

Navigation System

INTRODUCTION TO THE GLOBAL POSITIONING SYSTEM (GPS)

The system used to calculate the current position of the vehicle is called the GPS (global positioning system) . The system utilises satellites which are owned by the United States Department of Defence (DoD). A total of 24 satellites circular orbit the earth every 12 hours at a height of 20,000 km (12500 miles), and between 5 and 11 of these satellites can be seen from a single point at any given time. The orbits are tilted to the earth's equator by 55 degrees to ensure coverage of polar regions. Each satellite transmits radio signals to provide information about the satellite position i.e. latitude, longitude, altitude, almanac data and an accurate time signal generated by an on-board atomic clock. Each satellite contains four atomic clocks.

The vehicle needs to receive data from at least four different satellites to give a three dimensional fix on its current position.

As the vehicle moves, this information is continually being updated. The computer determines which satellites are 'visible' to the system and their current position and relationship to each other. Using this information the computer can account for positional deviations of the satellites and compensate to enhance the accuracy of the navigation system.

The GPS signal is also known as the Precision positioning signal (PPS). This is now the only GPS signal available, since the Selective positioning signal (a deliberately degraded signal) was turned off on the 2nd May 2000. This ensures that everyone can now use the higher accuracy available with PPS.

SPS predictable accuracy was:

- 100 metres horizontal accuracy
- 156 metres vertical accuracy
- 340 nanoseconds time accuracy.

PPS predictable accuracy is :

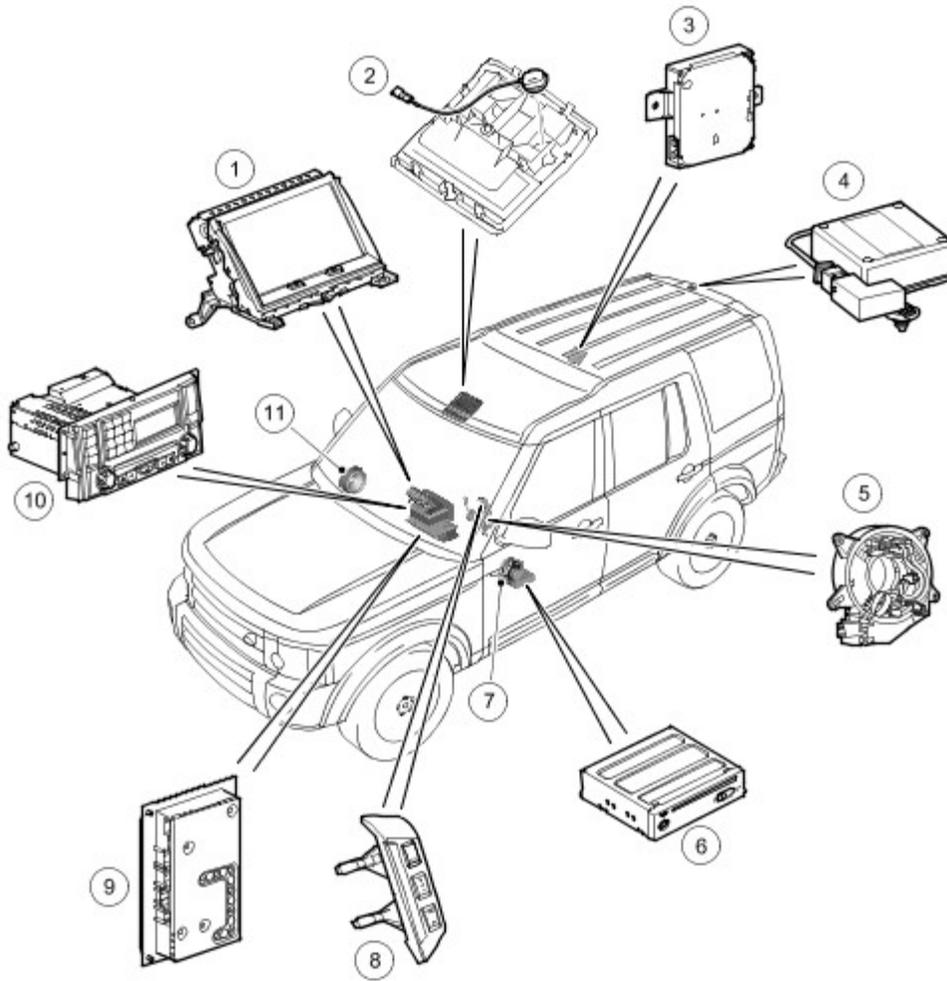
- 22 metres horizontal accuracy
- 27.7 metres vertical accuracy
- 200 nanoseconds time accuracy.

Each navigation system provides computer generated audible and visual route guidance information to enable the driver to reach a desired destination. The system allows the driver to choose the desired route using minor or major roads or motorways and the quickest or shortest route. Directions to hospitals, museums, monuments and hotels are also available. The computer uses map information stored on a CD-ROM to determine the best route for the journey and provide the driver with details of directions and approaching junctions.

The system uses almanac data to determine the vehicles position. Almanac data is the current status of the 24 satellites which orbit the earth. The computer determines which satellites are 'visible' to the system and their current position and relationship to each other. Using this information the computer can account for positional deviations of the satellites and compensate to enhance the accuracy of the navigation system. The navigation system requires the almanac data from at least four different satellites to calculate a three dimensional 'fix' on its location. As the vehicle moves the computer continually updates this information so that at all times the computer knows the precise location of the vehicle.

NAVIGATION SYSTEM

Navigation System Component Location



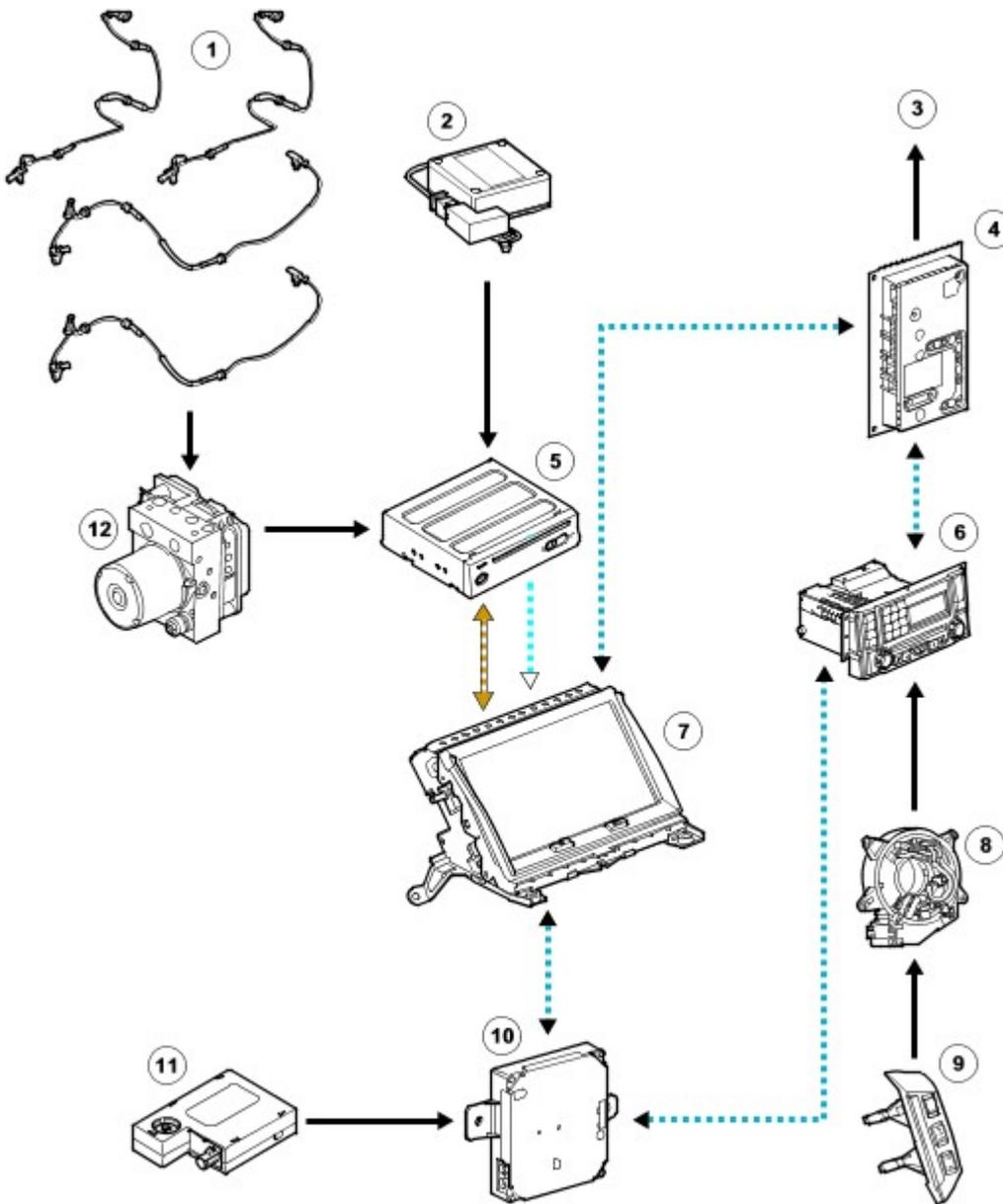
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Item	Part Number	Description
1	-	Touch Screen Display (TSD)
2	-	Microphone
3	-	Traffic Message Channel (TMC) receiver (where fitted)
4	-	GPS antenna
5	-	Clock spring
6	-	Navigation computer
7	-	Speaker
8	-	Steering wheel controls
9	-	Audio amplifier
10	-	Integrated Head Unit (IHU)
11	-	Speaker

Navigation System Control Diagram

NOTE :

A = Hardwired D= CAN P= MOST Q= GVIF



Item	Part Number	Description
1	-	Wheel speed sensors
2	-	GPS antenna
3	-	Speakers
4	-	Audio amplifier
5	-	Navigation computer
6	-	Integrated Head Unit (IHU)
7	-	Touch Screen Display (TSD)
8	-	Clock spring
9	-	Steering wheel controls
10	-	Traffic Message Channel (TMC) receiver (where fitted)

11	-	Traffic Message Channel (TMC) antenna amplifier
12	-	ABS control module

Navigation System Component Location with VICS (Japan only)

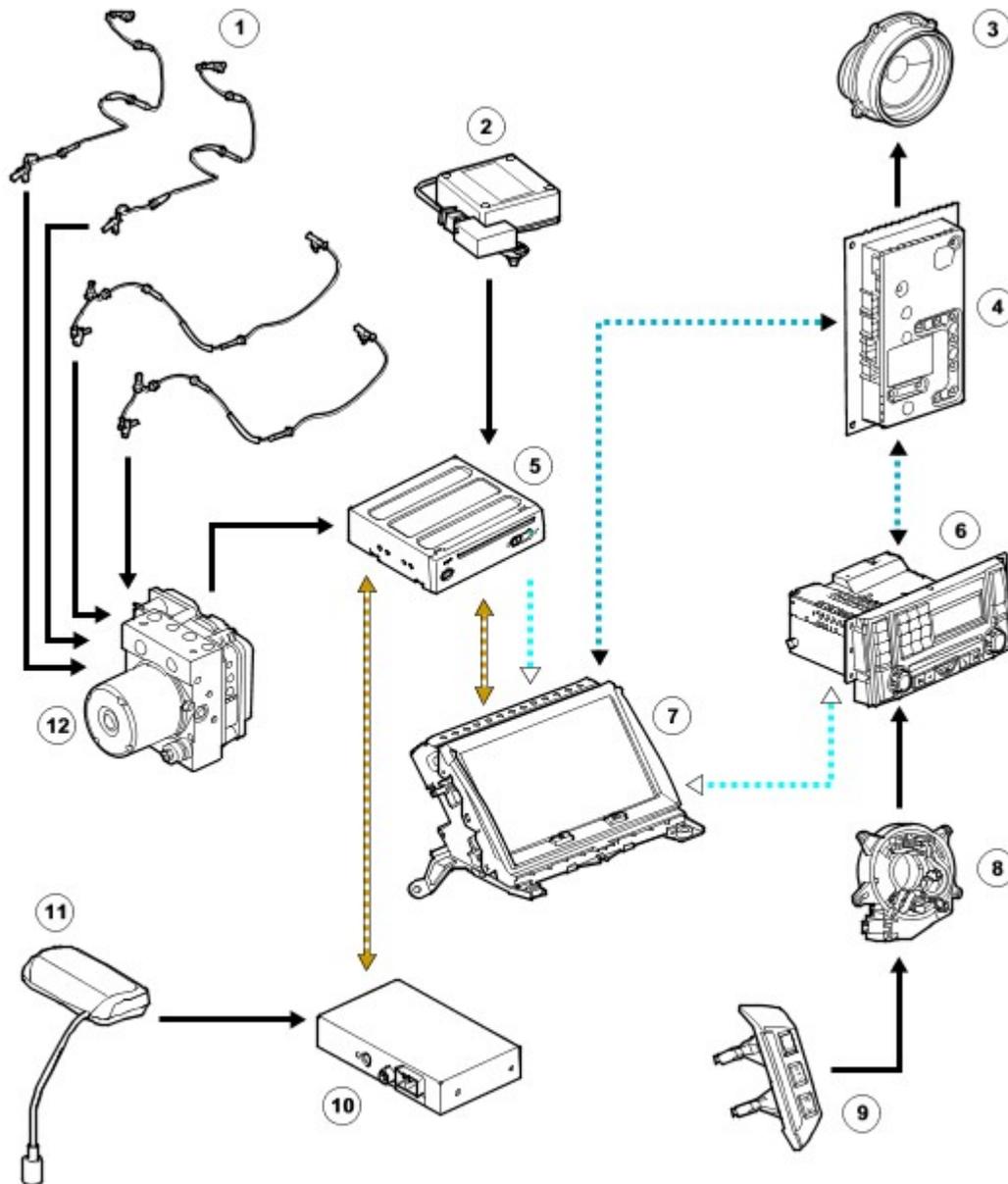


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3	-	GPS antenna
4	-	Steering wheel controls
5	-	Clock spring
6	-	Navigation computer
7	-	Speaker
8	-	VICS beacon antenna
9	-	Audio amplifier
10	-	VICS receiver
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Navigation System Control Diagram with VICS (Japan only)

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9	-	Steering wheel controls
10	-	VICS receiver

11	-	VICS beacon antenna
12	-	ABS control module

The navigation system comprises the following components:

- Touch Screen Display (TSD)
- Navigation computer
- GPS antenna

In addition to the standard navigation system it is possible in certain markets to add:

- Traffic Message Channel (TMC) system
- Vehicle Information and Communication System (VICS Japan only)

Touch Screen Display



The Touch Screen Display (TSD) is located in the centre of the instrument panel. The TSD is a touch sensitive 7 inch LCD VGA screen containing 800 x 480 pixels in a 15:9 format. The TSD is connected to the infotainment system on the Media Oriented Systems Transport (MOST) ring. The MOST ring is a fibre optic communications data bus that allows high speed transfer of control instructions and audio around the system. For additional information, refer to [Communications Network](#) (418-00 Module Communications Network)

For additional information, refer to [Audio System](#) (415-01 Audio Unit)

For additional information, refer to [Video System](#) (415-07 Video System)

The TSD processes its own video for system operation but receives the navigation graphics from the navigation computer on a dedicated serial link called GVIF (Gigabit Video Interface). For additional information, refer to [Communications Network](#) (418-00 Module Communications Network)

Connector No C2819 Pin Out Table

Pin No	Description	Input/Output
1	Battery voltage	Input
2	Ground	-
3	Ground	-
6	Audio screen	-
7	Audio -	-
11	ACC	Input
12	Dimming signal	Input
14	Private CAN high	-
15	Private CAN low	-
17	Audio +	Input

Connector No C2820 Pin Out Table

Pin No	Description	Input/Output
1	Video screen	-

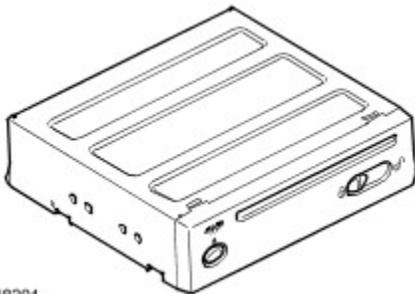
Connector No C2823 Pin Out Table

Pin No	Description	Input/Output
1	GVIF +	Input
2	GVIF -	-
3	GVIF Shield	-

Connector No C2825 Pin Out Table

Pin No	Description	Input/Output
1	MOST in	Input
2	MOST out	Output

Navigation Computer



The navigation computer is located under the left hand front seat. The computer is the main component in the navigation system and receives inputs from the ABS Unit and the GPS antenna. The navigation computer contains a solid state piezo gyro which measures the motion of the vehicle around its vertical axis. The gyro operates on the principle known as the Coriolis force. The Coriolis force is the force that appears to accelerate a body moving away from its rotational axis against the direction of rotation of the axis. Using the inputs from the ABS unit, the GPS antenna and the gyro sensor, the computer calculates the vehicle's current position, direction and speed.

The navigation computer also houses the DVD-ROM drive. The drive is used to read map data from region specific DVD's (1 DVD for each of the following regions: EU, US, Japan and Australia). A button, located adjacent to the DVD slot, is provided to eject the DVD from the unit. If ignition is on, or the Entertainment System is in 1-hour mode, one press of the button will eject the DVD.

The GPS receiver receives information from between 1 and 8 satellites at any one time. This information is received from the GPS antenna. The built in GPS receiver is used for calculating the position (i.e. Latitude, longitude and height), direction and speed.

The navigation computer uses non-volatile memory to store settings and configuration information when it is powered down. This process takes place just before the computer turns off.



CAUTION : If the unit is disconnected before the Entertainment System has powered down, the computer could fail to complete its data storage. This means that personal settings could be lost.

For the Japanese market the navigation computer is a different component. Although it looks identical the software is

specific to Japan market and the part number is different. The system also has extra components for the VICS system (a receiver and an antenna). The VICS system receives allows the vehicle to receive information about traffic conditions from roadside transmitters and adjust the navigation instructions accordingly. The VICS information is received by both a radio link and an infra red link. For this reason the antenna is located on the inside of the windscreen.

The navigation computer is connected to the TSD by a private CAN bus and a dedicated GVIF (Gigabit Video Interface). The GVIF carries all the video information to the TSD, while the CAN bus is used for data and control instructions to and from the TSD.

Connector No C2114 Pin Out Table

Pin No	Description	Input/Output
3	Ground	-
6	Private CAN Low	Input/Output
8	VICS receiver H-GND	Input
9	VICS reciever H-TX-	Input
14	Navigation and voice audio ground	-
15	Mic screen ground	-
16	Voice recognition microphone -	-
17	12V Battery voltage (fuse 49)	Input
18	12V Battery supply from infotainment relay	Input
19	Ground	-
21	Vehicle speed signal from ABS control module	Input
22	Private CAN high	Input/Output
30	Navigation and voice audio +	Output
31	Navigation and voice audio screen/ground	-
32	Voice recognition microphone +	Input

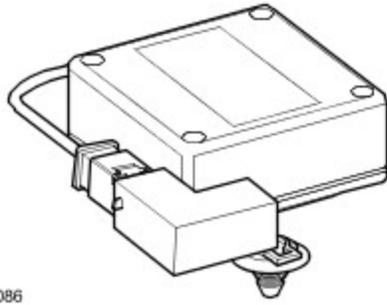
Connector No C2113 Pin Out Table

Pin No	Description	Input/Output
1	GVIF +	Output
2	GVIF -	-
3	GVIF ground	-

Connector No C1599 Pin Out Table

Pin No	Description	Input/Output
1	GPS antenna screen ground	Output
2	GPS antenna signal	Input

GPS Antenna

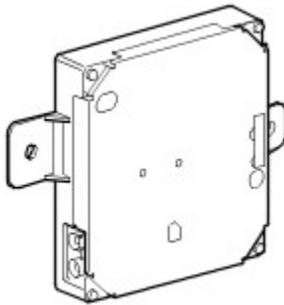


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The GPS antenna is located in a pod which is in the center on the vehicle roof at the rear. The GPS antenna is connected to the GPS computer by a single co-axial cable and passes signals from the GPS satellites to the navigation computers built in receiver for processing.

It is possible for the GPS antenna to lose the GPS signal from the GPS satellites in hilly or tree lined areas, built up areas with tall buildings, multi storey car parks, garages, tunnels, bridges and during heavy rain/ thunderstorms. When the signal is lost the navigation computer will continue to give guidance using memory mapped data from the DVD map until the signal is restored.

Traffic Message Channel (TMC) Receiver



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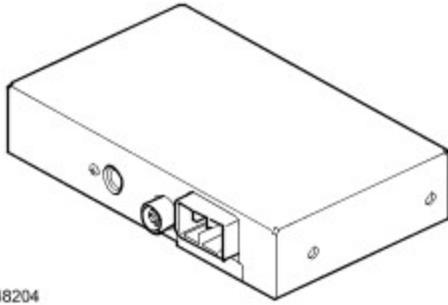
The Traffic Message Channel (TMC) receiver is located in the rear RH side of the luggage compartment. The TMC receiver is connected to the MOST ring and transmits TMC data to the navigation computer (via the TSD). The navigation computer then displays this information on the TSD and also re-routes the navigation guidance around any traffic hold ups. The TMC data is received via the FM antenna located in the rear screen via an antenna amplifier located above the rear tailgate spoiler. For additional information, refer to [Antenna](#) (415-02 Antenna)

TMC is available in many European markets.

Vehicle Information and Communication System (VICS Japan only) Receiver

The VICS system comprises the following components:

- VICS receiver
- VICS Beacon antenna
- VICS RF antenna



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The VICS receiver is located behind the Integrated Head Unit (IHU) in the instrument panel. The VICS receiver is connected to the navigation computer via a dedicated link.

The VICS receiver, receives information from the beacon antenna in the centre of the instrument panel and the VICS antenna located in the rear screen element. For additional information, refer to [Antenna](#) (415-02 Antenna)

VICS Beacon Antenna



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The VICS beacon antenna is located on top of the instrument panel. The antenna receives infra red and RF signals from road side transmitters.

NAVIGATION SYSTEM OPERATION

The navigation system receives GPS information via the GPS antenna. The GPS signals are used by the navigation computer to calculate the vehicles position. Once the driver has input a desired destination the navigation computer can calculate a route, based on the drivers pre-determined preferences or the default settings in the navigation computer.

The navigation system is accessed by pressing the navigation button at the bottom left hand side of the TSD. The driver will then have the option of on road navigation or off road navigation.

On Road Navigation

On road navigation is initiated by the driver inputting a destination. This can be achieved by:

- Typing in an address from the TSD.
- Entering a post code.
- Choosing a pre-entered address from the address book.
- Choosing a point of interest from an area.

The driver is then guided to the destination by a scrolling map display and voice guidance. The display can be varied by scale and display type.

Off Road Navigation

The off road navigation route comprises a series of way points which are followed sequentially. Direct point to point guidance is given to the first way point in the route. When the vehicle arrives at the first way point guidance is given to the second way point in the route. This process continues for subsequent way points until the final way point (destination) is reached.

The routes are stored in the non-volatile memory of the navigation computer.

The routes can be entered on the TSD and comprise way points, Longitude and latitude destination and previously stored routes.

The different route guidance screens give the user the information required for direct point to point direction to the selected destination (guidance mode). The same guidance screens are also available even when guidance is not being given (compass mode). All the destination and guidance information is not shown on the guidance screens when in compass mode. When the system is in compass mode with no guidance being given the route title is 'COMPASS MODE'.

4x4 I

4x4i Gives the driver additional information regarding vehicle systems.

- Suspension travel
- Gear selected
- Range selected
- Terrain response
- Vehicle heading
- Compass heading
- Steering wheel angle

The 4x4i System uses inputs from other vehicle systems to display information about suspension and transmission operation along with navigational information.

TRAFFIC MESSAGE CHANNEL (TMC) SYSTEM

The Traffic Message Channel (TMC) is a function of the FM Radio Data System (RDS). The system broadcasts real-time traffic and weather information. Data messages are received and decoded by the TMC receiver and passed onto the navigation system, which then delivers them via the navigation system interface. TMC messages are filtered by the navigation computer so that only those relevant to the current journey are displayed, allowing the navigation system to offer dynamic route guidance - alerting the driver of a problem on the planned route and calculating an alternative route to avoid the incident.

TMC traffic information systems conform to a global standard that has been adopted by traffic data gatherers, information service providers, broadcasters and vehicle/receiver manufacturers. TMC information is received via the normal FM radio antenna.

All TMC receivers use the same list of event codes, while the location database (on the map disc) contains both a country-specific set of location codes for the strategic European road network

TMC traffic data is currently broadcast in many European countries.

VEHICLE INFORMATION and COMMUNICATION SYSTEM (VICS Japan only)

The VICS system supplies the navigation computer with information to enable the navigation computer to re-route the navigation guidance or to inform the vehicle driver of traffic conditions in the vehicles vicinity. Information is provided to the system through three routes:

- RF transmission
- Infra-red transmission
- FM multiplex transmissions.

The information is passed to the navigation computer via the VICS receiver and the IHU

RF Transmission

RF transmission is generally transmitted from road side beacons mainly on expressways. The information transmitted is:

- Traffic congestion
- Travel time to next intersection
- Traffic conditions in surrounding areas and expressway turn offs
- Traffic accidents
- Speed limits
- Lane regulations
- Tyre chain regulations
- Parking availability at expressway service areas and parking areas

The RF transmissions are received by the beacon antenna mounted on the top of the instrument panel.

Infra-Red Transmission

Infra-Red transmissions are transmitted from road side beacons on major trunk roads. The information transmitted is:

- Traffic congestion and travel time
- Traffic accidents
- Breakdowns
- Roadworks restrictions
- Parking availability

FM transmissions

The FM transmissions are broadcast as part of the normal RDS FM transmissions. Information transmitted is:

- Traffic congestion and travel time for wide areas
- Traffic accidents, roadworks, speed limits and lane restrictions for a wide area
- Parking availability information.

DIAGNOSTICS

The TSD and the navigation computer both have built in self tests that allow the technician to diagnose fault conditions. Fault codes and diagnostics can also be achieved via T4.

TSD Diagnostics

The TSD has in built diagnostics to aid the diagnosis of system faults. The diagnostics allow the technician to interrogate the following:

- Hard key function
- Touch screen function.
- Video input.
- RGB video.
- Vehicle signals.
- Self test.
- Configurations
- Vehicle configurations
- MOST ring function.

The built in diagnostics are accessed as follows:

- Once the system is powered up enter the Home menu page.
- Press and hold the TSD in the center at the top of the screen for approximately 5 seconds and then press the navigation hard key.
- A Diag PIN Entry box will appear, type in the access code 753.
- Once this code has been accepted the Diagnostic Menu screen will be displayed.

Hard Key Test Screen

The hard key test is used to determine the function of the two switches integrated into the TSD. Pressing either of the buttons will turn the corresponding icon on the screen green if it is functioning correctly.

Touch Screen Test Screen

Entering the Touch screen test screen allows the technician to test the physical side of the touch screen. The technician can choose between checking the screen integrity and re-calibrating the screen. Using the Touch Switch Check button will display a blank screen. Touching the screen in any place will give a series of co-ordinates. If a faulty area of the screen is touched the co-ordinates will not display.

Re-calibrating the screen allows the technician to align the touch screen co-ordinates to the pressing of the screen. This is achieved by pressing a series of on screen targets.

Vehicle Signals

The vehicle signals screen displays the inputs from other vehicle system to the TSD. These signals include:

- Battery voltage
- Lights (on or off)
- Ambient light sensor voltage
- Graphic illumination dimming duty
- Output audio allocation
- PCB temp
- Speed inhibit (on or off)
- MOST FOT temperature
- Parking position (electric park brake on or off)
- Backlight PWM duty
- Beep volume
- Beep tone.

Video Input Test

This screen will allow the testing of video inputs that are connected to the TSD. This includes TV/DVD Rear Seat Entertainment (RSE) and television.

RGB Colour Test

This function allows the technician to test the colors generated by the TSD. A second screen displays six solid colors, selecting the color will fill the screen with the chosen color and pressing the TSD again will revert back to the color test screen.

Self Test

The self test function displays any fault codes that are present for the TSD. The screen also displays the current state of the ignition switch and the battery voltage.

Two additional buttons in the screen allow the technician to clear the fault codes and to test the TSD.

Configurations

The configurations screen displays information about the TSD and the navigation computer. Switching between the two components is achieved via the soft key at the top LH corner of the screen.

The information contained in the screens is as follow:

- Vehicle type
- Component serial number
- Component part number
- Component part level
- CPU/bootloader lever
- Main CPU application version
- Sub CPU software version
- Private CAN database version.

Vehicle Configurations

Selecting the vehicle configurations option allows the technician to inspect the components fitted to the vehicle entertainment system. There are four screens which can be navigated through via the next and previous buttons.

MOST Test

The MOST test screen displays information about the MOST signals being sent around the MOST ring. Using any part of the audio system will bring up the MOST message on the screen. This can be used to help diagnose MOST related faults.

Navigation Computer Diagnostics

The navigation computer has in built diagnostics to aid the diagnosis of system faults. The diagnostics allow the technician to interrogate the following:

- Navigation info
- Parts info
- Manual check
- Self check.

Each area has sub level of menus to access further information.

The built in diagnostics are accessed as follows:

- Once the system is powered up enter the navigation system via the navigation hard key.
- Agree to the disclaimer screen.
- Enter the navigation home menu.
- Press and hold the TSD in the center at the top of the screen.
- A Diag PIN Entry box will appear, type in the access code 753.

Once this code has been accepted the on screen diagnostics menu will be displayed. The menu has the following options:

- Navigation info
- Manual check
- Parts info
- Self check

Navigation Info

The navigation info menu has three sub menus:

- Vehicle signals
- GPS information
- Reset position

Parts Info

Parts info displays information on the system component and software versions.

Manual Check

The manual check menu enables the technician to complete the following self tests:

- Navi RGB screen test.
- Microphone input level test.
- Voice output test.

Self Check

Self check runs an internal check on the navigation computer and displays any fault codes on the TSD.

Navigation System DTC (diagnostic trouble code)

Displayed DTC	DTC Description	Fault Condition
U1A0087	Private CAN Communications fault	No Connector on navigation computer. Comms fault.
B1B0049	MMM internal fault	
B1A0049	HLDF internal fault	
B1A8911	GPS antenna short circuit to ground	GPS Comms error
B1A8913	GPS antenna open circuit	GPS Comms error
B1D6287	VICS ECU communication error	
B1D6249	VICS module error	
U1A0131	GVIF fault	GVIF not connected
U300068	MOST FOT Over-Temperature	MOST Transceiver overheating
B100E25	TV/RSE Video Input Failure	Input not connected
B100F25	Companion Video Input Failure	Input not connected
B101025	Rear Camera Video Failure	Input not connected
U200531	Vehicle Speed Signal Fault	GPS and Vehicle speed mismatch