Development of 2004 Model HDD AVN

Yoshitaka Oniwa
Toshihiro Oshima
Taku Yokawa
Masahiko Nakano
Tetsuaki Aono
Hirofumi Hamaoka
Tadashi Kidena
Keizou Ishimura

Satellite images provided by Japan Space Imaging Corporation. JSI

Abstract

In contrast to the sluggish audio market, the Japanese car navigation market has been pulled by genuine car navigation and has shown steady growth.

Since the release of the world's first AVN in 1997, our company has cultivated a market stimulating an evolution in the functionality and quality, including triple deck AVN (DVD/CD/MD), touch panel, display for VGA, twin HDD AVN and ETC built-in AVN and others. However, in recent years, with increased recognition of the AVN market, one company after another has entered the market, resulting in tough competition.

In this kind of environment, we wish to lead other companies as an AVN pioneer to introduce our flagship model: the 7-inch Display housing type second-generation AVN for market release.

1 Introduction

The Japanese car navigation market has shown steady growth, lead by genuine car navigation products. Further, in terms of product configurations, there has been a rapid transition from the dash-mount type to the in-dash type such as AVN, to attain better installation appearance and protection against break-ins and thefts.

For this reason, there has been an intensification of competition from other companies entering the AVN market one after another. In order to continue to maintain a leading position in the market as a pioneer of AVN, further improvement in the product value is necessary through enhanced product distinction and performance. The 2005 flagship model, the 7-inch retractable display type second-generation AVN for the Japanese market, has a styling that combines a spirit of innovation with the elegance befitting a flagship model, and the advanced technology and new functionality that our company offers.

Here, we would like to introduce this functionality, design and technology.

Fig.1 AVN 9904HD (when open)

2 Overview of the product

2.1 AVN9904HD specifications

An overview of the ECLIPSE 2004 autumn model "AVN9904HD" is provided below.

The structure can be roughly divided into "common components", "display components", "AV components", "navigation components", "sound quality components", and "system enhancement equipment".

Common components

- External dimensions: 2DIN (W178×H100×D165mm)
- Mass: 4.0kg (approximate)
- Decks: DVD/CD compatible deck and HDDs (20GB HDD for navigation/20GB HDD for audio)
- Control operation: when display is open (touch panel + front panel switch)
  When displayed is closed (front panel switch)
  Remote control operation

Display components

- 7-inch wide VGA display
- Screen size: W156×H83mm
- Number of pixels: 1,152,000 pixels (W480×H800×3)

AV components

- Radio (AM/FM/FM multiplex)
- TV (1 to 62 channels, multichannel compatible)
- CD (CD-R/RW compatible)
- DVD video playback
- MP3 and WMA playback compatible
- MAGIC GATE compatible MEMORY STICK music playback
- MUSIC JUKE (able to record up to 3,000 tracks)
- CD quad-speed audio recording with simultaneous playback function
- CDDB (with auto titling function)
- FM de TITLE (CDDB delivery service with FM multiplex) compatible
- Song agent compatible

Navigation components

- HDD navigation
- Equipped with high specification navigation engine
- Equipped with 3D hybrid sensors
- Evolution of satellite shot function (compatible with VICS/road display and sites of 47 prefectural and city governments)
- FM-VICS 2 tuner compatible
- Multi-window function
- 3D realistic intersection enlarged illustrations
- Agent function
- Route Bank function

Sound quality components

- Sound field control/graphic equalizer/position selector
- Built-in 5.1ch surround decoder
- Built-in 50W×4ch amplifier

System enhancement equipment

- CD changer (twin CD changer compatible)
- MD changer
- Center speaker
- Sub woofers
- 2-media VICS unit
- ETC unit
- Backeye camera
- 10-key remote control
- Hideaway Digital Terrestrial tuner connection compatible

(*parts underlined: functional compatibility is new from 2004 model)

2.2 Main features of this unit

The main features of this unit will now be described.

First, this unit is capable of ripping the music data from a CD at quad-speed during CD playback.

Conventionally, with single CD ripping speed, recording was not completed during a single ride in most cases. With this unit, as quad-speed recording has been achieved, it is possible to complete recording even when driving around to do a little shopping. Further, in contrast to equipment from other companies, this is always quad-speed recording. With most manufacturers, recording speed may drop during navigation usage such as route guidance and searches, or during VICS reception. However, this unit's recording speed remains constant in any case, including heavy use of navigation features. In this way, we have been able to achieve a dramatic improvement in product appeal and convenience.

Next feature to be noted is the compatibility of this unit with "Sound agent function", which uses MCDB from Media Click Inc. linked with CDDB.

Our company's Music Juke is able to record up to 3,000 tracks. Thus, one might find it quite difficult to search for the appropriate music quickly in some occasions, such as when driving with a date where playing suitable music to the mood is fundamental. In this case, selecting a category from a total of 4 types of search options - song image, scene, era, and tie-ins will allow all corresponding songs to be selected automatically, contributing to offer a better in-vehicle entertainment experience.

Finally, note the compatibility with "FM de TITLE", the CDDB delivery service using FM multiplex.

The details will be described later in section "5.1 Music Juke operability improvements".

3 System configuration

Overview of the system

The AVN9904HD was designed based on last year's release, the AVN9903HD.

The changes with this system are the adoption of Music Juke quad-speed recording capability, and the Digital Terrestrial TV tuner compatibility.

With regards to the quad-speed recording device, no problems were encountered as the design has been established with the AVN8804HD, already released in the spring. However, with Digital Terrestrial TV, the software is considered to be an interim version while a hardware interface was fixed. This is because the progress of Digital Terrestrial TV tuner development has not been concurrent, and the infrastructure remains unclear.

The final system configuration is shown in Fig.2.

4 Design

In recent years, the adoption rate of car navigation systems has increased sharply and steadily. According to an investigation by the Road Bureau, Ministry of Land, Infrastructure and Transport, at the end of March 2004, the number of units in use exceeded 14,540,000. Similar

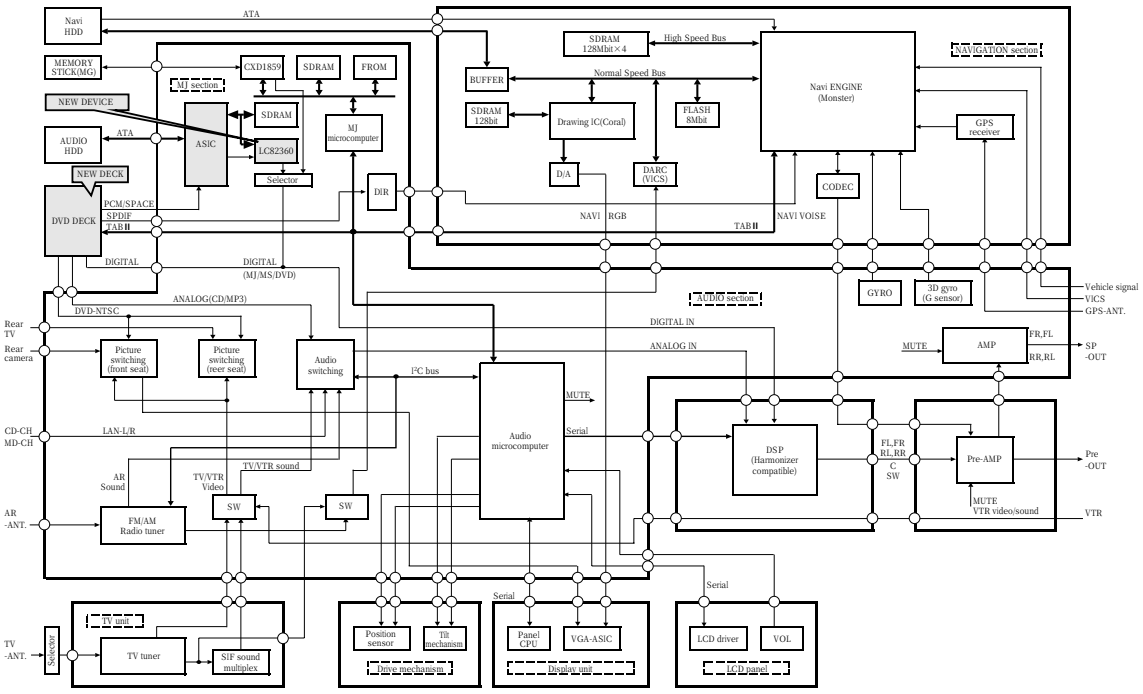

Fig.2 System diagram

AVN type navigation systems have been released by competitor manufacturers. An evolution has thus become necessary based on our proprietary concept while maintaining our strategy.

An internal investigation of the number of shipped units and units sold for silver and black color products showed a significant change in volume, with black towards the end of model life. Regarding trends in the number of shipments and sales of black and silver units, despite following parallel courses, the silver showed a slight decline, in contrast to the increase for black. To investigate the causes, hearings were held on market trends at sales companies in major cities. As a result, it was presumed that this sales figure reflected the trend in demand that is observed mainly in the Kanto area where there are many foreign car owners, for subtle proportion in the vehicle associated with the user preference for harmony in the vehicle cabin. This trend is expected to continue for a time, as reflected in the design as well as recent and predicted product design and advertising media trends. The illumination color was switched from greenish white to amber to follow recent user preference trends, while considering compatibility with front design panels and instrument gauges. In terms of the color of the front design panel, our theme has been "innovation and elegance", with a contrast between black - which exerts a fascination for people - and silver - with its shiny glamour. For the 2004 market model AVN series, a consistent color lineup was adopted from AVN2204D through AVN9904HD, in an attempt to render an even deeper sense of AVN consistency.

During a packaging study for display configuration, many people supposed that the audio hardware buttons could be used whether the display was OPEN or CLOSED if a layout was used in which the display was at the upper section of 2 DIN space, also supported by the opinion showing the advantage of structures that are similar to conventional design. In contrast, there were disadvantage from the point of view of safety in assuring the driver's view range, and of interference with the air conditioner ventilation ports above the audio section. Based on assuring a higher order of safety and comfort, where our company set "Multi In One" as the concept behind our AVN, the product features integrate audio and navigation in a limited 2DIN space. As the product advantage of AVN is a complete fit within the instrument panel, a display configuration that uses the lower section for retraction was adopted.

In terms of screen design, intuitive realistic icons were carried over from the predecessor models. Using function buttons (storage function) the design enables storage of buttons used infrequently in lower layer, to avoid complicating the screen design becoming increasingly multi-functional.

It has been designed to allow the screen to be visible at all times by reducing the complexity to eliminate operating stress. Further, from the point of view of entertainment, a slow-motion background animation has been added at a minimum level to avoid driver distraction. This screen design allows both safety and entertainment. (Refer to Fig. 3)

Fig.3 AVN9904HD NAVI FACE design

Regardless of the person, the foundation of market demand is an improved product, easy to look at and easy to use. In the design team, design development of the product proceeded with attention to these matters. With this characteristic design, we are assured of even further presence of the ECLIPSE in the AVN market, and of distinctiveness from other companies. "AVN" continuously evolves based on "Just Fit", an independent mindset and concept that only ECLIPSE offers.

5 Technical development items

5.1 Music Juke operability improvements

Goal

The Music Juke functions (referring to the hard disc audio functions) offered by our company include the "auto titling function": that automatically applies titles to the tracks from CDDB if the corresponding information for the recorded CD is available. This is a very handy function as there is no manual title input required. However, as title information for the latest CDs released after AVN purchase is not available in pre-stored CDDB, manual input of title information is still required. In addition, in the previous model, titles could not be input to songs once recorded.

Manual operation of title input was very inconvenient and required considerable effort. Thus "FM de TITLE"

functionality and "After-titling function" were developed, with the goal of enabling easy and simple titling. Here, an explanation is given of these two functions.

FM de TITLE function

This function enables reception of CDDB delivered using FM multiplex. This service is a world's first, achieved through business relationship between a total of four companies - Gracenote, which owns CDDB, Media Click Inc., which created CDDB for delivery, FM Tokyo, which delivers data via FM multiplex, and our company, which has developed a terminal for receiving the data delivered. As the same data delivers a maximum of 50 titles per week nationwide via the JFN affiliate, regardless of location, people in a locality where JFN can be received are able to take advantage of this service. Further, as FM multiplex broadcasting is used, the users are able to receive this service free of charge. This function was developed with the following points in mind.

①Convenience

In order to acquire the data, it is necessary to select a broadcast station within the JFN affiliate delivering the signal. However, this unit adopts a structure whereby JFN affiliate broadcast station data is loaded in advance. Based on the current location information, a search is automatically implemented of the applicable broadcast station (for example, Kiss-FM KOBE in Kobe City). In this way, CDDB can be received even if the user is not sure of the frequency of the broadcast station in the JFN affiliate.

②Coexistence with FM-VICS

As there is a single FM multiplex decoder built into this unit, it is not possible to simultaneously receive FM-VICS and the Visual Information Radio multiplex broadcast, the "FM de TITLE". FM-VICS uses the NHK affiliate, and "FM de TITLE" uses the JFN affiliate. These are completely different networks, and the user must choose which data to acquire. Thus a switch is included for selecting whether to receive FM-VICS or CDDB.

However, with a simple switch method, the user must switch every time the desired information changes. Thus a structure was realized in which a check is made of whether CDDB delivered in this way for that particular week is completely acquired, every time the engine is turned ON[f1]. If CDDB acquisition is entirely complete, FM-VICS is received even if CDDB is set. In this way, if CDDB is set, the product automatically receives FM-VICS without subsequent switching of settings, thus enabling efficient use of FM multiplex content.

Next, an explanation is given of the "After titling function".

After-titling function

This function performs automatic titling to recorded songs for which titles have been given, if title information is found through another search of the CDDB stored on the HDD. Services have now been enhanced, with downloads from our company's website (hereinafter referred to as WS), update services via MEMORY STICKs and CD-R/RW, as well as the previously mentioned "FM de Title" and CDDB update services. However, with conventional automatic titling designs, recorded music is excluded, and the user is obliged to input tiles manually. As manual operation is very inconvenient, and considerable effort is necessary, operability improvements were needed.

Thus a "Title reacquisition" button was included in the play list (folder storing recorded songs) editing screen, achieving the CDDB repeat search. As the CDDB repeat search is conducted in play list units, if there is title information, it can be reflected all at once for all tracks stored in the play list, reducing unnecessary effort by the user. By achieving the CDDB repeat search function, manual revision is no longer necessary for undesired title information previously added. Also, when multiple album title information is searched during CDDB search, it is possible to confirm the track information included in a given album. Thus the user can reliably input titles, making it possible to achieve improvements in convenience.

System configuration and control software

With the Fm de TITLE data, data is acquired with the FM multiplex decoder, installed in the navigation unit. It is transferred to the Music Juke unit and stored on the HDD. When all data delivered during a week has been received, the system switches automatically to VICS reception, achieving very efficient FM multiplex reception. (Refer to Fig.4)

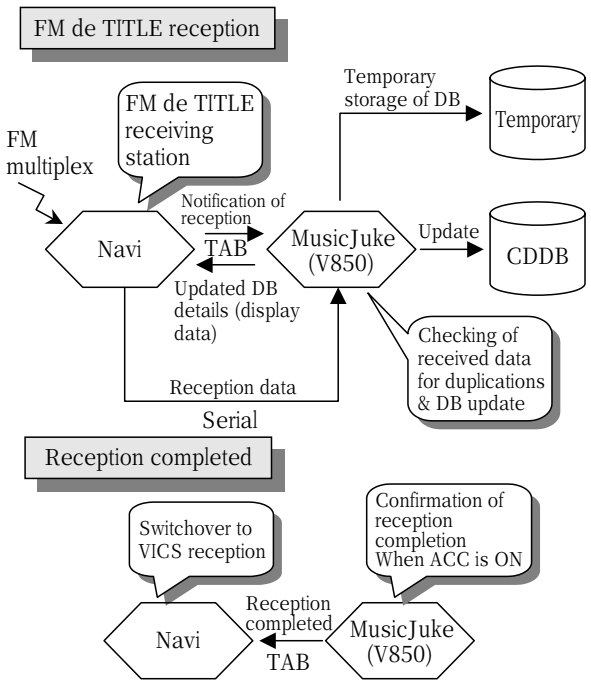

Fig.4 Data control of FM de TITLE

When Music Juke function or MEMORY STICK function are in use, update processing is not carried out, and the CDDB is temporarily stored in SDRAM. When switching to other modes, or when update instructions are given by the user, update processing is carried out based on the data stored in SDRAM. In this way, the occurrence of incomplete data is reduced. Sufficient memory is secured in the SDRAM's buffers to accumulate the data delivered during 1 week.

Further, the CDDB search function has been improved by a specification change such that after a CDDB update, a repeat search can be run to find title information for recorded tracks that had no title information assigned them. This has been realized by adding a TOC DB, necessary for CDDB searching, to the recorded track management DB. (Refer to Fig.5 and Fig.6)

Further, as explained previously, when carrying out repeat search, if multiple titles are retrieved, these are displayed in a list, and the album can be selected based on the user's instructions. During recording, a single album is fixed for titling. However, using this function, correct title revisions can be performed for incorrectly titled albums during automatic titling. (Refer to Fig.7)

5.2 Integrated technology for function loading

As described in the overview of the system, the circuit size increased for Music Juke quad-speed recording. However, in terms of structure, the board layout could basically not be changed. Thus the Music Juke circuit first needed to be put on a main circuit board capable of large-scale module mounting.

However, as the main circuit board was primarily taken up with audio microcomputer circuits and audio circuits, and no circuits were moved elsewhere although

D瀣骭瀼䤨瀢幷 circuit increased in size, the was that
we wf

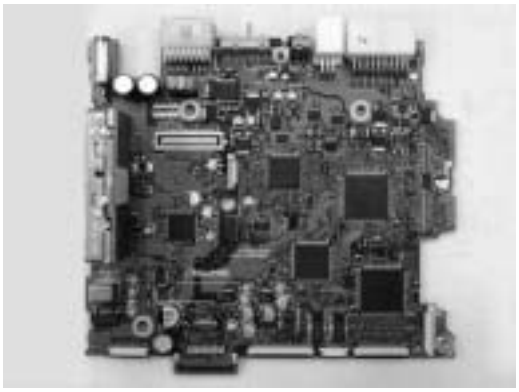

Fig.8 Main circuit board for conventional units

Fig.9 Main circuit board for this unit

Instead, convention 2125-type chips were replaced with further miniaturized 1005-type and multiple-type resistors. This contracted the module surface area, and revised the module layout, allowing unnecessary pattern wiring to be minimized. This allowed an increase in mounting density, enabling storage on the main circuit board. (Refer to Fig.10)

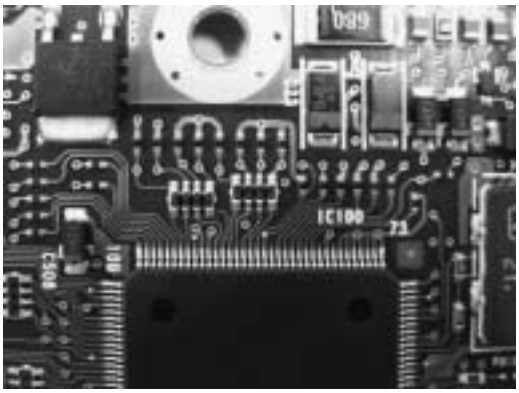

Fig.10 1005-type resistors and multiple-type resistors

5.3 Structure of the product

Structure of the AVN9904HD basically sticks to that of the AVN9903HD, the previous year's model. However, as described previously, improvement of design and addition of various functions were carried out.

For this reason, even the product structure was partially revised, enabling all functions to be built-in.

Design

The largest theme in design of this product was the presentation of elegance.

This was achieved with the following items:

- Adoption of plated parts at the CD opening
- Adoption of clear acrylic buttons on the audio face (2 tone type)
- Adoption of silver and black 2-tone panel for the navigational face (masking painted)
- Adoption of new tones for the button illumination color (new LED), etc.

Quality assurance for these changes became an issue, and this was immediately addressed. We achieved the required level for the product with optimizing the form of the paint border grooves (it prevents the paint from running off, even if it runs off, it will be unnoticeable), and with the painting trial at the prototype stage.

Interior parts

Development items based on structural additions involving the internal structure included:

- Map update interface for the front of the product (IEEE1394 connector) was built-in
- Connection interface added for Digital Terrestrial TV tuners, at the back of the product
- Change to new DVD deck (DV-03), for compatibility with Music Juke quad-speed recording

As development measures, modeling was implemented via 3D-CAD prior to component creation, so as to avoid component interference due to changes of form for each part. Obstruction checks were carried out, enabling obstructions to be avoided. Further, in terms of ease of assembly, care was taken so that there would be no changes to the assembly process from that for the previous model, enabling assembly work on the same line.

6 Conclusion

This paper has described the development of the 2005 flagship model AVN, equipped with Music Juke quad-speed recording, FM de TITLE and other new function, in pursuit of the spirit of innovation and elegance.

As noted at the outset, the AVN market is expected in future to become more and more competitive. As an AVN development pioneer, amidst the product variation resulting from entry by other companies, we should have the objective of developing new products, pursuing high capability, high performance and entertainment, and consistently satisfying our customers.

<Trademarks, registered trademarks>

The following product names and proper nouns are the trademarks or registered trademarks of their companies:

・Registered trademarks
"MUSIC Juke" FUJITSU TEN LIMITED
"AVN" FUJITSU TEN LIMITED
"MAGIC GATE" Sony Corporation
"MEMORY STICK" Sony Corporation
"CDDB" Gracenote Inc

・Trademarks
"FM de TITLE" FUJITSU TEN LIMITED

Profiles of Writers

Yoshitaka Oniwa

Entered the company in 1981. Since then, has engaged in AV device development, by way of car audio circuitry design and product planning. Currently in the Engineering Department of Engineering Division 2, Business Division Group.

Toshihiro Oshima

Entered the company in 1991. Since then, has engaged in car audio development by way of the Manufacturing Engineering Department and Fujitsu Tech. Currently in the Engineering Department of Engineering Division 2, Business Division Group.

Taku Yokawa

Entered the company in 1995. Since then, has engaged in the development of AVN software by way of the development of navigational hardware and software. Currently in the Software Engineering Department, Engineering Division 1, Business Division Group.

Masahio Nakano

Entered the company in 1998. Since then, has engaged in AVN product planning by way of LSI development and design. Currently in the Products Planning Department of Engineering Division 2, Business Division Group.

Tetsuaki Aono

Entered the company in 1999. Since then, has engaged in AVN design development. Currently in the Products Planning Department of Engineering Division 2, Business Division Group.

Hirohumi Hamaoka

Entered the company in 1991. Since then, has engaged in car audio structural design development. Currently in the Mechanical Engineering Department of Engineering Division 2, Business Division Group.

Tadashi Kidena

Entered the company in 1986. Since then, has engaged in AVN development, by way of car audio circuitry design and LSI development. Currently the General Manager of the Engineering Department of Engineering Division 2, Business Division Group.

Keizo Ishimura

Entered the company in 1982. Since then, has engaged in AV device product planning, by way of car audio structural design and assignment in overseas factory (North America). Currently the Manager of the Products Planning Department of Engineering Division 2, Business Division Group.