ECLIPSE 99 MODEL

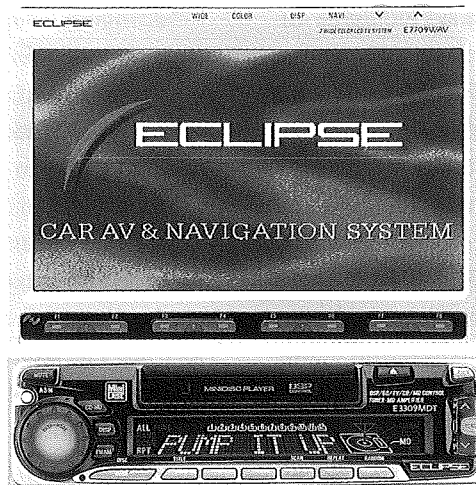● **Takao Yamaguchi**　　　● **Satoru Nagamoto**　　　● **Takayasu Kitamura**

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Abstract

In Japan, users' needs for after-market car AV products are becoming increasingly diverse and complex. Fujitsu Ten is responding to these new and growing demands by adding more attractive, unique features, unmatched by other manufacturers. In the North American market, meanwhile, demand for high quality audio equipment continues to grow. In addition, demand is also increasing for multimedia products, such as car navigation systems. In view of these trends, Fujitsu Ten is moving aggressively to develop and supply an array of products that meet the specific needs of individual markets.

A comprehensive approach to development across the entire product line is one key to meeting emerging needs; timely introduction of original products is another. Thus, we have been thorough in developing our multimedia equipment and other products, and quick to bring the newly developed models to market.

Reading the market and working to meet its demands culminated in development of the ECLIPSE '99 models we are introducing here. General information on the new product line, as well as the main features and key technologies incorporated, follow in this short description.

1. Introduction

In the aftermarket for car audiovisual equipment, the spread of MD equipment, and the appearance of DVD navigation systems (as well as home-use DVD video equipment) has led to acute changes that include a diversification of customer needs, and an intensification of competition.

In 1997, Fujitsu TEN began releasing a full line of ECLIPSE models in the Japanese aftermarket. Fujitsu TEN's integrated audio/visual/navigation (AVN) systems and CD and MD changers of one DIN size, products not offered by competitors, have also proven to be popular with consumers.

In the North American aftermarket, sales of navigation and DVD systems appear to be growing.

Under these circumstances, Fujitsu TEN has recently developed the ECLIPSE '99 models. This paper explains the purpose, outline, features, and technical points of the company's newly developed products.

2. Outline of ECLIPSE '99 Models

The release of the ECLIPSE '99 models represents the company's first full model change since the ECLIPSE '97 models were put on the market in Japan and the U.S. The ECLIPSE '99 models were developed as a result of improvements in such areas as ease of visibility and price competitiveness, following a review of the earlier model lineup.

2.1 Product Concepts

Automobiles have evolved under the key concepts of "safety," "comfort," and "good environment." Fujitsu TEN has planned and developed its products so that it can offer customers "safety," "comfort," and a "good environment" within the limited space that automobile interiors offer.

Since 1997, Fujitsu TEN has planned and developed the ECLIPSE series models for the Japanese and U.S. aftermarkets by pursuing consistent product concepts. In developing the ECLIPSE '99 models, Fujitsu TEN reviewed its product concepts to verify that its new products were actually satisfying the development targets represented by these concepts.

2.1.1 ECLIPSE models for Japanese market

The product concepts of the ECLIPSE series for the Japanese market are as follows:

(1) "Media in One Body" (merging of different types of media)

We are working on making full use of high-integration technologies to merge different kinds of media in individual, compartmentalized units. We are doing this to allow our customers to enjoy within limited automobile interior spaces.

(2) "Feel Conscious" (man-machine interface appealing to five senses)

We define "hearing," "sight," "touch," "bodily sensations," and "actual sensations" as the five senses required for man-machine interface enabling drivers and passengers to use with ease and comfort advanced, complex devices inside automobiles. In doing so, we are working on developing man-machine interfacing that appeals to the five senses, for user satisfaction and safe driving. In ECLIPSE '99 models, we especially improved those functions that appeal to the user's "sight." We enlarged the dashboard displays and indicators and increased their brightness for better visibility and safety, and added illuminations and easy-to-read illustrations in the displays for more "visual comfort."

(3) "Just Fit" (conformance to evolving vehicles)

We aim to supply products that conform to automobiles that are constantly evolving, while maintaining emphasis on a comfortable driver environment and safety.

In addition to the three product concepts described above, we came up with a total concept called "Multi-In-One" in the course of developing ECLIPSE '99 series models for the Japanese market. These new models were developed to provide "high performance sensory feedback," that is high performance that the user can readily "feel."

2.1.2 ECLIPSE models for the U.S.

Unlike the ECLIPSE '99 models for the Japanese aftermarket, those for the U.S. market, developed under the product concepts given below, are sold exclusively on the dealer market:

(1) Sound quality

We aim to ensure that our products provide sound quality that is comparable with that provided by products sold by car audio equipment specialty stores.

(2) Man-machine interface

We aim to provide products that are enjoyable to operate, and that are easy to find and easy to read,

key factors ensuring that users can fully enjoy their car audio systems.

(3) Reliability

We aim to supply our customers with products that offer total reliability. For example, products like our ECLIPSE security network (ESN) have been developed to let users use their car audio systems with assurance and confidence.

We have developed the ECLIPSE '99 models for the U.S. on the basis of the above three concepts that differ from the product concepts for the Japanese market.

2.2 Lineup of Main Products

In the ECLIPSE '99 series, eight new models were put on the market in Japan, while 14 new models were marketed in the U.S.

The key models are described in the following sections:

2.2.1 Key ECLIPSE '99 models for the Japanese market

(1) CD/MD main unit <E3309CMT>

The new CD/MD main unit is a low-priced, dual DIN model that houses CD and MD players, an FM/AM tuner, a DSP/equalizer, and a power amplifier (35W x 4).

(2) MD changer main unit <E5509MDT>

The new MD changer main unit uses a fluorescent display tube (VF) for the display panel of which indicators are linked to rotary controls to make them easy to find, easy to read, and easy to operate. This product also features a completely redesigned panel.

(3) CD player with built-in DSP/equalizer <E3309CDP>

The new CD player's position selector and 9-band graphic equalizer functions have been enhanced. This product, employing a spectrum analyzer display with unique cubic-like images displayed on its display panel, has been designed especially to enhance product appearance and marketability.

2.2.2 Main ECLIPSE '99 models for the U.S.

(1) ECLIPSE Commander <9002>

The ECLIPSE Commander (E-Commander) has an audio system/telephone control feature with a voice recognition function and a voice navigation system (providing directions with a synthesized voice and an arrow indicator). This product is combined with a CD main unit. A GPS unit can be added optionally.

(2) CD changer main unit <5605>

The new CD changer main unit is of a single-DIN type that has a newly developed 6-CD changer deck with a new sliding unit. The CD changer unit that comes with this model offers reduced access time, disk change time, and a more compact deck size, compared with the earlier model.

(3) CD main unit <5506>

The earlier CD main unit model provided a 5 V PRE OUT output that was well received by users. This new CD main unit has increased the voltage further to 8 V, or the highest PRE OUT voltage available on the market. The new CD main unit also has a map CD reproduction function and digital output and control terminals, so that it can be connected to the E-Commander described above, for an upgrade of the navigation system with the addition of the voice recognition and arrow indicator features.

(4) Hideaway 8-CD changer <5083>

The new hideaway 8-CD changer features a compact, lightweight deck mechanism and a variable-size fine-pitch magazine. The total volume of this 8-CD changer is smaller than the conventional 6-CD changer.
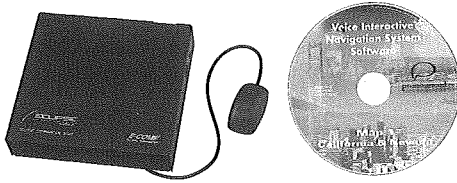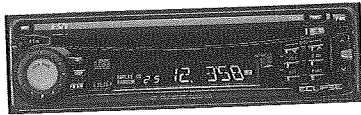
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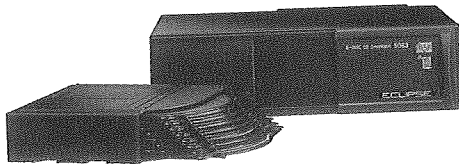<E5509MDT>

<E3309CDP>

Fig.1 New ECLIPSE Model (Domestic)

<9002>

<5605>

<5506>

<5083>

Fig.2 New ECLIPSE Model (U.S.A.)

3. Design and Technological Features of ECLIPSE '99 Models

3.1 Designing Concept

The concept behind the design of the ECLIPSE '99 models was "New dimensions in refinement and reconfiguration." In the aftermarket, a key concern for manufacturers is to come up with product designs that offer the customer added value for their money. Accordingly, manufacturers face a highly competitive environment in their efforts to come up with effective product designs. As a result, the aftermarket has become deluged with products with outlandish, imitative, or excessively complicated designs. The trend of product design in the market appears to be rather haphazard.

We targeted young people who were getting tired of outlandish, overly complicated designs, and aimed to reconstruct "the kind of beauty in design that users truly seek," from the user's point of view. We accomplished this by focusing on such features as ease of operation that does not sacrifice comfort or safety, and shapes and colors that are soft and soothing. In the design stage, we placed emphasis on the following three points:

(1) Sharpness and pliability (refined beauty in nature)

You never find perfectly straight lines and level surfaces in the natural world. Every living thing has its own beauty of form that has undergone constant refinement through necessity and natural selection. We have worked at designing our new models to have a kind of refined sharpness and pliability that will make users feel that these products are somehow "alive."

(2) Visual color harmony (harmony of color in the display panel)

In the aftermarket, one of the decisive factors that make products appeal to the customer and differentiate them from those sold by competitors is designing displays that are "pleasing to the eye." Attractive displays are made up of three key elements: "color," "shape," and "brightness." Colors and brightness in particular appeal to the sight, which accounts for over 80 percent of the total sensory activity of people. In designing our new models, we aimed at achieving harmony of color that provides a soft and soothing "feel," and enhancing the brightness for appeal.

(3) Trends in textures (textures that appeal to the senses of touch and sight)

In addition to shape, color, and structure, another key design element is texture. For the ECLIPSE '99 models, we aimed to create both the "feel of materials that appeal to the touch during operation," one of the themes for the ECLIPSE '97 models, and a "texture that appeals to the eye."

3.2 Product Reconfiguration Based on User Evaluations

To overcome the intense competition in the market that has been flooded with all kinds of designs, we need to clarify "what the customer wants" and "what the customer does not want." To this end, we carried out a market survey of designs, and an investigation in which we asked users to evaluate designs. These survey and investigation were carried out at an early stage of product development (earlier stage than that for the ECLIPSE '97 models). These two key activities are

described below:

(1) Survey (evaluation and analysis of old designs)

We surveyed salespersons and assistants (about 100 people) at our dealers throughout in Japan, as regards the designs of old models (ECLIPSE '97 and ECLIPSE '98 models). We conducted this survey with the aim of reviewing older designs in view of their effectiveness as commodities. We polled salespersons because we wanted to obtain from the people with a first-hand view of the market, detailed and varied information on the advantages and disadvantages of the designs that were employed in older models.

(2) Design evaluation by product users

In Tokyo and Osaka, we surveyed dozens of general users from 18 to 26 years of age who have a significant deal of interest in car audio products. We divided them into small groups, and had a professional interviewer interview each group. There were two objectives behind this investigation. One was to have users compare conventional Fujitsu TEN models with those of our competitors, and find out what the advantages and disadvantages of each model are. Our other objective was to have the users evaluate the draft designs of Fujitsu TEN's new models and check out the new designs. We had the users evaluate the designs from their own points of view, so that we could get an idea of what kinds of future trends are in the making regarding design, and to pick up the key words that are likely to become tomorrow's catch phrases. Through this investigation, we tried to find out who our true competitors are, and make forecasts regarding our future.
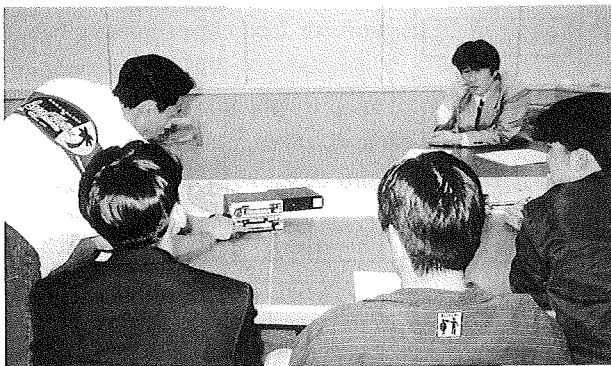

Fig.3 Design Evaluation by The Product Users

3.3 Design Essentials for Product Differentiation

We applied the key words described earlier that we obtained through our survey, to the development of our product design. As a result, we succeeded in designing our ECLIPSE '99 models that emphasize our originality and features that differentiate them from other products on the aftermarket.

(1) Further enhancement of jog volume controls

Jog volume controls had already been received well by the users of the ECLIPSE '97 models. For the ECLIPSE '99 models, we enhanced the jog volume controls in terms of both operability and originality. For lighting, we adopted blue LEDs that make the controls highly discernable even in during the daytime, making it easier for the driver to find the controls. We also adopted a three-layer structure using thermoplastic elastomer and transparent PC resins. Thus, the controls have a texture that feels pleasant to touch and also appeals to the eye when operated. The new jog volume controls were mounted as standard on ECLIPSE '99 models.

Similar jog volume controls were already used for some (integrated CD/MD AV unit models E8808DVZ and E5508AVZ) of the ECLIPSE '98 models released in the autumn of 1988. Improvements have also been incorporated into the brightness of, and other lighting specifications for the ECLIPSE '99 models.

(2) Three-dimensional display for the feel of depth and space

The conventional models had two-dimensional displays. For the ECLIPSE '99 models, we incorporated a three-dimensional display that can give the users a sense of depth and space. The contents of the display were designed to enhance interactive communication with the driver, using a spectrum analyzer display that gives the driving scenes illustrated a more realistic appearance. We selected light blue as the basic color used in the display because it was found to be a key word that appeared to make a good impression with the users who were surveyed as mentioned earlier. We tried to harmonize colors by area by using of a color harmony representing spatial rhythms (color ratios: main color = 70, subcolor = 25, and accent color = 5).

(3) Graphical display linked to operation status

Our "one touch volume operation" feature has been unique to Fujitsu TEN products. We extended this

feature to ECLIPSE '99 models so that the operation status of each control is linked to the display to create a visual effect. The operation status of the audio controls, e.g., volume, bass, and treble controls, can be checked graphically on the display.

(4) Texture design adding to refined forms

We chose warm metallic silver, which expresses refinement and warmth, for the coating color for the ECLIPSE '99 models for the Japanese market, and half flat black, which expresses dignity and serenity, for the ECLIPSE '99 models for the U.S. For the ECLIPSE '99 models for both markets, we used acrylic resin parts expressing a sense of clarity and wisdom, with some parts accented with plating to give them the look of precious metals.

3.4 Improvement of ECLIPSE Security Network (ESN) System

3.4.1 Outline of ESN system

In North America, car security systems, or anti-theft systems, have already been popular for some time, and the security systems for car audio products are also already in wide use. General security systems for car audio equipment incorporate a detachable system (using detachable front panels). Fujitsu TEN introduced the ECLIPSE security network (ESN) system as its original security system in 1994, which it installs in its products.

Unlike other car audio security systems, the ESN system supports a total security network.

(1) User management

The ESN system manages the serial number of each product and the information about the user of the product so that the owner of each product can always be checked.

(2) Use of electronic serial number

Most products usually have a serial number that is usually recorded on the unit itself, with a seal or a stamp. Thieves generally delete the serial numbers of stolen equipment. However, Fujitsu TEN product serial numbers are recorded in the internal memory of the product to enable such serial numbers to be determined if the product ever ends up being stolen.

(3) Table-of-content (TOC) security system

Fujitsu TEN has developed and used a product security system that uses the table-of-content (TOC) information stored on a CD as the protection key. If a thief ever disconnects a product from the battery,

the product ends up being locked and disabled from operating. To unlock the product, the CD containing the TOC information must be inserted into the product.

3.4.2 Improvement of ESN system

An additional security design feature of the ESN system makes it impossible to unlock a locked product if a "key" CD inserted in the product fails to unlock it after five attempts.

In the past, users had to send their locked products to Fujitsu TEN Corp. of America (FTCA) to get them unlocked. This procedure cost time and money. To eliminate this waste of time and money, and to enhance the ESN system, we began using a "set ID" system with the ECLIPSE '99 models.

With the set ID system, a unique six-digit unlock number is assigned to each product. If a product cannot be released from the locked status, the user reports this to the dealer and the dealer asks FTCA to confirm the identity of the user. If FTCA confirms that the serial number of the product and the identity of the user match the data registered with FTCA, FTCA notifies the dealer of the set ID assigned to the product. The dealer can then unlock the product with the set ID. (See Figure 4.)

This system can contribute to significant reductions in the amount of time and money required to unlock a product. To ensure that security is maintained, the set ID system is programmed to modify each set ID each
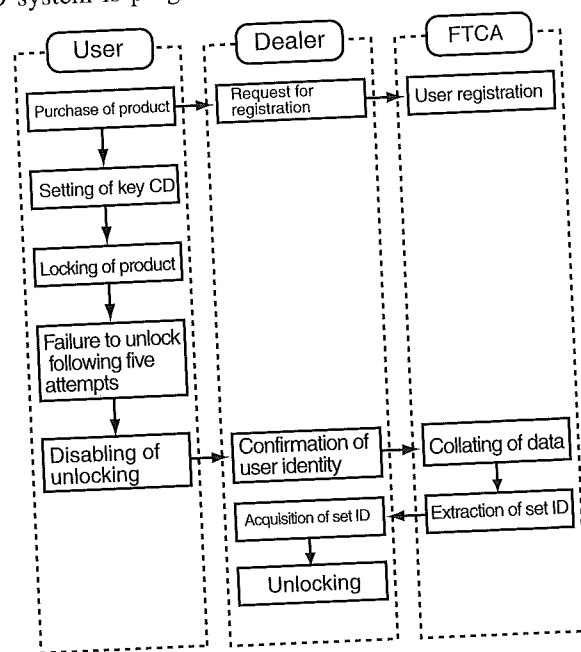

Fig.4 Security Cancel-Flow

time it is used for unlocking. A set ID that has been used once to unlock a product cannot be used any more.

3.5 Three-Dimensional Computer-Aided Design (CAD)

Because of keen price competition, Fujitsu TEN has been purchasing an increasing number of mechanical parts from suppliers outside Japan. In the course of doing so, we have already noticed that there are limitations to how well complex designs can be expressed with two-dimensional drawings, and have had to set up meetings with suppliers to make corrections to master drawings. However, we have experienced communication problems and problems involving technical knowledge in cases where we were dealing with suppliers from outside Japan. Additionally, we have experienced difficulties involving the exchange of accurate information on designs (shapes).

To solve these problem, we have incorporated a three-dimensional computer-aided design (CAD) system (Pro/ENGINEER [Pro/E] made by Parametric Technology, U.S.).

3.5.1 Features of Pro/E

(1) Unlike two-dimensional CAD systems, the Pro/E system allows us to create shapes by adding and cutting solid data (*1). We can rotate the created model data freely to check its shape.

*1 Solid data is three-dimensional shape data that also expresses the internal shapes of an object. This data enables us to easily execute internal processing (e.g., making holes on an object or making fine corrections to shapes).

(2) The shading function (Figure 5) of Pro/E allows us to express surface conditions on panels in three dimensions and check the finished status (shades on panels) visually.

(3) The assemble function (Figure 6) of Pro/E allows us to assemble components, then the interference check function enables us to ensure that there is no interference between parts.

(4) The data created by Pro/E can be sent to a metal mold maker, where the data can be used to design metal molds.

(Actually, it is necessary to convert Pro/E data into a format conforming to the Initial Graphics Exchange Specification [IGES], or a CAD data exchange specification in the U.S., before

transferring the data to a metal mold design system.)
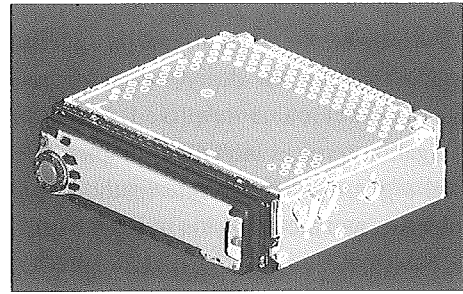
Fig.5 Shading Function
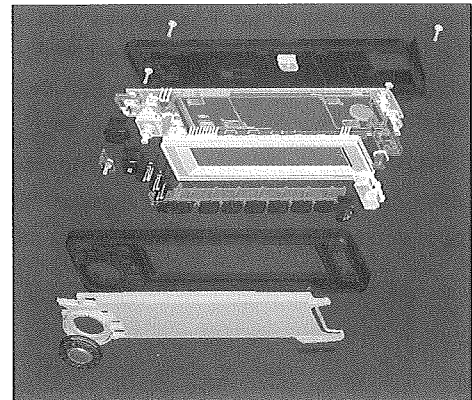
Fig.6 Assemble Function

3.5.2 Effects of Pro/E

(1) We can work concurrently with designers because we can use data in place of mockups in the middle of the design process.

(2) We can avoid parts interference due to design because of the interference check function.

(3) We can eliminate having to make corrections to master metal molds by using of Pro/E data.

4. ECLIPSE Commander System

4.1 Aims of Development

In North America, sales of our navigation systems have been stagnant because prices and specifications of the products have not adequately met the customers' needs. To cope with the growing demand for car-mounted multimedia systems, we aim to establish multimedia technologies as soon as possible.

Under these circumstances, we reassessed the voice-activated audio navigation (VAAN) system that we marketed in 1996 as the first generation of our navigation systems. As a result, we developed the ECLIPSE (E-Commander) system, keeping the points given below in mind:

(1) Suitability (of price and specifications) to the North American market

We designed the system and its specifications in consideration of the degree to which navigation in North America is required (a full range of navigation services including complete furnishing of road signs, an appropriate method of providing guidance, and the provision of road maps).

In North America, navigation using only the guidance by voice and simple indications (directions and street names) is sufficient, in place of the map-type of navigation used in Japan. This is because every street has a name and every address basically includes the state name, city name, street name, building number, and zip code. (See Figure 7.) In addition, map-type navigation systems are more costly ($2,000 to $3,000), and inexpensive systems are in demand.

Fig.7 Turn-by-Turn Navigation

(2) Investigation of the marketability of voice interface (voice-recognition interface)

(3) Accumulation of technical knowledge of voice interface

In the approaching era of multimedia systems, the application of voice-recognition technology to car-mounted equipment will likely become much more important. It will also probably be necessary to replace individual control of different media with the integrated control of all car-mounted equipment. We designed the E-Commander system to enable the driver to control the audio, telephone, and navigation systems via a single unit employing voice-recognition interface, and will be able to assess the marketability of this system. We will also be able to collect the technical knowledge on the new system when it is marketed and apply the knowledge to the future development of other systems and products.

4.2 Outline of ECLIPSE Commander System

The ECLIPSE Commander (E-Commander) is an integrated system that consists of the following units, including an integrated CD unit as the core:

(1) Integrated CD unit
(2) E-Commander unit
(3) GPS unit
(4) Phone control unit

The E-Commander unit has a route search function

Fig.8 System Block

for navigation and a voice recognition function for voice-activated control. The GPS unit has a GPS data reception function for determining the location of the car. The phone control unit employs an interface function for a general cellular phone. The phone control unit is available in different types to accommodate different cellular phone types.

The integrated CD unit and E-Commander unit are connected via special communication lines (4-wire serial control signal and power supply lines) and the digital output line from the CD deck. Navigation route information is read from a map CD inserted into the integrated CD unit, input from the digital output terminal to the E-Commander unit, and calculated and stored in the E-Commander unit. After the route information is stored, the map CD becomes unnecessary and the driver can use the CD unit as a music CD. When a command is input or guidance is activated automatically by GPS, route guidance information is input as character and voice signals to the integrated CD unit and displayed and output.

Route information is maintained while the Acc is on and deleted when the Acc is turned off. However, the final destination, starting point, and last guidance point (or current position when the GPS was connected) are not deleted but retained. This design enables the user to easily set the route again after having stopped (e.g., having turned off the ignition switch at a gas station) in the middle of the route. (See Figure 8.)

4.3 Voice Recognition and Synthesis

A key feature of the E-Commander system is the fact that the voice-recognition function is used for all operations. The voice-recognition system of the E-Commander is explained below:

4.3.1 Voice input methods

The E-Commander supports two voice input methods: Command input method to specify a desired operation and alphanumeric input to enter arbitrary data.
(1) Command input
    When the user utters a specific word called a "voice command" assigned to activate the navigation system, call a function, operate the audio equipment, or operate the telephone, the E-Commander operates in accordance with the voice command.
(2) Alphanumeric input

The user can input the name of the current position, the destination address, or landmark (e.g., the name of a place or facility [Disney Land, Dodger Stadium, etc.]) by spelling out the words that make up the names. Alphabetic characters A to Z and numbers 0 to 9 can be used.

Input by spelling brings the following advantages:
(1) The size of storage for voice-recognition templates (voice data for collating input voice) can be reduced. Tens of thousands of street names and landmark names can be handled using only 36 kinds of templates (26 kinds for alphabet and 10 kinds for numbers).
(2) Input data can be used as text data, simplifying the retrieval in the map database.
(3) Because the data handled by the system is text data, it can accommodate the spelling correction function described below.

4.3.2 Wild card function

A voice-activated navigation system requires the user to correctly pronounce the spellings of the addresses and names of destination and current position. But, correct pronunciation is difficult even for a native English speaker. The E-Commander eliminates this inconvenience with a function to search the database for a place or landmark name when only a part of the name is input.

For example, if the user only spells out "DISNEY" for "DISNEYLAND," the E-Commander lists on the display those words beginning with "DISNEY." The user can select the words successively displayed by using the voice commands "YES" and "NO."

4.3.3 E-Commander response modes

The E-Commander has two response modes, "beginner mode" and "expert mode," which can be used separately depending on the user's proficiency.
(1) Beginner mode
    In beginner mode, the user selects an input method (e.g., address, landmark name, interchange name, or intersection name) using the voice commands "YES" and "NO" for the input of destination and current position. After that, the user inputs each name by spelling out the name. This mode enables even beginners to operate the system, but making selections using the "YES" and "NO" commands takes time.

(2) Expert mode

In the expert mode, the user tells the E-Commander directly which input method is to be used by uttering the name of the method itself, then inputs required names by spelling them out. This mode enables a user who is already familiar with the operation of E-Commander to input data more quickly, compared with use of this system in beginner mode.

5. CD Changer Main Unit

5.1 Outline of Product

5.1.1 Purpose Behind Marketing of Product

A single-DIN source unit incorporating an in-dash CD changer deck was marketed as an ECLIPSE '98 model. However, in the North American market, there was significant demand for a product in which the in-dash CD changer was the main unit, and which allowed the user to conveniently replace CDs for the following reasons:

(1) The CD unit is conveniently positioned at the center of the console.

(2) Most vehicles are designed to mount single-DIN types.

The in-dash CD changer main unit could not be released as an ECLIPSE '98 model because its depth needed to be extended to position the display on the front panel, and there were fewer vehicles in which the unit could be mounted.

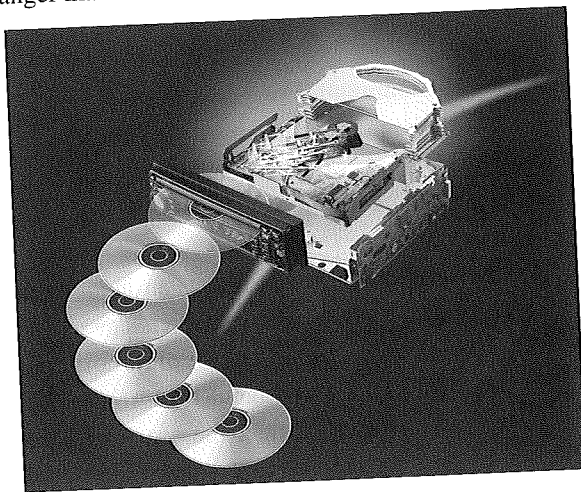This time, we developed and marketed a new CD changer main unit with a reduced depth. (See Figure 9.)

Fig.9 In-dash CD Changer MainUnit

5.1.2 Features

The main functions of the CD changer main unit are as follows:

- Fluorescent display tube (VF)
- Jog volume control with blue illumination
- Newly developed 6-CD changer mechanism
- High-voltage, low-impedance PRE OUT (5 V/55 Ω)
- ESN

The in-dash CD changer has the following features:

- Built-in shock-proof memory circuit to prevent sound skipping
- Simple insertion and continuous insertion functions for convenient insertion operation
- New sliding unit reducing the time required for disk replacement and insertion

5.2 Improvement of Operability and Visibility

As a main unit, this product required the display to be located at the front. However, this product has the CD inlet at a position that is lower than that on the single CD main unit. As a result, for this product, it became impossible to adopt the display section design that is employed with the relevant model of this series.

We reviewed the button layout, and concentrated the operation buttons (that were located at the bottom of the front panel on other models) at the right-end of the front panel. We also simplified the contents of the display as much as possible to incorporate the display using a fluorescent display tube (VF). (See Figure 10.)
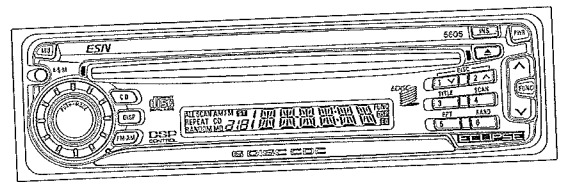

Fig.10 Design

We also modified the conventional CD insertion method for the in-dash CD changer and improved its operability.

The conventional CD insertion method was as follows:

(1) Select an empty CD slot by pressing one of numeric buttons 1 to 6.

(2) When the indicator at the CD inlet starts blinking to indicate that a CD can be inserted, insert a CD.

(3) To insert other CDs successively, repeat steps (1)

and (2) for each CD.

This conventional method required the user to check the slot numbers of empty CD slots and repeat the procedure for each CD. Such an operation was troublesome especially during driving, and there was some room for improvement.

We improved the insertion method for the CD changer deck in the ECLIPSE '98 series. With the new insertion method, the user need not specify the CD number for an empty CD slot, but only has to press the Insert button to let the system automatically select the lowest CD number among the CD numbers of empty CD slots. Accordingly, the user is freed from the trouble of checking numbers and the operation of the numbered buttons. The user only needs to carry out the same operation (pressing the Insert button) every time, resulting in improved operability. In addition, holding down the Insert button for a certain period of time places the system in continuous-insertion mode. In this mode, the system automatically repeats the CD insertion operation for the next CD when the insertion of a CD is completed. The user is also freed from the repetition of the insertion operation when inserting multiple CDs, resulting in the reduction of the amount of time required for continuous insertion, as well as enhanced driving safety.

6. Conclusion

This paper outlined the main models of the ECLIPSE '99 series.

The environment surrounding car-mounted audio equipment is changing drastically. We will continue in our efforts to develop new products that will add to the comfort and pleasure of our customers and enhance the images of ECLIPSE brand and Fujitsu TEN.

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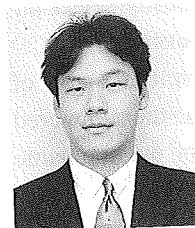
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