfer Q  
03 - Actuator diagnosis

### 03 - Actuator diagnosis

The loudspeakers and the display in the dash panel insert are tested by the actuator diagnosis.

At the same time, the functioning of all loudspeakers is tested with a test tone.

The text "DISPLAY TEST" appears on the display in the dash panel insert. The display switches between normal and inverse video (white on black and vice versa) in 4-second intervals.

Rapid data transfer Q  
07 - Encode radio functions

### 07 - Encode radio functions

The following radio functions can be encoded:

- Sound adaptation to vehicle type
- Number of loudspeakers
- DSP sound system
- CD changer

The code number can appear as follows:

01 Code number for sound adaptation

4 loudspeakers (channels)

2 code number for DSP sound system

7 Code number for CD changer, second display and active roof antenna

# ŠKODA

Rapid data transfer Q  
08 - Read measured value block

### 08 - Read measured value block

The input signals and voltages required for operation of the Radio Navigation System are continuously monitored by the self-diagnosis.

The state of the input signals in the measured value blocks can be displayed for troubleshooting purposes.

Example:

Measured value block 001

- 1 GALA signal
- 2 Supply voltage in volts
- 3 Dimmer for illumination in %
- 4 NO contact closed or open





# Operation and function

## Operation of the navigation unit

# SKODA

Loading tray for the navigation CD-ROM

### INFO button

To select the full destination address display:

- Momentary location,
- Current destination and
- Estimated time to journey end are displayed.

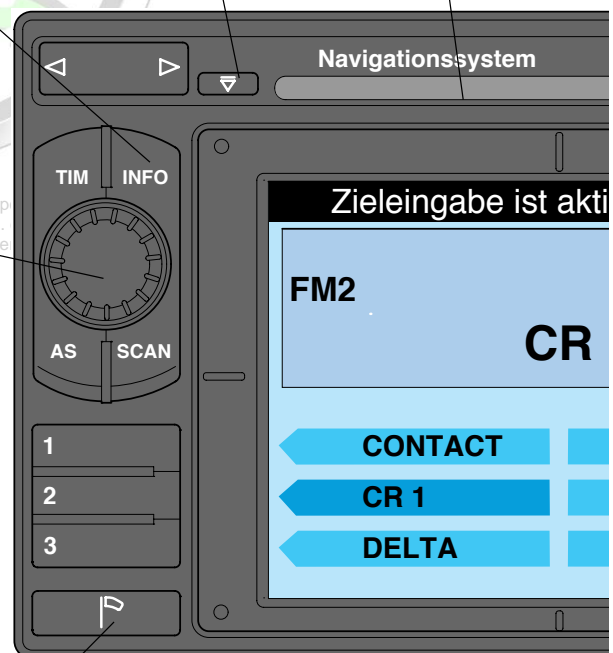
Repeat last voice message.

CD eject button

### Rotary push-button on left

- Press button to switch ON/OFF
- Turn knob to control volume

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### Button for saving vehicle's momentary position



- The vehicle's position is saved as a "flag destination"

If you discover, say, a point of interest en route, you can store this position as a flag destination by pressing this button. Later, you can use this flag destination to enter your destination.

This way, you can be sure you will find the point of interest easily and without searching.

Only one flag destination can be stored in memory at one time with this button.

Press the button again, and the "flag destination" will be overwritten by a new one.

You can store the flag destination permanently in the destination memory by selecting the basic navigation menu.



## Multifunction display

- Can be swivelled horizontally and vertically.

### Button for changing over to night display mode

When you switch the low beam headlight on or off, the display automatically switches between day and night display mode.

You can switch over to the other display mode by pressing this button.

A photocell which is located below the button controls monitor brightness.

### Flashing diode of anti-theft device

After entering the four-digit code number, the diode flashes when the ignition key is removed from the ignition lock.

### NAVI button

For selecting navigation system basic menu:

- Destination input
- Route options
- Start of navigation
- Destination memory
- Options
- MERIAN Scout guidebook with sections on:
  - Overnight accommodation
  - Places to eat and drink
  - Tourist information



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### Button

- for selecting the previous menu or main menu



### Button for traffic jam function selection

This function allows you to re-route the vehicle in order to bypass a traffic jam.

In the menu, specify whether you want the navigation system to plan a short, medium-length or long alternative route for you.

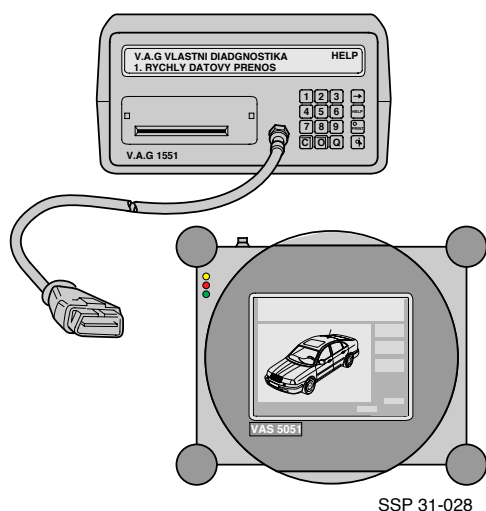
### Rotary push-button right

- Turn to select the menu fields and change the setting scales
- Press to confirm the menu fields



# Operation and function

## Self-diagnosis of the navigation unit



SSP 31-028

The address word for the navigation unit is 37.

The following functions can be selected:

Interrogate navigation system version

- 01- Interrogate navigation system version
- 02- Interrogate fault memory
- 03- Actuator diagnosis
- 05- Erase fault memory
- 06- End of output
- 08- Read measured value block
- 10- Adaptation

### 02 - Interrogate fault memory

Faults of the Radio Navigation System are saved to fault memory by the self-diagnosis.

These faults can be displayed on the monitor of the V.A.G 1551/52 or of the VAS 5051 diagnosis system:

Source of fault	Fault message	Effect
Vehicle power supply, terminal 30	Signal too low	Poor or no function
Radio display output, dash panel insert	No communication	Display NOK
Antenna for navigation system (GPS) - R50/R52	Open circuit/short circuit to positive, short circuit to earth	Navigation system (position fixing) not functioning properly
Connection to ABS control unit	No signal	Navigation system NOK
Databus information	No signal	DSP function-NOK
Control unit	Defective	No navigation possible

**The Workshop Manuals are updated after technical modifications are made. Please use the vehicle-specific Workshop Manuals as an aid to carrying out self-diagnosis.**



Rapid data transfer Q  
03 - Actuator diagnosis

### 03 - Actuator diagnosis

The function of the second display in the dash panel insert can be tested by the actuator diagnosis.

The "DISPLAY TEST" message is displayed. The display switches between normal and inverse video (white on black and vice versa) at 4-second intervals.

Rapid data transfer Q  
08 -Read measured value block

### 08 - Read measured value block

The input signals and voltages required for operating the Radio Navigation System are continuously monitored by the self-diagnosis.

The status of the input signals in the measured value blocks can be displayed for troubleshooting purposes.

Example:

Measured value block 001

- 1 GALA signal
- 2 Supply voltage in volts
- 3 Dimmer for illumination in %
- 4 NO contact closed or open

Schnelle Datenübertragung Q  
10 - Anpassung

### 10 - Adaptation

The navigation system also utilises the tyre circumference and the pulses generated by the ABS wheel speed sensor for calculating the distance travelled by the vehicle.

The following changes can be stored with the adaptation function:

- Changes in tyre size
- Changes in the number of pulses generated by the ABS wheel speed sensor

For a detailed description of the procedure, please refer to the Workshop Manual.



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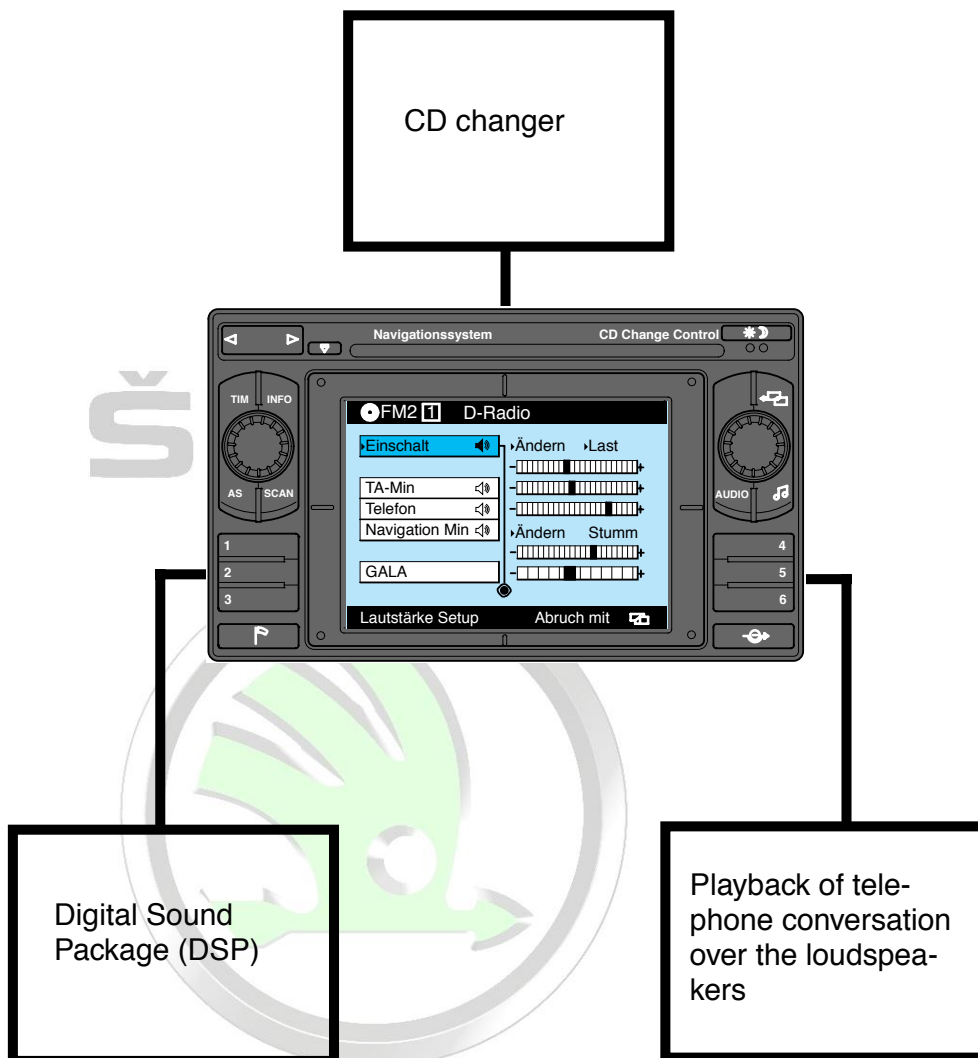


# Operation and function

## Possibilities for connection to the Radio Navigation System

Located on the rear panel of the equipment are terminals for:

- 6-disc CD changer
- Digital Sound Package (DSP) by NOKIA or BOSE
- Playback of car phone



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SSP 31-029

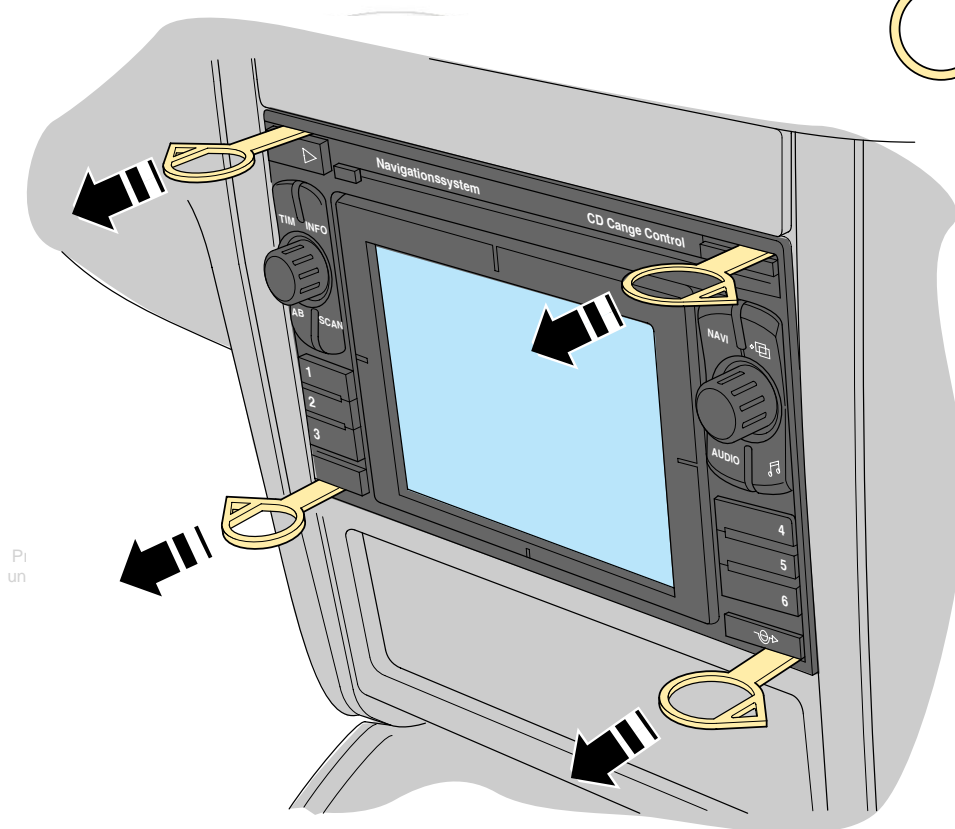
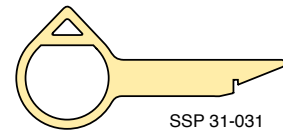
## Service

### Releasing the Radio Navigation System

The Radio Navigation System is locked in the installation compartment.

It can be removed using the four hooks of releasing tool 3344 A: Insert the hooks in the four openings. Then pull the Radio Navigation System from the compartment by the hooks.

Releasing tool 3344 A, contains 4x:



SSP 31-030

In order to avoid damage, do not apply pressure to the multifunction display or the buttons during installation.



# Test your knowledge

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## Test your knowledge

More than one answer may be correct!

1. What does satellite navigation mean?
  - a. Controls the satellite in outer space
  - b. Determines the speed and direction of travel of a vehicle using satellites
  - c. Can determines the position of a vehicle by means of satellites
  
2. What components are required to carry out vehicle navigation ?
  - a. Angle of turn sensor
  - b. ABS wheel speed sensor
  - c. Switch for reversing lights
  
3. How many satellites must at least be received by the Radio Navigation System in order to make an accurate position calculation possible?
  - a. One satellite
  - b. Three satellites
  - c. All 24 satellites
  
4. What does “dead-reckoning navigation“ mean?
  - a. The combination of direction of travel and speed for navigation purposes
  - b. The interplay of the signals generated by the angle of turn sensor and of the ABS wheel speed sensor
  - c. The radio is “coupled“ to the navigation system to form a unit
  
5. What is the function of the angle of turn sensor?
  - a. The angle of turn sensor records the angle of a single change of direction
  - b. The angle of turn sensor prevents the vehicle from skidding
  - c. Using the angle of turn sensor, the navigation control unit is able to calculate the curve radius

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6. Was bedeutet „Map-Matching“?

- a. die berechnete Fahrzeugposition wird mit den auf der CD-ROM gespeicherten Straßenkarten verglichen
- b. die auf der CD-ROM gespeicherten Straßenkarten werden laufend korrigiert



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Lösungen:

- 6.a
- 5.a, c
- 4.b
- 3.b
- 2.a, b, c
- 1.b, c



# Notes

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