Service Training

Self-study Programme 397

2007 Radio/Navigation Systems

Design and Function

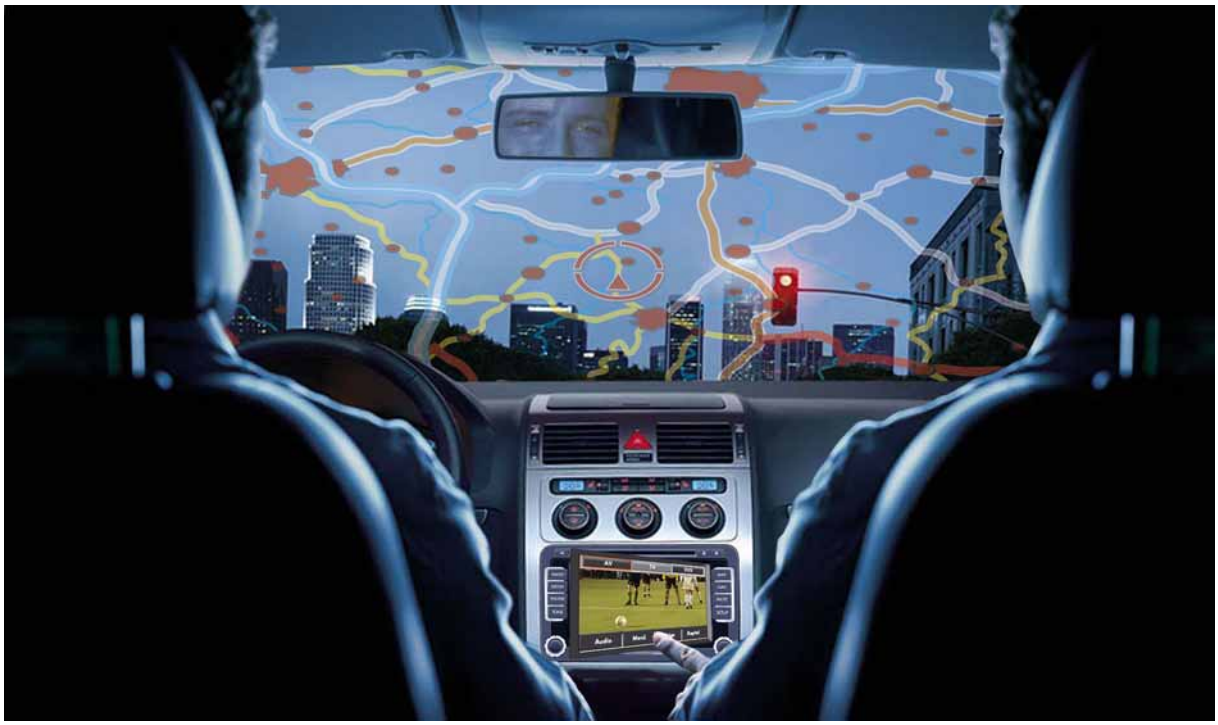
Today, due to the speed of technical development and the continuing growth in traffic density, it is increasingly important to provide car drivers with navigation systems in the form of orientation aids that support them while driving and do not create an additional distraction.

Customers expect systems that are simple and intuitive to use. Users are aware of some of the possibilities of today's navigation systems from private, non-automotive life.

Since these units are used in vehicles and not as a standalone system, but as part of a complex technical network, their adaptation to motorised vehicles requires some time.

In order to also take into account the increased amount of time that drivers spend in their cars today, Volkswagen has focussed on a collection of infotainment functions that make the time spent in the vehicle as pleasant as possible and entertaining.

You will also find basic information on the topics of radio and radio navigation in self-study programmes no. 199 "The Radio Navigation System" and no. 342 "Radio Systems 2006".



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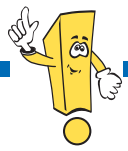


Important Note

The self-study programme shows the design and function of new developments.
The contents will not be updated.

For current testing, adjustment and repair instructions, refer to the relevant service literature.

Contents

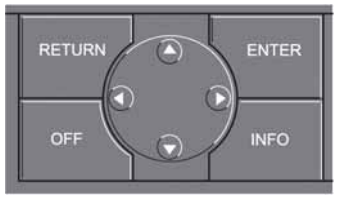
Introduction

Navigation units were used for the first time at Volkswagen Group in the Audi A8 model year 1994. The display, controls and CD drive were still accomodated in separate locations at this time. The CD drive was in the boot of the car, for example.

The acoustic guidance came from a separate loudspeaker. This system was also fitted in the Passat from model year 1997.

Display in combi instrument

S397_001



Navigation system controls

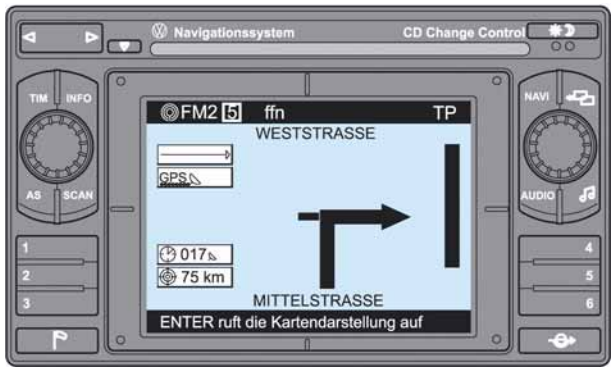
S397_002

S397_003

Drive for navigation DVD in boot

The navigation and radio functions were combined in a new generation of units from model year 1999. The units consisted of the radio receiver unit, the navigation computer, the navigation and audio CD drive, a colour display and the controls for radio, CD player and navigation. Depending on the type of unit, an external aerial diversity box for switching between the aerials was available.

The colour screen now allowed the map to be displayed for navigation guidance instead of icons. In addition, the directions were displayed in the dash panel insert display.
The acoustic navigation guidance was now heard over the vehicle audio system.



S397_004

Volkswagen radio navigation unit in model year 1999

The two radio navigation systems RNS 300 and RNS 510 represent the current development stage in the field of vehicle navigation at Volkswagen.

The RNS 510, in particular, with its large number of integrated components and interfaces to other units and systems represents a complex infotainment system that unites a large number of functions like radio, TV, CD and DVD playback, navigation as well as telephone operation.

The scope of functions and user-friendliness have been increased considerably by using a touch sensitive screen on the RNS 510.

In the following section, basic functions like, for example, the corridor function on the RNS 300 or the display functions of the RNS 510 are explained.

S397_006

RNS 300 radio/navigation system

RNS 510 radio/ navigation system

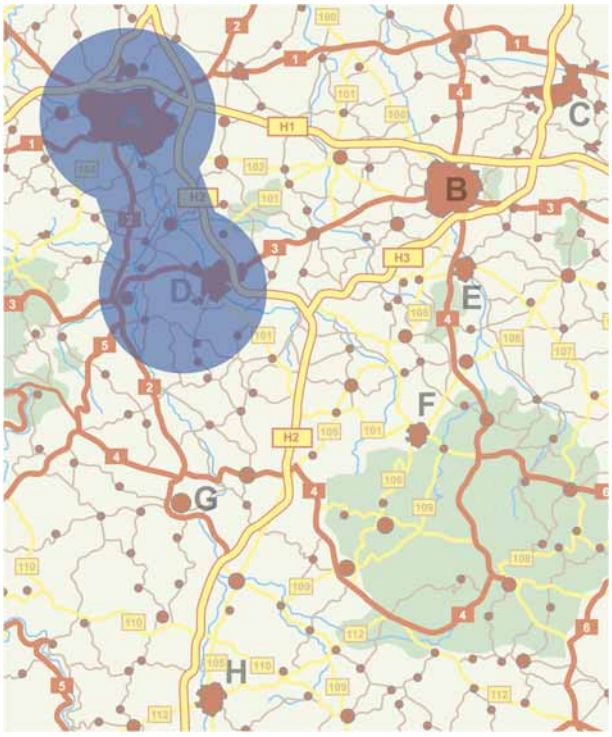
S397_032

Please refer to the corresponding operating manuals for detailed information on use of the numerous functions in the radio/navigation systems.

Corridor function

This function on the RNS 300 allows navigation without the navigation CD being inserted. The radio/navigation system is capable of temporarily storing the complete calculated route.
This does not just involve the storage of the exact order of the roads to be taken, but also the areas bordering on the route.

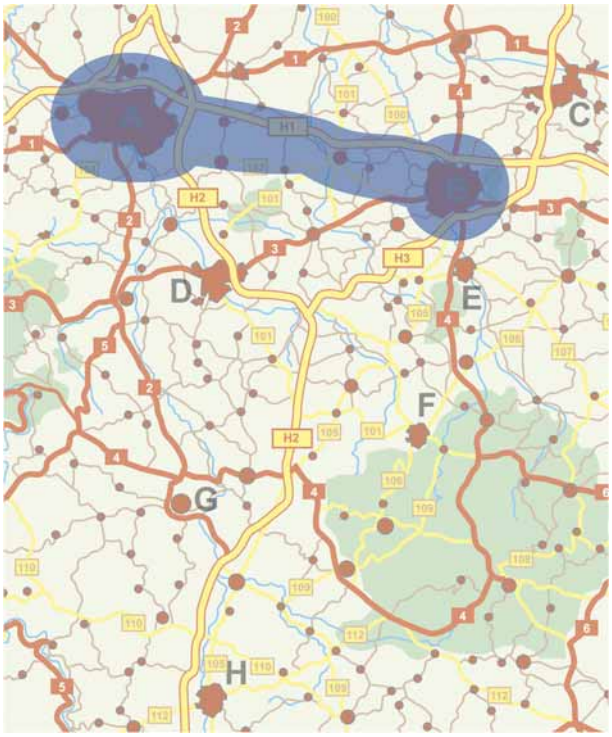
These bordering areas form the navigation corridor. This process takes a maximum of 15 to 20 minutes depending on the length of the route to be saved or the data quantity involved.
This allows you to remove the navigation CD after completing the process so you can put a music CD into the navigation system CD drive in the meantime, for example.



S397_011

Short distance – wide corridor

The form and area of the saved corridor varies depending on the length of the programmed route as only a limited amount of information can be stored in the memory. A larger area is recorded for the start and destination area than for the simple A to B route.
If the route to be navigated is extended, the start and destination area as well as the corridor width becomes smaller. If you leave the corridor, the navigation system will ask the driver to insert the navigation CD again to calculate a new route.



S397_010

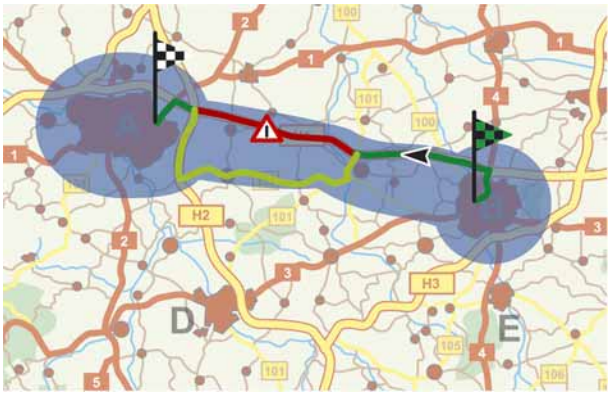
Medium distance – narrow corridor

S397_009

Long route – smaller corridor

On very long navigation routes, the memory is only sufficient for the streets immediately along the route and a narrow start and destination area.
In this case, the navigation system asks the driver to insert the navigation CD as soon as he leaves the route list so that a new route can be calculated.

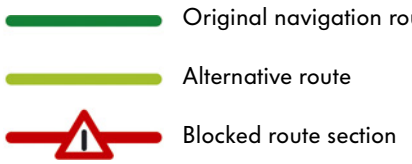
As the surrounding area is saved for shorter navigation routes in addition to the simple route, dynamic navigation is possible to a certain extent in this case without having to insert the navigation CD again.
A new destination can in principle be entered within the saved corridor.
Once a corridor has been saved, it is only deleted automatically on the RNS 300 after 72 hours unless the old data is overwritten due to a new route calculation with a different start and destination.
Due to the automatic storage duration, the RNS 300 has an increased stand-by power consumption.



S397_017

Dynamic navigation within the corridor

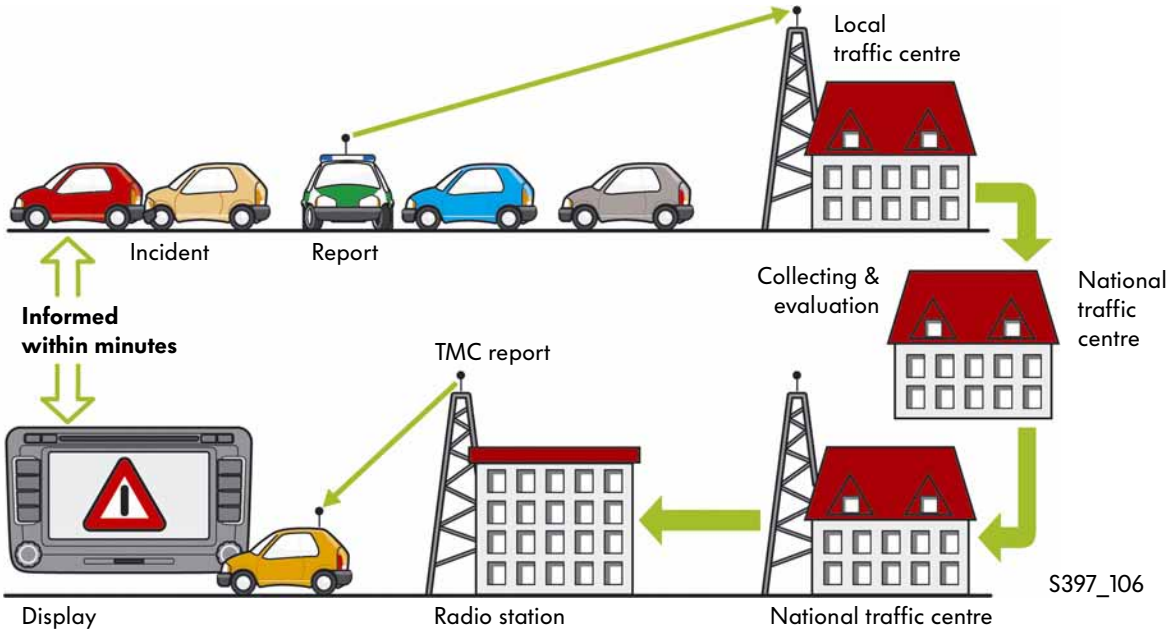
The corridor function is not necessary on the RNS 510 radio/navigation system as the whole navigation DVD is copied to the navigation unit hard drive.



S397_096b

Traffic Message Channel (TMC)

TMC is part of the Radio Data Systems RDS that has been used in Europe since 1987. TMC provides drivers with the latest traffic reports via radios and navigation systems free of charge. Incoming traffic reports, for example, from the police or recovery services are collected at the local and national traffic centres. The reports are forwarded to radio stations who encode these messages digitally and transmit them in the background of radio broadcasts with other RDS data like, for example, the station name.



How it works

A TMC-capable reception unit receives these reports, decodes them and outputs them in text form on the display or acoustically as speech.
Navigation systems use the TMC data to calculate alternative routes.

The coding for a TMC message consists of a code number from the event table, a code number from the list of all national roads and point locations (localisation table) as well as an expiry time.
The latter indicates how long the TMC message will be valid. The coding uses the internationally valid ALERT-C-STANDARD.

There is therefore, for example, a list of all national roads (localisation table) for Germany, Belgium, Denmark, France etc.
Localisation and event tables are stored on the navigation CD or DVD.
The TMC messages are displayed in the language that has been set in the reception unit.

Text	Code	N	Q	T	D	U	C	R
1st service level								
Traffic problem	1			D	1	U	1	A50
Slow-moving traffic	101			D	1	U	1	A1
Jam	102			D	1	U	1	A101
Tailback longer than 1km	103			D		U	1	A39

Extract from an event table (example) S397_113

Code	Type	Road number	Name	Geogr. coordinates north value	Geogr. coordinates east value	Direction
001	Town	- - - -	Wolfsburg	52°25'17.25"	10°46'59.13"	
002	Town	- - - -	Braunschweig	52°16'01.44"	10°31'20.80"	
003	Junction	A27/A7	Walsrode	52°47'11.99"	09°40'14.57"	H
004	Intersection	A2	Braunschweig North	52°18'52.91"	10°31'03.23"	
005	Intersection	A2/A39	Wolfsburg/ Königsluther	52°18'30.82"	10°43'38.00"	WOB

Extract from a localisation table (simplified example) S397_108

The event table contains all possible traffic incidents, for example, traffic jams, accidents, ice and road works.

The localisation table contains the names and ID numbers of all motorways, A roads and country roads. The current localisation table "LT Version 6.0" contains around 24,000 point locations (POINT LOCATION) and 12,000 area locations (AREA LOCATION). Using the TMC coding, it is therefore clearly defined which incident occurred at which location in which direction.

In order for a navigation unit to evaluate TMC messages, the navigation system needs to read the localisation table and event table from the navigation CD/DVD.

TMC on RNS 300

In the RNS 300 radio/navigation system, the localisation table that is required for TMC reception is also downloaded from the navigation CD into the memory just for the area of the corridor.
This means that,when there is a traffic jam report, not all data for the new route calculation is available if the navigation CD is not in the CD drive.

Dynamic navigation

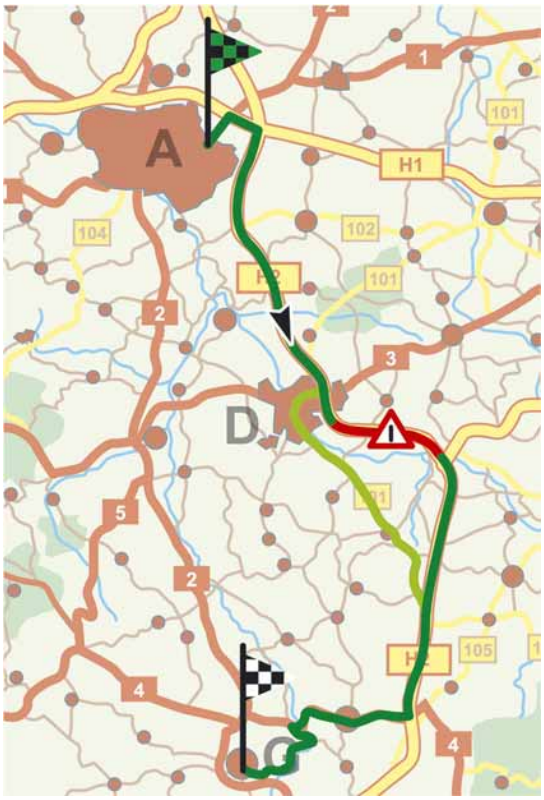
Basic principle

The dynamic navigation allows the navigation system to automatically provide the driver with a suitable reaction to a traffic incident. Depending on the severity of a recognised problem (blockage, tailback length, jam speed, closure etc.) on the calculated route, it may be a good idea to avoid the congestion area.

The requirement for this is that automatic traffic reports (TMC messages) are received and can be processed. The route for the rest of the journey is always recalculated whenever a traffic jam is reported. The route is also re-calculated when the traffic jam report is cleared.

The route is re-calculated in accordance with the set route options (depending on system type e.g. fast, short, economical).
In this case, the route with the reported jam is also taken into consideration in the calculation as a possible alternative, however, it is given another weighting or another priority than it had in the original, jam-free state.
Therefore the alternative route could correspond with the original route.

If the TMC options are set to “manual”, the driver needs to confirm the alternative route after the route has been recalculated. The calculated route and time is displayed compared with the original route.



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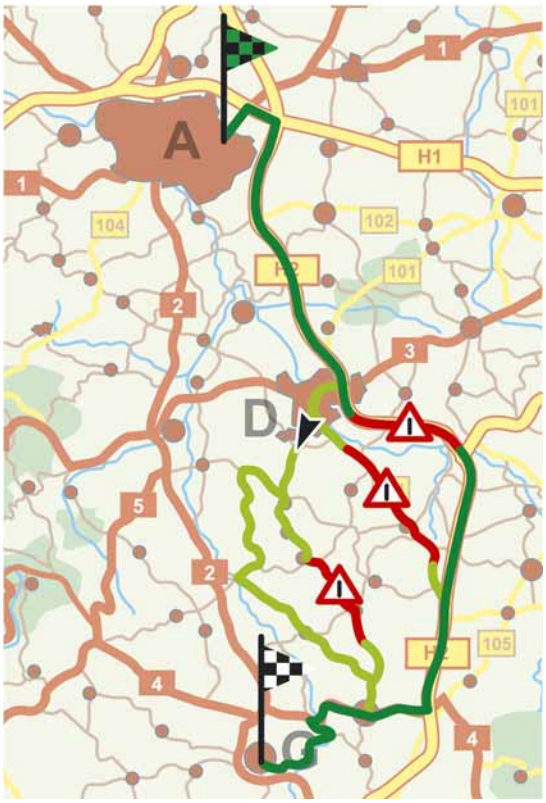
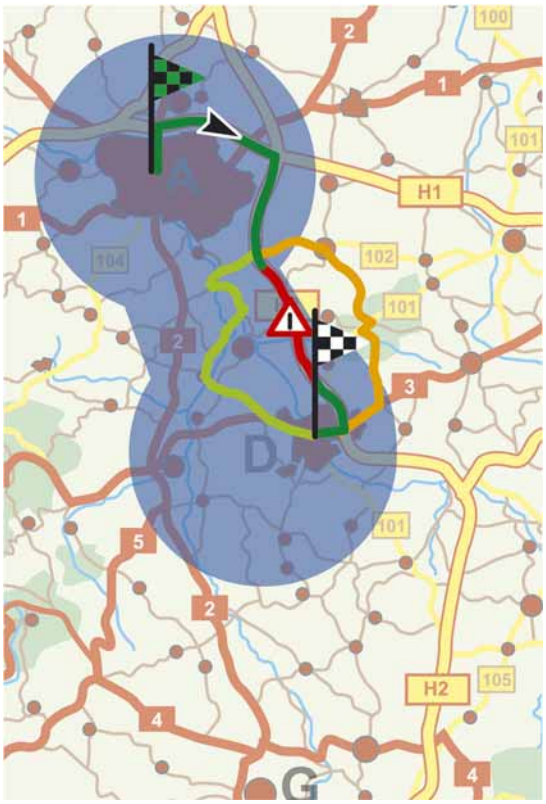


S397_018

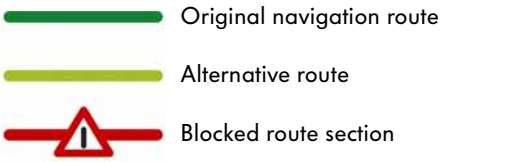
Dynamic navigation for corridor function

If the RNS 300 radio/navigation system calculates a navigation route, it is possible, to a certain extent, to use dynamic navigation without having to insert the navigation CD again particularly when short and medium navigation routes within the saved corridor are involved.
This can, however, only work if the road network within the corridor permits.

In the adjacent example, the navigation system can offer the driver an alternative route (light green) to the original route (dark green) within the corridor. The orange route cannot be calculated as a route by the system as the road is outside the corridor.



S397_016



S397_096

When using the dynamic navigation, it should be remembered that, depending on the set route option (see page 12) the TMC messages currently almost only refer to motorways and only to a small extent to A roads.
Country and local roads are not covered by TMC messages.
In some cases, it is possible for the navigation system to lead the driver to an alternative route via country roads in good time ahead of congestion on a motorway when using dynamic navigation, but the driver may end up in a longer jam that was not detected.

Route calculation

Route options

Navigation system users have a choice of three different route options so they can decide whether they, for example, want to reach the destination on a fast or shorter route or a mixture of both.

- Short route
- Fast route
- Economic route

Short route

For the short route, the respective shortest route sections are added up to connect the start and destination point. The routes possible are compared and the route is taken as a route list with the shortest kilometre distance.
The shortest route distance is chosen between two junctions in a route section. Each route crossing or road entrance represents a junction in digital form.

Influencing variables like speed limits or the statistically possible average speed are also not taken into consideration with this route option as long as no other settings like “Avoid motorways” or “Dynamic navigation” are enabled. In this way, it is possible for the journey to take longer despite the shortest route being taken.

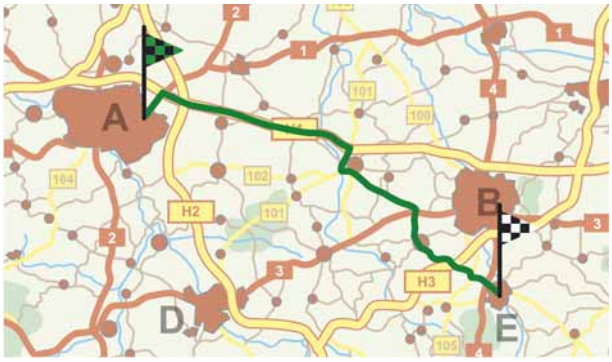
S397_012

Fast route

S397_014

When this route option is selected, the navigation system takes the road class (motorway, national road, country road, local road), the speed limits for these roads as well as a statistically expected average speed into consideration. This results in a time only calculation for the route assessment.
This means that a detour may be involved in some cases to obtain the shortest journey time.

Economic route



S397_013

When this route option is selected, the route planning takes a mixed calculation of time and route distance as a basis.
The route is calculated with a distance proportion of 30% and time proportion of 70%.

Please note:
In this example, the difference between the fast and economic route guidance is in the second route section. In the economic setting, the shorter, but slower route is preferred over the faster, but longer route under the aspect of the most favourable ratio of route to duration.

RNS 300 Radio/Navigation System

The RNS 300 is the entry-level version of the radio/navigation systems. It has the following controls and display elements on the front.

Drive slot for an audio or navigation CD

Set audio and volume levels

Info
repeats the last speech message during route guidance and shows the current destination, the current position and the current geo coordinates.

Radio
switches to radio mode and displays the radio main menu.

On/off switch and volume control
Pressing the knob switches the radio/navigation system on and off. Turning the control adjusts the volume of the audio output.
This also applies to the acoustic telephone and navigation output.

CD
Switches to audio CD mode or to an external CD changer or MP3 player.

Backwards button
Controls the active audio source, e.g. jump to previous audio CD track or to the preceding radio station. Press longer: Rewind audio track

Eject CD
If you do not remove the CD within 10 seconds, it will be drawn in again.

Set flag destination
When you press this button, the navigation system stores the current vehicle position in the destination memory.

Screen
5" monochrome display with a resolution of 240 x 128 pixels

The four unlabelled **function buttons** (soft buttons) on the right and left change their function depending on the selected menu.

Setup
allows general settings for the current area, e.g. settings for radio operation, screen settings etc.

Back
to higher menu point for the last setting up to the main menu of a selected menu.

Traffic
shows traffic messages of current TMC station.

S397_005

Menu button
Rotary press knob for selecting and confirming menus, submenus or values. The menu button does not have a mechanical start and end point.

Nav
switches to the navigation main menu

Forwards button
Controls the active audio source, e.g. jump to next audio CD track or to the next radio station.
Press longer:
Fast forward audio track

RNS 300 Radio/Navigation System

Features and controls on RNS 300

Features

- Output stage with 4 x 20 Watt output, optionally two or four loudspeakers can be connected
- 5" monochrome display with a resolution of 240 x 128 pixels
- RDS, FM and AM Europe radio
- FM single tuner with an aerial
- Integrated CD drive
- Playback functions for MP3 data
- Navigation symbols shown in dash panel insert display (only on Highline version of control unit with display in dash panel insert)
- Route guidance using symbols and speech
- Navigation also possible without inserting navigation CD (corridor function)
- TMC function
- CD navigation (data CD for different countries)
- Optionally compatible with mobile phone preparation and hands-free system
- Optionally compatible with multifunction steering wheel
- Optionally compatible with external CD changer (CDC)

Controls

The RNS 300 is operated with hard buttons and soft buttons.

Hard buttons

Hard buttons are buttons, switches, sliders or control knobs on an electronic unit that have permanent and fixed function assignments. Hard buttons can be recognised from a permanent label on the control.

S397_019

There are currently no plans to combine the RNS 300 radio/navigation system with the Volkswagen sound system.

S397_020

Soft buttons

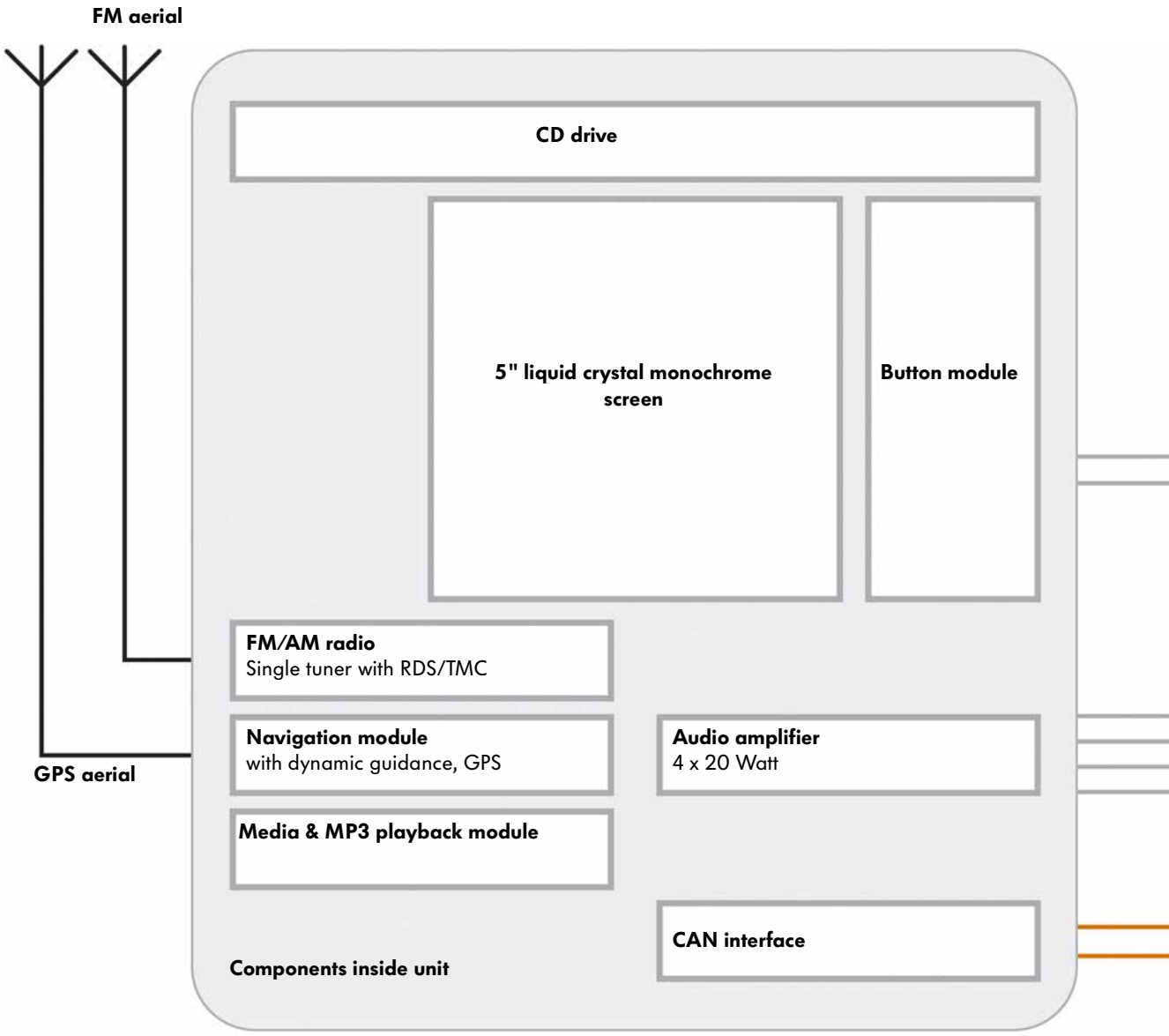
The four buttons on the left and right next to the display are soft buttons on the RNS 300 radio/ navigation system.
Unlike the hard buttons, the functions assigned to these buttons change depending on the current mode (e.g. radio, navigation, CD player etc.).
The soft button label changes on the display depending on which function you are using.

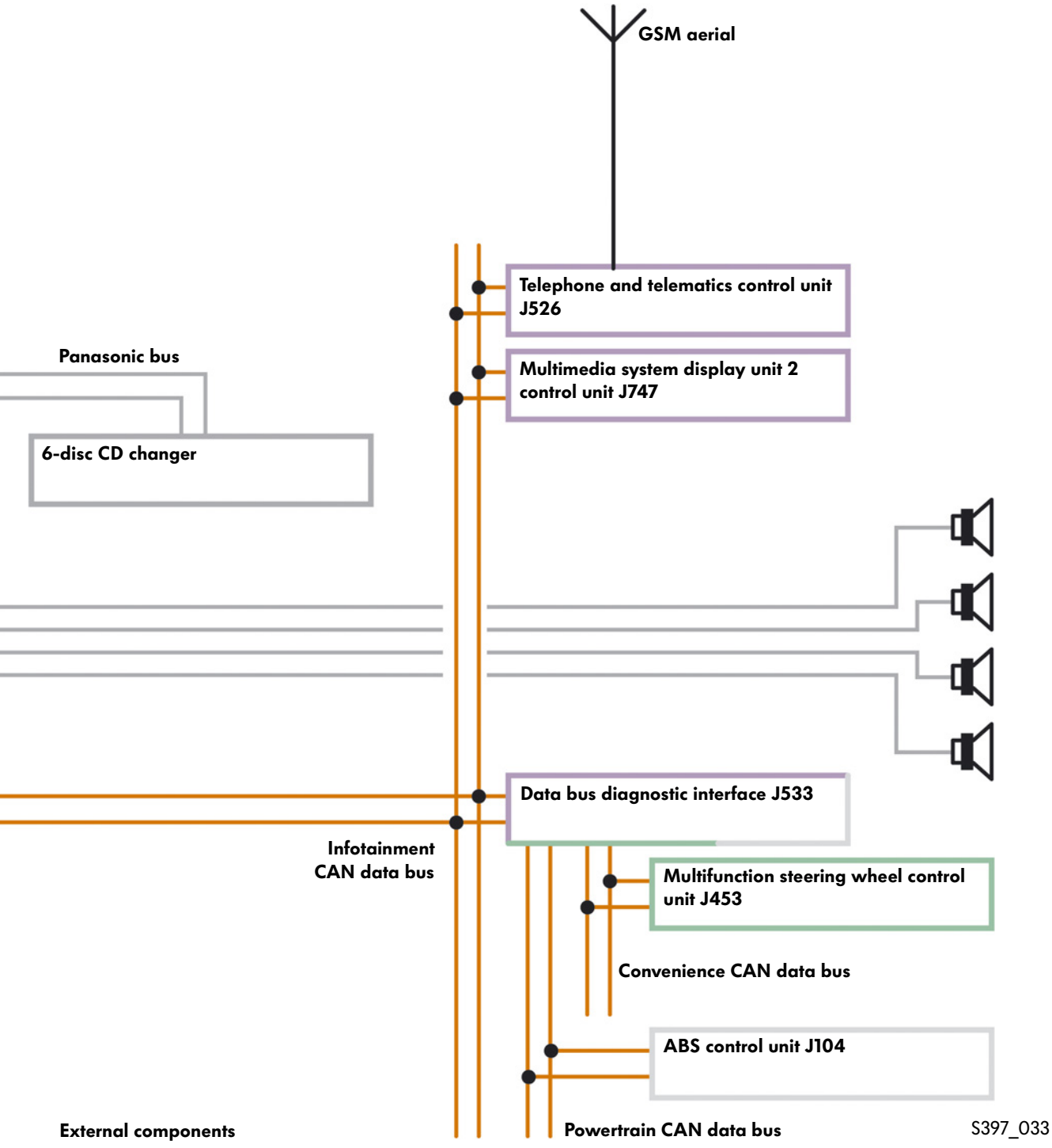
The use of soft buttons gives a unit more variations possible, for example new functions to be added in future software updates. This flexibility is also advantageous if different button functions are required for different export countries.
Hard and soft buttons can also be programmed so that different functions are carried out depending on whether you press the button briefly or hold it down.

RNS 300 Radio/Navigation System

Networking principle

In addition to the internal networking of the different device components like the radio or CD drive, the RNS 300 is connected to other control units via the CAN data bus so that all functions of the radio/navigation unit are distributed over several control units.




GSM aerial
Telephone and telematics control unit J526
Multimedia system display unit 2 control unit J747
Panasonic bus
6-disc CD changer
Data bus diagnostic interface J533
Infotainment CAN data bus
Multifunction steering wheel control unit J453
Convenience CAN data bus
ABS control unit J104
External components
Powertrain CAN data bus
S397_033

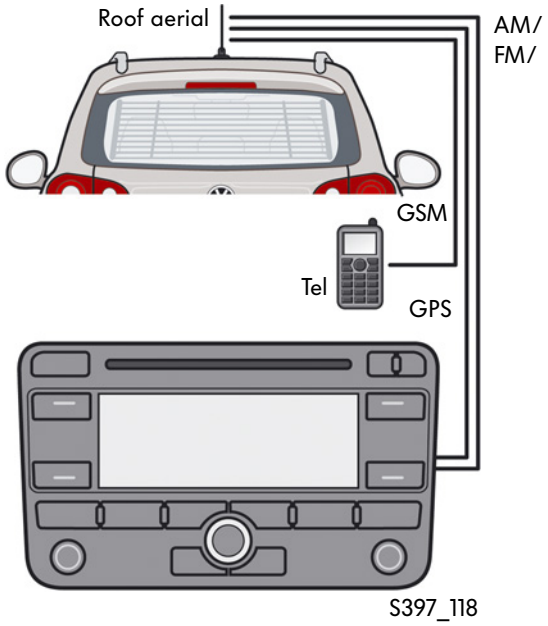
RNS 300 Radio/Navigation System

RNS 300 aerial concept

The aerial system for the RNS 300 radio/navigation system may differ depending on the vehicle type.

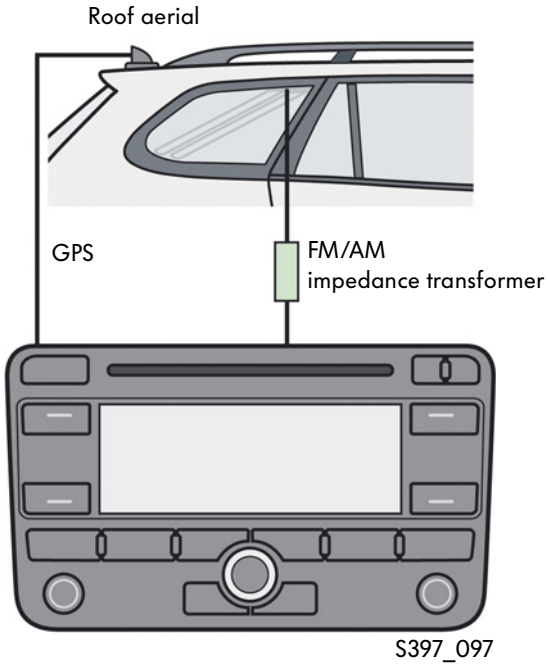
Aerial system in the Tiguan

If the Tiguan is equipped with the RNS 300, it will have a roof aerial that is connected to the GPS and the AM/FM tuner module in the radio/navigation system and the GSM module in the mobile phone. The aerial structure in the rear windscreen is not used. Compared with the Golf, the AM/FM blocking circuits as well as the AM/FM impedance transformers are omitted.



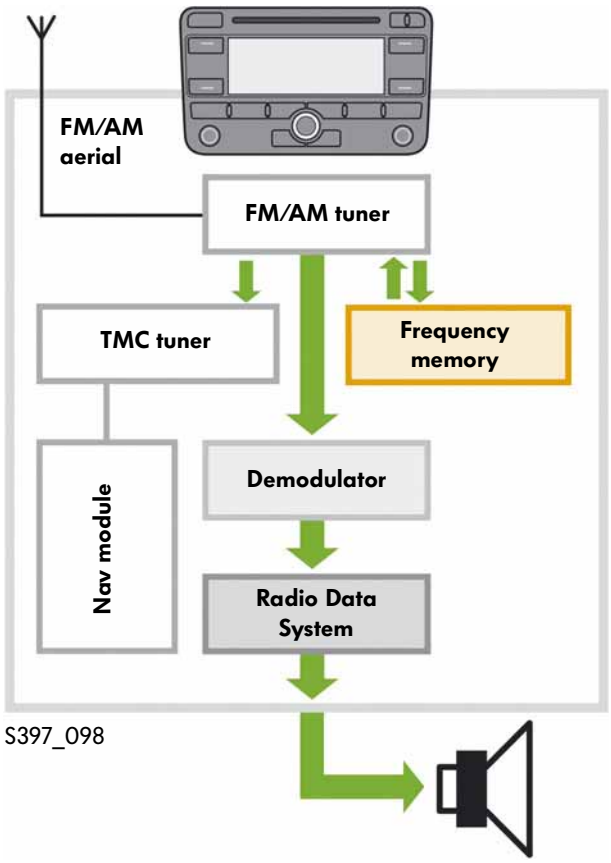
Aerial system in Golf estate

When the RNS 300 is fitted in the Volkswagen Golf Estate, the aerial system available with the basic equipment consists of an AM/FM window aerial in the right-hand side window and the shark fin aerial on the vehicle roof.
No blocking circuits are required since the aerial structure is only on the side window.



Single-tuner principle

Radio/navigation systems with an FM tuner work according to the single-tuner principle, those with two FM tuners according to the twin-tuner principle.



S397_098

If a single-tuner system leaves the reception area of a station, the system may in some cases lose the station if the reception quality of all stored broadcasting stations is not sufficient and the reception frequencies were not updated by a manual change of radio station.

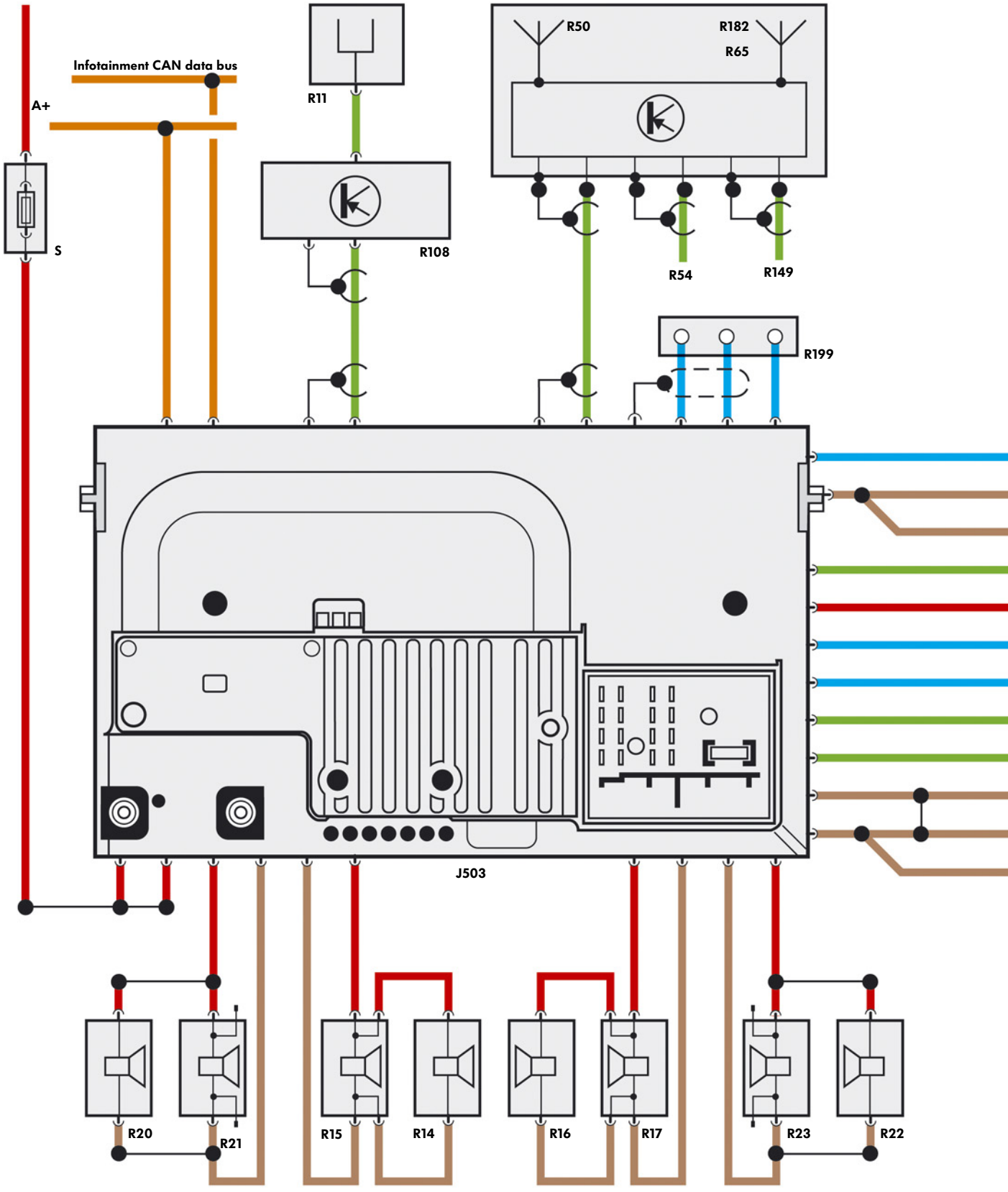
The RNS 300 radio/navigation system has one single FM tuner. The RNS saves all received frequencies for a recognised station in a station list. When changing stations, the unit then selects the frequency with the best reception from the list.
The reception frequency is always updated to the frequency with the best reception when the unit is switched on and off as well as when you switch between different radio stations.

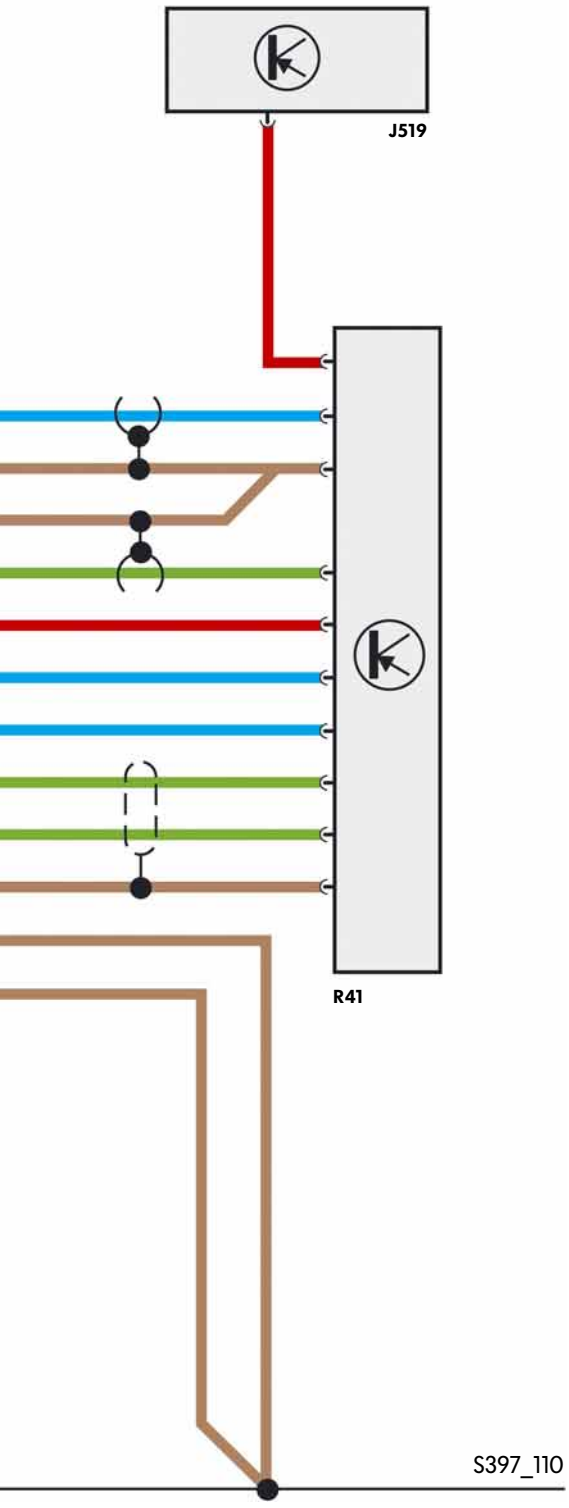
If the FM tuner detects that the reception quality of the selected radio station is deteriorating, it will switch to a different broadcasting station with better reception quality.
The switch-over pause is sometimes perceived as a minimal radio mute pause.

In the single-tuner principle, the simultaneous evaluation of TMC broadcasting information and thus dynamic navigation is also possible if a TMC-compatible station is set. The TMC-compatible station needs to be set as a second FM tuner and is not available to evaluate the TMC message parallel to another station.

RNS 300 Radio/Navigation System

Functional diagram





Legend

J503	Control unit with display for radio and navigation
J519	Onboard supply control unit
R11	Aerial
R14	Rear left treble loudspeaker
R15	Rear left bass loudspeaker
R16	Rear right treble loudspeaker
R17	Rear right bass loudspeaker
R20	Front left treble loudspeaker
R21	Front left bass loudspeaker
R22	Front right treble loudspeaker
R23	Front right bass loudspeaker
R41	CD changer*
R50	GPS aerial
R54	Mobile telephone*
R65	Telephone aerial
R108	Left aerial module
R149	Remote control receiver for auxiliary coolant heater*
R182	Auxiliary heater aerial
R199	Connection for external audio sources*
S	Fuse
A	Battery

* depending on equipment

The functional diagram shows the RNS 300 radio navigation system in the Touran.

Input signal
Output signal
Positive
Earth
CAN data bus

RNS 510 Radio/Navigation System

This radio/navigation system currently has the largest number of functions among all radio/navigation systems from Volkswagen. One basic difference in the RNS 510 system architecture from the RNS 300 is a built-in hard drive and the touch-sensitive screen.

CD/DVD drive slot
For audio CDs, MP3 CDs, audio DVDs, navigation DVDs and video DVDs

Backwards and forwards button
They affect the respective active audio or video source.

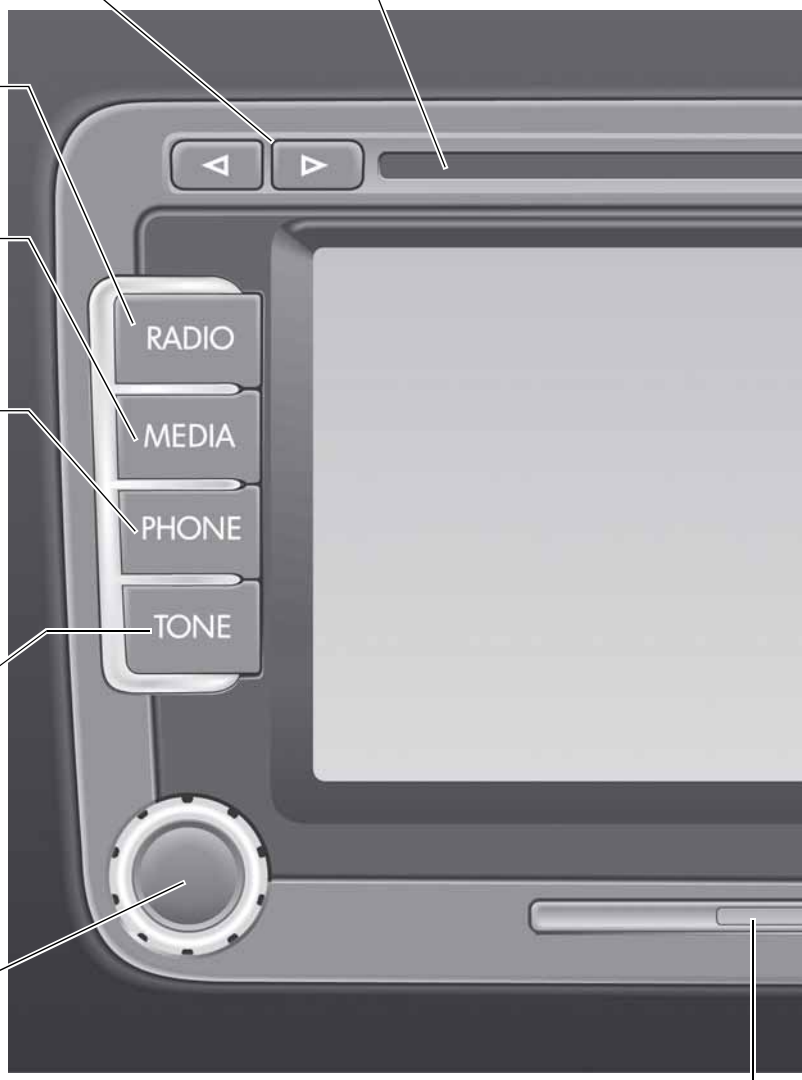
Radio
Switches to the radio main menu.

Media
Switches to CD, DVD, HDD, SD or AUX playback mode depending on what medium is available.

Phone
Shows the telephone main menu.
If a premium phone preparation is not connected, this button is simply used to mute the audio output.

Tone
Switches to the main menu for audio output values on the radio/navigation system. There you can set the sound balance, sound levels etc.

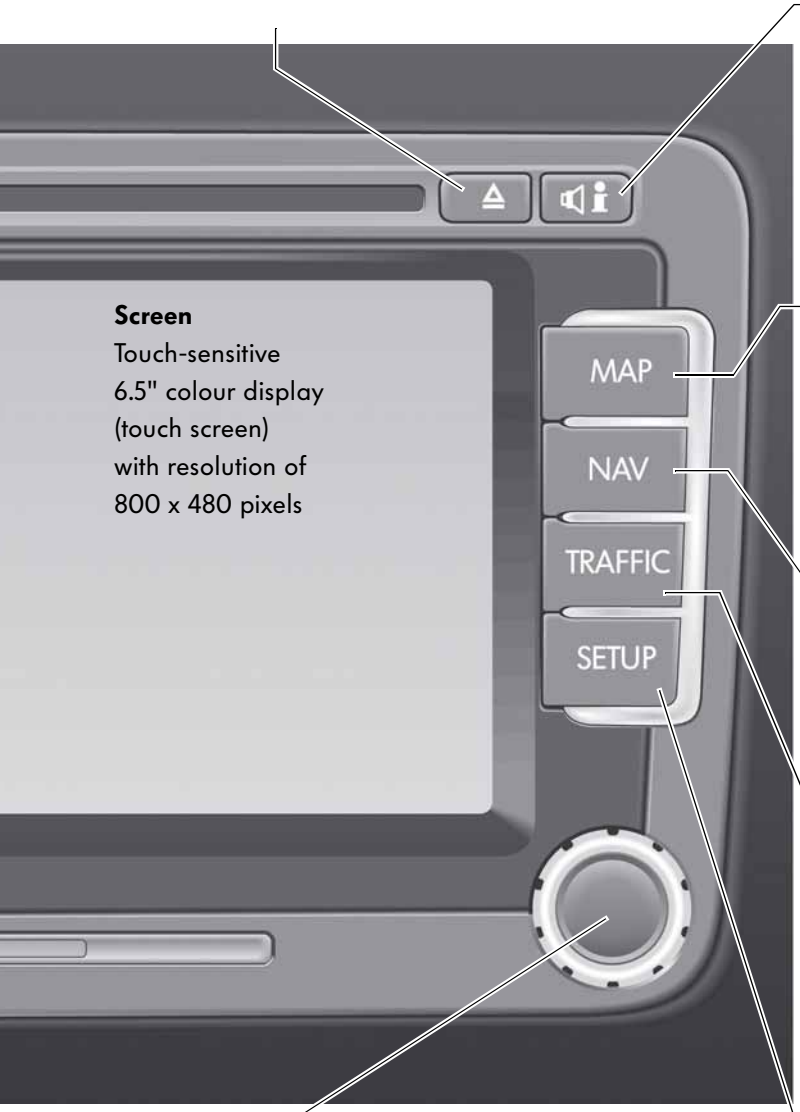
On/off switch and volume control
Pressing the rotary press knob, switches the unit on and off. Turning it adjusts the volume of the audio output. The two rotary pushbuttons on the unit do not have mechanical end points.



SD card reader slot
You can insert SD memory cards e.g. with MP3 music data for audio playback into this slot.

In the Touareg, the SD card reader is vertical on the left-hand side of the screen. (see page 37)

Button for ejecting medium
Pressing this button ejects the inserted audio, navigation or video CD/DVD. If you do not remove the medium within 10 seconds, the unit will draw the CD or DVD in again.



Screen
Touch-sensitive 6.5" colour display (touch screen) with resolution of 800 x 480 pixels

S397_007

Playback driving instruction
This button plays back the current guidance instruction for the selected route.

MAP
Calls up map display from current navigation DVD or switches to a split-screen display.

NAV
Starts or switches to navigation mode and shows the navigation main menu.

TRAFFIC
Shows the current TMC messages from the set station.

SETUP
Takes you to the main menu for configuring radio/navigation system features like, for example, screen, radio, video etc.

Right-hand rotary pushbutton
Depending on the set function, this knob can be used, for example, to switch between music tracks, manual selection of a radio station or to set the scale of the map display in navigation mode.

RNS 510 Radio/Navigation System

Features and controls on RNS 510

Features

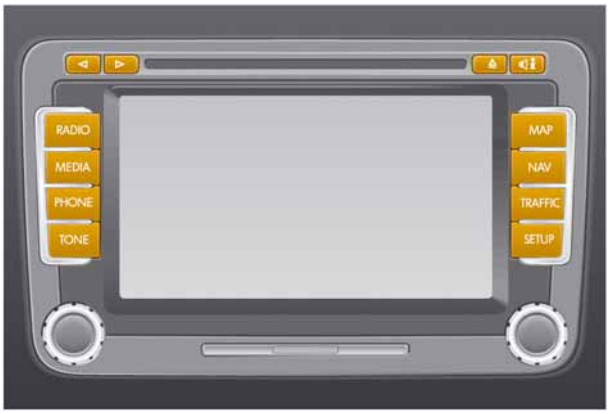
- Output stage with 4 x 20 Watt output, optionally two or four loudspeakers can be connected
- RDS, FM and AM Europe radio
- FM twin tuner with internal diversity
- SDARS tuner (depending on equipment)
- Integrated DVD drive
- Touch-sensitive 6.5" multi-colour display (MFD) with a resolution of 800 x 480 pixels
- Media support for MP3 and WMA audio data
- Navigation symbols shown in dash panel insert display
- Route guidance with symbols, map display and speech
- Maps also displayed in 3D bird's eye view (three-dimensional display)
- Integrated drive hard for storing navigation and audio data (navigation also possible without inserting navigation DVD)
- TMC function
- DVD navigation (data DVD for western or eastern Europe)
- DVD audio function
- DVD video function
- DAB (country-specific, used at a later date)
- Integrated SD memory card reader
- Optionally compatible with Volkswagen TV tuner
- Optionally compatible with mobile phone preparation including hands-free system
- Optionally compatible with multifunction steering wheel
- Speech control (depending on country, later introduction)
- Optionally compatible with reversing camera (Rear-View)

Due to the large number of functions included or modules as well as the PC technology on which the RNS 510 is based, it takes a few seconds longer to start (boot) the unit than with previous navigation systems.

Support of the Media Device Interface (MDI), e.g. for an iPod or other external, compatible storage media, will be added at a later date.

Controls

Hard buttons and soft buttons are also used to operate the RNS 510.
However, the touch-sensitive screen (touch screen) has brought a new operating philosophy for the soft buttons to the vehicle.



S397_023

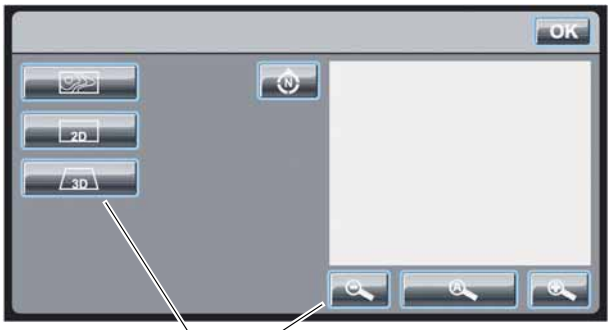
Hard buttons

The controls with fixed assignments are at the side and at the top of the RNS 510 touch screen.

Soft buttons

All other buttons required for operation of the RNS 510 appear as buttons reproduced with graphics on the touch screen surface.

This has the advantage that a “virtual” button can show its label in the respective local language. Furthermore it can always be placed on the screen in a position that seems to be logical with regard to user-friendliness, subject or graphics.
This combined display and operation concept allows more possibilities in the design of the screen interface. This is also increasingly important for expected software updates as there is greater flexibility.



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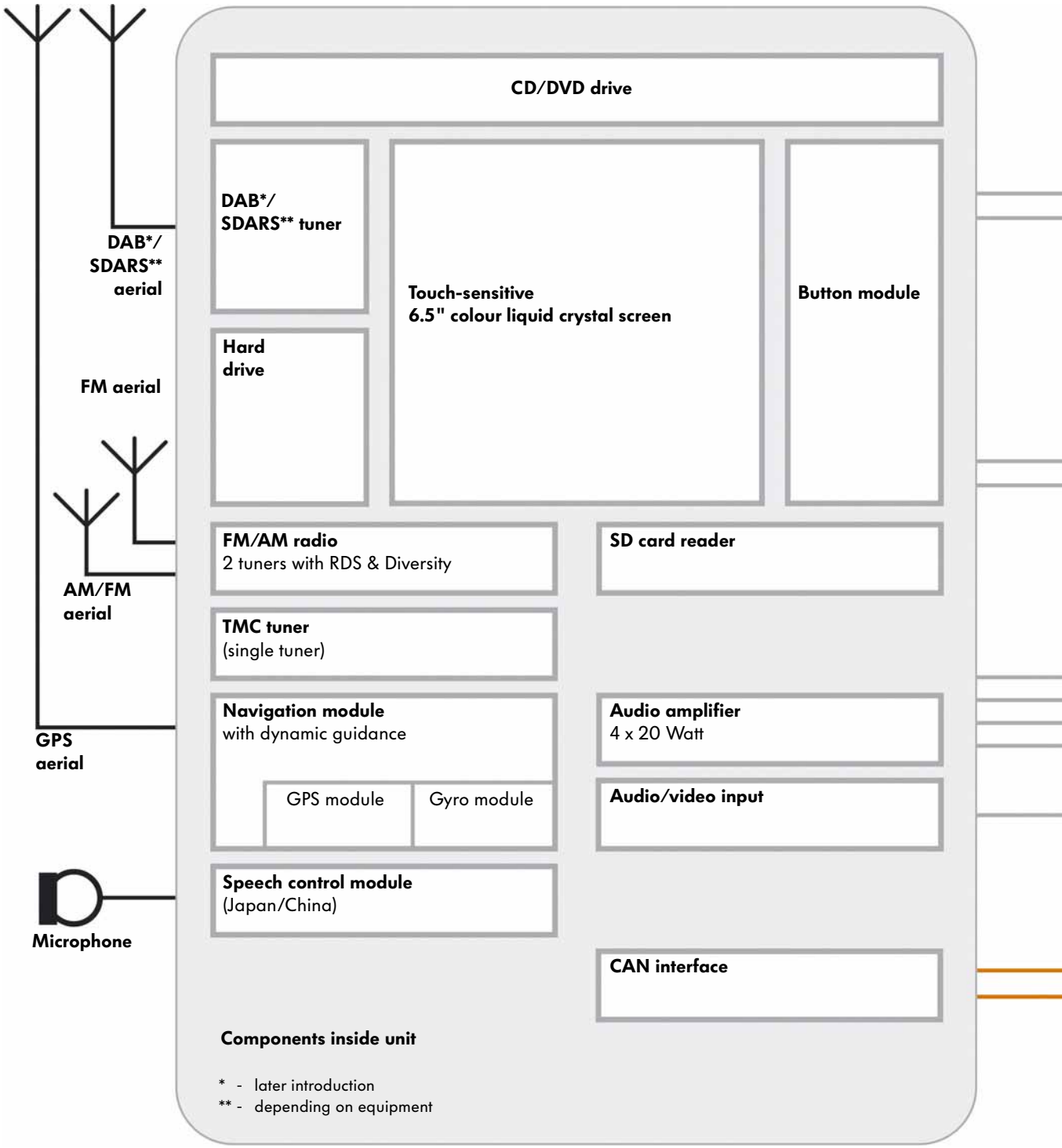
Virtual buttons on touch screen

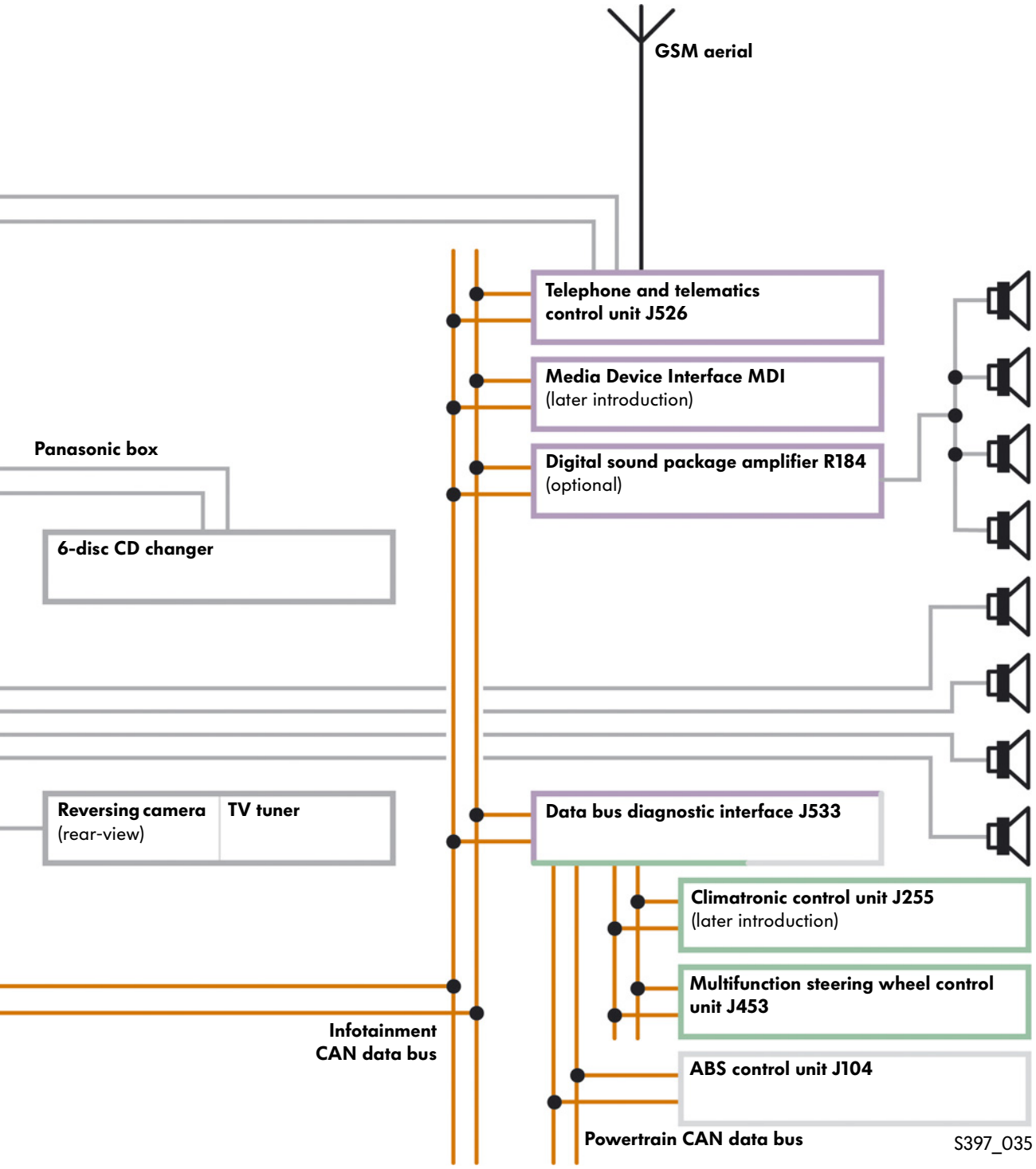
RNS 510 Radio/Navigation System

Networking principle

The networking possibilities for the RNS 510 are by far more complex than on the RNS 300.
For this reason, the adjacent diagram can only provide an overview without looking at the interaction or all usage possibilities.



External components



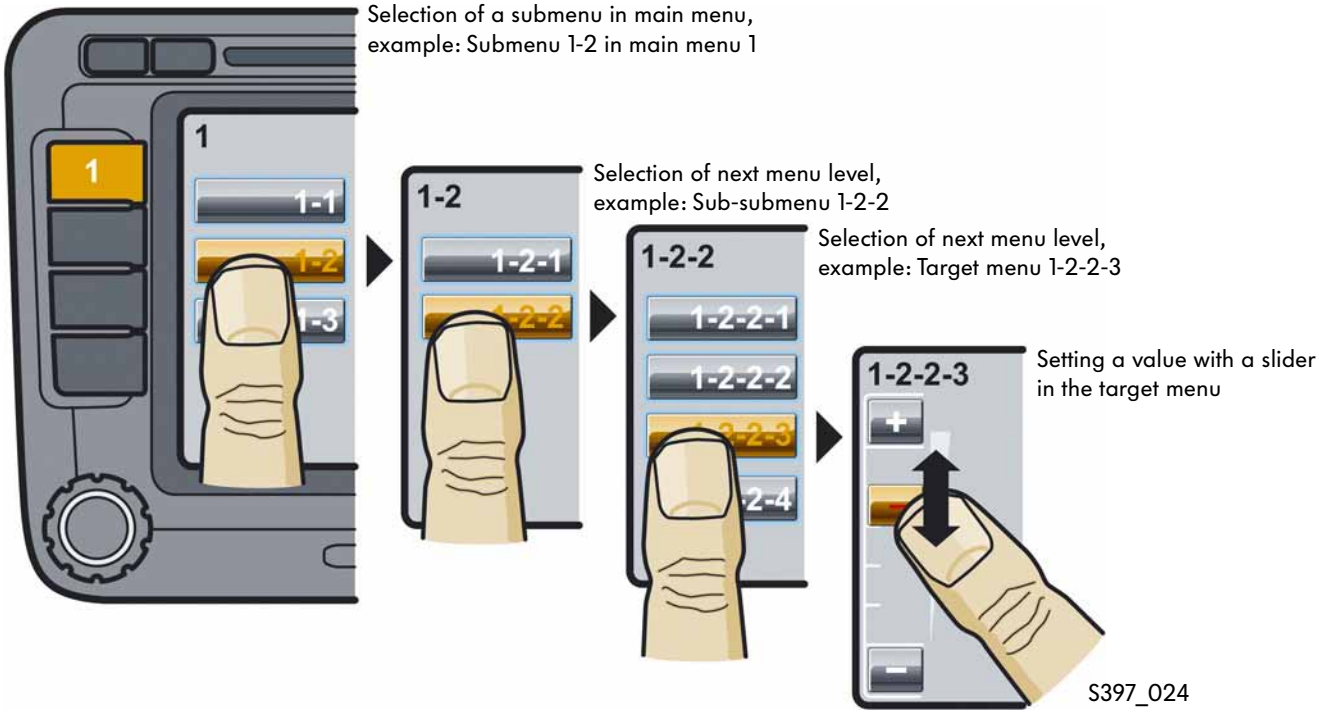
Touch-sensitive display (touch screen)

The screen forms an interface between technology and humans on multimedia systems.
It allows a large amount of complex information to be provided in a simple and well-organised way.
By using touch-sensitive screens, the user can be provided with a larger quantity of information and choices than before thanks to the freely programmable virtual buttons without making the display area and the dimensions of the unit itself too large.
This has been achieved with a complex menu structure through which users can navigate with the aid of the virtual buttons.

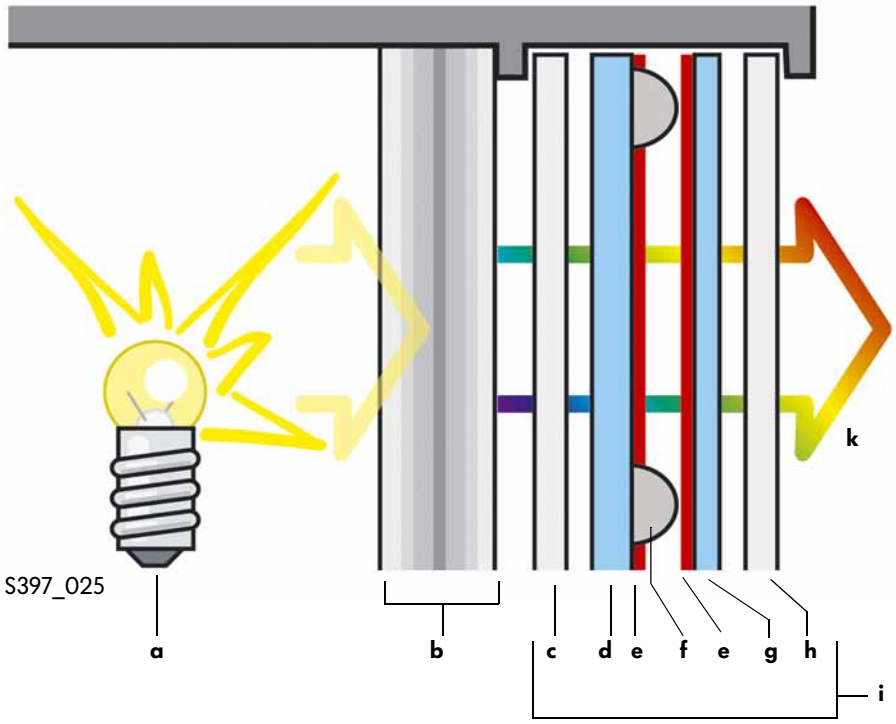
The advantages of the touch screen technology are:

- Any button shapes and sizes can be reproduced virtually.
  They are freely programmable as are the submenus and in-screen displays.
- The button labels can be shown in the local language.
- The screen display and the functions can be configured in any way and at any time with later software upgrades.
- Direct operation (finger, glove)
- Touch recognition from 10g touching pressure
- Low power consumption (approx. 1 mA)

Example of using the touch screen to select a path to a target menu within a menu structure



Structure of a touch screen



Legend

a Light source in monitor
b TFT display
c Delay layer
d Glass base layer
e Coating of conductive indium tin oxide alloy
f Spacer dots
g Flexible outer layer of glass
h Polarisation filter
i Touch-sensitive components
k Screen picture

The screen on the RNS 510 radio/navigation system has several layers.
The touch-sensitive surface is placed in front of the actual screen (TFT display). On this unit, it is made up of a rigid glass layer that is 1.1mm thick and a flexible outer layer also made from glass that is 0.2mm thick. These two glass layers are separated from each other by non-conductive spacers, called spacer dots.
Both glass layers have a conductive layer of indium tin oxide on the surfaces facing each other. This is required for the touch screen function.

A delay layer is applied between the TFT display surface and the two glass layers.
It has the task of changing the polarisation of the light waves of the monitor picture.

The outer glass layer of the touch screen has a polarisation film to reduce reflections. Despite this, the reflections that occur are partly caused by the use of glass materials that are slightly higher than those on touch-sensitive screens with a flexible outer layer made from polyester.

Please treat the outer layer of the touch screen with care to avoid damaging it.